Identifier: EP-DIV-SOP-20032
(Supersedes **SOP-5232, R1)**

Revision: 0

Effective Date: 10/14/11

Next Review Date: 10/14/16

Los Alamos NATIONAL LABORATORY EST 1943

Environmental Programs Directorate
Corrective Actions Projects

Standard Operating Procedure

For **GROUNDWATER SAMPLING**

APPROVAL SIGNATURES:			
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1. PURPOSE AND SCOPE

This standard operating procedure (SOP) describes the methods used to collected 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 and Bennett pump. Processes described include: well purging, sample collection, documentation, submitting samples, and setting up and breaking down all sampling systems. This procedure applies to all personnel assigned to collect groundwater samples using the methods discussed. Groundwater sampling with the Westbay MP System is covered in SOP 5225, Groundwater Sampling Using the Westbay MP System. Groundwater sampling from spring and base flow sites is covered in SOP-5224, Spring and Surface Water Sampling.

2. BACKGROUND AND PRECAUTIONS

2.1 Background

The goal 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 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, there is not one method that 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). General criteria for sampling groundwater are provided in Section 4.3-8. Some wells historically have not met all criteria for sampling and well-specific work plans have been prepared. These work plans describe criteria for sampling specific wells not meeting the general criteria in Section 4.3-8.

Occasionally, criteria requirements for sampling cannot be met. While it is preferable that the GTL or LANL Subcontractor Technical Representative (STR) be contacted in these situations, sometimes it is not possible and the field crew will need to make a decision based on their collective knowledge and experience. In cases where samples are collected, field crews must document readings outside the acceptable limits stated by the procedure and notify the GTL or LANL STR when available. Readings outside the acceptable limits for sampling will be documented thoroughly in the field logbooks, and in the Field Summary Report.

It is important to consider purging techniques when developing a plan for collecting representative samples from a monitoring well. As groundwater naturally moves through a hydrogeologic unit, it passes through the screened intervals and filter packs of monitoring wells in the unit. However, water that is above the screened interval in a well may become stagnant after well completion or between sampling events (Yeskis and Zavala, 2002). This stagnant water may not be representative of formation water because physio-chemical changes can occur as the water remains in contact with the well casing, dedicated sampling equipment, and the atmospheric air in the casing. The EPA (Yeskis and Zavala, 2002) and USGS (2006) recommend purging a well prior to sampling to remove stagnant water and ensure that samples collected from a monitoring well are representative. The EPA outlines two purging methods used for removing stagnant water from a well casing prior to sampling; the "Low- Flow Approach" and the "Well Volume Approach". Site-specific characterizations should be taken into account when deciding which method to use; however, most wells on LANL property will be sampled using the Well Volume Approach. This approach is outlined in Section 4. Step by Step Process Description, and will be followed unless permission is given by the GTL to use the Low-Flow Approach, outlined in Attachment 11.

In some cases, such as very low yielding wells or wells screened across the water table, it is not possible to follow either method, and the well must be purged dry. The EPA recommends that after a well is purged dry, it should be sampled no sooner than two hours later and after sufficient recharge has occurred (Yeskis and Zavala, 2002).

When using the Well Volume Approach, ideally, a well should be purged with minimal drawdown until a pre-set volume of water (typically one to three casing volumes) has been purged and field water-quality indicator parameters stabilize. Water-quality indicator parameters are monitored at 3 to 5 minute intervals until stability has been achieved. Once the parameters stabilize, it is presumed that all stagnant water has been removed from the well, and that representative formation water is available for sampling. Parameters measured include temperature, pH, specific conductance, oxidation-reduction potential (ORP), dissolved oxygen, and turbidity. The criteria for defining stability are discussed in section 4.3, Purging Operations. .

Personnel performing this work should be aware of hazards and recommended safety practices before setting up and operating pump and pressure systems.

This procedure has been developed to be consistent with the requirements of the March 1, 2005, Compliance Order on Consent and with the Interim Facility-Wide Groundwater Monitoring Plan (the Interim Plan).

2.2 Precautions

- If any issues arise in the field that would prevent sample collection, as described in this SOP, the field team leader (FTL) shall contact the GTL, STR, or Project Manager to discuss these issues before continuing with sampling.
- If unusual conditions occur at the sampling site or during the sampling that might affect the sampling results, the FTL shall discuss such conditions with the GTL STR, or Project Manager.
- Decontaminate all equipment that will be placed inside the well in accordance with the provisions of EP-ERSS-SOP-5061, Field Decontamination Equipment.
- 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.
- To minimize the potential for cross contamination, use dedicated sampling equipment whenever possible. Equipment blanks should be taken before use of non-dedicated equipment in accordance with the quality assurance/quality control (QA/QC) requirements specified in the Interim Plan.

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 Sample Management Office (SMO) database before leaving for field.
	2.	Review the sampling plan for the current sampling activity to ensure that 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 information will be entered on the Groundwater Sampling Log (Attachment 2) and in the field logbook.
	4.	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 (POD) for the appropriate facility in which work will be performed before starting any field or laboratory activities.
	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.	Calibrate field parameter instruments per manufacturer instruction. As recommend in the USGS National Field Manual for the Collection of Water-Quality Data, calibration should be conducted in temperature conditions similar to the water being monitored. The temperature of groundwater at the Pajarito Plateau ranges from 17 to 22 °C. This is nearly the same as room temperature (approximately 18-21°C). When sampling shallow alluvial wells, springs, or base flow, seasonal temperature considerations should be taken into account for determining whether calibrating at the sample site or indoors is appropriate. Meters should be calibrated within 24 hours of use, with the exception of the HACH Turbidimeters, which should be calibrated every three months. ***NOTE**: If sampling at multiple locations within the same day, perform calibration check at each subsequent sampling site. See attachment 13 for details.
4.2	**System Setup for Sampling**	
Field Team Member	1.	Mobilize the support equipment required for purging and sampling the well. Begin recording a log of sampling activities in the Field Logbook, following 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.

Field Team Leader (cont.)

2. If a large generator is required, follow the guidance in ENV-WQH-SOP-014, Large Generator Use of Pumping.

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

- Attachment 3—Electric Gear-driven Submersible Pump System
- Attachment 4—Bladder Pump System
- Attachment 5—Bennett Pump System
- Attachment 6—Baski Pumping Systems
- Attachment 7—Portable Bladder Pump System
- Attachment 8—Portable Bennett Pump System
- Attachment 10- Hand Bailer Purging and Sampling System
- Attachment 11 – Low Flow Purging and Sampling

If sampling a production or domestic well or sampling during drilling activities, see Attachment 12.

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

4.3 Purging Operations

Field Team Member

1. Determine the depth of the water table utilizing one of the methods below and record on the Groundwater Sampling Log (Attachment 2).

- If the well has a water-level transducer installed, record the water-level elevation on 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 on the Groundwater Sampling Log (Attachment 2).

NOTE: Alluvial wells may have water-level transducers, but alluvial water levels should be manually measured. Alluvial transducers are often located above the pump and are often set to measure depth of water, as opposed to 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 casing volume using the well diameter multiplier. Calculate the multiplier using the following formula: 0.7584 * (Diameter of Casing / 12) ^ 2 * 7.48 (multipliers for specific well diameters are in the Logbook front matter).

Field Team Leader (cont.)

- 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 diameter multiplier (found in the Logbook Front Matter).

NOTE: This step is unnecessary for Alluvial wells, due to the negligible contribution from the drop pipe.

- 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 casing volume (CV) AND until water quality parameters stabilize as defined in Section 8 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 in Section 8 below.
- Well specific work plans may provide additional direction where purge volume requirements cannot be met.
- Record the calculated 1 CV and 3 CV purge volumes on the Groundwater Sampling Log in Attachment 2.

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

- Attachment 3—Electric Gear-driven Submersible Pump System
- Attachment 4—Bladder Pump System
- Attachment 5—Bennett Pump System
- Attachment 6—Baski Pumping Systems
- Attachment 7—Portable Bladder Pump System
- Attachment 8—Portable Bennett Pump System
- Attachment 10—Hand Bailer Purging and Sampling System
- Attachment 11—Low Flow Purging and Sampling

Field Team Member (cont.)

5. The pumping rate should be adjusted, if possible, during purging so that excessive drawdown does not occur. Field crews may have limited ability to restrict flow, depending on the pumping system.

- Drawdown within alluvial wells should be minimized by maintaining a slow purge rate and sampling as soon as stability criteria allow. Alluvial pumping rates should not exceed ¼ gallons per minute (1 liter per minute).
- Drawdown within intermediate and regional wells should be limited to above the screened interval whenever possible. The purging rate should be slowed if the water level is rapidly approaching the top of the screened interval. If drawdown into the screen occurs, or if the initial water level is in the screen, field crews should note this in the logbook entry and continue with purging and sampling the well.
- Turning off the pump while purging regional and intermediate wells should be avoided unless absolutely necessary (such as when changing nitrogen tanks when using a Bennett pump). Turning off the pump could allow stagnant water to react with the well casing, which reduces the representativeness of water that is purged after the pump is turned back on.

6. Determine the discharge rate using one or both of the following methods and record in the Field Logbook and Attachment 2. Flow rate should be monitored 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 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 SOP Compliance Checklist (Attachment 9).
- 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 SOP Compliance Checklist (Attachment 9).

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 how much volume has been purged 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 a new of amount time for the remainder of the purge volume using the new discharge rate.

Field Team Member (cont.)

7. Measure the parameters indicated below a minimum of six times during the purge (or at least twice per casing volume when purging less than 3 CVs). One set of parameters should be recorded immediately after clearing the drop pipe, the following parameters should be collected at the FTL's discretion, and the final three sets of parameters should be collected at least 5 minutes apart (or 3 minutes for wells that take less than 20 minutes to purge 3 CVs). Record the data in the Groundwater Sampling Log (Attachment 2).

   - pH
   - Temperature
   - Specific Conductance
   - Dissolved Oxygen
   - Turbidity
   - Oxidation-Reduction Potential (ORP)
   - Water Level
   - Observations of water clarity, color, and odor.

8. When using a multi-parameter water quality instrument that has the capability to log parameters, use this function to log parameters every 5 minutes (or 3 minutes for wells that take less than 20 minutes to purge 3 CVs). If a transducer is installed in the well that allows for automatic polling of water level data, log this data to the computer or In-Situ Rugged Reader in 30 second intervals. Begin logging water level data before the pump is turned on and continue to log water level data until beginning Section 4.5, System Disassembly/Breakdown, so as to capture water level activity during the purge, sampling, and recovery.

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

10. In general, the well is ready to sample when the following criteria have been met:

   - A minimum of one CV has been removed for alluvial wells and a minimum of three CVs (plus drop pipe) have been removed for intermediate or regional wells. Note: Well-specific work plans may present additional direction for purge volumes, either for wells not capable of meeting these requirements or for wells that must be purged an additional amount.
   - The field indicator parameters have stabilized within their allowable ranges (Yeskis and Zavala, 2002) for at least three consecutive measurements taken a minimum of 3 or 5 minutes apart. Stability is calculated by averaging the last three recorded values for each parameter and using the average value to calculate an acceptable range using the criteria below. If all three of the recorded values fall within the calculated range, stability has been achieved

Field Team Member (cont.)

Field Parameter	Stabilization Criteria
Turbidity	< 10 NTUs, or ± 10%, when turbidity is greater than 10 NTUs (Ref: Yeskis and Zavala, 2002)
Dissolved Oxygen	± 0.3 mg/L (Ref: Yeskis and Zavala, 2002)
pH	± 0.1 (Ref: Yeskis and Zavala, 2002)
Specific Conductance	± 3% (Ref: Yeskis and Zavala, 2002)
Temperature	± 10% (Ref: NMED/LANL Order on Consent)

- If six CVs have been purged, and field parameters have not reached stability, sampling may begin. This is to prevent over-purging of the well (Yeskis and Zavala, 2002). If field parameters are not stable, but purging six CVs is time prohibitive or the field crew suspects that issues are arising that are inconsistent with past sampling events, the GTL or STR should be contacted for further direction.
- Alluvial wells often have excessive drawdown issues, and therefore are subject to different sampling requirements:
  - If a well purges dry before it has met CV and stability requirements, the well should be sampled as soon as sufficient groundwater has entered the well to enable collection of the necessary groundwater samples, preferably on the same day. Re-purging should be performed if a well is inactive for more than 24 hours after full recharge. In many cases, an abbreviated analytical suite must be collected due to insufficient water. The abbreviated suite prioritization is provided by the GTL.
  - In situations where the well purges dry during sampling but recovers quickly, the sampling event may be interrupted to permit recharge.
  - Alluvial wells may be sampled after three CVs have been purged, regardless of field parameter stability.

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

4.4 Sampling

Field Team Member

1. Remove in-line flow-through monitoring instruments from sampling apparatus.

2. Observe the following general precautions for beginning sampling operations:
   - 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 should be adjusted to minimize aeration of the sample while filling the bottles.
   - Decontaminated sampling equipment should not come into contact with the ground.
   - Groundwater samples should be collected as soon as possible after the well is purged. Water that has remained in the well casing for more than 2 hours has had the opportunity to exchange gases with the atmosphere and to interact with the casing material.
   - In-line filters should be rinsed with at least 1.25 liters of sample water prior to use. If insufficient sample water is available, deionized (DI) water may be used to rinse the filter prior to use.

3. Collect water samples in the order of priority as dictated by the Groundwater Technical Lead. If specific guidance is not available, the preferred collection order for some of the more common groundwater analytes is as follows:
   - Volatile organics (VOAs or VOCs) and total organic halogens (TOX)
   - Dissolved gases and total organic carbon (TOC)
   - Semivolatile organics (SVOCs)
   - Metals and cyanide
   - Major water quality cations and anions
   - Radionuclides.

4. Care should be taken when collecting samples to be analyzed for VOA/VOCs; follow the guidelines below (USGS, 2009):
   - Store sample bottles in a dedicated cabinet 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 (do not use felt-tip markers).
   - Rinse any sampling equipment (sampling trees, tubing) that will contact water used to analyze for VOA/VOCs thoroughly before sampling. This is typically accomplished during purging.

Field Team Member (cont.)	5.	Record the final water-level immediately after sampling on the Groundwater Sampling Log (Attachment 2). Record the total volume of waste water generated, as well as the contact waste volume.
	6.	Preserve the samples with the appropriate preservatives as identified on the field chain of custody form. Refer to WES-EDA-QP-219, Sample Control and Field Documentation for specific guidance. Filtration should be performed in the field or as soon after sample collection as possible.
	7.	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 VOA vial septum.
	8.	Complete the field chain-of-custody form for each sample set collected.
	9.	Handle, package, and transport samples in accordance with EP-ERSS-SOP-5057, Handling, Packaging, and Transporting Field Samples.

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 deionized (DI) water, and wipe dry with a paper towel. Refer to EP-ERSS-SOP-5061 and the applicable attachment for specific guidance.
	2.	Secure contact waste in a labeled drum.
	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 TA-64.

4.6 Records Management

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.

5. DEFINITIONS

None.

6. 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.

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.

NMED/LANL Compliance Order on Consent, March 1, 2005 (Revised June 18, 2008)

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. 7PP.

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

7. ATTACHMENTS

Attachment 1	Equipment and Supplies Checklist for Groundwater Sampling
Attachment 2	Groundwater Sampling Log
Attachment 3	Electric Gear-Driven Submersible Pump System
Attachment 4	Bladder Pump System
Attachment 5	Bennett Pump System
Attachment 6	Baski Pumping Systems
Attachment 7	Portable Bladder Pump System
Attachment 8	Portable Bennett Pump System
Attachment 9	EP-DIV-SOP 20032 Compliance Checklist
Attachment 10	Hand Bailer Purging and Sampling System
Attachment 11	Low-Flow Purging and Sampling Approach
Attachment 12	Sampling Production and Domestic Wells and Sampling Wells During Drilling Activities
Attachment 13	Obtaining Quality Field Parameters

8. REVISION HISTORY

Revision No. *(Enter current revision number, beginning with Rev.0)*	**Effective Date** *(DCC inserts effective date for revision)*	**Description of Changes** *(List specific changes made since the previous revision)*	**Type of Change** *(Technical [T] or Editorial [E])*
0	02/24/2009	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.	All
1	9/23/2010	SOP updated to current field practices. Alluvial sampling requirements clarified. Technical procedures for all pump systems clarified. Technical language corrected and standardized. Attachment 6 (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.	T/E
0	10/14/11	New document number assigned; Supersedes SOP-5232; Major revisions. Updated SOP to modify sampling requirements and stability criteria. Added Attachments 10 through 13 addressing the following: • Sampling using a hand-bailer, • Low-flow purging and sampling, • Sampling production and domestic wells, and • Obtaining quality field parameters.	T/E

ATTACHMENT 1

EP-DIV-SOP-20032-1

Records Use Only

EQUIPMENT AND SUPPLIES CHECKLIST FOR GROUNDWATER SAMPLING

Los Alamos NATIONAL LABORATORY EST 1943

Section 1: General Checklist for All Ground Water Sampling

-Field Logbook, Groundwater Sampling Log, Chain of Custody Forms, Plan of the Day, relevant IDW's & SOP's

-Roll-up Tables, Chairs, Shade Shelter, Historical Sampling Paperwork, Well Completion Information

-Radio, Cell Phones, Pagers, appropriate Keys

-1st Aid Kit, Eyewash, Fire Extinguisher, appropriate PPE

-Tool Box with Pipe Wrenches, Crescent Wrenches, Socket Wrenches, assorted other tools

-Ladder with Sump Pump & Hose (for 3000 gal purge containers), Carboys, Buckets

-Extension Cord, Computer with appropriate transducer connections, Inverter

-Manual Water Level Tape and Well Collar if necessary

-YSI multimeter and spare with Flow-Through Cell, Turbidimeter, Flow-meter

-Action Packer fully stocked with Nitrile Gloves, Wyp-alls, Polyethylene flexible tubing, Chain of Custody tape, DI Squirt Bottle, 0.45 micron filters, Pippettes, pH Test Strips, Zip Loc Bags, Duct Tape, Teflon Tape

-Assorted Preservatives (acids & bases)

-Cooler with blue ice

-Sampling Apparatus (specific to each pump type, see Attachments 3-8)

-Power System (specific to each pump type, see Attachments 3-8)

ATTACHMENT 2

EP-DIV-SOP-20032-2 Records Use Only

GROUNDWATER SAMPLING LOG

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GroundWater Sampling Log

Project: IFWGMP	LSD: ft. msl	Well Diameter: inches	Date:
Canyon:	Water Level: ft. msl	Top of Screen: ft	Notes:
Well No:	*TD:	Bottom of Screen: ft.	
Sampling Device:	*DTW:	Water Column: ft	
Measuring Point:	Drop Pipe: gal	1CV: gal	
* Completion Depth:		3CV: gal	Baski Packer Pressure
Sampling Personnel:			Before: psi
[* ft. BTOC / BTIC / BGS / MSL]	Note height of TOC/TIC on MP for Alluvials		After: psi

DTW = (LSD - Water Level)…. Water Column = (TD - DTW)… Drop Pipe = (DTW x Drop Pipe Diameter Multiplier)

1CV = (Water Column x Well Diameter Multiplier) … 3 CV = (1CV x 3)

TIME MST / DST	pH SU	TEMP °C	SPEC COND µs/cm	DO mg/l	Turb NTU	ORP mV	Water Level* ft_____	Discharge Rate (GPM)	NOTES
Stability:	± 0.1	± 10%	± 3%	± 0.3	<10 or ± 10%				

WASTE		*Purge: Formation water purged prior to sampling.
Contact: gal.	Drum#	
*Purge Water: gal.	Drum#'s	NOT drop pipe volume.
Total Waste Water: gal.		NOT water during sampling.

Refer to logbook EP2010-_____________ page_______ for sampling event details

ATTACHMENT 3

EP-DIV-SOP-20032-3 Records Use Only

ELECTRIC GEAR-DRIVEN SUBMERSIBLE PUMP SYSTEM

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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.

2. BACKGROUND AND PRECAUTIONS

2.1 Background

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

2.2 Precautions

Review any special electrical, mechanical, biological, or chemical conditions that are present for the well being sampled. These should be reviewed with the Groundwater Technical Lead prior to starting the sampling event.

3. STEP-BY-STEP PROCESS DESCRIPTION

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 to end of sampling tree, if available. Connect end of sampling apparatus to purge water container with hose.
	4.	Install in-line flow-though cell, using flexible polyethylene tubing to connect cell to sampling tree discharge units (valve and hose barbs).
	5.	Start the large generator (refer to ENV-WQH-SOP-014, Large Generator Use of Pumping). Throw the circuit breaker to allow a live connection.

Field Team Member (cont.)

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. 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.

3.2 System Shutdown - 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 that water can drain into the drop pipe.

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

4. Disconnect power cord and sampling apparatus.

5. Lock and secure well.

ATTACHMENT 4

Records Use Only

EP-DIV-SOP-20032-4

BLADDER PUMP SYSTEM

Los Alamos NATIONAL LABORATORY EST 1943

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.

2. BACKGROUND AND PRECAUTIONS

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.

2.2 Precautions

2.2.1 Operation of a bladder pump requires the use of pressurized gas cylinders. Operators should be familiar with LANL 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 for the bladder pump system.

2.2.2 When working on or around pressure systems, operators must adhere to the following safe work practices:

- Wear safety glasses with side shields or use a face shield.
- Wear appropriate work boots and leather gloves.
- Use warning signs and mark or label pressure vessels and systems to identify the operating pressure and contents.
- Handle and store gas cylinders safely.
- Avoid temperature extremes, which can cause pressure changes and component failure.
- Store cylinders that are not necessary for the current work in a safe location outside the work area.
- Never work on a pressure system under pressure; depressurize the system and use lockout/tagout, if appropriate.
- Release of inert gases displaces breathable air and can result in unconsciousness. In the event of an accidental or uncontrolled release of gas cylinder contents, evacuate the area and notify your supervisor.

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1 System Setup – Bladder Pump System

Field Team Member

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

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: Regulator, hoses, pump controller, and well assembly have been pre-fabricated. DO NOT remove or change coupling, valves, whip restraints, quick connects, or any other components of the pressure system in the field.

3. Connect pressure hose to the quick connect coupling on the regulator setup and secure 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 whatever manner the operator sees fit.

3.2 System Pressurization – 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.

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 a quarter turn.

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 of 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.

3.3 System Operation – 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 foot deep well:

   100 feet × 0.45 = 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 four 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.

3.4 System Shutdown – 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. Lock and secure well.

ATTACHMENT 5

Records Use Only

EP-DIV-SOP-20032-5

BENNETT PUMP SYSTEM

Los Alamos NATIONAL LABORATORY EST 1943

1. PURPOSE AND SCOPE

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

2. BACKGROUND AND PRECAUTIONS

2.1 Background

Many intermediate wells are equipped with the Bennett pump system, also known as a Reciprocating Submersible Pump (RSP). In addition, regional and intermediate wells that lack a pumping system can be sampled with a portable Bennett pump system (See Attachment 8). 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 C-1, Well Plate Schematic, at the end 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.

2.2 Precautions

2.2.1 Operation of a Bennett pump requires using pressurized gas cylinders. Operators should be familiar with LANL 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 for operating the Bennett pump system.

2.2.2 When working on or around pressure systems, operators should adhere to the following safe work practices:

- Wear safety glasses with side shields or use a face shield.
- Wear appropriate work boots and leather gloves while handling pressurized gas tanks.
- Handle and store gas cylinders safely.
- Avoid temperature extremes, which can cause pressure changes and component failure.
- Store cylinders that are not necessary for the current work in a safe location outside the work area.
- Never work on a pressure system under pressure. Depressurize the system and use lockout/tagout when appropriate.
- Release of inert gases displaces breathable air and can result in unconsciousness. In the event of an accidental or uncontrolled release of gas cylinder contents, evacuate the area and notify supervisor.

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1 System Setup –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 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 pressure hose to the quick connect coupling on the regulator and secure 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 & 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 done in whatever manner the operator sees fit.

3.2 System Pressurization – 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 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.

3.3 System Operation –Bennett Pump System

Field Team Member

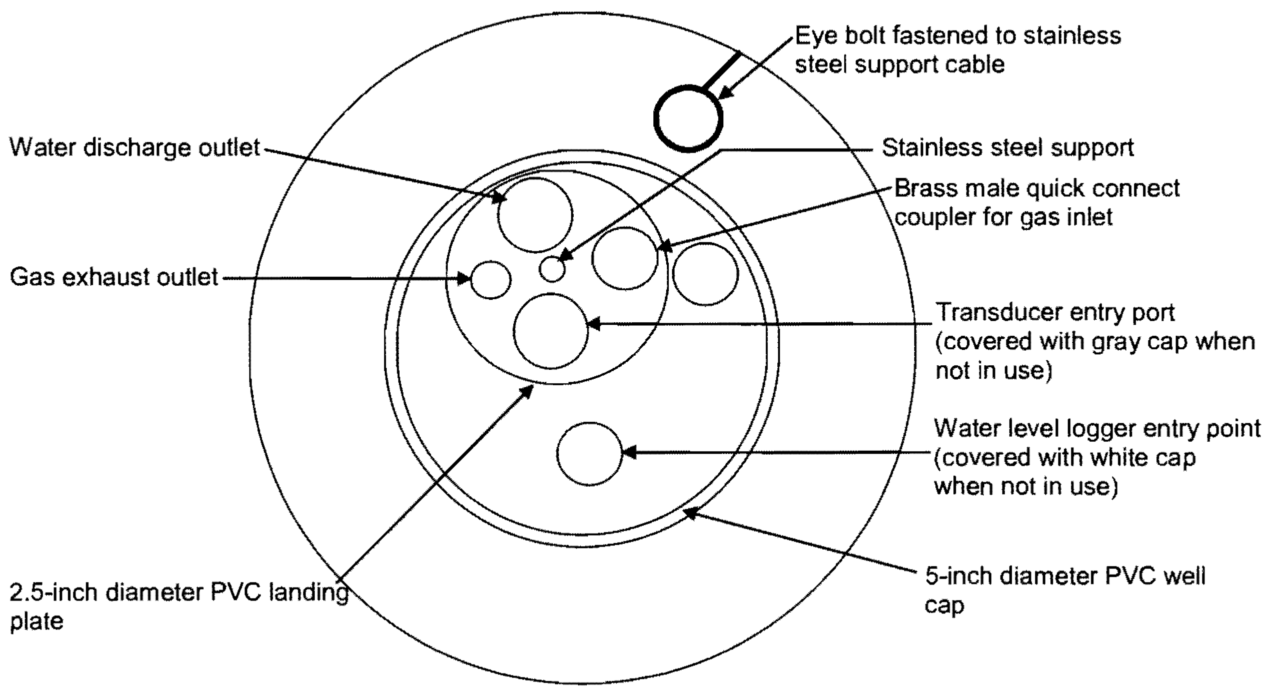
1. Ensure all pressure system connections are secure and functional. Ensure that the gas discharge line from the well is open and not blocked.
2. Adjust the pressure from the gas cylinder going into the pump to adjust the pumping speed. A pressure of 100 to 190 psi is usually sufficient to run the Bennett 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, the pressure should be slowly increased until the pump starts cycling. To a limited extent, gas pressure may be adjusted to control the pumping rate.

3.4 System Shutdown – 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 safety manifold and drain the nitrogen gas from the line until the pressure regulator reads near zero 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. If present, replace the stainless-steel cap 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 foot ¼-inch-outside-diameter (OD) nylon freeze prevention line as follows:
   - Insert the ¼-inch-OD nylon freeze prevention line while decontaminating with a DI-soaked paper towel into 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 with a DI-soaked paper towel.
   - The displaced water will lower the water level in the water discharge tubing sufficiently below the freezing line.

Figure C-1. Well Plate Schematic



ATTACHMENT 6

Records Use Only

EP-DIV-SOP-20032-6

BASKI PUMPING SYSTEM

Los Alamos NATIONAL LABORATORY EST 1943

1. PURPOSE AND SCOPE

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

2. BACKGROUND AND PRECAUTIONS

2.1 Background

There are two types of Baski systems 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 GSP is installed in the lower screen, however this may not be the case at all sites. Each screen will be sampled following the appropriate attachment for the well type that is installed, either Attachment 5 for a Bennett pump or Attachment 3 for a GSP. 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 gear-driven submersible pump (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 a ¼-inch 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.

2.2 Precautions

2.2.1 Operation of the Baski pumping system requires the use of pressurized gas cylinders. Operators should review LANL Engineering Standards Manual Chapter 17 – Pressure Safety and P101-34 - Pressure Safety, to be aware of hazards and recommended safety practices prior to setting up and operating a pressure system for operating the Baski pumping system.

2.2.2 When working on or around pressure systems, you must adhere to the following safe work practices:

- Wear safety glasses with side shields or use a face shield.
- Wear appropriate work boots and leather gloves when moving nitrogen cylinders.
- Use warning signs and mark or label pressure vessels and systems to identify the operating pressure and contents.
- Restrict access to high-pressure areas.
- Handle and store gas cylinders safely.
- Avoid temperature extremes, which can cause pressure changes and component failure.
- Store cylinders that are not necessary for the current work in a safe location outside the work area.

- Never work on a pressure system under pressure. Depressurize the system and use lockout/tagout when appropriate
- Release of inert gases displaces breathable air and can result in unconsciousness. In the event of an accidental or uncontrolled release of gas cylinder contents, evacuate the area and notify the supervisor.

2.2.3 Operation of the Baski pumping system requires the use of a large generator. Ensure the precautions in ENV-WQH-SOP-014, Large Generator Use of Pumping, are observed.

2.2.4 Prior to sampling any well with a Baski sampling system, 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 LANL or SUBCONTRACTOR personnel responsible for maintaining packer pressure in accordance with EP-DIV-SOP 20006 to request further assessment, and notify the GTL or project manager.

NOTE: Packer re-pressurization may only be conducted 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.

2.2.5 If 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 prior to continuation of sampling activities.

2.2.6 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

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1 System Setup – Baski Pumping System

Field Team Member	1.	Mobilize a large portable generator to the well site in accordance with ENV-WQH-SOP-014.
	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 found at http://adep.lanl.gov/epdc/EPDCS/Facility%20Support%20Docs/Drawings/CAP-WELLS-DWG-102Y231909.pdf. .
	3.	Determine from which screened interval the sample will be taken.
	4.	Connect computer to transducer for screen to be sampled.
	5.	Remove the cap from the nitrogen tank and install the pressure safety manifold. The pressure safety manifold is equipped with a PRV pre-set to 290 psi or 380 psi, depending on the well.

Field Team Member (cont.)

6. Connect a pressure hose from the regulator to the appropriate female quick disconnect fitting (upper or lower 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 done in whatever manner the operator sees fit.]

3.2 System Pressurization – 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 the manual vent valve is closed.

3. Check the fill valve is closed.

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

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. Cease 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.

3.3 System Operation – Baski Pumping System

Field Team Member

1. Turn on the generator and flip the circuit breaker [Refer to ENV-WQH-SOP-014 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 five minutes, turn off the pump and the nitrogen tank and perform the following:
   - Release pressure on the APV by slowly opening the manual vent valve.
   - Re-pressurize to re-open the APV in accordance with Section 3.2 above ensuring sufficient pressure is applied to open the APV.

3.4 System Shutdown – 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 re-equilibrates to pre-sampling 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 prior to sampling, and remains above "Minimum Packer Pressure" and "Action Pressure" found at http://adep.lanl.gov/epdc/EPDCS/Facility%20Support%20Docs/Drawings/CAP-WELLS-DWG-102Y231909.pdf.
5. Once venting is complete, disconnect the pressure hose from the quick connect coupling on the landing plate.

   NOTE: Care must be taken to ensure that system has fully vented prior to disconnecting the tube. **Do not disconnect while system is still venting**.
6. If the other screened interval is to be sampled, return to Section 3.1. Ensure that 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.

Field Team Member (cont.)	8.	Disconnect the power cable.
	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 PVC crossover nipple is left in place on the landing plate.
	12.	Ensure that all gauges and fittings that remain inside the well monument are below the top of the monument and close and lock the cover.
	13.	Lock and secure the well.

ATTACHMENT 7

EP-DIV-SOP-20032-7

Records Use Only

PORTABLE BLADDER PUMP SYSTEM

Los Alamos NATIONAL LABORATORY EST 1943

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-inch bladder pump (SamplePro), the MP15 Control and Power pack (QED Backpack), and the MP10 Controller (QED Controller).

2. BACKGROUND AND PRECAUTIONS

2.1 Background

Most shallow alluvial monitoring wells at the 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.

2.2 Precautions

2.2.1 Operation of a bladder pump requires the use of pressurized gas cylinders. Review LANL 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 for the bladder pump system.

2.2.2 When working on or around pressure systems, the operator must adhere to the following safe work practices:

- Wear safety glasses with side shields or use a face shield
- Wear appropriate work boots and leather gloves
- Use warning signs and mark or label pressure vessels and systems to identify the operating pressure and contents
- Handle and store gas cylinders safely
- Avoid temperature extremes, which can cause pressure changes and component failure
- Store cylinders that are not necessary for the current work in a safe location outside the work area

- Never work on a pressure system under pressure; depressurize the system and use lockout/tagout when appropriate
- Release of inert gases displaces breathable air and can result in unconsciousness. In the event of an accidental or uncontrolled release of gas cylinder contents, evacuate the area and notify your supervisor.

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1 System Setup – Portable Bladder Pump System

Field Team Member

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

2. If the well is near the vehicle, the FTL may decide to proceed with the setup for a dedicated bladder pump (see Attachment 4, 3.1 System Setup). This entails using a nitrogen tank with the QED controller.
   - Connect the QED controller to the SamplePro using the roving air fitting.

3. Remote wellsites 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 pump from protective case.
   - Inspect O-rings and check valves on pump head to ensure functional integrity, replace if necessary.
   - Install new Teflon bladder onto barb. Wells greater than 75 ft deep need bladder connector fitting attached.
   - Install new grab plate into head assembly.
   - Cut the appropriate lengths of Swagelok air tubing (opaque) and Teflon-lined polyethylene tubing (clear). Pump intake should sit within screened interval and below 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.

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

Field Team Member (cont.)

6. Insert pre-cut tubing ends into pump head and grab plate until firmly seated against O-rings. "W" indicates water line and "A" indicates air line.

7. It is necessary to prepare an Equipment Rinsate Blank (EQB) before lowering the pump down the well.
   - Pressurize system (see section 3.2) at approximately 1 psi per foot of tubing
   - attach new flexible polyethylene tubing to pump intake and lower free end into bottle of DI water
   - begin cycling pump via pump controller
   - collect sample from discharge tubing
   - discard flexible polyethylene tubing used for EQB sampling

8. Attach stainless steel security cable to pump head.

9. Deploy pump, with 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 de-ionized 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.

3.2 System Pressurization – 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 (nitrogen use only).

2. Ensure the vent valve is closed (nitrogen 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 a quarter turn.

3.3 System Operation – Portable Bladder Pump System

Field Team Member

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

2. Determine the proper pump operating pressure as follows:
   - Multiply the vertical depth below ground surface by 1 psi and add 10 - 15 psi.

     For example: Sample to be evacuated at 100 feet:

     50 ft × 1 = 50 psi lift + 10 - 15 psi = 60 -65 psi operating pressure

Field Team Member (cont.)

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

4. Cycle the pump and observe its operation. Start at four cycles per minute and put discharge line in a calibrated one liter bottle in order to determine a flow rate.

5. Adjust the pumping system, as necessary, to maximize the pumping rate.
   - If needed, increase/decrease pressure on controller and at the tank.
   - If flow rate is still far below one liter a minute the FTL may elect to increase the number of cycles per minute.

3.4 System Shutdown – Portable Bladder Pump System

Field Team Member

1. Press STOP button on controller.

2. Shut off the gas cylinder valve.

3. Vent the system to the atmosphere (nitrogen use only).

4. Disconnect all hoses and whip restraints.

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

6. Separate cable and tubing from Sample Pro.

7. Remove tubing from grab plate and add to the contact waste for that sampling event.

8. Disassemble pump and add grab-plate and bladder to contact waste. Empty bladder into purge water prior to disconnecting.

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

10. Lock and secure well.

ATTACHMENT 8

Records Use Only

EP-DIV-SOP-20032-8

PORTABLE BENNETT PUMP SYSTEM

Los Alamos NATIONAL LABORATORY EST 1943

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.

2. BACKGROUND AND PRECAUTIONS

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 feet of bundled tubing is coiled around a winch in the back of the trailer. The winch is operated with a motor which is 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) 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.

2.2 Precautions

2.2.1 Operation of a Bennett pump system requires using pressurized gas cylinders. Operators should be familiar with LANL 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 for operating the Bennett pump system.

2.2.2 When working on or around pressure systems, operators should adhere to the following safe work practices:

- Wear safety glasses with side shields or use a face shield.
- Wear appropriate work boots and leather gloves while handling pressurized gas tanks.
- Handle and store gas cylinders safely.
- Avoid temperature extremes, which can cause pressure changes and component failure.
- Store cylinders that are not necessary for the current work in a safe location outside the work area.
- Never work on a pressure system under pressure. Depressurize the system and use lockout/tagout when appropriate.
- Release of inert gases displaces breathable air and can result in unconsciousness. In the event of an accidental or uncontrolled release of gas cylinder contents, evacuate the area and notify supervisor.

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1	**System Setup – Portable Bennett Pump System**	
Field Team Member	1.	An Equipment Rinsate Blank (EQB) must be prepared prior to sampling. This is typically done onsite, but occasionally is performed indoors (TA-64 South Bay) during inclement weather. In extenuating circumstances, it may be performed the day before sampling with approval from the GTL. Refer to 3.3, System Pressurization and 3.4, System Operation – 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, which will 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 being lowered or raised within the well housing.
	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 inches 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 prior to 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.

Field Team Member (cont.)	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 DI-soaked paper towel while they are being lowered. It may be necessary to use several DI-soaked paper towels to ensure the tubing and pump are decontaminated well.
	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 water level 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.
	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 with a whip restraint.
	17.	Connect the other end of the hose to the back of the pump control box.

3.2 System Pressurization – 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 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 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.

3.3 System Operation – 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 noted 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 method above 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 EQB) will have to be purged from the tubing before well water exits the sample tree. Note that 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.

3.4 Removal of Portable Bennett Pump System

Field Team Member

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

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

   - Mix 1 gallon of DI water with Liquinox at a ratio of approximately 1:100 (about 1 capful of Liquinox)
   - Pump soap mixture through tubing
   - Pump 10 gallon DI water to thoroughly rinse tubing
   - Note that the first 5 gallons of water to exit the discharge line will be formation water, and must be disposed of as such.
   - 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 that all water is removed from the line so that the tubing bundle it is not damaged by freezing temperatures in the winter.

Field Team Member (cont.)	3.	Unthread and remove the bottom-most portion of the Bennett pump.
	4.	Attach the brass airline fitting (connected to the black pressure hose) to bottom of pump where water intake was removed.
	5.	Attach pressure hose to regulator.
	6.	Increase air pressure slowly to 100 psi to displace water from the pump discharge lines, collecting decontamination water as required to comply with waste disposal for the site. Continue applying pressure to the system until all the water has been removed.
	7.	Lock and secure well.

ATTACHMENT 9

Records Use Only

EP-DIV-SOP-20032-9

Compliance Checklist

Los Alamos NATIONAL LABORATORY EST 1943

EP-DIV-SOP-20032, R0 Compliance Checklist

Well Name:____________________

Date:____________________

Watershed/ Quarter:____________________

Sampling Personnel:____________________

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

	Stable for three consecutive readings?					
Parameters collected at proper intervals? (HH:MM)	pH ±0.1 STU	Temp ± 10%	Specific Conduct. ± 3%	Dissolved Oxygen ±0.3 mg/l	Turbidity <10 NTU or ± 10%	Comments:
Average:						
Range:	upper: lower:	upper: lower:	upper: lower:	upper: lower:	upper: lower:	
Y N	Y N	Y N	Y N	Y N	Y N	

SOP Requirements Met?	Comments:
Y N	

Refer to logbook EP2010-__________ page______ for sampling event details.

ATTACHMENT 10

Records Use Only

EP-DIV-SOP-20032-10

HAND BAILER PURGING AND SAMPLING SYSTEM

Los Alamos NATIONAL LABORATORY EST 1943

1. PURPOSE AND SCOPE

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

2. BACKGROUND AND PRECAUTIONS

2.1 Background

The EPA cautions that the use of hand bailer systems to purge and sample wells may not result in collecting representative samples, especially when monitoring for VOC/VOAs and metals (Yeskis and Zavala, 2002). Instead, the use of a dedicated sampling pump is recommended. Some wells on LANL property (specifically R-26 pz2) need to be purged and sampled with hand bailing techniques.

2.2 Precautions

When it is absolutely necessary to use a hand bailer system, such as very small diameter wells (~1 inch) or very low-yielding hydrogeologic units, the field team must make an effort 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 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 may bias inorganic metals

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1	**System Setup – Hand Bailer System**	
Field Team Member	1.	Prior to departing for the sampling destination, ensure that a new length of unused cord has been attached to the bailer. If this has not happened, the crew needs to perform this action
	2.	An Equipment Rinsate Blank (EQB) must be prepared prior to sampling. This is typically done on site, but occasionally is performed indoors (TA-64 South Bay) during inclement weather. In extenuating circumstances, it may be performed the day before sampling with approval from the GTL.
	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.

Field Team Member (cont.)	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 contacting the ground, and unfurl the nylon cord onto the tarp.

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 to permit this to occur. **NOTE:** Normal parameter stability may not be met due to insufficient volume to purge until meeting the stability criteria.
	3.	When purge volume requirements have been met (one CV for alluvial wells; 3 CVs for perched intermediate or regional wells), sampling can commence. Samples are collected in the order of the prioritized suite. **NOTE:** If well purges dry prior to the collection of one casing volume (CV), or during sampling, allow for recharge and collect a prioritized suite.

3.3 System Breakdown

Field Team Member	1.	Remove hand bailer from the well and detach the used nylon cord (this will become 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 ounce) into the bailer and slosh back and forth several times. Drain. Rinse by adding about 5 ounces of DI water, slosh, and drain. Repeat at least four times. Rinse the outside of the bailer with the Liquinox solution, 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 well.

ATTACHMENT 11

Records Use Only

EP-DIV-SOP-20032-11

LOW-FLOW PURGING AND SAMPLING APPROACH

Los Alamos NATIONAL LABORATORY EST 1943

1. PURPOSE AND SCOPE

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

2. BACKGROUND AND PRECAUTIONS

2.1 Background

Most wells on LANL 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. Written permission must be given by the GTL prior to 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.

2.2 Precautions

The following precautions must be taken to ensure that the Low-Flow Approach is being applied effectively (Yeskis and Zavala, 2002).

- The pump intake is preferable 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 that 0.33 feet)

- 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 liters per minute).

- The following step-by-step process description assumes that the Bennett system or Bladder pump system has been properly set up according to Attachment 4, 5, 7, or 8, of this document.

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1	**System Setup – 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 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.
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 liter per minute (0.25 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, pumping rate may be increased, but not exceed 0.25 gpm. Continue taking discharge rate measurements every two minutes until drawdown stabilizes.
	3.	If a stabilized drawdown in the well can't 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 minutes 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 minutes. Once parameters have stabilized according to the criteria in Section 4.3, step #9 in the main body of this document, sampling may commence. Maintain the same pumping rate or reduce slightly for sampling (0.2 to 0.5 liters per minute) in order to minimize disturbance of the water column. No CV requirements need to be met.
	5.	If field parameters do not stabilize, the sampling team should contact the groundwater technical lead, the STR, or the project manager for further direction.
3.3	**System Breakdown**	
Field Team Member	6.	Breakdown the Bennett or Bladder pump system following the steps in the appropriate attachment.

ATTACHMENT 12

Records Use Only

EP-DIV-SOP-20032-12

SAMPLING PRODUCTION AND DOMESTIC WELLS AND SAMPLING WELLS DURING DRILLING ACTIVITIES

Los Alamos NATIONAL LABORATORY EST 1943

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 LANL Interim Facility-Wide Groundwater Monitoring Plan.

2. BACKGROUND AND PRECAUTIONS

2.1 Background

Special considerations are necessary when sampling production or domestic wells. These wells are managed by county, city, 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 prior to the field crew arriving 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 GTL may request that samples be collected during drilling activities. Typically, these samples are collected at the end of a 24-hour aquifer pumping test, however they 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 previous to the field crew arriving on site. The field crew is not required to complete a purge or check for stability requirements before sampling.

2.2 Precautions

Because these sites are managed by county, city, Pueblo of San Ildefonso, 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 protection and eye protection may be required in addition to the personal protective equipment required for sampling activities, as outlined in the appropriate Integrate Work Document (IWD).

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 causing any additional costs to the homeowner such as excessive water usage or damaging property,

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1 Sampling Preparation

Field Team Member	1.	Follow the steps outlined in section 4.1, Sampling Preparation, of the main body of this document to prepare for sampling.
Field Team Member (cont.)	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 hour before sample collection. This will purge water in the well and piping so that samples collected are representative of the water in the formation. This task should be completed by the city, county, or Pueblo, but field crews must ensure this has been done before samples are collected. If the pump has not been running for an hour, monitor parameters at 5 minute intervals while purging the well for 15 minutes to flush standing water from the piping (EPA, 2007). At the conclusion of the 15 minute 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 #1, Black Mesa Well, and New Community Well. • Domestic wells do not need to run before sampling due to cost to the homeowner and logistical issues, but are assumed to be in regular use.

3.2 System Setup – Production Wells, Domestic Wells, Sampling During Drilling Activities

Field Team Member	1.	Upon arrival on site, identify and contact 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.

3.3 System Operation

Field Team Member	1.	After setup is completed by the site representative, install the brass tubing adapter on the discharge outlet (when possible). Turn on the discharge outlet and allow the water to flow freely from the sample tap for a minimum of three minutes to ensure that stagnant water is not collected in sample bottles. Follow the site representative's instructions regarding what to do with this water.
	2.	Collect field parameters. Parameters do not need to be collected using a flow-though cell (the calibration cup should be used for the YSI multi-parameter 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 main body of this document. It may be necessary to use a peristaltic pump to collect the filtered samples.

3.4 System Breakdown

Field Team Member	1.	Allow the site representative to conduct any necessary steps to breakdown the system. Assist if necessary.

ATTACHMENT 13

Records Use Only

EP-DIV-SOP-20032-13

OBTAINING QUALITY FIELD PARAMETERS

Los Alamos NATIONAL LABORATORY EST 1943

1. PURPOSE AND SCOPE

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

2. BACKGROUND AND PRECAUTIONS

2.1 Background

It is important to obtain quality field parameters during each purging event, as this data is used to determine the representativeness of the samples collected. Field parameters should represent, as closely as possible, the conditions in the hydrogeologic unit that is being sampled. If field parameters are suspected to be inaccurate during a purging event, follow the steps below to troubleshoot the water quality instrument. To ensure quality data is being recorded at each site visited during the day, perform a calibration check (as outlined below).

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
- Record all activities in the field logbook or calibration logbook

3. STEP-BY-STEP PROCESS DESCRIPTION

3.1		**Before Arriving Onsite**
Field Team Member	1.	Never use an instrument that did not pass calibration. Never use an instrument that is overdue to be factory calibrated. YSI meters are to be calibrated within 24 hours prior to use. HACH 2100P calibration is required every 3 months. Follow manufacturer instruction for other instrumentation.
	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 it was last calibrated by the manufacturer.
	3.	Bring the primary meter with calibration logbook, a full set of secondary meters with calibration logbook, and full calibration kit into the field every day. If using a HACH Turbidimeter as the primary turbidity meter, the turbidity probe on the YSI multi-parameter instrument may serve as the back-up meter.

Field Team Member (cont.)

4. When visiting more than one geographic location in a day, the field crew must perform a calibration check upon arrival at the second site. Only specific conductance and pH 7 need to be checked (in that order). Follow the ranges listed below, as specified by YSI:

   - Specific conductance: +/- .3% of the reading,
   - pH: +/- 0.2 STU

   If either parameter is outside of the allowable range, that parameter must be recalibrated using manufacturer's instructions. If pH 7 is out of range, a three-point calibration must be performed.

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 and stop purging (if at a well site).

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
DO (mg/L)	0 – 14	2 decimal places
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 of the feasible range, calibrate the secondary meter and begin using it.
   - DO cannot be validated in the field and the probe should be recalibrated.
   - Turbidity cannot be calibrated or validated in the field. If it is outside of the feasible range use the secondary meter.

Field Team Member (cont.)	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 STU • ORP: +/- 20 mV
	4.	If the meter passes validation, continue using the instrument. The "questionable parameter" is considered validated; continue entering those values into the appropriate forms. If the meter does not pass validation, clean the probes thoroughly and recalibrate the entire meter in the field using the portable calibration station.
	5.	If the newly-calibrated primary meter fails calibration in the field, calibrate the secondary meter and use it to measure the remaining set of field parameters.
	6.	If either the newly-calibrated primary meter or the secondary meter now reads values *within* the range of feasibility, use those values instead of the original parameter values. If the secondary meter reads within the range of feasibility while the primary meter did not, ensure that the primary meter receives the appropriate maintenance before being used again in the field.
	7.	If *both* the original meter and the second meter read parameters *outside* the range of feasibility, the "questionable parameter" is considered validated. Enter the parameters into the appropriate forms.