

GROUND WATER SAMPLING FROM MONITORING WELLS

What's New and Why?

Low-Flow Purging and Sampling is a relatively new technique, based upon the use of a submerged pump that can be adjusted to deliver ground water to the surface at rates from less than 100 mL per minute to a maximum of 1 L per minute. The purpose of this technique is the recovery of representative samples of the water in the formation adjacent to the well screen. Stagnant water above the screen and below will not usually be purged or sampled. The technique is also called "Low-Stress" purging and sampling, as it does not cause excessive movement of water from the soil formation into the well. Ideally, the flow rate of water from the pump will approximate or be less than that entering the well from the surrounding formation.

The technique eliminates the need for removal of several well volumes prior to the collection of samples, thus reducing the amount of IDW (Investigative Derived Waste) from wells containing contaminated water. Typically, by using a Low-Flow Purging and Sampling technique, the volume of water removed from a well will be a few liters, compared to more than 10 times this amount using the older, multiple well volume purging technique. Today purging and sampling are conducted as a continuous process.

This new technique is designed to allow the collection of representative ground water samples from the formation surrounding the screened section of the monitoring well. The pump is placed within the screened section and all water pumped is monitored for a number of chemical and physical parameters using a flow cell and field instrumentation. Water levels will also be checked to ensure that draw down is kept to a minimum. Care may need to be taken to ensure that the pumped water is protected at the ground surface from temperature extremes and excessive sunlight during the monitoring process. Sampling commences when the measured parameters have stabilized and turbidity is at an acceptable and constant level.

The success of any ground water sampling program is dependent on several factors. First and most important is a properly constructed and developed monitoring well. See ASTM Standard Practice D 5092* and Guide D 5521* for construction and development respectively. The wellhead needs to be secured and sealed to prevent vandalism and surface/rain water intrusion.

Measurement of ground water quality is the end result of a sampling program. Low-Flow Purging and Sampling is designed to provide samples that consistently represent formation-quality water. The technique is fully described in ASTM Standard Practice D 6771*. The benefits are as follows:

- ▶ Improved sample quality, accuracy, precision and variability through reduced disturbance to the well and formation, reduced mixing, analyte dilution, aeration and degassing.
- ▶ Reduced purge water volume (90-95%), leads to savings in disposal costs.
- ▶ Improved detection and resolution of contaminant distribution through sampling a smaller section of the formation.
- ▶ Improved ability to quantify total mobile contaminant load, without need for filtration.
- ▶ Increased well life, through reduced pumping stress.
- ▶ Reduced time for purging and sampling may reduce field labor costs.
- ▶ Significant technical and cost benefits at sites, suitable for Low-Flow Purging and Sampling.

Equipment selection for Low-Flow Purging and Sampling

A dedicated or permanently installed pump is preferred over portable systems as the sampling event will be easier to conduct and quicker. No decontamination of the in-well components will be needed. Neither will it be necessary to wait while the disturbance caused by the installation of the portable pump settles, prior to commencing purging and sampling.

Well components

A pneumatic bladder or electric submersible pump is required for pumping along with a controller that is capable of providing an adjustable pump output from less than 100 mL per minute to 1 L per minute. Durham Geo Slope Indicator's 1/2 in, 3/4 in and 1 in diameter MBP Mini Bladder Pumps and 2 in diameter Sample Plus Electric Pumps are well suited to Low-Flow Purging and Sampling.

Peristaltic pumps and other suction lift devices are not suitable for use in wells containing contaminants and/or measurable parameters that may be affected by the vacuum and degassing that occurs when these devices are used. Grab samplers, such as bailers and inertia-lift pumps are also unsuitable as they create too much disturbance to the water column.

Tubing and suspension cable will be needed to connect the bladder pump to the surface as well as an electric cable for

the electric pump. Durham Geo provides polyethylene, Teflon® lined polyethylene and Teflon® tubing for the MBP Bladder Pumps. Tefzel® motor leads with or without a PVC or Teflon® lined polyethylene hose are available for the Sample Plus Electric Pumps.

Durham Geo Slope Indicator Sealed and Lockable Well Caps are recommended for their MBP Bladder Pumps as they provide both a means to suspend the pump at a specific depth and an easy means to connect the pump to the controller and monitoring equipment through the use of bulkhead fittings attached to the underside of the Well Cap.

Pump Controllers

Precise control of air pressure and timing of the pressure and exhaust cycles is essential for control of the MBP Bladder Pumps. Durham Geo Slope Indicator supplies the Precision Dual Range Controller with independent circuits for the application of 2-50 psi and 5-100 psi air to the pump and adjustable cycle timing from 0.1 to 10 seconds. A self-contained Compressor with Precision Dual Range Controller is also available. It is specifically designed for Low-Flow Purging and Sampling and it eliminates the need for an external supply of compressed air for applications up to 50 ft deep.

Durham Geo Slope Indicator Sample Plus Electric Pumps are powered by either a 120 volt 60 Hz or 12 volt DC powered controller. Both models provide a variable speed control for a precise pump rate.

Water Level Monitoring

Water level monitoring is an essential part of this technique. It is used to ensure maintenance of the water level in the well as close to the static level as possible during purging and sampling. Durham Geo Slope Indicator supplies Slope Water Level Meters with either round polyurethane cable or flat Tefzel tape and ¼ in, 3/8 in or 5/8 in probes, depending on model selected. Tapes and cables are clearly graduated in 1/100 ft.

A new MBP Draw Down Controller and Water Level Meter with user settable draw down from 0.05 ft to 0.45 ft will be available early 2004. This simplifies the control of the water level in the well by automatically stopping the bladder pump controller at the maximum draw down point and restarting it when the well has recharged to the user set level. This device should be used in wells where the maximum permissible draw down has already been determined.

Water Quality Monitoring

Measurement of several chemical parameters is used in Low-Flow Purging and Sampling to indicate when purging is complete and sampling may begin. The measurements may be made periodically or preferably on a continuous basis using a multi-parameter probe installed in a flow cell connected to the outlet of the well pump. Durham Geo Slope Indicator

stocks Horiba and YSI Multiparameter Meters with flow cells and standalone turbidity meters by HF Scientific and LaMotte. First the static water in the pump and delivery tubing are removed, then pumping and monitoring continues until the chemical parameters have stabilized. All instrumentation used should be pre-calibrated and re-checked before field use. Measurement intervals should follow manufacturers advice regarding sensor reading stabilization times and be at least after one flow cell volume has been removed. The chemical stabilization is usually confirmed by turbidity measurements. ASTM Practice D 6771* suggests the following criteria to define stabilization:

pH:	± 0.2 pH units
Conductivity:	± 3% of reading
Dissolved Oxygen:	± 10% of reading or ± 0.2 mg/l, whichever is greater
Eh or ORP:	± 20 mV
Turbidity:	± 10% prior reading or ± 1.0 NTU

Sample Collection

Samples should be obtained directly from the well pump outlet and not from the flow cell outlet. Durham Geo Slope Indicator can provide a suitable Two Way Diverter Valve that may be installed between the well pump outlet and the flow cell. The pump rate used for purging may also be used for sample collection or it can be reduced to ease filling of small containers or vials. Collect samples for analysis of the most sensitive parameters first and any samples that require filtration last.

Documentation

ASTM Guide D 6089* provides guidance in documenting a ground water sampling event. For a Low Flow Purging and Sampling Event the following data should be recorded, as described in ASTM Practice D 6771:

- Equipment Calibration
- Equipment Decontamination
- Equipment Configuration for Purging and Sampling
- Pump Placement
- Initial Static Water Level
- Initial Pump Rate
- Drawdown Measurements
- Stabilized Pumping Water Level
- Final Pump Rate
- Water Quality and Turbidity Measurements, with Times
- Final Sampling Flow Rate

*The following referenced ASTM Standards may be obtained from ASTM:

D 6771	Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground Water Quality Investigations
D 5092	Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers
D 5521	Standard Guide for Development of Ground Water Monitoring Wells in Aquifers