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**Risk Reduction and Environmental Stewardship—  
Remediation Services**

**Standard Operating Procedure**

for **Sampling for Volatile Organic  
Compounds in Groundwater**

**NES Approved**

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## Revision Log

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# Sampling for Volatile Organic Compounds in Groundwater

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## List of Acronyms and Abbreviations

EPA	US Environmental Protection Agency	QP	quality procedure
FTL	field team leader	QPPL	quality program project leader
ID	identification number	RPF	Records Processing Facility
LANL	Los Alamos National Laboratory	RRES-RS	Risk Reduction and Environmental Stewardship—Remediation Services
PPE	personal protective equipment	SAP	sampling and analysis plan
PTL	project team leader	SMO	sample management office
QII	Quality Integration and Improvement Team	SOP	standard operating procedure
QMP	quality management plan	VOA	volatile organic analysis
		VOC	volatile organic compound

# Sampling for Volatile Organic Compounds in Groundwater

## 1.0 PURPOSE

This standard operating procedure (SOP) states the responsibilities and describes the process for sampling for volatile organic compounds (VOCs) in groundwater. This SOP also describes the selection of equipment and materials used in the sampling process. The success of this process directly ties to the participation of each employee within the Los Alamos National Laboratory (LANL) Risk Reduction and Environmental Stewardship, Remediation Services (RRES-RS).

## 2.0 SCOPE

- 2.1 All **RRES-RS project participants** shall implement this mandatory SOP.
- 2.2 **Subcontractors** performing work under the RRES-RS Quality Program shall follow this SOP.

OR

- 2.3 **Subcontractors** may use the subcontractor's procedure as long as the substitute meets the requirements prescribed by the RRES-RS Quality Management Plan (QMP) and the RRES-RS quality program project leader (QPPL) and an RRES-RS technical staff person approve the procedure before the subcontractor begins the designated activity.

## 3.0 TRAINING

- 3.1 **RRES-RS project participants** shall train to and use the current version of this SOP; contact the author if the SOP text is unclear.
- 3.2 **RRES-RS project participants** using this SOP shall document training in accordance with Quality Procedure 2.2 (QP-2.2).
- 3.3 The responsible **project team leader (PTL)** shall monitor the proper implementation of this procedure and ensure that the appropriate personnel complete all applicable training assignments.
- 3.4 The **field team leader (FTL)** shall ensure that field team members who collect VOC samples for the RRES-RS project are trained in the operation and calibration of field analytical equipment.
- 3.5 **RRES-RS project participants** may request any needed assistance with implementation of this procedure from the RRES-RS Quality Integration and Improvement (QII) team.

## 4.0 DEFINITIONS

- 4.1 *Site-specific health and safety plan (SSHASP)*—A health and safety plan that is specific to a site or RRES-RS project-related field activity and that has been approved by a RRES-RS project health and safety representative. A SSHASP contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.

## 5.0 RESPONSIBLE PERSONNEL

The following personnel are responsible for activities identified in this procedure:

- FTL
- PTL
- QPPL
- RRES-RS project participants
- user

## 6.0 BACKGROUND AND PRECAUTIONS

- 6.1 **RRES-RS project participants** shall use this SOP in conjunction with an approved SSHASP and shall consult the SSHASP for information on and use of all PPE.
- 6.2 **RRES-RS project participants** shall consider field and other conditions when choosing sample retrieval systems. The objectives are to collect valid samples for volatile organic analysis (VOA) and to subject samples to the least amount of turbulence and subsequent possible aeration. Potentially suitable sample retrieval systems are reciprocating piston-type submersible pumps, gear-driven submersible pumps, syringe samplers, and bailers (Barcelona et al., 1984; Bennett, 1988; Nielsen et al., 1985; US Environmental Protection Agency [EPA], 1986; EPA Region 4, 1991).
- 6.3 When selecting pumps, bailers, and tubing, the **user** shall take into account the tendency of organics to adsorb onto many materials. Project participants shall select pumps, bailers, and tubing constructed of stainless steel, Teflon, and/or glass and shall avoid those constructed of plastics such as Tygon.
- 6.4 To avoid the many ways by which foreign contaminants may be introduced into a sample, **RRES-RS project participants** shall follow

strict sampling procedures and ensure that only trained personnel conduct sampling activities

- 6.5 If floating organics are of concern (as determined by field measurement for floating organics), **RRES-RS project participants** shall recognize that a representative sample cannot be confidently obtained.
- 6.6 The sensitivity of the analysis and the fragility of the samples require that **RRES-RS project participants** shall employ a minimum of two containers (40 ml Teflon septum vials) for each sample collected for VOA.
- 6.7 **RRES-RS project participants** shall follow proper procedures for sample preservation and handling as described in SOP-01.02 and SOP-01.03.
- 6.8 **RRES-RS project participants** may keep properly preserved (i.e., with acid) vials for VOA for up to 14 days and shall ship samples to the Sample Management Office (SMO) daily or following each completed sampling effort.
- 6.9 **RRES-RS project participants** shall seal sample shippers (coolers) with custody seals (Attachment E, SOP-01.04), and shall adequately pack and cool sample shippers to ensure that they arrive intact and within the acceptable temperature range. Refer to SOP-01.03 and SOP-01.04 for further instructions.
- 6.10 Due to the short holding times, **RRES-RS project participants** shall avoid collecting VOC samples before holidays or weekends.

**Note:** Only samples submitted before 2:30 p.m. are same-day shipped.

## 7.0 EQUIPMENT

Attachment A provides a checklist of suggested equipment and supplies needed to implement this procedure. Sampling mechanisms capable of obtaining samples for VOC analyses are described below.

- 7.1 *Reciprocating piston-type submersible pumps*—These systems are portable, self-contained, and capable of delivery flow rates of 30 gal./hr at lifts up to 500 ft. The pump fits into 2-in. wells, which is the most common monitoring well diameter. The flow rate of the pump is varied by increasing or decreasing the driving pressure supplied to the pump from a compressed air container. The gasoline that powers the pump does not contact the sample being purged.
- 7.2 *Gear-driven submersible pumps*—These pumps provide samples comparable to those from other pumps and are often easier to handle and cleaner. More care, however, must be exercised when sampling with them

because the flow rate is not controllable and the potential for splashing and aeration of the sample is greater.

- 7.3 *Syringe samplers*—Only a limited number of commercial, syringe-type samplers are available (two vendors are IEA and TIMCO). These devices have limited sampling volume and are specifically for sampling for VOCs. They operate with an evacuated chamber that is lowered down the well and filled by the pressure of the water. The entire mechanism is brought to the surface with the sample, and the sample is transferred to a sample vial for shipment. If preservation with chemical additives is not required, the entire unit may be sent as the sample container.
- 7.4 *Bailers*—The Teflon closed-top, bottom-charging type is the most appropriate bailer to collect water samples for VOA. The bottom-emptying device with a tap is also desirable. Several vendors offer bailers with acceptable designs. Generally, bailers can collect a representative sample, provided that the sampling personnel use extra care in the collection process.

## 8.0 PROCEDURE

Make any deviations from this SOP in accordance with QP-5.7 and/or SOP-01.01.

### 8.1 Conduct Pre-operation Activities

8.1.1 **RRES-RS project participants** shall assemble the equipment and supplies listed in Attachment A and shall ensure that all equipment operates properly.

**Note:** If any equipment requires calibration, **RRES-RS project participants** shall record the calibration information on the Daily Activity Log form (Attachment F in SOP-01.04), the Water Quality Sampling record (Attachment B in SOP-06.01), and the field notebook (as specified in SOP-01.04).

8.1.2 **RRES-RS project participants** shall coordinate the sampling effort with the SMO.

**Note:** The SMO gives guidance regarding sample containers, preservation, and shipment to the SMO.

8.1.3 **RRES-RS project participants** shall locate monitoring/characterization wells requiring sampling, establish an appropriate decontamination area, and select the staging area and areas for managing purged water and expendable sampling materials.

8.1.4 In accordance with SOP-01.08, **RRES-RS project participants** shall decontaminate all sampling equipment before taking the first sample and in between the sampling intervals.

## 8.2 Perform Sampling

8.2.1 **RRES-RS project participants** shall purge wells before sampling (as specified in SOP-06.01), ensure that the wells were not pumped dry, and ensure that flow is at a rate that does not cause turbulence in the formation.

8.2.2 Before collecting samples for VOA, **RRES-RS project participants** shall perform other sampling tasks as specified in SOP-06.02.

8.2.3 **RRES-RS project participants** shall determine if residual chlorine is present in the sampled water and, if present, use sodium thiosulfate or another appropriate material to treat the sample vials before sample collection.

**Note:** Follow the site-specific sampling and analysis plan (SAP) for pretreatment of sampling vials. Residual chlorine is not likely to occur in groundwater because chlorine is not added to groundwater.

8.2.4 To reduce the possibility for sample cross-contamination, **RRES-RS project participants** shall determine the contamination levels of wells and collect samples by moving from wells with the lowest contamination levels to those with the highest.

8.2.5 **RRES-RS project participants** shall collect VOC samples using the sampling mechanism identified as the most appropriate in the site-specific SAP.

8.2.6 If a pump is used for sampling, **RRES-RS project participants** shall follow the manufacturer's operating instructions for the specific pump being used.

8.2.7 If a syringe is used for sampling, **RRES-RS project participants** shall follow these steps:

8.2.7.1 If necessary, evacuate the syringe. Lower the sampling device to just below the well screen.

8.2.7.2 Remove the constriction from the device and allow the syringe to fill with sample by applying slight suction.

8.2.7.3 Bring the unit to the surface. If necessary, transfer the sample to Teflon septum vials.



- 8.2.8 If a bailer is used, **RRES-RS project participants** shall employ the following procedure:
- 8.2.8.1 Establish a clean working area by spreading a new plastic sheet inside a secure, delineated zone on the ground around the wellhead.
  - 8.2.8.2 Decontaminate all sampling equipment as specified in SOP-01.08.
  - 8.2.8.3 Cool the bailer and sample containers before use to approximately the groundwater temperature. Avoid exposing the bailer or sample containers to direct sunlight.
  - 8.2.8.4 Lower the Teflon closed-top, bottom-charging bailer into the water column slowly and note its depth below ground level. Stop when the bailer reaches the well's screened interval.
  - 8.2.8.5 Slowly recover the bailer; collect the cable either onto a reel or into a cleaned stainless steel bucket.
  - 8.2.8.6 Use the bailer's bottom discharge tube (Teflon) to fill the 40-ml vials by slow drainage from the tube.
  - 8.2.8.7 Repeat steps in Sections 8.2.8.3 through 8.2.8.6 as often as necessary to acquire sufficient sample quantities.
- 8.2.9 To prevent volatilization, **RRES-RS project participants** shall completely fill the septum vials (40-ml), and avoid or minimize turbulence by exercising caution and carefully pouring down the side of the vial.
- Note:** As a rule, the best way to prevent volatilization is to gently pour the last few drops into the vial so that surface tension holds the water in a "convex meniscus" and then apply the cap. Some overflow is lost using this method, but air space in the vial is eliminated. After capping, turn the vial over and tap it to check for gas bubbles. If any gas bubbles are present, repeat the procedure only once. If a second try is required, use a new sample vial.
- 8.2.10 When collecting water samples for purgeable organic compounds, **RRES-RS project participants** shall collect duplicate samples from each sampling location. **RRES-RS project participants** shall store samples to be analyzed for purgeable organic compounds in 40-ml septum vials with a screw cap and a Teflon silicone disk in the cap.

**Note:** The Teflon silicone disk prevents contamination of the sample by the cap. The vendor of the sample container should place the disks in the caps before the beginning of the sampling program. Place the disks so that, after the vial is filled, the Teflon side of the disk contacts the sample.

8.2.11 In accordance with SOP-01.08, **RRES-RS project participants** shall decontaminate the sampling equipment after each use. .

8.2.12 **RRES-RS project participants** shall acquire a sampling blank at each monitoring/characterization well to test the decontamination procedure's efficiency.

### 8.3 Prepare Documentation

8.3.1 **RRES-RS project participants** shall follow SOP-01.04 for documenting all pertinent information (e.g., weather conditions, deviations, turbidity of sample) in field notebooks or on Daily Activity Log forms.

8.3.2 **RRES-RS project participants** shall complete and affix all labels as indicated in SOP-01.04.

8.3.3 **RRES-RS project participants** shall document the calibration of field instruments as specified in SOP-06.02.

8.3.4 **RRES-RS project participants** shall document well purging as specified in SOP-06.01.

### 8.4 Conduct Postoperation Activities

8.4.1 **RRES-RS project participants** shall decontaminate the sampling equipment as instructed in SOP-01.08.

8.4.2 **RRES-RS project participants** shall make sure that all wells are properly labeled and the location identification number (ID) is readily visible on the protective casing.

8.4.3 **RRES-RS project participants** shall prepare samples and transport them to the SMO as specified in SOP-01.02, SOP-01.03, and SOP-01.04.

8.4.4 The **FTL** shall contact the SMO to ensure that samples arrive safely and the instructions for sample analyses are clearly understood, recording this information in the field notebook or on the Daily Activity Log form.

## 9.0 LESSONS LEARNED

- 9.1 Before performing work described in this SOP, **RRES-RS project participants** should go to the Department of Energy Lessons Learned Information Services home page at <http://www.tis.eh.doe.gov/II/II.html>, and/or to the LANL Lessons Learned Resources web page at [http://www.lanl.gov/projects/lessons\\_learned/](http://www.lanl.gov/projects/lessons_learned/), and search for applicable lessons.
- 9.2 During work performance and/or after the completion of work activities, **RRES-RS project participants**, as appropriate, shall identify, document, and submit lessons learned in accordance with the LANL, Lessons Learned System located at [http://www.lanl.gov/projects/lessons\\_learned/](http://www.lanl.gov/projects/lessons_learned/).

## 10.0 RECORDS

The **FTL** shall submit the following records to the Records Processing Facility (RPF), in accordance with QP-4.4:

- Daily Activity Log forms (Attachment E in SOP-01.04) or field notebooks including deviation(s) and other pertinent information
- Sample Collection Log forms (Attachment C in SOP-01.04), including any deviation or other pertinent information.
- Water Quality Sampling Record forms (Attachment B in SOP-06.01)
- Water Quality Stabilization Record forms (Attachment B in SOP-06.02)

## 11.0 REFERENCES

- 11.1 To properly implement this SOP, **RRES-RS project participants** should become familiar with the contents of the following documents located at [http://erinternal.lanl.gov/home\\_links/Library\\_proc.shtml](http://erinternal.lanl.gov/home_links/Library_proc.shtml):
  - RRES-RS Quality Management Plan
  - QP-2.2, Personnel Orientation and Training
  - QP-4.2, Standard Operating Procedure Development
  - QP-4.3, Records Management
  - QP-4.4, Record Transmittal to the Records Processing Facility
  - QP-4.9, Document Development and Approval Process, Peer Review Required
  - QP-5.7, Notebook Documentation for Environmental Restoration Technical Activities
  - SOP-01.01, General Instructions for Field Investigations

- SOP-01.02, Sample Containers and Preservation
- SOP-01.03, Handling, Packaging, and Shipping of Samples
- SOP-01.04, Sample Control and Field Documentation
- SOP-01.08, Field Decontamination of Drilling and Sampling Equipment
- SOP-06.01, Purging and Sampling Methods for Single Completion Wells
- SOP-06.02, Field Analytical Measurements of Groundwater Samples

11.2 **RRES-RS project participants** implementing this procedure should also become familiar with the contents of the documents listed below.

Document availability is indicated in parentheses:

- Barcelona, M. J., J. A. Helfrich, E. E. Garske, and J. P. Gibb, Spring 1984. "A Laboratory Evaluation of Groundwater Sampling Mechanisms," *Groundwater Monitoring Review*, pp. 32–41.
- Bennett (Bennett Sample Pumps, Inc.), 1988. "Operation Manual for the Bennett Sample Pump," Amarillo, Texas.
- EPA (US Environmental Protection Agency), September 1986. "RCRA Ground-Water Monitoring Technical Enforcement Guidance Document," EPA Office of Solid Waste and Emergency Response, Washington, D.C. (Available from the RPF, ER ID 088971).
- EPA, November 2001, "Environmental Investigations Standard Operating Procedures and Quality Assurance Manual," Environmental Services Division, Athens, Georgia. (Available at <http://www.epa.gov/region4/sesd/eisopqam/eisopqam.pdf>).
- Nielsen, D. M., and G. L. Yeates, Spring 1985. "A Comparison of Sampling Mechanisms Available for Small-Diameter Groundwater Monitoring Wells," *Groundwater Monitoring Review*, pp. 83–99.

## 12.0 ATTACHMENTS

The **user** of this SOP may locate all forms associated with this procedure at <http://erinternal.lanl.gov/Quality/user/forms.asp>.

Attachment A: Equipment and Supplies Checklist for Sampling Volatile Organics  
(1 page)

[Using a token card, click here to record "self-study" training to this procedure.](#)

If you do not possess a token card or encounter problems, contact the RRES-ECR training specialist.

## Attachment A: Equipment and Supplies Checklist

CHECK	ITEM DESCRIPTION	QUANTITY
<input type="checkbox"/>	Teflon stainless steel bladder pump and manufacturer's operating manual	
<input type="checkbox"/>	Teflon stainless steel, gear-driven submersible pump and manufacturer's operating manual	
<input type="checkbox"/>	Syringe sampler (stainless steel, Teflon, or glass) and manufacturer's operating manual	
<input type="checkbox"/>	Teflon bailer (closed-top, bottom-charging) and manufacturer's operating manual	
<input type="checkbox"/>	Teflon or other chemically inert tubing	
<input type="checkbox"/>	Fittings for pump	
<input type="checkbox"/>	40-ml amber glass vials; Teflon-lined septa	
<input type="checkbox"/>	Hach field kit for chlorine (optional)	
<input type="checkbox"/>	Sodium sulfate (Na <sub>2</sub> SO <sub>4</sub> ) crystals, if appropriate	
<input type="checkbox"/>	Hydrochloric acid (HCl) (concentrated)	
<input type="checkbox"/>	Foam sleeves, coolers, and Blue Ice (or equivalent)	
<input type="checkbox"/>	Stainless steel cable, reel, and tripod (if needed)	
<input type="checkbox"/>	Air compressor or bottled nitrogen	
<input type="checkbox"/>	Plastic sheet	
<input type="checkbox"/>	Daily Activity Log forms or field notebook	
<input type="checkbox"/>	Sample Field Chain of Custody Form	
<input type="checkbox"/>	Sample Request Paperwork	
<input type="checkbox"/>	Sample Collection Log form(s)	
<input type="checkbox"/>	Water Quality Sampling Record form(s)	
<input type="checkbox"/>	Water Quality Stabilization Record form(s)	
<input type="checkbox"/>	Custody seals	
<input type="checkbox"/>	Sample labels	
<input type="checkbox"/>	Any PPE listed or required in the SSHASP	
<input type="checkbox"/>	Any additional supplies listed in associated procedures, as needed	
<input type="checkbox"/>		
<input type="checkbox"/>		
<input type="checkbox"/>		
<input type="checkbox"/>		

**SOP-06.03, R3**

**Los Alamos National Laboratory  
RRES-Remediation Services**