Western Regional Trenchless Review 2014

Reaching New Heights in Trenchless

INSIDE:
- Maintaining a Sanitary District's Pipes
- HDD Crossing of the Santa Maria River
- Three Pipes, Three Sliplining Projects
- Details on Conferences, Courses & Shows
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**Featured...**

### Options
Trenchless methods have proven both cost-efficient and effective for Central Contra Costa Sanitary District

### Success
Crossing the Santa Maria River was the most challenging part of a water distribution project in Nipomo County

### Tunneling
Some said the McCarrell Canyon Storm Drain System couldn’t be built, but trenchless professionals got it done

**Also...**

- WESTT Chair’s Message 4
- Message from NASTT 5
- WESTT Board of Directors 6
- NASTT Calendar of Events 7
- NASTT’s 2015 No-Dig Show 8
- Three Pipes, Three Projects 24
- WESTT’s 2014 Regional No-Dig Conference 27
- CIPP to Rehabilitate Water Pipe 28
- Northern California Pipe Users Group 30
- Website Supports HydraLiner Sales 24/7 32
- Index to Advertisers 35

**Cover Photo:** Ron Behrmann
Welcome to this year’s Western Regional Trenchless Review and what promises to be a great Western Regional No-Dig Conference in New Mexico, the Land of Enchantment.

The past 12 months have been an interesting and exciting time for WESTT, the Western Chapter of NASTT. Members came out of the 2013 regional conference, held last October 28-29 at Ala Moana Hotel in Honolulu, brimming with information and (one hopes) enthusiasm in the field of trenchless technology. A few months later, NASTT held its 2014 No-Dig Show at the Gaylord Palms in Orlando, Florida. Dubbed “The Magic of Trenchless,” the April 13-17 conference and exhibition was a huge success – from Kickoff Breakfast, to presentation of 150 excellent peer-reviewed papers, to Educational Auction and Reception, to Gala Awards Dinner, to closing luncheon.

I would to thank the WESTT board for their continued support and effort to lead this chapter and create value for our members. Last year the WESTT chapter sent to all of its members NASTT’s publication Horizontal Directional Drilling Good Practices Guidelines (Third Edition). We hope to continue this practice of building our members’ trenchless reference libraries.

This past year we honored each of WESTT’s previous chairpersons with a personal bobblehead doll. We offered one each of Dr. Sam Ariaratnam, Ms. Jennifer Glynn, and Dr. Jason Lueke.

Trenchless technology keeps on widening in acceptance and opportunities – in no small part because it offers cost-effective ways of building and rehabilitating underground infrastructure while being a “green” technology as trenchless typically requires less energy to install infrastructure of the same function and life cycle. This year’s Review includes outstanding examples of the innovative, cost-effective alternatives we bring to municipalities and utilities in our states.

WESTT is fortunate to have developed a strong and productive relationship with the Northern California Pipe Users Group (PUG) which has included PUG offering its members NASTT training courses. PUG just completed NASTT’s Pipe Bursting Good Practices Course. We thank them for their help in spreading the word on trenchless construction.

WESTT’s Tenth Annual Western Regional No-Dig Conference, Exhibition & Course is being held October 6-7 at 30 Rainbow Road NE, Albuquerque, New Mexico. This is the first No-Dig show in New Mexico since Albuquerque was the host city for No-Dig 1998. This is WESTT’s first regional conference in New Mexico.

In the interests of ensuring that the annual event is accessible for members throughout our region, we head west to California for the 2015 edition. This will be WESTT’s first regional conference in San Diego and the city’s first trenchless show since NASTT’s No-Dig Show was hosted there in 2007.

The mission of WESTT and parent organization NASTT is to advance trenchless technology and promote its benefits for the public and the natural environment by increasing awareness and knowledge through technical information dissemination, research and development, education, and training. If you wish to join this group of volunteers, please contact anyone on the board as many dedicated hands make the load easier on all and make a better organization for all.

Lastly, thanks to NASTT Chairman Derek Potvin, 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
Chairman, WESTT

Jason Lueke, Jennifer Glynn and Sam Ariaratnam received personal bobblehead dolls.
Many Thanks to WESTT Members

Derek Potvin - NASTT Chair

It has been a great year for NASTT, and our record-breaking 2014 No-Dig Show held in Orlando, Florida, was definitely a major highlight. We had over 1,800 attendees, an excellent technical program, and an exceptionally successful Educational Fund Auction, all thanks to our dedicated volunteer members including many WESTT chapter members.

NASTT’s No-Dig Show pre- and post-course training sessions are a valuable accompaniment to the technical papers, forums, exhibits and networking events during the course of the Show. Your chapter is home to many of the expert trainers who volunteer to teach these courses. Thank you to WESTT chapter members Dr. Sam Ariaratnam, Dr. Dave Bennett, Dr. Glenn Boyce, Craig Camp, Jennifer Glynn and Collins Orton for their expert instruction with our Good Practices Courses this year.

2014’s 13th Annual Educational Fund Auction and Reception was a Pirates of the Caribbean-themed night of fun and fundraising. WESTT chapter members Brian Avon and Cindy Preuss, who led our auction committee as Chair and Vice Chair, helped the event raise more than $130,000 for NASTT’s Education Fund! To date the auctions have raised over $750,000 for educational initiatives like sponsoring students’ attendance at NASTT’s No-Dig Shows, awarding scholarships, publishing trenchless resources and providing targeted training courses to the membership at-large.

NASTT is all about education, and our training program is made up of dedicated members who spread the trenchless good news story. So far this year we’ve already had 24 training courses on the books, and more are scheduled every month. I’d like to thank our WESTT chapter members for hitting the road on behalf of NASTT to bring these courses to audiences across North America. Earlier this year in February, Dr. Sam Ariaratnam taught NASTT’s HDD Good Practices Course in Des Moines, Iowa, along with Glenn Dayvestyn. In August, Brian Avon organized a New Installations Good Practices course in Northern California. NASTT partnered with the Northern California Pipe Users Group (PUG) to bring this training to fruition. Dr. Dave Bennett, Jennifer Glynn and Collins Orton taught the course in Martinez, California, along with Dave Mathy, who served as a guest instructor. Collins Orton will also teach the Pipe Bursting Good Practices Course in Edmonton, Alberta, in November along with Dr. Jason Lueke.

This year the WESTT chapter is holding the 10th Annual Western Regional No-Dig Show in Albuquerque, New Mexico, October 6 and 7. The first day will feature exhibits, educational presentations and networking events. On the second day, WESTT will host one of NASTT’s Good Practices Courses. Be sure to check out www.westt.org for more details.

Plans for NASTT’s 2015 No-Dig Show in Denver, March 15-19, are well under way. The technical program will have many valuable and informative presentations, and the exhibit hall will be full of new products and services to support the trenchless industry. WESTT chapter member Cindy Preuss will take the helm as the 2015 Auction Chair, so be sure to join us in Denver for NASTT’s 14th Annual Educational Fund Auction and the 1980s ski-themed auction reception, ‘Totally Rad Slopes’!

Again, I cannot thank our WESTT chapter volunteers and members enough for your dedication and support. You are truly Trenchless Champions!
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2014 - 2015

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Jennifer Glynn, Past Chair
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jglynn@rmcwater.com
October 6-7
Western Regional No-Dig Conference
Sandia Resort Hotel
Albuquerque, New Mexico
Information: craig.camp@hatchmott.com

November 6
NASTT’s Condition Assessment for Watermains Webinar
Your Computer
Information: mhill@nastt.org

November 13
Northwest Chapter Trenchless Conference
Fantasyland Hotel
Edmonton, Canada
Information: amiller@nastt-nw.com

November 14
NASTT’s Pipe Bursting Good Practices Course
Fantasyland Hotel
Edmonton, Canada
Information: www.nastt.org

February 4, 2015
NASTT’s Pipe Bursting Good Practices Course
PSE&G Edison Training & Development Center
Edison, New Jersey
Information: www.nastt.org

February 12, 2015
NASTT’s Laterals Good Practices Course
Surrey, Canada
Information: www.nastt.org

March 15, 2015
NASTT’s Trenchless Technology Short Course – New Installation
Colorado Convention Center
Denver, Colorado
Information: www.nastt.org

March 15, 2015
NASTT’s Trenchless Technology Short Course – Rehabilitation
Colorado Convention Center
Denver, Colorado
Information: www.nastt.org

March 18, 2015
March 19, 2015
NASTT’s HDD Good Practices Guidelines Course
Colorado Convention Center
Denver, Colorado
Information: www.nastt.org

March 18, 2015
March 19, 2015
NASTT’s Cured-In-Place Pipe Good Practices Course
Colorado Convention Center
Denver, Colorado
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March 18, 2015
March 19, 2015
NASTT’s Laterals Good Practices Course
Colorado Convention Center
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I go to No-Dig to learn about solutions that will help reduce my company’s construction costs.

NASTT’s 2015 No-Dig Show
March 15-19
Colorado Convention Center - Denver, Colorado

NASITT’s No-Dig Show offers a first-rate educational program that rivals no other! Ask George Ragula, No-Dig is his go-to show for a comprehensive technical program, knowledgeable people always willing to share trenchless experiences and exposure to cutting edge technologies that all help provide him with technical solutions to reduce his company’s construction costs. Attend the educational sessions at NASTT’s 2015 No-Dig Show and find cost saving solutions for your company!

Mark your calendar and make your plans to attend NASTT’s 2015 No-Dig Show in Denver, Colorado.

nodigshow.com
Trenchless Technology in Central Contra Costa Sanitary District: Past, Present, and Future

Nancy Molina
Central Contra Costa Sanitary District

The Central Contra Costa Sanitary District was formed in 1946 to serve an area of suburban cities northeast of San Francisco. Currently, the District serves 462,000 residents and maintains 1,500 miles of pipeline in Contra Costa County ranging in size from four inches to 102 inches in diameter. The majority of the aged infrastructure was installed as vitrified clay pipe (VCP) by the open-trench method.

Originally, the District’s preferred trenchless technology was jacking pipes to cross underneath highways and railroads. Eventually, the District began looking for alternative ways to renovate and install sewer pipelines while minimizing impacts to the community. Initially, the District sliplined six-inch VCP but discovered that maintenance was difficult with the reduced size. Slolining began to form the District’s trenchless technology program. As a result, the District’s leadership was very supportive with experimentation and innovation by both staff and contractors.

This support from the District developed into our Collection System Renovation program. Currently, of the 1,500 miles of pipeline, approximately 20,000–30,000 linear feet of sewer are renovated each year. In-house engineers design the replacement of the smaller-diameter lines ranging in size from six-inch to 12-inch on average. Many of the sewer pipelines were installed in the 1940s and 1950s and are reaching their useful life.

The District manages a CCTV program that helps to identify the pipes that need immediate replacement/repairs and those that need urgent replacement. The lines are compiled into a list and sorted by physical location within the District’s service area. Engineers then create two or three projects, each containing approximately 8,000-10,000 linear feet of replacement or rehabilitation. These projects take into account various degrees of information. This information can include CCTV video files and reports, maintenance records, maintenance crew folders, permits, right-of-way documentation, geotechnical investigation reports and site visits. Site visits typically become a determining factor in what construction method will be designed for a site. Until an engineer can see the topography, site enhancements, access, and equipment layout, a final method cannot be decided.

**TRENCHLESS METHODS**

*Figure 1: Schematic of Pipe Bursting*

*Figure 2: Photo of Pipe Bursting*
Pipe Bursting

The District has a long history of using trenchless technology. In the late 1980s, we began looking into alternatives to open-trench pipeline installation. Some of the first trenchless technologies we tried were variations of pipe bursting technology (Figure 1). In 1987, the District installed 2,830 linear feet of pipeline using the pneumatic version of the PIM (pipeline insertion method). The District was the first municipal agency in the United States to renovate/install gravity sewers utilizing pipe bursting. In 1988, we installed 4,090 linear feet of pipeline using the hydraulic PIM, and in 1989 we installed an additional 3,120 linear feet using the pneumatic PIM. In addition to the PIM, we also tried the XPA N D IT and Merit Engineering equipment. Some of the typical problems the equipment encountered were being underpowered and untested, breaking through clay soils, and having difficulty in negotiating curves. Overall, it was found that pipe bursting was a viable and cost-effective method of replacing deteriorating sewer pipe.

Horizontal Directional Drilling

Another method that the District began experimenting with in the late 1980s was horizontal directional drilling (HDD), a schematic of which can be found in Figure 3. Four pilot sites were installed in the years 1988 through 1990. Previous to this installation, the Flow Mole technology and True Track technology had not been applied on gravity sewer applications. The results on these four installations produced data that showed it was difficult to maintain grade and buckling of the high-density polyethylene (HDPE) pipe which occurred due to high drilling mud pressures. Since this early application of HDD on easement sites, the District has continued to assess and experiment with this method as improvement in the technology has continued over time. In our more recent designs, HDD has been used for very difficult access, landscape, and depth issues on easement pipeline locations.

Lining Methods

The District continued to look for other trenchless technologies that would be capable of renovating six-inch vitrified clay pipe and minimize disruption to our customers. Other methods tried were slip-lining, tight-lining, fold and formed pipe, spiral wound and cured-in-place pipe. The District installed these materials on various sites to see how the installation worked, the site setup, and to test out the replacement material.

Many of the lining options required a lot of prep work up front on the host pipe. Prep work included pre-cleaning, point repairs to structural defects, removal of objects, and correcting sags. In addition,
some of the methods required bypass pumping, excavating to reconnect laterals, and lay down/insertion pits. Drawbacks to some of these lining methods were found after the installation was completed in the six-inch sewer pipes. One of the main concerns was that the diameter of the pipe was reduced, making it difficult or impossible to use a sewer main camera for viewing the condition and limiting the use of cleaning tools. This reduction in size also created a reduction in capacity of the line and became a risk for containing blockages. These setbacks mainly affected six-inch pipelines, therefore, the District has continued to use lining methods on pipes eight-inch and larger.

**Tunneling Methods**

As the District’s needs were changing, pipes in more difficult locations and of larger size were in need of replacement and renovation. The District started evaluating alternatives to install new pipe in these challenging locations. Multiple methods have been used by CCCSD in construction of the sewer pipeline alignments. Choosing an acceptable construc-

![Figure 5: Bore-and-Jack Installation](image)

![Figure 6: Pilot Tube Microtunneling](image)
tion method depends on the pipe size, depth of pipe, topography, soil characteristics, and layout/staging areas. Some of the methods that have been used by CCCSD are bore-and-jack, conventional tunnel boring, microtunneling, earth-pressure balanced machine (EPBM), and pilot tube guided bore. Many of these sites were in difficult-to-access easements or highly congested urban areas, or where the pipelines required deep installations. Due to these constraints, alternative options were evaluated to eliminate the need to open-cut. The benefits of these sites were that they allowed for large staging areas and space for insertion/receiving pits.

**RESULTS & EFFECTIVENESS**

During the last 25 years, the District has constructed approximately 443,000 linear feet by various kinds of trenchless technology, (Table 1). Just in the last 10 years, we have more than doubled our usage of trenchless technology. This has aided the District in reducing restoration costs, construction costs, and disruption to our customers.

In addition, there have been other benefits District-wide. One of the major indications assessed for sewer line repair are areas of overflows and stoppages (Figure 9). Over the last 10 years, we have seen a major reduction in overflows in our service area. Overflow reduction helps the District redirect efforts and resources to other preventative measures.
During the last 25 years of trenchless technology pilot projects and Capital Project Renovation work, the District has had the opportunity to share our experiences with other agencies and consultants. One of the beneficial results from sharing information was the creation of the Pipe Users Group (PUG) in Northern California. The District was involved with forming PUG in 1992. PUG currently holds monthly meetings and an annual conference each February. There are over 50 members that come together to share information. Currently, the District reaches out to coordinate projects with the local agencies and consultants.

### Table 1: CCCSD’s Completed Trenchless Sewer Construction Footage

<table>
<thead>
<tr>
<th>Trenchless Technology</th>
<th>Sewer Pipe Sizes (diameter, in)</th>
<th>Footage (LF) or Units (EA) Installed to Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe Bursting</td>
<td>6&quot;-15&quot;</td>
<td>193,000'</td>
</tr>
<tr>
<td>Sliplining</td>
<td>5&quot; - 24&quot;</td>
<td>55,000'</td>
</tr>
<tr>
<td>Cured-In-Place Pipe</td>
<td>6&quot;-36&quot;</td>
<td>61,000'</td>
</tr>
<tr>
<td>Spray On Coatings</td>
<td>24&quot;-36&quot;</td>
<td>25,000'</td>
</tr>
<tr>
<td>Roto and Jack</td>
<td>15&quot;-48&quot;</td>
<td>22,000'</td>
</tr>
<tr>
<td>Microtunneling</td>
<td>24&quot;-78&quot;</td>
<td>21,400'</td>
</tr>
<tr>
<td>HDD</td>
<td>4&quot;-12&quot;</td>
<td>24,400'</td>
</tr>
<tr>
<td>Tunneling</td>
<td>72&quot;-120&quot;</td>
<td>17,000'</td>
</tr>
<tr>
<td>Conventional TBM</td>
<td>36&quot;-66&quot;</td>
<td>10,000'</td>
</tr>
<tr>
<td>Spray-On Linings</td>
<td>36&quot;-72&quot;</td>
<td>5,000'</td>
</tr>
<tr>
<td>EPBM</td>
<td>72&quot;-96&quot;</td>
<td>3,300'</td>
</tr>
<tr>
<td>Fold and Formed Pipe</td>
<td>6&quot;-24&quot;</td>
<td>2,500'</td>
</tr>
<tr>
<td>Pilot Tube Guided Bore</td>
<td>8&quot;-24&quot;</td>
<td>1,200'</td>
</tr>
<tr>
<td>Spiral Wound</td>
<td>15&quot;</td>
<td>600'</td>
</tr>
<tr>
<td>Horizontal Guided Drill</td>
<td>8&quot;-12&quot;</td>
<td>800'</td>
</tr>
<tr>
<td>Pipe Reaming</td>
<td>6&quot;</td>
<td>100'</td>
</tr>
<tr>
<td>WEKO Seals</td>
<td>18&quot;-66&quot;</td>
<td>300'</td>
</tr>
</tbody>
</table>

Figure 8: Running 12-Month Overflow Totals Since 2004
cities and utilities on a regular basis. This communication has reduced inconvenience to residents and produced better working relationships between agencies.

The District continues to evaluate and assess our trenchless technology options. We continue to attend conferences and seminars looking for better and less disruptive ways to renovate and replace aging infrastructure located in difficult to access locations. With the support of District leaders, we are able to pilot test technology and materials to evaluate their efficiency.

REFERENCES


Central Contra Costa Sanitary District (2011) – Collection System Asset Management Plan, Sewer Main Renovation Program


Gade, Tom (2002) – Smart Application of Sewer Renovation Technologies


Pilecki, T., and Woodhouse, B. (1992) – Bridging the Information Gap

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HDD Crossing of the Santa Maria River

Norman Joyal, PE, GE
President, Senior Associate, Jacobs Associates

Peter Sevcik, PE
Director of Engineering and Operations,
Nipomo Community Services District

Jody Parrish
HDD Manager, ARB

More than 10 years ago, the Nipomo Community Services District (NCSD) began an ambitious project to interconnect the NCSD water distribution system with the City of Santa Maria Water Distribution System. The project will deliver supplemental water purchased by NCSD from the City of Santa Maria. It also allows NCSD and thus reduce pumping from existing wells to slow the depletion of groundwater and reduce the potential for seawater intrusion on the Nipomo Mesa. The project will also increase the reliability of the NCSD water supply by providing an additional source other than groundwater.

The project is consistent with the settlement agreement and a judgment related to the groundwater adjudication of the Santa Maria groundwater basin. NCSD committed to a $17.5-million water distribution project that includes a pumping station, 7,500 linear feet of 24-inch ductile iron pipe water transmission main, a 2,600-linear-foot water transmission main crossing of the Santa Maria River and a flow meter and flow control station.

CHALLENGES

The most important and technically challenging element of this new distribution system is the $6-million transmission main crossing of the Santa Maria River. The river flows along the base of the 110-foot-high bluffs of the Nipomo Mesa, although historical meandering of the river has resulted in an environmental river basin that extends several thousand feet from the bluff toe.

This crossing forms the backbone of the NCSD’s Supplemental Water Project. The alignment not only had to navigate beneath the Santa Maria River and its broad flood plain, but it had to traverse up the inclined bluffs. This alignment was complicated by highly permeable riverbed deposits consisting of sand, gravel, and cobble zones. These materials were present within and beneath the environmental habitat of the river, and surface disturbance of this habitat was not desirable. NCSD anticipated that acquiring the permits necessary to allow conventional open-cut construction...
would be difficult, costly and time-consuming, and decided that the crossing would have to be made using trenchless construction.

The southern side of the river basin has farmland which provided an area from which to stage a trenchless operation. Even so, the designated work area was about 2,000 feet from the bluffs. The trenchless approach had to take this into consideration as well at the 110-foot inclined alignment up the bluffs. Microtunneling was discounted because of the ground conditions and the shaft depth that would have been needed in the bluff. The geometric layout of the crossing dictated that horizontal directional drilling (HDD) was the most feasible trenchless method to use.

The pipe selected for the project was a 30-inch (760 mm) outside diameter high-density polyethylene (HDPE) DR-9 product. The HDD crossing was designed as a 2,600-foot-long (792 m) reach beneath the river and up the bluff.

In order to provide sufficient separation between the abrupt bluff toe and the bore path, the entry angle from the bluff side was specified at 14.5 degrees. This geometric layout provided about 45 feet of separation between the bore at the bluff toe. An entry angle of nine degrees was specified at the pipe entry point.

The river crossing with HDD presented some formidable challenges from a geotechnical point of view. The upper reaches of the alignment had to penetrate about 80 feet of dune sand. Beneath the river basin, the alignment was challenged by highly permeable river bed deposits overlying the Paso Robles Formation, a finer-grained variation of the river bed deposits. Borehole descriptions of “rig chatter – possible cobbles” and notations indicating the loss of drilling fluid were good indicators that pilot hole drilling and subsequent reaming passes would be challenging even for the most experienced HDD contractor.

Furthermore, the alluvial channel deposits at the surface (20-40 feet thick) are recent unconsolidated loose deposits above groundwater. These materials were deemed unstable and prone to inadvertent surface returns because of the loose and permeable engineering properties of these channel deposits.

**ADDRESSING THE CHALLENGES**

Recognizing that the HDD bore and reaming processes were going to be challenging, NCSD thought it was in the best interest of the project to prequalify the HDD contractors for bidding. In the end, ARB was selected.

The formidable obstacles posed by the ground conditions, the elevation difference between entry and exit points, and environmental concerns over surface returns were dealt with in various fashions. The crossing was designed as a mid-path intercept for installation of the pilot bore. This requirement mitigated risk in more than one way. For one thing, it meant at least two rigs were needed on-site, which reduced the risk of major delays due to mechanical failure. Also, the mid-path intercept method results in lower borehole pressures as compared to the borehole pressures that would be developed by a single rig working on the mesa side.

To reduce the risk of surface returns, conductor barrels were required at the both entry points. Both conductor barrels were placed and set in side-sloped slot excavations and backfilled. Both barrels were outfitted with centralizers through which a 12-inch casing was installed beyond the barrel. The casing was used during the pilot bore, but it and the centralizers were removed from the barrel during the reaming process.

The pilot bore was guided along the design path using a Tensor Magnetic Guidance Probe and a Tru-Tracker guidance system. Guidance readings were taken at the end of every joint, and the data was juxtaposed against the design
bore path plotted to scale as the drilling progressed.

As expected, ground conditions were difficult and challenging for the two maxi rigs. In general, the pilot bores were drilled without too much difficulty and the mid-path intercept was successfully accomplished. Before the intercept, each rig was hampered by the loss of fluid returns; this provided a glimpse of what was to come in the reaming passes.

The contractor elected to ream from south to north – from river basin towards the mesa – using mill tooth split bit hole openers. The maxi rig at the river site did not work in tandem with the mesa rig and it was deployed only when needed. Working with 10 joint increments at the river worksite, the contractor added pipe joints to maintain continuity or removed joints when the string was advanced from the Mesa side, such that there was drill string continuity in the hole at all times.

The 26-inch ream pass went well and was rather uneventful. It was completed in four and one-half days even though cobbles and hard formations were encountered. The 36-inch ream also went well, taking four days to complete.

The 42-inch ream pass was another story. It seemed that everything that could go wrong did go wrong. The rate of penetration was very slow in the Paso Robles Formation. After pulling from south to north for 2,150 feet, there was a pin-to-box connection failure in the drill
string. The drill pipe threads had become stripped but did not disconnect. The crew moved back to the south side and rigged up to pull the reamer out from the south as the pipe string on the back side of the reamer was still in good shape. The reamer was pulled back towards the south pit from 2,150 feet to 680 feet, where it became stuck in a known gravel and cobbles zone.

In an attempt to alleviate the stuck reamer, the contractor jetted the gravel and some of the cobble away from the drill string with a jetting assembly, freeing up the reamer. The driller pulled the reamer back another 55 feet, at which point the drill string twisted off in the hole due to a failed crossover sub at the reamer. All the drill pipe was extracted from both ends of the hole, leaving the reamer in the hole. This required drilling another pilot hole from the south worksite with a 10-foot offset from the original insertion point and intersecting the reamed hole around 660 feet out. Once the intersect was re-established, a 26-inch ream pass was completed from north to south to re-lubricate the hole with drilling fluid. This was followed by a 36-inch ream pass from south to north. 

During this pass as the reamer was traversing beneath the bluff in the Dune Sands Formation, sinkholes developed on the surface and a large volume of material was returned with the mud to the south side. The project team met to discuss grouting the sandy material under the bluff that was being loosened by the reaming operation and causing sinkholes to form. The contractor mobilized a grouting contractor that worked 24 hours a day for nine days and injected grout into the drill zone creating a weak "sandstone." A new pilot hole had to be re-drilled in the improved ground which was subsequently reamed again to a 42-inch diameter. The process worked to stabilize the drill zone enough so that the pipe was installed successfully.

To reduce the frictional forces between the pipe and the excavated hole during pullback, the contractor was required to fill the pipe with water for ballast.

Water fill line on left, air line on right.
However, when pulling the pipe from the river low side to the mesa high side, negative internal pressures would develop in the pipe as the water column in the pipe transitioned out of the fluid-filled borehole up the inclined bluff. To overcome these challenges, the contractor devised a fill plan that aimed to keep the water level in the pipe at the same level as the entry point. A stationary fill point was established at the back end of the fused string, and the water fill line stayed stationary and did not move with the pipe as it was pulled in. To overcome the negative internal pressures that would develop from pulling a water-filled pipe up the 110-foot bluff, the contractor installed a four-inch-diameter (100 mm) pipe inside the pipe string to provide atmospheric pressure at the leading end of the pipe when it transitioned up the bluff. The line extended all the way to the front of the pipe and moved along with the pipe string.

**SUCCESSES AND LESSONS**

The pilot bore and reaming processes were completed without any inadvertent returns in the river basin area, to the delight of everyone concerned. Despite the challenges and adversity faced in completing the reaming process, during a 12-hour period on November 15–16, 2013, 2,600 feet (792 m) of 30-inch (760 mm) HDPE pipe was pulled across the river and the adjacent bluff. This crossing forms the backbone of the NCSD Supplemental Water Project.

The original construction contract cost was $5,847,090 and the revised contract cost including change orders was $6,068,228. The majority of the cost for change orders was for grouting on the mesa side to stabilize the materials above the borehole. The project was completed within the amount budgeted for construction and within the allowed contract time.

Knowing drilling would be difficult, NCSD prequalified the HDD contractors prior to bid, which worked in favor of the NCSD when the HDD contractor was challenged by cobble zones. The contractor’s experience in drilling and reaming through these types of ground conditions proved invaluable to the success of the bore.

Once the drilling and reaming issues were overcome, there was lingering concern about how the drilling issues might impact the pullback. The pullback was tackled in normal industry fashion with a reamer spearheading the pull with a swivel head connection between it and the pipe. The crossing was achieved quickly and successfully, and NCSD’s 10-year planning process finally came to fruition.
Some said the $7.5-million McCarell Canyon Storm Drain System could not be constructed, but City of Rancho Palos Verdes staff and the Harris team rose to the challenge to complete this system that is essentially “returning the river to the sea.”

The proposed 100-year storm drainage system in the City of Rancho Palos Verdes includes some unique and innovative elements to stop the erosion of coastal bluffs – erosion that jeopardized multi-million-dollar homes that were built within the historical flood plain. (See Photo 1.) The project became all the more urgent after the flooding that was experienced during the winter of 2005.

California’s steep McCarell Canyon watershed consists of 340 acres and has a 100-year storm peak flow rate of 630 cubic feet per second (cfs). The affected downstream areas that were in harm’s way (due to reoccurring flooding and sediment deposition) include Palos Verdes Drive (South), which is the primary roadway access into the Palos Verdes peninsula where there are single-family residences, Bay Club condominiums, and Saint Peter’s Presbyterian Church.

Proposed Welded Steel Pipe Mainline: A 66-inch-diameter welded steel pipe mainline was required to convey the 100-year storm. Though a somewhat unconventional choice, steel pipe was determined to be the most appropriate material for the storm drain mainline because of the high velocities anticipated (in excess of 45 feet per second) and water that would be heavily laden with sediment and cobbles. Other pipe materials were considered but eliminated from consideration due to their inability to resist long-term scouring in combination with shattering impacts from bouncing cobbles.

Proposed Hand-mined Tunnel: An 80-inch-diameter tunnel was required (at a 40% profile grade within the 150-foot-high coastal bluff to the Pacific Ocean) to allow the installation of the 66-inch storm drain pipe. A top-down tunneling method was required because of environmental concerns (limiting impacts and equipment on the beach) and due to limited access on the beach (all equipment had to traverse approximately a half mile along the beach below the bluff from the adjacent Abalone Cove Beach).

Several factors led to the recommenda-
tion to utilize a traditional hand-mined tunnel method, including:

- **Installation Direction:** The requirement to construct from top to bottom. (“Wet” tunneling methods require a bottom-to-top installation direction to allow drilling mud pipe conveyance systems to be drained, extended and re-pressurized as the drilling head moves forward.)
- **Bedrock Conditions:** The significantly varying bedrock hardness, which ranged from very soft weathered shale to very hard basalt. (A tunnel contractor noted that if the multi-million-dollar tunnel boring machine were to get stuck there is a considerable chance that it could not be retrieved, in which case he would go out of business. Also, a person working at the tunnel face can react to varying bedrock material conditions and modify methods in real time.)
- **Length of tunnel:** The tunnel is 300 feet long. (Tunnel contractors indicated short length did not justify mobilizing an expensive tunnel boring machine.)

**Tunnel Geotechnical Investigation:** The tunnel portion of the geotechnical investigation included three vertical borings that extended 31.5 feet, 60 feet and 120 feet deep, respectively, directly over the proposed tunnel alignment. The 2.4-inch-diameter cores were removed intact and stored for study and mapping purposes. The three borings in combination with mapping of the exposed bluff face allowed a cross-section to be developed and the creation of a 3D extrapolation of the soil conditions.

**Monitoring Soil Movement during Tunnel:** Two primary sources of potential movement were monitored during the tunneling operations to protect the adjacent Bay Club condominiums:

1. **Inclinometer:** Two inclinometers were utilized between the launch pit and the condominiums to monitor potential horizontal movement adjacent to the launch pit shoring on the top of the bluff. Geokon Model 6400 inclinometer casings were installed to a depth of 40 feet, and the City’s geotechnical inspector utilized a specialized probe and “read out” unit to determine if any horizontal movement occurred. The project specifications included strict requirements on allowable movement and project remediation/shutdown operations should movement occur.

2. **Extensometer:** Two extensometers were
utilized at the one-third points directly over the tunnel alignment to monitor potential vertical movement within the bluff due to tunneling. The project specifications included strict requirements on allowable movement and project remediation/shutdown operations should movement occur.

Additional highlights and innovations for the McCarrell Canyon Storm Drain project include:

- Protecting the public’s interest by gaining critical public input
via multiple public outreach meetings and City Council meet-
ing, and addressing public concerns via detailed contract
requirements to limit hours of work, aggressive dust control and
daily coordination during construction.
• Protecting the bluff and working operations on the beach by uti-
  lizing a “Geobrugg” rock fall protection system and installing
two 24-inch-diameter soldier piles to a depth of 45 feet, which
allowed a key to be cut at the toe of the bluff and temporary
shoring at the tunnel outlet point.
• Constructing a customized outlet structure tucked into the
  beach and bluff and also matches the bluff in color.
• Protecting adjacent existing utilities through the use of an elec-
  tronic utility detection survey during the design phase that
located existing utilities both horizontally and vertically to an
accuracy that was better than most of the existing record draw-
ings, which allowed a design that avoided utility impacts.
• Using “Permalok” welded steel pipe with an epoxy exterior coat-
ing and mastic interior liner to minimize field welding and
improve production, which also included velocity reducer rings
in the 40% “slant drain” tunnel portion of the mainline pipe to
dissipate energy from the flows (slowing the flow from 65 fps to
45 fps) as they are conveyed to the bottom of the bluff.
• Constructing 1,925 linear feet of open trench to install the 66-
inch diameter “Permalok” steel pipe mainline at a prevailing
grade of 7% from the system inlet to the tunnel.
• Jacking and boring 30-feet of mainline pipe at a depth of 16 feet
to protect an eight-foot-high retaining wall at the Bay Club /Saint Peter’s Church property line.

Conclusion: The McCarrell Canyon Storm Drain in Rancho
Palos Verdes presented some unique engineering challenges and
provided an opportunity to significantly benefit the local com-

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IN THIS ISSUE OF WESTT—
Read our recent storm drain success story by one of our tunneling design experts, Randall Berry, PE.

Vern Phillips | VPhillips@harris-assoc.com | WeAreHarris.com
Three Pipes, Three Projects – Sliplining at Three New Mexico Locations

Michael Rocco
AUI Inc.

In 2014 AUI had the unique opportunity to perform three slipline projects utilizing three different materials. The three pipe replacement materials were centrically cast Fiberglas-reinforced polymer pipe (CCFRPM) manufactured by HOBAS, corrugated metal pipe (CMP) – Ultraliner pipe manufactured by Contech Engineered Solutions, and polyvinyl chloride (PVC) A2 liner pipe also manufactured by Contech.

Each material was installed by the slipline method of construction, which involves installing a slightly smaller pipe inside an existing pipe or box culvert. The three projects were completed at three locations in New Mexico: Kirtland AFB, Artesia and Albuquerque.

The first slipline of the three projects was an emergency interceptor sewer rehabilitation of a collapsed old 48-inch reinforced concrete pipe (RCP) located next to the Tijeras Arroyo at Kirtland Air Force Base and also next to an ammunition storage facility. A sinkhole and a CCTV Inspection of the interceptor line indicated the old RCP was in immediate need of repair. Holes in the pipe, exposed rebar and exposed aggregate were all serious indications that the old pipe was in desperate rehabilitation.

AUI along with the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) immediately went to work with repairing the old RCP. Sliplining was selected as the best method for rehabilitation. CCFRPM pipe manufactured by HOBAS was chosen as the replacement pipe. The HOBAS pipe selected was 44-inch Flush Relign Pipe that has an outside diameter of 46.5 inches and an inside diameter of 44 inches. Two insertions pits were excavated to push the HOBAS inside the old RCP with the sewer flowing normally. The sewage flow during the slipline process was approximately 16 million gallons per day.

Project Details & Summary
Project Name: Tijeras Interceptor Emergency Slipline
Description: Interceptor 48-inch Sanitary Sewer Sliplining
Location: Kirtland Air Force Base, New Mexico
Slipline Quantity: 1,730 LF of 44-inch Pipe
Pipe Material: 44-inch HOBAS Flush Relign Pipe
Construction: Pipe Clean, CCTV, Slipline, 6’-Diameter Manholes

Our second slipline project was a New Mexico Department of Transportation (NMDOT) job in Artesia. AUI was the low bidder on a storm drain concrete box culvert rehabilitation for the NMDOT. The existing six-by-six-foot storm drain box culverts under US 82 state highway were deteriorating due to corrosion and age. Instead of demolishing, removing and rebuilding the box culverts (which would require several months of construction, major traffic control and expensive costs), the
NMDOT choose sliplining to rehabilitate the concrete box culverts. The existing box culverts were sliplined with 66-inch-O.D. Ultra-Flow CMP storm drain pipe. A total of 6,440 linear feet of box culvert was sliplined with the Ultra Flow CMP.

The old box culverts were first cleaned out by a small skid steer loader that fit inside the box culvert. After a box culvert was cleaned, the new Ultra-Flow was installed inside it; between the old box culvert and the new pipe was an epoxy-coated high chair. Two new headwalls were formed and poured on each end of the culverts and the annular space was grouted with flowable fill cement.

**Project Details & Summary**

**Project Name:** US 82, MP 110.00 to MP 111.00 - Eddy County, NMDOT

**Project No:** 2100350/CN2100350

**Description:** 6’ x 6’ Concrete Box Culvert Slip-Lining

**Location:** US 82, Artesia, New Mexico

**Slipline Quantity:** 6,440 LF of 66-inch CMP

**In Artesia, 66-inch corrugated metal pipe was sliplined to rehabilitate old culverts below a highway.**

**AUI sliplined 44-inch HORAS Flush Relign pipe at Kirtland AFB.**
The third slipline project was on a small-diameter sewer line located in Albuquerque on a major arterial street called Paseo Del Norte Boulevard. The street was about to take a major $75-million NMDOT renovation with road widening, retaining walls and major bridges over the highway (I-25) and Jefferson Boulevard. As NMDOT began construction, the existing 18-inch RCP sewer line was found to be in need of rehabilitation because some of the roads were being filled in earthwork and the new road elevation made the sewer line more than 20 feet deep in some areas. The old 18-inch sewer line was originally installed in 1963, and hydrogen sulfide gases had eaten up at the pipe to expose aggregate. Since the new urgency to repair the line came up, traditional open-cut construction was too time-consuming and cost-prohibitive. Slippining was picked as an economical and structural solution to the problem, and we went to work immediately with the NMDOT and ABCWUA to begin construction.

The project began with pipe cleaning and CCTV inspection of the existing sewer line. CCTV video showed typical deterioration of the sewer line and four sewer service connections. We strategically excavated three insertion pits for the replacement of 3,150 LF of pipeline.

Project Details & Summary
Project Name: Paseo Del Norte 18-inch Slipline Emergency
Description: 16-inch PVC Slippining
Location: Albuquerque, New Mexico
Slippining Quantity: 1,170 LF of 16-inch PVC
Pipe Material: 16-inch A2 PVC Liner Pipe
Construction: Pipe Clan, Slipline, 4’and 6’ Diameter Manholes

Special thanks goes out to AUI Project Managers Andre Houle and Erick Garcia, Project Superintendents Archie Lucero and Archie Lucero III, and Project Foremen Chris Benavidez and Jeremie Schaefer.
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Michels Pipe Services knows quality is not a game of chance, but rather something achieved through experience and ingenuity.

So when Michels was hired by general contractor Las Vegas Paving to rehabilitate 3,400 linear feet of a 16-inch water main, many steps were taken to make sure the project would be successful. The method specified by the owner was using a cured-in-place-pipe (CIPP) lining system for pressure pipes and to meet the drinking water NSF/ANSI 61 Standard.

“Success is never an accident,” said Jason Gubin, Michels project superintendent. “We always put time into developing a solid plan so we are prepared for the job we were hired to do, as well as for other variables that might come up along the way.”

The host pipe was an asbestos cement pipe stretched along busy Maryland Parkway from Sahara Avenue to Desert Inn Road, about a mile east of Las Vegas Boulevard. Traffic was extremely heavy and work areas were limited to one traffic lane, including excavations. The project included reinstating 22 service connections that ranged in size from three-quarters of an inch to two inches in diameter.

Initially, the work was scheduled to be completed in August, a month during which desert heat can easily top 100 degrees. That searing heat might be welcome when lying by a resort pool, but not when installing heat-sensitive CIPP liners. Plans were developed to cool and protect the resin, liner and job site.

Time Change

Ultimately, the timeline was changed to perform the work in November and December, when morning temperatures dip into the 30s. A wet-out facility was established in a warehouse near the job site because epoxy resin suitable for potable water use has a short pot life. The liner was impregnated with the resin, put into an ice bath, and stored overnight before being taken to the site and installed the next morning using a traditional air-inversion, steam-cure process.

“This was just another great exercise to show why we never make just one plan,” Gubin said. “We were prepared for every-
thing, which was very beneficial for the customer and for us.”

The project was divided into 14 separate installations with an average length of 243 feet. Las Vegas Paving elected to bypass the entire project at once to speed the pipe rehabilitation process, and to provide continuous water service to customers during the installations.

Michels used a Sekisui NordiPipe glass-fiber-reinforced pipe liner. The stand-alone lining system is designed to withstand high internal and external pressure. NordiPipe is approved for potable water systems and is fully structural. The trenchless CIPP method was a quick, efficient way to rehabilitate the water main and extend its life by about 50 years.

Once installed, the liner was pressure tested to 150 psi.

The 22 saddle connections were robotically sealed prior to installation of the liner and then reinstated after the liner was cured and pressure tested, said Gubin.

Before beginning work in Nevada, the team fine-tuned its techniques in Michels’ yard in Brownsville, Wisconsin. Among other operations, the crew tested several methods for setting plugs to make sure they could be easily located and removed after the liner was installed.

“That dedication to developing best practices paid off,” Gubin said. “We went into this project with the confidence that we would do exactly what was needed to get the project done quickly and correctly,” he said. “We knew what would work in those exact conditions and we executed our plan.”

Michels is continuing to evaluate other new water rehabilitation technologies as well, said David Rosenberg, senior manager of Water Rehabilitation Services.

“We never allow ourselves to become complacent and are diligent about developing new ways to improve our work, our methodology and our services,” he said.

FOR MORE INFORMATION:
Another Year at the Northern California Pipe Users Group

Roberts McMullin
East Bay Municipal Utility District

The Northern California Pipe Users Group (PUG) begins another fiscal year in the Bay Area of California. PUG is a non-profit organization comprised of agencies, districts, cities, consultants, suppliers, vendors, retirees, and enthusiasts within the pipeline industry for over 22 years. PUG offers great opportunities for its members to stay on the pipeline pulse by “sharing technologies together,” which is the maxim for PUG. This article provides a summary of the many events that took place this past year.

PUG hosted an American Society of Civil Engineers (ASCE) training course on the Design and Installation of Buried Pipes in December 2013 at the office of East Bay Municipal Utility District in Oakland. Amster Howard and Jesse Beaver were the course instructors and each conducted separate one-day trainings on pipeline installation and design, respectively.

Design concepts focused on pipeline materials, soil properties, loads, elasticity, Iowa deflection formula, and ring compression theory. The installation course emphasized installation techniques, shipping, handling, storage, inspection, trench excavation, foundation, bedding, laying, joining, embedment, backfill, compaction, and much more.

PUG had an overwhelming response and hosted over 60 members for the December event. As part of the training, each registration provided a book by Amster Howard titled Pipeline Installation and bound ASCE training course materials. PUG wants to extend our appreciation to Amster and Jesse for the educational training provided to our membership.

The January 2014 monthly meeting hosted an open panel on contractor pipeline construction perspectives where PUG members could have the opportunity to ask questions to construction contractors in an open forum format. The panel participants included Brandon Sjulin of Mladen Buntich Construction Co., Rick Evans of The HDD Company, Steve Haslam of Anderson Pacific Engineering Corporation, and Tom Grover of Ranger Pipelines. The panel answered questions pertaining to the construction economy, unit prices, cross-bore issues, mandatory prebid meetings, performance versus prescribed specifications, and much more. This monthly meeting reinforced the “sharing technologies together” motto of PUG. We look forward to hosting several more panel discussions in the future.

In February, the 22nd Annual PUG “Sharing Technologies Together” Seminar was held at Hs. Lordships in Berkeley. Yazdan Cindy Preuss has served on the PUG’s Board as Secretary, Vice-Chairman, and Chairman.
Emrani, Senior Vice-President of Hall & Foreman, Inc., gave an informative keynote presentation on the “American Society of Civil Engineers California Report Card with Emphasis on Pipeline Infrastructure.” Along with the keynote presentation, PUG moderated seven other presentations related to the pipeline industry. For example Rolando Bueno of East Bay Municipal Utility District presented on “Asbestos Cement Pipelines – Sampling, Testing, and Condition Assessment,” and Meghan Thomas of City of Napa Public Works presented on “Multiple HDD Water Main Installation Across Highway 29, Napa, California.” The moderators for the seminar included Jimmy Dang of Oro Loma Sanitary District and Rolf Ohlemutz of Vallejo Sanitation and Flood Control District. The photograph accompanying this article shows the presenters from the 2014 event. PUG expresses immense thanks to everyone involved with the seminar. We hope to see you at the 23rd Annual PUG Sharing Technologies Seminar scheduled for February 19, 2015.

PUG hosts annual social events for our membership. This past year we hosted a tour of Anchor Brewery in San Francisco. Anchor Brewery employees provided a walking tour of the brewery, information about Anchor Brewing, current list of beers offered, along with a tasting in the brewery taproom. Thirty PUG members were able to attend this great experience to learn about a local libation, as well as the piping and hydraulics required to run a brewery on a mass production level. Thank you, Anchor Brewery, for providing an outstanding tour of your facility.

Beginning in July 2014, the PUG membership elected a new Board of Directors for the fiscal years 2015 and 2016 term. The new Board of Directors include the following officers: Roberts McMullin, East Bay Municipal Utility District, as Chairman; Bill Chavez, Sacramento Regional County Sanitation Districts, as Vice-Chairman; Jimmy Dang, Oro Loma Sanitary District, as Chief Financial Officer; Brian Avon, Golder Associates, Inc., as Secretary; Sasha Mestetsky, Central Contra Costa Sanitary District, as At-Large Representative; Anne Prudhel, Carollo Engineers, as At-Large Representative; and Bob Allen, CDM Smith, as At-Large Representative.

The PUG Board wishes to thank Cindy Preuss for her 11 years of outstanding service and dedication for serving on the Board as Secretary, Vice-Chairman, and Chairman. PUG awarded Cindy with an appreciation award plaque at the July 2014 monthly meeting.

Looking ahead, PUG has some informative events planned for the 2015 fiscal year. In August, PUG will host a one-day training course by the North American Society for Trenchless Technology (NASTT) on Pipe Bursting Good Practices. At November’s monthly meeting, PUG will conduct an HDPE Roadshow that will provide on-site demonstrations of butt, saddle, and electro fusion HDPE connections. On February 19, PUG will host the its annual Sharing Technologies Seminar in Berkeley. We hope to see you sometime in the future.

The Northern California PUG's 22nd "Sharing Technologies Together" seminar was held in February.
The cured-in-place-pipe (CIPP) technique allows rehabilitation of pipes without excavation or demolition of walls, flooring, foundations or pavement. The process involves just a few components to uniformly impregnate liners that will be rolled up in an airtight drum and then pneumatically inverted down the existing pipe. Depending on the materials being used, an appropriate curing technique is used. Once cured, the pipe is immediately ready for reconnection and use.

The introduction of HammerHead’s HydraLiner lateral lining system, combined with their existing pipe bursting equipment, made HammerHead Trenchless Equipment the first manufacturer on the continent capable of supporting customers with everything needed to complete their low-impact, low-cost lateral pipe rehabilitation projects of pipes 2 to 12 inches in diameter, regardless of the rehabilitation method needed. And since February 2014, HammerHead has been serving its CIPP customers through its online B2B retail store. The online store gives customers 24/7 access to all of its HydraLiner consumables and equipment, whenever is most convenient.

Jason Haas, HammerHead’s director of marketing, said: “This is real upfront pricing. You don’t have to have a secret password to find out how much an item costs. You see the product, you see the price, you buy the product at that price. No surprises. That’s just part of our business philosophy, to work hard to be more than a vendor to our customers. We want to be a trusted partner, contributing to their success.”

The HydraLiner product line gives customers everything they need to complete a wide array of CIPP projects: inversion drums, steam and hot water curing equipment, drum nozzles, liners, hardeners, epoxy resins, wet-out tables, pumps and dozens of related products such as Picote’s reinstatement and cleaning equipment and Brawoliner®.

Haas said visitors to www.hydraliner.com can use a credit card to make a purchase. The system is automated, so existing customers with HammerHead accounts receive their volume discounts automatically.

“Besides the typical convenience of an e-commerce site,” Haas said, “we also offer visitors to the HydraLiner site an 800 number to call for additional help from a product specialist, weekdays from 7 am to 5 pm Central Time. They’re there to provide the trenchless solutions our customers need. We tell new customers that ‘trenchless’ is a puzzle we solve daily, and that certainly applies to the specialists who answer that 800 number.”

“Most people think of us as an engineering and performance-focused company, and they’re right,” said Ryan Boldan, HammerHead’s lateral systems product manager. “We do tend to obsess on making the product better, tougher, more productive, that kind of thing. But we also understand how important it is that our customers have a quick and convenient way to purchase those products, especially consumables.

“So if a contractor is researching our lining supplies online, maybe late in the evening after he or she has finished a long day, that customer doesn’t have to wait until office hours to make a purchase.”

HammerHead is also offering a 10 percent off introductory special for www.hydraliner.com customers who use the promotion code HYDRA14 at the time of checkout.
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INDEX TO ADVERTISERS

AUI Inc. 26
Hammerhead Trenchless Equipment OBC
Harris & Associates 23
The HDD Company 6
Jacobs Associates 14
Nor-Cal Pipeline Services IFC
Riverside Directional Drilling Inc. 12
RS Technical Services Inc. 23
Stantec 19
TT Technologies Inc. 14

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