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1.0 PURPOSE AND SCOPE

1.1 Purpose

This procedure describes the requirements for groundwater sampling.

1.2 Scope

This procedure shall be used by the Deactivation & Remediation (D&R) Contractor personnel, and subcontractor personnel that perform sampling of groundwater monitoring wells, as described in the Environmental Monitoring Plan, at the U.S. Department of Energy (DOE)-owned Paducah site.

2.0 REFERENCES

2.1 Use References

- CP2-HS-2000, *Worker Safety and Health Program*
- CP3-ES-0003, *Environmental Incident Reporting*
- CP3-WM-1037, *Generation and Temporary Storage of Waste Materials*
- CP4-ES-2100, *Groundwater Level Measurement*
- CP4-ES-2700, *Logbooks and Data Forms*
- CP4-ES-2702, *Decontamination of Sampling Equipment and Devices*
- CP4-ES-2704, *Trip, Equipment and Field Blank Preparation*
- CP4-ES-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*
- CP3-WM-9503, *Off-Site Shipments by Air Transport*
- Job Hazard Analysis (JHA) 10903

2.2 Source References

- CP2-ES-0006, *Environmental Monitoring Plan*
- Calibration manuals for turbidity

3.0 COMMITMENTS

None

4.0 PRECAUTIONS AND LIMITATIONS

4.1 Precautions

4.1.1 The sampling team performing the task of ground water sampling shall comply with the requirements of CP2-HS-2000, *Worker Safety and Health Program*, and any job hazard analyses (JHAs) that address safety and health, including JHA-10903.

4.1.2 Any spills and/or releases shall be reported according to CP3-ES-0003, *Environmental Incident Reporting*.

4.1.3 Do **NOT** introduce contaminants into the well that would compromise the quality of data collection.

4.2 Limitations

4.2.1 Groundwater sampling shall be performed by individuals whose primary responsibilities are to inspect monitoring wells (MWs), collect groundwater samples and groundwater level data, and are familiar with the design and construction aspects of the monitoring well.

> NOTE:
>
> Stabilization parameters include pH, specific conductance, dissolved oxygen, temperature, and turbidity.
>
> Water quality parameters have stabilized when measurements of the parameters vary within approximately 10 percent over the last two consecutive measurements that are three minutes apart.
>
> Turbidity measurements are considered stabilized when subsequent results vary within approximately 10 percent or turbidity measurements are approximately 10 Nephelometric Turbidity Units (NTU) or less.

4.2.2 Groundwater samples are collected as soon as possible after the well is purged and water quality parameters have stabilized.

> NOTE:
>
> Maintaining a drawdown of 0.3 ft. or less is typically **NOT** possible in Upper Continental Recharge System (UCRS) wells.

4.2.3 **When** pumping groundwater, discharge rate shall be controlled to maintain a water level drawdown of less than 0.3 feet, if possible.

4.2.4 Waste generated during groundwater sampling shall be handled according to CP3-WM-1037, *Generation and Temporary Storage of Waste Materials.*

5.0 PREREQUISITES

5.1 Review JHA-10903.

5.2 Notify RADCON and Safety & Health personnel before initiating sampling to determine required surveys and monitoring requirements for Radiological Work Permit (RWP) and Industrial Hygiene Work Permit (IHWP).

5.3 Obtain chain-of-custody forms, field sample logs, sample labels, and custody seals as necessary from Sample Management Office (SMO).

5.4 Ensure sampling operations are documented on MW groundwater data forms according to CP4-ES-2700, *Logbooks and Data Forms.*

5.5 Calibrate water quality meters for water quality parameters, according to manufacturer's instructions **and** document the calibration results.

5.6 Perform a visual inspection of the trailer and all field equipment, before each use for safety and operability.

5.7 Prepare the necessary sample containers **and** partially complete **and** attach sample labels.

5.8 Prepare necessary field quality control samples according to CP4-ES-2704, *Trip, Equipment and Field Blank Preparation.*

6.0 INSTRUCTIONS

6.1 General Requirements for Groundwater Sampling Using Bladder Pumps

Sampler

6.1.1 Upon arriving at the sampling site, inspect the site/well for damage or unusual circumstances such as tampering, vandalism, etc.

6.1.2 Open the well cap or lid **and** note any damage or unusual conditions of the well casing, cap, airline, and fittings for the discharge tube.

6.1.3 **If** any damage is observed, **then** record the damage or unusual circumstances **and** contact supervision.

6.1.4 Retrieve the discharge tubing from the well **and** connect to the well head.

6.1.5 **If** the discharge tubing comes in contact with the ground, **then** decontaminate the tubing with deionized water and a clean moist wipe **before** placing back into the well.

6.1.6 Connect the discharge tubing from the well head to the sampling box.

6.1.7 Place insulation on the discharge tube.

6.1.8 Determine the static water level using a water level meter **and** record the level.

NOTE:
The pump cycle control box is set up and operated according to the operations manual.

6.1.9 Connect the pump cycle control box air hose to well head air fittings.

6.1.10 Uncap nitrogen cylinder tank, if used, **and** attach regulator.

6.1.11 Adjust the regulator, if required.

6.1.12 Attach the air hose to the regulator.

6.1.13 Attach air hose to control box.

6.1.14 Position the water quality meter on the portable sampling box or other appropriate location.

6.1.15 Measure **and** record the static water level according to CP4-ES-2100, *Groundwater Level Measurement*.

6.2 Calculation of Purge Volumes

Sampler

NOTE:

A Paducah Environmental Management System (PEMS) report that accompanies the sample labels, documents the required purge volume to be used for the wells equipped with a bladder pump.

6.2.1 **When** Micropurging, begin by purging only the volume of water in the pump and discharge line, which is 450 milliliters (ml) for the pump and 40 ml for every foot of 1/2" discharge line or 22 ml for every foot of 3/8" discharge line.

6.2.2 **When** Micropurging, record the beginning **and** ending water level.

6.2.3 Record the required purge volume.

NOTES:

The packer purge method is only used at the direction of supervision.

The packer is inflated before beginning the "three well volumes with a packer" criterion for purging.

6.2.4 **When** purging with a packer, calculate the purge volume using the following formula:

Purge Volume = 3Cf(Wd-Pd)

- Well depth (Wd) minus packer depth (Pd) = the zone of isolation (sampling zone) in feet.
- The zone of isolation times casing factor (Cf) = volume of the zone of isolation in gallons.
- Volume of the zone of isolation times 3 = total purge volume in gallons.
- Casing factor (Cf) for a 2 inch well = 0.163 gallons per foot.
- Casing factor (Cf) for a 4 inch well = 0.653 gallons per foot.

6.2.5 Record the required purge volume calculated for the packer purge method.

NOTE:

Purging three-well-volumes without a packer is only used at the direction of supervision.

6.3 Purging of Groundwater Using Bladder Pumps

Sampler

6.3.1 **If** sampling box is used, **then** open the valve on the sampling box to direct the flow of purge water to the sample port.

6.3.2 Open the valve on the nitrogen tank regulator **or** start the air compressor, if used, **and** open the regulator.

NOTE:

The flow controller pressure output is set to 0.5 pounds per square inch (psi) per foot of lift.

6.3.3 Turn on the pump cycle control box and the adjust flow controller to the desired pressure output.

6.3.4 Adjust the period of the pump cycle to produce a flow rate of 300 mL/min or less (as measured with a flow meter) **and** allow 300 mL or more to flow through the sampling port.

6.3.5 Close the sampling port to direct the flow of purge water through the water quality meter flow-through cell.

6.3.6 Check for trapped air pockets in the flow-through cell **and** reposition, as necessary, to remove any trapped air.

6.3.7 At a minimum, pump the purge volume determined in Section **6.2** before monitoring the water quality parameters.

6.3.8 **When** the purge volume has been reached, record the initial water quality parameter readings.

6.3.9 Record a minimum of three measurements, including the initial reading, in three-minute intervals until stability has been achieved.

NOTES:

Groundwater samples are collected as soon as possible after the well is purged and water quality parameters have stabilized.

The reading for Oxidation-Reduction Potential (ORP) is documented but **NOT** used to determine stabilization.

6.3.10 Adjust the valves to direct the flow through the sample port and to isolate water within the flow-through cell from the sample port.

6.4 Collecting Sample with Bladder Pumps

<u>Sampler</u>

NOTE:

The sample flow rate is maintained at 300 milliliters per minute (ml/min) or less except for sampling of Volatile Organic Compounds (VOCs), which is maintained at a flow rate of 100 ml/min or less.

6.4.1 Before filling bottles, label sample bottles with date and sampler's initials.

6.4.2 Collect samples for the required analytes in the appropriate order.

6.4.3 Collect required field quality control samples.

6.4.4 **If** a well is purged to dryness, **then** return to the well within 24 hours of the initial sampling time **and** collect one round of water quality parameters, **then** collect the required sample parameters.

6.4.5 **If** the well pumps dry during the second sampling event, **then** abandon the remaining sample collection requirements for the well **and** consider the well dry.

6.5 Groundwater Sampling of Residential Wells

Sampler

NOTES:

A minimum of 2 project personnel are present during sampling of residential wells unless otherwise directed by supervision.

Residential wells are equipped with a bladder pump or electric pump.

6.5.1 Upon arriving at the sampling site, inspect the site/well for damage or unusual circumstances such as tampering, vandalism, etc.

6.5.2 For bladder pump well, open the well cap or lid **and** note the condition of the casing and fittings.

6.5.3 **If** any damage is observed, **then** record the damage or unusual circumstances **and** contact supervision.

NOTE:

Purge **and** sample the well consistent with requirements of Section **6.2**.

Purge water from the bladder pump residential wells is **NOT** containerized.

6.5.4 For residential wells with an electric pump, connect hose to an outside faucet.

6.5.5 Open the valve fully to receive the highest purge rate **and** continue this purge rate for 5 minutes.

6.5.6 **After** purging for a minimum of 5 minutes, reduce the water flow **and** connect the water quality meter to the water faucet hose.

6.5.7 Record field readings after the initial purge volume has been pumped.

6.5.8 Include the initial reading **and** record a minimum of three measurements of the water quality parameters (pH, specific conductivity, and temperature) in three-minute intervals until stability has been achieved.

6.5.9 Close the faucet valve **and** remove garden hose from faucet.

NOTE:

Sample flow rate for VOCs is maintained at 100 ml/minute or less.

6.5.10 Reduce the water flow rate to approximately 300 ml/min or less during collection of samples.

6.5.11 Collect samples for the required analytes in the appropriate order.

6.5.12 Collect required field quality control samples.

6.5.13 Close the faucet valve once all sampling is complete.

6.6 Groundwater Sampling of Residential Wells Carbon Filtration System

Sampler

6.6.1 Upon arriving at the sampling site, inspect the site/well for damage or unusual circumstances such as tampering, vandalism, etc.

6.6.2 **If** any damage is observed, **then** record the damage or unusual circumstances **and** contact supervision.

6.6.3 Identify all required sampling ports.

6.6.4 Locate **and** fully submerge sample port 1 in a cup of bleach for approximately 1 minute.

6.6.5 Remove from bleach and connect an appropriate length of ¼" Teflon tubing to sample port.

6.6.6 Open sample port fully to receive the highest purge rate and continue this purge rate for a minimum of 5 minutes.

6.6.7 **After** purging for a minimum of 5 minutes, reduce the water flow **and** connect the water quality meter to the Teflon tubing.

6.6.8 Record required filed readings after the initial purge volume has been pumped.

6.6.9 Close sample port **and** disconnect Teflon tubing from the water quality meter.

6.6.10 Open sample port to a flow rate of approximately 300ml/min or less during collection of sample.

6.6.11 Collect sample for the required analytes in the appropriate order.

6.6.12 Collect required field quality control samples.

6.6.13 Locate sample port 3 and perform steps **6.6.6** through **6.6.14** then exit this section.

6.7 Sampling of Multi-Port Wells

Sampler

NOTES:

Due to varying connections on the multi-port wells, a particular control box may be required. Multi-port wells in the C-400 Area (Six Phase Heating Treatability Study Wells) typically use the Solinst 466-160 pump controller box (or equivalent). Multi-port wells constructed for the Permeable Treatment Zone Treatability Study typically use the Solinst 465 pump controller box.

Operation of each of the controllers is similar. This procedure describes the Solinst 465 pump controller box (or equivalent) with the equivalent Solinst 466-160. The respective operator's manuals are referenced for additional instruction of the pump cycle control boxes.

6.7.1 Upon arriving at the sampling site, inspect the site/well for damage or unusual circumstances such as tampering, vandalism, etc.

6.7.2 Open the well cap or lid **and** note any damage or unusual conditions of the well casing, cap, airline, and fittings for the discharge tube.

6.7.3 **If** any damage is observed, **then** record any damage or unusual circumstances and contact supervision.

6.7.4 Position the water quality meter and the pump controller box on the portable sampling table or other appropriate location.

6.7.5 Uncap the nitrogen cylinder tank **and** attach the regulator.

6.7.6 Attach the air hose to the regulator.

6.7.7 Attach the air hose to the control box Nitrogen Air Pressure Inlet.

6.7.8 Connect the auxiliary airline to the Main Air Inlet on the controller box.

6.7.9 Connect the other end of the auxiliary airline to the airline connection fitting on the well head.

6.7.10 Connect the desired sample port discharge line to the water quality meter flow through cup.

6.7.11 Open the sample port that corresponds with the attached discharge line.

6.7.12 Operate the controller box in manual drive to achieve optimum flow rate through the flow through cup.

6.7.13 Allow the flow through cup to fill **and** ensure that the water quality meter is measuring all parameters.

6.7.14 Collect discharge from the water quality meter in an appropriate waste container.

NOTES:

If unable to achieve water quality stabilization of multiport wells, **then s**upervision is notified.

The water quality parameters include pH, specific conductance, dissolved oxygen, temperature, and turbidity.

The reading for ORP is documented, although **NOT** used to determine stabilization.

6.7.15 Record a minimum of three measurements, including the initial reading, in three-minute intervals **until** water quality stability has been achieved.

6.7.16 Once stabilization has been achieved, detach the port discharge line from the water quality meter and collect required well samples and quality control samples.

6.7.17 **After** sample collection close the sample port.

6.7.18 Repeat steps **6.6.10** through **6.6.17** as required for each port to be sampled.

6.7.19 **After** completion of sampling, turn off the nitrogen supply regulator **and** disconnect all air lines to and from the pump controller box and the well head.

6.7.20 Replace the well cap on the well.

6.8 Groundwater Sampling of Northwest Plume or Northeast Plume Extraction Wells

Sampler

6.8.1 Upon arriving at the sampling site, inspect the site/well for damage or unusual circumstances such as tampering, vandalism, etc.

6.8.2 **If** any damage is observed, **then** record any damage or unusual circumstances such as tampering, vandalism, etc., **and** contact the Facility Operations Manager.

NOTE:

Documentation of stable water quality conditions is **NOT** required at Northwest/Northeast Pump and Treat wells.

6.8.3 **Before** sampling, purge a minimum of 0.5 gallons of water from the sampling port.

NOTE:

Sample flow rate for VOCs is maintained at 100 ml/min or less.

6.8.4 Reduce the water flow rate to approximately 300 ml/min or less during sampling.

6.8.5 Collect samples for the required analytes in the appropriate order.

6.8.6 Collect required field quality control samples.

6.8.7 Return purge water from the Northwest Pump and Treat wells to the well of origin.

6.8.8 Dispose of purge water from the Northeast Pump and Treat wells in the sump located inside the fenced area.

7.0 ACCEPTANCE CRITERIA

None

8.0 POST PERFORMANCE WORK ACTIVITIES

8.1.1 Record the barometric pressure for wells where water level depth is measured.

8.1.2 Document any issues that may affect future analytical results in the well maintenance log.

8.1.3 Decontaminate sampling equipment according to CP4-ES-2702, **and** record the decontamination event in the logbook.

8.1.4 Complete Chain-of-Custody and MW groundwater data forms according to CP4-ES-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*.

8.1.5 Submit samples and appropriate Chain-of-Custody forms to the laboratory or for off-site shipment.

NOTE:

Residential well purge water may be discharged to the ground unless otherwise specified.

8.1.6 Drain all purge water from the water quality meter, sampling box, and discharge tubing into the waste container on the sample trailer.

8.1.7 Record purge water volume collected in the waste container on the container log sheet and the MW groundwater data form.

NOTES:

Well purge water is transported to the C-612 Pump and Treat facility at the end of every shift.

The sampling box is decontaminated with a minimum of 300 mL of analyte-free water through the sampling port on the sampling box.

8.1.8 Thoroughly decontaminate the sampling box and water level meter **and** record the decontamination event and time.

8.1.9 Disconnect the pump cycle control box from the well head, replace discharge tubing into well, **and** lock the well cap.

8.1.10 Transport the purge water waste container to C-612 for treatment.

8.1.11 Handle waste generated according to CP3-WM-1037

8.1.12 Record all observations and operations according to CP4-ES-2700.

8.1.13 Coordinate and release the sample(s) and related COC documentation to the Transportation Specialist for further handing in accordance CP3-WM-9503, *Off-Site Shipments by Air Transport.*

9.0 RECORDS

9.1 Records Generated

The following records may be generated by this procedure:

- Data Form Entries
- Logbook Entries

9.2 Records Disposition

The records are to be maintained according to CP3-RD-0010, *Records Management Process*.

Appendix A – Acronyms/Definitions

ACRONYMS

D&R - Deactivation & Remediation

DOE - U.S. Department of Energy

Cf – Casing factor

IHWP - Industrial Hygiene Work Permit

JHA – Job Hazard Analysis

ml/min – milliliters per minute

MW – Monitoring Wells

NTU – Nephelometric Turbidity Units

ORP – Oxidation Reduction Potential

Pd – Packer depth

PEMS – Paducah Environmental Management System

psi – pounds per square inch

RWP - Radiological Work Permit

SMO - Sample Management Office

UCRS – Upper Continental Recharge System

VOC – Volatile Organic Compounds

Wd – Well depth

DEFINITIONS

Monitoring Well – Any well intended to be used either to collect water samples for purposes of water quality testing, or to measure groundwater levels. A piezometer is a type of monitoring well which measures the pressure (more precisely, the piezometric head) of groundwater at a specific point.