

# Low-Flow Ground Water Sampling

## FSOP 2.2.6, September 8, 2016

### Ohio EPA Division of Environmental Response and Revitalization

#### 1.0 Scope and Applicability

- 1.1 Low-flow ground water sampling is designed to collect ground water samples under minimal drawdown (low-stress) conditions. This technique minimizes vertical gradients and turbulence within the well and surrounding formation, thereby reducing undesired sampling-related changes to in-situ ground water quality.
- 1.2 Low-flow sampling is based on the assumption that under low-flow purging conditions, ground water passes continuously through a well's screened interval and does not mix with the water above the screen. The well is pumped at a rate much lower than the saturated zone yield so that drawdown is minimized and stagnant water in the casing above the screened interval remains relatively undisturbed. Fresh ground water enters the pump intake at a low velocity that minimizes turbulence in the screened interval.
- 1.3 In addition to effectively facilitating the collection of a representative ground water sample, low-flow sampling significantly reduces the volume of purge water generated compared to other ground water sampling techniques.
- 1.4 Because low-flow sampling minimizes sample volatilization and turbidity compared to other ground water sampling techniques, it is recommended for collecting ground water samples for regulatory compliance, risk assessment or modeling, especially volatile organic compound (VOC) and metal samples.
- 1.5 All ground water sampling techniques and associated procedures should be consistent with Ohio EPA's [Technical Guidance Manual \(TGM\) for Hydrogeologic Investigations and Ground Water Monitoring](#), specifically [Chapter 10, Ground Water Sampling](#). In addition, [U.S. EPA 2002 \(Yeskis and Zavala\)](#) provides ground water sampling guidance for RCRA and CERCLA sites. The site-specific work plan (SSWP) will provide project objectives and data quality objectives (DQOs). In the event there appears to be inconsistency between the TGM and project objectives or DQOs, please contact the DERR SIFU supervisor and DERR site coordinator for clarification.
- 1.6 Ohio EPA's TGM recommends that low-flow sampling be performed using a bladder pump or variable-speed electric submersible pump. Depending on SSWP project objectives and DQOs, a peristaltic pump may also be used for low-flow sampling.
- 1.7 Low-flow sampling purging rates typically vary between 100 and 500 ml/min.

#### 2.0 Definitions

Low-flow purging is also referred to as low-stress purging, low-impact purging, minimal drawdown purging, or Micropurging®.

### 3.0 Health and Safety Considerations

- 3.1 Always review the site-specific health and safety plan (HASP) for site-specific hazards before performing work.
- 3.2 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling and health and safety considerations.
- 3.3 When sampling with a bladder pump and using compressed nitrogen or carbon dioxide gas, properly secure compressed gas cylinders when transporting, using or storing them.
- 3.4 When carrying a 12-volt battery, lift the battery properly. Bend your hips and knees to squat down, grasp the battery, and while keeping it close to your body, straighten your legs to lift it. Do not lift the battery by bending forward, which may cause back injury.

### 4.0 Procedure Cautions

- 4.1 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling procedure cautions.
- 4.2 If NAPL is encountered in a monitoring well, do not perform ground water sampling. Immediately notify the DERR-SIFU supervisor and DERR site coordinator.
- 4.3 Low-flow sampling should not be performed using single-speed pumps. Use of a ball or gate valve with a single-speed pump to lower the flow rate is not acceptable, because the valve will cause turbulence in the sample discharge line.
- 4.4 Low-flow sampling cannot be performed using bailers.
- 4.5 Accurately measuring the static water level before beginning the low-flow sampling process is critical for evaluating water level drawdown during sampling.
- 4.6 Avoid drawing the water level into the screened interval during low-flow purging and sampling (if the static water level is above the screened interval). If this happens, the ground water sample will need to be collected using the volumetric (well volume) technique.
- 4.7 Low flow ground water samples should not be collected until drawdown has stabilized and water quality indicator parameters have stabilized.
- 4.8 VOC sample vials should never be filled at flow rates exceeding 100 ml/min.

### 5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous

waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

## 6.0 Equipment and Supplies

- 6.1 Low-flow pump assembly, including control box and power supply or compressed nitrogen or carbon dioxide
- 6.2 Water quality meters and/or flow-through cell with data sonde to measure water quality stabilization parameters including pH, specific conductivity, temperature, dissolved oxygen (DO), oxidation reduction potential (ORP) and turbidity
- 6.3 Water level indicator
- 6.4 Stopwatch or timer (for measuring flow)
- 6.5 Graduated cylinder (for measuring flow)
- 6.6 Disposable discharge line tubing
- 6.7 Well construction information (total depth of well, depth to screened interval)
- 6.8 Other ground water sampling equipment and supplies as needed per FSOP 2.2.4, Ground Water Sampling (General Practices)

## 7.0 Procedures

- 7.1 Before installing the pump, measure the static water level in accordance with FSOP 2.2.2, Ground Water Level Measurement.
- 7.2 Slowly and carefully install the pump in a manner that minimizes disturbance to the water column in the well. The pump should be installed in the approximate center of the screened interval. Avoid placing the pump at the bottom of the well to avoid increasing turbidity.
- 7.3 Ensure that the flow-through cell and/or water quality meters have been calibrated and are set up and ready for use.
- 7.4 Start the pump at the lowest flow rate possible and measure the flow rate in a graduated cylinder (or similar device). The purge rate will depend on the well size (diameter) and yield. Typically, the purge rate will be between 100 and 500 ml/min for a two-inch inside diameter (ID) monitoring well. The purge rate for a smaller diameter well (e.g., 0.75-inch ID) may be lower and the purge rate for a larger diameter well (e.g., 4-inch ID) may be higher.
- 7.5 Monitor the water level drawdown in the well. If continuous drawdown is occurring, reduce the pumping rate until equilibrium is achieved, i.e., the water level stabilizes with the least amount of drawdown (as compared to pre-pumping static water level).
- 7.6 If the static water level was initially above the screened interval and drawdown into the screened interval cannot be avoided (despite efforts to lower the pumping rate), perform volumetric sampling by purging at least three well volumes before collecting the sample. Do not exceed a purge rate of 500 ml/min. Measure stabilization parameters as required by the SSWP.

- 7.7 While monitoring the water level drawdown as described above, measure and record stabilization (water quality) parameters using the flow-through cell and/or water quality meters. The SSWP will provide specific stabilization parameters, however, at least three stabilization parameters should be measured, and two of the parameters should always include specific conductance and either DO or ORP.
- 7.8 The time interval between successive stabilization parameter measurements should always be long enough to allow one equipment volume (pump + discharge line + flow through cell) to completely be purged from the well. Generally, a time three to five minutes is acceptable. If the pumping rate is very low, e.g., 80 ml/min, the time needed between stabilization parameter measurements may need to be longer, e.g., 5 to 12 minutes.
- 7.9 Continue low-flow purging until the water level drawdown has stabilized and the stabilization parameters have stabilized. Stabilization parameters are considered stable upon meeting the following criteria for at least three consecutive measurements:

<b>Stabilization Parameters</b>	<b>Criteria (<u>for at least three consecutive measurements</u>)</b>
Temperature	+/- 0.5° C
pH	+/- 0.2 standard units (S.U.)
Specific Conductance	+/- 3%
Oxidation-Reduction Potential	+/- 20 millivolts (mV)
Dissolved Oxygen	+/- 0.3 mg/L
Turbidity	< 10 nephelometric turbidity units (NTUs) is possible, or +/- 10% if > 10 NTUs

If stabilization cannot be achieved through low-flow sampling based on SSWP DQOs and other criteria, perform volumetric sampling by purging at least three well volumes before collecting the sample. Avoid drawing the water level into the screen if possible, and do not exceed a purge rate of 500 ml/min.

- 7.10 After purging is completed, collect and handle samples following the procedures outlined in FSOP 2.2.4, Ground Water Sampling (General Practices) and FSOP 1.5, Sample Custody and Sampling. Collect the ground water sample by filling containers for constituents other than VOCs first (in no particular order) at a flow rate of 500 ml/min or less, followed by filtered samples (if specified by the SSWP) and VOCs (last). Reduce the flow rate to 100 ml/min or less for VOCs. If elevated

turbidity is an issue, samples for metals may be collected last in an effort to minimize sample turbidity.

- 7.11 Decontaminate sampling equipment between each sampling location in accordance with FSOP 1.6, Sampling Equipment Decontamination. Discharge tubing should not be reused between sampling locations.
- 7.12 Dispose of discharge tubing and other investigation derived waste in accordance with FSOP 1.7 Investigation Derived Wastes.

## **8.0 Data Records and Management**

Refer to FSOP 1.3, Field Documentation.

## **9.0 Quality Assurance and Quality Control**

Refer to the SSWP and FSOP 2.2.4, Ground Water Sampling (General Practices)

## **10.0 Attachments**

None

## **11.0 References**

FSOP 1.3, Field Documentation.

FSOP 1.5, Sample Custody and Sampling

FSOP 1.6, Sampling Equipment Decontamination

FSOP 1.7, Investigation Derived Wastes

FSOP 2.2.2, Ground Water Level Measurement

FSOP 2.2.4, Ground Water Sampling (General Practices)

Ohio EPA, May 2012, Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring: Ohio EPA Division of Drinking and Ground Waters

U.S. EPA (D. Yeskis and B. Zavala), May 2002, Ground Water Sampling Guidelines for Superfund and RCRA Project Managers (Ground Water Forum Issue Paper): Office of Solid Waste and Emergency Response, EPA 542-S-02-001