

<p>CEMP-RT Engineer Technical Letter 1110-1-178</p>	<p>Department of the Army U.S. Army Corps of Engineers Washington, DC 20314-1000</p>	<p>ETL 1110-1-178 10 December 1996</p>
	<p>Engineering and Design HORIZONTAL DIRECTIONAL DRILLING FOR ENVIRONMENTAL APPLICATIONS</p>	
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DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, D.C. 20314-1000

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Technical Letter
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Engineering and Design
HORIZONTAL DIRECTIONAL DRILLING
FOR
ENVIRONMENTAL APPLICATIONS

1. **Purpose.** The purpose of this letter is to raise the awareness of horizontal well technology, identify Hazardous, Toxic, and Radioactive Waste (HTRW) applications for horizontal drilling, and call attention to the Environmental Protection Agency Manual (EPA) "Alternative Methods for Fluid Delivery and Recovery (EPA/625/R-94/003)." This manual describes four alternative methods for fluid delivery and recovery - horizontal wells, slant wells, induced fractures, and trenches. For the purpose of this letter, the emphasis will be on horizontal directional drilling (HDD) as it relates to the installation of horizontal environmental wells.
2. **Applicability.** This letter applies to HQUSACE elements, major subordinate commands, districts, laboratories, and field operating activities (FOA) having HTRW investigation, design and remedial action responsibility within the military or civil works program.
3. **Reference.** U.S. EPA. 1994. Manual: Alternative Methods for Fluid Delivery and Recovery. EPA/625/R-94/003. Prepared by: Murdoch, L., and Wilson, D.D.
4. **Background.** The environmental industry began modifying directional drilling technology in 1988 to install horizontal extraction and injection remediation systems where it was not practical to excavate trenches. The first directionally drilled horizontal environmental wells were installed at the Department of Energy's Savannah River Site in 1988. Since that time horizontal environmental wells have been installed at several Department of Defense sites and various private industry sites.
5. **Discussion.**
 - a. Horizontal wells used for environmental projects are being used predominantly for air sparging, soil vapor extraction, ground-water extraction and injection, and bioremediation. In addition, horizontal wells can be used for pump-and-treat systems, leachate collection, soil monitoring and sampling, and grouting. Possible future uses may include the chemical treatment of heavy metals in place, and in-situ vitrification of nuclear wastes.



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b. Horizontal wells are particularly suited to recovering contaminants distributed as broad, flat layers. Contaminant plumes usually are horizontally extensive and relatively thin vertically. Such a distribution may occur when light non-aqueous phase liquid (LNAPL) floats on a water table or when dense non-aqueous phase liquid (DNAPL) accumulates on a low-permeability bed. With the use of directional drilling, a screen can be placed parallel to the contaminated layer, whereas the screen of a vertical well may only intersect a very small portion of the contaminated layer. Therefore, horizontal wells better mimic this plume geometry and place more screen in contact with the target zone on a per well basis.

c. In tight formations, where vertical fractures provide the primary flow paths, horizontal wells can intersect many vertical fractures. This application facilitates access to the preferred flow paths, increases well discharge, and controls fluid flow in the formation.

d. Some advantages of horizontal wells are unrelated to hydrologic performance. In many locations, such as beneath landfills, tanks, buildings, roads, lagoons, or bodies of water, access limitations prohibit entry by a drill rig, prevent penetration by a vertical hole, or restrict the aboveground facilities necessary for recovery operations. As a result, recovery, sampling, or monitoring with conventional drilling technology is difficult beneath many structures that may be sources of contaminants. Horizontal or inclined wells overcome those difficulties by allowing the drill rig to be adjacent to the obstructing structure, and the well boring to be created beneath it. In addition, horizontal or inclined wells help keep the above-well system components out of the way of such things as landfill equipment, service station traffic, and the local wildlife habitat.

6. **Actions Required.**

a. Because horizontal wells have only recently been applied to solve environmental problems, there has been relatively little information published concerning the benefits and application of horizontal drilling technology. One of the most comprehensive pieces of information on horizontal wells can be found in EPA/625/R-94/003. The manual covers horizontal well construction, design considerations, applications, and case histories.

b. This guidance should be carefully considered by all staff involved in groundwater and soil remediation. Horizontal directional drilling has applications for ground-water remediation, leachate collection, in-situ air stripping (sparging), in-situ bioremediation, soil vapor extraction, thermally enhanced vapor extraction (steam injection), and grouting. Additional references are listed in Appendix A. Appendix B is a list of some Internet web sites relating to horizontal drilling.

c. In summary, horizontal wells show potential for providing both significantly better **performance** and lower total **remediation** costs than systems relying on only vertical wells for a large number of situations. These situations include not only areas where surface obstructions interfere with vertical access, but also areas where **hydrogeologic** or contaminant distribution conditions render vertical wells ineffective; situations where continuous horizontal exposure to the subsurface materials is advantageous; and areas where human health and safety concerns are of unusual severity.

FOR THE DIRECTOR OF MILITARY PROGRAMS:



CARY JONES, P.E.
Chief, Environmental Restoration Division
Directorate of Military Programs

2 Appendices
APP A - Bibliography
APP B - Internet Sites

APPENDIX A: BIBLIOGRAPHY

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9. Wilson, D.D., 1996, Use Of Horizontal Drilling In Environmental Remediation: A Horizontal Well Case Study . Water Well Journal, February.
10. Wilson, D.D., 1996, Horizontal Well Development Made Easy. Water Well Journal, October.

APPENDIX B: INTERNET SITES

1. Colorado Center for Environmental Management (CCEM). An industry survey of environmental wells in the U.S. is available on CCEM's Home Page:
<http://garfield.doegjpo.com/ccem>.
2. Horizontal Well & Environmental Consultants' Home Page: <http://www.horizontalwell.com/>. This web site contains articles, frequently asked questions, and a contractor directory on horizontal well technology.
3. North American Society for Trenchless Technology (NASTT) home page:
<http://www.bc.irap.nrc.ca/nodig/>.
4. Trenchless Information Center (TIC) home page: <http://www.no-dig.com/>. A link to other trenchless technology associated web sites may be found here.
5. Trenchless Technology Center (TTC), Louisiana Tech University Home Page:
<http://www.latech.edu/tech/engr/ttc/>.
6. U.S. Army Corps of Engineers, Waterways Experiment Station, Soils and Rock Mechanics Division, Trenchless Technology web site: <http://srm.wes.army.mil/trench.htm>.