Immediate Procedure Change (IPC) Cover

Section 1 – Originator Request

Document No.: EP-DIV-SOP-20032	Revision No.: 3	IPC No.: 1

Title: Groundwater Sampling

Description of need and requested action (Attach document mark-up and numbered additional sheets, if needed):

Error in mg/L for DO stability. Change from 0.2 mg/L to 0.3 mg/L on page 14, Sec. 4.3, Purging Operations 3rd sentence.

Originator Name (print): Tim Goering	Organization: CAP-ES	Z#: 140890	Date: 10/27/14

Section 2 –Reviews

Discipline:	Name:	Signature:	Date:
CAP	Danny Katzman	/s/ Danny Katzman	10/27/14
CAP	Steve Paris	/s/ Steve Paris	10/27/14

USQ/USI Number: EWMO-14-450-D ☐ N/A

Section 3– Final Approvals

FOD Concurrence: N/A	Print Name and Title: N/A	Z#: N/A	Date: N/A
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Comments:

Responsible Line Manager Signature: /S/Craig Douglass	Print Name and Title: Craig Douglass, Deputy Prog. Mgr.	Z#: 216051	Date: 10/28/14

EP-DIV-SOP-20032, R3 IPC-1

GROUNDWATER SAMPLING

Effective Date: 8/21/14

Procedure Owner:	Signature:	Date:
Craig Douglass	/s/ Signature on File	8/14/14

REVISION HISTORY

Document No./ Revision No.	Issue Date	Action	Description
SOP-5232, R0	02/24/2009	Major Revision	Replaces procedures RRES-WQH-SOP-048 and RRES-WQH-SOP-049. Incorporates NMED purging requirements specified in the NMED “Notice of Approval with Modifications for 2008 Interim Facility-Wide Groundwater Monitoring Plan,” NMED November 12, 2008. Incorporates revised indicator parameter stability criteria, and restrictions on excessive drawdown and pumping rates.
SOP-5232, R1	09/23/2010	Revision	SOP updated to current field practices. Alluvial sampling requirements clarified. Technical procedures for all pump systems clarified. Technical language corrected and standardized. Attachment 10 (Baski Pumping System) revised to provide additional direction on the operation of Baski packer system valves, gauges, and fittings, as applicable, and to require limited system inspections.
EP-DIV-SOP-20032, R0	10/14/2011	Revision	New document number assigned; supersedes SOP-5232; major revisions. Updated SOP to modify sampling requirements and stability criteria. Added attachments addressing the following: • Sampling using a hand-bailer, • Low-flow purging and sampling, • Sampling production and domestic wells, and • Obtaining quality field parameters.
EP-DIV-SOP-20032, R1	02/12/2013	Major Revision	Field parameter stability criteria updated for clarification. Purging and sampling procedures clarified. Procedures for filtration and preservation of samples added. Added Attachment 11: Peristaltic Pump System.

History of Revisions (cont.)

EP-DIV-SOP-20032, R1 IPC-1	04/3/13	IPC	The SOP was revised to remove the requirement for field crews to have a backup field instrument in possession during implementation of the procedure.
EP-DIV-SOP-20032, R2	08/21/13	Major Revision	SOP revised as follows: • The requirement for performance checks on field instrumentation between two sampling locations sampled in the same day was eliminated. • Minimum calibration frequencies were prescribed for field parameter instrumentation. • Requirement for backup field instrumentation was reinstated. • References to cancelled procedure ENV-WQH-SOP-014 were removed.
EP-DIV-SOP-20032, R3	8/21/14	Major Revision	• The requirement for carrying backup instruments has been removed. • The SOP provides guidance on maintaining a constant pumping rate during purging and on limiting drawdown when sampling intermediate and regional wells. • Field indicator parameter stability criterion for dissolved oxygen is increased from 0.2 mg/L to 0.3 mg/L to be consistent with EPA guidance and the requirements of the USGS Field Manual.
EP-DIV-SOP-20032, R3 IPC-1	10/29/14	IPC	• Corrected Page 14 from 0.2 mg/L to 0.3 mg/L.

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1. PURPOSE AND SCOPE

This standard operating procedure (SOP) describes the methods used to collect groundwater samples from alluvial, intermediate, and regional wells. This includes all wells sampled using electric gear-driven submersible pumps (GSP), bladder pumps, Bennett pumps, Baski pumps, hand bailers, and portable versions of the bladder pump, GSP pump, and Bennett pump. The processes described include purging the wells, measuring field parameters, collecting samples, documenting the sampling process, submitting samples to Sample Management Office (SMO), and setting up and breaking down all sampling systems.

Groundwater sampling with the Westbay MP System is described in SOP-5225, Groundwater Sampling Using the Westbay MP System. Groundwater sampling from spring and base-flow sites is described in SOP-5224, Spring and Surface Water Sampling.

2. BACKGROUND

The objective of the groundwater sampling program at Los Alamos National Laboratory (LANL) is to collect samples that are representative of physical and geochemical conditions in the targeted hydrogeologic unit (USGS, 2006). Sample quality can be affected by the methods used to collect and handle samples as well as by variability within these methods as applied by different sampling personnel. Because of variability between sampling locations, no one method can be applied to all groundwater sampling. Instead, site-specific considerations such as sampling objectives, equipment availability, site location, and physical constraints must be taken into account when deciding how to collect the most representative samples at a given location (Yeskis and Zavala, 2002).

The general criteria for sampling groundwater are provided in section 4.3.8. Some wells historically do not meet all the purging-volume requirements or field-stability criteria described in section 4.3; in these cases, well-specific work plans may be submitted by the groundwater technical lead (GTL) providing additional direction. The additional direction may include alternative purging and field parameter–stability requirements for sampling, and in these cases, the work plan requirements will supersede the requirements of this SOP.

The U.S. Environmental Protection Agency (EPA) (Yeskis and Zavala, 2002) and the U.S. Geological Survey (USGS, 2006) recommend purging a well before sampling to remove stagnant water and to ensure the samples collected from the monitoring well are representative. EPA outlines two purging methods to remove stagnant water from a well casing before sampling: the “low-flow approach” and the “well-volume approach.” Site-specific characterizations should be taken into consideration when deciding which method to use; however, most wells on LANL property are sampled using the well-volume approach described in section 4 of this SOP. The low-flow approach is discussed in Attachment 14 and may be used with the approval of the GTL.

2. BACKGROUND (continued)

When the well-volume approach is used, ideally, a well should be purged with minimal drawdown until a predetermined volume of water (typically 1 to 3 casing volumes [CVs]) has been purged and field water-quality indicator parameters (pH, specific conductance [SC], dissolved oxygen [DO], and turbidity) stabilize. Water-quality indicator parameters are usually monitored at 3- to 5-min intervals until stability has been achieved. Once the parameters stabilize, it is assumed all stagnant water has been removed from the well, and representative formation water is available for sampling. The field indicator parameter criteria for defining stability are discussed in section 4.3, Purging Operations.

3. EQUIPMENT AND TOOLS

Refer to Attachment 1, Equipment and Supplies Checklist for Groundwater Sampling.

4. STEP-BY-STEP PROCESS DESCRIPTION

4.1 Sampling Preparation

Field Team Leader

[1] Print out the applicable analytical request/chain-of-custody form(s) from the SMO database before leaving for the field.

[2] Review the sampling plan for the current sampling activity to ensure samples are collected as specified and discuss any purging, sample collection, or site issues with the GTL.

[3] Obtain and review pertinent information, such as the well construction diagrams or the well completion report. This well construction information will be entered on the Groundwater Sampling Log (Attachment 2) and in the field logbook.

[4] Before sampling, ensure that a process is in place for storing and disposing of purged water and that proper storage capacity is available for any purge water generated. Contact the waste coordinator for instructions on containerization or other waste handling measures. Samplers will use the appropriate waste disposal path for all other generated wastes.

[5] Ensure that work activities are on an approved plan of the day for the appropriate facility in which work will be performed before starting any field or laboratory activities.

4.1 Sampling Preparation (continued)

[6] Assemble the required equipment and supplies for the particular pump system according to the Equipment and Supplies Checklist for Groundwater Sampling (Attachment 1).

[7] Assemble and review information from previous sampling events, including observed depth-to-water measurements, casing and purge volumes, and ranges of drawdown and historical field parameter values. These historical data should be compared with the values measured during sampling, and if they vary significantly from present values, contact the subcontract technical representative (STR) or GTL for additional guidance.

[8] Calibrate the YSI meter and the Hach turbidimeter at the frequency listed in the table below. The YSI meter should be calibrated within 24 h of use for parameters that are calibrated daily.

Field Parameter	Required Calibration Frequency
pH	Daily – 3-point calibration
Temperature	No calibration required
Specific Conductance	Weekly
Turbidity	YSI – Daily 3-point calibration at the beginning of each week 1-point calibration subsequent days during the week Hach – Every 3 mo
Dissolved Oxygen	Daily
Oxidation-Reduction Potential (ORP)	Daily

4.2 System Setup for Sampling

Field Team Member

[1] Mobilize the support equipment required for purging and sampling the well. Begin logging sampling activities in the field logbook, following the requirements in SOP-5181, Notebook and Logbook Documentation for Environmental Directorate Technical and Field Activities. All times should be recorded in logbooks and field forms in Mountain Standard Time, unless otherwise noted. Sampling times should be recorded in Daylight Savings Time, when applicable, on sample labels and chain-of-custody forms.

4.2 System Setup for Sampling (continued)

Field Team Leader

[2] If a large generator is required, follow the requirements of the appropriate integrated work document related to generator use.

[3] Follow the appropriate attachment for setup of the pumping system to be used:

- Attachment 5 Electric Gear-Driven Submersible Pump System
- Attachment 6 Bladder Pump System
- Attachment 7 Portable Bladder Pump System
- Attachment 8 Bennett Pump System
- Attachment 9 Portable Bennett Pump System
- Attachment 10 Baski Pumping System
- Attachment 11 Peristaltic Pump System
- Attachment 12 Hand-Bailer Purging and Sampling System

[4] Set up the flow-through cell system, if applicable, for the pump type and the field parameter instruments to be used during the purging operation.

[5] Decontaminate all equipment that will be placed inside monitoring wells before placement in accordance with the provisions of EP-ERSS-SOP-5061, Field Decontamination of Equipment.

4.3 Purging Operations

Field Team Member

[1] Determine the depth of the water table using one of the methods below, and record the information in the Groundwater Sampling Log (Attachment 2)

- If a water-level transducer is installed in the well, record the water-level elevation in the Groundwater Sampling Log (Attachment 2).
- If a water-level transducer is not present, determine the water level using one of the methods described in SOP-5223, Manual Groundwater Level Measurements, and record the depth to water in the Groundwater Sampling Log (Attachment 2).

4.3 Purging Operations (continued)

- Measure water levels in alluvial wells manually. Transducers in alluvial wells are often located above the pump and are frequently set to measure depth of water rather than to measure water-level elevation.

[2] Determine the volume of water in the casing as follows:

- Determine the linear feet of water column by the difference between the total depth of well and the water level determined in Step 1 above.
- Calculate the CV using the well diameter multiplier from Table 1 or using the equation

$$V = 0.0408\ d^2h$$

where d = inner diameter of well in inches

h = height of the water column (feet). [This value may be determined by subtracting the depth to water from the total depth of the well as measured from the same reference point.]

V = volume of water in gallons

Table 1
Calculation of Casing Volume Based on Well Diameter

Inner Diameter of Casing/ Drop Pipe (in.)	Gal./ft 1 CV	Gal./ft 3 CVs
3/8	0.006	0.018
0.5	0.010	0.030
1	0.041	0.123
1.5	0.092	0.276
2	0.163	0.489
2.1	0.174	0.522
2.5	0.255	0.765
3	0.367	1.101
3.5	0.500	1.500
4	0.653	1.959
4.5	0.826	2.487
5	1.020	3.060
5.5	1.234	3.702
6	1.469	4.407
8	2.521	7.563
10	4.080	12.240
12	5.875	17.625

4.3 Purging Operations (continued)

If the well has a dedicated pump, calculate the volume of water in the drop pipe by subtracting the water-level elevation from the surface elevation and using the drop pipe inner diameter multiplier, provided in the table above and in the front matter of the logbook.

NOTE: This step is not necessary for alluvial wells because the contribution from the drop pipe is negligible.

If the well has multiple screened intervals, well-casing volume calculations are complicated by the presence of packers in the water column. Refer to well completion information to determine the appropriate water-column value. If a packer is located below the screened interval, the elevation of the top of that packer may be used as the total depth value for calculations made for that screen. If a packer is located above the screened interval, the elevation of the bottom of that packer may be used as the water-level value for calculations made for that screen.

[3] Determine the minimum required purge volume based on whether the well is completed in an alluvial aquifer or in an intermediate/regional aquifer.

- Alluvial wells are to be purged a minimum of 1 CV **and** until the water-quality parameters stabilize, as defined below.
- Intermediate and regional wells are to be purged a minimum of 3 CVs plus the volume of the drop pipe **and** until water-quality parameters stabilize as defined below.

In some cases, purge-volume and/or field-parameter stability requirements cannot be met or special sampling requirements may need to be implemented. In these cases, a sampling work plan approved by the GTL will be issued with additional direction. This work plan will supersede the requirements of this SOP.

Record the calculated 1-CV and 3-CV purge volumes in the Groundwater Sampling Log in Attachment 2.

4.3 Purging Operations (continued)

[4] Begin pumping following the steps in the appropriate attachment for the pump being operated:

- Attachment 5 Electric Gear-Driven Submersible Pump System
- Attachment 6 Bladder Pump System
- Attachment 7 Portable Bladder Pump System
- Attachment 8 Bennett Pump System
- Attachment 9 Portable Bennett Pump System
- Attachment 10 Baski Pumping System
- Attachment 11 Peristaltic Pump System
- Attachment 12 Hand-Bailer Purging and Sampling

[5] Maintain a constant rate of pumping during purging and maintain *the pumping rate during sample withdrawal and collection*. Fluctuations in pumping rate will affect sample quality.

[6] Limit drawdown in intermediate and regional wells to above the screened interval, where possible. The optimal pumping rate should be determined based on well performance during previous sampling events. If previous sampling events drew water levels into the screened interval, the pumping rate during the current sampling event should be reduced, if possible, to minimize the potential for drawdown into the screened interval, unless otherwise directed. Limit drawdown in alluvial wells by pumping at 0.25 gallons per minute or less.

If drawdown into the screened interval occurs (as is sometimes inevitable), note this in the field logbook.

NOTE: Ideally, the pumping rate while purging intermediate and regional wells should be fairly stable; avoid turning off the pump unless absolutely necessary (such as when changing nitrogen tanks when using a Bennett pump). However, the pumping rate may need to be reduced for wells with limited yield to avoid purging the wells dry. As water enters a well that has been purged to dryness, it may cascade down the filter pack and/or the well screen, stripping volatile organic constituents that may be present and/or introducing soil fines into the water column.

Wells should be sampled as soon as possible after purging, once sufficient recovery has occurred.

4.3 Purging Operations (continued)

[7] Determine the discharge rate using an in-line flow meter or making manual measurements of discharge and record in the field logbook and in Attachment 2. Monitor flow rate at regular intervals during the purge, preferably once per casing volume, and while the drop pipe is being cleared. If both methods are used and the calculated discharge rates are not the same, use the manually calculated discharge rate for total purge volume calculations.

If an in-line flow meter is installed, record the flow rate. Indicate that the flow meter was used for flow rate calculations by recording "flow meter" in the discharge calculation method field on the Compliance Checklist (Attachment 3).

If a flow meter is not available or is suspected to be inaccurate, calculate the discharge rate manually. Fill a bucket or bottle of known volume and divide by the fill time. Convert to gallons per minute, if necessary. Indicate that the flow rate was calculated manually by recording "manual" in the discharge calculation method field on the Compliance Checklist (Attachment 3).

When using the flow meter method, record the number of gallons reported on the flow meter before the pump is turned on. Add the total purge volume to this number to determine what the flow meter should read when the purge has been completed.

When using the manual method, to determine the cumulative purge volume at any point during the purge, multiply the total purge time by the calculated discharge rate. To determine at what time the minimum purge volume requirement will be met, divide the total volume to be purged by the discharge rate. If the discharge rate changes at any point during the purge, record the time that the rate changed and the total volume purged until that point. Then, recalculate the required time to complete the purge using the new discharge rate.

[8] Measure the field water-quality indicator parameters below at least twice per CV, with the first set of parameters recorded immediately after clearing the drop pipe. As the minimum required purge volume is approached, the field indicator parameters may need to be measured more frequently to determine stability. Measurements used to determine stability should be taken at approximately 5-min intervals (or 3-min intervals for wells that purge within 20 min or less).

4.3 Purging Operations (continued)

Record the data for the following parameters in the Groundwater Sampling Log (Attachment 2).

- pH
- Temperature
- SC
- DO
- Turbidity
- ORP
- Water level
- Observations of water clarity, color, and odor

[9] When using a multiparameter water-quality instrument with the ability to log parameters, record the parameters every 3 to 5 min, with the recommended frequency no greater than the time required to purge 1 volume of the flow-through cell.

[10] Review the parameters being monitored periodically (about every CV), and recalculate the discharge rate as described in Step 5 above.

[11] In general, sample the well when the following criteria have been met:

Field indicator parameters are stable and a minimum of 1 CV has been removed for alluvial wells and a minimum of 3 CVs (plus drop pipe) have been removed for intermediate or regional wells.

If 3 CVs have been purged from alluvial wells or 6 CVs have been purged from intermediate or regional wells, proceed with sampling even if field-indicator parameters do not stabilize. The STR should be notified in the daily status report if wells were sampled without obtaining stable indicator parameters.

4.3 Purging Operations (continued)

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Stabilization occurs when, for at least three consecutive measurements, the pH remains within 0.2 Standard Unit (SU), SC varies no more than 3%, DO varies no more than 0.3 mg/L, and turbidity is less than 10 nephelometric turbidity units (NTU) (see Table 2). To calculate stability, subtract the lowest of the final three readings from the highest of the final three readings. This number should be less than or equal to the given allowable range (i.e., 0.2 SU for pH). To calculate stability when the stability criteria are defined by a percentage, calculate the allowable range using the median value of the final three readings.

- Measure DO using a flow-through cell to minimize oxygenation of the sample during measurement
- Highly effervescent water will affect turbidity and SC readings, with significant differences between consecutive readings as a result of effervescence. Obtain more accurate turbidity readings by manually measuring turbidity in effervescent water with the Hach turbidimeter (or equivalent), applying a partial vacuum to the turbidimeter sample cell using a sample degassing kit. Do not remove air bubbles by letting the sample stand for a period of time. Similarly, obtain more accurate SC readings in highly effervescent water by measuring the SC outside the flow-through cell in a calibration cup. If readings are taken using a meter other than the primary YSI meter, explain the deviation in detail in the logbook.
- If excessive turbidity is anticipated or encountered with the pump startup, collect initial parameters outside of the flow-through cell (i.e., using the calibration cup) to minimize particulate buildup in the cell.
- Although turbidity of 10 NTU is normally considered the minimum goal for groundwater sampling objectives, one can achieve lower turbidity (<5 NTU) in most situations, and the sampling team should make reasonable attempts to achieve these lower levels within the standard purge volume requirements if turbidity is trending downward rapidly.

4.3 Purging Operations (continued)

Table 2
Stabilization Parameters

Field Parameter	Field Indicator Parameter Stability Criteria (for at least 3 consecutive measurements)	References
Turbidity	<10 NTUs, or If turbidity ≥ 10 NTUs, turbidity should vary no more than 10%.	Yeskis and Zavala, 2002
DO	DO varies no more than 0.3 mg/L	Yeskis and Zavala, 2002; USGS Field Manual, 2006
pH	pH varies no more than 0.2 SU	Based on accuracy limit of pH probe
SC	For SC>100 µS/cm, SC varies no more than 3%, or for SC≤100 µS/cm, SC varies no more than 5%	Yeskis and Zavala, 2002; Puls and Barcelona, 1996; USGS Field Manual, 2006

[12] Sample monitoring wells immediately after purging, unless site-specific conditions preclude it (e.g., if some wells are too low-yielding). This minimizes the time for physical and chemical alteration of water in the well casing. Where immediate sampling is precluded, begin sample collection no later than 24 h after purging.

NOTE: In some situations, even with reduced pumping rates, a well may go dry during purging. In these situations, the above constitutes an adequate purge, and it is not necessary to purge 3 CVs. The well can be sampled following sufficient recovery.

[13] Collect a final set of field parameter measurements (stability criteria) immediately before sampling. Record the stability criteria in the Attachment 2, Groundwater Sampling Log, and in Attachment 3, Compliance Checklist.

[14] Record the purge volume (volume purged at time of sampling minus the drop pipe volume) in the Attachment 2, Groundwater Sampling Log.

NOTE: The GTL may submit well-specific work plans, as appropriate, that provide additional direction for purging, either for wells that cannot meet these requirements or that must be purged for more than the standard 1 to 6 CVs. The work plans may include alternative purging and field parameter stability requirements that supersede the requirements of this SOP.

4.4 Sampling

Field Team Member

[1] Never sample through in-line flow-through cell.

[2] Observe the following general precautions during sampling:

- The rate of pumping during purging should remain constant *and be maintained as the pumping rate for sample withdrawal and collection*. Fluctuations in pumping rate affect sample quality.
- There may be times during purging when a decision may need to be made whether to reduce the pumping rate, limiting drawdown into the screened interval, or to maintain a constant pumping rate, allowing drawdown into the screened interval. In these cases, maintaining a constant pumping rate has a higher priority than limiting drawdown into the screened interval, unless otherwise directed.
- The pumping rate at which a well is sampled should not exceed the rate at which it was purged. During sampling, the flow rate into the sample bottles may be adjusted to minimize aeration of the sample while filling the bottles.
- Decontaminated sampling equipment should not come in contact with the ground.

[3] In wells with limited water, collect a prioritized (limited) analytical suite, as appropriate. Use the well-specific or monitoring group–specific prioritized suite provided by the GTL.

[4] Exercise care when collecting samples to be analyzed for volatile organic compounds (VOCs), and follow the guidelines below (USGS, 2009):

Store sample bottles in a VOC-free area until preparing for a sampling event (away from gasoline, office supplies, and cleaning equipment).

When transporting samples and sample bottles, use secondary containment to minimize the potential for contamination (such as storing in a closed cooler or sealed bag).

When labeling sample bottles, use a ball-point pen, not felt-tip markers.

Rinse any sampling equipment (sampling trees, tubing) that will contact water used to analyze for VOCs thoroughly before sampling. This is typically accomplished during purging.

4.4 Sampling (continued)

To prevent volatilization, minimize turbulence in the bottle by filling it slowly and pouring the water down the side of the bottle.

When collecting samples in 40 mL, pre-preserved vials, ensure that little to no head space occurs once the cap is screwed on completely. Do not allow the vial to overflow. When transporting the sample, ensure that the septum on the cap does not contact anything that might contaminate it.

[5] Record the final water-level immediately after sampling in the Groundwater Sampling Log (Attachment 2). Record the total volume of waste water generated as well as the contact waste volume.

[6] Filter samples that require filtration before they are preserved.

Some pumps do not generate sufficient pressure to force the water through the filter. In these cases, collect water in a clean secondary container and use a peristaltic pump to filter the samples.

Filter the sample immediately after collection in a manner that minimizes aeration. Do not allow the filter cake to become too thick, as indicated by reduced flow. Discard the first 150 mL to 200 mL of the sample to allow the filter to chemically equilibrate with the groundwater. If insufficient sample water is available or if the well typically has high turbidity, use deionized (DI) water to prerinse the filter. Filtration must always precede preservation and should be performed in the field.

[7] Preserve the sample immediately after filtration using the appropriate preservatives identified on the field chain-of-custody form. Preservation should always be conducted in the field.

NOTE: Exercise extreme care when using acids and bases. Use gloves, protective eyewear, and long sleeves. Add preservative to the sample bottle then invert the bottle to mix it. Avoid shaking the bottle. Use a precleaned pipette to put a small amount of the water on a pH strip to ensure the sample has been properly preserved. The pH should be <2 for samples preserved with acid and >12 for samples preserved with a base.

[8] Seal the lid of every sample container with a custody seal (i.e., custody tape) to ensure samples are not tampered with. Do not place the custody seal over a VOC vial septum.

[9] Complete the field chain-of-custody form for each sample set collected.

4.4 Sampling (continued)

[10] Handle, package, and transport the samples in accordance with EP-ERSS-SOP-5057, Handling, Packaging, and Transporting Field Samples. Place samples on ice for shipment to the laboratory.

4.5 System Disassembly/Breakdown

Field Team Member

[1] Remove and rinse any equipment that has been in contact with the groundwater stream such as the water-level measuring tape, in-line flow-through cell and all monitoring parameter probes using DI water, and wipe dry with a paper towel. Refer to EP-ERSS-SOP-5061, Field Decontamination of Equipment, for specific guidance.

[2] Secure contact waste in a labeled drum or place in location specified by the waste characterization strategy form.

[3] Secure the waste water container(s).

[4] Secure all field equipment.

[5] Secure and lock well.

[6] Transport all sealed sample containers directly to the SMO. If this is not possible, store samples and their chain-of-custody forms overnight in the locked refrigerator at Technical Area 64.

5. RECORDS PROCESSING

Field Team Member

[1] Maintain and submit records and/or documents generated to the Records Processing Facility according to EP-DIR-AP-10003, Records Management Procedure for ADEP Employees.

6. REFERENCES

ASTM, 2002. Standard practice for low-flow purging and sampling for wells and devices used for ground-water quality investigations, ASTM D6771-02, American Society for Testing and Materials. West Conshohocken, PA. 7 pp.

Compliance Order on Consent, March 1, 2005 (Revised April 20, 2012).

EPA, 2007. SESD Standard Operating Procedure, Groundwater Sampling.

Puls, R. and Barcelona, M., 1996. Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. U.S. Environmental Protection Agency Ground-Water Issue Paper, 540-S-95-504. 12 pp.

USGS, 2006. National Field Manual for the Collection of Water-Quality Data. Chapter A4. Collection of Water Samples, V. 2.0. 231 pp.

USGS, 2009. Office of Water Quality Technical Memorandum 2009.04. Reminders of How to Minimize Contamination of Volatile Organic Compound Samples. 13 pp.

Yeskis, D. and Zavala, B., 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. U.S. Environmental Protection Agency Ground-Water Forum Issue Paper, 542-S-02-001. 53 pp.

7. ATTACHMENTS

Attachment 1	Equipment and Supplies Checklist for Groundwater Sampling
Attachment 2	Groundwater Sampling Log
Attachment 3	Compliance Checklist
Attachment 4	Obtaining Quality Field Parameters
Attachment 5	Electric Gear-Driven Submersible Pump System
Attachment 6	Bladder Pump System
Attachment 7	Portable Bladder Pump System
Attachment 8	Bennett Pump System
Attachment 9	Portable Bennett Pump System
Attachment 10	Baski Pumping Systems
Attachment 11	Peristaltic Pump System
Attachment 12	Hand-Bailer Purging and Sampling System
Attachment 13	Sampling Production and Domestic Wells and Sampling Wells during Drilling Activities
Attachment 14	Low-Flow Purging and Sampling Approach

Click here for “Required Read” credit.

Attachment 1
Equipment and Supplies Checklist for Groundwater Sampling
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- ☐ Field logbook, groundwater sampling log, chain-of-custody forms, plan of the day, relevant integrated work document and standard operating procedures
- ☐ Tables, chairs, shade shelter, historical sampling paperwork and field parameter plots, well completion information
- ☐ Radio, cell phones, pagers, appropriate keys
- ☐ First aid kit, eyewash, fire extinguisher, appropriate personal protective equipment
- ☐ Tool box with pipe wrenches, crescent wrenches, socket wrenches, and assorted other tools
- ☐ Ladder with sump pump and hose (for 3000-gal. purge containers), carboys, buckets
- ☐ Extension cord
- ☐ Computer or RuggedReader handheld PC with appropriate transducer connections and inverter
- ☐ Manual water-level tape and well collar if necessary
- ☐ YSI multimeter with flow-through cell, turbidimeter, calibration kit
- ☐ Action Packer fully stocked with nitrile gloves, Wyp-alls, polyethylene flexible tubing, chain-of-custody tape, squirt bottle for deionized water, 0.45 micron filters, pipettes, pH test strips, ziploc bags, duct tape, Teflon tape
- ☐ Assorted preservatives (acids and bases)
- ☐ Cooler with blue ice
- ☐ Sampling apparatus (specific to each pump type, see Attachments 5–14 EP-DIR-SOP-20032)
- ☐ Power system (specific to each pump type, see Attachments 5–14 of EP-DIR-SOP-20032)

Attachment 2
Groundwater Sampling LogPage 1 of 1

Groundwater Sampling Log

Project: IFWGMP MY2014	**LSD:** ft. msl	**Well Diameter:** inches	**Date:**
Watershed:	**Water Level:** ft. msl	**Top of Screen:** ft.	**Notes:**
Well:	***TD:**	**Bottom of Screen:** ft.	
Sampling Device:	***DTW:**	**Water Column:** ft.	
Measuring Point:	**Drop Pipe:** gal.	**1CV:** gal.	**Packer Pressure**
*** Completion Depth:**		**3CV:** gal.	**Before:**____________psi
[* ft. BTOC / BTIC / BGS / MSL]	Note MP height (stickup) of TOC/TIC for Alluvials	ft	**Actuation:**__________ psi
DTW = (LSD - Water Level)…… **Water Column =** (TD - DTW)….. **Drop Pipe =** (DTW x Drop Pipe Diameter Multiplier)			**Opening:**___________psi
1CV = (Water Column x Well Diameter Multiplier)….. 3 CV = (1CV x 3)			**After:** ______________psi

TIME MST / DST	**pH** SU	**TEMP** °C	**SPEC COND** μs/cm	**DO** mg/l	**Turb** NTU	HACH	**ORP** mV	**Water Level*** ft.__________	**Discharge Rate** (GPM)	**NOTES**
Stability:	≤ 0.2 STU variance		± 3% (>100) ± 5% (≤100)	≤ 0.3 mg/l variance	<10 or ± 10%	Yes or No				

Yes in HACH column = HACH Turbidimeter #____ used because ____________________________		Final Water Level: ft____
Contact Waste: gal.	**Drum#:**	
***Purge Water:** gal.	**Drum#'s:**	*Purge: Formation water purged prior to sampling (excluding drop pipe water and sampling water)
Total Waste Water: gal.		

Attachment 3
Compliance Checklist
Page 1 of 1

SOP-20032 Rev. 1 Compliance Checklist

Well Name:______________________

Date:__________________________

Discharge calculation method	Calculated volumes (gal):	Drop pipe volume purged (gal)	Purge water volume purged (gal)	CV's Purged before sampling	Minimum Purge Met?	Comments:
Flow Meter	Drop Pipe:				Y N	
Manual	3 CVs:					

	Stable for three consecutive readings?				Comments:
Parameters collected at proper intervals? (HH:MM)	pH ≤ 0.2 STU variance	Specific Conduct. ± 3% (>100) ± 5% (≤100)	Dissolved Oxygen ≤ 0.3 mg/l variance	Turbidity <10 NTU or ± 10%,	
Calculations:	Upper: Lower: Difference:	Median: Upper: Lower:	Upper: Lower: Difference:	Median: Upper: Lower:	
Y N	Y N	Y N	Y N	Y N	

SOP Requirements Met?	Comments:
Y N	

Attachment 4
Obtaining Quality Field Parameters
Page 1 of 4

A4-1. PURPOSE AND SCOPE

This attachment describes the process for obtaining quality field parameters, specifically by performing calibration checks on YSI multiparameter instruments in the field and troubleshooting all water quality instruments in the field.

A4-2. BACKGROUND AND PRECAUTIONS

A4-2.1 Background

It is important to obtain quality field parameters during each purging event because these data are used to determine the representativeness of the samples collected. Field parameters should represent, as closely as possible, the conditions in the hydrogeologic unit sampled. If field parameters are suspected to be inaccurate during a purging event, follow the steps below to troubleshoot the water quality instruments.

A4-2.2 Precautions

The following precautions should be taken to ensure safety and quality while performing these tasks:

- Wear nitrile gloves, long sleeves, and safety glasses when working with calibration standards
- Refer to the integrated work document (IWD) for additional hazards and controls.
- Record all activities in the field logbook or calibration logbook

Attachment 4
Obtaining Quality Field Parameters
Page 2 of 4

A4-3. STEP-BY-STEP PROCESS DESCRIPTION

A4-3.1 Before Arriving On-site

Field Team Member

[1] Never use an instrument that did not pass routine calibrations identified below. Calibrate individual parameters on the YSI multimeter and the Hach turbidimeter at the frequency listed in the table below. Factory calibration of the YSI multimeter shall be conducted in accordance with the manufacturer instructions. The YSI multimeter should be calibrated within 24 h of use for parameters that are calibrated daily.

Field Parameter	Required Calibration Frequency
pH	Daily – 3 point calibration
Temperature	No calibration required
Specific Conductance	Weekly
Turbidity	YSI– daily 3 point calibration at the beginning of each week 1 point calibration subsequent days during the week Hach – every 3 months
Dissolved Oxygen	Daily
Oxidation-reduction potential	Daily

[2] Record the calibration process of the primary meter to be used that day in its assigned logbook. The instrument calibration logbook and a sticker on the instrument should also indicate when the manufacturer last maintained the instrument.

[3] Bring the instrument with calibration logbook and a full calibration kit into the field every day. If using a YSI multiparameter instrument as the primary turbidity meter, bring a Hach turbidimeter as the backup meter.

[4] Whenever possible, use the YSI multiparameter probe and flow-through cell for all field measurements. This allows for continuous monitoring of parameters and logging of parameters at regular intervals, resulting in more consistent field data. Extreme effervescence in a well may cause the YSI to measure some field parameters inaccurately. If specific conductance or turbidity appear to be affected, follow step 4.3 of this SOP.

Attachment 4
Obtaining Quality Field Parameters
Page 3 of 4

A4-3.1 Before Arriving On-site (continued)

Occasionally, the YSI may report negative turbidity values. Negative turbidity values are not acceptable, and indicate the meter is out of calibration. If the meter is out of calibration, follow step 1 in section A4-3.2 of this SOP.

A4-3.2 Troubleshooting in the Field

Field Team Member

[1] During use, if a parameter reads outside its feasible range, as listed below, do not record the parameter. Notify the subcontractor technical representative, and stop purging (if at a well site). Field parameters may be within the feasible range but may be questionable for other reasons, such as varying greatly from past sampling events or drifting more than expected. In these cases, the field team leader (FTL) may decide whether or not to follow the troubleshooting procedure and should document this decision in the logbook.

Parameter (units)	Range	Significant Figures
pH (SU)	5–10	2 decimal places
Temp (deg. C)	0–30	1 decimal place
Specific Conductance (µS/cm)	50–2000	3 significant figures
Turbidity (NTU)	0–1000	3 significant figures
Dissolved oxygen (DO) (mg/L)	0–14	2 decimal places
Oxidation-reduction potential (ORP) (mV)	−400 to +820	1 decimal place

[2] Begin to diagnose the meter using the steps below:

- For pH, clean the probe and submerge it in pH 4, 7, and 10 solutions. Field crews may also check the water with a pH indicator strip to get a general idea of the pH, but pH strips may not be used as validation or to collect data.
- For ORP and specific conductance, submerge the probe in the respective solutions. Temperature cannot be calibrated or validated in the field. If it is outside the feasible range, replace unit with the calibrated multimeter.
- DO cannot be validated in the field, and the probe should be recalibrated.
- Temperature cannot be calibrated or validated in the field. If it is outside the feasible range, replace the temperature probe or use another calibrated multimeter.

Attachment 4
Obtaining Quality Field Parameters
Page 4 of 4

A4-3.2 Troubleshooting in the Field (continued)

[3] Check the results of the validation with the acceptable ranges as described by YSI:

- Specific conductance: +/−0.5% of the reading, or +/−1 µS, whichever is greater
- pH: +/−0.2 SU
- ORP: +/−20 mV

[4] If the multimeter passes validation, continue using the instrument. The “questionable parameter” is considered validated; continue entering those values into the appropriate forms. If the multimeter does not pass validation, clean the probes thoroughly and recalibrate the multimeter for the questionable parameter in the field using the portable calibration station.

[5] If the recalibration attempt fails in the field, replace the multimeter with another calibrated multimeter. The problematic multimeter should be tagged and removed from service, and should be assessed offline to determine whether it can be repaired in-house, or whether it should be sent to the manufacturer for servicing.

[6] If either the newly calibrated multimeter or the replacement multimeter now measures values *within* the range of feasibility, use those values instead of the original parameter values. If the replacement multimeter reads within the range of feasibility while the primary instrument did not, ensure that the primary multimeter receives appropriate maintenance before it is used again in the field.

[7] If both the original multimeter and the replacement multimeter read parameters outside the range of feasibility, the “questionable parameter” is considered validated. Enter the parameters on the appropriate form.

Attachment 5
Electric Gear-Driven Submersible Pump System
Page 1 of 2

A5-1. PURPOSE AND SCOPE

This attachment describes the process for setting up, operating, and securing the electric gear-driven submersible pump (GSP) system used in groundwater sampling activities.

A5-2. BACKGROUND AND PRECAUTIONS

A5-2.1 Background

Many deep regional groundwater monitoring wells at Los Alamos National Laboratory are sampled using a GSP, which is operated with either a 240- or 480-V portable generator, depending on the specific model.

A5-2.2 Precautions

Review any special electrical, mechanical, biological, or chemical conditions pertaining to the sampled well. These should be reviewed with the Groundwater Technical Lead before the sampling event begins.

Refer to the integrated work document for hazards and controls.

A5-3. STEP-BY-STEP PROCESS DESCRIPTION

A5-3.1 System Startup and Operation of a GSP

Field Team Member

[1] Connect the trailer-mounted large generator to the pump control box using the appropriate power cord (usually 480 V). If possible, park the generator downwind of the well and as far away as the well pad or power cord length will allow.

[2] Install sampling tree into drop pipe. Do not over tighten with a wrench. Ensure the valve on the sampling tree is open.

[3] Install flow-meter as needed to end of sampling tree. Connect the end of sampling apparatus to purge the water container with the hose.

Attachment 5
Electric Gear-Driven Submersible Pump System
Page 2 of 2

A5-3.1 System Startup and Operation of a GSP (continued)

[4] Install the in-line flow-through cell using flexible polyethylene tubing to connect the cell to the sampling tree discharge units (valve and hose barbs).

[5] Start the large generator. Throw the circuit breaker to allow a live connection.

[6] Start the pump by flipping the control box circuit breaker to ON, turning the dial on the control box, and pushing the START button. An audible click should be heard.

[7] Adjust the flow rate using the valve on the sampling tree. The flow rate should be adjusted so that excessive drawdown does not occur.

NOTE: The order of the connection steps described above is not relevant to proper system functioning and may therefore be done in whatever manner the operator sees fit.

A5-3.2 System Shutdown of a GSP

Field Team Member

[1] Stop the pump by turning the dial on the control switch to stop and flipping the circuit breaker to OFF.

[2] Ensure the valve in the sampling tree is open so water can drain into the drop pipe.

[3] Turn the generator off, throw circuit breaker to OFF, and disconnect battery.

[4] Disconnect the power cord and sampling apparatus.

[5] Lock and secure the well.

Attachment 6
Bladder Pump System
Page 1 of 4

A6-1. PURPOSE AND SCOPE

This attachment describes the process for setting up, operating, and breaking down the bladder pump systems used in groundwater sampling activities.

A6-2. BACKGROUND AND PRECAUTIONS

A6-2.1 Background

Most shallow alluvial monitoring wells at the Laboratory are equipped with either Monoflex Isomega bladder pumps or QED bladder pumps dedicated to each well. The bladder pump parts that are in contact with formation water are constructed of Teflon.

Bladder pumps are used to sample alluvial monitoring wells. During operation, the bladder pump fills with water through a screen inlet and ball valve, expanding the bladder. The introduction of pressurized (nitrogen or carbon dioxide) gas into the pump chamber causes the bladder to collapse, forcing the water into the sample discharge line. A pressure of 0.45 psi per foot of depth is required to lift a sample to the surface. The pump is operated via the QED control box, although the portable QED backpack controller may also be used.

A6-2.2 Precautions

Refer to the integrated work document for hazards and controls.

A6-3. STEP-BY-STEP PROCESS DESCRIPTION

A6-3.1 System Setup of a Bladder Pump System

Field Team Member

[1] Ensure the nitrogen tank or carbon dioxide tank (depending on manufacturer's specifications) is secured in the vehicle.

Attachment 6
Bladder Pump System
Page 2 of 4

A6-3.1 System Setup of a Bladder Pump System (continued)

[2] Install the low-pressure regulator setup on the nitrogen or carbon dioxide tank, tightening with a crescent wrench. The setup includes the following:

- regulator with two gauges
- manual vent valve
- pressure relief valve set to 205 psi
- quick-connect coupling.

NOTE: The regulator, hoses, pump controller, and well assembly have been prefabricated. DO NOT remove or change coupling, valves, whip restraints, quick connects, or any other components of the pressure system in the field.

[3] Connect the pressure hose to the quick-connect coupling on the regulator setup and secure the hose with whip restraint.

[4] Connect the other end of the pressure hose to the QED control box.

[5] Connect the QED control box to the well head assembly.

NOTE: The order of the connection steps described above is not relevant to proper system functioning and may therefore be done in the manner the operator sees fit.

A6-3.2 System Pressurization of a Bladder Pump System

Field Team Member

[1] Ensure the T-screw on the pressure regulator is loose, but do not unthread it all the way out.

[2] Ensure the vent valve is closed.

[3] Gently open the gas cylinder valve and check for leaks.

[4] Fully open the gas cylinder valve, then close it a quarter turn.

Attachment 6
Bladder Pump System
Page 3 of 4

A6-3.2 System Pressurization of a Bladder Pump System (continued)

[5] Adjust the regulator T-screw until the regulator pressure reads at the proper pump operating pressure, as defined in Section 3.3, Item 3 below.

[6] Leak test all the fittings, quick connects and hose connections. The leak test should be conducted at the proper pump operating pressure, as defined in section 3.3, item 3, below.

A6-3.3 System Operation of a Bladder Pump System

Field Team Member

[1] Ensure all hose and gas cylinder connections are secure and functional.

[2] Determine the proper pump operating pressure as follows:

- Multiply the total depth of the well in feet by 0.45 psi.
- Add 10–15 psi to obtain the operating pressure.

For example, pumping from a 100-ft-deep well:

100 ft × 0.50 = 50 psi lift + 10–15 psi = 60–65 psi operating pressure

[3] Set the pressure on the regulator to calculated value. Ensure QED control box pressure matches regulator pressure.

[4] Adjust the timers to 4 cycles per minute on the QED. This is usually the optimal setting.

- The pump pressure timer controls the amount of time the pump is pressurized and pumping water to the surface. If the time setting is too short, the pump will not have sufficient time to empty.
- The pump vent timer controls the amount of time the pump is allowed to vent. If the time setting is too short, the pump will not have sufficient time to completely fill.

Attachment 6
Bladder Pump System
Page 4 of 4

A6-3.4 System Shutdown of a Bladder Pump System

Field Team Member

[1] Shut off the QED control box.

[2] Shut off the gas cylinder valve.

[3] Vent the system to the atmosphere.

[4] Disconnect all hoses.

[5] Plunge water in drop pipe to prevent the line from freezing.

[6] Lock and secure the well.

Attachment 7
Portable Bladder Pump System
Page 1 of 5

A7-1. PURPOSE AND SCOPE

This attachment describes the process for groundwater sampling using the portable bladder pump system. The specific systems pertaining to this attachment are the QED Sample Pro 1.75-in. bladder pump (SamplePro), the MP15 Control and Power pack (QED Backpack), and the MP10 Controller (QED Controller).

A7-2. BACKGROUND AND PRECAUTIONS

A7-2.1 Background

Most shallow alluvial monitoring wells at Los Alamos National Laboratory are equipped with dedicated bladder pumps (either Monoflex Isomega or QED) constructed of Teflon. Alluvial wells that do not have dedicated pumps in place are sampled using the QED SamplePro bladder pump. During operation, the SamplePro bladder fills with water through a screen inlet and ball valve. The introduction of carbon dioxide or nitrogen gas into the pump chamber causes the bladder to collapse, forcing the water into the sample discharge line. Venting the pump chamber allows the bladder to refill. A pressure of approximately 1 psi per foot of depth is required to lift a sample to the surface. Either the QED Backpack or the QED Controller may be used to operate the pump.

A7-2.2 Precautions

Refer to the integrated work document for hazards and controls.

A7-3. STEP-BY-STEP PROCESS DESCRIPTION

A7-3.1 System Setup of a Portable Bladder Pump System

Field Team Member

[1] Ensure that a sufficient number of carbon dioxide or nitrogen tanks are available.

<u>Attachment 7</u>
Portable Bladder Pump System
Page 2 of 5

A7-3.1 <u>System Setup of a Portable Bladder Pump System (continued)</u>

[2] If the well is near the vehicle, the field team leader (FTL) may decide to proceed with the setup for a dedicated bladder pump (see Attachment 6 section A6-3.1, System Setup of a Bladder Pump System). This step entails using a nitrogen tank with the QED controller.

- Connect the QED controller to the SamplePro using the roving air fitting.

[3] Remote well sites require use of the QED Backpack. This backpack houses a QED controller and a carbon dioxide tank.

- Connect the backpack QED controller to the SamplePro using the roving air fitting

NOTE: The backpack QED controller may be used with nitrogen if in range of the vehicle.

[4] Setup/prepare the SamplePro bladder pump by performing the following steps:

NOTE: Wear nitrile gloves during pump setup/preparation.

- Remove the pump from protective case.
- Inspect the O-rings and check the valves on pump head to ensure functional integrity, replace if necessary.
- Install a new Teflon bladder onto the barb. Wells greater than 75 ft deep need a bladder connector fitting attached.
- Install a new grab plate into the head assembly.
- Cut the appropriate lengths of Swagelok air tubing (opaque) and Teflon-lined polyethylene tubing (clear). The pump intake should sit within the screened interval and below the water level. Cut approximately 6 extra feet of tubing to facilitate purging and sampling.
- Set both tubing and pump in a clean place free of potential contamination until ready to deploy.

Attachment 7
Portable Bladder Pump System
Page 3 of 5

A7-3.1 System Setup of a Portable Bladder Pump System (continued)

[5] Connect the pump controller to the Swagelok air tubing via the roving air fitting.

[6] Insert precut tubing ends into pump head and grab plate until it is firmly seated against the O-rings. “W” indicates water line, and “A” indicates air line.

[7] Prepare an equipment rinsate blank (EQB) before lowering the pump down the well.

- pressurize the system (see section A7-3.2) at approximately 1 psi per foot of tubing
- attach new flexible polyethylene tubing to the pump intake and lower the free end into bottle of deionized (DI) water
- begin cycling the pump via pump controller
- collect a sample from the discharge tubing
- discard the flexible polyethylene tubing used for EQB sampling

[8] Attach s stainless-steel security cable to pump head.

[9] Deploy the pump with the attached air tubing, water tubing, and security cable slowly down the well. The security cable should always be weighted to prevent tubing lines from tangling or disconnecting. While lowering the pump into the well, decontaminate the cable and tubing lines with a paper towel and DI water.

[10] Pump should be set above sump with the pump intake located near the bottom of the screened interval to maximize the available water column. The steel cable should be clamped at the surface to ensure pump stays at desired depth.

Attachment 7
Portable Bladder Pump System
Page 4 of 5

A7-3.2 System Pressurization of a Portable Bladder Pump System

Field Team Member

[1] Ensure the T-screw on the pressure regulator is loose, but do not unthread all the way out (with nitrogen cylinder use only).

[2] Ensure the vent valve is closed (with nitrogen cylinder use only).

[3] Gently open the nitrogen or carbon dioxide gas cylinder valve and check for leaks.

[4] Fully open the nitrogen or carbon dioxide gas cylinder valve, then close it a quarter turn.

A7-3.3 System Operation of a Portable Bladder Pump System

Field Team Member

[1] Ensure all pressure system connections are secure and functional.

[2] Determine the proper pump operating pressure, multiply the vertical depth below ground surface by 1 psi and add 10 to 15 psi.

For example: Sample to be evacuated at 100 ft:

100 ft × 1 = 100 psi lift + (10 to 15 psi) = 110 to 115 psi operating pressure

[3] Set the tank pressure and pump to the calculated value.

[4] Cycle the pump and observe its operation. Start at 4 cycles per minute and put discharge line in a calibrated 1-L bottle to determine a flow rate.

[5] Adjust the pumping system, as necessary, to maximize the pumping rate.

- If necessary, increase or decrease the pressure on controller and at the tank.
- If flow rate is still far below 1 L/min, the FTL may elect to increase the number of cycles per minute.

Attachment 7
Portable Bladder Pump System
Page 5 of 5

A7-3.4 System Shutdown of a Portable Bladder Pump System

Field Team Member

[1] Press the STOP button on controller.

[2] Shut off the gas cylinder valve.

[3] Vent the system to the atmosphere (NO_2 and CO_2).

[4] Disconnect all hoses and whip restraints.

[5] Carefully pull the pump out of the well while decontaminating the steel cable with DI water and a paper towel.

[6] Separate the cable and tubing from Sample Pro.

[7] Remove the tubing from grab plate and dispose of it with any contact waste for that sampling event.

[8] Disassemble the pump and dispose of the grab plate and bladder with any contact waste. Empty the bladder into purge water before disconnecting it.

[9] Decontaminate the pump and all of its components using DI water and paper towels before returning it to the protective case. Thoroughly dry the pump and components with paper towels to prevent rust.

[10] Lock and secure the well.

Attachment 8
Bennett Pump System
Page 1 of 5

A8-1. PURPOSE AND SCOPE

This attachment describes the process for setting up, operating, and securing the Bennett pump system used in groundwater sampling activities.

A8-2. BACKGROUND AND PRECAUTIONS

A8-2.1 Background

Many intermediate wells are equipped with the Bennett pump system, also known as a reciprocating submersible pump. In addition, regional and intermediate wells that lack a pumping system can be sampled with a portable Bennett pump system (see Attachment 9). The Bennett pump system is pressure-actuated. The system can provide depth-discrete groundwater samples from a single subsurface stratigraphic horizon from a converted borehole or well. The Bennett pump consists of a piston activated with pressurized gas through a Teflon tube, a second Teflon tube that returns groundwater to the surface, and a third Teflon tube for gas exhaust. The wellhead is set up to facilitate installation of a pressure transducer and obtain water levels without disturbing the dedicated components of the Bennett pump system. Refer to Figure 1 of this attachment.

The Bennett pump operates by pressurized gas (nitrogen), which does not come in contact with the groundwater sample. Components of the pump that make contact with the sample fluids are composed of inert materials, namely, stainless steel and Teflon.

A8-2.2 Precautions

Refer to the integrated work document for hazards and controls.

Attachment 8
Bennett Pump System
Page 2 of 5

A8-3. STEP-BY-STEP PROCESS DESCRIPTION

A8-3.1 System Setup of a Bennett Pump System

Field Team Member

[1] Ensure the nitrogen tank is secured in the vehicle or a stanchion.

[2] Install the regulator setup on the nitrogen tank, tightening it with a wrench. The setup includes the following:

- Regulator with two gauges
- Manual vent valve
- Pressure relief valve set to 200 psi
- Quick-connect coupling.

[3] Connect the pressure hose to the quick-connect coupling on the regulator and secure the hose with whip restraint.

[4] Connect the other end of the pressure hose to the quick-connect coupling on the well head landing plate.

[5] Remove the protective stainless-steel cap (if present) from the water discharge line, and set the cap aside where it will not be misplaced.

[6] Remove the protective stainless-steel cap (if present) from the exhaust discharge line and set the cap aside where it will not be misplaced.

[7] Secure a stainless steel sampling elbow with two discharge units (valve and hose barb) to the water discharge outlet by tightening the stainless-steel connector on the bottom of the sampling elbow.

NOTE: The order of the connection steps described above is not relevant to proper system functioning, and may, therefore, be performed in a manner the operator sees fit.

Attachment 8
Bennett Pump System
Page 3 of 5

A8-3.2 System Pressurization of a Bennett Pump System

Field Team Member

[1] Ensure the T-screw on the pressure regulator is loose, but do not unthread all the way out.

[2] Check the vent valve is closed.

[3] Gently open the nitrogen gas cylinder valve and check for leaks.

[4] Fully open the nitrogen gas cylinder valve, then close it a quarter turn.

[5] Adjust the regulator T-screw until the regulator pressure reads 50 psi.

[6] Leak test all of the fittings, quick connects, and hose connections.

A8-3.3 System Operation of a Bennett Pump System

Field Team Member

[1] Ensure all pressure system connections are secure and functional. Ensure the gas discharge line from the well is open and not blocked.

[2] Adjust the pressure from the gas cylinder going into the pump to adjust the pumping speed. A pressure of 100 to 190 psi is usually sufficient to run the Bennett pump at any depth.

[3] Determine if the pump has started cycling by noting if a gas flow is exiting the gas exhaust outlet.

[4] If the pump is determined not to be cycling, slowly increase the pressure until the pump starts cycling. To a limited extent, gas pressure may be adjusted to control the pumping rate.

Attachment 8
Bennett Pump System
Page 4 of 5

A8-3.4 System Shutdown of a Bennett Pump System

Field Team Member

[1] Turn off the gas-supply valve at the top of the nitrogen cylinder.

[2] Open the manual vent valve on the regulator and drain the nitrogen gas from the line until the pressure regulator reads near 0 psi.

[3] Disconnect the black pressure hose from the pump by removing the quick-connect coupling at the gas inlet on the landing plate. Disconnect the regulator setup.

[4] Disconnect the sample elbow from the water discharge outlet at the landing plate.

[5] Complete the disassembly of the system.

[6] Replace the stainless-steel cap, if present, on the water-discharge outlet at the landing plate and replace the stainless-steel cap on the gas exhaust outlet at the landing plate.

[7] Lower the water level in the water discharge tubing to a depth that is sufficient to prevent freezing by using the 20-ft long, 0.25-in.–outside diameter (O.D.) nylon freeze prevention line as follows:

- Insert the 0.25-in.-O.D. nylon freeze prevention line while decontaminating it with a paper towel soaked in deionized (DI) water and place in the water discharge tubing to the stop at the end of the freeze prevention line.
- Remove the freeze prevention line from the water discharge tubing while decontaminating it with a paper towel soaked in DI water. The displaced water will lower the water level in the water discharge tubing sufficiently below the freezing line.

<u>Attachment 8</u>
Bennett Pump System
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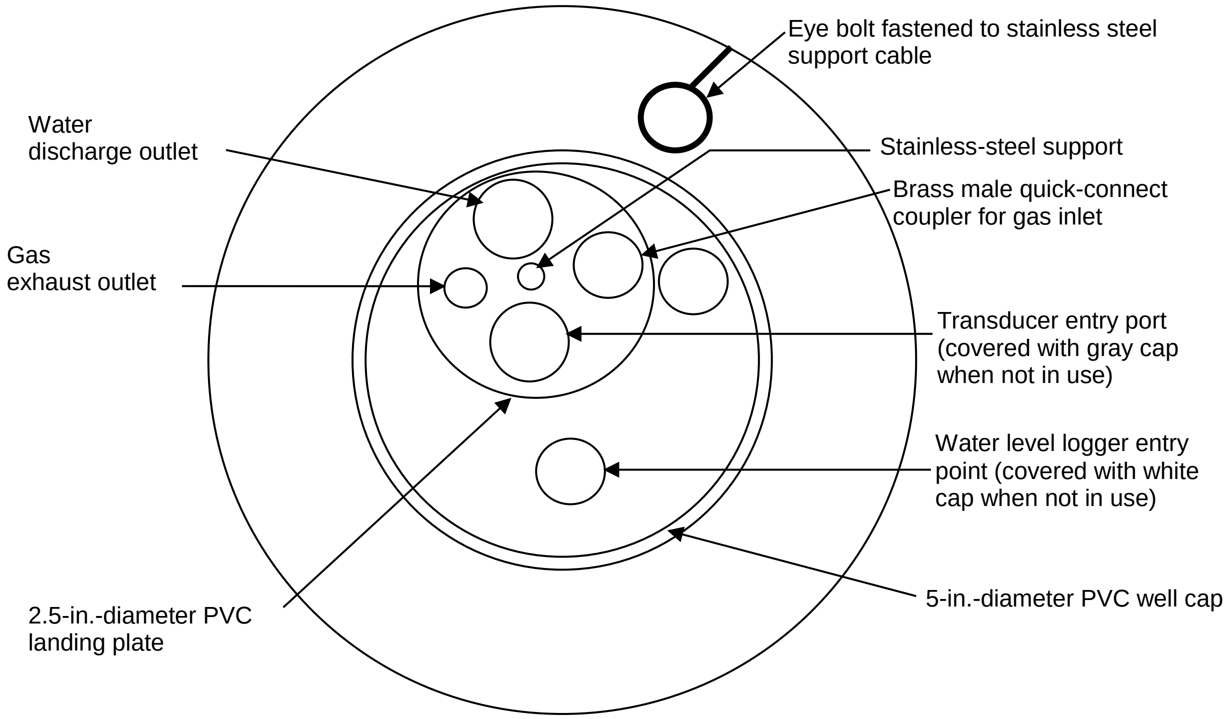

Figure 1. Well plate schematic

Attachment 9
Portable Bennett Pump System
Page 1 of 6

A9-1. PURPOSE AND SCOPE

This attachment describes the process for setting up, operating, and securing the portable Bennett pump system used in groundwater sampling activities.

A9-2. BACKGROUND AND PRECAUTIONS

A9-2.1 Background

Regional and intermediate wells that lack a pumping system can be sampled with the portable Bennett pump system. The Bennett pump system consists of a piston activated with pressurized gas through a Teflon tube, a second Teflon tube that returns groundwater to the surface, and a third Teflon tube for gas exhaust. The portable Bennett pump system is mounted in a trailer. The Bennett pump and 850 ft of bundled tubing is coiled around a winch in the back of the trailer. The winch is operated with a motor powered by a medium-sized portable generator. The pump system is operated via a control box attached to the winch.

The Bennett pump operates by pressurized gas (nitrogen) that does not come in contact with the groundwater sample. Components of the pump that make contact with the sample fluids are composed of inert materials, namely, stainless steel and Teflon.

A9-2.2 Precautions

Refer to the integrated work document for hazards and controls.

Attachment 9
Portable Bennett Pump System
Page 2 of 6

A9-3. STEP-BY-STEP PROCESS DESCRIPTION

A9-3.1 System Setup of a Portable Bennett Pump System

Field Team Member

[1] An equipment rinsate blank must be prepared before sampling. This is typically done on-site but occasionally is performed indoors (e.g., at the Technical Area 64 south bay) during inclement weather. In extenuating circumstances, it may be performed the day before sampling with approval from the groundwater technical lead (GTL). Refer to 3.3, System

Pressurization, and A9-3.4, System Operation of a Portable Bennett Pump System, for details on pump operation.

[2] Load a portable, medium-sized generator onto the transport vehicle and tow the portable Bennett pump trailer to the well sampling site.

[3] Collect a water-level reading by using the transducer installed in the well or by taking a manual measurement in accordance with SOP-5223, Manual Groundwater Level Measurements, or by taking a reading from the pressure transducer.

[4] Once the water level has been measured, remove the water-level tape from the well to prevent damage while installing the pump. If a pressure transducer is installed, remove the transducer in accordance with SOP-5227, Pressure Transducer Installation, Removal, and Maintenance.

[5] Back up the trailer until it is within 5 ft of the well casing and extend the adjustable arm on the back of the trailer. A cotter pin at the bottom of the adjustable arm can be pulled out to allow the arm to move up and down and in and out but NOT side to side.

[6] Move the trailer back toward the well casing until the roller on top of the adjustable arm is lined up with the center of the casing to allow the pump to enter the casing exactly in the middle.

NOTE: It is very important to ensure the pump is properly aligned over the center of the well to ensure the pump does not get hung up or damaged while it is lowered or raised within the well housing.

Attachment 9
Portable Bennett Pump System
Page 3 of 6

A9-3.1 System Setup of a Portable Bennett Pump System (continued)

[7] Fine tune the distance of the roller from the back of the trailer by placing a bolt through the holes in the adjustable arm. The holes can be found every 6-in. along the shaft.

[8] Turn on the portable generator and plug in the motor for lowering and raising the pump.

NOTE: Ensure that the control handle on the motor is in the OFF position before powering the system.

[9] Turn on the water level alarm located on the top of the pump unit. The switch to operate the water-level alarm is located on the control box in the front of the Bennett pump.

[10] Lower the pump into the well, using the up/down switch attached to the motor. One field team member should control the switch and guide the pump and tubing towards the roller on the arm. A second field team member should control the pump and tubing as it is lowered in to the well. The pump and tubing must be decontaminated with a paper towel soaked in deionized (DI) water while they are being lowered. It may be necessary to use several DI-soaked paper towels to ensure the tubing and pump are adequately decontaminated.

[11] Lower the pump unit until the water level alarm indicates when the top of the pump is under water or until the bottom of the well is reached if the alarm does not sound.

[12] If possible, continue lowering the pumping unit until it is submerged below the water table but above the sump. If the bottom of the well is reached before the water level alarm sounds, raise the pump back up until it is out of the sump (use well completion information to determine the sump length).

[13] Turn off the generator after the pump is set at the desired depth.

[14] Ensure the nitrogen tank is secured.

Attachment 9
Portable Bennett Pump System
Page 4 of 6

A9-3.1 System Setup of a Portable Bennett Pump System (continued)

[15] Install the regulator setup on the nitrogen tank, tightening with a wrench. The setup includes the following:

- Regulator with two gauges
- Manual vent valve
- Pressure relief valve set to 200 psi
- Quick-connect coupling

[16] Connect the black pressure hose to the setup and secure it with a whip restraint.

[17] Connect the other end of the hose to the back of the pump control box.

A9-3.2 System Pressurization of a Portable Bennett Pump System

Field Team Member

[1] Ensure the T-screw on the pressure regulator is loose, but do not unthread all the way.

[2] Check that the vent valve is closed.

[3] Gently open the nitrogen gas cylinder valve and check for leaks.

[4] Fully open the nitrogen gas cylinder tank valve, then close it a quarter turn.

[5] Adjust the regulator T-screw until the regulator pressure reads 100 psi.

[6] Leak test all of the fittings, quick connects, and hose connections.

Attachment 9
Portable Bennett Pump System
Page 5 of 6

A9-3.3 System Operation as a Portable Bennett Pump System

Field Team Member

[1] Ensure pressure system connections are secure and functional.

[2] Adjust the pressure from the gas cylinder going into the pump to adjust the pumping speed using one of the methods discussed below. A pressure of 100 to 150 psi is usually sufficient to run the Bennett pump at any depth.

- Adjust the small black knob on the control box located on the front of the Bennett pump just below the water-level on/off switch. This knob is used to fine-tune the pressure going into the pump and is the preferred method. Pull up on the knob to adjust it, and push down to lock it.
- Adjust the regulator on the nitrogen tank. This will give a coarse adjustment to the operating pressure and should be used if the above method will not give the required operation.

On the left-hand side of the pump control is a discharge hose connected to a sampling tree with two discharge units (valve & hose barbs). Once the pressure is turned on and the pump begins cycling, approximately 5 gal. of DI water (from the equipment rinsate blank [EQB]) will have to be purged from the tubing before well water exits the sample tree.

NOTE: This will not be the case if the tubing has been evacuated post-EQB.

[3] If the pump is determined not to be cycling, the pressure should be gently increased until the pump starts cycling using the methods in step 2.

A9-3.4 Removal of Portable Bennett Pump System

Field Team Member

[1] Remove the portable pump from the well while decontaminating the tubing with a DI-soaked paper towel, which will need to be replaced frequently.

Attachment 9
Portable Bennett Pump System
Page 6 of 6

A9-3.4 Removal of Portable Bennett Pump System (continued)

[2] Pump tubing must be decontaminated internally. Collect decontamination waste separately from purge waste.

- Mix 1 gal. of DI water with Liquinox at a ratio of approximately 1:100 (about 1 capful of Liquinox)
- Pump soap mixture through tubing
- Pump 10 gal. of DI water to thoroughly rinse tubing
- Note that the first 5 gal. of water to exit the discharge line will be formation water and must be properly disposed of.
- When suds appear in discharge line, immediately switch to a new water collection device (carboy or bucket), as the water is now decontamination waste and must be disposed of as such.
- Continue pumping until no more water is being purged from the discharge line. At this point, most of the water has been removed from the discharge line. Follow Steps 3 through 7 to ensure all the water is removed from the line so the tubing bundle is not damaged by freezing temperatures in the winter.

[3] Unthread and remove the bottom-most portion of the Bennett pump.

[4] Attach the brass air line fitting (connected to the black pressure hose) to bottom of pump where water intake was removed.

[5] Attach the pressure hose to regulator.

[6] Increase the air pressure slowly to 100 psi to displace water from the pump discharge lines, collecting decontamination water as required to comply with waste disposal requirements for the site. Continue applying pressure to the system until all the water has been removed.

[7] Lock and secure well.

Attachment 10
Baski Pumping System
Page 1 of 6

A10-1. PURPOSE AND SCOPE

This attachment describes the process for setting up, operating, and securing the Baski pumping system.

A10-2. BACKGROUND AND PRECAUTIONS

A10-2.1 Background

Two types of Baski systems are used to sample wells with multiple screened intervals. Dual-pump Baski systems have separate pumps installed for each screen in the well. Typically, a Bennett pump is installed in the upper screen and a gear-driven submersible pump (GSP) is installed in the lower screen, although this is not always the case. Each screen will be sampled following the appropriate attachment for the well type that is installed, either Attachment 5 for a GSP or Attachment 8 for a Bennett pump. The other type of Baski system is the dual-valve pumping system. The procedure for sampling this type of system is outlined in this attachment.

The Baski dual-valve pumping system relies on two access port valves (APV) to sample two screened intervals in a well using a single electric GSP. The APVs are pneumatic valves that are opened and closed based on differential pressure. Each APV remains closed as a result of pressure from the inflated packer that separates the screened intervals. The APV is opened from the surface by overcoming this pressure using nitrogen gas pumped in through a0.25-in. nylon tube. The GSP is isolated from the regional groundwater at its installed depth by a sealed shroud. When either APV is opened, hydrostatic pressure causes the shroud to fill through the drop pipe from the selected screened interval.

A10-2.2 Precautions

Operation of the Baski pumping system requires the use of pressurized gas cylinders. Operators should review Los Alamos National Laboratory Engineering Standards Manual Chapter 17, Pressure Safety, and P101-34, Pressure Safety, to be aware of hazards and recommended safety practices before setting up and operating a pressure system to operate the Baski pumping system.

Refer to the integrated work document for hazards and controls related to working around pressure systems and using the large generator.

Attachment 10
Baski Pumping System
Page 2 of 6

A10-2.2 Precautions (continued)

Before any well with a Baski sampling system is sampled, the packer pressure must first be assessed and recorded in accordance with the packer maintenance table referenced in EP-DIV-SOP-20006, Pressure Monitoring of Packer Systems in Monitoring Wells. If the packer pressure is below the minimum packer pressure in the table, contact the appropriate personnel responsible for maintaining packer pressure in accordance with EP-DIV-SOP 20006 to request further assessment, and notify the groundwater team lead (GTL) or the project manager.

NOTE: The packer may be repressurized only by personnel trained to do so in accordance with EP-DIV-SOP-20006. Sampling personnel may not adjust the packer pressure without formal training to EP-DIV-SOP-20006.

If the packer pressure is below the minimum packer pressure in the packer maintenance table, personnel from the packer pressure team shall assess and adjust the pressure in the packer as necessary, and the water-level data from each screen must be downloaded and evaluated to determine whether cross-flow has occurred. These activities must be conducted before sampling activities continue.

If water-level data confirm that no cross-flow has occurred, sampling may continue as planned. If water-level data indicate cross-flow has occurred, the GTL may request that sampling be postponed until cross-flow has been removed.

A10-3. STEP-BY-STEP PROCESS DESCRIPTION

A10-3.1 System Setup as a Baski Pumping System

Field Team Member

[1] Mobilize a large portable generator to the well site.

[2] Observe packer pressure and record in Groundwater Sampling Log (Attachment 2). Confirm that observed pressure is above “Minimum Packer Pressure” and “Action Pressure,” as stated on the wellhead pressure settings drawing CAP-WELLS-DWG-102Y231909, available at https://adep.lanl.gov/epdc/EPDCS/CAP-WELLS-DWG-102Y231909.pdf. If the packer either below or above the operating range, then notify the STR.

Attachment 10
Baski Pumping System
Page 3 of 6

A10-3.1 System Setup of a Baski Pumping System (continued)

[3] Determine from which screened interval the sample will be taken.

[4] Connect computer to transducer for the screen to be sampled.

[5] Remove the cap from the nitrogen tank and install the regulator, which is equipped with a pressure-release valve reset to 290 psi or 380 psi, depending on the well.

[6] Connect a pressure hose from the regulator to the appropriate female quick disconnect fitting (upper or lower access port valve (APV) on top of the landing plate (refer to drawing CAP-WELLS-DWG-102Y231907 for the preferred connection port locations or the specific well completion schematic).

[7] Connect the sampling tree to the drop pipe.

[8] Connect the outlet of the sampling tree to a flow-meter, if available, and then connect a discharge hose to the water collection container.

[9] Connect the electric cable from the generator to the pump control box.

NOTE: The order of the connection steps described above is not relevant to proper system functioning, and may, therefore, be performed in a manner the operator sees fit.

A10-3.2 System Pressurization as a Baski Pumping System

Field Team Member

[1] Ensure the T-screw on the pressure regulator is loose, but do not unthread all the way out.

[2] Check that the manual vent valve is closed.

[3] Check that the fill valve is closed.

[4] Gently open the nitrogen gas cylinder tank valve and check for leaks.

Attachment 10
Baski Pumping System
Page 4 of 6

A10-3.2 System Pressurization of a Baski Pumping System (continued)

[5] Fully open the nitrogen gas cylinder tank valve.

[6] Leak test all the fittings, quick connects, and hose connections.

[7] Begin pressurization of the APV by opening the fill valve while monitoring the packer pressure gauge. Increase pressure on the APV by screwing in the T-Screw. The APV will open when the pressure gauge ticks up a few (~3) psi. Stop increasing pressure when this movement is noted, and record the opening pressure in the field logbook. Each APV has a unique pressure range under which it can open. Consult the Baski pressure table in the logbook front matter.

[8] Once the pressure gauge has ticked upwards and shows stable pressure, the APV should be open. Leave the fill valve open during pumping.

NOTE: As the drop pipe and shroud are filling with groundwater, it may be possible to hear air escaping from the vent hole in the landing plate, indicating the valve is open and groundwater is entering the shroud. This process is complete when the pressure gauge shows stable pressure.

A10-3.3 System Operation of a Baski Pumping System

Field Team Member

[1] Turn on the generator and flip the circuit breaker (Refer to IWD for details).

[2] Flip the circuit breaker switch on the control box to ON, turn the dial on the control box, and push the START button. An audible click should be heard.

[3] Note the time the pump was started, and monitor the discharge line for flow.

[4] If water has not started flowing from the discharge line after 5 min, turn off the pump and the nitrogen tank and perform the following:

- Release pressure on the APV by slowly opening the manual vent valve.
- Repressurize to reopen the APV in accordance with section A10-3.2 above ensuring sufficient pressure is applied to open the APV.

Attachment 10
Baski Pumping System
Page 5 of 6

A10-3.4 System Shutdown of a Baski Pumping System

Field Team Member

[1] Stop the pump by turning the dial to stop and flipping the circuit breaker to OFF.

WARNING: The pump must be turned off before closing the APV valve to prevent a vacuum forming at the inlet.

[2] Turn off the flow from the nitrogen tank into the Baski pumping system.

[3] Open the manual vent valve to relieve all pressure from the APV. As venting occurs, nitrogen will be expelled from the system, and a small (~3 psi) drop in pressure may be observed on the pressure gauge as pressure in the packer reequilibrates to presampling conditions.

[4] Observe the final packer pressure and record in Groundwater Sampling Log (Attachment 2). Confirm that the final pressure is consistent with the pressure observed before sampling, and remains above "Minimum Packer Pressure" and "Action Pressure" found at https://adep.lanl.gov/epdc/EPDCS/CAP-WELLS-DWG-102Y231909.pdf. If the final pressure is not consistent with the pressure observed before sampling and/or the pressure is below the minimum packer pressure and/or below the action pressure, notify the STR.

[5] Once venting is complete, disconnect the pressure hose from the quick-connect coupling on the landing plate.

NOTE: Ensure that the system has fully vented before disconnecting the tube. **Do not disconnect while system is still venting**.

[6] If the other screened interval is to be sampled, return to section A10-3.1. Ensure all screen-dependent fittings and lines are properly switched. This includes the transducer, the APV gas inlet, and the water discharge hose to the proper water container.

[7] Turn the generator off, throw circuit breaker to OFF, and disconnect battery.

[8] Disconnect the power cable.

Attachment 10
Baski Pumping System
Page 6 of 6

A10-3.4 System Shutdown of a Baski Pumping System (continued)

[9] Remove the regulator from the nitrogen tank and replace the cap.

[10] Disconnect the water discharge hose from the sampling tree.

[11] Remove the sampling tree from the landing plate and ensure the polyvinyl chloride crossover nipple is left in place on the landing plate.

[12] Ensure that all gauges and fittings remaining inside the well monument are below the top of the monument, and close and lock the cover.

[13] Lock and secure the well.

Attachment 11
Peristaltic Pump System
Page 1 of 3

A11-1. PURPOSE AND SCOPE

This instruction describes the process for setting up, operating, and sampling using peristaltic pump for groundwater sampling activities.

A11-2. BACKGROUND AND PRECAUTIONS

A11-2.1 Background

A peristaltic pump may be used for various activities. If spring and base-flow samples cannot be collected using direct containment, they may be collected using a peristaltic pump and clean tubing. Filtered spring and base-flow samples must always be collected using a peristaltic pump. For some shallow alluvial wells, a peristaltic pump may be used to sample and purge if a dedicated pump is not available. Additionally, filtered samples may need to be collected using a peristaltic pump at a variety of sites (Westbay sampling systems, production and domestic wells, and any intermediate and regional wells with low water pressure).

The U.S. Environmental Protection Agency cautions that the use of a peristaltic pump to purge and sample wells may not result in collecting representative samples. The negative pressure may impact contaminant concentrations at depths greater than 15 to 20 ft (Yeskis and Zavala, 2002). Instead, use of a dedicated sampling pump is recommended.

A11-2.2 Precautions

When using a peristaltic pump, the field team must make an effort to prevent sample contamination and to collect the most representative samples possible by following the precautions listed below.

- Ensure that the materials introduced to the well are constructed of chemically inert materials and always use new, precleaned tubing if the tubing will come into contact with the sample water.
- Minimize the disturbance to the water column to prevent increasing turbidity, which may affect analytical results.
- Do not collect an equipment rinsate blank (EQB) when sampling with a peristaltic pump if clean tubing is used at each site sampled.

Attachment 11
Peristaltic Pump Operation
Page 2 of 3

A11-3. STEP-BY-STEP PROCESS DESCRIPTION

A11-3.1 System Setup of a Peristaltic Pump

Field Team Member

[1] Before leaving for the sampling destination, ensure that a sufficient amount of charged batteries are available. Also, bring sufficient length of sample tubing.

[2] If purging and sampling a well using the peristaltic pump, follow the appropriate steps in section 4 of SOP-20032 to prepare the well for sampling.

A11-3.2 System Operation

Field Team Member

[1] Set up the peristaltic pump on a flat surface and install a sufficient length of new tubing. Be sure not to contaminate the tubing by letting it come in contact with the ground. Connect the pump to a power source. Use either portable batteries or an adaptor for plugging the pump into the power source in a vehicle or a wall outlet.

[2] If purging and sampling a well, install one end of the tubing in the well within the screened interval. Install the in-line flow through cell on the opposite end of the tubing. If the volume of purge water is not sufficient to use the flow-through cell, the calibration cup may be used to collect parameters.

If collecting a spring or base-flow sample, one end of the tubing will be placed in a shallow pool. Be sure not to rest the tubing on the bottom of the pool so that the sediment is not disturbed.

If collecting a filtered sample, discard the first 150 m/L to 200 mL of the sample to allow the filter to chemically equilibrate with the groundwater.

[3] Ensure that the pump is operating in the right direction. Use the toggle switch to ensure water is being pumped from the well or spring/ base-flow site towards the sample bottles. Turn the pump on using the on/off switch. The speed of the pump may be adjusted using the dial.

Attachment 11
Peristaltic Pump Operation
Page 3 of 3

A11-3.3 System Breakdown

Field Team Member

[1] Turn off the pump and dispose of the tubing properly, following the direction of the waste coordinator.

A11-4. REFERENCE

Yeskis, D. and Zavala, B., 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. U.S. Environmental Protection Agency Ground-Water Forum Issue Paper, 542-S-02-001, 53 pp.

Attachment 12
Hand-Bailer Purging and Sampling System
Page 1 of 3

A12-1. PURPOSE AND SCOPE

This instruction describes the process for setting up, operating, and sampling by hand bailing technique used in groundwater sampling activities.

A12-2. BACKGROUND AND PRECAUTIONS

A12-2.1 Background

The U.S. Environmental Protection Agency cautions that the use of hand-bailer systems to purge and sample wells may not result in collecting representative samples, especially when monitoring for volatile organic compound or volatile organic analytes and metals (Yeskis and Zavala, 2002). Instead, use a dedicated sampling pump. Some wells on Los Alamos National Laboratory property (specifically R-26pz2) need to be purged and sampled with hand-bailing techniques.

A12-2.2 Precautions

When it is necessary to use a hand bailer system, such as very small diameter wells (~1 in.) or very low-yielding hydrogeologic units, the field team must make an effort to collect the most representative samples possible by ensuring that the materials introduced to the well are constructed of chemically inert materials and that the bailer has a double-check valve and bottom-emptying device to minimize the loss of volatiles during the sampling process. Care should be taken to minimize the disturbance to the water column to prevent increasing turbidity, which will affect analytical results.

A12-3. STEP-BY-STEP PROCESS DESCRIPTION

A12-3.1 System Setup of a Hand-Bailer System

Field Team Member

[1] Before leaving for the sampling destination, ensure a new length of unused cord has been attached to the bailer. If unused cord has not been attached, the crew member must perform this action.

Attachment 12
Hand-Bailer Purging and Sampling System
Page 2 of 3

A12-3.1 System Setup of a Hand-Bailer System (continued)

[2] If required by sampling plans, an equipment rinsate blank (EQB) must be prepared before sampling. This is typically done on-site but occasionally is performed indoors (e.g., at the Technical Area 64 south bay) during inclement weather. In extenuating circumstances, it may be performed the day before sampling with approval from the groundwater team lead.

[3] Collect a water-level reading by using the transducer installed in the well or by taking a manual measurement in accordance with SOP-5223, Manual Groundwater Level Measurements, or by taking a reading from the pressure transducer.

[4] Once the water level has been measured, remove the water-level tape from the well to prevent tangling with the hand bailer.

[5] Place a tarp around the well pad area to prevent the hand bailer from coming into contact with the ground and unfurl the nylon cord onto the tarp.

A12-3.2 System Operation

Field Team Member

[1] Lower the bailer down the well in a controlled manner to minimize disturbing the water column during purging.

[2] Fill YSI calibration cup with purge water and record parameters when enough water has been collected.

NOTE: Normal parameter stability may not be met due to insufficient volume.

[3] When purge volume requirements have been met (1 casing volume [CV] for alluvial wells; 3 CVs for perched intermediate or regional wells), sampling can begin. Samples are collected in the order of the prioritized suite.

NOTE: If well purges dry before 1 CV can be collected or during sampling, allow for recharge and collect a prioritized (limited) suite.

Attachment 12
Hand-Bailer Purging and Sampling System
Page 3 of 3

A12-3.3 System Breakdown

Field Team Member

[1] Remove the hand-bailer from the well and detach the used nylon cord (this cord becomes contact waste).

[2] Collect a final water-level reading by taking a manual measurement in accordance with SOP-5223, Manual Groundwater Level Measurements. If it is necessary, reinstall the pressure transducer in accordance with SOP-5227, Pressure Transducer Installation, Removal, and Maintenance, and use the transducer to take the final water-level measurement.

[3] Decontaminate the stainless-steel bailer using a solution of 1% Liquinox by volume. Pour a small amount (approximately 1 oz) into the bailer and slosh back and forth several times. Drain. Rinse by adding about 5 oz of deionized (DI) water, slosh, and drain. Repeat at least four times. Rinse the outside of the bailer with the Liquinox solution, and then rinse with DI water until all Liquinox has been removed.

NOTE: Decontamination waste must be collected separately from purge waste.

[4] Lock and secure the well.

A12-4. REFERENCE

Yeskis, D. and Zavala, B., 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. U.S. Environmental Protection Agency Ground-Water Forum Issue Paper, 542-S-02-001, 53 pp.

Attachment 13
Sampling Production and Domestic Wells and Sampling Wells during Drilling Activities
Page 1 of 3

A13-1. PURPOSE AND SCOPE

This instruction describes the process for sampling production and domestic wells or sampling wells during drilling activities. In general, this instruction applies to most sampled wells that are not managed under the Los Alamos National Laboratory (LANL) Interim Facility-Wide Groundwater Monitoring Plan.

A13-2. BACKGROUND AND PRECAUTIONS

A13-2.1 Background

Special considerations are necessary when sampling production or domestic wells. These wells are managed by the County of Los Alamos, the City of Santa Fe, or Pueblo of San Ildefonso personnel and a representative from the appropriate entity must be on-site to assist field crews with access and technical issues. Typically, these wells have a pump installed and a permanent power source, so the field crew does not have to mobilize this equipment. Because these wells are sampled when they are in use, they are considered to be purged before the field crew arrives on-site. The field crew is not required to complete a purge or check for stability requirements before sampling.

As new wells on LANL property are completed, the groundwater team lead (GTL) may request that samples be collected during drilling activities. Typically, these samples are collected at the end of a 24-h aquifer pumping test; however samples may also be collected at the end of any other extended purging event. The purging event is conducted by drilling personnel, so the well will be purged before the field crew arrives on-site. The field crew is not required to complete a purge or check for stability requirements before sampling.

A13-2.2 Precautions

Because these sites are managed by the county, the city, the Pueblo, or drilling personnel, field crews must follow the site-specific safety precautions. Field crews should contact the appropriate personnel to determine the necessary safety precautions. Hearing and eye protection may be required, in addition to the personal protective equipment required for sampling activities, as outlined in the appropriate integrated work document.

Field team members need to be considerate when sampling domestic wells and minimize any disruption to the homeowner’s routine or property. Additionally, crews should avoid incurring additional costs to the homeowner, such as excessive water usage or property damage.

Attachment 13
Sampling Production and Domestic Wells and Sampling Wells during Drilling Activities
Page 2 of 3

A13-3. STEP-BY-STEP PROCESS DESCRIPTION

A13-3.1 Sampling Preparation

Field Team Member

[1] Follow the steps outlined in section 4.1, Sampling Preparation, of this procedure to prepare for sampling.

[2] Before arrival on-site, field crews must ensure that the wells are ready to be sampled.

- Production wells must run a minimum of 1 h before samples are collected. This will purge water in the well and piping so the samples collected are representative of formation water. This task should be completed by the county, city, or Pueblo, but field crews must ensure this activity has been performed before samples are collected. If the pump has not been running for an hour, monitor parameters at 5-min intervals while purging the well for 15 min to flush standing water from the piping (EPA, 2007). At the conclusion of the 15-min purge, follow the steps below to collect samples and report the final parameters. Wells subject to this requirement include, but are not limited to, G-1A, G-2A, G-3A, G-4A, G-5A, O-4,)-1, PM-1, PM-2, PM-3, PM-4, PM-5, Buckman 1, Buckman 6, Buckman 8, LA-5, Otowi House Well, Pajarito Well Pump No. 1, Black Mesa Well, and New Community Well.
- Domestic wells do not need to run before sampling because of the cost to the homeowner and logistical issues but are assumed to be in regular use.

A13-3.2 System Setup of Production Wells, Domestic Wells, Sampling during Drilling Activities

Field Team Member

[1] After arriving at the site, identify and contact the appropriate site representative to assist with access to the well. Allow the representative to conduct any necessary steps to setup system for sampling. Assist if necessary.

Attachment 13
Sampling Production and Domestic Wells and Sampling Wells during Drilling Activities
Page 3 of 3

A13-3.3 System Operation

Field Team Member

[1] After the site representative sets up, turn on the discharge outlet and allow the water to flow freely from the sample tap for a minimum of 3 min to ensure stagnant water is not collected in sample bottles. Follow the site representative's instructions regarding disposition of this water.

NOTE: Do not allow the water to pass through any type of adaptor that could potentially contaminate the sample.

[2] Collect field parameters. Parameters do not need to be collected using a flow-through cell (the calibration cup should be used for the YSI multiparameter instrument), and only one set of parameters needs to be collected. Water-level and flow rate may be recorded if provided by the site representative.

[3] Begin sampling following directions provided on the Sample Collection Logs and the steps in section 4.4, Sampling, in the procedure. It may be necessary to use a peristaltic pump to collect the filtered samples.

A13-3.4 System Breakdown

Field Team Member

[1] Allow the site representative to conduct any necessary steps to breakdown the system. Assist if necessary.

A13-4. REFERENCE

EPA, 2007. SESD Standard Operating Procedure, Groundwater Sampling.

Attachment 14
Low-Flow Purging and Sampling Approach
Page 1 of 3

A14-1. PURPOSE AND SCOPE

This instruction describes the process for setting up, operating, and sampling using the Low-Flow Approach for groundwater sampling activities.

A14-2. BACKGROUND AND PRECAUTIONS

A14-2.1 Background

Most wells on Los Alamos National Laboratory property are sampled using the well-volume approach. However, in some cases, the low-flow approach may be better suited for collecting representative samples from some wells. Obtain the groundwater team lead's approval before using the low-flow approach.

The purpose of the low-flow approach is to minimize the impact that the purging and sampling process has on the well and surrounding hydrogeologic unit (Yeskis and Zavala, 2002). Additionally, this method results in smaller purge volumes and less waste water.

A14-2.2 Precautions

The following precautions must be taken to ensure that the low-flow approach is applied effectively (Yeskis and Zavala, 2002).

- The pump intake should be positioned at or near the middle of the screened interval, and it is preferable to use a dedicated sampling system
- Drawdown must be minimized (less than 0.33 ft)
- Purge rates are based on a number of factors, including hydraulic conductivity of the aquifer and drawdown. The pumping rate should be less than the natural rate of recovery to minimize drawdown (usually between 0.1 and 0.5 L/min).
- The following step-by-step process description assumes that the Bennett or bladder pump system has been properly set up according to Attachments 6 through 9 of this procedure.

Attachment 14
Low-Flow Purging and Sampling Approach
Page 2 of 3

A14-3. STEP-BY-STEP PROCESS DESCRIPTION

A14-3.1 System Setup of the Low-Flow Approach

Field Team Member

[1] Collect a water-level reading by using the transducer installed in the well or by taking a manual measurement in accordance with SOP-5223, Manual Groundwater Level Measurements, or by taking a reading from the pressure transducer.

[2] Determine the volume of the drop pipe or tubing by subtracting the water-level elevation from the surface elevation and using the drop pipe diameter multiplier (found in the logbook front matter) or interior diameter of the tubing. Add the volume of the pump and flow-through cell to this volume.

[3] Set up the Bennett or bladder pump system following the steps in the appropriate attachment.

A14-3.2 System Operation

Field Team Member

[1] Start pumping at the lowest rate possible for the system being used (no more than 0.2 to 0.5 liters per minute). Monitor water levels to maintain drawdown at less than 0.33 ft. Pumping rates are not to exceed 1 L/min (0.25 gallons per minute [gpm]).

[2] Determine the discharge rate by filling a bucket or bottle of known volume and record the fill time. If it is determined that the water level is not dropping, the pumping rate may be increased, but must not exceed 0.25 gpm. Continue taking discharge-rate measurements every 2 min until the drawdown stabilizes.

Attachment 14
Low-Flow Purging and Sampling Approach
Page 3 of 3

A14-3.2 System Operation (continued)

[3] If a stabilized drawdown in the well cannot be maintained at 0.33 ft and the water level is approaching the top of the screened interval, reduce the flow rate or turn the pump off for 15 min and allow for recovery. A check valve is required if the pump is shut off. Under no circumstance should the well be pumped dry. Begin pumping at a lower flow rate. If the water draws down to the top of the screened interval again, turn the pump off and allow for recovery. If two tubing volumes (including the volume of water in the pump and the flow cell) have been removed during purging, then sampling can proceed the next time the pump is turned on. This information should be noted in the field notebook or groundwater sampling log, with a recommendation for a different purging and sampling procedure.

[4] Once the tubing bundle volume (including the volume of water in the pump and the flow cell) has been cleared, measure the field indicator parameters every 5 min. Once parameters have stabilized according to the criteria in section 4.3, Step 9 in the procedure, sampling may begin. Maintain the same pumping rate or reduce slightly for sampling (0.2 to 0.5 L/min) to minimize disturbance of the water column. No casing volume requirements need to be met.

[5] If field parameters do not stabilize, the sampling team should contact the groundwater technical lead, the subcontractor technical representative, or the project manager for further direction.

A14-3.3 System Breakdown

Field Team Member

[1] Breakdown the Bennett or bladder pump system following the steps in the appropriate attachment.

A14-4. REFERENCES

Yeskis, D. and Zavala, B., 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. U.S. Environmental Protection Agency Ground-Water Forum Issue Paper, 542-S-02-001, 53 pp.