Horizontal Directional Drilling Guide

A Comprehensive Look at the North American HDD Industry
WELL

EXCALIBUR BITS
sand, clay, dirt

ULTRA BITS
caliche, shale, compact soil

BEAR CLAW BITS
rocky caliche, sandstone

EAGLE CLAW BITS
cobbles, caliche, sandstone

STEER TAPER BITS
shale, sandstone, cobbles

ROCK-IT BITS
sandstone, solid rock, shale

CHUNKY BITS
sand, dirt, sandstone

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The Maturation of an Industry

As I paged through the initial review of the 2011 Horizontal Directional Drilling Guide, I can’t help but reflect on our history in HDD. The industry was developed out of a need—a need to limit the social and environmental impact of construction while installing critical utility lines. At the onset, HDD was a primitive construction technology at best—sort of a shot in the dark—but the industry developed rapidly as the demand for HDD services grew.

Over the last 20 years, I have had the opportunity to visit a number of HDD companies—all while making great friends in the industry. Old pictures of thin-rod, pit-launched machines and innovative tooling adorn the walls of Melfred Borzall. Sometimes you hear a bark in the background when speaking on the phone with Digital Control, where dogs are welcome and so are you. Both companies showcase the ingenuity that has helped develop HDD in the last 20 years, through tooling and locating.

Today, the HDD industry is strong and growing once again. Vermeer, Ditch Witch, Astec, TT Technologies and others are building new rigs to help develop the geothermal market. The big rig contractors are drilling longer, installing larger diameter pipe and becoming more efficient, thus increasing their opportunities in a wide range of markets. We are seeing design-build applications and the engineers are embracing HDD, not as an alternative, but as the preferred method of installation.

This is why we are bringing the readers of Trenchless Technology and select readers of North American Pipelines the 2011 Horizontal Directional Drilling Guide—that is, to showcase the companies that have built the market and provide an invaluable service to a wide range of industries. Be sure to check out the rig specs in this issue and find the rig that fits your need, or read through the cover story to find out about the current state of the market.

The bottom line—HDD is cool!

Rob Krzys
Associate Publisher

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As the construction industry continues to find its way out of the Great Recession of 2008, the horizontal directional drilling market appears to be on solid footing in 2011 with contractors finding more work and starting to make equipment purchases again.

Contractors and manufacturers share a cautious positive outlook for HDD’s immediate future, but the fear of another economic downturn keeps them from being overly enthused.

Over the past few years, there have been HDD contractor, manufacturer and engineering consolidations, such as Vermeer Corp. acquiring HDD Broker, Ditch Witch purchasing Radius Professional HDD Tools earlier this year, contractor Southeast Directional Drilling purchasing Frontier Pipeline in 2010, and The Crossing Co. acquiring The HDD Co. in 2009. In recent years, Integrated Pipelines Services has acquired Sheehan Pipe Line Construction and Snelson Companies. What effect these consolidations and others will have on the overall HDD industry is too soon to tell.

Stimulus funds that were to aid in U.S. infrastructure projects had little effect on the HDD market in 2010 but have rejuvenated the fiber-optic work in 2011 for some areas of the country. Pipeline work has picked up and manufacturers are reporting increased sales of rigs and accessories.

The economic downturn put a renewed look on bidding projects, as contractors competed for fewer jobs, driving down pricing. Pricing has stabilized in some areas some say, but overall, it remains a big issue for contractors.

Manufacturers are seeing contractors restocking their equipment — from rigs to tooling to accessory items like drill pipe — which gives an indication that HDD work is being done and more is on the horizon.

How Is the Market?

“Cautiously optimistic.” That’s how folks in the HDD industry are describing the state of the HDD industry.

“We definitely see the industry on an upswing but I and everybody I talk to from contractors to those on the distribution side, you get the feeling that everybody is cautiously optimistic,” says Klane Kirby, general manager of Hunting Trenchless, a manufacturer of drill pipe and tooling. “It’s like they are waiting for the other shoe to fall. They like what they are seeing but contractors are tentative.”

“[Contractors] are cautiously optimistic,” says Richard Levings, product manager for trenchless applications at
Ditch Witch. “But worldwide, the directional drilling market is in very good shape. We’ve continued to see utilization of HDD as the chosen method for installing product increase. We saw a lot of decline in 2008 and 2009 because of funding uncertainty. Some of that came back in 2010. The stimulus funds didn’t affect the underground market in 2010 but in 2011, we have seen that really heavily influence it, primarily with fiber-to-the-home and some water [projects]. There was $7 billion allocated to fiber projects and it just took a long time for that to come into play.”

“It’s very strong right now,” says Todd Barton, vice president of pipeline operations at Southeast Directional Drilling, an HDD contractor based in Casa Grande, Ariz. “Last year was a good year. The three previous years the trend was definitely big pipe jobs. Now, 90 percent of the work being bid is 24 in. and less. It’s a whole different market. Gas is the place to be right now.”

“Licking its wounds would probably be about the best analogy that I can come up with,” says HDD Broker general manager Bob Martin. “I can see the worst seems to be over and that an abundance of work seems to be just over the horizon. Hard lessons about aggressive expansion and over extension were learned across the board and the benefits of those lessons will extend far into the future.”

One area of the industry that is still feeling the recession is the bid prices, remaining much lower than in previous times. “The prices were driven down because there is much competition for the same work,” Barton says. “In the last few months we have started to see a little stabilization as far as prices go but over the last eight to 12 months, the prices are down considerably… Just off the cuff, our prices are down 25 to 30 percent.”

Buying Again

With the uptick in work, contractors are returning to the stores, so to speak — upgrading, replacing or buying additional equipment for their business. Manufacturers are seeing an increase in new equipment purchases.

“The demand for new equipment picked up in mid-2009 and began to ramp up. It has continually grown since,” says Levings, who as a veteran of the HDD industry has seen the highs and lows. “In 2011, the demand is off the chart for everything: rigs and accessories and used and new.”

With contractors keeping equipment manufacturers busy, what has the effect been on used equipment sales? In recent years used equipment sales benefited from lackluster new equipment sales. In the last year, however, used sales are now feeling the benefits of the demand for more equipment being needed out in the field — contractors turning to the used market to beef up their fleets.

“We can certainly see contractors buying new units again. Hand-in-hand with that is the steadily increasing demand for premium used equipment with low hours and recent dates of manufacture,” says Martin. “The stirring of new HDD sales is actually helping the used market as well, as contractors make room for new drills by liquidating or trading in older ones. With demand high in the used market, the influx of these used drills is a welcome and healthy occurrence.”

Levings concurs with Martin, saying he can tell new equipment sales are strong just by looking over the online used equipment sites and using what he sees there as a barometer for the market. “I look at the used equipment sites and I look at the age of the equipment listed,” he explains. “If you want to buy something, it was made in the 1990s or early 2000s. What that tells me is that people are so busy that they have soaked up all of the most recent used equipment, meaning anything built between 2003 and 2011. That indicates to me that [new equipment manufacturers] are very busy.”

In recent years, Martin says there has been customer apprehension about spending, as the worldwide economy tumbled and forced contractors to postpone needed equipment upgrades and replacements indefinitely. Today, the biggest issue for potential customers isn’t should they spend but it is getting financing — a direct result of the 2008 recession as creditors cracked down on lending.

“We are seeing a very positive outlook on business in general from customers,” Martin says. “More than anything else, we’re seeing frustration on behalf of some consumers at not having the ability to purchase needed equipment for upcoming work. The downturn has affected the credit of many contractors and has also negatively impacted the readiness of lenders to let money out for new purchases.”

Kirby says the purchasing market is definitely improving over recent years. “Compared to the last two years, it’s greatly improved,” he says. “Speaking from an accessory side, it has picked up tremendously. In talking with the manufacturers and distributors, I know there are shortages
of new drills, especially the mid-size drills. They can’t seem to build them fast enough. Demand for drill pipe for mid-size drills is tremendous right now. Hunting Trenchless is a company that stocks millions of dollars of drill pipe and we can’t keep certain sizes in stock.”

Kirby says as more HDD work is awarded, contractors are looking to upgrade or replace those drills or ancillary equipment they held onto during the recession. “We are seeing in 2011 that people are starting to get some jobs they feel comfortable with and they are replacing some worn out drill pipe and worn out tooling.”

**Where Is the Work?**

HDD is having a good year but where is all the work? That depends on who you speak with. The Marcellus shale region — which encompasses all of Pennsylvania, as well as parts of New York, Ohio and West Virginia — has become a boon for contractors, particularly those who handle small- to medium-size diameter pipe.

“There are a ton of contractors up there right now,” says Barton. “We have six of our 11 rigs involved up there as well. This is one of the largest natural gas finds in U.S. history. The volume of work is tenfold of what it would be in Texas or somewhere where there is a fairly good infrastructure for gas transportation.”

Barton explains that in the Marcellus shale region, there is no existing infrastructure in the area so all of the gas exploration and all of the wells going in are starting from scratch. “All the trunk lines and feeder lines…all the piping that needs to go in is all new,” he says. “There is no existing infrastructure to tie into.”

This HDD work has been a boon for smaller to mid-size contractors as the pipe diameters being drilled are 24 in. and smaller.

Levings says he sees all facets of the HDD industry working, albeit some areas of the country still feeling the pinch. He says it’s the fiber work, pipeline work and municipal work that has put HDD contractors back to work. “It’s a broad spectrum of work across the entire underground infrastructure industry,” Levings says.

**Pipeline Work and HDD**

One area of HDD that has been pretty strong for the industry the last few years has been pipeline installations. With the demand for energy increasing, pipeline work has been a steady force for HDD in recent years as other HDD segments, such as fiber, slowed.

“[Pipeline work] has been a great addition to the HDD industry,” Levings says. “If you look at 10 years ago, the number of large rig contractors and the number of large rigs and the demand for those rigs, it was just OK. Today, those numbers have grown immensely because the pipeline industry worldwide — not just in North America — has pushed the demand for larger units. The pipeline industry and HDD industry complement each other very well.”

Barton says the pipeline work is all centered around where the shale regions are, such as the Marcellus Formation in the Northeast and the Bakken Formation, which stretches from Canada to North Dakota and in Montana and could possibly be the largest finding in U.S. history, next to the oilfield in Alaska.

ARB Inc. HDD manager Jody Parrish says the HDD market is recovering from a recent slowdown in pipeline construction. “There was a lull in the market after the boom in cross country gas pipelines over the last four years,” he says. “The slowdown in the economy has led to the cancellation or delay of some intermediate size pipeline construction projects.”

“The boom in the gas well drilling shale formations has led to the need for construction of collection pipelines to deliver the gas to larger existing pipelines in Texas, Wyoming and Pennsylvania. This will result in more horizontal directional drilling opportunities in pipeline construction as those collection lines cross streams, wetlands, highways and other obstacles.”

Levings and Parrish note that the demand worldwide for energy is there and will continue, aiding HDD even more.

**HDD Is Here to Stay**

Levings sees the HDD market today as its strongest point — in terms of general acceptance. “Strength comes from your base,” he says. “That broad spectrum of utilization has made our base so much stronger…When we first started out over 20 years ago, there used to be this saying that you plow everything you can, you trench what you can’t plow and backhoe what you can’t trench. Directional drilling was just for those things that you absolutely could not trench or open-cut. Today, it’s directional bore everything you possibly can. There are just so many benefits that people now recognize.”

In its infancy, HDD was markedly project driven. Today, the key to survival and success is diversification and with the general acceptance of HDD in terms of all things being put underground, HDD contractors are no longer concentrating just on fiber, water, gas, etc. They are doing them all.

“We just suffered one of the worst recessions in worldwide history but HDD didn’t lose a lot of contractors, unlike in 2001 and 2002,” Levings says. “That means our base is strong.”

Sharon M. Bueno is managing editor of Trenchless Technology
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When our sister publication *Directional Drilling* would publish the rig specs in height of the drilling boom in the mid- to late-1990s for the compact, mid-size and maxi rigs, there were more than 15 North American manufacturers that the drillers could choose from. How have times changed. Today, there are eight rig manufacturers featured as business consolidations and shuttered companies have trimmed the list. 

*Trenchless Technology* contacted the industry’s rig makers and asked them to provide the specifications for their fleet. No direct quality comparisons between equipment or manufacturers are implied. To get more information, contact the manufacturers directly.

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### Ditch Witch

1959 West Fir Street, Perry, Okla. 73077  
800-654-6481 | www.ditchwitch.com

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### Horiztonal Directional Drilling Guide

**Herrenknecht**  
Schlehenweg 2, 77963 Schwanau, Germany  
+49 (0) 7824-302-0 | www.herrrenknecht.de

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For more information visit www.trenchlessonline.com/info  
www.trenchlessonline.com
### TT Technologies Inc.
2020 East New York Street, Aurora, Ill. 60502
800-533-2078 | www.tttechnologies.com

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### Universal HDD
1221 Flex Court, Lake Zurich, Ill. 60047
847-955-0050 | www.unihdd.com

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### Vermeer
1210 Vermeer Road East, Pella, Iowa 50219
641-628-3141 | www.vermeer.com

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In the mid to late 1990s, the horizontal directional drilling (HDD) market was exploding, due mostly to rapid growth in telecom and construction of the fiber-optic backbone across the United States.

Unfortunately, as the industry expanded quickly, problems arose from a combination of inexperienced drillers, inadequate geotechnical investigations and a lack of established good practices.

In 1998, the California Department of Transportation (Caltrans) expressed concern about potential damages from HDD installations beneath its roadways and considered enacting regulations requiring training for horizontal directional drilling contractors drilling under state lands. Similar concerns were being raised around the country by other transportation and environmental agencies. Some agencies, such as Santa Clara County, considered declaring a moratorium on all drilling operations until a standardized set of practices was established and training of operators was implemented.
In 1999, the North American Society for Trenchless Technology (NASTT), working in conjunction with Caltrans, developed a three-day “HDD Academy” training course for HDD contractors and inspectors. Concurrently, at the No-Dig conferences in 1999 and 2000, committee panels met to discuss the concerns related to directional drilling and to develop a consensus path forward. The Horizontal Directional Drilling – Industry Consortium (HDD-IC) was born from these growing concerns and was comprised of a cross-section of contractors, manufacturers, suppliers and trade organizations. In 2000, HDD-IC sponsored the development of a set of HDD Good Practices, with the objective of providing comprehensive training and guidance for competent persons, inspectors and engineers.

With the HDD-IC’s support and guidance, the first edition of the HDD Good Practices Guidelines was developed and authored by David Bennett, Samuel Ariaratnam and Casey Como. The Guidelines included a training curriculum and testing procedure that was reviewed by an 18-member panel from all segments of the industry. The guidelines addressed the need for experienced, qualified owners, designers, contractors and inspectors through comprehensive training. The Guidelines also became an educational resource for regulatory and permitting agencies, and many agencies now base their permitting requirements on the guidelines.

Since the original 2001 publication of the Horizontal Directional Drilling (HDD) Good Practices Guidelines, much has changed in the HDD industry. Economic pressures from the telecom and fiber-optic downturns from 2000 to mid-2003 resulted in consolidation and a general downsizing of the industry, resulting in less work at lower prices. Used rigs flooded the market for a period. Migration away from the industry resulted in fewer contractors, fewer vendors, fewer skilled operators and fewer new HDD rigs sold.

However, the industry has not only survived but has prospered, with encouraging growth in the last few years. New applications in water and sewer pipelines and gas and oil pipeline work helped fuel the growth. The growth in business opportunities has been accompanied by improvements, some incremental, some more drastic, in equipment, tooling, design, protection of existing utilities and development of means and methods that are more sensitive to environmental concerns and the issues that accompany working in congested urban environments. The mid-size and large-size HDD rig range has seen especially robust growth, and improvements in capabilities and offerings. For example, bores of up to 10,000 ft have now been successfully completed using the Intersect Method with two HDD rigs at opposite ends of the crossing. Improvements in
guidance and tracking systems have fueled these achievements, while every aspect of HDD equipment and practice has evolved.

In 2004, the first edition of the *HDD Good Practices Guidelines* was updated to reflect evolving practices and to make the guidelines more consistent with the constantly evolving training course. The second edition addressed incremental changes in the HDD industry.

By 2008, the *HDD Good Practices Guidelines* needed a substantial overhaul to reflect the growth and changes in the industry. The HDD Good Practices training course had been informally and continuously updated, especially after the second edition was published in 2004. For the third edition, in addition to updating the good practices information in the earlier edition, the authors, with the support of the HDD Consortium, desired to add value by addressing design issues and problems. Consequently, a new chapter on design was added. This chapter covers design practice, including several specialized issues that must often be addressed, such as evaluation of hydrofracture risks and evaluation of settlement risks. Hydrofracture and settlement risks present significant concerns to regulatory and permitting agencies that must be addressed in design and construction. The new chapter provides guidance for managing these risks.

The co-authors of the third edition of the *HDD Good Practices Guidelines*, Bennett and Ariaratnam, wish to acknowledge several individuals and organizations for their assistance and support of this effort. The HDD Consortium provided financial support, as well as thorough technical review of the draft manuscript, and furnished updated photographs, illustrations and text descriptions. We deeply appreciate the support of the Consortium and the individual members of the Consortium, NASTT, the National Utility Contractors’ Association (NUCA), the Association of Equipment Manufacturers (AEM), the Power and Communications Contractors Association (PCCA) and the Distribution Contractors Association (DCA). The Directional Crossing Contractors Association (DCCA) no longer exists but supported the original Guidelines publication, and many of its former members have remained very active in sister organizations and have provided assistance on the

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Other areas of the trenchless industry. Short courses and guidelines have been developed for Pipe Bursting, Cured-In-Place Pipe Rehabilitation, New Installations and Laterals. These offerings have positioned NASTT as the “go to” source for trenchless technical training and reference documents.

Dr. David Bennett, P.E., is principal with Bennett Trenchless Engineers. Dr. Sam Ariaratnam, P.E., is a professor at Arizona State University and is chairman of ISTT.

Revision. Bennett and Ariaratnam greatly appreciate their help. Likewise, an original co-author, Casey Como, provided excellent support during the preparation of the original edition and remains a strong supporter of the guidelines.

Special thanks are due to Kathryn Wallin and Mary Asperger for their hard work on the new design chapter (Chapter 4) and in organizing, formatting and proofreading the entire draft, including the appendices, and coordinating with the review team and sponsors. Special thanks must also go to John Hemphill, the former executive director of NASTT and current executive director of the International Society for Trenchless Technology (ISTT), for his unwavering support and guidance throughout the period from 1998, when The Guidelines were just a vague notion, to publication of this third edition, some 10 years later. Likewise, special thanks to Mike Willmets, current executive director of NASTT and to the Board of Directors of NASTT for their strong support over the past few years.

The HDD Good Practices course has achieved enduring success as the most highly attended NASTT short course, and The HDD Good Practice Guidelines, Third Edition, remains the strongest seller among NASTT’s publications. As of June 2011, approximately 1,000 students have taken the HDD Good Practices Course, and approximately 2,070 hard copies and 660 CDs of The HDD Good Practices Guidelines have been sold.

The success of the HDD Good Practices course and Guidelines has encouraged and allowed NASTT to sponsor short courses and guidelines in other areas of the trenchless industry. Short courses and guidelines have been developed for Pipe Bursting, Cured-In-Place Pipe Rehabilitation, New Installations and Laterals. These offerings have positioned NASTT as the “go to” source for trenchless technical training and reference documents.

Dr. David Bennett, P.E., is principal with Bennett Trenchless Engineers. Dr. Sam Ariaratnam, P.E., is a professor at Arizona State University and is chairman of ISTT.

Instructors of the HDD Good Practices course are highly respected HDD professionals.
Portland, Ore., is known as one of the “greenest” cities in the United States, especially when it comes to urban and regional planning and new construction projects. The area around Portland is no exception. Engineers are designing projects that make sustainability and the environment a priority in new construction.

One such project is the building of a new high school in Sandy, Ore. — a city located less than 30 miles outside of Portland. The new school was designed to accommodate a growing high school population. Situated on 82 acres of property along Bell Street, the new 310,000-sq ft school will be considerably larger than the previous 160,000-sq ft school. The campus, which is set to open in the fall 2012, will accommodate a minimum of 1,600 students and support space for an additional 200.

Geothermal Heating and Cooling

To ensure environmental sustainability and at the same time to have an efficient and cost-effective system for heating and cooling, the new school’s building design included a geothermal system. Geothermal systems use a safe, renewable alternative energy that is stored within the earth. A constant temperature is maintained below the earth’s surface and that energy can be harvested from its natural source to efficiently heat and cool a building. At the same time, use of this type of energy does not harm the environment and is not reliant on non-renewable fossil fuels.

In a geothermal system, the source of the energy from the earth is captured by creating a series of horizontal and vertical loops underground. The loops are filled with water (or a water-based liquid) and are connected to a heat pump inside the building. The pump circulates the liquid through the ground loops, which creates a heat exchange. A geothermal circuit vault works as the central control point of the geothermal well field where the loops are connected. A circuit vault that is prefabricated helps save time and money during installation.

For this project, Interface, an engineering firm in Portland, designed the building; Hoffman Construction Co. served as the general contractor; and GeoTility Geothermal Systems was chosen as the main geothermal contractor. ISCO Industries LLC supplied the geothermal materials.

A Series of “Firsts”

There were several unique aspects of this building project. Some components of the geothermal system were installed using horizontal directional drilling (HDD), which included installing different sizes of HDPE Unicoils. A Unicoil comprises of a manufactured u-bend that is factory fused to measured lengths of HDPE pipe. This was the first time HDD was used to install this type of piping for a geothermal system in the West. The pipe coils were installed under a field in order to connect to a geothermal circuit vault.

The u-bend pipe coil lengths were some of the longest that the HDD drilling company, Lovett Inc., had ever worked with — the longest of which were 750 ft (for a total of 1,510 ft). They were also the longest to have been manufactured. According to Waylon Knight, project manager for Lovett Inc., putting in a total of 610 ft of pipe was more typical for other types of HDD installations.

Addressing Geothermal Supply Needs

To meet the geothermal supply needs for the project, GeoTility worked with Shelby Heritage, geothermal representa-
tive with ISCO Industries, to provide the materials. ISCO supplied a custom 72-in. HDPE geothermal vault — ISCO’s Circuit Maker Vault. The prefabricated vault included butt-fused circuitry and data-logged joints.

“The original design specification included the use of a concrete vault. However, I worked hard to get the specification changed to an HDPE vault,” said Gerard Maloney, project manager for GeoTility. “We are very happy with the time and energy saved on this project, as well as the quality of the product and its leak-proof feature.”

ISCO also supplied 104 of the 1510-ft Unicoils, 96 sets of 1010-ft Unicoils, as well as fittings and pipe fusion equipment.

**HDD Installation**

To install the pipe coils, Lovett Inc. drilled 675 ft under a baseball field, which was left undisturbed during the entire process. The length of the baseball field was approximately 450 ft. At certain ends, Lovett needed to drill a total of 725 ft, which included the entrance and exit points of the drill. This required the use of the 750-ft one and a quarter inch u-bend pipe coil. Lovett bored on one side of the field and then pulled the pipe back underneath the field from the other end.

During the first few weeks of the drilling process, Knight said, “The drilling is going better than expected. The soil condition is a little different than originally reported but we are on schedule. It is made up of mostly clay with some boulders. We should be done in 12 weeks time and are in our fourth week right now.”

According to Knight, normally when they use HDD for installing utility pipe, the pipe only needs to be installed 3 to 4 ft deep. For the geothermal application, the pipe was installed much deeper. Some coils were installed 30 ft deep while others were 15 ft below the surface.

Using HDD to install the pipe, Lovett bored a hole in the ground, attached the pipe and pulled it through back to the other side. They had 35 to 40 ft of extra pipe available in order to know how far to pull back.

GeoTility and Lovett ran into one challenge while installing some of the coil, mainly due to where the drill was set up in order to bore under the field. Basically, because of the location of the drill in relation to the site, the coils could not be grabbed from the u-bend to pull underneath the field. However, GeoTility was able to uncoil the pipe and attach the drill to the loose ends of pipe to pull through to the other side.

When only 22 coils were left to install, Jerry Carter, senior estimator for GeoTility, said, “There were a lot of schedule opportunities and we are ahead in the drilling.”

Overall, the HDD installation ran ahead of schedule. The contractors were able to install six coils per day using HDD, which is comparatively fast for this type of installation and application.

For the vault installation, GeoTility excavated approximately 9 ft down. The base for the vault was made of sand. Once the vault was inside the excavated site, the headers for the project, which were prefabricated by GeoTility, were dropped in and fused to the header pipe. Next, the pipe coils were tied into the vault. Once that was complete, GeoTility tested all the individual circuits. There were a total of 18 3-in. circuits.

**Conclusion**

Once the school is complete in 2012, it will have the added advantage of using a renewable, environmentally sustainable and efficient system to heat and cool its building. With the added benefit of having sections of the system installed with HDD, large tracts of land are left undisturbed and the geothermal system installation was both speedy and successful.

Joanna Climer is a public relations specialist with ISCO Industries.
Over the last 30 years, horizontal directional drilling has become the preferred pipeline construction method to cross major waterways. The construction impact of HDD is generally limited to each side of the waterway and associated wetlands. This has made HDD the method of choice with most permit authorities and environmental regulators. HDD also provides significant depth of cover under the river bed. This provides protection from moving debris on the river bed, anchors and potential scour of the river bed. As the number and capability of HDD contractors has grown, most often HDD is also the least expensive alternative.

There are many factors when considering the site for a HDD installation. Local topographic maps are a good resource for this investigation along with actually visiting the sites. Obviously a section of the waterway with the least width usually reduces costs. The actual crossing site is often dictated by available work space on either side of the waterway. For the HDD rig spread, a work space of 100 ft wide by 150 ft long is sufficient in most cases. On the opposite bank, it is beneficial to have work space available where the pipeline can be prefabricated in one string. This workspace requires a minimal width usually needed for pipeline construction (50 to 75 ft) with additional space near the HDD exit also approximately 100 ft wide by 150 ft long. Both sides require good access and need to be reasonably level.

The ground conditions expected during drilling strongly influence HDD costs and feasibility. During preliminary site selection, a general geologic review should be performed. Such a review can include a review of United States Geological Survey (USGS) records, historical geotechnical investigations from nearby structures (bridges, piers, levees, previous HDD installations, etc.), and general surface observations (rock outcrops, gravel deposits, etc.).

Using this background information, a surface survey of the proposed HDD alignment should be taken. This survey includes surface elevations over a 100-ft width along the centerline, surface features (buildings, roads, etc.) and subsurface features (other pipelines, utilities, pilings, etc.). Any areas of contamination should also be delineated. Waterway crossings also require a hydrographic survey indicating water depths. River bed or bank movement should also be investigated. The nearest U.S. Army Corps of Engineers District Office is a good resource for past river meandering and also for predictions of future river movement.

With the surface survey, a preliminary HDD profile can be constructed. HDD profiles are a series of straight tangents and long radius arcs. The entry angles are usually between 8 and 16 degrees. The long radius arcs follow a well accepted rule of thumb for steel pipelines of 100 ft of radius per inch of pipeline diameter (i.e. a 3,000-ft radius for a 30-in. diameter pipeline). The exit angle is usually between 5 and 12 degrees. The depth of cover under the river bed should be 20 to 25 ft or more if future scour or channel movement is anticipated.

Final Considerations

To finalize the HDD profile design, a site-specific soil boring program is strongly recommended. The depth of the borings is dictated by the preliminary HDD profile, borings should extend to the profile’s deepest sections with an additional 20 ft. The number of borings, and their horizontal spacing, depends on the complexity of the local geology and the quality of access along the HDD alignment. There should be a sufficient number of borings to be able to draw a reasonable conclusion of the soil materials to be encountered. A formal report should be prepared of the geotechnical investigation and laboratory analysis.

Special consideration should be given to the pipe wall thickness and steel grade for a HDD installation. Larger diameter pipelines...
(greater than 24-in. diameter) can actually be buoyant in the drilling fluid. This can increase pull forces. In many HDD applications, a thicker wall pipe should be considered. The thicker wall is also an allowance for corrosion — it is difficult to “dig up” a HDD installation for pipe repairs (especially under a waterway). There are several vendors providing software to estimate anticipated pulling loads and resulting pipe stresses. The calculation of installation loads is very important. If you are not familiar or experienced with the methods, HDD design professionals can be of assistance. Pipe coaters have a variety of suitable coatings for HDD installations. For HDD installations, the coating should be smooth, free of upsets, and resistant to damage while being pulled into the drilled hole.

The biggest environmental impact from HDD is most often considered to be the use of the slurry or “drilling mud.” In spite of the name, mud is an engineered fluid and a key contributor to a successful HDD installation. The properties of the drilling mud are monitored and adjusted to most efficiently carry cuttings from the drilled hole, stabilize the drilled hole and provide lubricity for the drilling tools and pipeline during pullback. Large volumes of drilling mud are circulated downhole and usually flow back to surface pits near the entry and exit work locations. There the drilling mud is cleaned of cuttings and circulated again downhole. For most HDD installations, the drilling mud is a mixture of fresh water (approximately 95 percent) and Wyoming bentonite. Bentonite is a special clay that acts as a viscosifier.
Bentonite is chemically inert and is also used to drill water wells. Other benign polymers are often used to enhance the engineering properties of the drilling mud.

An all too common event during HDD is the inadvertent surface release (frac-outs) of drilling mud along the HDD alignment. This can be caused by a variety of reasons; such as fluid pressures in the drilled hole exceeding the soil’s strength to contain it, preexisting fractures in the soil or rock, or where ground has been previously disturbed (previous excavations, piling, etc.). There are methods to analyze soils for strength to withstand calculated pressures in the drilled hole. However, when soil conditions vary, the strength analysis becomes frayed. Tools which measure actual pressures in the drilled hole have proven helpful in preventing some inadvertent releases, but the tools do not eliminate the events.

Even with the potential for inadvertent release of drilling mud, HDD still has far less environmental impact than other methods. During the permitting phase of the project, a plan for containment and clean-up of inadvertent release should be put in place. In many cases, moving in vehicles, pumps or equipment for containment efforts may have a worse impact than leaving the bentonite slurry in place. Each containment and clean-up plan will be very site specific.

Following pipeline pullback, there are usually large quantities of drilling mud and cuttings. Again during the permit phase, it is necessary to pull together a disposal plan. These materials are frequently “land farmed”. With the agreement of a nearby property owner, the material is dumped, spread and allowed to dry. The materials can also be disposed at local landfills. Whatever the disposal method, records should be kept of quantities and any material testing required by the property owner.

If you are new to HDD, there are plenty of publications which can be of great help. The American Society of Civil Engineers (ASCE) has issued the “Manual of Practice 108 — Pipeline Design for Installation by Horizontal Directional Drilling.” This publication is an excellent guideline for engineering and construction considerations and many planning issues are addressed in great detail. You should also contact HDD contractors early in the process so that their experience and expertise can enhance the overall planning. There are also many HDD design professionals available who add value to almost any HDD installation. This issue of Trenchless Technology and North American Pipelines features stories and information about many of these companies.

Eric Skonberg is principal engineer with Trenchless Engineering Corp. and a member of North American Pipelines Editorial Advisory Board.

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Most of the shorter horizontal directional drilling (HDD) bores take place in urban areas where the benefits of this trenchless method are most apparent: relatively small footprint for the equipment, limited disturbance to traffic and commerce, fast and economic installation and almost negligible restoration.

These same urban areas are crowded both above ground and below. The existing utilities and underground infrastructure can sometimes make it difficult to navigate the pilot bore. It is therefore important to do some project planning prior to showing up on the jobsite. Calling 811 will route you to your local one-call center and ensure that utilities in the area of your installation will be located and marked. Once utilities have been located, you may have to modify the planned bore path based on adjacent utilities or other obstructions. Although a rod by rod plan that details desired depth and pitch is preferable, at the least, entry and exit angles and critical depths along the bore path should be identified prior to starting the pilot bore.

Adjacent utilities and structures can cause two kinds of interference, active and passive. Active interference can be defined as “anything that emits a signal or generates its own magnetic field.” That being said, all things electrical emit a magnetic field. Some examples of active interference include power lines, traffic loops, fiber-optic trace lines and invisible dog fences. Some of the possible effects of active interference on a
receiver include erratic signal strength and depth readings, loss of pitch and roll data and inaccurate calibration, which may lead to depth errors.

Passive interference as the name implies does not generate a signal. It could be defined as “anything that blocks, absorbs or distorts a magnetic field.” Examples include metal structures such as chain link fences, rebar and salt water, to name a few. Anything that is conductive has the potential to act as a passive interference. Possible effects include depths appearing greater (or in some cases shallower) than they actually are, incorrect drill head location and direction, all information being blocked and incorrect calibration, which may lead to depth errors.

The presence of active interference can be detected by using the locating system you plan to employ during the pilot bore of your installation. The higher the signal registered on the receiver, the greater the interference. Some locating systems have the capability to use multiple frequencies. Switch between the frequencies in the receiver to determine which frequency registers the lowest signal. Once it has been determined which frequency is least affected by interference, an additional test can be used to evaluate the effects of the interference. Let’s assume that the planned depth for this particular bore is 15 ft. At this depth the receiver will see a pitch/roll signal from the transmitter in the ground at a given signal strength. The question now becomes, is this signal powerful enough to overcome the interference? One way to find out is as follows: Insert batteries in the transmitter of the chosen frequency and place the receiver on the bore path. Move the transmitter 15 ft off to the side of the receiver and check a few roll positions on the transmitter. If the pitch and roll information is not affected during this test, it is reasonable to assume limited problems during the bore. Although this test is quite effective, it cannot always pick up all potential problems.

Having frequency options is very beneficial since it increases the likelihood of being able to select a usable frequency that is only marginally affected by local interference. If multiple frequencies are not an option, transmitters with a greater depth rating, which equates with a greater signal strength, may be required to overcome the interference.

Passive interference cannot be detected by the above test, but the best solution is typically a very low frequency transmitter. The lower the transmitter frequency, the less the effects on the signal are. Therefore, having a locating system that supports a low frequency is often the only reasonable solution. In the case of passive interference, a higher powered transmitter will typically only make the problem worse.

Once the pilot bore commences, there are a number of locating issues that could potentially arise.

There may be areas where there are obstacles on the bore path or where streets with traffic have to be crossed. Both of those make traditional locating difficult. Remote or target steering is a locating method whereby the receiver is placed ahead of the drillhead by 30 to 40 ft and it becomes the target for the drillhead. This allows for circumventing of obstacles along the bore path. The target depth is programmed into the receiver and information on direction, depth, roll and pitch of the drillhead is transmitted to the drill rig based remote. This allows the rig operator to guide the drillhead to the receiver without any walk-over locating. This is an especially efficient way to cross streets as it eliminates most of the risk to locating personnel due to traffic. Another situation might require the receiver to be raised off the ground to minimize the effects of interference or to change the transmitter’s frequency down hole for optimum performance.

Since the conduit being installed is an addition to an already crowded underground, documentation of its placement is important as it allows for easier locating of the line later on. This can either be done by keeping good manual drill logs or by using data logging capabilities available with some locating systems. In this manner, all the data required to plot the bore profile is logged during the pilot bore and stored in a file on the receiver. After the pilot bore is complete, this data can be downloaded to create as-built documentation for the owner of the utility being installed, as well as for future reference.

Planning and proper understanding of jobsite conditions are paramount to a successful HDD installation. Once the pilot bore is under way, having a locating system that is flexible enough in terms of its capabilities to handle some of the invariable surprises found in the underground is your best option for a successful installation.

Siggi Finnsson is product manager at Digital Control Inc.

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The Trenchless Technology Road Shows connect municipalities, engineering firms, utility contractors and suppliers with the products, tools and services for the trenchless installation and rehabilitation of sewer collection systems and water distribution pipelines. This is a must-attend event for anyone in the trenchless industry.

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For a project where directional drilling may not be the best option, pilot-tube microtunneling — a hybrid of auger boring, directional drilling and microtunneling — can work. Because of its ability to install small-diameter pipes with a high degree of line and grade accuracy, pilot-tube microtunneling (also referred to as guided boring) has grown in popularity in recent years.

That’s what the Metropolitan St. Louis Sewer District (MSD) found out when it had to consider another trenchless approach for installation of gravity flow sewer lines. Upon further evaluation, pilot-tube microtunneling was the only method of installation that met all of the demands of the Black Creek Sanitary Relief Sewer project.

The demands of this project weren’t all that different than the requests system designers hear on a regular basis:
- maintain safe, pleasant ingress and egress
- limit the loss of parking spaces during the construction
- protect and maintain underground power, communications, water and gas utilities
- protect trees, landscaping, sidewalks and signage as much as possible, and
- minimize dust and debris

These demands were driven by a property owner who also represented an important community resource — a large regional mall. Other concerns on the site included a delivery truck and emergency vehicle access tunnel to avoid, multiple crossings under existing RCP storm sewers and a concern about the depth to rock and other undesirable materials for a pilot tube project.

Horner & Shifrin (H&S) worked closely with MSD to design the Black Creek Sanitary Relief Sewer, which included approximately 46 ft of 8-in. and 1,900 ft of 18-in. vitrified clay jacking pipe. Numerous design meetings and brainstorming sessions were instrumental in building a team that successfully reduced construction costs, enhanced schedule coordination, minimized contractor claims and improved the technical quality of the contract documents.

A thorough subsurface investigation was carried out in the design phase to identify the geologic conditions that would be encountered along the sewer alignment and their influence on the design and construction of the project. Subsurface investigations were performed by Geotechnology, Inc. of St. Louis, Mo. A total of 17 borings were drilled along the alignment of the proposed sewer. One at each proposed jacking/receiving shaft and a maximum spacing of about 200 ft between borings. Generally the soil along the sewer alignment was comprised of fill, silty clay, shaley clay and clay.

“If I were to offer a general recommendation to engineers or cities considering undertaking a PTMT project, I’d strongly recommend that you take the old carpenter’s adage to heart,” said Ed Sewing, design engineer for Horner & Shifrin. “Measure twice and cut once. Only in this case that means make sure you thoroughly understand the soil conditions you’ll be operating in. Good geotechnical information is critical when doing any kind of trenchless work.”
The final selection of pilot-tube microtunneling as the installation method was driven by smaller construction staging footprint requirements and smaller jacking and receiving shafts, all facilitated by the diameter of pipe to be installed.

“This project was a great illustration of how things should be done," according to Jeff Boschert of the National Clay Pipe Institute. “The owner, designer and contractor all appreciated the importance of planning as a critical element in the success of the overall project. If I were to make one recommendation to an owner considering a pilot-tube microtunneling project it would be to emulate this planning and teamwork approach.”

Two different pilot-tube microtunneling installation methods were used on this project — one for each diameter of pipe installed. The first two steps were the same for both methods.

**Step 1: Install the 4-in. pilot tubes on line and on grade.**

During this installation, soil was displaced by the slant-faced steering head on the tip and no spoil was removed. The pilot tubes were then directed on line and grade by rotation during advancement. The hollow stem of the pilot tubes provide an optical path for the camera to view the LED target housed inside the steering head. This target also displayed the head position and steering orientation. This established the center-line of the new sewer installation; the remaining steps follow this path. Once the pilot tubes reached the reception shaft, the theodolite target, video camera and monitor (guidance system) were no longer needed and were removed from the jacking pit.

**Step 2: Follow the pilot tubes with a reaming head.**

The front of an 11-in. reaming head was attached to the last pilot tube in the same manner the pilot tubes fasten to each other. The remaining pilot tubes and the reaming head were then advanced using 11-in. (OD) thrust (auger) casings, which transported the spoil to the jacking shaft for removal. The contractor removed the spoil conventionally using a muck bucket, but a vacuum method is sometimes a good alternative. During the installation of the auger casings, the pilot tubes were dismantled and removed as they were advanced into the receiving shaft. This step was completed when the reamer and auger casings reached the reception shaft and all spoil was removed from the bore.
Method 1
This method was used on the part of the project that included 8-in. diameter pipe.

Step 3: Install pipe.
The jacking pipe was used to advance the auger casings into the jacking shaft where the casings were uncoupled and removed one-by-one. There was no spoil removed in this step since the pipe had the same outside diameter as the auger casings.

Method 2
This method was used for all the 18-in. diameter pipe on this project and is the newest innovation to pilot tube installation.

Step 3: A powered cutterhead (PCH) is installed behind the auger casings advanced by the product pipe.
The cutterhead increased the diameter of the bore to match the outside diameter of the larger pipe. The remaining soil around the previously installed 11-in. auger casings (Step 2) was taken into the PCH and discharged via the reception shaft by reversing the auger flight direction. The final product pipe was then installed directly behind the PCH. As each section of auger casing was removed from the reception shaft, a section of pipe was installed in the launch shaft. This step was completed when the PCH entered the reception shaft.
The outside diameter of the PCH matched the OD of the vitrified clay jacking-pipe. There are two hydraulic motors housed in this particular PCH; the first to drive the auger flights and the second to drive the rotating cutterface. Housed inside the cutterface are three jetting ports connected by one hose for water distribution to keep the face clean and ease spoil transport. Lubrication ports keep jetting pressures down and were located in the rear of the machine connected by a single hose.
A total of seven hoses (four hydraulic, one for lubrication, one for jetting and one from a check valve) ran through the pipe to the PCH unit. Staging the pipe at the surface with the hoses installed before the start of this step was crucial to production times.

Conclusion
This project was delivered on time and on target. The pipe was installed on a 0.5 percent grade. Even with the
longest drive at 280 ft, the greatest deviation from the exact target, both horizontally and vertically, was less than ¼ in. The success of this project demonstrates why pilot-tube microtunneling can be a viable or even preferred method for trenchless installation of gravity sewers.

The considerations that drive a decision to undertake a pilot-tube project are generally the same goals communities always plan to achieve:
- High levels of worker safety
- Minimal disruption to the community
- Reduced requirements for site restoration
- Maximization of long-term value to the community

The selection of pilot-tube installation methods is becoming more common as added emphasis is placed on the social costs of traditional open-cut construction. The inconveniences, business disruptions and property destruction, as well as engineering, environmental and safety issues involved with open-trench sewer construction, are beginning to challenge the practicality of open-cut in urban areas. Pilot-tube microtunneling technology virtually eliminates the social costs of open-cut trenching and reduces basic construction costs in congested urban settings.

Some of the other important considerations when considering a pilot tube project include:
- Low equipment costs.
- Small topside footprint, small jacking pits and minimal surface disruption.
- No need for slurry separation tanks.
- Serious reduction in the amount of excavated material to be stockpiled or removed.
- Elimination of bedding. No materials purchase, no stockpiling and no trucking it in.
- Minimization of problems in contaminated soils as soil is not removed with a slurry.
- Eliminates the need to dewater an open-cut pipe trench. Significantly reduces the risk of collapse/settlement to surrounding structures and roads.
- Pipe movement/settlement from soil disturbance in an open trench and in the surrounding pipe zone is eliminated by tunneling.

This particular project used No-Dig pipe from Mission Clay. “Vitrified clay jacking pipe is well suited to this application,” Boschert said. “Its compressive strength is unmatched and no other pipe material can reasonably challenge the life-cycle offered by clay pipe.”

This article is abridged from a white paper on this project by Ed Sewing, Horner & Shifrin, Mike Luth, Luth & Sons, and Jeff Boschert, National Clay Pipe Institute.
If horizontal directional drillers were asked to describe their drilling fluid, the most likely word out of their mouths would be “mud.”

The slang term “mud” typically refers to a sodium bentonite-based drilling fluid. Bentonite, however, is just one of several drilling fluids that have been adapted for use within the horizontal directional drilling industry. Due to emergent technology by tooling manufacturers, the popularity of “soap” as drilling fluids has increased greatly over the past 10 years. The slang term “soap” typically refers to drilling foam or surfactant-based drilling fluid. Like bentonite fluids, drilling foams have a number of practical applications and a host of additives to improve function.

In order to compare bentonite and drilling foam, one must first understand the properties that make up a good drilling fluid. The single-most important function of a drilling fluid is to facilitate cuttings removal. When the drilling fluid transports the cuttings out of the borehole correctly, the operator will experience greater borehole stability, cutting returns and dramatically reduced pullback pressures. Two properties aid in the removal of cuttings, the first of which is velocity. Velocity of the drilling fluid in the borehole helps to suspend the cuttings and transport them to the surface.

One can compare the velocity of drilling fluid to that of a flowing river transporting silt and sand. However, the fluid in the borehole is not always moving (e.g. changing rods, equipment failure, etc.). It is during these times that it becomes important to maintain the suspension qualities of the fluid even when static. This characteristic is “gel strength.” If a given fluid does not have enough gel strength to support the cuttings, one risks loss of flow, frac-outs, increased pullback pressure and the possibility of getting stuck.

The second function of a drilling fluid is to maintain borehole stability. This is especially important in unconsolidated and loose formations. Hydrostatic head pressure exerts force on the borehole walls helping to increase stability. Viscosity also increases borehole stability and helps to decrease fluid loss. Viscosity is a measure of the resistance to flow or the thickness of a fluid.

Finally, an important but sometimes overlooked property is that the drilling fluid cools and lubricates the bit. This improves penetration rate and reduces wear on the cutting face and drill rods. If one is drilling with a locator sonde it is extremely important to keep temperatures low to avoid burning up the unit. Drilling fluid plays an important role in cooling the sonde and the drill steel.

As a non-Newtonian fluid, bentonite encompasses all of these basic principles. By nature, bentonite has the ability to achieve gel strength — higher gel strengths can be achieved with additives. Whether you are drilling in reactive or non-reactive soils, consolidated or unconsolidated soils, bentonite is quite universal. Throughout the years, drilling fluid manufacturers have produced a number of additives to tackle just about any geological formation. However, hard rock and very dense soils have always presented a challenge for bentonite. The added time and tooling wear seem to be the biggest concern amongst drillers operating in these conditions.

Technological advances from both tooling and drilling fluid manufacturers have helped increase the popularity of foam drilling. Foam and downhole hammers are being used successfully in a vast number of applications involving drilling hard rock, shale, caliche and other very dense formations. This type of drilling greatly increases penetration rate when compared to the typical mud motor setup. Unlike your typical dish soap, these foams have very small dense bubbles that resemble a thick shaving cream. Foams have the capability of suspending and transport-
ing the suspended rock fragments out of the borehole. Drilling fluid manufacturers may also recommend the addition of Partially Hydrolyzed Polyacrylamide (PHPA) and Polyanionic Cellulose (PAC) polymers to the drilling foam. This helps to coat any reactive soils such as swelling clay. In addition, the long polymer chains increase foam stability and stiffness, which in turn increases the carrying capacity.

Thought of in the same context as bentonite-based drilling fluid, drilling foams do little to control borehole stability. Applied in rock, however, the concern of collapse is quite minimal and in less than consolidated rock drilling foam provides stability in other ways. In situations of varying geology, drilling foam can be combined with bentonite and polymers to produce a stiff drilling foam that also creates a filter cake to help control zones of unconsolidated soils. This combination of products will allow for greater drilling versatility and increase borehole stability. Although drilling foam exhibits gel strength and viscosity, these attributes are impossible to measure using standard API testing. Therefore, it is important to follow the manufacturer’s guidelines when beginning a drilling foam project. It is also critical to take note and watch the cuttings coming out of the borehole. This will help confirm that the viscosity, gel strength and velocity are in line with what is required. Finally, foam is an excellent means of lubricating and controlling temperatures associated with the cutting face without reducing penetration rate. This increases the time and efficiency of the drilling operation.

Disposing of bentonite can often be difficult, especially in urban areas. Unlike disposing of bentonite, drilling foam can easily be broken down with a defoamer or an anti-foaming agent. This defoamer or anti-foaming agent can be sprayed into the pit and will almost instantly dissolve the drilling foam after it exits the borehole. There are many types of drilling foam on the market today. Most are completely non-hazardous and some even exhibit the NSF/ANSI Standard 60 certification (National Sanitation Foundation/American National Standards Institute). Picking the right type of drilling foam for your horizontal directional drilling project is important. Also make certain you have the right size air compressor to match your drilling foam and borehole size. Your local drilling fluid representative should be able to assist you in finding the right product and calculating the cubic feet per minute (cfm) you will need for that particular drilling foam.

Whether you are drilling with foam, bentonite or a combination of the two products, it is essential to match the drilling fluid to the subsurface conditions. As foam drilling continues to grow in popularity, expect to see new technologies to emerge, which will remove some of the geology and mixing restrictions.

Wesley Gibson is a regional manager for CETCO.
Over the past few years, horizontal directional drilling (HDD) has been completing larger diameter — greater than 36 in. — and longer length — longer than 5,000 ft — installations. The complexity and challenges associated with these installations are much greater, since issues that are easily dealt with or overcome on smaller diameter and shorter installations can produce significant challenges on larger diameter and longer length installations. These challenges are commonly associated with exposing a greater surface area within the bore, ability to properly condition the bore, and ability to maintain stability over a longer duration prior to installing the product pipe.

Large diameter and long-length HDD installations place a greater emphasis on proper planning, design and construction, including risk management. Identifying and managing site- and installation-specific risks are critical to successful completion. The focus during the planning stage should consist of identifying and characterizing high-risk geologic materials and collection of data to develop strategies to avoid or minimize contact with these materials (developed later during the design phase).

Geotechnical investigations should be completed to properly characterize the anticipated subsurface conditions to allow placement of an HDD installation within more favorable geologic materials. High-risk materials, such as soils with a very high percentage of gravel and larger sized particles, should be avoided if possible, whether planning a large or smaller diameter project. However, large diameter installations expose a much larger surface area increasing the potential for these materials to collapse into the bore. If these materials are present, the HDD installation should be designed as steep as possible through these materials to allow gravity to assist in keeping the bore stable rather than working against it. However, this not a panacea and consideration should also be given to the use of a steel conductor casing to help support these materials and prevent their collapse into the HDD bore.

The design phase for a large diameter or long-length HDD installation should focus on managing and mitigating risks as they are identified. Experience has demonstrated that application of systematic risk management procedures, starting in the project planning phases and continuing through design and construction, is particularly important to secure the best practice for the minimization and management of risks. Key steps in the risk assessment process include:

- Identifying and cataloguing risks and their causes within a “risk register” as the project progresses.
- Assessing the probability of occurrence and consequence for each identified risk.
- Development of mitigation measures or actions that may reduce or avoid an identified risk.
- Identifying project alternatives that offer the most tolerable risks, given all foregoing considerations.
- Having identified and evaluated the risks, they can be managed by:
  - Re-evaluating design concepts and developing risk-reducing mitigation measures that can be incorporated into the design.
  - Introducing procedures to monitor risks with predefined contingency plans for all eventualities.
  - Applying risks to third parties via insurance or contract clauses, as appropriate, and
  - Accepting risks and implementing contingencies.

Considerations for Large Diameter or Long Length HDD Installations

By Glenn M. Duyvestyn, Ph.D., P.E., P.Eng
Risk registers are living documents and should be continuously updated throughout the project life cycle for both previously and newly identified hazards to ensure that the adopted risk response strategies continue to be valid. This approach also ensures that secondary risks that may arise out of adopted risk response strategies are properly managed. Ultimately the risk register should indicate how each risk was dealt with and should indicate how/where in the Contract Documents the risk was handled and who was responsible for implementing the mitigation measure(s).

The use of a risk register is now commonplace on large diameter tunnel installations and becoming much more prevalent for HDD installations. This is especially true within the gas pipeline industry, where the majority of large diameter and/or long length installations are completed to avoid environmentally sensitive areas and reduce the environmental impacts associated with more traditional open cut construction techniques. For these installations, experience is one of the key factors for success, both in design and construction.

Hydraulic fracturing (commonly referred to as hydrofracturing) tends to represent the biggest risk to an HDD installation and is associated with loss of drilling fluids into the surrounding soil mass in response to high induced bore slurry fluid pressures that exceed the resisting strength of the overlying soils. Hydraulic fracturing can occur when a bore is designed with insufficient depth of cover where the overlying soil/bedrock materials do not provide sufficient resistance against the installation-induced fluid pressure within the bore. When this occurs, the slurry creates its own pathway away from the bore through the overlying soils and rock. Aside from the environmental issues associated with loss of drilling fluids to the surrounding environment, a hydraulic fracture event also can significantly reduce the ability to convey drilling fluid flow to the HDD entry or exit locations decreasing the ability to properly maintain bore stability and condition the bore and remove a sufficient volume of cuttings to allow proper installation of the product pipe.

One mitigation consideration that has proven to work well for long installations in lowering the required installation-induced down-hole fluid pressure associated with drilling fluid flow (and hence hydraulic fracture potential) is requiring the use of the “drill and intersect” construction method. This method involves using drill rigs setup on both ends of an HDD installation to drill the individual pilot bores toward each other intersecting in an identified target zone in the middle of an installation. The advantage of this method is that the flow path length for fluid flow is significantly decreased in comparison to the situation where a single HDD rig drills the entire bore. Experienced drilling personnel, appropriately sized drilling equipment, advanced tracking systems and properly prepared work plans are critical to the successful completion of this type of installation.

The use of the drill and intersect method is not restricted to long length installations, as this method is also effective for installations where conductor casings are required on either end of an HDD installation to support near-surface geologic materials that are not considered amenable to an HDD installation. Here, the use of the drill and intersect method is preferred as it is easier to install conductor casings on each end of an alignment with individual drill rigs initiating their respective pilot bores out of these casings, as opposed to trying to track and steer a drill bit into a pre-installed conductor casing on the far end of an alignment.

Proper planning is not limited to the design, as it is also essential for the HDD contractor prior to and during construction. It is becoming more common to maintain a risk register during construction. While the designer’s risk register should have dealt with risk to the extent possible, residual or different risks are possible during construction and the use of a risk register maintained by the contractor (with input from the owner and designer) during construction can help when developing and reviewing method statements. Shortcuts, common to smaller and shorter installations, may inadvertently increase construction risks for larger and/or longer installations and should be avoided. Contractor work plans should be fully developed, detailing the equipment, materials, and procedures to be employed for a specific project. This plan should also contain site-specific contingency plans developed by experienced personnel to address assigned construction risks. The work and contingency plans should be evaluated and compared to the risk register to assess whether the risk response strategies are appropriate and properly managed. This effort should be continued throughout the construction process.

Through improvements in technology and contractor experience, HDD will continue to increase the achievable installation diameter and/or length. Proper planning, design and construction is critical to keep up with these changes and ultimately, a project’s success will be a function of properly characterizing the installation risks and developing appropriate mitigation measures to manage the identified risks.

Glenn M. Duyvestyn, Ph.D., P.E., P.Eng., is an associate and principal project engineer for Hatch Mott MacDonald.
This HDD project was a 1,460-m crossing of the Grand Canal du Le Havre undertaken between 2008 and 2009. The pipeline was commissioned by Total to supply crude oil to a local refinery and the drilling contractor was Horizontal Drilling International SA (HDI), a French HDD company with the experience and the drilling rigs capable of installing such crossings. The intersect guidance contractor was Prime Horizontal Ltd., the company that originally developed the guidance methodology for HDD intersects.

The installation involved two parallel pipes, a 6-in. mud return line and the main product of 34-in. steel pipe. The crossing passed under an island about midway between the entry and exit points separating the Grand Canal from the sea channel. This island was convenient for locating one of the magnetic sources, the AC Beacon, to help guide the first pilot hole. Installation of the crude oil product pipe was finished shortly after completion of the two pilot holes, on time and on schedule with a minimum of drilling problems.

There are a number of reasons that a project is designed to use intersect technology. For example, intersects are now used for extended reach crossings, for relief in pressure sensitive formations and for casing-to-casing crossings, such as in this project. The formation was predominately clay with a 10-m layer of flintstone and gravel above the bedrock starting at a depth of approximately 25 m. The hole containing the 34-in. steel product pipe was cased because of this flintstone layer. Casing of 66 in. was used since this was the diameter of the pre-installed casing on both sides of the planned crossing.

The purpose of the casing was to keep the ground open around this section and to avoid unnecessary dog-legs when drilling pilot holes through this formation.

Based on the collaborative planning undertaken for this project with the final client and subcontractors, it was decided to use an underground intersect instead of a conventional crossing. This article discusses the intersect methodology and the guidance of this intersect with several different magnetic sources to create magnetic fields sensed by the ParaTrack II Steering Tool for computing the positions of the drill bits along the planned track of the crossing. These sources consisted of the surface coil, the underground coil, the AC Beacon and the Rotating Magnet Ranging Source (RMRS).

The choice of the optimum magnetic source for a given crossing is a function of magnetic signal-to-noise ratio and depends strongly on the range from the magnetic source to the steering tool, on any magnetic noise along the track of the crossing and on the intrinsic magnetic signal strength of the deployed source. The sources all have different specifications and, in pre-project planning, the selection of sources is made to match the choice of source to the geological and geographical parameters of the project.

**Magnetic Source — Surface and Underground Coils**

The surface coil is the most used tracking method for magnetic steering tools. An insulated electrical cable is placed on the ground over, or close to, the planned bore line. The position of this cable is then measured using land survey techniques and a known electrical current is passed through it, which generates an electromagnetic field of a known strength and frequency. The strength of this field and its direction is measured by the downhole steering tool that, when combined with the known position of the cable, gives a measured position relative to the coordinate system being used during the pilot hole process. The use of alternating current (AC) gives much more sensitivity and accuracy than does the use of direct current (DC).

Shown in Figure 2 is a surface coil when it is not feasible for one coil to be laid across the body of water as, for example, across a shipping lane or across a harbor that is too wide for one coil. In this case, two coils are installed,
one on each side of the crossing as shown. This is the coil geometry used in the Le Havre project for guidance of the initial pilot hole.

The underground coil is simply a surface coil placed inside an existing parallel pipeline near or at the water bottom. This enables close range tracking for the entire pilot hole resulting in high magnetic signal strengths and very high accuracy. This geometry was used in the Le Havre Project to guide the pilot hole for the 34-in. product pipe. The geometry of the underground coil is shown schematically in Figure 3 where the underground coil was installed inside the 6-in. pilot hole.

**Magnetic Source — AC Beacon**

In the case where the crossing is too long for the surface coils of Figure 2 to give good signal strength across the entire range of the crossing, the AC Beacon may be used to extend the range beyond the extent of the coils. For this project, the AC Beacon was placed on an island almost midway between the entry and exit points of the crossing to allow more accuracy for location of the 6-in. pilot hole. The AC Beacon, shown in Figure 4, is a small...
apparatus (approximately 1.2 m by 1.2 m), which generates an AC electromagnetic (EM) field with two large solenoids. These are mounted on top of the beacon perpendicular to each other, thus generating EM fields along two axes, which enable the magnetic steering tool to uniquely measure its location. Generally, the AC Beacon can track the pilot hole location about 75 m in front and 75 m behind the beacon. For extended range crossings, it is often feasible to use several AC Beacons deployed like a chain of pearls to extend the range of guidance across the entire crossing.

### Magnetic source — Rotating Magnet

When planning an intersect, detailed and accurate ranging within a tolerance of several centimeters...
between the two drill strings is of paramount importance. For this project, the RMR5, as shown in Figure 5, was chosen since it is based on the use of the rotating movement of the mud motor to create the rotating magnetic signature. A magnetic field is generated by rare earth magnets placed in the Rotating Magnet sub between the bit and the mud motor. As the bit rotates, the rare earth magnets spin and the magnet sub generates an AC magnetic field which is measured by the steering tool in the other drill string.

Overview of Intersect Methodology of the Le Havre Project

The project was completed in two parts: (1) Installation of the 6-in. pilot hole, and (2) Installation of the main product pipe in the second pilot hole. Table 1 shows where multiple magnetic sources fit into the order of operations of the project to successfully complete the underground intersect for the pipeline.

The Intersection Region

Drilling from both sides using the guidance coil source proceeded until the region of the planned intersect was reached. At that point, the Rotating Magnet Source was placed in one of the drill strings and used for final guidance to the intersection. Once the drill strings overlapped in the intersect area as shown in Figure 6, then detailed and accurate positions were measured in the form of pass-bys with the rotating magnet source. Once the intersection was completed, an underground bit touch was performed to confirm that the intersection was successful, and also to confirm the exact measured depth of the pilot hole.

The timely completion of this intersection with a minimum of problems was due to the thorough planning of the pilot holes, the use of good intersect procedure and the use of the various magnetic sources available for the crossing. The final success of this challenging enterprise was made possible thanks to the excellent collaboration between the various teams, from Total to HDI to Prime Horizontal.

Daniel Billig is Europe operations manager and Thomas Teer, Ph.D., is marketing director for Prime Horizontal Ltd.

Figure 6, the intersection region.
Historically, the word “utilities” was considered a four letter word to many engineers, designers and contractors simply because conflicts with buried utilities accounted for the majority of the cost and scheduling over-runs on construction projects. Over the years, this stigma has slowly changed for the better with advancements in technology and the further development of subsurface utility engineering (SUE) and horizontal directional drilling (HDD) processes.

The use of subsurface utility engineering during HDD projects — whether it is during design or the actual construction — has become a normal operating procedure or a requirement for many departments of transportation (DOTs), municipalities and utility owners. This is due to

**Benefits of Using Subsurface Utility Engineering for HDD Projects**

By Robert L. Clemens Jr.
the fact that subsurface utility engineering accurately maps the horizontal and vertical location of underground utilities providing the necessary data to avoid damage to underground facilities. The marriage of HDD and subsurface utility engineering allows a driller to maneuver around existing underground utilities or avoid them all together. This significantly minimizes the risk of a utility strike and, often, eliminating unnecessary utility relocations. Breaking ground can be risky business; knowing what’s underneath the surface and where it is helps to minimize this risk.

Subsurface utility engineering has evolved from a test hole (ASCE Quality Level A) focus to a stronger designating (ASCE Quality Level B) focus and work efforts have gone from 99 percent in the design phase of a project to a three to one ratio of design and construction. This swing is in part due to the cost associated with right of way acquisition and owners doing more within a limited space. This change has lead to more drilling within rights of way by utility owners. The ability to do less with more is also due to the development of a more sophisticated drilling method — HDD. Instead of drilling straight down or at a linear angle, advanced technology allows drill operators to maneuver the head through a maze of utility facilities.

In many states, contacting the one-call system is a required step prior to construction or breaking ground. This valued system has its place providing the “approximate” horizontal location of utilities prior to construction. However, drilling and avoiding the approximate horizontal location of a utility can be hazardous to the driller, the public and any buried facility in the corridor. Because of this, most if not all, HDD installers field verify the utilities to the best of their ability prior to drilling. When subsurface utility engineering is used prior to construction the need for field verification goes away as both the horizontal and vertical component of a buried utility is provided to the contractor or engineer by the subsurface utility engineering provider. When projects used subsurface utility engineering early in the design or construction process, the project plans depict highly accurate utility locations that provide a road map for horizontal directional drilling.

The requirement for completing ASCE Quality Level A subsurface utility engineering prior to starting a horizontal
directional drill has almost become mandatory to reduce risk in many areas around the country. The contractor completing the HDD is financially responsible for any damage to other facilities (drainage, utilities and other equipment) during the drill operation. If during the HDD, a contractor damages a facility, it could actually cause additional damage to other facilities and compromise the structural integrity of a road, highway or vertical structure. This utility damage has the potential to cause voids or fissures and damage to roadways increasing repair costs, all of which becomes the financial responsibility of the contractor or their insurance carrier. Frequent claims to a contractor’s insurance causes an increase in premiums, which makes ASCE Quality Level A subsurface utility engineering (at a minimum) prior to starting a HDD an apparent necessity.

In some states when subsurface utility engineering is not completed or required during the design phase, SUE providers are often called in during construction. This is especially evident on compensable interest projects where the state or owner is paying utility costs. Instead of paying downtime to the contractor, while utility companies decide where they are and why they are in conflict, subsurface utility engineering can be completed to minimize the delays. The same holds true for the HDD effort, if a contractor damages a major utility system then construction operations could be interrupted resulting in work delays/non-budgeted financial costs for the owner.

In today’s economy more than ever, there is an increased need to ensure that damage to buried facilities that result in financial hardship to a contractor, the public, utility owners or engineer is held to a minimum. The benefits of completing subsurface utility engineering during the design or construction of a HDD project has proved time and time again to far outweigh the cost. These savings of time, money and effort are evident in the projects listed below.

An example of a subsurface utility engineering provider’s ability to quickly mobilize resources for a HDD installation in construction is the Ohio DOT West Avenue Emergency Project (PID No. 23062). Cardno TBE provided approximately 500 lf of designating (ASCE Quality Level B) and three test holes (ASCE Quality Level A) on the existing Level 3 Communication’s fiber-optic line within the project limits. This project was already under construction when Cardno TBE began its subsurface utility engineering work. The project contractor needed to know the location of the existing fiber-optic line so a directional sewer bore could be completed. Coordinating with Level 3 Communication, Cardno TBE field crews successfully located the fiber-optic line. A 12-in. diameter, 15-ft PVC pipe was placed in the test hole so the contractor was able to physically see the fiber-optic line during directional boring operations. Because of Cardno TBE’s quick response to this emergency project, the contractor’s downtime was minimal prior to completing the installation.

The utility owners have also used these services. The Ameritech Phone Co. was in its relocation operations in Bloomington for an Indiana DOT project when Cardno TBE was called upon to provide approximately 2,500 lf of designating (ASCE Quality Level B) and eight test holes (ASCE Quality Level A). Cardno TBE placed 12-in. diameter, 8-ft long cardboard cylinders in the test holes so the HDD contractor was able to see the buried phone and fiber-optic lines during construction. With months in between Cardno TBE’s services and highway construction, this helped maintain the integrity of the utility as opposed to traditional PVC piping used on projects where there is a shorter timeframe.

Applied early in the design or construction phase, subsurface utility engineering minimizes risk and saves time and money for all parties involved with HDD projects. The recognized benefits include: time savings for
the HDD installer, a true clear window available for drilling operations, minimized damage to utility facilities and the owner’s ability to continue minimizing his or her right of way acquisition needs. Subsurface utility engineering can also reduce project impacts to construction schedules, the traveling public and business owners within the construction zone.

Robert L. Clemens Jr. is a vice president of Cardno TBE with more than 30 years of experience. He has managed/directed the successful completion of more than 1,400 subsurface utility engineering and utility coordination projects of various size and scope in nearly 25 states.

Subsurface utility engineering provides a roadmap for HDD operators to navigate the maze of current underground facilities.
American Augers: DD-220T Track Mounted Directional Drill

American Augers continues to revolutionize horizontal directional drilling with the newly re-designed DD-220T. Engineered for modular Tier 3/Tier 4 Cummins power, the DD-220T features a touch screen display, is remote data-acquisition capable, includes the exclusive Quiet Pak noise reduction system and is Europe legal. For increased power and strength, the DD-220T provides 30,000 ft lbs of rotary torque and 220,000 lbs (thrust/pullback. Optional equipment with the DD-220T includes a knuckle boom crane, ISO-style driller’s cabin and a microprocessor controlled operator’s console.

Look to American Augers for an experienced manufacturer that continues to provide reliable, field-tested and versatile systems that exceed expectations on every jobsite.

Century Products: Hole Openers

Century Products introduces the new 20-in. Century Hole Opener. Century now offers custom designed Hole Openers from 20 to 60 inches with four different bearing sizes to choose from – 12.5-in., 16-in., 22-in. and 26-in.. Three different cutting structures are available incorporating TCI Conical and Chisel Profiles as well as Milled Tooth. Working closely with the customer, Century’s engineers review job parameters to ensure the best bit selection for the formation to be encountered.

This new Hole Opener incorporates all of the same design features as previous ones. The integrity advantage of Century’s solid body design along with built-in stabilization features results in a well-balanced tool machined to exacting tolerances. A rebuildable design allows for multiple cutting structures to be inserted into one body, transforming an otherwise disposable piece of equipment into an asset.

Customers can expect two to three times the ROP of off-the-shelf, non-customized products when they use Century’s Engineering expertise and state-of-the art 3D modeling system to design their unique drilling solution. Through innovative advancements, Century continually strives to optimize drilling performance while lowering the cost per foot for customers.

Ditch Witch: JT100 All-Terrain Drill

With 100,000 lbs of pullback and 12,000 ft-lbs of torque, the JT100 All Terrain is built for extended-range bores and installations of large-diameter pipe. The machine’s 268-hp engine delivers more raw power more efficiently to all machine functions so the installation can be completed faster. And with its exclusive, patented two-pipe drilling system, the JT100 All Terrain can install pipe in most ground formations, including solid rock. The All Terrain system has a mechanical motor system that is designed to transfer more power to the bit than any other rock-drilling system in its class. Its unique shaft-within-a-pipe design features a strong, hex-shaped rod that turns inside an outer pipe.

Melfred Borzall: Hedgehog Reamer

Melfred Borzall delivers with its new Hedgehog Reamer. The compact design from front to back makes the Hedgehog highly maneuverable in tight situations and features more carbide cutters per square inch that any other reamer in its class. A tapered blade design, combined with the cutters, provides smooth, efficient cutting action. The carbide cutters are brazed onto a block, the same design used on the highly successful UltraBit Blade series. The Hedgehog is designed so that in the event the carbides do wear, it can be rebuilt by Melfred Borzall technicians at a much lower cost than replacing the entire reamer.

The Hedgehog is available in sizes 6 to 20 in. and accommodates rigs from 5,000 to 50,000 lbs. Reamers larger than 8 in. are designed with a ring for strength and stability.

Mud Technology International: MTP-475 Triplex Mud Pump.

The MTP-475 is a single acting triplex piston pump rated at 423 HP in continuous duty services and up to 492 HP in intermittent duty. This versatile pump is offered with a variety of material and design options that make it ideal for general industrial and reverse osmosis.

The MTP-475 is equipped with a triple runner oilfield style skid with lifting bars on each end, heavy-duty electric start system and a 120 psi air system with an air volume tank on the unit. This mud
pump is rated at 722 gpm at 1050 psi, with a maximum volume of 983 gpm. In addition, it has safety guards and covers and a pressure gauge and adjustable pressure relief valve.

**RADIUS: HDD Tooling**

The Radius line of HDD tools offers many innovative features to contractors on tough bores. Radius rock housing is the only side load housing on the market designed specifically for rock drilling. The patented reduced window allows the Radius rock housing to withstand much greater torque loads than common side load housings. It is so tough in fact, that even mud motor and hammer operators are turning to the Radius housing to make the pilot bore and ensure the safety of their valuable electronics. Besides the quality and durability of all Radius tools, our competitive pricing sets us above our competitors. Call or visit Radius online at www.radiusHDD.com to learn more about the complete Radius line of tools and join the growing number of drillers who have discovered the benefits of running Radius tools.

**StraightLine Mfg.: Swivels**

StraightLine’s new generation of pullback swivels are designed to meet the demands of HDD contractors whose fleets include rigs sized from 5,000 to 120,000-pounds of pullback. Engineered to effi-
ciently handle both thrust and radial loads with ease, “angular contact” bearings are assembled in a stack to provide safe performance at rated load. The bearing stack also includes two bearings positioned in the thrust direction to protect the swivel from excessive forces in pushback. To ensure long life, these swivels are protected by a sealing system that consists of a shaft seal and two lips seals with steel reinforcing rings. This all but eliminates soil and drilling fluid intrusion. Swivels are available in 5-, 10-, 15-, 20-, 30-, 45- & 60-ton sizes with CLEVIS X CLEVIS and BOX X CLEVIS configurations.

Underground Tools Inc.: Sonde Housing

Underground Tools Inc. offers one of the industry’s most comprehensive selections of premium quality directional drilling pipe, as well as HDD tooling. UTI has drill pipe for nearly every make and model of drill rig on the market. UTI’s drill pipe is readily available and made from top quality materials, with careful consideration given to precise threaded connections. In addition, HIWS drill stems Versions I and II are also available through manufacturer-direct distribution at UTI.

Underground Tools’ HDD tooling selection includes a new sonde housing. The 3/4-in. thick access door on the sonde housing provides superior protection for valuable electronics. The housing is as much as 33 percent thicker than comparable units and features a slightly larger body diameter for greater wear resistance and durability.

The housing incorporates a seven-hole Vermeer pattern that is compatible with UTI pilot bits, including UTI Gold Series bits or Vermeer pilot bits. Custom adapters allow the housing to be used with all makes and models of drill rigs.

All UTI products come with exclusive DirtSmart technical service where questions are answered by the industry’s most knowledgeable technical support team.

VACMASTERS: SpoilVac

VACMASTERS SpoilVac systems were the first vacuum systems designed specifically for underground utility applications such as HDD slurry clean-up. SpoilVac systems are built and tailored to meet your specific requirements. You can choose from more than 100 different models including various spoils tank sizes, gas or diesel powered, with or without a high pressure water system, etc.

Designed and manufactured to the highest quality standards, VACMASTERS SpoilVac Systems incorporate many exclusive features including Posi-Seal Manway, a cyclonic filtration system and a forward tank clean-out port.

If you are looking for a vac system to accompany your HDD rigs, look no further! Sold factory-direct, you will not find a better priced HDD vacuum system than our SpoilVac.

Vactor: Full-Size HXX Hydro-Excavator

With so many costs associated with striking a utility, excavating in this environment requires safe digging processes. Vactor Mfg., a trusted name in air conveyance and water and vacuum technology for nearly 50 years, has developed a safer, easy-to-use alternative for contractors for uncovering buried utilities, precision and slot trenching, potholing, water valve box repair and locating of existing fiber optic lines, cables and other utilities. The Vactor HXX Hydro-Excavator is versatile enough to handle potholing, waterline repair, slot trenching, directional drilling, sign and pole installation, pipe and line installation and other large-volume excavation.

This machine provides up to seven hours of continuous operation with the on-board water. Lower water flow results in less operator fatigue and a cleaner, more precise digging process. Other HXX features include a 12 cubic-yard debris tank, a 1,300-gallon single-cell stainless steel water tank and a 320-degree rotating boom. The HXX works on frozen ground in sub-zero temperatures thanks to heated pump cabinets and a built-in boiler.

Vac-Tron Equipment: Remote Debris Trap for Air Series

New remote debris trap pivots from the rear of Vac-Tron Air Series machines to collect the dry debris during the potholing process, keeping it separate from the main debris tank. After dry potholing, users position the remote pivot arm over the hole to return dry material without having to move the machine. The main debris tank can be used to collect drill slurry or wet materials without contaminating the dry spoils. Gravity feeds materials from the remote trap into drums for storage and/or transportation. The pivot arm also supports the remote suction hose for ease of use.
**Vermeer: Armor Drilling System**

The Armor Drilling System from Vermeer is a single HDD tooling system with multiple drilling options designed to provide versatility and performance, and the integrated modular design allows the tooling to be adapted to various ground conditions.

A unique and patent-pending advanced bit mounting design utilizes a solid pin for bit retention and for ease in bit interchangeability and maintenance. The housing is constructed with dual water ports that deliver up to 50 gpm at 500 psi of mud flow to effectively carry cuttings out of the bore hole.

To eliminate bolts that can vibrate loose during the drilling process, potentially causing electronics to be lost, the sonde lid is designed with a proven roll pin retention feature and is built from heavy-duty materials to minimize distortion caused by flexing.

The sonde isolation/clocking feature is designed for ease of use and provides that the electronics do not engage any metal surface helping to reduce the transfer of vibration in tough drilling conditions.

**Vermeer: R9x12T Drilling Fluid Reclaimer**

Vermeer Corp. has introduced the R9x12T drilling fluid reclaimer, a machine that allows Vermeer to broaden the package (drill, reclaimer and tooling) of trenchless equipment offered to pipeline contractors. The foundation of the R9x12T reclaimer is based on the PowerFlow design with several additional enhancements, including a one-level working deck and space to place a pallet of bentonite near the hopper.

In addition, the Vermeer R9x12T reclaimer features popular industry components that will allow contractors with access to standardized replacement parts, including MCM electric pumps, pump flanges with standard-size values, no-drill cones and clamps, diaphragm pressure gauges and worldwide John Deere engine support. Pipeline contractors will also appreciate the ongoing service and parts support provided by the independent, authorized Vermeer global network of dealerships.

Each shaker is equipped with four vibration-isolating airbags that are manually inflatable via the onboard air compressor. Airbags are highly effective in isolating shaker vibration from the rest of the machine. A generator set enclosure helps protect critical components from the elements, while reducing sound levels; and two entry points provide service and operational access.

**Vermeer: Navigator D20x22FX Series II Flex Angle-Drill**

Vermeer Corp. has introduced two new products designed specifically to assist with geothermal field loop installations. The D20x22FX Series II will be the industry’s first flex-angle drill capable of drilling at any specified angle ranging from 18 to 90 degrees. Engineered with input and feedback from contractors who specialize in geothermal loop system installations, specifically for residential applications, the D20x22FX Series II is another Vermeer product innovation in response to the increasing worldwide focus on renewable energy.

Capable of completing vertical and steep-angle geothermal loop installations, the D20x22FX Series II is also a fully functioning horizontal directional drill that can install horizontal loops as well as conventional utilities. This feature offers exceptional adaptability in meeting varying project specifications.

The Navigator D20x22FX Series II flex-angle drill comes equipped with an automated rod loader that is modeled after a conventional HDD rod loader with modifications to operate at the fully vertical position. This feature eliminates the need to manually handle each rod, enhancing productivity and operator safety. The auto-drill feature allows the operator to set thrust/pullback speed, pressure or rotation modes and revert back to original setting with the simple push of a button.

At only 65 in. in width, the D20x22FX Series II offers greater maneuverability in confined spaces making it an ideal drill for residential vertical loop installations. The machine is self-propelled on rubber tracks controlled from the rear of the machine which help to evenly disperse weight for minimal ground surface disturbance.
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MORE HUSTLE LESS HASSLE

Today's FTTP and short bores have a variety of challenges such as tough conditions, tight bore paths and competitive pricing. Contractors know that profitability requires good bores made quickly.

The Radius Hot-Shot pull back adapter has become so popular with HDD contractors on the 9K-12K machines, the patent pending feature is now available on 12K - 20K rigs as well as the 20K - 40K size drills.

While every bore on mid-size rigs might not require the Hot Shot feature, when the need arises for a pilot hole pull, the crew will appreciate the quick and simple pull back connection while you see a quicker completion to the project.

Today's HDD contractors need all the help they can get. Put the Radius Hot Shot to work on your drill today and swap the short bore “hassle” for a bit more hustle.

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**Optimum Job Site Mobility**

American Augers continues to revolutionize horizontal directional drilling with the newly re-designed DD-220T. Engineered for modular Tier 3/Tier 4 Cummins power, the DD-220T features a touch screen display, is remote data-acquisition capable, includes the exclusive Quiet Pak noise reduction system, and is Europe legal. For increased power and strength, the DD-220T provides 30,000 ft. lbs. (40,675 Nm) of rotary torque and 220,000 lbs. (100 Tonnes) thrust/pullback. Optional equipment with the DD-220T includes a knuckle boom crane, ISO-style driller's cabin and a microprocessor controlled operator's console.

Look to American Augers for an experienced manufacturer that continues to provide reliable, field-tested and versatile systems that exceed expectations on every jobsite.

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