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TRI-PARTY AGREEMENT

Change Notice Number TPA-CN- 0814	TPA CHANGE NOTICE FORM	Date: 6/14/18
Document Number, Title, and Revision: DOE/RL-2014-44-ADD2, Rev. 0, *Remedial Design Report/Remedial Action Work Plan Addendum for the 100-F/IU Groundwater*		Date Document Last Issued: August 2015
Approved Change Notices Against this Document: TPA-CN-708 and TPA-CN-0736		
Originator: MJ Hartman		Phone: 509-376-4385

1231516

Description of Change: Changes are needed to the sampling frequency and constituents in the 100-F/IU groundwater RD/RAWP Addendum due to field observations. Locations are proposed for Phase 2 wells.

M.W. Cline (**DOE**) and R.A. Lobos (**Lead Regulatory Agency**) agree that the proposed change 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*.

This change notice revises the groundwater sampling and analysis plan (Appendix A). Sampling frequency and constituents analyzed are revised for some wells in response to observations from drilling and sampling in 2016 and 2017. Locations and sampling requirements for Phase 2 wells are listed. Changes affect text within Appendix A, Table A-8, Figure A-16, and Table A-9. New references are added to Section A6.

Table C-7 in the Waste Management Plan is revised to include Phase 2 wells.

Additional text added with double underline, removed text is with ~~strikeout~~. Table A-8 is replaced in its entirety, along with Figure A-16 for ease of viewing.

Note: Include affected page number(s): A-4, A-44, A-47 through A-49, A-51, A-54 through A-56, A-64, A-65, C-3

Justification and Impacts of Change:
The work plan groundwater addendum anticipated that Phase 2 wells would be needed, and stated that their locations would be determined based on results of Phase 1 wells and monitoring. Adjustment of sampling frequency was needed for other wells to respond to increases in nitrate and chromium concentrations in 2017.

Approvals:

DOE Project Manager	6/18/2018 Date	X Approved [ ] Disapproved
EPA Project Manager	6/26/2018 Date	X Approved [ ] Disapproved
N/A Ecology Project Manager	Date	[ ] Approved [ ] Disapproved

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DQO report (SGW-58291, *Data Quality Objectives for 100-FR-3 Monitored Natural Attenuation*). The report is included with this appendix for convenience.

Water levels will be measured manually at periods of low, high, and moderate river stage. A network of wells will be incorporated into an automated water level network (AWLN) for hourly measurements. Water level data will be used to improve interpretations and models of groundwater flow in the 100-FR-3 OU.

A1.2 Background

This section summarizes hydrogeology, groundwater flow, contaminant sources, and contaminant plumes of the 100-FR-3 OU as known in 2014. For updated interpretations, see SGW-61298, *Evaluation of 100-FR-3 Groundwater Monitoring Results from Phase 1 Wells*, or the most current groundwater annual report (e.g., DOE/RL-2016-67, *Hanford Site Groundwater Monitoring Report for 2016*).

A1.2.1 Site Hydrogeology

A detailed description of the 100-F/IU site history and hydrogeologic conditions is included in Sections 1.2 and 3.4 through 3.6 of the 100-F/IU RI/FS (DOE/RL-2010-98). The primary geologic units are the Hanford formation, the Ringold Formation upper mud unit (RUM), deeper units of the Ringold Formation, and Columbia River Basalt (Figure A-2). Chapter 3 of the 100-F/IU RI/FS (DOE/RL-2010-98) includes detailed information about site geology.

Figure A-3 is a geologic cross section through 100-F Area, trending southwest to northeast. A thick unit of Ringold Formation mud (silt) forms the base of the section. In some locations, remnants of Ringold unit E (silty gravelly sand) overlie the mud. The uppermost geologic unit (Hanford formation) varies in thickness from approximately 6 m (20 ft) in the southwest to approximately 21 m (69 ft) in the northeast. Gravel-rich strata appear to be most common. Sand-dominated intervals also are present but appear to be local in extent. Silt-dominated strata have not been identified at 100-F.

Figure A-4 is a geologic cross section through the eastern end of Gable Mountain to the Columbia River. The cross section parallels the northern section of the 100-FR-3 OU nitrate plume. Most of the well logs do not provide sufficient detail to distinguish between Hanford and Ringold E sediments, nor between RUM and other Ringold silt/clay units. The top of the RUM north of Gable Mountain is at approximately the same elevation as the Ringold lower mud south of the structure.

Ringold unit E is not present beneath much of the 100-FR-3 OU. However, recent interpretations of borehole logs from some wells suggest the presence of remnants of this unit. Figure A-5 illustrates the elevation extent of these remnants, with the largest one in southwestern 100-F Area and smaller remnants in central and eastern 100-F Area. Where unit E extends above the water table, it comprises the entire unconfined aquifer. Ringold unit E is less transmissive than the Hanford formation, which may contribute to the persistence of the TCE plume in groundwater (Figure A-5; Section A1.2.4).

The RUM underlies the Hanford formation (and Ringold unit E, where present) beneath the 100-F Area. Figure A-6 illustrates a recent interpretation of the RUM surface beneath 100-F Area. It slopes generally from southwest to northeast.

The unconfined aquifer beneath the 100-F Area comprises Hanford formation gravels or Ringold Formation silty sandy gravels (Figure A-2). The thickness of the uppermost aquifer in the 100-FR-3 OU ranges from less than 1 to 8 m (3 to 26 ft). The unconfined aquifer is absent in a region just north of Gable Mountain. Below the unconfined aquifer, the Ringold Formation consists of a series of aquitards and water bearing zones. The low-permeability RUM is the base of the unconfined aquifer.

meet the project DQOs. For routine groundwater monitoring undertaken through this SAP, the DQA is captured in QC associated with the annual groundwater report (e.g., DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*), evaluating field and lab QC, and usability of data. Further DQAs will be performed at the discretion of the OU Project Manager and documented in a report overseen by SMR.

A1 Field Sampling Plan

This chapter lists the groundwater wells and aquifer tubes to be monitored, sampling frequency, and constituents to be analyzed.

The data will be evaluated as described in Chapter 6 of the Groundwater Addendum.

A1.1 Sampling Objectives

The primary objective of groundwater sampling in the 100-FR-3 OU is to monitor the natural attenuation of groundwater COCs in accordance with the data requirements identified in the DQO report (SGW-58291). Monitoring results will be used to assess the effectiveness of natural attenuation in meeting cleanup levels. Contaminants in groundwater in 100-FR-3 OU that will be managed through MNA are nitrate, Cr(VI), TCE, and strontium-90. Monitoring for TCE degradation products (*cis*-1,2-dichloroethene and vinyl chloride) will also be performed.

Due to analytical uncertainties identified in the 100-F/IU RI/FS (DOE/RL-2010-98), an investigation of antimony, cadmium, and cobalt was identified in the DQO report (SGW-58291) to determine if these analytes are present below the action level. Sampling for these metals will be performed using an analytical method with a sufficiently low detection limit.

These objectives are accomplished in the field by sampling groundwater at designated wells, aquifer tubes, and a riverbank seep and analyzing the samples for the COCs and other identified analytes.

A1.2 Sample Location, Frequency, and Constituents to be Monitored

The DQO process was used to identify sample locations, frequencies for collection, and constituents for monitoring. Problem statements were used to identify PSQs that can be answered using data inputs to satisfy specific data needs. PSQs are discussed in Section A3.2.1 and in the DQO report. (SGW-58291). The DQOs were reviewed in 2017 following installation and sampling of the Phase 1 wells, as documented in Appendix B of SGW-61298. The locations of the 100-FR-3 OU monitoring network, including wells, aquifer tubes, and a seep, are presented in Figures A-16 and A-17.

~~Based on the DQO (SGW-58291), eight locations were identified for installation of new Phase 1 monitoring wells.~~ Details on the installation of the wells are presented in Section A3.2.2[1]. The sample locations, frequency, and constituents to be monitored are identified in Table A-8. Additional samples may be collected on an as needed basis.

[1]During the first phase of well installations in 2016, the unconfined aquifer was found to be absent at two of the locations (C9474 and C9479) and wells could not be installed. The lack of a well at C9474 left a gap in the network between the nitrate plume and the river. Existing well 699-70-23 was considered, but appears to be an old dug well cased with a metal culvert. The poor construction and lack of documentation precludes its use for sampling. Instead, aquifer tubes 75-D and 77-D are added to the network to monitor nitrate near the river.

~~Table A-8. 100-FR-3 Operable Unit Summary of Monitoring Locations, Frequencies, and Constituents~~

~~Monitoring Location~~	~~Analytes~~					~~Water Level[a]~~		~~Data Need~~								~~Sample Frequency~~		
	~~Cr(VI) (Filtered)~~	~~TCE and Degradation Products~~	~~Nitrate~~	~~Strontium-90~~	~~Trace Metals[b]~~	~~AWLN~~	~~Manual~~	~~PSQ 1a, 1b: Contamination Decreasing as expected?~~	~~PSQ 1c: Changes in environmental conditions that reduce effectiveness?~~	~~PSQ 1d: Unacceptable impacts to river?~~	~~PSQ 1e: Evidence of new contaminant releases?~~	~~PSQ 2: Trace metals below action levels?~~	~~PSQ 3: Geologic and hydrologic data confirm Conceptual Site Model?~~	~~PSQ 4a, 4b: Remediation objectives achieved?~~	~~Year 1~~	~~Year 2 to Year 5~~	~~Year 6 and Onward~~
~~Existing Monitoring Wells~~																		
~~199-F5-1~~			~~X~~	~~X~~			~~X~~	~~X~~	~~X~~		~~X~~			~~X~~	~~A, S[c]~~	~~A, S[c]~~	~~B~~
~~199-F5-4~~	~~X~~	~~X~~	~~X~~		~~X~~		~~X~~	~~X~~	~~X~~		~~X~~	~~X~~		~~X~~	~~A, S[d]~~	~~A, S[d]~~	~~B[e]~~
~~199-F5-42~~	~~X~~		~~X~~	~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~A~~	~~A~~	~~B~~
~~199-F5-43A~~	~~X~~		~~X~~	~~X~~	~~X~~		~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~	~~X~~	~~A~~	~~A~~	~~B[e]~~
~~199-F5-44~~	~~X~~		~~X~~	~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~A~~	~~A~~	~~B~~
~~199-F5-45~~	~~X~~	~~X~~	~~X~~			~~X~~	~~X~~	~~X~~	~~X~~		~~X~~		~~X~~	~~X~~	~~A~~	~~A~~	~~B~~
~~199-F5-46~~	~~X~~	~~X~~	~~X~~	~~X~~			~~X~~	~~X~~	~~X~~		~~X~~			~~X~~	~~S~~	~~S~~	~~B~~
~~199-F5-47~~	~~X~~		~~X~~	~~X~~			~~X~~	~~X~~	~~X~~		~~X~~			~~X~~	~~A~~	~~A~~	~~B~~
~~199-F5-48~~	~~X~~	~~X~~	~~X~~		~~X~~		~~X~~	~~X~~	~~X~~		~~X~~	~~X~~		~~X~~	~~A~~	~~A~~	~~B[e]~~
~~199-F5-52~~	~~X~~		~~X~~			~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~	~~A~~	~~A~~	~~B~~
~~199-F5-54~~	~~X~~		~~X~~	~~X~~			~~X~~	~~X~~	~~X~~		~~X~~			~~X~~	~~A~~	~~A~~	~~B~~
~~199-F5-55~~	~~X~~		~~X~~	~~X~~			~~X~~	~~X~~	~~X~~		~~X~~			~~X~~	~~A, S[c]~~	~~A, S[c]~~	~~B~~
~~199-F5-56~~	~~X~~	~~X~~	~~X~~	~~X~~			~~X~~	~~X~~	~~X~~		~~X~~			~~X~~	~~A~~	~~A~~	~~B~~
~~199-F5-6~~	~~X~~		~~X~~	~~X~~			~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			~~X~~	~~A, S[d]~~	~~A, S[d]~~	~~B~~
~~199-F6-1~~	~~X~~		~~X~~	~~X~~		~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~	~~A~~	~~A~~	~~B~~
~~199-F7-1~~		~~X~~	~~X~~			~~X~~	~~X~~	~~X~~	~~X~~		~~X~~		~~X~~	~~X~~	~~A~~	~~A~~	~~B~~
~~199-F7-2~~		~~X~~	~~X~~			~~X~~	~~X~~	~~X~~	~~X~~		~~X~~		~~X~~	~~X~~	~~A~~	~~A~~	~~B~~
~~199-F7-3~~		~~X~~	~~X~~				~~X~~	~~X~~	~~X~~		~~X~~			~~X~~	~~A~~	~~A~~	~~B~~
~~199-F8-2~~	~~X~~			~~X~~			~~X~~	~~X~~	~~X~~		~~X~~			~~X~~	~~A~~	~~A~~	~~B~~
~~199-F8-4~~			~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~X~~	~~A~~	~~A~~	~~B~~
~~199-F8-7~~		~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~	~~X~~		~~X~~	~~X~~		~~X~~	~~A~~	~~A~~	~~B[e]~~
~~699-58-24~~							~~X~~		~~X~~						~~A[g]~~	~~A[g]~~	~~B[g]~~
~~699-59-32[h]~~			~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~X~~	~~A~~	~~A~~	~~B~~
~~699-60-32[h]~~			~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~X~~	~~A~~	~~A~~	~~B~~

~~Table A-8. 100-FR-3 Operable Unit Summary of Monitoring Locations, Frequencies, and Constituents~~

	~~Analytes~~					~~Water Level[a]~~		~~Data Need~~							~~Sample Frequency~~		
~~Monitoring Location~~	~~Cr(VI) (Filtered)~~	~~TCE and Degradation Products~~	~~Nitrate~~	~~Strontium-90~~	~~Trace Metals[b]~~	~~AWLN~~	~~Manual~~	~~PSQ-1a, 1b: Contamination Decreasing as expected?~~	~~PSQ-1c: Changes in environmental conditions that reduce effectiveness?~~	~~PSQ-1d: Unacceptable impacts to river?~~	~~PSQ-1e: Evidence of new contaminant releases?~~	~~PSQ-2: Trace metals below action levels?~~	~~PSQ-3: Geologic and hydrologic data confirm Conceptual Site Model?~~	~~PSQ-4a, 4b: Remediation objectives achieved?~~	~~Year 1~~	~~Year 2 to Year 5~~	~~Year 6 and Onward~~
~~699-61-37~~						~~X~~	~~X~~						~~X~~		~~A[c]~~	~~A[c]~~	~~B[c]~~
~~699-62-31~~			~~X~~				~~X~~	~~X~~	~~X~~				~~X~~	~~X~~	~~A~~	~~A~~	~~B~~
~~699-63-25A~~			~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~X~~	~~A~~	~~A~~	~~B~~
~~699-64-27~~			~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~X~~	~~A~~	~~A~~	~~B~~
~~699-66-23~~			~~X~~			~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			~~X~~	~~X~~	~~A~~	~~A~~	~~B~~
~~699-70-23~~						~~X~~	~~X~~		~~X~~				~~X~~		~~A[c]~~	~~A[c]~~	~~B[c]~~
~~699-71-30~~		~~X~~	~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~X~~	~~A~~	~~A~~	~~B~~
~~699-74-44~~							~~X~~		~~X~~				~~X~~		~~A[c]~~	~~A[c]~~	~~B[c]~~
~~699-77-36~~		~~X~~	~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~X~~	~~A~~	~~A~~	~~B~~
~~New Monitoring Wells (Phase 1)~~																	
~~C9472 C9628 (699-75-34B)[j]~~		~~X~~	~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~X~~	~~Q~~	~~A~~	~~B~~
~~C9474[i]~~			~~X~~			~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			~~X~~	~~X~~	~~Q~~	~~A~~	~~B~~
~~C9475 (699-71-34)~~		~~X~~	~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~X~~	~~Q~~	~~A~~	~~B~~
~~C9476 (699-75-31)~~		~~X~~	~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~X~~	~~Q~~	~~A~~	~~B~~
~~C9477 (699-75-28)~~			~~X~~			~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			~~X~~	~~X~~	~~Q~~	~~A~~	~~B~~
~~C9478 (699-66-32)~~			~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~X~~	~~Q~~	~~A~~	~~B~~
~~C9479[k]~~			~~X~~			~~X~~	~~X~~	~~X~~	~~X~~				~~X~~	~~X~~	~~Q~~	~~A~~	~~B~~
~~C9480 (699-67-26)~~			~~X~~			~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			~~X~~	~~X~~	~~Q~~	~~A~~	~~B~~

Table A-8. 100-FR-3 Operable Unit Summary of Monitoring Locations, Frequencies, and Constituents

Monitoring Location	Analytes					Water Level[a]		Data Need							Sample Frequency		
	Cr(VI) (Filtered)	TCE and Degradation Products	Nitrate	Strontium-90	Trace Metals[b]	AWLN	Manual	PSQ 1a, 1b: Contamination Decreasing as expected?	PSQ 1c: Changes in environmental conditions that reduce effectiveness?	PSQ 1d: Unacceptable impacts to river?	PSQ 1e: Evidence of new contaminant releases?	PSQ 2: Trace metals below action levels?	PSQ 3: Geologic and hydrologic data confirm Conceptual Site Model?	PSQ 4a, 4b: Remediation objectives achieved?	Year 1	Year 2 to Year 6	Year 6 and Onward
Aquifer Tubes																	
64-M	X		X	X				X		X					A	A	B
C6302	X		X	X				X		X					A	A	B
C6303	X		X					X		X					A	A	B
C6306	X		X	X				X		X					A	A	B
C6309	X		X	X				X		X					A	A	B
C6315	X		X	X				X		X					A	A	B
75-D			X					X		X					A	A	B
77-D			X					X		X					A	A	B
Riverbank Seep																	
Seep 187-1	X		X					X		X					A	A	B
River Gauge																	
100-F River Gauge						X			X	X			X				

a. Manual water level measurements will be obtained at low, high, and moderate river stage during sample years for the first 10 years of performance monitoring. For wells identified for only manual water level measurements, measurements will be taken each year for the first 5 years, and biennially thereafter. Manual water level measurements will not be obtained from wells within the AWLN during the operational period.

b. Trace metals include antimony, cadmium, and cobalt. These analytes are included for samples collected only during the first 10 years of monitoring until sufficient data are obtained for evaluation (eight samples).

c. Semiannual sample frequency will be performed for strontium-90. Other analytes are sampled at an annual frequency.

d. Semiannual sample frequency will be performed for Cr(VI), TCE, and nitrate. Trace metals sampled at an annual frequency.

e. Antimony, cadmium, and cobalt are not included for analysis after year 10.

f. Semiannual sample frequency will be performed for Cr(VI). Other analytes sampled at an annual frequency.

g. Water level measurements only.

h. Only one of Wells 699-59-32 and 699-60-32 will be included in the monitoring network. The decision of which well to be included will be based on well investigation results.

i. Well C9472 was constructed incorrectly and subsequently decommissioned. It was replaced by C9628 at the same location.

j. The aquifer at the location of borehole C9474 (699-71-26) was too thin to monitor. A water sample was collected (primarily from the Ringold upper mud unit) and the borehole was decommissioned.

k. Borehole C9479 was dry 10 ft into the Ringold upper mud unit and was decommissioned.

A = annual
B = biennial
AWLN = automated water level network
Cr(VI) = hexavalent chromium
PSQ = principal study question
S = semiannual
TCE = trichloroethene

Table A-8. 100-FR-3 Operable Unit Summary of Monitoring Locations, Frequencies, and Constituents

Monitoring Location	Analytes						Water Level		Data Need							Sample Frequency		
	Cr(VI) (Filtered)	TCE and Degradation Products	Nitrate	Strontium-90	Trace Metals[a]	General Chemistry[b]	AWLN	Manual[c]	PSQ 1a, 1b: Contamination Decreasing as expected?	PSQ 1c: Changes in environmental conditions that reduce effectiveness?	PSQ 1d: Unacceptable impacts to river?	PSQ 1e: Evidence of new contaminant releases?	PSQ 2: Trace metals below action levels?	PSQ 3: Geologic and hydrologic data confirm Conceptual Site Model?	PSQ 4a, 4b: Remediation objectives achieved?	Year 1 (July 2016-June 2017)	Year 2 to Year 5 (July 2017-June 2022)	Year 6 and Onward (After June 2022)
Existing Monitoring Wells																		
199-F5-1			X	X		X		X	X	X		X			X	A, S[d]	A, S[d]	B
199-F5-4	X	X	X		X	X		X	X	X		X	X		X	A, S[e]	A, Q[e]	B[f]
199-F5-42	X		X	X		X		X	X	X	X				X	A	A	B
199-F5-43A	X		X	X	X	X		X	X	X	X		X	X	X	A	A	B[f]
199-F5-44	X		X	X		X		X	X	X	X				X	A	A	B
199-F5-45	X	X	X			X		X	X	X		X		X	X	A	Q	B
199-F5-46	X	X	X	X		X		X	X	X		X			X	S	S	B
199-F5-47	X		X	X		X		X	X	X		X			X	A	Q	B
199-F5-48	X	X	X		X	X		X	X	X		X	X		X	A	Q[e]	B[f]
199-F5-52	X		X			X	X	X	X	X	X	X		X	X	A	A	B
199-F5-54	X		X	X		X		X	X	X		X			X	A	A	B
199-F5-55	X		X	X		X		X	X	X		X			X	A, S[d]	A, S[d]	B
199-F5-56	X	X	X	X		X		X	X	X		X			X	A	Q	B
199-F5-6	X		X	X		X		X	X	X	X	X			X	A, S[g]	A, S[g]	B
199-F6-1	X		X	X		X	X	X	X	X	X	X		X	X	A	A	B
199-F7-1[h]		X	X			X	X	X	X	X		X		X	X	A	A	B
199-F7-2		X	X			X	X	X	X	X		X		X	X	A	A	B
199-F7-3		X	X			X		X	X	X		X			X	A	A	B
199-F8-2	X			X				X	X	X		X			X	A	Q	B
199-F8-4			X			X	X	X	X	X				X	X	A	A	B
199-F8-7		X	X	X	X	X		X	X	X		X	X		X	A	A	B[f]
699-58-24								X		X								
699-59-32			X			X	X	X	X	X				X	X	A	A	B

Table A-8. 100-FR-3 Operable Unit Summary of Monitoring Locations, Frequencies, and Constituents

Monitoring Location	Analytes						Water Level		Data Need							Sample Frequency		
	Cr(VI) (Filtered)	TCE and Degradation Products	Nitrate	Strontium-90	Trace Metals[a]	General Chemistry[b]	AWLN	Manual[c]	PSQ 1a, 1b: Contamination Decreasing as expected?	PSQ 1c: Changes in environmental conditions that reduce effectiveness?	PSQ 1d: Unacceptable impacts to river?	PSQ 1e: Evidence of new contaminant releases?	PSQ 2: Trace metals below action levels?	PSQ 3: Geologic and hydrologic data confirm Conceptual Site Model?	PSQ 4a, 4b: Remediation objectives achieved?	Year 1 (July 2016-June 2017)	Year 2 to Year 5 (July 2017-June 2022)	Year 6 and Onward (After June 2022)
699-60-32							X	X	X	X				X	X			
699-61-37							X	X						X				
699-62-31			X			X		X	X	X				X	X	A	A	B
699-63-25A			X			X		X	X	X				X	X	A	A	B
699-64-27			X			X	X	X	X	X				X	X	A	A	B
699-66-23			X			X	X	X	X	X	X			X	X	A	A	B
699-70-23							X	X		X				X				
699-71-30[h]		X	X			X	X	X	X	X				X	X	A	A	B
699-74-44								X		X				X				
699-77-36		X	X			X	X	X	X	X				X	X	A	A	B
Phase 1 Wells																		
699-66-32			X			X	X	X	X	X				X	X	Q	A	B
699-67-26			X			X	X	X	X	X	X			X	X	Q	Q[i]	B
699-71-34		X	X			X	X	X	X	X				X	X	Q	Q[i]	B
699-75-28			X			X	X	X	X	X	X			X	X	Q	Q[i]	B
699-75-31		X	X			X	X	X	X	X				X	X	Q	Q[i]	B
699-75-34B		X	X			X		X	X	X				X	X	Q	Q[i]	B
Phase 2 Wells[j]																		
C9872 (1)			X			X		X	X	X	X			X	X	–	Q[i]	B
C9873 (2)			X			X		X	X	X				X	X	–	Q[i]	B
C9874 (3)			X			X	X	X	X	X				X	X	–	Q[i]	B
C9875 (4)			X			X		X	X	X				X	X	–	Q[i]	B
C9876 (5)		X	X			X		X	X	X				X	X	–	Q[i]	B
C9877 (6)		X	X			X		X	X	X		X		X	X	–	Q[i]	B

Table A-8. 100-FR-3 Operable Unit Summary of Monitoring Locations, Frequencies, and Constituents

Monitoring Location	Analytes						Water Level		Data Need							Sample Frequency		
	Cr(VI) (Filtered)	TCE and Degradation Products	Nitrate	Strontium-90	Trace Metals[a]	General Chemistry[b]	AWLN	Manual[c]	PSQ 1a, 1b: Contamination Decreasing as expected?	PSQ 1c: Changes in environmental conditions that reduce effectiveness?	PSQ 1d: Unacceptable impacts to river?	PSQ 1e: Evidence of new contaminant releases?	PSQ 2: Trace metals below action levels?	PSQ 3: Geologic and hydrologic data confirm Conceptual Site Model?	PSQ 4a, 4b: Remediation objectives achieved?	Year 1 (July 2016-June 2017)	Year 2 to Year 5 (July 2017-June 2022)	Year 6 and Onward (After June 2022)
Aquifer Sampling Tubes, Seep, and River Gauge																		
64-M	X		X	X					X		X					A	A	B
C6302	X		X	X					X		X					A	A	B
C6303	X		X						X		X					A	A	B
C6306	X		X	X					X		X					A	A	B
C6309	X		X	X					X		X					A	A	B
C6315	X		X	X					X		X					A	A	B
75-D			X						X		X					A	A	B
77-D			X						X		X					A	A	B
Seep 187-1	X		X						X		X					A	A	B
100-F River Gauge							X			X	X			X				

a. Trace metals include antimony, cadmium, and cobalt. These analytes are included for samples collected only during the first 10 years of monitoring until sufficient data are obtained for evaluation (eight samples).

b. General chemistry analytes include alkalinity, calcium, magnesium, potassium, sodium, chloride, and sulfate.

c. Manual water level measurements will be obtained at low, high, and moderate river stage every year during years 1 through 5, and biennially thereafter.

d. Semiannual sample frequency will be performed for strontium-90. Other analytes are sampled at an annual frequency.

e. Trace metals sampled at an annual frequency.

f. Antimony, cadmium, and cobalt are not included for analysis after year 10.

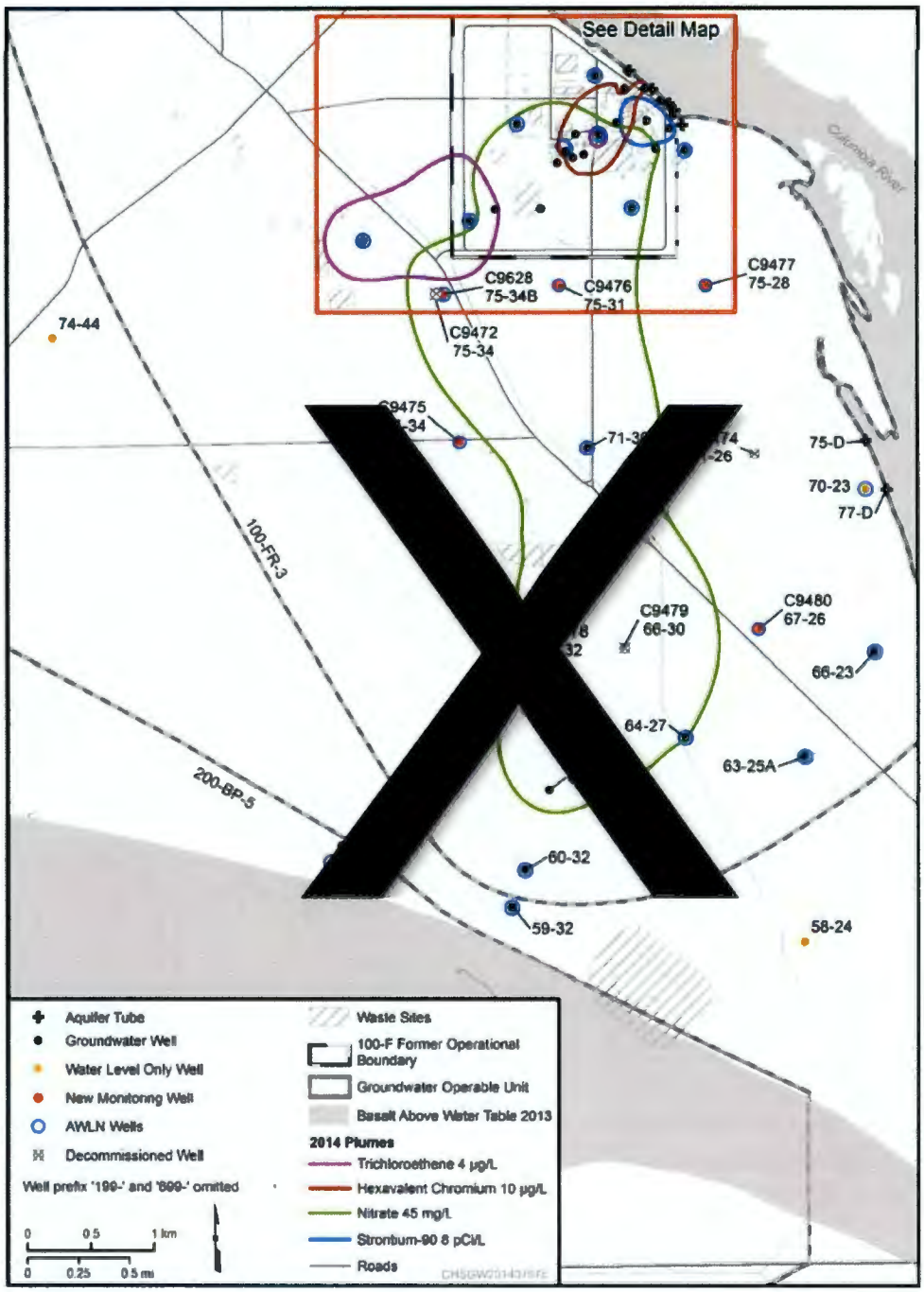
g. Semiannual sample frequency will be performed for Cr(VI). Other analytes sampled at an annual frequency.

h. These wells are being replaced by Phase 2 wells. They will be sampled concurrently with the new wells at least once, then sampling will cease. AWLN stations will be maintained in the old wells.

i. Phase 1 wells will continue quarterly for year 2, and may change to annual thereafter, if contaminant concentrations are stable. Phase 2 wells will be sampled quarterly for the first year after installation and may change to annual thereafter, if contaminant concentrations are stable.

j. Phase 2 wells proposed in SGW-61298, *Evaluation of 100-FR-3 Groundwater Monitoring Results from Phase 1*, and discussed in Section A.3.2.2

A = annual
B = biennial (every other year)
AWLN = automated water level network
Cr(VI) = hexavalent chromium
PSQ = principal study question
Q = quarterly
S = semiannual
TCE = trichloroethene



~~Note: Either Well 59-32 or 60-32 will be included in the network depending on field investigation results.~~

~~Figure A-16. 100-FR-3 Operable Unit Performance Monitoring Network~~

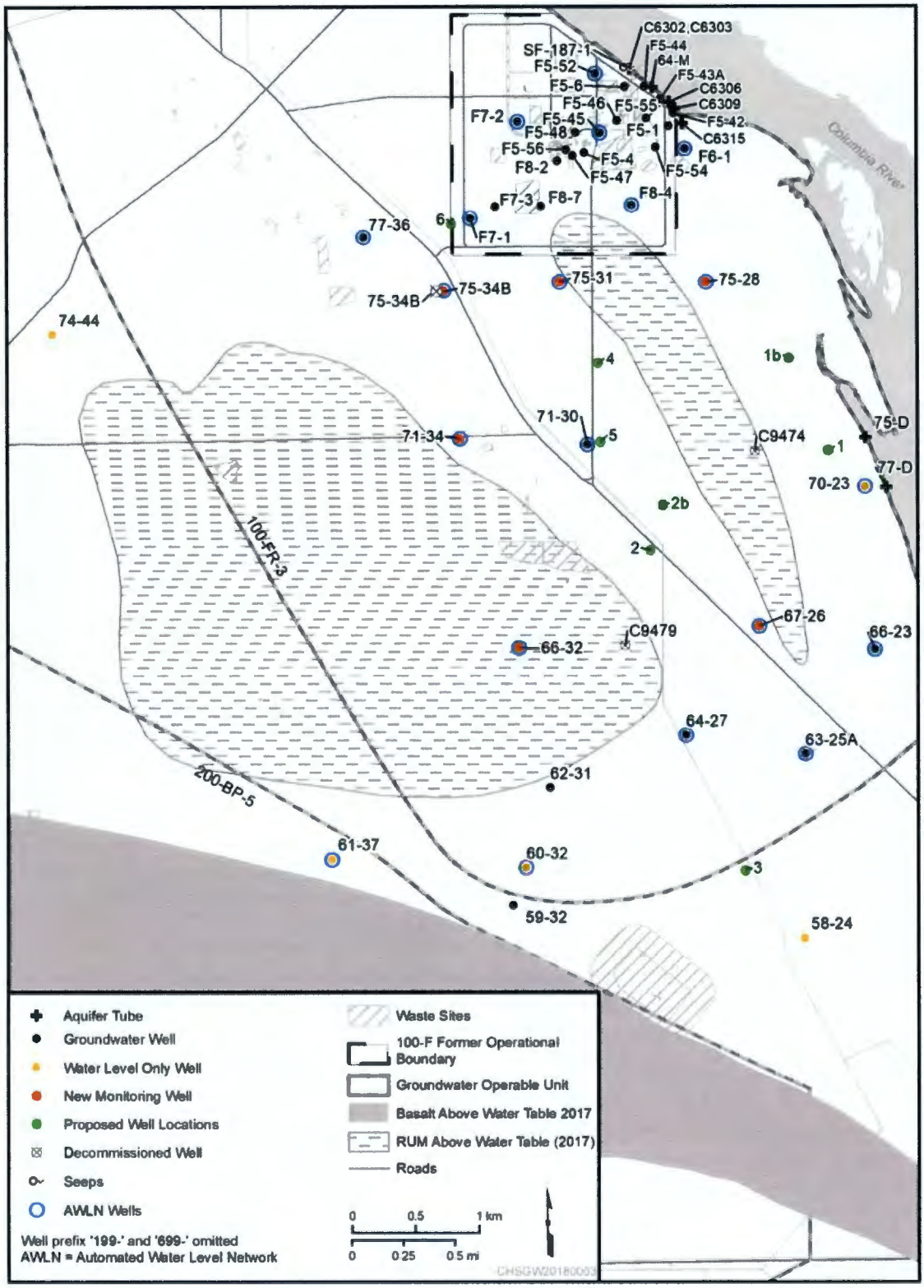


Figure A-16. 100-FR-3 Operable Unit Performance Monitoring Network

drilling. Borehole geophysical logging was conducted in all boreholes except C9628 (replacement for C9472).

Slug tests and/or single-well pumping tests were not performed to characterize hydraulic conductivity because the hydrogeology of the region was adequately understood.

Additional Phase 2 monitoring wells were identified based on evaluation of results from the Phase 1 well samples. Table A-9 lists information about the wells and Figure A-16 shows approximate locations. Phase 2 wells will be constructed using the same instruction as the Phase 1 wells.

A3.2.2.1 Well Depth and Screen Placement

Each ~~new~~ Phase 1 well was drilled approximately 3 m (10 ft) into the RUM unit to facilitate geologic and geophysical interpretations. Phase 2 wells also will be drilled 3 m (10 ft) into the RUM. Table A-9 summarizes depths and construction information.

A3.2.2.2 Well Drilling, Completion, and Development

Phase 1 Well drilling and completion were performed in accordance with WAC 173-160. The wells were drilled using 20 cm (8 in.) diameter temporary casing and were constructed with 10 cm (4 in.) diameter stainless steel casing and 1.5 to 4.6 m (5 to 15 ft) long, continuous wire-wrap stainless steel screen, atop a 1.0 to 1.5 m (3 to 5 ft) long stainless steel sump with end cap.

Table A-9. 100-FR-3 Operable Unit Phase 1 and 2 Monitoring Well Locations

Well ID	Well Name	Northing (m)	Easting (m)	Depth to Water (m bgs)	Aquifer Thickness (m)	Total Depth (m bgs)	Elevation Top of Screen (m)	Elevation Bottom of Screen (m)
Phase 1 Wells (Installed 2016)								
C9472	699-75-34	146444.09	579477.05	7.28	2.7	13.6	Decommissioned[a]	
C9474	699-71-26	145176.00	581918.55	9.37	0.1	12.4	Decommissioned[b]	
C9475	699-71-34	145271.21	579602.08	6.28	1.6	11.2	116.1	113.0
C9476	699-75-31	146516.19	580385.85	8.87	0.6	12.4	115.3	113.8
C9477	699-75-28	146514.93	581538.22	11.79	2.8	18.0	115.0	110.4
C9478	699-66-32	143628.39	580059.33	7.49	1.0	11.9	119.6	118.0
C9479	699-66-30	143649.79	580895.57	None	0.0	9.6	Decommissioned[b]	
C9480	699-67-26	143798.07	581949.54	8.28	0.9	12.6	113.2	111.6
C9628	699-75-34B	146447.03	579478.30	7.84	2.5	12.6	117.1	112.6
Planned Phase 2 Wells[c]								
C9872	1 (1b)	145183 (145913[d])	582501 (582189[d])	7.0 to 9.5	2.5 (5.5[d])	15 (16[d])	TBD	TBD

Table A-9. 100-FR-3 Operable Unit Phase 1 and 2 Monitoring Well Locations

Well ID	Well Name	Northing (m)	Easting (m)	Depth to Water (m bgs)	Aquifer Thickness (m)	Total Depth (m bgs)	Elevation Top of Screen (m)	Elevation Bottom of Screen (m)
C9873	2 (2b)	144393 (144753[d])	581096 (581195[d])	7.5 to 8.0	3.0 (3.0[d])	14 (14[d])	TBD	TBD
C9874	3	141878	581838	12 to 13.5	7.5	24.0	TBD	TBD
C9875	4	145874	580687	6.7 to 7.2	1.8	12.0	TBD	TBD
C9876	5	145251	580707	9.0 to 9.5	1.5	14.0	TBD	TBD
C9877	6	146974	579538	4.2 to 4.5	4.5	12.0	TBD	TBD

bgs = below ground surface

ID = identification

TBD = to be determined

a. Well constructed incorrectly, decommissioned and replaced by C9628

b. Insufficient aquifer thickness

c. Well names listed for Phase 2 wells correspond to those shown in Figure A-16. Hanford Site well names will be assigned after installation. Locations and depths are approximate. Depths to water include low and high river stage.

d. Information for alternative locations shown in parentheses

Protective casing, protective guard posts, and cement pad were installed at the completed wells.

Phase 2 wells will be drilled and constructed to the same specifications.

Final well design, including screen placement and length, were determined by concurrence of the field geologist, drilling lead, and OU lead based upon field conditions.

Following completion, well locations and elevations will be surveyed, and dedicated sampling pumps will be installed in each well.

A3.2.3 Automated Water Level Network

AWLN is the combination of equipment, hardware, and software for the measurement, collection, transmittal, storage, and management of water level data in the aquifer. Water-level data are measured by submersible pressure transducers installed in a network of monitoring locations. The data are then directly transmitted to a base station via telemetry or can be manually downloaded to portable computers.

AWLN stations were established at 20 monitoring wells and the 100-F gauging station during Phase 1 (Table A-8). After installation of Phase 2 wells, some of the stations may be relocated to optimize the network.

~~The 100-F automated river gauge and 20 monitoring wells will comprise the AWLN for the 100-FR-3 OU (Table A-8). Fourteen existing wells and six new wells will be incorporated into the AWLN and equipped as required for the automated measurements. Two of the existing wells (699-61-37 and 699-70-23) are included in the network for the purpose of the AWLN only. For new wells, equipment~~

~~necessary for automated measurements will be installed when the wells are completed. The 100-F river gauge station will also be re-established to allow safe access to the location. The AWLN may be modified based on field conditions and data needs.~~

The AWLN will be operated for the first 5 years of the performance monitoring period. At the end of the fifth year, the continuing need for AWLN will be evaluated. When AWLN is no longer needed, the associated equipment will be removed from the wells.

A3.2.4 Rehabilitation of Old Wells

Several existing wells that were installed prior to 1987 were identified for the monitoring network (Table A-10). The wells were video surveyed and some had geophysical surveys ~~Some of these wells require investigation and/or rehabilitation prior to use. Investigation of the wells will be performed with a downhole camera survey. Geophysical logging will be performed on selected wells~~ to determine the depth of geologic contacts.

Several pre-1987 wells ~~that~~ extend into the RUM. The feasibility of grouting the lower portion of the wells was considered, but was rejected due to the possibility of grout leakage into the annular space adjacent to the aquifer. ~~will require rehabilitation to isolate the unconfined aquifer. Grout will be added to the base of these wells to fill the portion of the well in the RUM. Information from the geophysical investigation will be used to determine the depth of grout needed to ensure sampling of the unconfined aquifer.~~

A3.3 Sampling Methods

Sampling may include, but not be limited to, the following methods:

- Field screening measurements
- Radiological screening
- Groundwater sampling
- Aquifer tube sampling
- Riverbank seep sampling
- Water level measurements

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Table C-1. Wells Associated with the 100-FR-3 Operable Unit

Well Name	Well Identification	Well Name	Well Identification	Well Name	Well Identification
199-F1-2	A4586	199-F8-2	A4607	699-69-45R	A9761
199-F5-1	A4587	199-F8-3	A4608	699-70-23	A5318
199-F5-4	A4590	199-F8-4	A4609	699-71-30	A5320
199-F5-42	A4591	199-F8-7	C6834	699-71-52	A5321
199-F5-43A	A4592	699-57-29A	A5267	699-74-44	A5328
199-F5-43B	A4593	699-57-29B	A5268	699-77-36	A5330
199-F5-44	A4594	699-58-24	A5275	699-77-54	A5331
199-F5-45	A4595	699-59-32	A5276	699-80-43P	A8993
199-F5-46	A4596	699-60-32	A5279	699-80-43S	A5336
199-F5-47	A4597	699-62-31	A5287	699-81-38	A5337
199-F5-48	A4598	699-63-25A	A5289	699-83-47	A5341
199-F5-52	C7790	699-64-27	A5295	699-84-34B	A9021
199-F5-53	C7791	699-65-22	A5297	699-84-35A	A5342
199-F5-54	C7792	699-66-23	A5306	699-84-35AO	A9769
199-F5-55	C7970	699-66-38	A5307	699-84-35AP	A9770
199-F5-56	C7972	699-66-39	A5308	699-84-35AQ	A9771
199-F5-6	A4600	699-69-38	A5316	699-84-35AR	A9772
199-F6-1	A4602	699-69-45	A8967	699-84-35AS	A9773
199-F7-1	A4603	699-69-45O	A5317	699-86-42	A5344
199-F7-2	A4604	699-69-45P	A9759	699-87-42A	A5345
199-F7-3	A4605	699-69-45Q	A9760	699-61-37	A5283
Phase 1 ~~New~~ Boreholes or Wells					
699-75-34*	C9472	699-75-31	C9476	699-66-30*	C9479
699-71-26*	C9474	699-75-28	C9477	699-67-26	C9480
699-71-34	C9475	699-66-32	C9478	699-75-34B	C9628
Planned Phase 2 Wells					
TBD	C9872	TBD	C9874	TBD	C9876
TBD	C9873	TBD	C9875	TBD	C9877

Note: Wells identified in Table C-1 are associated with the 100-FR-3 groundwater interest area as of July 2016.

*Decommissioned

TBD = Well names to be determined after installation