

ATTACHMENT VI-1

GROUNDWATER FIELD SAMPLING PLAN

This Attachment outlines the procedures relating to groundwater sample collection, sample preservation, sample shipment, analytical procedures, chain-of-custody controls, equipment calibration, quality assurance, and quality control. This Attachment satisfies the requirements of Utah Admin. Code R315-264-97(d) and (e).

1. Documentation

- a. The following forms shall be used to document groundwater sample collection information:
 - i. Groundwater Sampling Sheet;
 - ii. Groundwater Elevation Measurement Form; and
 - iii. Groundwater Monitoring Field Instrumentation Calibration Sheet.
- b. At a minimum, the Groundwater Sampling Sheet shall include:
 - i. well conditions;
 - ii. weather conditions;
 - iii. depth to groundwater data;
 - iv. purge volumes;
 - v. field analytical results;
 - vi. appearance of the collected groundwater;
 - vii. samples collected; and
 - viii. any concerns or problems.
- c. These forms shall be maintained as part of the Operating Record.
- d. The Permittee shall also maintain a Field Sampling Logbook consisting of a weather resistant, bound, survey-type book, with non-removable, numbered pages. The logbook shall be updated on a daily basis during fieldwork and shall include the following information:

- i. Name of individual making entry;
- ii. Personnel involved in the sampling event;
- iii. Date and time of sampling;
- iv. Weather conditions; and
- v. Monitoring well number.

2. Sample Collection

- a. Prior to sampling, the Permittee shall perform the following:
 - i. Begin a Groundwater Sampling Sheet and prepare a complete set of sample containers for each well;
 - ii. Check the monitoring well for proper identification; and
 - iii. Check the wellhead for any signs of tampering or damage;
- b. All samples shall be collected in new, and certified clean (by manufacturer), sample containers.
- c. The Permittee shall label each container submitted for analysis with the following information:
 - i. Project name and location (well number);
 - ii. Field sample identification;
 - iii. Date and time sample was collected;
 - iv. Preservative (if applicable);
 - v. Sampler's initials; and
 - vi. Analysis type.
- d. The Permittee shall perform depth to groundwater measurements prior to each sampling event and total well depth measurements on an annual basis at each monitoring well.
 - i. Depth to groundwater measurements shall be performed as follows:
 - A. The water level probe shall be rinsed with distilled or de-ionized

water and inspected for any foreign material.

- B. A straight edge or framing square shall be placed across the top of the protective well casing and the water level probe lowered into the well until either the audible or visual alarm activates. The measurement is repeated until at least two successive values are observed. This level shall be recorded on the Groundwater Sampling Sheet.
- ii. Total well depth measurements shall be performed using a total depth or electronic indicator as follows:
- A. Prior to measuring the total depth of each well, the dedicated pumps shall be extracted from the wells.
 - B. The condition of each pump shall be checked and any maintenance shall be performed to ensure proper operating conditions of the pumps.
 - C. The measurement shall be made from a surveyed reference location at the top of the protective casing.
 - D. A straight edge shall be placed across the open protective casing and measurements shall be determined from the bottom of the straight edge.
 - E. Prior to insertion into the well casing, the Permittee shall rinse the electric water level probe with distilled or de-ionized water and inspect it for foreign matter to ensure proper decontamination.
 - F. The Permittee shall lower the probe slowly into the well until it is in contact with the bottom of the well.
 - G. The depth to the bottom of the well shall be determined by observing the place on the water level indicator's line at the bottom of the straight edge when the probe indicates it is at the bottom of the well.
 - H. Depths to the bottom of the well measurements shall be recorded on the Groundwater Sampling Sheet.
- iii. The Permittee shall add a correction factor to each measurement. The correction factor represents the distance from the depth to water sensor (where the measuring tape is referenced) to the end of the steel probe (which contacts the bottom of the well).

- iv. The measured water column shall be compared to the theoretical water column (based on monitoring well completion diagrams) to evaluate the amount of silt that has accumulated in the bottom of the monitoring wells using the following equation:

$$\text{Percent Theoretical Water Column} = \frac{(T_{d_m} - \text{DTW})}{(T_{d_t} - \text{DTW})} \times 100$$

where: T_{d_m} is the measured well depth
 T_{d_t} is the as-built well depth
DTW is the measured depth to water

- A. If the measured water column is less than 90 percent of the theoretical water column, the monitoring well shall be redeveloped prior to sampling.

- v. Water level data shall be recorded on the Groundwater Elevation Measurement Form.

e. Pre-Sampling Purging

- i. The Permittee shall purge a minimum of three casing volumes of groundwater using a dedicated bladder pump to ensure samples are representative of the aquifer by performing the following:

- A. The height of the water column in the well shall be determined by measuring the static water level and the total well depth according to Condition 2.d.
- B. The volume of water to be purged from the monitoring well shall be calculated using the height of the water column in the well casing using the following formula:

$$\text{Total Purge Volume: } V_t = 3(V_c) \times 7.48 \text{ gal/ft}^3$$

where: V_t = Total Purge Volume (gallons)
 V_c = Volume of water in well casing (ft^3)

$$\text{Casing Volume: } V_c = \pi r_1^2 h_1$$

where: V_c = Casing Volume (ft^3)
 r_1 = Inside radius of monitoring well casing (ft)
 h_1 = Height of water column (i.e., total well depth minus static water level depth) (ft)

Note: For two-inch diameter wells, the difference between the total depth and the depth to groundwater multiplied by 0.5 equals V_t (V_p) in gallons.

- C. If there is insufficient groundwater recharge to evacuate three casing volumes from the well, the Permittee shall evacuate the well to dryness and then sample after the well has recovered to 80 percent of the static water level.
 - D. If the well becomes dry before all sample containers are filled, then the remaining sample containers shall be filled after the well recharges sufficiently.
 - E. Purge volume calculations and the actual purge volume removed from each well shall be recorded on the Groundwater Sampling Sheet.
- ii. To ensure the groundwater samples are representative of the aquifer, the Permittee shall monitor the following parameters using a flow-through cell during pre-sampling purging:
- A. Specific conductivity (SC);
 - B. pH;
 - C. Temperature;
 - D. Dissolved oxygen (DO); and
 - E. Reduction/oxidation (redox) potential (Eh or ORP).
- iii. Before sampling is initiated, a minimum of three casing volumes shall be purged from the well and three consecutive water quality measurements shall meet the following criteria:
- A. Specific conductivity = ± 3 percent;
 - B. pH = ± 0.1 units; and
 - C. Temperature = $\pm 1^\circ\text{C}$.
- iv. All of the water quality measurements listed in Condition 2.e.ii above shall be documented on the Groundwater Sampling Sheet. The appearance of the discharge water shall also be documented.

- v. Purge water evacuated from the monitoring wells shall be containerized and placed in the Decontamination Pad Settling Tank, Surface Impoundment or one of the Evaporation Tanks in accordance with Condition VI.E.3.A. of Module VI, *Groundwater Monitoring*.
- f. Environmental Samples
 - i. Groundwater samples shall be collected directly into the appropriate sample container from the discharge line of the dedicated bladder pump.
 - ii. For all samples, the sample bottles shall be filled in the order of compound volatility or stability as follows:
 - A. Volatile Organics (VOCs);
 - B. Semi-Volatile Organic Compounds (SVOCs);
 - C. Dioxins/furans (if required);
 - D. Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Nitrates, Nitrites, and Anions;
 - E. Sulfides;
 - F. Metals (unfiltered)/Cations (unfiltered); and
 - G. Radiological Compounds.
 - iii. For groundwater samples collected for VOCs from the bladder pumps, the discharge rate of the pump shall be reduced to allow gentle filling of the sample bottles without aeration.
 - A. On the first well sampled during a sampling event, the Permittee shall measure and document the reduced flow rate for VOC sampling.
 - B. Should the sampling team leader change during the course of a sampling event, the flow measurement shall be repeated and documented.
 - iv. The Permittee shall provide at least one VOA trip blank for each cooler containing samples for VOC analysis, one set of replicates representing 10% of the total number of samples, one laboratory blank, and one VOA pour blank for analysis for each sampling event.

3. Sample Preservation and Shipment

- a. Immediately after sample collection, the Permittee shall place sample containers in a cooler containing ice and chilled to 4°C.
- b. Preservatives shall be added according to the analytical method applicable for each sample or may be added to sample bottles prior to sampling.
- c. All groundwater samples shall be packaged on the day of collection in coolers containing ice. Conventional chemistry samples shall be transported to the laboratory on the day of collection.
- d. In the event the samples require shipping, the following procedures shall be followed for packing samples:
 - i. Samples shall be placed upright in a waterproof cooler.
 - ii. Ice shall be placed in double Ziploc™ bags or equivalent (to prevent leakage) and arranged around, among, and on top of the sample bottles. Sufficient ice shall be used so samples will reach and maintain a temperature of approximately 4°C.
 - iii. The cooler shall be filled with inert cushioning material, such as shipping peanuts, additional bubble wrap, or cardboard dividers to prevent the sample containers from sliding during shipment.
 - iv. The Permittee shall place the completed Chain-of-Custody (COC) form in a waterproof plastic bag and tape it to the inside of the cooler lid.
 - v. The Permittee shall secure the cooler lid with strapping tape by wrapping it completely around the cooler.
 - vi. The Permittee shall sign and date custody seals and place them on the cooler in two locations across the opening of the cooler lid.

4. Analytical Procedures

- a. Samples shall be analyzed in accordance with Condition VI.E.3.c.

5. Chain-of-Custody Controls

- a. Chain-of-custody procedures provide an accurate written record of the possession of each sample from the time of collection in the field through laboratory analysis. A sample shall be considered in custody if one of the following applies:
 - i. It is in an authorized person's immediate possession,

- ii. It is in view of an authorized person after being in physical possession,
 - iii. It is in a secure area after having been in physical possession of an authorized field person,
 - iv. It is in a designated secure area, restricted to authorized laboratory personnel only.
- b. Chain-of-Custody Field Procedures
- i. The sample custody and documentation procedures shall be initiated at the time of sample collection.
 - A. Sample collection details shall be documented on the Groundwater Sampling Sheet.
 - B. Samples shall be labeled and the appropriate information shall be recorded on the COC.
 - C. All entries shall be made in indelible ink.
 - D. Any errors shall be corrected by drawing a single line through the incorrect entry, entering the correct information, and then initialing and dating the change.
 - ii. Properly completed COC records shall ensure that sample custody is documented, appropriate sample fractions have been collected, and scheduled analyses are properly assigned.
 - iii. Custody seals shall be placed in two locations across the cooler closure to ensure that any tampering is detected. The date and initials of the sample shall be written on the custody seal.
 - iv. The Permittee shall ensure that the receiving laboratory employs standard laboratory custody procedures.

6. Equipment Calibration

- a. Field equipment used during groundwater sampling shall be calibrated as outlined below. Results shall be documented on the Groundwater Monitoring Field Instrument Calibration Sheet.

- b. Water Quality Parameter Meters. Any meter used for water quality parameter measurements shall be calibrated using reliable commercial reference standards or solutions in accordance with the manufacturer's instructions.
 - i. pH Meter. Three buffer standards (4, 7, and 10) shall be used for pH meter calibration.
 - ii. Specific conductance meter. A standard 100,000 µmhos/cm solution shall be used for calibration.
 - iii. Calibration shall occur prior to daily use or at any time a meter drift is suspected.
 - iv. In addition, a calibration check shall occur during the middle of the day and at the end of the day for radiological sampling. The pH portion of the flow-through cell will be checked at each monitoring well using the pH 7 buffer.

7. Quality Assurance and Quality Control

- a. The Permittee shall provide VOA pour blanks, laboratory blanks, and trip blanks for the purpose of quality assurance/quality control in accordance with Condition VI.E.3.c.i. of Module VI, *Groundwater Monitoring*.

END OF ATTACHMENT VI-1