# 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.**

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DIRECT-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 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

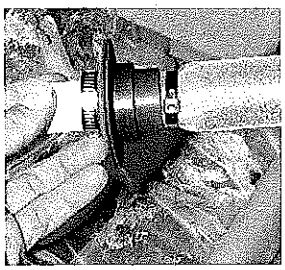

Figure 1. ¾-inch pre-pack direct-push well screen design. The mesh and sand pack cover the screened zone. The flange keeps grout materials from entering the screened zone.

monitoring/ continues on page 18

monitoring/ from page 16

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 piezocone 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 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.

**Table 1**
**Cost Comparison Between Direct-Push and Drilled Monitoring Wells**

| | Direct Push | | Drilled | Savings | |
|---|---|---|---|---|---|
| Total Depth | 3/4" | 2" | 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.

## 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. *WWJ*


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