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View from the Chair

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Horizontal well technology was introduced to environmental remediation projects nearly 20 years ago to address the challenges of soil and ground water remediation at large industrial facilities, military bases, Department of Defense and other government facilities. Besides providing long screens for large plumes at such sites, horizontal wells provided access to target zones in areas vertical wells simply could not reach. Horizontal wells allowed the placement of well screens directly beneath process units with complex piping structures and utility networks at refineries and chemical plants, and beneath hangars and buildings with sometimes monumental proportions at military bases and at least one commercial airport (JFK in New York). Today, horizontal wells are bringing the same physical and hydraulic advantages to bear at brownfield restoration sites. At a growing number of brownfield sites, horizontal wells are employed to meet the challenges of restricted space, compressed construction schedules, and accelerated cleanup milestones. Two such projects are described in articles in this newsletter.

Unlike petrochemical plants and military bases, brownfield restoration sites are typically small and in urban settings with restricted space, surrounded by commercially active properties. Many brownfield sites are burdened by adversarial relationships with owners of adjacent properties, access restrictions, and multiple permit requirements for utilities, railroads, and various easements. To overcome these restrictions, horizontal wells offer flexibility in the surface layout and subsurface configuration of the well system components.

Brownfield remediation schedules are usually driven by real estate transaction timelines and construction schedules, which allow no room for schedule adjustments. Schedule challenges can be compounded by site access restrictions defined by property boundaries, especially in urban settings. The alternative to meeting project deadlines while complying with site restrictions is often cancellation of the project, not delay. A single horizontal air sparging, bioventing, or soil vapor extraction well can often replace a field of 10 or more vertical wells on the basis of zones of influence. Recent site closure trends suggest that horizontal sparging and biosparging wells achieve cleanup criteria more quickly than equivalent vertical well systems, due in part to the continuity of the screen in the target zone and the prevention of short-circuiting along well riser pipes. In cases where shallow vertical soil vapor extraction wells, 5 feet deep or less, can be installed at low cost, a directional rig may still be needed to install trenches connecting vertical wellheads with the blower and treatment compound. In some cases, surface trenching requirements tip the installation cost balance in favor of using the directional drilling rig to install the entire system, including shallow vertical wells. The simplicity of the horizontal well system saves time and possibly cost during planning, installation, and later during operation and maintenance of the remediation system.

Commingled plumes with various unrelated sources represent another hallmark of urban brownfield restoration sites. Brownfield developers can avoid spending money cleaning up someone else's problem by selecting in situ remediation technologies that are able to focus the remediation effort on a restricted target zone. Horizontal wells can prevent or minimize the unnecessary use of resources for removing contaminant mass introduced by other parties. Delivery of in situ agents or bioamendments under a building through horizontal wells avoids over-injecting through vertical wells placed along the edges of the building. A vertical pump-and-treat well placed at the edge of a building must create a zone of influence large enough to reach under the building. This also places a

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Inside

Editorial

QA/QC Programs for Horizontal Wells

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Let's face it. Quality assurance and quality control programs are pretty boring. That is, until something goes wrong. Then life can get pretty exciting. Two articles in this issue of *Horizontal News* address the need for the development of QA/QC programs for horizontal wells. The first, "Development of a Horizontal Well QA/QC Program," describes in some detail the efforts to recognize the need for and then to develop a QA/QC program specifically intended to address the slotting of horizontal wellscreen. Because of the article's length, it does not include many of the technical conclusions of the program concerning the special QA/QC challenges of HDPE, including thermal expansion during slotting and controlling slot length on the inside wall of the pipe. Consistent slot size is difficult to achieve for 0.010-inch slot size, and slots less than about 0.5-inch long tend to not go all the way through commonly used HDPE pipe.

These are some of the challenges that take the horizontal well designer beyond his or her experience with vertical wells.

Some people have advised me that talking about problems with horizontal wells could scare prospective clients away from using them. I disagree. I think that recognizing problems and finding ways to address them is a major step in a maturing industry. The second article in this newsletter lists other areas where horizontal well QA/QC programs are needed.

Development of a Horizontal Well QA/QC Program

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The intent of this article is to focus on the inspection and acceptance requirements for fabricated horizontal well materials delivered to a horizontal drilling site. Horizontal well materials differ from vertical well materials in that they are custom-engineered and manufactured for the specific project and are not readily replaced if a deficiency is found during assembly. Typically, well materials arrive at the site just prior to drilling and must undergo inspection while the horizontal well is being drilled. If materials are determined to warrant replacement, it can take weeks, and drilling is discontinued until new materials arrive. That is a costly inconvenience. It is far better to conduct the quality assurance/quality control inspection either at the slotting shop or prior to the arrival of the drill crew at the site.

The current article is based on nearly two decades of experience with horizontal wells, over which period of time the need for a QA/QC program for well materials has been amply demonstrated.

New York Project

Six directionally drilled horizontal biosparge wells arranged in a hexagonal pattern were designed to surround and contain a release of petroleum hydrocarbons from a pipeline in western New York state. The horizontal biosparge wells were ideal for containing the release as the site is covered by many feet of snow during much of the winter. In addition, prior experience with horizontal well projects in New York had demonstrated to pertinent regulatory agencies that a horizontal biosparge well could be used to halt the migration of both free and dissolved product. Regulations did not recommend vertical biosparge wells in the presence of free product.

The screened interval for horizontal wells must be carefully designed using fluid mechanics prinicples to ensure that air is evenly distributed over its full length. The use of ordinary vertical biosparge well screen will normally result in distortion of the distribution with a greater flow of air near the blower end of the horizontal well and no air exiting at the distal end. The slotting required for each well was determined with the use of a computer program and well materials were ordered from an experienced slotter. The well materials were delivered to the site and appeared from external inspection to have the specified slot width, slot lengths, and number of slots to meet the open area requirements for each well.

During the early stages of drilling, the well materials were subjected to close scrutiny wherein we observed that most of the well material looked acceptable to external inspection, but many slots did not fully penetrate the HDPE well materials to the inside of the well. In some cases, a full row of slots had not actually penetrated to the inside. Every slot on every 20-foot length of well material had to be inspected.

Drilling had already started and time was of the essence. Several thousand feet of screen were unacceptable and the deficiencies were random. The slotting shop was contacted. The in-shop inspection had not revealed the problem as it was based on an external inspection of the screen only.

Replacement of the existing well screen was not considered to be an option, but not because it would be costly and time-consuming. Rather, an analysis of the manufacturing operation by the slotter concluded that it was not possible to reliably slot the specified HDPE well materials with slot lengths of 0.25 to 0.375 inches. In some cases, the roundness and elasticity of the HDPE combined with the characteristics of the saw blades resulted in only partial penetration of the pipe wall. This was an unanticipated problem not previously experienced with PVC well materials. The recommendation of the slotter was to redesign all well materials to have fewer but longer slots.

This recommendation was not supported by the driller as an increase in slot lengths would reduce the pullback strength of the well materials and increase the risk of breakage during installation.

The option of using longitudinal slots rather than conventional slots was evaluated. This was not considered to be an acceptable option.

Because of time constraints, defective slots were lengthened by hand using X-acto knives, an operation which took nearly two weeks. After the experience, the slotter and I agreed to a general QA/QC program for horizontal wells:

- First, the slotter would attempt to manufacture well screen according to the specifications.
- Second, if the slotter experienced manufacturing difficulties with the specifications, he would be free to adjust the length of slots and their number just as long as he preserved the same amount of open area per 20-foot segment.
- Third, once manufactured, the well screen would be subjected to the shop's normal rigorous QA/QC inspection.
- Fourth, before shipping finished well screen to a customer, I would come to the shop and personally measure the widths and lengths of randomly selected slots and count the number of slots for each 20-foot length in order to calculate the open area (and percent open area) per length of well screen. Screen would only be shipped after this final inspection.

Florida Project

We decided to perform an inspection of the delivered well screen as part of our contract to provide oversight of drilling and well installation. The upside of this decision was that the client would not have to pay travel costs and time to have the screen inspected in the shop. The downside was that well drilling would have to cease if unacceptable materials were delivered to the job site and had to be replaced.

Well screen for an approximately 1200-foot-long horizontal well was delivered to the site in 40-foot sections. The order for well materials was placed by the driller and the client had these specifications:

- All materials were to be fabricated from nominal 6″ diameter, 40′ long lengths of SDR-11 HDPE.
- Five slot zones were specified giving the total footage and open area for each slot zone.
- All slots were to be circumferential rather than longitudinal with 0.02″ slot widths.

The lengths of randomly selected slots on the inside wall of the pipe, and the total number of slots per pipe segment, were used to calculate the percent open area of each pipe segment. Results and observations are summarized in Table 1. Overall, the delivered well screen was judged to be acceptable except that Zone 1 consisted of two 40-foot lengths, one with 10% less area than specified and one with 30% less, so the average was 20% less open area than specified.

Table 1
Summary of Pipe Observations by Zone

Zone	% Average Deviation from Specifications*	Comments/Observations
1	–20%	• Less open area than specified was deemed acceptable for the Zone 1 position of the well.
2	–5%	• Acceptable
3	3%	• Acceptable
4	–0.5%	• Specific slots gave 15% less open area than specified. • Overall, the slot measurements gave open areas which deviated less than 10% from the specification (0.542%).
5	–1%	• Burred 40′ length was not used. • Open area ranged from 10% less than specification to 14% more than specification. • There were also a variety of flaws and inconsistencies in the manufacturing operation. • We were able to select 4 pipes which were deemed acceptable from a total of 10 delivered pipes. • Several of the delivered pipes contained slots which appeared to be greater than 0.02″ wide and which were irregular in shape or orientation.

*Negative % average deviation indicates less open than specification.

It is generally the practice in the environmental industry to accept well materials that are delivered to a project site without rigorously counting slots and measuring the inside pipe slot widths and lengths. While this practice may be acceptable when using standardized routine production well materials, experience at a number of horizontal well projects with custom-manufactured well materials teaches us that a more rigorous QA/QC inspection and evaluation procedure is required. Such an inspection is best performed at the slotting shop so that unacceptable materials can be immediately rejected and replaced, but the inspection can also be performed in the field.

Experience at the two projects that are described here (and at other projects) indicates that the inspection should be conducted by someone familiar with (1) the screen design program and the numerous variables that went into the well design, (2) the contamination distribution, and (3) the remediation technology to be deployed. An evaluation of the well screen delivered to the project may lead to rejection of materials and consequently project delays. Failure to identify and resolve screen manufacturing errors will usually result in the installation of a horizontal well that does not perform properly.

The need for a QA/QC inspection of well materials and its possible adverse consequences should be built into the project timetable.

Horizontal Well QA/QC Programs

By Louis B. Fournier, Ph.D., STAR Environmental LLC, starcompany@erols.com, 998 956.6151

With the development of remediation techniques based on the use of directionally drilled horizontal wells over the past two decades have come a host of challenges and concerns not usually seen with vertical wells. Among these are:

- The ability of the drill rig to install the well
- The ability of the drilling fluid to maintain hole stability over the duration of the project
- Acceptability of the drilling fluid to regulators
- The choice of well development method, chemicals, and procedures
- The capability of the drill head location equipment to accurately determine the depth and location of the drill head
- The ability of the drill crew to maintain a horizontal drill path over the length of the screened interval (often 1000 feet or longer) within the acceptable deviation range in the formation that exists at the site and using the drilling fluid specified for the project
- The choice and design of well materials for the project
- The order of assembly of well materials delivered to the site
- The acceptability of delivered well materials (vs. ordered well materials) for the project
- The well segment fabrication or assembly process to be utilized
- The ability of the assembled/fabricated well material to be installed without breaking
- Prevention or repair of damage to overlying structures or facilities during the drilling process
- Avoidance or cleanup of drilling fluid "frac-outs"
- Proper well development methods
- The ability of the installed well to operate in a leak-free manner
- Specification and selection of remediation equipment to be used with the horizontal well
- Design, placement, installation, operation, and sampling of vertical monitoring wells
- Startup, routine operation, and maintenance of the horizontal well over its time of operation
- Testing the performance of the installed horizontal well system to determine its ability to clean up the site and to determine the efficiency of the system
- Modification of the installed horizontal well remediation system in response to observed performance deficiencies
- Post project removal or closure of the horizontal well
- The ability of the drilling contractor to comply with local licensing requirements.

Other aspects of the horizontal remediation project may be the same as or a variation of activities ordinarily seen with vertical well remediation projects including:

- Gaining the approval of various regulatory agencies for utilizing a horizontal well remediation system to address contamination at the site
- Meeting the regulatory agency design and installation requirements for horizontal vs. vertical well systems.

Frequently, regulatory agency requirements for the design, installation, and operation of horizontal well systems have not yet been developed within a regulatory agency and the fallback position is to apply vertical well requirements, often with nonsensical results. For example, in one jurisdiction the agency required that only a state-licensed vertical well driller was allowed to install the horizontal well. There were no directional drillers who were also licensed as a vertical well driller. And there were no licensed vertical well drillers who were capable of installing the horizontal wells. To meet the agency requirement, a licensed vertical well driller was retained to oversee the horizontal well installation, without the ability to operate the horizontal drill rig or specify the drilling procedures.

None of these areas has a QA/QC specification specifically for horizontal wells. All need to have a formal program or specification developed.

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large portion of the zone of influence outside of the building. Cleaner ground water from outside the building is extracted along with the more contaminated ground water under the building, adding unnecessary operation costs for pumping and treating ground water.

Two articles in this newsletter issue describe remediation projects in urban settings and exemplify the use of horizontal wells to meet various challenges of brownfield remediation. The first is a large brownfield construction project in Houston, Texas. It highlights the power of horizontal wells to overcome space limitations and compressed schedules. The second is a small brownfield site in Columbus, Indiana. It shows how integrated directional drilling and trench construction can overcome subsurface obstructions typical of brownfield sites with long and often unknown histories.

Successful management of a brownfield remediation project requires management of compressed schedules, and alteration of proven technologies to accommodate site requirements. The design, construction, and operation of horizontal well remediation systems at the two sites in Texas and Indiana exemplify these critical aspects of environmental management at brownfield sites.

The use of horizontal wells for their original purpose, large sites, is coming of age.

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In Situ Chemical Oxidation Using a Horizontal Well

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A directionally drilled horizontal well was installed at a site in Massachusetts to remediate a chlorinated solvent release using in situ chemical oxidation (ISCO). Tetrachloroethene (PCE) and the associated breakdown products trichloroethene (TCE) and cis-1,2-dichloroethene (DCE) are the primary dissolved constituents present at the site. To address these dissolved impacts, the remedial plan proposed ISCO, which is an emerging remedial technology that uses the injection of an oxidant solution to destroy (oxidize) volatile organic compounds upon contact. At this particular site, the ISCO remediation plan proposed injecting approximately 16,000 gallons of 40% sodium permanganate solution into the main portion of the contaminant plume.

To be effective, ISCO technology requires the oxidant solution to be in direct contact with the impacted media. Therefore, properly positioning injection wells and screened intervals relative to the impacted area is critical to the remedial design. Although several vertical injection wells were included in the remedial plan, directional drilling was selected to install the primary injection well where most (approximately 10,000 gallons) of the oxidant solution would be focused (i.e., within the axis of the plume). Use of the horizontal well was selected for the following reasons:

1. A significant portion of the site was not readily accessible to conventional (vertical) drilling equipment.
2. The impacts near the release source are located in the shallow portion of the overburden (generally less than 10 feet below grade), but are located in the deep portion of the overburden (greater than 20 feet below grade) downgradient from the source.
3. The dissolved plume was relatively long and narrow, which suggested that a directionally drilled well installed above the axis of the plume would allow the injected oxidant solution to spread downward into the main portion of the plume (the 40% sodium permanganate solution is heavier than water and will spread downward through the impacted area).
4. The screened interval of a horizontal well covers a much larger area than vertical wells, and injecting the oxidant solution into one horizontal well (as opposed to multiple vertical wells) simplifies the field injection.

In February 2005, GeoInsight Inc. oversaw the advancement of the horizontal injection well by Directional Technologies Inc. of North Haven, Connecticut. The horizontal borehole was advanced in the overburden along the approximate center of the plume axis and along the top of the plume. The boring advancement was steered to follow the plume axis and also to install the horizontal well between existing vertical monitoring wells that would be used to monitor the permanganate injection.

The total borehole length was approximately 450 feet and the maximum boring depth was approximately 29 feet below grade. The horizontal well was constructed of 20-foot sections of 4-inch-diameter high density polyethylene (HDPE) pipe that were heat-fused together into a single 450-foot-long section prior to installation. Two separate screened intervals, one 100-foot interval and one 20-foot interval that were separated by 40 feet, were used to focus the injection into the two areas where the greatest impacts were observed. The well screen was constructed with 0.020-inch slot machine slotted HDPE pipe. Well materials were installed during backreaming of the initial pilot hole, and the backreaming also removed mud cake buildup on the borehole wall. A 6-inch-diameter borehole remained following backreaming. The horizontal borehole and well were drilled and constructed during a period of four days.

A total of approximately 10,900 gallons of 40% sodium permanganate solution was injected into the horizontal well during four injection events. The sodium permanganate solution was injected through a tremie tube (constructed of 0.75-inch HDPE tubing) that was placed in the approximate center of the 100-foot screened interval. Tremie injection into the horizontal well was selected to force distribution of the sodium permanganate solution along the entire well screen. Because of the large screened area of the horizontal well and the resultant ease of injection, it was possible to conduct the large-volume injections into the horizontal well under gravity, as opposed to the vertical injection wells where injection under pressure was required to "force" the sodium permanganate solution into the subsurface. The sodium permanganate solution is a strong oxidizer, and the ability to inject under gravity in the horizontal well reduced safety concerns associated with potential "sprays" of permanganate solution from burst fittings under pressure.

The 40% sodium permanganate solution was shipped in 55-gallon drums. After the sodium permanganate solution was removed, the drums were rinsed to remove residual permanganate on the interior drum walls. Because of the high "injection capacity" of the horizontal well, the rinsate from the permanganate drum decontamination was also injected into the horizontal well, often concurrently with the main injection event. The ability for the horizontal well to accept the rinsate greatly simplified the drum cleaning operations and allowed the drum cleaning to be conducted at the same time as the permanganate solution injection. At other sites where only vertical wells were used, alternative means for handling the drum rinsate were necessary because of the limited "injection capacity" of vertical wells.

Using the horizontal well for ISCO injection proved to be successful. The horizontal drilling method allowed us to install well screens at locations where conventional drilling would have been difficult or impossible, as well as letting us place well screens directly above the most impacted areas. We were able to quickly inject a large volume of 40% sodium permanganate solution under gravity into the most impacted portion of the dissolved plume. The ease of injection also allowed us to inject the rinsate liquids from the drum cleaning into the horizontal well, which simplified the cleaning operations. Post injection monitoring indicates that the permanganate solution is spreading into the impacted areas as anticipated, and the initial results indicate that the permanganate solution is effectively treating the dissolved impacts.

Horizontal Well Remediation Project at Brownfield Site Nominated for EPA Award

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An environmentally impacted idle brownfield site located within several blocks of downtown Houston was successfully remediated using primarily horizontal wells. The site was redeveloped on schedule from 2003 to 2005 and today is the location of a new Federal Reserve Bank of Dallas (FRBD) Houston Branch building (see photo). The project has been nominated for the U.S. EPA Phoenix Award for best brownfield site in its region (Region 6). This prestigious award honors individuals and groups who are working to solve the critical environmental challenge of transforming abandoned areas into productive new uses.

The Federal Reserve Bank of Dallas (FRBD) Houston Branch building located at a Brownfields site remediated using horizontal wells.

An adjacent liquid petroleum storage tank (LPST) site had affected the site during several decades by releasing light nonaqueous phase liquid into the subsurface. Previous owners of the property had initiated a remediation program that interfered with construction of the bank building. The responsible party managing the existing remediation program predicted continued operation of the system for more than two years. The system comprised 14 vertical dual-phase extraction wells, 9 of which interfered with bank construction. The FRBD recognized that unless it took control of the remediation program, its Houston Branch would have to be built elsewhere. Except for the environmental impact, the chosen location for the Houston Branch was geographically highly desirable. Therefore, FRBD voluntarily assumed responsible party designation for the LPST case with the Texas Commission on Environmental Quality in order to control the cleanup and closure of the site. This action allowed plans for the construction of the Houston Branch to go forward.

A team of environmental consultants received notice from FRBD in January 2003 to proceed with removal of the existing remediation system at the future bank site, and design, pilot test, procure, and install a new remediation system in its place. Remediation system construction at the site of the bank building had to be completed before the onset of construction of the bank building in May 2003. The new system was to be constructed without interference with bank construction activities, operated within the logistical limitations imposed by bank operations, and properly abandoned after achieving site closure within an agreed timeframe. The environmental management team, consisting of SKA Consultants LLC and GeoSyntec Consultants Inc., met the project goals by multitasking to meet compressed schedules and applying innovative technology that offered the flexibility needed to comply with site restrictions.

To meet the brownfield site demands, a system was designed that takes advantage of the spatial flexibility offered by horizontal wells. Two horizontal multiphase extraction wells were installed. The geometry of two compound-curved wellpaths allowed placement of the well screens within the outline of the product plume beneath the building, in spite of inadequate space at either end of the building for conventional step-back to entry and exit holes along a straight line. At one end of the bank property, the two wells meet in a single underground vault. The wellpaths diverge under the product plume, and at the distal end, each well intersects a narrow vertical sump in the subsurface.

During its 16 months of operation, the system removed approximately 89,000 pounds of hydrocarbons, including approximately 98% in the vapor phase, and approximately 2% as phase-separated and dissolved-phase hydrocarbons. The system met performance specifications, including dewatering goals and hydrocarbon recovery rates, and remediation goals were met. Site closure was granted by the Texas Commission on Environmental Quality in January 2006.

Horizontal Bioventing Wells Installed for Reuse of Midwestern Downtown Brownfield Site

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Columbus, Indiana, is one of many small Midwestern cities that have been redeveloping brownfield sites. The site of a 70-year-old bulk petroleum storage facility in downtown Columbus is being cleaned up using two horizontal bioventing wells. The property was purchased by the City of Columbus and is currently being used as a storage and training facility. During its operation, the storage facility contained underground storage tanks holding up to 8000 gallons, and aboveground storage tanks holding more than 12,000 gallons. The facility stored a variety of fuel and lubricating products.

A risk integrated system of closure-based site investigation conducted by SESCO Group identified total petroleum hydrocarbons (TPHs) in the unsaturated zone in two commingled plumes at depths ranging from a few feet to 25 feet below grade. Cost analysis indicated that regulatory cleanup requirements would be met most efficiently with vertical soil vapor extraction wells in the deeper plume and horizontal bioventing wells in the shallower plume. Two horizontal bioventing wells with up to 200 feet of screen were installed at depths of 4 feet to nearly 7 feet below grade. One of the wells was placed beneath a warehouse. The wells were completed with 4-inch-diameter high density polyethylene (HDPE) pipe. The screens were placed predominantly within sand lenses of a heterogeneous geologic formation. The screens were slotted circumferentially, providing an open area of 0.64%, as indicated by air flow modeling.

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Horizontal Well Information Presented at 2006 NGWA Ground Water Summit

The second Ground Water Summit took place April 22-27, 2006, in San Antonio, Texas. Engaging local, national, and international science partners in a venue designed to facilitate the exchange and dissemination of technical information and new science developments, the Ground Water Summit allowed a means for discussing policy and regulatory issues pertaining to ground water, and promoted goodwill among ground water professionals. The sessions covered a range of topics to allow recent issues and advances in ground water science, technology, and policy to be brought to the forefront.

A session titled "Advances in Aquifer Access," moderated by Dawn Kaback of Geomatrix Consultants Inc. and sponsored by the NGWA Horizontal Well Interest Group, addressed advances in technology that can better meet ground water needs tied to discussions in many of the other sessions, such as sustainability, water supply in third world nations, remediation, aquifer storage and recovery, and modeling. This session focused on advances in improved aquifer access technologies, with emphasis on horizontal wells. The discussions centered on improving aquifer performance for applications such as water supply and water quality (remediation). Presentations were given by the following:

Hydraulics of Horizontal Wells – David Schafer, David Schafer and Associates

Directional Water Well Completions in Deep Aquifers – Theresa Jehn-Dellaport, PG, Jehn Water Consultants Inc.; Ray Newmyer, NWP, Drilling and Consulting Inc.

Enhanced Access Penetration System for Cone Penetration Soundings at Difficult Sites
James D. Shinn and John W. Haas, Applied Research Associates Inc.

Complex Horizontal Well Remediation System Meets Demands of Fast-Track Brownfields Redevelopment Project – Darren M. DeFabo, PE, SKA Consultants LP; George Losonsky, Ph.D., PG, Losonsky & Associates Inc.; John Mastroianni, PG, GeoSyntec Consultants Inc.; David S. Bardsley, WDC Exploration & Wells

Innovative Horizontal Strategies for Diverse Hydrogeologic Settings
Matthew J. Rhoades, CPG, PG, Golder Associates Inc.

Horizontal Leachate Collection Under a Landfill in Illinois: Six Years After Installation
James Doesburg, Directed Technologies Drilling; Kim Groharing, Whiteside County Public Works

Accessing the Inaccessible: Installing a Ground Water Remediation System Under an Active Air Force Base Tarmac and Hangar – Dan Ombalski, Directed Technologies Drilling

Thanks and Farewell, John Berry

Effective May 2, 2006, John Berry of CETCO resigned as a member of and secretary for the Horizontal Wells Interest Group. John has been transferred to the Construction Drilling Division of CETCO.

Accepting his resignation, George Losonsky, chair, thanked Berry for his many contributions to our conference sessions, newsletter, and *Water Well Journal*. He also noted that Berry's expertise in drilling fluids and experience with horizontal drilling projects will be missed by the Horizontal Wells Interest Group Committee.

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The site's long history of industrial use suggested that buried obstructions may be encountered during drilling. The wellbores were therefore prereamed to facilitate their completion with the HDPE casing. The prereaming operation was challenged by subsurface objects that included large reinforced concrete blocks, long metal tubes, automobile parts, angle iron pieces, and a chain-link fence. The directional driller was able to navigate the bore path around all obstacles and maintain grade. During the backreaming operation, however, the chain-link fence necessitated excavation of a portion of the bore path. Excavation had been planned as an integral part of the well installation procedure, and the necessary equipment was at hand during drilling. The well design called for excavation of the proximal screen end points, in order to accommodate space restrictions at the site. The additional excavation required by the subsurface obstructions was readily accommodated by the drilling contractor, Joe Dock Construction of Warsaw, Indiana, who was able to integrate the use of excavation and directional drilling equipment to provide the flexibility needed to install the horizontal wells in a difficult setting typical of brownfield sites.

Well seal construction and well development were customized to integrate the horizontal well with the excavations. The presence of the trench intersecting the well screen facilitated well development. The trench collected a large portion of the xanthan-based drilling fluid during well development, and allowed direct observation of the success of the breaker additive in reducing the viscosity of the drilling fluid.

Early operation data bear evidence for the successful installation. A pressure gradient has been established around the wells, reaching out to a distance of at least 40 feet. Injection of air through the bioventing wells is maintaining oxygen levels of approximately 19% in the soil. After the third month of operation, the horizontal bioventing system reduced TPH levels from more than 1000 to less than 10 ppm in the vicinity of the wells. The system continues to operate, and is anticipated to reach its remediation goals by 2008. The municipality continues to utilize the facility for storage and training during operation of the remediation system.

Upcoming NGWA Events of Interest

2006 NGWA Ground Water Expo

December 5-8, 2006, Las Vegas, Nevada

Keynote speaker Larry Winget, author of *Shut Up, Stop Whining & Get a Life*, which reached number one on the *Wall Street Journal* business books list, will share his funny yet very insightful personal philosophy of success through service and the power of taking personal responsibility. As usual, the annual meeting of the Horizontal Wells Interest Group will also be held at this event. All members of the interest group and other interested parties are invited to attend.

21st Century Ground Water Systems Conference

October 12-13, 2006, Costa Mesa, California

Population growth, regulatory requirements, aging infrastructure, climate change, and increased security risks—all of these factors, plus others, are converging on the nation's water systems. Where will our water come from? What solutions can water systems employ to supply this precious resource? How will we manage and conserve the resource? What technologies are available or under development to help? What research is ongoing and what more needs to be done? What are the implications of water resource issues to developers, business leaders, agricultural interests, and ecosystem health? Will the 20th century water system model work in the 21st century?

This two-day event will focus on the following topic areas with special emphasis on the utilization of ground water resources:

- Water resource management and planning in the new century
- Strategies to optimize current water sources, including water use efficiency, system design, financial incentives, artificial recharge, and conservation
- New and emerging water sources—desalination, water reuse and recycling, brackish ground water
- Treatment and monitoring options and future needs
- Technology innovations and alternative approaches to water quality management or water supply
- Infrastructure—traditional and nontraditional approaches to meet the challenges ahead
- Minimizing risk from natural and manmade disasters
- Well maintenance and restoration
- Public policy, business, and customer relations models

Planners; community, business, and agricultural leaders; developers; regulatory, research, and academic personnel; and contracting, engineering, and consulting communities are encouraged to participate.

Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection, and Remediation® Conference

November 6-7, 2006, Houston, Texas

This year's conference is expanding to include sessions on pesticides and herbicides, chlorinated solvents, and polycyclic aromatic hydrocarbons, in addition to the offerings on petroleum hydrocarbons and underground storage tank cleanup. Also, NGWA has added to this conference the former Remediation Conference: Site Closure and the Total Cost of Cleanup—it's like attending two conferences for the price of one, and under one roof! For the first time, the Horizontal Wells Interest Group will present a workshop on horizontal wells and horizontal well remediation.

Industry Happenings

Precision Assessment Technology Corporation

(Vancouver, British Columbia)

The principal activities of Precision Assessment Technology Corporation (PATC) are to provide drilling services for site assessment and ground water characterization and remediation in the United States. These services are provided using drilling and sampling equipment and technologies. On November 3, 2005, PATC acquired Groundwater Protection Inc. (Orlando, Florida) and Trenchless Specialties Inc. (Orlando, Florida).

Layne Christensen Company

(Mission Woods, Kansas)

Reynolds Inc. (Orleans, Indiana)

In September 2005, Layne Christensen Co., a public engineering firm with a global presence, purchased Reynolds Inc., a privately held utility construction contractor in the United States. The Reynolds organization will partner with Layne's Water Resources and Geo Construction groups to form the new Water and Infrastructure Division.

The 4th World Water Forum

(March 2006, Mexico City)

The meeting drew 20,000 people from 149 countries. The week-long event was designed to raise awareness of global water issues. According to participants, the worldwide water shortage is not only a water shortage, it is also a sanitary crisis and a political crisis. In a recorded message, French President Jacques Chirac explained that water shortages lead to tensions which can lead to conflict in some parts of the world. He urged that creative solutions be found to address the issues.

NGWA Horizontal Wells Publications Are Online

Have you missed some of the NGWA's publications on horizontal wells? If so, you can read them online at *www.ngwa.org/sig/goals.cfm#pubs*.

Horizontal News

Horizontal News is a publication of the National Ground Water Association (NGWA)
601 Dempsey Road
Westerville, OH 43081- 8978

The newsletter describes horizontal well technologies and projects and informs Horizontal Wells Interest Group members of initiatives currently under way that they can participate in. Interested NGWA members may participate in the Horizontal Wells e-list discussion group as well as provide informative articles for this newsletter, presentations at NGWA educational events, and information to be posted on the HWIG portion of the NGWA Web site. If you would like to actively participate in any of these activities, please contact Derek Neal at NGWA.

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We want to reach everyone who is interested in receiving notice of future issues of *Horizontal News* or would like to participate in other methods of networking horizontal wells information through this NGWA members-only interest group. Please complete and fax back this form right away.

- ❑ Yes, I want to keep receiving notice of future issues of *Horizontal News*, an NGWA members-only newsletter.
- ❑ I would like to be subscribed to the *Horizontal Wells* e-list discussion group.
- ❑ Please send me NGWA membership information so I can join the NGWA Horizontal Wells Interest Group.
- ❑ Please change my contact information below as I have noted.

Name ______________________________

Company name ______________________________

Address ______________________________

City ______________ State ______________ Zip ______________

Phone ______________ Fax ______________

E-mail address ______________________________

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national ground water association

Horizontal News

Your online resource for Horizontal Well information.

Published by NGWA for the Horizontal Wells Interest Group

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