

# Direct-Push Wells Prove Effective for Long-Term Ground Water Monitoring

Study results to date suggest that direct-push wells can provide a cost-effective alternative to drilled wells for use in long-term ground water contaminant monitoring.

By Mark Kram!, Dale Lorenzana, Joel Michaelsen, William Major, Louise Parker, Chris Antwort, and Tim McHale

**D**IRECT-PUSH MONITORING WELLS ARE TYPICALLY considered "temporary" monitoring points, because detailed comparisons with conventional drilled hollow stem auger monitoring wells have not previously been conducted.

However, we have recently found that when working in unconsolidated fine- to medium-grained strata, direct-push installed monitoring wells can be good cost-effective alternatives to drilled wells for characterizing ground water chemical distribution.

## What Are the Pros and Cons of Direct-Push Wells?

For relatively shallow screens (50 feet or less), direct-push wells can be installed at rates up to 10 times as fast as conventional drilled wells. At one of our sites, 42 direct-push wells were installed to depths of approximately 25 feet in two days.

Here are several advantages and limitations of direct-push monitoring wells:

### Advantages

- Minimal cutting wastes
- Fewer development wastes
- Rapid installation

- Less worker exposure to contaminants
- Representative chemistry
- Very discreet screen depth ranges possible
- Inexpensive to replace if plugged
- Well installation step can be integrated into a comprehensive dynamic characterization plan using chemical and lithologic sensors within a single deployment.

### Limitations

- Not applicable when cobbles or consolidated materials are present
- Not accepted for long-term monitoring in most states
- Debate remains regarding hydrogeologic characterization capabilities
- Boring log not generated during installation (but can use soil classification sensors and even collect samples if so desired)

- Seal above screen is sometimes difficult to achieve (however, several exceptional sealing options exist)
- Many practitioners still use screens without filter packs, which could increase turbidity and compromise results.

The main regulatory concerns regarding the use of direct-push wells for long-term ground water monitoring include:

1. Filter pack materials (for preventing sediment entry) are either not used or are generally not based on grain-size distribution of the formation in contact with the well screen section.
2. Minimum annular sealing and annular size requirements are based on drilled well specifications and emplacement logistics (e.g., tremmie versus gravity feed).
3. Annular sealing may not be complete for pre-packaged (or "pre-packed") well screen devices and tremmied filter pack applications under some geologic conditions.

Because the design theory of sand pack gradation is based on mechanical retention of the formation particles, a



Figure 1. 7/8-inch pre-pack direct-push well screen design. The mesh and sand pack cover the screened zone. The flange keeps grout materials from entering the screened zone.

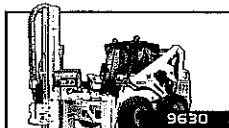
pack thickness of only two or three grain diameters is required to retain and control the formation materials (Driscoll 1986). Because it is impractical to tremmie a filter pack in a drilled well annulus only a fraction of an inch thick and expect the material to completely surround the well screen, a 4-inch annular

monitoring continues on page 18

**PowerProbe**  
The Ultimate in Direct Push Technology


**With the PowerProbe 9630 You'll get More than Just a lot of Power, You'll also get...**

**MORE**



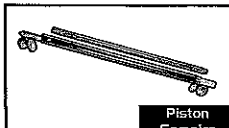
9630 Skid

Mounting Options



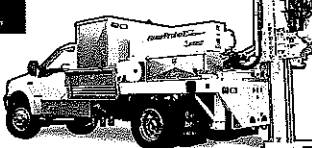
Auto-Drop Hammer

Equipment Options



Piston Sampler

Tooling Options



For **MORE** Information See Our Videos Online at: [www.ams-samplers.com](http://www.ams-samplers.com)

**AMS Inc.**  
1-800-635-7330  
[www.ams-samplers.com](http://www.ams-samplers.com)

# Sampling Made Simple

## Signature SERIES



- Zinc Coating for Rust Resistance
- Faster Assembly/Disassembly
- Quicker Soil Penetration
- Torque-Resistant Bail
- More Soil Capacity

105 Harrison  
American Falls, ID 83211  
Toll Free 1-800-635-7330  
(208) 226-2017 • FAX: (208) 226-7280

Order Online Today & Receive **FREE Shipping**

[www.ams-samplers.com](http://www.ams-samplers.com)




requirement (beyond the outside diameter of the riser pipe) has been used as a minimum criteria for many states (e.g., State of California 1981).

Current designs for pre-pack direct-push well screens (Figure 1) allow for the use of "thin" filter packs. Therefore, the 4-inch requirement applied to drilled wells should not be necessary for direct-push pre-pack screened wells. In fact, Oregon recently altered its well construction standards to allow for direct-push pre-pack screened wells placed in boreholes a minimum of one inch greater than the outside diameter of the well casing (OWRD 2001).

### How Were the Direct-Push Wells Proven Effective?

A comprehensive evaluation of several monitoring well designs was conducted to determine the potential effectiveness of direct-push wells for long-term ground water monitoring in alluvial sediments.

The investigators compared the performance of several types of direct-push installed monitoring wells to conventional hollow stem auger drilled wells. The purpose of this effort was to determine whether representative chemical and water table data could be generated using properly designed direct-push monitoring wells. Field efforts included piezometer measurements, collection of core and water samples from selected depths, installation of customized monitoring well test cells, and sampling of the wells using a low flow sampling procedure developed by EPA Region 1 through several rounds (Kram et al. 2001).

Laboratory efforts included chemical analysis of water samples (for organic

Total Depth	Direct Push		Drilled 2"	Savings	
	3/4"	2"		3/4"	2"
20	\$6799	\$9254	\$12,146	44.0%	23.8%
50	\$9664	\$13,575	\$23,418	58.7%	42.0%
75	\$12,876	\$18,543	\$36,393	64.6%	49.0%

Authors assumed 10 wells each with 5-foot screens per scenario.

and various inorganic materials and parameters), determination of permeability for selected core samples (via ASTM D2434), and determination of grain-size distribution (for well design as required by ASTM D5092). The 82-well investigation was conducted within four solute contaminant plumes located in California, Delaware, Florida, and New Hampshire through support from the Department of Defense Environmental Security Testing and Certification Program (ESTCP) and the Naval Facilities Engineering Command Southwest Division (NAVFACSWDIV).

An extensive statistical effort was conducted to compare the performance of the different well designs for each hydrogeologic regime. Analysis of variance was selected as the best technique for evaluating data consisting of categorical factor predictors and a continuously varying response variable. No significant statistical differences were observed between the direct-push and drilled wells over the more than two-year duration of the study. Results to date suggest that direct-push wells can be used for long-term ground water contaminant monitoring.

### What's Next?

Current efforts are under way to collect additional data for long-term evaluation

and to partner with regulators, technology developers, and users in the generation of standards and guidelines. Recently, the American Society for Testing and Materials released ASTM D6724: Guide for Installation of Direct-Push Ground Water Monitoring Wells and ASTM 6725: Practice for Direct-Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers. Our group is also working with the Interstate Technology Regulatory Council to generate a TECHREG guidance document on this subject. We are hopeful that direct-push monitoring wells, when properly designed and installed, will prove to be cost-effective tools for long-term applications. WWW

### Acknowledgments

Funding for field installations, ground water monitoring, and report preparation was provided by the Department of Defense ESTCP and NAVFACSWDIV. We are also grateful for assistance provided by members of the LTM Advisory Committee, members of the project review committee, and Dorothy Cannon of NFESC.

### References

- American Society for Testing and Materials. ASTM D2434: Standard Test Method for Permeability of Granular Soils (Constant Head).

- American Society for Testing and Materials. ASTM D5092: Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers.
- American Society for Testing and Materials. ASTM D6724: Guide for Installation of Direct-Push Ground Water Monitoring Wells.
- American Society for Testing and Materials. ASTM D6725: Practice for Direct-Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers.
- Driscoll, F.G. 1986. *Groundwater and Wells*. St. Paul, Minnesota: Johnson Filtration Systems Inc.
- Kram, Mark L., Dale Lorenzana, Joel Michaelsen, and Ernest Lory. 2001. Performance comparison: Direct-push wells versus drilled wells. NFESC Technical Report TR-2120-ENV (full text available at [www.epa.gov/superfund/programs/dfo/direct.htm](http://www.epa.gov/superfund/programs/dfo/direct.htm)).
- Oregon Water Resources Department. 2001. Well Construction Standards, Administrative Rules, Chapter 690, Division 240, November 15, 2001.
- State of California. 1981. California Department of Water Resources Bulletin 74-81: Water Well Standards: State of California.

Mark Kram is a hydrogeologist for the U.S. Navy, specializing in environmental site characterization and remedial design. He earned a B.A. in chemistry from the University of California at Santa Barbara, an M.S. in geology from San Diego State University, and a Ph.D. in environmental science and management from the University of California at Santa Barbara. He has more than 17 years of experience using environmental assessment techniques and has authored papers, national standards, articles, and book chapters on the subject. He has been instrumental in the areas of dense nonaqueous phase liquid (DNAPL) site characterization and chemical field screening, and holds several patents for hydrogeologic and chemical characterization tools and methods.

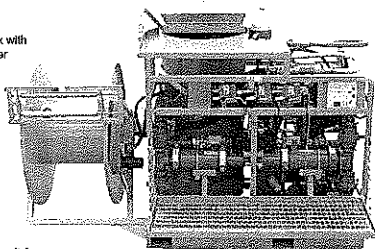
## Fill, Mix, And Pump...

# A Batch Of Grout In Less Than 2 Minutes!

### Geo-Loop Ultimate Grouter Model 50-500

#### Features...

- Produces 0-50 gallon per minute at forceful pressures up to 500 PSI
- Massive 60 gallon stainless steel mixing tank with stainless steel paddle mixer and smooth taper cone bottom for easy clean up and labor savings
- Dependable 5" bore 8" stroke piston pump
- Bullet proof chrome-lined cylinders with hammer union construction pump
- Powerful 20 HP electric start Honda engine (diesel engine available)
- Easy-to-read hour meter and tachometer
- High capacity water fill pump and high pressure wash down line
- Efficient 10 gallon hydraulic oil reservoir with sight glass and thermometer
- Thermostatically controlled oil cooler with 12 volt fan
- Durable powder coat paint framework
- Versatile fork lift pockets on both sides of grouter
- Approx. weight 1,700 pounds
- Large stainless steel bag platform for operators ease of loading
- Quality 53"x19" grip tread foot platform
- Optional hose reel (holds up to 500' of 1" or 3/50' of 1 1/4" hose)
- Optional self-priming water pump
- Technologically advanced grout pump covered by United States patent D4950-454

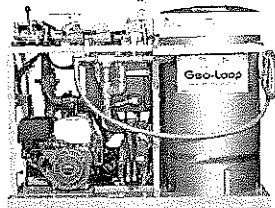


OMERSI  
EXCELLENT PERFORMANCE WITH  
BENTONITE - THERMAL ENHANCE  
- SAND BENTONITE - CEMENT  
GROUTS

### Geo-Loop Grout Pro Model 30-500

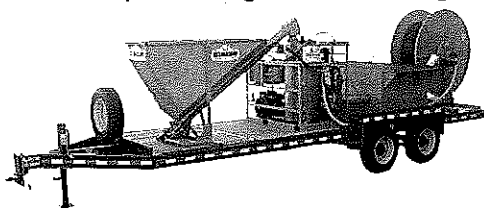
#### Features...

- Economical 0-30 gallon per minute at forceful pressures up to 500 PSI (optional 35 gallon per minute at 415 PSI)
- Generous 60 gallon stainless steel mixing tank with stainless steel paddle mixer and smooth taper cone bottom for easy clean up and labor savings
- Dependable 3" bore 8" stroke piston pump
- Bullet proof chrome-lined cylinders with hammer union construction pump
- Strong 13 HP electric start Honda engine
- Easy-to-read hour meter and tachometer
- High capacity water fill pump and high pressure wash down line
- Efficient 10 gallon hydraulic oil reservoir with sight glass and thermometer
- Thermostatically controlled oil cooler with 12 volt fan (optional)
- Durable powder coat paint framework
- Versatile fork lift pockets on both sides of grouter
- Approx. weight 980 pounds
- Optional hose reel (holds up to 500' of 1" or 3/50' of 1 1/4" hose)
- Optional self-priming water pump (as shown)
- Technologically advanced grout pump covered by United States patent D4950-454



14 YEARS PROVEN FIELD  
DRILLING AND GROUTING  
EXPERIENCE HAS TAUGHT US TO  
BUILD THE TOP MACHINES  
CAPABLE OF TACKLING MORE  
KINDS OF PROJECTS AND  
SATISFYING MORE CUSTOMERS

### The Ultimate In Job-Site Mobility... Geo-Loop Sand Auger Trailer Package



#### Features...

- Greatly reduces the manual labor of thermal enhanced grout
- Specially designed, custom-built trailer-78"x22"
- Sturdy 14,000 pound rating will meet your needs
- Two standard - 7,000 pound axles with brakes (8,000 and 10,000 pound axles available)
- Heavy duty adjustable hitch (2 5/16" ball or pintle hitch available)
- Generous Geo-Loop Ez Load 2500 hopper holds 2,500 pounds of sand with an auger rate of approximately 500 pounds per minute
- Hopper can be loaded with ease with a skid loader using bulk sand or super sacks
- Durable 525 gallon stainless steel water tank and pallet table combination with two 4" fill ports and a non-skid rubber mat
- Innovative Geo-Loop grouters
- Eliminates unwanted empty sacks

LEASE-PURCHASE FINANCING  
DELIVERY AND FIELD TRAINING  
AVAILABLE. CALL FOR DETAILS!

Call ...  
**Geo-Loop**  
GEO-LOOP INC. Aurelia, IA 51005  
Phone: 712-434-2125 FAX: 712-434-2115  
Contact us On-Line at [www.geo-loop.com](http://www.geo-loop.com)

For the latest quote on any Geo-Loop product contact Jeff Bowen at (800)-580-5865.

Geothermal and Water Well Grouting Experts