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WELCOME TO THE newest edition of the Western Regional Trenchless Review! Our first two issues saw nationwide distribution and received excellent feedback, and we hope that this issue will continue to be a valuable source of trenchless industry information. Thank you to all the advertisers and article contributors for helping to make this year’s issue a success.

There has been a changing of the guard and the introduction of new faces within our group this year. I would like to personally thank our past Chair, Dr. Sam Ariaratnam, for all of his hard work in establishing and growing the Western Society for Trenchless Technology (WESTT). WESTT was formed in 2004 as a regional chapter of the North American Society for Trenchless Technology (NASTT) covering a four state region of Arizona, California, Nevada, and New Mexico with a volunteer Board of Directors comprised of representation from academia, government, and industry covering all four States. I am proud to say that I have been involved with the group from its inception and I am excited to continue to play a role in shaping its future.

Our group’s objective is to advance the science and practice of Trenchless Technology for public benefit; to promote and conduct education, training, study and research for the public benefit; and to make information readily available to all interested and concerned parties. WESTT aims to be a “local” source for connecting individuals interested in learning about adoption of various trenchless techniques as a viable solution to their infrastructure needs. Sharing of experiences is an excellent way for evaluating the suitability of a particular trenchless method to your specific situation. Furthermore, sharing ideas amongst colleagues within our region helps to disseminate information while building local networks and industry connections.

This year the Chapter will hold the Fourth Annual Western Regional Mini No-Dig Conference and Exhibition on October 13-14th, 2008 in downtown Sacramento, California. The event will be held at The Holiday Inn Capitol Plaza, which is just steps from the California Capitol Building as well as more than 100 unique shops, restaurants and museums in Old Sacramento. The Conference will be an excellent opportunity to learn more about trenchless methods from technical presentations and an exhibition area featuring various vendors from trenchless industry companies. I am excited about the networking that will take place during the event. The Chapter is also pleased to announce a post-conference site tour of a local large scale micro tunneling project in the Sacramento area. Stay tuned for more details.

I look forward to another excellent year for trenchless activities in the Western region and welcome new members to join the Western Chapter. Please feel free to contact me at jglynn@rmcwater.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
AS I ENTER the final stretch of my term as NASTT Chair, I am feeling quite content with what I have seen and what is going on with our Regional Chapters. The WESTT society is heading into its Fourth Annual Regional No-Dig in Sacramento, California. As I stated last year, their grass roots involvement is a model to be looked at by other Chapters. Well done!

Once again, this year’s program is full and technically sound. I have penciled the dates of the conference in and will be going west!

Huge congratulations to the WESTT and their ongoing successes and participation at the No-Digs. I expect a great representation at the next No-Dig, the International No-Dig in Toronto from March 29th to April 3rd 2009 at the Sheraton Centre Toronto.

See you there!

Piero Salvo, P.Eng., M.Eng.
Chairman, NASTT
WSA Trenchless Consultants Inc.
THIS IS MY first opportunity to directly address the Western Society for Trenchless Technology and to personally thank the members for their dedication and outstanding commitment to NASTT and our industry. The strength of NASTT evolves almost exclusively from the Chapter membership and it is that volunteer spirit that makes NASTT unique. While still a relatively new chapter, WESTT members continue to impress. That was certainly witnessed at No-Dig 2008 in Dallas, Texas where WESTT had strong representation once again. WESTT abounded from the podiums of the session halls and from the floor of the trade show. You have much to be proud of.

This year has presented change at NASTT and as many of you already know, John Hemphill, our Executive Director for nearly a decade, has retired. Often described as the face of NASTT, John’s contribution to our Society is immeasurable. Under John’s leadership, there was significant growth in membership, in the number of regional and student chapters, as well as the establishment of our highly regarded training courses. John believed strongly in the peer-review process for our No-Dig technical sessions and always knew how to enlist the expertise of our chapter members for the Program Committee. John will be missed and I wish him well with his new role as Executive Director of the International Society for Trenchless Technology.

As the new Executive Director, I’ve inherited something of great value and I could not be more honoured. NASTT is in great shape and our membership has never been stronger. This again is due to the extraordinary enthusiasm of the membership and their understanding of the benefits of trenchless technologies to the public and to the environment. I look forward to working with you in the years to come and wish WESTT the best of times with your plans for the future.

Best wishes,
Mike Willmets
Executive Director, NASTT
## 2008-09 Calendar of Events

### September 2008
- **29-Oct. 3** IPLOCA 42nd Annual Convention, Athens, Greece

### October 2008
- **13-14** 4th Annual Western Regional No-Dig Conference & Exposition, Sacramento, CA
- **18-22** WEFTEC 2008 Annual Conference & Expo, Chicago, IL
- **20-23** Cal-Nevada AWWA Annual Fall Conference, Reno, NV
- **28** NASTT CIPP Course, Martinez, CA

### November 2008
- **6-8** ASCE 138th Annual Conference, Pittsburgh, PA
- **12** NASTT New Installations Methods Course, Edmonton, Alberta
- **13** 2008 Alberta Trenchless Technology Symposium, Edmonton, Alberta
- **25-28** China Bauma 2008, Shanghai, China

### December 2008
- **9-10** 2008 Damage Prevention Conference & Expo, Las Vegas, NV

### January 2009
- **20-23** 2009 UCT International Conference & Exposition, San Antonio, TX
- **20** NASTT HDD Good Practices Guidelines Course, San Antonio, TX
- **21** NASTT Pipe Bursting Good Practices Course, San Antonio, TX

### February 2009
- **11-15** 41st Annual Pipe Line Contractors Association Conference, Carlsbad, CA
- **16** NASTT Pipe Bursting Good Practices Course, Orlando, FL
- **17** NASTT Horizontal Directional Drilling Good Practices Course, Orlando, FL
- **17-19** 2009 CGA Excavation Safety Conference & Expo, Orlando, FL
- **22-27** 48th Annual Distribution Contractors Association Convention, Maui, HI
- **25-28** Pumper & Cleaners International Expo, Louisville, KY
- **27-4** Power & Communications Contractors Association 64th Convention, Hawaii

### March 2009
- **4-6** NUCA Utility Construction Expo’09, Phoenix, AZ
- **29-3** 2009 International No-Dig Conference & Exhibition, Toronto, Ontario Canada

### April 2009
- **5-7** 2009 ASCE Construction Research Congress, Seattle, WA

### June 2009
- **14-18** AWWA Annual Conference & Exposition, San Diego, CA

### August 2009
- **16-19** ASCE International Pipelines Conference 2009, San Diego, CA
## 2008-09 Training Courses, Chapter Events & Conferences

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<tr>
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<th>Date</th>
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<tbody>
<tr>
<td><strong>Western Regional No-Dig Conference &amp; Exhibition</strong></td>
<td>Monday, October 13, 2008 – Tuesday, October 14, 2008</td>
<td>Holiday Inn Capitol Plaza - Sacramento, California</td>
<td>Western Society for Trenchless Technology (WESTT)</td>
<td>Website: <a href="http://www.westt.org">http://www.westt.org</a> Jennifer Glynn Email: <a href="mailto:jglynn@rmcwater.com">jglynn@rmcwater.com</a></td>
</tr>
<tr>
<td><strong>Horizontal Directional Drilling Good Practices Guidelines (HDD) Course</strong></td>
<td>Tuesday, January 20, 2009</td>
<td>Henry B. Gonzalez Convention Center - San Antonio, Texas</td>
<td>North American Society for Trenchless Technology (NASTT)</td>
<td>Website: <a href="http://www.uctonline.com">http://www.uctonline.com</a> Angela Ghosh, NASTT Phone: 703-217-1382 Email: <a href="mailto:aghosh@nastt.org">aghosh@nastt.org</a></td>
</tr>
<tr>
<td><strong>NASTT Pipe Bursting Good Practices Course</strong></td>
<td>Wednesday, January 21, 2009</td>
<td>Henry B. Gonzalez Convention Center - San Antonio, Texas</td>
<td>North American Society for Trenchless Technology (NASTT)</td>
<td>Website: <a href="http://www.uctonline.com">http://www.uctonline.com</a> Angela Ghosh, NASTT Phone: 703-217-1382 Email: <a href="mailto:aghosh@nastt.org">aghosh@nastt.org</a></td>
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<tr>
<td><strong>NASTT Cured-in-Place-Pipe (CIPP) Good Practices Course</strong></td>
<td>Wednesday, January 21, 2009</td>
<td>Henry B. Gonzalez Convention Center - San Antonio, Texas</td>
<td>North American Society for Trenchless Technology (NASTT)</td>
<td>Website: <a href="http://www.uctonline.com">http://www.uctonline.com</a> Angela Ghosh, NASTT Phone: 703-217-1382 Email: <a href="mailto:aghosh@nastt.org">aghosh@nastt.org</a></td>
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<tr>
<td><strong>NASTT New Installation Methods Good Practices Course</strong></td>
<td>Thursday, January 22, 2008</td>
<td>Henry B. Gonzalez Convention Center - San Antonio, Texas</td>
<td>North American Society for Trenchless Technology (NASTT)</td>
<td>Website: <a href="http://www.uctonline.com">http://www.uctonline.com</a> Angela Ghosh, NASTT Phone: 703-217-1382 Email: <a href="mailto:aghosh@nastt.org">aghosh@nastt.org</a></td>
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<tr>
<td><strong>NASTT Laterals Good Practices Course</strong></td>
<td>Thursday, January 22, 2008</td>
<td>Henry B. Gonzalez Convention Center - San Antonio, Texas</td>
<td>North American Society for Trenchless Technology (NASTT)</td>
<td>Website: <a href="http://www.uctonline.com">http://www.uctonline.com</a> Angela Ghosh, NASTT Phone: 703-217-1382 Email: <a href="mailto:aghosh@nastt.org">aghosh@nastt.org</a></td>
</tr>
<tr>
<td><strong>2009 International No-Dig Conference &amp; Exhibition</strong></td>
<td>Sunday, March 29, 2009 – Friday, April 3, 2009</td>
<td>Sheraton Centre Toronto - Toronto, Ontario Canada</td>
<td>North American Society for Trenchless Technology (NASTT) and the International Society for Trenchless Technology (ISTT)</td>
<td>Website: <a href="http://www.nodigshow.com">http://www.nodigshow.com</a> Benjamin Media, Inc. (Conference Management) Phone: 330-467-7588 Email: <a href="mailto:info@benjaminmedia.com">info@benjaminmedia.com</a></td>
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Come to lively Sacramento, California and learn about the latest in Trenchless Technology from experts in the field through an informative technical program and product exhibit area.
THE EAST SIDE Combined Sewer Overflow (CSO) Tunnel Project will convey captured flows from Southeast Portland to a pump station on Swan Island, traveling under a busy industrial area along the Willamette River. The main tunnel is being constructed at a depth ranging from 100 to 160 feet and, when finished, will be approximately 30,000 feet long with a finished inside diameter of 22 feet. The main tunnel will function as a storage and conveyance conduit, intercepting a series of gravity conduits and drop structures that will collect flows from 13 of the system’s existing outfalls. Flows from several of the existing outfalls will be conveyed to the new tunnel via nine 84-inch-diameter reinforced concrete pipe microtunnels. The nine microtunnel drives total approximately 7,825 linear feet. One of the drives, the Outfall 46 drive, is a 3,055-foot-long microtunnel that was completed in April 2008. It is currently the longest microtunnel driven in the United States. The Outfall 46 alignment passes between an active railroad yard and a cement storage and shipping facility.

The $426 million East Side CSO Tunnel Project, constructed by the Joint Venture of Kiewit-Bilfinger Berger (KBB), is scheduled for completion in 2011. Jacobs Associates assists the owner, Portland’s Bureau of Environmental Services (BES), with construction management (CM) services, including contract administration and resident engineering. Craig Kolell, Associate at Jacobs Associates, provides CM services to the bureau for the microtunnel and pipeline work on the East Side CSO Tunnel Project. Mr. Kolell has over 24 years in the heavy civil construction industry, focusing on tunneling and microtunneling operations. He recently served as Assistant Construction Manager for the successful West Side CSO Tunnel project in Portland, Oregon. Christa Overby, Field Engineer for BES, now supervises all of the East Side CSO microtunnel and pipeline construction after working as Task Lead on the design. Ms. Overby has over 10 years of experience in civil design and construction. The superintendent responsible for the pre-planning and management of the microtunnel operations for KBB is Matt Roberts. Mr. Roberts has over 15 years of experience in the heavy civil construction industry, focusing on underground construction.

Geologic Conditions

The Outfall 46 drive was driven through two geologic units: artificial fill (Qaf) and sand/silt alluvium (Qal and Qff). These two units were defined in the GBR as follows:

- **Artificial Fill (Qaf)** mostly consists of gravel, sand, sandy silt, and silt with organic debris. However, in this case, it will also contain building debris, abandoned steel rails and timber railroad ties, concrete, logs, and wood waste including sawdust, branches, wood chips and fragments. Fill composition will vary within the project area depending on previous site-use.
A three chambered structure was built around the existing 78-inch outfall pipe. The existing pipe will be removed and an elbow will be placed diverting flows into the 84-inch microtunnel limiting flows into the river.

- Sand/Silt Alluvium (Qal and Qff) predominately comprises interbedded sandy silt and silty fine sand deposited as recent alluvium (Qal) and late Pleistocene fine-grained catastrophic flood deposits (Qff). They are typically non-plastic to low plasticity, but some zones of moderate to high plasticity elastic silt are found. Some gravel lenses are also found in this unit. The alluvium is typically stratified with alternating layers of fine sand, sandy silt, silt, and clayey silt. The consistency of the alluvium is most often described as soft to medium stiff for fine-grained layers or loose to medium dense for coarse-grained layers. Organic material was encountered during drilling within the Sand/Silt Alluvium, especially in sloughs and gulches. Organic material commonly consists of organic silts, wood fragments, logs, and wood debris.

**Design Considerations**

A slurry pressure microtunnel boring machine (MTBM) was required to prevent the soil from running or flowing uncontrollably into the machine face. Slurry microtunnelling minimizes groundwater drawdown and provides positive face support, thereby minimizing the effects of tunneling on nearby structures and utilities. The MTBM is capable of supporting the soil exposed in parts of the face while cutting harder layers and concretions in other parts. It is equipped with a stone crusher and disc cutters to break up boulders with compressive strengths up to 55,000 psi. A manlock was included to allow hyperbaric interventions for removal of obstructions and changes to cutterhead tools.

The original design for the Outfall 46 drive called for two microtunnels of 1,934 feet and 991 feet respectively, with an intermediate shaft. During construc-
tion, KBB proposed eliminating the intermediate shaft. It should be noted that the construction contract is cost reimbursable fixed-fee with labor, equipment, and materials paid by the owner as reimbursable costs. BES accepted the higher calculated risk of the long drive, which brought potential cost savings from the elimination of the intermediate shaft. The decision was based on BES’ experience with microtunneling on the West Side CSO Project in similar ground conditions and with a similar machine along with the technical feasibility performed for this long drive by KBB. The advantage of the longer drive to KBB was the schedule savings from the elimination of the shaft, which was located in a difficult position with limited space. After the decision was made, design modifications were made to the MTBM system to support the longer alignment, including changes to the slurry system, intermediate jacking stations controls, and electrical equipment.

Construction

An AVN 2000D machine built by Herrenknecht Tunnelling Systems was purchased for the project. The 104-inch-diameter cutting wheel can rotate in both directions to compensate for any rolling of the machine caused by reaction to the torque of the cutting wheel. Situated in the shield directly behind the cutting wheel, the excavation chamber processes all excavated material, crushing it to a grain size suitable for transportation by slurry circuit. The conveyance of the excavated and crushed material is undertaken in a slurry suspension. A feed pump pushes this suspension through a feed line into the excavation chamber, where it mixes with the excavated material. Then the mixture gets pumped via slurry pumps to the separation plant at the ground surface. The separation plant disjoins the material and slurry suspension. The addition of bentonite allows the density and viscosity of the slurry suspension to be varied to suit geological conditions.

The jacking shaft was a 24-foot-diameter, 54-foot-deep secant pile shaft with a jet grout bottom plug. Due to space lim-
iterations at the bottom of the shaft, a platform was erected 10 feet off the bottom for the slurry pump. A 1,100 ton indexing jacking frame was used to handle the 10-foot pipe sections.

The receiving shaft is located at the existing 78-inch outfall that will eventually divert flow into the microtunnel. The floor and walls of the structure were completed prior to the drive and the MTBM was removed from within the 14 foot wide by 18 foot long chamber in the structure. An 11 by 11 foot opening was left in the diversion structure wall to allow for the break in.

Because of the length of the drive, seven 1,100 ton Intermediate Jacking Stations (IJSs) were used. The length of the drive also required some additional electrical equipment be set in the pipes behind the machine. Therefore, the first IJS was installed approximately 150 feet behind the machine. Subsequent IJSs were installed approximately every 420 feet. The jacking forces slowly increased from 150 to 250 tons to approximately 700 tons towards the end of the drive. 900 to 1,000 tons was sometimes required to start the pipe moving again after down time for adding pipe, surveying, or maintenance. On most pushes, only one or two IJSs were needed.

Tunneling of the Outfall 46 drive started on February 14, 2008 and was completed on April 19, 2008. At the start of the drive the high silt content in the ground required some modifications to the separation plant equipment and handling procedures. Production rates were reduced when wood piles and miscellaneous pieces of metal — including large spikes, nails, and bolts were encountered. The average daily production was approximately 54 feet per day, with production on the best day being 152 feet. No hyperbaric interventions were required and no cutterhead tools needed to be replaced.

The 3,055-foot Outfall 46 drive is now the longest microtunnel ever driven in the United States. Like most rewarding tunneling achievements, it was accomplished through hard work and long hours by a team of laborers, operators, engineers, and managers. Most importantly, it was completed safely. Three hundred and six pieces of undamaged pipe were installed with no injuries.
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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.

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NASTT provides top-notch, quality education and training programs for trenchless professionals. Currently, NASTT offers six training courses covering Cured-in-Place-Pipe (CIPP), Horizontal Directional Drilling (HDD), pipe bursting, sewer lateral rehabilitation, an overview of trenchless technologies, and new installation methods such as auger boring, pipe jacking, pipe ramming, and the pilot tube method. Earn Continuing Education Units (CEUs) for your participation.

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From educational resources to training tools and more, NASTT members have access to a wealth of valuable information and networking opportunities.

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Joining is easy. Visit our Web site at www.nastt.org or call 613-424-3036 (in Canada) or 703-217-1382 (in U.S.) for membership details.

The Show!
The annual 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 125 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 the 2009 International No-Dig Show, March 29 – April 3. in Toronto, Ontario, Canada!
Western Society for Trenchless Technology (WESTT)

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SINCE THE INCEPTION of HDD, the desire for advanced technology has dominated the mind-set of the industry. The basic story is simple. The competition for early contractors was not each other but the task of convincing the construction world that Horizontal Directional Drilling was a viable installation method. Contractors honed their skills with comparatively few projects and usually in remote areas. About 1988, guidance capabilities advanced giving the operator the ability to precisely locate the steering tool below the surface. Prior to this, no one ever knew where the drill bit was located until it exited the ground, severely limiting the areas that HDD was feasible. By positioning an artificial magnetic field on the surface, the precise location of the steering tool below that field could be determined. The steering software offered precision beyond expectations. The advent of surface tracking allowed HDD contractors to know the location of the drill bit at all times. This was a gold-mine for the developer but a bigger boom for the HDD industry, creating the ability to install lines safely in congested areas. Things changed quickly.

Few newcomers understood that the catalyst for the industry’s amazing expansion was steering accuracy, but entrepreneurs recognized the opportunities and wanted in. The complexion changed rapidly and competition required contractors to do one of two things, be low bidder or promise some type of an advantage to their client. Industry growth created a severe experience shortage that affected the industry at all levels. Pipeline companies had very little HDD experience and were looking to an ever growing number of contractors with equally diluted expertise for advice. “Cowboy” contractors were financing rigs, pulling onto locations and drilling ahead with little or no planning. HDD standards were being lowered across the board. The steering specialist, a position previously requiring years of experience, was now open to anyone who would take the job.

In addition, a version of surface tracking, previously discarded as inferior, was being misleadingly promoted as a single wire system, marketed as newer and faster. To contractors who knew nothing about steering tools or the physics of how they worked, new meant better. Owners and engineers alike mistakenly assumed wire-line steering was all the same. Without question, there must be an advantage to anything new. Nothing could have been farther from the truth. The result was that many tools were sold and hundreds of lines installed using a system inferior to established industry standards. How did this occur? Contractors wanted a competitive edge and someone promised them one. In a quote usually attributed to Mark Twain, “A lie will travel around the world before the truth can get its boots on.”

The experience shortage was across the board and a hindrance to the industry, but it created an opportunity for the truly knowledgeable veterans to offer consulting services to both pipeline owners and contractors. Even here, expansion exceeded available personnel, allowing overnight-experts to fill the void. Knowledgeable HDD consulting firms were quickly in competition with less knowledgeable, but enthusiastic hustlers who promised the same service for less. If you knew a little of the terminology and had the gumption to call yourself an expert, you were in business.

The result was inexperienced HDD contractors using inferior steering methods, working under the supervision and instruction of less experienced, and sometimes unscrupulous, consultants. (Some consulting firms found ways to siphon a commission from the drilling tools or service companies they required contractors to use.)

Two decades later, the experience level is finally starting to close the gap. People are finally starting to ask questions. A healthy dose of skepticism is beginning to take hold. Contractors and, more importantly, engineering firms, are beginning to realize how good the technology is and that all wire-line steering is not equal. The search for the “magic-bean” has been replaced by requirements of planning and design. Owners and engineers have learned the hard way that a magnetic beacon or an AC wire laid across the surface is inept and inaccurate, especially when compared to the DC tracking system responsible for the industry’s tremendous expansion. All levels of HDD management are learning that accurate steering requires proper set up, planning and experience. Almost no one who purchased the new AC system, or required a contractor to use it, wants to acknowledge that the accuracy is inferior to the established tracking method and that the actual location of many of those lines will need to be re-established.
That's right; the equipment that most of these companies already owned was more accurate than the new method they purchased. Some projects installed with the "new" system have already had to be re-drilled using the more accurate DC tracking method. Contractors have had to absorb these tremendous costs. Many right-of-ways are possibly unusable for additional lines because the precise location of existing HDD crossings is unknown. Who knows how many lines are actually off the right-of-ways and what the costs of future court cases will be?

Owners and consulting firms are learning the key to a successful drill is planning and that nothing is more accurate than a precise DC based job set up and operated by an experienced, well trained steering person. The lifeline of HDD is accuracy, and we have the most precise guidance method available at our fingertips today.

In many cases, shortcuts and the search for a technological edge had replaced planning and proven HDD methods. As the industry matures, this trend is slowly being reversed. The HDD industry has always relied on the drilling technology developed by the Oil & Gas industry, but the oilfield has never abandoned their proven drilling techniques or well planning. Oilfield-developed drill motors, drill bits and steering tools are only a few of the essentials required for installing HDD lines. In our industry, references to the oilfield technology and advancements are made on a daily basis, but few understand the technology already available to HDD contractors. In fact, because of surface tracking, the drilling accuracy available and required in our industry far exceeds that available in the Oil & Gas industry. The most important thing we can copy from the Oil & Gas Industry is planning and record keeping. This remains the most notable difference between our industries and is the Achilles heel of HDD. Professionalism is dependent on improved planning and documentation.

There are many professional HDD contractors. Contractors are learning that the key to profits is planning and open communication with the inspectors and owners. The more professional the HDD industry becomes, the quicker the competition will thin and allow pricing to reach a more realistic standard. The secret is planning and the use of proven HDD methods. By definition, technology must be an improvement, not new or different. If it isn't better than what exists it is simply regression. Today's technology includes advanced steering and intersect software, automated reports that can be emailed direct to the inspectors and owners after every survey, pressure tools that record annular and drill-pipe pressures, planning software that works with time-saving data collectors and documentation to record all relevant information, just to name a few.

Unchecked growth had resulted in the industry taking a number of backward steps; the most significant being related to guidance and accuracy. Things are changing. Engineering firms and owners are learning that the pull-up and drill attitude is costing them time and money, not to mention a lifetime of uncertainty and liability. Proper HDD techniques take time, and the planning must occur before the project is mobilized. This investment in professionalism is preventing post-bore arguments and improving directional accuracy through better documentation. Talking about new technology is one thing, but the use of proven technology takes planning and discipline. Successful contractors are rediscovering HDD technology developed by the industry pioneers. Owners and engineering firms are asking the right questions and demanding the best HDD technology and methods be used. For the first time in a long time, directional projects are being designed to enhance the guidance accuracy while improving the chances of a successful completion. The results are improving profits for everyone.
Dear Trenchless Professionals,

You know that excited feeling you get when you hear people talking about a conference a year in advance? The momentum is building. People are getting excited. People want to get involved. That is what’s happening for the International No-Dig Show slated for 29 March – 3 April, 2009, in Toronto. This year’s No-Dig Show is truly special as NASTT is very proud to be co-sponsoring this worldwide event with the International Society for Trenchless Technology (ISTT).

The International No-Dig Show program is driven and developed by a group of NASTT and ISTT members called the Program Committee. Their spirit of volunteerism and hard work will result in a high-quality information exchange for everyone who will attend in Toronto. By the time you read this letter, our planning committee has already met to review abstracts and layout the technical paper program.

Nearly 200 high-quality abstracts were submitted for consideration, surpassing the number of abstracts submitted in past years. This outpouring of interest indicates strong growth in the trenchless technology industry – not only here in North America – but also from around the world. International papers from Denmark, France, Germany, Italy, Japan, Poland, Taiwan, the Netherlands and the United Kingdom will be presented, showcasing innovative new ideas in the global trenchless marketplace. (All papers will be presented in English.)

No-Dig attendees may choose to attend from amongst 140 of the most interesting and compelling papers published and presented, all of which will be carefully peer-reviewed for relevance, usefulness and non-commercialism, and make a long-lasting contribution to the trenchless technology industry. Paper presentations are arranged in a 5-track schedule by subject matter. Full conference registrants will take home CD-ROM conference proceedings of published papers.

Conference organizers predict that overall participation in the International No-Dig Show will reach record numbers, especially with the international delegates in attendance. The ISTT has invited its 23 affiliated societies to get involved by attending, presenting a paper, exhibiting or sponsoring the show. Nearly 2,000 people from around the world are expected to attend.

The exhibition area has increased in size from previous North American No-Digs, and already 50% of booth space is reserved. Several top industry manufacturers have stepped forward to sponsor the international No-Dig Show, and more are coming. Exhibiting and sponsoring is a great opportunity to get your company name in front of a global audience focused entirely on trenchless technology. It’s not too late to get involved – sponsorships and premium booth spaces are still available.

In addition to the quality technical paper presentations and large exhibition hall, the Program Committee is working diligently to offer an educational, yet fun No-Dig program and plenty of opportunities for networking. The show offers specialized seminars, awards and recognitions, and entertaining events that you won’t want to miss. All of this will take place under one roof at the stylish and comfortable Sheraton Centre Hotel in downtown Toronto.

The host city of Toronto, with a growing population of 4.7 million people, offers warmth, energy and cultural diversity for the No-Dig crowd. Toronto is an intimate metropolis featuring some of the best the world has to offer in dining, shopping, creativity, entertainment and sports. Enjoy fabulous regional attractions and breathtaking vistas including nearby Niagara Falls and the wine region, outstanding theatres and galleries.

Things are definitely looking “up” for the International No-Dig Show, and this is only the beginning! Come see for yourself. Join us in Toronto, 29 March – 3 April, and experience this truly global event. For more information, visit us at www.nodigshow.com.

Warmest Regards,

Joe Loiacono
2009 International No-Dig Program Chairman
HORIZONTAL DIRECTIONAL DRILLING has become established as a viable construction method, as the growth during the past few years indicates. The technology keeps advancing, and most manufacturers consistently introduce improvements. One of those improvements is documentation of the installation process. This is especially important in light of the need to convince design and consulting engineers to specify HDD where appropriate. This is where education and properly documented information will go a long way towards assisting engineers and municipalities in justifying the use of HDD.

In recent years, requirements for monitoring the HDD installation process in more detail have emerged. Some countries in Europe are working on mandating stricter rules when installing gas pipes. One area in particular is the tension load applied to the product pipe during installation. The drilling fluid pressure during installation is another variable that is of interest as it relates to helping prevent frac-outs.

To address the some of the above, Digital Control Incorporated developed the TensiTrak™ tension load and drilling fluid pressure monitor. The concept includes a strain gauge and a pressure-measuring device which are connected to a transmitter. The transmitter transmits the load and pressure readings in real time on the frequency used by the Eclipse® locating system. The information transmitted includes the instantaneous pull force, maximum pull force, drilling fluid pressure, transmitter temperature, transmitter battery life and a magnetic signal, which can be used to locate the depth and direction of the TensiTrak monitor should this be desired. This will allow for confirmation of the placement of the product pipe.

The TensiTrak monitor is connected to a swivel between the reamer and the product. In this configuration, only the load on the product is measured (see figure 1). This is an important distinction to make, since traditionally there is no way to gauge whether increased pulling loads are due to harder ground conditions, i.e., higher loads caused by the reaming process or due to direct loads on the product being installed. In the case of increased loads, the TensiTrak readout will identify where the issue might lie.

The current TensiTrak monitor is available in two versions, a 60,000 and 100,000 pound load reading capability. The mechanical capability of the units, however, far exceeds those levels. The load is displayed in 15 lb. increments. The drilling fluid pressure is displayed in 1 psi increments and the system is capable of measuring pressures as high as 127 psi. Although data is sampled much more often, readings of fluid pressure and tension are displayed every four seconds on the receiver. In addition, the maximum force measured is stored in the TensiTrak unit, and this value is transmitted along with the instantaneous force and pressure values. The receiver transmits this information to the remote display at the drill ring, so that the drill rig operator can continu-
ously monitor the fluid pressure and pipe loads during the installation, and take corrective action should it be needed. In addition to displaying the data in real time, the receiver can store the data to be downloaded at a later date for documentation of the installation.

In mid August, 2007 BT Construction out of Henderson Colorado used the TensiTrak system to monitor the installation of a little over 1000 ft. of 16” DR 18 Fusible C-905® pipe for a potable water main. Maximum depth was about 11 ft. and the pullback was completed in about 5 hours. The project is located in Broomfield, a suburb of Denver.

Figure 2 shows the reamer, TensiTrak and PVC pipe ready for the pullback, while Figure 3 shows the first 1000 data points logged. Tension is displayed on the upper graph and pressure on the lower one. As one would expect, the pressure readings remained zero at the outset while on the surface. It gradually increased as the depth increased. Maximum pressure logged was 8 psi at the center of the bore. The tension load shows the up and down characteristics of the pulling process; during rod changes the load on the pipe relaxes, and as pulling commences on the next pipe, the load increases until the pipe starts moving and then stays relatively constant during the pull.

The maximum load was 22,700 lbs., which happened after a 25-30 minute break while the drill pipe rack on the machine was being changed. This might have allowed the drilling fluid to set up a little more, requiring more force to get it moving. The majority of the time the tension load was on the order of 16,000 - 18,000 lbs.

The TensiTrak monitor is another tool in the contractor’s hands that allows for a better understanding of the HDD process through real time information and documentation. It should allow for better planning and execution of future projects.

Siggi Finnson has been with Digital Control Incorporated since 1995, and his primary responsibilities include product management, engineering liaison and marketing communications.
The target's 100 yards away.

The drill's alongside the railroad track.

There's a train coming.

Good thing your HDD equipment is ahead of the curve.

Every job comes with its fair share of pitfalls. And if your equipment isn't on the cutting edge, then you're really fighting an uphill battle. That's why it pays to work with a company like DCI. We continue to push the boundaries of HDD technology and set new standards of ingenuity and innovation for the industry—and for our customers.

In fact, since the introduction of the first DigiTrak locating system in 1991, we've been arming our customers with the most revolutionary HDD equipment found on the planet. From the locating systems above, to the transmitters below, our full line of intuitive, accurate products and 24/7 customer support is there to keep your job on track—and help you stay ahead of the curve.

For more information, visit digitrak.com or call us at (800) 238-3610. Because when it comes to getting your jobs done right, we've always got our eyes on what's up ahead. DCI. We're leaders in the field.

Industry leaders. Passionate visionaries. And genuinely nice guys.

Digital Control, Inc.
CONFIDENCE.

Confidence is why government agencies and engineers choose UV CIPP liners by International Pipelining Technologies for successful pipe rehabilitation.

Why take risks with expensive, out of date CIPP methods?

IPL Technologies’ proven experience supplying liners and UV-curing equipment to contractors for large CIPP jobs takes the worry out of pipe rehabilitation challenges.

IPL’s LightStream™ ultraviolet light cured in place fiberglass pipe liner is North America’s #1 leader in UV CIPP. Quarterly sales exceed 200,000 linear feet for sewer mains, force mains and stormwater pipes.

IPL is lighting the way for cured in place pipe™
With lower costs than hot water and steam-cured methods, LightStream™ is the CIPP leader in quality, environmental sensitivity and speed. Unequalled access to backyards, canyons and steep slopes without air or water discharges.

IPL Technologies is North America’s leading manufacturer of UV CIPP liner. Ask about our 30-mile City of San Diego install. Meet us at WESTT 2008. See us online. Call us today.
17th Annual No-Dig Show, Dallas, TX

By Angela Ghosh, NASTT Assistant Executive Director

NASTT HOSTED ITS 17th Annual No-Dig Conference and Exhibition, April 27 – May 3, 2008, in Dallas (Grapevine) drawing more than 1,500 key trenchless players – specifically utilities, engineers, contractors, manufacturers and suppliers – to do business in the one forum that is dedicated to exclusively promoting trenchless technology.

This year’s No-Dig program offered an impressive collection of 109 quality technical papers, an exhibition hall with 122 trenchless companies displaying their products and services, four specialized pre- and post-conference seminars, and many entertaining networking events and special awards.

The No-Dig program is driven and developed by a group of NASTT members, known as the Program Committee, who work diligently to provide attendees with a quality educational program.

“This conference would not have been possible without the dedication of many individuals. In particular, I would like to thank members of the Program Committee,” said Kaleel Rahaim, No-Dig Program Chairman. “They have spent countless hours selflessly devoting their time to the program, and they should be recognized for their efforts.”

The Program Committee works hard to put on a “show” which combines a great mix of educational opportunities with a lot of fun activities throughout the conference. The No-Dig Show kicked-off with a crowd-pleasing Monday Opening Breakfast. Later that evening, the NASTT Education Fund Auction raised over $40,000 for student chapter support, research and training initiatives. On Tuesday, the Gala Awards Dinner provided great food and live band entertainment. The Wednesday Closing Lunch set the stage for the final farewell of another successful No-Dig Show.

Photos of the No-Dig Show are available for viewing at www.nodigshow.com courtesy of David Crowder, a member of NASTT and the No-Dig Program Committee.

The ISTT and NASTT will join forces in Toronto, Ontario, Canada’s largest city, and host of the International No-Dig Show crowd, March 29 – April 3, 2009, at the Sheraton Centre. For more information, visit www.nodigshow.com.

No-Dig 2008 Raises Record Amount of Sponsorship Support

No-Dig 2008 raised a record setting amount of sponsorship support from among the industry’s top manufacturers and suppliers, including: TT Technologies, Inc. (Platinum level); Hammer-Head/Vermeer (Gold level); Interplastic Corp. (Silver level); Rain for Rent (Silver level); International Pipe Lining Technologies (Silver level) and Ditch Witch (Silver level). Numerous other companies sponsored No-Dig events and giveaways. The generosity of these sponsors, as well those companies participating in the exhibition, greatly serves to enhance the No-Dig experience for all attendees. Thank you! For a complete listing of 2008 sponsors/exhibitors, please visit www.nodigshow.com.

NASTT Recognizes Individuals and Companies for Contributions and Achievements

Throughout the No-Dig Show in Dallas, NASTT recognized a number of individuals and companies for their contributions and achievements for NASTT and the trenchless industry.

Bill Gray Receives NASTT Chairman’s Award for Outstanding Lifetime Service

Bill Gray was honored with the 2008 NASTT Chairman’s Award for Outstanding Lifetime Service at the No-Dig Show annual Gala Awards Dinner, April 29, in Dallas, Texas. Since 2004, NASTT has presented this prestigious award to individuals who have provided the organization and the trenchless technology industry with meritorious service throughout the course of their careers. Past award recipients include Trent Ralston, Bernard P. Krzys and Tom Iseley.

Gray recently retired after 47 years specializing in the design and construction of gravity and pressure pipelines including extensive involvement in the application of large and small diameter tunnels. While working as Project Manager with PB Water in the Atlanta office, he served as the PB water PAL for Wet Weather specializing in the use of storage and transport tunnel systems for mitigation of CSOs across the nation. Gray was an early member of ISTT, as well as NASTT, having served as Chairman of NASTT in 1996. Gray is a long-time proponent of trenchless technology believing that “the use of trenchless methods is a necessity for the design and construction of infrastructure in present-day cities and environments.”

Awards/Recognition on next page...
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<th>Award/Recognition</th>
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<tr>
<td>2007 NASTT No-Dig Outstanding Paper Award (Rehabilitation)</td>
<td>Michael Delzingaro, Goldwin Pumps of America</td>
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<tr>
<td>2007 NASTT No-Dig Outstanding Paper Award (New Construction)</td>
<td>Robert Kahl and David Mathy, DCM Engineering, Tim Nealy, NAPA Sanitary District; and Ted Whiton, Winzler &amp; Kelly</td>
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<td>2007 NASTT Outgoing Board Members</td>
<td>Joe Abbott, Michael Spero and Michael Willmets</td>
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<td>2008 Trenchless Technology Person of the Year</td>
<td>Maynard Akkerman</td>
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<td>NASTT Student Poster Competition (1st Place – Research)</td>
<td>Ivan Diaz, Louisiana Tech University</td>
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<td>NASTT Student Poster Competition (Runner-Up – Research)</td>
<td>Sherif Kamel, McGill University</td>
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<td>NASTT Student Poster Competition (1st Place – General)</td>
<td>Denise Morello and Charles Ormsby, McGill University</td>
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<td>NASTT Student Poster Competition (1st Place – General)</td>
<td>John Matthews, Louisiana Tech University</td>
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<td>John P. Lake – Rain for Rent Academic Scholarship Awards ($1,000 each)</td>
<td>Adam Kolwicz, Bowling Green State University; John Matthews, Louisiana Tech University; Robert Pohlman, Bowling Green State University; and Todd Snyder, University of Texas at Arlington</td>
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<td>NASTT Innovative Product Award (Rehabilitation)</td>
<td>TT Technologies, Inc.</td>
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<td>NASTT Innovative Product Award (New Installation)</td>
<td>Herrenknecht AG</td>
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<td>NASTT Chairman’s Award for Outstanding Lifetime Service</td>
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<td>NASTT Appreciation Award</td>
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<td>NASTT Student Pipeline Assessment Competition (1st Place)</td>
<td>Ivan Diaz and John Matthews, Louisiana Tech University</td>
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<td>NASTT Student Pipeline Assessment Competition (2nd Place)</td>
<td>Sneha D. Chavan and Priyant K. Sawant, University of Texas at Arlington</td>
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<td>NASTT Student Pipeline Assessment Competition (3rd Place)</td>
<td>Denise Morello and Charles Ormsby, McGill University</td>
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<tr>
<td>2008 Outgoing No-Dig Program Chairperson Award</td>
<td>Kaleel Rahaim</td>
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The potential for differing site condition (DSC) claims is a fact of life on all underground construction projects. The trenchless installation of buried pipelines presents a whole new set of challenges of understanding to owners and engineers in the prevention, mitigation and resolution of DSC claims. These new challenges include understanding trenchless equipment capabilities, limitations and operational parameters, developing true trenchless designs and trenchless specifications (not just modifying open-cut designs and specifications), completing geotechnical investigations and providing sufficient and appropriate subsurface data and interpretation of data for trenchless design and construction, evaluating construction risks and providing experienced construction management/inspection. This article addresses traditional design, bid, and build new construction projects without a Geotechnical Baseline Report (GBR). Typical projects include water, wastewater, recycled water and storm drain pipelines 6 inches to about 96 inches in diameter and from a few hundred feet to several thousand feet in length. These types of trenchless installations typically include microtunneling, pilot tube guided boring (PTGB) and horizontal directional drilling (HDD).

The potential for encountering differing site conditions is particularly high for long, linear pipeline projects which pass through multiple geologic deposits with changing soil composition and consistency, changing bedrock composition, hardness, jointing and fracturing and changing groundwater elevations, pressures and flow rates. Conventional open-cut trenching, while not immune from differing site condition claims, is far less sensitive to subsurface conditions and changing geology than trenchless construction. The complexity of trenchless construction equipment makes trenchless methods far more sensitive to subsurface conditions and changes in subsurface conditions. As a result, the trenchless industry is faced with the compounding impacts of long, linear subsurface construction with highly complex equipment and remote, sight-unseen, excavation. The fact that most, if not all, trenchless excavation is made sight unseen and the fact that excavated soils/bedrock are highly modified during excavation (e.g., crushed by microtunnel boring machines, mixed by horizontal directional drilling, etc.) makes judgment of the validity of differing site condition claims all the more difficult. In addition, it is not uncommon for contractor operation of complex trenchless equipment to significantly affect the progress of construction and be misinterpreted and/or misrepresented as a differing site condition. Some typical differing site condition claims on trenchless projects include:

*Don’t end up inside the court house*.
Obstructions
Low production rates
Excessive cutter face/tooling wear
Deviation from line and grade
Excessively high jacking/pull back forces
Ground surface heave or settlement
Undermining and damaging existing utilities
Fluids hydrofracture and fluids loss
Settlement and inability to steer
Cracked or damaged pipe

Some of these conditions can be fatal to the process and cause abandonment of the trenchless method. Almost all of these claim sources are unique to trenchless construction and will not typically be found in traditional open-cut trenching. Most importantly, the majority of these potential claim sources can be caused by natural or manmade subsurface conditions or by contractor operations.

One of the most consistent themes in trenchless technology literature over the past 15 years in the United States is the importance of geotechnical information upon which to base both owner design and contractor selection of trenchless equipment and equipment options (i.e., match equipment to the ground). Just as trenchless equipment is far more complex than open-cut trenching equipment, and just as trenchless equipment is far more sensitive to subsurface conditions and less forgiving to changes in subsurface conditions, the need for geotechnical information and geotechnical interpretation is greater for trenchless projects. Unfortunately, many owners and design engineers don’t yet recognize this fact and specify the same geotechnical investigation that has been used for years for open-cut trenching projects. A typical geotechnical investigation for open-cut trenching will not be able to identify the many and diverse risk factors for trenchless construction. A geotechnical investigation for trenchless projects should include the following phases:

**Phase 1** – Establish alignment geologic setting and development history through geologic research, reconnaissance and field mapping of geomorphic and development features and research into private and public sector development along the alignment. It is imperative to establish geologic setting to allow for planning the subsurface geotechnical investigation and interpret/interpolate between and beyond test boring locations. It is equally important to establish alignment development history to check for potential obstructions (e.g., fill debris, basement tie-backs, remnant pile foundations, contamination, etc.). This research can be done through historic maps, historic aerial photographs, local government agency records (e.g., city, county, state), local historic societies and environmental regulatory agency records. Phase 1 should also include research into construction precedence (i.e., similar trenchless construction in the vicinity of the project in the same geologic formations).

**Phase 2** – Preliminary subsurface investigation including borings, test pits and/or large diameter borings (to examine fill debris, oversize material, cobbles and boulders, etc.), cone penetration tests and geophysical testing all widely spaced along the alignment. The results of Phase 1 and 2 will allow for project alignment commitment, design of shaft spacing for microtunneling and PTGB and bore path profile design for HDD.

**Phase 3** – Final subsurface investigation including test
borings at all shafts, mid-drive borings, (when shaft spacing exceeds about 500 feet), large diameter borings, test pits, cone penetration tests, geophysical testing and groundwater monitoring wells. The results of Phase 3 (combined with Phase 1 and 2) will provide tunnel zone and bore path specific soil, bedrock and groundwater conditions and engineering properties.

The importance of research into alignment development history cannot be overstated. In most urban settings, there will be a wealth of subsurface information potentially covering multiple generations of development. Research should include “abandoned” or demolished facilities to ensure that the alignment is not close to remnant foundations, etc.

Historically, geotechnical reports for underground pipelines to be installed by open-cut trenching are completed at a very early stage of design and with minimal coordination with the final project plans and specifications. In addition, these reports often do not do a good job of separating findings from conclusions and recommendations. Some of the conclusions and recommendations of these reports may not apply to the final design. As a result, owners have become reluctant to include geotechnical reports in the contract documents for fear of having inconsistencies with the final plans and specifications and having those inconsistencies used against them in a DSC claim. For trenchless projects, it is useful to follow the major underground construction and tunneling model and divide the geotechnical investigation into the following two parts:

- **Part 1 – Geotechnical Data Report**
- **Part 2 – Geotechnical Design Summary Report** (sometimes referred to as Geotechnical Interpretive Report or Geotechnical Memoranda for Design)

The Geotechnical Data Report (GDR) should contain all of the objective data generated by the geotechnical investigation (e.g., research results, geologic mapping, boring logs, lab tests, CPT logs, geophysical plots, etc.). The geotechnical data can then be provided directly to bidding contractors in the contract documents. The Geotechnical Design Summary Report (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 con-
The GDSR report should be carefully coordinated with the final project plans and specifications. In the major underground construction and tunneling model, these reports are followed by a Geotechnical Baseline Report (GBR) in which subsurface quantities (e.g., groundwater, boulders, fill debris and obstructions) are quantified for contract and bidding purposes.

The topic of DSC claims on trenchless projects is much too big for an article of this size. The principal objective here is to reinforce with owners and engineers that trenchless designs and the evaluation of DSC claims on trenchless projects is much more complicated and demanding than conventional open-cut trenching. In addition, there is much more pressure to resolve a DSC claim and keep the project moving forward because of the contractor’s commitment of very expensive equipment and personnel. For the most part, this equipment cannot be easily and quickly demobilized, particularly when compared to an open-cut excavator. It is in no one’s interest to incur standby charges for idle trenchless equipment and specially trained operators, which in the case of microtunneling, can amount to as much as $1,000 per hour for equipment only, plus labor costs of a typical six man crew. (Combined equipment and labor standby can be as much as $15,000 per day for microtunneling.) While the potential for differing site condition claims will never be eliminated, it can be reduced and the resolution can be quickened to the benefit of owners and contractors by:

- an experienced design team;
- thorough alignment research looking into development history;
- thorough research into, and incorporation of, construction precedence in the project vicinity in the same geologic deposits;
- thorough and accurate geotechnical investigations specifically tailored to the trenchless method;
- experienced interpretation of geotechnical data in the context of geologic setting, site history and trenchless methods of construction;
- detailed plans and specifications written specifically for the trenchless method to be used; and
- experienced construction management working with the contractor to complete a successful project.
In October 2004, the City of Los Angeles Department of Public Works (DPW) reached a settlement agreement with various governmental and environmental agencies to rehabilitate and replace old, damaged, and substandard sewer pipes throughout the City for the next 10 years. This work will be done by the Secondary Sewer Renewal Program (SSRP). The sewer pipes in this program are small—less than 16 inches in diameter—but are important because they are connected to residents’ and businesses’ private sewers. There are approximately 6,500 miles of them which serve more than four million people in the San Fernando Valley, West LA, Central LA, and Harbor areas (Figure 1). The smaller sewers convey the waste stream to larger sewers that carry wastewater to the Hyperion Treatment Plant in Playa del Rey where it is treated to a high quality before being released into the Santa Monica Bay. Rehabilitation of the faulty sewer pipes will improve sewer flow, reduce maintenance and potential sewer spills, and help minimize sewer odors. In order to meet the requirements and deliver the increased number of projects in a timely manner, sewers are being renewed by R&R (Remove & Replace) or lining at an average rate of 60 miles per year. The SSRP is commonly referred to as the 60-Mile Program. Since this program started in 2005, the work completed has exceeded the annual 60 mile/year schedule. The GIS-based program SMARTS© (Sewer Management Automated Repair Tracking System) is dedicated to planning, designing, constructing, and managing the wastewater network in the City of LA.

II. SMARTS© Induced Sewer Management

SMARTS© is a system of customized tools developed in ARCGIS to help engineers design for the secondary sewer renewal. It has been developed by GIS consulting companies (MARRS Services in the development stage, and currently by Super GIS, Inc.) and the SSRP group. It offers a unique blend of capabilities in secondary sewer management and repair design. The system employs GIS technology to use the up-to-date geographic information and sewer pipe survey information to deliver design projects faster, more accurately, more efficiently, and more cost-effectively.

As presented in Figure 2, by using GIS and database technology, SMARTS© integrates a large amount of both spatial and non-spatial information into the GIS system. This program helps design engineers analyze the location and all important characteristics of damaged pipes, resulting in the best design for the pipe repairs and sewer management. SMARTS© provides SSRP engineers all the necessary information relating to sewer mains, sewer maintenance holes, sewer laterals, and other sewer related facilities fund CCTVs. This information is then rendered on top of the City base map Parcels, streets, free-
ways, and easements to show the location of the damaged pipe on the map. More maps (House connection vector data, easement data, Thomas map grid, Council boundary, etc.) and color aerial photos have been added into SMARTS© recently. In addition to this, SMARTS© incorporates other information that will help SSRP engineers identify factors relating to sewer repair. This includes but is not limited to storm drains, substructure utilities, and aerial photograph images.

Below are the major feature/functionailities of SMARTS©.

- Quick search of the pipe and its location
- Identify/highlight pipes that need repair
- Incorporate CCTV log information and pipe condition information to identify damaged segments
- Incorporate CCTV videos of the sewer pipe, which will enable engineers to review the CCTV just by clicking the pipe
- Spatially identify sewer laterals/WYE along the reach
- Provide initial repair approach based on SSRP guidelines.

In the design methods, structural lining is added in addition to original non-structural lining and R&R. Recently Blind or capped WYE identification has been added to SMARTS©.

- Add/Remove repair segment of the pipe
- Spatially identify neighboring utilities’ orientation and station
- Input and store the design data into the database
- Generate “Vicinity Map”, “Index Map”, “Key Map” and “Construction Map” for the project. The repair design maps can be referenced and color-coded to represent different repair methods so the construction engineers can see the design on the maps. (See Figure 3)
- Generate various reports (Schedule of Repairs, Pre-Design and initial Cost “C” Estimates etc.) for the project. More reports (e.g. Field Investigation Checklist, Class “A” Cost Estimate, 60-Mile Project Tracking and Street Category, etc.) have been added into SMARTS© and can be auto-generated by SMARTS©.

Overall, SMARTS© allows users to review pipe condition assessments, construction constraints (utilities, site conditions, etc.), verify pipe information, help engineers to do the design, input and manage design data, and print design documents and various maps. The system continues to be developed as the new design procedures and functions are suggested by the engineers and needed for the SSRP group.

III. Recent and On-Going Progress of SSRP

Recently, the City of LA endowed the DPW with a “Technological Innovative Award,” for the SMARTS program used by SSRP. It was also presented at the 2008 WEFTEC (Water Environment Federation Technical Exhibition and Conference) in San Diego. The SSRP, using the SMARTS program, received attention from both private and governmental sectors. A protocol has been set up to expedite the delivery of these projects. As part of this process, the City subdivided the entire project area into 210 sewersheds, as shown in the Figure 1. In the sewersheds, more than 100 projects are identified. Among them, twenty five projects have been successfully completed by 12 city engineers and 5 consulting engineers in terms of project design. Engineers in the SSRP design team have a wide range of work experience, from 32 years to recent graduates. The current design group includes 1 Senior Civil Engineer, 2 Civil Engineers, 6 Civil Engineer Associates II and IIIs, 5 Consultants, and 6 Civil Engineer Associate I new employees.

For the Fiscal Year 2007/08, an average of eight contractors bid on SSRP projects. For the Fiscal Year 2008/09, designs for 60.57 miles were finished and designs for an additional 12.32 miles were already completed for the Fiscal Year 2009/10. Some of these projects are under construction by the bid-won contractor, based on the design package. The revised design package form includes: project maps (vicinity, index, key maps), schedule of repair, cost estimate, SSRP general requirement (GR), general conditions and technical specifications, and is packaged in an 8½” x 11” letter size format.

Given the delivery goal of 60 miles designed annually, the Bureau of Engineering (BOE) created a standardized design manual in which all viable rehabilitation methods and design guidelines are described in detail: for instance, the R&R methods and lining are explained. The design manual conforms to a well-defined regimen. The defects of pipes are categorized to root intrusion/blockage (light, medium, severe), various
structural upgrades such as new maintenance hole installation, remodeling of maintenance hole base, chimney replacement, drop connection, lamp-hole replacement, flush tank replacement, etc. Three rehabilitation methods are feasibly applied: remove and replace (R&R), lining, or a combination of these two. The lining material can be any of the City’s approved products for structural or nonstructural lining. When there is more than one option to repair a reach, a cost-benefit analysis is performed to find the most economical solution. Additional factors such as traffic conditions will also have impact on the selection of repair method. When it comes to the method selection, the sewer design is performed with the goal of minimizing the inconvenience to residents and providing the best quality of sewer work. The design manual and maps are continually updated due to the innovative approach of repair methods and redefined repair items. Figure 3 illustrates an improvement in the construction map where different repair methods such as R&R, lining, and structural lining, are shown.

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IT SHOULD BE no big secret that one of the fastest growing segments of trenchless technologies today are the municipal markets. With so many different ways to approach a project, engineers are faced with the daunting task of not only understanding all the different types of trenchless technologies available to them (HDD, pipe bursting, slip lining, etc.) but they are also expected to know how to effectively select the most appropriate technology for the project at hand. In addition, as these technologies continue to improve, the challenge of providing project owners with effective trenchless solutions continues to become more complex. For those who find themselves in this situation, and lacking the ability to become an expert with all the different trenchless options available today, it may be more advantageous to focus on the few technologies that can offer the most “bang for your buck”. One such technology has been the process of installing Ductile Iron Pipe utilizing Horizontal Directional Drilling (HDD).

Many municipal owners and operators have chosen Ductile Iron Pipe as the preferred material with which to build their infrastructure. While many of these people see a great opportunity for trenchless installations of their pipelines, they are often left with the misconception that HDD can only be used to install plastic or steel pipe. Nothing could be further from the truth. With the use of a Restrained Joint Ductile Iron Pipe, entire water transmission and distribution systems have been constructed exclusively through the use of HDD.

From the owner’s perspective, the use of HDD can offer several advantages to a trenchless pipeline installation. HDD installations often result in significantly less disturbance to the public throughout the project, less social costs, and many times can even be faster and cheaper when compared to traditional construction methods. Installation of ductile iron pipe will also allow municipalities to utilize a material that is familiar and will not create the maintenance issues that result from having various types of pipe materials in one system. Some of the advantages specific to Ductile Iron Pipe are its ability to handle higher pressures and structural loads than plastic pipes, the ability to locate the pipe without needing a tracer wire, and the corrosion protection obtained by installing the pipe with a polyethylene wrap and or cathodic protection.

From an HDD contractors perspective, pulling ductile iron can often times be easier than pulling a steel pipe, because a restrained joint ductile iron pipe allows a generous amount of deflection at each of the joints, which in turn allows a drilled bending radius that would not be possible with steel pipe installation. Another advantage to drilling with Ductile Iron Pipe is the ability to use the cartridge method of installation. When pulling steel or plastic, it is often necessary to preassemble the pipe prior to the pullback so that the borehole does not collapse within the time it takes to fuse or weld sections of pipeline. When using the cartridge method with Ductile Iron Pipe, the joints can be assembled in such a short amount of time that the pullback phase and assembly of the pipe string can occur at the same time. This reduces or even eliminates the need for large staging areas to preassemble pipe.

In today’s environment of increasing performance standards and decreasing budgets, we need to find ways of leveraging technology to keep up and maintain our infrastructure. Horizontal Directional Drilling has proven to be an effective installation method for Ductile Iron Pipe. Not only has it been used in situations where roads and waterways need to be crossed, HDD has been used in situations where traditional cut and cover methods are appropriate, but a trenchless alternative proved to be cheaper, quicker, or just plain cleaner.

If you should have further questions about the use of HDD to install Ductile Iron Pipe, please contact Aaron Cohen with Apollo Trenchless, Inc. at (480) 310-0734, or visit our website at www.apollotrenchless.com.
THE UTAH TRANSIT Authority (UTA) is working on final construction of a 44-mile commuter based rail line connecting Salt Lake City with the communities to its north. While the task of constructing these rail lines includes many forms of above ground construction, trenchless technology is playing a role as well. Claude H. Nix Construction/Jasco, Inc. (C.H. Nix), Ogden Utah, was contracted to complete a complicated series of casing installations under the rail line.

According to C.H. Nix Project Manager Jon Nix, initially they were called in to assist Commuter Rail Constructors with the preliminary budget numbers for the project, but did not get the bid when the project was awarded. However, the original bore contractor had been on the project for about four months when they were asked to leave, and Nix was called in on an emergency basis.

C.H. Nix needed to rescue an auger bore with a 60-inch steel casing that was stuck 40 feet into an 80-foot storm drain bore. The auger had created a void and subsequent 15-foot diameter sinkhole between two Union Pacific tracks. C.H. Nix brought in an 18-inch Grundoram Goliath pipe rammer from trenchless equipment manufacturer TT Technologies, Aurora, Ill. to complete the bore. Once ground water issues were under control and the pit set up, crews were able to complete the ram in short order.

In addition, a second 60-inch bore at the location had also been started and not completed. According to Nix, the second casing had been sitting at the 60-foot mark for over three months. Even though the casing had sat idle in the ground for several months, the Nix crew was able to break the casing free with the Goliath rammer and ram the casing an additional 20 LF to complete the alignment. From there, CNC became an integral part of the project, as did pneumatic pipe ramming.

Ramming Basics & Benefits

Trenchless pipe installation through ramming is a fairly simple process. A pneumatic hammer is attached to the rear of the casing or pipe. The ramming tool drives the pipe through the ground with repeated percussive blows.

According to TT Technologies pipe ramming specialist Jim Moore, several options are available for ramming various lengths of pipe. He said, “An entire length of pipe can be installed at once or, for longer runs, one section at a time can be installed. In that case, the ramming tool is removed after each section is in place and a new section is welded on to the end of the newly installed section. The ramming tool is connected to the new section and ramming continues. Depending on the size of the instal-
Above left: C.H. Nix crews used a Grundoram Goliath pneumatic pipe rammer from TT Technologies to install numerous casings at different locations along the new rail line. Top right: In several situations the C.H. Nix crew used the Grundoram Goliath in conjunction with a pilot tube boring machine to complete the casing installations. Note the ramming adapter attached to the lead end of the casing. At right: Casing diameters on the project ranged from 20 inches all the way up to 60 inches. Lengths ranged from 140 feet to 225 feet.

lation, spoil from inside the casing can be removed with compressed air, water, an auguring system or other types of earthmoving equipment."

Some casing installation methods are impaired or even rendered inoperable by rock or boulder filled soils. Pipe ramming is different. During pipe ramming, boulders and rocks as large as the casing itself can be "swallowed up" as the casing moves through the soil and can be removed after the installation is complete.

Ramming tools, in general, are capable of installing 4- through 147-inch diameter pipe and steel casings. Ramming requires minimal working depths and has proven effective for horizontal, vertical, and angled applications. Ramming is also ideal for installations under roads and rail lines because it displaces the soil without creating voids or slumps.

**Multiple Rams**

After freeing and installing the stuck 60-inch casing the crew moved on to the next project site (3rd and 4th crossings) for another storm drain installation. It included two parallel 48-inch steel casings. Difficulties on this site included minimal cover over the casing, less than 18 inches below tracks, very limited muddy access, and proximity to the railroad tracks.

The third site (5th crossing) was the most difficult. The scope of work included boring under three sets of tracks and into an existing freeway embankment in order to realign an existing pressure irrigation water line. The owner wanted to encase the line in one continuous steel casing across both the freeway and railroad tracks. The existing irrigation line had a horizontal bend in it that needed to be removed and re-aligned.

Prior to construction, no one knew where the end of the existing casing for the irrigation line was located or exactly how deep it was. Nix knew that once they located the existing end of casing, that accuracy in order to line up and bore to the existing end from the opposite side of the tracks would be critical. C.H. Nix crews opted to use an Akkerman TBM and series 5000 pipe jacking system. Nix used this method because of the pipe size, minimal grade, and tight alignment. They were able to come in on design line and grade with less than 0.05 feet of deviation.

The 10th crossing included the installation of a 36-inch storm drain culvert crossing. It was similar to the others with minimal cover, poor soil conditions, and high ground water. C.H. Nix crews were able to complete the crossing successfully using pipe ramming.

The 11th crossing was completed for a water transmission re-alignment and included ramming 120 lf of 36-inch casing, and the sliding a 30-inch HDPE through the casing. Then crews installed a 16-inch ductile iron pipe on either side of the tracks and connected it to the 30-inch HDPE.

The final three crossings (12th through 14th) will be constructed in downtown Salt Lake City. They will consist of three 24-inch bores. All three crossings will be completed using pilot tube technology and the Goliath pipe rammer.
A NEW WATER intake facility on the Sacramento River will supplement groundwater and existing water conservation programs to the Sacramento County and East Bay area of California for many years to come. Mining 30' below the water table requires expertise. Microtunneling, often referred to as remote controlled pipejacking, is the best application for unstable ground conditions. In the spring of 2008, subcontractor Water C. Smith successfully installed 829' of 102" steel casing under I-5 in Sacramento, just east of the intake facility with Akkerman microtunneling equipment.

The Freeport Regional Water Intake Facilities job, owned by the Freeport Regional Water Authority, will provide up to 185 mgd of drinking water to an estimated 2.5 million customers. The scope of the project includes several pipeline segments and a water surface treatment plant. The contractor is Balfour/Beatty.
Pipelines will provide Sacramento County residents with supplemental groundwater and East Bay residents with water during dry periods. The $903 million costs were split between the two communities. The construction portion of this project began in December 2006 and will continue through 2011. The Freeport Regional Intake Facility, located on the Sacramento River, will feature a landscaped buffer and art and poetry wall to help with aesthetics for adjacent homes.

Walter C. Smith’s work consisted of two drives, the first 487’ drive under I-5 and the second 342’ drive under Freeport Boulevard. A few years earlier, an attempted drive by a different contractor near the same area as the first drive was conducted via microtunneling, and failed due to the varied, wet ground conditions. Consequently, Walter C. Smith had some justified apprehension when approaching this drive, as well as concerns about the larger sized Microtunneling Boring Machine (MTBM) and drive length in this type of soil.

The launch shaft needed to be 65’ deep with the ability to withstand the high water head and an estimated 1,400 tons of jacking force for pipeline advancement. Both the launch and reception shafts were designed with grout concrete in front of the pit seal and applied to the entrance and exit portals to properly hold back the high water head.

Superior MTBM operation was essential to avoid any ground subsidence. Walter C. Smith operators encountered some challenges with the constant monitor and control of water pressures. They found that the MTBM performed best when the microtunneling slurry pressure was adjusted to counterbalance the ground water pressure and in turn, decrease jacking forces.

Walter C. Smith used an Akkerman MTBM SL74 with an increase kit to 102” and control container, Westfallia jacking frame and custom separation plant. Despite their initial uneasiness, operators reported that all components performed well with very little down time.

Construction on the Freeport Regional Water Intake Facilities job will continue through 2011 and commence with the construction of the Vineyard Surface Water Treatment Plant.

Laura Anderson is a marketing specialist for Earth Pressure Balance, Guided Boring Machine, Microtunneling, Tunneling and Pipejacking equipment manufacturer, Akkerman Inc. of Brownsdale, M N.

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Introduction:
Saint Croix is an island in the Caribbean Sea, and a county and constituent district of the United States Virgin Islands (USVI), an unincorporated territory of the United States. It is the largest of the U.S. Virgin Islands, being 28 by 7 miles (45 by 11 km) and hosts one of the world’s largest and most modern oil refineries.

Construction of the 45,000 barrels per day (BPD) refinery began in October of 1966. Substantial expansion occurred in the period 1966 to 1974 to increase the refinery’s capacity and making it the largest refinery in the world at that time. Heavy oil upgrading capacity was gradually added beginning in 1981, eventually increasing the refinery’s capacity to 485,000 barrels per day BPD.

To accommodate the original 2,000+ acre facilities on the south shore of St. Croix, a ¾ mile of wetlands was dredged and contained by a 120’ long x 20’ high dike that eventually became home to a service road, power and fire lines, and four major fuel lines that connected the refinery to adjacent holding tanks.

Many years and four major hurricanes later, two of four fuel lines had to be shut down due to leaks. At a cost of $800,000 per day in lost revenue, immediate upgrades were required.

Design Considerations
Lack of as-builts and supporting documentation for the original facility and containment areas proved an immediate challenge. Although it was well known that a 30” fire line, a 12” water line, and a 12,000 KV electric line existed in the area of the newly proposed pipelines, their exact location and depth was unknown. Initial soil investigation revealed moderate clay and coral at 15-ft., however soil conditions beyond that point were also unknown.

To minimize the cost and risks associated with this project, horizontal auger bore was selected as the most suitable method. Four 120’ auger bores to install (2) 30” OD steel casings and (2) 48” OD steel casings were required.

Installation Challenges
Construction began in early October 2007. The first of the two bores to install 48” OD steel casing failed. Extreme weather had stripped the binding material from the outer layer of coral, causing the loose material it to cave in. Dropping a foot below grade, a second bore successfully cleared the loose material, but became bound in dense sticky clay at approximately 60ft. Water was pumped in and around the auger to loosen the clay and allow the auger to glide for another 40 ft. Once again, the auger encountered the outer layer of coral as it exited the dike, making turning the auger impractical. It was then shut down and used as a ramming device for the remaining 20 ft., successfully avoiding an overflow oil drain that was discovered during the installation.

With little room to maneuver, and little time to spare, each of the three remaining casings were installed successfully and the project was completed in mid October 2007, amazingly eight days ahead of schedule.

Although the lack of as-builts did
prove detrimental initially, we were able to employ a combination of innovation, technology, and experience that resulted in success.

As demonstrated on this project, the lack of as-builts and documentation will be the initial hurdle for any project. An excellent set of as-builts can save much time and money for an owner and contractor, helping them to make more informed decisions and reduce risk. It is common for changes to be made during construction. What becomes the challenge is making sure those changes are reflected in the as-built records.

Arvid Véidmark, III has more than two decades of operational experience and holds multiple licenses and certifications. He has sponsored over 50 educational seminars and has been consulting on major City improvement projects in the Phoenix metropolitan area since 1997.
IN 2006, THE CITY OF PHOENIX began the Sanitary Sewer Relief and Replacement Program to increase the capacity of city sewer lines to combat sanitary sewer overflows and provide for future development. The areas requiring increased capacity were determined by the city’s Water Services Department and arranged into a series of projects by priority. Sundt/AUI, A Joint Venture was awarded Priority Project No. 13 titled “Basin K01 Maryland Avenue - N. 33rd Avenue to N. 27th Avenue”. The scope of work for this project included installation of approximately 4,000 LF of 10” through 15” VCP sewer lines using open-cut-and-replace construction, installation of 3,200 LF of 14” and 18” HDPE sewer lines using pipe bursting, sewer dewatering and by-pass pumping, rehabilitation of existing sewer manholes, construction of new sewer manholes, removal and replacement of existing asphalt, curb and gutter, sidewalk and landscaping, and abandonment of existing sewer lines. As part of the joint venture team, AUI Inc. (AUI) provided the services of their Trenchless Technology Division to complete the pipe bursting portion of the scope of work.

Background - In 1998, AUI completed a pipe bursting pilot project for the City of Phoenix. This pilot project included replacement of 521 LF of failing sanitary sewer line with new 24” VCP using pipe bursting. The City of Phoenix was tempted by advantages of trenchless pipe replacement to reduce replacement duration, minimize the duration by-pass pumping, minimize or eliminate roadway closures and traffic control issues, minimize the potential for damage to existing utilities through excavation, and reduce the costs associated with surface restoration. Through this pilot project, AUI effectively demonstrated to the city representatives that pipe bursting offered a solution to the problem of replacing underground utility lines in highly developed urban settings with minimal inconvenience to the inhabitants and without increasing construction costs. Since that pilot project, the AUI pipe bursting team has completed 110,000 feet of pipe bursting over 42 separate projects.

The Phoenix Project - The 3,200 LF of pipe bursting included in this project was divided into three segments along Bethany Home Road, Maryland Avenue and 27th Avenue. In July of 2007, the AUI pipe bursting team, including Project Manager Gary Huffman and Project Superintendent Archie Lucero, mobilized to Phoenix to begin the first segment on Bethany Home Road. This first segment would require three separate pulls to burst the 919 feet of 10” VCP with 18” HDPE. AUI’s pipe bursting team subdivided this segment into three pulls to minimize the risk of binding (specifically...
when passing through the existing sewer manholes) due to the substantial increase in pipe size, almost double the pipe size from 10 to 18 inches. The pipe bursting team completed all three pulls in 26.5 hours and completely replaced this segment of the sewer main in under ten days (including sewer lateral reconnections and surface restoration). This segment included a burst directly across an arterial, signaled intersection with no lane drops; completely undetectable to the traveling public.

The second pipe bursting segment of this project ran east along Maryland Avenue for approximately 1,345 feet. Although the pipe size increase on this portion of the project was less than the previous pipe burst segment, from 10 to 14 inches or about 1.5 times, the team decided that it would still be a good idea to divide the segment into four separate pulls to (again) minimize the risk of binding. The third segment of the project was 975 feet of 10 inch to 14 inch along 27th Avenue.

Michael Rocco, AUI’s Trenchless Technology Division Manager and former Chairperson of the International Pipe Bursting Association (IPBA), counts this project among the successes of the division and as a victory for pipe bursting technology in general. “Not only did we get to prove the pipe bursting process is a solution to some of the common issues that cities have with the open-cut-and-replace method, but we also made inroads for alternative pipe materials in what has historically been considered a clay pipe market.”
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