SAMPLING AND ANALYSIS PLAN

PREPARED FOR
2014 Groundwater Investigation
Fremont County, Pavillion, Wyoming
Wyoming Department of Environmental Quality
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PREPARED BY
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1. INTRODUCTION

This Sampling and Analysis Plan (SAP) describes procedures to be followed by Acton • Mickelson • Environmental, Inc. (AME), during collection of groundwater samples, and the methods to be utilized by the analytical laboratory. Sampling will be conducted in general accordance with procedures outlined in guidance documents from the Wyoming Department of Environmental Quality, Water Quality Division, Ground Water Section (WDEQ), the U.S. Geological Survey (USGS), the U.S. Environmental Protection Agency (EPA), and ASTM International.

2. OBJECTIVES

The objective of the work is to characterize water quality in the private water-supply wells listed in Table 1 with regard to water-quality standards or other parameters that might cause palatability or toxicity issues.

3. BACKGROUND

Pavillion is a town of 231 residents in west-central Wyoming, which became the subject of a EPA groundwater investigation in 2008 when residents contacted the EPA about smells, tastes, and adverse changes in the water quality of their domestic wells.

The EPA conducted sampling from March 2009 to April 2011, including:

- March 2009: Aqueous samples from 35 domestic and 2 municipal wells
- January 2010: Groundwater samples from 17 domestic, 4 stock, and 2 municipal wells
  - A filter sample from a reverse osmosis system
  - Surface-water and sediment samples from 5 locations along Five-Mile Creek
  - Gas and produced water/condensate samples from 5 production wells
  - Groundwater samples from 3 shallow monitoring wells
  - Soil samples near the perimeter of three known pit locations
- June 2010: Installation of 2 deep monitoring wells to differentiate potential deep versus shallow sources of groundwater contamination
  - September 2010: Gas samples from the well casings of MW01 and MW02
  - October 2010: Groundwater samples from MW01 and MW02 and 3 domestic wells
- April 2011: Resampling of MW01, MW02, and 8 domestic and 3 stock/irrigation wells

The EPA released the results of their sampling at a public meeting in November 2011, followed by a draft investigation report in December 2011. The draft report integrated multiple lines of reasoning to formulate the explanation that constituents associated with hydraulic fracturing were at least partially to blame for resident complaints about drinking-water quality.
Questions were subsequently raised about the methodology and interpretation of data in the draft report, leading to additional sampling by the EPA in the first half of 2012, a USGS investigation of the EPA investigation, multiple extensions of the public comment period on the draft report, and agreement by the EPA in June 2013 to forego finalization of their draft report in favor of further investigation by the State of Wyoming.

4. WATER SUPPLY WELL SAMPLING

4.1 Overview and Schedule

Private water-supply wells will be sampled twice: once near the beginning of the irrigation season and once near the end of the irrigation season. The first sampling event is scheduled for the second and third weeks of June 2014, and the second sampling event is scheduled for August 2014.

Access to sampling locations will be obtained by the WDEQ in advance using written access agreements.

4.2 Selection of Sampling Points

On May 21 and 22, 2014, AME personnel completed a reconnaissance of water-supply wells included in the sampling program. Information from the site reconnaissance for each proposed sampling location is provided in Table 1, which also includes summary information on the sampling point, wellhead configuration, and location for purge water discharge.

In general, sample locations were selected that meet the following characteristics:

- Upstream of the pressure tank, when present, unless otherwise noted
- Upstream of treatment systems or other equipment
- A spigot or frost-proof hydrant to which a fitting for sampling equipment may be attached, located in an accessible location

The sampling points for wells PGDW05, PGDW20, PGDW33, PGDW41A, and PGDW41B are located downstream of pressure tanks, and possibly the sampling point for PGW30. Wells PGDW41A and PDGD41B are connected to a manifold ahead of the sampling point, and controls to isolate the wells may not be accessible during sampling.

4.3 Groundwater Level Measurements

Groundwater level measurements will be obtained in advance of sampling at the well locations equipped with an access port at the top of the well casing, provided it is in an accessible location (Table 1). Since the wells are equipped with downhole pumps, piping, and cables, measurements will be made using an acoustic water level meter in accordance with the Standard Operating Procedure (SOP) for Groundwater Level Measurement, Acoustic Meter provided in Appendix A.
4.4 Supply Well Sampling

Groundwater samples will be collected from the locations listed in Table 1. In general, prior to sample collection, a minimum of three casing volumes will be purged from each well. In some instances, a portion of the purging may be accomplished by the owner operating the well during the 3-hour period prior to the scheduled sampling.

Field water-quality parameters will be measured during purging, and purging will continue until the parameters have stabilized. At some locations, due to the depth of the well and the pump capacity, the casing volume may be large enough that it may not be practical to purge three casing volumes and sample within a work day. In these instances, field water-quality parameters will be monitored for stability before three casing volumes are purged.

Once field water-quality-parameter measurements have stabilized, groundwater samples will be collected. To minimize atmospheric contact and potential ambient contamination, a dedicated sampling manifold made of non-contaminating materials (NCM) attached to the sampling point will be used to convey the groundwater into sample containers. Well purging, monitoring of field parameters, and sample collection will be performed in accordance with the SOP for Groundwater Sampling, Private Water Supply Well in Appendix A.

Field-parameter measurements and methods are listed in Table 2. In addition to the parameters commonly monitored for well purge stability criteria (temperature, specific conductance, pH, dissolved oxygen, and turbidity), field measurements will be obtained for oxidation-reduction potential, ferrous iron, and sulfide. Salinity will be reported based on specific conductance measurements. Table 2 includes summary information on the methodology and calibration notes.

In general, water-supply wells listed in Table 1 are expected to yield sufficient water to allow for purging of three casing volumes before sampling. Well PGDW05 reportedly has limited capacity, and if it runs dry it will be sampled after water levels recover in accordance with the SOP.

4.5 Field Quality Control Sampling

The primary samples and field quality-control samples are listed on Table 3. Quality-control samples will include field duplicates, field blanks, and matrix spike/matrix spike duplicate (MS/MSD) samples.

Field duplicates will be collected at a rate of approximately 20 percent. Wells selected for collection of field duplicate samples are those where the sampling point is ahead of the pressure tank, and where access was granted in advance of work planning. Field duplicate samples will be collected for the full suite of analytical parameters, following collection of the entire primary sample.

Field blanks will be collected at a rate of approximately 10 percent. Since dedicated equipment will be used to obtain the samples, field blanks will be analyzed for a subset of analytical parameters.
An MS/MSD sample will be obtained during each sampling event, consisting of a sample of triplicate volume. Sample containers will be filled in the same order as the primary samples.

Trip blanks will be included with each cooler shipped that contains samples for: volatile organic compounds (VOCs) by EPA Method 8260B, gasoline range organics (GRO) by EPA Method 8015D, and dissolved gases by RSK-SOP 175. Trip blanks will consist of sample containers filled with organic-free deionized water at the laboratory.

4.6 Sample Analysis, Preservation and Handling

Sample analyses, containers, preservatives, and holding times are listed in Table 4A by parameter group. Samples will be analyzed for dissolved gases, general chemistry (including major anions, alkalinity, nutrients, total dissolved solids), microorganisms, radiochemistry, semi-volatile organic compounds (SVOCs, including pesticides, herbicides, fungicides, and diesel range organics), stable isotopes (isotopes of methane, ethane, dissolved inorganic carbon, and dissolved nitrate), trace metals, and VOCs including volatile organic acids, glycols, and GRO. Sample analyses, containers, preservatives, and holding times are listed in order of sampling in Table 4B. The order is based upon USGS guidance (USGS 2009).

As noted in Section 4.4, samples will be collected using dedicated equipment constructed of NCM, specifically fluoropolymers and a polyethylene two-way hose fitting connected to the sampling point. This eliminates the need to decontaminate equipment in the field. Since dedicated sampling equipment will be used, field blanks will be obtained for a subset of parameters judged to be most susceptible to contamination from the sampling equipment or from ambient conditions. This includes microorganisms, VOCs, GRO, volatile organic acids, and SVOCs.

Trip blank samples will be analyzed for: VOCs by EPA Method 8260B, GRO by EPA Method 8015D, and dissolved gases by RSK-SOP 175.

Samples for dissolved organic and inorganic carbon, isotopes of carbon in dissolved inorganic carbon, and isotopes of nitrogen and oxygen in dissolved nitrate will be filtered using certified pre-cleaned 0.45 µm in-line filter cartridges fitted to the sample fill tubing.

Samples will be collected for both total and dissolved metals concentrations in groundwater, and thus one of two metals samples will be filtered in the field. In accordance with the WDEQ Quality Assurance and Project Plan, in the event that field turbidity readings remain above 20 nephelometric turbidity units, only filtered (i.e. dissolved) samples for trace metals will be collected.

Groundwater samples will be collected into certified-clean and pre-preserved containers provided by the laboratory. Only sample containers appropriate for the intended analyses will be used.

After sample collection, the samples will be sealed in sealable plastic bags and then placed into coolers with water ice. The internal temperatures of the coolers will be maintained at approximately 4 degrees Celsius. Samples will be kept in coolers during transport to the analytical laboratory. Samples for volatile constituents (VOCs by EPA Method 8260B, GRO by
EPA Method 8015D, and dissolved gases by RSK-SOP 175) will be placed in the same cooler as the trip blank samples.

When preparing coolers for shipment via common carrier, sample containers will be wrapped in plastic bubble wrap, and any void space in the cooler will be filled with bubble wrap or other inert packaging material to avoid container breakage.

5. FIELD MEASUREMENT PROCEDURES

5.1 General Parameters: Temperature, Specific Conductance, pH, Dissolved Oxygen, Turbidity, and Oxidation-Reduction Potential

Temperature, specific conductance, pH, dissolved oxygen turbidity, and oxidation-reduction potential measurements will be obtained in the field with a multi-parameter water-quality meter equipped with a flow-through cell throughout the purging of the well. Final field parameter readings will be reported along with laboratory analytical data. The method description and daily instrument-calibration notes are included in Table 2. Further details on calibration and maintenance are provided in the AME Quality Assurance Project Plan (QAPP).

5.2 Ferrous Iron

Ferrous iron will be measured in the field using a portable colorimeter. Samples will be obtained following completion of well purging and stabilization of field parameters. The method description is included in Table 2. Further details on calibration and maintenance are provided in the QAPP.

5.3 Sulfide

Sulfide will be measured in the field using a portable colorimeter by method SM 4500 S2-D. Samples will be obtained along with ferrous iron samples following completion of well purging and stabilization of field parameters. The method description is included in Table 2. Further details on calibration and maintenance are provided in the QAPP.

6. SAMPLE IDENTIFICATION AND SAMPLE CUSTODY

This section describes standard operating procedures for sample identification, sample custody, and custody documentation. Sample custody procedures are to be followed so that sample integrity is maintained during collection, transportation, and storage prior to analysis.

6.1 Field Sample Identification

A specific nomenclature will be used to identify all samples collected during the investigation as indicated below:
### Sampling and Analysis Plan

#### Sample Location Type

<table>
<thead>
<tr>
<th>Sample Matrix</th>
<th>Sample Type</th>
<th>Location Description on COC</th>
<th>Sample ID Format</th>
<th>Sample ID Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqueous</td>
<td>Primary Sample</td>
<td>Well ID</td>
<td>Well ID-Date</td>
<td>PGDW30-06172014</td>
</tr>
<tr>
<td></td>
<td>Field Duplicate</td>
<td>QAQC</td>
<td>Dupe-N-Date</td>
<td>Dupe-1-06172014</td>
</tr>
<tr>
<td></td>
<td>Field Blank</td>
<td>QAQC</td>
<td>FB-N-Date</td>
<td>FB-1-06172014</td>
</tr>
<tr>
<td></td>
<td>Trip Blank</td>
<td>QCTB</td>
<td>TB-N-Date</td>
<td>TB-1-06172014</td>
</tr>
</tbody>
</table>

**Notes:**
- **COC** = chain of custody
- **N** = Sequential integer assigned to each quality control sample per sampling event.
- Date is listed as whole numbers without slashes or dashes.

#### 6.2 Field Custody Procedures

A minimal number of individuals will handle samples. The field sampler is personally responsible for collection and custody of samples until they are transferred.

##### 6.2.1 Field Documentation

Each sample will be labeled immediately after collection. Sample-identification documents will be prepared so that identification and chain-of-custody records can be maintained and sample disposition can be controlled. Forms will be filled out with waterproof ink. The following sample identification documents will be utilized:

- Sample labels
- Field notes
- Chain-of-custody forms

##### 6.2.2 Sample Labels

Pre-printed sample labels will be provided. Where necessary, labels will be protected from water and solvents with clean label-protection tape. Each label will contain the following information:

- Sample ID
- AME project number
- Date and time of collection (time written by hand on pre-printed labels)
- Initials of collector
- Sample analysis
- Preservative (if any)
6.2.3 Field Notes

Information pertinent to a field survey, measurements, and/or sampling will be recorded in a bound notebook, on the daily field log, on log sheets, or on sampling forms. Notes should include the following:

- Name and title of author, date and time of entry, and physical/environmental conditions during field activity
- Location of sampling or measurement activity
- Name(s) and title(s) of field crew
- Type of sampled or measured media (e.g., soil, groundwater, or air)
- Sample collection or measurement method(s)
- Number and volume of sample(s) taken
- Number of sample containers
- Description of sampling point(s)
- Description of measuring reference points
- Date and time of collection or measurement
- Sample identification number(s)
- Sample preservative (if any)
- Sample distribution (e.g., laboratory)
- Field observations/comments
- Field measurements data (e.g., pH)

6.2.4 Chain-of-Custody Record

A chain-of-custody record will be filled out for and accompany every sample and shipment of samples to analytical laboratories in order to establish documentation necessary to trace sample possession from the time of collection. Records will contain the following information:

- Sample or station number or sample I.D.
- Signature of collector, sampler, or recorder
- Date and time of collection
- Place of collection
- Sample type
- Signatures of persons involved in the chain of possession
- Inclusive dates of possession

The laboratory portion of the form should be completed by laboratory personnel and will contain the following information:

- Name of person receiving the sample
- Laboratory sample number
- Date and time of sample receipt
- Analyses requested
- Sample condition and temperature
6.3 Sample Packing and Shipment

Samples will always be accompanied by a chain-of-custody record. When transferring samples to a courier or directly to sample receiving at a laboratory, individuals relinquishing and receiving samples will sign, date, and note the time on the chain-of-custody record.

When shipping samples by common carrier, the method of shipment, courier name(s), and other pertinent information will be entered in the chain-of-custody record, which will then be sealed in a waterproof plastic bag and placed on top of the shipping container.

Chain-of-custody seals will be affixed across the openings of shipping containers (e.g., across the front and back of their lids).

6.4 Corrections to Documentation

Original data recorded in field notes, chain-of-custody records, and other forms should be written in ink. These documents should not be altered, destroyed, or discarded, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made or found on a document, the individual making the corrections will do so by crossing a single line through the error, entering the correct information, and initialing and dating the change.

7. SAMPLE ANALYSES AND REPORTING

Sample analyses, containers, preservatives, holding times, and laboratories are listed in **Table 4A** by parameter group and in **Table 4B** by order sampled. Analyses for VOCs by EPA Method 8260B and SVOCs by EPA Method 8270D will include reporting of tentatively identified compounds.

Laboratory analytical reports will include electronic data deliverables for database upload. Data deliverables will be provided with Level IV quality assurance/quality control documentation. Further information on data assessment and management are provided in the QAPP.

8. EQUIPMENT DECONTAMINATION PROCEDURES

8.1 Use and Maintenance of Dedicated Sampling Equipment

Sample collection at each well will be accomplished using dedicated equipment consisting of a sampling manifold. Dedicated equipment will be stored in a sealable plastic bag labeled with a well identification number. Only equipment that does not contact samples (e.g., discharge line and flow totalizer) will be used at multiple locations.
8.2 Reusable Equipment

Field monitoring equipment (pH, conductivity, or temperature probes) will be rinsed with clean water prior to use and between samples.

9. REMARKS

This SAP represents our professional opinions, which are based in part on client-supplied and currently available information and are arrived at in accordance with accepted hydrogeologic and engineering practices at this time and location. Other than this, no warranty is implied or intended. This report was prepared solely for the use of our client. Any reliance on the information contained herein by third parties shall be at such parties’ sole risk.

10. REFERENCES


<table>
<thead>
<tr>
<th>Well ID</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Original Well Use</th>
<th>Well Status</th>
<th>Total Depth</th>
<th>Well Location and Surrounding Land Use</th>
<th>Sampling Point Description</th>
<th>Vault Depth Where Present</th>
<th>Well Head Description</th>
<th>Access Port</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD02</td>
<td>43.251542</td>
<td>-108.591198</td>
<td>Never used</td>
<td>Not used</td>
<td>610</td>
<td>Well is located near residence. Open access to well. Adjacent land use surrounding residence is agricultural use and farming equipment.</td>
<td>Sampling point is at well casing. Bailer or hydrosleeve could possibly be used for sample collection. No pump in well. No piping or pressure tank connected to well. Purge water discharged to ditch near well.</td>
<td>6-inch PVC casing with 6-inch PVC well cap. No pump in well. No piping from well.</td>
<td>Y</td>
<td>Well has never been in production because of odor. Well is not plumb which caused EPA downhole sampling pump to become stuck, leading to difficult removal. EPA used bailer to purge.</td>
<td></td>
</tr>
<tr>
<td>PGDW05</td>
<td>43.258851</td>
<td>-108.612630</td>
<td>Domestic supply</td>
<td>In use, low yield</td>
<td>210</td>
<td>Well is located within lawn adjacent to residence. Adjacent land use surrounding residence is agricultural and livestock use.</td>
<td>Well located in 7.5 feet deep vault (permit required confined space) in grass area approximately 20 feet E of house. Heavy concrete lid requires sturdy bar/tool for lifting/removal. Recommended sample spigot has 3/4-inch hose thread and is on outside N wall of W portion of house, immediately W of and below RainBird box. Sample spigot is downstream of pressure tank which are located under house. No recommended sampling point between well and pressure tank. Discharge purge water to grass area on NW side of house.</td>
<td>7-inch diameter metal casing. Pitless adapter with 1-inch pipe. Watertight seal that is removable. Top of well riser is near ground surface in vault and could be removed for video w/o entering vault.</td>
<td>N</td>
<td>Well is water supply to house. Owner said well has lost production capacity and runs dry. EPA sampled at wellhead by removing well cap and mechanically lifting pump and from faucet in mudroom. Coordinates for sample spigot are offset 10.5 feet to N of spigot.</td>
<td></td>
</tr>
<tr>
<td>PGDW14</td>
<td>43.251533</td>
<td>-108.627365</td>
<td>Domestic supply</td>
<td>190</td>
<td>Well is located in an 8-foot-deep concrete culvert vault (permit required confined space). Access to vault is a wooden door with metal ladder to vault bottom. Sampling point is a blue freezeless yard hydrant 4-feet NE of wellhead. Hydrant has 3/4-inch hose thread. No pressure tank or RO unit observed. Purge water to irrigate landscape trees and plants.</td>
<td>Well casing size, material, and exact location is uncertain (may be located under blue hardboard insulation in vault or in black plastic box outside of vault). Pitless adapter to metal piping manifold located in vault.</td>
<td>N</td>
<td>Hydrant was EPA sampling point. Original domestic well was west of residence.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PGDW20</td>
<td>43.251666</td>
<td>-108.591265</td>
<td>Domestic supply</td>
<td>Not used</td>
<td>380</td>
<td>Well is located near residence. Open access to well. Adjacent land use surrounding residence is agricultural use and farming equipment. Cow manure present on ground around well.</td>
<td>Sample point is a freezeless yard hydrant with 3/4-inch hose thread in corral located approximately 250 feet N of wellhead. Piping from well runs N for 15 feet to pumphouse containing RO unit and pressure tank and then further N for approximately 235 feet to the spigot. Well currently is not supplying sampling location (Cistern water currently supplies hydrant. Valves need to be adjust by owner prior to sampling). No sampling point prior to pressure tank unless installed by owner. Piping from well to spigot is black poly. Purge water discharged to ditch to N of spigot and fence.</td>
<td>5-inch metal casing. Pitless adapter that goes to pump house. Watertight well cap that is removable. No access port. Well is open hole completion with no slots.</td>
<td>N</td>
<td>Was used as domestic well for residence; however, cistern system was installed at residence (has RO system and pressure tank with booster pumps). Well original TD 410 feet collapsed to 380 feet. Hydrant was EPA sampling point. OWNER HAS TO ADJUST PUMPHOUSE VALVES PRIOR TO OUR SAMPLING. Horse manure in corral.</td>
<td></td>
</tr>
</tbody>
</table>
## TABLE 1

### SAMPLE LOCATIONS

<table>
<thead>
<tr>
<th>Well ID</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Original Use</th>
<th>Well Status</th>
<th>Total Depth</th>
<th>Well Location and Surrounding Land Use</th>
<th>Sampling Point Description</th>
<th>Vault Depth Where Present</th>
<th>Well Head Description</th>
<th>Access Port</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGDW23</td>
<td>43.248660</td>
<td>-108.622587</td>
<td>Domestic supply</td>
<td>In use</td>
<td>500 (175?)</td>
<td>Well is located near residence. Open access to well. Adjacent land use surrounding residence is agricultural use and property is sloped.</td>
<td>Well located in open area SW of house and adjacent to a metal tank. Sampling point is freezeless yard hydrant 5-feet from wellhead. Hydrant has 3/4-inch hose thread (was EPA sampling point). Sample point prior to pressure tank (pressure tank, if present, are likely located under house). Purge water to irrigate landscape trees and shrubs.</td>
<td>6-inch PVC casing. Pitless adapter goes to pressure tank under house. Has freezeless yard hydrant within 5-feet of wellhead. Has watertight well cap that is removable. There is no access port</td>
<td>N</td>
<td>Septic is located north of house.</td>
<td></td>
</tr>
<tr>
<td>PGDW30</td>
<td>43.257541</td>
<td>-108.622552</td>
<td>Domestic supply</td>
<td>Unknown</td>
<td>260</td>
<td>Well is located near residence in a shed. Limited access to well. Adjacent land use surrounding residence is agricultural and livestock use. Goat pen located near wellhead</td>
<td>Well is located in shed ENE of house. Well is in NW corner of shed in a closet. Closet has one open side allowing access (right) to wellhead. Spigot on outside W wall of shed was used as EPA sampling point and is sampling point. Spigot has 3/4-inch hose thread. Pressure tank located in shed between wellhead and spigot. Pressure tank can be bypassed so well can discharge direct to spigot. Another potential sampling point is in piping between well and pressure tank; this would require installation of a valve/spigot. Discharge purge water onto field E of well shed and E of fence.</td>
<td>6-inch PVC casing that is flush to surface, and is within a closet in a shed (limited access/close confines). No pitless adapter present. Traditional well seal. No access ports</td>
<td>N</td>
<td>Was a domestic water supply. Cistern now installed at residence.</td>
<td></td>
</tr>
<tr>
<td>PGDW32</td>
<td>43.246751</td>
<td>-108.594132</td>
<td>Domestic, stock</td>
<td>In use</td>
<td>900</td>
<td>Well is located near residence. Open access to well. There are two aboveground storage tanks (ASTs) used to fuel ranch vehicles near well. Adjacent land use surrounding residence is agricultural and livestock use.</td>
<td>Well located in SW corner of grass yard. Sampling point is red-handle freezeless yard hydrant approximately 100 feet NE of well. Hydrant has 3/4-inch hose thread. Sampling point before pressure tank, which are located under house to N of hydrant. Purge water to be discharged to grass in yard.</td>
<td>6-inch metal casing. Pitless adapter goes to pressure tank under house. Sampling point is before pressure tank (pressure tank located under house). Has a traditional well seal. Well seal has 3/4-inch access port.</td>
<td>Y</td>
<td>Hydrant was EPA sampling point.</td>
<td></td>
</tr>
<tr>
<td>PGDW33</td>
<td>43.238541</td>
<td>-108.596406</td>
<td>Domestic supply</td>
<td>In use</td>
<td>30</td>
<td>Well is located approximately 1200 feet away from residence. Access is limited. Adjacent land use surrounding well is agricultural and livestock use.</td>
<td>Well is located approximately 1200 feet SW of house within a pump house with a 4-foot deep vault. Sampling point in blue handle freezeless hydrant in grass yard approximately 50 feet SW of house. Sample point possible prior to pressure tank. Pressure tank and possible sampling point located in vault. Hydrant has 3/4-inch hose thread and possible sampling point in vault is 3/4-inch spigot. Hydrant sampling point is downstream of pressure tank. Purge water to be discharged to grass yard.</td>
<td>4 6-inch casing of unknown material (wellhead covered by metal cap). No pitless adapter present. Well has a single jet pump that is plumbed to pressure tank, then towards house. An access port to well could not be determined.</td>
<td>N</td>
<td>Hydrant was EPA sampling point.</td>
<td></td>
</tr>
<tr>
<td>Well ID</td>
<td>Latitude</td>
<td>Longitude</td>
<td>Original Use</td>
<td>Well Use</td>
<td>Well Status</td>
<td>Total Depth</td>
<td>Well Location and Surrounding Land Use</td>
<td>Sampling Point Description</td>
<td>Vault Depth Where Present</td>
<td>Well Head Description</td>
<td>Access Port</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>-------------</td>
<td>--------------</td>
<td>----------</td>
<td>-------------</td>
<td>-------------</td>
<td>----------------------------------------</td>
<td>------------------------------</td>
<td>----------------------------</td>
<td>------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>PGDW41A</td>
<td>43.262126</td>
<td>-108.637800</td>
<td>Domestic</td>
<td>Supply</td>
<td>Stock, irrigation</td>
<td>Unknown</td>
<td>Well located near residence. Originally was told there was a single well. Two wells were identified. Open access to well.</td>
<td>Well located 8 feet SW of vault (7 feet deep, permit required confined space) which contains pressure tanks and breakers. Sampling point is freeze-freezable yard Hydrant downstream of pressure tanks and adjacent to N wall of vault. Hydrant has 3/4-inch hose thread. Sample point possible prior to pressure tanks. Possible sampling point located in vault. Purge water to be discharged to ditch located W of horse corrall located W of the well.</td>
<td>7</td>
<td>7-foot vault houses pump breakers and pressure tanks from wells 41a and 41b. 6-inch PVC casing. Pitless adapter goes to vault containing breaker, valves, and pressure tanks. Has watertight well cap that is removable. There is no access port.</td>
<td>N</td>
</tr>
<tr>
<td>PGDW41B</td>
<td>43.262139</td>
<td>-108.637845</td>
<td>Domestic</td>
<td>Supply</td>
<td>Stock, irrigation</td>
<td>Unknown</td>
<td>Well located near residence. Originally was told there was a single well. Two wells were identified. Open access to well.</td>
<td>Well located 4 feet SW of vault (7 feet deep, permit required confined space) which contains pressure tanks and breakers. Sampling point is freeze-freezable yard Hydrant downstream of pressure tanks and adjacent to N wall of vault. Hydrant has 3/4-inch hose thread. Sample point possible prior to pressure tanks. Possible sampling point located in vault. Purge water to be discharged to ditch located W of horse corrall located W of the well.</td>
<td>7</td>
<td>7-foot vault houses pump breakers and pressure tanks from wells 41a and 41b. 8-inch PVC casing. Pitless adapter goes to vault containing breaker, valves, and pressure tanks. Has watertight well cap that is removable. There is no access port.</td>
<td>N</td>
</tr>
<tr>
<td>PGDW44</td>
<td>43.250277</td>
<td>-108.626442</td>
<td>Stock, irrigation</td>
<td>In use</td>
<td>750 Access to well is limited and would require partial removal of wood floor to access wellhead. Adjacent land use surrounding residence is agricultural use and property is sloped.</td>
<td>8 Well is located in an 8-foot deep concrete culvert vault (permit required confined space). Wellhouse is a metal tank. Sampling point is freeze-freezable yard Hydrant 10-feet N of wallhead (near fence). Hydrant has 3/4-inch hose thread. Sampling point before pressure tank. Purge water to irrigate landscape trees and plants.</td>
<td>8</td>
<td>9-inch diameter steel casing. Pitless adapter to black plastic piping manifold. No well cap or seal present (need to unscrew wood floor for access to well for open access to well). Pressure tank plumbed on opposite side of plastic manifold and is after sampling location.</td>
<td>Y</td>
<td>Former Shell exploratory well. Hydrant was EPA sampling point. Able to supply drinking water for 750 head of horses during summer.</td>
<td></td>
</tr>
<tr>
<td>PGDW45</td>
<td>43.258888</td>
<td>-108.612953</td>
<td>Stock, irrigation</td>
<td>In use</td>
<td>Unknown Well is located within lawn adjacent to residence. Adjacent land use surrounding residence is agricultural and livestock use.</td>
<td>Well is located within a vault. Sampling point is a 3/4-inch hose thread (Y adapter) spigot located in the piping approx. 10 N of the well. No pressure tank present. Well pumps directly to surface piping. Purge water to be discharged to grass areas around well and house.</td>
<td>8</td>
<td>6-inch PVC well casing. No pitless adapter. Traditional well seal. 3/4-inch access port.</td>
<td>Y</td>
<td>Irrigation well. Well access ports large enough for water level and video. Well cap can easily be removed.</td>
<td></td>
</tr>
<tr>
<td>PGDW49</td>
<td>43.255080</td>
<td>-108.618107</td>
<td>Stock supply</td>
<td>In use</td>
<td>50 Well is at location of livestock holding pen, and cow manure is present. Adjacent land use surrounding residence is agricultural and livestock use.</td>
<td>Well is within a large rubber tractor tire in a stock pen. Sampling point is a 3/4-inch hose thread spigot located immediately above the wellhead. No pressure tank present. Pumps directly to surface piping. Purge water to be discharged to agriculture field N of well.</td>
<td>6</td>
<td>6-inch metal well casing. No pitless adapter. Traditional well seal. 1/2-inch access port.</td>
<td>Y</td>
<td>Access port is too small for water level or video. Cow manure on ground around well.</td>
<td></td>
</tr>
</tbody>
</table>
**TABLE 1**

**SAMPLE LOCATIONS**

<table>
<thead>
<tr>
<th>Well ID</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Original Well Use</th>
<th>Well Status</th>
<th>Total Depth</th>
<th>Well Location and Surrounding Land Use</th>
<th>Vault Depth Where Present</th>
<th>Well Head Description</th>
<th>Access Port</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>60F</td>
<td>43.258881</td>
<td>-108.613004</td>
<td>Stock supply</td>
<td>Unknown</td>
<td></td>
<td>Well is located within a shed near livestock pens. Open access to well. Cow manure is present. Adjacent land use surrounding residence is agricultural and livestock use.</td>
<td>6-inch PVC well casing. No pitless adapter. Has pressure tank. Traditional well seal, 3/4-inch access port. Well is not in a vault.</td>
<td>Y</td>
<td>Cow manure on ground around wellhouse.</td>
<td></td>
</tr>
</tbody>
</table>

*Well Designated for Groundwater Level Measurement Only: Will Not be Sampled*
## TABLE 2

### FIELD PARAMETER MEASUREMENTS AND METHODS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Stability Criterion</th>
<th>Measurement Method</th>
<th>Method Description</th>
<th>Stated Accuracy</th>
<th>Calibration Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>+/- 0.5 degree C</td>
<td>Meter/flow-through cell*</td>
<td>Thermistor</td>
<td>+/- 0.15 degree C</td>
<td>Check prior to each sampling event; +/- 0.2 C.</td>
</tr>
<tr>
<td>Specific Conductance</td>
<td>+/- 5 percent</td>
<td>Meter/flow-through cell*</td>
<td>Four electrode cell</td>
<td>+/- 0.5%</td>
<td>Check start and end of each day; +/- 5% 1 point with mid-range solution (e.g. 10 mS/cm) plus distilled water check (&lt;0.03 mS/cm).</td>
</tr>
<tr>
<td>pH</td>
<td>+/- 0.1 pH unit</td>
<td>Meter/flow-through cell*</td>
<td>Glass sensing and Ag/AgCl reference electrodes</td>
<td>+/- 0.2 unit</td>
<td>Calibrate start and end of each day; +/- 0.5 units. Two-point pH 7 and 10.</td>
</tr>
<tr>
<td>Oxidation-Reduction Potential</td>
<td>NA</td>
<td>Meter/flow-through cell*</td>
<td>Ag/AgCl reference electrode</td>
<td>+/- 20 mV</td>
<td>Calibrate start and end of each day; +/- 20 mV, following pH calibration.</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>+/- 0.3 mg/L</td>
<td>Meter/flow-through cell*</td>
<td>Optical luminescence (ROX™)</td>
<td>+/- 0.1 mg/L</td>
<td>Check start and end of each day; +/- 5% to water-saturated air, 15 minutes. Sensor must be kept wet.</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Minimize. Greater of +/- 10 percent or +/- 1 NTU</td>
<td>Meter/flow-through cell*</td>
<td>Optical</td>
<td>+/- 2%</td>
<td>Calibrate start and end of each day 1 point with 0 NTU solution plus mid-point check (e.g. 12.7 NTU) +/- 5% using AMCO-AEPA standards (polymer beads).</td>
</tr>
<tr>
<td>Ferrous Iron</td>
<td>NA</td>
<td>Colorimetric**</td>
<td>Hach method 8146 with AccVac™ Ampules</td>
<td>+/- 1% in lab</td>
<td>Zero instrument with blank each reading.</td>
</tr>
<tr>
<td>Sulfide</td>
<td>NA</td>
<td>Colorimetric**</td>
<td>SM 4500 S2-D</td>
<td>+/- 3% in lab</td>
<td>Zero instrument with blank each reading.</td>
</tr>
<tr>
<td>Salinity</td>
<td>NA</td>
<td>Determined from specific conductance</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
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</table>

**Notes**
* YSI 6920V2-2 multiparameter meter with two optical ports for turbidity and dissolved oxygen by optical luminescence.
** Hach DR/890 portable colorimeter or similar model.
<table>
<thead>
<tr>
<th>Well ID</th>
<th>Primary Sample</th>
<th>Field Duplicate</th>
<th>Field Blank</th>
<th>MS/MSD</th>
<th>Trip Blank</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>60F</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Groundwater level only.</td>
</tr>
<tr>
<td>LD02 ST</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not equipped with pump. Bent casing.</td>
</tr>
<tr>
<td>PGDW05</td>
<td>X</td>
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<td></td>
<td></td>
<td></td>
<td>Low yield.</td>
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<tr>
<td>PGDW14</td>
<td>X</td>
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<td></td>
<td>VOC</td>
<td></td>
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<tr>
<td>PGDW20</td>
<td>X</td>
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<tr>
<td>PGDW23</td>
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<tr>
<td>PGDW30</td>
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<td>X</td>
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<td>VOC</td>
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<td>PGDW32</td>
<td>X</td>
<td>X</td>
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<td></td>
<td></td>
<td>VOC</td>
</tr>
<tr>
<td>PGDW33</td>
<td>X</td>
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<td></td>
<td></td>
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<td>VOC</td>
</tr>
<tr>
<td>PGDW41A</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>VOC</td>
</tr>
<tr>
<td>PGDW41B</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>May be combined with PGDW41A.</td>
</tr>
<tr>
<td>PGDW44</td>
<td>X</td>
<td></td>
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<tr>
<td>PGDW45</td>
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<td>X</td>
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<td></td>
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<td>VOC</td>
</tr>
<tr>
<td>PGDW49</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>VOC</td>
</tr>
</tbody>
</table>

Notes

MS/MSD = Matrix spike/ matrix spike duplicate
VOC = Trip blanks included with each cooler shipped that contains samples for:
  Volatile organic compounds by EPA 8260B
  Gasoline range organics by EPA 8015D
  Dissolved gases by RSK-SOP 175
<table>
<thead>
<tr>
<th>Group</th>
<th>Analysis</th>
<th>Method</th>
<th>Total or Dissolved</th>
<th>Laboratory</th>
<th>Equip Blank</th>
<th>MS/MSD</th>
<th>Trip Blank</th>
<th>Number of Containers</th>
<th>Size Liters</th>
<th>Description</th>
<th>Preservative</th>
<th>Holding Time</th>
</tr>
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<tbody>
<tr>
<td>Dissolved gases</td>
<td>Complete compositional gas analysis</td>
<td>GC</td>
<td>T</td>
<td>Isotech</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>0.75</td>
<td>Isoflask</td>
<td>Bactericide</td>
<td>NS</td>
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<tr>
<td>Dissolved gases</td>
<td>Methane, ethane, propane, butane</td>
<td>RSK-SOP 175</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>3</td>
<td></td>
<td>0.04</td>
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<td>VOA</td>
<td>HCl</td>
<td>14 days</td>
</tr>
<tr>
<td>General chemistry</td>
<td>Alkalinity</td>
<td>SM 2320B</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>1</td>
<td>0.25**</td>
<td>P</td>
<td>Cold</td>
<td>14 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General chemistry</td>
<td>Cyanide</td>
<td>SM 4500-CN-E</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>1</td>
<td>0.5</td>
<td>P</td>
<td>NaOH</td>
<td>14 days</td>
<td></td>
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</tr>
<tr>
<td>General chemistry</td>
<td>Dissolved organic and inorganic carbon</td>
<td>SM 5310C</td>
<td>D</td>
<td>C&amp;T</td>
<td>X</td>
<td>1</td>
<td>0.25</td>
<td>G</td>
<td>H2SO4</td>
<td>28 days</td>
<td></td>
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<tr>
<td>General chemistry</td>
<td>Major anions: Br, Cl, F, NO2, NO3, SO4</td>
<td>EPA 300.0</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>1</td>
<td>0.25**</td>
<td>P</td>
<td>Cold</td>
<td>48 hours</td>
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<tr>
<td>General chemistry</td>
<td>Methylene Blue Activated Substances</td>
<td>SM 5540C</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>0</td>
<td>0.25**</td>
<td>P</td>
<td>Cold</td>
<td>48 hours</td>
<td></td>
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<tr>
<td>General chemistry</td>
<td>Nitrogen, ammonia</td>
<td>SM 4500NH3-D</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>*</td>
<td></td>
<td>0.25</td>
<td>P</td>
<td>H2SO4</td>
<td>28 days</td>
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<tr>
<td>General chemistry</td>
<td>Oil and grease, petroleum (non-polar)</td>
<td>EPA1664A</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
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<td>1</td>
<td>G</td>
<td>HCl</td>
<td>28 days</td>
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<td>T</td>
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<td>P</td>
<td>Cold</td>
<td>NS</td>
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<td>General chemistry</td>
<td>Total dissolved solids</td>
<td>SM 2540C</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>1</td>
<td>0.25**</td>
<td>P</td>
<td>Cold</td>
<td>7 days</td>
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<tr>
<td>Microorganisms</td>
<td>E. Coli</td>
<td>SM 9223B</td>
<td>T</td>
<td>Precision</td>
<td>X</td>
<td>1</td>
<td>0.125</td>
<td>P</td>
<td>Na2SO4</td>
<td>30 hours</td>
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<td>Microorganisms</td>
<td>Total coliform</td>
<td>SM 9223B</td>
<td>T</td>
<td>Precision</td>
<td>X</td>
<td>*</td>
<td>*</td>
<td>P</td>
<td>Na2SO4</td>
<td>30 hours</td>
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<td>Microorganisms</td>
<td>Iron reducing bacteria</td>
<td>BART™ Bioreactor</td>
<td>T</td>
<td>Precision</td>
<td>X</td>
<td>*</td>
<td>*</td>
<td>P</td>
<td>Cold</td>
<td>30 hours</td>
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<tr>
<td>Microorganisms</td>
<td>Sulfate reducing bacteria</td>
<td>BART™ Bioreactor</td>
<td>T</td>
<td>Precision</td>
<td>X</td>
<td>*</td>
<td>*</td>
<td>P</td>
<td>Cold</td>
<td>30 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiochemistry</td>
<td>Gross-alpha, including Ra-226 but not Ra and U)</td>
<td>NS</td>
<td>T</td>
<td>C&amp;T/GEL</td>
<td></td>
<td>1</td>
<td>0.5</td>
<td>P</td>
<td>HNO3</td>
<td>6 months</td>
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<td>Radiochemistry</td>
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<td>EPA 903.1</td>
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<td>C&amp;T/GEL</td>
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<td>1</td>
<td>1</td>
<td>P</td>
<td>HNO3</td>
<td>6 months</td>
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<td>C&amp;T/GEL</td>
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<td>P</td>
<td>HNO3</td>
<td>6 months</td>
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<td>C&amp;T/GEL</td>
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<td>1</td>
<td>P</td>
<td>HNO3</td>
<td>6 months</td>
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<tr>
<td>Semivolatile organics</td>
<td>Acrylamide</td>
<td>SW846 8032A or 8316</td>
<td>T</td>
<td>C&amp;T/TBD</td>
<td>X</td>
<td>1</td>
<td>1</td>
<td>G</td>
<td>Cold</td>
<td>7 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semivolatile organics</td>
<td>Diesel range organics, with and without SGC</td>
<td>SW846 8015D</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>4</td>
<td>0.5</td>
<td>G</td>
<td>Cold</td>
<td>14 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semivolatile organics</td>
<td>Nitrogen- and phosphorus-containing pesticides</td>
<td>EPA 507</td>
<td>T</td>
<td>C&amp;T/APPL</td>
<td>X</td>
<td>1</td>
<td>1</td>
<td>G</td>
<td>Cold</td>
<td>14 days</td>
<td></td>
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</tr>
<tr>
<td>Semivolatile organics</td>
<td>Organochlorine pesticides</td>
<td>EPA 8081</td>
<td>T</td>
<td>C&amp;T/APPL</td>
<td>X</td>
<td>1</td>
<td>1</td>
<td>G</td>
<td>Cold</td>
<td>14 days</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Organophosphorus compounds</td>
<td>EPA 8141B</td>
<td>T</td>
<td>C&amp;T/APPL</td>
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<td>1</td>
<td>1</td>
<td>G</td>
<td>Cold</td>
<td>7 days</td>
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</tr>
<tr>
<td>Semivolatile organics</td>
<td>Semivolatile organic compounds</td>
<td>SW846 8276D, report TICs.</td>
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<td>C&amp;T</td>
<td>X</td>
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<td>1</td>
<td>G</td>
<td>Cold</td>
<td>7 days</td>
<td></td>
</tr>
<tr>
<td>Stable isotopes</td>
<td>Isotopes of carbon (d13C) and hydrogen (dD) in methane, and (d13C) ethane</td>
<td>GC/ Dual Inlet MS</td>
<td>T</td>
<td>Isotech</td>
<td></td>
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<td>*</td>
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<td>Bactericide</td>
<td>NS</td>
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<td>Isotopes of carbon (d13C) in dissolved inorganic carbon</td>
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<td>Isotech</td>
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<td>Cold</td>
<td>NS</td>
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<tr>
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<td>Isotopes of nitrogen (d15N) and oxygen (d18O) in dissolved nitrate</td>
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<td>D</td>
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<td>1</td>
<td>P</td>
<td>Cold</td>
<td>NS</td>
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<tr>
<td>Group</td>
<td>Analysis</td>
<td>Method</td>
<td>Total or Dissolved</td>
<td>Laboratory</td>
<td>Equip Blank</td>
<td>Trip Blank</td>
<td>Number of Containers</td>
<td>Size Liters</td>
<td>Description</td>
<td>Preservative</td>
<td>Holding Time</td>
<td></td>
</tr>
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<td>---------------------</td>
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<tr>
<td>Trace metals</td>
<td>Metals, 24 trace and cations, unfiltered: Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Li, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Sr, Th, U, V, Zn</td>
<td>SW846 6010B / 6020</td>
<td>T and D***</td>
<td>C&amp;T/ TBD for Li, U</td>
<td>X</td>
<td>2</td>
<td>0.5</td>
<td>P</td>
<td>HNO3</td>
<td>6 months</td>
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</tr>
<tr>
<td>Trace metals</td>
<td>Mercury, Hg, unfiltered</td>
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<td>C&amp;T</td>
<td>X</td>
<td>*</td>
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<td>P</td>
<td>HNO3</td>
<td>28 days</td>
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<td>Gasoline range organics</td>
<td>SW846 8015D</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>0.04</td>
<td>VOA</td>
<td>HCl</td>
<td>14 days</td>
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<td>Volatile organics</td>
<td>Glycols: 2-butoxyethanol, diethylene glycol, triethylene glycol,</td>
<td>SW846 8015B</td>
<td>T</td>
<td>C&amp;T/ Week</td>
<td>X</td>
<td>3</td>
<td>0.04</td>
<td>VOA</td>
<td>Cool</td>
<td>14 days</td>
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<td></td>
<td>tetraethylene glycol</td>
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<tr>
<td>Volatile organics</td>
<td>Volatile organic acids: acetate, butyrate, formate, lactate, propionate</td>
<td>RSK-SOP 112v6</td>
<td>T</td>
<td>C&amp;T/ Microbac</td>
<td>X</td>
<td>X</td>
<td>2</td>
<td>0.04</td>
<td>VOA</td>
<td>H3PO4</td>
<td>NS</td>
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<td>Volatile organics</td>
<td>Volatile organic compounds</td>
<td>SW846 8260B w/ 5033 prep, report TICs.</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
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<td>X</td>
<td>0.04</td>
<td>VOA</td>
<td>HCl</td>
<td>14 days</td>
<td></td>
</tr>
</tbody>
</table>

**Notes**

- All samples are aqueous samples.
- * = Container already listed on previous line item.
- ** = May be combined in single larger container
- *** = In the event that field turbidity readings remain above 20 NTU, only filtered (i.e. dissolved) samples for trace metals will be collected.

All abbreviations are as follows:
- SGCU = Silica gel cleanup
- TICs = Tentatively identified compounds
- G = Amber glass laboratories
- P = Polyethylene VOA
- VOa = 40mL Amber VOA Vial
- HCL = Hydrochloric Acid to pH < 2
- HNO3 = Nitric Acid to pH < 2
- H2SO4 = Sulfuric Acid to pH < 2
- NaOH = Sodium Hydroxide to pH > 12
- Laboratories:
  - C&T = Cuts and Tompkins Laboratories in Berkeley, California
  - C&T/ APPL = Agriculture & Priority Pollutants Laboratories, Inc. in Clovis, California subcontracted to C&T
  - C&T/Microbac = Microbac Laboratories, Inc. in Marietta Ohio subcontracted to C&T
  - C&T/Weck = Weck Laboratories, Inc. in City of Industry, California subcontracted to C&T
  - C&T/GEL = GEL Laboratories in Charleston, South Carolina subcontracted to C&T
  - Iotech = Iotech Laboratories, Inc. in Champaign, Illinois
  - Precision = Precision Analysis in Riverton, Wyoming
<table>
<thead>
<tr>
<th>Group</th>
<th>Analysis</th>
<th>Method</th>
<th>Total or Dissolved</th>
<th>Laboratory</th>
<th>Equip Blank</th>
<th>MS/MSD</th>
<th>Trip Blank</th>
<th>Number of Containers</th>
<th>Size Liters</th>
<th>Description</th>
<th>Preservative</th>
<th>Holding Time</th>
</tr>
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<tbody>
<tr>
<td>Volatile organics</td>
<td>Gasoline range organics</td>
<td>SW846 8015D</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3</td>
<td>0.04</td>
<td>VOA</td>
<td>HC1</td>
<td>14 days</td>
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<tr>
<td>Volatile organics</td>
<td>Glycols: 2-butoxyethanol, diethylene glycol, triethylene glycol, tetraethyleneglycol</td>
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<td>T</td>
<td>C&amp;T/ Weck</td>
<td>X</td>
<td></td>
<td></td>
<td>3</td>
<td>0.04</td>
<td>VOA</td>
<td>Cool</td>
<td>14 days</td>
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<tr>
<td>Volatile organics</td>
<td>Volatile organic acids: acetone, butyrate, formate, lactate, propionate</td>
<td>RSK-SOP 112v6</td>
<td>T</td>
<td>C&amp;T/ Microbac</td>
<td>X</td>
<td>X</td>
<td></td>
<td>2</td>
<td>0.04</td>
<td>VOA</td>
<td>H3PO4</td>
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<tr>
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<td>Volatile organic compounds</td>
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<td>C&amp;T</td>
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<td>X</td>
<td>X</td>
<td>3</td>
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<td>VOA</td>
<td>HCl</td>
<td>14 days</td>
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<td>Dissolved gases</td>
<td>Methane, ethane, propane, butane</td>
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<td>C&amp;T</td>
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<td></td>
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<td>VOA</td>
<td>HCl</td>
<td>14 days</td>
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<td>Dissolved gases</td>
<td>Complete compositional gas analysis</td>
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<td>T</td>
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<td>Stable isotopes</td>
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<td>GC/ Dual Inlet MS</td>
<td>T</td>
<td>Isotech</td>
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<td>Semivolatile organics</td>
<td>Diesel range organics, with and without SGC</td>
<td>SW846 8015D</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>4</td>
<td>0.5</td>
<td>G</td>
<td>Cold</td>
<td>14 days</td>
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<tr>
<td>Semivolatile organics</td>
<td>Nitrogen- and phosphorus-containing pesticides</td>
<td>EPA 507</td>
<td>T</td>
<td>C&amp;T/ APPL</td>
<td>X</td>
<td>1</td>
<td>1</td>
<td>G</td>
<td>Cold</td>
<td>14 days</td>
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<td>Semivolatile organics</td>
<td>Organochlorine pesticides</td>
<td>EPA 8081</td>
<td>T</td>
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<td>G</td>
<td>Cold</td>
<td>14 days</td>
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<td>Semivolatile organics</td>
<td>Organophosphorus compounds</td>
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<td>C&amp;T/ APPL</td>
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<td>G</td>
<td>Cold</td>
<td>7 days</td>
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<td>Semivolatile organic compounds</td>
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<td>C&amp;T</td>
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<td>1</td>
<td>G</td>
<td>Cold</td>
<td>7 days</td>
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<tr>
<td>Trace metals</td>
<td>Metals, 24 trace and cations, unfiltered: Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Li, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Sr, Tb, U, V, Zn</td>
<td>SW846 6010B / 6020</td>
<td>T and D***</td>
<td>C&amp;T/ TIBD for Li, U</td>
<td>X</td>
<td>2</td>
<td>0.5</td>
<td>P</td>
<td>HNO3</td>
<td>6 months</td>
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<tr>
<td>Trace metals</td>
<td>Mercury, Hg, unfiltered</td>
<td>SW846 7470</td>
<td>T and D***</td>
<td>C&amp;T</td>
<td>X</td>
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<td>P</td>
<td>HNO3</td>
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<tr>
<td>General chemistry</td>
<td>Dissolved organic and inorganic carbon</td>
<td>SM 5310C</td>
<td>D</td>
<td>C&amp;T</td>
<td>X</td>
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<td>0.25</td>
<td>G</td>
<td>Cold</td>
<td>28 days</td>
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<tr>
<td>Stable isotopes</td>
<td>Isotopes of carbon (d13C) in dissolved inorganic carbon</td>
<td>NS</td>
<td>D</td>
<td>Isotech</td>
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<td>0.125</td>
<td>P</td>
<td>Cold</td>
<td>NS</td>
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<td>Stable isotopes</td>
<td>Isotopes of nitrogen (d15N) and oxygen (d18O) in dissolved nitrate</td>
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<td>Isotech</td>
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<tr>
<td>General chemistry</td>
<td>Alkalinity</td>
<td>SM 2320B</td>
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<td>P</td>
<td>Cold</td>
<td>14 days</td>
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<tr>
<td>General chemistry</td>
<td>Cyanide</td>
<td>SM 4500-Ca-E</td>
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<td>C&amp;T</td>
<td>X</td>
<td>1</td>
<td>0.5</td>
<td>P</td>
<td>NaOH</td>
<td>14 days</td>
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<tr>
<td>General chemistry</td>
<td>Major anions: Br, Cl, F, NO2, NO3, SO4</td>
<td>EPA 300.0</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>1</td>
<td>0.25**</td>
<td>P</td>
<td>Cold</td>
<td>48 hours</td>
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</table>
### TABLE 4B

**SAMPLE ANALYSES, CONTAINERS, PRESERVATION, AND HOLDING TIMES**

**LISTED BY ORDER SAMPLED**

<table>
<thead>
<tr>
<th>Group</th>
<th>Analysis</th>
<th>Method</th>
<th>Total or Dissolved</th>
<th>Laboratory</th>
<th>Equip Blank</th>
<th>MS/MSD</th>
<th>Trip Blank</th>
<th>Number of Containers</th>
<th>Size Liters</th>
<th>Description</th>
<th>Preservative</th>
<th>Holding Time</th>
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<tbody>
<tr>
<td>General chemistry</td>
<td>Methylene Blue Activated Substances</td>
<td>SM 5540C</td>
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<td>C&amp;T</td>
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<td>P</td>
<td>Cold</td>
<td>48 hours</td>
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<td>Nitrogen, ammonia</td>
<td>SM 4500NH3-D</td>
<td>T</td>
<td>C&amp;T</td>
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<td>*</td>
<td>0.25</td>
<td>P</td>
<td>H2SO4</td>
<td>28 days</td>
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<td>General chemistry</td>
<td>Oil and grease, petroleum (non-polar)</td>
<td>EPA1664A</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>1</td>
<td>1</td>
<td>G</td>
<td>HCl</td>
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<tr>
<td>General chemistry</td>
<td>Sulfide</td>
<td>EPA 376.2</td>
<td>T</td>
<td>Precision</td>
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<td>0.25</td>
<td>P</td>
<td>Cold</td>
<td>NS</td>
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<td>SM 2540C</td>
<td>T</td>
<td>C&amp;T</td>
<td>X</td>
<td>1</td>
<td>0.25**</td>
<td>P</td>
<td>Cold</td>
<td>7 days</td>
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<td>Radiochemistry</td>
<td>Gross-alpha including Ra-226 but not Rn and U</td>
<td>T</td>
<td>C&amp;T/GEL</td>
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<td>0.5</td>
<td>P</td>
<td>HNO3</td>
<td>6 months</td>
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<tr>
<td>Radiochemistry</td>
<td>Radium-226</td>
<td>EPA 903.1</td>
<td>T</td>
<td>C&amp;T/GEL</td>
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<td>1</td>
<td>P</td>
<td>HNO3</td>
<td>6 months</td>
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<td>Radium-228</td>
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<td>C&amp;T/GEL</td>
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<td>VOA</td>
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<td>4 days</td>
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<td>Radiochemistry</td>
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<td>C&amp;T/GEL</td>
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<td>0.5</td>
<td>P</td>
<td>HNO3</td>
<td>6 months</td>
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<td>Microorganisms</td>
<td>E. Coli</td>
<td>SM 9223B</td>
<td>T</td>
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<td>30 hours</td>
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<td>Microorganisms</td>
<td>Total coliform</td>
<td>SM 9223B</td>
<td>T</td>
<td>Precision</td>
<td>*</td>
<td>*</td>
<td>P</td>
<td>Na2S2O3</td>
<td>30 hours</td>
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<td>Microorganisms</td>
<td>Iron reducing bacteria</td>
<td>BART™ Bioreactor</td>
<td>T</td>
<td>Precision</td>
<td>1</td>
<td>0.25</td>
<td>P</td>
<td>Cold</td>
<td>30 hours</td>
<td></td>
<td></td>
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<tr>
<td>Microorganisms</td>
<td>Sulfate reducing bacteria</td>
<td>BART™ Bioreactor</td>
<td>T</td>
<td>Precision</td>
<td>*</td>
<td>*</td>
<td>P</td>
<td>Cold</td>
<td>30 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

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- NaOH = Sodium Hydroxide to pH > 12 Precision = Precision Analysis in Riverton, Wyoming
Notes:
1. Water supply well locations were collected with sub-meter GPS equipment by AME, 2014.
2. All other locations provided by WY DEQ; locations and dimensions are approximate.
STANDARD OPERATING PROCEDURE

GROUNDWATER LEVEL MEASUREMENT, ACOUSTIC METER

1. Scope and Application

This is a technical procedure for measuring groundwater levels with an acoustic water level meter. This method is applicable where downhole equipment such as pumps, pump cables, and discharge lines are present in the well, and the well is not equipped with a sounding tube. This method is also appropriate where the depth to water in a well is greater than the length of readily available electronic water level meters.

To use this method, the well must be fitted with an access port at least 5/8 inches in diameter in an accessible location. If torque arrestors, wire shields, or other equipment are present that cover more than half the area of the casing, erroneous readings may result.

In monitoring wells without downhole equipment, use of an electronic water level meter is recommended.

2. Equipment

2.1 Acoustic water level meter

2.2 Optional cap for water level meter for open casings

2.3 Wrench or other tools to open access port

2.4 Disposable nitrile gloves

2.5 Detergent/water mix in a spray bottle, tap water in a spray bottle, and disposable paper towels

3. Procedure

3.1 Review the Job Safety Analysis for this task.

3.2 Inspect and Open Access Port on the Well Head

- Don disposable gloves
- Inspect well completion (including sanitary seal) and note condition on field form
- Remove fluid and debris before opening the access port
- Note damage or debris/ fluid on field form
3.3 Collect Depth to Groundwater Measurement

- Depending on the meter, turn it on and set the temperature to match the approximate air temperature in the well casing. Refer to maps and tables supplied in the meter manual.

- Insert the measuring duct (sound wave guide) of the meter into the access port, so that the duct extends through the seal.

- Momentarily press power button and record the reading.

- In an uncased well, add the cap to the measuring duct to close off the open top of the casing.

3.4 Close Access Port

- Replace the cap on the access port and verify it is secure.

3.5 Decontaminate Meter

- Spray the probe and the section of tape that was submerged with the detergent/water mix, and rinse using the spray bottle with water.

- Use paper towels along with detergent/water mix to remove LPH or grease if present, and rinse.

4. References

AME. 2013. JSA Groundwater Level Measurements

STANDARD OPERATING PROCEDURE

GROUNDWATER LEVEL AND APPARENT LIQUID PHASE
HYDROCARBON THICKNESS MEASUREMENT

1. Scope and Application

This is a technical procedure for measuring groundwater levels and apparent liquid phase hydrocarbons (LPH) thickness. For sites where LPH may be present, the static water level and apparent LPH thickness in each well will be measured with an electronic interface probe prior to purging or sampling.

Where downhole equipment such as pumps, pump cables, and discharge lines are present in the well, and the well is not equipped with a sounding tube, use of an acoustic water level meter is strongly recommended (see separate SOP). Also, if level meter with a tape is used in a water-supply well, additional equipment disinfection procedures are required.

2. Equipment

2.1 Conductance probe level meter with tape marked on 0.01 foot increments
2.2 Electronic interface meter (where LPH may be present) with tape marked on 0.01 foot increments
2.3 Socket wrenches or other tools to access well
2.4 Pry bar for well lid
2.5 Key to unlock the padlock on the well head
2.6 Disposable neoprene gloves
2.7 Detergent/water mix in a spray bottle, tap water in a spray bottle, and disposable paper towels
2.8 Disposable clear plastic bailer (where LPH may be present) and cord

3. Procedure

3.1 Review the Job Safety Analysis for this task.
3.2 Inspect and Clean up Well Head
   - Don disposable gloves
   - Inspect well completion (including well box lid and bolts for traffic boxes) and note condition on field form
   - Open well box lid
• Inspect well box for damage and presence of debris and fluid
• Remove fluid and debris before unlocking and removing well cap
• Note damage or debris/ fluid on field form

3.2 Collect Depth to Groundwater and LPH Measurements

• Turn on the meter and check the meter for proper functioning by pressing the test button.
• Locate the reference point on the casing, which may be marked with a notch. If no reference point is visible, measure from the north side of the casing.
• Slowly lower the tape of the interface probe until a tone is emitted. Prevent the probe tip from contacted the ground or the interior of the well box.
• If the first encountered substance is LPH, lower the tape until the tone corresponding to water is emitted.
• At this point, the mark on the tape opposite the permanent reference point on the top of the well casing will be read to the nearest 0.01 foot.
• Repeat the measurement by slowly raising and lowering the tape. Measurements should agree within 0.01 to 0.02 foot. If not repeat a third time.
• Record the reading to the nearest 0.01 foot as depth to water.
• Slowly raise the tape until the tone for LPH ceases, which is the top of the LPH.
• Repeat the measurement by slowly raising and lowering the tape. Measurements should agree within 0.01 to 0.02 foot. If not repeat a third time.
• Record this reading to the nearest 0.01 foot as depth to LPH.

3.3 Collect LPH Sample (if applicable)

• Gently lower the bailer approximately one-half the bailer length past the air/LPH interface.
• Retrieve the bailer.
• Note the appearance (color, opacity, "freshness") of the LPH on field notes.

3.4 Collect Depth to Groundwater Measurement

• Locate the reference point on the casing, which may be marked with a notch. If no reference point is visible, measure from the north side of the casing.
• Slowly lower the tape of the conductance probe until a tone is emitted (typically a steady tone).
• At this point, the mark on the tape opposite the permanent reference point on the top of the well casing will be read to the nearest 0.01 foot.

• Repeat the measurement by slowly raising and lowering the tape. Measurements should agree within 0.01 to 0.02 foot. If not repeat a third time.

• Record this reading to the nearest 0.01 foot as depth to water.

3.5 Close Well Head

• Replace well cap securely and replace lock.

• Replace well box and verify that bolts are secure.

3.6 Decontaminate Meter

• Spray the probe and the section of tape that was submerged with the detergent/water mix, and rinse using the spray bottle with water.

• Use paper towels along with detergent/water mix to remove LPH or grease if present, and rinse.

4. References

AME. 2013. JSA Groundwater Level Measurements


STANDARD OPERATING PROCEDURE

GROUNDWATER SAMPLING, PRIVATE WATER SUPPLY WELLS

1. Scope and Application

This is a technical procedure for sampling private water-supply wells. This procedure is written for typical well construction that supplies domestic water for a private residence and/or small-scale irrigation or livestock supply. The water-supply system typically includes:

- A water-supply well with a casing less than 10 inches in diameter
- A submersible pump or jet pump
- A well head completion on the surface or in a shallow pit, possibly with a pitless adapter in cold climates
- A pressure tank if for domestic use, either near the well or inside the residence

To collect representative groundwater samples, a sampling point must include the following characteristics:

- Upstream of pressure tank when possible
- Upstream of treatment systems or other equipment, unless these can be bypassed
- A spigot or drain to which a fitting for sampling equipment may be attached, located in an accessible location

Where possible, the sample location should be identified during a site reconnaissance ahead of the scheduled sampling time. Items to assess include site access, the location of the sampling point, adjoining land use, the location of the well, the current well use, well construction information if available, the configuration of the well head including access ports for sounding devices, and a location for purge water discharge.

This procedure assumes that no modification to the water-supply system will be made. Based on project-specific requirements and access arrangements with property owners, modifications such as the addition of sampling ports may be provided separately.

This procedure also assumes that the well is not equipped with a dedicated sampling port, which is not a typical configuration. (In the event that a sampling port is present that meets the above criteria, the portion of the sample manifold for the water-quality measurements and sample collection may be fitted to the sampling port, while the discharge hose and flow totalizer may be connected to a separate downstream spigot.)
2. **Equipment**

2.1 Keys and/or tools to access the sampling location

2.2 Groundwater level measurement equipment (see separate SOP)

2.3 Dedicated sampling manifold consisting of: 1) a connection fitting for the sampling point (typically 0 inch), 2) a reducing tee with a hose fitting connected to the large discharge end, 3) a flow-regulating valve, 4) a 3-way valve, and 5) tubing to connect the fittings and the flow-through cell and to fill sample containers (**Figure 1**). Fittings, valves, and tubing will consist of pre-cleaned fluoropolymer or food-grade polyethylene.

2.4 Bag for storing dedicated sampling equipment, labeled with well name

2.5 Multi-parameter water-quality meter for measuring field parameters (temperature, specific conductance, pH, dissolved oxygen, and turbidity) equipped with a flow-through cell

2.6 A hose to convey groundwater discharge from purging to the designated disposal location

2.7 A totalizing flow meter with fittings to connect to the discharge of the sample manifold and to the discharge hose. A flow-regulating valve should be included at the discharge end to regulate flow if needed.

2.8 Plastic sheeting or tarp to place at the sample collection location

2.9 Bucket to collect purge water from the flow-through cell at the sample collection location

2.10 Sample containers, pre-cleaned and containing preservative when required

2.11 Pre-cleaned cartridge filters with fittings to match the sample collection tubing, when samples are to be filtered for analysis for dissolved constituents

2.12 Supplies for field quality assurance samples, such as: trip blank samples in 40 ml VOA vials, distilled/deionized water for field blank samples

2.13 Disposable nitrile gloves

2.14 Ice for samples

2.15 Sample coolers and packing material

3. **Procedure**

3.1 Review the Job Safety Analysis for this task

3.2 Prepare Sampling Location

- Optionally, if feasible, request the owner to operate the well within a 3-hour period in advance of the scheduled sampling
• Clear the work area of obstructions
• Position vehicles and/or equipment near the work area
• Place plastic sheeting or tarp on the ground where the sample bottles will be filled and water quality meter with flow-through cell will be located
• Check that the sampling location spigot or drain is clear of obstructions and remove aerator if present
• Attach the sampling manifold to the spigot or drain and attach the flow-through cell. Close the three-way valve.
• Attach a discharge hose to the manifold with the totalizing flow meter in line
• Prepare the water quality meter
• If included in the work scope, prepare a clean and protected work location for obtaining other field water quality measurements, and prepare the equipment

3.3 Measure Water Level and Estimate Casing Volume
• Refer to the SOP Groundwater Level Measurement, Acoustic Meter
• Estimate the casing volume: \[ V = 0.0408 \times H \times D^2 \] where \( V \) is the volume in gallons, \( H \) is the height of the water column in feet, and \( D \) is the inside diameter of the well casing in inches.
• Ascertain if the well has been in use within approximately 3 hours of sample collection for long enough periods to have removed three casing volumes of water. If so, proceed directly to measurement of field parameters for stability.

3.4 Purge Well and Monitor Field Parameters
• Note the starting value at the totalizing flow meter.
• Open the valve at the sampling location.
• Ascertain that the sampling train and flow meter are functioning and that the purge water is discharging at the designated location.
• Open the 3-way valve to divert flow to the flow-through cell and begin to monitor field parameters. Record the purge volume and purging rate. During purging of the initial 3 casing volumes, at a minimum, collect a reading after each casing volume is removed.
• As the third casing volume is purged, collect at least 5 sets of field parameter measurements at regular intervals while maintaining the pumping rate. Compare the field parameter readings against the following stability criteria:
### Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Stability Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>+/- 0.5 degree C</td>
</tr>
<tr>
<td>Specific Conductance</td>
<td>+/- 5 percent</td>
</tr>
<tr>
<td>pH</td>
<td>+/- 0.1 pH unit</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>+/- 0.3 mg/L</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Minimize. Greater of +/- 10 percent or +/- 1 NTU</td>
</tr>
</tbody>
</table>

- Once the stability criteria have been met, proceed to collect the sample.

- If the stability criteria are not met after approximately 5 casing volumes have been purged, evaluate the feasibility of continued purging. Note on the sampling form if samples are collected before stability criteria are not met.

- If the well is a poor producer and is purged dry, turn off the pump immediately and allow water levels to recover to approximately 90 percent of the static water level. Proceed to sample collection while monitoring field parameters, and note the exception to the standard procedure on the field form.

#### 3.5 Collect the Sample

- Maintain the pumping rate, do not decrease. Decreasing the pumping rate may cause cycling of the pump and possible backflow of water from the plumbing system and/or pressure tank.

- Implement clean hands/dirty hands (CH/DH) for collecting samples. Delegate one team member to don fresh disposable gloves and handle the sample containers and discharge tubing.

- Switch the 3-way valve to direct the flow to the sample fill tubing.

- Allow for a minimum of 5 tubing volumes to flow to waste in the bucket.

- Adjust flow for filling sample containers: approximately 500 ml/minute for large containers, and approximately 150 ml/minute for VOAs and other small containers.

- Do not touch the lip of sample containers or inside edges of the caps.

- For samples WITHOUT preservatives, rinse the bottle with sample water by filling 1/10 full, shaking, and discarding the contents to the bucket. DO NOT rinse bottles with preservatives.

- Fill sample containers from discharge tube while minimizing aeration of the sample. Do not overfill containers containing preservative. Fill VOA vials to a meniscus and check that there are no air bubbles once the cap is in place.
• In general, fill sample containers in the following order: 1) volatile organic compounds, 2) semi-volatile organic compounds, 3) trace and major element cations, 4) general chemistry (nutrients, major anions, alkalinity), 5) radiochemicals and isotopes, 6) filtered dissolved organic carbon, and 7) microorganisms.

• For samples requiring field filtration, attach the filter cartridge to the end of the sample fill tubing. Allow the initial flow from the filter to discharge to waste before filling the sample container.

3.6 Prepare the Sample for Transport from the Site

• Review sample container labels against the chain-of-custody form

• Verify sample containers are in the correct cooler if transporting to multiple laboratories

• Place sample containers into cooler with water ice inside sealable plastic bags. Maintain the internal temperature of the cooler at approximately 4 degrees C.

• Verify field QA samples such as trip blanks are included where needed, in the cooler with samples for VOC analysis.

• Maintain sample chain-of-custody.

3.5 Remove Equipment and Clean Up Site

• Place the dedicated sampling manifold in a bag labeled with well name and store for use during next sampling event.

• Remove plastic sheeting from the sample location.

• Restore site to original condition.

4. References

AME. 2013. JSA, Ground Water Sampling


5. Attachments

Figure 1: Dedicated Sampling Manifold.
FIGURE 1
SAMPLING MANIFOLD

Pavilion 2014 Groundwater Investigation
Fremont County, Wyoming

DEDICATED TUBING TO SAMPLE LOCATION

1/4" FEP TUBE TO FLOW THROUGH CELL

1/4" TEFLON LINED TUBE FOR SAMPLING

1/4" FLUOROPOLYMER PRESS TO CONNECT TEE

1/4" FLUOROPOLYMER PRESS TO CONNECT INLINE STOP VALVES

1/4" FEP PRESS TO CONNECT TEE

1/4" FEP PRESS TO CONNECT INLINE STOP VALVES

3/4" GARDEN HOSE

3/4" GARDEN HOSE THREAD (GHT) TO DISCHARGE HOSE

3/4" BALL VALVE

TOTALIZER FOR PURGE WATER VOLUME

3/4" GARDEN HOSE

3/4" GHT TO 1/4" POLYETHYLENE COMPRESSION ADAPTERS

3/4" FEP TUBE TO FLOW THROUGH CELL

3/4" POLYETHYLENE GARDEN HOSE Y-ADAPTER WITH SHUTOFF

3/4" POLYETHYLENE GARDEN HOSE Y-ADAPTER WITH SHUTOFF

1/4" TEFLON LINED TUBE FOR SAMPLING

1/4" TEFLON LINED TUBE FOR SAMPLING

1/4" FEP PRESS TO CONNECT TEE

DRAFT
Collection of Ground Water Samples from Domestic and Municipal Water Wells for Dissolved Gas Analysis Using IsoFlasks®

1. Sampling source: Water samples should either be collected from a pressurized water system or by using a suitable water pump. When sampling from a pressurized water system, it is recommended to use an outdoor spigot or other source which bypasses any water treatment systems (i.e. water softeners, etc.). When using a pump, it should be capable of maintaining a constant pressure at or above that which exists within the aquifer. This is to ensure that gases dissolved in the water within the aquifer remain dissolved until the water is transferred into an IsoFlask. If using a pulsating pump such as a bladder pump, please contact Isotech for additional recommendations.

2. Record sample information onto the IsoFlask using the provided soft-tip, permanent pen.

3. Purge the well (see reverse side).

4. Attach the fill tube and purge with the source water. A control valve is included on the fill tube to assist in sampling. Use the control valve to stop/start flow into the IsoFlask (after purging).

5. The IsoFlasks have been evacuated in advance. A capsule filled with bactericide has also been inserted. A properly evacuated IsoFlask will be tightly held against the bactericide capsule. If the IsoFlask appears to have lost vacuum, do not use and contact Isotech for further instruction and/or replacement.

6. While the water is flowing attach the fill tube to an evacuated IsoFlask.

7. The IsoFlask should be filled with 600-700 cc of water (i.e. to a thickness of about 2 inches). When sufficient sample has been collected, close the sampling valve and quickly disconnect the fitting from the IsoFlask. The water flow can now be turned off and the hose disconnected. NOTE: Do not overfill the IsoFlask (the IsoFlask should not be under pressure).

8. Submission of samples: Place the IsoFlask into its protective box laying flat. Complete a Chain-of-Custody/Analysis Request Form and include it with the sample(s). If possible, samples should be shipped the same day collected, via an overnight delivery service. Client MUST inform Isotech of shipment prior to arrival. Please note Isotech's receiving hours of Monday through Friday 8:00 a.m. to 4:30 p.m.

Ship samples to:
Isotech Laboratories, Inc.
1308 Parkland Court
Champaign, IL 61821

These instructions have been provided to simplify the collection of samples for dissolved gas analysis. Although we try to foresee and avoid problems in the field, it is never possible to predict every situation. If you encounter any difficulties, or if any additions or changes in these instructions would be beneficial, please let us know.

Isotech Laboratories, Inc. makes no warranty as to the applicability and/or safety of the procedures described herein.
How to properly fill an IsoFlask

1. Purge line
2. Attach fill tube & purge
3. Attach evacuated IsoFlask (while water is still flowing)
4. Fill IsoFlask 2/3 full (approximately 2 inches thick, see below)
5. Detach IsoFlask from fill tube

Not full enough
Correct
Too full