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How innovative engineers overcame challenges to upgrade more than 7,000 linear feet of water transmission main.

**West Sacramento**
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COVER PHOTO: City of Napa
Welcome to this year’s Western Regional Trenchless Review. We hope you enjoy the articles and our annual conference. The past year has been a year of change, starting with our meeting in Nashville during No-Dig 2012 where we elected new officers. We have subsequently lost two board members as they have moved out of the WESTT region. The WESTT board has had discussions regarding WESTT’s mission and this year’s conference in Ontario, California. Our focus on mission is reflected in our pricing for our upcoming conference and the offering of two NASTT training sessions.

We have seen the trenchless industry grow, with great projects across the country and our region, over the last year in spite of the overall slow economy. This year’s Review includes articles on some of those projects, including a CIPP installation for the Sausalito-Marin City Sanitary District and an upgrade of more than 7,000 linear feet of water main in Napa.

WESTT and the Northern California Pipe Users Group (PUG) are reaching out to each other and developing a strong relationship, as demonstrated by PUG offering a NASTT training class this year. PUG has offered NASTT training courses over the last few years and the courses have been well received.

Trenchless is "catching on" with municipalities, utilities and other project owners. We need to continue to raise awareness of the benefits of trenchless methods in reducing projects’ social and environmental impacts, including carbon footprint. A “carbon calculator” developed by engineers in British Columbia and Arizona can help us in that pursuit, by allowing designers to determine the carbon savings obtained through trenchless instead of conventional open-cut construction. The calculator has been a great tool and, with the support of NASTT national and others, it has been developed further to the next level.

This year, WESTT’s Eighth Annual Western Regional Do-Dig Conference will be held October 29-30 at the Ayres Hotel & Suites in Ontario, California. Ontario is the first southern California location for our annual regional conference since the inception of WESTT. We intend to vary conference location – “move it around,” if you will – and thus ensure that it’s accessible throughout our region. Doing so should go a long way towards “spreading the word” about trenchless construction and developing our membership.

WESTT exists to help educate people on the benefits of trenchless technology and services. Towards that end, it helps that we’ve been blessed with a dedicated group on our Board of Directors. We continue to see great enthusiasm and great work from our board. Particular thanks to Jason Lucke, who chaired the board for most of the past 12 months until a career opportunity called him back to his native Canada. (Good luck, Jason!) I am fortunate to work with such a bright and dedicated group of volunteers.

Lastly, thanks to NASTT Chairman George Ragula, NASTT Executive Director Mike Willmets, and the hard-working staff at NASTT for all their efforts. They’ve made our work a lot easier.

Regards,

Craig Camp
Interim Chairman, WESTT
Greetings from NASTT

Mike Willmets - NASTT Executive Director

Summer is a time for relaxing, traveling and getting away from it all. But we have been diligently working to prepare for a busy fall and much anticipated return to the West Coast for NASTT’s 2013 No-Dig Show. I wish I had the space to discuss with you everything that is going on.

In a few short months, NASTT’s 2013 No-Dig Show will be here – March 3-7 at the Sacramento Convention Center. Sacramento is the perfect location for NASTT’s No-Dig Show to return to the West Coast after six years. The Sacramento area has been home to a tremendous amount of trenchless work over the years and recently completed an extensive, long-term trenchless program. The locale welcomes our attendees with its incredible weather and great restaurants. The Sacramento Convention Center offers our attendees and exhibitors a fantastic venue in the heart of downtown Sacramento. I know WESTT is also working above and beyond to help make this conference successful. I appreciate more than I can express the countless hours WESTT members volunteer to our annual event.

I am also happy to share with you a few exciting developments that recently came out of NASTT’s 2013 No-Dig Show Program Committee and NASTT Board of Directors meetings held in Sacramento this past July. Planning and preparation for the 2013 Show are well under way, as work started immediately following the incredible success of NASTT’s 2012 No-Dig Show in Nashville. The Program Committee is building off that fantastic momentum with fresh ideas for the growth of the world’s best trenchless conference. Get ready for the “flower child” theme at the Education Fund Auction!

The Program Committee is truly blessed to be planning what is shaping up to be another record-setting technical program. Hosted by NASTT’s 2013 No-Dig Show Program Committee Chair Kim Staheli, the committee reviewed what can only be described as an overwhelming number of high-quality abstracts. Our technical program sets the standard by which other conferences hope to achieve, and the competition to have a paper selected for these sessions is fierce. Tough decisions were made to ensure that the best of the best technical papers were chosen for presentation at NASTT’s 2013 No-Dig Show, and I’m sure that they all will be enthusiastically received. Congratulations to the chosen authors.

One of the most highly anticipated events at NASTT’s 2013 No-Dig Show is the induction of the second NASTT Trenchless Hall of Fame class. This is already my favorite event of our No-Dig Show experience. I am so proud to announce that the NASTT Board of Directors has again selected an outstanding group of trenchless trailblazers to honor at the Sacramento No-Dig Show.

The members of the 2013 Hall of Fame class are: Insituform founder and inventor of the CIPP process, the late Eric Wood (1935–1994); trenchless author and engineering expert, Dr. David Bennett of Bennett Trenchless Engineers; and Ditch Witch founder and machinery developer, Ed Malzahn. I want to note that having David Bennett inducted into the Hall of Fame in Sacramento is incredibly fitting as he and his trenchless specialty firm are based in the Sacramento area. You’ll definitely want to be there when this inspiring group is honored during the Gala Awards Dinner on March 5.

There is one last bit of exciting No-Dig Show news I want to share with you: The NASTT Board of Directors has selected the City of Denver as the host city for NASTT’s 2015 No-Dig Show! What a great section the Board has made — I have no doubt that your sister Rocky Mountain Chapter is over the moon in bringing NASTT’s No-Dig Show to their neck of the woods for the very first time.

I also wanted to congratulate NASTT Board member Dr. Jason Leuke on his new position at Associated Engineering in Alberta, Canada. Unfortunately for WESTT, his exciting career opportunity means that he will leave his duties as your Chapter’s Chair. I want to thank Jason for all he has given to WESTT during his years at Arizona State University. He has made an indelible mark on trenchless in the academic field, preparing the next wave of young trenchless professionals. Good luck, Jason, and welcome back to the Great White North! I hope you still have your snow shovel.

This also leads me to congratulate all the members of the WESTT Chapter for your daily efforts to expand trenchless technology industry in your area. A successful society such as NASTT is only as strong and vital as its Regional Chapters. Thank you for diligently delivering the trenchless message and for making our volunteer Society that much stronger.

Finally, I am extremely pleased to tell you that we kicked off our first-ever trenchless webinar series this summer, and the response was more than we could have ever hoped for. More than 1,000 attendees logged into the first two sessions of the four-part “Introduction to Trenchless Technology” series, which focuses on rehabilitation and new installation methods. I hosted the sessions with our amazing instructors: NASTT Vice Chair Derek Potvin, longtime NASTT member Ian Doherty and WESTT Chapter superstar Jennifer Glynn! What an impressive new education vehicle for NASTT. We are able to reach a huge, hungry-for-trenchless audience, all at no cost to attendees who don’t need to leave their office to take part. I sincerely want to thank our Communications and Training Manager, Michelle Hill, for her role in making this webinar series a reality.

NASTT has many great things on the horizon in the months to come, and I enthusiastically look forward to working with the WESTT Chapter to make them happen!
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2011 - 2012

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No-Dig’s Return to Nashville a Success

Sharon M. Bueno  Trenchless Technology

The No-Dig Show, the annual conference and exhibition of the North American Society for Trenchless Technology, returned to Nashville and brought with it more than 1,600 attendees who successfully mixed business, education and country western hospitality.

Trenchless professionals from around the globe gathered in the Tennessee capital city March 11-15 for the 21st annual No-Dig Conference and Exhibition. The all-trenchless event took place at the Gaylord Opryland Hotel and Convention Center.

The show was a great tribute to the trenchless industry, as NASTT inducted its first Hall of Fame class: the late Gary Vermeer (founder of Vermeer Corp.), Frank Canon (Baroid IDP), and Bernie Krzys (publisher/president of Trenchless Technology magazine).

International Society of Trenchless Technology executive director John Hemphill received NASTT’s Chairman’s Award for Outstanding Lifetime Service. Dan Willems of Stantec received the NASTT Trent Ralston Award for Young Trenchless Achievement. The 2012 Trenchless Technology Person of the Year Award was presented to Dr. Sam Ariaratnam, and all the winners for the 2011 Trenchless Technology Projects of the Year were recognized.

There are two main attractions that draw people to the No-Dig Show. One is the technical paper sessions that provide detailed, peer-reviewed papers covering a broad range of topics relevant to the industry. This year, there were 155 papers presented covering the gamut of trenchless methods and issues.

The other main component of the No-Dig Show is the exhibition hall, in which attendees can see first-hand the latest products that are keeping the industry at the forefront of utility construction and repair. About 140 exhibiting companies occupied the 70,000-square-foot exhibition hall.

The 11th annual Educational Fund Auction was held on March 12 and raised a record amount: $100,636. The auction raises financial support for NASTT’s 11 student chapters, while attendees have a great time bidding on amazing items. Since 2002, the auction has raised more than $533,636.

NASTT annually recognizes two companies with state-of-the-art products in either new installation or rehabilitation for their achievements in advancing the trenchless industry. The recipients of this year’s Joseph L. Abbott Jr. Innovative Product Awards, Vermeer Corp. and LiquiForce, were formally recognized at the Gala Dinner.

Vermeer received the New Installation Award for its D36x50 Series II Navigator horizontal directional drill, featuring the MAGnum rock drilling system. The drill was unveiled at the ICUEE show in October.

LiquiForce received the Rehabilitation Award for its Junction Liner lateral rehabilitation system, which was unveiled at the No-Dig Show.

So while the 2012 No-Dig Show may have just ended, plans are already underway for the 2013 show in Sacramento, California. The event will take place March 3-7 at the Sacramento Convention Center. The deadline to submit an abstract was June 30, 2012.

The No-Dig 2013 program chair is Kim Staheli, who served as cochair of the 2012 Program Committee. “I am excited to have the No-Dig show return to the West Coast because of all of the trenchless advances that have occurred on projects in the West since the No-Dig Show was here last,” Staheli said.

“Sacramento is a wonderful city to host the show since it just finished its series of big interceptor projects that included thousands of feet of trenchless pipeline installation.”

Additional No-Dig 2013 information will be available at www.nodigshow.com as it is finalized.

Article courtesy NASTT’s Trenchless Today. Sharon Bueno is managing editor of Trenchless Technology.
8th Annual Western Regional No-Dig Conference & Exhibition  
October 29-30, 2012  
Ayres Hotel & Suites  
Ontario Convention Center, Ontario, CA  

Contact Info:  
Matthew Wallin,  
Matthew.Wallin@bennetttrenchless.com  
www.WESTT.org  

NASTT’s HDD Consortium Horizontal Directional Drilling Good Practices Guidelines Course  
Wednesday, November 7, 2012  
Westminster, CO  

Contact Info:  
Al Paquet,  
Al.Paquet@CH2M.com,  
www.NASTT.org/training  

NASTT’s New Installation Methods Short Course  
Tuesday, October 30, 2012  
Ayres Hotel & Suites  
Ontario Convention Center, Ontario, CA  

Contact Info:  
Matthew Wallin,  
Matthew.Wallin@bennetttrenchless.com,  
www.NASTT.org/training  

Rocky Mountain Regional No-Dig Conference and Exhibition  
November 7-8, 2012  
Doubletree Hotel, Westminster, CO  

Contact Info:  
Al Paquet,  
Al.Paquet@CH2M.com,  
www.NASTT.org/training  

NASTT’s Pipe Bursting Short Course  
Tuesday, October 30, 2012  
Ayres Hotel & Suites  
Ontario Convention Center, Ontario, CA  

Contact Info:  
Matthew Wallin,  
Matthew.Wallin@bennetttrenchless.com,  
www.NASTT.org/training  

NASTT’s 2013 No-Dig Show  
March 3-7, 2013  
Sacramento Convention Center, Sacramento, CA  

Contact Info:  
info@benjaminmedia.com,  
www.nodigshow.com
In 2012, the City of Napa awarded The HDD Company, Inc. a contract for $3.1 million to upgrade approximately 7,400 linear feet of water transmission main along Highway 221. The replacement was needed to eliminate an existing pinchpoint in the city’s water transmission system which restricted water supply along the east side of the water system. The Transmission Main Upgrade (TMU) project basically consisted of the replacement of an aged 16-inch-diameter steel water main with a new 24-inch-diameter Fusible C905® PVC water main.
The project area contained a variety of visible and buried complications. Above ground, there were "significant trees," active burial grounds, overhead utilities and power poles, structural signage, varying topography, creeks, and private properties. Below ground, there was the existing water transmission main, services to the Napa Valley College and the state hospital, unknown abandoned irrigation and utility mains, corrosive soils, an active meter station, and signal loops to Caltrans signalized intersections. To add to the complexity of the area, access to the site was limited to the use of Caltrans right-of-way, and the work area was limited to an existing 20-foot-wide water utility easement.

DESIGN

The majority of pipe replacement projects for the City have been trench installations. It was the method the City was historically most familiar with, and the density of services in most areas made trenching a more financially feasible option. When the City became aware of Fusible PVC™ pipe, which is a thermally butt-fused PVC piping product, they decided to conduct a couple of test projects utilizing the material in horizontal directionally drilled (HDD) installations. The test projects were small, using four-inch- and 12-inch-diameter pipelines, but they were substantial enough to fine-tune the City specifications.

The TMU project was a prime candidate for the use of HDD installation methodology. The site constraints alone proved to have significant cost savings if the trench method was not used. However, the City still evaluated the feasibility of trenching instead of using HDD to confirm that it was the most economical and applicable method for the TMU project.

If trenching was selected, the project would have had to incorporate the removal of a half-mile of established trees, relocation of burial sites, replacement of existing private utilities and structural signage, Fish & Game permits for creek water diversion, storage of more than 5,000 cubic yards of spoils during the winter, extra grading for construction-vehicle access, supports for the adjacent utility poles, and special storm water protection permits from the state due to the increased work area – just to name a few of the constraints. The use of HDD methodology would eliminate the majority of these conflicts and reduce the risk of damage to the existing transmission main while water service continued during construction.

In addition to the site-related concerns, in order to reduce the risk of damage to the existing transmission main, construction had to be limited to the lowest-water-demand period, which occurs in winter. Winter rains could mean great difficulty for trenching operations, resulting in delayed construction and potential change orders.

Delay of the schedule would not be an option, as City water supply capabilities would be impacted. As a result, in addition
to requiring a winter installation period, the City incorporated a forced deadline with no availability of extension, plus a limited 14-calendar-day window in which to complete the full activation of the new main.

Without a doubt, the use of trenchless technology was going to be the least expensive method to replace the water transmission main with the least amount of risk to the water system.

CONSTRUCTION
The City had a tight deadline to bring the new water main into operation before the water demands increased for the spring. By the time the contracts were signed, construction easements were obtained by Caltrans, and the kickoff meeting occurred, the contractor had less than four months to complete the work. In order to meet the schedule, the contractor brought in a second drilling team to increase productivity. The City also opened up Saturdays as optional construction days to assist with the timeline.

The choice of material also assisted with the timeline. Fusible C905 pipe provided the City with the maximum flow area coupled with the smallest outer diameter at the required pressure class. This minimized the required bore hole size, resulting in a reduction of drilling mud quantities, the amount of reaming that was required, and the time needed to complete each bore.

However, trenching could not be entirely avoided. The drill input and outlet sites required trenching for the drill equipment and for the pulling of the pipe through the bore hole. Where trenching was necessary, it was quickly realized how many unknown buried facilities would have in conflict with a normal trench project. The City was lucky to have selected HDD because without significant changes to the design or significant change orders, the contractor was able to work around the conflicts without any damage to the existing facilities.

LESSONS LEARNED
The construction went smoothly with very few incidents or corrections. Part of the smoothness of the work had to do with having a knowledgeable team from the contractor’s side and the City’s side.

The City increased the chances of a competent driller by pre-qualifying drillers before the project went out to bid. Having reviewed contractor qualifications up front hastened the project award process and ensured that the driller was qualified to complete a project of this size and was familiar with large-diameter-pipe installations.

City staff was directly involved with the project from start to finish. It allowed for field directives to occur at the time conflicts were found, which resulted in fewer delays and change orders. By the time the project ended, the contractor was almost a full month ahead of schedule and completed the project within budget.
Fifty Feet of Peat!
Design Challenges of Three HDD Crossings of the Sacramento River

Mary Asperger,
Dave Bennett &
Matthew Wallin
Bennett Trenchless Engineers,
Folsom, California

INTRODUCTION

The City of West Sacramento is home to the Port of West Sacramento, a significant Pacific Coast port. The port is accessed from the ocean through the San Francisco Bay, into the Sacramento River, and then through the 45-mile Sacramento River Deep Water Ship Channel (SRDWSC) which flows partially within the Sacramento River channel and partially in an artificial channel parallel to the river, as shown in Figure 1.

The U.S. Army Corps of Engineers has proposed increasing the dredged depth of the SRDWSC from 30 to 35 feet to expand the capabilities of the port. A significant challenge in doing this is the relocation of utilities within the dredge zone. Along the lower stretch of the SRDWSC, within the active Sacramento River channel, PG&E owns and operates three large gas transmission lines ranging in diameter from 12 to 27 inches. Lines 130, 114, and 400 were all installed using open-cut dredging methods at shallow depth. These lines directly conflict with the planned dredging work for the SRDWSC. The locations of the existing lines and new HDD crossings are shown in Figure 2.

GEOTECHNICAL CONDITIONS

The three HDD crossings pass through two distinct geologic areas. The first of these, located in the Montezuma Hills to the north and west of the Sacramento River, is the Montezuma Formation, which is primarily composed of semi-consolidated river deposits of clay, sand, silt, and gravel. In addition, a few areas along the north and west banks of the river have deposits of very soft delta mud and/or dredge materials. The area to the east and south of the river is part of the Sacramento-San Joaquin River Delta and includes the second major geologic formation, Delta Mud. The Delta Mud is primarily very soft to soft organic peat which extends to depths of 50 to 60 feet below ground in this area. Groundwater removal for irrigation has caused substantial subsidence in this area, resulting in ground surface elevations approximately 10 to 20 feet below sea level. An extensive system of levees, constructed with little or no engineering design using dredged materials from the river channel, protects these low-lying "islands" from flooding.

The geotechnical conditions at each of the crossings were very
challenging for HDD. The geotechnical profiles, an example of which is shown in Figure 3, illustrate the results of the geotechnical investigation. The first challenge was the approximately 50 to 60 feet of Delta Mud. The Line 130 borings encountered these very soft materials on both sides of the crossing. Below the very soft to soft materials, the borings encountered predominantly medium dense to dense sands and silty sands as well as medium to hard clays—materials that were much more favorable for drilling. The Line 130 over-water borings also encountered pockets of up to 45% gravel from 20 feet to 140 feet below the river bottom.

The crossings had to be sited deep enough to minimize the risks of hydrofracture and settlement beneath the Sacramento River and its levees. In addition, for the Line 130 crossing the gravel had to be avoided.

ALIGNMENT SELECTION

Flood control levees that run along the east (or south) bank of the river protect the lowlands of Brannan and Sherman Islands from the Sacramento River. The levees are mostly un-engineered fills placed by dredging sediments from the river. The design for the new HDD bores had to protect these levees.

Deep peat deposits on the same side of the river create an additional design challenge. The eastern entry/exit points for the bores were located a minimum of 500 feet from the landside toe of the levee, which allowed the bore profile to penetrate the very soft peat deposits and enter more stable alluvium before passing beneath the levee itself, reducing the risk of potential settlement or hydrofracture damage to the levee.

HYDROFRAC TURE ANALYSES

Detailed hydrofracture evaluations were conducted for each of the three crossings. The evaluations indicated that, due to the length of the crossings, the risk of hydrofracture was unacceptably high for a conventional pilot bore installation. The crossings, therefore, had to be designed using the intersect method, which involves completing the pilot bore by drilling simultaneously with two rigs from opposite ends of the crossing. Normal angle-rig reaming, pullback, and installation procedures can then complete the installation. By breaking the pilot bore into two separate reaches completed by two drill rigs, the maximum required drilling fluid pressure to complete the pilot bore was reduced by approximately 50%. Figure 4 shows the results of the hydrofracture analyses for the Line 130 pilot bore drilled with the intersect method.

Even using the intersect method, however, it was still deemed necessary to site the bores approximately 80 feet below the river bottom for Lines 114 and 400. The Line 130 crossing was sited 60 feet below the river bottom to minimize the risks of encountering difficult drilling in gravel, while reducing the hydrofracture risk to acceptable levels.

Due to the thick deposits of very soft and soft materials, the risk of hydrofracture was high near the crossing entry.
points. To mitigate this risk, long conductor casings were specified. The conductor casings reduce the risk of collapse of the borehole in the very soft soils, reduce the risk of a sudden drilling fluid pressure spike, and provide a stable, enclosed path for the drilling fluid. Because the soft layers extend to great depths and because the entry angles on the southeast side of the river must remain fairly low (10°) to allow for the steel pipe to be pulled back without excessive bending stresses, the conductor casings must be 250 to 300 feet long. Special procedures will be required to install them.

The deep deposits of very soft to soft materials also pose steering problems. HDD bits require a reaction force from the soil to be able to make steering corrections. In very soft soil, the bit tends to go straight in spite of steering inputs. To enhance steering response, the crossings were designed with long straight tangents so that the curved portions of the bore would not be within the very soft to soft deposits.

**GROUTING, CORROSION CONCERNS**

Any trenchless crossing beneath a flood control levee could create a preferential seepage path and cause flooding. To minimize this risk and seal the annular space, grout can be injected into the end of the bore to displace the drilling fluid and create an impermeable plug. This is most commonly done after pullback is complete. The distance that tremie pipes can be inserted is highly dependent on the size of the annulus, the stability of the bore, and elapsed time before grouting begins. For these crossings the long conductor casings will maintain an open and stable bore, allowing grout to be injected over the length of the casings (from 250 to 300 feet).

Corrosion protection is a second concern for these crossings. Typically, the steel product pipe would be surrounded only by soil and/or grout. However, it is impractical to remove the long conductor casings after the product pipe is installed. Removal of the conductor casings would certainly make grouting the annulus very difficult and could also lead to bore collapse, preferential seepage paths, and settlement concerns in zones where the bore passes through very soft soils. To minimize the risk of corrosion of the product pipe, it will have to be electrically isolated from the conductor casing.
Figure 4. Results of the hydrofracture analysis for the Line 130 crossing assuming an intersect bore. Hydrofracture risk is highest when the minimum required pressure exceeds the maximum allowed pressure. Areas of highest risk are highlighted in pink.
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The Show!
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Littleton, Colorado, is a suburb south of Denver, on the west side of Interstate 25. Like Denver, Littleton is also a mile above sea level. The city of 41,000 is known for its “small town” atmosphere.

The beginnings of Littleton can be traced to the “Pike’s Peak” gold rush of 1859. Along with the gold-seekers came merchants and farmers to provide the necessities of life. As population grew in the Denver area, the need arose to construct a series of ditches to carry water to farms and businesses that didn’t already have ready access to rivers and creeks in this arid land.

Pipe is lowered into an insertion pit for slip lining in Littleton’s sanitary sewer system.
As Littleton has grown over the years, so has the sewer system and the need for replacing the aging infrastructure. The City of Littleton over the past five years has started an Interceptor Rehabilitation project to help with the need to replace the sewers. Trenchless methods were chosen because of all the benefits they bring instead of open-cut replacement.

The 2011 Sanitary Sewer Rehabilitation Project was put out to bid in October, and the City decided to allow several trenchless rehabilitation processes.

AUI was the low bidder utilizing the slip-line method to replace the old 66-
inch RCP sewer with new 54-inch HOBAS pipe.

There were two unique aspects about this project. The first was that the old 66-inch RCP was originally installed curvilinear for about 300 linear feet and slip lining a curved sewer is difficult at times. AUI decided to use 10-foot joints of 54-inch HOBAS sn 46psi, low-profile bell pipe and successfully installed the new pipe inside the old pipe along the curved radius.

The second unique aspect of this project was that the first joint of 66-inch RCP pipe originally installed into the manhole had a 16.5-degree bend. AUI excavated at this bend, removed the top half of the sewer, and then installed a 16.5-degree bend of new HOBAS pipe.

Some of the early concerns of the project were due to the distance from AUI's home office, the careful coordination of our subcontractors, and ensuring that schedules were met and good communication was always in place. Due to all the quality and safe work performed, the project was completed on time and on budget.

A special thanks to AUI's project superintendent, Archie Lucero, and crew for all their hard work and dedication to the project.

AUI would also like to recognize our subcontractors on this project: Spectra-Shield, which handled the specialized manhole coatings; Condeck Corporation, which grouted annular space; and Guildner Pipeline, which cleaned and CCTV-inspected the lines before and after slip-line construction.
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The F5® Fluid Pressure Transmitter from DCI. Ready to take HDD in a whole new direction.
Asbestos cement (AC) pipe, also known as “transite,” was a popular choice of engineers for potable water, sanitary sewer, and storm drain pipelines during the 1940s, 1950s, and 1960s. AC pipe was touted for its light weight and ease of handling, low coefficient of friction (Manning’s “n” = 0.010), and corrosion-resistance properties. An estimated 600,000 miles of AC pipe were installed in the U.S. and Canada.

Due to health concerns associated with the manufacturing process, production of AC pipe ceased in the United States in the early 1970s. The U.S. Environmental Protection Agency (EPA) issued a complete ban on all asbestos-containing products in 1979, but was defeated in the U.S. Fifth Circuit Court of Appeals and the ban was lifted. The Court did, however, reinforce the EPA’s responsibility to regulate asbestos.

Hundreds of thousands of miles of AC pipe are beyond or are approaching the end of their 50-year design lives. Two very effective technologies for replacing AC pipe are pipe bursting and pipe reaming. However, existing regulations limit the use of these trenchless construction methods.

Many public agency officials and engineers are not familiar with the regulations restricting pipe bursting and pipe reaming of AC pipe. Regulatory application is not consistent from one state to the next, or even within the same state in many instances. Enforcement is occurring much more frequently, however, and it is important for those in our industry to clearly understand the restrictions. Several efforts are underway to develop additional important information examining reasonable performance durations for AC pipe and possible management strategies to extend life, the potential health implications of AC pipe bursting, and to recommend modifications to existing enforcement policies.

INTRODUCTION

AC pipe became a viable option for water, wastewater, and storm drainage systems beginning in the mid-1940s. The materials used to fabricate it included Portland cement, up to 12 percent asbestos fibers, water, and silica or silica-containing materials. AC pipe was typically formed under pressure and heat cured in an autoclave. The presence of the asbestos fibers in lieu of reinforcing steel provided adequate strength with lower weight. In addition to its light unit weight, AC pipe was marketed as having very good resistance to the effects of hydrogen sulfide corrosion and soils that were aggressive to steel, and low operating costs because the smooth walls of the pipe provided low friction factors. The major U.S. manufacturers of AC pipe were Cement Asbestos Product Company (CAPCO), Certain-teed Products, Flintkote Company, and the Johns-Manville Company.

AC pipe was manufactured in four different classes, for various applications. Each type of pipe was manufactured to specific ASTM standards. The individual characteristics for each material are shown in Table 1. Each section of pipe and each fitting were marked with the size and pipe class, manufacturer’s name or trademark, and date of manufacture. Each rubber gas-
ket was also marked with the manufacturer’s trademark and date of manufacture.

One of the identifying characteristics of AC pipe is the unique pipe-joining method used. A pipe joint for AC pipe, taken from a CAPCO catalog, is shown in Figure 1.

Vitrified clay pipe provided a competitive alternative for use in sanitary sewer systems, but AC pipe soon became the pipe of choice for water and storm drainage systems in the 1950s until the 1970s. A survey conducted by the American Water Works Association (AWWA) in 2004 found that, on average, AC pipes constitute approximately 15–18 percent of the nation’s water distribution and transmission systems.

Communities that experienced significant growth during the 1950s and 1960s constructed their infrastructure systems when the use of AC pipe was prevalent. These cities have percentages of AC pipe that are much higher than the national average, especially if one or more AC pipe manufacturing facilities were located nearby. Through literature research, we found that infrastructure systems in the western states had AC pipe usage rates as high as 80 percent. Usage rates as found through our literature search for the various systems are shown in Figure 2. The results of the AWWA survey are shown for comparison. Overall, it is estimated that more than 600,000 miles of AC pipe are in use throughout the U.S and Canada.

Under certain conditions, AC pipe has experienced failures at rates that are similar to other pipe types during their 50-year design lives. Many public agencies have reported significantly higher failure rates for AC pipe than for other pipe materials, however. Ironically, the major factor in predicting failures of AC pipe appears to be aggressive soils—one of the conditions that AC pipe was supposed to protect against. Overall, however, studies have shown that the failure rate for AC pipe increases dramatically with age. After 50 years of use, AC pipe failure rates are about one per year per mile of pipe.

THE HISTORY OF ASBESTOS REGULATION

In 1973 the National Emissions Standards for Hazardous Air Pollutants (NESHAP) was implemented by the United States Environmental Protection Agency (EPA) when it was determined that asbestos was a leading contributor to asbestosis and certain forms of cancer. Through NESHAP, the EPA sought to protect the public by controlling exposure to asbestos during the milling, manufacture, common use, spraying, renovation, demolition, and disposal of more than 3,000 asbestos-containing products.

Effectively regulating such a large class of diverse products proved to be a daunting task. In 1979 the EPA announced its intent to ban all asbestos-containing materials. By 1986 the EPA proposed a rule to ban asbestos. The EPA’s Asbestos Ban and Phaseout Rule was published in the Federal Register in 1989, proposing to eliminate all asbestos-containing materials in three stages between 1990 and 1997.

The Asbestos Information Administration and the Asbestos Institute (with major funding from the government of Canada) conducted significant lobbying efforts against the Asbestos Ban and Phaseout Rule. One large manufacturer of asbestos-containing products, Corrosion-Proof Fittings, successfully sued the EPA.
to block implementation of the ban. The U.S. Fifth Circuit Court of Appeals ruled that the EPA had failed to present a compelling case for banning all asbestos-containing materials. The Court did, however, reinforce the EPA’s responsibility to regulate asbestos, and new products containing asbestos were banned.

The impact on the asbestos pipe industry was uncertainty and fear. After 1973, the asbestos fiber content in AC pipe was reduced from 12 percent to less than 0.2 percent. By the 1980s the popularity of AC pipe had waned dramatically due to fears of liability and the availability of PVC pipe. Manufacturers stopped producing AC pipe in the United States. However, the machines were moved to other countries including Mexico and Saudi Arabia, and AC pipe is still produced and available today.

ASTM Subcommittee C17.03 remains active and tasked with maintaining a series of specifications related to the manufacture, installation, and testing of AC pipe. Table 2 lists the ASTM specifications for AC pipe.

Table 3 shows the AC pipe standards promulgated by the American Water Works Association (AWWA). In November 2008, the AWWA withdrew its AC pipe standards.

**REGULATIONS FOR AC PIPE**

In most states, public agencies are not required to remove and replace AC pipe. Studies have indicated that, in normal use, AC pipe does not pose a threat to public health. However, certain activities—including tapping, cutting, crushing/removing, and disposing—are regulated.

Contrary to common belief, in many states specially licensed contractors are not required when working with AC pipe. Many states have developed programs to train individual employees in safe practices involving the regulated AC pipe practices. These training programs provide an employer exemption for registration requirements. In addition, guidelines have been established for licensing of course providers in order to extend the available training resources while maintaining consistency in content and message.

Proper handling procedures for AC pipe include the requirement to spray water on the pipe whenever cutting into the pipe, such as for a repair; use of full-circle saddles where tees or services are connected; and bagging broken pipe segments (as shown in Figure 3) for disposal at a Class II waste facility.

The EPA has addressed replacement of AC pipe using the pipe bursting method. In a letter issued July 17, 1991, the EPA stated its position that “the crushing of asbestos cement pipe with mechanical equipment would cause this material to become ‘regulated asbestos containing material’ (RACM)” and “... the crushed asbestos cement pipe in place would cause these locations to be considered active waste disposal sites and therefore, subject to the requirements of §61.154 (NESHAP).” Furthermore, in this same letter, the EPA goes on to advise that “[i]n order to avoid the creation of a waste disposal site which is subject to the Asbestos NESHAP, the owners or operators of the pipe may want to consider other options for dealing with the abandoned pipe.” Since the EPA’s letter did not specifically identify pipe bursting, interpretation of the intent was inconsistent throughout the industry.

NESHAP includes an important exclusion for pipeline replacements. This exclusion allows single renovations of up to 260 linear feet or within a calendar year for nonscheduled operations. Although the exclusion was likely intended to allow some flexibility for small replacement projects, it also provides us with the opportunity to pilot test rehabilitation methods for AC pipe and test the impacts of construction.

**SPECIFIC STATE REGULATIONS**

The EPA has delegated administration and enforcement of asbestos regulations to many of the individual states. Program administration often falls to a statewide department that enforces many environmental policies. In California, NESHAP enforcement has been delegated to 19 of the
35 air pollution control boards in the state. As might be expected considering the diverse group of public agencies administering NESHAP regulations, enforcement varies widely. The Bay Area Air Quality Management District (BAAQMD) has chosen to develop more stringent policies associated with AC pipe. The BAAQMD issued a Compliance Advisory on June 21, 2006. The advisory addresses the pipe bursting and pipe reaming construction methods, as well as EPA’s determination concerning these specific techniques. This document clearly states “The bursting and reaming processes have been determined by EPA to make the transite pipe friable and therefore a regulated asbestos containing material (RACM) waste ... [B]oth processes have been determined by the EPA to create an active asbestos waste disposal site.” The BAAQMD Compliance Advisory cites specific notification requirements regarding asbestos pipe replacement by the pipe bursting or reaming methods. If an agency chooses to replace AC pipe by pipe bursting or pipe reaming, the agency is responsible for identifying the location of each “active asbestos waste disposal site,” meeting certain deed restrictions, and submitting closure plans. In addition, any subsequent work (such as connection of new laterals) requires a 45-day advance notification. BAAQMD also reduces the exclusion length to 100 feet.

Policies in other states are different. In Arizona and New Mexico AC pipes can be replaced by pipe bursting or pipe reaming following filing of a notice of intent. In Oregon specially licensed abatement contractors are required to remove and dispose of AC pipe. Oregon is also the only state that requires all AC pipe to be removed if it is exposed for any reason. In Nevada, New Jersey, and New York, specially licensed contractors are required for any work (including taps) performed on AC pipe.

During pipe reaming, drilling fluid is pumped into the borehole to flush pipe fragments and soil to the downstream receiving pit. The mixture of mud, soil, and pipe fragments can be collected for disposal. When the host pipe is AC, the collected mixture must be containerized and disposed of at an appropriate landfill site. This ability to contain and appropriately dispose of the AC pipe fragments is the primary reason that the EPA favors pipe reaming. To date, no studies have been done to quantify how much of the pipe is recovered during reaming, but the EPA staff member meeting with an author of this article offered an opinion that up to 90% of the pipe fragments may be removed.

Whereas pipe reaming is a patented process, the patent on pipe bursting has expired. There are far more contractors who are experienced pipe bursters. The number of projects completed by pipe bursting is much greater than pipe reaming. Only a few projects resulting in instal-
lation of pipes over 18 inches have been performed by pipe reaming. Pipe bursting can be used to install pipe up to 48 inches in diameter. The unit cost of pipe bursting is less than pipe reaming.

Certain EPA staff members are of the opinion that matters such as number of contractors, installation size range, and cost are market driven. If there is more demand for pipe reaming, then more contractors will become licensed and experienced, resulting in a wider installation range and more competition (leading to lower costs).

CURRENT EFFORTS REGARDING AC PIPE AND PIPEBURSTING

The American Water Works Association Water Research Foundation (WRF) and the National Research Council of Canada recently released a study entitled Long Term Performance of Asbestos Cement Pipe (Project 4093). This study provides an in-depth examination of the factors that impact AC pipe performance, predictive modeling and test methods to determine remaining life of in-service pipes, an overview of rehabilitation/replacement methods, and a discussion of safe handling practices.

Two new WRF projects are just beginning. Project 4297, led by John Matthews of Battelle Memorial Institute and Jason Leuke of Arizona State University, will provide drinking water utilities with reliable performance, cost, and environmental data relating to asbestos cement (AC) pipe renewal practices. This will be accomplished through an investigation of renewal practices and regulatory standards, demonstration of innovative drinking water main renewal technologies, and evaluation of the environmental impact of those renewal techniques related to the renewal of AC pipe.

Project 4480, led by Ron Hunsinger, East Bay Municipal Utility District, and Roy Martinez and Dan Ellison, HDR, is a multi-funded research effort that will involve an extensive program of sampling and testing to establish appropriate condition assessment techniques for AC pipe and determine a method of degradation estimation that is not anticipated to be linear. The concept of water quality optimization for extension of AC pipe service will be examined, and management tools will be developed for determining and projecting remaining life to avoid service failures.

Rehabilitation methods, largely focused on lining techniques, will be evaluated as a method to arrest corrosion and the value of these techniques as a method to extend service life will be investigated. Tools to project renewal priorities will be developed and a cost model will be established to evaluate cost effectiveness of rehabilitation versus replacement.

The AC Pipe Bursting Task Force is a collective effort of industry leaders from municipalities and utility providers, engineers, contractors, pipe manufacturers, technology developers, and national associations representing the industry. This group has taken on the daunting task of developing an Administrator Approved Alternate (AAA) to be submitted to the EPA. The AAA will seek to provide detailed technical information to help the EPA consider appropriate revisions to their policies regarding pipebursting of AC pipe.

These efforts are indicative of the great value associated with rehabilitation of AC pipe. Hundreds of thousands of miles of AC pipe are reaching the end of their 50-year useful lives and will need to be replaced soon. EPA surveys have projected that $335 billion in drinking water improvements (2007 dollars) and $298 billion in wastewater and stormwater improvements are needed over the next 20 years. Meeting these needs without suffering incredible service failures is going to require our industry to use every tool available to us. Each engineer, contractor, and public official responsible for replacing AC pipe should be aware of the policies in place in the area where they work.

REFERENCES

Construction of pipes requires fairly complex manufacturing facilities. As a result, all pipes are constructed in short segments and shipped to the job site, where they are joined together. The outcome is a pipeline with joints every 20 feet or so. It is well recognized that these joints are a potential source of leaks, which can inflict significant loss of revenue as well as harm to the environment. For larger-diameter pipes, the transportation costs from the plant to the job site could add significant expense to the project.

Mo Ehsani, President of PipeMedic, has developed a pipe that can be manufactured on-site to almost any length.
To overcome the above shortcomings, the author has developed a new non-metallic pipe that can be manufactured on-site in virtually unlimited length, thus eliminating all joints. Pipes must possess two primary attributes: a) sufficient strength and stiffness so they can be handled and resist gravity loads safely, and b) adequate strength to resist the internal fluid pressure. These can be addressed economically in the new InfinitPipe™.

Similar to the construction of an I-beam, the wall of this pipe is made up of a lightweight core that is covered with carbon or glass Fiber Reinforced Polymer (FRP) materials as the skin. The carbon fabric is used on the interior surface of the pipe to resist internal hoop and thrust loads.

Additional layer(s) of glass or carbon FRP will be used as the outer skin of the pipe. As an example, if we consider the stiffness of a 1/8-inch-thick carbon FRP as unity, when the same amount of FRP is sandwiched between a 3/8-inch-thick honeycomb, making the total thickness a half-inch, the stiffness of the panel is increased by 37 times while there is only a 9% increase in weight.

The constituent materials for the construction of this pipe are lightweight and can be packaged in compact fashion for ease of transportation to site. A full-size container, for example, may carry enough fabric and resin to construct thousands of feet of pipe. Prior to the construction of the pipe, a trench will be cut for placement.

A 20-foot-long mandrel having the same diameter as the pipe to be manufactured is mounted on a trailer that can move along the trench. The steps of the construction can be summarized as follows; the choice of carbon or glass fabric and the number of layers is a function of the design and loading requirements for the project:

a) A bond-breaker layer is applied to the outer surface of the mandrel.
b) A roll of carbon or glass fabric is saturated with epoxy resin using the onboard saturating machine and it is wrapped once or twice around a 20-foot length of the mandrel.
c) A honeycomb panel is wrapped around the mandrel.
d) Additional layer(s) of glass or carbon fabric saturated with epoxy resin is wrapped around the mandrel.
e) The epoxy resin will start to harden in about an hour in ambient temperature; a slight heating of the mandrel can reduce this time to 20-30 minutes.
f) The mandrel is partially collapsed, and the finished pipe is mostly slipped off the mandrel, leaving about two feet of it on the mandrel.
g) Steps b) through f) are repeated to build a continuous joint-free pipe.
h) The finished pipe is lowered in the trench as the trailer travels along the trench.

A crew of five can easily manufacture and place 150 feet of a 24-inch pipe in an eight-hour shift. Automation of this process is planned and it will significantly reduce manufacturing time. This construction technique allows for easy modification to the pipe. For example, if a portion of the pipeline is going to be subjected to traffic loads, that region can be constructed with more layers of fabric or a thicker honeycomb to provide additional stiffness for the pipe; such stronger sections offer a seamless transition to the remaining portion of the pipe.

InfinitPipe is subject to several pending patent applications.
LMK Technologies licensee Nor-Cal Pipeline Services was presented with a tough initial trenchless repair in Sausalito, California, just across the bay from San Francisco.

Although the scenery of battleships, fishing ships and playful seals in San Francisco Bay makes Sausalito a striking and unique locale, the contractor’s focus was a 21-inch-diameter pipe connecting a clarifier to secondary sewage treatment.
This is the last 17-foot section of pipe installed in 1952 and originally serving as the plant’s outfall pipe. This line was concrete-encased but was becoming increasingly restricted due to the growth of material inside it, effectively reducing its diameter from 21 inches to roughly 16 inches.

The San Francisco area is home to many beautiful rolling hills, presenting one of the complications in doing this repair as the crew had to carry equipment down a very steep hill to reach the access manhole (“Manhole 1”) where the liner would be inserted to renew the deteriorated pipe.

Due to the portability of the sectional CIPP system, moving the rehabilitation equipment into place did not require a vehicle or any other heavy equipment.

One of the major complications in this project was that the repair’s termination point, at “Manhole 2,” is located under the district’s wastewater treatment plant access causeway and on the beach of the San Francisco Bay. The termination point was in a deep concrete vault with its opening 10 feet in the air, which would have made insertion from that point exceedingly difficult.

Kevin Rahman, Associate Engineer and project manager for Sausalito–Marin City Sanitary District Plant, told the contractor that the accumulated pipe material had been tested. The tests revealed that

San Francisco Bay provided a backdrop for repair work. Nor–Cal Pipeline Services performed in Sausalito.

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On a recent SBU project in Afghanistan, three Robbins technicians helped the excavation team locate and avoid underground land mines. Working on-site throughout the project, the technicians enabled the team to double production—advancing at five inches per minute upon completion.
the pipe material content was 93% iron and 7% bacteria. This accumulated buildup on the pipe was likely the result of using high doses of ferric chloride in prior years to reduce hydrogen sulfide concentrations.

Knowing the pipe was concrete-encased, Nor-Cal Pipeline Services attempted to remove the buildup inside the pipe with a chain flail. This method was ineffective, as the material was relatively soft and coated the chain.

The contractor then proceeded to use a 10,000-pounds-per-square-inch water jetter to remove the debris. After three passes the debris was removed except for a small ridge along the top of the pipe. The District determined the ridge to be an insignificant reduction of area. Thus, the pipe was ready for CIPP lining.

Manhole 1 is located on the plant’s causeway and provides access to a concrete chamber about eight feet below where the receiving manhole (“Manhole 2”) is located, separating the facility and the bay. The tides would dictate when the crew could gain access to Manhole 2, which is covered by water during high tide.

The contractor waited for a minus tide to begin work, thereby allowing about a six-hour window before the tide would again flood Manhole 2. The liner was wet-out as the tide began to recede and drop below the level of Manhole 2. The water level had to drop enough to open the manhole cover without waves splashing inside.

Nor-Cal Pipeline Services only had six hours to complete the trenchless CIPP repair and restore the sealed manhole cover. Due to space constraints, the sectional liner launcher had to be carefully and precisely maneuvered to reach the pipe access point.

The liner and bladder assembly was threaded through Manhole 1, routed over the edge of a sea wall, and inserted into Manhole 2 where it was inverted to the primary effluent box 17 feet down the prepared 21-inch pipe. It was then cured at ambient temperatures during low tide, which took approximately two hours.

After the liner was cured, and just as the tide began to approach the level of Manhole 2, both ends of the liner were cut. The repair was a complete success for the Sausalito-Marin City Sanitary District, restoring this bottlenecked section of old pipe back to its required capacity.
Industry Outreach & Resources in California: The Northern California Pipe Users Group

Cindy Preuss, PUG Chairman, Sr. Project Manager, HydroScience Engineers

Roberts McMullin, PUG Vice-Chairman, Associate Engineer, East Bay Municipal Utility District

Over the years, the Northern California Pipe Users Group (PUG) has grown not only in membership but also in breadth and depth of presentation topics, industry event sponsorships (conferences, road shows), professional training, field trips (active construction sites, pipe manufacturing plants), and social activities. With more than 57 mem-
About eight years ago, PUG discovered many similarities with the North American Society for Trenchless Technologies. Both organizations strive to provide their members with the best value, resources, and education possible. While PUG focuses on any topic associated with pipeline assessment, design, and construction, NASSTT provides specialized excellence to the industry with its focus specific to trenchless technologies.

In response to PUG’s membership feedback and technology interests, PUG began offering annual training courses on contemporary engineering topics. Given the thirst for up-to-date and comprehensive training on trenchless technologies, PUG coordinated with NASSTT, with early co-sponsorship with WESTT, to negotiate training agreements at reasonable costs to maximize attendance and

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For information please contact Vern Phillips, PE vphillips@harris-assoc.com

NASSST looks forward to many more NASSTT training opportunities in the future.

PUG strives to provide knowledge and is proud to sponsor members and engineering students alike to partake in educational opportunities. Each year, PUG reinforce our shared mission. Previous training courses included Pipe Bursting (2006), Introduction to Trenchless Technology (2007), Cured-in-Place Pipe (CIPP) (2008), New Installation Methods (2009), Laterals (2010), and Horizontal Directional Drilling (2011).
encourages its Board members to attend one national or regional conference with partial sponsorship to help cover registration fees, airfare, and other travel-related expenses. Upon return from the conference at a subsequent monthly PUG meeting, each Board attendee presents an informative PowerPoint presentation on the highlights of what they learned. These presentations are well received by members and cover topics ranging from new or unique technologies discovered in exhibit halls to record-breaking or challenging installations and lessons learned presented in the technical paper sessions.

To further our members’ exposure to the pipeline industry, PUG also sponsors member attendance for up to two individuals at regional conferences such as the Western Regional No-Dig event. Sponsorship covers all conference and travel costs for PUG member raffle winners.

Lastly, PUG understands the importance of educating and supporting our up-and-coming industry engineers (current students). Not only does PUG donate generously to the annual No-Dig conference educational fund auction, it also participates in the live auction. Winnings from the auction are raffled away to PUG members at monthly meetings and/or the annual seminar during February in Berkeley, California.

PUG’s work has gained welcome support and recognition from trenchless professionals. “As a national trenchless pipeline contractor,” says SAK Construction’s Matt Wassam, “we are often asked to speak to groups about the cutting-edge technologies SAK is delivering to the market. The participants at the Pipe Users Group were influential decision makers who were engaged and involved in the presentation and the specific project discussions. The questions they asked indicated a clear understanding of the nuances of trenchless water main rehabilitation projects. The Pipe Users Group was one of the best audiences I have presented to.”

With a shared mission for education, PUG is honored to have found such synergy with NASTT/WESTT. Working together benefits members of both non-profit organizations. PUG looks forward to future activities, events, and outreach with NASTT/WESTT that will continue to enhance the pipeline industry and its professionals.

For more information on PUG, please visit www.norcalpug.com.

THE FRP PIPE EXPERTS

Professor Mo Ehsani is a pioneer in the development of applications of FRP technology and is internationally recognized as an expert on this subject. A few of his innovative solutions are listed below:

**Wet Layup**
Layers of carbon or glass FRP are applied inside the pipe to create a pressure vessel that can resist all or part of the internal pipe pressure. The solution also makes pipe watertight and it can also be used as a spot repair on short segments of a pipeline.

**PipeMedic™ Laminates**
High-strength 0.025 inch thick carbon or glass laminates applied with a packer for spot repair of pressure pipes. Winner of Trenchless Technology Project of the Year Award in 2011 for repair of a high-pressure gas pipe.

**StifPipe™ Honeycomb Pipe**
An economical light-weight pipe manufactured to any shape or size for slip-lining applications.

**InfinitPipe™**
A revolutionary on-site manufactured pipe of virtually any length or diameter for new installations. Eliminates all joints, transportation costs and delays for ordering and manufacturing.

Read the article on page 29 of this issue.

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While Magnetic Flux Leakage (MFL) is widely used in oil and gas pipeline condition assessment, Pure Technologies’ MFL technology provides the most comprehensive and accurate non-destructive metallic pipeline condition assessment in the water and wastewater market.

Inline MFL is used to scan the full circumference of at-risk pipe sections at an extra-high resolution, and detects corrosion, pitting and wall loss in ferrous pipes eight inches or larger. MFL is able to scan the pipe through various linings and can quantify the remaining wall thickness and provide depth and location of wall loss. Each MFL tool is custom designed or modified for each specific project, since it must be as close as possible to the diameter of the pipeline without touching it to achieve the most accurate results.

All MFL inspections are non-destructive; however, large-diameter inspections require the pipeline to be completely dewatered, since the tool is very large and designed to cover the full circumference of the pipeline. Small-diameter inspections are free flowing and can be completed if the pipeline is depressurized. With MFL technology, permanent magnets are used to temporarily magnetize the steel pipe and the magnetic field changes are recorded and analyzed. The magnetic flux is uniform if there are no flaws in the pipe wall. If internal or external flaws are present, such as pitting, corrosion or other forms of damage, the magnetic flux is distorted beyond the wall of the pipe, and this distortion or ‘leakage’ is measured by Hall Effect sensors. Contact with the pipe wall is not a requirement to accurately detect flaws.

In order to complete a large-diameter MFL inspection, there are some specific logistics. Because of its size, the large-diameter tool must be assembled inside a large manhole and pulled through the pipeline using robotics or a manned cart. In order to inspect inclines or declines in the pipeline, the tool must be attached to a winch, which is set up above ground at a manhole, and raised and lowered carefully.
Pure Technologies has completed two high-profile MFL projects on large-diameter pipelines that have had positive results for the utility involved.

San Francisco Public Utilities Commission (SFPUC) contracted Pure to develop a customized extra high resolution MFL tool, measuring tool, and propulsion equipment to carry out full-scale field inspections. SFPUC operates three parallel cement mortar-lined steel pipelines about 48 miles long, known as the San Joaquin Pipelines, which range in size from 56 inches to 78 inches in diameter. Some sections have been operating for nearly 80 years, which prompted SFPUC to seek an advanced method of condition assessment for their pipeline to prepare a replacement or repair plan if necessary.

The inspections were highly successful, detecting the exact locations of pipe wall loss and hidden pitting in the pipeline that were not visible through an external assessment. The MFL results were validated by internal inspections of damaged pipe sections. Overall, the project provided a comprehensive understanding of the pipeline location, its full circumference and length, and established damaged areas for repair. The inspection allowed for selective pipeline rehabilitation and better understanding of the system, saving millions of dollars in capital replacement costs.

Pure also completed an MFL inspection on behalf of The San Diego County Water Authority (SDCWA) on their 73-inch and 76-inch mortar-lined steel water transmission main, called the Second San Diego Aqueduct (SSDA). This inspection is largest-diameter MFL inspection to date. Pure inspected just over five miles of the SSDA pipeline, which was built in the 1950s and is an important link between the Metropolitan Water District and the San Diego County Water Authority. The inspection was needed because SDCWA needed to verify that their major transmission main could handle the additional flow created from a new desalination plant.

Both large-diameter MFL projects show the capability of MFL to assess ferrous pipe materials and provide worthwhile information for utilities on the condition of their pipeline. Pure is continuing to develop and improve its MFL technology to continue providing utilities with quality condition assessment of their metallic pipelines.
As our wastewater infrastructure continues to age, the importance of maintaining and replacing these facilities increases. Additionally, with pipe rehabilitation and replacement costs on the rise, it can be a challenge for utility owners to acquire the necessary funds to not only assess where this work is most needed but also what type of work is required. Through the use of a Benchtop Study, a unique strategy can be developed for prioritizing the available funds for the condition assessment of a pipeline in such a way that the funds are spent efficiently to identify the areas most needing repair.

A Benchtop Study has two key steps prior to initiating field investigations. The first step is to gather and evaluate existing facility information from the many different sources into one main data bank; the second step is to use that information to identify where the most efficient use of available funds should be spent.

In developing projects of this nature, the typical work plan approach is no longer a cost-effective solution. Historically, the typical work plan has taken the following approach:

A Benchtop Study approach optimizes the typical work plan to take into account the limited available funds. The optimized work plan takes the following approach:

Utilizing this cost-effective optimized approach, a condition assessment was performed for the City of Santa Clara on the Trimble Road Trunk Sewer. The City is located in the middle of the Silicon Valley of the San Francisco Bay Area in Northern California. The City owns and operates approximately 277 miles of sanitary sewer collection pipelines.

The Trunk Sewer is a critical component of the City’s wastewater collection system. The Trunk Sewer consists of more than 13,000 linear feet of gravity pipeline ranging from 33 to 48-inches in diameter with 49 manholes, and five siphons ranging from 15 to 24 inches in diameter. Pipe materials include both lined and unlined reinforced concrete pipe (RCP), ductile iron pipe (DIP), and Techite pipe material. The original Trunk Sewer was constructed in 1948, with major portions replaced in 1972 (Techite), 1979 (unlined RCP), and 2001 (lined RCP). Carollo initiated a Benchtop Study by gathering and reviewing existing City information and data sets including as-built drawings, construction records, previous studies, and flow-monitoring data.

The benchtop evaluation provided valuable insight into the areas in the system most likely to experience corrosion. This information was used to help tailor the field inspections to focus on areas with
the greatest potential for corrosion.

Based on the information provided, a risk analysis was performed on the entire Trunk Sewer. Risk scores were assigned based on an analysis of criticality and vulnerability. Criticality scores are a function of repair costs, loss of service impacts, health and safety impacts, and environmental impacts. Vulnerability scores are a function of age, pipe material, pipe slope, history of failure, seismic zones, traffic impacts, and soil corrosively.

The project team calculated risk scores for each pipe segment based upon the available information. The Benchtop Study provided three key items: the potential areas of greatest concern, the most likely field conditions, and identification of appropriate field inspection technologies. A geographical information system (GIS) map was developed to graphically present this information to the City.

FIELD INVESTIGATIONS

The next phase of the project proceeded to the implementation of the field investigation. The field investigation included hydrogen sulfide monitoring, manhole inspections, and internal pipeline inspection.

HYDROGEN SULFIDE MONITORING

Eight manholes were selected for hydrogen sulfide (H₂S) monitoring, and testing was conducted over a seven-day period. Grab samples were taken by field staff and by an automated sampler. OdaLog Gas Loggers were used to monitor H₂S levels.

Results from the grab samples revealed that the dissolved sulfides in the wastewater ranged from 0.3 to 2.1 parts per million (ppm). Average manhole temperatures during the sampling ranged from 76 degrees Fahrenheit to 82o F. The data revealed a significant increase in H₂S concentration at the two manholes closest to the San Jose interceptor where the Trunk Sewer discharge is located. It was also found that during normal daily operation, MH 79-3 saw levels of H₂S that were higher than the OdaLog data collector could record. During times of low flow, the concentration of H₂S at MH 79-3 would reduce to near normal levels, while the level in the downstream manhole (MH 79-13) between manhole 79-3 and the interceptor would spike. It was later discovered that these very high H₂S levels were caused by downstream surcharging during peak dry weather flows.

MANHOLE AND PIPE INSPECTIONS

Confined space entry inspections were completed on all 49 manholes (MHs) and junction structures associated with the Trunk Sewer. Each MH inspection involved concrete penetration tests, removal of concrete core samples for pH analysis, wastewater grab samples, measurement of sediment levels, and photographs to document the manhole condition and its influent and effluent pipe connections.

Several of the manholes inspected were found to have severe corrosion. Six of the seven manholes at the northeast end of the pipeline (just prior to discharging into the San Jose interceptor) were in very poor condition and had severely corroded reinforcement. Of the 90 pH samples taken, 77 had a pH below 6.5, indicating the concrete in the majority of these manholes is experiencing moderate to severe corrosion.

The project team determined that during low-flow conditions (12:00 AM and 8:00 AM), closed-circuit television (CCTV) would be the most effective method to accomplish detailed internal pipe inspections. The CCTV inspections revealed several pipe segments with lining failures, exposed aggregate, and insufficient slopes. Condition ratings were developed for each pipe segment using NASSCO’s Pipeline Assessment and Certification Program (PACP) coding system on a scale ranging from 1 (excellent) to 5 (very poor). These condition grades were presented to the City on a GIS map and provided an overall view of the condition of the Trunk Sewer.

CONCLUSIONS

The project team correlated the expected conditions from the Benchtop Study with the actual conditions from the field investigations to determine the accuracy of the Benchtop Study. The Benchtop Study identified approximately 9,300 lf of moderate to high corrosion potential in the interceptor. The field investigation confirmed 6,800 lf of actual corrosion; therefore, it validated 73% of the Benchtop Study. As a result, the Benchtop Study methodology can be implemented to prioritize available funds for field investigations. Field inspections of low-risk areas can be postponed in favor of inspecting high-risk areas as time and budget allow.
Dear Trenchless Colleagues:

We are calling the 2013 No-Dig Show “The Great Trenchless Gold Rush!” – and what an adept description for this fabulous event as attendees, sponsors, students and exhibitors will face a “Gold Rush” of trenchless information at the only conference in North America that focuses solely on trenchless technology!

We are thrilled to return the No-Dig Show to the West Coast, and Sacramento offers the perfect setting to promote and celebrate our exciting industry. We officially invite you to join us and the global trenchless community at NASTT’s 22nd annual No-Dig Show, March 3-7 at the beautiful Sacramento Convention Center!

Trenchless technology continues to grow throughout North America, as municipalities and cities look for cost-effective and non-disruptive solutions to their infrastructure challenges. Sacramento is a city rich with trenchless experience, having just completed an extensive, long-term trenchless program.

The volunteer members of the Program Committee have worked tirelessly during the past year to offer you an extensive educational program that overflows with opportunities to learn everything about trenchless technology and is packed with outstanding cutting-edge trenchless advances in the technical sessions. In addition, there is no better place to network with your peers and talk with vendors offering the latest technology and products — a true “Trenchless Gold Rush”!

NASTT is committed to trenchless education, and our No-Dig program is full of the best the industry can offer. Our Technical Program — the “gold” standard of technical programs — begins on Monday, featuring 150 high-quality, peer-reviewed, non-commercial papers in a six-track schedule. And there’s more: Our pre- and post-conference courses feature topics on the gamut of trenchless applications, including pipe bursting, HDD, laterals and CIPP.

Networking and interacting with our trenchless professionals, educators and experts is a key component of our No-Dig Show and we have several excellent events where you can kick back or kick up your heels! Monday begins and ends with two fantastic networking events. The day begins with our “Kickoff Breakfast” and ends with NASTT’s fundraising social event of year, the Educational Auction and Reception. Not only is the Auction a great time where you can network over drinks and appetizers, but it’s also a wonderful opportunity for you to give back to the industry by bidding on amazing items. The Auction helps NASTT support the future of the industry by raising money for its educational initiatives. Since 2002, NASTT has raised more than $500,000 for the fund. You don't want to miss this event!

One of the highlights of any No-Dig is our Gala Awards Dinner, held on Tuesday evening. Here, NASTT gathers for an evening of incredible food, awards and live entertainment. NASTT will formally recognize the recipients of the Chairman’s Award for Outstanding Lifetime Service, the Trent Ralston Award for Young Trenchless Achievement and the winners of the Joseph L. Abbott, Jr. Innovative Product Awards. The highlight of the evening will be the induction of the second class to NASTT’s Hall of Fame. Stay tuned for more details of this event!

The 2013 No-Dig Show ends Wednesday with our annual Closing Luncheon, where we will also draw the winning “golden” ticket for our second annual vacation raffle. This year’s raffle will send the winner on an all-expenses-paid vacation to the Caribbean—we hope you have your tickets! Purchase your tickets today at www.no-digshow.com/student-fundauction for your chance to win some fun in the sun! All proceeds benefit NASTT’s Educational Fund. This cool raffle is made possible through the generous donation of Vermeer Corp.

All of these events will take place at the gorgeous Sacramento Convention Center Exhibit Hall, located in the heart of downtown Sacramento. Our host hotels are just a few steps away from the Convention Center at the Hyatt Regency Sacramento and Sheraton Grand Sacramento Hotel. Call today to make your reservations at the group discounted rate. Save $100 on your full conference fee when you register before Feb. 8.

Kim Staheli
No-Dig Program Chair

Kevin Nagle
No-Dig Program Vice-Chair

We can’t wait to see you in Sacramento!
All of the benefits of a national conference program in a smaller forum with a personalized touch! Come to California’s Inland Empire and learn about the latest in trenchless technology from experts in the field. Registration for the first day of the conference includes an informative technical program and product exhibition area. On the second day of the conference, two 8-hour NASTT Good Practices Courses will be offered: Pipe Bursting and New Installation Methods. Attendees may participate in either or both days of the conference (see rates). For more information on course content and instructors, go to www.NASTT.org/training.

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

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Conference Registration Fees:
Technical Program and Exhibition—Oct 29

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NASTT Good Practices Courses—Oct 30
(Choice of Pipe Bursting or New Installations)

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† Both discounts may be used, if applicable
‡ Discounted government rate available until 10/15/12

Exhibitor Rates

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** Includes booth, up to 2 representatives, half-page ad in conference program
*** Includes booth, up to 2 representatives
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