Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Pump Operation**

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Document Control Coordinator.

History	Effective Date
SESDPROC-203-R2, *Pump Operation*, replaces SESDPROC-203-R1. **Title Page** Under Approvals changed Branch Chief from Antonio Quinones to Archie Lee **History:** Changed Field Quality Manager to Document Control Coordinator. **Section 1.3:** Omitted reference to the H: drive. Changed the Field Quality Manager to the Document Control Coordinator. **Section 1.4:** Updated References	November 6, 2009
SESDPROC-203-R1, Pump Operation, replaces SESDPROC-203-R0. **General** Corrected any typographical, grammatical and/or editorial errors. **Title Page** Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch. Added signature block for Bill Cosgrove. **Section 1.3** Updated information to reflect that the procedure is located on the H: drive of the LAN. Clarified Field Quality Manager (FQM) responsibilities. **Section 1.4** Alphabetized and revised the referencing style for consistency. **Section 1.5.1** Corrected the title of the Safety, Health, and Environmental Management Program Procedures and Policy Manual.	November 1, 2007
SESDPROC-203-R0, *Pump Operation*, Original Issue	February 05, 2007

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1 General Information

1.1 Purpose

This document describes procedures, methods and considerations to be used and observed when operating a variety of pumps that may be used for purging monitoring wells and for collecting samples of aqueous phase environmental media, including groundwater, surface water and certain wastewaters, for field screening or laboratory analysis.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when using pumps during the process of collecting samples of aqueous phase environmental media in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section cannot be used to obtain samples of the particular media of interest, and that another method or pump must be used to obtain said sample, use of the variant pump and/or procedure will be documented in the field log book, along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC, SESDPROC-206, Most Recent Version

SESD Operating Procedure for Groundwater Sampling, SESDPROC-301, Most Recent Version

US EPA. Analytical Support Branch Laboratory Operations and Quality Assurance Manual. Region 4 SESD, Athens, GA, Most Recent Version

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when operating the pumps described in this section. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines should be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when operating pumps used for collecting samples of aqueous environmental media:

- When using pumps for collection of environmental samples, always work from the anticipated cleanest, i.e., least contaminated location, to the most contaminated location. This minimizes the opportunity for cross-contamination to occur during sampling.
- Observe limitations of certain pumps for collection of certain analyte groups (SESD Operating Procedure for Groundwater Sampling (SESDPROC-301), Section 2, Special Sample Considerations).
- Documentation of field sampling is done in a bound logbook.
- Observe appropriate safety and cross-contamination precautions when operating pumps powered by gasoline-powered generators.

2 Peristaltic Pump

2.1 General

Groundwater sampling procedures are detailed in the SESD Operating Procedure for Groundwater Sampling (SESDPROC-301). When relatively small volumes of water are required for purging and sampling, and the water level is within the limit of suction, peristaltic pumps can be used. These pumps are generally small, light-weight, portable, and are powered by 12-volt batteries. The limit of suction is approximately 25 - 27 feet of vertical separation between the pump and water surface.

The application of these pumps differs with respect to purging and sampling. The following sections detail the use of peristaltic pumps for both purposes.

2.2 Purging with a Peristaltic Pump

The following step-by-step procedures describe the process of purging with a peristaltic pump:

1. Cut a length of standard-cleaned (SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206) Teflon® tubing, equal to the well depth plus an additional five to ten feet. Enough tubing is needed to run from the ground surface up to the top of the well casing and back down to the bottom of the well. This will allow for operation of the pump at all possible water level conditions in the well.

2. Place one end of the tubing into the vacuum side of the peristaltic pump head. Proper sizing of the Teflon® and Silastic® or Tygon® tubing should allow for a snug fit of the Teflon® tubing inside the flexible tubing mounted in the pump head.

3. Run a short section of tubing (does not have to be Teflon®) from the discharge side of the pump head to a graduated bucket.

4. Place the free end of the Teflon® tubing into the well until the end of the tubing is just below the surface of the water column.

5. Secure the Teflon® tubing to the well casing or other secure object using electrician's tape or other suitable means. This will prevent the tubing from being lost in the well should the tubing detach from the pump head.

6. Turn on the pump to produce a vacuum on the well side of the pump head and begin the purge. Observe pump direction to ensure that a vacuum is being applied to the purge line. If the purge line is being pressurized, either switch the tubing at the pump head or reverse the polarity of the cables on the pump or on the battery.

7. Purge the well according to the criteria described in Section 3 of the SESD Procedure for Groundwater Sampling (SESDPROC-301). If the pumping rate exceeds the recovery rate of the well, continue to lower the tubing into the well, as needed, until the drawdown stabilizes or the well is evacuated to dryness. If the pump is a variable speed peristaltic pump, and the water level in the well is being drawn down, reduce the speed of the pump in an attempt to stabilize the drawdown. If the well can be purged without evacuating the well to dryness, a sample with greater integrity can be obtained.

8. For wells which are not evacuated to dryness, particularly those with recovery rates equal to or very nearly equal to the purge rate, there may not be a complete exchange and removal of stagnant water in that portion of the water column above the tubing intake. For this reason, it is important that the tubing intake be placed in the very uppermost portion of the water column while purging. Standard field measurements should frequently be taken during this process to verify adequacy of the purge as described in Section 3 of the SESD Operating Procedure for Groundwater Sampling (SESDPROC-301).

2.3 Sampling with a Peristaltic Pump

It is not acceptable to collect samples for organic compounds analyses through the flexible tubing used in the pump head. When collecting samples for organic compound analyses it is necessary to use a vacuum container, placed between the pump and the well for sample collection. Samples of some inorganic constituents (i.e., metals and cyanide) may be collected directly through the tubing if a rinse blank of the tubing is collected. The vacuum container method is detailed in the following steps.

The following step-by-step procedures describe the process of sampling with a peristaltic pump (see note following these procedures for collection of VOC samples):

1. Disconnect the purge tubing from the pump. Make sure the tubing is securely attached to the protective casing or other secure object.

2. Insert the tubing into one of the ferrule nut fittings of a Teflon® vacuum container transfer cap assembly.

3. Place a suitable length of Teflon® tubing between the remaining transfer cap assembly ferrule nut fitting and the vacuum side of the flexible tubing in the peristaltic pump head. Securely hand-tighten both fittings.

4. Turn the pump on. Water should begin to collect in the transfer container (typically a 1-liter sample container) within a few minutes. If water does not begin to flow into the container within several minutes, check the transfer

cap fittings and make sure the assembly is tightly attached to the container. It may be necessary to tighten the ferrule nuts with a wrench or pliers to achieve a vacuum in the system, particularly when approaching the maximum head difference between the pump and water table (limit of suction).

5. When the transfer container is nearly full, turn off the pump, remove the transfer cap assembly, and pour the sample into the appropriate containers. Because the 1-liter containers used by the Branch are rinsed with nitric acid during cleaning, they cannot be used for collecting samples to be analyzed for nitrogen sensitive parameters.

6. If additional sample volume is needed, replace the transfer cap assembly, turn the pump on, and collect additional volume. The use of Teflon® valves or ball check devices to retain the water column in the sample delivery tubing during the transfer phase, when large volumes of sample are required, is acceptable. These devices, however, must be constructed so that they may be completely disassembled and cleaned according to the procedures in SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205).

7. When sampling is completed, all Teflon® tubing should be discarded.

NOTE: Samples for volatile organic compound analyses cannot be collected using this method. If samples for VOC analyses are required, they must be collected with a Teflon® or stainless steel bailer or by other approved methods, such as the "soda straw" method. The "soda straw" method involves allowing the tubing to fill, by either lowering it into the water column (A) or by filling it via suction applied by the pump head (B). If method (A) is used, the tubing is removed from the well after filling and the captured sample is allowed to drain into the sample vial. If method (B) is used, after running the pump and filling the tubing with sample, the pump speed is reduced and the direction reversed to push the sample out of the tubing into the vials. Avoid completely emptying the tubing when filling the sample vials when using method (B) to prevent introducing water that was in contact with the flexible pump head tubing. Either method is repeated, as necessary, until all vials are filled.

3 Small Diameter Electric Submersible Pumps

3.1 General

Included within this category is the Grundfos® Redi-Flo2 small diameter electric submersible pump. With a diameter of approximately 1.75 inches, it is designed to be used in 2-inch diameter and larger wells. (Note: If used in any well larger than 4-inch diameter, this pump must be equipped with a cooling shroud to prevent the pump from overheating. If this condition occurs, internal sensors will send a shut-off signal to the controller and the pump will not be operable until it cools to a temperature within the operating range). The Redi-Flo2® is a variable speed pump capable of providing pump rates from less than 100 ml/minute to in excess of 8 gallons per minute.

The pump, depending on the controller being used, operates with either 115v or 220v power. The pump rate is controlled by adjusting the frequency of the current going to the pump motor. It is a light-weight pump and can be easily handled by one person when lowering, but two people are generally needed when removing the pump, one to pull and another to reel in the hose and power lead.

3.2 Safety

1. Place the generator on dry ground or plastic sheeting as far as practical from the well, in the down-wind direction, and ground it. Several grounding kits consisting of a roll of copper wire and a grounding rod are available. Wet the ground thoroughly with tap water at the grounding location, if dry, and drive the grounding rod several feet into the ground.

2. Inspect the electrical extension cord, as well as the lead to the pump, for frays, breaks, exposed wiring, etc.

3. Check the head space of the well for the presence of an explosive atmosphere with a combustible gas meter.

4. Wear rubber boots to insulate against shock hazards.

5. If purge water is not collected, direct the discharge away from the well and generator, preferably down gradient of the area.

6. Make sure that the generator is set to the proper voltage.

7. Do not add gasoline or oil to the generator while it is running.

8. Store the generator, gasoline, and oil in a trailer dedicated to this type of equipment. Do not haul this equipment in the back of any passenger vehicle or with any sampling equipment or containers.

3.3 Pre-Loadout Checkout Procedures

1. Check the oil and gasoline in the generator, making sure that there is enough gasoline to test the generator prior to loading onto the trailer. Take the generator outside and start. Place a load on the generator, if possible.

2. Inspect the pump and all hoses, rope, and electrical cord and connections. In particular, open the water reservoir on the bottom of the pump and check to make sure that it is full of water. If not, using the syringe in the controller case, top the reservoir off with organic-free water. Return the pump to its operating vertical position and shake. Re-open the reservoir and add additional water, if needed, to top it off a second time.

3.4 Operation

1. Place the pump, the controller, and enough hose for the measured well depth on plastic sheeting next to the well. Set the generator in a dry, safe location downwind of the well, but do not plug the cord from the controller into the generator.

2. Lower the pump, power lead, and hose into the well, placing the pump approximately five feet into the water column.

3. Start the generator, then connect the power cord from the pump. Make sure the proper voltage has been selected.

4. After starting the pump, closely observe operation to determine if drawdown is occurring in the well. If the water level is not pulled down, raise the pump in the water column one to two feet from the top of the water column and continue to purge. If the water level drops, however, lower the pump to keep up with the drawdown. Do not allow the pump to run dry. This condition will create a thermal overload and shut the pump down. While this may not necessarily damage the pump, it will create delays in sampling.

3.5 Maintenance and Precautions

1. Empty the hose of contaminated water before leaving the sampling location. Do not bring the hose back to the FEC if it contains purge water from a site.

2. Field clean the pump prior to using at the next sampling location in accordance with the SESD Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205-R0).

3. Do not run the generator without first checking the oil.

4. Do not put the pump in the trailer with the generator.

5. If the pump is equipped with a check valve or back flow preventer, periodically check this device to make sure that it is operating. This is a common place for debris or other material to accumulate and interfere with the proper operation of the device.

3.6 Trouble Shooting

Generator running, no pump output	1.	Loose connection at pump.	1.	Check wiring at pump. Repair as needed. (Generator off!!)
	2.	Cord unplugged at generator.	2.	Plug pump back in.
	3.	Over voltage on controller display.	3.	Adjust generator output/idle speed; allow generator more warm-up time.
	4.	Pump out of water.	4.	Lower pump into water.
	5.	Hose collapsed or kinked.	5.	Un-kink hose.
	6.	Pump will not run or shuts down with thermal overload signal.	6.	Open cooling water reservoir and check cooling water. Add additional organic-free water to cooling water reservoir.

4 Geoprobe® GW 1400 Series Bladder Pump

4.1 General

The Geoprobe® GW 1400 Series Bladder Pump can be used for purging small diameter temporary monitoring wells pushed with the Geoprobe®. These pumps represent one of only a few types of pumps that are capable of fitting inside the ID of the probe rod and that are also capable of pumping ground water whose water level is below the limit of suction.

The GW 1400 Series® pump operates by cycling a pressurized gas on and off in a discharge and refill cycle. The gas, usually atmospheric air, is pressurized and regulated by a compressor/regulator combination (the GW 1400 Pneumatic Pump Controller). The basic operation is as follows.

4.2 Operation

1. Connect air supply hose to the gas inlet connection (male) on controller. Run air line from gas outlet (female) to gas inlet on pump.

2. Lower pump into well and place top of pump several feet below the top of the water column.

3. Open air supply (gas cylinder) or turn on the compressor. If a gasoline-powered compressor is used, place as far from the well as possible, in the down wind direction.

4. Adjust the timing of the discharge and refill cycles on the GW 1400 Pneumatic Pump Controller until maximum flow is achieved.

5. Lower pump, as necessary, if water level is lowered in well.

4.3 Trouble Shooting

Compressor running//Gas supply on, no pressure on discharge cycle	1.	Air supply fittings loose.	1.	Check all fittings and tighten.
	2.	Bladder is perforated.	2.	Replace bladder.
	3.	Exhaust adapter installed in wrong direction.	3.	Remove adapter and replace in correct orientation.
Compressor running/ Gas supply on, pressure low, no water discharged	1.	Obstruction in ball check assembly allowing water to be pushed out of pump at check.	1.	Remove obstruction.
	2.	Air supply fittings loose.	2.	Check all fittings.

5 Geoprobe® Model MBP 470 Mechanical Bladder Pump

5.1 General

The Geoprobe® Model MBP 470 Mechanical Bladder Pump can be used for purging small diameter temporary monitoring wells pushed with the Geoprobe®. These pumps represent one of only a few types of pumps that are capable of fitting inside the ID of the probe rod and that are also capable of pumping ground water whose water level is below the limit of suction.

5.2 Operations

The Geoprobe® Model MBP 470 Mechanical Bladder Pump operates by manually or mechanically cycling a corrugated FEP Teflon® bladder contained within a small diameter pump body. The basic operation is as follows.

1. Following manufacturers guidelines, construct bladder pump and tubing assembly.

2. Lower pump into well and place top of pump several feet below the top of the water column.

3. Secure outer tubing to probe rod. After securing outer tubing to probe rod, inner tubing is cycled up and down with an approximately 6-inch stroke. These compressions set the ball check and push water to the surface. After sufficient cycles, ground water will discharge from the inner tubing. The up and down cycles can be achieved either manually or by securing the inner tube to a mechanical actuator.

4. Lower pump, as necessary, if water level is lowered in well.

5.3 Trouble Shooting

Compressor running//Gas supply on, no pressure on discharge cycle	1.	Air supply fittings loose.	1.	Check all fittings and tighten.
	2.	Bladder is perforated.	2.	Replace bladder.
	3.	Exhaust adapter installed in wrong direction.	3.	Remove adapter and replace in correct orientation.
Compressor running/ Gas supply on, pressure low, no water discharged	1.	Obstruction in ball check assembly allowing water to be pushed out of pump at check.	1.	Remove obstruction.
	2.	Air supply fittings loose.	2.	Check all fittings.

6 Inertial Pump (Waterra®)

6.1 General

The inertial pump is basically a string of Teflon® tubing with a small diameter check valve affixed to the lower end of the tubing. It is a very simple device that can be used to move small volumes of water from inside small diameter well casing or probe rod. The inertial pump operates by manually or mechanically cycling the length of tubing and attached check valve up and down in the water column. The basic operation is as follows.

6.2 Operation

1. Affix small diameter check valve to bottom of Teflon® tubing cut to sufficient length to reach from surface to the intended purging/sampling depth, allowing, if necessary, for drawdown in well.

2. Either by hand or by attaching the tubing to a mechanical actuator, rapidly move tubing and check valve up and down in the water column.

3. During each cycle, as the tubing is plunged downward in the water column, water will move upward through the check valve, pass the ball check. On the upward stroke, the ball check will seat in the check valve, capturing the water that has just move up into the tubing.

4. Lower tubing, as necessary, if water level is lowered in well.