LMS/PLN/S04351-13.0

Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites

Stoller
Legacy Management Team

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Contents

Figures

Tables

Appendixes

Abbreviations

BOA	Basic Ordering Agreement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
EDD	Electronic Data Deliverable
EPA	U.S. Environmental Protection Agency
FDCS	Field Data Collection System
ft	foot (or feet)
GPS	global positioning system
HDPE	high-density polyethylene
ICPT	Integrated Contractor Purchasing Team
JSA	job safety analysis
L	liter
LM	Office of Legacy Management
µm	micrometer(s)
mg/L	milligram(s) per liter
mL	milliliter(s)
mL/min	milliliter(s) per minute
NIST	National Institute of Standards and Technology
NTU	nephelometric turbidity unit
PCB	polychlorinated biphenyl
PDA	personal digital assistant
PDF	Portable Document Format
QC	quality control
QSAS	Quality Systems for Analytical Services
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
VOC	volatile organic compound

1.0 Introduction

This plan incorporates U.S. Department of Energy (DOE) Office of Legacy Management (LM) standard operating procedures (SOPs) into environmental monitoring activities and will be implemented at all sites managed by LM. This document provides detailed procedures for the field sampling teams so that samples are collected in a consistent and technically defensible manner. Site-specific plans (e.g., long-term surveillance and maintenance plans, environmental monitoring plans) document background information and establish the basis for sampling and monitoring activities. Information will be included in site-specific tabbed sections to this plan, which identify sample locations, sample frequencies, types of samples, field measurements, and associated analytes for each site. Additionally, within each tabbed section, program directives will be included, when developed, to establish additional site-specific requirements to modify or clarify requirements in this plan as they apply to the corresponding site. A flowchart detailing project tasks required to accomplish routine sampling is displayed in Figure 1.

LM environmental procedures are contained in the *Environmental Procedures Catalog* (LMS/PRO/S04325), which incorporates American Society for Testing and Materials (ASTM), DOE, and U.S. Environmental Protection Agency (EPA) guidance. Specific procedures used for groundwater and surface water monitoring are included in Appendix A. If other environmental media are monitored, SOPs used for air, soil/sediment, and biota monitoring can be found in the site-specific tabbed sections in Appendix E or in site-specific documents. The procedures in the *Environmental Procedures Catalog* are intended as general guidance and require additional detail from planning documents in order to be complete; the following sections fulfill that function and specify additional procedural requirements to form SOPs.

Routine revision of this Sampling and Analysis Plan will be conducted annually at the beginning of each fiscal year when attachments in Appendix E, including program directives and sampling location/analytical tables, will be reviewed by project personnel and updated. The sampling location/analytical tables in Appendix E, however, may have interim updates according to project direction that are not reflected in this plan. Deviations from location/analytical tables in Appendix E prior to sampling will be documented in project correspondence (e.g., startup letters). If significant changes to other aspects of this plan are required before the annual update, then the plan will be revised as needed.

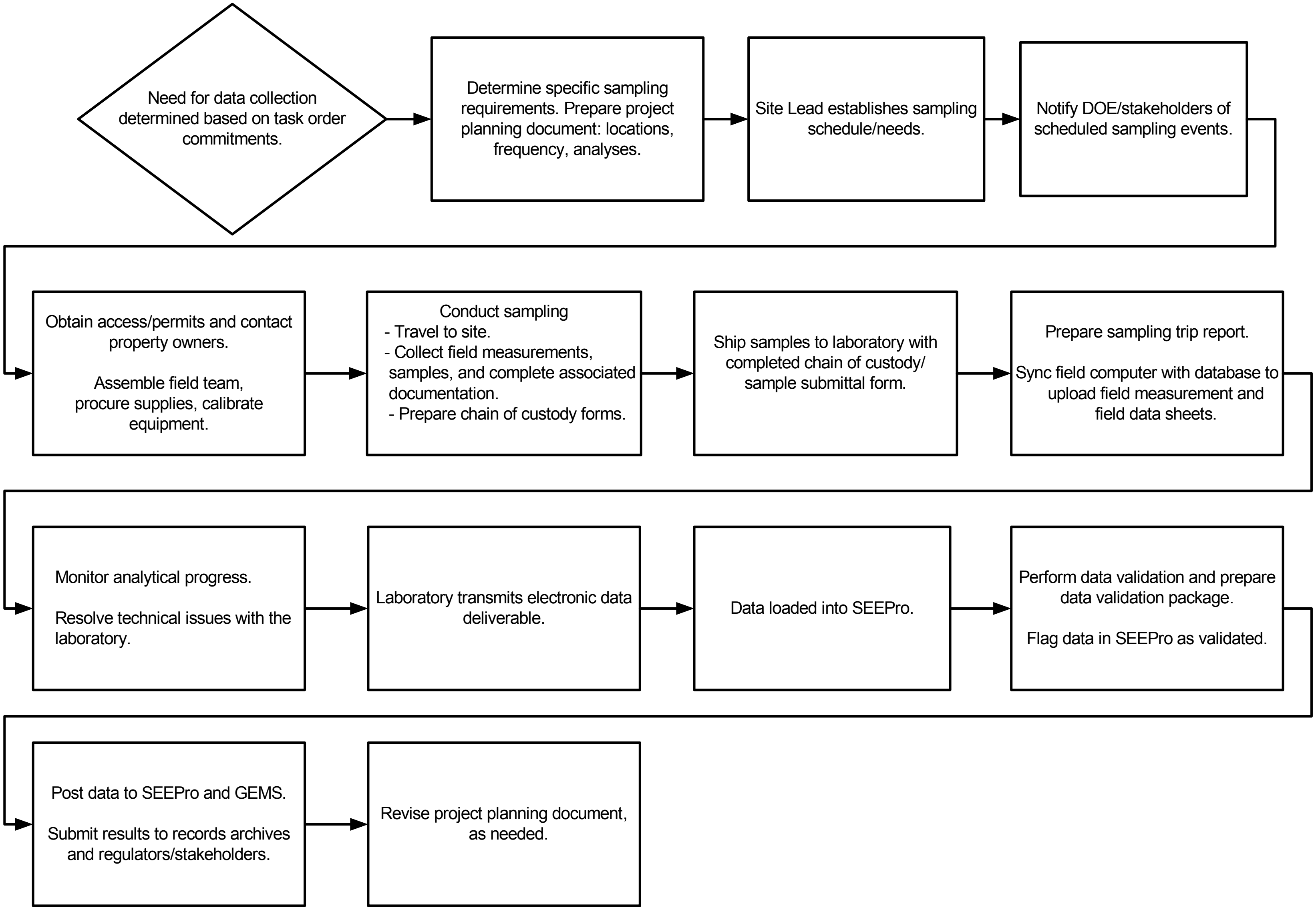

Figure 1. Sampling Flowchart

2.0 Pre-Trip Planning

Sampling personnel will meet with the site lead or appropriate manager before each sampling event. The purpose of the meeting is to:

- Discuss any new site issues involving safety, access to locations, or landowner concerns.
- Identify tasks that the sampling team can complete while at the site. These may include conducting well maintenance, collecting global positioning system (GPS) data, downloading data loggers, repairing or replacing pumps, replacing signs, repairing fences, and providing telemetry support.
- Capture changes to sampling locations and, if necessary, required analyses.
- Sign off on the Plan-of-the-Week to authorize the planned sampling, the planned maintenance work, or both.

The site lead is responsible for ensuring that valid access agreements are in place and that landowner notifications are made before a sampling event. The Real and Personal Property group will assist the site lead by managing the access agreement process, including drafting access agreements, obtaining the required approvals, tracking expiration dates, and processing renewals. The Real and Personal Property group will notify landowners of the upcoming sampling event. Any property damage that occurs as a result of the sampling event must be reported immediately to the site lead.

Other pre-trip planning activities may include:

- Taking an inventory of sampling equipment and supplies, and loading them.
- Syncing field computers.
- Obtaining sampling documentation, including sampling lists, pre-printed labels, chain of custody forms, signed job safety analyses (JSA), and material safety datasheets sheets.
- Calibrating field instrumentation.
- Taking an inventory of the equipment in the sampling vehicle, including a winch kit, first aid kit, and fire extinguisher.
- Trip logistics.

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3.0 Sampling Protocol

3.1 Water

3.1.1 Groundwater

3.1.1.1 Groundwater Quality

Well Classification

Groundwater sampling protocol will vary based on the classification of the well. Wells will be classified according to their hydraulic properties or use, as follows:

Classification	Properties/Use
Category I	Wells that produce a minimum of 100 mL/min.[a]
Category II	Wells that produce less than 100 mL/min and have either an initial water level above the top of the screened interval or have a dedicated pump/tubing installed.
Category III	Wells that produce less than 100 mL/min and have an initial water level within the screened interval.
Category IV	Domestic and flowing wells.

[a] mL/min = milliliters per minute.

Category I Protocol

Category I wells will be purged and sampled using a low-flow method, as described in ASTM D 4448-01 (Reapproved 2007), "Standard Guide for Sampling Ground-Water Monitoring Wells," which is provided in the *Environmental Procedures Catalog* and Appendix A. Category I protocol combines the monitoring of water levels and indicator parameters, purging at a low-flow rate, and a sampling device within the screened interval, as described in the guidance. In theory, the slow pumping rate will allow water to flow directly from the formation to the pump intake. The slow pumping rate will cause minimal mixing with the stagnant water column above the pump intake, minimal pumping-induced turbidity, and minimal disturbance of sediment accumulated in the end cap of the well. Using the Category I sampling protocol will provide the highest-quality sample (Korte 2001).

Category I wells will be purged using the following guidelines:

- The intake of the portable pump, dedicated pump, or dedicated tubing should be placed in the approximate middle of the screened interval.
- If a portable pump is used, a minimum of 4 hours after installation is required before purging and sampling can commence.

As described in the *Environmental Procedures Catalog* procedure (which is included in Appendix A, "ASTM D 4750-87 [Reapproved 2001]—Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well [Observation Well]"), depth to water will be measured with an electric sounder immediately before purging. The average flow rate during the purging process must be less than 500 milliliters per minute (mL/min); therefore, the initial pumping should be adjusted accordingly. At the start of pumping, the water level should be monitored continuously to determine if drawdown is occurring. If drawdown is occurring at the initial pumping rate, the pumping rate should be decreased until the drawdown stops or a pumping rate of 100 mL/min is obtained. If the water level stabilizes (essentially no drawdown), then purging and sampling may continue at that flow rate. Water levels in the well will be measured and recorded at regular intervals (minimum of 3 minutes apart) during the purging process to document that drawdown was not occurring during the purge. If the water level does not stabilize at the minimum flow rate of 100 mL/min, then the well will be classified as Category II or Category III.

After one pump/tubing volume has been purged, pH, specific conductance, and turbidity will be measured at regular intervals based on volume purged or time, with measurements recorded a minimum of 3 minutes apart. Sample collection will begin as soon as pH, specific conductance, and turbidity measurements stabilize and one pump/tubing volume has been removed. Specific conductance and pH measurements will be considered stable when the three most recent consecutive readings are within 10 percent and 0.2 pH units, respectively; turbidity measurements will be considered stable when the most recent reading is less than 10 nephelometric turbidity units (NTUs). All field measurements will be recorded in the Field Data Collection System (FDCS), which will alert the sampler when stability criteria have be attained. Criteria for purging a Category I well are summarized in Table 1.

Table 1. Summary of Groundwater Sampling Protocol

Well Classification	Parameter	Purge Criteria	Qualification
Category I	Purge volume	One pump/tubing volume	Qualify[b] field and laboratory results with "F." If water level criterion is not met, the well may have been misclassified.
	Average flow rate	<500 mL/min	
	Water level	<0.05 ft drop[a,c]	
	pH	± 0.2 pH units[a]	
	Specific conductance	± 10 percent[a]	
	Turbidity	<10 NTUs	
Category II	Purge volume	One pump/tubing volume	Qualify field and laboratory results with "F" and "Q."
	Average flow rate	<500 mL/min	
	Water level	None	
	pH	None	
	Specific conductance	None	
	Turbidity	None	
Category III	All parameters	No purge required	Qualify field and laboratory results with "F" and "Q."
Category IV	All parameters	No purge required	No qualification of results required.

[a] Criterion is for the three most recent consecutive readings; the range between the highest and the lowest values for the last three measurements cannot exceed the stated limits.
[b] See Section 5.2 and Appendix C for descriptions of the qualifiers.
[c] When the water level is rising, there is no criteria limit.

Category II Protocol

The following protocol will apply to wells that are classified as Category II. A maximum flow rate of 500 mL/min will be used to purge and sample wells in this category. There are no stabilization or drawdown criteria for Category II wells. Sampling can occur as soon as one pump/tubing volume is removed. Recording of water levels and flow rates will be used to initially document that the well is a Category II well. Criteria for purging a Category II well are summarized in Table 1.

Category III Protocol

The following protocol will apply to wells that are classified as Category III. There are no stabilization, drawdown, or purge volume criteria for Category III wells. If a bailer is used to sample, it must be lowered very slowly into the water column in order to minimize sampling-related turbidity. Typically, only the first bailer of water will be used because subsequent bailers introduced into the water column increase turbidity and reduce sample quality. If directed by the site lead, additional trips down the well with the bailer may be required to get sufficient sample volume. Because the volume of water may be limited using a bailer, prioritization of analytes may be required. Prioritization will require an estimation of sample volume before the sampling event. The volume estimate will be discussed with the site lead and the analytical laboratory to determine which constituents will be analyzed. If the water column has sufficient volume to use a portable pump or tubing, then the entire water volume available can be sampled. Recording of water levels and flow rates will be used to initially document that the well is a Category III well.

Note — *If a dedicated pump or tubing is used, then the well must be classified, purged, and sampled as a Category II well. (One pump/tubing volume must be purged before sampling.)*

Because obtaining a representative sample from a low-producing well (Category II and Category III) is problematic (Korte 2001), and because guidance for sampling wells completed in low-permeability formations is inadequate (EPA 1995), site-specific documents may require an alternative method for sampling low-producing wells. Such a method may include purging a well dry and sampling when recovery is sufficient, purging without dewatering the screen, or passive diffusive sampling.

Category IV Protocol

With domestic and flowing wells, it is assumed that formation water flows continuously from the well, eliminating stagnant water and the need to purge. These wells will be sampled by filling bottles at the discharge point and, if required, filtering. When sampling from a tap, allow a sufficient volume of water to flow before sample collection until the purged water is not visibly changing (e.g., rust, particulates have cleared).

Sample Collection

Groundwater samples can be collected with a peristaltic pump, bladder pump, submersible pump, or bailer. Selection of specific pump type/bailer used for withdrawing water from the well, including the type of material it is made of, will be determined in the field based on site-specific conditions, the well category, and the guidance in ASTM D 4448-01 (Reapproved 2007), "Standard Guide for Sampling Ground-Water Monitoring Wells," which is provided in the *Environmental Procedures Catalog* and Appendix A. Sample collection will be conducted with the same flow rate used during the purging of the well. Generally, sampling will be conducted proceeding from the least to most contaminated areas of the site, as access allows, unless dedicated pumps or dedicated down-hole tubing is used.

Samples will be filtered as specified in Table 2 if sample turbidity is greater than or equal to 10 NTUs; no sample filtration is required if turbidity is less than 10 NTUs. An alternative sample filtration protocol will be specified in a program directive. Samples requiring filtration will be pumped through a 0.45 micrometer (µm) filter, and samples requiring cooling will be stored in a cooler with ice immediately after they have been collected. For samples preserved with acid or sodium hydroxide, the pH of selected samples will be checked (using pH paper) to establish the volume of preservative required and to verify that the proper pH level has been obtained. Only commercially supplied and certified solutions will be used for sample preservation. Sample container and preservation requirements are shown in Table 2.

3.1.1.2 Groundwater Levels

Groundwater levels will be measured according to "ASTM D 4750-87 (Reapproved 2001) —Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)," which is provided in the *Environmental Procedures Catalog* and Appendix A. If water level measurements are required on wells that are not sampled, the information should be collected using the Water Level Recorder program installed on a personal digital assistant (PDA) or other electronic device. The Water Level Recorder is a computer-based system designed to (1) interface with LM databases and software to download needed information into a PDA before collecting water levels, (2) provide for the collection of water level data or document well inspection and maintenance activities in an electronic format, (3) interface with LM databases to automatically upload water level data or well-inspection and maintenance information after collection, (4) produce an electronic summary report of water level data or well-inspection information and automatically move the report to an LM share drive for storage, (5) provide a well-specific quality control (QC) check of the water level, and (6) provide a paper-free method of data collection.

Operation and use of the Water Level Recorder is detailed in "Water Level Recorder Desk Instructions" (Appendix B). In some cases (e.g., a computer malfunctions, a PDA is unavailable), use of the Water Level Recorder may not be practical, so paper forms will be used instead.

Data loggers may be installed in some wells to provide a continuous record of water levels. Operation, maintenance, calibration, and downloading of data loggers will be conducted according to "Standard Practice for Data Logger System Field Measurements," which is provided in the *Environmental Procedures Catalog* and Appendix A.

Table 2. Water Sample Collection Requirements

Analytical Parameter	Container Type[b]/Size	Filtration[c]	Preservation	Holding Time
Alkalinity	HDPE/500 mL[d]	Filtered	Cool 0 °C to 6 °C	14 days
Am-241	HDPE/500 mL[d]	Filtered	HNO_3 pH < 2	6 months
Ammonia	HDPE/125 mL	Filtered	H_2SO_4 pH < 2, cool 0 °C to 6 °C	28 days
Anions (Br, Cl, F, SO_4, SiO_2)	HDPE/125 mL	Filtered	Cool 0 °C to 6 °C (Cooling required for SO_4 only)	28 days
Chemical oxygen demand	HDPE/125 mL	**Do not filter**	H_2SO_4 pH < 2, cool 0 °C to 6° C	28 days
Cyanide	HDPE/1 L	Filtered	NaOH pH > 12, 0.6 g ascorbic acid if Cl_2 present, cool 0 °C to 6 °C	14 days
Gamma spectrometry	HDPE/1 L[d]	Filtered	HNO_3 pH < 2	6 months
Gross α, gross β	HDPE/1 L[d]	Filtered	HNO_3 pH < 2	6 months
Hardness	HDPE/125 mL	Filtered	HNO_3 pH < 2	6 months
Herbicides	Amber glass/1 L[e]	**Do not filter**	Cool 0 °C to 6 °C	7 days
Metals	HDPE/500 mL	Filtered	HNO_3 pH < 2	6 months
Ni-63	HDPE/1 L[d]	Filtered	HNO_3 pH < 2	6 months
Nitrate plus nitrite as N, as N	HDPE/125 mL	Filtered	H_2SO_4 pH < 2, cool 0 °C to 6 °C	28 days
Nitroaromatics	Amber glass/1 L[e]	**Do not filter**	Cool 0 °C to 6 °C	7 days
Np-237	HDPE/1 L[d]	Filtered	HNO_3 pH < 2	6 months
PAH, polynuclear aromatic hydrocarbons	Amber glass/1 L[e]	**Do not filter**	Cool 0 °C to 6 °C	14 days
Pb-210	HDPE/1 L[d]	Filtered	HNO_3 pH < 2	6 months
PCBs	Amber glass/1 L[e]	**Do not filter**	Cool 0 °C to 6 °C	1 year
Pesticides	Amber glass/1 L[e]	**Do not filter**	Cool 0 °C to 6 °C	7 days
Phosphate	HDPE/125 mL	Filtered	H_2SO_4 pH < 2, cool 0 °C to 6 °C	28 days
Po-210	HDPE/1 L[d]	Filtered	HNO_3 pH < 2	6 months
Pu-238, Pu-239, Pu-240	HDPE/1 L[d]	Filtered	HNO_3 pH < 2	6 months
Ra-226	HDPE/2 @ 1 L[d]	Filtered	HNO_3 pH < 2	6 months
Ra-228	HDPE/2 @ 1 L[d]	Filtered	HNO_3 pH < 2	6 months
Rn-222	Glass/3 @ 40 mL	**Do not filter**	Cool 0° C to 6 °C, no headspace	Not established
Sulfide	HDPE/1 L[d]	Filtered	NaOH pH > 9, 2 mL of 2 N zinc acetate, cool 0 °C to 6 °C, no headspace	7 days
Tc-99	HDPE/1 L	Filtered	HNO_3 pH < 2	6 months
Th-230	HDPE/1 L	Filtered	HNO_3 pH < 2	6 months
Total dissolved solids	HDPE/125 mL	Filtered	Cool 0 °C to 6 °C	7 days
Total organic carbon	HDPE/125 mL	**Do not filter**	H_2SO_4 pH < 2, cool 0 °C to 6 °C	28 days
Total suspended solids	HDPE/1 L	**Do not filter**	Cool 0 °C to 6 °C	7 days
TPH	Amber glass/1 L[e]	**Do not filter**	Cool 0 °C to 6 °C	14 days
Tritium	HDPE/1 L[d]	**Do not filter**	No preservative	6 months
Semivolatiles	Amber glass/1 L[e]	**Do not filter**	Cool 0 °C to 6 °C	7 days
U-234, U-238	HDPE/1 L	Filtered	HNO_3 pH < 2	6 months
Volatiles	Amber glass/3 @ 40 mL with Teflon-lined septa	**Do not filter**	Cool 0 °C to 6 °Cs, HCl pH < 2, no headspace	14 days

[a] This table incorporates the majority of analyses conducted for LM projects; consult the site-specific environmental planning document for the analyses required at a particular site.
[b] HDPE = high-density polyethylene.
[c] Filtration through a 0.45 µm pore-size filter is required only if sample turbidity is greater than or equal to 10 NTUs.
[d] Collection of sample volume in duplicate for every 20 samples collected is required for laboratory quality control.
[e] Collection of sample volume in triplicate for every 20 samples collected is required for laboratory quality control.
L = Liter
mL = milliliter
µm = micrometer

3.1.2 Surface Water

For the purposes of this plan, surface water may include contained water within any natural or manmade surface water feature (e.g., ponds, lakes, seeps, rivers, ditches, drainages) as well as effluent from passive treatment systems, leachate collection systems, or water treatment plants.

Surface water sampling will be conducted according to the following protocol unless an alternate protocol is specified in a project-planning document, in a permit, or in the appropriate site-specific tabbed section in Appendix E. Specifically, surface water grab samples will be collected as follows:

- Surface water samples will be collected by using a stainless-steel weight attached to the intake tubing of the peristaltic pump, by directly immersing the sample container, or by using a dip-type sampler. If the surface water is flowing, approach the sampling location from downstream and point the sample container or dip sampler upstream.
- For surface water features less than 6 feet (ft) wide, the sample will be collected from approximately the middle.
- For surface water features greater than 6 ft wide, the sample will be collected 1 to 3 ft from the shore. Samples collected in flowing surface water features greater than 6 ft wide (e.g., rivers, streams, ditches) will be collected within the main current and not in stagnant or back eddy areas.
- If stagnant or back eddy areas extend greater than 3 ft from the shore, then samples will be collected at the nearest downstream location where the main current is within 3 ft of the shore. This approach can be modified to meet special data quality objectives, such as sampling fish habitats, and will be specified in a project-planning document.
- All surface locations will be designated by a wooden lath or metal post inscribed with the location identification so that samples from subsequent rounds may be collected from approximately the same location, or navigation to the location can be accomplished using a GPS device.
- Sample location data should be collected using a GPS device and downloaded into the SEEPro database. Any departure from collecting a sample at the normal location must be documented in the FDCS or other field notes.

Samples will be filtered as specified in Table 2 if sample turbidity is greater than or equal to 10 NTUs; no sample filtration is required if turbidity is less than 10 NTUs. Alternate sample filtration protocol will be specified in a program directive. Samples requiring filtration will use a 0.45 μm filter, and samples requiring cooling will be stored in a cooler with ice immediately after sample collection. For samples preserved with acid or sodium hydroxide, the pH of selected samples will be checked (using pH paper) to establish the volume of preservative required and to verify that the proper pH level has been obtained. Only commercially supplied and certified solutions will be used for sample preservation. Sample container and preservation requirements are shown in Table 2.

3.1.3 Field Measurements and Calibration

Field measurements of alkalinity, dissolved oxygen, oxidation-reduction potential, and temperature may be required on a site-specific basis. Specific conductance, pH, and turbidity are considered stabilization parameters when purging a well and are required measurements at all wells. Field measurements will be made according to *Environmental Procedures Catalog* procedure "Standard Practice for Conducting Field Measurements During Water Sampling Activities," which is included in Appendix A.

Field instruments must be calibrated before a sampling event begins. For occupied sites that sample continuously and do not sample in distinct events, field instrumentation will be calibrated at least monthly. Calibration and operational check requirements for field instruments are shown in Table 3. If the acceptance criteria are not met during the operational check, then a primary calibration of the affected probes and instruments must be conducted.

Table 3. Calibration and Operational Check Requirements for Field Instruments

Parameter	Requirement	Frequency	Operational Check Criteria
pH	3-point calibration	Prior to start of sampling event	NA[a]
	1-point check with pH 4, 7, or 10 buffer	Daily and at end of sampling event	± 0.2 pH unit
Specific conductance	1-point calibration	Prior to start of sampling event	NA
	1-point operational check	Daily and at end of sampling event	± 10 percent of standard
Oxidation-reduction potential	1-point calibration	Prior to start of sampling event	NA
	1-point operational check	Daily and at end of sampling event	± 10 percent of standard
Dissolved oxygen	Calibration in water saturated air	Prior to start of sampling event	NA
	1-point operational check in water saturated air	Daily and at end of sampling event	± 0.3 mg/L of theoretical DO in water-saturated air
Turbidity	4-point calibration	Every 3 months	NA
	3-point operational check	Daily and at end of sampling event	± 10 percent of standard
Temperature	Operational check	Prior to start of sampling event	± 1.5 °C compared to NIST-[b] traceable thermometer

[a] NA = Not applicable.
[b] NIST = National Institute of Standards and Technology.

Occasionally, calibration and operational checks are acceptable but probe or instrument functionality is suspect. Indications of a reduction in probe or instrument performance may include the following:

- A response time is slower than normal.
- A probe diagnostic parameter is within the acceptance range but close to a limit of the range.
- The age of a probe is nearing the manufacturer's recommended lifetime.
- There is visible contamination on a sensing surface (hard water deposits, oil or grease, organic matter, etc.).

If a reduction in instrument or probe performance is suspected, one or more of these additional measures may be necessary to improve performance:

- Probe cleaning
- Probe replacement
- Sonde cleaning
- Sonde resistance checks

If a reduction in instrument or probe performance is suspected, additional operational checks in solutions with different values may be required to verify probe performance. These may include:

- A zero-oxygen solution for dissolved oxygen.
- Additional calibration solutions for pH (4, 7, or 10 buffers) and specific conductance (100 or 10,000 µmhos/cm).
- Tap water to verify that the probes are giving meaningful readings in environmental water.

Calibration, operation, cleaning, and troubleshooting of field instruments will be conducted according to manufacturers' instructions.

3.1.4 Field Data Collection System

Sampling activities will be captured using the FDCS. The FDCS is a computer-based system designed to (1) interface with LM databases and software to download needed information into a field computer before a sampling event, (2) provide for collection of field information and data in an electronic format during water sampling activities, (3) interface with LM databases to automatically upload field data after collection, (4) produce an electronic report of sampling data and information from each sampling location and automatically move the report to an LM share drive for storage, (5) provide QC checks through the sampling process, and (6) provide a paper-free method of data collection.

Operation and use of the FDCS is detailed in "Field Data Collection Desk Instructions" (Appendix B–1). In some cases (e.g., nonroutine sampling activities, computer malfunction), use of the FDCS may not be practical; paper forms will be used instead.

3.1.5 Sample Identification and Handling Procedures

Each sample will be assigned a unique sample number and a location number corresponding to each well or surface sample location. QC samples will be assigned a fictitious location number and submitted to the laboratory without identifying them as QC samples. The true site identification number and the type of QC sample will be documented in the FDCS.

Immediately upon collection, samples requiring refrigeration will be placed in ice chests containing an ice-and-water bath. An ice-and-water bath will be maintained within the ice chests at all times and will be checked and then documented in the FDCS at each location sampled.

Sample bottles used for water sampling will be pre-cleaned to guidelines established by EPA in *Specification and Guidance for Contaminant-Free Sample Containers* (EPA 1992). Sample bottles will be labeled before or immediately after sample collection according to *Environmental Procedures Catalog* procedure “Standard Practice for Field Documentation” (Appendix A).

To ensure the integrity of the sample, the sampling lead or a designee is responsible for the care, packaging, and custody of the samples until they are dispatched to the laboratory. The “Standard Practice for Field Documentation” will be implemented to provide security and document sample custody, and the “Standard Practice for Sample Submittal to Contract Analytical Laboratories” will be implemented to transfer samples to the designated laboratory.

Custody seals, evidence tape, or both will be placed on each ice chest or storage/shipping container that is not in direct control of a sampling team member (e.g., when the container is temporarily stored in a motel room) to keep the samples secure from the time of collection to analysis. Samples locked in the sampling vehicle are considered in direct control of the sampling team. Samples not in direct control of a sampling team member will be stored in a secured (locked) location. Ice chests, cartons, and trays that are used for temporary sample storage and that are not custody-sealed must be in direct control of a sampling team member.

If samples are transported by subcontract employees or a commercial carrier, the shipping container will have custody seals, evidence tape, or both placed over the opening, before shipment, to ensure that the integrity of the samples is not compromised during transport. The sampling lead will be responsible for ensuring that the samples are transferred to the laboratory in sufficient time for the laboratory to complete extraction and analysis before the expiration of sample holding times.

If a commercial carrier sends the packages, receipts and any other shipping-related documents will be retained as part of the chain-of-custody documentation. The laboratory services coordinator will retain carrier and shipping receipts as long as they have value associated with the laboratory sample-receiving activities.

Chain-of-custody records document all transfers of sample possession and show that the samples were in constant custody between collection and analysis. A Chain-of-Custody form will accompany samples sent or transported to an analytical laboratory. Documentation of a change in custody is not required if samples are transferred among members of the sampling team or to other contractor personnel to ship or transport the samples.

3.1.6 Sampling Equipment

3.1.6.1 Operation and Maintenance

A variety of equipment and instrumentation is used when conducting sampling activities. Examples of equipment and instrumentation used during a water sampling event include a water quality meter, water level indicator, colorimeter, turbidity meter, pumps, generator, compressor, compressed air cylinder, control box, all-terrain vehicle, winch, motor vehicle, data loggers, field computer, and hand tool. Operation, inspection, maintenance, calibration (if required), and safety precautions associated with using this equipment will be conducted according to manufacturer’s instructions, which can be found in the Equipment Manuals and Procedures folder found at \\crow\Projects\SamplingProg\Equipment Manuals and Procedures.

3.1.6.2 Equipment Decontamination

Nondedicated sampling equipment will be decontaminated by rinsing all equipment surfaces with diluted detergent followed by deionized water as described in "Technical Comments on ASTM D 5088-02 (Reapproved 2008) Standard Practice for Decontamination of Field Equipment Used at Waste Sites" (*Environmental Procedures Catalog* and Appendix A). If nondedicated sampling equipment is used to collect samples for organic analyses, then an additional rinse with an organic desorbing agent (e.g., isopropanol) will be used followed by a final deionized-water rinse. Nondedicated sampling equipment will be decontaminated immediately after use at a sampling location. Between samplings or until further use, decontaminated equipment will be stored in protective containers or plastic bags.

3.1.7 Investigation-Derived Waste

Purge water generated during groundwater sampling activities, including decontamination water and excess sample water, will be managed as specified in Table 4. Solid waste generated during sampling activities (e.g., gloves, filters, wipes, containers) will be managed by bagging the waste and placing the bag in a trash receptacle for disposal at a municipal landfill.

3.2 Air

Air monitoring may include sampling air particulates, radon, or tritium; measuring gamma radiation; or conducting meteorological monitoring. Air monitoring procedures, if required, will be included in program directives located in the appropriate site-specific tabbed section in Appendix E or in a site-specific document.

3.3 Soil and Sediment

Soil and sediment sampling generally will be conducted according to procedures listed in the "Solids" section of the *Environmental Procedures Catalog*. Soil sampling associated with drilling activities will be specified in a Statement of Work. If site-specific procedures are required, they will be included in program directives in the appropriate site-specific tabbed section in Appendix E or in a site-specific document.

3.4 Ecological

Ecological monitoring may include sampling biota or vegetation, monitoring vegetation, controlling noxious weeds, or monitoring animal populations. Ecological procedures, if required, will be included in program directives located in the appropriate site-specific tabbed section in Appendix E or in a site-specific document.

Table 4. Purge Water Disposition at LM Sites

Category	Site	Applicable Documents	Disposition	Comments
UMTRCA Title I	Ambrosia Lake	*Management Plan for Field-Generated Investigation Derived Waste* (DOE 2000)	Disperse on ground	Keep purge[a] water from entering surface water
	Burrell			
	Canonsburg			
	Durango			
	Falls City			
	Grand Junction			
	Green River			
	Gunnison			
	Lakeview			
	Lowman			
	Monument Valley			
	Naturita			
	Rifle			
	Riverton			
	Sherwood			
	Shiprock			
	Slick Rock			
	Tuba City			
UMTRCA Title II	Bear Creek	Analysis of expected concentrations in purge water from Title II sites is pending, and the *Management Plan for Field-Generated Investigation Derived Waste* will be updated to include Title II sites.	To be determined	Purge water disposition will be specified in a Notice to File or SAP[b] program directive until the *Management Plan for Field-Generated Investigation Derived Waste* is updated.
	Bluewater			
	Gas Hills East			
	Gas Hills North			
	L-Bar			
	Sherwood			
	Shirley Basin South			
	Split Rock			
D&D Sites	Grand Junction	Notice to file	Disperse on ground	
	Hallam			

Table 4 (continued). Purge Water Disposition at LM Sites

Category	Site	Applicable Documents	Disposition	Comments
Offsites Project	CNTA	*Fluid Management Plan Central Nevada Test Area Corrective Action Unit 443*, LMS/CNT/S03736	Discharge to infiltration basin/ground	
	Gasbuggy	NA	NA	No purge water generated
	Gnome-Coach	Notice to file	Contain purge water from wells USGS-4, USGS-8, and LRL-7 and transport back to Grand Junction for temporary storage. Disperse purge water from other wells on ground.	
	Rio Blanco	NA		No purge water generated
	Rulison	NA		No purge water generated
	Salmon	Notice to file	Contain purge water from well HMH-5R, and ship back to Grand Junction for treatment and disposal. Combine purge water from HM-3, SA1-3-H, and SA4-5-L and disperse on the ground. All other wells: disperse on ground.	
	Shoal	Notice to file pending	Disperse on ground	
CERCLA	Monticello	*Monticello Mill Tailings Site Operable Unit III Post-Record of Decision Monitoring Plan* (DOE 2004)	Disperse on ground at all wells except permeable reactive barrier wells. Return purge water at the permeable reactive barrier to the well from which it was purged.	
	Mound		Contain water at wells with contaminant concentrations that exceed EPA's maximum contaminant level; disperse on ground at all other wells.	
	Rocky Flats	SAP Program Directive – *Guidelines for the Disposition of Purge, Decontamination, and Excess Sample Water*	Dispose of in applicable on-site treatment system.	
	Pinellas	SAP	Dispose in on-site treatment system —Air Stripper # 1	
	Weldon Spring	SAP Program Directive	Type I wells—disperse on ground. Type II wells—dispose of at LCRS	
Other	Parkersburg	*Long-Term Surveillance Plan for the Parkersburg, West Virginia, Disposal Site*, September 1995	Disperse on ground	Groundwater meets state and federal groundwater and drinking water standards, respectively.

[a] Purge water includes purge water, decontamination water, and excess sample water.
[b] SAP = Sampling and Analysis Plan

4.0 Analytical Program

Analytical services are procured under the DOE Integrated Contractor Purchasing Team (ICPT) Basic Ordering Agreement (BOA) as specified in Attachment 1 of *Basic Ordering Agreement, Statement of Work, Laboratory Analytical Services* (DOE 2006) and modified by the LM BOA Implementation Requirements document (DOE 2007). The ICPT BOA provides a standardized system for procuring analytical services from commercial laboratories and includes provisions for laboratory audits.

The constituents analyzed at each site are specified in the site-specific environmental planning document. A comprehensive list of analytes, along with the required analytical methods and required detection limits, is provided in Attachment 1 of the LM BOA Implementation Requirements document (DOE 2007). Site-specific analytical requirements, including required analytical methods and required detection limits, are listed in Appendix E. The analytical methods used for groundwater and surface water analyses as specified in Attachment 1 are typically from *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 1996) or *Methods for Chemical Analysis of Water and Wastes* (EPA 1983).

Commercial laboratories provide these analytical services in accordance with the *DOE Quality Systems for Analytical Services* (QSAS) (updated annually) to ensure that data are of known, documented quality. The QSAS provides specific technical requirements, clarifies DOE requirements, and conforms to DOE Order 414.1C, *Quality Assurance*. The QSAS is based in total on EPA's *National Environmental Laboratory Accreditation Conference*, Chapter 5, "Quality Systems" (EPA 2003), which was implemented in July 2005 and was based on *General Requirements for the Competence of Testing and Calibration Laboratories* (ISO 1999). The QSAS provides a framework for performing, controlling, documenting, and reporting laboratory analyses. Analytical data will be validated according to "Standard Practice for Validation of Laboratory Samples" (*Environmental Procedures Catalog*).

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5.0 Quality Assurance

The *Quality Assurance Manual* (LMS/POL/S04320) specifies quality assurance requirements used to implement all environmental sampling and monitoring programs. This manual addresses the requirements necessary for planning, implementing, documenting, and reviewing the activities, equipment, and records resulting from using this Sampling and Analysis Plan. Additional quality assurance requirements and guidance for LM Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites (i.e., Monticello, Fernald, Mound, and Rocky Flats) are provided in the *Legacy Management CERCLA Sites Quality Assurance Project Plan* (LMS/PLN/S04353).

5.1 Field Quality Assurance

Field quality assurance procedures include following the SOPs discussed in this document, collecting and analyzing QC samples, and inspecting and maintaining monitoring wells. The types of QC samples collected include field duplicates, equipment blanks, and trip blanks. QC samples will be submitted to the laboratory under a fictitious identifier.

5.1.1 Field Duplicates

Duplicate water samples will be collected in the field on a frequency of one duplicate sample per 20 water samples for each analytical parameter. If fewer than 20 water samples are collected during a sampling event, one field duplicate will be required. Duplicate water samples will be collected by alternately filling the original and duplicate sample containers according to analytical parameter. The frequency of duplicate samples for other matrices is specified in the site-specific procedure located in the appropriate tabbed section in Appendix E.

5.1.2 Equipment Blanks

Equipment blanks provide a check for cross-contamination of samples from ineffective equipment decontamination. One equipment blank sample will be prepared in the field for every 20 water samples that are collected with nondedicated equipment. If fewer than 20 samples—and at least one sample—are collected with nondedicated equipment, then one equipment blank will be required. Equipment blanks will be prepared by collecting a sample of the final deionized rinse water (rinsate) used to decontaminate nondedicated sampling equipment. The collection and frequency of equipment blanks for other matrices or filter blanks (air) are specified in the site-specific procedure in Appendix E.

5.1.3 Trip Blanks

Trip blanks will be prepared using organic-free water obtained from a certified source and taken to the field by the sampling team. Trip blank samples will be prepared before the sampling trip when collection of water samples for volatile organic compound (VOC) analyses is required. Trip blanks subsequently will be handled as all other water samples collected for analysis of VOCs. Each ice chest in which VOC samples are stored or shipped will have an accompanying trip blank, which will be analyzed for VOCs only.

5.1.4 Monitoring Well Inspection and Maintenance

Because of natural processes and human activities, the condition of groundwater monitoring wells deteriorate with time, and a routine monitoring well inspection and maintenance program is necessary to mitigate deterioration. As a quality assurance component of a comprehensive groundwater monitoring program, a routine inspection and maintenance program should be in place that includes periodic monitoring well redevelopment in order to promote collection of representative samples, especially when using low-flow purging and sampling techniques (Korte 2001). Inspection and maintenance activities will be conducted according to the "Standard Practice for the Inspection and Maintenance of Groundwater Monitoring Wells," which is provided in the *Environmental Procedures Catalog* and Appendix A. Monitoring well inspection and maintenance information should be collected using the Water Level Recorder program installed on a PDA or other electronic device. Instructions for using the Water Level Recorder program are provided in Appendix B-2. The frequency of monitoring well inspection and maintenance will be determined on a site-specific basis.

5.2 Data Qualification and Validation

Data obtained from groundwater samples collected from Category II and Category III wells will be qualified with a "Q" flag, indicating the data are qualitative due to sampling technique. This qualification will occur during the data validation process when "Q" flags will be entered into the SEEPro database. The "Q" flag will be displayed in the data validation column of the SEEPro database reports to provide notification to the data user. Results associated with a Category I well where a purging stability criterion was not met may be qualified with a "J" flag (estimated). Data obtained from samples collected at Category I and Category IV wells are considered to be of the highest quality, and qualification is not required.

Following a sampling event or period of ongoing monitoring, field and laboratory data will be validated and may be documented in summary reports. Data validation guidance and preparation of data validation packages are addressed in Appendix C.

5.3 Training

Personnel participating in sampling activities and using SOPs addressed in this plan will be proficient in the procedures and equipment/instrumentation used for the work they perform. Specifically, personnel will complete "Water Sampling Training" (WS300), which was developed according to the requirements of the *Training Manual* (LMS/POL/S04323). This course involves the following on-the-job training:

- Required reading of this plan.
- Calibration and operation of instrumentation and test kits used to collect field data.
- Operation of various sampling pumps and associated equipment (e.g., controllers, compressors, generators).
- Well purging and groundwater sampling protocol.
- Surface water sample collection.
- Operation of the FDCS.
- Sample labeling, preservation, and chain of custody.

- Decontamination of sampling equipment.
- Collection of QC samples.
- Operation of the Water Level Recorder program.
- Review and sign-off of the JSA for water sampling.

Training will be conducted by an experienced sampler with a minimum of 10 years of experience. An example of a form used to document water sampling training is shown in Figure 2. Training for sampling other media will be documented on a similar form. Completed forms will be transferred to the Training department and included in an individual's training file.

5.4 Data Quality

Data generated from routine water sampling activities using procedures specified in this plan will be of sufficient quality to make defensible decisions regarding compliance to applicable permits and standards, establishment of remediation strategies, assessment of the progress of remedial actions, regulatory issues, assessment of the effectiveness of treatment systems, and assessment of risk to human health and the environment.

Data of known, documented quality are produced through the following aspects of this plan:

- Defensible and comprehensive sampling procedures
- Calibration of field instrumentation
- Collection of field QC samples
- Documentation of sampling activities
- Training of sampling personnel
- Records management
- Use of accredited commercial laboratories that:
  - Conform to QSAS requirements
  - Are audited according to the DOE Consolidated Audit Program annually
  - Use approved analytical procedures
- Data validation and qualification

If a project does not require the level of documented data-quality generated by using the procedures specified in this plan, and a lower level of rigor is applied, then data objectives and project goals must be documented that detail the sampling and analysis protocols necessary to obtain the level of data quality required to make project decisions.

Water Sampling Qualification

Completion of this form documents the training and qualification necessary to perform routine water sampling activities at sites managed by the U.S. Department of Energy's Office of Legacy Management (LM).

Sampling and Analysis Plan Acknowledgement

I, ______________________________, have read and understood the controlled version of the Sampling and Analysis Plan (SAP) entitled *Sampling and Analysis Plan for the U.S. Department of Energy, Office of Legacy Management Sites*, which specifies requirements for routine water sampling activities at sites managed by LM.

________________________ ________________

Sampler Signature Date

Water Sampling Equipment/Procedures Proficiency

I certify that ______________________________ has received on-the-job training in groundwater and/or surface water sampling at the ___________________ site. This person has demonstrated proficiency in the operation of specific monitoring equipment, operation and calibration of instrumentation, use of computerized data collection systems, and implementation of SAP water sampling protocols as specified in WS-300, "Water Sampling Training."

________________________ ________________

Sampling Instructor Date

Figure 2. Example Water Sampling Qualification and Proficiency Documentation Form

5.5 Program Directives

Program directives are used to document and authorize interim or site-specific changes to project documents. The procedures and format used for preparing program directives are found in Quality Assurance Instruction 1.5, "Program Directives," within the *Quality Assurance Manual*. When needed, site-specific changes to this plan will be documented and approved through the use of a program directive. Program directives that affect changes to this plan are prepared by the Environmental Monitoring/Field Services manager and approved by the site task manager. Program directives will be managed as controlled documents and issued to all copyholders for inclusion in the appropriate tabbed section following the appendixes to this plan. Guidelines, tracking logs, directive templates, and Portable Document Format (PDF) files of approved directives are managed by the Environmental Monitoring/Field Services lead on the "Projects" share directory, as follows: \\crow\Projects\SamplingProg\Program Directives.

5.6 Documentation

After the completion of a sampling event or period, the sampling lead will prepare a trip report that will document the specifics of the sampling event. Items that will be documented in the report may include:

- Dates of the sampling event.
- Team members.
- Number of locations sampled.
- Field variances.
- Site disturbances.
- Air sampler volume.
- Air sampler flow rate.
- QC samples.
- Analytical report identification numbers.
- Equipment problems.
- Required action items.
- Well inspection summary.
- Dates of deployment (thermoluminescent dosimeters, passive radon monitors).
- Weight of particulates.

The FDCS will be used at each water sampling location to record and document sample collection and identification, purge volume calculations, field measurement data, sampling equipment used, instrument operational check time, and sampling personnel. The FDCS will also be used to document pre-trip calibrations, daily operational checks, and daily safety meetings. If the FDCS cannot be used, the Water Sampling Field Data form will be completed. Water sampling documentation will follow the protocol specified in "Standard Practice for Field Documentation" in the *Environmental Procedures Catalog* and included in Appendix A. Deviations from the procedures specified in this plan will be documented as a field variance comment in the FDCS and included in the sampling trip report (if required). The Water Level Recorder program will be used to record water level data or well inspection and maintenance activities for wells that are not sampled.

5.7 Records

Records associated with or generated through sampling activities may include:

- The *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites*.
- Program directives.
- Water Sampling Field Data form.
- PDF reports from the FDCS.
- Chain-of-Custody forms.
- Sampling trip reports.
- Laboratory analytical data reports.
- Field and laboratory data validation summary reports.
- Air monitoring logs.
- Calibration logs.
- Soil sample collection logs and field maps.
- JSAs.

Records will be transferred to the appropriate records coordinator when complete and will be filed under the applicable record file index or project file index. Records will be maintained in accordance with the *Records Management Manual* (LMS/POL/S04327).

6.0 Health and Safety

Sampling activities will be conducted according to the health and safety requirements specified in the *Health and Safety Manual* (LMS/POL/S04321). At some sites where site conditions are more complex (e.g., Tuba City), site access training will be specified in a formal site briefing. Task-specific health and safety requirements (including personal protective equipment) are addressed in JSAs. An example of a JSA for sampling activities is found in Appendix D. All signed copies of JSAs generated for sampling activities, including copies with field changes, will be transferred to the applicable records coordinator for archiving and management as a record. Daily safety meetings will be conducted and documented to highlight specific hazards and controls specified in the JSA that will be applicable to the planned work for the day. Nonroutine sampling activities not specified in the JSA for sampling will be addressed in additional health and safety documents, such as an additional JSA, Safe Work Permit, Radiological Work Permit, or Confined Space Evaluation.

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7.0 References

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Korte, N., 2001. *Application of Low-Flow Purging to the UMTRA Ground Water Project*, Grand Junction, Colorado.

Legacy Management CERCLA Sites Quality Assurance Project Plan, LMS/PLN/S04353, continually updated, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado.

Quality Assurance Manual, LMS/POL/S04320, continually updated, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado.

Training Manual, LMS/POL/S04323, continually updated, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado.

Appendix A

Procedures Used for Groundwater and Surface Water Sampling and Analysis

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Preparing or Revising Procedures for the *Environmental Procedures Catalog*

1.0 Purpose and Scope

This practice describes the preparation, review, approval, and distribution of procedures in the *Environmental Procedures Catalog* (LMS/POL/S04325).

The procedures in this catalog are not intended to address all of the details and variations that might apply to an individual project. Therefore, a site-specific plan or other project-specific document will describe in detail the work that will be performed and will identify procedures from the *Environmental Procedures Catalog* that will be used.

2.0 Terminology

Acceptance criteria—Specified limits, requirements, or tolerances placed on the variation permitted in the characteristics of an item, process, report, data, or service as defined in codes, standards, drawings, specifications, procurement documents, or other requirements documents. The criteria must be definitive for decision-making purposes, but might not be related to instruments or measurements.

Guide—A procedure that outlines a suggested approach through a series of options or instructions, but does not recommend a specific course of action.

May—In procedures, a suggestion only.

Must—In procedures, a required action. Synonymous with "shall" and "will."

Planning document—A document prepared to guide a project or task. These documents may be called Work Plans, Sample and Analysis Plans, project plans, task plans, or other names, depending on sponsor requirements.

Practice—A definitive procedure for performing one or more specific operations or functions that does not produce a test result.

Procedure—Steps to perform, explain, or accomplish a task. As used in this catalog, a procedure may be a practice, guide, or test method.

Qualified—An employee who has met the requirements for a specific position or task.

Shall—In procedures, a required action. Synonymous with "must" and "will."

Should—In procedures, a recommendation.

Test method—A definitive procedure for the identification, measurement, and evaluation of one or more characteristics of a material, product, system, or service that produces a test result.

Will—In procedures, a required action. Synonymous with “must” and “shall.”

3.0 Procedures

3.1 New Procedures

New procedures may be needed to support new work, changes in work scope, new technology or instruments, or improved methods. When the need for a procedure to be added to the catalog is known, management will review the suggested procedure to determine if it is appropriate for inclusion.

The following sections should be included in new procedures:

- Title (mandatory)
- Purpose and Scope (mandatory)
- Terminology (mandatory)
- Materials and Equipment (optional)
- Procedure (mandatory)
- Checklist (optional)
- Documentation (mandatory)
- References (optional)

Procedures will adequately describe the work so that a qualified person could use the procedure to perform work. The procedure will describe responsibilities and interfaces, delineate the method and sequence, and provide a means of recording data when appropriate. Acceptance criteria will be identified when applicable.

Procedure Format—The format of procedures should follow the standard format. Procedures purchased from the American Society of Testing and Materials (ASTM) are identified within the procedure title by a procedure number with the last two digits indicating the year the procedure was last revised. A year within parentheses indicates when the procedure was last reviewed by an ASTM committee, but no revisions took place. An epsilon superscript indicates that an editorial change has been made since the last revision (ε for last change, etc.)

3.2 Miscellaneous Points of Style

Units of Measure—Consistent units of measure will be used throughout the procedure. Units of measure are always spelled out the first time they appear in the text and any time they are not preceded by a value.

Uppercase Letters—Do not use uppercase letters when writing text or numbered text headings (e.g., "5.5.9 Uppercase Letters," not "5.5.9 UPPERCASE LETTERS"). Use of all uppercase letters is acceptable in trade names, equations, etc.

Text should be provided to Document Production by a word file attached to an e-mail. The file should include all figures and forms. Document Production will ensure that the procedure is in the proper format, coordinate reviews, and assist the author in comment resolution.

3.3 Changes to Procedures

When changes to a procedure are required, the originator shall submit an electronic copy of the proposed revision to the assigned lead (per Legacy Management Support Contractor Work Control Documents on the portal). For questions, contact the assigned lead.

If only editorial changes are needed, and the changes do not affect the quality of work performed or data generated, the changes may be made without going through the formal reviews that are required for technical changes; however, the changes must be approved by the assigned lead.

Procedures from this catalog that will be used on a specific project in planning documents should be identified in those documents.

Industry-recognized procedures from source documents published by the U.S. Environmental Protection Agency (EPA), ASTM, U.S. Department of the Interior, National Water Well Association, American Petroleum Institute, or other recognized organizations should be used, if possible instead of generating new procedures. Permission from the sponsoring agency, such as ASTM, may be required to reproduce and distribute the procedure.

4.0 Documentation (Procedure Review, Publication, Approval, and Distribution)

Each new, revised, or adopted procedure in this catalog will be sent electronically to qualified technical individuals and personnel from environmental, safety, and quality groups for review. Editorial changes, as described in Section 3.3, require review only by the catalog lead. Reviews will use a Record of Review form (LMS 1696e). Comments must be resolved by the author and/or assigned lead before submitting the procedure for publication.

New and revised procedures are posted on the Contractor Information page of the LM Portal as a controlled document.

An electronic copy of the final procedure is submitted to the catalog lead for approval before the procedure is released and distributed. A record of the approval will be maintained by the catalog lead.

Procedures may be printed directly from the Contractor Information page of the LM Portal, and will be automatically marked as "Uncontrolled if Printed." They may be inserted into other documents, such as Sampling and Analysis Plans. Catalog procedures may be identified in the documents by reference only; however, it is recommended that they be physically attached to the documents.

5.0 Records

Records of review and comment resolution will be maintained for the current version of each procedure; such records of previous versions may be destroyed.

Standard Practice for Sample Submittal to Contract Analytical Laboratories

1.0 Purpose and Scope

This standard practice describes the process for submitting samples to contracted analytical laboratories. This practice applies to the submittal of samples to laboratories that provide services procured under the Integrated Contractor Purchasing Team (ICPT) Basic Ordering Agreement (BOA) as modified by the *Legacy Management BOA Implementation Requirements* document.

This practice applies to the submittal of all sample types, including samples of groundwater, surface water, soil, vegetation, biota, wastes, and other types of samples collected for analysis within the scope of the BOA.

This practice complements procedures for the collection, preservation, and shipment of samples as documented elsewhere (see "References").

2.0 Terminology

Basic Ordering Agreement—The ICPT BOA provides a standardized system for procuring analytical services from commercial laboratories, including a statement of work for analytical services and provisions for laboratory audits.

Environmental samples—Samples of air, soil, water, or other media that are not expected to exhibit properties classified by the U.S. Department of Transportation (DOT) as hazardous.

Integrated Contractor Purchasing Team—The ICPT was established by the U.S. Department of Energy (DOE) to provide a vehicle for communicating procurement-related issues of the prime Legacy Management Support contractor (Contractor) community. The ICPT provides BOAs negotiated by or in support of ICPT for use by DOE and its eligible subcontractors.

Line item code—A cost code used to specify analytes or analyte groups. Line item codes are defined in the BOA based on sample matrices, analytes, analytical methods, and required detection limits.

Radioactive material—Any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in Title 49 *Code of Federal Regulations* Part 173.436 (49 CFR 173.436).

Requisition index number—A unique eight-digit number that identifies a group of samples that are submitted, analyzed, and reported together.

U.S. Department of Transportation–regulated samples—Samples of air, soil, water, or other media that are known or thought to meet the definition of a hazardous material as defined in

49 CFR 171.8. In this procedure, “hazardous” does not refer to Resource Conservation Recovery Act hazardous wastes unless so stated.

3.0 Procedure

Note

Deviations from procedures are made in accordance with the Contractor Quality Assurance Manual *(LMS/POL/S04320).*

3.1 Sample Type Classification—Environmental or DOT Regulated

In general, samples collected are expected to have a low concentration of potential contaminants, although higher concentrations will be present in some cases. These low-concentration samples are classified as environmental samples because they do not meet the DOT hazard-class definitions and are not subject to DOT regulations. Historical data, knowledge of processes, and field screening results will assist in classifying samples as “environmental” or as a DOT-regulated material.

The classification of sample types to be collected must be made as part of the planning process to comply with DOT shipping requirements.

3.2 Laboratory Coordinator

The laboratory coordinator is responsible for scheduling chemical analyses with contracted analytical laboratories. The laboratory coordinator must be notified of upcoming sampling events in advance (usually 5 days or more) to arrange sample analyses. More lead time may be needed when a large number of samples are planned or if unusual analyses are requested. The following information is needed:

- Number and types of samples
- Analytes requested
- Special requirements, regulatory methods, detection limits, etc.
- Turnaround time requirements
- Reporting requirements

The analytical requirements of routine sampling events are listed in Appendix E of the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (SAP) (LMS/PLN/S04351).

The laboratory coordinator assigns a unique requisition index number (RIN) to the sample event and selects the line item codes (LICs) to specify the analyses to be performed. RINs are generated using the Sample Management System (SMS) application. The Sample Tracking System application is also used to produce Chain of Custody (COC) forms and sample labels.

Laboratory Notification—The laboratory coordinator prepares an Analysis Confirmation form listing the number and types of samples, LICs, required turnaround times, and expected delivery date, and sends it to a selected laboratory. A laboratory representative will sign and return the Analysis Confirmation form to indicate that the laboratory can provide the requested services. Figure 1 is an example of the Analysis Confirmation form.

Project Manager Notification—The Analysis Confirmation form is also sent to the applicable project manager or site lead as notification of the services requested of the laboratory.

3.3 Sample Collection

Samples are collected, preserved, and packaged in accordance with the plan governing the sample event, such as a sampling and analysis plan.

Field activities and all comments regarding or deviations from procedures are documented in the Field Data Collection System (FDCS), on the Water Sampling Field Data form (Figure 2), or in the trip report in accordance with the "Standard Practice for Field Documentation" chapter.

Samples are sealed and labeled for shipment; refer to the "Standard Practice for Field Documentation" chapter.

Sample security must be maintained (samples must be locked and/or under constant supervision, and protected from tampering) and sample transfers documented on a COC form. Refer to the "Standard Practice for Field Documentation" chapter for guidance on protecting sample custody. See Figure 3 for an example of a COC form.

3.4 Sample Shipment and Receipt Requirements

The samples are shipped in compliance with DOT regulations. The shipment must include copies of signed COC form(s).

Upon sample receipt, the contracted analytical laboratory is required to:

- Sign and record the date and time on the COC form, indicating sample receipt.
- Assign unique laboratory identification numbers to the samples.
- Measure the pH and/or temperature of each aqueous sample or cooler, as appropriate, to verify that the sample has been preserved correctly. (In the case of a volatile analysis, measure the pH at the time of analysis to avoid contamination, and record in the lab notebook if the COC form has already been returned to the laboratory coordinator).
- Record the pH and/or temperature (if measured) on the COC form or sample receiving report.
- Contact the laboratory coordinator to resolve any discrepancies in documentation or samples received.
- Return a copy of the COC form and, if applicable, a copy of the sample receiving report to the laboratory coordinator.

- Notify the laboratory coordinator within 24 hours of discovering that samples have been lost, damaged, or destroyed.
- Provide a Sample Condition Upon Receipt report to the laboratory coordinator within 24 hours of receipt.

It is the responsibility of the laboratory coordinator to ensure that the laboratory complies with these requirements.

4.0 Documentation

The following documents may be generated by the use of this procedure:

- Analysis Confirmation form
  - This form is generated by the laboratory coordinator. It is signed by a representative of the Analytical Laboratory prior to sample submittal. A copy is also sent to the project manager or site lead.
- Chain of Custody/Sample Submittal form
  - The form is generated by the laboratory coordinator using the SMS. It may also be generated in the field by the sampling team. The original of this form is returned by the Analytical Laboratory as part of the analytical report.
- Analytical reports
  - The laboratory sends an analytical report to the laboratory coordinator at the completion of sample analysis. Other deliverables are provided as specified in the *Grand Junction Site Statement of Work for Analytical Laboratory Services*. The laboratory coordinator then initiates data review and validation. If an electronic data deliverable (EDD) is part of the analytical package, it is forwarded to the Data Management group for loading into the SEEPro database. Electronic deliverables are managed by the Data Management group.

5.0 References

Environmental Procedures Catalog, LMS/POL/SO4325, continually updated, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado.

Standard Practice for Field Documentation

Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites, LMS/PLN/S04351, continually updated, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado.

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Page 1 of 1

SAMPLE MANAGEMENT OFFICE ANALYSIS CONFIRMATION FORM

RIN : 08031439

Expected arrival date at lab: 3/13/2008

Turnaround Time: 28 Day

Date of request: 3/12/2008

Other Instructions: *LMM-02 - Total Uranium

Requesting Project: Fernald Surface Water

Qty	Matrix	Analysis	Line Item Code	Level
8	WATER	Thorium Isotopes	ASP-A-008	ASL D
8	WATER	Radium-226	GPC-A-018	ASL D
8	WATER	Radium-228	GPC-A-020	ASL D
11	WATER	ICPMS Metals (Single Element)	LMM-02*	ASL D
3	WATER	Total Recoverable Metals (Single Element)	LMM-03	ASL D
8	WATER	Technetium-99	LSC-A-015	ASL D
3	WATER	Cyanide, Total	WCH-A-013	ASL D

Note: If the expected sample arrival date becomes more than 7 days from the indicated date above, then reconfirmation with the laboratory should be made to check on the labs capacity and ability to accommodate the samples.

PLEASE NOTE THIS IS AN APPROXIMATE SAMPLE COUNT. MORE SAMPLES MAY BE ADDED TO THE FINAL COC UPON SHIPMENT. PLEASE RETURN ALL BLUE ICE AND COOLERS.

Accepted by: ______________________
Laboratory Representative Date

Not accepted: ______________________ Reason: ______________________
Laboratory Representative Date

Figure 1. Analysis Confirmation Form

Water Sampling Field Data

Date 4/20/2009 Project Location GUN01 Well/Location No. 0062 Category: I

Arrival Time 15:02 RIN # 09032202 TICKET # HEV 060

Well Purging Information Well Condition: Acceptable (X) See Comments: ( )

Water Level (ft): 7.20 Casing Diameter (in): 2-inch Depth of Well (ft): 63.42 One Pump/Tubing Volume (L): 0.69

Sampling Equipment

Peristaltic Pump (X) Portable Bladder Pump ( ) Portable Submersible Pump ( ) Tubing Reel with weight ( )

Dedicated Bladder Pump ( ) Dedicated Poly Tubing (X) Dedicated Submersible Pump ( ) Container Immersion ( )

Bailer ( ) Tap ( ) Other ( )

Measurement Equipment Calibration Time 07:30

Equipment Type	Manufacturer	Model #	Property #	Serial #
Turbidimeter	Hach	2100p	S14818	S14818
Water Quality Meter	YSI	A	A	

Purge Data Purge Start: 04/20/2009 15:04 Purge Stop: 04/20/2009 15:16
Measured From: Open Container ( ) Air Exclusion (X) In-situ ( )

Time	Total Volume Purged (L)	Water Level (ft)	Temp. (°C)	Spec Cond. (µmhos/cm)	DO (mg/L)	pH (s.u.)	ORP (mV)	Turbidity (NTU)
15:10	0.7	7.24	9.26	523		7.05	84	1.72
15:13	1.4	7.24	9.36	524		7.03	83	1.78
15:16	1.9	7.24	8.81	524		7.00	79	1.93

Sample Time: 04/20/2009 15:20

Weather [Precipitation : clear], [Wind : none], [Temperature (°F) : 60 to 70]

Date Signed 4/20/2009 Sampler(s) Jeff Price, Sam Campbell

Comments:

Figure 2. Water Sampling Field Data Form Example

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Chain of Custody / Sample Submittal Form

RIN: 09062378
COC: 09062378.1.1
Sampler(s): G. Baer, S. Campbell

Page 1 of 2

Project: Green River
Purchase Order: 3862
Cost Number: 1-501-1-02-107-4-02
Turnaround (Days): 28
Matrix: WA - Water

Laboratory: ALS Laboratory Group
Address: 225 Commerce Dr.
Ft. Collins, CO 80524
Phone: 970.490.1511

Ship #	Ticket	Sample Date	Time	Site	Location	Container	# Cont.	Preservation	Matrix	Comp.	Grab	Filtered	QC	Analysis
1	HHS 307	06/26/2009	11:50	GRN01	0171	HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
						HDPE 500 mL	1	HNO3	WA			N		As,Se,U
1	HHS 308	06/26/2009	10:50	GRN01	0173	HDPE 500 mL	1	HNO3	WA			N		As,Se,U
						HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
1	HHS 312	06/26/2009	10:10	GRN01	0176	HDPE 500 mL	1	HNO3	WA			N		As,Se,U
						HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
1	HHS 313	06/26/2009	9:35	GRN01	0179	HDPE 500 mL	1	HNO3	WA			N		As,Se,U
						HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
1	HHS 309	06/26/2009	11:20	GRN01	0181	HDPE 500 mL	1	HNO3	WA			N		As,Se,U
						HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
1	HHS 314	06/25/2009	13:10	GRN01	0188	HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
						HDPE 500 mL	1	HNO3	WA			N		As,Se,U
1	HHS 315	06/25/2009	12:45	GRN01	0189	HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
						HDPE 500 mL	1	HNO3	WA			N		As,Se,U
1	HHS 316	06/25/2009	11:45	GRN01	0192	HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
						HDPE 500 mL	1	HNO3	WA			N		As,Se,U

Reliquished by (signature)	Date	Time	Reliquished by (signature)	Date	Time	Reliquished by (signature)	Date	Time
Received by (signature)	Date	Time	Received by (signature)	Date	Time	Received by (signature)	Date	Time

Figure 3. COC Form

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Standard Practice for Sample Management Office Operations

1.0 Purpose and Scope

This standard practice describes sample management including preparing statements of work (SOWs), placing subcontracts for analytical services, overseeing analytical work, tracking the status of sample analysis and reporting, and evaluating laboratory performance.

This practice applies to the management of submittals to laboratories that provide services as specified in the ICPT BOA or other SOWs.

This practice provides an organized, documented sample management process when submitting samples to contract laboratories and will be used for all sample submittals to commercial laboratories.

This practice complements procedures for the collection, preservation, and shipment of samples as documented elsewhere (see Section 5.0, "References").

All samples shipments must comply with DOT regulations (49 CFR 171–179) that govern the transportation of hazardous materials and hazardous substances. Individual sampling plans or work plans should identify samples that must be shipped as DOT-regulated material.

2.0 Terminology

Analytical Service Level—There are five analytical service levels that are assigned depending on the intended use of the data. The following are definitions of Analytical Service Levels A through E.

> **Analytical Service Level A (Field Analyses)**—Field measurements of alkalinity, dissolved oxygen, oxidation-reduction potential, temperature, and other parameters may be required on a project-specific basis. Specific conductance, pH, and turbidity may also be required or may be used as stabilization parameters when purging a monitoring well. See the SAP for calibration and quality control requirements pertaining to field measurements. Field data are recorded in the FDCS or on the Water Sampling Field Data form.

> **Analytical Service Level B (Quantitative with Results Only Deliverable)**—Laboratory data fully compliant with requirements specified in the *Quality Systems for Analytical Services* (QSAS), the SOW, or project-specific documents. The "results only" deliverable comprises the sample results, case narrative, and COC documentation. No calibration or quality assurance sample data are reported. Analytical Service Level B may be used when rapid turnaround results of undocumented quality are needed.

> **Analytical Service Level C (Quantitative with Standard Deliverable)**—Laboratory data meeting the same requirements as for Analytical Service Level B with a standard deliverable. The standard deliverable includes those deliverables defined for the "results

only” package plus all applicable EPA Contract Laboratory Program forms or their equivalent. No raw data, spectra, or laboratory logbook copies are required.

Analytical Service Level D (Quantitative with Standard Plus Raw Data Deliverable)—Laboratory data meeting the same requirements as Analytical Service Level C with a standard plus raw data deliverable. The standard plus raw data deliverable includes those deliverables defined for the standard data package plus all raw data and spectra generated in the acquisition of the samples. This is to include, but not be limited to, laboratory-originating quality indicator samples, analyses performed but not used for reporting, data for all preparation, chemistry, counting, and instrument data generated during sample analysis.

Analytical Service Level E (Nonstandard Methods)—Analyses using nonstandard methods for unusual analytes or when the method performance standards cannot be met. Nonstandard methods may be needed to meet project-specific requirements that cannot be met using existing analytical methods.

Basic Ordering Agreement—The ICPT BOA provides a standardized system for procuring analytical services from commercial laboratories including a statement of work for analytical services and provisions for laboratory audits.

Integrated Contractor Purchasing Team—The ICPT was established by DOE to provide a vehicle for the communication of procurement-related issues of the prime Contractor community. The ICPT negotiates BOAs for use by DOE and its eligible subcontractors.

Line Item Code—A cost code used to specify analytes, or analyte groups. Line item codes are defined in the BOA based on sample matrices, analytes, analytical methods, and required detection limits.

Mixed Analyte Performance Evaluation Program—A single-blind performance evaluation program administered by the DOE Analytical Services Division. Laboratories analyze performance evaluation samples containing organic, inorganic, and radiochemical analytes at concentrations known only to the program to assess laboratory performance.

Quality Systems for Analytical Services—The quality requirements document that supplements the ICPT BOA. The Quality Systems for Analytical Services is prepared and maintained by the DOE Consolidated Audit Program (CAP) team.

Radioactive material—Any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in 49 CFR 173.436.

Requisition index number—A unique 8-digit number that identifies a group of samples that are submitted, analyzed, and reported together.

Sample Management System—A database application used to define sample submittals (requisition index numbers), track sample analysis progress and analytical costs, and support data validation.

U.S. Department of Energy Consolidated Audit Program—The laboratory auditing program administered by the DOE Analytical Services Division. The CAP team performs annual audits of contract laboratories to assess performance and contract compliance.

3.0 Procedure

Note

Deviations from procedures are made in accordance with the Contractor Quality Assurance Manual.

3.1 Placement of Analytical Subcontracts

The subcontract technical representative (STR) determines the analytical requirements of a site or project by consulting with the project manager (or other project contact) and reviewing relevant project documents.

The STR determines if a project-specific SOW is needed to define requirements that have not been previously identified in the BOA SOW, the associated QSAS, or other requirements documents. SOWs with limited scope can be amended according to an existing laboratory agreement as needed.

The STR prepares the following documents, as needed:

- The SOW that clarifies the technical requirements.
- A document list comprising the documents that will be requested of the prospective laboratories for use during proposal evaluation.
- An evaluation plan that details how the proposals will be evaluated and ranked.
- A list of prospective laboratories, prepared from the laboratories that have current ICPT agreements.
- A requisition with an estimated cost, charge codes, and appropriate manager approval.

Laboratories must meet the requirements specified in the SOW to be approved for contract award. Fundamental requirements include that the laboratory:

- Has been audited by the DOE CAP or other accrediting authority as specified in the SOW within the last 18 months.
- Has a proper license to handle radioactive material, as needed, and has procedures for the control of radioactive material.
- Has procedures for sample receiving, login, storage, analysis, and disposal with appropriate COC.
- Has procedures for the implementation of the analytical methods to be performed.
- Has a facility with adequate building security.
- Has a document control system.

- Has a quality assurance program that meets the requirements in the QSAS or other Quality Systems as specified in the SOW.
- Has documented personnel and laboratory experience in the analysis category (inorganic, organic, radiochemical, geotechnical), including acceptable performance in performance evaluation programs.
- Has demonstrated the ability to comply with all applicable reporting requirements.
- Has demonstrated the ability to comply with all other contractual requirements as set forth in technical SOWs.
- Has administrative programs in place that comply with the Occupational Safety and Health Administration (OSHA) requirements of 29 CFR 1910.1450 and 10 CFR 835, as applicable, and has a hazardous waste management program.
- Has demonstrated successful performance in at least two recognized inter-laboratory performance evaluation programs, such as the Mixed Analyte Performance Evaluation Program (MAPEP).
- Has the necessary equipment, in working order and capable of performing the analyses for which the laboratory will be contracted.

A review of the requirements may be included in the technical evaluation plan.

The STR submits the documents for technical review to a review committee composed of the project manager or a designee and other appropriate personnel. Quality assurance, data validation, and sample management personnel may be included in the review of the proposal as determined by the STR.

After reviews and modifications are complete, the STR submits the requisition package to Procurement for placement.

The review committee recommends placement of the contract after ranking the responses to the SOW in accordance with the evaluation plan.

3.2 Sample Collection and Submittal

Samples are collected in accordance with the SAP or project-specific sampling plans. Variances from the SAP are documented in a project-specific program directive.

Samples are submitted to the contract laboratory as specified in the “Standard Practice for Sample Submittal to Contract Analytical Laboratories” chapter. The laboratory coordinator or a designee selects the analytical service level (ASL) and turnaround time requirements when the submittal is defined in SMS.

All documentation associated with the submittal, including COC forms, Sample Submittal forms, Nonconformance Notifications (NCNs), communications with the laboratory, and the required deliverables are stored in the RIN subdirectory under the SMS directory on the network (//condor/SMS).

3.3 Monitoring Analytical Work Progress

The following events are recorded in SMS by the laboratory coordinator or a designee as they occur:

- Sample shipment
- Receipt of samples at the laboratory
- Receipt of deliverables from the laboratory
- Invoice receipt

The laboratory coordinator or a designee:

- Updates the RIN information in SMS upon receiving a copy of the COC form from the laboratory.
- Checks on the status of submitted samples, confirms expected data delivery dates, and resolves any technical issues concerning the handling or analysis of, or analytical data reporting for, the submitted samples, including issues regarding contract relief.
- Reviews and reconciles all analytical invoices received from contract laboratories.

3.4 Receipt of Deliverables from Contract Laboratories and Data Validation

The deliverables required from the contract laboratory generally include a hard-copy report that satisfies the requirements of the ASL specified, a PDF of the hard-copy report, and an EDD file. EDD files are e-mailed to an EDD delivery account and are accompanied by an EDD notification message. Upon receiving the deliverables, the laboratory coordinator or a designee:

- Notifies the site lead or project manager and the data management group, by e-mail, that the work has been completed.
- Verifies that the EDD meets specifications, using the EDD validation module in SMS.
- Verifies that the deliverables meet the specified ASL requirements.
- Validates the data in accordance with the "Standard Practice for Validation of Laboratory Samples" chapter, to a degree comparable with the ASL selected, and qualifies the data as necessary.
- Requests clarification or corrections from the laboratory if errors are detected.
- Issues NCNs when contract requirements are not satisfied.
- Prepares a data validation package, if required, or forwards the report to the designated person for data-validation-package preparation.

3.5 Request for Corrections

Questions concerning data entry errors, data calculation errors, lack of expected information, illegible documents, or other errors may require resolution with the laboratory. Errors may be detected:

- When sample information is being updated after sample receipt.
- When deliverables are received from the laboratory.
- During the EDD file-checking process.
- During data validation.

Requests for additional information, data entry corrections, EDD revision, etc., are communicated to the laboratory via e-mail. The nature of the request and the laboratory response is documented in the data validation package or can be saved in the RIN subdirectory under the SMS directory on the network. Errors that indicate noncompliance with contract requirements are documented in an NCN.

Nonconformance Reporting

The laboratory coordinator or a designee issues an NCN to document cases of noncompliance with contract requirements. The NCN states:

- The date it was issued.
- An explanation of the problem.
- A statement of the requirement.
- The source document that states the requirement.
- The corrective action required.
- The response-by date.
- The affected RINs and LICs.

NCNs and the associated laboratory responses are stored in the NCR subdirectory under the SMS directory.

3.6 Assessing Contract Laboratory Performance

Laboratory performance is assessed using the following elements:

- Annual DOE CAP audit reports and corrective action reports.
- MAPEP sample analysis results.
- NCN reports, corrective action reports, reoccurring NCNs.
- Data validation results.
- Percentage of on-time deliverables.

The following conditions may preclude continued use of a laboratory:

- Issuance of a Priority I finding during a DOE CAP audit.
- Issuance of a Priority II finding during a DOE CAP audit that may significantly impact data quality.
- Continued poor performance on MAPEP or other performance evaluation samples.
- Continued poor performance in meeting the analytical method performance criteria.
- Poor performance in meeting turnaround time requirements.

4.0 Documentation

4.1 Documents Prepared by the STR

The STR may prepare the following documents, as required:

- The SOW that clarifies the technical requirements.
- A list comprising the documents that will be requested of the prospective laboratories for use during proposal evaluation.
- An evaluation plan that details how the proposals will be evaluated and ranked.
- A list of prospective laboratories, prepared from the laboratories that have current ICPT agreements.
- A requisition with an estimated cost, charge codes, and appropriate manager approval.
- NCNs.
- Data validation packages. These documents are part of the project records and are forwarded to the Archive Information and Records Management group for inclusion in the project files.

Copies of these documents are kept in the SMS directory, and except as noted, the originals are retained as records by the Contracts Services group.

4.2 Other Documents

Other documents may include:

- Analytical invoices. These are kept as records by the Finance department.
- Hard-copy analytical reports. These are part of the project records and are forwarded to Archive Information and Records Management for inclusion in the project files.
- EDDs. These are not considered records. Copies are kept in the SMS RIN folders and in the Environmental Data Management folders on the Legacy Management Support network.

5.0 References

49 CFR 171–179. U.S. Department of Transportation, *Code of Federal Regulations*, including HM230, 2006.

Attachment 1, *Basic Ordering Agreement, Statement of Work, Laboratory Analytical Services*, 2006, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado.

DOE (U.S. Department of Energy), 2007. *Quality Systems for Analytical Services*, Revision 2.3.

Environmental Procedures Catalog, LMS/POL/S04325, continually updated, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado.

Standard Practice for Sample Submittal to Contract Analytical Laboratories

Standard Practice for Field Documentation

Standard Practice for the Validation of Laboratory Samples

Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites, LMS/PLN/S04351, continually updated, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado.

Standard Practice for Field Documentation

1.0 Purpose and Scope

This procedure covers the general requirements for documenting activities related to field sampling and measurement. These records include sample logs, COC records, technical record books, and data collection forms. These records may be either in a hard copy or an electronic format. This practice covers photographs, videos, and other electronic media.

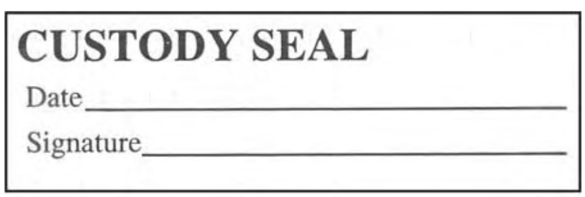
This practice also covers the general requirements for sample labeling and for creating a COC form.

2.0 Terminology

Chain of Custody form—A form used to document sample custody and receipt. It also may contain other information, such as the sample analyses required, sample preservation, filtration status, and traceability.

Custody—To maintain a sample in sight, immediate possession, or locked under one's personal control. Custody may be individual, apply to all members of a sampling team, or apply to members of the same company.

Custody seals or tags—Adhesive-backed strips, or metal or plastic tags, fastened to the sample container or the shipping container in such a way as to demonstrate that no tampering with the sample has occurred. Custody seals also may be manufactured in the field by using paper strips and clear plastic tape. An example is shown in Figure 1.


CUSTODY SEAL

Date____________________

Signature____________________

Figure 1. Custody Seal

Duplicate sample—More than one sample collected from the same source location but placed in separate containers.

Field—Any place where the material for analyses or testing is collected.

Records (Quality Assurance)—Information or data on a specific subject collected and preserved in writing or other permanent form that has been verified and authenticated as technically complete and correct. Records may include but are not limited to data sheets, logbooks, field notebooks, maps, drawings, photographs, and electronic data-recording media.

Sample (*n.*)—A portion of material collected from a larger mass.

Sample (*vt.*)—To select and collect a sample.

Sample label—The documentation attached to the sample or sample container and marked with required information about the sample. An example is shown in Figure 2.

U.S. Department of Energy Project: Rocky Flats Ground Water		RIN:	08111927
Sampler(s): Chaz Gunning	Date: 11/4/2008	Time:	11:34:28
Site:	Rocky Flats Ground Water	Preserve:	4 C, H2SO4
Location:	70099	Filtered:	Yes
Matrix:	Water	Ticket:	GMZ 331
Analytes:	NO3NO2-N		

Figure 2. Sample Label

Sample log—A document that lists all samples collected during a field visit or visits. A COC form or sample ticket book are examples of sample logs.

Sample number—The unique identification number assigned by the Contractor to each sample and attached to, or written on, the sample label or sample container. The sample number will normally consist of three letters and three numerals.

Split sample—A sample that has been subdivided into two or more parts, each representative of the original sample.

Technical record books—For the purposes of this procedure, "technical record books" will refer to logbooks and field notebooks. These books are to be bound and the pages consecutively numbered.

Water Sampling Field Data—Form used to document routine groundwater and surface water sampling activities.

3.0 General Procedures for Records

All records, paper and electronic, shall be traceable to the program or site, the person generating the record, the date the record was generated, and the type of data or activity recorded. The term "record" in this procedure is used as a quality assurance term and does not imply management and storage requirements as a project record by Archive Information and Records Management.

3.1 Paper Records

Paper records must be clear, legible, and reproducible. For paper documentation, black or blue ink is preferred. Reproducible photocopies of penciled documents are acceptable as records.

Errors on paper records will be corrected by drawing a single line through the incorrect entry, making the correction, and initialing and dating the correction. The erroneous information must not be obliterated or erased.

3.2 Electronic Records

Electronic records must be in a format approved by the project manager. The required information on the project or site, the generator of the record, and the date may be conveyed through comments inserted into the media file or through the file titles and naming conventions of the directory where it is stored. For example, "\\condor\projects\LM\Work Dir\DoeJ\SAL(JRD)\SAL_2008_Images\SAL_Images_14-18Apr08\2008_04_14" would identify the site as Salmon, Mississippi, the owner of the image as John Doe, and the date the image was taken as April 14, 2008.

Errors in electronic media should be corrected when noticed during the field activities or data review and validation. If corrections are required while the data is being uploaded into SEEPro, or after the data have been uploaded, corrections shall be tracked using the SEEPro Issue Tracking database.

Errors in other electronic media (such as photographs) may be corrected at any time. If possible, a note should be inserted into the file, stating who made the correction, the data that was corrected, and the reason for the correction.

3.3 Sample Labeling

All samples collected by Contractor personnel shall have a sample label and a Contractor-generated sample number. Sample labels may be obtained by using the SMS or purchased from a vendor.

Normally, the sampler will complete the entire label. If some of the requested information is not relevant, "NA"—for "not applicable"—shall be written in that space.

The sample label shall include the following information, at a minimum:

- Sample number.
- Date and time the sample was collected.
- Name or initials of the person who collected the sample.
- Analysis required for the portion of the sample in the container to which the label is attached.
- Location at which the sample was collected. Examples of sample locations include well numbers, grid locations, or surveyed coordinates.

- Whether the sample is filtered or unfiltered.
- Whether the sample was cooled.
- Any preservatives used.

Additional information such as the project, sample matrix, or comments may also be included on the label.

The sampler shall maintain a record of sample numbers and other pertinent information on a sample log.

If multiple sample fractions are taken at the same location or if split samples are made in the field, the sample number shall be identical for each sample in the entire group of fractions or splits. The exception is quality control duplicates, which shall be given a fictitious sample number. The fictitious sample number will be tracked through the Contractor copy of the sample log.

3.4 Chain of Custody

An example of a COC form is shown in Figure 3. A COC form may be generated by the sample management office (SMO) or purchased from a vendor.

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Chain of Custody / Sample Submittal Form

RIN: 09062378
COC: 09062378.1.1
Sampler(s): G. Baer, S. Campbell

Page 1 of 2

Project: Green River
Purchase Order: 3862
Cost Number: 1-501-1-02-107-4-02
Turnaround (Days): 28
Matrix: WA - Water

Laboratory: ALS Laboratory Group
Address: 225 Commerce Dr.
Ft. Collins, CO 80524
Phone: 970.490.1511

Ship #	Ticket	Sample Date	Time	Site	Location	Container	# Cont.	Preservation	Matrix	Comp.	Grab	Filtered	QC	Analysis
1	HHS 307	06/26/2009	11:50	GRN01	0171	HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
						HDPE 500 mL	1	HNO3	WA			N		As,Se,U
1	HHS 308	06/26/2009	10:50	GRN01	0173	HDPE 500 mL	1	HNO3	WA			N		As,Se,U
						HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
1	HHS 312	06/26/2009	10:10	GRN01	0176	HDPE 500 mL	1	HNO3	WA			N		As,Se,U
						HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
1	HHS 313	06/26/2009	9:35	GRN01	0179	HDPE 500 mL	1	HNO3	WA			N		As,Se,U
						HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
1	HHS 309	06/26/2009	11:20	GRN01	0181	HDPE 500 mL	1	HNO3	WA			N		As,Se,U
						HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
1	HHS 314	06/25/2009	13:10	GRN01	0188	HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
						HDPE 500 mL	1	HNO3	WA			N		As,Se,U
1	HHS 315	06/25/2009	12:45	GRN01	0189	HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
						HDPE 500 mL	1	HNO3	WA			N		As,Se,U
1	HHS 316	06/25/2009	11:45	GRN01	0192	HDPE 125 mL	1	4 C, H2SO4	WA			N		NO3NO2-N,NH3-N
						HDPE 500 mL	1	HNO3	WA			N		As,Se,U

Reliquished by (signature)	Date	Time	Reliquished by (signature)	Date	Time	Reliquished by (signature)	Date	Time
Received by (signature)	Date	Time	Received by (signature)	Date	Time	Received by (signature)	Date	Time

Figure 3. COC Form

The purpose of the custody records is to demonstrate that custody of the samples was maintained. It provides documentation of the control and transfer of samples. Custody documentation is not required when samples are transferred between members of the sampling team or other Contractor employees such as personnel shipping the samples.

When the samples are physically transferred from Contractor personnel to a commercial carrier, the Contractor shall sign the “Relinquisher” blocks on the COC form, with the date and time of sample transfer. The relinquisher, by signing, verifies that sample custody has been maintained, and samples have been physically secure. The relinquisher retains a copy of the form. Noncontractor employees (e.g., employees of commercial carriers) are not required to sign the form; the subcontracted laboratory shall sign the “Received” block on the COC form with the data and time the samples were received.

The samplers shall attach custody tags or seals to the container openings when the container is not in sight or is not otherwise under their control—for example, when samples are stored in a hotel room or shipped by a commercial carrier.

The original COC form shall accompany the samples until they are received by the laboratory.

The COC form should contain the following information:

- Ticket number
- Data and time sample was collected
- Site
- Location where sample was collected
- Type and number of containers
- Preservative used on the sample
- Sample matrix
- Type of sample (composite or grab)
- Whether the sample was filtered or unfiltered
- Analyses requested
- Optional information (e.g., whether the sample is for laboratory quality control)

3.5 Water Sampling Field Data

The Water Sampling Field Data form is used to document routine water sampling activities. The form may be generated and completed electronically (Figure 4) using the FDCS.

4.0 Documentation

Not all the documents produced using this procedure are considered project records. Some documents, such as sample labels, are no longer required once the sample analyses are completed. All documents must be protected against damage, deterioration, and loss until they are no longer required, or until they are properly transferred to Archive Information and Records Management as project records.

For short-term tasks, the work plan will define the project records for each task conducted and the management of the records. The following are suggested records of a short-term task:

- Operational check data
- Data sheets
- Technical record books
- Official correspondence
- Planning documents
- Electronically stored data

For established programs, a Working Records File Index defines what records will be generated, how long they will be retained, and how they will be disposed of.

Water Sampling Field Data

Date 4/20/2009 Project Location GUN01 Well/Location No. 0062 Category: I

Arrival Time 15:02 RIN # 09032202 TICKET # HEV 060

Well Purging Information Well Condition: Acceptable (X) See Comments: ( )

Water Level (ft): 7.20 Casing Diameter (in): 2-inch Depth of Well (ft): 63.42 One Pump/Tubing Volume (L): 0.69

Sampling Equipment

Peristaltic Pump (X) Portable Bladder Pump ( ) Portable Submersible Pump ( ) Tubing Reel with weight ( )

Dedicated Bladder Pump ( ) Dedicated Poly Tubing (X) Dedicated Submersible Pump ( ) Container Immersion ( )

Bailer ( ) Tap ( ) Other ( )

Measurement Equipment Calibration Time 07:30

Equipment Type	Manufacturer	Model #	Property #	Serial #
Turbidimeter	Hach	2100p	S14818	S14818
Water Quality Meter	YSI	A	A	

Purge Data Purge Start: 04/20/2009 15:04 Purge Stop: 04/20/2009 15:16
Measured From: Open Container ( ) Air Exclusion (X) In-situ ( )

Time	Total Volume Purged (L)	Water Level (ft)	Temp. (°C)	Spec Cond. (µmhos/cm)	DO (mg/L)	pH (s.u.)	ORP (mV)	Turbidity (NTU)
15:10	0.7	7.24	9.26	523		7.05	84	1.72
15:13	1.4	7.24	9.36	524		7.03	83	1.78
15:16	1.9	7.24	8.81	524		7.00	79	1.93

Sample Time: 04/20/2009 15:20

Weather [Precipitation : clear], [Wind : none], [Temperature (°F) : 60 to 70]

Date Signed 4/20/2009 Sampler(s) Jeff Price, Sam Campbell

Comments:

Figure 4. Water Sampling Field Data Form Example

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Technical Comments on ASTM D 5088-02 (Reapproved 2008) Standard Practice for Decontamination of Field Equipment Used at Waste Sites

Summary of ASTM D 5088-02

The purpose of this practice is to provide guidance for the decontamination of field equipment used in the sampling of soils, soil gas, sludges, surface water, and groundwater at waste sites.

Additions Applicable to the Operating Contractor and its Subcontractors

This standard guide shall be referenced when preparing sampling and analysis plans for site investigation activities. The guidance provided may be superseded by other project documents, such as project sample and analysis plans, safety plans, or project quality assurance plans.

The following sections shall be used in conjunction with the current published version of the ASTM guide. The sections shall be inserted in numerical order, using the published version as the base document for reference.

4. Summary of Practice

4.1—Some nonsample contacting equipment may not require decontamination due to limited use and/or site conditions that do not pose a risk.

4.2—The information included in an equipment decontamination protocol, as well as how the information is presented in site plans should be determined on a site-specific basis.

7. Procedure for Sample Contacting Equipment

7.2.3—When samples will undergo inorganic analyses, the use of an inorganic desorbing agent may not be required if the quality assurance/quality control program documents that the decontamination protocol is sufficient for the sampling methods being used.

8. Quality Assurance/Quality Control

8.1.3—The frequency for the minimum number of samples to demonstrate completeness of decontamination for quality assurance/quality control purposes may be either increased or decreased on a site-specific basis based on an evaluation of quality assurance/quality control samples and project-specific objectives.

9. Report

9.1—The activities associated with reporting equipment decontamination should be determined on a site-specific basis based on the specific objectives of each project.

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Designation: D 5088 – 02 (Reapproved 2008)

Standard Practice for Decontamination of Field Equipment Used at Waste Sites[1]

This standard is issued under the fixed designation D 5088; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers the decontamination of field equipment used in the sampling of soils, soil gas, sludges, surface water, and ground water at waste sites which are to undergo both physical and chemical analyses.

1.2 This practice is applicable only at sites where chemical (organic and inorganic) wastes are a concern. It is not intended for use at radiological, mixed (chemical and radiological), or biohazard sites.

1.3 Procedures are included for the decontamination of equipment which comes into contact with the sample matrix (sample contacting equipment) and for ancillary equipment that has not contacted the portion of sample to be analyzed (non-sample contacting equipment).

1.4 This practice is based on commonly recognized methods by which equipment may be decontaminated. The procedures described for sample contacting equipment are commonly prescribed, however there is a minimum of scientific data that supports these methods (Mickam et al. 1989[2], Parker[34], 1995). Therefore the user is reminded of the importance of QA/QC samples that document decontamination effectiveness and that these samples can be used to modify or enhance decontamination techniques. Decontamination at radiologically contaminated sites should refer to Practice D 5608.

1.5 This practice is applicable to most conventional sampling equipment constructed of metallic and synthetic materials. The manufacturer of a specific sampling apparatus should be contacted if there is concern regarding the reactivity of a decontamination rinsing agent with the equipment.

1.6 *This practice offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgement. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the documents has been approved through the ASTM consensus process..*

1.7 *This standard does not purport to address the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [5]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids

D 5608 Practices for Decontamination of Field Equipment Used at Low Level Radioactive Waste Sites

3. Terminology

3.1 *Definitions:*

3.1.1 *contaminant*—an undesirable substance not normally present or an unusually high concentration of a naturally occurring substance in water or soil.

3.1.2 *control rinse water*—water used for equipment washing and rinsing having a known chemistry.

3.1.3 *decontamination*—the process of removing or reducing to a known level undesirable physical or chemical constituents, or both, from a sampling apparatus to maximize the representativeness of physical or chemical analyses proposed for a given sample.

3.1.4 *non-sample contacting equipment*—related equipment associated with the sampling effort, but that does not directly contact the sample (for example, augers, drilling rods, excavations machinery).

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[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground Water and Vadose Zone Investigations .

Current edition approved Sept. 15, 2008. Published October 2008. Originally approved in 1990. Last previous edition approved in 2002 as D 5088 – 02.

[2] Mickam, J. T., Bellandi, R., and Tifft, Jr., E. C., *Equipment Decontamination Procedures for Ground Water and Vadose Zone Monitoring Programs: Status and Prospects*, *Ground Water Monitoring Review*, Vol 9, No. 2, 1989, pp. 100–121.

[3] Parker, L. V., *A Literature Review on Decontaminating Groundwater Sampling Devices: Organic Contaminates*, CRREL Report 95–14, U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH, 1996.

[4] Parker, L. V., and Ranney, T. A., *Decontamination Materials Used in Groundwater Sampling Devices*, CRREL Special Report 97–24, U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH, 1997a.

[5] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.1.5 *quality assurance/quality control (QA/QC)*—the efforts completed to evaluate the accuracy and precision of a sampling or testing procedure, or both.

3.1.6 *sample contacting equipment*—equipment that comes in direct contact with the sample or portion of sample that will undergo chemical analyses or physical testing (for example, ground water well bailer, split-spoon sampler, soil gas sampling probe).

3.1.7 For definitions of other terms used in this practice, see Terminology D 653.

4. Summary of Practice

4.1 Two different procedures are presented for the decontamination of sample-contacting and non-sample contacting equipment. The procedures have been developed based on a review of current state and federal guidelines, as well as a summary of commonly employed procedures. In general, sample contacting equipment should be washed with a detergent solution followed by a series of control water, desorbing agents and deionized water rinses. Nonsample contacting equipment should be washed with a detergent solution and rinsed with control water. Although such techniques may be difficult to perform in the field, they may be necessary to most accurately evaluate low concentrations of the chemical constituent(s) of interest.

4.2 Prior to initiating a field program that will involve equipment decontamination, a site specific equipment decontamination protocol should be prepared for distribution to the individuals involved with the particular sampling program. Information to be presented in the protocol should include:

4.2.1 Site location and description,

4.2.2 Statement of the sampling program objective and desired precision and accuracy, that is, is sampling effort for gross qualitative evaluation or for trace concentration, parameter specific evaluations,

4.2.3 Summary of available information regarding soil types, hydrogeology and anticipated chemistry of the materials to be sampled,

4.2.4 Listing of equipment to be used for sampling and materials needed for decontamination,

4.2.5 Detailed step by step procedure for equipment decontamination for each piece or type of equipment to be utilized and procedures for rinse fluids containment and disposal as appropriate,

4.2.6 Summary of QA/QC procedures and QA/QC samples to be collected to document decontamination completeness including specific type of chemical analyses and their associated detection limit, and

4.2.7 Outline of equipment decontamination verification report.

5. Significance and Use

5.1 An appropriately developed, executed and documented equipment decontamination procedure is an integral and essential part of waste site investigations. The benefits of its use include:

5.1.1 Minimizing the spread of contaminants within a study area and from site to site,

5.1.2 Reducing the potential for worker exposure by means of contact with contaminated sampling equipment, and

5.1.3 Improved data quality and reliability.

5.2 This practice is not a substitute for a well-documented Quality Assurance/Quality Control (QA/QC) program. Because the ultimate test of a decontamination procedure is its ability to minimize erroneous data, a reasonable QA/QC program must be implemented.

5.3 This practice may not be applicable to all waste sites. When a sampling effort is completed to determine only the general range of chemical concentrations of interest less rigorous decontamination procedures can be adequate. Investigators should have the flexibility to modify the decontamination procedures with due consideration for the sampling objective or if QA/QC documentation supports alternative decontamination methods.

5.4 At sites where the reactivity of sampling equipment to decontamination washes creates concern for the generation of undesirable chemical by-products, the use of dedicated sampling equipment should be considered.

5.5 This practice, where applicable, should be used before, between, and after the completion of sampling events.

5.6 This practice is appropriate for use at sites where chemical (organic and inorganic) contamination is known or expected. The application of this practice to other types of sites radiological, mixed (radiological and chemical), or biohazard contaminated sites may not be applicable. The application of this practice to these types of sites should be undertaken with care and consideration, along with QA/QC documentation that supports the effectiveness of these decontamination techniques.

6. Reagents

6.1 *Detergent*, non-phosphate detergent solution.[6]

6.2 *Acid Rinse (inorganic desorbing agent)*, 10 % nitric or hydrochloric acid solution-made from reagent grade nitric or hydrochloric acid and deionized water (1 % is to be applied to low-carbon steel equipment).

6.3 *Solvent Rinse (organic desorbing agent)*, isopropanol, acetone, or methanol; pesticide grade.

6.4 *Control Rinse Water*, preferably from a water system of known chemical composition.

6.5 *Deionized Water*, organic-free reagent grade.

7. Procedure for Sample Contacting Equipment

7.1 At a minimum, sample contacting equipment should be washed with a detergent solution and rinsed with control water.

7.2 For programs requiring more rigorous decontamination to meet the sampling or QA/QC objectives, the following procedures are indicated: Table 1 provides applications of various solutions for decontamination of field equipment and materials. Table 2 provides commonly recommended decontamination procedures for various equipment and materials,

7.2.1 Wash with detergent solution, using a brush made of inert material to remove any particles or surface film.

[6] Liquinox or Detergent 8 or similar solution has been found suitable for this purpose. Detergent 8 is recommended for spray cleaning.

TABLE 1 Applications of Various Solutions for Decontamination of Field Equipment and Materials[A,B,C]

Solution	Concentrations	Remarks
Portable Water	Tap water (demonstrated to be analyte free)	Used under high pressure or steam to remove heavy mud and dirt, or to rinse off other solutions
Laboratory-grade water	Distilled Deionized Reagengrade distilled and deionized water	
Low sudsing non-phosphate detergents (Liquinox, Detergent 8)	Typical concentrations are 0.5 to 2% solution by volume	General all-purpose cleaner. Detergent 8 is recommended for spray cleaning.
Sodium carbonate (baking soda)	5 to 15% aqueous solution	Used to neutralize either acidic or strongly basic contaminants
Sodium carbonate (washing soda)	10 to 20% aqueous solution	Effective for neutralizing inorganic acids, organic acids, heavy metals, metal processing wastes.
Trisodium phosphate (TSP Oakite)	10% aqueous solution	Similar to sodium carbonate. Good rinsing solution for organic compounds (such as toluene, chloroform, TCE, PBBs, and PCBs).
Calcium hypochlorite (HTH)	10% aqueous solution	Disinfectant, bleaching, and oxidizing agent for pesticides, fungicides, chlorinated phenols, dioxins, cyanides, ammonia and other non-acidic inorganic wastes.
Hydrochloric acid, nitric acid	10% nitric 10% to 20% hydrochloric	Used for inorganic bases, alkali and caustic wastes
Citric, tartaric, oxalic acids or their respective salts	5% solution	Used to clean heavy-metal contaminants
Organic solvents	Concentrated	Used to remove organic compounds that have poor solubility in water, such as oil and grease. do not use a solvent that is one of the analytes of interest or interferes with analyses. Porous materials such as polymers can absorb these solvents.

[A] Examples of commonly recommended cleaning solvents include pesticide-grade" isopropanol, acetone, methanol, hexane, heptane, and ethanol.
[B] Adapted for Mickam et al. (1989), Moberly (1985), and Richter and Collentine (1983).
[C] Many of the solvents listed are themselves hazardous materials. Care should be taken in both use and disposal of these materials.

TABLE 2 Commonly Recommended Decontamination Procedures for Different Equipment and Different Materials of Construction[A,B]

	Soapy Water Wash	Tap Water Rinse	10% Nitric Acid Rinse[C]	Organic-Free Water Rinse	Rinse with Solvent	Air Dry for 24h	Oven Dry	Store in Aluminum Foil or Polyethylene	Discard After Use
Glass	1	2,4	3	5	6^D	7		8	
Teflon	1	2,4	3	5	6^E	7		8	
Metals and Stainless Steel	1	2		3	4^D	5		6	
Teflon Tubing	1	2			3^E		4^F	5	
PVC Tubing				Use Only New PVC Tubing					1
Stainless Tubing	1	2		3	4^D	5		6	
Glass Tubing	1	2,4	3	5	6^D	7		3	
Well Sounders	1	2		3					
Submersible Pumps	1	2		3					

[A] These procedures are based on commonly recommended practices. It should be noted that there is not a lot of experimental data to support some of these practices. Mickam et al., 1989, Parker 1995, Parker and Ranney 1997a, 1997b.
[B] Sampling equipment that employs a process whereby potentially contaminated material passes through internal mechanical workings (pump, houisng, impellers, etc.) can be very difficult to decontaminate. This should be considered when identifying an appropriate decontamination procedure for equipment with internal sample contacting parts.
[C] This step is used in removing inorganic contaminants and can be eliminated if they are not of concern.
[D] Data by Parker and Ranney 1997a, 1997b should show that solvent rinsing may not be needed.
[E] Data by Parker and Ranney 1997a, 1997b, show that oven drying may be more effective than an organic solvent rinse for removing sorbed organic contaminants.
[F] Excessive heat that could damage the polymer should not be used. Check manufacturer's recommendations for heat tolerance.

7.2.1.1 For equipment that, because of internal mechanism or tubing cannot be adequately cleaned with a brush, the decontamination solutions should be circulated through the equipment.

7.2.2 Rinse thoroughly with control water.

7.2.3 Rinse with an inorganic desorbing agent (may be deleted if samples will not undergo inorganic chemical analysis). This rinse is effective only on non-metal surfaces.

7.2.4 Rinse with control water.

7.2.5 Rinse with organic desorbing agent (may be deleted if samples will not undergo organic chemical analyses).

7.2.6 Rinse with deionized water.

7.2.7 Allow equipment to air dry prior to next use.

7.2.8 Wrap equipment for transport with inert material (aluminum foil or plastic wrap) to direct contact with potentially contaminated material.

7.3 *Nonsample Contact Equipment*:

7.3.1 Clean the equipment with portable power washer or steam cleaning machine. Alternatively, hand wash with brush using detergent solution.

7.3.2 Rinse with control water.

7.3.3 The more rigorous decontamination procedures may be employed if necessary to meet sampling or QA/QC objectives.

7.4 Depending on site conditions, it may be appropriate to contain spent decontamination rinse fluids. If this is the case the appropriate vessel[7] for fluid containment should be used depending on the ultimate disposition of the material.

7.5 Depending on site conditions, it may be desirable to perform all equipment decontamination at a centralized location as opposed to the location where the equipment was used. If this is the case, care must be taken to transport the equipment to the decontamination area such that the spread of contaminants is minimized.

8. Quality Assurance/Quality Control

8.1 It is important to document the effectiveness of the decontamination procedure. To that end the projects QA/QC program should include provisions for the collection of samples to evaluate the completeness of a specific decontamination procedure. This could include:

8.1.1 Collection of rinse or wipe samples before the initial equipment decontamination prior to its use for sampling to establish a base line level of contaminants residing on or in the equipment,

8.1.2 Collection of final rinse or wipe samples after equipment decontamination following its use, and

8.1.3 The frequency of sampling to demonstrate the completeness of equipment decontamination is dependent upon objectives of the project as they relate to QA/QC. At a minimum it is recommended after every ten decontamination washings.

9. Report

9.1 The activities completed for each equipment decontamination should be documented in writing. Included in this report should be the following information:

9.1.1 Site location, date, time, and weather,

9.1.2 Sample location where equipment was employed,

9.1.3 Location where decontamination was performed,

9.1.4 Individuals performing the decontamination,

9.1.5 Decontamination procedures,

9.1.6 Source of materials (solutions) used for decontamination,

9.1.7 Handling of rinse fluids and accumulates solids, if any, and

9.1.8 QA/QC sampling performed and analytical results of QA/QC samples whether completed in the field or laboratory subsequent to sampling event.

10. Keywords

10.1 contaminant; decontamination; sampling; waste

[7] A drum approved by the Department of Transportation or similar container has been found suitable for this purpose.

Designation: D 4448 – 01 (Reapproved 2007)

Standard Guide for
Sampling Ground-Water Monitoring Wells[1]

This standard is issued under the fixed designation D 4448; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers sampling equipment and procedures and "in the field" preservation, and it does not include well location, depth, well development, design and construction, screening, or analytical procedures that also have a significant bearing on sampling results.This guide is intended to assist a knowledgeable professional in the selection of equipment for obtaining representative samples from ground-water monitoring wells that are compatible with the formations being sampled, the site hydrogeology, and the end use of the data.

1.2 This guide is only intended to provide a review of many of the most commonly used methods for collecting ground-water quality samples from monitoring wells and is not intended to serve as a ground-water monitoring plan for any specific application. Because of the large and ever increasing number of options available, no single guide can be viewed as comprehensive. The practitioner must make every effort to ensure that the methods used, whether or not they are addressed in this guide, are adequate to satisfy the monitoring objectives at each site.

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses are provided for information only.

1.4 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 4750 Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)

D 5088 Practices for Decontamination of Field Equipment Used at Waste Sites

D 5792 Practice for Generation of Environmental Data Related to Waste Management Activities: Development of Data Quality Objectives

D 5903 Guide for Planning and Preparing for a Groundwater Sampling Event

D 6089 Guide for Documenting a Ground-Water Sampling Event

D 6452 Guide for Purging Methods for Wells Used for Ground-Water Quality Investigations

D 6517 Guide for Field Preservation of Ground-Water Samples

2.2 *EPA Standards:*

EPA Method 9020A

EPA Method 9022

3. Terminology

3.1 *Definitions:*

3.1.1 *low-flow sampling*—a ground water sampling technique where the purge and sampling rates do not result in significant changes in formation seepage velocity.

3.1.2 *minimal purge sampling*—the collection of ground water that is representative of the formation by purging only the volume of water contained by the sampling equipment (that is, tubing, pump bladder).

3.1.2.1 *Discussion*—This sampling method should be considered in situations where very low yield is a consideration and results from this sampling method should be scrutinized to confirm that they meet data quality objectives (DQOs) and the work plan objectives.

3.1.3 *passive sampling*—the collection of ground-water quality data so as to induce no hydraulic stress on the aquifer.

3.1.4 *water quality indicator parameters*—refer to field monitoring parameters that include but are not limited to pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature, and turbidity that are used to monitor the completeness of purging.

4. Summary of Guide

4.1 The equipment and procedures used for sampling a monitoring well depend on many factors. These include, but are not limited to: the design and construction of the well, rate of ground-water flow, and the chemical species of interest.

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[1] This guide is under the jurisdiction of ASTM Committee D34 on Waste Management and is the direct responsibility of Subcommittee D34.01.02 on Sampling Techniques.

Current edition approved Oct. 15, 2007. Published October 2007. Originally approved in 1985. Last previous edition approved in 2001 as D 4448–01.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

Sampling procedures may be different if analyses for trace organics, volatiles, oxidizable species, or trace metals are needed. This guide considers all of these factors by discussing equipment and procedure options at each stage of the sampling sequence. For ease of organization, the sampling process can be divided into three steps: well purging, sample withdrawal, and field preparation of samples. Certain sampling protocols eliminate the first step.

4.2 The sampling must be well planned and all sample containers must be prepared prior to going to the field. These procedures should be incorporated in the approved work plan that should accompany the sampling crew so that they may refer to it for guidance on sampling procedures and analytes to be sampled (see Guide D 5903).

4.3 Monitoring wells must be either purged to remove stagnant water in the well casing or steps must be taken to ensure that only water meeting the DQOs and the work plan objectives is withdrawn during sampling (see Practice D 5792). When well purging is performed, it is accomplished by either removing a predetermined number of well volumes or by the removal of ground water until stable water quality parameters have been obtained. Ideally this purging is performed with minimal well drawdown and minimal mixing of the formation water with the stagnant water above the screened interval in the casing. Passive sampling and the minimal purge methods do not attempt to purge the water present in the monitoring well prior to sampling **(1)**.[3] The minimal purge method attempts to purge only the sampling equipment. Each of these methods is discussed in greater detail in Section 6.

4.4 The types of chemical species that are to be sampled as well as the reporting limits are prime factors for selecting sampling devices **(2, 3)**. The sampling device and all materials and devices the water contacts must be constructed of materials that will not introduce contaminants or alter the analytes of concern in any way. Material compatibility is further discussed in Section 8.

4.5 The method of sample collection can vary with the parameters of interest. The ideal sampling scheme employs a completely inert material, does not subject the sample to pressure change, does not expose the sample to the atmosphere, or any other gaseous atmosphere before conveying it to the sample container or flow cell for on-site analysis. Since these ideals are not always obtainable, compromises must be made by the knowledgeable individual designing the sampling program. These concerns should be documented in the data quality objectives (DQOs) of the sampling plan (see Practice D 5792) **(4)**.

4.6 The degree and type of effort and care that goes into a sampling program is always dependent on the chemicals of concern and their reporting levels as documented in the project's DQOs. As the reporting level of the chemical species of analytical interest decreases, the precautions necessary for sampling generally increase. Therefore, the sampling objective must clearly be defined ahead of time in the DQOs. The specific precautions to be taken in preparing to sample for trace organics are different from those to be taken in sampling for trace metals. A draft U.S. EPA guidance document **(5)** concerning monitoring well sampling, including considerations for trace organics, is available to provide additional guidance.

4.7 Care must be taken not to contaminate samples or monitoring wells. All samples, sampling devices, and containers must be protected from possible sources of contamination when not in use. Water level measurements should be made according to Test Method D 4750 before placing, purging, or sampling equipment in the well. Redox potential, turbidity, pH, specific conductance, DO (dissolved oxygen), and temperature measurements should all be performed on the sample in the field, if possible, since these parameters change too rapidly to be conducted by a fixed laboratory under most circumstances. Field meter(s) or sondes equipped with flow-through cells are available that are capable of continuously monitoring these parameters during purging if they are being used as water quality indicator parameters. These devices prevent the mixing of oxygen with the sample and provide a means of determining when the parameters have stabilized. Certain measurements that are used as indicators of biological activity, such as ferrous iron, nitrite, and sulfite, may also be conducted in the field since they rapidly oxidize. All temperature measurements must be done prior to any significant atmospheric exposure.

5. Significance and Use

5.1 The quality of ground water has become an issue of national concern. Ground-water monitoring wells are one of the more important tools for evaluating the quality of ground water, delineating contamination plumes, and establishing the integrity of hazardous material management facilities.

5.2 The goal in sampling ground-water monitoring wells is to obtain samples that meet the DQOs. This guide discusses the advantages and disadvantages of various well sampling methods, equipment, and sample preservation techniques. It reviews the variables that need to be considered in developing a valid sampling plan.

6. Well Purging

6.1 Water that stands within a monitoring well for a long period of time may become unrepresentative of formation water because chemical or biochemical change may alter water quality or because the formation water quality may change over time (see Guide D 6452). Even if it is unchanged from the time it entered the well, the stagnant water may not be representative of formation water at the time of sampling. There are two approaches to purging that reflect two differing viewpoints: to purge a large volume of ground water and to purge a minimum of, or no ground water before collecting a sample. The approach most often applied is to purge a sufficient volume of standing water from the casing, along with sufficient formation water to ensure that the water being withdrawn at the time of sampling is representative of the formation water. Typically, three to five well volumes are used. An alternative method that is gaining acceptance is to minimize purging and to conduct purging at a low flow rate or to eliminate purging entirely.

6.2 In any purging approach, a withdrawal rate that minimizes drawdown while satisfying time constraints should be

[3] The boldface numbers in parentheses refer to a list of references at the end of this guide.

used. Excessive drawdown distorts the natural flow patterns around the well. Two potential negative effects are the introduction of ground water that is not representative of water quality immediately around the monitoring well and artificially high velocities entering the well resulting in elevated turbidity and analytical data that reflects the absorption of contaminants to physical particles rather than soluble concentrations in ground water. It may also result in cascading water from the top of the screen that can result in changes in dissolved gasses, redox state, and ultimately affect the concentration of the analytes of interest through the oxidation of dissolved metals and possible loss of volatile organic compounds (VOCs). There may also be a lingering effect on the dissolved gas levels and redox state from air being introduced and trapped in the sandpack. In no instance shall a well be purged dry. If available, the field notes or purge logs generated during previous sampling or development of the well as well as construction logs should be reviewed to assist in the selection of the most appropriate sampling method.

6.3 The most often applied purging method has an objective to remove a predetermined volume of stagnant water from the casing prior to sampling. The volume of stagnant water can either be defined as the volume of water contained within the casing and screen, or to include the well screen and any gravel pack if natural flow through these is deemed insufficient to keep them flushed out. Research with a tracer in a full scale model 2-in. polyvinyl chloride (PVC) well (**6**) indicates that pumping 5 to 10 times the volume of the well via an inlet near the free water surface is sufficient to remove all the stagnant water in the casing. This approach (with three to five casing volumes purged) was suggested by the U.S. EPA (**7**).

6.4 In deep or large diameter wells having a volume of water so large as to make removal of all the water impractical, it may be feasible to lower a pump or pump inlet to some point well below the water surface, purge only the volume below that point then withdraw the sample from a deeper level. Research indicates this approach should avoid most contamination associated with stagnant water (**6, 8**). Sealing the casing above the purge point with a packer may make this approach more dependable by preventing migration of stagnant water from above. But the packer must be above the top of the screened zone, or stagnant water from above the packer may flow into the purged zone through the well's gravel/sand pack.

6.5 An alternate method is based on research by Barcelona, Wehrmann, and Varlien (**1**) and Puls and Powell (**2**). Their research suggests that purging at rates less than 1 L/min (approximately 0.25 gal/min) provides more reproducible VOCs and metals analytical results than purging at high rates. This method is based on the premise that at very low pumping rates, there is little mixing of the water column and laminar ground-water flow through the screen provides a more consistent sample. This sampling method also produces less turbid samples that may eliminate the need for filtration when collecting metals. This method is commonly referred to as low-flow sampling.

6.6 The low-flow sampling approach is most applicable to wells capable of sustaining a yield approximately equal to the pumping rate. A monitoring well with a very low yield may not be applicable to this technique since it may be difficult to reduce the pumping rate sufficiently to prevent mixing of the water column in the well casing in such a well. The water level in the well being sampled should be continuously monitored using an electronic water-level indicator during low-flow sampling. Such a water-level indicator could be set below the water surface after sufficient water has been withdrawn to fill the pump, tubing, and flow cell. The water-level indicator would then produce a continuous signal indicating submersion. When the well is purged, if the water level falls below the water-level indicator probe, the signal indicates that the water level has fallen below the maximum allowable drawdown and the pumping rate should be decreased. Pumping is started at approximately 100 mL/min discharge rate and gradually adjusted to match the well's recharge rate. The selection of the type of pump is dependent on site-specific conditions and DQOs. The bladder pump design is most commonly used in this sampling method, however, the depth limitation of this pump may necessitate the use of a gas-driven piston pump in some instances.

6.7 A variation on the above purging approaches is to monitor one or more indicator parameters until stabilization of the selected parameter(s) has been achieved. Stabilization is considered achieved when measurements are within a predefined range. This range has been suggested to be approximately 10 % over two successive measurements made 3 min apart by the U.S. EPA (**4**). More recent documents (**9**) have suggested ranges ±0.2°C for temperature, ±0.1 standard units for pH, ±3 % for specific conductance, ±10 % for DO, and ±10 mV for redox potential. A disadvantage of the stabilization approach is that there is no assurance in all situations that the stabilized parameters represent formation water. These criteria should therefore be set on a site by site basis since if set too stringent, large volumes of contaminated purge water may be generated without ensuring that the samples are any more representative. In a low yielding formation, this could result in the well being emptied before the parameters stabilize. Also, if significant drawdown has occurred, water from some distance away may be pulled into the screen causing a steady parameter reading but not a representative reading. If these criteria are properly selected, the volume of investigative derived waste water may be reduced.

6.8 The indicator parameters that may be monitored include pH, temperature, specific conductance, turbidity, redox potential, and DO. A combination of a pump and field meter(s) or sondes equipped with a flow-through cell is ideal for this purpose since it allows the monitoring of one or more of these parameters on a continuous basis without exposure to the atmosphere. A typical flow-through cell application is shown in Fig. 1. The pump used in this technique may be any pump capable of producing a steady flow such as a peristaltic or bladder pump. If a submersible pump is used, the hydraulic pressure developed in the flow-through cell may be sufficient to force the probes out of their position. This problem may be eliminated by installing a tee connector in the discharge line to allow only a portion of the flow to enter the flow-through cell. Another concern with the low-flow sampling method is sorption onto the tubing. Studies have indicated that at flow rates of

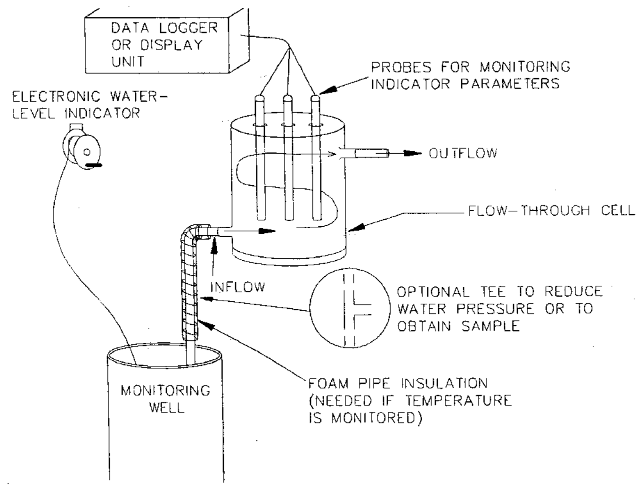


FIG. 1 Flow-Through Cell

0.1 L/min (0.026 gal/min), low-density polyethylene (LDPE) and plasticized polypropylene tubings are prone to sorption and TFE-fluorocarbon should be used. This is especially a concern if tubing lengths of 15 m (50 ft) or longer are used (**10**).

6.9 Gibb and Schuller (**11**) have described a time-drawdown approach using knowledge of the well hydraulics to predict the percentage of stagnant water entering a pump inlet near the top of the screen at any time after flushing begins. Samples are collected when the percentage is acceptably low. As before, the advantage is that well volume has no direct effect on the duration of pumping. A current knowledge of the well's hydraulic characteristics is necessary to employ this approach. Downward migration of stagnant water due to effects other than drawdown (for example, density differences) is not accounted for in this approach.

6.10 An alternative to purging a well before sampling is to collect a water sample within the screened zone without purging. These techniques are based on studies that under certain conditions, natural ground-water flow is laminar and horizontal with little or no mixing within the well screen (**12, 13**). To properly use these sampling techniques, a water sample must be collected within the screened interval with little or no mixing of the water column within the casing. Examples of these techniques include minimal purge sampling which uses a dedicated sampling pump capable of pumping rates of less than 0.1 L/min, discrete depth sampling using a bailer that allows ground water entry at a controlled depth, (for example, differential pressure bailer (**14**)), or diffusion sampling. These sampling techniques are discussed in 8.1.10.

7. Materials and Manufacture

7.1 The choice of materials used in the construction of sampling devices should be based upon knowledge of what compounds may be present in the sampling environment and how the sample materials may interact via leaching, adsorption, or catalysis. A second concern is that corrosion or degradation may compromise the structural integrity of the sampling device. In some situations, PVC or other plastic may be sufficient. In others, an all TFE-fluorocarbon apparatus may be necessary. The potential presence of nonaqueous phase liquid (NAPL) should also be a consideration since its presence would expose the sampling equipment to high concentrations of potential solvents. No one material is ideal in that each material will, to some degree absorb or leach chemicals or may degrade on exposure to a chemical.

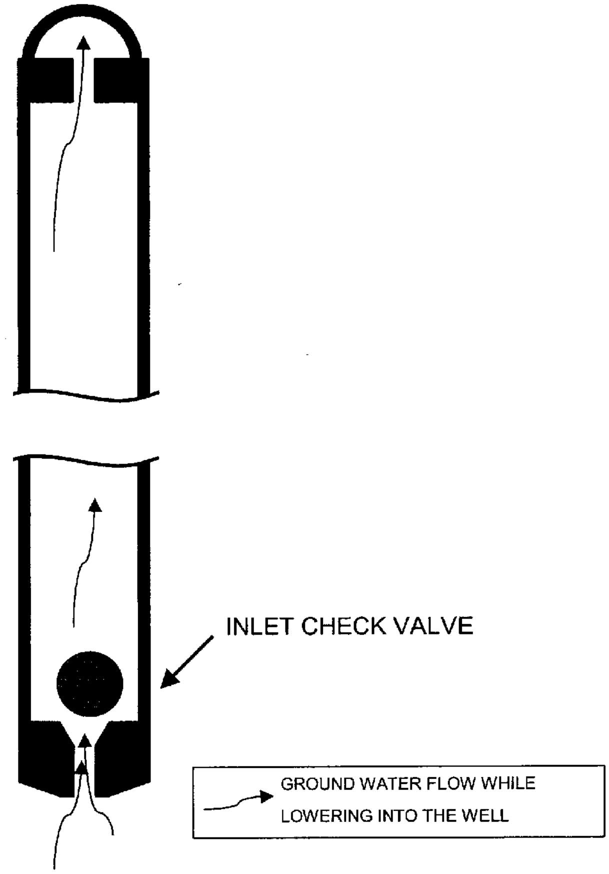


FIG. 2 Single Check Valve Bailer

7.2 The advantages and disadvantages of these materials for sampling equipment are summarized in Table 1.

7.3 *PVC*:

7.3.1 If adhesives are avoided, PVC is acceptable in many cases although their use may still lead to some problems if trace organics are of concern or NAPL is present (**15**). At present, interactions occurring between PVC and ground water are not well understood. Tin, in the form of an organotin stabilizer added to PVC, may enter samples taken from PVC (**16**).

7.3.2 The structural integrity concerns with PVC increase with the concentration of PVC solvents in ground water. As such, NAPLs that are PVC solvents are a primary concern. Potential NAPLs that are of a concern for PVC and other commonly used plastics are listed in Table 2. Degradation of these materials is primarily by solvation, which is the penetration of the material by the solvent that ultimately causes softening and swelling that can lead to failure. Even in lower concentrations, however, PVC solvents may deteriorate PVC. Methylene chloride, which is a very effective PVC solvent, will

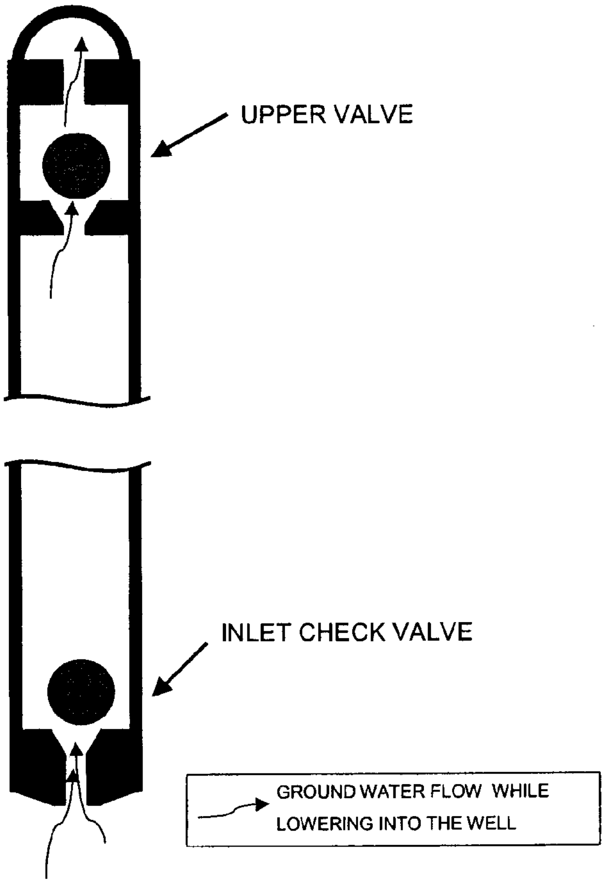


FIG. 3 Double Check Valve Bailer

soften PVC at one tenth its solubility limit while trichloroethylene, which is a less effective solvent, will begin to soften PVC at six tenths its solubility limit (**17**).

7.4 *TFE-Fluorocarbon Resins*:

7.4.1 TFE-fluorocarbon resins are highly inert and have sufficient mechanical strength to permit fabrication of sampling devices. Molded parts are exposed to high temperature during fabrication that destroys any organic contaminants. The evolution of fluorinated compounds can occur during fabrication, will cease rapidly, and does not occur afterwards unless the resin is heated to its melting point. Relative to PVC and stainless steel, TFE-fluorocarbon is less sorptive of cations (**18**).

7.4.2 Extruded TFE-fluorocarbon tubing may contain surface traces of an organic solvent extrusion aid. This can be removed easily by the fabricator and, once removed by flushing, should not affect the sample. TFE-fluorocarbon fluorinated ethylene propylene (FEP) and TFE-fluorocarbon perfluoroalkoxy (PFA) resins do not require this extrusion aid and may be suitable for sample tubing as well. Unsintered thread-sealant tape of TFE-fluorocarbon is available in an "oxygen service" grade and contains no extrusion aid and lubricant.

7.5 *Glass and Stainless Steel*:

7.5.1 Glass and stainless steel are two other materials generally considered inert in aqueous environments. Glass is generally not used, however, because of difficulties in handling and fabrication. Stainless steel is strong and easily machined to fabricate equipment. It is, however, not totally immune to corrosion that could release metallic contaminants (see Table 1). Stainless steel contains various alloying metals, some of these (that is, Nickel) may catalyze reactions. The alloyed constituents of some stainless steels can be solubilized by the pitting action of nonoxidizing anions such as chloride, fluoride, and in some instances sulfate, over a range of pH conditions. Aluminum, titanium, polyethylene, and other corrosion resistant materials have been proposed by some as acceptable materials, depending on ground-water quality and the constituents of interest.

7.5.2 Where temporarily installed sampling equipment is used, the sampling device that is chosen should be able to be cleaned of trace organics, and must be cleaned between each monitoring well use to avoid cross-contamination of wells and samples. Decontamination of equipment PVC and stainless steel constructed sampling equipment exposed to organic chemicals, pesticides or nitroaromatic compounds generally can be successfully accomplished using a hot detergent solution followed by a hot water rinse. Equipment constructed of LDPE and TFE-fluorocarbon should also be hot air dried or oven dried at approximately 105°C to remove residual pesticides and organic contaminants, respectively (**19, 20**). A common method to verify that the device is "clean" and acceptable is to analyze a sample (equipment blank) that has been soaked in or passed through the sampling device, or both, to check for the background levels that may result from the sampling materials or from field conditions. Thus, all samplings for trace materials should be accompanied by samples that represent the sampling equipment blank, in addition to other blanks (field blank and trip blank). Decontamination procedures are further discussed in Practice D 5088.

7.6 Additional samples are often collected in the field and spiked (spiked-field samples) in order to verify that the sample handling procedures are valid. The American Chemical Society's committee on environmental improvement has published guidelines for data acquisition and data evaluation, which should be useful in such environmental evaluations (**21**).

8. Sampling Equipment

8.1 The choice of sampling technique must be based on an understanding of the hydrogeology of the site under investigation and the end use of the data. Since each technique has its advantages and disadvantages, no one technique can be chosen as the best overall technique. Since different techniques will likely yield different results, it is best to be consistent throughout an investigation to facilitate the comparison of data values over time. There is a fairly large choice of equipment presently available for ground-water sampling. The sampling devices can be categorized into the following nine basic types as described in the following sections:

8.1.1 *Down-Hole Collection Devices*:

8.1.1.1 Bailers, messenger bailers, or thief (**22, 23**) are examples of down-hole collection devices. They are not practical for removal of large volumes of water but are relatively inexpensive permitting their dedicated use and are widely used. These devices can be constructed in various shapes and sizes from a variety of materials. They do not subject the sample to pressure extremes.

TABLE 1 Material Considerations In Selection Of Sampling Equipment (76)

Material	Considerations
Polytetrafluoroethylene	• Virgin PTFE readily sorbs some organic solutes **(17)** • Ideal material in corrosive environments where inorganic compounds are of interest • Useful where pure product (organic compound) or high concentrations of PVC solvents exist • Potential structural problems because of its low tensile and compressive strengths, low wear resistance, and the extreme flexibility of the casing string as compared to other engineering plastics **(40, 70, 71)** • Potential problems with obtaining a seal between the casing and the annular sealant because of PTFEs low coefficient of friction and antistick properties as compared to other plastics **(71)** • Maximum string length of 2-in. (~5-cm) diameter schedule PTFE casing should not exceed about 375 ft (~115 m) **(72)** • Expensive
Polyvinylchloride	• Leaching of compounds of tin or antimony, which are contained in original heat stabilizers during polymer formulation, could occur after long exposure • When used in conjunction with glued joints, leaching of volatile organic compounds from PVC primer and glues, such as THF (tetrahydrofuran), MEK (methylethylketone), MIBK (methylisobutylketone) and cyclohexanone could leach into ground water. Therefore, threaded joints below the water table, sealed with O-rings or Teflon tape, are preferred • Cannot be used where pure product or high concentrations of a PVC solvent exist • There is conflicting data regarding the resistance of PVC to deterioration in the presence of gasoline **(73)** • Maximum string length of 2-in. (~5-cm) diameter threaded PVC casing should not exceed 2000 ft (~610 m) **(72)** • PVC can warp and melt if neat cement (cement and water) is used as an annular or surface seal because of heat of hydration **(74, 40)** • PVC can volatilize CFCs into the atmosphere within the unsaturated zone, which can be a potential problem for studies of gas and moisture transport through the unsaturated zone • Easy to cut, assemble, and place in the borehole • Inexpensive
Stainless steel	• Generally has high corrosion resistance, which differs with type • Corrosion can occur under acidic and oxidizing conditions • Corrosion products are mostly iron compounds, with some trace elements • Primarily two common types: (*1*) Type 304 Stainless Steel: Iron alloyed with the following elements (percentages): Chromium (18-20 %), Nickel (8-11 %), Manganese (2 %), Silicon (0.75 %), Carbon (0.08 %), Phosphorus (0.04 %), Sulfur (0.03 %) (*2*) SS 316: Iron alloyed with the following elements (in percentages): Chromium (16-18 %), Nickel (11-14 %), Manganese (2 %), Molybdenum (2-3 %), Silicon (0.75 %), Carbon (0.08 %), Phosphorus (0.04 %), Sulfur (0.03 %) • Corrosion resistance is good for Type 304 stainless steel under aerobic conditions. Type 316 stainless steel has improved corrosion resistance over Type 304 under reducing conditions **(75)** • Expensive
Galvanized steel	• Less corrosion resistance than stainless steel and more resistance to corrosion than carbon steel (see Carbon steel entry) • Oxide coating could dissolve under chemically reduced conditions and release zinc and cadmium, and raise pH • Weathered or corroded surfaces present active adsorption sites for organic and inorganic constituents • Inexpensive
Carbon steel	• Corrosion products can occur (for example, iron and manganese oxides, metal sulfides, and dissolved metal species) • Sorption of organic compounds onto metal corrosion products is possible • Weathered surfaces present active adsorption sites for organic and inorganic constituents • Inexpensive

8.1.1.2 A schematic of a single check valve unit is illustrated in Fig. 2. The bailer may be threaded in the middle so that additional lengths of blank casing may be added to increase the sampling volume. TFE-fluorocarbon, stainless steel, and PVC are the most common materials used for construction **(24)**.

8.1.1.3 In operation, the single check valve bailer is gently lowered into the well to a depth just below the water surface, water enters the chamber through the bottom, and the weight of the water column closes the check valve upon bailer retrieval. The specific gravity of the ball should be about 1.4 to 2.0 so that the ball almost sits on the check valve seat during chamber filling. Upon bailer withdrawal, the ball will immediately seat without sample loss through the check valve.

8.1.1.4 A double check valve bailer allows point source sampling at a specific depth **(25, 26)**. The double check valve bailer is also effective at collecting dense, non-aqueous phase liquid (DNAPL) from the bottom of a monitoring well. An example is shown in Fig. 3. In this double check valve design, water flows through the sample chamber as the unit is lowered. A venturi tapered inlet and outlet ensures that water passes through the unit with limited restriction. When a depth where the sample is to be collected is reached, the unit is retrieved. Because the difference between each ball and check valve seat is maintained by a pin that blocks vertical movement of the check ball, both check valves close simultaneously upon retrieval. A drainage pin is placed into the bottom of the bailer to drain the sample directly into a collection vessel to reduce the possibility of air oxidation.

8.1.1.5 A top-filling bailer is a closed bottom tubular device, opened on top and provided with a loop or other fixture to attach to the drop line. The top-filling bailer is gently lowered below the water surface in the well and water pours into the bailer from the top. Although this variation on the bailer design

TABLE 2 Chemical Compatibility Table For Selected NAPL (78)

Chemical	PTFE (Teflon)	PP (Polypropylene)	PVC (Type I)	PVC (Type II)	304 Stainless	316 Stainless	Carbon Steel
Benzene	R	X	U	U	G	G	G
Carbon Tetrachloride	R	U	X	U	E	E	G
Dichlorobenzene	R	R	U	U	. . .	G	. . .
Dichloroethane (DCA)	R	X	U	U	G	G	G
Dichloroethylene (DCE)	R	R	U	U	G	G	. . .
Diesel Fuel	R	R	R	. . .	E	E	G
Ethyl Benzene	R	U	U	U	S	G	U
Gasoline	R	X	R	. . .	G	G	G
Hydraulic Oil (petro.)	R	X	R	. . .	R	R	. . .
Hydraulic Oil (synthetic)	R	X	R	. . .	R	R	. . .
Jet Fuels	R	X	R	R	G	G	G
Kerosene	R	R	R	R	G	G	G
Motor Oil	R	X	R	R	G	G	G
Napthalene	R	R	U	U	E	E	G
Tetrachloroethylene (PCE)	R	U	U	U	E	E	G
Toluene	R	R	U	U	E	E	E
Trichloroethylene (TEC)	R	R	U	U	G	G	G
Xylenes	R	R	U	U	G	G	G

For Metals
E < 2 mills Penetration/Year
G < 20 mills Penetration/Year
S < 50 mills Penetration/Year
U > 50 mills Penetration/Year
(1 mill = 0.001 in.)
R = Resistant (No corrosion rate reported)

For All Non-Metals
R = Resistant
U = Unsatisfactory
X = Conflicting Data, at least one reference reported unsatisfactory

results in greater agitation of the sample, it may be used to collect a sample of light, non-aqueous phase liquid (LNAPL) by lowering it just below the surface of the LNAPL and allowing the bailer to skim the LNAPL from the surface of the water column.

8.1.1.6 The differential pressure bailer is a sealed canister body with two small diameter tubes of different heights built into its removable top **(14)**. The bailer is usually constructed of stainless steel to provide sufficient weight to allow it to sink relatively quickly to the desired sampling depth. Once the bailer's downward progress is stopped, differences in hydrostatic pressure between the two tubes allows the bailer to fill through the lower tube as air is displaced through the upper tube. This type of bailer minimizes the exposure of the sample to air especially if fitted with internal 40 mL vials for direct sample bottle filling.

8.1.1.7 Special care must be taken to minimize exposing the sample to the atmosphere during the transfer of the sample from the bailer to the sample bottle. There are several approaches to overcome this issue. Bottom-emptying bailers used for sampling of VOCs, for example, should have an insertable sample cock or draft valve cock (often referred to as a bottom or bailer emptying device) in or near the bottom of the sampler allowing withdrawal of a sample from the bailer with minimal atmosphere exposure.

8.1.1.8 Suspension lines for bailers and other samplers should be kept off the ground and free of other contaminating materials that could be carried into the well. A plastic sheet may be spread out on the ground around the monitoring well for this purpose. Disposable TFE-fluorocarbon, PVC, polyethylene, and polypropylene bailers are available which offer time savings and all but eliminates the potential for cross contamination during sampling.

8.1.1.9 Sample oxidation is a concern with single check valve and top filling bailers. Sample oxidation might occur during the extended time it takes to bail a sample if water levels are a great depth below the ground surface or if there is a delay in the transfer of the sample from the bailer to the sample bottles. Using point source bailers, however, minimizes the oxidation problem.

8.1.1.10 Another approach for obtaining point source samples employs a weighted messenger or pneumatic change to "trip" plugs at either end of an open tube (for example, tube water sampler or thief sampler) to close the chamber **(27)**. Foerst, Kemmerer, and Bacon samplers are of this variety **(23, 24, 26)**. A number of thief or messenger devices are available in various materials and shapes. Differential pressure bailers **(14)** also provide a point source sample but do not require manual tripping.

8.1.2 *Bladder Pumps*:

8.1.2.1 Bladder pumps consist of a flexible membrane enclosed by a rigid housing. Water enters the pump cavity through an inlet, usually located on the bottom of the pump. Compressed gas either from a compressor or air cylinder is injected into a bladder within the pump cavity forcing the check valve on the inlet to close and the sample up through a second check valve at the top of the pump and into a discharge line (Fig. 4). Water is prevented from re-entering the bladder by the top check valve. The bladder is then depressurized, allowing the pump to refill. The process is repeated to cycle the water to the surface. Samples taken from depths of 122 m (400 ft) have been reported.

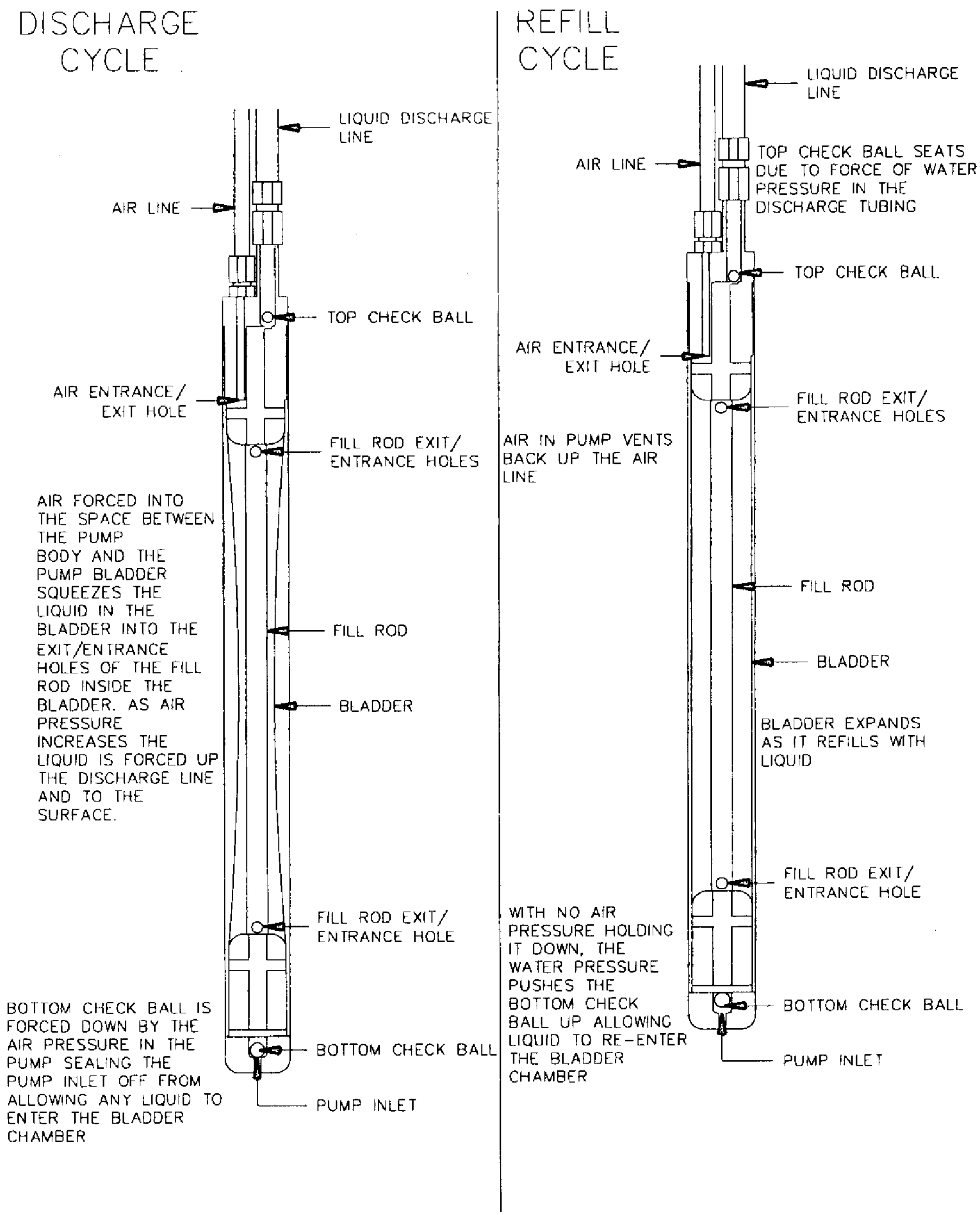


FIG. 4 Squeeze Type Bladder Pump

8.1.2.2 A variety of design modifications and materials are available (**29**, **30**) however, TFE-fluorocarbon bladders, either PVC, TFE-fluorocarbon resin or stainless steel bodies and fittings are most common. An automated controller system is used to control the time between pressurization cycles and regulate pressure.

8.1.2.3 Bladder pumps have a distinct advantage over gas displacement pumps in that there is no contact with the driving gas. Disadvantages include the large gas volumes required, and difficulty in decontaminating the pump. This pump design is most applicable to dedicated well installations and where low pump rate or flow rate (less than 0.5 L/min) are required. The flow rate from a bladder pump is dependent on the dimensions of the bladder pump, controller settings, gas pressure, and total dynamic head.

8.1.3 *Suction Lift Pumps*:

8.1.3.1 Three types of suction lift pumps are the direct line, centrifugal, and peristaltic. A major disadvantage of any suction pump is that it is limited in its ability to raise water by the head available from atmospheric pressure. The theoretical suction limit is about 10.4 m (34 ft), but most suction pumps are capable of maintaining a water lift of only 7.6 m (25 ft) (**31**).

8.1.3.2 Many suction pumps draw water through a volute in which impellers, pistons, or other devices operate to induce a vacuum. Such pumps are probably unacceptable for most sampling purposes because they are usually constructed of non-inert materials such as brass or mild steel and may expose samples to lubricants. They often induce very low pressures around rotating vanes or other such parts such that degassing or potentially cavitation may occur. They can mix air with the sample via small leaks in the casing, and they are difficult to adequately clean between uses. Such pumps may be acceptable for purging of wells, but should not generally be used for sampling.

8.1.3.3 An exception to the above statements is a peristaltic pump (also known as a rotary peristaltic pump). A peristaltic pump is a self-priming, low-volume suction pump that consists of a rotor with rollers (**32**). Flexible tubing is inserted around the pump rotor and squeezed by rollers as they rotate. One end of the tubing is placed into the well (a weighted end may be used) while the other is connected directly to a receiving vessel. As the rotor moves, reduced pressure is created in the well tubing and an increased pressure on the tube leaving the rotor head. Pumping rates may be controlled by varying the speed of the rotor or by changing the size of the pump head, which contains the pump rotor.

8.1.3.4 The peristaltic pump moves the liquid totally within the sample tube. No part of the pump contacts the liquid. The sample may be degassed (cavitation is unlikely), but the problems due to contact with the pump mechanism are eliminated. Peristaltic pumps do require a fairly flexible section of tubing within the pump head itself. A section of silicone tubing is commonly used within the peristaltic pump head, but other types of tubing can be used particularly for the sections extending into the well or from the pump to the receiving container. The National Council of the Paper Industry for Air and Stream Improvement (**33**) recommends using medical grade silicone tubing for VOC sampling purposes as the standard grade uses an organic vulcanizing agent which has been shown to leach into samples. Various manufacturers offer tubing lined with TFE-fluorocarbon or Viton[4] for use with their pumps. Plasticized polypropylene tubings and LDPE should be avoided if flow rates less than 0.1 L/min (0.025 g/min) are used (**10**). The extraction rate with this method can range from 0.04 to 30 L/min (0.01 to 8 gal/min) (**34**).

8.1.3.5 There is disagreement on the applicability of peristaltic pumps for the collection of groundwater samples. Research by Tai, et al (**35**) has shown that peristaltic pumps provide adequate recovery of VOCs. The U.S. EPA (**4**) does not recommend its use because of studies that suggest that VOCs may be lost during sampling (**36**).

8.1.3.6 A direct method of collecting a sample by suction consists of lowering one end of a length of plastic tubing into the well or piezometer. The opposite end of the tubing is connected to a two-way stopper bottle and a hand held or mechanical vacuum pump is attached to a second tubing leaving the bottle. A check valve is attached between the two lines to maintain a constant vacuum control. A sample can then be drawn directly into the collection vessel without contacting the pump mechanism (**37**, **38**).

8.1.3.7 A centrifugal pump can be attached to a length of plastic tubing that is lowered into the well. A foot valve is usually attached to the end of the well tubing to assist in priming the tube. The maximum lift is about 4.6 m (15 ft) for such an arrangement (**37**, **38**, **39**).

8.1.3.8 Suction pump approaches offer a simple sample retrieval method for shallow monitoring wells. The direct line method is portable though considerable oxidation and mixing may occur during collection. A centrifugal pump will agitate the sample to an even greater degree although pumping rates of 19 to 151 L/min (5 to 40 gal/min) can be attained. A peristaltic pump provides a lower sampling rate with less agitation than the other two pumps, as discussed in 8.1.3.4.

8.1.3.9 All three systems can be specially designed so that the water sample contacts only the TFE-fluorocarbon or silicone tubing prior to sample bottle entry. Dedicated tubing is recommended for each well or piezometer sampled. Each of these methods that relay on suction can change solution chemistry by causing degassing which may result in loss of volatile compounds and dissolved gasses and this should be a consideration in their application (**34**).

8.1.4 *Electric Submersible Pumps*:

8.1.4.1 A submersible pump consists of a sealed electric motor that powers a piston, impeller, or helical single thread worm. Water is brought to the surface through a discharge tube. Similar pumps are commonly used in the water well industry and many designs exist (**40**).

8.1.4.2 Submersible pumps provide relatively high discharge rates for water withdrawal at depths beyond suction lift capabilities. A battery operated unit 3.6 cm (1.4 in.) in diameter and with a 4.5 L/min (1.2 gal/min) flow rate at 33.5 m (110 ft) has been developed (**41**). Another submersible pump has an

[4] Viton is a trademark of E. I. du Pont de Nemours & Co., Wilmington, DE 19898 and has been found suitable for this purpose.

outer diameter of 11.4 cm (4.5 in.) and can pump water from 91 m (300 ft). Pumping rates vary up to 53.0 L/min (14 gal/min) depending upon the depth of the total dynamic head **(42)**.

8.1.4.3 A submersible pump provides higher extraction rates than many other methods. Considerable sample agitation results, however, in the well and in the discharge tube during sampling. The possibility of introducing trace metals into the sample from pump materials also exists; however, submersible pumps designed specifically for environmental work do exist. These pumps are constructed of relatively inert materials such as stainless steel, TFE-fluorocarbons and Viton. Decontamination procedures are discussed in Practice D 5088. Recent research, however, has suggested that steam cleaning followed by rinsing with unchlorinated, deionized water should be used between samplings when analysis for VOCs is required **(43)**. Complete decontamination of submersible pumps is difficult and should be confirmed by the collection of equipment blanks.

8.1.4.4 Submersible pumps have several disadvantages that should be considered. The silt and fine sand commonly present in monitoring wells may cause excessive wear to internal impellers and staters. These pumps also commonly require a high-amperage 120/220-V power source and a reel and winch system that limit their mobility. Submersible pumps may also not be suitable for collecting liquids containing VOCs or dissolved gasses because of their potential to degas the sample.

8.1.5 *Gas-Lift Pumps*:

8.1.5.1 Gas-lift pumps use compressed air to bring a water sample to the surface. Water is forced up an eductor pipe that may be the outer casing or a smaller diameter pipe inserted into the well annulus below the water **(44, 45)**.

8.1.5.2 A similar principle is used for a unit that consists of a small diameter plastic tube perforated in the lower end. This tube is placed within another tube of slightly larger diameter. Compressed air is injected into the inner tube; the air bubbles through the perforations, thereby lifting the water sample via the annulus between the outer and inner tubing **(45)**. In practice, the eductor line should be submerged to a depth equal to 60 % of the total submerged eductor length during pumping **(40)**. A 60 % ratio is considered optimal although a 30 % submergence ratio is adequate.

8.1.5.3 The source of compressed gas may be a hand pump for depths generally less than 7.6 m (25 ft). For greater depths, air compressors, and pressurized air cylinders have been used. When air compressors are used, an air-oil filter must be installed to minimize the introduction of oil to the well.

8.1.5.4 As already mentioned, gas-lift methods result in considerable sample agitation and mixing within the well, and cannot be used for samples which will be tested for VOCs or dissolved gasses (for example, DO, methane). The eductor pipe or weighted plastic tubing is a potential source of sample contamination. In addition, Gibb **(11)** expressed concerns in sampling for inorganics. These concerns were attributed to changes in redox, pH, and species transformation due to solubility constant changes resulting from stripping, oxidation, and pressure changes.

8.1.6 *Gas Displacement Pumps*:

8.1.6.1 Gas displacement or gas drive pumps are distinguished from gas-lift pumps by the method of sample transport. Gas displacement pumps force a discrete column of water to the surface via mechanical lift without extensive mixing of the pressurized gas and water as occurs with air-lift equipment. The principle is shown schematically in Fig. 5. Water fills the chamber. A positive pressure is applied to the gas line closing the sampler check valve and forcing water up the sample line. The cycle is repeated by removing the pressure. Vacuum can also be used in conjunction with the gas **(46)**. The device can be permanently installed in the well **(47, 48, 49)** or lowered into the well **(50, 51)**.

8.1.6.2 A more complicated two stage design constructed of glass with check valves made of TFE-fluorocarbon has been constructed **(52, 53)**. The unit was designed specifically for sample testing for trace level organics. Continuous flow rates of up to 38 L/min (10 gal/min) are possible.

8.1.6.3 Gas displacement pumps offer reasonable potential for preserving sample integrity because little driving gas comes in contact with the sample as the sample is conveyed to the surface by a positive pressure. There is, however, a potential loss of dissolved gasses and contamination from the driving gas and the housing materials.

8.1.7 *Gas Driven Piston Pumps*:

8.1.7.1 A double piston pump powered by compressed air is illustrated in Fig. 6. Pressurized gas enters the chamber between the pistons; the alternating chamber pressurization activates the piston that allows water entry during the suction stroke of the piston and forces the sample to the surface during

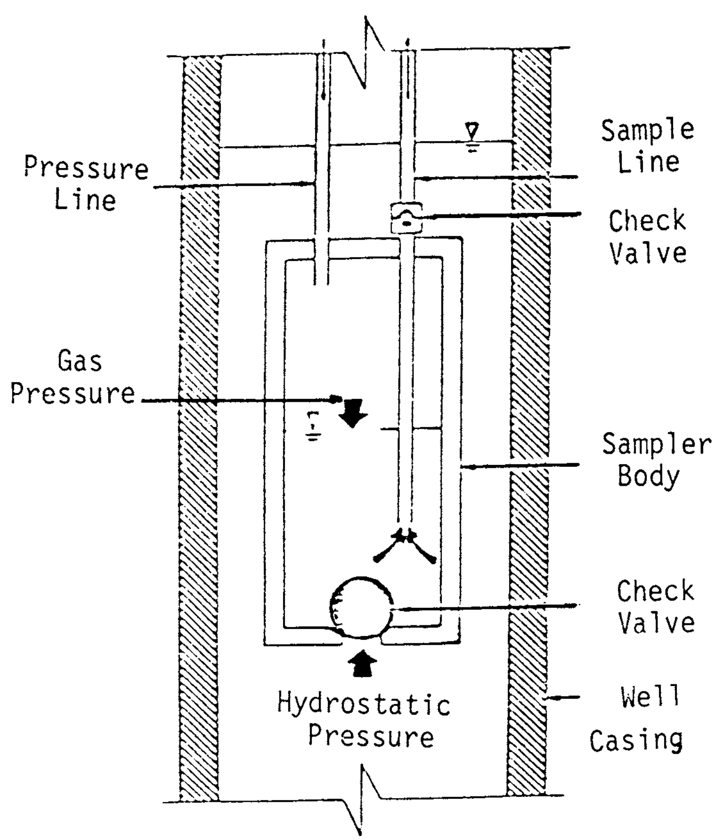


FIG. 5 The Principle of Gas Dispalcement Pumping

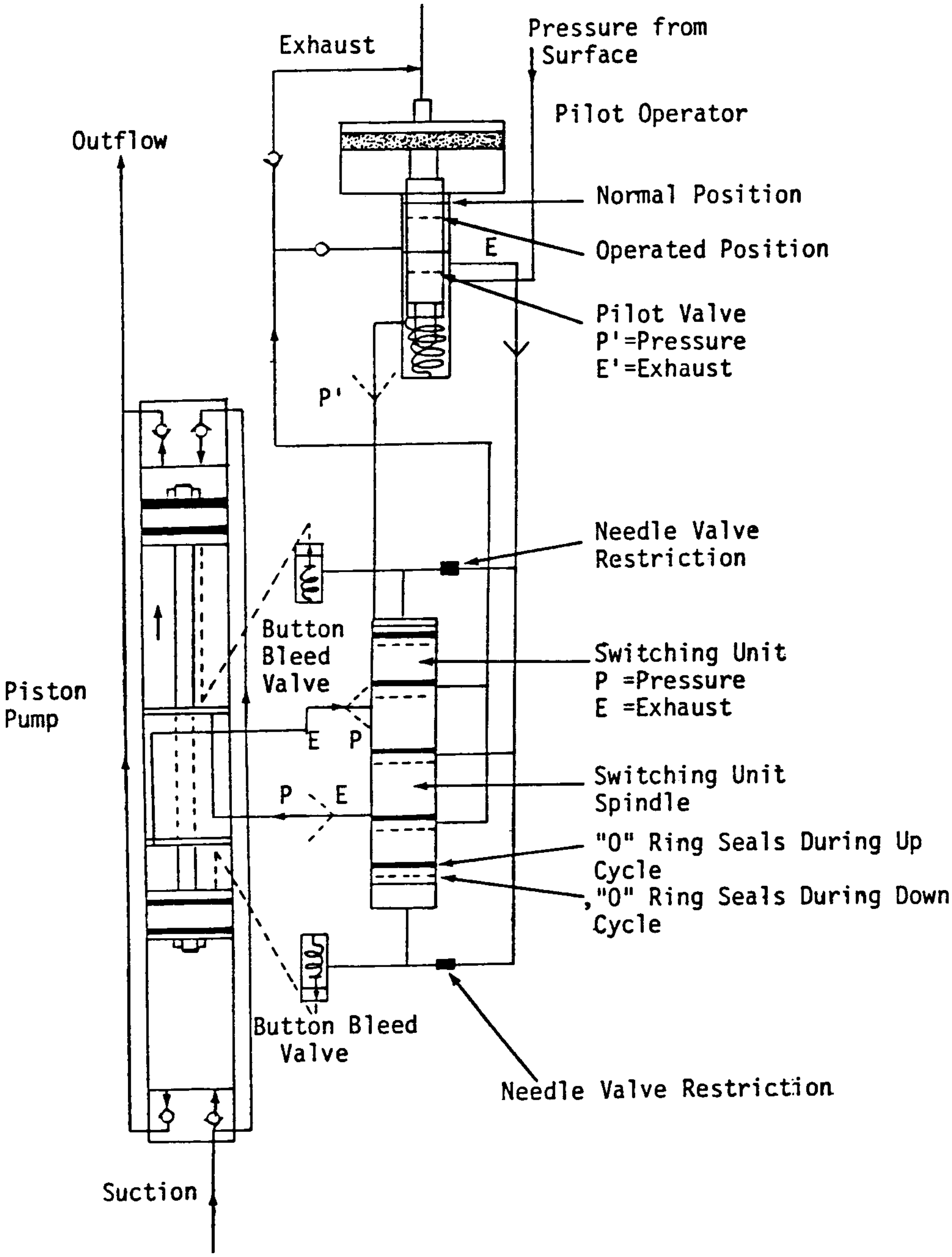


FIG. 6 Gas-Driven Piston Pump

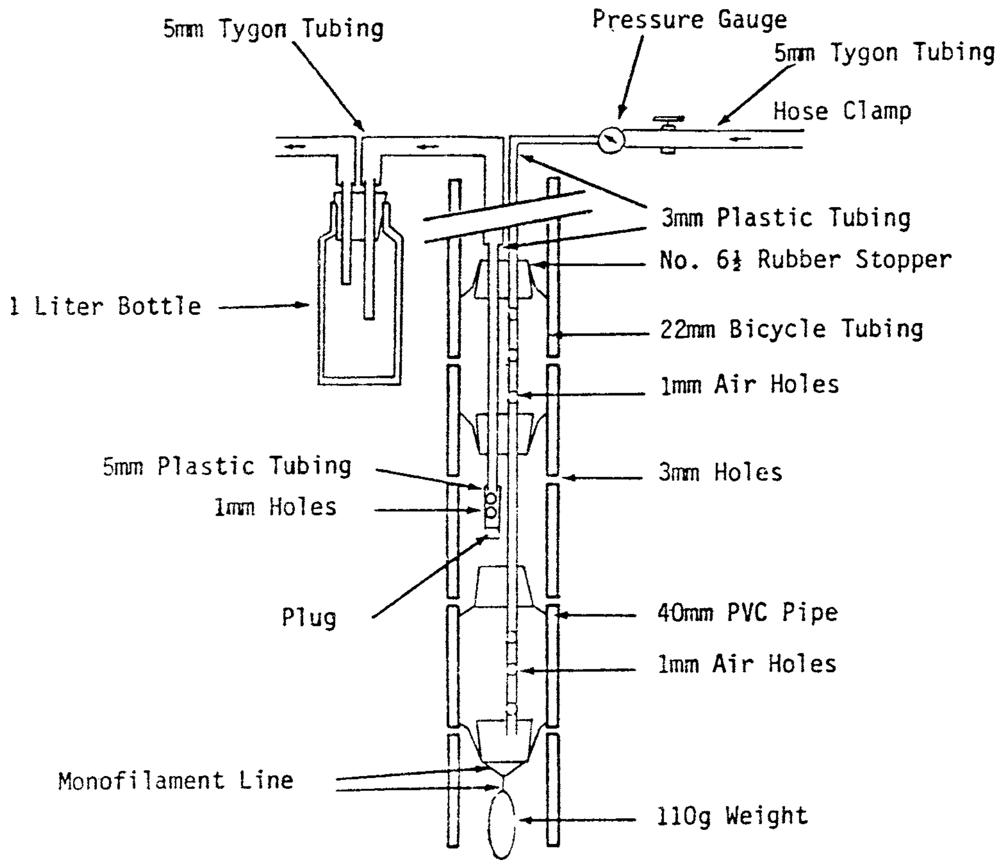
the pressure stroke **(54)**. Pumping rates between 0.16 and 0.51 L/min (0.04 and 0.13 gal/min) have been reported from 30.5 m (100 ft). Depths in excess of 457 m (1500 ft) are possible.

8.1.7.2 The gas piston pump provides continuous sample withdrawal at depths greater than is possible with most other approaches. Nevertheless, contribution of trace elements from the stainless steel and brass is a potential problem and the quantity of gas used is significant.

8.1.8 *Packer Pump Arrangement*:

8.1.8.1 A packer pump arrangement provides a means by which two expandable "packers" isolate a sampling unit between packers within a well. Since the hydraulic or pneumatic activated packers are pressed against the casing wall, the sampling unit will obtain water samples only from the isolated well portion. The packers are deflated for vertical movement within the well and inflated when the desired depth is attained. Submersible, gas lift, and suction pumps can be used for sampling. The packers are usually constructed of a rubber compound **(54-57)**. A packer pump unit consisting of a vacuum sampler positioned between packers is illustrated in Fig. 7 **(58)**.

8.1.8.2 A packer assembly allows the isolation of discrete sampling points within a well. A number of different samplers can be situated between the packers depending upon the analytical specifications for sample testing. Because access to



Taken from Ref **(79)**

FIG. 7 Packer Pump Arrangement

the interval between packers is blocked once the packers are inflated, the selection of sampling devices is limited to sampling pumps. Vertical movement of water outside the well casing during sampling is possible with packer pumps but depends upon the pumping rate and subsequent disturbance. Deterioration of the expandable materials will occur with time with the increased possibility of undesirable organic contaminants contributing to the water sample.

8.1.9 *Inertial-Lift Pumps*:

8.1.9.1 The inertial-lift pump consists of a foot valve at the end of a flexible tube. The tube and foot valve is inserted into the well with one end of the tube remaining at the surface. The tube is then rapidly moved in a continuous up-and-down motion. Each upward stroke lifts the water column in the tubing a distance equal to the stroke length. At the end of the upstroke, the water continues to move slightly upward by inertia. On the down stroke, the foot valve opens allowing fresh water to enter the tube. This process continues resulting in a flow to the surface.

8.1.9.2 The inertial-lift pump is capable of operating efficiently at depths to 30 m (100 ft). It is effective in small diameter wells or direct-push technology probes which are typically 12.5 mm (½-in.) diameter. The pumping rate ranges from 0 to 7.6 L/min (0 to 2 gal/min) **(34)**, depending on the rate of the up and down pumping stroke and the tube diameter. The equipment used in this pump is inexpensive enough to be dedicated to a well with the exception of the pump handle or motor drive that do not contact the sample.

8.1.9.3 The inertial-lift pump, however, has several disadvantages. It is difficult to operate in deep, large diameter wells. Although a motor drive can overcome this limitation, the incorporation of a motor drive limits the portability of the equipment. The foot valve must be selected to match the casing material since it will tend to ride against the casing and potentially will either damage the casing or wear out. The discharge tubing must be stiff for the pump to operate properly. This makes the tubing awkward to install and remove from a monitoring well.

8.1.10 *Minimal Purge, Discrete Depth, and Passive Sampling*—Sampling techniques that do not rely on, or require only minimal purging may be used if a particular zone within a screened interval is to be sampled or if a well is not capable of yielding sufficient ground water for purging. These techniques include minimal purge, discrete depth sampling, and passive sampling.

8.1.10.1 A dedicated pump is used for minimal purge sampling so that only enough water is purged through the pump so that the volume of water contained by the pump and discharge tube is removed before sampling. No attempt is made to purge the casing, screen, or formation. This volume should be minimized by the selection of small diameter tubing and the smallest possible pump chamber. This initial volume of discharged water is discarded since it had prolonged contact with the sampling device.

8.1.10.2 The discrete depth sampler is often non-dedicated. It is lowered very slowly to the depth of the screen where a water sample is drawn into the sampling chamber. This is accomplished either manually by using a triggering mechanism such as a cable or automatically such as with a differential pressure bailer **(14)**. Discrete depth samplers, however, must be used with great caution because of the potential of mixing of the water column in the well casing while lowering the sampler to its sampling depth.

8.1.10.3 Passive sampling, using diffusion samplers (a water-filled membrane), is based on the principle of molecular diffusion of VOCs from the ground water into the sampler. (Research is currently being conducted by the U. S. Geological Survey to evaluate diffusion samplers for the collection of non-VOC parameters, however, study results have not been published.) The samplers must remain in the borehole for an adequate time for the water initially within the sampler to equilibrate with that in the borehole. The diffusion sampler typically consists of water-filled, low-density polyethylene tubing, which acts as a semi-permeable membrane. The sampler is attached to a weighted line, and lowered to a predetermined depth within the screened interval. Since the sample is depth specific, multiple samplers may be strung together to provide samples from different depths within the well. After adequate residence time has elapsed, the sampler(s) are removed from the well, punctured and the sample transferred into sample bottles. The samples are preserved and submitted to the laboratory for analysis. In a study of this technique, a minimum of 11 days was required to achieve equilibration **(59, 60)**. Concerns about the applicability of this sampling method to specific VOCs have been raised, however, no detailed evaluation of this issue has been published. In a comparison of sampling techniques, samples collected by the diffusion method were found to be biased lower than samples collected using a low-flow method **(61)**, however, this difference was attributed to issues with the laboratory or to the depth-specific nature of diffusion samplers.

9. Sample Containers and Preservation

9.1 The order of sample container filling, method of filling, selection of sample container type, and preservation method should be provided in the sampling and analysis plan. Generally, the order of sample container filling should proceed from most volatile to least volatile compound.

9.2 Complete and unequivocal preservation of samples, whether domestic wastewater, industrial wastes, or natural waters, is practically impossible. At best, preservation techniques only retard the chemical and biological changes that inevitably continue after the sample is removed from the source. Therefore, insuring the timely analysis of a sample should be one of the foremost considerations in the sampling plan schedule. Methods of preservation are somewhat limited and are intended to retard biological action, retard chemical reactions and complexes, and reduce the volatilization of constituents. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and freezing. For water samples, immediate refrigeration just above freezing (4°C in wet ice) is often the best preservation technique available, but it is not the only measure nor is it applicable in all cases. There may be special cases where it might be prudent to include the temperature to which the samples were exposed. Inexpensive devices for this purpose, such as a recording thermometer, are available for this purpose. A water-filled bottle may be included in the sample-shipping container for temperature measurement by the laboratory receiving the samples.

9.3 All bottles and containers must be specially pre-cleaned, and organized in ice chests (isolating samples and sampling equipment from the environment) before one goes into the field. The time in the field is very valuable and should be spent on taking field notes, measurements, and in documenting samples, not on labeling and organizing samples. Therefore, the sampling plan should include clear instructions to the sampling personnel concerning the information required in the field data record logbook (notebook), the information needed on container labels for identification, the chain-of-custody protocols, and the methods for preparing field blanks and spiked samples. Examples of detailed plans and documentation procedures have been published **(23, 62,** see Guide D 6089**)**.

9.4 The exact requirements for the volumes of sample needed and the number of containers to use may vary from laboratory to laboratory. This will depend on the specific analyses to be performed, the concentration levels of interest, the individual laboratory protocols, and the required QC samples. Since a well may not be capable of yielding adequate sample volume, a minimum required sample volume should be provided to the sample crew. The manager of the sampling program should make no assumptions about the laboratory analyses. He should discuss the analytical requirements of the sampling program in detail with the laboratory coordinator beforehand. This is especially the case since some analyses and preservation measures must be performed at the laboratory as soon as possible after the samples arrive. Thus, appropriate arrangements must be made.

9.5 There are a number of excellent references available which list the containers and preservation techniques appropriate for water and soils **(22, 23, 29, 58, 63-65)**. Some of this information is summarized in Table X1.1 and Guide D 6517, however, different regulatory programs have specific requirements that must be met.

9.6 Sample containers for VOC samples require special cleaning and handling considerations **(66)**. The sample container for purgeable organics consist of a screw-cap vial (25 to 125 mL) fitted with a TFE-fluorocarbon faced silicone septum. The vial is sealed in the laboratory immediately after cleaning and is only opened in the field just prior to pouring a sample into it. The water sample then must be sealed into the vial headspace free (no air bubbles) and immediately cooled (4°C) for shipment. Multiple samples are taken because leakage of containers may cause losses, may allow air to enter the containers, and may cause erroneous analysis of some constituents. Also, some analyses are best conducted on independently preserved samples. The sampling program for VOCs should include at a minimum trip blanks. Trip blanks and field spikes should also be considered for low level analysis.

9.7 The laboratory must analyze the purgeable samples within 14 days after collection. For samples for solvent extractions (extractable organics-base neutrals, acids, pesticides, herbicides), the sample bottles are narrow mouth, screw cap quart bottles or half-gallon bottles that have been precleaned, rinsed with the extracting organic solvent and oven dried at 105°C for at least 1 h. These bottles must be sealed with TFE-fluorocarbon lined caps (Note 1). Samples for organic extraction must be extracted within 7 days and analyzed within 40 days after extraction.

NOTE 1—When collecting samples, the bottles should not be overfilled or prerinsed with sample before filling because oil and other materials may remain in the bottle. This can cause erroneously high results.

9.8 For a number of ground-water parameters, the most meaningful measurements are those made in the field at the time of sample collection or at least at an on-site laboratory. These include the water level in the well (see Test Method D 4750) and parameters that can change rapidly with storage. A discussion of the various techniques for measuring the water level in the well is contained in a NCASI publication **(67)** and detailed procedures are outlined in a U.S. Geological Survey publication **(68, 69)**. Although a discussion of water level measuring techniques is beyond the scope of this guide, it is important to point out that accurate measurements must be made either before a well is purged or after it has had sufficient time to recover. Parameters that can change rapidly with storage include pH, turbidity, redox potential, DO, and temperature. Specific conductance, although most accurately determined in a laboratory setting, often is measured in the field where it is used as an indicator parameter to determine the completeness of purging. For some of the other parameters, the emphasis in ground-water monitoring is on the concentration of each specific dissolved component, not the total concentration of each. Samples for these types of measurements should be filtered through 0.45 µm membrane filters ideally in the field or possibly at an on-site laboratory as soon as possible. Analyses often requiring filtered samples include metals, radioactivity parameters, dissolved organic carbon, dissolved orthophosphate, and total dissolved phosphorous **(22, 23)**. If metals are to be analyzed, filter the sample prior to acid preservation. If concerns related to the loss of mobile colloidal material by filtering is a consideration, sampling protocol should be modified to limit sample turbidity during collection so that filtering is not necessary. This is often done by using very low purge and sample flow rates. For total organic carbon (TOC), the filter material should be tested to assure that it does not contribute to the TOC. The type or size of the filter to be used is not well determined. However, if results of metal, TOC or other parameters that could be affected by solids are to be compared, the same filtering procedure must be used in each case. Repeated analytical results should state whether the samples were filtered and how they were filtered.

9.9 Shipment and receipt of samples must be coordinated with the laboratory to minimize time in transit or weekend delivery receipt. All samples for organic analysis (and many other parameters), should be maintained at 4°C (±2°C) **(65)** during storage and shipping and should arrive at the laboratory within one day after shipment. Sample receipt should be verified to provide an opportunity to trace a lost shipment or to resample if breakage occurs during shipment.

9.10 A commonly used shipping container is an insulated ice chest (cooler) equipped with bottle dividers. An overnight courier service is recommended, if personal delivery service is not practical. Care must be taken in packaging the ice so that no leakage occurs. Such leakage may damage sample labels or, if it escapes the sample cooler, may be misconstrued to be hazardous liquid by the courier. Sample paperwork, including the chain-of-custody, should be enclosed in a sealed plastic bag and taped to the inside lid of the shipping container to protect it from water. Sample containers may be sealed in plastic bags to protect sample labels from water damage from melting ice or sample leakage from other bottles.

9.11 Many courier services have strict shipping requirements for samples that are "hazardous." The courier service should be contacted prior to field activities if there is a concern about how to ship a sample.

10. Keywords

10.1 diffusion sampling; ground water; low flow; low stress; minimal purge; monitoring; purge; sampling; stabilization; well

APPENDIX

(Nonmandatory Information)

X1. SAMPLE HANDLING PROCEDURES FOR GROUND WATER MONITORING PARAMETERS

X1.1 See Table X1.1 for procedures for handling samples.

TABLE X1.1 Sample Handling Procedures For Ground Water Monitoring Parameters (77)

Parameter[A]	Bottle Type[A]	Preservative	Volume Required for Analysis, min (mL)[B]	Storage Time[C] (with Preservation, where applicable), max
pH	P,G	None, analyze immediately for field measurement	25	ASAP (≤48 h) for lab measurement
Specific Conductance	P,G	Cool (4°C)	100	28 days
Alkalinity and Bicarbonate	P,G	Cool (4°C)	100	14 days
COD	P,G	Analyze ASAP (≤48h) or add H_2SO_4 to pH<2; cool (4°C)	100	28 days
TDS	P,G	Cool (4°C)	100	7 days
TSS	P,G	Cool (4°C)	100	7 days
Chloride	P,G	None	50	28 days
Fluoride	P	None	300	28 days
Nitrate	P,G	Analyze ASAP (≤48h) or add H_2SO_4 to pH<2; cool (4°C)	100	28 days
Sulfate	P,G	Cool (4°C)	50	28 days
Ammonia	P,G	Analyze ASAP (≤48h) or add H_2SO_4 to pH<2; cool (4°C)	500	28 days
Mercury	P,G	HNO_3 to pH<2	100	28 days
Metals, Dissolved (Including Ca, Mg, K, Na)	P,G	Filter on site; HNO_3 to pH<2	200	6 months
Metals, Total (Including Ca, Mg, K, Na)	P,G	HNO_3 to pH<2	100	6 months
Phenols	P,G	Add H_2SO_4 pH<2; cool (4°C)	500	28 days
Hardness	P,G	HNO_3 to pH<2	100	6 months
Volatile Organic Compounds (VOC)	G, TFE-lined cap	Add HCL to pH<2; cool (4°C)	2 × 40 ml	14 days
Total Organic Carbon (TOC)	G, TFE-lined cap	Add H_2SO_4 or HCL to pH<2; cool (4°C)	40	28 days
Total Organic Halogen (TOH)	Amber glass, TFE-lined cap	H_2SO_4 to pH<2 and cool (4°C) for EPA 9020A; cool (4°C) for EPA 9022	250	28 days
Turbidity	P, borosilicate glass	Cool (4°C)	100	48 h

[A] P = Plastic (polyethylene or equivalent); G = Glass; G, TFE-lined cap = Glass screw-cap vials sealed with Teflon-faced silicone septa.
[B] Individual laboratories may request more than the minimum volume.
[C] ASAP = As soon as possible.

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Designation: D 4750 – 87 (Reapproved 2001)

Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)[1]

This standard is issued under the fixed designation D 4750; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method describes the procedures for measuring the level of liquid in a borehole or well and determining the stabilized level of liquid in a borehole.

1.2 The test method applies to boreholes (cased or uncased) and monitoring wells (observation wells) that are vertical or sufficiently vertical so a flexible measuring device can be lowered into the hole.

1.3 Borehole liquid-level measurements obtained using this test method will not necessarily correspond to the level of the liquid in the vicinity of the borehole unless sufficient time has been allowed for the level to reach equilibrium position.

1.4 This test method generally is not applicable for the determination of pore-pressure changes due to changes in stress conditions of the earth material.

1.5 This test method is not applicable for the concurrent determination of multiple liquid levels in a borehole.

1.6 The values stated in inch-pound units are to be regarded as the standard.

1.7 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[2]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *borehole*—a hole of circular cross-section made in soil or rock to ascertain the nature of the subsurface materials. Normally, a borehole is advanced using an auger, a drill, or casing with or without drilling fluid.

3.1.2 *earth material*—soil, bedrock, or fill.

3.1.3 *ground-water level*—the level of the water table surrounding a borehole or well. The ground-water level can be represented as an elevation or as a depth below the ground surface.

3.1.4 *liquid level*—the level of liquid in a borehole or well at a particular time. The liquid level can be reported as an elevation or as a depth below the top of the land surface. If the liquid is ground water it is known as water level.

3.1.5 *monitoring well (observation well)*—a special well drilled in a selected location for observing parameters such as liquid level or pressure changes or for collecting liquid samples. The well may be cased or uncased, but if cased the casing should have openings to allow flow of borehole liquid into or out of the casing.

3.1.6 *stabilized borehole liquid level*—the borehole liquid level which remains essentially constant with time, that is, liquid does not flow into or out of the borehole.

3.1.7 *top of borehole*—the surface of the ground surrounding the borehole.

3.1.8 *water table (ground-water table)*—the surface of a ground-water body at which the water pressure equals atmospheric pressure. Earth material below the ground-water table is saturated with water.

3.2 *Definitions:*

3.2.1 For definitions of other terms used in this test method, see Terminology D 653.

4. Significance and Use

4.1 In geotechnical, hydrologic, and waste-management investigations, it is frequently desirable, or required, to obtain information concerning the presence of ground water or other liquids and the depths to the ground-water table or other liquid surface. Such investigations typically include drilling of exploratory boreholes, performing aquifer tests, and possibly completion as a monitoring or observation well. The opportunity exists to record the level of liquid in such boreholes or wells, as the boreholes are being advanced and after their completion.

4.2 Conceptually, a stabilized borehole liquid level reflects the pressure of ground water or other liquid in the earth material exposed along the sides of the borehole or well. Under suitable conditions, the borehole liquid level and the ground-water, or other liquid, level will be the same, and the former can be used to determine the latter. However, when earth materials are not exposed to a borehole, such as material which is sealed off with casing or drilling mud, the borehole water

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[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground Water and Vadose Zone Investigations.

Current edition approved Nov. 27, 1987. Published January 1988.

[2] *Annual Book of ASTM Standards*, Vol 04.08.

levels may not accurately reflect the ground-water level. Consequently, the user is cautioned that the liquid level in a borehole does not necessarily bear a relationship to the ground-water level at the site.

4.3 The user is cautioned that there are many factors which can influence borehole liquid levels and the interpretation of borehole liquid-level measurements. These factors are not described or discussed in this test method. The interpretation and application of borehole liquid-level information should be done by a trained specialist.

4.4 Installation of piezometers should be considered where complex ground-water conditions prevail or where changes in intergranular stress, other than those associated with fluctuation in water level, have occurred or are anticipated.

5. Apparatus

5.1 Apparatus conforming to one of the following shall be used for measuring borehole liquid levels:

5.1.1 *Weighted Measuring Tape*—A measuring tape with a weight attached to the end. The tape shall have graduations that can be read to the nearest 0.01 ft. The tape shall not stretch more than 0.05% under normal use. Steel surveying tapes in lengths of 50, 100, 200, 300, and 500 ft (20, 30, 50 or 100 m) and widths of ¼ in. (6 mm) are commonly used. A black metal tape is better than a chromium-plated tape. Tapes are mounted on hand-cranked reels up to 500 ft (100 m) lengths. Mount a slender weight, made of lead, to the end of the tape to ensure plumbness and to permit some feel for obstructions. Attach the weight to the tape with wire strong enough to hold the weight but not as strong as the tape. This permits saving the tape in the event the weight becomes lodged in the well or borehole. The size of the weight shall be such that its displacement of water causes less than a 0.05-ft (15-mm) rise in the borehole water level, or a correction shall be made for the displacement. If the weight extends beyond the end of the tape, a length correction will be needed in measurement Procedure C (see 7.2.3).

5.1.2 *Electrical Measuring Device*—A cable or tape with electrical wire encased, equipped with a weighted sensing tip on one end and an electric meter at the other end. An electric circuit is completed when the tip contacts water; this is registered on the meter. The cable may be marked with graduations similar to a measuring tape (as described in 5.1.1).

5.1.3 *Other Measuring Devices*—A number of other recording and non-recording devices may be used. See Ref. **(1)** for more details.[3]

6. Calibration and Standardization

6.1 Calibrate measuring apparatus in accordance with the manufacturers' directions.

7. Procedure

7.1 Liquid-level measurements are made relative to a reference point. Establish and identify a reference point at or near the top of the borehole or a well casing. Determine and record the distance from the reference point to the top of the borehole (land surface). If the borehole liquid level is to be reported as an elevation, determine the elevation of the reference point or the top of borehole (land surface). Three alternative measurement procedures (A, B, and C) are described.

NOTE 1—In general, Procedure A allows for greater accuracy than B or C, and B allows for greater accuracy than C; other procedures have a variety of accuracies that must be determined from the referenced literature **(2-5).**

7.2 *Procedure A—Measuring Tape*:

7.2.1 Chalk the lower few feet of tape by drawing the tape across a piece of colored carpenter's chalk.

7.2.2 Lower a weighted measuring tape slowly into the borehole or well until the liquid surface is penetrated. Observe and record the reading on the tape at the reference point. Withdraw the tape from the borehole and observe the lower end of the tape. The demarcation between the wetted and unwetted portions of the chalked tape should be apparent. Observe and record the reading on the tape at that point. The difference between the two readings is the depth from the reference point to the liquid level.

NOTE 2—Submergence of the weight and tape may temporarily cause a liquid-level rise in wells or boreholes having very small diameters. This effect can be significant if the well is in materials of very low hydraulic conductivity.

NOTE 3—Under dry surface conditions, it may be desirable to pull the tape from the well or borehole by hand, being careful not to allow it to become kinked, and reading the liquid mark before rewinding the tape onto the reel. In this way, the liquid mark on the chalked part of the tape is rapidly brought to the surface before the wetted part of the tape dries. In cold regions, rapid withdrawal of the tape from the well is necessary before the wet part freezes and becomes difficult to read. The tape must be protected if rain is falling during measurements.

NOTE 4—In some pumped wells, or in contaminated wells, a layer of oil may float on the water. If the oil layer is only a foot or less thick, read the tape at the top of the oil mark and use this reading for the water-level measurement. The measurement will not be greatly in error because the level of the oil surface in this case will differ only slightly from the level of the water surface that would be measured if no oil was present. If several feet of oil are present in the well, or if it is necessary to know the thickness of the oil layer, a water-detector paste for detecting water in oil and gasoline storage tanks is available commercially. The paste is applied to the lower end of the tape that is submerged in the well. It will show the top of the oil as a wet line and the top of the water as a distinct color change.

7.2.3 As a standard of good practice, the observer should make two measurements. If two measurements of static liquid level made within a few minutes do not agree within about 0.01 or 0.02 ft (generally regarded as the practical limit of precision) in boreholes or wells having a depth to liquid of less than a couple of hundred feet, continue to measure until the reason for the lack of agreement is determined or until the results are shown to be reliable. Where water is dripping into the hole or covering its wall, it may be impossible to get a good water mark on the chalked tape.

7.2.4 After each well measurement, in areas where polluted liquids or ground water is suspected, decontaminate that part of the tape measure that was wetted to avoid contamination of other wells.

7.3 *Procedure B—Electrical Measuring Device*:

7.3.1 Check proper operation of the instrument by inserting the tip into water and noting if the contact between the tip and

[3] The boldface numbers in parentheses refer to the list of references at the end of this standard.

the water surface is registered clearly.

NOTE 5—In pumped wells having a layer of oil floating on the water, the electric tape will not respond to the oil surface and, thus, the liquid level determined will be different than would be determined by a steel tape. The difference depends on how much oil is floating on the water. A miniature float-driven switch can be put on a two-conductor electric tape that permits detection of the surface of the uppermost fluid.

7.3.2 Dry the tip. Slowly lower the tip into the borehole or well until the meter indicates that the tip has contacted the surface of the liquid.

7.3.3 For devices with measurement graduations on the cable, note the reading at the reference point. This is the liquid-level depth below the reference point of the borehole or well.

7.3.4 For measuring devices without graduations on the cable, mark the cable at the reference point. Withdraw the cable from the borehole or well. Stretch out the cable and measure and record the distance between the tip and the mark on the cable by use of a tape. This distance is the liquid-level depth below the reference point.

7.3.5 A second or third check reading should be taken before withdrawing the electric tape from the borehole or well.

7.3.6 Decontaminate the submerged end of the electric tape or cable after measurements in each well.

NOTE 6—The length of the electric line should be checked by measuring with a steel tape after the line has been used for a long time or after it has been pulled hard in attempting to free the line. Some electric lines, especially the single line wire, are subject to considerable permanent stretch. In addition, because the probe is usually larger in diameter than the wire, the probe can become lodged in a well. Sometimes the probe can be attached by twisting the wires together by hand and using only enough electrical tape to support the weight of the probe. In this manner, the point of probe attachment is the weakest point of the entire line. Should the probe become "hung in the hole," the line may be pulled and breakage will occur at the probe attachment point, allowing the line to be withdrawn.

7.4 *Procedure C—Measuring Tape and Sounding Weight*:

7.4.1 Lower a weighted measuring tape into the borehole or well until the liquid surface is reached. This is indicated by an audible splash and a noticeable decrease in the downward force on the tape. Observe and note the reading on the tape at the reference point. Repeat this process until the readings are consistent to the accuracy desired. Record the result as the liquid-level depth below the reference point.

NOTE 7—The splash can be made more audible by using a "plopper," a lead weight with a concave bottom surface.

7.4.2 If the liquid level is deep, or if the measuring tape adheres to the side of the borehole, or for other reasons, it may not be possible to detect the liquid surface using this method. If so, use Procedure A or Procedure B.

8. Determination of a Stabilized Liquid Level

8.1 As liquid flows into or out of the borehole or well, the liquid level will approach, and may reach, a stabilized level. The liquid level then will remain essentially constant with time.

NOTE 8—The time required to reach equilibrium can be reduced by removing or adding liquid until the liquid level is close to the estimated stabilized level.

8.2 Use one of the following two procedures to determine the stabilized liquid level.

8.2.1 *Procedure 1*—Take a series of liquid-level measurements until the liquid level remains constant with time. As a minimum, two such constant readings are needed (more readings are preferred). The constant reading is the stabilized liquid level for the borehole or well.

NOTE 9—If desired, the time and level data could be plotted on graph paper in order to show when equilibrium is reached.

8.2.2 *Procedure 2*—Take at least three liquid-level measurements at approximately equal time intervals as the liquid level changes during the approach to a stabilized liquid level.

8.2.2.1 The approximate position of the stabilized liquid level in the well or borehole is calculated using the following equation:

$$h_o = \frac{y_1^{\ 2}}{y_1 - y_2} \tag{1}$$

where:

h_o = distance the liquid level must change to reach the stabilized liquid level,
y_1 = distance the liquid level changed during the time interval between the first two liquid-level readings, and
y_2 = distance the liquid level changed during the time interval between the second and the third liquid level readings.

8.2.2.2 Repeat the above process using successive sets of three measurements until the h_o computed is consistent to the accuracy desired. Compute the stabilized liquid level in the well or borehole.

NOTE 10—The time span required between readings for Procedures 1 and 2 depends on the permeability of the earth material. In material with comparatively high permeability (such as sand), a few minutes may be sufficient. In materials with comparatively low permeability (such as clay), many hours or days may be needed. The user is cautioned that in clayey soils the liquid in the borehole or well may never reach a stabilized level equivalent to the liquid level in the earth materials surrounding the borehole or well.

9. Report

9.1 For borehole or well liquid-level measurements, report, as a minimum, the following information:

9.1.1 Borehole or well identification.

9.1.2 Description of reference point.

9.1.3 Distance between reference point and top of borehole or land surface.

9.1.4 Elevation of top of borehole or reference point (if the borehole or well liquid level is reported as an elevation).

9.1.5 Description of measuring device used, and graduation.

9.1.6 Procedure of measurement.

9.1.7 Date and time of reading.

9.1.8 Borehole or well liquid level.

9.1.9 Description of liquid in borehole or well.

9.1.10 State whether borehole is cased, uncased, or contains a monitoring (observation) well standpipe and give description of, and length below top of borehole of, casing or standpipe.

9.1.11 Drilled depth of borehole, if known.

9.2 For determination of stabilized liquid level, report:

9.2.1 All pertinent data and computations.

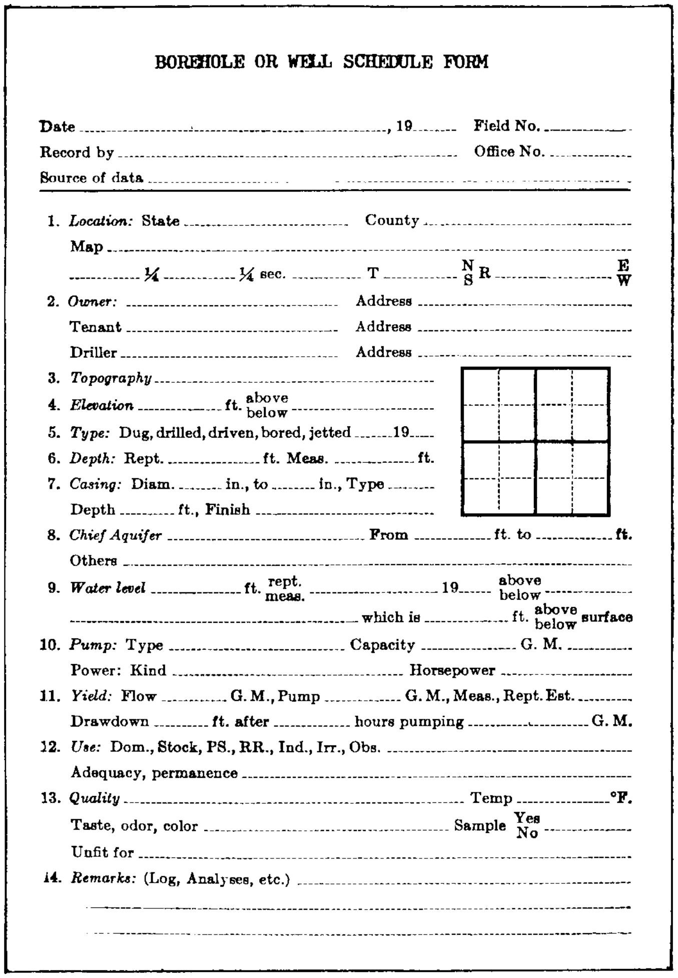
9.2.2 Procedure of determination.

9.2.3 The stabilized liquid level.

9.3 *Report Forms*—An example of a borehole or well-schedule form is shown in Fig. 1. An example of a liquid-level measurement form, for recording continuing measurements for a borehole or well, is shown in Fig. 2. An example of a borehole or well schedule form designed to facilitate computer data storage is shown in Fig. 3.

10. Precision and Bias

10.1 Borehole liquid levels shall be measured and recorded to the accuracy desired and consistent with the accuracy of the measuring device and procedures used. Procedure A multiple measurements by wetted tape should agree within 0.02 ft (6 mm). Procedure B multiple measurements by electrical tape should agree within 0.04 ft (12 mm). Procedure C multiple measurements by tape and sounding weight should agree within 0.04 ft (12 mm). Garber and Koopman **(2)** describe corrections that can be made for effects of thermal expansion of tapes or cables and of stretch due to the suspended weight of tape or cable and plumb weight when measuring liquid levels at depths greater than 500 ft (150 m).

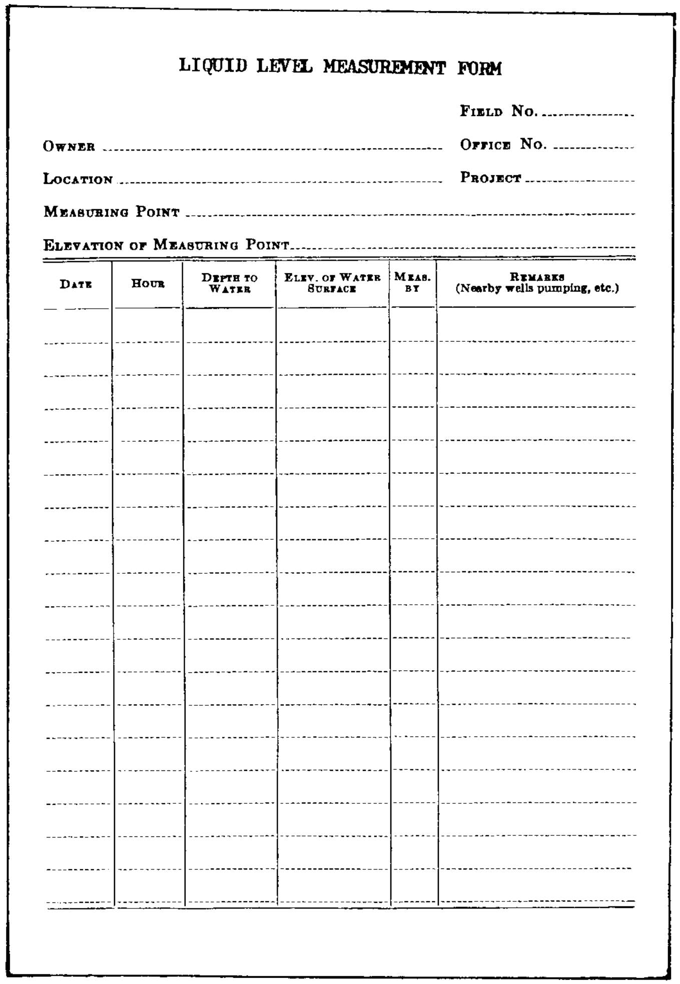


BOREHOLE OR WELL SCHEDULE FORM

Date ...., 19...... Field No. ....
Record by .... Office No. ....
Source of data ....

1. *Location:* State .... County ....
Map ....
.... ¼ .... ¼ sec. .... T .... N/S R .... E/W
2. *Owner:* .... Address ....
Tenant .... Address ....
Driller .... Address ....
3. *Topography* ....
4. *Elevation* .... ft. above/below ....
5. *Type:* Dug, drilled, driven, bored, jetted ...... 19......
6. *Depth:* Rept. .... ft. Meas. .... ft.
7. *Casing:* Diam. ...... in., to ...... in., Type ......
Depth .... ft., Finish ....
8. *Chief Aquifer* .... From .... ft. to .... ft.
Others ....
9. *Water level* .... ft. rept./meas. .... 19...... above/below ....
.... which is .... ft. above/below surface
10. *Pump:* Type .... Capacity .... G. M. ....
Power: Kind .... Horsepower ....
11. *Yield:* Flow .... G. M., Pump .... G. M., Meas., Rept. Est. ....
Drawdown .... ft. after .... hours pumping .... G. M.
12. *Use:* Dom., Stock, PS., RR., Ind., Irr., Obs. ....
Adequacy, permanence ....
13. *Quality* .... Temp .... °F.
Taste, odor, color .... Sample Yes/No ....
Unfit for ....
14. *Remarks:* (Log, Analyses, etc.) ....

FIG. 1 Example of a Borehole or Well Schedule Form



LIQUID LEVEL MEASUREMENT FORM

Field No. ....
Owner .... Office No. ....
Location .... Project ....
Measuring Point ....
Elevation of Measuring Point ....

Date	Hour	Depth to Water	Elev. of Water Surface	Meas. by	Remarks (Nearby wells pumping, etc.)

FIG. 2 Example of a Liquid Level Measurement Form

11. Keywords

11.1 borehole; electrical measuring device; ground water; liquid level; measuring tape; well

SITE NO.

BOREHOLE OR WELL SCHEDULE FORM

Recorded by ____________________ Date ____________

Check One ____ English ____ Metric Units

GENERAL SITE DATA (0)

Site Ident No [5 … 19] RG Number [R = 0 *] Transaction [T = A D M V *] (add, delete, modify, verified)

Site-Type [2 = C D E H I M Ø P S T W X *] (collector, drain, excavation, sink-hole, connector well, multiple, outcrop, pond, spring, tunnel or shaft, well, test hole) Data Reliability [3 = C U *] (field checked, unchecked) Reporting Agency [4 = *]

Project No. [5 = *] District [6 = *] State [7 = *] County (or town) ______ [8 = *]

Latitude [9 = deg min sec *] Longitude [10 = deg min sec *] Lat-Long Accuracy [11 = S F T M *] (sec, 5 sec, 10 sec, Min)

Local Number [12 = *] Land Net Loc [13 = 1/4 1/4 1/4 S section T township R range meridian *]

Location Map [14 = *] Scale [15 = *]

Altitude [16 = *] Method of Measurement [17 = A L M *] (altimeter, level, map) Accuracy [18 = *]

Topo Setting [19 = A B C D E F G H K L M Ø P S T U V W *] (alluvial fan, playa, stream channel, depression, dunes, flat, flood plain, hill top, sink, swamp, mangrove swamp, offshore, pediment, hill side, terrace, undulating, valley flat, upland draw) Hydrologic Unit (OWDC) [20 = *]

Use of Site [23 = A C D E G H M Ø P R S T U W X Z *] (anode, standby emer supply, drain, geothermal, seismic, heat reservoir, mine, observation, oil or gas, recharge, repressurization, test, unused, withdrawal, waste, destroyed) Secondary Site Use [301 = *] Tertiary Site Use [302 T *]

Use of Water [24 = A B C D E F H I J K M N P Q R S T U Y Z *] (air cond, bottling, commercial, dewater, power, fire, domestic, irrigation, industrial (cooling), mining, medicinal, industrial, public supply, aquaculture, recreation, stock, institution, unused, desal, other)

Secondary Water Use [25 = *] Tertiary Use of Water [26 = *] Depth of Hole [27 = *] Depth of Well [28 = *] Source of Depth Data ① [29 = *]

Water Level [30 = *] Data Measured [31 = month / day / year *] Source ① [33 = *]

Method of Measurement [34 = A B C E G H L M N R S T V Z *] (airline, analog, calibrated airline, estimated, pressure gage, calibrated pressure gage, geophysical logs, manometer, non rec. gage, reported, steel tape, electric tape, calibrated electric tape, other)

Site Status [37 = D E F G H I J N Ø P R S T V W X Z *] (dry, recently flowing, flowing, nearby flowing, nearby recently flowing, injector site, injector monitor, measurement discontinued, obstruction, pumping, recently pumped, nearby pumping, nearby recently pumped, foreign substance, well destroyed, surface water effects, other)

Source of Geohydrologic Data ① [36 = *] Pump Used [35 = no *] Date of First Construction Completion [21 = month / day / year *]

OWNER IDENTIFICATION (1)

[R = 158 *] [T = A D M *] (add, delete, modify) Date of Ownership [159 = month / day / year *]

Name: Last [161 = *] First [162 = *] Middle Initial [163 = *]

OTHER SITE IDENTIFICATION NUMBERS (1)

[R = 189 *] [T = A D M *] (add, delete, modify) Ident [190 = *] Assigner [191 = *]

[New Card Same R & T] Ident [190 = *] Assigner [191 = *]

SITE VISIT DATA (1)

[R = 186 *] [T = A D M *] (add, delete, modify) Date of Visit [187 = month / day / year *] Name of Person [188 = *]

FIELD WATER QUALITY MEASUREMENTS (1)

[R = 192 *] [T = A D M *] (add, delete, modify) Date [193 = month / day / year *] Geohydrologic Unit [195 = *]

[New Card Same R thru 195] Temperature [196 = 0 0 0 1 0 *] Degrees C [197 = *]

Conductance [196 = 0 0 0 9 5 *] µ Mhos [197 = *]

Other (STORET) Parameter [196 = *] Value [197 = *]

Other (STORET) Parameter [196 = *] Value [197 = *]

FOOT NOTES

① Source of Data Codes

A	D	G	L	M	O	R	S	Z
other gov't	driller	geologist	logs	memory	owner	other reported	reporting agency	other

FIG. 3 Example of a Borehole or Well Schedule Form

REFERENCES

(**1**) "*National Handbook of Recommended Methods for Water Data Acquisition—Chapter 2—Ground Water*", Office of Water Data Coordination, Washington, DC, 1980.

(**2**) Garber, M. S., and Koopman, F. C., "Methods of Measuring Water Levels in Deep Wells," *U.S. Geologic Survey Techniques for Water Resources Investigations*, Book 8, Chapter A-1, 1968.

(**3**) Hvorslev, M. J., "Ground Water Observations," in *SubsurfaceExploration and Sampling of Soils for Civil Engineering Purposes*, American Society Civil Engineers, New York, NY, 1949.

(**4**) Zegarra, E. J., "Suggested Method for Measuring Water Level in Boreholes," *Special Procedures for Testing Soil and Rock for Engineering Purposes, ASTM STP 479*, ASTM, 1970.

(**5**) "Determination of Water Level in a Borehole," CSA Standard A 119.6 – 1971, Canadian Standards Association, 1971.

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Standard Practice for Conducting Field Measurements During Water Sampling Activities

1.0 Purpose and Scope

This practice contains procedures necessary to obtain field measurements of known quality during routine water sampling activities. These measurements are useful for assessing general water quality, assessing geochemical conditions, and indicating when purging of a groundwater monitoring well is complete. This practice refers to the common field measurements taken during routine water sampling activities, which include dissolved oxygen, oxidation-reduction potential, pH, temperature, specific conductance, total alkalinity, and turbidity.

2.0 Terminology

Dissolved Oxygen—The concentration of molecular oxygen dissolved in water. Units are typically reported in milligrams per liter (mg/L) or percent (of air saturation). Dissolved oxygen data are useful as a general water quality indicator for biota, in geochemical characterization and modeling, and as an indicator parameter of stability during purging of a monitoring well.

Flow Cell—Apparatus that allows flow of water across instrument probes while excluding atmospheric contact.

In Situ—Being in the original position. When referring to field measurements, making a measurement in the original environment, such as in a stream or in a monitoring well.

Oxidation-Reduction Potential—The electromotive force developed when a noble metal electrode and a reference electrode are placed in an aqueous sample. The electromotive force relates to the potential for the water to be oxidizing or reducing. Units are typically measured in millivolts (mV). Oxidation reduction potential data are useful in geochemical characterization and modeling, and in predicting migration or attenuation of contaminants in groundwater and surface water.

pH—The negative logarithm to the base 10 of the hydrogen ion activity in moles per liter: $pH = -\log [H^+]$. Units are measured in standard units (s.u.). pH data are useful as a general water quality indicator, in geochemical characterization and modeling, in predicting migration and attenuation of contaminants, and as an indicator parameter of stability during purging of a monitoring well.

Specific Conductance—Conductivity is the ability of water to conduct an electrical current. Conductivity of water is related to the type and concentration of ions dissolved in the water along with the temperature. Specific conductance is conductivity adjusted to standardized conditions of electrode geometry (1 cm cube) and temperature (25 °C).

Temperature—A basic physical property that is measured by the response of matter to heat. Temperature is typically measured in units of degrees Celsius (°C) for water sampling applications, but may also be measured in units of degrees Fahrenheit (°F).

Total Alkalinity—The capacity of water to neutralize acid. Specifically, total alkalinity using a titration method is a quantitative measurement of the amount of acid required to reduce the pH of water to an established end point. Units are typically reported in mg/L as $CaCO_3$. Total alkalinity data are useful as a general indicator of water quality and are used in anion/cation balance calculations.

Turbidity—An indirect measure of the amount of particulate matter (silt, clay, organic matter) in water. Units are generally expressed in nephelometric turbidity units (NTUs), which refer to the optical properties of the sample (related to particulate matter) that causes light to be scattered/absorbed and not transmitted.

3.0 Material and Equipment

Following are the minimum specifications for instrumentation and test kits to perform the field measurements (HACH 1992; YSI 2008).

Dissolved oxygen (polarographic method)

- One point calibration capability
- Outputs in mg/L and % air saturation
- Range: 0 to 20 mg/L, 0 to 200 percent air saturation
- Accuracy: ± 2 percent of reading or 0.2 mg/L, whichever is greater; ± 2 percent of air saturation or 2 percent of reading, which ever is greater.
- Rapid pulse or similar technology that does not require a specified flow rate across the probe.
- Barometer specifications (if included with instrument)
  - Range: 500 to 800 millimeters mercury (mm Hg)
  - Accuracy: ± 3 mm Hg within ± 15 °C of calibration temperature
  - Resolution: 0.1 mm Hg

Oxidation-reduction potential

- One point calibration capability
- Range: -999 to 999 mV
- Accuracy: ± 20 mV
- Resolution: 0.1 mV

pH

- Two (or three) point calibration capability
- Range: 0 to 14 s.u.
- Accuracy: ± 0.2 s.u.
- Resolution: 0.01 s.u.

Specific conductance

- One point calibration capability
- Range: 0 to 100,000 µmhos/cm
- Accuracy: ± 1 percent of reading
- Resolution: 1 µmhos/cm

Temperature

- Calibration capability not required
- Range: -5 to 45 °C
- Accuracy: ± 0.15 °C
- Resolution: 0.1 °C

Total alkalinity

- Range 0 to 10,000 mg/L as $CaCO_3$
- Accuracy ± 1 percent of reading
- Resolution: 1 mg/L as $CaCO_3$

Turbidity

- Four point calibration capability
- Range: 0 to 1,000 NTUs
- Accuracy: 2 percent of reading in 0 to 500 NTU range, 3 percent of reading in 500 to 1,000 NTU range
- Resolution: 0.01 NTU

4.0 Procedure

4.1 Conducting Measurements

Measurements will be conducted according to the manufacturer’s instructions.

Maintenance, cleaning, and storage of instrumentation, probes, and test kits also will be conducted according to the manufacturer’s instructions. These instructions will be kept in a centralized file that is accessible to field personnel. Any deviations from these instructions will be documented in the appropriate sampling plan.

Measurements of dissolved oxygen, oxidation-reduction potential, pH, temperature, and specific conductance should be collected using a flow cell or in situ to minimize atmospheric contact that might affect the measurement and to make the measurement more representative of the environment from which the sample was collected. The flow rate through the flow cell should be less than 1 liter per minute to avoid streaming potentials that may affect readings. Streaming potentials are caused by the static charge effect of water moving through small openings.

4.2 Calibration and Operational Checks

A calibration/operational check schedule will be implemented for all instruments/test kits used to make field measurements. The types, frequency, and acceptance criteria of calibration/operational checks will be specified in the appropriate sampling plan. Following are some general calibration/operational check requirements for each field measurement:

- Dissolved oxygen—one point calibration check in water-saturated air.
- Oxidation-reduction potential—one point calibration in Zobell solution.
- pH—minimum of two point calibration that brackets expected pH of samples.
- Temperature—calibration not required; one point operational check against a National Institute of Standards and Technology traceable thermometer.
- Specific conductance—one point calibration with a standard that most represents expected specific conductance of samples.
- Total alkalinity—factory calibration of digital titrator (if used).
- Turbidity—four point calibration with standards bracketing the expected turbidity of samples.

5.0 Documentation

Documentation of field measurements will include:

- Recording field measurements on electronic/paper forms specified in the sampling plan, including:
  - Date and time of measurement.
  - Value of the measurement and units.
  - Instrumentation/test kits used.
  - Name of the person conducting the field measurement.
  - Last time of calibration/operational check.

- Recording calibration/operational check information including:
  - Lot numbers and expiration dates of standards.
  - Instrument readings versus acceptance criteria.
  - Calibration values.
  - Name of person conducting the calibration/checks.
  - Date and time of calibration/operational check.

6.0 References

HACH, 1992. *Water Analysis Handbook*, Loveland, Colorado.

YSI, Inc., 2008. YSI 5563 MPS Sensor Specifications, available at http://www.ysihydrodata.com/pdfs/pdfs_02/556.pdf, Yellow Springs, Ohio.

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Standard Practice for the Inspection and Maintenance of Groundwater Monitoring Wells

1.0 Introduction

Groundwater monitoring wells are commonly used for obtaining groundwater samples, groundwater elevation measurements, and aquifer hydraulic parameters. Because of natural processes and human activities, the condition of groundwater monitoring wells deteriorates with time. Routine inspection and maintenance of monitoring wells are required to mitigate deterioration so that decisions based upon data collected from that well are not compromised.

2.0 Purpose and Scope

The purpose of this procedure is to describe the standard practice for conducting routine inspections of groundwater monitoring wells in order to document the condition of wells, to provide guidance on preventative maintenance, and to establish criteria used to determine if and when a monitoring well should receive corrective maintenance. Corrective maintenance activities are based on the results of the routine inspections. Well maintenance includes correcting deficiencies in the surface components of a monitoring well and redevelopment.

This procedure shall be applied only to groundwater monitoring wells. Groundwater production wells and high volume extraction wells, used for water supply and in remediation systems, respectively, are beyond the scope of this procedure. Because of the limitations associated with redevelopment methods described in this procedure, the redevelopment section is not applicable to wells exceeding 6 inches in diameter.

This procedure shall be conducted on all monitoring wells at LM sites unless other procedures are specified in a site-specific planning document. This procedure may be implemented in conjunction with routine groundwater sampling and data collection activities.

3.0 Terminology

Surging—The process of forcing water into a well, in and out of the formation and filter pack. This is usually accomplished by moving an object, such as a surge block, up and down in the water column of a well.

Surge block—A round disk or cylinder with a diameter close to the inside diameter of the well casing.

Nitrogen jetting—The process of surging a well using compressed nitrogen gas to raise and lower the water column.

Air-lift pump—The process of removing water from a well using compressed gas (nitrogen) by lifting the water column.

Suction lift pump—Pump at the surface that lowers pressure in the down-hole tubing to less than atmospheric pressure. Atmospheric pressure on the water column then pushes water up the tubing. This pump is limited by atmospheric pressure (and therefore elevation) and can only lift water (depth to water) approximately 25 to 30 ft. Typical maximum flow rates are in the 1 to 2 gallons/minute range.

Foot-valve pump—A length of semi-rigid tubing with a foot-valve (check ball) on the down hole end that uses momentum or inertia of the water in the tubing as the tubing is rapidly moved up and down (also referred to as an inertial pump). Standard models of this pump are capable of lifting water 200 ft and capable of maximum flow rates up to 1 gallon/minute.

Submersible pump—Down-hole centrifugal pump (uses impeller or series of impellers to drive water) capable of pumping from deep wells (> 250 ft) and capable of high flow rates (up to 10 gallons/minute for environmental applications in 2-inch wells). These pumps are susceptible to damage when used for development because of sediment liberated during surging.

4.0 Material and Equipment

The following equipment and materials may be used during inspection and maintenance of monitoring wells.

- Monitoring well location map.
- Well inspection and maintenance form or FDCS.
- Well development log.
- Water level indicator.
- Surge block.
- Pumps—peristaltic pump, submersible pump, foot-valve pump, bladder pump.
- Bailer.
- Nitrogen tank, regulator, and associated transmission hose/pipe.
- Paint.
- Metal stamp (for labeling wells).
- Distilled or deionized water in a squeeze wash bottle.
- Paper towel.
- Containers to collect purge water.

5.0 Procedure

This procedure is composed of two sections: “Well Inspection and Maintenance,” and “Well Development/Redevelopment Procedures.”

5.1 Well Inspection and Maintenance

Inspection of monitoring wells includes surface and subsurface inspection and maintenance. Whenever possible, required maintenance identified during the inspection should be implemented during the same field trip. All inspected well components should be documented as acceptable or deficient, and any maintenance item identified and/or completed must be noted on an approved Well Inspection and Maintenance form or in the FDCS.

5.1.1 Surface Components Inspection and Maintenance

The first step of the inspection is to inspect the above-ground components of a monitoring-well installation. Some surface components identified in this section of the procedure are optional and will not be required at each well installation. Examples of components that may not be present are guard posts and concrete pads.

- Check for presence of a lid on the outer protective casing. If hinged at the lid and/or hasp, check for proper operation.
- Check for the presence and proper operation of a lock on the outer protective casing. Note if a lubricant is applied to the lock. If the lock is missing or not operating properly, replace with a lock that is keyed the same as other monitoring-well locks at the site.
- Inspect the outer protective casing for damage and stability. The outer casing should be vertical and immovable when force is applied by hand. If a drain or vent hole is present in the casing, check to ensure that it is not plugged with debris. Clean the hole if necessary. Outer protective casings made of steel should have a painted finish. Paint is not required for aluminum, PVC, or galvanized-finished well casings. If painted, check the condition of the paint and repaint if needed. If steel casing is not painted, paint the casing.
- Check for presence of a casing-riser cap. If the well is a flush-mount, a watertight, expansion cap should be used unless the well vault was designed to permit drainage from the vault or a watertight lid is installed on the flush-mount well. If water is present in the well vault, remove water before removing the riser cap. Note if there is evidence that water in the well vault is flowing into the well.
- Inspect the casing riser for damage. No debris or water should be able to enter the well through openings in the side of the casing riser. Note that some casing risers have a “weep” hole drilled just below the riser cap. This hole allows air pressure in the well to equilibrate with atmospheric pressure as water levels or the atmospheric pressure fluctuates. Check weep hole to ensure it is not plugged. If the casing riser is damaged to the extent that standing liquids inside the security casing can enter the well, the damaged section should be cut off below the point of breakage and a new section of riser installed. The new elevation of the riser must be obtained by measurement of the difference in lengths at the time of repair or resurvey.
- Check for the presence of guard posts. If present, check if guard posts are secure and adequately painted for high visibility.
- Check for the presence of a concrete surface pad surrounding the outer protective casing. If present, check the integrity by noting major cracks and by assessing the stability of the pad.

- If a concrete surface pad is absent, check the surface seal around the outer protective casing and note any cracks that would allow surface water to flow downward along the casing. The surface seal may be bentonite, cement grout, or natural backfill.
- Check that the well identifier is present, legible, readily visible, and in agreement with the well location map. If missing, illegible, or wrong, the well must be labeled as soon as practical. Following are acceptable methods for labeling the outer protective casing of a well: stamping with a steel stamp, installing a metal tag, painting, and installing stickers. The well identifier can be placed on the lid of the outer protective casing and/or on the outer protective casing itself. The identifier should also be written on the riser cap with a permanent marker. Multiple-completion wells should have the top of each riser cap marked with a letter designating the completion, such as "U" and "L" for "upper" and "lower," respectively. The casing risers in a multiple-completion well also should be marked in a similar manner.

5.1.2 Subsurface Inspection and Maintenance

The second step of the inspection is to determine the subsurface condition of the well. This includes measuring the depth to water and the depth to the bottom of the well. These measurements should be recorded to the nearest 0.01 ft below the top of the inner casing. The measured depth to the bottom of the well, when compared to the recorded well depth and screened interval depth, will indicate the amount of sediment in the well. If sediment has accumulated to a level above the bottom of the screened interval, the well should be redeveloped. Excessive sediment accumulation could indicate a damaged well screen. If a damaged well screen is suspected, a down-hole camera should be used to visually inspect the well.

- Measure and record the depth to water to the nearest 0.01 ft. The depth shall be measured from the top of the inner casing riser, and the measurement shall be made according to ASTM D4570-87 (Reapproved 2001)—Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well).
- Measure the total depth of the well by gently lowering the probe to the bottom of the well. After the probe reaches the well bottom, slowly raise and lower it several times to accurately determine the depth to the top of any sediment column that may have accumulated in the well. Record the depth to the nearest 0.01 ft. Note that if an electric water level indicator is used to measure the total depth, an additional amount needs to be added to the measurement to account for the difference between the end of the probe and the measuring point. This amount will vary with the brand of water level indicator.
- If evidence of biological growth, including roots, algae, and bacteria, is observed on the outside of the water level indicator, the well should be redeveloped.

Use a disposable tissue and distilled or deionized water to clean the cable as it is removed from the well. Additional decontamination of the probe may be required depending upon contaminant types and site-specific requirements.

5.2 Well Development/Redevelopment Procedures

All new monitoring wells should be developed after installation to remove remnants of drilling fluid, to remove geologic debris generated from the drilling process, and to establish hydrologic connection between the filter pack and the formation. Criteria for completion of initial monitoring well development typically involve removal of a specified volume of water and meeting a turbidity criteria used for groundwater sampling. Well development criteria are typically specified in the statement of work created to guide the well drilling and installation process. Management of water generated during monitoring well development activities also is typically specified in the statement of work.

Monitoring wells should be redeveloped periodically as part of a regular maintenance program to enhance collection of high-quality samples that are representative of the subsurface environment and to minimize localized well affects. Low-flow sampling does not provide flow rates or purge volumes necessary to remove build-up of fine-grained sediment in the filter pack and well sump, or to provide removal of biological build-up in the well; therefore, routine redevelopment is an essential component of a low-flow sampling program. Management of water generated during monitoring-well redevelopment will be conducted according to site-specific planning documents.

In addition to routine redevelopment, monitoring wells should be redeveloped if the following conditions are encountered.

- The well-inspection process indicates that excessive sedimentation is occurring.
- The capacity of the well appears to have significantly declined during the course of a sampling program.
- There is evidence of excessive biological growth in the well.

Development/redevelopment techniques include: (1) compressed-nitrogen jetting and air-lift pumping, (2) surge block and pumping or bailing, (3) pumping only.

Successful development/redevelopment requires that water be forced (or surged) from the well screen interval into the filter pack and formation, and from the formation and filter pack into the well screen interval. This is best accomplished through the use of a surge block or a bailer as a surging tool. Compressed-nitrogen jetting can also accomplish this flow reversal to some extent. Pumping only is not as effective in achieving flow reversal (although reversing the pump can be effective) and is, therefore, best used in conjunction with nitrogen jetting or surge blocking.

Before placing any redevelopment equipment in a monitoring well, the equipment shall be cleaned using decontamination procedures specified for groundwater sampling at the site. After removing redevelopment equipment from a well, the equipment shall be decontaminated again.

5.2.1 Nitrogen-Jetting

A discharge-control apparatus should be used to facilitate collection discharge water (if required) and to prevent discharge water from splashing on maintenance personnel. This apparatus typically consists of a compression-sleeve coupling with a discharge port that is connected to the well riser. A compression-type seal for the jetting pipe is rigged at the top of the discharge-control apparatus.

A jetting-T is connected to a series of PVC pipes (the jetting pipe) and lowered to the top of the screened interval. The top of the jetting pipe is then connected to a compressed nitrogen source via a flexible compressed gas transmission hose. The flexible hose is connected to a two-stage regulator on the nitrogen source. The first stage of the regulator displays the pressure in the nitrogen tank. The second stage displays the pressure at the flexible hose when the regulator is opened. To prevent injury caused by the nitrogen tank falling over, the tank must be either secured in an upright position with a chain or placed on its side and secured by wheel chocks.

Set the line pressure on the regulator at a maximum of 60 pounds per square inch. Jet the well screen by quickly opening the line valve, allowing the water to rise in the well, and then closing the line valve. As air (or nitrogen) escapes from the water column, the water in the well will fall back to near static levels and give rise to a flow reversal from the well into the formation. This pulsed jetting should be repeated for the entire length of screened interval by lowering the jetting pipe in small increments. The pulsed jetting will loosen sediment from the screen, the filter pack, and the well bottom.

As material is loosened during the pulsed jetting, the well should be air-lift pumped to remove the dislodged sediment. Air-lift pumping is accomplished by slowly but steadily opening the line valve. This action will discharge nitrogen into the water column within the well. The water will rise in the well as the nitrogen is introduced and expands. If the water level reaches the top of the well before the injected nitrogen reaches the top of the water column, "successful" air-lift pumping will occur. Air-lift pumping can continue as long as water is entering the well at a fast enough rate to maintain an aerated water column that extends to the top of the well.

Repeat the combination of pulsed jetting over the length of the well screen and air-lift pumping at least once. This process should be repeated until turbidity criterion is met. The criterion used to determine the completion of development/redevelopment should be the same as required during groundwater sampling.

5.2.2 Surge-Block and Pumping

Lower the surge block into the well to a position below the water level in the well but above the top of the screened interval. Move the surge block up and down in the water column to create a surging action that should loosen obstructing sediment. Follow the well surging with a pumping cycle to remove the dislodged sediment from the well. Pumping can be accomplished using a suction-lift pump, submersible pump, foot-valve pump, or a bailer. The type of pump used is typically dictated by the physical and hydrologic properties of the well including depth of the well, depth to water, well diameter, and well yield.

Note

Use of a bailer may be effective in removing the majority of dislodged sediment; however, obtaining low turbidity water is not feasible because of the surging action of the bailer as it is moved through the water column. An effort should be made to remove accumulated sediment from the bottom of the well using a suction-lift pump, foot-valve pump, or bailer prior to and during development/redevelopment process.

After operating the surge block in a given depth increment followed by pumping, lower it to the next interval and repeat the surge and pumping action. This process should be repeated until surge blocking has been conducted in the entire screened interval. Cycles of surge-blocking and pumping should be repeated until turbidity criterion is met. The criterion used to determine the completion of development/redevelopment should be the same as required during groundwater sampling.

5.2.3 Pumping Only

Pumping only can be used to clear accumulated sediment and biological growth from a well, but has a limited effect in removing accumulated fines from the filter pack because of the lack of surging action. Some pumps have the ability to reverse the flow direction, which may have a surging effect. Pumping without surging requires a greater volume of water be removed from the well than surging and pumping.

6.0 Documentation

Monitoring well inspection and maintenance must be documented on an approved well inspection and maintenance form (Figure 1) or in the FDCS (Figure 2). Monitoring well components should be documented as acceptable or deficient, and any maintenance item identified and/or completed must be noted. All maintenance items completed and maintenance items required must be communicated to the site lead via a trip report.

Documentation of well development should include the following information: site, well identification, date, start and stop time of pump cycles, volume of water removed during each pump cycle, number of times surged, turbidity, water levels, and persons performing the work. An example of a well development log is shown in Figure 3.

7.0 References

Environmental Procedures Catalog, LMS/POL/SO4325, continually updated, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado.

ASTM D4750-87 (Reapproved 2001)—Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)

WATER LEVELS and WELL MAINTENANCE DATA SHEET

Site:_______________ Measuring Device_______________ Date_______________

	Subsurface Inspection			Surface Components Inspection							
Well ID	Time	Depth to Water (ft.)	Total Depth (ft.)	Well Label	Guard-posts	Lock	Conc. Pad	Protective Casing	Riser Cap	Technician Initials	Comments

Surface Components Inspection: S – Satisfactory D- Deficient (comment to describe problem)

Figure 1. Example of a Well Inspection and Maintenance Form

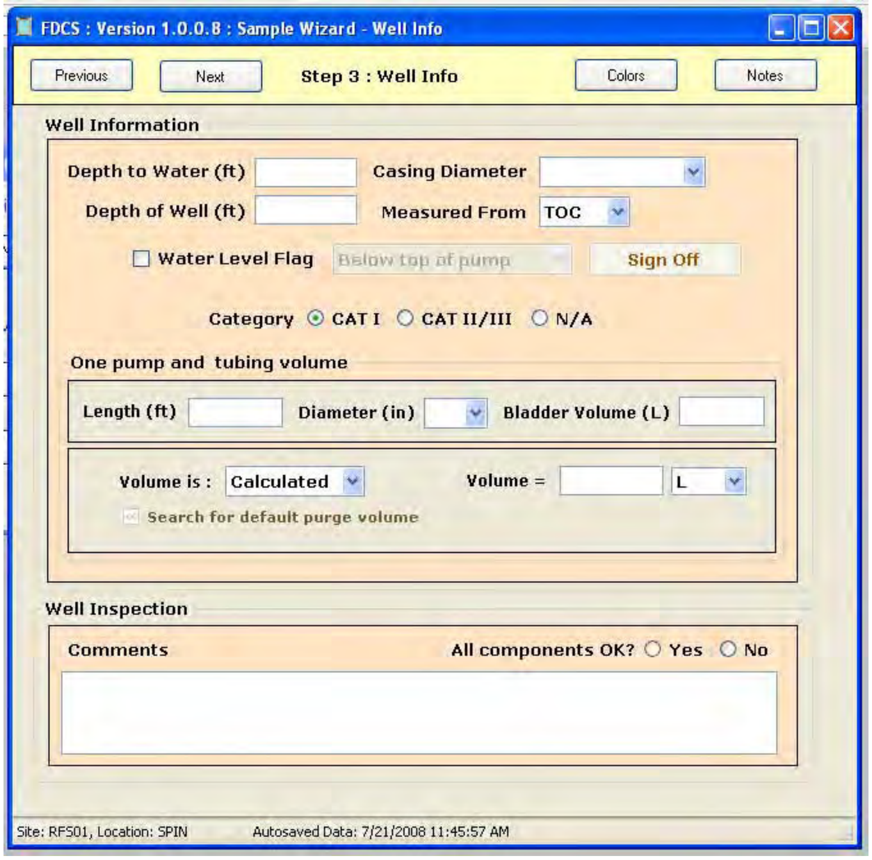


Figure 2. FDCS Well Inspection Form

Well Development Log

Site______________ Well Number_____________ Date_____________

Time	Cumulative Volume (gallons)	Surged Well	Turbidity (NTUs)	Water Level (feet BTC)	Comments

Conducted by ___________________________

Figure 3. Example of a Well Development Log

Standard Practice for Data Logger System Field Measurements

1.0 Purpose and Scope

This practice contains procedures necessary for the use of a data logger system for measuring level and temperature of natural groundwater and surface water, as well as industrial, waste, and other installations. Although there are several different models of data logger systems currently in use, this procedure addresses the general practice of installing and running data loggers, and retrieving logged data.

2.0 Terminology

Data Logger System—Components include the data logger, vented and non-vented cables, communication cables, external power accessories, desiccants and other installation accessories, and software.

Transducers—Vented or non-vented pressure/level sensors (gauged measurements) inside the data logger. A pressure transducer senses changes in pressure, measured in force per square unit of surface area, exerted by water or other fluid on an internal media-isolated strain gauge. Common measurement units are pounds per square inch (psi) or newtons per square meter (pascals).

Vented Cable—Vent tube within a cable that insures that atmospheric pressure is the reference pressure applied to the pressure sensor diaphragm.

Non-vented Cable—Non-vented cable may be used with non-vented transducer (absolute measurements).

3.0 Material and Equipment

Following are the minimum equipment specifications for instrument start up and collecting water level and temperature measurements.

3.1 Data Logger

Generally a cylindrical tube made of metal that contains and includes transducers, real-time clock, micro-processor, alkaline/lithium batteries, and memory. Options include a vented or non-vented pressure sensor in a variety of ranges.

3.2 Cable

The following are several basic cables used to suspend and communicate to the transducer and generally include:

- Rugged cable, TPU-jacketed (thermoplastic polyurethane)
- Vented or non-vented
- Halogen-free vented or non-vented (low smoke zero halide rated)
- Vented fluorinated ethylene propylene cable
- Stainless steel suspension wire for deployment of non-vented transducers
- Communication cables for programming the device/downloading the logged data

3.3 Power Components

- Internal Power—Components in the instrument body operate on 3.6 VDC, supplied by a sealed or non-sealed, non-replaceable AA lithium or alkaline batteries.
- External Power
  - — External Battery Pack—A sealed submersible battery pack (lithium) supplies 14.4 volts when the power source is connected. The instrument body will use the external battery source first and switch to the internal batteries when external battery power is depleted.
  - — AC Adapter—AC adapter provides 24 VDC, 0.75 amp, AC input 100−250 volts. The programming cable includes an external power input for connection to this adapter.

3.4 Control Software

Win-Situ is the software for programming all the data logger instruments. Win-Situ provides instrument control for direct reads and profiling, long-term data logging, data downloads, data viewing, data export to popular spreadsheet programs, choice of units and other display options, battery/memory usage tracking, interface to networks and telemetry.

Minimum system requirements: 400 MHz Pentium® II processor, 128 Mb RAM, 100 Mb free disk space, Internet Explorer® 5.0 or higher, Windows® 2000 Professional SP2 or better or Windows XP Professional SP1 or better. Win-Situ connects through a serial COM port or a USB.

4.0 Procedure

4.1 Installation and Logging of Data

The installation and logging of data will be conducted according to the manufacturer's instructions. Maintenance, cleaning, and storage of data logger system equipment also will be conducted according to the manufacturer's instructions. These instructions will be kept in a centralized file that is accessible to field personnel. Any deviations from these instructions will be documented in the appropriate sampling plan.

Installing the data logger system always requires care when lowering the data logger to the approximate desired depth. Position the data logger below the lowest anticipated water level, but not so low that its range might be exceeded at the highest anticipated level. Refer to the relevant operator's manual for usable depth and stabilization time before continuing.

Connect the data logger system (cable quick disconnect) to the laptop computer and launch the appropriate software and follow the steps required to set up and run the data logger. A "Logging Setup Wizard" will prompt you through the configuration of a data logger—including the site, log name, parameters to measure, sample schedule, start time, stop time (optional), output (pressure, depth, or water level with a reference), and other options.

Once the process to start a data logger has been completed exit the program and disconnect the computer from the data logger system at the suspended cable connection.

4.2 Retrieval of Logged Data

The retrieval of logged data from the data logger will also be conducted according to the manufacturer's instructions. The steps for retrieving the logged data are the same steps required to install and start logging data. Connect the computer to the cable and launch the same software program where data can then be extracted. Data can be viewed electronically via a report or graph and then stored automatically as a file in the computer.

4.3 Factory Calibration and Field Operational Check

The pressure sensor (transducer) accuracy can be adversely affected by improper care and handling, lightning strikes and similar surges, exceeding operating temperature and pressure limits, physical damage or abuse, as well as normal drift in the device's electronic components. Aside from damage to the sensor, the need for factory recalibration is dependent upon the amount of drift. Factory calibration will be conducted if drift is greater than the specified amount described in the operator's manual.

A field operational check of the transducer will be conducted each time the logged data are retrieved. Following are the steps required to perform an operational check for each data logger installed:

[1] Obtain water level—measure actual water level using hand held water level indicator and record.

[2] Extract logged data—connect computer to data logger and run appropriate software.

[3] View specific report—Using the software click on “View Report” and compare the most recent logged data (generally the last reading recorded on the report) to the manual water level.

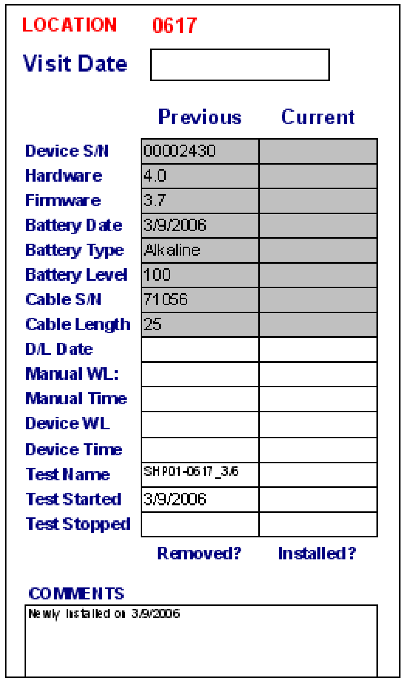
[4] Water level accuracy—after comparing water levels, the transducer is considered accurate if the measurements are within 0.3 ft of each other. If the measurements are greater than 0.3 ft then perform a field calibration described in the operator’s manual.

[5] Field calibration—to conduct a field calibration remove the transducer and conduct the field calibration. If determined that the data logger meets the acceptance criteria defined in the operator’s manual then reinstall and restart it accordingly. If the data logger does not meet the criteria then remove and send it in for a factory calibration.

5.0 Documentation

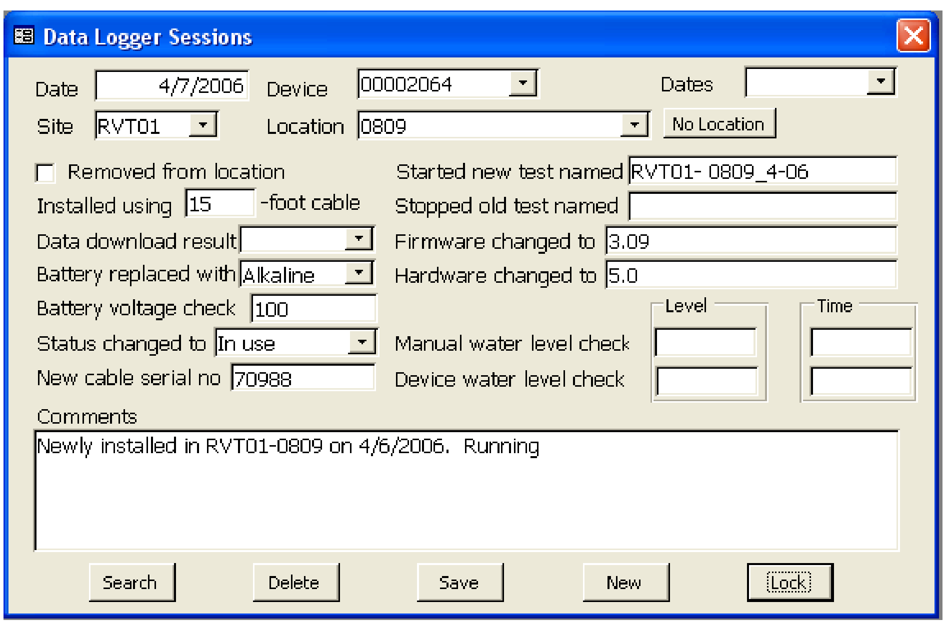
Documentation for installing/removing of data loggers and extracting logged data will include:

- Field documentation on paper forms (Data Logger Site Visit Report—refer to Data Logger Manager Technical Reference) includes:
    - Date and time−Installation/data extraction and water level taken.
    - Software and hardware used.
    - Battery−Installation date, type, and level.
    - Cable−Serial number and length.
    - Water level−Manual (measure with water level indicator) and device (last reading recorded on the report).
    - Test−Name, started, and stopped.
    - Comments−Notes regarding to other pertinent information.

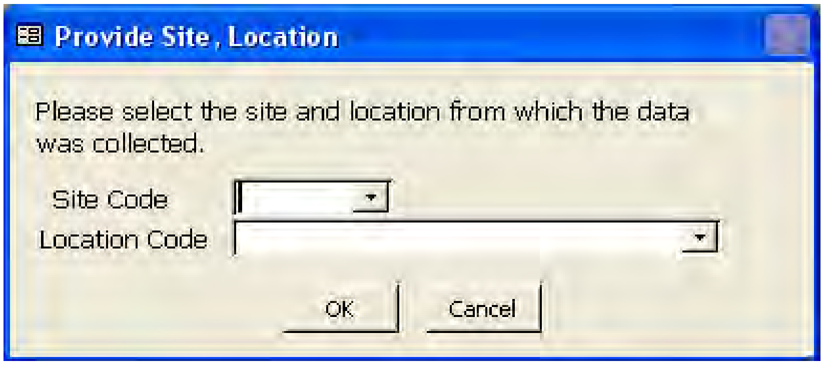


- Uploading of field documentation and extracted logged data/reports to data base using electronic forms in Data Logger Editor software application (Refer to Data Logger Manager Technical Reference) includes:

  — Edit Sessions Form−electronic form, as shown below is used to enter information that was hand written on the Site Visit Report in the field.



  — Edit/Load Data Form−electronic form used to upload logged data/reports to the data base automatically. A location selector similar to the one show below prompts the user to provide the site code and location code for the location whose data is to be loaded and/or edited.

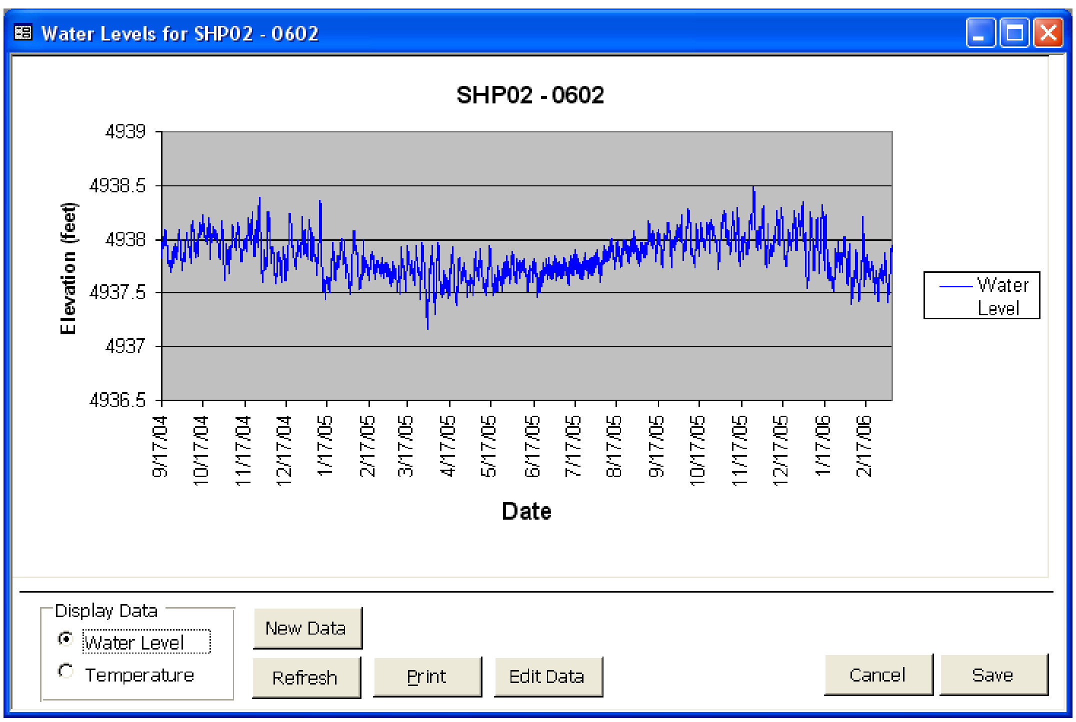


- Final reports/graphs generated using the Data Logger Editor software application (Refer to Data Logger Manager Technical Reference) includes:

  — Site Visit Report−field information.

  — Site History Report−continuous tracking report of the data logger history at each site.

  — Graph−automatically generated graph, as shown below, showing actual water levels to true elevations.



- Recording factory calibration/field operational check information includes:

  — Water level comparisons within or outside acceptance criteria

  — Name of person conducting the calibration/checks

  — Date and time of factory calibration/field operational check

6.0 References

In-Situ Inc., 2005. Level TROLL Operator's Manual, available at www.in-situ.com.

Data Logger Manager Technical Reference, available at \\Condor\raapps\Data Logger Manager\Documentation.

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Appendix B

Desk Instructions

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Appendix B–1

Field Data Collection System—Version 1.8 Desk Instructions

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Contents

Figures

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1.0 Introduction

The Field Data Collection System (FDCS) is a computer-based system designed to: (1) interface with Legacy Management (LM) databases and software programs to download needed information into the Toughbook field computer prior to a sampling event; (2) provide for electronic collection of water sampling field data at LM sites; (3) interface with LM databases to upload field data after collection; (4) provide quality control checks through the sampling process; (5) generate print and/or electronic reports for documentation; and (6) provide a paper-free method of data collection.

2.0 Purpose

The purpose of this desk instruction is to provide guidance to personnel using the FDCS during routine water sampling activities at LM sites. A copy of this desk instruction will be available on each Toughbook field computer that has the FDCS installed so that field personnel can access the instructions in the field. In addition, a copy of the FDCS Desk Instructions will be appended to the *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (SAP) (LMS/PLN/S04351).

3.0 Scope

The FDCS was designed for use in routine groundwater and surface water sampling at LM sites. It is not intended to be used for collection of soil, air, or biological samples. In addition, there may be some non-routine water sampling activities where the FDCS is appropriate to use.

4.0 Startup

Click on the FDCS icon on the desktop to start the program. The opening menu (Figure 1) has nine buttons that function as follows.

1. New Session

   This function is used to open a new file at the start of sampling activities at a well/surface water location. If a safety meeting attendance record has not been created on the current day, the user is alerted with the Safety Meeting Check window (Figure 2) before a new file is opened.

2. Recover Session

   This function is used to recover a previous session (open a file) for a location that was not completed (e.g. because of power loss or return later to sample), or to open a file to edit a location that has been completed (signed off). To view and recover locations that have been completed, the check box at the bottom must be unchecked (Figure 3). The time and date, site, and location are part of the file name to aid in the selection of the correct file.

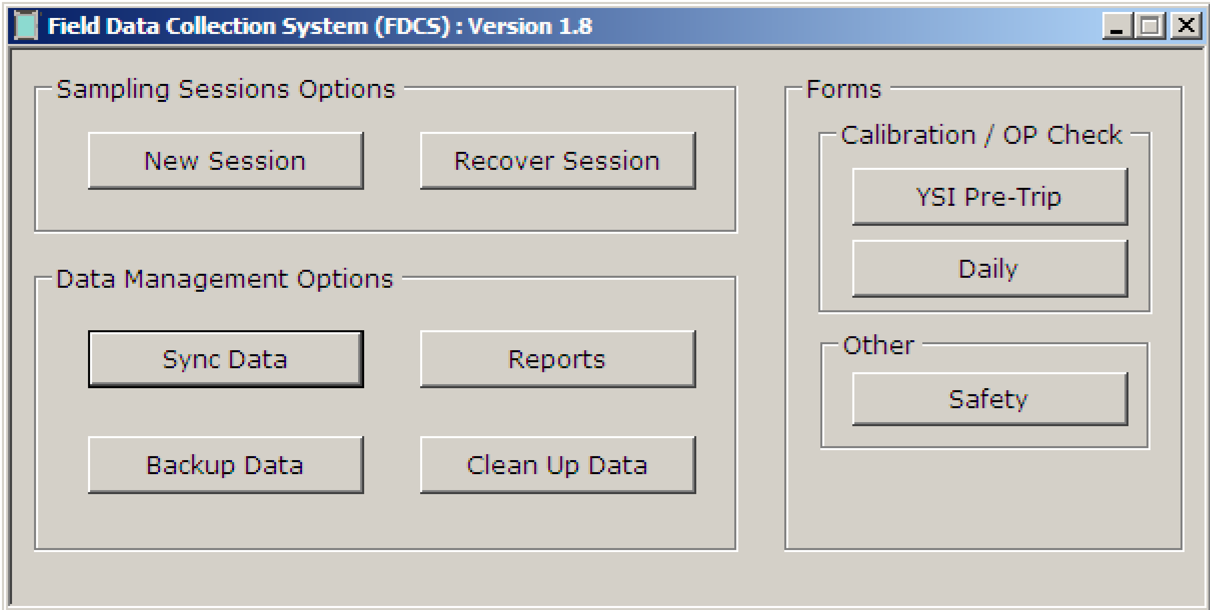


Figure 1. Opening Menu

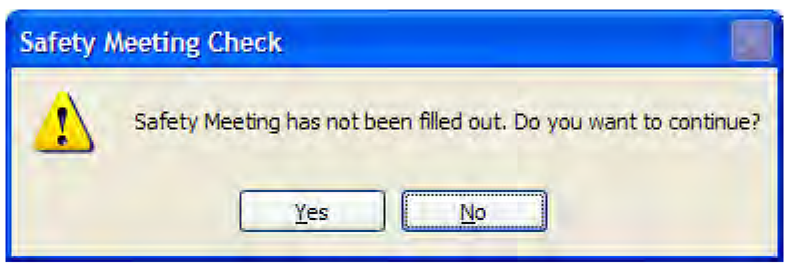


Figure 2. Safety Meeting User Alert

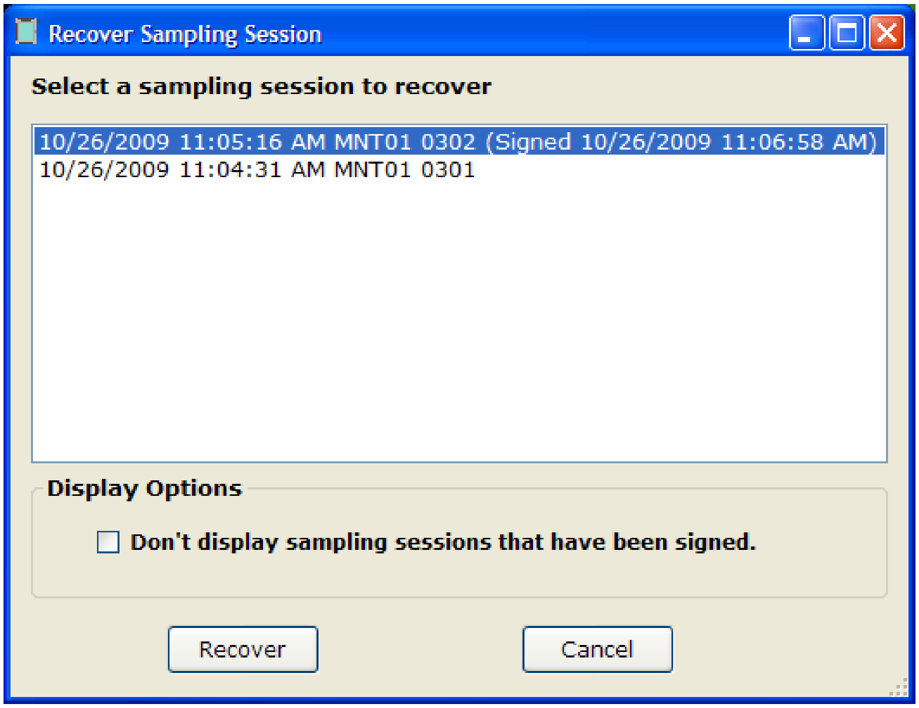


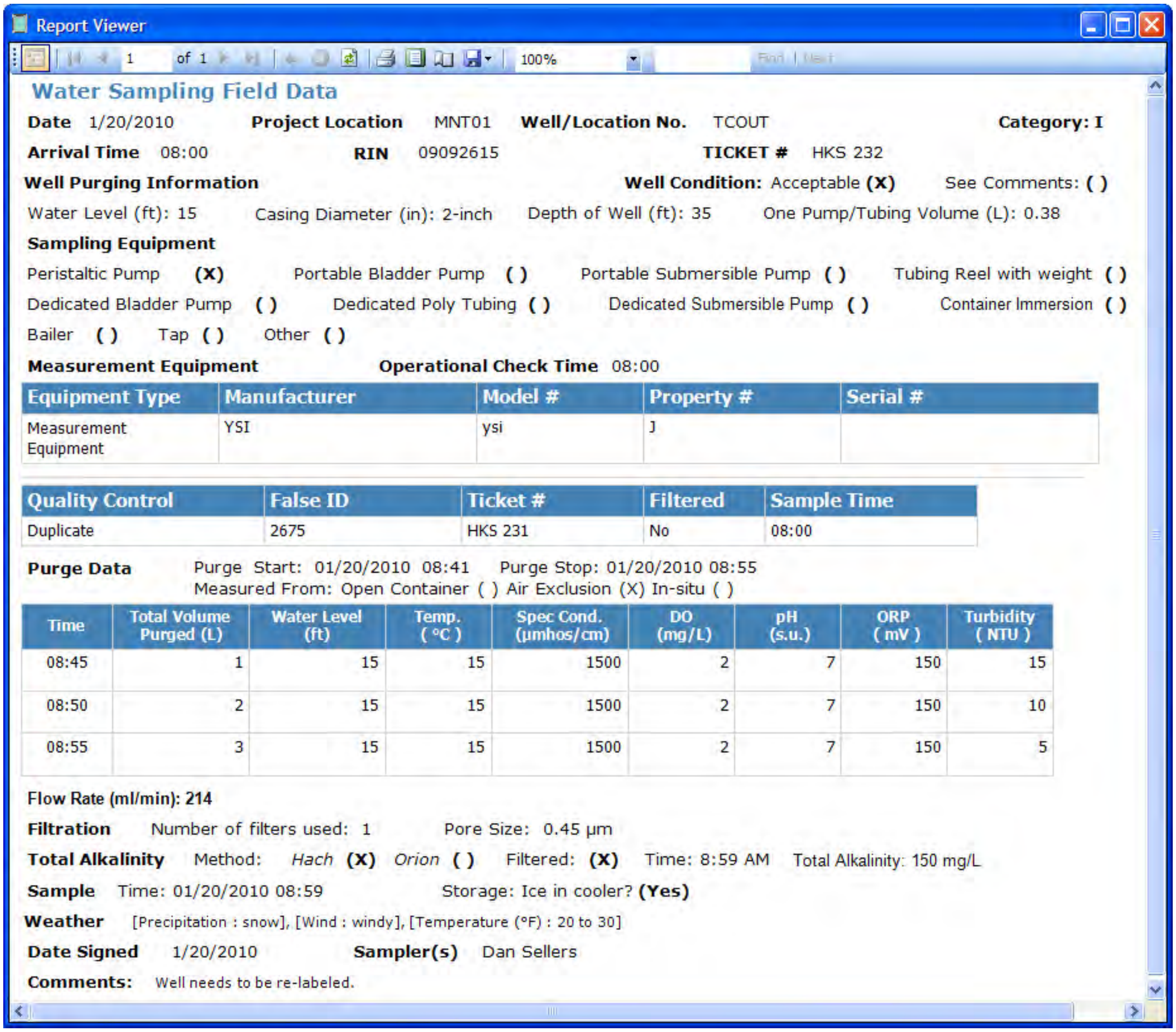
Figure 3. Recover Sampling Session

3. Sync Data

   This function is used to load data into the Toughbook field computer prior to going out to the field, and to upload field data at the end of a sampling period or end of a sampling event.

4. Reports

   This function is used to view data collected at a location after sign-off (Figure 4) or to view the Summary Report (Figure 5). These reports are for viewing only and cannot be edited. If editing is needed, the Recover Session function is used to retrieve the file, which may be edited.



Report Viewer

Water Sampling Field Data

Date 1/20/2010 **Project Location** MNT01 **Well/Location No.** TCOUT **Category: I**

Arrival Time 08:00 **RIN** 09092615 **TICKET #** HKS 232

Well Purging Information **Well Condition:** Acceptable **(X)** See Comments: **( )**

Water Level (ft): 15 Casing Diameter (in): 2-inch Depth of Well (ft): 35 One Pump/Tubing Volume (L): 0.38

Sampling Equipment

Peristaltic Pump **(X)** Portable Bladder Pump **( )** Portable Submersible Pump **( )** Tubing Reel with weight **( )**

Dedicated Bladder Pump **( )** Dedicated Poly Tubing **( )** Dedicated Submersible Pump **( )** Container Immersion **( )**

Bailer **( )** Tap **( )** Other **( )**

Measurement Equipment **Operational Check Time** 08:00

Equipment Type	Manufacturer	Model #	Property #	Serial #
Measurement Equipment	YSI	ysi	J	

Quality Control	False ID	Ticket #	Filtered	Sample Time
Duplicate	2675	HKS 231	No	08:00

Purge Data Purge Start: 01/20/2010 08:41 Purge Stop: 01/20/2010 08:55
Measured From: Open Container ( ) Air Exclusion (X) In-situ ( )

Time	Total Volume Purged (L)	Water Level (ft)	Temp. (°C)	Spec Cond. (µmhos/cm)	DO (mg/L)	pH (s.u.)	ORP (mV)	Turbidity (NTU)
08:45	1	15	15	1500	2	7	150	15
08:50	2	15	15	1500	2	7	150	10
08:55	3	15	15	1500	2	7	150	5

Flow Rate (ml/min): 214

Filtration Number of filters used: 1 Pore Size: 0.45 µm

Total Alkalinity Method: *Hach* **(X)** *Orion* **( )** Filtered: **(X)** Time: 8:59 AM Total Alkalinity: 150 mg/L

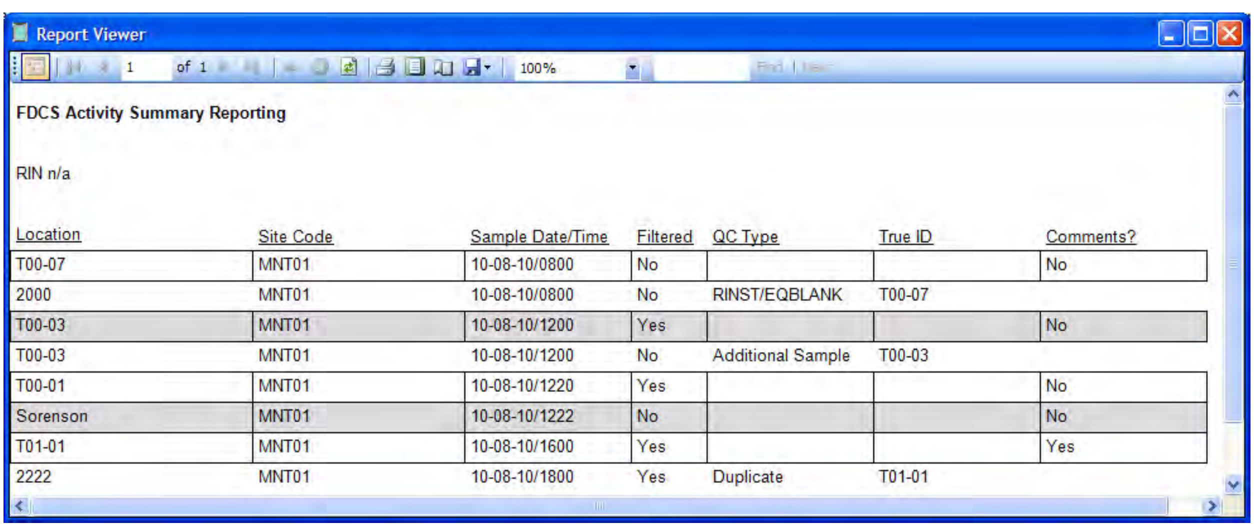
Sample Time: 01/20/2010 08:59 Storage: Ice in cooler? **(Yes)**

Weather [Precipitation : snow], [Wind : windy], [Temperature (°F) : 20 to 30]

Date Signed 1/20/2010 **Sampler(s)** Dan Sellers

Comments: Well needs to be re-labeled.

Figure 4. Example Report for a Location



Report Viewer

FDCS Activity Summary Reporting

RIN n/a

Location	Site Code	Sample Date/Time	Filtered	QC Type	True ID	Comments?
T00-07	MNT01	10-08-10/0800	No			No
2000	MNT01	10-08-10/0800	No	RINST/EQBLANK	T00-07	
T00-03	MNT01	10-08-10/1200	Yes			No
T00-03	MNT01	10-08-10/1200	No	Additional Sample	T00-03	
T00-01	MNT01	10-08-10/1220	Yes			No
Sorenson	MNT01	10-08-10/1222	No			No
T01-01	MNT01	10-08-10/1600	Yes			Yes
2222	MNT01	10-08-10/1800	Yes	Duplicate	T01-01	

Figure 5. Example Summary Report

5. Backup Data

   This function is used to back up data collected on the Toughbook field computer to another location. Backup should be conducted daily if the sync process is not conducted.

6. Clean Up Data

   This function is used to delete locations/files that were not completed and will never be completed.

7. YSI Pre-Trip

   This function is used to create a pre-trip calibration form for the field measurement equipment.

8. Daily

   This function is used to create an operational checks form for the field measurement equipment.

9. Safety

   This function is used to create a safety meeting attendance record.

5.0 Pre-Sampling Sync

Prior to sampling, the Toughbook field computer needs to be connected to the LM network, and the Sync Data function performed. The pre-sampling sync loads the site, Requisition Index Number (RIN), well information, and ticket numbers into the Toughbook field computer.

The FDCS program will ask two questions during the sync. The first question, “Do you want to replace the sites you have available in the application?” is shown in Figure 6. If you answer “Yes” to the first question, a menu of all LM sites will be displayed (Figure 7). The site (or sites) to be sampled is selected by checking the adjacent box. After site selection, the user will be asked to verify (Figure 8). If you answer “No” to the first question, you will have only sites available from the previous sync.

The second question, “Do you want to load data associated with a RIN #?” is shown in Figure 9. If you answer “Yes” to this question, the current RINs available for the sites selected will be displayed (Figure 10). The appropriate RIN (or RINs) is selected by checking the adjacent box.

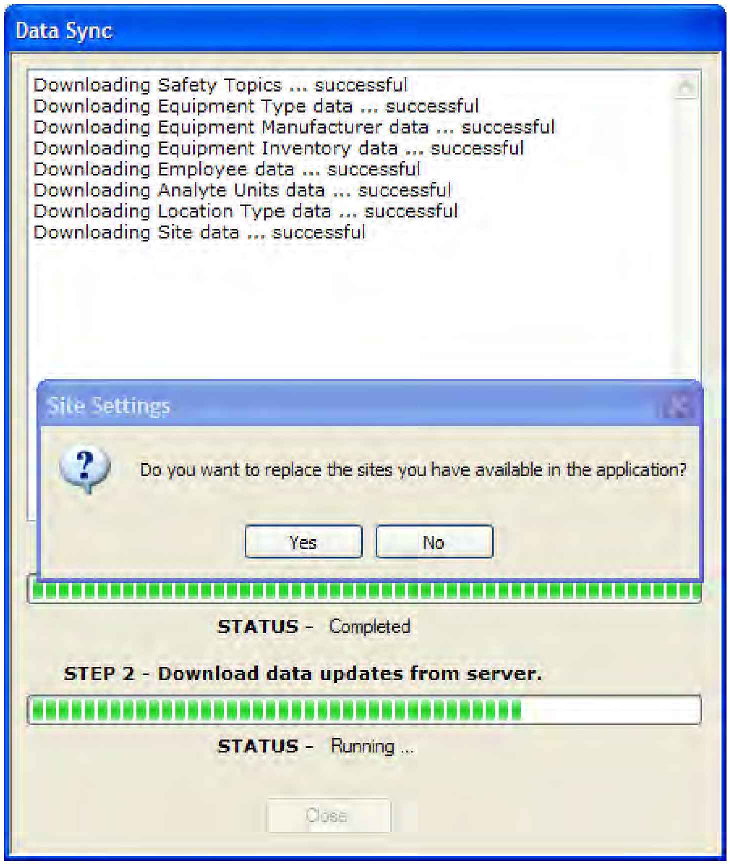


Figure 6. Sync Question 1

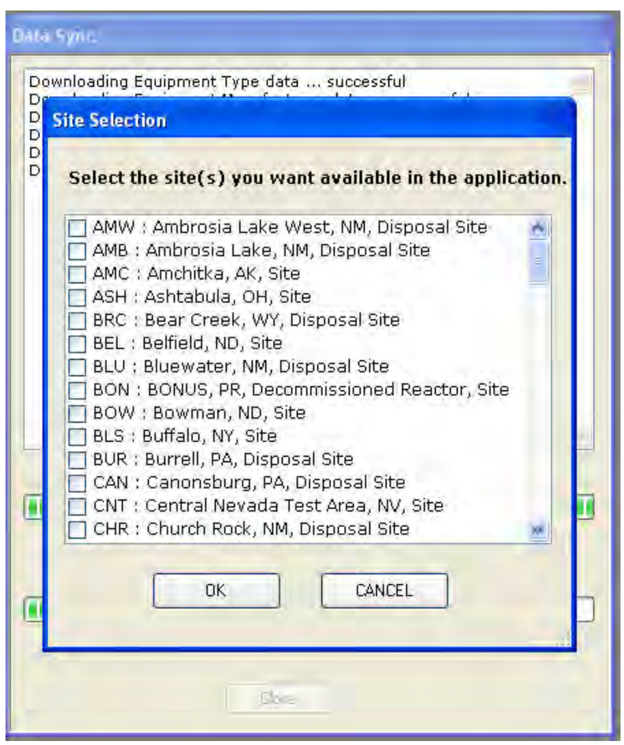


Figure 7. Sites Menu from Sync Question 1

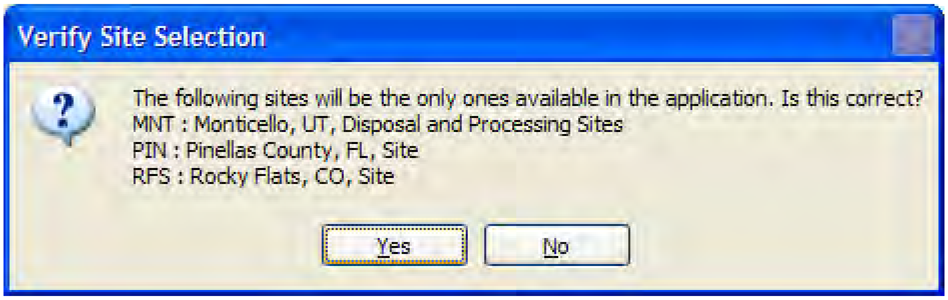


Figure 8. Verify Site Selection

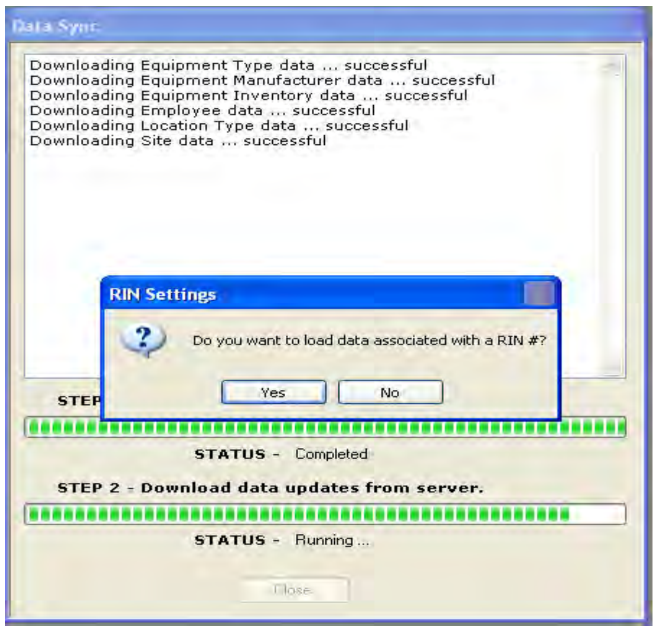


Figure 9. Sync Question 2

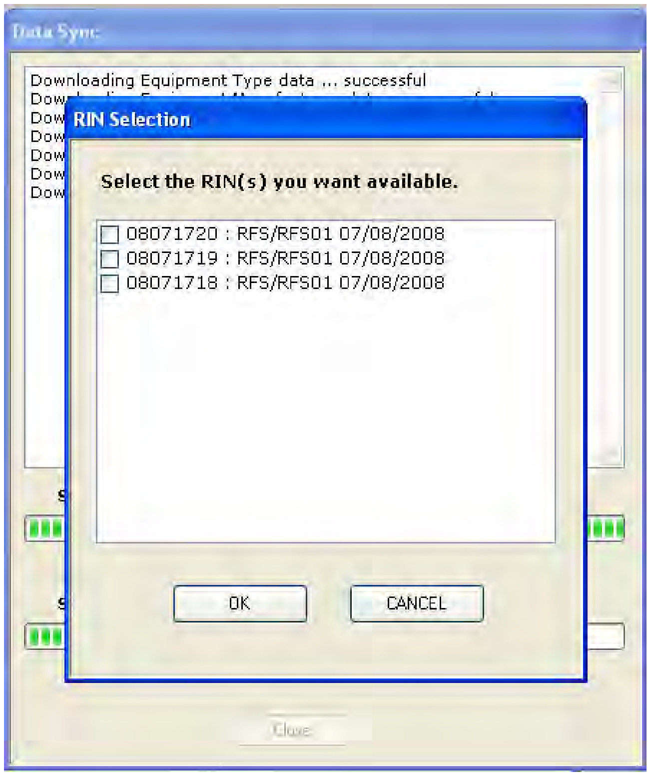


Figure 10. RIN Menu from Sync Question 2

6.0 Sampling a New Location

To start sampling at a new location, click on the New Session button on the opening menu. The FDCS will advance through numerous steps as the sampling process proceeds. These steps are described in this section.

<u>Step 1: Header Information</u>

Header information is shown in Figure 11. Throughout the FDCS, moving around to various fields can be accomplished with the mouse/cursor, or moving between adjacent fields can be accomplished by using the tab key (forward) and shift tab keys (backward). Following is the function of each field/button.

> Next—Proceed to Step 2 after Header Information is completed.
>
> Colors—Allows user to change screen colors used for quality control lights (Step 4) and for the information bar in order to make the colors visible while working in the field.
>
> Sensor—Opens the Sensor Control window, which initiates communication between FDCS and the Sonde, and displays the Opening menu for Sonde operations. This opening menu allows selection of the "Report" function to change the view of available measurements (Section 7.0).
>
> Comments—Allows addition of notes throughout the sampling process.

Arrival Date/Arrival Time—Computer date and time are captured when a new sampling location is opened. Both date and time can be edited manually by highlighting a value and using the adjacent up and down arrows.

RIN—Select the proper preloaded RIN or check the N/A box.

Site—Select sampling site.

Search Options—Can be used to help find a location ID.

Location—Select sampling location.

Add—Allows addition of a sampling location (new or existing location) that was not specified in the RIN. If a previously unsampled location is added (not in the SEEPro database), the FDCS will ask if this location is a groundwater or surface water location in order to proceed to the proper steps and/or forms.

Ticket #—The ticket number may be preloaded, entered manually if using a paper ticket, or the N/A boxed checked if a ticket number is not used.

Samplers—Select samplers at the location by checking the box adjacent to the name. Sampler names selected will be carried over to the next location.

Order By—Allows sorting of sampler names.

Weather—Drop down boxes to describe weather conditions.

Quality Control/Additional Sample—List quality-control-sample information (Figure 12) in this section by clicking the Add button if quality control samples or additional samples are collected.

Moving the Navigation Bar—The small icon in the lower left corner of the window (it has been circled in Figure 11) allows the user to move the navigation bar to the bottom of the window.

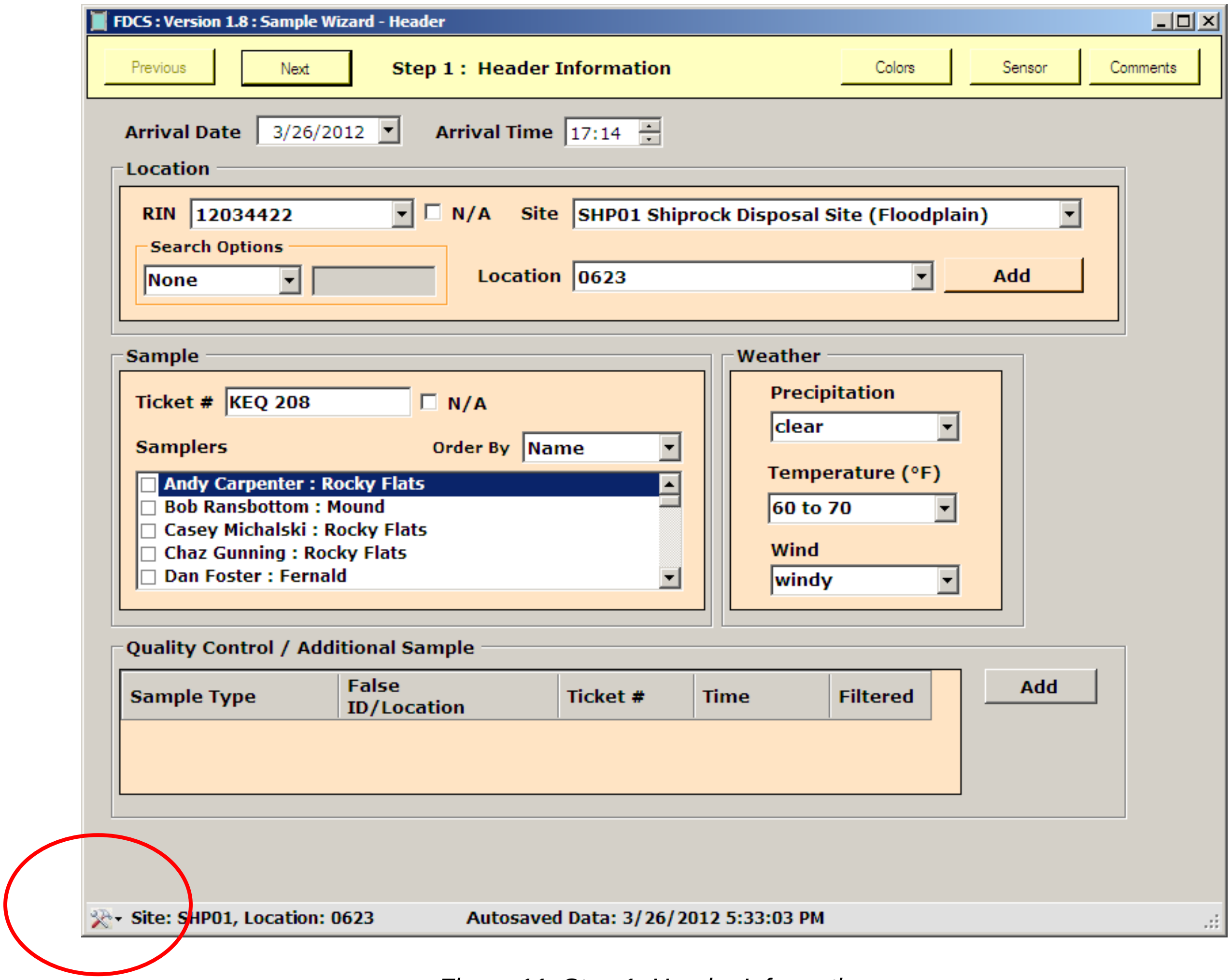


Figure 11. Step 1: Header Information

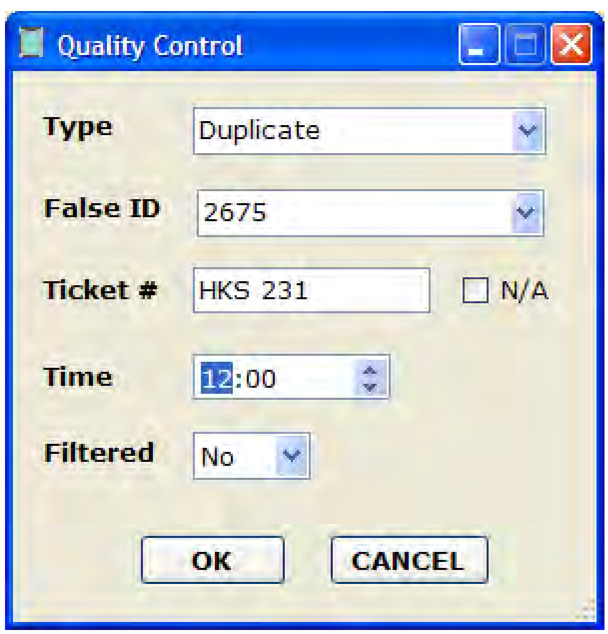


Figure 12. Quality Control Information

Step 2: Calibration and Equipment

Calibration and Equipment information is shown in Figure 13. Following is the function of each field/button.

Previous—Go back to Step 1.

Next—Proceed to Step 3 after Calibration and Equipment Information is completed.

Colors—Allows user to change screen colors used for quality control lights (Step 4) and for the information bar in order to make the colors visible while working in the field.

Sensor—Opens the Sensor Control window, which initiates communication between FDCS and the Sonde, and displays the Opening menu for Sonde operations. This opening menu allows selection of the "Report" function to change the view of available measurements (Section 7.0).

Comments—Allows addition of notes throughout the sampling process.

Sampling Equipment—Select sampling equipment by checking the box adjacent to the equipment.

Operational Check Time—If an operational checks form is completed using the FDCS, then the operational check time will be transferred automatically from the operational checks form. If an operational checks form is not completed, enter the time of the last operational check or calibration; if the measurement equipment used does not require an operational check or calibration, then check the "Calibration N/A for selected equipment" box.

Add Equipment—Check the box adjacent to the measurement equipment used. Use the Add Equipment button to view the master list of equipment to select from. Once equipment is selected for a sample, the equipment will be displayed in Step 2 at each subsequent location but can be removed using the Remove button. Although the measurement equipment will be displayed at each location, it may have to be selected (by checking the box in the Use column) at each new location.

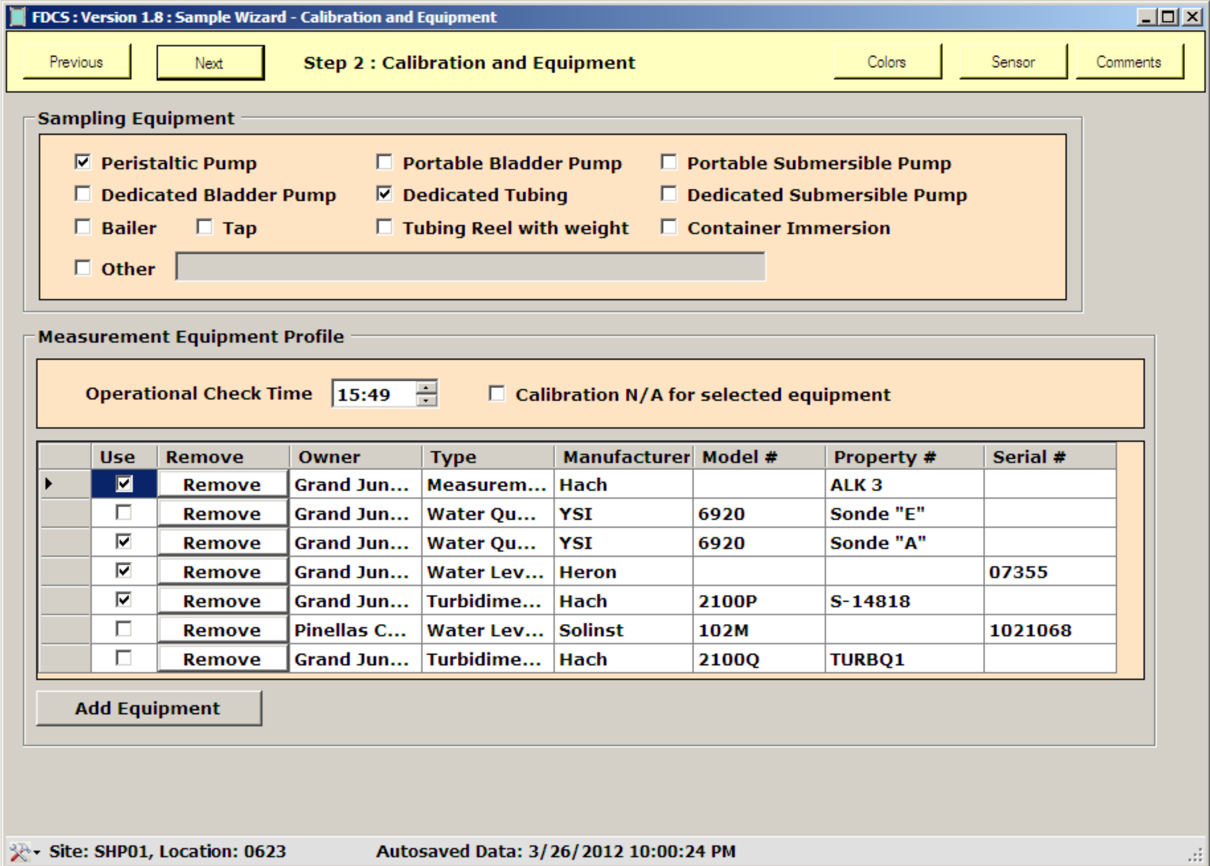


Figure 13. Step 2: Calibration and Equipment

<u>Step 3: Well Information</u>

If a well location was selected in Step 1, this step will contain well information (Figure 14). If a surface water location was selected in Step 1, continue to the next section, Step 3: Surface Location Field Measurements. Following is the function of each field for the Well Information form.

Previous—Go back to Step 2.

Next—Proceed to Step 4 after Well Information is completed. A Category must be selected on this Step 3 screen for the Next button to be activated.

Colors—Allows user to change screen colors used for quality control lights (Step 4) and for the information bar in order to make the colors visible while working in the field.

Sensor—Opens the Sensor Control window, which initiates communication between FDCS and the Sonde, and displays the Opening menu for Sonde operations. This opening menu allows selection of the "Report" function to change the view of available measurements (Section 7.0).

Comments—Allows addition of notes throughout the sampling process.

Depth to Water—Enter the initial depth to water measurement at a well. For locations with accepted water level ranges, a red quality control light will illuminate if the measurement is out of range. See the example in Figure 14. The control light functions only to alert the user and will not prevent entry of the measurement.

Casing Diameter—Casing diameter, in inches, will be preloaded if the diameter is in the database. Otherwise, use the drop down menu or enter the value directly.

Depth of Well—Depth of well will be preloaded if it is in the database. Otherwise, enter the well depth manually.

Measured From—Use the drop down menu to enter where the water level was measured from, either TOC (top of casing) or TPC (top of protective casing).

Water Level Flag—Use the check box and drop-down list to indicate if well is dry or flowing (artesian), or if the water level is below the top of the pump. If the well is dry, select a well category (this will activate the Next button) then use the Next button to advance to step 5, where the location can be signed off.

Category—Select the Category of well per SAP protocol.

Note

The FDCS will track the site from Step 1 and will go to the specific purging criteria developed for that site. Not all sites will have well categories (i.e., Pinellas and Fernald) and there will be slight differences in the required information and appearance of Steps 3 and 4. Some sites will have different purge options also (e.g., high flow).

One Pump and Tubing Volume—Enter values for tubing length, tubing diameter, and bladder volume (if applicable) and the FDCS will calculate one pump and tubing volume. The pump and tubing volume may be preloaded during the sync process for some sites. In addition, the purge volume may be provided ("Provided" in Volume is dropdown menu). To manually enter the pump and tubing volume, select "Provided" and de-select the box next to "Search for default purge volume."

Well Inspection—Click "Yes" or "No" to answer the question if all components of a well are acceptable. Enter comments about components of the well that are deficient and need attention. These comments will be displayed in the report along with all other notes taken at a location.

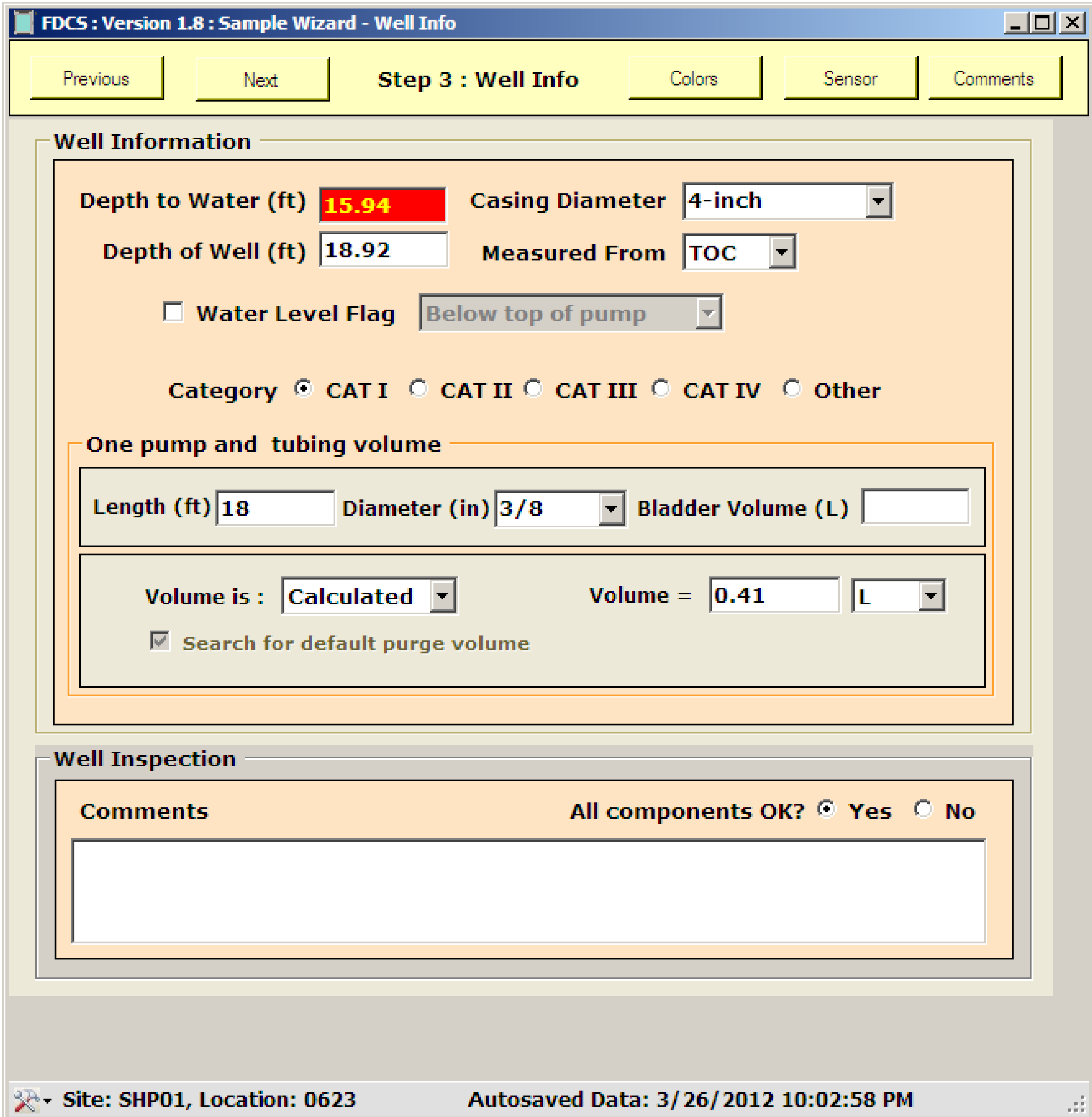


Figure 14. Step 3: Well Info

Step 3: Surface Location Field Measurements

If a surface water location was selected in Step 1, this step will contain surface location field measurements (Figure 15). Following is the function of each field for the Surface Location Field Measurements form.

Previous—Go back to Step 2.

Next—Proceed to Step 4 after surface location measurements are completed.

Colors—Allows user to change screen colors used for quality control lights (Step 4) and for the information bar in order to make the colors visible while working in the field.

Sensor—Opens the Sensor Control window, which initiates communication between FDCS and the Sonde, and displays the Opening menu for Sonde operations. This opening menu allows selection of the "Report" function to change the view of available measurements (Section 7.0).

Comments—Allows addition of notes throughout the sampling process.

Sonde Data Capture—Opens the Sensor Control window, which initiates communication between FDCS and the Sonde, and displays Sonde measurements in the Sensor Control window.

Measurement(s) made—Check the box adjacent to one of the choices to indicate how field measurements were made.

Time—Computer time is captured when a box is checked in the Enter Data column. Time may be adjusted by highlighting a value and using the adjacent up and down arrows.

Field Data—Once the Enter Data column is checked, field data (water level, temperature, specific conductance, dissolved oxygen, pH, ORP, and turbidity) will be captured by the computer or hand entered by the user into the appropriate column.

Sensor Reading—This column contains buttons that are activated if the FDCS is in communication with the Sonde (see Section 7.0, "Sonde Data Capture"). While live Sonde data are being read by FDCS, the user can lock the readings with the LOCK button. If desired, the readings can be unlocked (to resume the reading of live data) by selecting the LOCK button again.

Add Row—This button is used to add a row at the bottom of the page for additional collection of field data. As more rows are added and the screen is filled, the top rows will scroll off the screen.

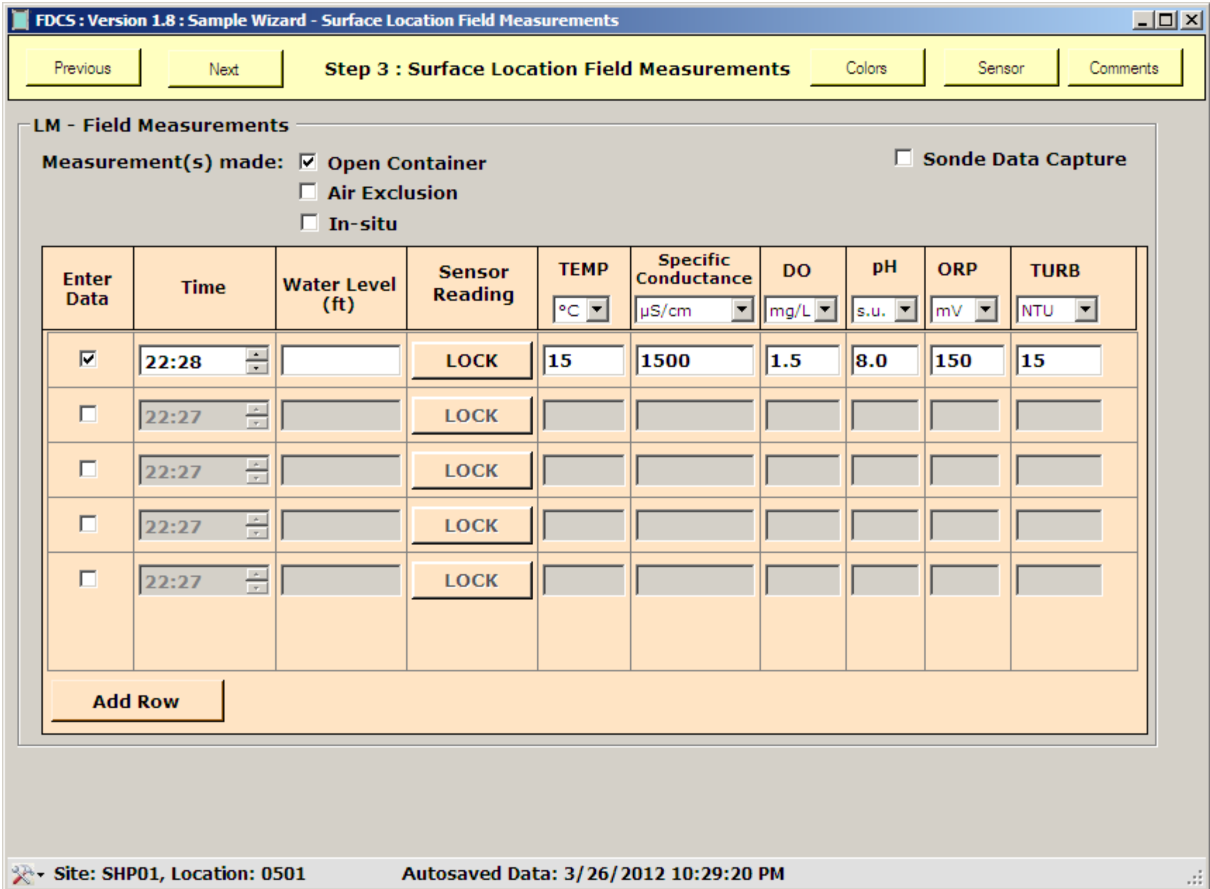


Figure 15. Surface Location Field Measurements

Step 4: Purge Data

Purge Data is shown in Figure 16. The FDCS will track the site selected in Step 1 and will use the proper purge data form designed for that site. Figure 16 shows purge criteria for a Category I well at Rocky Flats. If a surface water location is selected, this form will be replaced with the Surface Location Field Measurement form (Figure 15). Following is the function of each field for the Purge Data form.

Previous—Go back to Step 3.

Next—Proceed to Step 5 after purge is completed.

Colors—Allows user to change screen colors used for quality control lights (see below) and for the information bar in order to make the colors visible while working in the field.

Sensor—Opens the Sensor Control window, which initiates communication between FDCS and the Sonde, and displays the Opening menu for Sonde operations. This opening menu allows selection of the "Report" function to change the view of available measurements (Section 7.0).

Comments—Allows addition of notes throughout the sampling process.

Purge Start Time—Computer time and date is captured by clicking on the Start button at the start of the purging process. The purge start time and date can be adjusted by highlighting a value and using the adjacent up and down arrows.

Sonde Data Capture—Opens the Sensor Control window, which initiates communication between FDCS and the Sonde, and displays Sonde measurements in the Sensor Control window.

Measurement(s) Made—Check the box adjacent to one of the choices to indicate how field measurements were made.

Depth to Water (DTW)—Informational only. Lets the sampler(s) know the initial depth to water.

Minimum Purge Volume—Informational only. Lets the sampler know the minimum purge volume required before sampling can commence. The quality control light will turn from red to green (or whatever color the user has selected) when the minimum volume has been obtained.

Overall Flow Rate—The average purge rate is calculated by the FDCS by dividing the overall volume by the overall time. The quality control light will turn from red to green (or whatever color the user has selected) when the flow rate is below the maximum allowed.

Time—Computer time is captured when a volume is entered. Time may be adjusted by highlighting a value and using the adjacent up and down arrows.

Total Purge Volume—The user manually enters the cumulative volume purged. A unit of either liters or gallons must be selected using the dropdown menu in the header.

Flow Rate—The flow rate is calculated since the last set of time and volume measurements. Units of mL/min or gal/min may be selected using the dropdown menu in the header.

Field Data—Enters field data (water level, temperature, specific conductance, dissolved oxygen, pH, ORP, and turbidity) into the appropriate column. Quality control lights in the header will change from red to green (or whatever color the user has selected) as purge stabilization criteria is achieved. In addition, a red quality control light will illuminate for a particular value if it is out of the normal range for that parameter. Quality control lights for purge stability and individual parameter values function only to alert the user and will not prevent entry, continuation to the next step, or uploading of field data.

Sensor Reading—This column contains buttons that are activated if the FDCS is in communication with the Sonde (see Section 7.0, "Sonde Data Capture"). While live Sonde data are being read by FDCS, the user can lock the readings with the LOCK button. If desired, the readings can be unlocked (to resume the reading of live data) by selecting the LOCK button again.

Add Row—This button is used to add a row at the bottom of the page for additional collection of field data. As more rows are added and the screen is filled, the top rows will scroll off the screen.

Purge Stop Time—The time and date of the last row of field measurements will be captured by clicking the “Stop” button at the end of the purge. The date and time can be manually adjusted by highlighting a value and using the adjacent up and down arrows.

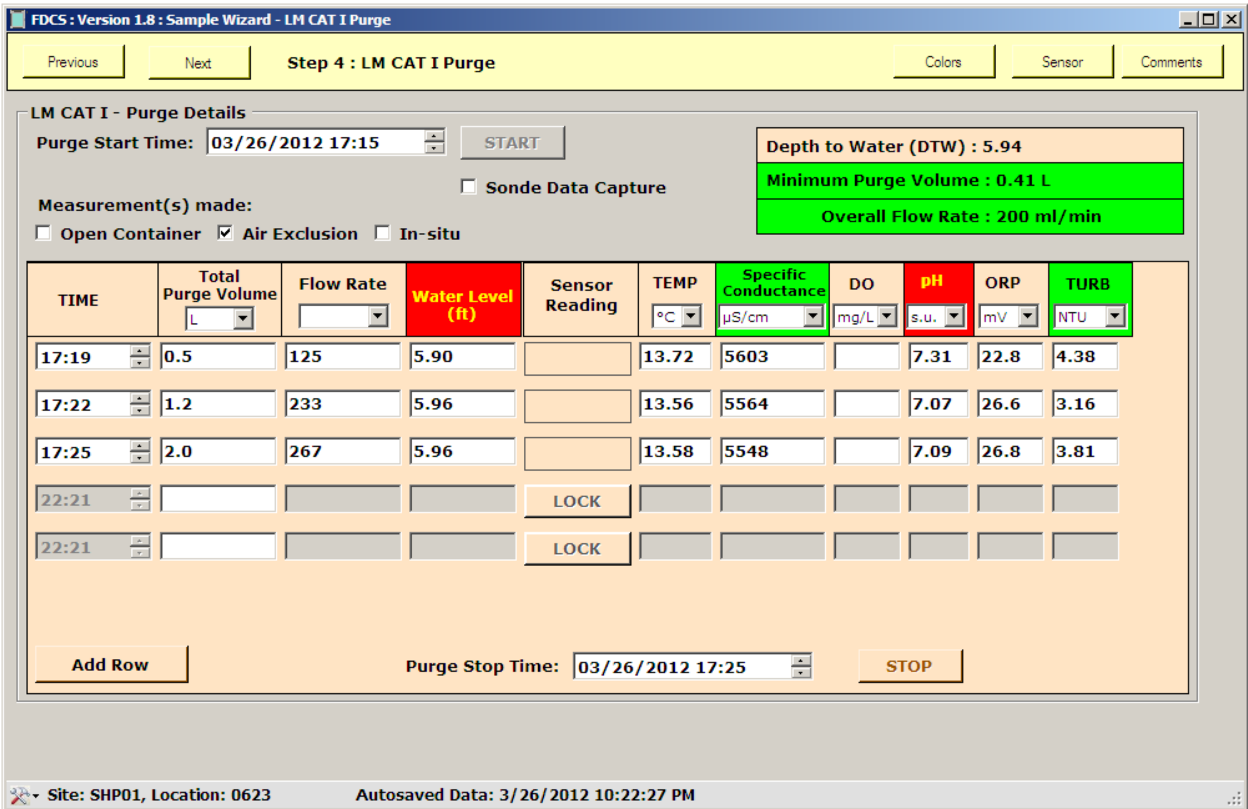


Figure 16. Purge Data

<u>Step 5: Field Measurements</u>

Note: For surface water locations, the field measurements are collected as Step 4.

Field Measurements are shown in Figure 17. Following is the function of each field.

Previous—Go back to Step 4.

Colors—Allows user to change screen colors used for quality control lights and for the information bar in order to make the colors visible while working in the field.

Sensor—Opens the Sensor Control window, which initiates communication between FDCS and the Sonde, and displays the Opening menu for Sonde operations. This opening menu allows selection of the “Report” function to change the view of available measurements (Section 7.0).

Comments—Allows addition of notes throughout the sampling process.

Additional Field Measurements—Check the box next to a field measurement on the left to bring up a form used to record the required information.

Sample Time—Click the Set button to indicate sample date and time. The Set button will capture computer date and time, but date and time can be adjusted by highlighting a value and using the adjacent up and down arrows.

Ice in cooler?—Use the adjacent dropdown box to indicate if ice is present (or not) in the cooler when sample aliquots require cooling, or check the N/A box if no sample aliquots require cooling.

Sign Off—The Sign Off button is used when the location is complete. This will close the file, and the FDCS will return to the opening menu.

View Report—Click on the View Report button to review all information collected at the current location (Figure 4). The Report cannot be edited here; to make changes use the Previous/Next buttons to navigate to the appropriate step. A report can be viewed after sign off using the Reports function on the opening menu.

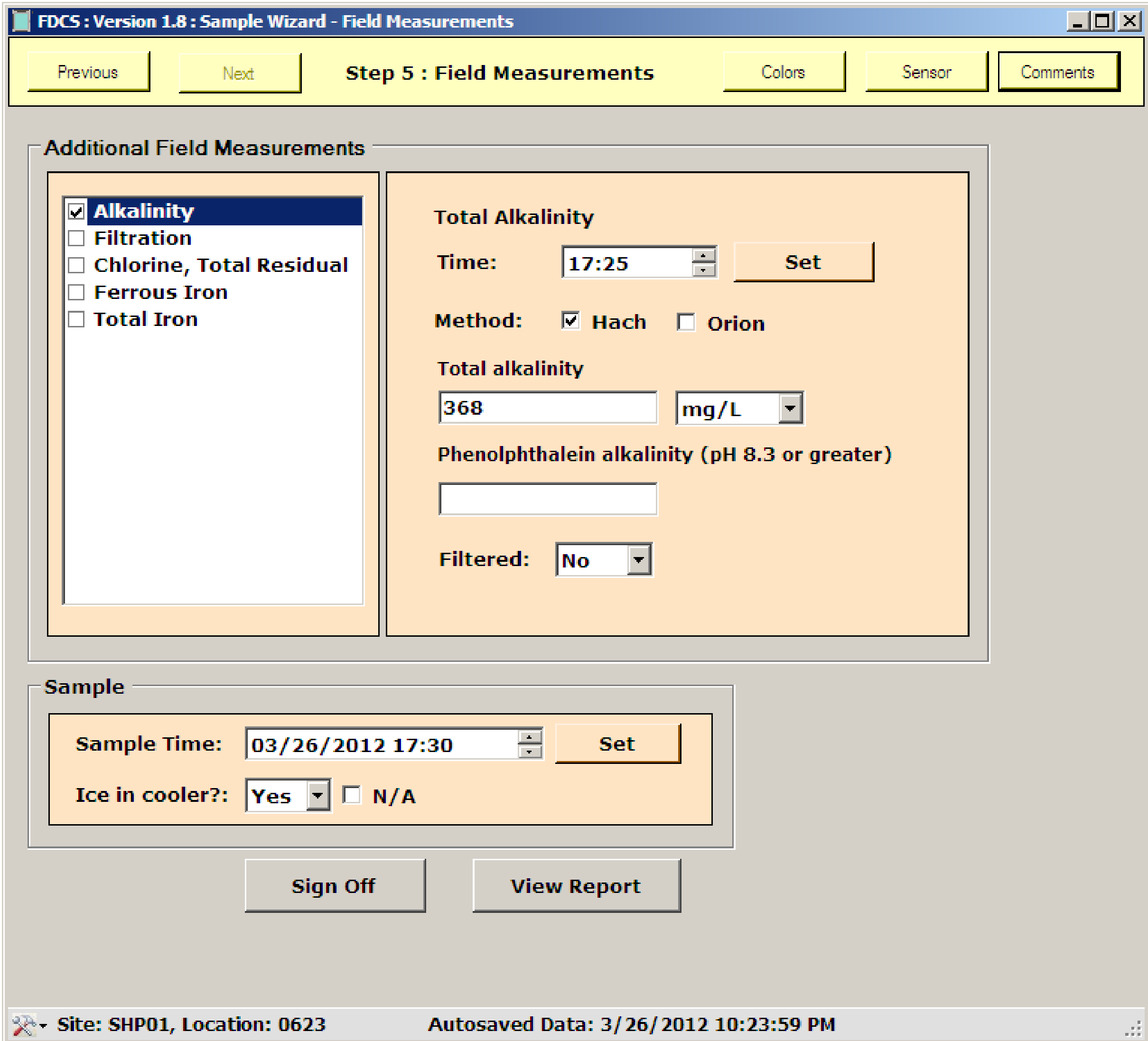


Figure 17. Step 5: Field Measurements

7.0 Sonde Data Capture

To capture live readings from the Sonde, select the "Sonde Data Capture" box (Step 4 for groundwater measurements) or in the Surface Location Field Measurements window (Step 3 for surface water measurements). The Sensor Control window (Figure 18) will open, allowing live readings from the Sonde to be captured by FDCS. Select the Sensor button at any step to open the Main menu (Figure 19). This opening menu allows selection of the "Report" function to change the view of available measurements.

For the data capture to function correctly, the following conditions must be met:

- Power must be supplied to the Sonde, either from an external source or from batteries inside the Sonde.
- The Sonde must be connected to FDCS through a COM port on the laptop and the correct COM port must be selected in the Sensor Control window (Figure 18). To select the

correct COM port, click the enable button and select the COM port from the drop down list on Sensor COM Port. Once the correct COM port is chosen (COM 1), the "Enable" box must be un-checked.

Figure 18. Sensor Control Window Displaying Live Readings

Figure 19. Opening Menu for Sonde Operations

8.0 Post-Sampling Sync

The sync function at the end of the sampling period or sampling event is used to upload field data to a centralized FDCS database and to FieldPar, which is a temporary database for field data. During the data loading process, field data is merged with analytical laboratory data and entered into the SEEPro database. The sync also will file the reports of all completed locations, safety meeting reports, and pre-trip and daily calibration forms electronically in the “SMS on Condor” network location under the appropriate RIN number. **Reminder: Don’t forget the Post-Sampling Sync.** Once the post-sampling sync is performed, recovery of and edits to a sampled location are no longer possible through the FDCS.

9.0 FDCS Updates

Periodic FDCS updates will be required as adjustments are made based on user input and as new functionality is added to the FDCS. When updates are needed, all Toughbook field computers will be updated through the Information Technology group.

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Appendix B−2

Water Level Recorder Desk Instructions

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Contents

Figures

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1.0 Introduction

The Water Level Recorder is a computer-based system designed for use on a personal digital assistant (PDA) to: (1) interface with Legacy Management (LM) databases and software programs to download needed information into the PDA prior to a making water-level measurements; (2) provide for electronic collection of water-level data, well inspection observations, and well maintenance notes at LM sites; (3) interface with LM databases to upload water-level data after collection; (4) provide quality control checks through the water-level measurement process; (5) generate electronic reports for documentation; and (6) provide a paper-free method of data collection.

2.0 Purpose

The purpose of this desk instruction is to provide guidance to personnel using the Water Level Recorder when conducting water-level measurements, well inspections, or well maintenance at LM sites. A copy of the Water Level Recorder Desk Instructions will be appended to the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (SAP) (LMS/PLN/S04351).

3.0 Scope

The Water Level Recorder was designed for use when conducting routine water-level measurements at LM sites, which involves measuring water levels at numerous locations at a site over a short time-frame. It is not intended to be used to collect water-level data during groundwater sampling because the Field Data Collection System is used for that purpose. In addition, there may be some non-routine water level measurement activities, e.g., during pump tests, where the Water Level Recorder is not appropriate to use. The Water Level Recorder may also be used to record well inspection observations and to document well maintenance.

4.0 Startup

Click on the "Water Level" icon on the Start menu to start the program. The opening menu (Figure 1) has four buttons and other information that function as described below.

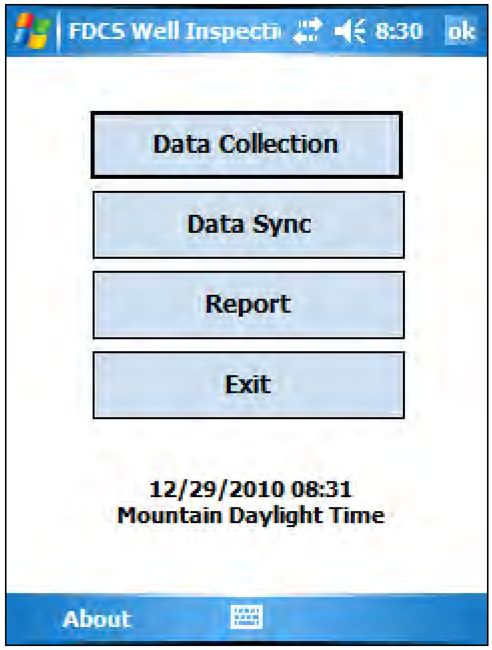

Figure 1. Opening Menu

Data Collection

This function is used to access the steps to record new water-level data, inspection observations, and well maintenance documentation.

Data Sync

Prior to taking measurements, this function is used to select the site where data will be collected and to download locations and historical data into the PDA. After taking measurements, this function is used to upload water-level data to the database.

Report

This function is used to view water-level data and/or actions performed (i.e. well inspection and well maintenance) on the PDA from locations collected since the last sync. Records may also be deleted using this function.

Exit

This function is used to exit the program.

Date, Time, and Time Zone

This information is intended to alert the user to the date and time the PDA is currently set to. Often, the PDA is taken to different time zones to collect water levels, so the user must change the system time to match the local time. The date and time may have to be corrected if the PDA battery runs low. The time zone, date, and time can be changed by using the "Clock and Alarms" application. From the main PDA screen, click Start, Settings, the System tab, and then click the "Clock and Alarms" icon.

About

Clicking on the "About" icon in the footer will display the version of the Water Level Recorder program (Figure 2).

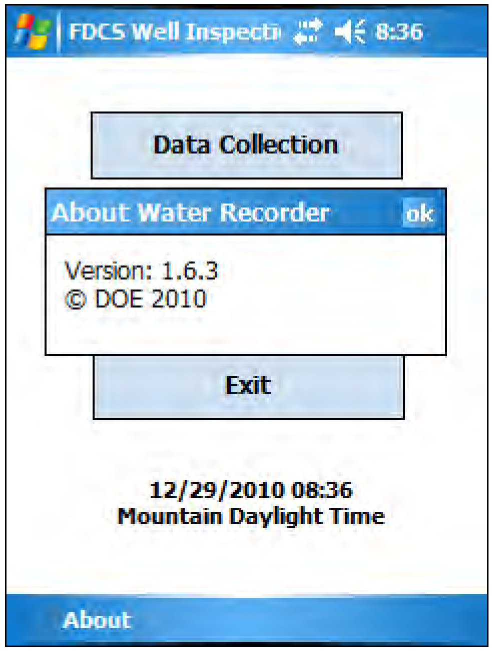

Figure 2. "About" Icon

Data Entry Keyboard

Clicking on the keyboard or Trimble icon in center of the footer (Figure 3) will maximize the keyboard to allow data entry. Clicking on the data entry icon again will minimize the keyboard.

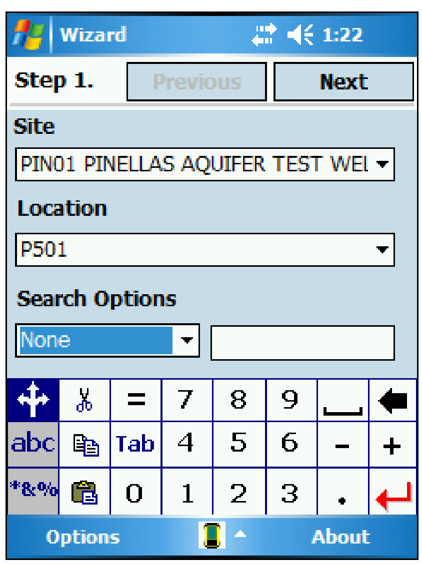

Figure 3. Data Entry Keyboard Maximized

5.0 Data Collection

The remainder of this procedure is organized to provide detail for each button (in descending order) on the opening menu. Click on the "Data Collection" button to initiate recording of water-level data and well inspection/maintenance information.

Step 1. Select Location

Step 1, with the keyboard minimized, is shown in Figure 4. The features of this step are listed below.

- Previous/Next—Use the "Previous" and "Next" buttons to move backward and forward, respectively, within the program. Because this is Step 1, the "Previous" button is grayed out and going to a previous screen is not an option.
- Site—Select the site from the site dropdown list which will include the site(s) downloaded during the sync process.
- Location—Select the location identification code from the location dropdown list or use "Search Options" to find the proper location. A location can be found more quickly in the dropdown list by using the keyboard to select the first letter or number of the desired location.
- Search Options—Use search options, if needed, to quickly find the location. Search Options include "Begins With" and "Contains." Highlight one of the two options and start to search for the location by entering letters/numbers in the field to the right using the keyboard. Click on the keyboard or Trimble icon in the middle of the footer to maximize the keyboard (Figure 5).

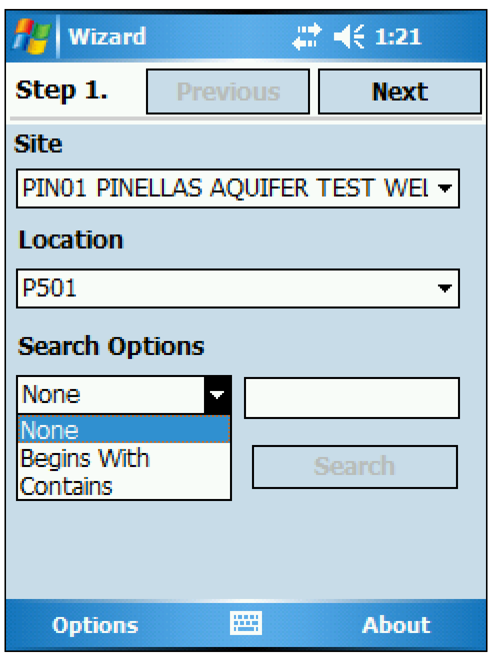

Figure 4. Step 1

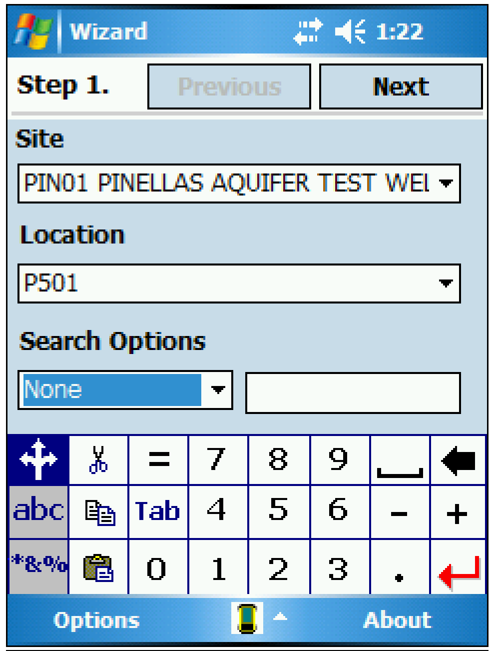

Figure 5. Numerical Recon Keyboard Maximized

- If letters need to be entered, click on the "abc" button to bring up the alpha keyboard (Figure 6). Clicking on the "123" button will toggle back to the numeric keyboard. A Recon or standard keyboard can be selected using the up-arrow next to the icon, and the keyboard can be customized by selecting "Settings," then "Input" on the PDA menu.

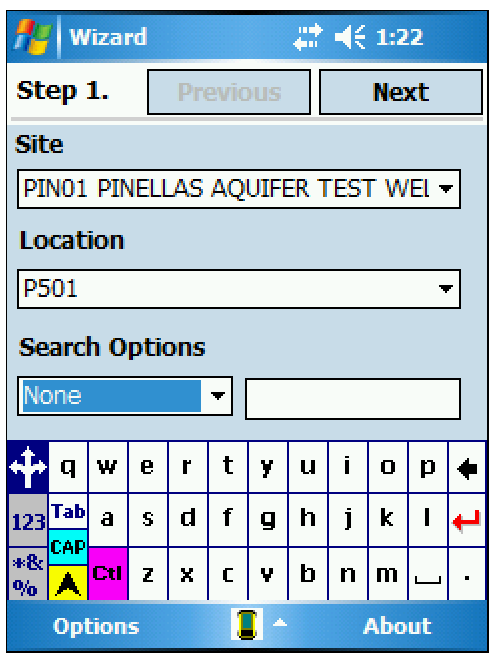

Figure 6. Alpha Recon Keyboard Maximized

- Selecting "Options" on the left side of the footer will allow the user to:
  - — "Exit Without Saving" which lets the user go back to the opening menu without saving any data entered at the current location.

— Turn the "Duplicate data check" off (unchecked) and on (checked) by clicking in the highlighted field (Figure 7). When the duplicate data check is on, it will alert the user if the selected location has already been measured since the last sync (Figure 8).

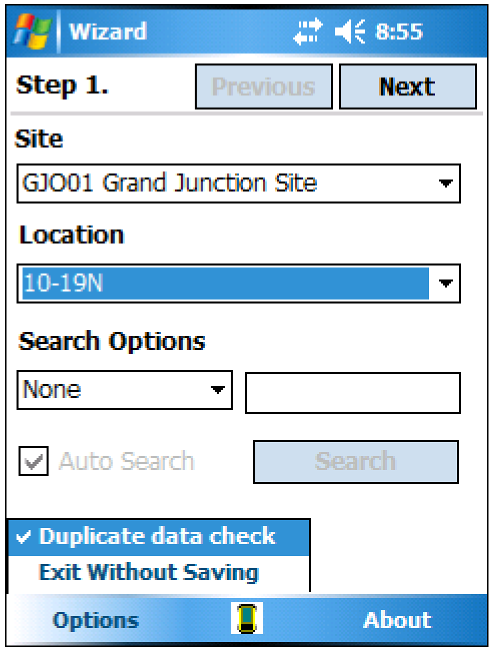

Figure 7. Duplicate Data Check Enabled

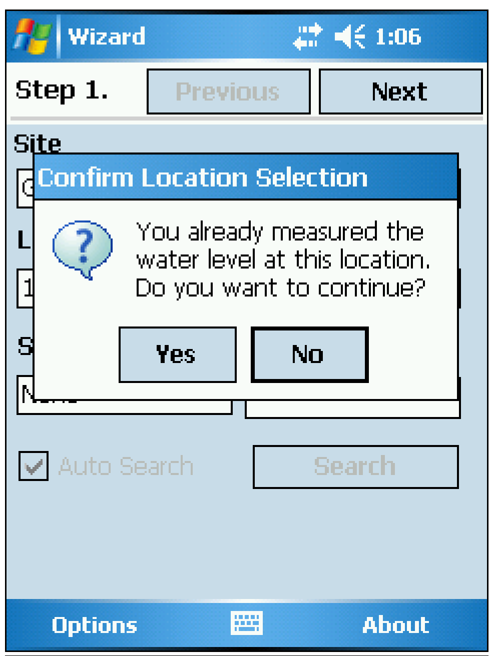

Figure 8. Duplicate Location Selected with Duplicate Data Check Enabled

Step 2. Select Technician Name(s)

- The site code and location selected in Step 1 is displayed in the header of subsequent steps. This information is displayed to verify the correct selection. If the location or site code is incorrect, select the "Previous" button to go back to Step 1 and change the site code or location.
- The technician names can be selected by checking the appropriate boxes (Figure 9). At the first location of the day or after a sync, scroll down the entire list to ensure only the correct names have been selected. Once selected, the name(s) will remain selected at subsequent locations.

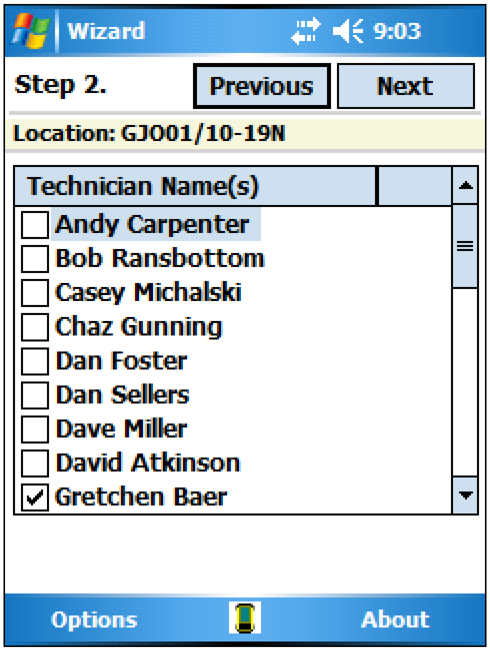

Figure 9. Step 2

Step 3. Selecting the Type of Data That Will Be Collected

Select one of the four available options (Figure 10):

Option 1, **Water Level Only**—goes directly to the water level input page.

Option 2, **Water Level and Inspection**—goes to both the water level and the inspection programs. There is a maintenance option at the end of each inspection category to allow input for maintenance conducted while at the well.

Option 3, **Inspection Only**—goes to the inspection program only with a maintenance option the end of each inspection category to allow input for maintenance conducted while at the well.

Option 4, **Maintenance Only**—for when returning to a location to conduct maintenance.

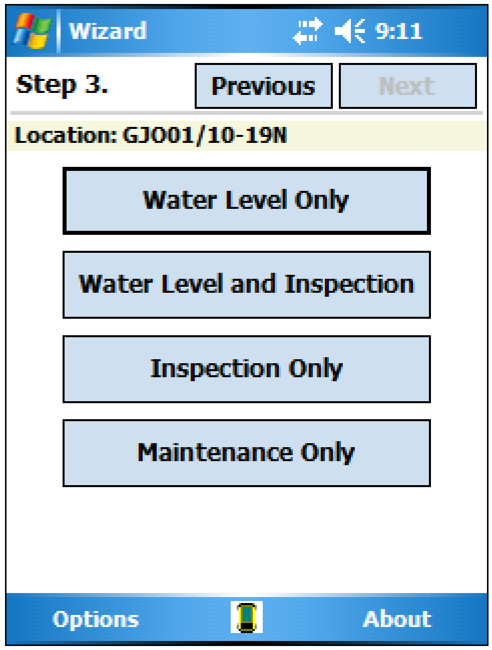

Figure 10. Step 3

Option 1, Water Level Only (This option is selected in Step 3)

- Date/Time displayed will be the current PDA system date and time (Figure 11). If it is incorrect, highlight the incorrect number and use the up and down arrows to change the numbers or enter the correct number with the keyboard.

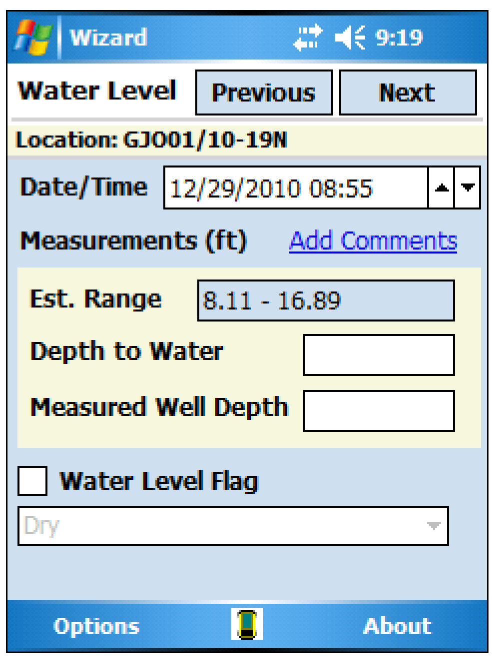

Figure 11. Water Level Entry

- Est. Range (Estimated range)—A statistical range calculated using historical data from the selected well is used as a quality control check. The range is developed by using an outlier test to remove outliers from the historical range. If a depth to water is entered that is outside the estimated range, the "Depth to Water" field will turn red alerting the user to a possible misread of the water level indicator and/or data entry error.
- Depth to Water—Enter the measured depth to water. If the depth to water field turns red (Figure 12) after entry (outside statistical range), depth to water should be re-measured and re-entered.

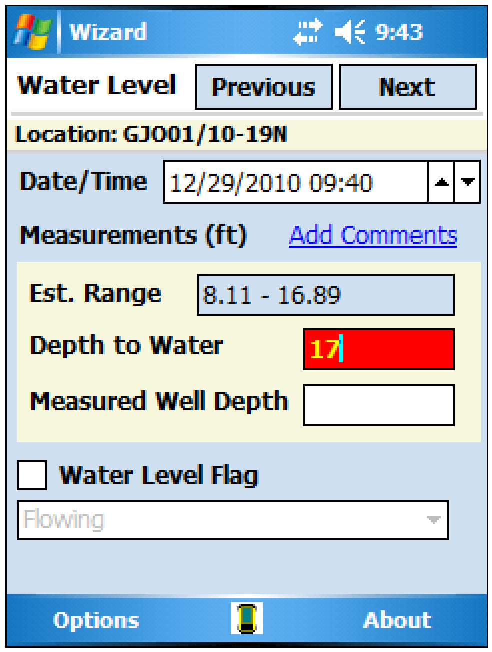

Figure 12. Depth to Water Outside the Estimated Range

- Measured Well Depth—If the depth of the well is measured, enter the measured depth of the well.
- Water Level Flag—If the well is dry, flowing, or the water level is below the top of the pump, check the "Water Level Flag" box (Figure 13), which will enable the dropdown list with these three choices. Highlight the appropriate choice to select it. Note that selecting the "Water Level Flag" box will clear the "Depth to Water" field.
- Add Comments—Select this link to open a window that will allow comments to be entered. Enter any additional comments or information that may have an influence on the water level or indicate a problem with the integrity of the well.

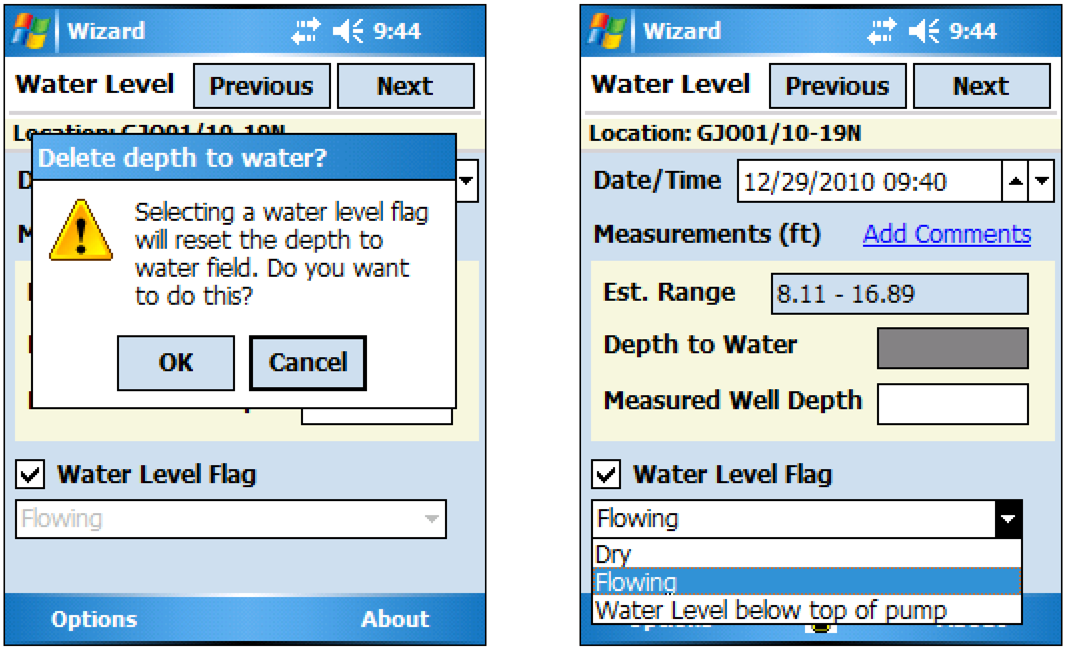

Figure 13. Water Level Flag Dropdown Box

- **Step 4**. Completion (Figure 14)
  - — Review any comments.
  - — Click on the “Sign” button to save the entered data. The data will be saved and a dialog box will open to ask the user “Do you want to enter data for another location?” Click on the “Yes” button to enter more data and the program will go back to Step 1. Click the “No” button and the program will go back to the opening menu.
  - — Click on the “Exit Without Saving” button to discard the collected data. A dialog box will come up and ask the user “Are you sure you want to exit without saving?” Click on the “Yes” button to delete the collected data and return to the opening menu. Click on the “No” button to remain in Step 4.
  - — In the Water Level Only mode, the “Inspection Date/Time” field does not apply and is inactive.

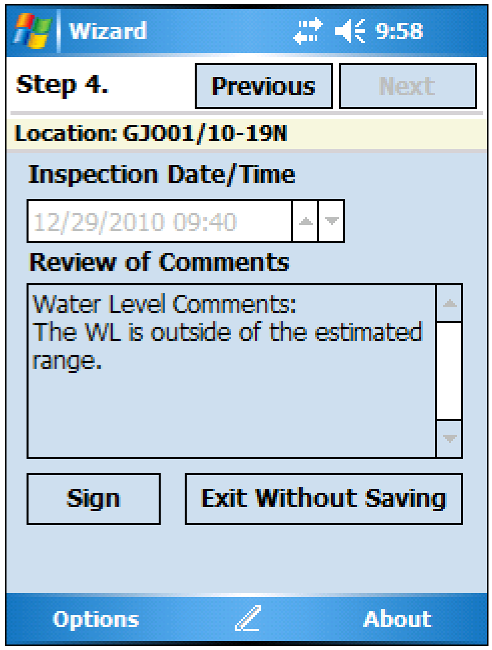

Figure 14. Step 4

Option 2, Water Level and Inspection (This option is selected in Step 3)

- Enter the water-level information as in Option 1, Water Level Only, described above.
- Well inspection items are separated into 5 categories:

  1. Surrounding Area
  2. Well Integrity Components
  3. Protective Casing
  4. Well Interior–If the "Grade to Top of Casing" and/or the "Well Depth" are measured, these values are entered in this category.
  5. Monitoring Equipment

  Within each category is a list of components to inspect. If the question at the beginning of each category "Are all applicable components satisfactory?" is answered with a "Yes," then the program will proceed to the next category.

  If the question at the beginning of each category "Are all applicable components satisfactory?" is answered with a "No," then a list of components will be displayed and the unsatisfactory component(s) must be checked. If a component is selected as being unsatisfactory, a maintenance option window will open to allow the user to describe any maintenance performed. Following is a list of the categories and the associated components available for each category:

Category 1—Surrounding Area

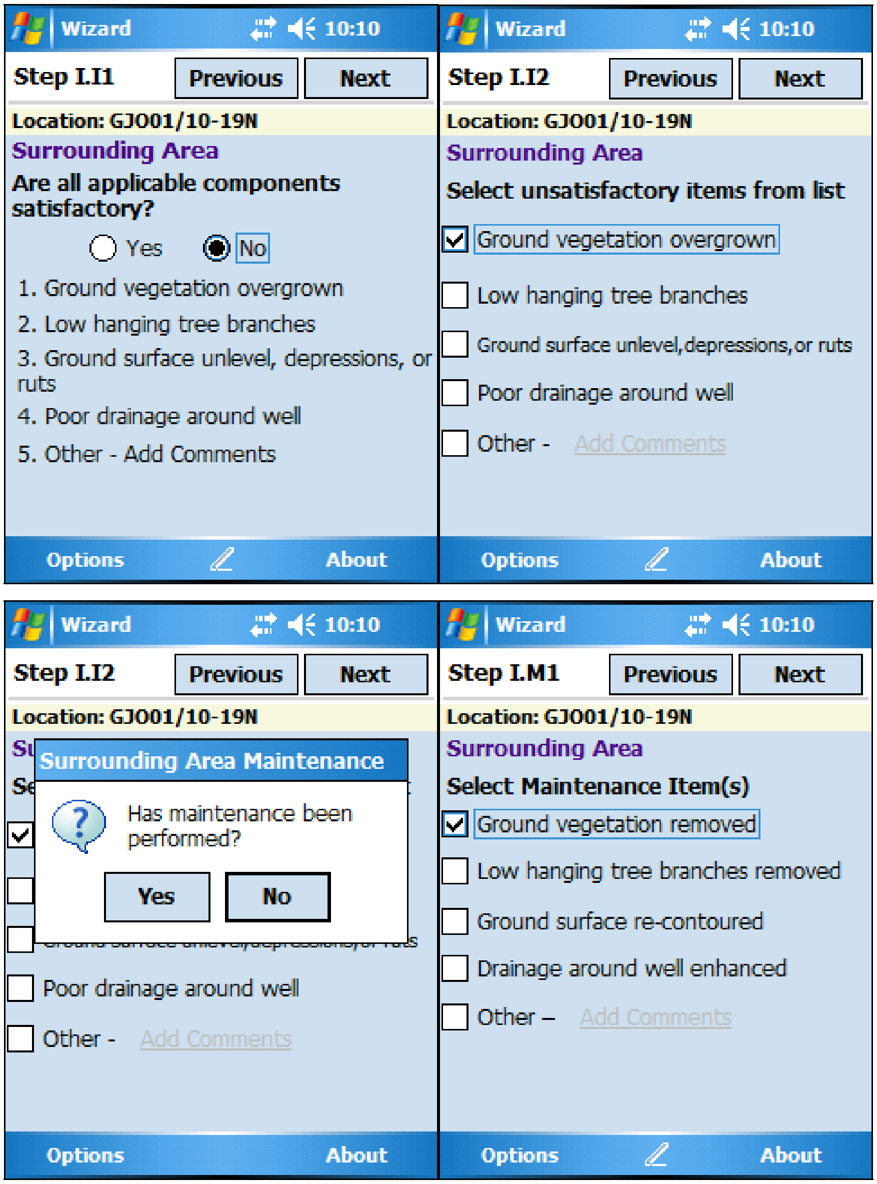

Figure 15. Surrounding Area—Inspection and Maintenance Items

Category 2—Well Integrity Components

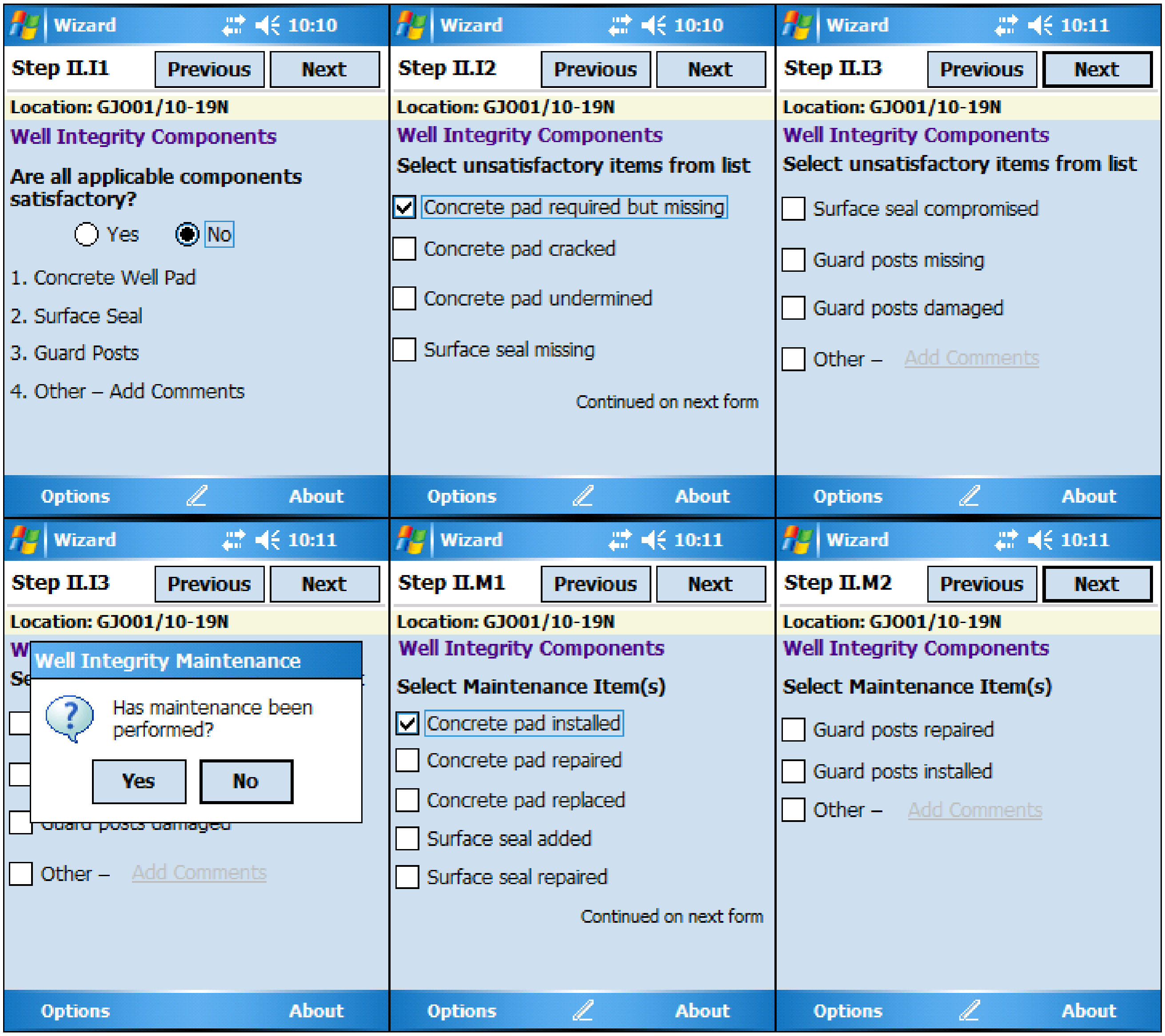

Figure 16. Well Integrity Components—Inspection and Maintenance Items

Category 3—Protective Casing

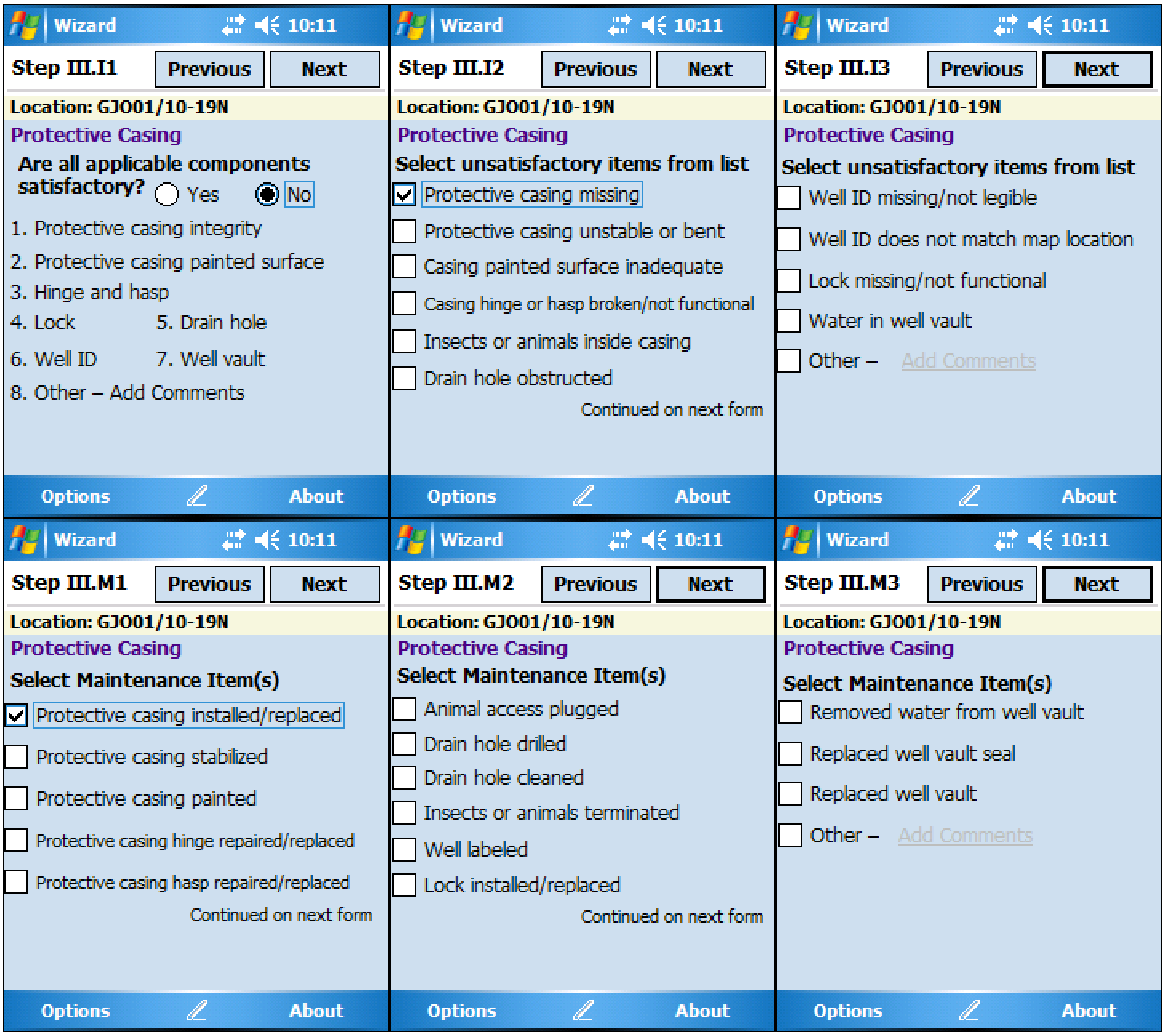

Figure 17. Protective Casing—Inspection and Maintenance Items

Category 4—Well Interior

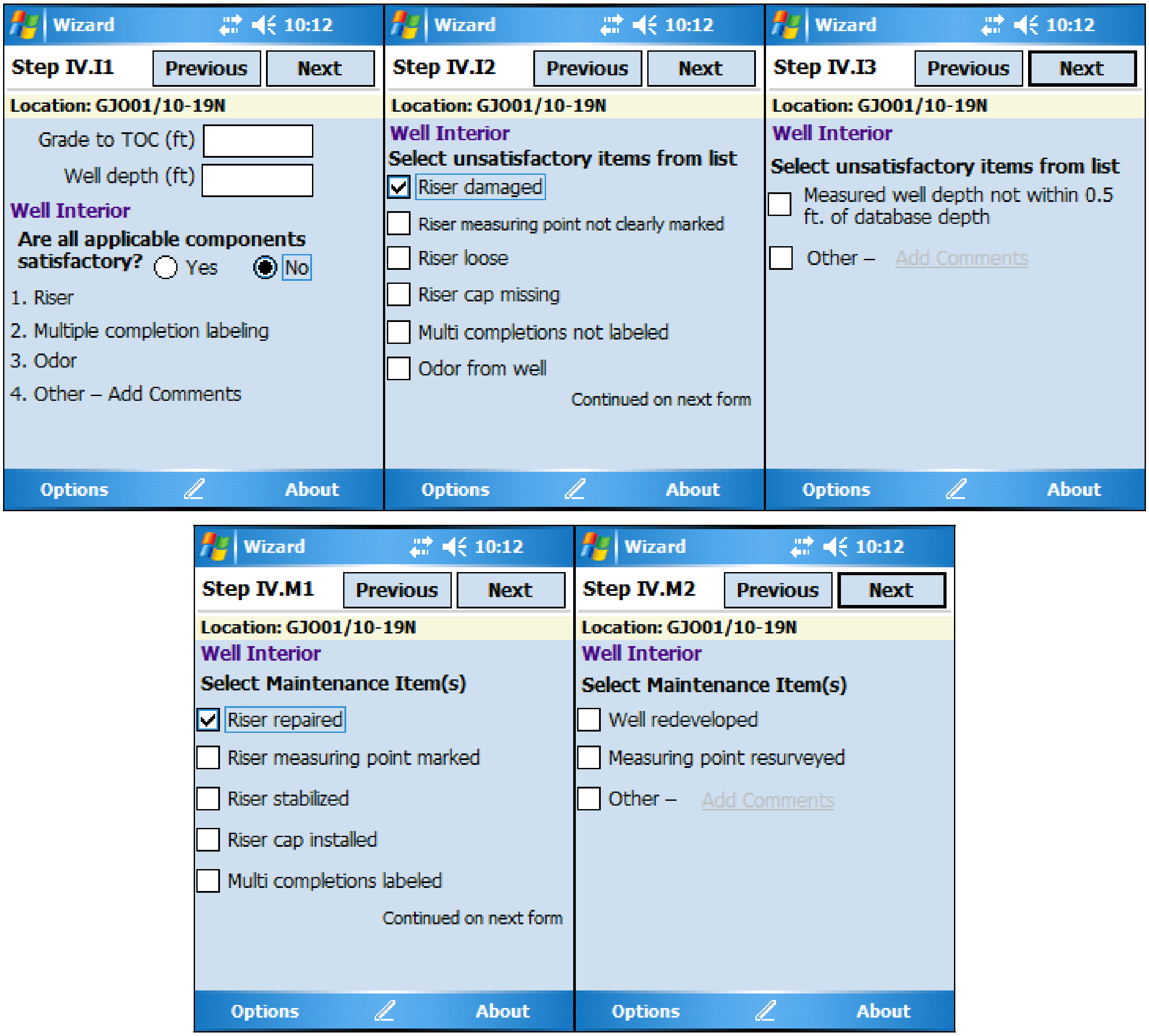

Figure 18. Well Interior—Inspection and Maintenance Items

Note that if "Grade to Top of Casing" and/or the "Well Depth" measurements are taken, they can be entered into Step IV.I1, pictured in Figure 18.

Category 5—Monitoring Equipment

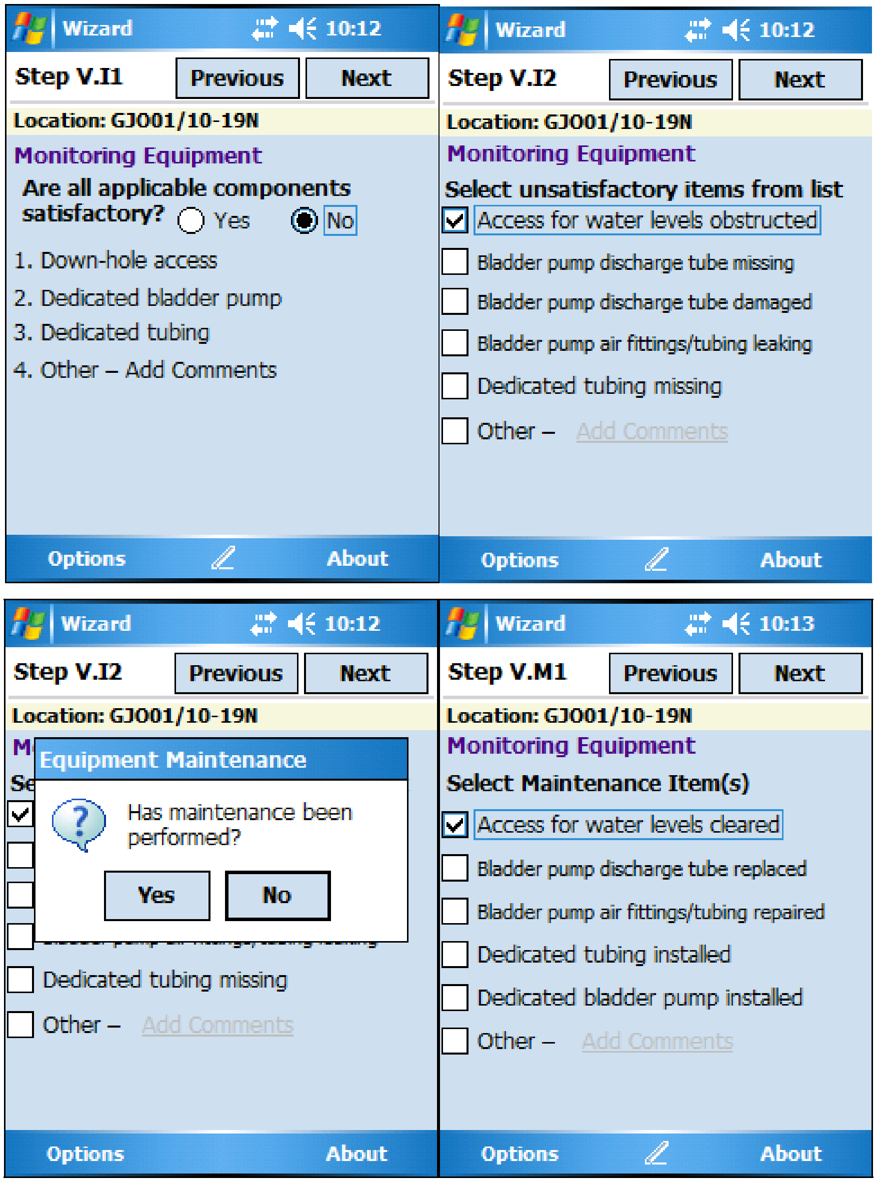

Figure 19. Monitoring Equipment—Inspection and Maintenance Items

- **Step 4**. Completion (Figure 14)
  - Review any comments.
  - Enter the date and time of the Inspection.
  - Click on the "Sign" button to save the entered data. The data will be saved and a dialog box will open to ask the user "Do you want to enter data for another location?" Click on the "Yes" button to enter more data and the program will go back to Step 1. Click the "No" button and the program will go back to the opening menu.
  - Click on the "Exit Without Saving" button to discard the collected data. A dialog box will come up and ask the user "Are you sure you want to exit without saving?" Click on the "Yes" button to delete the collected data and return to the opening menu. Click on the "No" button to remain in Step 4.

Option 3, Inspection Only (This option is selected in Step 3)

- Well inspection items are separated into 5 categories:
  1. Surrounding Area.
  2. Well Integrity Components.
  3. Protective Casing.
  4. Well Interior–If the "Grade to Top of Casing" and/or the "Well Depth" are measured, these values are entered in this category.
  5. Monitoring Equipment.

  Within each category is a list of components to inspect. If the question at the beginning of each category "Are all applicable components satisfactory?" is answered with a "Yes," then the program will proceed to the next category.

  If the question at the beginning of each category "Are all applicable components satisfactory?" is answered with a "No," then a list of components will be displayed and the unsatisfactory component(s) must be checked. If a component is selected as being unsatisfactory, a maintenance option window will open to allow the user to describe any maintenance performed. See Option 2, Water Level and Inspection, above, for the associated components available for each category.
- **Step 4**. Completion (Figure 14)
  - Review any comments.
  - Enter the date and time of the Inspection.
  - Click on the "Sign" button to save the entered data. The data will be saved and a dialog box will open to ask the user "Do you want to enter data for another location?" Click on the "Yes" button to enter more data and the program will go back to Step 1. Click the "No" button and the program will go back to the opening menu.
  - Click on the "Exit Without Saving" button to discard the collected data. A dialog box will come up and ask the user "Are you sure you want to exit without saving?" Click on the "Yes" button to delete the collected data and return to the opening menu. Click on the "No" button to remain in Step 4.

Option 4, Maintenance Only (This option is selected in Step 3)

- Well maintenance items are separated into 5 categories:
  1. Surrounding Area
  2. Well Integrity Components
  3. Protective Casing
  4. Well Interior
  5. Monitoring Equipment

  Within each category is a list of components. Following is a list of the categories and the associated components available for each category:

Category 1—Surrounding Area

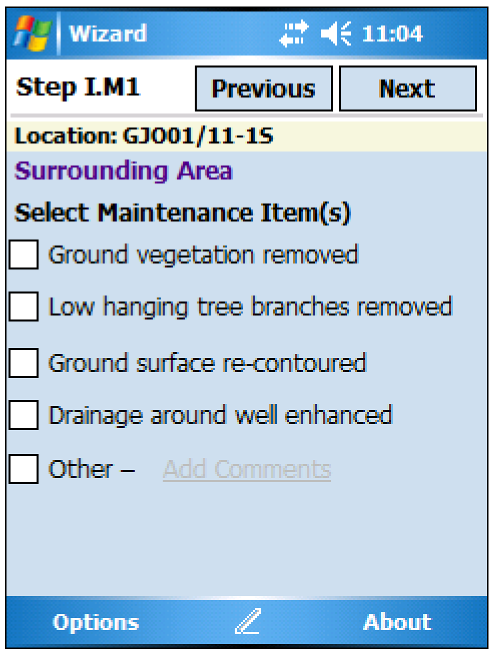

Figure 20. Surrounding Area—Maintenance Items

Category 2—Well Integrity Components

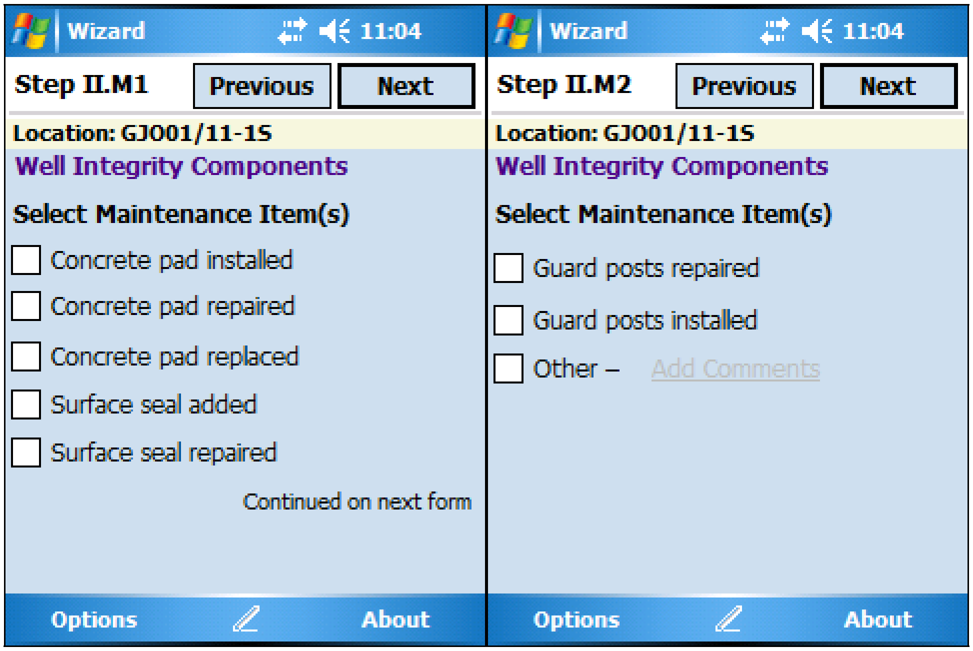

Figure 21. Well Integrity Components—Maintenance Items

Category 3—Protective Casing

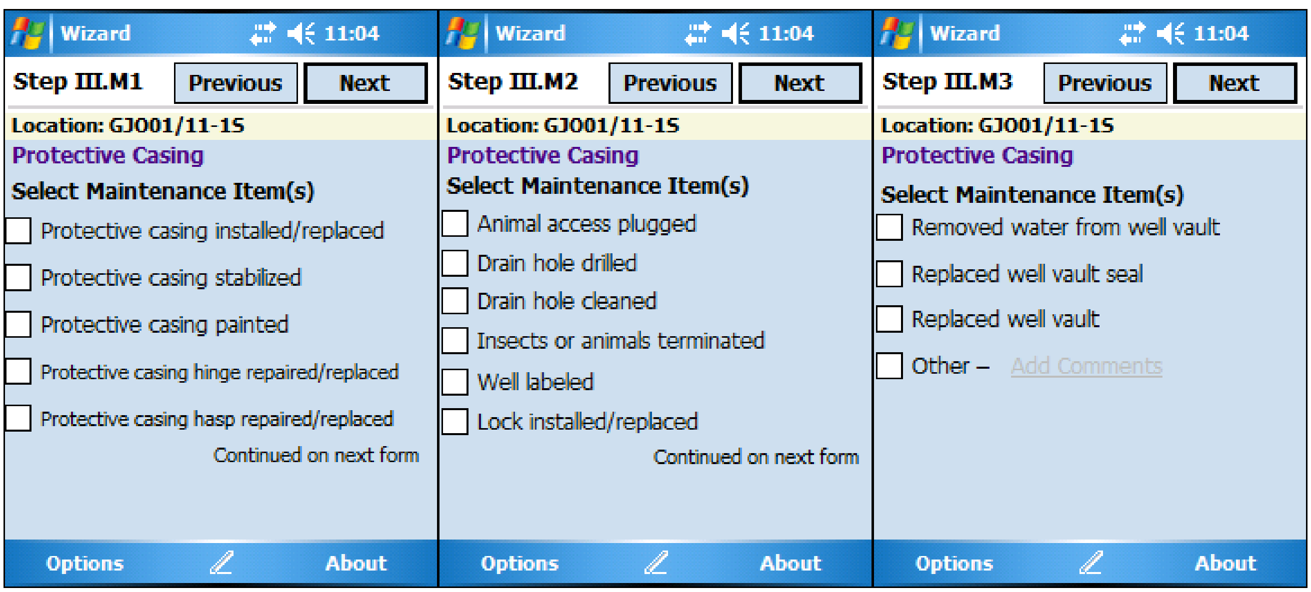

Figure 22. Protective Casing—Maintenance Items

Category 4—Well Interior

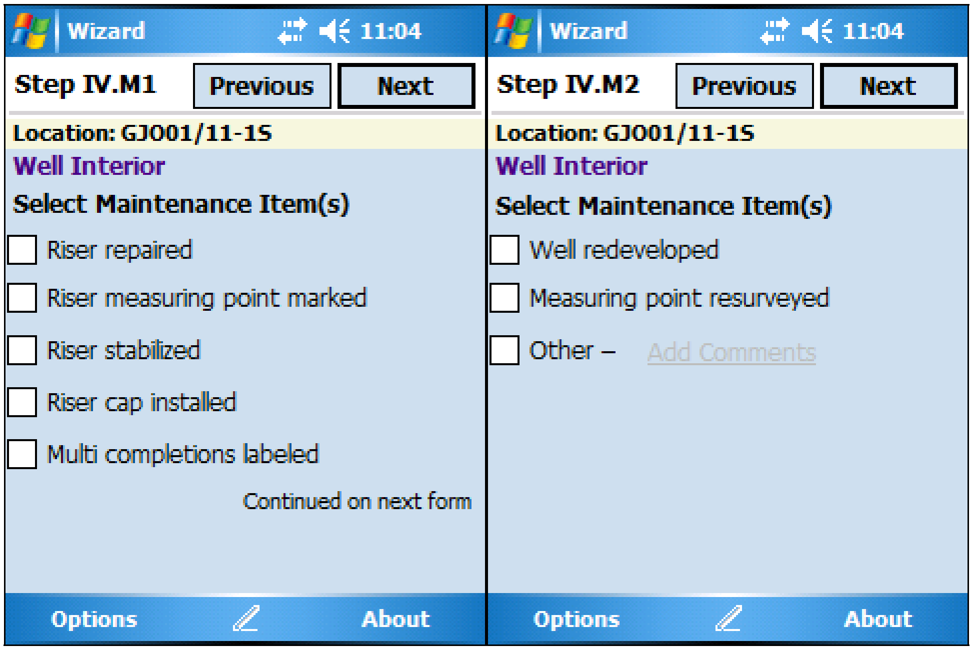

Figure 23. Well Interior—Maintenance Items

Category 5—Monitoring Equipment

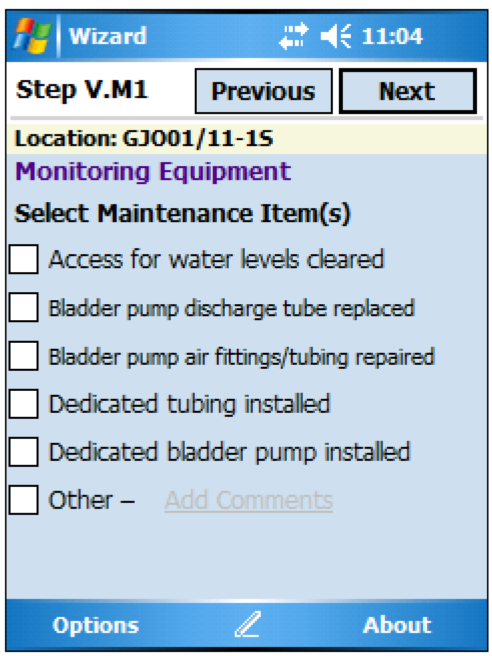

Figure 24. Monitoring Equipment—Maintenance Items

- **Step 4**. Completion (Figure 14)
  - Review any comments.
  - Enter the date and time of the Maintenance.
  - Click on the “Sign” button to save the entered data. The data will be saved and a dialog box will open to ask the user “Do you want to enter data for another location?” Click on the “Yes” button to enter more data and the program will go back to Step 1. Click the “No” button and the program will go back to the opening menu.
  - Click on the “Exit Without Saving” button to discard the collected data. A dialog box will come up and ask the user “Are you sure you want to exit without saving?” Click on the “Yes” button to delete the collected data and return to the opening menu. Click on the “No” button to remain in Step 4.

6.0 Data Sync

Click on the “Data Sync” button to start the sync process.

Pre-Measurement Data Sync

The purpose of the sync process prior to taking measurements is to download the site(s) associated well identifications and historical data from the SEEPro database to the PDA. To sync the PDA, it must be connected to a computer that is connected to the LM network, and Microsoft Active Sync software must be installed on the computer.

- Click on the “Data Sync” button. A dialog box will come up and ask the user “Do you want to change the sites you have available in the application?” (Figure 25). Click the “Yes” button to change the site(s), or click the “No” button to keep the same site(s) since the last sync.
- If the “Yes” button is clicked, the list of sites will be displayed (Figure 26). Select the site(s) by highlighting and checking the site(s).

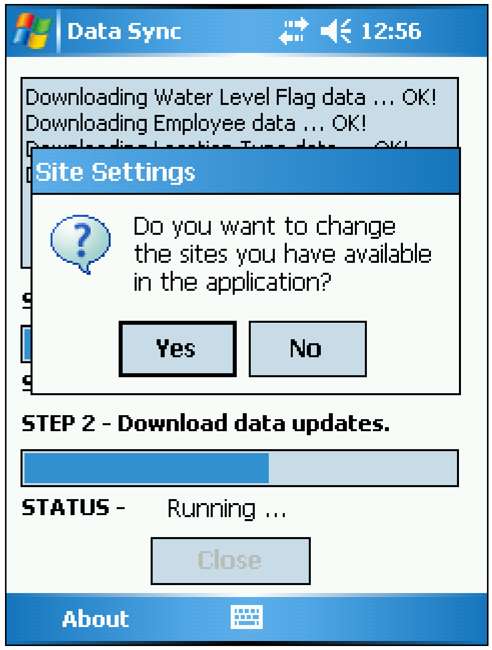

Figure 25. Site Settings Dialog Box

Figure 26. Site Selection Menu

Post-Measurement Data Sync

The purpose of the post-measurement sync is to upload the collected water-level and well depth data to the SEEPro database. During the sync, a PDF water level report that summarizes the data collected (Figure 27 and Figure 28) is generated and stored in the SMS directory on Condor in the FDCS/WATER LEVELS and FDCS/INSPECTION FORMS folders. The file name is coded with the site code and date. For example, water levels uploaded at the Weldon Spring site on December 27, 2010, will have the file name WEL01_12272010.pdf.

Water Level Data

Submitted On: 12/27/2010 7:08:04 AM

SITE	LOCATION	DTW	WLF	WELL DEPTH	COMMENTS	LOG TIME	SAMPLER NAMES
WEL01	MW-2053	42.66				12/21/2010 07:58	Tom Welton, Tim Zirbes
WEL01	MW-2012	37.54				12/21/2010 08:28	Tom Welton, Tim Zirbes
WEL01	MW-2054	49.79				12/21/2010 08:30	Tom Welton, Tim Zirbes
WEL01	MW-2013	44.15				12/21/2010 08:34	Tom Welton, Tim Zirbes
WEL01	MW-2033	42.95				12/21/2010 08:35	Tom Welton, Tim Zirbes
WEL01	MW-2050	38.94				12/21/2010 08:36	Tom Welton, Tim Zirbes
WEL01	MW-2049	37.29				12/21/2010 08:41	Tom Welton, Tim Zirbes
WEL01	MW-2006	35.82				12/21/2010 09:04	Tom Welton, Tim Zirbes
WEL01	MW-2056	34.18				12/21/2010 09:05	Tom Welton, Tim Zirbes
WEL01	MW-2052	27.51				12/21/2010 09:07	Tom Welton, Tim Zirbes
WEL01	MW-2051	40.15				12/21/2010 09:08	Tom Welton, Tim Zirbes
WEL01	MW-2046		B			12/21/2010 09:11	Tom Welton, Tim Zirbes
WEL01	MW-2023	54.09				12/21/2010 09:14	Tom Welton, Tim Zirbes
WEL01	MW-2032	55.21				12/21/2010 09:18	Tom Welton, Tim Zirbes
WEL01	MW-2022	51.46				12/21/2010 09:21	Tom Welton, Tim Zirbes
WEL01	MW-2005	47.78				12/21/2010 09:26	Tom Welton, Tim Zirbes
WEL01	MW-2001	25.55				12/21/2010 09:27	Tom Welton, Tim Zirbes
WEL01	MW-2002	33.58				12/21/2010 09:32	Tom Welton, Tim Zirbes
WEL01	MW-2021	37.79				12/21/2010 09:35	Tom Welton, Tim Zirbes
WEL01	MW-2003	42.14				12/21/2010 09:37	Tom Welton, Tim Zirbes
WEL01	MW-3023	46.27				12/21/2010 09:40	Tom Welton, Tim Zirbes
WEL01	MW-3006	54.59				12/21/2010 09:43	Tom Welton, Tim Zirbes
WEL01	MW-3003	48.32				12/21/2010 09:44	Tom Welton, Tim Zirbes
WEL01	MW-3037	38.90				12/21/2010 09:45	Tom Welton, Tim Zirbes
WEL01	MW-3030	27.15				12/21/2010 09:49	Tom Welton, Tim Zirbes
WEL01	MW-3031	38.72				12/21/2010 09:53	Tom Welton, Tim Zirbes
WEL01	MW-3040	59.58				12/21/2010 09:56	Tom Welton, Tim Zirbes
WEL01	MW-3025	49.26				12/21/2010 10:00	Tom Welton, Tim Zirbes

DTW: Depth to Water (DTW is out of range if colored red); WLF: Water Level Flag (D - Dry, F - Flowing, B - Water level below top of pump)

Figure 27. Example of a Water Level Report

In the example in Figure 27, the red highlighted depths indicate values that are outside the historical range.

Well Inspection and Maintenance Summary Report

Site Code	Location Code	Inspection Date/Time	Technicians	All Components Satisfactory	Components Unsatisfactory	Maintenace Conducted	Grade to TOC	Well Depth
WEL01	MW-2002	1/3/11 2:01:09 PM	Chaz Gunning, Bob Ransbottom	No	Protective casing missing, Bladder pump discharge tube missing	Bladder pump discharge tube replaced	2.11	
WEL01	MW-2003	1/3/11 2:03:30 PM	Chaz Gunning, Bob Ransbottom	No	Ground Vegetation Overgrown, Guard posts missing	Ground vegetation removed		
WEL01	MW-2005	1/3/11 2:05:52 PM	Chaz Gunning, Bob Ransbottom	n/a		Protective casing stabilized, Drain hole drilled, Lock installed/replaced, Riser cap installed, Well redeveloped		
WEL01	MW-2001	1/3/11 2:21:01 PM	Chaz Gunning, Bob Ransbottom	Yes				

Figure 28. Example of a Well Inspection Report

7.0 Report

Click on the “Report” button to view a summary report on the PDA (Figure 29). The report displays data collected since the last sync, which allows the user to assess progress or review data. The report on the PDA is an abbreviated version of the report(s) generated during the sync process (Figure 27). It contains site, location, time, depth to water information, and actions performed, and can be sorted differently by selecting items in the “Order By” drop down menu.

A measurement can be deleted by selecting the appropriate row, then clicking on the “Options” icon in the footer (Figure 30). A dialog box will open to confirm that it is safe to delete the record.

After the data sync function is performed, the summary report can no longer be viewed on the PDA, nor can a measurement be deleted on the PDA.

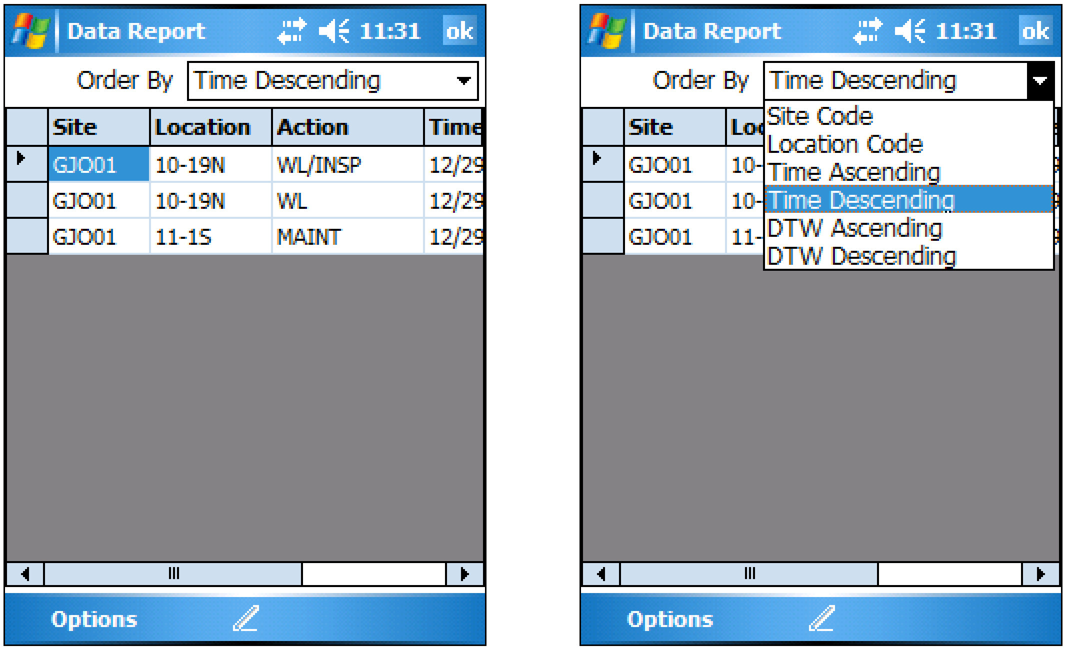

Figure 29. Summary Report

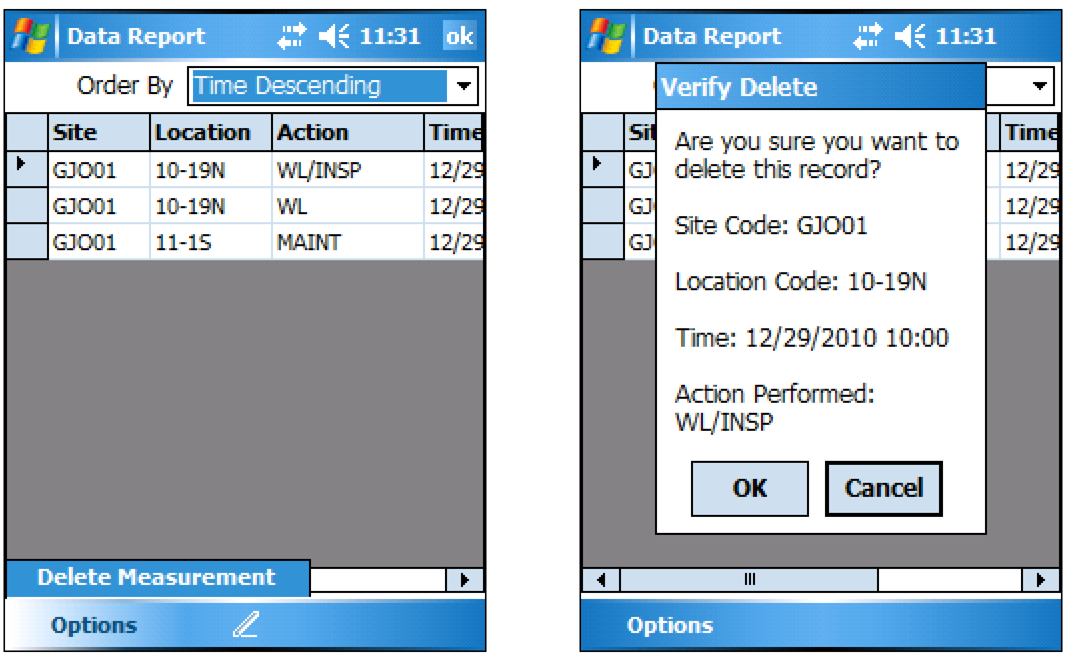

Figure 30. Deleting a Record

8.0 Exit

Click on the "Exit" button to exit the program.

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Appendix B–3

Compressed Gas Operations

Desk Instructions for Environmental Monitoring Operations Using Compressed Gas

Scope

These desk instructions have been developed to aid trained personnel to fill compressed air cylinders and to use compressed gas to power groundwater bladder pumps.

Using a High-Pressure Compressor to Fill Compressed Air Cylinders

Purpose

This procedure will be used to aid authorized and trained personnel in operating a Coltri MCH-6 high-pressure compressor and filling a compressed air cylinder to 2,000 pounds per square inch (psi).

Responsibilities

Authorization to perform this operation must be obtained from the Environmental Monitoring Operations Manager**.**

Equipment

Equipment used for this procedure includes the Coltri MCH-6 high-pressure compressor, air cylinders, the fill line, and the flow/pressure control manifold. All equipment is shown in Figure 1.

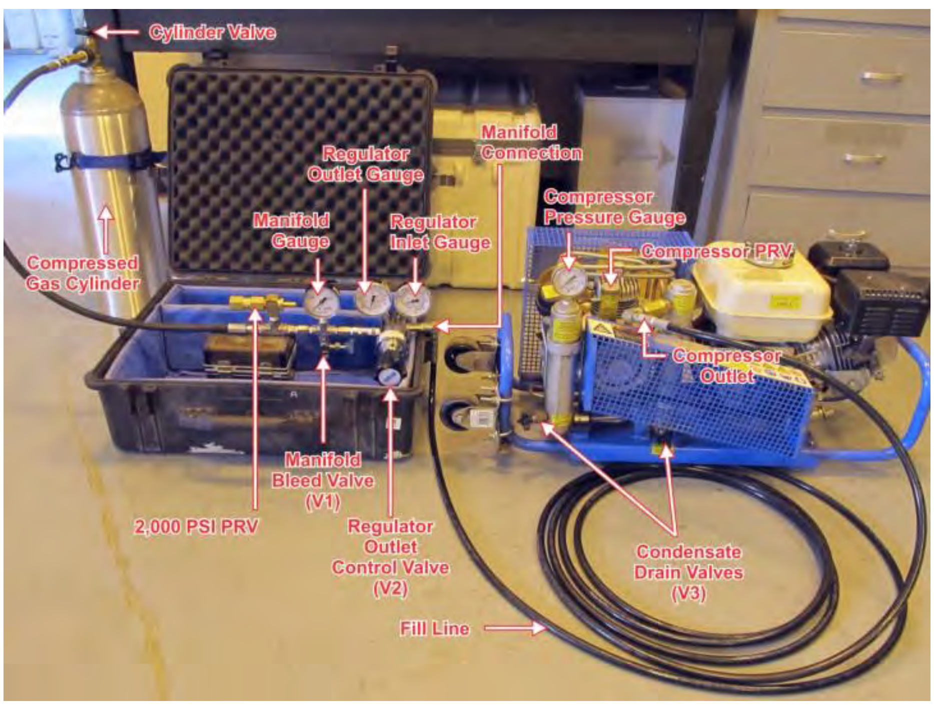


Figure 1. Cylinder Filling System

Procedure

Operation of the compressor shall be conducted outside in a well-ventilated area; cylinders being filled shall be secured. Although redundant safety controls have been engineered into the filling apparatus, a responsible person must be present during the filling operation.

A professional engineer has reviewed this assembly to ensure that all components are rated to withstand the system pressure. The engineered drawings of this assembly are attached to this procedure. Use only this approved assembly during filling operations. If a component in the assembly needs to be replaced, then consultation with the Engineering department and an update of the drawing (as needed) are required.

The following safety guidelines apply:

- When lifting the air compressor and air cylinders, use proper lifting techniques.
- Keep heavy loads close to your body, bend at your knees, and keep your back straight.
- Never rotate your back while handling a heavy load, and never carry a load that blocks your vision.
- Fuel the gasoline motor before starting the compressor.
- Use only National Fire Protection Association–approved gasoline containers, have a fire extinguisher nearby, and do not smoke or have other spark-producing objects within 50 feet of the compressor.
- Contact the Environmental Compliance and Health and Safety groups for cleanup and reporting guidance for all spills from equipment.
- Ensure that the cylinder inspection due date has not expired; if the inspection date has passed or is illegible, take the cylinder out-of-service and tag them “Do Not Use.”

Perform cylinder filling to 2,000 psi using the following steps:

[1] Place the compressor on a level, clean, and hard surface outdoors in a well-ventilated area. Do not use the compressor in dusty areas.

[2] Assemble the components for filling the air cylinders:

  [a] Attaching the fill line from the compressor to the manifold.

  [b] Remove the protective cap from the cylinder.

  [c] Ensure that the cylinder is secure and that the cylinder valve is closed.

  [d] Attach the manifold to the cylinder; avoid cross-threading the manifold nut when attaching the manifold to the cylinder.

[3] Open the compressor condensate drain valves (V3) and manifold bleed valve (V1).

Caution

Wear hearing protection and safety glasses when operating and working within 20 feet of the compressor.

[4] Start the compressor gasoline motor. Starting and operation of compressor engine instructions can be referenced in the manufacturer's instructions located at \\crow\Projects\SamplingProg\Equipment Manuals and Procedures\Air Cylinders and Pressure Systems. The file name is "High Pressure Air Compressor-Aerotecnica-MCH-6.pdf."

[5] Once the motor has started and is running at full speed, close the condensate drain valves.

[6] Once air begins to vent from the manifold bleed valve, perform the following steps:

[a] Turn the regulator outlet control valve (V2) counterclockwise until the regulator outlet gauge reads zero.

[b] Close the manifold bleed valve.

[7] Ensure that the compressor pressure-relief valve (PRV) is venting at 2,700 psi (±100 psi) by monitoring the compressor pressure gauge.

[a] IF the PRV does not vent at the prescribed pressure (2,700 psi ±100 psi), THEN turn the compressor off and diagnose the problem.

Note

Since this is an adjustable spring loaded PRV, it is possible that the PRV has loosened, thereby changing the PRV setting.

[b] Once the problem is solved, restart the compressor, and recheck the PRV.

[8] **Before** opening the cylinder valve to fill the cylinder, a safety check of the 2,000 psi manifold PRV must be performed:

Caution

During the safety check of the 2,000 psi manifold PRV, be aware of any unexpected leaks in the manifold assembly.

[a] Adjust the regulator outlet control valve clockwise until the regulator outlet gauge indicates 2,000 psi.

[b] With the compressor running, monitor the manifold gauge and ensure that the PRV begins to vent at 2,000 psi (±100 psi).

[c] IF the PRV does not vent at the prescribed pressure (2,000 psi ±100 psi), THEN turn the compressor off and diagnose the problem.

[9] IF the PRV vents at the proper pressure, THEN open the cylinder valve to begin cylinder filling.

Note

The opening of these condensate drain valves and the resultant release of air and moisture could cause sand and other fine particles to become airborne.

Caution

- *Do not stand in front of the condensate drain valve to drain accumulated condensate.*
- *Wear leather gloves to drain accumulated condensate.*
- *Wear safety glasses to drain accumulated condensate.*

[10] During the filling process, briefly open both condensate drain valves every 10 minutes to drain accumulated condensate. Depending on the starting tank pressure, cylinder filling can take up to 1 hour.

[11] When the manifold gauge reaches 2,000 psi, close the cylinder valve and shut off the compressor motor.

[12] Open the condensate drain valves and manifold bleed valve to relieve pressure in the fill line and manifold.

[13] Detach the manifold from the cylinder and replace the protective cap on the cylinder.

[14] Detach the fill line from the compressor and carefully store the manifold and fill line in a protected area.

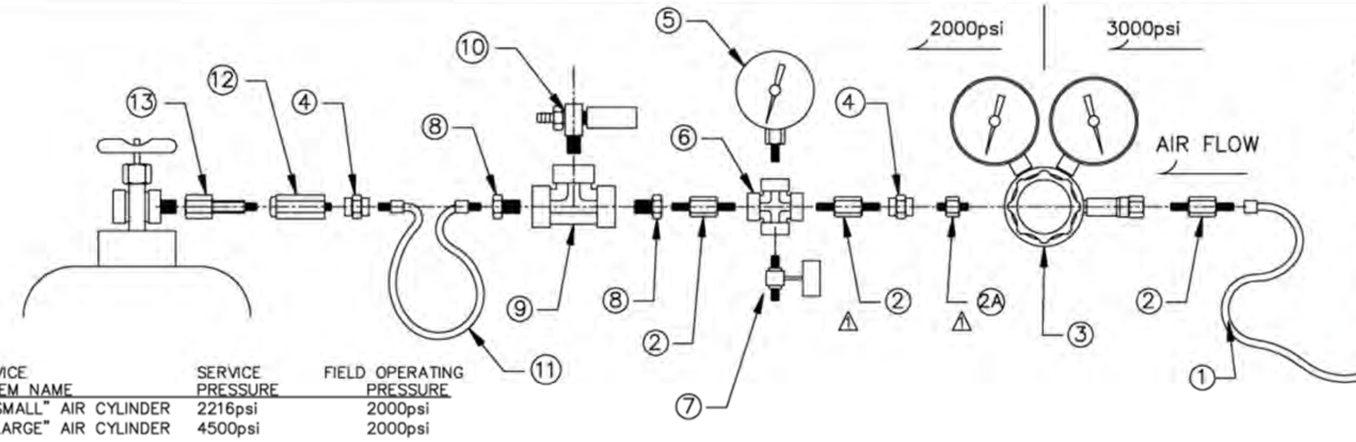
[15] Air cylinders must be stored in a secure manner with the protective cap in place. When transporting cylinders in a vehicle, the cylinders must be securely stowed with the protective caps on.

[16] Allow the compressor to cool, and store the compressor in a protected area. Both the compressor and the gasoline motor need periodic maintenance; refer to the Coltri use and maintenance manual for proper operation, care, maintenance, inspection, and troubleshooting. The Coltri manual can be found at \\crow\Projects\SamplingProg\Equipment Manuals and Procedures\Air Cylinders and Pressure Systems. The file name is “High Pressure Air Compressor-Aerotecnica-MCH-6.pdf.”

Using Compressed Gas to Operate Groundwater Bladder Pumps

Only personnel who have received Water Sampling Training (WS-300) and been briefed on, read, and signed the “Water Sampling and Minor Well Maintenance at LM Sites” job safety analysis are authorized to perform this function.

When using compressed gas to operate groundwater bladder pumps, use only the regulator-hose-control box assemblies as shown in the attached engineering drawings. A professional engineer has reviewed these assemblies to ensure that all components are rated to withstand the system pressures of each assembly. The engineered drawings of all assemblies are attached. If a component in the assemblies needs to be replaced, then consultation with the Engineering department and an update of the drawing (as needed) are required.



AEROTECNICA COLTRI COMPRESSOR (MCH-6/SH)
WORKING PRESSURE(psi): 3200–4300–4700
DIRECTIVES: 2006/42/CE, 2004/108/CE
STANDARDS: EN12100–1, EN12100–2, ENISO14121–1, ENISO13857, EN60204–1, EN61000–6–2, EN61000–6–4

NOTE:
BUILT IN RELIEF VALVE SET FOR 3000psi

SOURCE DEVICE NO.	ITEM NAME	SERVICE PRESSURE	FIELD OPERATING PRESSURE
14	"SMALL" AIR CYLINDER	2216psi	2000psi
15	"LARGE" AIR CYLINDER	4500psi	2000psi

PARTS LIST

	NO.	ITEM	MATERIAL TYPE	PRESSURE RATING	OPERATING PRESSURE	PRODUCT INFORMATION	NATIONAL RECOGNIZED TESTING LAB (NRTL)
	1	1/4"ø AIR HOSE	RUBBER	RATED FOR 5000psi (STAMPED ON HOSE)	3000psi	PROVIDED BY AEROTECNICA COLTRI WITH COMPRESSOR	NOT AVAILABLE
	2	1/4" HEX 2" LONG NIPPLE	STAINLESS STEEL	RATED FOR 7500psi @72°F	3000psi, 2000psi AFTER REGULATOR	McMASTER–CARR PART NUMBER: 48805K23	ANSI B31.1, B31.3, ANSI/ASME B1.20.1
⚠	2(A)	1/4" HEX NIPPLE	STAINLESS STEEL	RATED FOR 7500psi @72°F	3000psi, 2000psi AFTER REGULATOR	McMASTER–CARR PART NUMBER: 48805K81	ANSI B31.1, B31.3, ANSI/ASME B1.20.1
	3	AIRGAS 0–6000 HIGH PRESSURE REGULATOR	STAINLESS STEEL/BRASS	MAX PRESSURE: 6000psi (IN), 6000psi (OUT)	3000psi (IN) 2000psi (OUT)	AIRGAS 0–6000, MODEL Y11–N198K	FACTORY TESTED, CGA STANDARD V–11, CGA STANDARD 022
	4	1/4" COUPLING	STAINLESS STEEL	RATED FOR 6000psi	2000psi	PARKER 1/4"GG, SAE 140138, HPD BASE #0202	NOT AVAILABLE
	5	PRESSURE GAUGE	BRASS/ ABS THERMOPLASTIC DIAL	OPERATING PRESSURE RANGE 0–4000psi	2000psi	McMASTER–CARR PART NUMBER: 9796T314	FACTORY CALIBRATED, NIST TESTED AND CERTIFIED, ASME B40.1
	6	1/4"x1/4"x1/4"x1/4" FEMALE CROSS	STAINLESS STEEL	RATED FOR MAX 7500psi @72°F	2000psi	McMASTER–CARR PART NUMBER: 48805K631	ANSI B31.1, B31.3, ANSI/ASME B1.20.1
⚠	7	1/4" PRESSURE RELIEF VALVE (VENT VALVE)	STAINLESS STEEL	RATED FOR 6000psi	2000psi	AIRGAS, PART CAME WITH 0–6000psi REGULATOR	NOT AVAILABLE
	8	3/8"x1/4" HEX REDUCING BUSHING	STAINLESS STEEL	RATED FOR MAX 5300psi @72°F	2000psi	McMASTER–CARR PART NUMBER: 48805K525	ANSI B31.1, B31.3, ANSI/ASME B1.20.1
	9	3/8"x3/8"x3/8" FEMALE TEE	STAINLESS STEEL	RATED FOR MAX 5000psi @72°F	2000psi	McMASTER–CARR PART NUMBER: 48805K49	ANSI B31.1, B31.3, ANSI/ASME B1.20.1
	10	3/8" MPT BRASS SAFETY RELIEF VALVE	BRASS	RATED FOR 2000psi	2000psi	J.E. ADAMS, MODEL NUMBER: 7416	FACTORY CALIBRATED (NON–ADJUSTABLE)
	11	1/4" AIR HOSE WITH DUAL MALE NPT ENDS	WIRE BRAIDED RUBBER HYDRAULIC HOSE, STAINLESS STEEL MALE NPT ENDS	RATED FOR 5800psi (STAMPED ON HOSE) MALE NPT FITTINGS RATED FOR 5076psi	2000psi	MANULI ROCK MASTER, 2SN–4EN, 853, 2SN, DN6WP MSHA IC 126/8–FRAS–2008 (MANUFACTURED BY MUNRO SUPPLY INC.)	NOT AVAILABLE
	12	HIGH PRESSURE CHECK VALVE MALE(INLET)xFEMALE(OUTLET)	BRASS, STAINLESS STEEL	RATED FOR 3000psi @ 180°F	2000psi	McMASTER–CARR PART NUMBER: 8549T25	FACTORY TESTED
	13	STANDARD AIR TANK NUT/NIPPLE CONNECTOR	STAINLESS STEEL	NUT–347–2, 5000psi NIPPLE–347–3, 5000psi	2000psi	MANUFACTURE–WESTERN (FROM AIR GAS)	NOT AVAILABLE
	14	"SMALL" AIR CYLINDER (9156–P)	6061–T6 ALUMINUM ALLOY	TC TEST PRESSURE 3324psi, DOT TEST PRESSURE 3693psi, SERVICE PRESSURE 2216psi	2000psi	CATALINA CYLINDERS, 9156–P (60FT³)	5YR RE–TEST PERIOD, DOT–3AL, TC–3ALM
	15	"LARGE" AIR CYLINDER (NUVT 4500)	STEEL	TEST PRESSURE 6750psi, SERVICE PRESSURE 4500psi	2000psi	NUVAIR, NUVT 4500 (437FT³)	10YR RE–TEST PERIOD, ISO 9809, DOT–E10869 4500psi, TC–SU4369–310

NOTE:
SAFETY VALVE MANUALLY ADJUSTED TO 3000psi BY MANUFACTURER

WHIP CHECK: ⚠
1) WHIP CHECKS ARE NOT REQUIRED BY OSHA FOR HOSE SIZES NEEDED IN THIS OPERATION (Standards 29 CFR, 1926.302, 30 CFR §56/57.13021, 30 CFR §75.1730, 30 CFR §77.412)

REVISION NO.	DATE	DESCRIPTION	DRAWN BY	CHECKED BY	PROJECT A/E	APPROVAL
⚠	2/22/11	NEEDLE VALVE WAS SWITCHED TO AN AIRGAS PRESSURE RELIEF VALVE, UPDATED TABLE/NOTES	SP	MM	MM	SC

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

Work Performed by
S.M. Stoller Corporation
Under DOE Contract
No. DE–AM01–07LM00060

PROJECT LOCATION: GRAND JUNCTION
GRAND JUNCTION, CO

APPROVALS	
S. PITTON	2/22/11
S. PITTON	2/22/11
A. PAXTON	2/22/11
M. MADRIL	2/22/11
S. CAMPBELL	2/22/11

WELL MONITORING EQUIPMENT MODIFICATIONS

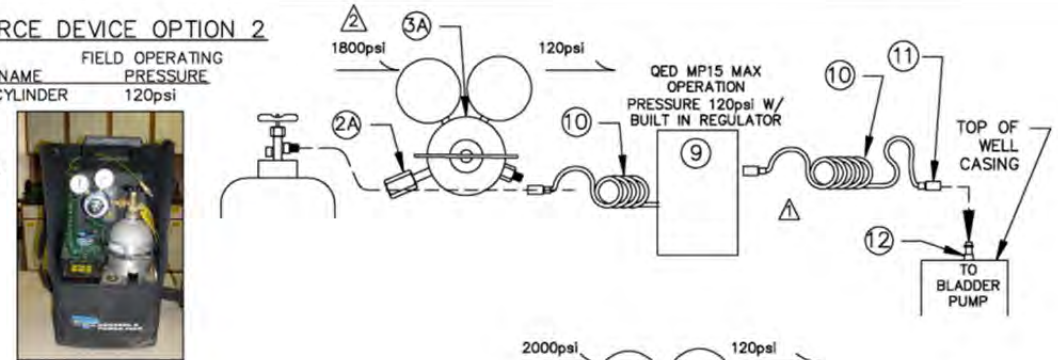
AIR TANK
FILLING COMPONENTS
AND DETAILS

PROJECT NO. LTS–111–0001–17–000
DRAWING NO. S07328–R00–C01–C+
SHT. 1 OF 3

M:\LTS\111\0001\17\000\S0732801.DWG 02/23/11 10:21am pittons

SOURCE DEVICE OPTION 2

NO.	ITEM NAME	FIELD OPERATING PRESSURE
1(C)	CO_2 CYLINDER	120psi



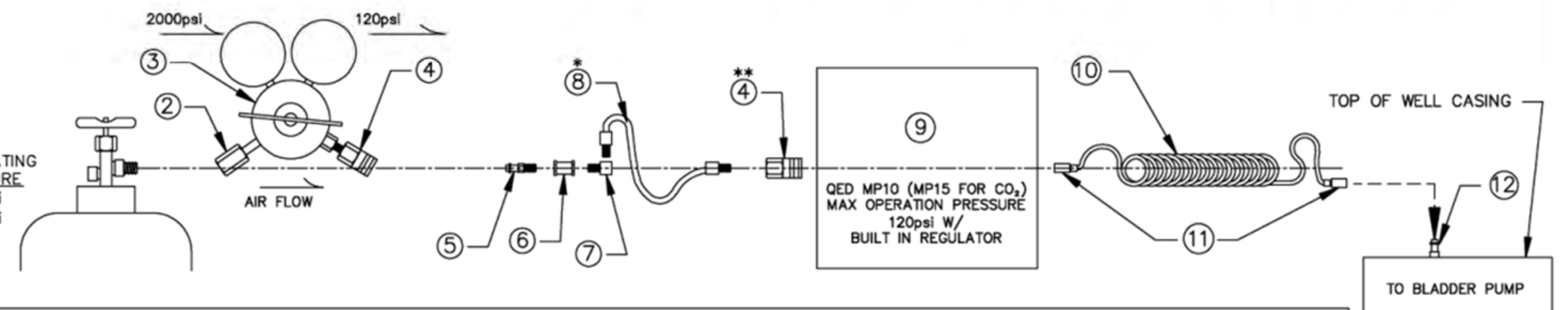
SOURCE DEVICE OPTION 3

NO.	ITEM NAME	FIELD OPERATING PRESSURE
1(D)	MP40 AIR COMPRESSOR	125psi

NOTE:
COMPRESSOR SYSTEM WILL CONNECT TO QED MP10 WITH THE SAME TYPE OF QUICK COUPLING USED IN "OPTION 1". THE SYSTEM WILL REMAIN THE SAME FOR ALL OPTIONS FROM THE QED MP10 CONTROL BOX.

SOURCE DEVICE OPTION 1

NO.	ITEM NAME	FIELD OPERATING PRESSURE
1(A)	"SMALL" AIR CYLINDER	2000psi
1(B)	"LARGE" AIR CYLINDER	2000psi



PARTS LIST

	NO.	ITEM NAME	MATERIAL TYPE	PRESSURE RATING	OPERATING PRESSURE	PRODUCT INFORMATION	NATIONAL RECOGNIZED TESTING LAB (NRTL) OR CERTIFICATION
OPTION 1	1(A)	"SMALL" AIR CYLINDER (9156-P)	6061-T6 ALUMINUM ALLOY	TC TEST PRESSURE 3324psi, DOT TEST PRESSURE 3693psi, SERVICE PRESSURE 2216psi	2000psi	CATALINA CYLINDERS, 9156-P (60FT³)	5YR RE-TEST PERIOD, DOT-3AL, TC-3ALM
	1(B)	"LARGE" AIR CYLINDER (NUVT 4500)	STEEL	TEST PRESSURE 6750psi, SERVICE PRESSURE 4500psi	2000psi	NUVAIR, NUVT 4500 (437FT³)	10YR RE-TEST PERIOD, ISO 9809, DOT-E10869 4500psi, TC-SU4369-310
OPTION 2	1(C)	CO_2 TANK	3ALM ALUMINUM ALLOY	RATED FOR 1800psi (2)	1800psi	TC-3ALM124 LUXFER T3.5KG	DOT-3AL 1800 X688876 M4141 05A03 5#
OPTION 3	1(D)	MP40 AIR COMPRESSOR	–	MAX PRESSURE 125psi (2)	120psi	QED MP40, 4.0HP HONDA	NOT AVAILABLE
	2	STANDARD AIR TANK NUT/NIPPLE CONNECTOR	STAINLESS STEEL	NUT-347-2, 5000psi NIPPLE-347-3, 5000psi	2000psi	MANUFACTURE-WESTERN (FROM AIR GAS)	NOT AVAILABLE
	2(A)	STANDARD CO_2 NUT/NIPPLE CONNECTOR	STAINLESS STEEL	MIN PRESSURE RATING 1800psi	1800psi	NOT AVAILABLE, PROVIDED WITH HARRIS REGULATOR	NOT AVAILABLE
	3	* RADNOR COMPRESSED GAS REGULATOR WITH AIR TANK CONNECTOR	STAINLESS STEEL AND BRASS	RATED FOR MAX INLET PRESSURE 3000psi, MAX OUTLET PRESSURE 125psi	120psi	RADNOR, MODEL NO. 350-125-540-06	ASME B40.100, SA568 DATE CODE KL, UL LISTED 54IL
(2)	3(A)	REGULATOR FOR CO_2 SYSTEM	STAINLESS STEEL AND BRASS	RATED FOR MAX INLET PRESSURE 3000psi	120psi	HARRIS MODEL 25-125PS	FACTORY PRE SET TO 125psi, UL CGA E-4
	4	1/4"-QUICK COUPLING	BRASS	MAX WORKING PRESSURE 300psi	120psi	PARKER 30 SERIES PART NO. B30-3B	FACTORY TESTED, ISO-7241-1, SERIES B
	5	1/4" QUICK COUPLING MALE PORT CONNECTION	STEEL	MAX WORKING PRESSURE 300psi	120psi	PARKER 30 SERIES	FACTORY TESTED, ISO-9001:2000, ISO-14001:2004
	6	1/4" COUPLING	BRASS	MINIMUM RATING FOR 300psi	120psi	NOT AVAILABLE	NOT AVAILABLE
	7	1/4" STREET ELBOW	BRASS	MINIMUM PRESSURE RATING 200psi	120psi	NOT AVAILABLE	NOT AVAILABLE
	8	1/4" AIR HOSE (MNPT,MNPT)	THERMOPLASTIC	RATED FOR 300psi	120psi	KURITEC K1134 POLY AIR, CANADA K061208	ISO 9001:2000, 21CFR177.1350, RoHS-EU DIRECTIVE 2002/95/EC
(1)	9	MICRO PURGE CONTROL BOX	–	RATED FOR MAX INPUT 120psi (125psi per QED)	120psi	QED MP10 (MP15 FOR CO_2)	NOT AVAILABLE
	10	1/4" PARAFLEX NoMar FAST-STOR	POLYURETHANE	RATED FOR MAX 125psi	120psi	PARKER PARAFLEX SERIES 385132	NOT AVAILABLE
	11	1/4" QUICK COUPLING	BRASS	RATED FOR 200psi	120psi	PARKER P200 SERIES NO. P201-1A	FACTORY TESTED, ISO-9001:2000, ISO-14001:2004
	12	1/4" QUICK COUPLING MALE PORT CONNECTION	BRASS	RATED FOR 200psi	120psi	PARKER P200 SERIES	FACTORY TESTED, ISO-9001:2000, ISO-14001:2004
	13	3/8" AIR HOSE	RUBBER-NYLON FIBER BRAID	SERVICE PRESSURE 400psi	120psi	WEATHERHEAD H75706	SAE J2064, TYPE C CLASS 1

* RADNOR REGULATOR IS DESIGNED FOR OXYGEN BUT IS COMPATIBLE WITH AIR AND ACCEPTABLE FOR THIS USE PER AIRGAS INC. RECOMMENDATION.

MARKINGS ON SMALL AIR CYLINDER:
DOT-3AL2216 E10013968
10 TC-ALM1530
UL18 EN849

MARKINGS ON LARGE AIR CYLINDER:
RIN C6A347 0608
EN849 6V V26
P625-19N, 6750

MARKINGS ON CO_2 CYLINDER:
TC-3ALM 124 DOT-3AL 1800

WHIP CHECK: (1)
WHIP CHECKS ARE NOT REQUIRED BY OSHA FOR HOSE SIZES NEEDED IN THIS OPERATION (Standards 29 CFR, 1926.302, 30 CFR §56/57.13021, 30 CFR §75.1730, 30 CFR §77.412)

RADNOR REGULATOR STAMPED IDENTIFICATION

REVISION NO.	DATE	DESCRIPTION	DRAWN BY	CHECKED BY	PROJECT A/E	APPROVAL
(2)	3/7/11	CO_2 CYLINDER CAPACITY, REGULATOR INLET PRESSURE	SP	MM	MM	SC
(1)	2/22/11	BACKPACK SYSTEM COMPONENTS ADJUSTED, COMPRESSOR HOSE CHANGED, TABLE/NOTES UPDATED	SP	MM	MM	SC

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

Work Performed by
S.M. Stoller Corporation
Under DOE Contract
No. DE-AM01-07LM00060

PROJECT LOCATION: GRAND JUNCTION
GRAND JUNCTION, CO

APPROVALS	
DRAWN BY: S. PITTON	2/11/11
CHECKED: S. PITTON	2/11/11
PROJECT ENGINEER: A. [illegible]	2/11/11
ENGINEERING MANAGER: M. MADRIL	2/11/11
PROJECT LEAD: S. CAMPBELL	2/11/11
SITE MANAGER/LEAD:	

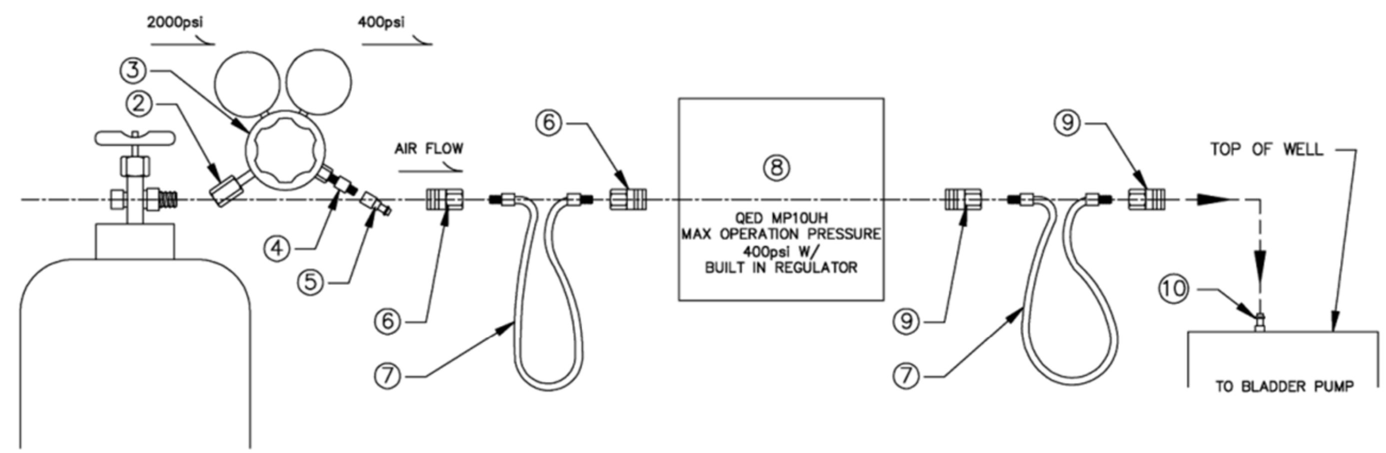
WELL MONITORING EQUIPMENT MODIFICATIONS

LOW PRESSURE BLADDER PUMP OPERATING SYSTEM

PROJECT NO. LTS-111-0001-17-000
DRAWING NO. S07329-R02-C02-C+
SHT. 2 OF 3

M:\LTS\111\0001\17\000\S0732902.DWG 03/07/11 11:53am pittons

⚠
WHIP CHECK:
WHIP CHECKS ARE NOT REQUIRED BY OSHA FOR HOSE SIZES NEEDED IN THIS OPERATION (Standards 29 CFR, 1926.302, 30 CFR §56/57.13021, 30 CFR §75.1730, 30 CFR §77.412)



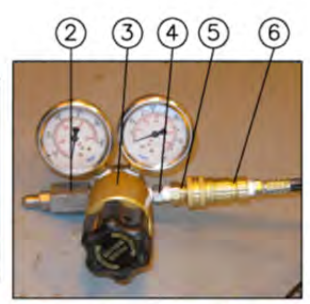
SOURCE DEVICE

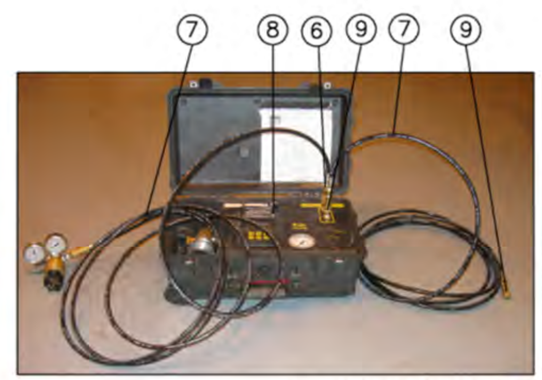
NO.	ITEM NAME	FIELD OPERATING PRESSURE
1(A)	"SMALL" AIR CYLINDER	2000psi
1(B)	"LARGE" AIR CYLINDER	2000psi

PARTS LIST

	ITEM	MATERIAL TYPE	PRESSURE RATING	OPERATING PRESSURE	PRODUCT INFORMATION	NATIONAL RECOGNIZED TESTING LAB (NRTL) OR CERTIFICATION
1(A)	"SMALL" AIR CYLINDER (9156–P)	6061–T6 ALUMINUM ALLOY	TC TEST PRESSURE 3324psi, DOT TEST PRESSURE 3693psi, SERVICE PRESSURE 2216psi	2000psi	CATALINA CYLINDERS, 9156–P (60FT³)	5YR RE–TEST PERIOD, DOT–3AL, TC–3ALM
1(B)	"LARGE" AIR CYLINDER (NUVT 4500)	STEEL	TEST PRESSURE 6750psi, SERVICE PRESSURE 4500psi	2000psi	NUVAIR, NUVT 4500 (437FT³)	10YR RE–TEST PERIOD, ISO 9809, DOT–E10869 4500psi, TC–SU4369–310
2	STANDARD AIR TANK NUT/NIPPLE CONNECTOR	STAINLESS STEEL	NUT–347–2, 5000psi NIPPLE–347–3, 5000psi	2000psi	MANUFACTURE–WESTERN (FROM AIR GAS)	NOT AVAILABLE
3	HIGH PRESSURE SYSTEM REGULATOR	BRASS, STAINLESS STEEL	RATED FOR MAX INLET PRESSURE 6000psi, MAX OUTLET PRESSURE 400psi	2000psi (INLET), 400psi (OUTLET)	AQUA ENVIRONMENT MODEL 4515–400	ASME VESSEL CODE SECTION 8, ISO09001
4	1/4" HEX NIPPLE	STAINLESS STEEL	RATED FOR 1000psi	400psi	PARKER PART NUMBER: 216P-4	SAE J530, SAE J531, ASA
5	3/8" HYDRAULIC QUICK COUPLING MALE PORT CONNECTION	BRASS	RATED FOR 5000psi	400psi	PARKER 60 SERIES PART NO. BH3–60	FACTORY TESTED, ISO–9001:2000, ISO–14001:2004
6	3/8"–HYDRAULIC QUICK COUPLING	BRASS	MAX SERVICE PRESSURE 5000psi	400psi	PARKER 60 SERIES PART NO. BH3–61	FACTORY TESTED, ISO–7241–1, SERIES B
7	1/4" AIR HOSE (MNPT,MNPT)	TEFLON, STEEL WIRE BRAID CORE	MAX SERVICE PRESSURE RATING 2785psi	400psi	EVERFLEX H43604	SAE 100R14, ISO3949/R7–1
8	MICRO PURGE CONTROL BOX	–	RATED FOR MAX INPUT 500psi	400psi	QED MP10UH	FACTORY TESTED, TEST AMERICA APPROVED FOR IN–HOUSE TESTING
9	1/4"–HYDRAULIC QUICK COUPLING	BRASS	MAX SERVICE PRESSURE 5000psi	400psi	PARKER 60 SERIES PART NO. BH2–60	FACTORY TESTED, ISO–7241–1, SERIES B
10	1/4"–HYDRAULIC QUICK COUPLING MALE PORT CONNECTION	BRASS	MAX SERVICE PRESSURE 5000psi	400psi	PARKER 60 SERIES PART NO. BH2–61	FACTORY TESTED, ISO–7241–1, SERIES B

"LARGE" AIR CYLINDER IS SHOWN ABOVE





INTERNAL REGULATOR FOR THE QED MP10UH

MARKINGS ON SMALL AIR CYLINDER:
DOT–3AL2216 E10013968
10 TC–ALM1530
UL18 EN849

MARKINGS ON LARGE AIR CYLINDER:
RIN C6A347 0608
EN849 6V V26
P625–19N, 6750

REVISION NO.	DATE	DESCRIPTION	DRAWN BY	CHECKED BY	PROJECT A/E	APPROVAL
⚠	2/22/11	UPDATED NOTES	SP	MM	MM	SC

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

Work Performed by
S.M. Stoller Corporation
Under DOE Contract
No. DE–AM01–07LM00060

PROJECT LOCATION: GRAND JUNCTION
GRAND JUNCTION, CO

APPROVALS

DRAWN BY	S. PITTON	2/11/11
	S. PITTON	2/11/11
PROJECT ENGINEER	A. PAJTON	2/11/11
ENGINEERING MANAGER	M. MADRIL	2/11/11
PROJECT LEAD	S. CAMPBELL	2/11/11

WELL MONITORING EQUIPMENT MODIFICATIONS

HIGH PRESSURE
BLADDER PUMP
OPERATING SYSTEM

PROJECT NO. LTS–111–0001–17–000
DRAWING NO. S07330–R01–C03–C+
SHT. 3 OF 3

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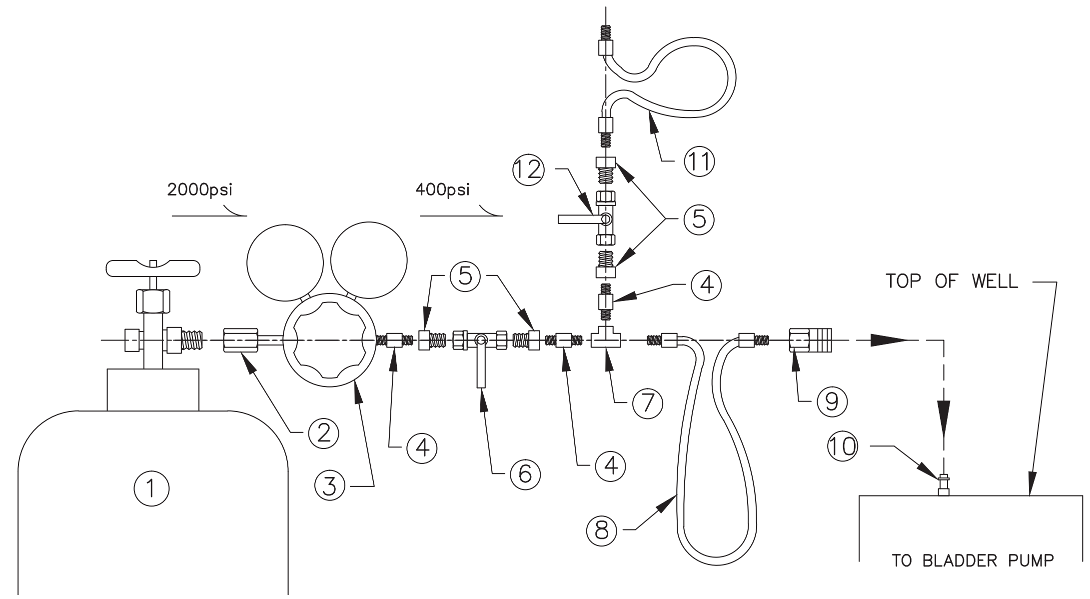
WHIP CHECK:
WHIP CHECKS ARE NOT REQUIRED BY OSHA FOR HOSE SIZES NEEDED IN THIS OPERATION (Standards 29 CFR, 1926.302, 30 CFR §56/57.13021, 30 CFR §75.1730, 30 CFR §77.412)

SOURCE DEVICE

NO.	ITEM NAME	FIELD OPERATING PRESSURE
1(A)	"SMALL" AIR CYLINDER	2000psi
1(B)	"LARGE" AIR CYLINDER	2000psi

MARKINGS ON SMALL AIR CYLINDER:
DOT–3AL2216 E10013968
10 TC–ALM1530
UL18 EN849

MARKINGS ON LARGE AIR CYLINDER:
RIN C6A347 0608
EN849 6V V26
P625–19N, 6750



PARTS LIST

	ITEM	MATERIAL TYPE	PRESSURE RATING	OPERATING PRESSURE	PRODUCT INFORMATION	NATIONAL RECOGNIZED TESTING LAB (NRTL) OR CERTIFICATION
1	"LARGE" AIR CYLINDER (NUVT 4500)	STEEL	TEST PRESSURE 6750psi, SERVICE PRESSURE 4500psi	2000psi	NUVAIR, NUVT 4500 (437FT^3)	10YR RE–TEST PERIOD, ISO 9809, DOT–E10869 4500psi, TC–SU4369–310
2	STANDARD AIR TANK NUT/NIPPLE CONNECTOR	STAINLESS STEEL	NUT–347–2, 5000psi NIPPLE–347–3, 5000psi	2000psi	MANUFACTURE–WESTERN (FROM AIR GAS)	NOT AVAILABLE
3	HIGH PRESSURE SYSTEM REGULATOR	BRASS, STAINLESS STEEL	RATED FOR MAX INLET PRESSURE 6000psi, MAX OUTLET PRESSURE 400psi	2000psi (INLET), 400psi (OUTLET)	AQUA ENVIRONMENT MODEL 415–400	ASME VESSEL CODE SECTION 8, ISO9001
4	1/4" HEX NIPPLE	BRASS	RATED FOR 1000psi	400psi	PARKER NIPPLE 216P PART NO. 216P–4	SAE J530, SAE J531, ASA
5	3/8"x1/4" HEX REDUCING BUSHING	BRASS	RATED FOR 1000psi	400psi	PARKER BUSHING 209P PART NO. 209P–6–4	SAE J530, SAE J531, ASA
6	3/8"–BRASS BALL VALVE (FEMALE–FEMALE)	BRASS	MAX SERVICE PRESSURE 600psi@250°F AND BELOW	400psi	PARKER PIPE ENDS V500P PART NO. V500P–4	FACTORY TESTED, ISO–7241–1, SERIES B
7	1/4" TEE	BRASS	RATED FOR 1000psi	400psi	PARKER TEE PART NO. 2224P–4	SAE J530, SAE J531, ASA
8	3/16"x20FT AIR HOSE (MNPT,MNPT)	SYNTHETIC RUBBER, FIBER BRAID, STEEL BRAID	WORKING PRESSURE 3000	400psi	PARKER TRANSPORTATION 201 AIR BRAKE HOSE	SAE 100R5, SAE J1402 ALL/ D.O.T. FMVSS 106 ALL
9	1/4"–HYDRAULIC QUICK COUPLING	BRASS	MAX SERVICE PRESSURE 5000psi	400psi	PARKER 60 SERIES PART NO. BH2–60	FACTORY TESTED, ISO–7241–1, SERIES B
10	1/4"–HYDRAULIC QUICK COUPLING MALE PORT CONNECTION	BRASS	MAX SERVICE PRESSURE 5000psi	400psi	PARKER 60 SERIES PART NO. BH2–61	FACTORY TESTED, ISO–7241–1, SERIES B
11	1/4"x4FT AIR HOSE (MNPT,MNPT)	SYNTHETIC RUBBER, FIBER BRAID, STEEL BRAID	WORKING PRESSURE 3000	400psi	PARKER TRANSPORTATION 201 AIR BRAKE HOSE	SAE 100R5, SAE J1402 ALL/ D.O.T. FMVSS 106 ALL
12	1/4"–BRASS BALL VALVE (FEMALE–FEMALE)	BRASS	MAX SERVICE PRESSURE 600psi@250°F AND BELOW	400psi	PARKER PIPE ENDS V500P PART NO. V500P–4	FACTORY TESTED, ISO–7241–1, SERIES B

REVISION NO.	DATE	DESCRIPTION	DRAWN BY	CHECKED BY	PROJECT A/E	APPROVAL

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO

Work Performed by
S.M. Stoller Corporation
Under DOE Contract
No. DE–AM01–07LM00060

PROJECT LOCATION: GRAND JUNCTION
GRAND JUNCTION, CO

REFERENCE

APPROVALS		
DRAWN BY	S. PITTON	8/13/12
ENGINEER	S. PITTON	8/13/12
PROJECT ENGINEER	S. PITTON	8/13/12
ENGINEERING MANAGER	M. MADRIL	8/13/12
PROJECT LEAD	S. CAMPBELL	8/13/12
SITE MANAGER/LEAD		

WELL MONITORING EQUIPMENT MODIFICATIONS

HIGH PRESSURE
BLADDER PUMP
CONTROL MANIFOLD

PROJECT NO. LTS–111–0001–17–000
DRAWING NO. S09301–R00–C01–C+
SHT. 1 OF 1

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Appendix B–4

Desk Instructions for Using the Trailer-Mounted 20-Kilowatt Olympian Generator

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Desk Instructions for Using the Trailer-Mounted 20-Kilowatt Olympian Generator

Introduction and Purpose

This procedure will be used to aid a properly trained and authorized individual to operate the trailer-mounted 20-kilowatt Olympian generator. This generator is primarily used to power deep submersible groundwater pumps at the Shoal, Nevada, Site and the Central Nevada Test Area. However, this generator (Figure 1) could be used at other sites, as needed. This generator can only be used as a portable generator and is not designed to be connected to a permanent structure.

Figure 1. Olympian 20-Kilowatt Generator

Safety

This generator set is designed to be safe when used as a portable generator. However, responsibility for safety rests with properly trained and authorized personnel who use the generator. The following safety precautions will minimize the possibility of accidents.

Caution

1. *Electrocution is the greatest risk to human health associated with operation of any generator.*
2. *Always use a ground-fault circuit interrupter (GFCI).*
3. *Never start or operate the generator unless it is safe to do so.*
4. *If an unsafe condition is identified, remove the generator from service.*
5. *Before towing the generator, complete a Pre-Trip Towing Checklist (form LMS 2164).*

This generator set power distribution system (i.e., breaker panel, disconnect switches, bonding of generator to trailer frame) has been constructed by competent licensed electricians; no unauthorized alteration of the distribution system or of the generator is allowed.

Grounding Requirements

According to the Occupational Safety and Health Administration (29 CFR 1926.404(f)(3)(i)), the frame of the generator need not be grounded (connected to earth), and the frame may serve as the ground, under the following conditions:

- The generator supplies equipment mounted on the generator, cord-end and plug-connected equipment, or both through receptacles mounted on the generator.
- The noncurrent-carrying metal parts of equipment (such as the fuel tank, the internal combustion engine, and the generator’s housing) are bonded to the generator frame, and the equipment grounding conductor terminals (of the power receptacles that are a part of, and mounted on, the generator) are bonded to the generator frame.

Current configuration and specified use of this generator meets this Occupational Safety and Health Administration definition for grounding requirements.

Operation

The Environmental Monitoring Operations group is responsible for keeping the generator maintained and in proper operating condition. However, before each use, the generator should be inspected by the user as follows:

[1] Check fluid levels in the generator motor, including motor oil, fuel, and coolant levels. The fuel tank is mounted below the generator; the fill port is at the rear of the tank, below the control panel. All other fluid levels can be assessed by opening the side panels.

[2] Ensure that the trailer is free from unnecessary equipment or other loose items that could become tripping hazards or inhibit safe operation.

[3] Visually inspect the entire generator for signs of fuel, coolant, or lubricant leakage.

[4] Inspect power cords and cord-end connectors for signs of excessive wear or damage.

[5] Check the onboard fire extinguisher.

[6] Check the generator for any general wear and tear.

[7] Ensure that the generator trailer is as level as possible before operating the generator.

Start and operate the generator as follows:

[1] Open the engine compartment on the right and turn the battery isolation switch to the RUN position (Figure 2). Close the compartment.

[2] Loosen the fuel tank fill cap, but do not remove it.

[3] Open the control panel’s clear plastic door, and depress the GLOW PLUGS button for 15 seconds (Figure 3).

[4] Turn the start switch to the START/RUN position, which will start the generator.

[5] Allow the engine to run for 5 minutes before placing a load on it.

Caution

Never connect the generator cord-end connector to the pump cord-end connector (or disconnect the generator cord-end connector from it) unless the disconnect switch is in the OFF position (Figure 4). Doing so could cause an arc-flash reaction.

Figure 2. Battery Isolation Switch

Figure 3. Control Panel

Figure 4. Typical Disconnect Switch

Caution

To stop the generator in the event of an emergency, press the red button below the control panel (Figure 5).

Figure 5. Emergency Stop Button

- Before energizing the disconnect switch, connect the cord-end connectors after ensuring that a portable GFCI is in place.

Caution — *Always use a GFCI when powering pumps or other equipment.*

- Turn the disconnect switch to the ON position to power the pump.
- De-energize the pump by turning the disconnect switch to the OFF position.

Caution — *Never connect or disconnect cord-end connectors unless the disconnect switch is in the OFF position.*

Storage

Successful long-term use and operation of the generator depends on the generator's being stored properly during long periods of nonuse. Before storing the generator, complete the following actions:

[1] Ensure that the battery isolation switch is in the OFF position.

[2] Clear the trailer of all extra supplies and equipment that may have accumulated during use.

[3] Wash the generator and trailer.

[4] Refill the fuel tank; add diesel fuel conditioner/stabilizer to the fuel during the filling operation.

[5] Park the trailer in a level position.

More detailed maintenance and operations information can found in the owner's manual located at \\GJO\Projects\SamplingProg\Equipment Manuals and Procedures.

Appendix C

Data Validation Guidance

C1.0 Introduction

This document provides guidance when preparing data validation packages (DVPs) for routine water sampling events conducted for the U.S. Department of Energy (DOE) Office of Legacy Management. The standardized format and content of DVPs as described in the following sections provides for a consistent, high-quality deliverable to DOE.

C2.0 Data Validation Package Format and Content

The following items are required in each DVP submitted to DOE. Each DVP is assembled in an electronic format to facilitate storage and transmittal. Figure 1 shows an example DVP table of contents.

C2.1 Sampling Event Summary

The results of the sampling event are summarized in this section. The summary will include a short introduction with the number and types of samples collected and any problems encountered during the event. The following elements, if applicable, are addressed in the summary.

C2.1.1 Results from domestic wells that exceeded a U.S. Environmental Protection Agency (EPA) primary drinking water standard or health advisory. The appropriate DOE project manager must be notified immediately when a standard is exceeded in a sample from a domestic well.

C2.1.2 A comparison to UMTRCA standards table—When applicable, all wells with results that exceed EPA groundwater standards for inactive uranium processing sites (40 CFR 192.02, Table 1 to Subpart A) will be listed in the table. Exceedances at point-of-compliance wells should be highlighted and the implications discussed.

C2.1.3 A comparison to other groundwater benchmarks that may be listed in compliance documents such as groundwater compliance action plans, long-term surveillance plans, or long-term management plans. These benchmarks may include alternate concentration limits, benchmarks based on background concentrations, or risk-based benchmarks.

C2.1.4 Discussion of contaminant plume (or plumes) movement—This includes discussion of any unexpected contaminant plume movement, such as evidence of contamination in cross-gradient portions of an aquifer or in deeper aquifers that were previously unaffected. In addition, historically unaffected downgradient wells that show evidence of arrival of the contaminant plume are addressed. If there is no evidence of contaminant plume movement, and current results are consistent with historical results, then that is noted. A discussion of the progress of the natural flushing compliance strategy (if applicable) is included if results indicate an upward or downward trend. All interpretations of contaminant plume movement may be illustrated with time versus concentrations graphs or plume maps (as appropriate).

Contents

Sampling Event Summary

Sample Location Map

Data Assessment Summary

Water Sampling Field Activities Verification Checklist
Laboratory Performance Assessment
Sampling Quality Control Assessment
Certification

Attachments

Attachment 1—Assessment of Anomalous Data

- Potential Outliers Report
- Anomalous Data Review Checksheet

Attachment 2—Data Presentation

- Groundwater Quality Data
- Surface Water Quality Data
- Equipment Blank Data
- Static Water Level Data
- Time Versus Concentration Graphs

Attachment 3—Sampling and Analysis Work Order

Attachment 4—Trip Report

Figure 1. Example of Data Validation Package Contents

C2.1.5 Discussion of impacts to surface water—An assessment of potential impacts on surface water quality from site contamination is performed when surface water features such as rivers, streams, seeps, and ponds are sampled. The assessment is made to determine if there is statistical evidence that site-related contaminants were detected in a surface body of water in greater concentrations than in upstream or ambient water**.** This requires calculation of a statistical benchmark derived from historical data to compare with current data. Benchmark values are calculated using the following guidance, which is derived from *Data Quality Assessment: Statistical Methods for Practitioners* (EPA 2006).

- Greater than 50 percent nondetects or less than 10 data points in the historical upstream data set.

When the assumptions of normality and lognormality cannot be justified, especially when a significant portion of the samples are nondetects, the use of nonparametric tolerance intervals is applied. With greater than 50 percent nondetects, the benchmark value is the maximum concentration detected or the highest detection limit, whichever is greater. The calculation of a benchmark value from a limited data set (less than 10 data points) is not recommended. However, an assessment of impacts to surface water is sometimes required; therefore, the benchmark for a limited data set will also be the maximum detected value or the highest detection limit, whichever is greater.

- Between 15 and 50 percent nondetects in the historical upstream data set (with greater than 10 data points).

  The application of tolerance limits preceded by Cohen's method (EPA 2006 guidance) to adjust the mean and standard deviation of a data set cannot be used because detection limits usually vary in the historical data. Additionally, Cohen's method assumes that the data are either normally or lognormally distributed, which is frequently not the case. Therefore, the benchmark value is the nonparametric, 95th upper tolerance limit as described above.

- Less than or equal to 15 percent nondetects in the historical upstream data set (with greater than 10 data points).

  The benchmark value is derived from the 50 (or fewer) most recent data values as follows:

  —Test the set of nontransformed data for normality using the Shapiro-Wilk test of normality.

  If data are normally distributed, then

  —Calculate the mean and standard deviation of the data set.

  —Use Aitchison's method (EPA 2006 guidance) to adjust the mean standard deviation for the number of nondetects.

  —Compute the benchmark as the one-sided upper tolerance limit:

  - ➢ mean + K(standard deviation), where K is the one-sided tolerance factor.

  If data are not normally distributed, then log-transform the data set and test the log-transformed data for normality using the Shapiro-Wilk test of normality.

  If data are lognormally distributed, then

  —Calculate the mean and variance of the data set.

  —Use Aitchison's method (EPA 2006 guidance) to adjust the mean standard deviation for the number of nondetects.

  —Compute the benchmark as the one-sided upper tolerance limit:

  - ➢ exp[mean + K(standard deviation)], where K is the one-sided tolerance factor.

If none of the nontransformed data or log-transformed data pass the normality or lognormality test, then compute the benchmark as the nonparametric 95% upper tolerance limit as described above.

Concentrations of site-related contaminants that exceed the benchmark must be listed and discussed. The discussion will include the type of surface water feature (e.g., river, seep, pond) and the implication of exceeding the benchmark.

C2.1.6 Evaluations in the summary may be modified to address unique circumstances or monitoring objectives for a site.

C2.1.7 The site lead is responsible for content of the summary, including additional details specific to a site. The site lead (or designee) must sign the summary page when completed.

C2.2 Sample Location Map

This section contains a site map displaying locations sampled during the event.

C2.3 Data Assessment Summary

This section contains the following items:

- Water Sampling Field Activities Verification Checklist
- Laboratory Performance Assessment
- Sampling Quality Control Assessment
- Certification

Each of these items is detailed in the following subsections.

C2.3.1 Water Sampling Field Activities Verification Checklist

Because consistent sample collection is the first step in obtaining valid and defensible data, an assessment of sample collection activities is an important step in the data validation process. The Water Sampling Field Activities Checklist was developed primarily from criteria listed in the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351) (SAP). The SAP is the primary document that specifies sampling procedures and quality assurance measures to ensure that water samples are collected in a consistent and technically sound manner. The Water Sampling Field Activities Verification Checklist is used to document the comparison of sampling requirements with actual sample collection activities. Discrepancies noted on the checklist may require additional action. For example, data may be qualified at the discretion of the site lead or the data validation lead or both. Significant discrepancies will be documented in the Sampling Event Summary section.

C2.3.2 Laboratory Performance Assessment

Assessment of laboratory performance is conducted using the procedure "Standard Practice for Validation of Laboratory Data," in the *Environmental Procedures Catalog* (LMS/POL/S04325).

This procedure is based on EPA guidance for verification and validation of laboratory data and provides criteria for qualification of data that do not meet recommended quality control acceptance criteria.

Laboratory performance is assessed by reviewing and evaluating quality indicators that include the following: sample shipping and receiving practices, holding times, instrument calibrations, laboratory blanks, interference check samples, matrix spike and matrix spike duplicates, laboratory replicates, laboratory control samples, serial dilutions, sample dilutions, detection limits, peak integrations, radiochemical results uncertainty, and the electronic data deliverable (EDD). The results of the laboratory performance assessment are summarized in a Data Review and Validation Report that is archived as record material along with the data package received from the laboratory.

Data qualifiers resulting from the validation process are added to the results records in the SEEPro database by the data validation lead using a Microsoft Access application (DataVal).

C2.3.3 Sampling Quality Control Assessment

Additional data qualifiers may be applied to the sample data based on sampling protocol, field measurements, field duplicate sample results, or field blank sample results.

Qualifiers based on sampling protocol include “F” and “Q” flags. Results obtained from a well that was sampled using a low-flow sampling method are qualified with an “F” flag. This includes Category I, II, and III wells as specified in the SAP. Additionally, results obtained from Category II and III wells are qualified with a “Q” flag indicating that the data are qualitative because of the sampling protocol used. Results obtained from a Category IV well (domestic well or flowing well) are not qualified based on sampling protocol.

Results obtained from wells with a pH greater than 9 will be qualified with a “G” flag indicating potential grout contamination.

Organic and inorganic field duplicate sample results are assessed using the following criteria. A control limit of ± 20 percent relative percent difference (RPD) is used for sample concentrations greater than 5 times the reporting limit. RPD is calculated using the following formula:

$$RPD = \frac{|S - D|}{(S + D)/2} \times 100$$

Where

S = sample concentration
D = duplicate concentration

For sample concentrations less than 5 times the reporting limit, a control limit of ± the reporting limit will be used.

Radiological field duplicate results are assessed using the following criteria. Radiological duplicate results are considered acceptable if the relative error ratio is less than 3. The relative ratio error is defined using the following formula:

$$RER = \frac{|S - D|}{\sqrt{\sigma^2 + \sigma^2}}$$

Where

RER = relative error ratio
S = sample concentration
D = duplicate concentration
σ = Uncertainty* ÷ 1.96

*Assumes uncertainty is reported as 2σ as specified in the laboratory statement of work.

Duplicate sample results that do not meet criteria are noted in this section along with a discussion of potential implications on overall data quality. Data may be qualified if duplicate sample results do not meet criteria based on the professional judgment of the data validation lead.

Equipment blank results are evaluated using the following criteria. Equipment blanks are assumed to be contaminant free; therefore, results should be below the required detection limit. Analytes detected in the equipment blank will be noted in this section. Associated samples results (except for major anions and cations) that are less than five times the blank concentration are qualified with a “J” flag as estimated values. Sample results for major anions and cations (chloride, sulfate, calcium, sodium, magnesium, and potassium) that are less than ten times the blank concentration are qualified with a “J” flag as estimated values.

Trip blank results are evaluated using the following criteria. Trip blanks are assumed to be contaminant free; therefore, trip blank results should be below the required detection limit. Analytes detected in the trip blank will be noted in this section. Associated samples results (except for common laboratory contaminants) that are less than five times the blank concentration are qualified with a “U” flag as not detected. Sample results for the common laboratory contaminants methylene chloride, acetone, 2-butanone, and cyclohexane (EPA 1999) that are less than ten times the blank concentration are qualified with a “U” flag as not detected.

C2.3.4 Certification

The data are certified as validated by the primary personnel responsible for completing the DVP. This section must be signed by the laboratory coordinator and the data validation lead or their respective designee. In addition, the data are specified as available for use as final results, or specified as conditional and not available for use.

C2.4 Assessment of Anomalous Data

New data are assessed for potential anomalies by comparison to the historical data set. Data are initially screened using the Potential Outliers Report. Data listed in the Potential Outliers Report are further evaluated by the data validation lead, and follow-up action is implemented (if required). After follow-up action is completed, a decision of the final disposition of the potentially anomalous data is made and documented. Details of the assessment process and the associated documentation are presented in the following subsections.

C2.4.1 Potential Outliers Report

Potential outliers are measurements that are extremely large or small relative to the rest of the data and, therefore, are suspected of misrepresenting the population from which they were collected. Potential outliers may result from transcription errors, data-coding errors, or measurement system problems. However, outliers may also represent true extreme values of a distribution and indicate more variability in the population than was expected.

The Potential Outliers Report is generated using the Sample Management System (SMS) application. A module in SMS compares new data with the historical data set and lists all new data that fall outside the historical data range. Data listed are highlighted if the concentration detected is not within 50 percent of historical minimum or maximum values. A determination is also made if the data are normally distributed using the Shapiro-Wilk Test. An appropriate statistical test is then applied. Dixon's Extreme Value test is used to test for statistical outliers when the sample size is less than or equal to 25. This test considers both extreme values that are much smaller than the rest of the data (case 1) and extreme values that are much larger than the rest of the data (case 2). This test is valid only if the data without the suspected outlier are normally distributed. Rosner's Test is a parametric test that is used to detect outliers for sample sizes of *25* or more. This test also assumes that the data without the suspected outliers are normally distributed.

Further data review is required if normally distributed data are identified as potentially anomalous or if the data are otherwise suspected of being extreme values.

C2.4.2 Anomalous Data Review Checksheet

Data listed on the Potential Outliers Report that do not meet the criteria above are considered potentially anomalous and warrant further investigation. These data are listed on the Anomalous Data Review Checksheet along with the appropriate follow-up action. Follow-up action may include one or more of the following: consultation with the laboratory to check for errors; reanalysis of samples; comparison to results from the next sampling event; and qualification of data with a “J” (estimated) or “R” (unusable) flag.

C2.5 Data Presentation

This section of the DVP includes all of the data being validated. SEEPro database reports for groundwater data, surface water data, field blank data, and static water level data are included (if applicable). Time versus concentration plots that support the interpretations and conclusions in the Sampling Event Summary are included in this section. The data validation lead determines the locations and constituents for time versus concentration graphs, which can be produced from the SEEPro database. The time versus concentration graphs are exported to Excel to facilitate the compilation of the DataVal package into one electronic file.

C2.6 Sampling and Analysis Work Order

The sampling and analysis work order letter (or other planning document, if applicable) details the sample locations and the analyte list that were planned for a particular event. The work order is included in this section of the DVP.

C2.7 Trip Report

The trip report details field activities of the sampling event. It is prepared by the sampling lead and is included in this section of the DVP.

C3.0 Logistics

The goal for completion of DVPs and transmittal to DOE is 90 days after the completion of a sampling event or sampling period (e.g., calendar quarter). Actual due dates vary from year to year depending upon goals established in the task order. When the data validation lead responsible for a particular event or site is identified, his or her name will be entered on the Requisition Tracking spreadsheet by the water sampling coordinator. This form is used to track the DataVal process from the start of fieldwork to the final submittal to DOE. The water sampling coordinator will update the Requisition Tracking spreadsheet as each component of the spreadsheet is completed. Figure 2 shows an example of the spreadsheet. Figure 3 shows a flowchart detailing the data validation process.

C4.0 Reporting

The completed draft DVP is forwarded to DOE for review. When comments from DOE are addressed, the final DVP is delivered to DOE for distribution. Copies of each package are delivered (electronically if possible) to the stakeholders (see Table 1 for example).

If samples have been collected from domestic-supply wells, a letter and table for each sampling event are sent to the owners of the property where the wells are located. Figure 4 presents a sample letter and table.

C5.0 References

Environmental Procedures Catalog, LMS/POL/S04325, continually updated, prepared by S.M. Stoller Corporation for the U.S. Department of Energy, Office of Legacy Management, Grand Junction, Colorado.

EPA (U.S. Environmental Protection Agency), 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, EPA-540/R-99-008, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, DC.

EPA (U.S. Environmental Protection Agency), 2006. *Data Quality Assessment: Statistical Methods for Practitioners,* EPA/240/B-06/003, quality management guidance document EPA QA/G-9S, Office of Environmental Information, February.

Site	Work Order Letter Sent	Start of Field Work	Submit Samples to Lab	Lab Code	Req./RI No.	Report Due to TAC	Date Report Received	Elect. File Received from Lab	Field Data Entered	Database Updated	Outstanding Date Due to DOE	Standard Date Due to DOE	DV Package Submitted to DOE	Data Validation Lead	Comments

Figure 2. Example of the Requisition Tracking Spreadsheet

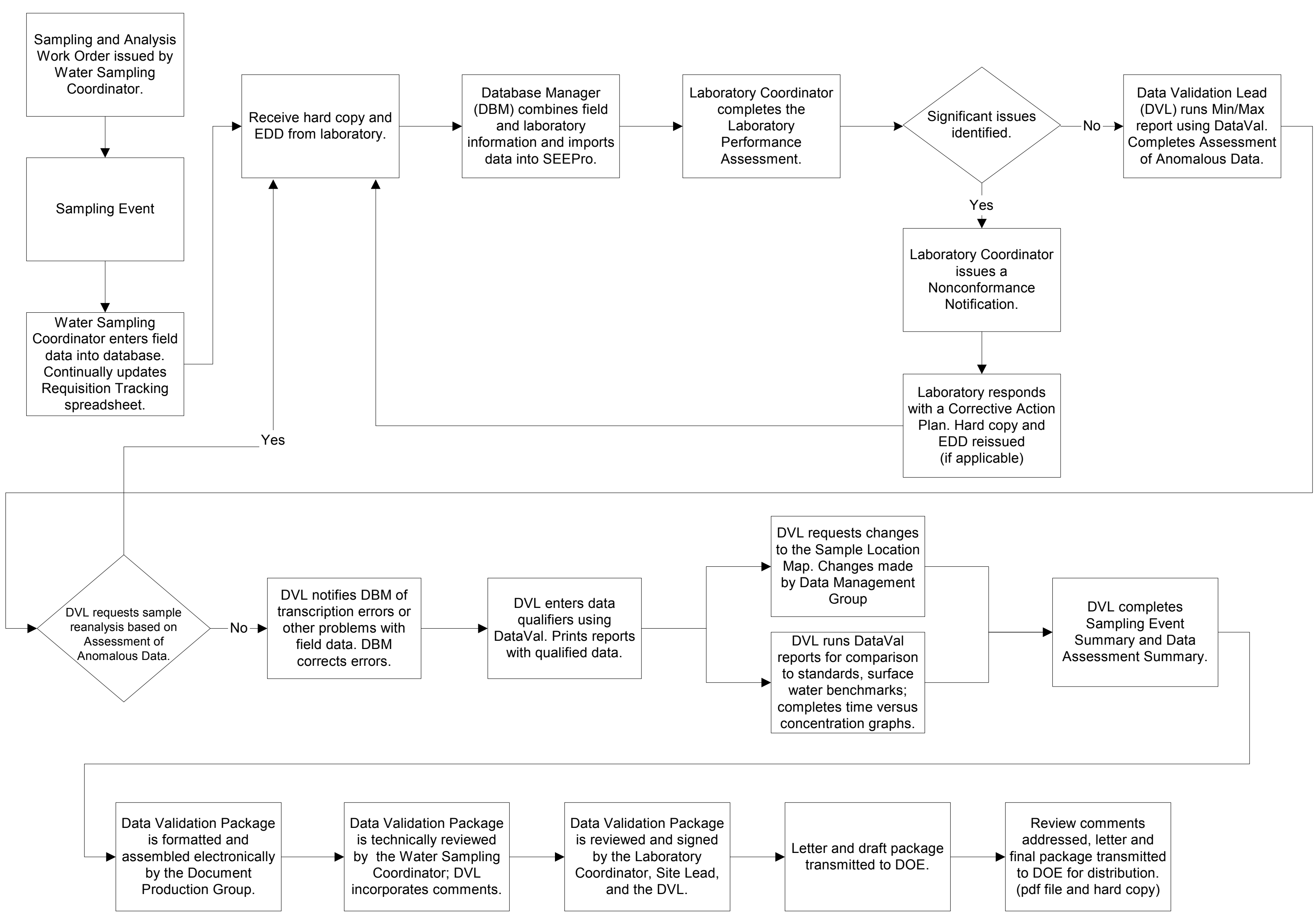

Figure 3. Data Validation Flowchart

Table 1. Example of a Data Validation Report Distribution List

Site	Project	Stakeholder	Total Number of Copies/Disks
Ambrosia Lake	LM	Scott McKitrick, New Mexico Environment Department (e-copy) cc w/enclosure: Kenneth Hooks, NRC/Rockville, MD	3/1
Canonsburg	LM	James Yusko, Pennsylvania Dept. of Environmental Protection cc w/enclosure: S. Harper, Pennsylvania Dept. of Environmental Protection cc w/enclosure: Mike Layton, NRC	4/0
Durango	LM	Wendy Naugle, CDPHE cc w/enclosure: W. Urbonas, San Juan Basin Health Dept. cc w/enclosure: Durango Public Library	4/0
Falls City	LM	Bruce Calder, Texas Dept. of Health, Bureau of Radiation Control (e-copy) cc w/enclosure: Falls City Public Library cc w/o enclosure: Gary Smith, Texas Dept. of Health, Bureau of Radiation Control	3/1
Grand Junction	LM	Wendy Naugle, CDPHE/Denver cc w/enclosure: Mesa County Public Library	3/0
Green River	LM	Rob Herbert, Utah Department of Environmental Quality (e-copy) cc w/enclosure: Green River Public Library cc w/o enclosure: Loren Morten, UDEQ	3/1
Gunnison	LM	Wendy Naugle, CDPHE/Denver Gunnison Public Library	3/0
Hallam	LM	Todd A. Chinn, Nebraska Public Power District cc w/enclosure: Jim DeFrain, Nebraska Health and Human Services	3/0
Lakeview	LM	David Stewart-Smith, State of Oregon, Office of Radiation Control (e-copy) cc w/enclosure: Lake County Library	3/1
Lowman	LM	No DVPs being sent on this site (per M. Plessinger, OK'd by D. Metzler)	
Maybell	LM	Wendy Naugle, CDPHE/Denver	2/0
Mexican Hat	LM	Madeline Roanhorse, Navajo UMTRA Program (always gets 3 DVPs + e-copy) cc w/enclosure: Steve Osterberg, Knight Piesold cc w/enclosure: Eric Rich, Navajo EPA cc w/enclosure: Monument Valley High School Library cc w/o enclosure: Levon Benally, Navajo UMTRA	7/1

Mr. George Smith
c/o Smith Construction, Co.
2720 Jones Avenue
Washington, Colorado 83838

SUBJECT: Water Quality Tests

Dear Mr. Smith:

In 2007, the U.S. Department of Energy (DOE) Office of Land and Site Management representatives collected two water samples from the well that provides drinking water to 921 Rendezvous Road as part of the ongoing assessment of groundwater conditions near the Riverton, Wyoming, Processing Site. The samples were collected from an exterior tap on the house and were not filtered, thus representing the water as you would use it.

Contaminants related to the Riverton Processing Site have not affected the water from this well, and no effects are expected in the future. However, to alleviate public concern, DOE is committed to sampling this well as part of the long-term monitoring effort.

Background Information

For most common chemicals, the U.S. Environmental Protection Agency (EPA) established standards for drinking water under the Safe Drinking Water Act called "maximum contaminant levels" (MCLs). These values are based on available health effect data for each chemical and are designed to protect municipal drinking water supplies. Although MCLs are not used to regulate privately owned wells, the MCLs are commonly used to evaluate the quality of water in private wells.

For some chemicals, EPA has set "secondary MCLs" (SMCLs) for drinking water. An SMCL is simply a suggested level based on aesthetic qualities of the water such as taste and odor and is not based on health effects.

Some chemicals, such as molybdenum, do not have a standard established under the Safe Drinking Water Act but are considered site contaminants. For these chemicals, an additional standard is used to evaluate the water quality. The U.S. Nuclear Regulatory Commission regulates compliance for the Riverton Processing Site under the Uranium Mill Tailings Radiation Control Act (UMTRCA). The EPA established groundwater quality standards under UMTRCA also called MCLs. Contaminant concentrations found below these levels in groundwater are considered protective of human health and the environment.

Figure 4. Example of Domestic Well Reporting

Results of the Sampling Program

Summary tables of the June and November 2007 sampling events are enclosed with this letter. These summary tables present data that have an associated MCL or SMCL. In the table, column 1 lists the chemical name, column 2 lists the concentration detected at the external tap, and column 3 shows the units of measurement. The common unit of measurement is milligrams per liter (mg/L), which is approximately equivalent to one part per million. Column 4 shows the MCL or SMCL for the chemical. If more than one MCL exists for a chemical, the table lists the most restrictive value. Column 5 indicates whether the concentration exceeds the MCL or SMCL associated with that chemical.

The water from your well comes from the Wind River Formation, which is the primary source of groundwater in the region. Although the chemicals listed in the table are considered site contaminants, they also occur naturally in the groundwater within the Wind River Formation; therefore, a chemical (such as uranium) may be detected at a low concentration and not be indicative of site contamination. In addition, common groundwater constituents, such as sulfate, may be detected in higher concentrations and still considered naturally occurring if similar concentrations are found in Wind River Formation wells outside of the influence of the site.

As shown in the tables, no MCLs were exceeded, which indicates there are no site-related health risks from drinking water obtained from your well. Although the sulfate and pH concentrations exceeded the SMCL, this is typical of natural concentrations found regionally in the groundwater of the Wind River Formation and is not considered site related.

If you have any questions regarding this information, please feel free to contact me at (970) 248-6016.

Sincerely,

Jalena Maestas
Site Manager

Enclosure

cc w/enclosure:
J. Erickson, WDEQ
D. Aragon, WREQC
John Arum, Ziontz, Chestnut, Varnell, Berley, and Slonim
Valarie Thomas, Thomas Law Office
RVT 410.02 (Thru D. Roberts)

Figure 4 (continued). Example of Domestic Well Reporting

Table 1.

Water Quality Analytical Results | Unfiltered Well Water
Well Number: 0405; 921 Rendezvous Road | Sample Date: 6/5/2007

(1) CHEMICAL	(2) RESULT	(3) UNITS	(4) MCL	SMCL	(5) EXCEEDS?
Manganese	0.0026B	mg/L		0.05	NO
Molybdenum	0.0029	mg/L	0.1		NO
pH	8.66	s.u.		6.5–8.5	YES
Sulfate	290	mg/L		250	YES
Uranium	0.000052B	mg/L	0.030		NO

Table 2.

Water Quality Analytical Results | Unfiltered Well Water
Well Number: 0405; 921 Rendezvous Road | Sample Date: 11/13/2007

(1) CHEMICAL	(2) RESULT	(3) UNITS	(4) MCL	SMCL	(5) EXCEEDS?
Manganese	0.0038B	mg/L		0.05	NO
Molybdenum	0.0051	mg/L	0.1		NO
pH	9.21	s.u.		6.5 – 8.5	YES
Sulfate	390	mg/L		250	YES
Uranium	0.000021B	mg/L	0.030		NO

Notes: B = Result is between the instrument detection limit and the contract required detection limit
mg/L = milligrams per liter
s.u. = standard units
MCL = maximum contaminant level
SMCL = secondary maximum contaminant level

Figure 4 (continued). Example of Domestic Well Reporting

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Appendix D

Job Safety Analysis

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Job Safety Analysis

Descriptive Title: Water Sampling and Minor Well Maintenance at LM sites

General LMS ☒ or Specific Site: Numerous LM sites Issuance Date: 3/22/2012 Expiration Date: 3/22/2013

Work Scope	
1.	Work involves routine water sampling and minor well maintenance. Routine water sampling tasks include collection, preservation, and shipping of water samples, and collection of field measurements including water levels and water quality measurements. Routine maintenance tasks include painting well casings; repairing/replacing hinges, hasps, and locks on well casings; replacing concrete well pads; redeveloping wells; and removing vegetation in the vicinity of sample locations. Driving to sites and sample locations, on- and off-road, is required along with periodic use of an ATV. Under the EMS, workers will minimize impacts to the environment by reusing and recycling materials to the extent practical, using less or non-hazardous or bio-based paints, solvent and other chemical products, and using concrete with recycled content per the “green 3800 series” cost element requirements.
2.	Work will be conducted at most LM sites that require water sampling.
3.	Work will be conducted outside during all seasons of the year.
4.	The following equipment may be used: ATVs, compressors, generators, compressed gas cylinders, hand tools, paint sprayer, truck-mounted winch, weed eater, batteries, sample pumps, and concrete mixer.
5.	Work will be performed by Stoller personnel.

Define the Scope of Work by Individual Tasks (ISMS Core Function #1)	Analyze the Safety and Environmental Hazards (ISMS Core Function #2)	Develop and Implement Controls (ISMS Core Function #3)
Working outdoors	Heat/cold exposure Medical emergency	• Watch for signs of heat and cold stress in self and others; these include unusual redness or profuse sweating, or uncontrollable shivering. Take breaks as necessary to cool down or warm up. • Wear adequate clothing for weather conditions. • Drink sufficient fluids, approximately 8 ounces every hour of active work. • At least one person in the group shall have current first aid/CPR training. • Carry a first aid kit that meets the LMS requirements. • Some form of external communication should be present. This may be a cell phone or personal locator beacon. Verify that radios work before taking them to a site. Cell phones may require a booster at remote locations. • Use the “buddy system”—at least 2 people should be present on a site, and they should have visual or radio contact at all times.
	Slips, trips, and falls over uneven terrain and equipment	• Be aware of uneven terrain and remove slip and trip hazards, if possible. • Establish an equipment lay-down area and keep all items, neatly, in this area when they are not in use. • Wear sturdy work boots that provide ankle support.

Job Safety Analysis (continued)

Define the Scope of Work by Individual Tasks (ISMS Core Function #1)	Analyze the Safety and Environmental Hazards (ISMS Core Function #2)	Develop and Implement Controls (ISMS Core Function #3)
Working outdoors	Slips, trips, and falls over uneven terrain and equipment	• Follow designated routes/trails when possible. • When crossing rock-armored features, be aware of the potential for the rock to move—concentrate on each step and do not carry items that obscure vision.
	Falls to lower level	Be very careful when working near escarpments or other features that are more than 4 feet directly above a lower surface. Stay at least 6 feet from the edge; use a dedicated spotter if the edge must be approached.
	Hunting activities	• Wear orange vests when conducting field work in remote areas during hunting season if hunting activities are expected in the area. • Notify or alert hunters that you are working in the area if possible.
	Inclement weather (wind, lightning, tornados)	• If thunder is audible, evaluate the need to seek shelter. Use the 30/30 rule at a minimum. Cease field activities when lightning is within 6 miles (30 seconds between flash and bang). Field activities can resume 30 minutes after the last audible thunder. Suspend outdoor work when a severe thunderstorm or tornado warning has been issued. • Cease field activities when wind is strong enough to move equipment or materials unexpectedly and in an unsafe manner. • Identify a tornado shelter location before it is needed. • Be aware of the potential for flash flooding; know the topography around the site and have an exit route planned when working in a wash or low area. Avoid streams, gullies, arroyos, or other drainage features when storms are occurring in the drainage basin upgradient of the site.
Operating a vehicle	Vehicle accidents	• Inspect vehicle prior to use and understand how to use the vehicle functions before operating. • No use of any two-way communication device while operating a vehicle. • When towing a trailer, ensure all items in truck and trailer are securely fastened and hitch is securely engaged. Check trailer lights and connections. Match hitch with trailer ball size using color coding. Use a spotter when backing truck hitched with trailer. • Do not operate a vehicle while fatigued. Do not work a total of more than 12 hours in a single day, driving and on-site time combined. Alternate driving duties to prevent driving while fatigued.
Jump starting a vehicle	Chemical exposure, battery explosion, electric burns	• Wear safety glasses. • Do not allow vehicles to touch. • Ensure both vehicles' electrical systems are the same voltage. • Cover battery caps with a damp cloth if available.

Job Safety Analysis (continued)

Define the Scope of Work by Individual Tasks (ISMS Core Function #1)	Analyze the Safety and Environmental Hazards (ISMS Core Function #2)	Develop and Implement Controls (ISMS Core Function #3)
Jump starting a vehicle	Chemical exposure, battery explosion, electric burns	1. Clamp one end of red cable to + terminal of dead battery. 2. Clamp other end of red cable to + terminal of good battery. 3. Clamp one end of black cable to – terminal of good battery. 4. Clamp other end of black cable to metal on vehicle with bad battery (any metal away from battery, carburetor, fuel line, tubing, or moving parts). 5. Observers stand back from both vehicles. 6. Start vehicle with good battery, then start vehicle with bad battery. 7. Remove clamps in reverse order, beginning with the metallic ground.
Driving off-road – sampling vehicle	Vehicle accidents, rollovers, getting stuck/stranded, damaging road surfaces	• Use high-clearance 4WD vehicle when necessary. • Watch for rough road conditions including rocks, brush, and well heads. • Use a spotter when backing into obscure or tight areas. • Do not attempt to cross extreme surfaces. • Drive vehicles on established roads or tracks when possible. • Do not drive on roads or tracks that are extremely muddy or sandy. Use an ATV or walk to the sampling location. • Report any spills of fuel or chemicals to the EC POC. Contact the EC group ASAP for spills of fuel (>25 gallons) or chemicals (>10 gallons) and any spills into waters of the State. Cleanup minor spills (<10 gallons) using absorbent materials on asphalt and concrete or shovel and bucket in soil. Manage cleanup materials compliantly; contact EC with questions.
	Inadvertently destroying threatened or endangered species or their habitat	Contact the Ecology Group to determine if T&E species exist on the site.
	Disturbing wetlands or cultural or archaeological artifacts	Contact the Ecology Group to determine if wetlands or protected areas exist on the site.
	Grass fires	Use discretion when traveling off-road in grassy areas. If grass is determined to be dry, tall enough to contact the bottom of the vehicle, and dense enough to sustain a fire, then use an ATV or walk to the sample location. A fire extinguisher or shovel (for grass fires) may be used to extinguish small fires based on personnel training. Evacuate the site for large fires.
	Injury from use of a winch	• Wear leather gloves when handling winch cable/hook. • Inspect before use. Do not use winch if cable is kinked or frayed, or the hook is damaged; tag and remove from service. • Use hook strap whenever spooling cable in or out. • Do not operate winch if less than 5 wraps of cable are left around the drum.

Job Safety Analysis (continued)

Define the Scope of Work by Individual Tasks (ISMS Core Function #1)	Analyze the Safety and Environmental Hazards (ISMS Core Function #2)	Develop and Implement Controls (ISMS Core Function #3)
Driving off-road – sampling vehicle	Injury from use of a winch	• Cover middle of steel cable with blanket or other covering. • Secure winch cable to an anchor of adequate size and strength. • Stand clear of cable and load (as far as the remote control allows) during winching operations. • Stop winching operation if the winch drum stops turning. • Do not touch the cable or hook when the remote control is plugged in. • Secure the cable and engage the drum clutch when in transport. • Refer to manufacturer's instructions for operation and safety.
Driving off-road – ATVs	Rollovers, cuts, abrasions, scratches, head/bodily injury	• Chock trailer before unloading ATVs. • Riders must wear an approved safety helmet for ATVs without roll protection. • Wear gloves while operating ATV. • Inspect ATV prior to operating. • Operators must complete ATV Safe Operations Training. • Avoid steep terrain. • ATV speeds should be maintained as appropriate for the conditions. • Report any spills of fuel or chemicals to the EC POC.
Opening wells/well vaults and accessing sample locations	Pinch points, crush hazards, cuts to hands	Keep hands and fingers out of pinch points and crush areas. Wear leather work gloves to protect hands from cuts, abrasions, blisters, etc.
	Insect bites/irritating plants	• Wear appropriate clothing covering as much exposed skin as possible. • Wear insect repellent or ivy block as necessary. • Beware of insects when opening a well; wear gloves and consider spraying an insecticide. • If exposed to irritating plants or ticks, take a shower and examine body when activities are completed.
	Snakes/animals	• Do not attempt to capture or handle snakes or animals. • Maintain a safe distance. • Be aware of hands and feet in areas with thick vegetation and in well vaults. • Wear snake chaps in areas of high poisonous snake density.
Opening wells/well vaults and accessing sample locations	Injury or death from permit-required confined space entry	**Permit Required Confined Space Entry (**posted as "Permit-Required Confined Space")**. Prior to entering ANY confined space – notify Health and Safety -** CSEP required for entry; entrants and attendants must be current in confined space entry training; follow permit required confined space entry protocol. Emergency rescue team must be available. Contact Health and Safety for guidance.
		Non-Permit Confined Space Entry (posted as "Non-Permit Required Confined Space")**. Prior to entering ANY confined space – notify Health and Safety.** This task is for inspection, maintenance, and sampling only. Follow steps: 1. Open and secure the lid to prevent inadvertent closure.

Job Safety Analysis (continued)

Define the Scope of Work by Individual Tasks (ISMS Core Function #1)	Analyze the Safety and Environmental Hazards (ISMS Core Function #2)	Develop and Implement Controls (ISMS Core Function #3)
Opening wells/well vaults and accessing sample locations	Injury or death from non-permit required confined space entry Injury or death from non-permit required confined space entry	2. Vent the space for a minimum of 5 minutes. 3. Test the atmosphere at the top, middle, and bottom of the space using a multi-gas meter. 4. Ensure the buddy system is in place. 5. Enter the space if the atmosphere is safe, as determined by the multi gas-meter. If the atmosphere is not safe, continue to vent the space and retest again after 5 minutes. If the atmosphere still is not safe, DO NOT ENTER. Be aware that a confined space may become permit-required due to the introduction of items as simple as PVC glue, water, or exhaust from a generator or vehicle. Use caution during ingress and egress, particularly when using a ladder. For additional information, refer to H&S Manual, Standard 7.5.
	Radiological	• Contact Heath and Safety and follow the Radiological Work Permit If galvanized pipe is to be disconnected. Fixed contamination likely will be encountered. • Contaminated components shall be stored and disposed of per RCT direction. Whenever possible, galvanized components shall be replaced with PVC or stainless steel to alleviate future contamination hazards.
	Hantavirus	If rodent droppings or nests are encountered in well vaults, follow “Hantavirus Precautions” procedure in the *Health and Safety Manual*, which includes use of respiratory protection and a disinfectant. Contact Health and Safety for guidance.
	Falls from ladders	• Inspect ladders prior to use and remove and tag those found unserviceable. • Use only ladders that are rated for the weight and the work situation. • Maintain 3 points of contact when ascending and descending.
Sample collection and preservation; field measurements	Radiological	• Use nitrile gloves when collecting samples or conducting field measurements. Contact Heath and Safety and follow the Radiological Work Permit when accessing wells that penetrate directly into a disposal cell or when posted as a Radiological Contamination Area. • Radiological Worker II training required for sampling wells that penetrate directly into the disposal cell.
	Chemical exposure and spills	• Review MSDSs for all chemicals being used on site. • Use nitrile gloves and safety glasses with side shields when dispensing sample preservatives (acids and bases), using calibrations solutions, or field test reagents. • Spills of chemicals should be cleaned up as soon as possible, and EC must be notified.
	Drowning	• Drowning hazard exists if still water is more than 2 feet deep at the edge, or the water is more than 1 foot deep and is moving rapidly. • Use the buddy system, wear a life vest, and have a ring buoy with a minimum of 90 feet of line for emergency rescue when working within 5 feet of water where a drowning hazard exists.

Job Safety Analysis (continued)

Define the Scope of Work by Individual Tasks (ISMS Core Function #1)	Analyze the Safety and Environmental Hazards (ISMS Core Function #2)	Develop and Implement Controls (ISMS Core Function #3)
Use of sampling and well maintenance equipment	Back injury	• Get help with heavy or awkward items, and use a hand truck when able. • No person shall lift more than 50 pounds without assistance. • Use proper lifting form (load close to the body, bend at the knees, keep back straight, do not rotate) when lifting, never carry a load that blocks your vision. • Use correct bending form (bend at the knees or kneel, turn entire body rather than just torso) when working close to ground or when lowering body position.
	Noise exposure	Reduce noise exposure by placing generators and compressors away from work areas using extension cord/extra air hose. Based on a noise survey performed by Health and Safety on sampling equipment, hearing protection is required only when using the Honda 3500 generator if personnel are within 20 feet of the generator. In general, always wear hearing protection if the noise levels prevent a normal conversation between 2 people standing 3 feet apart.
	Electric shock from generators and electrical equipment	• Inspect equipment prior to use and remove unserviceable cords and tools. • Use only double insulated tools. • Use GFCI protection when using outdoor outlets and generators. • Ground generators per manufacturer's recommendations. Each generator should have an LMS sticker that indicates the grounding requirements.
Use of sampling and well maintenance equipment	Flying particles, pinch points, and cuts from power tools	• Inspect all power tools prior to use; remove from service and tag those that are unserviceable. • Wear safety glasses with side shields when potential exists for flying particles. • Wear a face shield and safety glasses when using a weed eater. • Wear leg chaps when using a weed eater with a metal cutting blade. • Wear leather work gloves to protect from cuts, scrapes, etc. • Keep hands and fingers out of pinch points associated with power tools. • Make sure all manufacturer supplied guards are in place, or that the tool is properly guarded.
	Fires/explosions from refueling	• Vehicles and equipment shall not be fueled with the engine running. • Allow equipment to cool prior to fueling. • Cigarettes, open flames, or other ignition sources are not allowed within 50 feet of the fueling location. • Flammable and combustible liquids shall be handled and used in NFPA-approved safety cans that have flame arresters (screens), spring-closing (self-closing) lids, and spout covers. • A fire extinguisher with ABC rating shall be at the fueling location. • Fuel spills shall be cleaned up immediately and EC shall be notified. • Spills of greater than 25 gallons or spills to waterways have special reporting requirements, notify EC immediately.
	Unexpected pressure releases from gas cylinders, compressors, and pneumatic equipment	• Only individuals trained in the safe use of compressed gas cylinders may use them on site.

Job Safety Analysis (continued)

Define the Scope of Work by Individual Tasks (ISMS Core Function #1)	Analyze the Safety and Environmental Hazards (ISMS Core Function #2)	Develop and Implement Controls (ISMS Core Function #3)
Use of sampling and well maintenance equipment	Unexpected pressure releases from gas cylinders, compressors, and pneumatic equipment	• Cylinders shall be secured with the regulator removed and protective cap in place during transport (for cylinders designed to accept a protective cap). • Acetylene must be transported upright. • Use a properly rated regulator for the control of gas flow. • Maintain all fittings, connections and keep free from dirt, grease, and oil. • Check for leaks after regulator and fittings are in place. • Examine all hoses regularly and replace if damaged. • Keep hoses away from sharp objects. • Use whip checks on pressurized hoses greater than ½ inch inside diameter. • Use only approved pressure system configurations as shown in the current version of Engineering drawings S07329-R01-C02-C+ and S07330-R01-C03-C+. • Never put any part of your body in front of the pressure discharge of the system.
	Chemical exposure, explosion, electric burn from battery charging	• Wear safety goggles, nitrile gloves, and apron when handling batteries. • Inspect charger and battery for deficiencies; if found, correct prior to charging. Connect charger cables to battery before plugging charger into AC supply. • Charge battery with caps in place. • Connect positive cable to positive terminal first, negative cable to negative terminal last. After charging, disconnect in reverse sequence. • Always plug charger into a GFCI-protected outlet. • Set charger to appropriate voltage for battery being charged. • Follow manufacturer's instructions for the charging unit. • Ensure that there are no spark or flame generating sources near. • Ensure good ventilation to area. • Provide secondary containment for battery during charging, and have a spill kit available.
	Chemical exposure from prepping and painting well casing	• When scraping rust/paint from well casing wear safety glasses with side shields and leather gloves. • When painting, review MSDS sheets prior to use and wear nitrile gloves and safety glasses with side shields. • Only paint in open areas with good ventilation. • A dust mask may be worn for employee comfort if approved by a supervisor and the employee is briefed on the use and limitations of the dust mask.
	Fire	• Keep the spray gun at least 25 ft away from the generator while in use.
	Overhead hazards	Wear hard hat when working in areas where overhead work is being performed or head bump hazards exist.
	Asphyxiation from gas-powered equipment	Use in ventilated areas to avoid CO inhalation/accumulation.
	Chemical exposure from concrete or bentonite	• Review MSDS sheets prior to use. • Wear nitrile gloves, safety glasses with side shields.

Job Safety Analysis (continued)

Define the Scope of Work by Individual Tasks (ISMS Core Function #1)	Analyze the Safety and Environmental Hazards (ISMS Core Function #2)	Develop and Implement Controls (ISMS Core Function #3)
Use of sampling and well maintenance equipment	Chemical exposure from concrete or bentonite	• A dust mask may be worn for employee comfort if approved by a supervisor and the employee is briefed on the use and limitations of the dust mask. • Minimize generation of dust by pouring slowly. • Stand upwind. • Rinse concrete dust or cement off skin surfaces.
	Rotational hazard and pinch points from a concrete mixer	• Ensure all manufacturer's guards are in place and functional. • Stand clear of drum when rotating. Keep all tools away from drum when rotating. • Refer to manufacturer's instructions for operation and safety.
Managing purge water and investigation derived waste	Improper/illegal management	Refer to the *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* for controls in place to manage purge water and investigation derived waste.
	Environmental releases	Contact the Environmental Compliance and Health and Safety groups for clean-up and reporting guidance for all spills from equipment, leaks from gas containers, and chemical spills. If directed, report the spill on the Incident Reporting form.

Job Safety Analysis (continued)

I have reviewed, thoroughly understand, and will comply with this ISMS Core Functions Work Planning and Control Document.

Print Name	Signature	Company	Date
David Atkinson		Stoller	
Gretchen Baer		Stoller	
Sam Campbell		Stoller	
Kent Moe		Stoller	
Joe Trevino		Stoller	
Jeff Price		Stoller	
Dan Sellers		Stoller	
David Miller		Stoller	
Jeff Walters		Stoller	
Lauren Goodknight		Stoller	

Job Safety Analysis (continued)

JSA Review/Approval

Print Name	Signature	Date
Sam Campbell	2012.03.21 11:04:45 -06'00'	
Line Supervisor (Print Name)	Signature	Date
Andria Dutcher	Andria R. Dutcher 2012.03.21 11:01:14 -06'00'	
H&S Representative (Print Name)	Signature	Date
Darlene DePinho		2012.03.20 12:42:04 -06'00'
Environmental Compliance Representative (Print Name)	Signature	Date
NA		
Subcontractor/Worker Representative (Print Name)	Signature	Date

Job Safety Analysis (continued)

Field Change Authorization and Review

Field Management Changes (use a separate sheet if more space is necessary)

Define New or Changed Scope of Work by Tasks (ISMS Core Function #1)	Analyze the New or Changed Hazards (ISMS Core Function #2)	Develop and Implement New Controls (ISMS Core Function #3)

Line Supervisor (Print Name)	Signature	Date
Worker or Subcontractor Representative (Print Name)	Signature	Date

Job Safety Analysis (continued)

I acknowledge I have had the opportunity to provide input to the field change and am aware of the scope change, new or changed hazards, and associated work controls.

Print Name	Signature	Company	Date

Provide Feedback and Improvement Suggestions (ISMS Core Function #5)

Appendix E

Site-Specific Information and Program Directives

Current Index of Site-Specific Program Directives as of October 2012

Directive No.	Effective Date	Expiration Date	Initiated By	Subject
BLU-2013-01	10/01/2012	09/30/2014	Sam Campbell	Groundwater Sampling
CNT-2013-01	10/01/2012	09/30/2014	Sam Campbell	High-Flow purging
CNT-2012-02	06/25/2012	09/30/2013	Sam Campbell	Sampling with a Depth-Specific Bailer
DUR-2013-01	10/01/2012	09/30/2014	Sam Campbell	Radon Monitoring at the Durango Disposal Site
DUP-2012-02	06/25/2012	09/30/2013	Sam Campbell	Sampling of Monitoring Well 0789
GNO-2013-01	10/01/2012	09/30/2014	Sam Campbell	Miscellaneous Sampling Activities
GSB-2013-01	10/01/2012	09/30/2014	Sam Campbell	Natural Gas Sampling at a Natural Gas Production Well
MND-2013-01	10/01/2012	09/30/2014	Sam Campbell	Groundwater Monitoring Program
PIN-2013-01	10/01/2012	09/30/2014	Sam Campbell	Groundwater Sampling Procedures
PIN-2013-03	10/01/2012	09/30/2014	Sam Campbell	Sampling of Monitoring Well PIN15-0594
PIN-2013-05	10/01/2012	09/30/2014	Sam Campbell	Sampling of Monitoring Well PIN20-M056
RBL-2013-01	10/01/2012	09/30/2014	Sam Campbell	Natural Gas Sampling at a Natural Gas Production Well
RFS-2013-01	10/01/2012	09/30/2014	Sam Campbell	Miscellaneous Sampling Activities
RFS-2013-02	10/01/2012	09/30/2014	Sam Campbell	Disposition of Excess Water
RFS-2013-03	10/01/2012	09/30/2014	Sam Campbell	Processing of Composite Surface Water Samples
RUL-2013-01	10/01/2012	09/30/2014	Sam Campbell	Natural Gas Sampling at a Natural Gas Production Well
SAL-2013-01	10/01/2012	09/30/2014	Sam Campbell	High Flow Purging
SHL-2014-01	10/01/2012	09/30/2014	Sam Campbell	Miscellaneous Sampling Activities
TUB-2013-01	10/01/2012	09/30/2014	Sam Campbell	Sampling of the Tuba City Evaporation Pond
WEL-2013-01	10/01/2012	09/30/2014	Sam Campbell	Sampling Activities

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Sampling Frequencies for Locations at Ambrosia Lake, New Mexico

Location ID	Quarterly	Semiannually	Annually	Triennially	Not Sampled	Notes
Monitoring Wells						
409			X			Usally dry; sample if water is present
675			X			
678			X			

Sampling conducted in November

Constituent Sampling Breakdown

Site	Ambrosia Lake				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	2	0			
Field Measurements					
Alkalinity					
Dissolved Oxygen	X				
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Arsenic	X		0.0001	SW-846 6020	LMM-02
Bicarbonate	X		10	SM2320 B	WCH-A-003
Calcium	X		5	SW-846 6010	LMM-01
Carbonate	X		10	SM2320 B	WCH-A-004
Chloride	X		0.5	SW-846 9056	WCH-A-039
Iron					
Lead					
Magnesium	X		5	SW-846 6010	LMM-01
Manganese					
Molybdenum	X		0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N	X		0.05	EPA 353.1	WCH-A-022
Potassium	X		1	SW-846 6010	LMM-01
Radium-226					
Radium-228					
Selenium	X		0.0001	SW-846 6020	LMM-02
Silica					
Sodium	X		1	SW-846 6010	LMM-01
Strontium					
Sulfate	X		0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids	X		10	SM2540 C	WCH-A-033
Total Organic Carbon					
Tritium					
Uranium	X		0.0001	SW-846 6020	LMM-02
U-234, -238					
Vanadium					
Zinc					
Total No. of Analytes	14	0			

Note: All analyte samples are considered unfiltered unless stated otherwise. All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Bear Creek, Wyoming

Location ID	Quarterly	Semiannually	Annually	Triennially	Not Sampled	Notes
Monitoring Wells						
MW-9			X			Background well
MW-12			X			POC well in Lang Draw flow path
MW-14			X			Lang Draw flow path well
MW-43			X			Northern flow path well
MW-74			X			POC well in Northern flow path
MW-108			X			Buffer zone well in Lang Draw flow path
MW-109			X			Buffer zone well near property boundary on Lang Draw flow path
MW-110			X			Buffer zone well in Northern flow path
MW-111			X			Buffer zone well near property boundary on Norther flow path

Sampling conducted in July

Constituent Sampling Breakdown

Site	Bear Creek				
Analyte	**Groundwater**	**Surface Water**	**Required Detection Limit (mg/L)**	**Analytical Method**	**Line Item Code**
Approx. No. Samples/yr	9	0			
Field Measurements					
Alkalinity					
Dissolved Oxygen					
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Beryllium					
Cadmium					
Calcium					
Chloride	X		0.5	SW-846 9056	MIS-A-039
Chromium					
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum					
Nickel	X		0.02	SW-846 6010	LMM-01
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
PCBs					
Potassium					
Radium-226	X		1 pCi/L	Gas Proportional Counter	GPC-A-018
Radium-228	X		1 pCi/L	Gas Proportional Counter	GPC-A-020
Selenium					
Silica					
Sodium					
Strontium					
Sulfate	X		0.5	SW-846 9056	MIS-A-044
Sulfide					
Thorium-230	X		1 pCi/L	Alpha Specrtrometry	ASP-A-008
Total Dissolved Solids					
Total Organic Carbon					
Uranium	X		0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	7	0			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Program Directive
Bluewater Site

Activities Groundwater Water Monitoring **Directive No.** BLU-2013-01

Initiated By: Sam Campbell

Directive Subject: Groundwater Sampling

Directive and Associated Task Changes:

Groundwater sampling at wells S (SG) and OBS-3 will be conducted with high-volume submersible pumps using a high-flow procedure. For wells that will yield sufficient water, 3 casing volumes will be purged prior to sampling. For low yielding wells, wells will be purged dry and sampled when sufficient recovery has occurred. Field parameter stability is not required prior to sampling.

Organization(s) Affected: Environmental Monitoring Operations, Projects/Programs.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351-xx, current version)

Justification for Directive:

These wells were constructed with hand-slotted steel casing that has deteriorated over time causing the slots to close-off and restrict water flow into the well. This resulted in stagnant water in the well with prolonged contact with the steel casing. The goal of this procedure is to purge stagnant water from the casing prior to sampling in order to minimize impacts to groundwater-sample quality caused by the deteriorating steel casing.

Review and Concurrence:

Dick Johnson, Site Lead

Linda Tegelman, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell, Environmental Monitoring Operations

Date 9/17/2012

Effective Date: 10/1/2012 **Expiration Date:** 9/30/2014

Distribution: Document Production – Master Copy
Sampling and Analysis Plan for U. S. DOE LM Sites
Rc-grand.junction

Sampling Frequencies for Locations at Bluewater, New Mexico

Location ID	Quarterly	Semiannually	Annually	Triennially	Not Sampled	Notes
Monitoring Wells						
E(M)		X				PCBs in November only
Y2(M)		X				PCBs in November only
F(M)		X				PCBs in November only
T(M)		X				PCBs in November only
X(M)		X				
L(SG)		X				
S(SG)		X				
OBS-3		X				
I(SG)		X				
11(SG)		X				
13(SG)		X				
14(SG)		X				
15(SG)		X				
16(SG)		X				

Constituent Sampling Breakdown

Site	Bluewater				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	21	0			
Field Measurements					
Alkalinity					
Dissolved Oxygen	X				
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Arsenic	X		0.0001	SW-846 6020	LMM-02
Bicarbonate	X		10	SM2320 B	WCH-A-003
Calcium	X		5	SW-846 6010	LMM-01
Carbonate	X		10	SM2320 B	WCH-A-004
Chloride	X		0.5	SW-846 9056	WCH-A-039
Iron					
Lead					
Magnesium	X		5	SW-846 6010	LMM-01
Manganese					
Molybdenum	X		0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N	X		0.05	EPA 353.1	WCH-A-022
PCBs	E(M), Y2(M), F(M), T(M), and X(M) only		0.0005	SW-846 8082	PEP-A-006
Potassium	X		1	SW-846 6010	LMM-01
Radium-226					
Radium-228					
Selenium	X		0.0001	SW-846 6020	LMM-02
Silica					
Sodium	X		1	SW-846 6010	LMM-01
Strontium					
Sulfate	X		0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids	X		10	SM2540 C	WCH-A-033
Total Organic Carbon					
Uranium	X		0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	15	0			

Note: All analyte samples are considered unfiltered unless stated otherwise. All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Burrell, Pennsylvania

Location ID	Quarterly	Semiannually	Annually	Biennially	Every 5 Years	Notes
Monitoring Wells						
420					X	Next in October 2014
422					X	Next in October 2014
423					X	Next in October 2014
424					X	Next in October 2014
520					X	Next in October 2014
522					X	Next in October 2014
523					X	Next in October 2014
524					X	Next in October 2014
Surface Locations						
611					X	SEEP on cell; next in 10/14
612					X	SEEP on cell; next in 10/14

Sampling conducted in October
Based on LTSP dated April 2000

Constituent Sampling Breakdown

Site	Burrell				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	8	2			
Field Measurements					
Alkalinity	X	X			
Dissolved Oxygen					
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X	X			
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium	X	X	5	SW-846 6010	LMM-02
Chloride	X	X	0.5	SW-846 9056	MIS-A-039
Chromium					
Gross Alpha					
Gross Beta					
Iron	X	X	0.05	SW-846 6020	LMM-02
Lead	X	X	0.002	SW-846 6020	LMM-02
Magnesium	X	X	5	SW-846 6010	LMM-01
Manganese	X	X	0.005	SW-846 6010	LMM-01
Molybdenum	X	X	0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N	X	X	0.05	EPA 353.1	WCH-A-022
Potassium	X	X	1	SW-846 6010	LMM-01
Radium-226					
Radium-228					
Selenium	X	X	0.0001	SW-846 6020	LMM-02
Silica					
Sodium	X	X	1	SW-846 6010	LMM-01
Strontium					
Sulfate	X	X	0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids	X	X	10	SM2540 C	WCH-A-033
Total Organic Carbon					
Uranium	X	X	0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	14	14			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Canonsburg, Pennsylvania

Location ID	Quarterly	Semiannually	Annually	Every 5 Years	Not Sampled	Notes
Monitoring Wells						
0406A				X		Next in 10/2013
0412				X		Next in 10/2013
0413				X		Next in 10/2013
0414B				X		Next in 10/2013
0424				X		Next in 10/2013
Surface Locations						
0602				X		Next in 10/2013

Sampling conducted in October
Based on LTSP dated 2008

Constituent Sampling Breakdown

Site	Canonsburg				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	5	1			
Field Measurements					
Alkalinity					
Dissolved Oxygen	X	X			
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X	X			
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium					
Chloride					
Chromium					
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum					
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Radium-226					
Radium-228					
Selenium					
Silica					
Sodium					
Strontium					
Sulfate					
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Uranium	X	X	0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	1	1			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Program Directive
Central Nevada Test Area, Nevada

Activities Groundwater Monitoring **Directive No.** CNT-2013-01

Initiated By: Sam Campbell

Directive Subject: High-flow purging

Directive and Associated Task Changes:

1. Samples will be collected from wells UC-1-P-1SRC, and HTH-2 using the dedicated high-flow submersible pump after one well casing volume has been purged and field parameters have stabilized (i.e. pH within 0.2 units and conductivity/temperature within 10% over final 3 readings). A minimum of three field parameter readings will be taken during the final 100 gallons of purging.

Organization(s) Affected: Environmental Monitoring Operations, Projects/Programs.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites (SAP)* (LMS/PLN/S04351-xx, current version).

Justification for Directive:

The current dedicated pump configuration is designed for high-flow sampling, and the SAP does not address high-flow sampling. Use of the specific purging and sampling methods will continue because it's consistent with the sample collection process historically used at the site for these wells.

Review and Concurrence:

Rick Hutton Digitally signed by Rick Hutton DN: c=us, o=u.s. government, ou=department of energy, ou=Energy IT Services, ou=Legacy Management, ou=People, cn=Rick Hutton Date: 2012.09.27 10:53:42 -06'00'

Rick Hutton, Nevada Off-Sites Project Manager

Richard C. Findlay Rick C Findlay 2012.09.18 10:07:47 -06'00'

Rick Findlay, Project Technical Lead

Digitally signed by Linda S. Tegelman Date: 2012.09.27 11:05:25 -06'00'

Linda Tegelman, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell

Sam Campbell, Environmental Monitoring Operations Manager

10/25/2012

Date

Effective Date: 10/01/2012 **Expiration Date:** 9/30/2014

Distribution: rc-nevada (ADM 130.10)
Sampling and Analysis Plan for U. S. DOE LM Sites

Program Directive
Central Nevada Test Area, Nevada

Activities Groundwater Monitoring **Directive No.** CNT-2012-02

Initiated By: Sam Campbell

Directive Subject: Sampling with a Depth-Specific Bailer

Directive and Associated Task Changes:

Samples will be collected from multiple intervals within well UC-1-P-2SR and from a select interval within piezometers MV-4PZ and MV-5PZ using a depth-specific bailer.

Organization(s) Affected: Environmental Monitoring Operations, Projects/Programs.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites (SAP)* (LMS/PLN/S04351-xx, current version).

Justification for Directive:

These wells do not have a pump installed, so a depth-specific bailer is currently the only option for a sampling device because of the depth to water in these wells. Utilization of the specific purging and sampling methods will continue because it's consistent with the sample collection process historically used at the site.

Review and Concurrence:

Rick Hutton, Nevada Off-Sites Project Manager

Rick Findlay, Project Technical Lead

Linda Tegelman, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell, Environmental Monitoring Operations Manager

6/21/2012
Date

Effective Date: 06/25/2012 **Expiration Date:** 9/30/2013

Distribution: rc-nevada (ADM 130.10)
Sampling and Analysis Plan for U. S. DOE LM Sites

Sampling Frequencies for Locations at Central Nevada Test Area, Nevada

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
MV-1			X			
MV-2			X			
MV-3			X			
HTH-1RC			X			
HTH-2			X			
UC-1-P-1SRC			X			
MV-4			X			
MV-5			X			

Sampling conducted in May.

Constituent Sampling Breakdown

Site	Central Nevada Test Area					Laboratory	
Analyte	**Groundwater**	**Surface Water**	**Required Detection Limit (mg/L)**	**Analytical Method**	**Line Item Code**	**ALS**	**University of Arizona**
Approx. No. Samples/yr	8	0					
Field Measurements							
Alkalinity	X						
Dissolved Oxygen	X						
Redox Potential	X						
pH	X						
Specific Conductance	X						
Turbidity	X						
Temperature	X						
Laboratory Measurements							
Aluminum							
Ammonia as N (NH3-N)							
Bromide							
Calcium							
Chloride							
Chromium							
Gamma Spec							
Gross Alpha							
Gross Beta							
Iodine-129							
Iron							
Lead							
Magnesium							
Manganese							
Molybdenum							
Nickel							
Nitrate + Nitrite as N (NO3+NO2)-N							
Potassium							
Selenium							
Silica							
Sodium							
Strontium							
Sulfate							
Sulfide							
Tritium	X		400 pCi/L	Liquid Scintillation	LSC-A-001	X	
Tritium, enriched							
Uranium							
Vanadium							
Zinc							
Total No. of Analytes	1	0					

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Program Directive
Durango, Colorado, Site

Activities Air Monitoring **Directive No.** DUR 2013-01 .

Initiated By: Sam Campbell

Directive Subject: Radon Monitoring at the Durango Disposal Site

Directive and Associated Task Changes:

Radon will be monitored at the Durango Disposal Site according to the *Sampling and Analysis Plan for Radon Monitoring at the Durango, Colorado, Disposal Site*.

Organization(s) Affected: Environmental Monitoring Operations and Programs and Projects.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351-xx, current version)

Justification for Directive:

The sampling and analysis plan states that air monitoring will be specified in a Program Directive located in the site-specific tabbed section in Appendix E.

Review and Concurrence:

David E. Miller 2012.09.20 13:40:47 -06'00'

David Miller, Site Lead

Digitally signed by Linda S. Tegelman Date: 2012.10.02 12:10:51 -06'00'

Linda Tegelman, Quality and Performance Assurance

Task Order Manager Approval to Issue:

Sam Campbell, Environmental Monitoring Operations Manager

10/2/2012
Date

Effective Date: 10/1/2012 **Expiration Date:** 9/30/2014

Distribution: rc-gand.junction (ADM 130.10)
Sampling and Analysis Plan for U. S. DOE LM Sites

Program Directive
Durango, Colorado, Site

Activities Groundwater Monitoring **Directive No.** DUP-2012-02

Initiated By: Sam Campbell

Directive Subject: Sampling of Monitoring Well 0879

Directive and Associated Task Changes:

Monitoring well 0879 will be purged and sampled using a high-flow purging protocol. Samples will be collected after one casing volume has been purged followed by stabilization of field parameters. The pump intake will be placed near the top of the water column during purging and sampling. Measurements of pH, specific conductance, and turbidity will be made approximately every ¼ casing volume after one casing volume has been removed; stabilization criterion for these parameters is the same as for a Category I well. There are no maximum flow-rate or water level drawdown requirements.

Organization(s) Affected: Environmental Monitoring Operations and Programs and Projects.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351-current version)

Justification for Directive:

A low-flow sampling technique requires that the pump intake be placed in the screened interval of the well. Construction activities in the vicinity of monitoring well 0879 caused debris to fall in the well, which wedged the dedicated bladder pump in place. After the bladder pump quit working, there was no way to remove the bladder pump and to set another pump with the intake into the screened interval; therefore, a high-flow purging technique must be used to remove stagnant water from the well.

Review and Concurrence:

David Miller, Site Lead

06/21/2012
Linda Tegelman, Quality and Performance Assurance

Task Order Manager Approval to Issue:

Sam Campbell, Environmental Monitoring Operations Manager

Date 6/21/2012

Effective Date: 06/25/2012 **Expiration Date:** 9/30/2013

Distribution: rc-gand.junction (ADM 130.10)
Sampling and Analysis Plan for U. S. DOE LM Sites

Sampling Frequencies for Locations at Durango, Colorado

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
DUR01 Mill Tailings						
612			X			
617			X			
630			X			
631			X			Download datalogger
633			X			Download datalogger
634			X			
635			X			
859					X	Download datalogger
863			X			Download datalogger
DUR02 Raffinate Pond						
594			X			Se and U ONLY
596					X	Download datalogger
598			X			Se and U ONLY
607			X			Se and U ONLY
879			X			Se and U ONLY
884			X			Se and U ONLY
888					X	Download datalogger
889					X	Download datalogger
890					X	Download datalogger
DUR03 Bodo Canyon						
605			X			
607			X			POC WELL
608			X			"
612			X			"
618			X			"; supplements 608
621			X			"
623			X			BACKGROUND
MW-1					X	Download datalogger
NVP					X	Download datalogger
P7					X	Download datalogger
Surface Locations						
DUR01 Mill Tailings						
584			X			
586			X			
652			X			RIVER
691			X			RIVER
DUR02 Raffinate Pond						
588			X			
654			X			RIVER
656			X			

Groundwater sampling conducted in June; surface water sampling conducted in September.

Constituent Sampling Breakdown

Site	Durango				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	20	7			
Field Measurements					
Alkalinity	X	X			
Dissolved Oxygen					
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X				
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Cadmium	0612 & 0863 only	X	0.001	SW-846 6020	LMM-02
Calcium	DUR03 only		5	SW-846 6010	LMM-01
Chloride	DUR03 only		0.5	SW-846 9056	MIS-A-039
Chromium					
Gross Alpha					
Gross Beta					
Iron	DUR03 only		0.1	SW-846 6020	LMM-01
Lead					
Magnesium	DUR03 only		5	SW-846 6010	LMM-01
Manganese	All Mill Tailings Areas and Bodo Canyon locations		0.005	SW-846 6010	LMM-01
Molybdenum	All Mill Tailings Areas and Bodo Canyon locations	X	0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium	DUR03 only		1	SW-846 6010	LMM-01
Radium-226					
Radium-228					
Selenium	X	X	0.0001	SW-846 6020	LMM-02
Silica					
Sodium	DUR03 only		1	SW-846 6010	LMM-01
Strontium					
Sulfate	All Mill Tailings Areas and Bodo Canyon locations		0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids	DUR03 only		10	SM2540 C	WCH-A-033
Uranium	X	X	0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	13	4			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Falls City, Texas

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
709			X			
858			X			
862			X			
880			X			
886			X			
891			X			**Collect duplicate from this well**
906			X			
908			X			
916			X			
921			X			
924			X			
963			X			

Annual sampling conducted in April
Based on LTSP dated March 2008

Constituent Sampling Breakdown

Site	Falls City				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	12	0			
Field Measurements					
Alkalinity					
Dissolved Oxygen	X				
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium					
Chloride					
Chromium					
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum					
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Radium-226					
Radium-228					
Selenium					
Silica					
Sodium					
Strontium					
Sulfate					
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Uranium	X		0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	1	0			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Program Directive

Gasbuggy Site

Activity or Task Natural Gas Sampling **Directive No.** GSB-2013-01 .

Initiated By: Sam Campbell

Directive Subject: Natural Gas Sampling at a Natural Gas Production Well

Directive and Associated Task Changes:

Collection of a natural gas sample at the wellhead of a producing natural gas well will be conducted as described in the attached procedures.

Organization(s) Affected: Projects/Programs, Environmental Monitoring Operations

Affected Documents: Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites (LMS/PLN/S04351-xx, current version)

Justification for the Directive:

Procedures for sampling natural gas are not addressed in the Sampling and Analysis Plan. This Program Directive will be used to guide sample collection.

Review and Concurrence:

Rick Hutton, Nevada Off-Sites Project Manager

Mark Plessinger, Project Technical Lead

Linda Tegelman, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell, Manager Environmental Monitoring Operations

Date 9/17/12

Effective Date: 10/1/2012 **Expiration Date:** 9/30/2014

Distribution: w Attachments
rc-nevada (ADM 130.10)
Sampling and Analysis Plan for US DOE LM Sites

Sampling Frequencies for Locations at Gasbuggy, New Mexico

Location ID	Quarterly	Semiannually	Annually	Every 5 Years	Not Sampled	Notes
Monitoring Wells						
Jicarilla Well 1				X		Windmill; next in 6/2014
Lower Burro Canyon				X		Windmill; next in 6/2014
Well 30.3.32.343 (N)				X		Windmill; next in 6/2014
Well 28.3.33.233 (S)				X		Windmill; next in 6/2014
Windmill #2				X		Windmill; next in 6/2014
Surface Locations						
Bubbling Springs				X		Next in 6/2014
Cave Springs				X		Next in 6/2014
Cedar Springs				X		Next in 6/2014
La Jara Creek				X		Next in 6/2014
Pnd N WL 30.3.32.343				X		Next in 6/2014
Gas and Produced Water Locations						
30-039-21744			X			
30-039-21620			X			
30-039-29988			X			
30-039-30161			X			
30-039-21743			X			
30-039-07525			X			
30-039-21647			X			

Annual GAS sampling conducted in June; water sampling every 5 years

Constituent Sampling Breakdown

Site	Gasbuggy						
Analyte	**Groundwater**	**Surface Water**	**Gas**	**Produced Water**	**Required Detection Limit (mg/L)**	**Analytical Method**	**Line Item Code**
Approx. No. Samples/yr	5	5	7	7			
Field Measurements							
Alkalinity							
Dissolved Oxygen	X	X					
Redox Potential							
pH	X	X					
Specific Conductance	X	X					
Turbidity	X						
Temperature	X	X					
Laboratory Measurements							
Aluminum							
Ammonia as N (NH3-N)							
Calcium							
Carbon-14			X		NA	Accelerator Mass Spectrometry	LMR-16
Chloride							
Chromium							
Gamma Spec	X			X	10 pCi/L	Gamma Spectrometry	GAM-A-001
Gross Alpha				X	2 pCi/L	EPA 900.0	GPC-A-001
Gross Beta				X	4 pCi/L	EPA 900.0	GPC-A-001
Iron							
Lead							
Magnesium							
Manganese							
Molybdenum							
Nickel							
Nickel-63							
Nitrate + Nitrite as N (NO3+NO2)-N							
Potassium							
Radium-226							
Radium-228							
Selenium							
Silica							
Sodium							
Strontium							
Total Dissolved Solids							
Total Organic Carbon							
Tritium	X	X	X	X	400 pCi/L	Liquid Scintillation	LSC-A-001
Uranium							
Vanadium							
Zinc							
Total No. of Analytes	2	1	2	4			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Program Directive
Gnome-Coach, New Mexico

Activities Groundwater Monitoring **Directive No.** GNO-2013-01

Initiated By: Sam Campbell

Directive Subject: Miscellaneous Sampling Activities

Directive and Associated Task Changes:

1. Samples will be collected from wells USGS-4, USGS-8, and LRL-7 using the dedicated bladder pump after one pump tubing volume has been purged.
2. The water purged from these wells will be containerized for disposal.
3. Samples will not be filtered.

Organization(s) Affected: Environmental Monitoring Operations, Projects/Programs.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351-xx, current version).

Justification for Directive:

Purge water must be managed as a radiological waste because of high concentrations of radioisotopes in the wells listed above (USGS-4, USGS-8, and LRL-7); therefore, minimization of purge water volume and no field filtration is required for waste handling and disposal considerations and for adherence to ALARA principles. One pump tubing volume is the minimum purge required to remove stagnant water remaining in the pump tubing between sampling events. The sample collected from these wells will represent a grab sample within the screened interval of the well, which will be consistent with past EPA protocol.

Review and Concurrence:

Rick Hutton Digitally signed by Rick Hutton DN: c=us, o=u.s. government, ou=department of energy, ou=Energy IT Services, ou=Legacy Management, ou=People, cn=Rick Hutton Date: 2012.09.27 10:49:24 -06'00'

Rick Hutton, Nevada Off-Sites Project Manager

Richard C. Findlay Rick C Findlay 2012.09.18 09:10:54 -06'00'

Rick Findlay, Project Technical Lead

Digitally signed by Linda S. Tegelman Date: 2012.09.27 11:17:11 -06'00'

Linda Tegelman, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell

Sam Campbell, Environmental Monitoring Operations Manager

Date 10/8/2012

Effective Date: 10/01/2012 **Expiration Date:** 9/30/2014

Distribution: rc-nevada (ADM 130.10)
Sampling and Analysis Plan for U. S. DOE LM Sites

Sampling Frequencies for Locations at Gnome-Coach, New Mexico

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
LRL-7					X	Bladder pump; not sampled per R. Findlay, 1/11/12
USGS-1			X			Electric pump; add a sample port to the plumbing
USGS-4			X			Bladder pump
USGS-8			X			Bladder pump

Annual sampling conducted in January

Constituent Sampling Breakdown

Site	Gnome-Coach				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	3	0			
Field Measurements					
Alkalinity	X				
Dissolved Oxygen	X				
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium					
Chloride					
Chromium					
Gamma Spec	X		10 pCi/L	Gamma Spectrometry	GAM-A-001
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum					
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Radium-226					
Radium-228					
Selenium					
Silica					
Sodium					
Strontium-90	X		1 pCi/L	Gas Proportional Counter	GPC-A-009
Sulfate					
Sulfide					
Total Dissolved Solids	X		10	SM2540 C	WCH-A-033
Total Organic Carbon					
Tritium	X		400 pCi/L	Liquid Scintillation	LSC-A-001
Enriched Tritium	USGS-1 only		10 pCi/L	Liquid Scintillation	LMR-15
Uranium					
Vanadium					
Zinc					
Total No. of Analytes	5	0			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Grand Junction Disposal Site, Colorado

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
731			X			Download data logger
732			X			Download data logger
733			X			Download data logger

Sampling conducted in August

Constituent Sampling Breakdown

Site	Grand Junction Disposal				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	3	0			
Field Measurements					
Alkalinity	X				
Dissolved Oxygen					
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium					
Chloride					
Chromium					
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum	X		0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N	X		0.05	EPA 353.1	WCH-A-022
PCBs	X		0.0005	SW-846 8082	PEP-A-006
Potassium					
Radium-226					
Radium-228					
Selenium	X		0.0001	SW-846 6020	LMM-02
Silica					
Sodium					
Strontium					
Sulfate	X		0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids	X		10	SM2540 C	WCH-A-033
Total Organic Carbon					
Uranium	X		0.0001	SW-846 6020	LMM-02
Vanadium	X		0.0003	SW-846 6020	LMM-02
Zinc					
Total No. of Analytes	8	0			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Grand Junction Office Site, Colorado

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
8-4S			X			
11-1S			X			
6-2N			X			
14-13NA			X			
GJ84-04			X			
GJ01-01			X			
10-19N			X			
Surface Locations						
Upper Gunnison			X			
Upper Middle Gunnison			X			
Lower Gunnison			X			
South Pond			X			
North Pond			X			
Wetland Area			X			

Sampling conducted in February

Constituent Sampling Breakdown

Site	Grand Junction Office				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	7	6			
Field Measurements					
Alkalinity					
Dissolved Oxygen					
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X	X			
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium					
Chloride					
Chromium					
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium					
Manganese	X		0.005	SW-846 6010	LMM-01
Molybdenum	X	X	0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Radium-226					
Radium-228					
Selenium	X	X	0.0001	SW-846 6020	LMM-02
Silica					
Sodium					
Strontium					
Sulfate	X	X	0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Uranium	X	X	0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	5	4			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Grand Junction Processing Site, Colorado

Location ID	Quarterly	Semiannually	Annually	Every 5 Years	Not Sampled	Notes
Monitoring Wells						
590				X		Download data logger; next sampling in 1/2016
748				X		Next sampling in 1/2016
1001				X		Download data logger; next sampling in 1/2016
1014					X	In Parkway; safety hazard
1036				X		Next sampling in 1/2016
Surface Locations						
423				X		Next sampling in 1/2016
427				X		Next sampling in 1/2016

Sampling conducted in January

Constituent Sampling Breakdown

Site	Grand Junction Processing				
Analyte	**Groundwater**	**Surface Water**	**Required Detection Limit (mg/L)**	**Analytical Method**	**Line Item Code**
Approx. No. Samples/yr	4	2			
Field Measurements					
Alkalinity	X	X			
Dissolved Oxygen					
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X				
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)	X	X	0.1	EPA 350.1	WCH-A-005
Calcium					
Chloride					
Chromium					
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum	X	X	0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Radium-226					
Radium-228					
Selenium					
Silica					
Sodium					
Strontium					
Sulfate					
Sulfide					
Total Dissolved Solids	X	X	10	SM2540 C	WCH-A-033
Total Organic Carbon					
Uranium	X	X	0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	4	4			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Green River, Utah

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
171			X			Telemetry
173			X			Telemetry
176			X			Telemetry
179			X			Telemetry
180					X	Telemetry
181			X			
182			X			Telemetry
183					X	Telemetry; WL only
184			X			Telemetry;
185			X			Telemetry
188			X			
189			X			
192			X			
194			X			
582					X	Telemetry; WL only
588			X			Telemetry
707					X	
813			X			Telemetry
817					X	Telemetry; WL only
Surface Locations						
801			X			
846			X			
847			X			

Annual sampling conducted in June

Site-wide water levels. Do water levels first prior to sampling. Record exact time that water levels are measured.

Constituent Sampling Breakdown

Site	Green River				
Analyte	**Groundwater**	**Surface Water**	**Required Detection Limit (mg/L)**	**Analytical Method**	**Line Item Code**
Approx. No. Samples/yr	10	2			
Field Measurements					
Alkalinity	X	X			
Dissolved Oxygen					
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X	X			
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)	X	X	0.1	EPA 350.1	WCH-A-005
Arsenic	X	X	0.0001	SW-846 6020	LMM-02
Calcium					
Chloride					
Chromium					
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum					
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N	X	X	0.05	EPA 353.1	WCH-A-022
Potassium					
Radium-226					
Radium-228					
Selenium	X	X	0.0001	SW-846 6020	LMM-02
Silica					
Sodium					
Strontium					
Sulfate	X	X	0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Uranium	X	X	0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	6	6			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Gunnison, Colorado

Location ID	Quarterly	Semiannually	Annually	Every 5 years	Not Sampled	Notes
Monitoring Wells						
GUN01						
002			X			
005			X			
006			X			
012R			X			
013			X			
062			X			
063			X			
064			X			
065			X			
066			X			
102			X			
105			X			
106			X			
112			X			
113			X			
125			X			
126			X			
127			X			
135			X			
136			X			
160			X			
161			X			
181			X			
183			X			
186			X			
187			X			
188			X			
189			X			
GUN08						
609				X after 5/15		BKGD; next in 2016
630					X	WLs ONLY; next in 2016
634					X	WLs ONLY; next in 2016
663					X	WLs ONLY; next in 2016
709					X	WLs ONLY; next in 2016
710					X	WLs ONLY; next in 2016
712					X	WLs ONLY; next in 2016
714					X	WLs ONLY; next in 2016
715					X	WLs ONLY; next in 2016
716				X after 5/15		BKGD; next in 2016
720				X after 5/15		POC; next in 2016
721				X after 5/15		POC; next in 2016
722				X after 5/15		POC; next in 2016
723				X after 5/15		POC; next in 2016
724				X after 5/15		POC; next in 2016
725				X after 5/15		POC; next in 2016

Sampling Frequencies for Locations at Gunnison, Colorado

Location ID	Quarterly	Semiannually	Annually	Every 5 years	Not Sampled	Notes
Surface Locations						
GUN01						
248			X			
250			X			
777			X			
780			X			
792			X			
795			X			
Domestic Wells						
GUN01						
476			X			
477			X			
478			X			
479					X	Connected to water system
667			X			
683			X			

GUN01 Sampling conducted in April

GUN08 sampling at the disposal cell must not be conducted before May 15th due to CDOW requirements regarding access to this site during Sage Grouse mating.

Constituent Sampling Breakdown

	Gunnison					
Analyte	**Groundwater**		**Surface Water**	**Required Detection Limit (mg/L)**	**Analytical Method**	**Line Item Code**
Approx. No. Samples/yr	33 (41 every 5th year)		6			
Field Measurements						
Alkalinity						
Dissolved Oxygen						
Redox Potential	X	X	X			
pH	X	X	X			
Specific Conductance	X	X	X			
Turbidity	X	X	X			
Temperature	X	X	X			
Laboratory Measurements	*GUN01*	*GUN08*	*GUN01*			
Aluminum						
Ammonia as N (NH3-N)						
Calcium		X		5	SW-846 6010	LMM-01
Chloride		X		0.5	SW-846 9056	WCH-A-039
Chromium						
Gross Alpha						
Gross Beta						
Iron		X		0.05	SW-846 6020	LMM-02
Lead						
Magnesium		X		5	SW-846 6010	LMM-01
Manganese	X	X	X	0.005	SW-846 6010	LMM-01
Molybdenum						
Nickel						
Nickel-63						
Nitrate + Nitrite as N (NO3+NO2)-N						
Potassium		X		1	SW-846 6010	LMM-01
Radium-226						
Radium-228						
Selenium						
Silica						
Sodium		X		1	SW-846 6010	LMM-01
Strontium						
Sulfate		X		0.5	SW-846 9056	MIS-A-044
Sulfide						
Total Dissolved Solids		X		10	SM2540 C	WCH-A-033
Total Organic Carbon						
Uranium	X	X	X	0.0001	SW-846 6020	LMM-02
Vanadium						
Zinc						
Total No. of Analytes	2	10	2			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Hallam, Nebraska

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
1A				X		Next in 6/2014
1B				X		Next in 6/2014
2A				X		Next in 6/2014
2B				X		Next in 6/2014
2B2				X		Next in 6/2014
2C2				X		Next in 6/2014
3A				X		Next in 6/2014
3B				X		Next in 6/2014
4A				X		Next in 6/2014
4B				X		Next in 6/2014
4C				X		Next in 6/2014
5A				X		Next in 6/2014
5B				X		Next in 6/2014
6A					X	Water level; micropurge if possible
6B					X	Water level; micropurge if possible
7B				X		Next in 6/2014
7C				X		Next in 6/2014
8B				X		Next in 6/2014
8C				X		Next in 6/2014

Sampling conducted in June
Based on LTSP dated June 2008

Constituent Sampling Breakdown

Site	Hallam				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	17	0			
Field Measurements					
Alkalinity	X				
Dissolved Oxygen					
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium					
Chloride					
Chromium					
Gamma Spec	X		10 pCi/L	Gamma Spectrometry	GAM-A-001
Gross Alpha	X		2 pCi/L	EPA 900.0	GPC-A-001
Gross Beta	X		4 pCi/L	EPA 900.0	GPC-A-001
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum					
Nickel					
Nickel-63	X		700 pCi/L	Liquid Scintillation	LSC-A-009
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Radium-226					
Radium-228					
Selenium					
Silica					
Sodium					
Strontium					
Sulfate					
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Tritium	X		400 pCi/L	Liquid Scintillation	GPC-A-001
Uranium					
Vanadium					
Zinc					
Total No. of Analytes	5	0			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at L-BAR, New Mexico

Location ID	Quarterly	Semiannually	Annually	Triennially	Not Sampled	Notes
Monitoring Wells						
1A				X		Next sampling November 2013
17B				X		Next sampling November 2013
29A				X		Next sampling November 2013
61				X		Next sampling November 2013
62				X		Next sampling November 2013
63				X		Next sampling November 2013
69				X		Next sampling November 2013
72				X		Next sampling November 2013
81				X		Next sampling November 2013
100				X		Next sampling November 2013
Moquino - Old				X		Next sampling November 2013; Water users backup well.*
Moquino - New				X		Next sampling November 2013; Water users supply well.*

Sampling conducted in November

*Obtain a sample if the well is in operation and access is granted; otherwise, do not sample and document accordingly.

Constituent Sampling Breakdown

Site	L-Bar				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr.	12	0			
Field Measurements					
Alkalinity					
Dissolved Oxygen					
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium					
Chloride	X		0.5	SW-846 9056	MIS-A-039
Chromium					
Magnesium					
Manganese					
Molybdenum					
Nitrate + Nitrite as N (NO3+NO2)-N	X		0.05	EPA 353.1	WCH-A-022
Potassium					
Radium-226					
Radium-228					
Selenium	X		0.0001	SW-846 6020	LMM-02
Silica					
Sodium					
Sulfate	X		0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids	X		10	SM2540 C	WCH-A-033
Total Organic Carbon					
Uranium	X		0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	6	0			

Note: All analyte samples are considered unfiltered unless stated otherwise. All private well samples are to be unfiltered.
The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Lakeview, Oregon

Location ID	Quarterly	Semiannually	Annually	Biennially	Every 5 years	Notes
Monitoring Wells						
LKV01 - Processing Site						
503				Even year		Next sampling in 5/2014
505				Even year		Next sampling in 5/2014
509				Even year		Next sampling in 5/2014
540				Even year		Next sampling in 5/2014
LKV02 - Disposal Site						
515					X	Every 5 years; next in 5/2014
602					X	Every 5 years; next in 5/2014
603					X	Every 5 years; next in 5/2014
604					X	Every 5 years; next in 5/2014
605					X	Every 5 years; next in 5/2014
606					X	Every 5 years; next in 5/2014
607					X	Every 5 years; next in 5/2014
608					X	Every 5 years; next in 5/2014
609					X	Every 5 years; next in 5/2014
Private Wells						
LKV01 - Processing Site						
543				Even year		Next sampling in 5/2014

Sampling conducted in May.

Constituent Sampling Breakdown

Site	Lakeview				
Analyte	Groundwater		Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	5 every 2 yrs; 14 every 5 yrs				
Field Measurements					
Alkalinity	X				
Dissolved Oxygen					
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements	***Disposal Site***	***Processing Site***			
Aluminum					
Ammonia as N (NH3-N)					
Arsenic	X		0.0001	SW-846 6020	LMM-02
Cadmium	X		0.001	SW-846 6020	LMM-02
Calcium	X		5	SW-846 6010	LMM-01
Chloride	X		0.5	SW-846 9056	WCH-A-039
Gross Alpha					
Gross Beta					
Iron	X		0.05	SW-846 6020	LMM-02
Lead					
Magnesium	X		5	SW-846 6010	LMM-01
Manganese	X	X	0.005	SW-846 6010	LMM-01
Molybdenum					
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium	X		1	SW-846 6010	LMM-01
Radium-226					
Radium-228					
Selenium					
Silica	X		0.1	SW-846 6010	LMM-01
Sodium	X		1	SW-846 6010	LMM-01
Strontium					
Sulfate	X	X	0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids	X		10	SM2540 C	WCH-A-033
Total Organic Carbon					
Uranium	X	0509 and 0540 only	0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	13	3			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Monticello, Utah

Location ID	Quarterly	Semi-annually	Annually	Every 5 Years	Not Sampled	Notes
North Off-Site Wells						
31NE93-205				X[a]		Water Level (WL) Semi-annually
95-07				X[a]		WL Semi-annually
Former Millsite Wells						
93-01			X			WL Semi-annually
MW00-01		X				WL Semi-annually
MW00-02					X	WL Semi-annually
MW00-03					X	WL Semi-annually
T00-01			X			WL Semi-annually
T00-04			X			WL Semi-annually
T01-01		X				
T01-02		X				
T01-04		X				
T01-05		X				
T01-06					X	WL Semi-annually
T01-07		X				
T01-08					X	WL Semi-annually
T01-09					X	WL Semi-annually
T01-10					X	WL Semi-annually
T01-12		X				
T01-13			X			WL Semi-annually
T01-18			X			WL Semi-annually
T01-19		X				
T01-20			X			WL Semi-annually
T01-23			X			WL Semi-annually
T01-24					X	WL Semi-annually
T01-25			X			WL Semi-annually
T01-26					X	WL Semi-annually
T01-27					X	WL Semi-annually
T01-28					X	WL Semi-annually
T01-35		X				
Downgradient Wells						
82-08		X				
83-70			X			WL Semi-annually
88-85		X				Datalogger
92-07		X				
92-08		X				
92-09		X				
92-10			X			WL Semi-annually
92-11		X				
92-12					X	WL Semi-annually
95-01			X			WL Semi-annually
95-02					X	WL Semi-annually
95-03			X			WL Semi-annually
95-04					X	WL Semi-annually
95-06				X[a]		WL Semi-annually
95-08					X	WL Semi-annually
0200		X				

Sampling Frequencies for Locations at Monticello, Utah

Location ID	Quarterly	Semi-annually	Annually	Every 5 Years	Not Sampled	Notes
Downgradient Wells (continued)						
202		X				
MW00-06		X				
MW00-07			X			WL Semi-annually
P92-02					X	WL Semi-annually
P92-06		X				
PW-10		X				WL Semi-annually
PW-14					X	WL Semi-annually
PW-16					X	WL Semi-annually
PW99-16					X	WL Semi-annually
PW-17		X				
PW-18					X	WL Semi-annually
PW-20					X	WL Semi-annually
PW-22					X	WL Semi-annually
PW-23					X	WL Semi-annually
PW-28		X				
PRB Wells						
R1-M1					X	WL Semi-annually
R1-M3		X				
R1-M4		X				
R1-M6					X	WL Semi-annually
R2-M4					X	WL Semi-annually
R2-M7					X	WL Semi-annually
R3-M2		X				
R3-M3		X				
R4-M3		X				
R4-M6		X				
R6-M1					X	WL Semi-annually
R6-M2					X	WL Semi-annually
R6-M3		X				
T6-D					X	WL Semi-annually
R6-M4		X				
R6-M5					X	WL Semi-annually
R6-M6					X	WL Semi-annually
R7-M1					X	WL Semi-annually
R8-M1					X	WL Semi-annually
R9-M1					X	WL Semi-annually
R10-M1		X				
R11-M1					X	WL Semi-annually
Former Millsite Seeps and Wetland (W3) Locations						
Seep 1		X				
Seep 2		X				
Seep 3		X				
Seep 5		X				
Seep 6		X				
W3-03		X				
W3-04		X				

Sampling Frequencies for Locations at Monticello, Utah

Location ID	Quarterly	Semi-annually	Annually	Every 5 Years	Not Sampled	Notes
Surface Water Locations (stream flow is measured semi-annually at each SW location)						
SW00–01		X				
SW00–02		X				
SW01–02		X				
SW01–03		X				
SW01–01		X				
Sorenson		X				
SW00–04		X				
SW92–08		X				
SW92–09		X				
SW94-01		X				

Semi-annual sampling occurs the first week of April and October
Annual sampling occurs the first week of October

[a] 5-year sample frequency next in October 2016.

The wells listed below are inactive and are not included in the monitoring program (water level measurements or sampling). These wells are inspected for surface component integrity during the Annual LTSM Site Inspection, which typically occurs in September.

Former Millsite Wells

T00-02 T00-03 T00-05 T00-06 T00-07

Downgradient PeRT Wells

R1-M2	R2-M9	R4-M7	R5-M7	T2-S	T7-D	TW-08
R1-M5	R2-M10	R4-M8	R5-M8	T3-D	TW-01	TW-09
R2-M1	R3-M1	R5-M1	R5-M9	T3-S	TW-02	TW-10
R2-M2	R3-M4	R5-M2	R5-M10	T4-S	TW-03	TW-11
R2-M3	R4-M1	R5-M3	R7-M2	T4-D	TW-04	TW-12
R2-M5	R4-M2	R5-M4	T1-D	T5-D	TW-05	TW-13
R2-M6	R4-M4	R5-M5	T1-S	T5-S	TW-06	TW-14
R2-M8	R4-M5	R5-M6	T2-D	T6-S	TW-07	

Constituent Sampling Breakdown

Site	Monticello						
Analyte	Groundwater	PeRT Wells	Surface Water	Seeps	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	57	18	16	14			
Field Measurements							
Alkalinity	X	X	X	X			
Dissolved Oxygen	88-85, 92-07, and 92-11 only	X					
Redox Potential	88-85, 92-07, and 92-11 only	X					
pH	X	X	X	X			
Specific Conductance	X	X	X	X			
Turbidity	X	X					
Temperature	X	X	X	X			
Laboratory Measurements							
Aluminum							
Ammonia as N (NH3-N)							
Arsenic	X	X	X	X	0.0001	SW-846 6020	LMM-02
Calcium	X	X	X	X	5	SW-846 6010	LMM-01
Chloride	X	X	X	X	0.5	SW-846 9056	WCH-A-039
Chromium							
Fluoride	X	X	X	X	0.5	SW-846 9056	MIS-A-040
Gross Alpha							
Gross Beta							
Iron	X	X	X	X	0.05	SW-846 6020	LMM-02
Lead							
Magnesium	X	X	X	X	5	SW-846 6010	LMM-01
Manganese	X	X	X	X	0.005	SW-846 6010	LMM-01
Molybdenum	X	X	X	X	0.003	SW-846 6020	LMM-02
Nickel							
Nickel-63							
Nitrate + Nitrite as N (NO3+NO2)-N	X	X	X	X	0.05	EPA 353.1	WCH-A-022
Potassium	X	X	X	X	1	SW-846 6010	LMM-01
Radium-226							
Radium-228							
Selenium	X	X	X	X	0.0001	SW-846 6020	LMM-02
Silica							
Sodium	X	X	X	X	1	SW-846 6010	LMM-01
Strontium							
Sulfate	X	X	X	X	0.5	SW-846 9056	MIS-A-044
Sulfide							
Total Dissolved Solids	T01-01, T01-12, 88-85, 82-08, and MW00-06 only		SW01-02, SW00-02, SW01-01, and Sorenson only	Seep 2 only	10	SM2540 C	WCH-A-033
Total Organic Carbon							
Uranium	X	X	X	X	0.0001	SW-846 6020	LMM-02
Vanadium	X	X	X	X	0.0003	SW-846 6020	LMM-02
Zinc							
Total No. of Analytes	16	15	16	16			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Monument Valley, Arizona

Location	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
402		X				
602		X				
603		X				
604		X				
605		X				
606		X				
618		X				
619		X				
648		X				
650		X				
651		X				
652		X				
653		X				
655		X				
656		X				
657		X				
662		X				
669		X				
711		X				
715		X				
719		X				
727		X				
733		X				
734		X				
735		X				
738		X				
739		X				
740		X				
741		X				
742		X				
743		X				
744		X				
760		X				
761		X				
762		X				
764		X				
765		X				
766		X				
767		X				
768		X				
770		X				
771		X				
772		X				
774		X				
775		X				
776		X				
Surface Locations						
623		X				

Sampling conducted in December and June

Constituent Sampling Breakdown

Site	Monument Valley				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	68	1			
Field Measurements					
Alkalinity	0603, 0611, 0615, 0618, and 0772 only				
Dissolved Oxygen					
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)	X	X	0.1	EPA 350.1	WCH-A-005
Arsenic	0603, 0611, 0615, 0618, and 0772 only		0.0001	SW-846 6020	LMM-02
Calcium	0603, 0611, 0615, 0618, and 0772 only		5	SW-846 6010	LMM-01
Chloride	X	X	0.5	SW-846 9056	MIS-A_039
Chromium					
Gross Beta					
Iron	0603, 0611, 0615, 0618, and 0772 only		0.05	SW-846 6020	LMM-02
Lead					
Magnesium	0603, 0611, 0615, 0618, and 0772 only		5	SW-846 6010	LMM-01
Manganese	0603, 0611, 0615, 0618, and 0772 only		0.005	SW-846 6010	LMM-01
Molybdenum	0603, 0611, 0615, 0618, and 0772 only		0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N	X	X	0.05	EPA 353.1	WCH-A-022
Potassium	0603, 0611, 0615, 0618, and 0772 only		1	SW-846 6010	LMM-01
Selenium					
Silica					
Sodium	0603, 0611, 0615, 0618, and 0772 only		1	SW-846 6010	LMM-01
Strontium					
Sulfate	X	X	0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Uranium	X	X	0.0001	SW-846 6020	LMM-02
Vanadium	X	X	0.0003	SW-846 6020	lMM-02
Zinc					
Total No. of Analytes	14	6			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Mound Site

Activity or Task: Groundwater Monitoring **Directive No.:** MND-2013-01

Initiated By: Sam Campbell

Directive Subject: Groundwater Monitoring Program

Directive and Associated Task Changes:

Groundwater sampling will be conducted according to the procedures specified in the *Sampling and Analysis Plan for the U.S. Department of Energy Office of Legacy Management Sites*, with the following exceptions:

Additional purge stability requirements

1. Dissolved oxygen ± 10 % over the last three readings
2. Turbidity ≤ 50 NTUs on last reading, except where samples are collected for chromium and nickel analyses.
3. Filtration of samples with turbidity > 10 NTUs is not required.

When a portable pump is used

1. Pump placement must be approximately 2 feet from the bottom of the well screen.
2. Purging can commence immediately after installation.

Category II wells

1. Contact the site hydrologist prior to sampling wells 0411 and 0443 using Category II criteria.
2. Measure field parameters prior to and after sample collection.
3. Measure water level after sample collection.

Sampling of seeps

1. Document the conditions of the seep water (e.g., flow estimate, color, turbidity) prior to sampling.
2. If needed, create a basin to pond the seep water, and allow water to flow through the basing until sediment is cleared.
3. Pre-preserved samples bottles must not be used as a sampling device by submerging the bottle in the seep water.

Organization(s) Affected: Geosciences, Projects/Programs, Quality Assurance, Environmental Monitoring Operations

Affected Documents: *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351-xx, current version), *Phase I Remedy (Monitored Natural Attenuation) Groundwater Monitoring Plan* (CH2MHILL 2004), *OU-I Pump and Treatment Operation and Maintenance Plan* (DOE 2000), and *Parcel 6, 7, and 8 (Monitored Natural Attenuation) Groundwater Monitoring Plan* (CH2MHILL 2008).

Justification for the Directive:

The Mound groundwater monitoring program administrative, data management, and quality assurance/quality control activities are performed in accordance with the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351). Mound field sampling procedures are governed by regulator-approved DOE-EM documents *Phase I Remedy (Monitored Natural Attenuation) Groundwater Monitoring Plan, Parcel 6, 7, and 8 (Monitored Natural Attenuation) Groundwater Monitoring Plan*, and the *OU-I Pump and Treatment Operation and Maintenance Plan*. Interim Directive IP-12-02 provides the traceability between these documents.

Currently, DOE-EM is working on consolidating the three groundwater monitoring plans into one. When a site wide groundwater monitoring plan is developed, the Mound Site Long-Term Surveillance and Maintenance Plan will be revised to provide traceability between the site wide plan and the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites.*

Greg Lupton (signature) Gregory J. Lupton
2012.10.16 16:19:01
-04'00'

Greg Lupton, Site Manager

(signature) 10-16-12

Rebecca Cato, Project Technical Lead

(signature) Michael B. Hoge
2012.10.04
21:09:00 -04'00'

Mike Hoge, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell (signature) Sam Campbell
2012.10.04 15:07:38 -06'00'

Sam Campbell, Environmental Monitoring Operations Manager

Date

Effective Date: 10/01/2012 **Expiration Date:** 9/30/2014

Distribution: w Attachments
Document Production—Master Copy
Record File at rc-grand.junction.lm.doe.gov (ADM 130.10)
Sampling and Analysis Plan for US DOE LM Sites

Sampling Frequencies for Locations at Naturita, Colorado

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
NAT01						
715			X			
718			X			
NAT01-1			X			
NAT02			X			
NAT08			X			
NAT26			X			
MAU07			X			
MAU08			X			
DM1			X			
NAT14						
BR95-1				Even year		Next in 7/2014
BR95-2				Even year		Next in 7/2014
BR95-3				Even year		Next in 7/2014
Surface Locations						
531			X			
533			X			
SM2			X			
SM4			X			

Annual sampling conducted in July
Biennial sampling conducted in July

Constituent Sampling Breakdown

Site	Naturita				
Analyte	**Groundwater**	**Surface Water**	**Required Detection Limit (mg/L)**	**Analytical Method**	**Line Item Code**
Approx. No. Samples/yr	14	5			
Field Measurements					
Alkalinity	X	X			
Dissolved Oxygen					
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X				
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Arsenic	X	X	0.0001	SW-846 6020	LMM-02
Calcium					
Chloride					
Chromium					
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum	BR and CM wells only		0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Radium-226					
Radium-228					
Selenium					
Silica					
Sodium					
Strontium					
Sulfate					
Sulfide					
Total Dissolved Solids	X	X	10	SM2540 C	WCH-A-033
Total Organic Carbon					
Uranium	X	X	0.0001	SW-846 6020	LMM-02
Vanadium	X	X	0.0003	SW-846 6020	LMM-02
Zinc					
Total No. of Analytes	5	4			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Parkersburg, West Virginia

Location ID	Quarterly	Semiannually	Annually	Every 5 years	Not Sampled	Notes
Monitoring Wells						
MW-1					X	Water levels
MW-2					X	Water levels
MW-3					X	Water levels
MW-4					X	Water levels
MW-5				X		Next sampling 10/13
MW-6				X		Next sampling 10/13

Sampling conducted in October
Based on LTSP dated September 1995

Constituent Sampling Breakdown

Site	Parkersburg				
Analyte	Ground Water	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	2	0			
Field Measurements					
Alkalinity					
Dissolved Oxygen					
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Alkalinity, total as CaCO3	X		10	SM2320 B	WCH-A-002
Ammonia as N (NH3-N)					
Antimony	X		0.003	SW-846 6020	LMM-02
Arsenic					
Barium	X		0.02	SW-846 6010	LMM-01
Beryllium	X		0.0008	SW-846 6010	LMM-01
Bromide					
Cadmium	X		0.001	SW-846 6020	LMM-02
Calcium	X		5	SW-846 6010	LMM-01
Chloride	X		0.5	SW-846 9056	MIS-A-039
Chromium	X		0.002	SW-846 6010	LMM-01
Gamma Spec					
Gross Alpha	X		2 pCi/L	EPA 900.0	GPC-A-001
Gross Beta	X		4 pCi/L	EPA 900.0	GPC-A-001
Iron					
Lead	X		0.002	SW-846 6020	LMM-02
Lead-210					
Magnesium	X		5	SW-846 6010	LMM-01
Manganese					
Mercury	X		0.0001	SW-846 7470	LMM-01
Molybdenum					
Nickel	X		0.02	SW-846 6010	LMM-01
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N	X		0.05	EPA 353.1	WCH-A-022
Nitrite	X		0.5	EPA 354.1	WCH-A-021
PCBs					
Potassium	X		1	SW-846 6010	LMM-01
Radium-226	X		1 pCi/L	Gas Proportional Counter	GPC-A-018
Radium-228	X		1 pCi/L	Gas Proportional Counter	GPC-A-020
Selenium	X		0.0001	SW-846 6020	LMM-02
Silica					
Sodium	X		1	SW-846 6010	LMM-01
Strontium					
Sulfate	X		0.5	SW-846 9056	MIS-A-044
Sulfide					
Thallium	X		0.004	SW-846 6020	LMM-02
Thiocyanate	X		0.1	EPA 300.0	MIS-A-045
Tritium					
Uranium	X		0.0001	SW-846 6020	LMM-02
Zinc			0.02	SW-846 6010	LMM-01
Zirconium	X		0.001	SW-846 6010	LMM-02
Total No. of Analytes	25	0			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

NOTE: Hafnium was removed from the analyte list in 2008. The 1994 sampling plan lists hafnium as a process related analyte. The zirconium ores processed at the site contained approximately 2-3% hafnium. Zirconium is expected to be a better indicator of contamination originating from the disposal cell because of its higher concentration in the ores processed.

Program Directive
Pinellas Environmental Restoration Project

Activities Groundwater Monitoring **Directive No.** PIN-2013–05

Initiated By: Sam Campbell

Directive Subject: Sampling of Monitoring Well PIN20-M056

Directive and Associated Task Changes:

Monitoring well PIN20-M056 will be purged without using a YSI water quality instrument, which is used to measure dissolved oxygen, oxidation-reduction potential, pH, and temperature at the Pinellas site. Completion of the purging process will be determined by meeting turbidity, water level, and purge volume criteria only.

Organization(s) Affected: Environmental Monitoring Operations, Programs and Projects, and Ecology/Hydrology.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351-xx current version).

Justification for Directive:

The water chemistry in the immediate vicinity of this monitoring well has been affected by injection of soy-bean oil. The injection resulted in changes in groundwater chemistry that adversely affect the YSI instrumentation by causing probes to malfunction and not read accurately. Prolonged exposure to this groundwater has destroyed probes in past sampling events. Because most of the measurements made by the YSI are used as stability criteria for purging, this Program Directive functions to amend the required purging protocol.

Review and Concurrence:

Julian Caballero, Site Hydrologist

Michael B. Hoge 2012.09.25 12:36:57 -04'00'

Mike Hoge, Quality and Performance Assurance

9-26-12

Charles Tabor, Project Technical Lead

Joe Daniel, Pinellas Site Manager

Issuing Manager Approval:

Sam Campbell 2012.09.26 14:12:58 -06'00'

Sam Campbell, Environmental Monitoring Operations Manager

Date

Effective Date: 10/1/2012 **Expiration Date:** 9/30/2014

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Sampling and Analysis Plan for DOE LM sites

Program Directive
Pinellas Environmental Restoration Project

Activities Groundwater Monitoring **Directive No.** PIN-2013–03

Initiated By: Sam Campbell

Directive Subject: Sampling of Monitoring Well PIN15-0594

Directive and Associated Task Changes:

Monitoring well PIN15-0594 will be sampled with a peristaltic pump by filling sample bottles immediately after purging one tubing volume; field measurements and parameter stability are not required. The intake of the dedicated tubing will be placed one foot above the bottom of the well for purging and sampling to allow collection of water within the screened interval. Normal Pinellas protocol will be used for sample collection – samples for metals analysis will be collected directly through the peristaltic pump, and samples collected for volatile organic compounds will be collected by pulling the dedicated tubing and reversing the flow of the pump.

Organization(s) Affected: Environmental Monitoring Operations, Programs and Projects, and Ecology/Hydrology.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351-xx current version).

Justification for Directive:

The yield of this monitoring well has been significantly reduced by injection of soy-bean oil in the immediate vicinity of the well. The low yield precludes micropurge sampling because a stable water level cannot be maintained during the purging process. In addition, the soy-bean oil injection caused changes in groundwater chemistry that adversely affects field instrumentation and the associated measurements; obtaining accurate field measurements, therefore, is not possible. Removing a minimal volume of purge water with the tubing placed near the bottom of the screen will allow groundwater within the screened interval to be collected and analyzed.

This monitoring well has been identified as a compliance well for risk-based closure of the site; therefore, this Directive functions to highlight the alternative sampling protocol for this well so that issues of data quality and representativeness are vetted early in the closure process.

Review and Concurrence:

Julian Caballero, Site Hydrologist

Michael B. Hoge
2012.09.25
12:35:55 -04'00'
Mike Hoge, Quality and Performance Assurance

9-26-12
Charles Tabor, Project Technical Lead

Joe Daniel, Pinellas Site Manager

Issuing Manager Approval:

Sam Campbell
2012.09.26 14:11:21 -06'00'
Sam Campbell, Environmental Monitoring Operations Manager

Date

Effective Date: 10/1/2012 **Expiration Date:** 9/30/2014

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Sampling and Analysis Plan for DOE LM sites

Program Directive
Pinellas Environmental Restoration Project

Activities Groundwater Monitoring **Directive No.** PIN-2013-01

Initiated By: Sam Campbell

Directive Subject: Groundwater Sampling Procedures

Directive and Associated Task Changes:

The *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (SAP) will be used as the applicable document for groundwater sampling procedures at the Pinellas site. The attached protocol for purging and sampling, instrument calibration, maintenance documentation, decontamination, and equipment blank collection will modify the SAP to reflect Florida Department of Environmental Protection (FDEP) requirements.

Organization(s) Affected: Environmental Monitoring Operations, Programs and Projects, and Ecology/Hydrology.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351-xx, current version)

Justification for Directive:

The Pinellas Environmental Restoration Project is required to follow FDEP procedures; this Program Directive modifies the criteria in the SAP to reflect FDEP requirements.

Review and Concurrence:

Julian Caballero, Site Hydrologist

Michael B. Hoge
2012.09.25
12:32:29 -04'00'

Mike Hoge, Quality and Performance Assurance

Charles Tabor, Project Technical Lead

Joe Daniel, Pinellas Site Manager

Issuing Manager Approval:

Sam Campbell
2012.09.25 13:13:09 -06'00'

Sam Campbell, Environmental Monitoring Operations Manager

Date

Effective Date: 10/1/2012 **Expiration Date:** 9/30/2014

Distribution: Document Production – Master Copy
Record File through rc-grandjunction.lm.doe.gov (ADM 130.10)
Sampling and Analysis Plan for DOE LM sites

Micropurge Sampling

Sampling Method

	Requirement
Pump/tubing intake placement	In screened interval.
Purging	Purge one pump/tubing/flow cell volume after stabilizing water level, and then take readings at least 2 minutes apart. Purge until the following criteria below are met.
Sampling VOCs (including 1,4-dioxane) by peristaltic pump	Collect VOCs last. Ensure that there is sufficient tubing volume to fill the requisite number of VOC vials. (For ¼" tubing, the ID ≈ 0.17" and 10 feet of tubing contains ≈ 40 mL). 1. After purging is complete and after any non-VOC samples have been collected, turn off the pump and leave the pump head tubing clamped so that a volume of water is retained in the tubing. 2. Remove the drop tubing from the well and fill the vials by reversing the flow on the pump to deliver the sample into the vials at a slow, steady rate. The flow rate must be **<100 mL/minute**. The tubing cannot be reinserted into the well to collect additional sample.

Primary Purging Criteria

Parameter	Criteria
Temperature	± 0.2 °C [a,c]
pH	± 0.2 pH standard units [a,c]
Specific conductance	± 5% of reading [a,c]
Turbidity	≤ 20 NTUs[a,b]
Dissolved oxygen	≤ 20% saturation[a]
Water level	Stable water level
Purge volume	3 pump/tubing/flow cell volumes prior to sample collection

[a]Criterion is for three consecutive measurements.
[b]Nephelometric turbidity unit (NTU).
[c]The range between the highest and the lowest values for the last three measurements cannot exceed the stated limits. For example, if the last three temperature readings are 20.0, 20.3, and 20.1, criterion has NOT been met.

Secondary Purging Criteria

Parameter	Criteria
Turbidity	± 5 NTUs or 10% (whichever is greater)[a]
Dissolved oxygen	± 0.2 mg/L or 10% (whichever is greater)[a]

[a]Criterion is for three consecutive measurements. The range between the highest and the lowest values for the last three measurements cannot exceed the stated limits. For example, if the last three turbidity readings are 25, 26, and 20, secondary criterion of ± 5 NTUs has NOT been met.

CMT Wells—Conventional Sampling

Sampling Method

	Requirement
Tubing	Place intake at top of water column. Use new tubing for each sampling event.
Purging	Purge one casing volume after stabilizing the water level, then take readings no sooner than every 1/4 casing volume. Purge until the following criteria below are met.
Stabilizing water level (WL) during purge	If needed, take an initial WL measurement. 1. Begin pumping with the tubing above the water table. Slowly lower the tubing into the water. As bubbles appear, continue to slowly lower the tubing. When a steady stream of water in the tubing (no bubbles) is obtained, the well yield is equal to the pump rate indicating water level stabilization. 2. When WL is stable, start measuring purge volume.
Sampling VOCs (including 1,4-dioxane) by peristaltic pump	Collect VOCs last. 1. After purging is complete and after any non-VOC samples have been collected, turn off the pump and leave the pump head tubing clamped so that a volume of water is retained in the tubing. 2. Remove the drop tubing from the well and fill the vials by reversing the flow on the pump to deliver the sample into the vials at a slow, steady rate. The flow rate must be **<100 mL/minute.** The tubing may be reinserted into the well to collect additional volume as needed.

Primary Purging Criteria

Parameter	Criteria
Temperature	± 0.2 °C [a,c]
pH	± 0.2 pH standard units [a,c]
Specific conductance	± 5% of reading [a,c]
Turbidity	≤ 20 NTUs[a,b]
Dissolved Oxygen	≤ 20% saturation[a]
Water Level	Stable water level (No air in tubing as it is lowered from top of water column)

[a]Criterion is for three consecutive measurements.
[b]Nephelometric turbidity unit (NTU).
[c]The range between the highest and the lowest values for the last three measurements cannot exceed the stated limits. For example, if the last three temperature readings are 20.0, 20.3, and 20.1, criterion has NOT been met.

Secondary Purging Criteria

Parameter	Criteria
Turbidity	± 5 NTUs or 10% (whichever is greater)[a]
Dissolved Oxygen	± 0.2 mg/L or 10% (whichever is greater) [a]
Purge Volume	Purging complete after 5 casing volumes at the discretion of the sampling lead

[a] Criterion is for three consecutive measurements. The range between the highest and the lowest values for the last three measurements cannot exceed the stated limits. For example, if the last three turbidity readings are 25, 26, and 20, secondary criterion of ± 5 NTUs has NOT been met.

Calibration and Operational Check Specifications for Field Instrumentation

Parameter	Calibration	ICV/CCV[a] Frequency	ICV/CCV Acceptance Criteria	Corrective Actions
pH	3-point calibration with 4, 7, and 10 pH buffers at start of sampling event	ICV – Immediately after calibration CCV – start of each day and end of sampling event	One point check ± 0.2 pH units	If the CCV does not meet criteria Repeat the CCV. If still out of range recalibrate and read new ICV. J-flag data as estimated between last successful CCV and failed CCV.
Specific Conductance	One point calibration (~1000 μmhos/cm[b]) at start of sampling event	ICV – immediately after calibration	2-point check (~100 and ~10,000 μmhos/cm) to bracket the expected sample range ± 5%	
		CCV – start of each day and end of sampling event	1-point check (~10,000 μmhos/cm) ± 5%	
Temperature	No calibration required	ICV – start of sampling event CCV – end of sampling event	± 0.5 °C from corrected NIST thermometer reading at three temperatures in the expected sample range	
Dissolved Oxygen	Calibrate in water-saturated air at beginning of sampling event and every membrane change-out	ICV – Immediately after calibration CCV – start of each day and end of sampling event	± 0.3 mg/L of theoretical DO in water-saturated air	
Turbidity	4-point calibration at start of sampling event	ICV – Immediately after calibration. Must use primary standard for ICV	1-point check: 0 to 10 NTU ± 10% 10 to 40 NTU ± 8% 41 to 100 NTU ± 6.5% >100 NTU ± 5%	
		CCV – start of each day and end of sampling event. Use either primary or secondary (Gelex) standard.	3-point check: 0 to 10 NTU ± 10% 10 to 40 NTU ± 8% 41 to 100 NTU ± 6.5% >100 NTU ± 5%	
Oxidation-Reduction Potential	One point calibration at start of sampling event	ICV – immediately after calibration CCV – start of each day and end of sampling event	1-point check ± 10%	

[a] Initial calibration verification/continuing calibration verification
[b] micromhos per centimeter

Other Notes

Instrument Maintenance: Maintenance of field instrumentation must be documented in the FDCS on a Pre-trip Calibration or a Daily Calibration/Operational Check form. *FD 3000 Documentation of Equipment Maintenance*

Include:

- Routine cleaning procedures
- Corrective actions performed during calibrations or verifications
- Parts replacement for instrument probes
- Date for the procedures performed
- Names of personnel performing the maintenance or repair
- Description of malfunctions necessitating repair or service

Record the following for rented equipment:

- Equipment type and model, inventory number, or other description

Water Level Meter Decontamination:

- Decontaminate water level meter with—at minimum—detergent/tap water/analyte-free water sequence before use. When measuring water level only, decontaminate the probe. When measuring total depth, decontaminate the length of tape that will contact the groundwater in the well. *FS 2211.3.1.1 and FC 1000 Cleaning/Decontamination Procedures*

Equipment Blanks

- Tubing will be purchased in bulk and a pre-cleaned equipment blank will be collected through the bulk tubing reel. If the pre-cleaned equipment blank has no analytes detected, then no decontamination is required prior to tubing installation. If there are analytes detected in the equipment blank, then tubing will need to go through a decontamination process (soap/tap water/analyte-free water). New tubing will be installed in CMT wells prior to sampling. *FC1160 3.1.2 and email from FDEP*

Sampling Frequencies for Locations at Rifle, Colorado

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
New Rifle						
169		X				
170		X				
172		X				
195		X				
201		X				Data logger
215		X				
216		X				
217		X				
590		X				Data logger
620		X				
635		X				
658		X				
659		X				
664		X				
669		X				
670		X				
855		X				
Old Rifle						
292A		X				GCAP; bkgd well
304		X				GCAP
305		X				GCAP
309		X				GCAP
310		X				GCAP; data logger
655		X				GCAP; data logger
656		X				GCAP
658		X				Background well
742		X				Background well
743		X				Background well
744		X				Background well
Surface Locations						
New Rifle						
320		X				Wetland Pond
322		X				Colorado River
323		X				Gravel pit pond
324		X				Colorado River downgradient
452		X				Wetland Pond
453		X				Wetland Pond
575		X				Gravel pit pond
Old Rifle						
294		X				River, upstream
395		X				Seep, upgradient
396		X				River
398		X				Ditch, onsite
741		X				River
Disposal Cell						
RFL08-Disposal Cell Effluent						
MW03			X			July

Semi-annual sampling conducted in June and November; annual sampling conducted for Rifle Disposal Cell in July

Constituent Sampling Breakdown

Site	Rifle							
Analyte	Groundwater		Surface Water			Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	57		24					
Field Measurements								
Alkalinity	X		X					
Dissolved Oxygen								
Redox Potential	X		X					
pH	X		X					
Specific Conductance	X		X					
Turbidity	X							
Temperature	X		X					
Laboratory Measurements	**RFO*	**RFN*	*RFO*	*RFN*	*RFL*			
Aluminum								
Ammonia as N (NH3-N)		X		X		0.1	EPA 350.1	WCH-A-005
Arsenic		X		X		0.0001	SW-846 6020	LMM-02
Calcium								
Chloride								
Chromium								
Gross Alpha								
Gross Beta								
Iron								
Lead								
Magnesium								
Manganese								
Molybdenum		X		X		0.003	SW-846 6020	LMM-02
Nickel								
Nickel-63								
Nitrate + Nitrite as N (NO3+NO2)-N		X		X		0.05	EPA 353.1	WCH-A-022
Potassium								
Radium-226								
Radium-228								
Selenium	X	X	X	X		0.0001	SW-846 6020	LMM-02
Silica								
Sodium								
Strontium								
Sulfate								
Sulfide								
Total Dissolved Solids								
Total Organic Carbon								
Uranium	X	X	X	X	X	0.0001	SW-846 6020	LMM-02
Vanadium	X	X	X	X	X	0.0003	SW-846 6020	LMM-02
Zinc								
Total No. of Analytes	3	7	3	7	2			

*RFN = New Rifle; *RFO = Old Rifle

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Program Directive

Rio Blanco Site

Activity or Task Natural Gas Sampling **Directive No.** RBL-2013-01 .

Initiated By: Sam Campbell

Directive Subject: Natural Gas Sampling at a Natural Gas Production Well

Directive and Associated Task Changes:

Collection of a natural gas sample at the wellhead of a producing natural gas well will be conducted as described in the attached procedures.

Organization(s) Affected: Projects/Programs, Environmental Monitoring Operations

Affected Documents: Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites (LMS/PLN/S04351-xx, current version)

Justification for the Directive:

Procedures for sampling natural gas are not addressed in the Sampling and Analysis Plan. This Program Directive will be used to guide sample collection.

Review and Concurrence:

Rick Hutton
2012.09.14 13:54:52 -06'00'

Rick Hutton, Nevada Off-Sites Project Manager

Digitally signed by Linda S. Tegelman
Date: 2012.10.02 12:12:29 -06'00'

Linda Tegelman, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell
2012.09.27 07:40:42 -06'00'

Sam Campbell, Environmental Monitoring Operations Manager

Date

Effective Date: 10/1/2012 **Expiration Date**: 9/30/2014

Distribution: w Attachments
rc-nevada (ADM 130.10)
Sampling and Analysis Plan for US DOE LM Sites

Sampling Frequencies for Locations at Rio Blanco, Colorado

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
On-Site						
RB-D-01			X			
RB-D-03			X			
RB-S-03			X			
RB-W-01			X			
Off-Site						
Johnson Artesian WL			X			
Brennan Windmill			X			
Surface Locations						
On-Site						
Fawn Creek 500ft Dwn			X			
Fawn Creek 500ft Ups			X			
Off-Site						
B-1 Equity Camp			X			
CER #1 Black Sulphur			X			
CER #4 Black Sulphur			X			
Fawn Creek #1			X			
Fawn Creek #3			X			
Fawn Creek 6800ft Up			X			
Fawn Creek 8400ft Dw			X			

Sampling conducted in May

Constituent Sampling Breakdown

Site	Rio Blanco				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	6	9			
Field Measurements					
Alkalinity					
Dissolved Oxygen					
Redox Potential					
pH	X	X			
Specific Conductance	X	X			
Turbidity	X				
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium					
Chloride					
Chromium					
Gamma Spec	X	X	10 pCi/L	Gamma Spectrometry	GAM-A-001
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum					
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Radium-226					
Radium-228					
Selenium					
Silica					
Sodium					
Strontium					
Sulfate					
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Tritium	X	X	400 pCi/L	Liquid Scintillation	LSC-A-001
Tritium, enriched	25% of the samples	25% of the samples	10 pCi/L	Liquid Scintillation	LMR-15
Uranium					
Vanadium					
Zinc					
Total No. of Analytes	3	3			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Riverton, Wyoming

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
101					X	WL only
110					X	WL only
111					X	WL only
700					X	WL only
702					X	Data logger
705	X					
707	X					Data logger
709					X	WL only; Data logger
710	X					
716	X					
717	X					
718	X					
719	X					
720	X					
721	X					
722R	X					
723	X					
724					X	WL only
725					X	WL only
726					X	WL only
727					X	WL only
728					X	WL only
729	X					
730	X					
732					X	WL only
733					X	WL only
734					X	WL only
736					X	WL only
784	X					
788	X					
789	X					Data logger
824	X					
825					X	Not drilled yet
826	X					

Sampling Frequencies for Locations at Riverton, Wyoming

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Surface Locations						
747	X					
749	X					
794	X					
796	X					
810	X					Gravel pit
811	X					Little Wind River
812	X					Little Wind River
822	X					
823	X					
Domestic Wells						
405	X					921 Rendezvous Road
422	X					10 Whitetail Drive
430	X					204 Goes in Lodge Road
436	X					33 St Stephens Road
440					X	898 Rendezvous Road; on hold
441					X	898 Rendezvous Road; pending owner's permission
460	X					140 Goes in Lodge Road
828	X					33 St Stephens Road
841	X					22 Whitetail Dr
842	X					14 Whitetail Dr
Alternate Water Supply System						
813		X				
814		X				
815		X				
816		X				
817		X				
818		X				
819		X				
820		X				
821		X				
829		X				
830		X				
834		X				

Quarterly sampling conducted in December, March, June, and August
Semiannual sampling conducted in October and April

Constituent Sampling Breakdown

Site	Riverton				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	138	36			
Field Measurements					
Alkalinity	X	X			
Dissolved Oxygen	X	X			
Redox Potential	X	X			
Residual Chlorine					
pH	X	X			
Specific Conductance	X	X			
Turbidity	X	X			
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium					
Chloride					
Chromium					
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium					
Manganese	X	X	0.005	SW-846 6010	LMM-01
Molybdenum	X	X	0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Radium-226		0822 only	1 pCi/L	Gas Proportional Counter	GPC-A-018
Radium-228		0822 only	1 pCi/L	Gas Proportional Counter	GPC-A-020
Selenium					
Silica					
Sodium					
Strontium					
Sulfate	X	X	0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Uranium	X	X	0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	4	6			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Program Directive
Rocky Flats Site

Activities Surface Water Monitoring **Directive No.** RFS-2013-03

Initiated By: Sam Campbell

Directive Subject: Processing of Composite Surface Water Samples

Directive and Associated Task Changes:

Composite surface water samples will be processed using the attached procedure.

Organization(s) Affected: Environmental Monitoring Operations, Hydrology, Projects/Programs.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351-xx, current version).

Justification for Directive:

Because composite surface water samples have the potential to remain in the composite sampler carboy for extended periods of time, special processing procedures are required for homogenization, preservation, and splitting of sample fractions.

Review and Concurrence:

Linda Kaiser, Site Manager

George Squibb, Surface Water Lead

Linda Tegelman, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell, Environmental Monitoring Operations Manager

10/2/2012
Date

Effective Date: 10/1/2012 **Expiration Date:** 9/30/2014

Distribution: re-rocky flats (ADM 130.10)
Sampling and Analysis Plan for U. S. DOE LM Sites

Program Directive
Rocky Flats Site

Activities Groundwater and Surface Water Monitoring **Directive No.** RFS-2013-02

Initiated By: Sam Campbell

Directive Subject: Disposition of Excess Water

Directive and Associated Task Changes:

Disposition of excess water generated during sampling activities will conducted according to instructions specified in the attached *Guidelines for the Disposition of Purge, Decontamination, and Excess Sample Water*

Organization(s) Affected: Environmental Monitoring Operations, Hydrology, Projects/Programs.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351-xx, current version).

Justification for Directive:

Prior to closure of site, all excess water generated during sampling activities was managed through an onsite water treatment facility. This facility was removed during remediation of the site, and the guidelines to manage and dispose of excess water were revised.

Review and Concurrence:

Linda Kaiser, Site Manager

George Squibb, Surface Water Lead

John Boylan, Groundwater Lead

Linda Tegelman, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell, Environmental Monitoring Operations Manager

10/2/2012
Date

Effective Date: 10/1/2012 **Expiration Date:** 9/30/2014

Distribution: rc-rocky.flats (ADM 130.10)
Sampling and Analysis Plan for U. S. DOE LM Sites

Program Directive
Rocky Flats Site

Activities Groundwater and Surface Water Monitoring **Directive No.** RFS-2013–01

Initiated By: Sam Campbell

Directive Subject: Miscellaneous Sampling Activities

Directive and Associated Task Changes:

1. Samples for the analysis of volatile organic compounds (VOCs) may be collected through a peristaltic pump.
2. Holding time for unpreserved (i.e., not chemically preserved, but chilled to 4° C) VOCs will be 14 days.
3. Groundwater samples collected for americium, plutonium, uranium, and metals analyses will be field-filtered through a 0.45 µm pore-size filter regardless of sample turbidity.

Organization(s) Affected: Environmental Monitoring Operations, Hydrology, Projects/Programs.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351, current version). *Rocky Flats Legacy Management Agreement*, Attachment 2 (2007). *Rocky Flats Site Operations Guide*, (LMS/RFS/S03037-xx, current version).

Justification for Directive:

1. Because of geologic and hydrologic conditions at the Rocky Flats Site, numerous low-producing wells with highly variable water levels exist, which limits the options to withdraw water from a well. Collection of samples, including VOC samples, through a peristaltic pump may be the best alternative for many wells, even though there is a potential for lower VOC concentrations through increased volatilization caused by the suction lift pump.
2. Unpreserved volatile organic compound samples typically have a 7-day holding time; however, an agreement with the State of Colorado allows an increase in the holding time to 14 days. This increase in holding time will ease constraints on sample shipping and batching.
3. Filtration of americium, plutonium, uranium, and metals has been conducted historically at the site to ensure that groundwater samples are not biased by suspended particulate matter. Studies at the site have shown that americium and plutonium are not very soluble but attach to particulate matter.

Review and Concurrence:

Linda Kaiser, Site Manager

George Squibb, Surface Water Lead

John Boylan, Groundwater Lead

Linda Tegelman, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell, Environmental Monitoring Operations Manager

10/2/2012
Date

Effective Date: 10/1/2012 **Expiration Date:** 9/30/2014

Distribution: rs-rocky flats (ADM 130.10)
Sampling and Analysis Plan for U. S. DOE LM Sites

Program Directive

Rulison Site

Activity or Task Natural Gas Sampling **Directive No**. RUL-2013-01 .

Initiated By: Sam Campbell

Directive Subject: Natural Gas Sampling at a Natural Gas Production Well

Directive and Associated Task Changes:

Collection of a natural gas sample at the wellhead of a producing natural gas well will be conducted as described in the attached procedures.

Organization(s) Affected: Projects/Programs, Environmental Monitoring Operations

Affected Documents: Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites (LMS/PLN/S04351-xx, current version)

Justification for the Directive:

Procedures for sampling natural gas are not addressed in the Sampling and Analysis Plan. This Program Directive will be used to guide sample collection.

Review and Concurrence:

Rick Hutton
2012.09.14 13:52:25 -06'00'

Rick Hutton, Nevada Off-Sites Project Manager

Digitally signed by Linda S. Tegelman
Date: 2012.10.02 12:13:53 -06'00'

Linda Tegelman, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell
2012.09.27 07:39:11 -06'00'

Sam Campbell, Environmental Monitoring Operations Manager Date

Effective Date: 10/1/2012 **Expiration Date**: 9/30/2014

Distribution: w Attachments
rc-nevada (ADM 130.10)
Sampling and Analysis Plan for US DOE LM Sites

High Pressure Natural Gas Sampling Using a Propane Tank

Introduction and Purpose

The following procedure will be used to collect samples from privately owned natural gas production wells for analysis of carbon-14 and tritium. The work will be conducted at several natural gas production facilities near the Rulison, Colorado, Site; Rio Blanco, Colorado, Site; and Gasbuggy, New Mexico, Site. Site elevations vary from approximately 6,000 feet (ft) to 9,500 ft.

Isotech Laboratories Inc. will be conducting the analyses of the gas samples and will provide a prepared "propane" tank to collect the natural gas sample. This procedure is a compilation of three Isotech Laboratories Inc. procedures related to gas sampling and incorporates contractor health and safety integrated safety management system control measures.

Health and Safety

See Table 1, "Tasks, Analyzed Hazards, and Control Measures."

Equipment

Equipment used for this procedure includes flexible natural gas tubing (350 pounds per square inch [psi] working pressure), brass connectors, Teflon tape, a pressure regulator (rated to 3,000 psi), a standard 20-pound propane tank, and a high-pressure gauge (5,000 psi). The flexible tubing/pressure regulator assembly and the propane tank are shown in Figure 1. Additional tools include traffic cones or pin flags, and a non-sparking wrench.

Personal protective equipment (PPE) required includes a fire retardant shirt, hardhat, safety glasses, and safety-toe boots. Hearing protection, leather work gloves**,** and nitrile gloves may also be required as determined by individual tasks and hazards. Additional PPE or safety training may be required by some well field operators.

The propane tank is provided by Isotech Laboratories and is purged and evacuated prior to delivery.

Caution

All tools must be non-sparking. All fittings must be brass.

Sampling team members must wear a 4-gas personal detector at all times. *The "high alarm" must be set at 5% (full scale) of the lower explosive limit (LEL) for methane. Check handheld monitors for methane levels; if levels exceed LEL minimums follow well field operator's instructions for moving away from the site.*

Prerequisite Actions

Hazard Classification per National Electrical Code, NFPA 70, Ch. 5 Article 500: Class 1 (flammable methane gas, hazardous by nature and ignitable), Division 1 (methane is present). Request that the well field operator conduct an initial sweep of the dog house and sampling area to monitor gas levels. If an explosive condition exists, follow the operator's requirements and leave the area immediately.

Sampling team members must "bump check" the 4-gas personal detectors at least once a week.

Procedure

Gas samples will be collected from pressurized well head collection systems, through a sampling regulator and tubing system, into a small propane tank. Samples will be taken from an existing sampling port; the port may be inside or outside the operator's "dog house." The well field operator will determine the location of the gas sampling port to be used.

[1] Meet with a representative from the company that is responsible for operation of the production well. Have the representative locate a sampling port with control valve on a line coming from the well. Sampling locations for other media (e.g., condensate water) may be located at this time.

[2] Inspect pressure fittings, regulators, and hoses for signs of wear, cracks, and breakage. Ensure sampling hoses, fittings, and pressure reducing regulators are rated to handle the gas delivery pressures at the sampling port.

[3] Verify acceptable line pressure from an inline pressure gauge or the LCD monitor readouts, or install a high pressure gauge (5,000 psi) at the sampling port. Ensure the port is free of debris prior to connection. Wear protective gloves as needed. Use Teflon tape at all threaded connections.

[4] **<u>IF</u>** the pressure is greater than 2,500 psi, **<u>THEN</u>** do not attempt to sample from that location.

[5] If the pressure is less than 2,500 psi, install the inlet side of the pressure regulator directly to the sample port via a properly sized threaded bushing. Use the spark-free bronze wrench to make this and all other connections.

Caution

Do not *use any flame or carry any device capable of creating a spark (e.g., cell phone) when connecting sampling hardware. Keep such items inside the vehicle. Keep vehicle 50 ft away from the sampling port or where the well field operator directs. Keep vehicle ignition in the off position during gas sampling activities.*

Do not *operate any valves, chokes, or switches unless specifically requested by the well field operator. No smoking anywhere on the well field operator's site. Only brass fittings and non-sparking tools shall be used.*

[6] Connect the outlet side of the flexible tubing/pressure regulator assembly to the propane tank.

Note *The threads on the propane tank are left-handed thread, so turn counterclockwise to tighten. **Do not** over tighten.*

[7] Open the control valve at the sampling port.

[8] Adjust the outlet pressure on the pressure regulator to 20 psi.

[9] Place bypass vent line exhaust end downwind from sampling assembly. When purging sample lines use a 25-foot extension line with the discharge located downwind of samplers.

[10] Establish a C1D2 exclusion zone as a 15-foot-radius exclusion zone around the vent line discharge point using pin flags or cones. When an operator is venting natural gas from the well or piping system, stop sampling activities and move at least 100 ft upwind from the discharge point until venting is complete.

[11] Open the bypass valve on the propane tank for approximately 10 seconds to purge the air space in the pressure regulator and flexible tubing; close the bypass valve.

[12] Open (for approximately 2 seconds) and close the bypass valve approximately 15 times to purge the air space between the bypass valve and the propane tank.

[13] With the bypass valve closed, open the valve on the propane tank and allow the tank to fill until gas flow into the propane tank is no longer audible (approximately 30 seconds).

[14] Close the valve on the propane tank. Do not over tighten.

[15] Close the control valve at the sample port.

[16] Open the bypass valve on the propane tank to release the pressure and then close the bypass valve.

[17] Disconnect the flexible tubing/pressure regulator assembly.

[18] Label the propane tank and complete chain-of-custody form.

Shipping

The natural gas sample contained within the propane tank is regulated by the U.S. Department of Transportation (DOT), and, therefore, must be shipped as a hazardous material per DOT regulations. Contact a Certified Shipper to complete and sign the required documentation and oversee the shipment. The gas collection tank must be secure and upright when transporting the sampling container.

References

Isotech Laboratories, Inc., 2007. Sampling procedures Sample Collection Procedures Using a 12 Volt Pump and Propane Tanks; Collection of Gas Samples with Single-Ended Cylinders; Sampling from High-Pressure Wells; and Shipping Instructions for Gas Samples in LP Tanks, located at http://www.isotechlabs.com/customersupport/samplingprocedures/, last accessed on 10/10/2011.

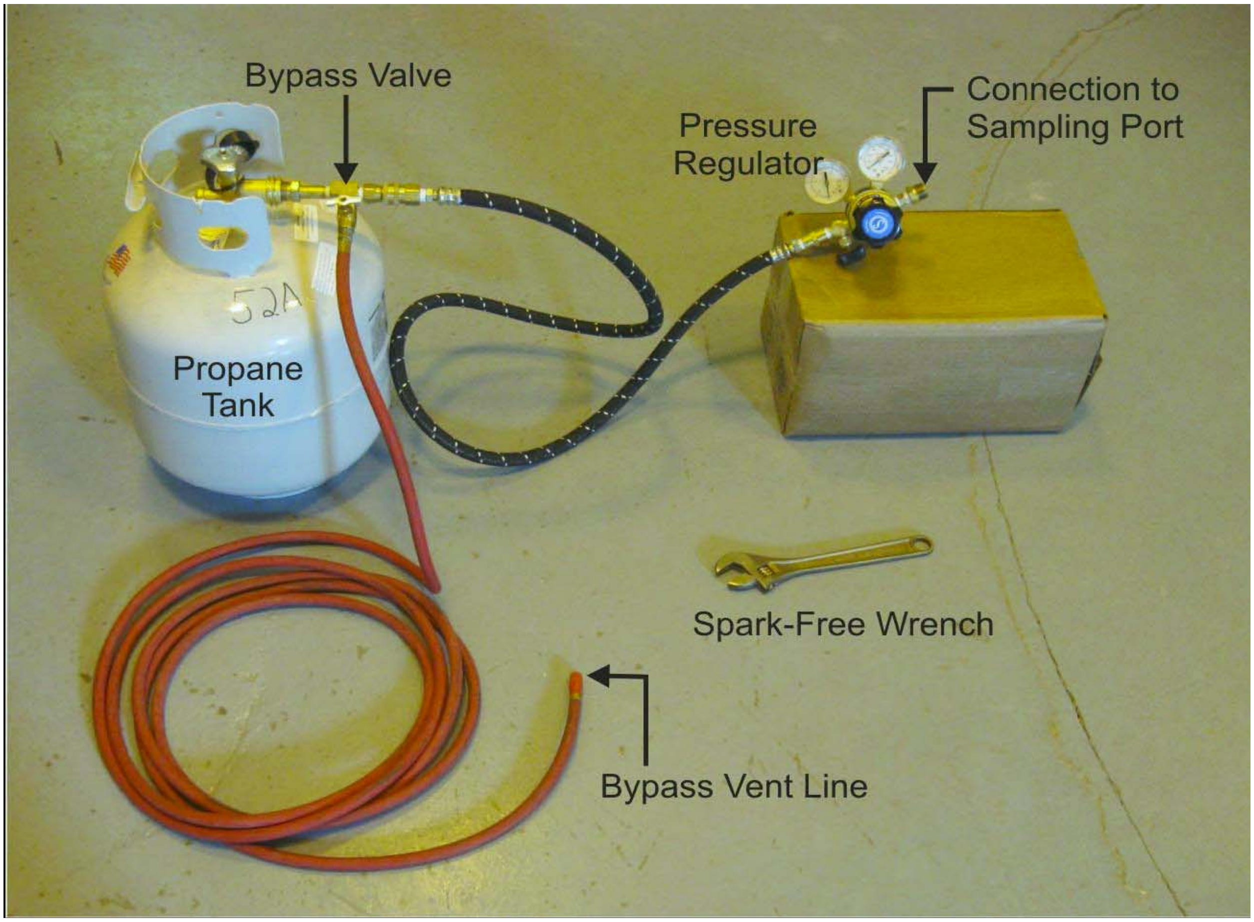

Figure 1. Flexible Tubing/Pressure Regulator Assembly and Propane Tank

Table 1. Tasks, Analyzed Hazards, and Control Measures

Task	Hazard	Controls
Driving to and from the gas well sites	1) Slippage and loss of control due to steep grades and wet road conditions 2) Vehicle accidents 3) Driving hazards caused by well field operator activities	1) Conform to the well field operator's speed limit requirements. If road conditions make driving unsafe, postpone the sampling event. Use 4WD vehicle and carry tire chains, tow-chain, and shovel. 2) When approaching sharp corners slow down, move to the right, and pay attention to driving conditions. Pull over to allow oncoming traffic to pass if road is too narrow. Keep vehicles a safe distance from drop offs. The driver will not use two-way communication devices while vehicle is in motion. Be very alert to the potential for wildlife or livestock on the roads. 3) Follow the well field operator to the designated parking area. Follow their instructions for parking. When leaving or backing up, have a spotter assist in backing out of parking space if there is other vehicle traffic or equipment in the area. Obey all well field operator restrictions.
Hazards common to all site activities Hazards common to all site activities	1) Slips, trips, falls	1) Keep work area uncluttered; remove tripping hazards if possible. Drill rigs, platforms and associated equipment have many tripping hazards; be cautious, use hand rails, especially on stairways when carrying sampling equipment and samples; pay attention to surroundings. Use extra caution on stairways and platforms when ice, snow, or muddy conditions exist.
	2) Head, eye, or foot injury, burns	2) PPE shall be worn in accordance with the well field operators' requirements; at a minimum wear hard hat, eye protection, safety-toe boots, and fire retardant shirt at all times outside the vehicle. Hearing protection and nitrile gloves may be required during sample collection. Adhere to noise area postings and procedure requirements.
	3) Injury to hands	3) Keep hands and fingers out of pinch points and crush areas. Wear leather work gloves if there is a potential for cuts, abrasions, blisters etc. (e.g., installing chains on the vehicle).
	4) Inclement weather and lightning strikes	4) Seek shelter when weather conditions present a threat to safe working conditions. Use the 30/30 rule to assess a threat. Cease field activities when lightning is within 6 miles (30 seconds between flash and bang). Field activities can resume 30 minutes after the last audible thunder. Suspend work if strong winds cause a hazard.
	5) Biological hazards—snakes, insects, and bears	5) Remain alert for snakes and avoid them. Do not put hands into dark or obscured areas. Remain alert for bears—if a bear enters the work area, get inside a vehicle or the dog house as quickly as possible.
	6) Explosion caused by spark or fire in the work area	6) Samplers must not use any flame or carry any device capable of creating a spark (e.g., cell phone) when connecting sampling hardware. Keep such items inside the vehicle. Keep vehicle 50 ft away from sampling port or where well field operator directs. Keep vehicle ignition off during gas sampling activities. Do not operate any valves, chokes, or switches unless specifically requested by the well field operator. No smoking anywhere on the well field operators' site. Only brass fittings and non-sparking tools shall be used.
	7) Explosive atmosphere within work area	7) Request that the well field operator conduct an initial sweep of the dog house and sampling area to monitor gas levels. If an explosive condition exists, follow the well field operator's requirements and leave the area immediately. Sampling team members will wear a 4-gas personal detector at all times while sampling. The high alarm should be set at 5% (full scale) of the lower explosive limit (LEL) for methane. When purging sample lines use a 25-foot extension line with the discharge located downwind of the samplers. Establish a C1D2 exclusion zone as a 15-foot radius around the purging hose discharge point. Cones or pin flags should be used to define the C1D2 zone. When the well field operator is venting natural gas from well or piping system, stop sampling activities and move at least 100 ft upwind from the discharge point until venting is complete.

Task	Hazard	Controls
Gas Sample Collection	Methane release due to equipment failure such as (1) blockage of sampling regulator causing sampling line break, or (2) regulator damage or breakage from higher than anticipated inline pressure	Prior to sampling, inspect pressure fittings, regulators, and hoses for signs of wear, cracks, and breakage. Ensure sampling hoses, fittings, and pressure reducing regulators are rated to handle the gas delivery pressures at the sampling port. Verify acceptable pressures at a pressure gauge or the LCD monitor readout before sample collection in accordance Step 2 of the "High Pressure Natural Gas Sampling Procedure." The well field operator will inform the sampling team which sample port to use for gas collection. The sampling team will check to make sure the port is free of debris prior to connection.
	Explosive atmosphere created during sampling	When purging sample lines use a 25-foot extension line with the discharge located downwind of samplers. Establish a C1D1 exclusion zone as a 15-foot radius around the discharge point. Cones or pin flags should be used to define the C1D1 zone. When an operator is venting natural gas from a well or piping system, stop sampling activities and move at least 100 ft upwind from the discharge point until venting is complete. Hazard Classification per National Electrical Code, NFPA 70, Ch. 5 Art. 500: Class 1 (flammable methane gas, hazardous by nature and ignitable), Division 1 (methane is present). Check handheld monitors for methane levels; if levels exceed LEL minimums, follow operators' instructions for moving away from the site. Samplers must not use any flame or carry any device capable of creating a spark (e.g., cell phone) when connecting sampling hardware. Keep such items inside the vehicle. Keep vehicle 50 ft away from sampling port or where operator directs. Keep vehicle ignition off during gas sampling activities. Do not operate any valves, chokes, or switches unless specifically requested by the well field operator. No smoking anywhere on the well field operators' site. Only brass fittings and non-sparking tools shall be used.
Transporting Natural Gas Samples	Explosive atmosphere created by damage to cylinder valve during transport, causing gas leak	When transporting a sampling container, the gas collection tank must be secure and upright.

Sampling Frequencies for Locations at Rulison, Colorado

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
Off-Site						
CER Test Well			X			
Daniel Gardener			X			
Kevin Whelan			X			
Morrissania Ranch			X			
Patrick McCarty			X			
Tim Jacobs Ranch New			X			
On-Site						
Cary Weldon House W					X	
Wesley Kent House W					X	
Municipal Water Supply						
City Springs			X			
Surface Locations						
On-Site						
Spr 300 Yrd N Of GZ			X			
Sprg 500ft E of GZ			X			
Off-Site						
Battlement Creek			X			
Potter Ranch			X			

Sampling conducted in May

Constituent Sampling Breakdown

Site	Rulison				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	9	4			
Field Measurements					
Alkalinity					
Dissolved Oxygen					
Redox Potential					
pH	X	X			
Specific Conductance	X	X			
Turbidity	X				
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium					
Chloride					
Chromium					
Gamma Spec	X	X	10 pCi/L	Gamma Spectrometry	GAM-A-001
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum					
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Radium-226					
Radium-228					
Selenium					
Silica					
Sodium					
Strontium					
Sulfate					
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Tritium	X	X	400 pCi/L	Liquid Scintillation	LSC-A-001
Tritium, enriched	25% of the samples	25% of the samples	10 pCi/L	Liquid Scintillation	LMR-15
Uranium					
Vanadium					
Zinc					
Total No. of Analytes	3	3			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Program Directive
Salmon Site, Mississippi

Activities Groundwater Monitoring **Directive No.** SAL-2013-01

Initiated By: Sam Campbell

Directive Subject: High Flow Purging

Directive and Associated Task Changes:

Samples will be collected from wells SA5-4-4 and SA5-5-4 with high-flow, dedicated submersible pumps after one well casing volume (3,500 gallons) has been purged and, thereafter, field parameters have stabilized (i.e., pH within 0.2 units, conductivity, and temperature within 10% over final 3 readings). A minimum of three field parameter readings will be taken during the final 100 gallons of purging.

Organization(s) Affected: Environmental Monitoring Operations, Geosciences, Projects/Programs.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351, current version).

Justification for Directive:

The current dedicated pump configuration is designed for high-flow purging/sampling, and the SAP only addresses low-flow purging/sampling. Use of the specific purging and sampling methods will continue because it's consistent with the sample collection process historically used at the site for these wells.

Review and Concurrence:

10-25-2012

Rick Hutton, Nevada Off-Sites Project Manager

John R. Duray
2012.09.14 12:45:04 -06'00'

Jack Duray, Project Technical Lead

Digitally signed by Linda S. Tegelman
Date: 2012.10.02 12:15:17 -06'00'

Linda Tegelman, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell
2012.09.27 07:42:34 -06'00'

Sam Campbell, Environmental Monitoring Operations Manager

Date

Effective Date: 10/1/2012 **Expiration Date:** 9/30/2014

Distribution: rc-nevada (ADM 130.10)
Sampling and Analysis Plan for U. S. DOE LM Sites

Sampling Frequencies for Locations at Salmon, Mississippi

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
On-Site						
Source Area 1						
SA1-1-H			X			
SA1-2-H			X			
SA1-3-H			X			
SA1-4-H			X			
SA1-5-H			X			
SA1-6-H			X			
SA1-7-H			X			
SA1-12-H			X			
HMH-5R			X			
HMH-16R			X			
HM-S			X			
SA1-8-L			X			
HM-L			X			
HM-1			X			
HM-2A			X			
HM-2B			X			
HM-3			X			
SA1-11-3			X			
Source Area 2						
SA2-1-L			X			
SA2-2-L			X			
SA2-4-L			X			
Source Area 3						
SA3-4-H			X			
E-7			X			
SA3-11-3			X			
Source Area 4						
HM-L2			X			
SA4-5-L			X			
Source Area 5						
SA5-4-4			X			
SA5-5-4			X			

Sampling Frequencies for Locations at Salmon, Mississippi

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Surface Locations						
On-Site						
HALFMOON CREEK			X			
HALFMOONCRK OVERFLOW			X			
Pond west of GZ			X			
REECo Pit (A)			X			
REECo Pit (B)			X			
REECo Pit (C)			X			
Grantham Ck Entry			X			
Half Moon Ck Entry			X			
Hick Hollow Ck Entry			X			
Half Moon Ck Exit			X			
Off-Site						
HickHCrTSD-East			X			Hickory Hollow Creek where it exits under the east side of Tatum Salt dome road

Sampling conducted in April

Constituent Sampling Breakdown

Site	Salmon				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	28	11			
Field Measurements					
Alkalinity					
Dissolved Oxygen	X				
Redox Potential	X				
pH	X	X			
Specific Conductance	X	X			
Turbidity	X				
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Antimony					
Arsenic	Selected wells only	Selected locations only	0.0001	SW-846 6020	LMM-02
Barium	Selected wells only	Selected locations only	0.1	SW-846 6010	LMM-01
Beryllium					
Cadmium					
Calcium					
Chromium	Selected wells only	Selected locations only	0.002	SW-846 6010	LMM-01
Gamma Spec	Selected wells only	Selected locations only	10 pCi/L	Gamma Spectrometry	GAM-A-001
Gross alpha/Gross beta	Selected wells only	Selected locations only	2/4	Gas proportional counter	GPC-A-001
Iron					
Lead	Selected wells only	Selected locations only	0.002	SW-846 6020	LMM-02
Magnesium					
Manganese					
Mercury					
Molybdenum					
Nickel					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Selenium					
Silver					
Sodium					
Sulfate					
Tritium	X	X	400 pCi/L	Liquid Scintillation	LSC-A-001
Tritium, enriched	25% of the samples	25% of the samples	10 pCi/L	Liquid Scintillation	LMR-15
Uranium					
Vanadium					
VOCs	Selected wells only		0.001	SW-846 8260, Low Level	LMV-05
Zinc					
Total No. of Analytes	9	8			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Sherwood, Washington

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
MW-2B			X			
MW-4			X			
MW-10			X			
P1					X	Water level only
P2					X	Water level only
P3					X	Water level only
P4					X	Water level only

Sampling conducted in July

Constituent Sampling Breakdown

Site	Sherwood				
Analyte	**Groundwater**	**Surface Water**	**Required Detection Limit (mg/L)**	**Analytical Method**	**Line Item Code**
Approx. No. Samples/yr	3	0			
Field Measurements					
Alkalinity					
Dissolved Oxygen					
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium					
Chloride	X		0.5	SW-846 9056	MIS-A-039
Chromium					
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum					
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Radium-226					
Radium-228					
Selenium					
Silica					
Sodium					
Strontium					
Sulfate	X		0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids	X		10	SM2540 C	WCH-A-033
Total Organic Carbon					
Uranium					
Vanadium					
Zinc					
Total No. of Analytes	3	0			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Shiprock, New Mexico

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
FLOODPLAIN - SHP01						
608		X				Low flow
610		X				
611		X				
612		X				
614		X				Low flow
615		X				Low flow
617					X	Data logger only
618		X				Low flow
619		X				Low flow
622		X				
623		X				
625		X				
626		X				
628		X				
630		X				
734		X				Low flow
735		X				Low flow
736		X				Low flow; data logger
766		X				
768		X				
773		X				
775		X				
779		X				
782R		X				
783R		X				
792		X				
793		X				
797		X				Low flow
798		X				
850		X				Low flow
853		X				
854		X				Data logger
855		X				
856		X				
857		X				Data logger
862					X	WLs only
863					X	WLs only
1000					X	WLs only
1001					X	WLs only
1008		X				Data logger
1009		X				
1062					X	WLs only
1089		X				U, SO4, N as NO3 only at vault
1104		X				U, SO4, N as NO3 only at vault
1105		X				
1109		X				Trench 2; U, SO4, N as NO3 only at vault
1110		X				Trench 1; U, SO4, N as NO3 only at vault
1111		X				Well point; U, SO4, N as NO3 only. Purge 1 casing vol then sample

Sampling Frequencies for Locations at Shiprock, New Mexico

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
FLOODPLAIN - SHP01						
1112		X				Well point; U, SO4, N as NO3 only. Purge 1 casing vol then sample
1113		X				Well point; U, SO4, N as NO3 only. Purge 1 casing vol then sample
1114		X				Well point; U, SO4, N as NO3 only. Purge 1 casing vol then sample
1115		X				Well point; U, SO4, N as NO3 only. Purge 1 casing vol then sample
1117		X				Well point; U, SO4, N as NO3 only. Purge 1 casing vol then sample
1128		X				
1132		X				
1134		X				
1135		X				
1136		X				
1137		X				
1138		X				
1139		X				
1140		X				
1141		X				
1142		X				
1143		X				
TERRACE - SHP02						
600		X				
602		X				Data logger
603		X				
604		X				Data logger
648				Odd year		Measure flow rate semiannually; sample biennially; next in 2013
725		X				Data logger
726		X				
727		X				
728		X				Data logger
730		X				Data logger
731		X				Data logger
800					X	WLs only
801					X	WLs only
802					X	WLs only
803					X	WLs only
812		X				
813		X				Data logger
814		X				
815		X				
816		X				
817		X				Low flow
818		X				Ext. well; U, SO4, N as NO3 only at vault
819		X				Data logger
820		X				
821		X				
822		X				
823		X				

Sampling Frequencies for Locations at Shiprock, New Mexico

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
TERRACE - SHP02						
824		X				
825		X				
826		X				Data logger
827		X				Data logger
828		X				Data logger
829		X				
830		X				Data logger
832		X				Low flow
833		X				
835		X				Low flow; data logger
836		X				Low flow; data logger
837		X				Data logger
838		X				Low flow
841		X				Low flow; data logger
843		X				Data logger
844		X				
846		X				Low flow; data logger
848		X				Data logger
1002		X				
1003		X				
1004		X				
1007		X				
1011		X				
1048		X				
1049		X				
1057		X				
1058		X				
1059		X				
1060		X				Low flow; data logger
1067					X	WL only; Bob Lee Wash
1068		X				Bob Lee Wash
1069		X				Bob Lee Wash; data logger
1070		X				Ext. well; U, SO4, N as NO3 only at vault
1071		X				Ext. well; U, SO4, N as NO3 only at vault
1073		X				Data logger
1074		X				
1078		X				Ext. well; U, SO4, N as NO3 only at vault
1079		X				Low flow
1087		X				SUMP-Bob Lee Wash
1088		X				SUMP-Many Devils Wash
1091		X				Ext. well; U, SO4, N as NO3 only at vault
1092		X				Ext. well; U, SO4, N as NO3 only at vault
1093R		X				Ext. well; U, SO4, N as NO3 only at vault
1095		X				Ext. well; U, SO4, N as NO3 only at vault
1096		X				Ext. well; U, SO4, N as NO3 only at vault
1120		X				
1122		X				
MW1		X				
DM7		X				

Sampling Frequencies for Locations at Shiprock, New Mexico

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Surface Locations						
FLOODPLAIN - SHP01						
501		X				East of disposal cell
655		X				Drainage channel
887		X				Distributary channel
897		X				Just below mouth of Many Devils Wash
898		X				San Juan River upgradient
899		X				
937		X				
938		X				
939		X				
940		X				Just NE of 1004, San Juan River
956		X				San Juan River at intake
959		X				Distributary channel just below 1st wash
965		X				San Juan River about 1500' below dist. Channel
1118		X				Seep sump (423/426) U, SO4, N as NO3 only at vault
1203		X				East of disposal cell
1205		X				San Juan River E of well 853
TERRACE - SHP02						
662		X				Lower Bob Lee Wash
786		X				Seep below US Hwy 491 bridge; FLOW RATE
884		X				Irrigation return flow
885		X				Upper Bob Lee Wash; water level
889		X				Many Devils Wash
933		X				1st wash W of Highway 491
934		X				2nd wash W of Highway 491
936		X				Seep between 1st & 2nd washes
942		X				Pond NW of 847
949		X				
958		X				Helium lateral canal where water comes into canal at pump station
1215		X				
1218		X				NEW LOCATION
1219		X				NEW LOCATION
1220		X				NEW LOCATION
1221		X				NEW LOCATION

Sampling conducted in March and September

NOTE: All San Juan River locations will have both filtered and unfiltered samples collected

Constituent Sampling Breakdown

Site	Shiprock				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	244	56			
Field Measurements					
Alkalinity	X	X			
Dissolved Oxygen					
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X	X			
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)	X	X	0.1	EPA 350.1	WCH-A-005
Calcium	X	X	5	SW-846 6010	LMM-01
Chloride	X	X	0.5	SW-846 9056	MIS-A-039
Chromium					
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium	X	X	5	SW-846 6010	LMM-01
Manganese	X	X	0.005	SW-846 6010	LMM-01
Molybdenum					
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N	X	X	0.05	EPA 353.1	WCH-A-022
Potassium	X	X	1	SW-846 6010	LMM-01
Radium-226					
Radium-228					
Selenium	X	X	0.0001	SW-846 6020	LMM-02
Silica					
Sodium	X	X	1	SW-846 6010	LMM-01
Strontium	X	X	0.2	SW-846 6010	LMM-01
Sulfate	X	X	0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Uranium	X	X	0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	12	12			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Shirley Basin South, Wyoming

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
100-SC			X			
101-SC			X			
102-SC			X			
110-DC			X			
112-DC			X			
113-DC			X			
40-SC			X			
5-SC			X			
51-SC			X			
54-SC			X			
10-DC			X			
5-DC			X			
19-DC			X			
K.G.S.#3			X			

Sampling conducted in June

Constituent Sampling Breakdown

Site	Shirley Basin South				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	14	0			
Field Measurements					
Alkalinity					
Dissolved Oxygen					
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Cadmium	X		0.001	SW-846 6020	LMM-02
Calcium					
Chloride	X		0.5	SW-846 9056	MIS-A-039
Chromium	X		0.005	SW-846 6010	LMM-01
Gross Alpha					
Gross Beta					
Iron					
Lead	X		0.002	SW-846 6020	LMM-02
Magnesium					
Manganese					
Molybdenum					
Nickel	X		0.02	SW-846 6010	LMM-01
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N	X		0.05	EPA 353.1	WCH-A-022
Potassium					
Radium-226	X		1 pCi/L	Gas Proportional Counter	GPC-A-018
Radium-228	X		1 pCi/L	Gas Proportional Counter	GPC-A-020
Selenium	X		0.0001	SW-846 6020	LMM-02
Silica					
Sodium					
Strontium					
Sulfate	X		0.5	SW-846 9056	MIS-A-044
Sulfide					
Thorium-230	X		1 pCi/L	Alpha Specrtrometry	ASP-A-008
Total Dissolved Solids	X		10	SM2540 C	WCH-A-033
Total Organic Carbon					
Uranium	X		0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	13	0			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Program Directive
Project Shoal Area, Nevada

Activities Groundwater Monitoring **Directive No.** SHL-2013-01

Initiated By: Sam Campbell

Directive Subject: Miscellaneous Sampling Activities

Directive and Associated Task Changes:

1. Samples will be collected from wells HC-4, HC-5, HC-7, HC-8, MV-1, MV-2, and MV-3 using the dedicated high-flow submersible pump after one well casing volume has been purged and field parameters have stabilized (i.e. pH within 0.2 units and conductivity/temperature within 10% over final 3 readings). A minimum of three field parameter readings will be taken during the final 100 gallons of purging.
2. Samples will be collected from the screen interval of wells HC-1, HC-2, HC-3, and HC-6 using a depth-specific bailer.

Organization(s) Affected: Environmental Monitoring Operations, Projects/Programs.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites (SAP)* (LMS/PLN/S04351-xx, current version).

Justification for Directive:

The current dedicated pump configuration is designed for high-flow sampling, and the SAP does not address high-flow sampling. Wells listed in item 2 above do not have a pump installed, so a depth-specific bailer is currently the only option for a sampling device because of the depth to water in these wells. Utilization of the specific purging and sampling methods will continue because it's consistent with the sample collection process historically used at the site.

Review and Concurrence:

Rick Hutton
2012.09.27 10:25:32 -06'00'

Rick Hutton, Nevada Off-Sites Project Manager

Rick C Findlay
2012.09.18 09:51:25 -06'00'

Rick Findlay, Project Technical Lead

Digitally signed by Linda S. Tegelman
Date: 2012.09.27 11:15:41 -06'00'

Linda Tegelman, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell, Environmental Monitoring Operations Manager

10/8/2012
Date

Effective Date: 10/01/2012 **Expiration Date:** 9/30/2014

Distribution: rc-nevada (ADM 130.10)
Sampling and Analysis Plan for U. S. DOE LM Sites

Sampling Frequencies for Locations at Shoal, Nevada

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
H-2					X	Download transducers
H-3					X	Download transducers
HC-1			X			Download transducers
HC-2			X			Download transducers
HC-3			X			Download transducers
HC-4			X			Download transducers
HC-5			X			Download transducers
HC-6			X			Download transducers
HC-7			X			Download transducers
HC-8			X			Download transducers
MV-1			X			Download transducers
MV-2			X			Download transducers
MV-3			X			Download transducers
Piezometers						
MV-1PZ					X	Download transducers
MV-2PZ					X	Download transducers
MV-3PZ					X	Download transducers

Sampling conducted in March

Constituent Sampling Breakdown

Site	Shoal Site				
Analyte	**Groundwater**	**Surface Water**	**Required Detection Limit (mg/L)**	**Analytical Method**	**Line Item Code**
Approx. No. Samples/yr	11				
Field Measurements					
Alkalinity	X				
Dissolved Oxygen	X				
Redox Potential	X				
pH	X				
Specific Conductance	X				
Turbidity	X				
Temperature	X				
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Bromide					
Calcium					
Carbon-14					
Chloride					
Chromium					
Gamma Spec					
Gross Alpha	X		2 pCi/L	EPA 900.0	GPC-A-001
Gross Beta					
Iodine-129					
Iron					
Lead					
Magnesium					
Manganese					
Molybdenum					
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N					
Potassium					
Radium-226					
Radium-228					
Selenium					
Silica					
Sodium					
Strontium					
Sulfate					
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Tritium	X		400 pCi/L	Liquid Scintillation	LSC-A-001
Tritium, enriched					
Uranium-234, -235, -238	X		1 pCi/L	Alpha Spectrometry	ASP-A-024
Uranium	X		0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	4	0			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Sampling Frequencies for Locations at Slick Rock, Colorado

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
WEST						
317			X			
318A			X			
319			X			
320			X			
339			X			
340			X			
508			X			
510			X			
684			X			
EAST						
300			X			
303			X			
305			X			
307			X			
309			X			
310			X			
311			X			
312			X			
Surface Locations						
WEST						
347			X			
349			X			
693			X			
694			X			
EAST						
692			X			
696			X			
700			X			

Sampling conducted in September

Constituent Sampling Breakdown

Site	Slick Rock				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	14	7			
Field Measurements					
Alkalinity	X	X			
Dissolved Oxygen					
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X	X			
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Calcium					
Chloride					
Chromium					
Gross Alpha					
Gross Beta					
Iron					
Lead					
Magnesium					
Manganese	0318A, 0320, 0339, 0340, 0508, 0510, 0684	0347, 0349, 0693, 0694	0.005	SW-846 6010	LMM-01
Molybdenum	0317, 0318A, 0320, 0339, 0340, 0508, 0510, 0684	0347, 0349, 0693, 0694	0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N	0318A, 0320, 0339, 0340, 0508, 0510, 0684	0347, 0349, 0693, 0694	0.05	EPA 353.1	WCH-A-022
Potassium					
Radium-226	0319		1 pCi/L	;as Proportional Counte	GPC-A-018
Radium-228	0319		1 pCi/L	;as Proportional Counte	GPC-A-020
Selenium	0305, 0307, 0317, 0318A, 0319, 0320, 0339, 0340, 0508, 0510, 0684	0347, 0349, 0693, 0694	0.0001	SW-846 6020	LMM-02
Silica					
Sodium					
Strontium					
Sulfate					
Sulfide					
Total Dissolved Solids					
Total Organic Carbon					
Uranium	0303, 0305, 0307, 0309, 0310, 0311, 0312, 0318A, 0320, 0339, 0340, 0508, 0510, 0684	X	0.0001	SW-846 6020	LMM-02
Vanadium					
VOCs (BETX)	0319 only		0.005	SW-846 8260	VOA-A-009
Zinc					
Total No. of Analytes	8	5			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Program Directive
Tuba City, Arizona

Activities Surface Water Sampling **Directive No.** TUB-2013-01

Initiated By: Sam Campbell

Directive Subject: Sampling of the Tuba City Evaporation Pond

Directive and Associated Task Changes:

Samples will be collected from the evaporation pond using the following protocol. Sampling crews will not cross the radiological control boundary when sampling. Samples will be collected through dedicated tubing installed in the pond and secured to a post that forms the boundary of the radiological control area. A peristaltic pump will be used to pump water from the pond and through a 0.45 micron disposable filter prior to collecting samples or making field measurements. Filtration is required regardless of pond turbidity in order to control solids pumped from the pond. Because all water is filtered, turbidity measurements will not be made. After completion of sampling, the filter will be placed in a sealable plastic bag and stored in the site RMA because of it may contain solids from the pond. Excess water pumped while taking field measurements will be returned to the pond by directing the discharge from the flow-cell down the pond liner.

Organization(s) Affected: Environmental Monitoring Operations, Projects/Programs.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351-xx, current version).

Justification for Directive:

This protocol is necessary because the evaporation pond is designated as a radiological area and the solids in the pond are the primary radiological concern. This directive provides a direction to sample water from the pond (not a radiological concern) while managing the solids (radiological concern) that may potentially removed from the pond.

Review and Concurrence:

10-2-2012

Andria Dutcher, Health and Safety Lead

9/20/12

Scott Smith, Site Manager

Digitally signed by Linda S. Tegelman
Date: 2012.10.02 12:18:04 -06'00'

Linda Tegelman, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell
2012.09.26 08:23:51 -06'00'

Sam Campbell, Environmental Monitoring Operations Manager

Date

Effective Date: 10/1/2012 **Expiration Date:** 9/30/2014

Distribution: re-grand junction (ADM 130.10)
Sampling and Analysis Plan for U. S. DOE LM Sites

Sampling Frequencies for Locations at Tuba City, Arizona

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
251		X				
252		X				
258		X				
261			X			August
262		X				
263		X				
264		X				
265		X				
266		X				
267		X				
268		X				
271			X			August
272		X				
273		X				
274		X				
275		X				
276		X				
277			X			August
278			X			August
279			X			August
280			X			August
281		X				
282		X				
283		X				
284					X	Water level only
285					X	Water level only
286		X				
287		X				
288		X				
289		X				
290		X				
683			X			August
684			X			August
685			X			August
686			X			DATA LOGGER; August
687			X			DATA LOGGER; August
688			X			DATA LOGGER; August
689			X			August
690			X			August
691		X				
692			X			August
695			X			August
901			X			August
902					X	Water level only
903			X			August
904			X			August
906		X				DATA LOGGER
908		X				DATA LOGGER
909		X				DATA LOGGER

Sampling Frequencies for Locations at Tuba City, Arizona

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
910			X			August
911			X			August
912			X			August
913			X			August
914			X			August
915			X			August
916			X			August
917					X	Water level only
918					X	Water level only
919					X	Water level only
920			X			August
921			X			August
929		X				
930		X				
932		X				
934		X				DATA LOGGER
935		X				Converted to extraction well 7/05
936		X				DATA LOGGER
938		X				Converted to extraction well 7/05
940		X				DATA LOGGER
941		X				DATA LOGGER
942		X				DATA LOGGER
943			X			DATA LOGGER; August
945			X			August
946			X			DATA LOGGER; August
947			X			August
948					X	Water level only
1003			X			August
1004			X			August
1005					X	Water level only
1006			X			August
1007			X			August
1008					X	Water level only
1101			X			August
1102			X			August
1103			X			August
1104			X			August
1105			X			August
1106			X			August
1107			X			August
1108			X			August
1109			X			August
1110			X			August
1111			X			August
1112			X			August
1113			X			August
1114			X			August
1115			X			August
1116			X			August

Sampling Frequencies for Locations at Tuba City, Arizona

Location ID	Quarterly	Semiannually	Annually	Biennially	Not Sampled	Notes
Monitoring Wells						
1117			X			August
1118			X			August
1119			X			August
1120			X			August
1121			X			August
1122			X			August
1123			X			August
1124			X			August
1125			X			August
1126			X			August
1127			X			August
1128			X			August
1129			X			August
1130			X			August
1131			X			August
1132			X			August
1133			X			August
NMW-1A		X				Added by T. Bartlett 1/24/12
NMW-6S		X				Added by T. Bartlett 1/24/12
NMW-7D		X				Added by T. Bartlett 1/24/12
NMW-8S		X				Added by T. Bartlett 1/24/12
NMW-9D		X				Added by T. Bartlett 1/24/12
Surface Locations						
759			X			August; Moenkopi wash-downgradient
778			X			August; Moenkopi wash-at Jimmy Spring
965			X			August; Moenkopi wash-far upgradient
1205		X				Treatment system distillate; verify location with system operators
1569		X				Evap pond - North
1570		X				Evap pond - South
1571			X			Jimmy Spr West - August
1573			X			West pipe Shonto Well - August
Treatment System Locations						
1202		X				
1205		X				Treatment system distillate; verify location with system operators
1206		X				

Semi-annual sampling conducted in February and August; Annual sampling conducted in August.

Constituent Sampling Breakdown

Site	Tuba City				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	143	9			
Field Measurements					
Alkalinity	X	X			
Dissolved Oxygen					
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X				
Temperature	X	X			
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)	X		0.1	EPA 350.1	WCH-A-005
Arsenic	X	X	0.0001	SW-846 6020	LMM-02
Calcium	X	X	5	SW-846 6010	LMM-01
Chloride	X	X	0.5	SW-846 9056	WCH-A-039
Chromium					
Gross Alpha					
Gross Beta					
Iron	X	X	0.05	SW-846 6020	LMM-02
Lead					
Magnesium	X	X	5	SW-846 6010	LMM-01
Manganese	X	X	0.005	SW-846 6010	LMM-01
Molybdenum	X	X	0.003	SW-846 6020	LMM-02
Nickel					
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N	X	X	0.05	EPA 353.1	WCH-A-022
Potassium	X	X	1	SW-846 6010	LMM-01
Radium-226					
Radium-228					
Selenium	X	X	0.0001	SW-846 6020	LMM-02
Silica	X		0.2	SW-846 6010	LMM-01
Sodium	X	X	1	SW-846 6010	LMM-01
Strontium					
Sulfate	X	X	0.5	SW-846 9056	MIS-A-044
Sulfide					
Total Dissolved Solids	X	X	10	SM2540 C	WCH-A-033
Total Organic Carbon					
Uranium	X	X	0.0001	SW-846 6020	LMM-02
Vanadium					
Zinc					
Total No. of Analytes	16	14			

Note: All private well samples are to be unfiltered. The total number of analytes does not include field parameters.

Program Directive
Weldon Spring Site

Activities Groundwater Monitoring **Directive No.** WEL-2013-01

Initiated By: Sam Campbell

Directive Subject: Sampling Activities

Directive and Associated Task Changes:

1. Purging and sampling at RMW wells will be accomplished using a high-flow method rather than a low-flow method. Samples will be collected from wells RMW-1, RMW-2, RMW-3 and RMW-4 with dedicated submersible pumps after one well casing volume has been purged and field parameters have stabilized (i.e., pH within 0.2 units and specific conductance within 10% over final 3 readings and turbidity less than 10 NTU for the last reading).
2. Filtration of samples will be accomplished as follows: Samples collected for dissolved iron analysis at the 1000 series and RMW wells at the quarry will be filtered at the time of collection through a 0.45 µm pore-size filter. All other sample collection will be conducted without filtration regardless of sample turbidity.

Organization(s) Affected: Environmental Monitoring Operations, Programs and Projects.

Affected Documents: *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351-xx, current version).

Justification for Directive:

1. The sampling method for the RMW wells is consistent with historical sampling events. The current dedicated pump configuration is designed for high-flow sampling and does not allow for low-flow sampling.
2. Modification of filtration criterion is needed to be consistent with the Weldon Spring Long-Term Surveillance and Maintenance Plan and data quality objectives at the site.

Review and Concurrence:

Randy Thompson, Weldon Spring Site Manager

Rebecca Cato, Site Hydrologist

Michael B. Hoge
2012.09.19 16:09:44 -04'00'

Mike Hoge, Quality and Performance Assurance

Issuing Manager Approval:

Sam Campbell
2012.09.27 07:37:25 -06'00'

Sam Campbell, Environmental Monitoring Operations Manager Date

Effective Date: 10/1/2012 **Expiration Date:** 9/30/2014

Distribution: rc-weldon.spring (ADM 130.10)
Sampling and Analysis Plan for U. S. DOE LM Sites

Sampling Frequencies for Locations at Weldon Spring, Missouri

Location ID	Bi-Monthly	Quarterly	Semiannually	Annually	Not Sampled	Notes
Quarry Monitoring Wells						
MW-1002			X			
MW-1004			X			
MW-1005			X			
MW-1006		X				
MW-1007		X				
MW-1008		X				
MW-1009		X				
MW-1012		X				
MW-1013		X				
MW-1014		X				
MW-1015		X				
MW-1016		X				
MW-1017			X			
MW-1018		X				
MW-1019			X			
MW-1021			X			
MW-1027		X				
MW-1028		X				
MW-1030		X				
MW-1031		X				
MW-1032		X				
MW-1044		X				
MW-1045		X				
MW-1046		X				
MW-1047		X				
MW-1048		X				
MW-1049		X				
MW-1050			X			
MW-1051		X				
MW-1052		X				
RMW1				X		
RMW2				X		
RMW3				X		
RMW4				X		
Chemical Plant Monitoring Wells						
MW-2001					X	Water level only
MW-2002					X	Water level only
MW-2003					X	Water level only
MW-2005					X	Water level only
MW-2006					X	Water level only
MW-2012			X			
MW-2013					X	Water level only
MW-2014			X			
MW-2017				X		
MW-2021				X		
MW-2022				X		
MW-2023				X		

Sampling Frequencies for Locations at Weldon Spring, Missouri

Location ID	Bi-Monthly	Quarterly	Semiannually	Annually	Not Sampled	Notes
Chemical Plant Monitoring Wells						
MW-2032				X		Disposal Cell Monitoring Well
MW-2033					X	Water level only
MW-2034					X	Water level only
MW-2035				X		
MW-2036					X	Water level only
MW-2037					X	Water level only
MW-2038			X			
MW-2039					X	Water level only
MW-2040			X			
MW-2046			X			Disposal Cell Monitoring Well
MW-2047			X			Disposal Cell Monitoring Well
MW-2049					X	Water level only
MW-2050				X		
MW-2051				X		Disposal Cell Monitoring Well
MW-2052			X			
MW-2053			X			
MW-2054			X			
MW-2055			X			Disposal Cell Monitoring Well
MW-2056				X		
MW-3003			X			
MW-3006			X			U - bimonthly
MW-3023					X	Water level only
MW-3024	X					U - bimonthly
MW-3025					X	Water level only
MW-3026					X	Water level only
MW-3027					X	Water level only
MW-3028					X	Water level only
MW-3029					X	Water level only
MW-3030	X					U - bimonthly
MW-3031			X			U - semiannual
MW-3034			X			
MW-3037			X			
MW-3038					X	Water level only
MW-3039			X			
MW-3040	X					U - bimonthly
MW-4001					X	Water level only
MW-4006					X	Water level only
MW-4007				X		U - bimonthly
MW-4011					X	Water level only
MW-4013			X			
MW-4014				X		
MW-4015				X		
MW-4020					X	Water level only
MW-4022				X		
MW-4023				X		
MW-4026			X			
MW-4027					X	Water level only
MW-4028					X	Water level only

Sampling Frequencies for Locations at Weldon Spring, Missouri

Location ID	Bi-Monthly	Quarterly	Semiannually	Annually	Not Sampled	Notes
Chemical Plant Monitoring Wells						
MW-4029			X			
MW-4030					X	Water level only
MW-4031			X			
MW-4032					X	Water level only
MW-4033					X	Water level only
MW-4036			X			U - bimonthly
MW-4037					X	Water level only
MW-4038					X	Water level only
MW-4039			X			
MW-4040	X					U - bimonthly
MW-4041			X			U - bimonthly
MW-4042			X			U - bimonthly
MW-4043	X					U - bimonthly
MWD-2	X		X			U - bimonthly
MWS-1			X			U - bimonthly
MWS-2	X					U - bimonthly
MWS-4			X			U - bimonthly
Springs						
SP-5303		X				
SP-5304		X				
SP-6201	X					U - bimonthly
SP-6301		X				U - bimonthly
SP-6303		X		X		
Surface Water						
SW-1003		X				
SW-1004		X				
SW-1005		X				
SW-1010		X				
SW-2004				X		
SW-2005				X		
SW-2007			X			
SW-2012				X		
SW-2016				X		
SW-2024				X		
Disposal Cell Leachate						
LW-DC10	X		X			Sampling dependant on leachate volume/hauling
LW-DC12	X					Sampling dependant on leachate volume/hauling

Constituent Sampling Breakdown

Site	Weldon Spring				
Analyte	Groundwater	Surface Water	Required Detection Limit (mg/L)	Analytical Method	Line Item Code
Approx. No. Samples/yr	231	22			
Field Measurements					
Alkalinity					
Dissolved Oxygen	X	X			
Redox Potential	X	X			
pH	X	X			
Specific Conductance	X	X			
Turbidity	X				
Temperature	X	X			
Ferrous Iron	108			HACH	
Laboratory Measurements					
Aluminum					
Ammonia as N (NH3-N)					
Antimony					
Arsenic	16		0.0001	SW-846 6020	LMM-02
Barium	16		0.1	SW-846 6010	LMM-01
Boron					
Beryllium					
Bromide					
Cadmium					
Calcium					
Chloride	2		0.5	SW-846 9056	MIS-A-039
Chromium	16		0.002	SW-846 6010	LMM-01
Cobalt	2		0.05	SW-846 6010	LMM-01
Chemical Oxygen Demand	4		5	EPA 410.4	WCH-A-010
Copper	2		0.025	SW-846 6010	LMM-01
Fluoride	2		0.5	SW-846 9056	MIS-A-040
Gamma Spec					
Gross Alpha	2		2 pCi/L	EPA 900.0	GPC-A-001
Gross Beta					
Iron	112		0.05	SW-846 6010	LMM-01
Lead	16		0.002	SW-846 6020	LMM-02
Lead-210					
Magnesium					
Manganese	14		0.005	SW-846 6010	LMM-01
Mercury	2		0.0001	SW-846 7470	LMM-01
Molybdenum					
Nickel	16		0.02	SW-846 6010	LMM-01
Nickel-63					
Nitrate + Nitrite as N (NO3+NO2)-N	45		0.05	EPA 353.1	WCH-A-022
Nitroaromatics	87		0.00003	SW-846 8330	LMN-02
PAHs	16		0.005	SW-846 8310	LMS-02
PCBs	16		0.00005	SW-846 8082	PEP-A-006
Phosphate					
Polonium-210					
Potassium					
Radium-226	16		1 pCi/L	Gas Proportional Counter	GPC-A-018
Radium-228	16		1 pCi/L	Gas Proportional Counter	GPC-A-020
Selenium	16		0.0001	SW-846 6020	LMM-02
Silica					
Silver	2		0.001	SW-846 6020	LMM-02
Sodium					
Strontium					
Sulfate	106	16	0.5	SW-846 9056	MIS-A-044
Sulfide					
Thallium	14		0.004	SW-846 6020	LMM-02
Thorium, isotopic	14		1 pCi/L	Alpha Spectrometry	ASP-A-008
Tin					
Total Dissolved Solids	2		10	SM2540 C	WCH-A-033
Total Suspended Solids	2		5	SM2540 D	WCH-A-034
Total Organic Carbon	2		1	SM5310 B, C, D	WCH-A-025
Tritium					
Uranium-234, -238					
Uranium	227	23	0.0001	SW-846 6020	LMM-02
Vanadium					
VOCs	24		0.005	SW-846 8260	VOA-A-009
Zinc	2		0.02	SW-846 6010	LMM-01
Total No. of Analytes	31	2			

Note: All analyte samples are considered unfiltered unless stated otherwise. All private well samples are to be unfiltered. The total number of analytes does not include field parameters.