

**TRI-PARTY AGREEMENT**

**Change Notice Number**  
TPA-CN- 0910

**TPA CHANGE NOTICE FORM**

**Date:**  
June 16, 2022

**Document Number, Title, and Revision:**  
DOE/RL-2014-51, *Sampling and Analysis Plan for the 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction*, Rev. 0

**Date Document Last Issued:**  
December 2015

**Approved Change Notices Against this Document:** TPA-CN-0720, -0796, -0878

**Originator:** M. E. Byrnes

**Phone:** 509-373-3996

**Description of Change:**

DOE/RL-2014-51 is amended to remove reference to DOE/RL-2014-37, Rev 0, Appendix C, *Air Monitoring Plan*. Analytes and analytical methods are updated. In addition, information on two future extraction wells (299-E33-269 [D0112] and 299-E33-270 [D0113]) have been added.

\_\_\_\_\_ M. W. Cline \_\_\_\_\_ and \_\_\_\_\_ D. Goswami \_\_\_\_\_ agree that the proposed change  
**DOE** **Lead Regulatory Agency**  
modifies an approved workplan/document and will be processed in accordance with the Tri-Party Agreement Action Plan, Section 9.0, *Documentation and Records*, and not Chapter 12.0, *Changes to the Agreement*.

The following changes have been made:

- Appendix C, *Air Monitoring Plan* of the 200-DV-1 removal action work plan (DOE/RL-2014-37) was deleted in March 2021 through TPA-CN-0907. This appendix was the basis for including cadmium and manganese in the groundwater sampling design. Text in Section 3.2.2 of the 200-DV-1 SAP (DOE/RL-2014-51) is being revised to remove reference to DOE/RL-2014-37, Rev 0, Appendix C and as a result, manganese and cadmium are deleted from Tables 2-3 and 3-1. In Table 3-1, sampling using the vacuum-enhanced recovery, footnote b is deleted, and the footnotes are renumbered. Updated section to include sampling frequency.
- Separate analysis of bicarbonate alkalinity and carbonate alkalinity in Tables 2-3 and 3-1 is changed to total alkalinity.
- Total and free cyanide are added as analytes. The analytical methods for sulfide and uranium isotopes are added to reflect current analytical methods.
- Two extraction wells (299-E33-269 [D0112] and 299-E33-270 [D0113]) have been added to this SAP. Section 1.2 and Figure 1-2 have been revised to include the wells. Section 3.2 has been revised to include the new wells.
- Table 2-6 footnote h and Table 3-1 footnote c, that specifies only PNNL to complete isotopic and major ion analyses have been deleted.

Additions are shown using double underline. Deletions are shown using ~~strikeout~~.

Note: Include affected page numbers: 1-2, 1-4, 2-13, 2-14, 2-20, 3-1, 3-3, 3-4, and 3-5

**Justification and Impacts of Change:**

Continued page 2

**Approvals:**

\_\_\_\_\_  
DOE Project Manager

\_\_\_\_\_  
Date

Approved  Disapproved

\_\_\_\_\_  
EPA Project Manager

\_\_\_\_\_  
Date

Approved  Disapproved

\_\_\_\_\_  
Ecology Project Manager

\_\_\_\_\_  
Date

Approved  Disapproved

**Justification and Impacts of Change:**

Section 3.2.2 of DOE/RL-2014-51, Sampling Parameters and Frequency, is revised to remove reference to DOE/RL-2014-37, Rev 0, Appendix C, *Air Monitoring Plan*. The Air Monitoring Plan (AMP) has been removed from DOE/RL-2014-37, Rev 0 because the optional technology of vacuum-enhanced recovery is no longer a requirement of the removal action. To date, vacuum-enhanced recovery has not been used, but is an option that may be added if/when the project and regulators approve its use. The AMP was the basis for including cadmium and manganese in the groundwater sampling design. The removal of the AMP from the RAWP eliminates the requirement to analyze groundwater for cadmium and manganese.

If the pH of groundwater is less than 8.3 then the alkalinity is attributed to the bicarbonate ion only. In Table 2-3 and 3-1 the separate analysis of bicarbonate alkalinity and carbonate alkalinity are changed to total alkalinity. This change is based on local monitoring wells pH measurements measuring nominally <8.3. If a pH measurement is obtained that is >8.3 the carbonate, bicarbonate and hydroxyl ion can be calculated and reported by the analytical lab.

The 200 West P&T facility requires analysis of water received by the facility for anticipated analytes to determine treatment needs therefore, total and free cyanide are added to this SAP. The uranium isotopes, U-233/234 and U-235/236, are included. The previous version of the SAP did not correctly have the analytes listed.

Two extraction wells, 299-E33-269 (D0112) and 299-E33-270 (D0113), constructed in FY2021 and FY2022, respectively, have been added to this SAP. Connection of the wells to the 200W P&T is dependent on Hanford Priority and available funding. This SAP will implement the routine sampling of the perched water from the extraction wells.

the underlying aquifer. Two additional perched water extraction wells (299-E33-350 and 299-E33-351) were drilled and constructed in 2014 to support extraction operations and obtain additional information about the deep vadose zone (SGW-57488, *Borehole Summary Report for the Installation of Two Perched Groundwater Wells in the 200-DV-1 Operable Unit, FY 2014*). Construction of well D0112 was completed in FY2021, and well D0113 in FY2022. Routine sampling of perched water from these wells will be performed in accordance with this SAP. The extracted perched water will be collected in a centralized perched water container at the 200-DV-1 OU site, then transported to the 200 West P&T for treatment. Actual completion of the extraction wells is dependent on Hanford Priority and available funding. Figure 1-1 shows the locations of the Hanford Site, the 200-DV-1 OU perched water, and the 200 West P&T. Figure 1-2 provides a plan view of the 200-DV-1 OU perched water area within the B Tank Farm complex.

The perched water contains uranium, technetium-99, nitrate, total chromium, hexavalent chromium, and tritium at concentrations above maximum contaminant levels (MCLs), as identified in the action memorandum (DOE/RL-2014-34). These contaminants are slowly moving downward, entering the 200-BP-5 OU aquifer and contributing to groundwater contamination. Actual and threatened releases and the migration of hazardous substances from the perched water to the underlying aquifer present an imminent and substantial endangerment to human health and the environment.

### 1.3 Site Geology/Hydrogeology

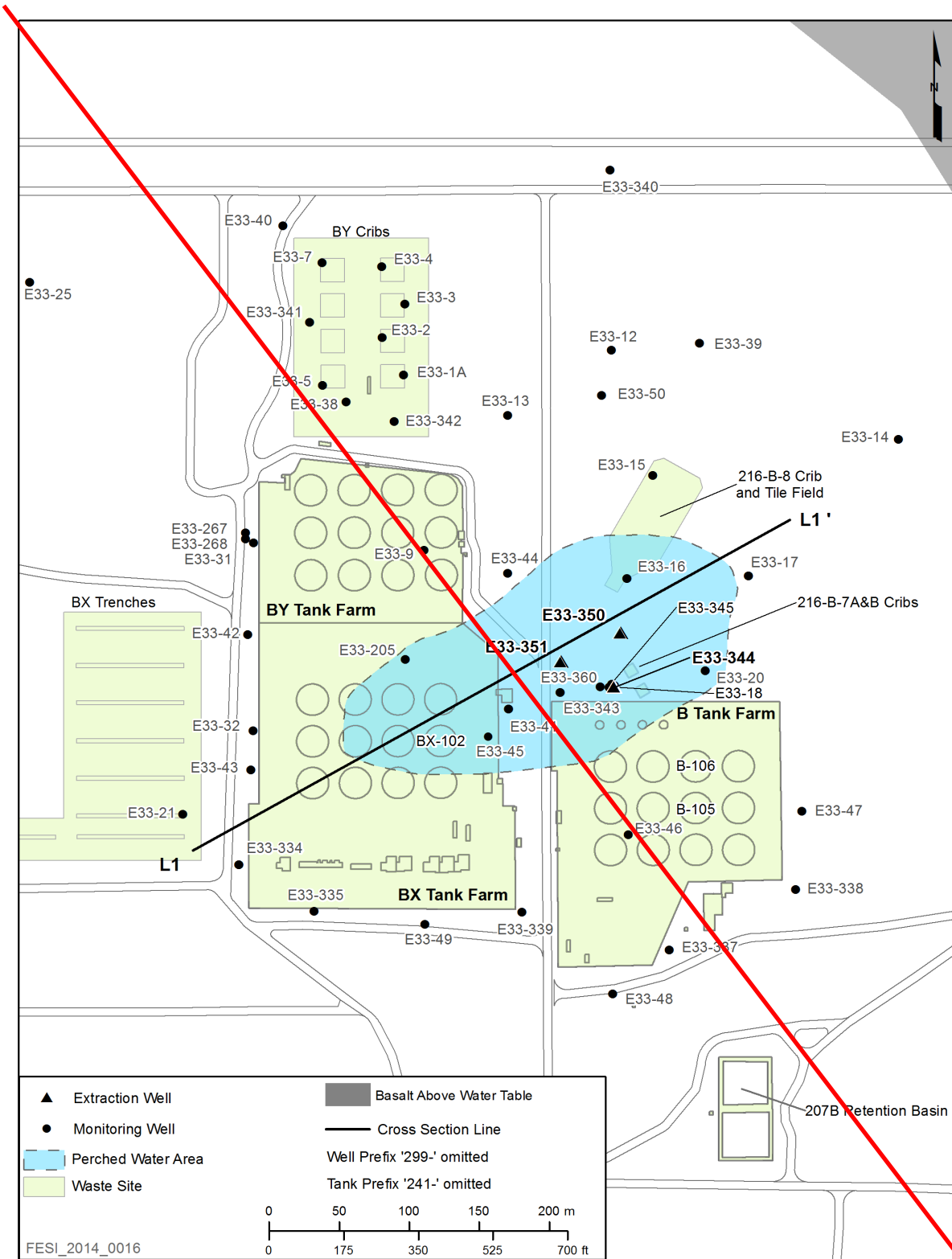
The following subsections provide an overview of the stratigraphic units and geology in the 200-DV-1 OU perched water area.

#### 1.3.1 Stratigraphic Units

The geology in the perched water area is composed of the following five stratigraphic units, in descending order:

- Hanford formation unit 1 (H1) (gravel dominated sequence)
- Hanford formation unit 2 (H2) (sand-dominated sequence)
- Cold Creek unit (CCU) – silt dominated (CCU<sub>z</sub>) (silt, fine-grained)
- CCU – gravel dominated (CCU<sub>g</sub>) (gravel, coarse-grained)
- Columbia River Basalt Group – bedrock

Detailed discussion of the various stratigraphic units beneath the B Complex area is provided in Sections 2.3 and 2.5 of PNNL-19277, *Conceptual Models for Migration of Key Groundwater Risk Contaminants Through the Vadose Zone and Into the Unconfined Aquifer Below the B-Complex*, and in Chapter 3 of SGW-58147, *Annual Performance Report for the 200-DV-1 Operable Unit Perched Water Extraction, Fiscal Year 2014*. Backfill material was added to the surface during construction of the tanks, cribs, and trenches used in this area for liquid waste storage or disposal. The H1 underlies disturbed and manmade structures and consists of highly permeable gravel dominated basaltic sediment. The H2, a sand-dominated unit that underlies H1, extends vertically through approximately two-thirds of the vadose zone and is the thickest of the units. The H2 contains several thin, fine-grained, silty lenses that promote horizontal spreading of waste liquids that accumulate and migrate through the vadose zone. The CCU, which contains the perching interval, underlies H2. The Columbia River Basalt Group forms the bedrock and bottom of the unconfined aquifer and lies just a few meters below the bottom of the CCU perching silt layer (CCU<sub>z</sub>). Highly transmissive, coarse-grained, gravelly deposits (CCU<sub>g</sub>) overlie basalt and form the sediment interval containing the unconfined aquifer.



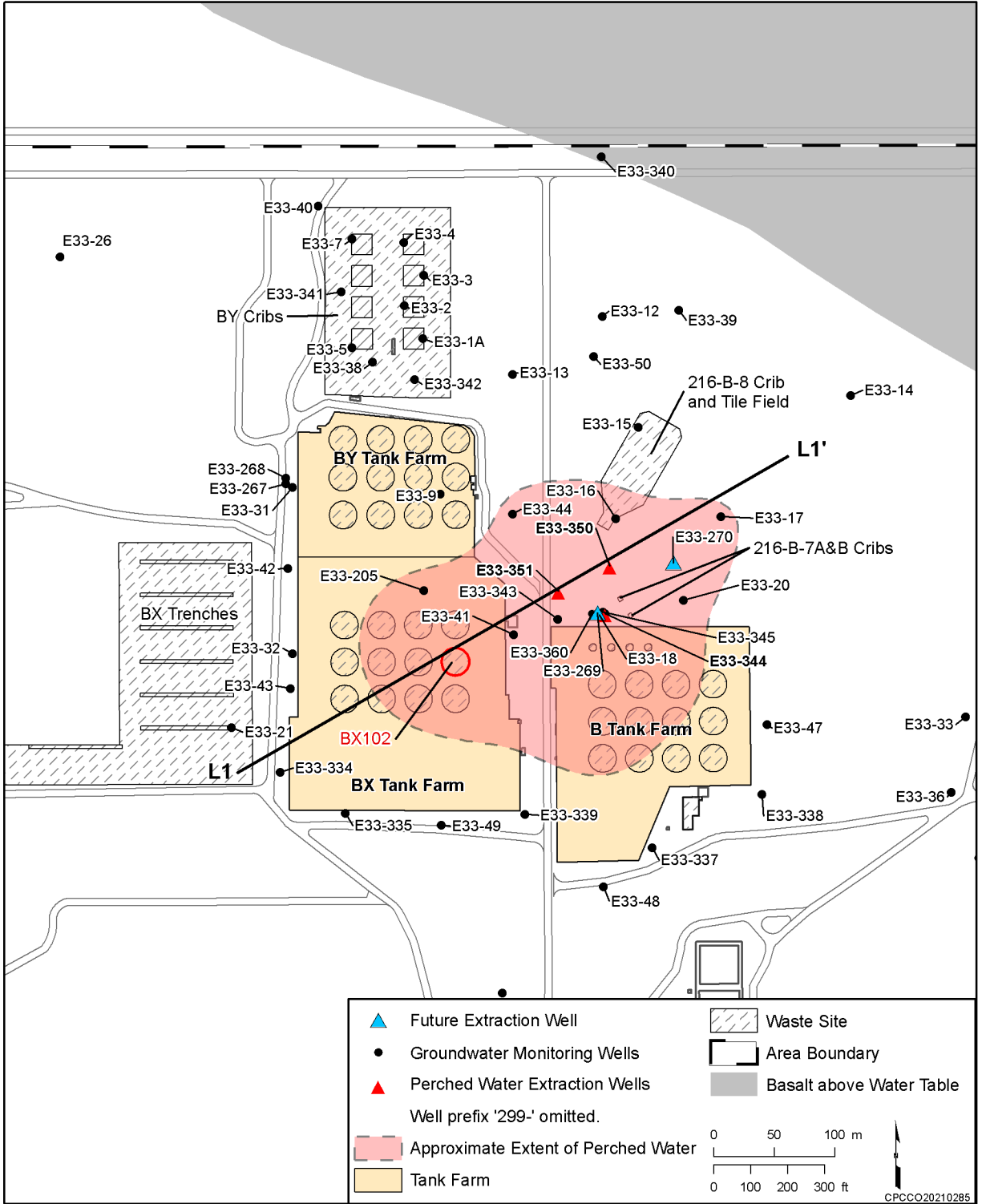


Figure 1-2. Plan View of 200-DV-1 OU Perched Water Area

Table 2-3. Performance Requirements for Perched Water Analysis

Constituent	CAS No.	MCL	Analytical Method <sup>a</sup>	Highest Allowable PQL <sup>b</sup>	Precision	Accuracy
<b>Radionuclides (pCi/L)</b>						
Carbon-14	14762-75-5	2,000	Carbon-14 liquid scintillation	5	≤20	80 to 120
Iodine-129	15046-84-1	1	Iodine-129 liquid scintillation (low level)	1		
Technetium-99	14133-76-7	900	Technetium-99 liquid scintillation or GPC	15		
Tritium	10028-17-8	20,000	Tritium liquid scintillation	400		
<u>Uranium-233/Uranium-234</u>	<u>U-233/U-234</u>	<u>20</u>	<u>Alpha Energy Analysis</u>	<u>1</u>		
<u>Uranium-235/Uranium-236</u>	<u>U-235/U-236</u>	<u>20</u>	<u>Alpha Energy Analysis</u>	<u>1</u>		
<u>Uranium-238</u>	<u>U-238</u>	<u>20</u>	<u>Alpha Energy Analysis</u>	<u>1</u>		
<b>Inorganics – Metals (µg/L)</b>						
Arsenic	7440-38-2	10	EPA 6010	10	≤20	80 to 120
<del>Cadmium</del>	<del>7440-43-9</del>	<del>5</del>	<del>EPA 6010</del>	<del>5</del>		
Calcium	7440-70-2	<sup>c</sup>	EPA 6010	1,000		
Chromium (total)	7440-47-3	100	EPA 6010	10		
Iron	7439-89-6	300	EPA 6010	50		
Magnesium	7439-95-4	<sup>c</sup>	EPA 6010	750		
<del>Manganese</del>	<del>7439-96-5</del>	<del>50<sup>d</sup></del>	<del>EPA 6010</del>	<del>5</del>		
Potassium	7440-09-7	<sup>c</sup>	EPA 6010	4,000		
Sodium	7440-23-5	<sup>c</sup>	EPA 6010	500		
Uranium (total)	7440-61-1	30	EPA 6020	15		

Table 2-3. Performance Requirements for Perched Water Analysis

Constituent	CAS No.	MCL	Analytical Method <sup>a</sup>	Highest Allowable PQL <sup>b</sup>	Precision	Accuracy
<b>Inorganics – Miscellaneous (µg/L)</b>						
Chromium (hexavalent)	18540-29-9	48 <sup>c</sup>	EPA 7196	10	≤20	80 to 120
<b>Inorganics – Anions (µg/L)</b>						
Chloride	16887-00-6	250,000	Anions by IC – 300.0	400	≤20	80 to 120
Fluoride	16984-48-8	4,000	Anions by IC – 300.0	500		
Nitrate	14797-55-8	10,000 (as N)	Anions by IC – 300.0	250		
Nitrite	14797-65-0	1,000 (as N)	Anions by IC – 300.0	250		
Sulfate	14808-79-8	250,000 <sup>d</sup>	Anions by IC – 300.0	550		
<u>Sulfide</u>	<u>18496-25-8</u>	ε	<u>Anions by IC – 300.0</u>	<u>2,100</u>		
<b>General Chemistry (µg/L)</b>						
Bicarbonate alkalinity	HCO <sub>3</sub> ALKALINITY	e	Alkalinity by 310.1	5,000	≤20	80 to 120
<u>Carbonate-a-Total Alkalinity</u>	CO <sub>3</sub> ALKALINITY	c	Alkalinity by 310.1	5,000		
<u>Cyanide, total</u>	<u>57-12-5</u>	ε	<u>Cyanide by 9012</u>	<u>15.75</u>		
<u>Cyanide, free</u>	<u>FREE-CN</u>	ε	<u>Free Cyanide by 9014</u>	<u>4</u>		
Total inorganic carbon	TINC	c	TOC by 9060	500		
Total organic carbon	TOC	c	TOC by 9060	1,000		
Total dissolved solids	TDS	500,000 <sup>d</sup>	TDS by 160.1	10,000		

a. For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*. Equivalent methods may be substituted.

b. Highest allowable PQLs are specified in contracts with analytical laboratories. Actual quantitation limits vary by laboratory and may be lower. Method detection limits are three to five times lower than quantitation limits. For radionuclides, values in this column are the highest allowable minimum detectable concentrations.

c. Does not have an MCL.

d. Secondary MCL.

**Table 2-3. Performance Requirements for Perched Water Analysis**

<b>Constituent</b>	<b>CAS No.</b>	<b>MCL</b>	<b>Analytical Method<sup>a</sup></b>	<b>Highest Allowable PQL<sup>b</sup></b>	<b>Precision</b>	<b>Accuracy</b>
--------------------	----------------	------------	--------------------------------------	--	------------------	-----------------

e. WAC 173-340-720, "Model Toxics Control Act—Cleanup," "Groundwater Cleanup Standards," Method B.

CAS = Chemical Abstracts Service

EPA = U.S. Environmental Protection Agency

GPC = gas proportional counting

IC = ion chromatography

MCL = maximum contaminant level

PQL = practical quantitation limit

TDS = total dissolved solid

TOC = total organic carbon

Table 2-6. Preservation, Container, and Holding-Time Guidelines

Constituent Parameter	Minimum Volume	Container Type <sup>a</sup>	Preservation <sup>b</sup>	Holding Time
<b>Metals<sup>c</sup></b>				
ICP/MS (with/without mercury)	500 mL	Narrow-mouth poly or glass	Adjust pH to <2 with nitric acid	28 days/6 months <sup>c</sup>
Dissolved metals (with/without mercury)	500 mL	Narrow-mouth poly or glass	Filter prior to pH adjustment to <2 with nitric acid	28 days/6 months <sup>c</sup>
<b>Inorganic – Miscellaneous</b>				
Hexavalent chromium	60 mL	Amber glass	Store at ≤6°C	24 hours
<b>Anions, General Chemistry Parameters</b>				
Chloride	500 mL	Poly or glass	Store at ≤6°C	28 days
Fluoride	500 mL	Poly or glass	Store at ≤6°C	28 days
Nitrate	500 mL	Poly or glass	Store at ≤6°C	48 hours
Nitrite	500 mL	Poly or glass	Store at ≤6°C	48 hours
Sulfate	500 mL	Poly or glass	Store at ≤6°C	28 days
Cyanide (Total) / Cyanide (Free)	500 mL	Poly or glass	NaOH to pH ≥ 12 Cool <6°C	14 days <sup>d,e,f</sup>
Sulfide	500 mL	Poly or glass	ZnAc+NaOH to pH >9 Cool <6°C	7 days <sup>d,e,f</sup>
<b>Radiochemical Analyses</b>				
Carbon-14	2 × 1 L	Narrow-mouth poly or glass	None	6 months
Iodine-129	2 × 4 L	Narrow-mouth poly or glass	None	6 months
Technetium-99 by liquid scintillation	1 L	Narrow-mouth glass	Adjust pH to <2 with HCl	6 months
Tritium	1 L	Narrow-mouth glass	None	6 months
AEA (Uranium isotopes)	1 L	Narrow-mouth poly or glass	HNO <sub>3</sub> to pH <2	6 months <sup>g</sup>
<b>Other Analyses<sup>h</sup></b>				
Isotopic analysis (O-18/O-16 and H-2/H-1)	1 L	Narrow-mouth poly	Filter	6 months
Major ions	1 L	Poly or glass	Anions – store at ≤6°C Cations – adjust pH to <2 with nitric acid	Anions – 28 days/48 hours Cations – 6 months

**Table 2-6. Preservation, Container, and Holding-Time Guidelines**

<b>Constituent Parameter</b>	<b>Minimum Volume</b>	<b>Container Type<sup>a</sup></b>	<b>Preservation<sup>b</sup></b>	<b>Holding Time</b>
------------------------------	-----------------------	-----------------------------------	---------------------------------	---------------------

## Notes:

The information in this table does not represent EPA requirements but is intended solely for use as guidance.

Selection of containers, preservation techniques, and applicable holding times should be based on the stated project-specific data quality objectives.

a. Under the “Container” heading, the term “poly” stands for EPA clean polyethylene bottles.

b. For preservation identified as “store at  $\leq 6^{\circ}\text{C}$ ,” the sample should be protected against freezing unless it is known that freezing will not impact the sample integrity.

c. For metals analysis, the 28 days/6 months holding time defines 28 days for mercury and 6 months for all other metals.

d. 40 CFR 136, Table II.

e. SW-846, Table 3-2.

f. SW-846, Table 2-40(B).

g. DOE/RL-96-68, Vol. 2, Appendix A.

~~h. These analyses will be performed at PNNL and will be conducted in accordance with PNNL procedures, QC standards, and analytical performance requirements.~~

EPA = U.S. Environmental Protection Agency

ICP/MS = inductively coupled plasma/mass spectrometry

PNNL = Pacific Northwest National Laboratory

QC = quality control

### 3 Field Sampling Plan

This chapter identifies the locations to be sampled, the sampling frequency, the data to be collected, and the contaminants to be analyzed.

#### 3.1 Sampling Objectives

The main sampling objectives for the perched water removal action are to (1) assess the recovered masses and concentrations of the COCs, (2) measure the volume of extracted water, (3) optimize the extraction system operations, and (4) investigate the perched zone characteristics. These objectives are accomplished by obtaining perched water data at the extraction and monitoring wells and from the perched water container. The samples will be analyzed for COCs, and hydraulic data for the perched zone will be collected. The data will be used for the treatment of perched water at the 200 West P&T and to support decisions on adjusting, transitioning, or terminating the 200-DV-1 OU perched zone extraction system.

#### 3.2 Sample Location, Frequency, and Constituents to Be Monitored

The following subsections provide details for the sampling activities performed under this SAP. This includes sample locations, sample identification, sampling frequency, sampling methods, and shipping requirements.

##### 3.2.1 Sampling Location

Figure 3-1 shows the locations of the extraction and monitoring wells located within the perched water zone. During perched water extraction operations, samples will be drawn from the sampling port located on the pipe that transports water from the extraction wells to the perched water container. Figure 3-2 shows the operational flow diagram at the wellhead. Samples will also be drawn from the sampling port on the perched water container. Samples will be collected from monitoring wells using a downhole pump. The sample number, well number, and perched water container identification number will be documented (e.g., in the field logbook) for each perched water sample collected.

##### 3.2.1.1 Sample Identification

The SMR organization will use a sample tracking database to track the perched water samples from collection through the laboratory analysis process. The HEIS database is the repository for the laboratory analytical results. HEIS sample numbers will be issued to the sampling organization for this project. The radiological and physical properties of each sample will be identified and labeled with a unique HEIS

A custody seal is fixed to each sample container and sample collection package in such a way as to indicate potential tampering. The seal will be fixed to the lid of each sample container, and the custody seal will be inscribed with the sampler's initials and the date. Sample custody during laboratory analysis is addressed in the applicable laboratory's standard operating procedures.

##### 3.2.1.4 Sample Containers, Preservatives, and Holding Times

Appropriate sample containers will be used for perched water samples collected for analysis. Container sizes may vary, depending on the laboratory-specific volumes needed to meet analytical detection limits. If, however, the radiological dose rate on the outside of a sample jar or the curie content within the sample exceeds levels acceptable to an offsite laboratory, the analytical project coordinator may send smaller volumes to the laboratory after consultation with SMR to determine acceptable volumes. Sample volumes, container types, and sample preservation requirements are maintained in the HEIS database and are captured on the sample chain-of-custody via the sample data tracking system.

### 3.2.1.5 Sample Collecting Procedure

During extraction operations, perched water is collected in a clean plastic container by using a tube connected to the sampling port, and field readings (e.g., temperature, pH, and conductivity) are recorded. After field readings are recorded, perched water is either collected in a large sample bottle and then pumped into the appropriate sampling containers or pumped directly from the system through the tubing into each sample bottle required for that sampling event as specified in Table 2-6.

### 3.2.1.6 Sample Shipping

Samples may not be transported without authorization from the S&GRP-authorized shipper. As applicable, the RCT will measure the contamination levels on the outside of each sample jar and the dose rates on each sample jar. The RCT will also measure the radiological activity on the outside of the sample container (through the container) and will document the highest contact radiological reading (in mrem/hr). This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork in accordance with U.S. Department of Transportation (DOT) regulations (49 CFR, “Transportation”) and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory’s acceptance criteria. The sampler will send copies of the shipping documentation to SMR within 48 hours of shipping.

As a general guideline, samples with activities less than 5 Sv/hr (0.5 mrem/hr) can be shipped to an appropriate offsite laboratory (e.g., DOE contract laboratory or a laboratory with a U.S. Nuclear Regulatory Commission or state license for specific radionuclides). Samples with activities between 5 and 100 Sv/hr (0.5 and 10 mrem/hr) may be shipped to an offsite laboratory, although samples with dose rates within this range will be evaluated on a case-by-case basis by SMR. Samples with activities greater than 100 Sv/hr (10 mrem/hr) may be sent to an onsite laboratory, as arranged by SMR.

## 3.2.2 Sampling Parameters and Frequency

At the startup of the gravity drain extraction operations under this removal action, perched water samples will be collected from ~~all three initial~~ each new extraction wells. Existing extraction wells will be sampled quarterly with an annual frequency re-evaluation of each well. For newly installed extraction well(s), sampling is designed to provide baseline aquifer concentrations and response to pumping. New extraction wells will be sampled quarterly for COC analytes the first year of sustained pumping. Quarterly sampling will continue unless an alternative frequency is deemed necessary.

~~The sampling requirements for COCs, non-COCs, and physical and operational parameters are provided in Table 3-1. Constituents for analysis and sample frequency for extraction wells are included in Table 3-1.~~

~~The air emission plan (Appendix C in the RAWP [DOE/RL 2014 37]) was prepared to determine the potential for radiological and chemical releases to the atmosphere during the vacuum enhanced recovery phase of the removal action. The potential to emit was calculated for all chemical contaminants found in the 200-DV-1 OU perched water. Four metals (arsenic, cadmium, hexavalent chromium, and manganese) were the only constituents to exceed their de minimis values, as specified in WAC 173-460, “Controls for New Sources of Toxic Air Pollutants.” Hexavalent chromium is a COC in the extracted perched water~~

~~and is being sampled on a quarterly basis; arsenic is a non-COC and is being sampled on an annual basis. Cadmium and manganese are not perched water COCs and, therefore, will be monitored during the vacuum enhanced recovery phase. For radiological contaminants, the unabated potential to emit is considered a minor source; therefore, only periodic confirmatory measurements are required for radiological monitoring.~~

Table 3-1. Sampling Frequency

Media	Constituent	CAS No.	Sampling Frequency from <u>Extraction Wells<sup>d</sup> Perched Water Wells and Container</u>
Perched water	<b>COCs</b>		
	Technetium-99	14133-76-7	Once per quarter
	Tritium	10028-17-8	Once per quarter
	Chromium (total) <sup>a</sup>	7440-47-3	Once per quarter
	Hexavalent chromium <sup>a</sup>	18540-29-9	Once per quarter
	Nitrate as N	14797-55-8	Once per quarter
	Uranium <sup>a</sup>	7440-61-1	Once per quarter
	<b>Non-COCs</b>		
	Carbon-14	14762-75-5	Semiannual
	Iodine-129	15046-84-1	Annual
	Uranium-233/ <u>Uranium-234</u>	<del>103968-55-3</del> <u>U-233/234</u>	Annual
	<u>Uranium-234</u>	<del>103966-29-5</del>	<del>Annual</del>
	Uranium-235/ <u>Uranium-236</u>	<del>15117-96-1</del> <u>U-235/236</u>	Annual
	Uranium-238	U-238	Annual
	Arsenic <sup>a</sup>	7440-38-2	Annual
	Calcium <sup>a</sup>	7440-70-2	Annual
	<del>Cadmium<sup>a,b</sup></del>	<del>7440-43-9</del>	<del>Annual</del>
	Chloride	16887-00-6	Annual
	Fluoride	16887-00-6	Annual
	Iron <sup>a</sup>	7439-89-6	Annual
	Magnesium <sup>a</sup>	7439-95-4	Annual
	<del>Manganese<sup>a,b</sup></del>	<del>7439-96-5</del>	<del>Annual</del>
	Molybdenum <sup>a</sup>	7439-98-7	Annual
	Nickel <sup>a</sup>	7440-02-0	Annual
	Nitrite as N	14797-65-0	Annual
	Potassium <sup>a</sup>	7440-09-7	Annual
Sodium <sup>a</sup>	7440-23-5	Annual	

Table 3-1. Sampling Frequency

Media	Constituent	CAS No.	Sampling Frequency from <u>Extraction Wells<sup>d</sup></u> <del>Perched Water Wells and Container</del>
	Sulfate	14808-79-8	Annual
	Sulfide	18496-25-8	Quarterly
	Total inorganic carbon	TINC	Quarterly
	Total organic carbon	TOC	Quarterly
	Total dissolved solids	TDS	Quarterly
	<u>Total Alkalinity</u>	ALKALINITY	Quarterly
	<u>Bicarbonate alkalinity</u>	HCO <sub>3</sub> ALKALINITY	Quarterly
	<u>Carbonate alkalinity</u>	CO <sub>3</sub> ALKALINITY	Quarterly
	<u>Cyanide, total</u>	<u>57-12-5</u>	<u>Quarterly</u>
	Cyanide, free	FREE-CN	Quarterly
	Isotopic analyses (O-18/O-16 and H-2/H-1) <sup>e</sup>	—	Once at startup <sup>dh</sup>
	Other analyses (magnesium, potassium, <del>bicarbonate alkalinity, carbonate total alkalinity</del> , total inorganic carbon, total organic carbon, total dissolved solids) <sup>dh</sup>	—	Once at startup <sup>dh</sup>
Field/operational parameters	Barometric pressure <sup>esc</sup>	—	Continuous
	Conductivity	—	Continuous
	Extracted flow rate	—	Continuous
	Conductivity	—	Once per quarter

**Table 3-1. Sampling Frequency**

Media	Constituent	CAS No.	Sampling Frequency from Extraction Wells <sup>a</sup> Perched Water Wells and Container
	Dissolved oxygen	—	Once per quarter
	pH	—	Once per quarter
	Temperature	—	Once per quarter
	Turbidity	—	Once per quarter
	Water level (well)	—	Continuous
	Water level (container)	—	Once per shipment

a. Both filtered and unfiltered samples will be collected for all metal constituents except hexavalent chromium (filtered only).

~~b. Sample only when using the vacuum-enhanced recovery extraction technology.~~

~~c. These analyses will be performed by PNNL and will be conducted in accordance with PNNL procedures, QC standards, and analytical performance requirements.~~

~~d. These analytes were specified for the initial startup of the extraction system using wells 299-E33-344, 299-E33-350, and 299-E33-351.~~

~~e. Barometric pressure readings will be taken from the nearest in-service Hanford Site barometric station to a well at the approximate time of sampling.~~

~~f. New extraction wells will be sampled quarterly for COC analytes for the first year of sustained pumping. Quarterly sampling will continue unless an alternative frequency is deemed necessary.~~

CAS = Chemical Abstracts Service

COC = contaminant of concern

PNNL = Pacific Northwest National Laboratory

QC = quality control

At the startup of the gravity drain extraction operations under this removal action, perched water samples, along with operational and physical parameters, will be collected from ~~all three initial~~ each new extraction wells. All chemical (~~except for cadmium and manganese~~) and radiological parameters will be analyzed for baseline development purposes. For COCs and physical parameters, the sampling activity will be repeated every quarter thereafter. The sampling frequency for the non-COC carbon-14 is semiannual and annual for all other non-COCs.

~~At the startup of~~ If the vacuum-enhanced recovery operations system is approved and implemented, perched water samples will be obtained from all operational wells in accordance with the approved air monitoring plan. Physical parameters will also be obtained. All chemical (~~including cadmium and manganese~~) and radiological parameters will be analyzed for baseline development purposes. For COCs