

Appendix A

Supporting Information for CERCLA Groundwater Operable Units

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Appendix A

Supporting Information for CERCLA Groundwater Operable Units

The groundwater and vadose zone beneath contaminated portions of the Hanford Site are divided into 11 groundwater operable units, discussed in alphanumeric order in this appendix. Figure A.1 shows the locations of these units and related groundwater interest areas on the Hanford Site. Table A.1 gives a brief synopsis of remediation activities at each operable unit. Table A.2 lists wells that were not sampled as scheduled during fiscal year 2003. Table A.3 lists the maximum concentrations for contaminants of concern in fiscal year 2003 by groundwater interest area. Tables A.4 through A.19 list the constituents of concern, monitoring wells used in the networks, and the frequency of sampling for each operable unit.

A.1 100-BC-5 Operable Unit

A sampling and analysis plan (PNNL-13326) specifies wells, constituents, and sampling frequency for this operable unit. That plan included the same well and constituent lists defined in *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement; Ecology et al. 1998) Change Control Form M-15-99-03. Subsequent to publication of the sampling and analysis plan, Change Control Form M-15-00-07 was approved, substituting one upgradient well for another. Wells, constituents, and sampling frequencies are shown in Table A.4.

During fiscal year 2003, the objective of monitoring groundwater in this operable unit was to define contaminant plumes and track trends in concentration until final cleanup decisions are made. The Groundwater Performance Assessment Project (groundwater project) met this objective; plumes and trends are discussed in Section 2.2 of the main text.

During fiscal year 2003, all wells were sampled as scheduled, but one well was missing several analyses. Samples from well 699-63-90, located southwest of 100-B/C Area between Umtanum Ridge and Gable Butte, were not analyzed for gross alpha, gross beta, or strontium-90. The well was not scheduled according to the approved constituent list due to human error. The impact of this omission is minimal, since the well is upgradient from contaminant sources in the operable unit.

One seep, 039-2 (Figure 2.2-1), was not sampled for the 100-BC-5 Operable Unit because it was not flowing at the time of sampling in fall 2002. It was sampled in September 2003 for the site-wide Surface Environmental Surveillance Project. Those data will be included in the Hanford Site environmental report for 2003.

In fiscal year 2003, the groundwater project applied the U.S. Environmental Protection Agency's (EPA's) data quality objectives process to groundwater monitoring at the 100-BC-5 Operable Unit (PNNL-14287). Based on the results of that process, the groundwater project developed a new sampling and analysis plan (DOE/RL-2003-38) that EPA approved at the end of fiscal year 2003. The new plan was implemented in fiscal year 2004.

A.2 100-FR-3 Operable Unit

A sampling and analysis plan (PNNL-13327) specifies wells, constituents, and sampling frequency for this operable unit. That plan included the same well and constituent lists defined in Tri-Party Agreement Change Control Form M-15-99-02. Subsequent to publication of the sampling and analysis plan, Change Control Form M-15-01-06 was approved, removing well 199-F5-3 from the network and changing quarterly strontium-90 sampling to annual in one well. Wells, constituents, and sampling frequencies that were required for fiscal year 2003 are shown in Table A.5.

During fiscal year 2003, the objective of monitoring groundwater in this operable unit was to define contaminant plumes and track trends in concentration until final cleanup decisions are made. The groundwater project met this objective; plumes and trends are discussed in Section 2.7 of the main text.

All wells were sampled as scheduled in fiscal year 2003. Two of the three seeps listed in the sampling and analysis plan were not sampled because the specific conductance of the seep water was the same as river water; therefore, the water would not have represented discharging groundwater.

In fiscal year 2003, the groundwater project applied EPA's data quality objectives process to groundwater monitoring of the 100-FR-3 Operable Unit (PNNL-14287). Based on the results of that process, the groundwater project developed a new sampling and analysis plan (DOE/RL-2003-49) that EPA approved at the end of fiscal year 2003. The new plan was implemented in fiscal year 2004.

A.3 100-HR-3 Operable Unit

This operable unit includes two remediation systems in the 100-D Area (a pump-and-treat system and an in situ redox system) and a pump-and-treat system in the 100-H Area. In addition to the remedial action monitoring, 100-D and 100-H Area wells are sampled to track contaminant plumes and trends (long-term monitoring).

100-D Pump-and-Treat. Monitoring requirements for this system are included in DOE/RL-96-90, as modified by DOE/RL-96-84. Wells, constituents, and sampling frequencies for interim action monitoring are shown in Table A.6. Table A.7 shows the same elements for long-term monitoring in the 100-D Area, which were derived from Change Control Form 107 as modified by Fluor Hanford, Inc.^(a)

During fiscal year 2003, all wells were sampled as scheduled. Two shoreline seeps, scheduled as part of 100-HR-3 long-term monitoring, were not sampled. Seep 102-1 was dry. Seep 110-2 inadvertently was not scheduled. It is located near another seep (110-1) that was sampled.

Results of work completed in calendar year 2003 are summarized in Section 2.5 and will be reported fully in an upcoming annual report for the 100-HR-3 Operable Unit.

100-D Redox. Monitoring requirements for this system are described in DOE/RL-99-51. Wells, constituents, and sampling frequencies are shown in Table A.8.

During fiscal year 2003, several quarterly sampling events were missed due to problems in the field (see Table A.2). The impact of these omissions is minimal, since the wells were sampled the other three quarters and nearby wells were sampled all four quarters. One river bottom tube was not sampled, but a nearby aquifer tube was.

Results of work completed in fiscal year 2003 are summarized in Section 2.5 and will be reported fully in an upcoming annual report for the redox system.

100-H Pump-and-Treat. Monitoring requirements for this system are included in DOE/RL-96-90, as modified by DOE/RL-96-84. Wells, constituents, and sampling frequencies for interim action monitoring are shown in Table A.9. Table A.10 shows the same elements for long-term monitoring in the 100-H Area, which were derived from Change Control Form 107 as modified by Fluor Hanford, Inc.^(a)

During fiscal year 2003, all wells were sampled as scheduled. Results of work completed in calendar year 2003 are summarized in Section 2.6 and will be reported in detail in an upcoming annual report for the 100-HR-3 Operable Unit.

A.4 100-KR-4 Operable Unit

The most recent performance evaluation and annual summary report (DOE/RL-2003-09) indicates that the pump-and-treat system captures most of the groundwater flow field occupied by the chromium plume. Removal of chromium from the extracted groundwater significantly reduces the amount of chromium available for movement into the river environment. Data on water levels, contaminants, system treatment cost and efficiency, and hydrogeology contribute to building a technical basis for a future final remedy decision. DOE/RL-96-90 and DOE/RL-96-84 describe the operational and environmental monitoring required as part of the interim action. Sampling and analysis is currently governed by a modification to the Tri-Party Agreement (TPA 1996). Tables A.11 and A.12 lists wells, contaminants of concern, and sampling frequencies for the 100-KR-4 Operable Unit. Results of work completed in fiscal year 2003

(a) Letter FH-0205249 from RT Wilde (Fluor Hanford, Inc.) to JS Fruchter (Pacific Northwest National Laboratory), *Revised FY 2003 Sampling Schedule for Groundwater Remediation Monitoring*, dated November 11, 2002.

are summarized in Section 2.3. Three wells in the 100-KR-4 Operable Unit (199-K-114A, 199-K-130, and 199-K-18) were not sampled during one month each due to scheduling and pump problems (Table A.2). An upcoming annual report for the 100-KR-4 Operable Unit will describe progress in calendar year 2003.

The 100-KR-4 Operable Unit includes the groundwater that underlies the 100-K Area. Monitoring activities under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) continued during fiscal year 2003 as part of the remedial investigation that will lead to a future record of decision for final groundwater remedial action. A decision regarding final remedial action is expected to follow completion of source remedial actions and KW and KE Basins cleanup activities. Institutional controls are currently in place to prevent human access to groundwater beneath the 100-K Area. Groundwater monitoring for the operable unit consists predominantly of annual sampling of wells, with analyses for anions, metals, and radiological indicators. The list of wells, frequency of sampling, and analyses to be performed are described in National Priorities List Agreement/Change Control Form No. 108, dated November 20, 1996, as updated by changes documented in letters from the U.S. Department of Energy (DOE) and Fluor Hanford, Inc. to the Washington State Department of Ecology (Ecology) and EPA in September 1998.^(b,c)

An interim remedial action is underway to address groundwater contaminated by hexavalent chromium, which poses a threat to aquatic organisms that reside in the interface between the aquifer and the nearby Columbia River (ROD 1996a). A pump-and-treat system is used to reduce the amount of chromium in groundwater in the area between the 116-K-2 trench and the Columbia River.

A.5 100-NR-2 Operable Unit

The monitoring requirements for the pump-and-treat system at this operable unit are specified by Tri-Party Agreement Change Control Form M-15-96-08 as modified by Fluor Hanford, Inc.^(c) Wells, constituents, and sampling frequencies for interim action monitoring are shown in Table A.13. During fiscal year 2003, all wells were sampled as scheduled.

Results of work completed in calendar year 2003 are summarized in Section 2.4 and will be reported fully in an upcoming annual report for the 100-NR-3 Operable Unit.

A.6 200-BP-5 Operable Unit

The CERCLA monitoring objectives for this operable unit, which encompasses the north portion of 200 East Area in the vicinity of B Plant, are similar to the *Atomic Energy Act of 1954* (AEA) objectives. The operable unit includes the past-practice sites 216-B-5 injection well, BY cribs, and Gable Mountain Pond. CERCLA groundwater sampling was suspended in the 200-BP-5 Operable Unit until completion and approval of waste management documentation. See Section 2.10 in the main text for additional discussion.

In fiscal year 2002, the groundwater project developed data quality objectives for monitoring the 200-BP-5 Operable Unit (PNNL-14049). During fiscal year 2003, DOE released a sampling and analysis plan (DOE/RL-2001-49), a waste control plan (DOE/RL-2003-30), and conducted initial sampling and analysis activities for this unit. Table A.13 describes the well network, the contaminants of concern, and sampling frequencies. Not all wells could be sampled in fiscal year 2003 because the plans were not approved until May 2003. Two of the wells scheduled for sampling could not be sampled because of pump problems and another well was determined to be dry (Table A.2).

A.7 200-PO-1 Operable Unit

The 200-PO-1 Operable Unit is a *Resource Conservation and Recovery Act* (RCRA) past-practice groundwater operable unit, and there is no record of decision. The objective is to monitor groundwater under the requirements for RCRA past practice and for AEA as directed in DOE orders. The long-term goal is to monitor the contaminants of concern until final cleanup decisions are made. Near-field wells are shown in the south portion of Figure 2.11-1, and far-field well locations are shown in Figure 2.1-2.

(b) Letter report 062039 from DM Wanek (U.S. Department of Energy, Richland, Washington) to SM Alexander (Washington State Department of Ecology) and DR Sherwood (U.S. Environmental Protection Agency), *Sampling Changes to the 100-HR-3 and 100-KR-4 Operable Units (OU)*, dated September 16, 1998.

(c) Letter FH-0205249 from RT Wilde (Fluor Hanford, Inc.) to JS Fruchter (Pacific Northwest National Laboratory), *Revised FY 2003 Sampling Schedule for Groundwater Remediation Monitoring*, dated November 11, 2002.

A temporary plan was presented that is nearly identical to the plan for monitoring the far-field wells in the RCRA groundwater monitoring plan (PNNL-11523) for the Plutonium-Uranium Extraction (PUREX) cribs and later proposed in a draft sampling and analysis plan. During fiscal year 2003, the operable unit was monitored according to a temporary plan (PNNL-11523). A new sampling and analysis plan was prepared in fiscal year 2003 and approved in early fiscal year 2004. The draft plan also adds requirements for sampling Columbia River shoreline aquifer tubes and two proposed new wells near the BC cribs.

Most of the near-field wells are sampled annually or semiannually, but many of the far-field wells (600 Area wells between the 200 East Area and the 300 Area) are sampled every 3 years (Table A.14). During fiscal year 2003, two wells were not sampled as scheduled (see Tables A.2 and A.15). Far-field (or major) contaminants of concern include tritium, iodine-129, and nitrate. Near-field (or minor) contaminants of concern include arsenic, chromium, cobalt-60, cyanide, manganese, strontium-90, technetium-99, and vanadium.

Discussion of groundwater contamination at the 200-PO-1 Operable Unit is presented in Section 2.11.

A.8 200-UP-1 Operable Unit

During fiscal year 2003, the environmental restoration contractor continued to operate a pump-and-treat system in this operable unit, which underlies the southeast 200 West Area (Figure A.1). Table A.15 lists monitoring wells, constituents, and sampling schedule for the 200-UP-1 Operable Unit in effect during fiscal year 2003. The sampling and analysis plan for the 200-UP-1 Operable Unit is described by DOE/RL-2002-10.

Results of the interim action are summarized annually (DOE/RL-2003-58). As of January 2003, the high concentration portions of the technetium-99 and uranium plumes were hydraulically contained and remediated at nearly all wells to levels required by the interim action objectives (ROD 1997). The only exception is well 299-W19-43, which in July 2003 met the record of decision for technetium-99. However, the uranium concentration at well 299-W19-43 (July 11, 2003) was right at the remedial action objective concentration of 480 µg/L. Additional details of analytical results are provided in Section 2.9.

The capability to monitor and track changes in plume configuration has been limited by wells going dry in the baseline plume area; three of these wells went dry during fiscal year 2003 (Table A.2). Well 299-W19-46 was added in November 2002 and other wells will be added in fiscal years 2004 and 2005 to improve this situation. As a result of poor well control, the plume maps and evaluation of the extent of remediation are based on historical interpretation and the limited amount of data collected in fiscal year 2003.

To accelerate remediation, and to help with declining extraction production, well 299-W19-43 was converted from a monitoring to an extraction well by moving well head piping and instrumentation from well 299-W19-36. Well 299-W19-36 was re-equipped for extraction at the end of fiscal year 2003, and will be operated in fiscal year 2004 to maintain elevated extraction rates and reduce strain on pumping equipment. Thus, three extraction wells will be available in fiscal year 2004. Section 2.9 in the main text discusses groundwater remediation in more detail. Table A.15 lists contaminants of concern, well network, and sampling frequencies.

A.9 200-ZP-1 Operable Unit

The environmental restoration contractor continued to operate a pump-and-treat system in this operable unit, which underlies the north half of 200 West Area (Figure A.1). Table A.16 lists monitoring wells, constituents, and sampling schedule for the 200-ZP-1 Operable Unit in effect during fiscal year 2003. The purpose of the pump-and-treat system is to prevent further movement of groundwater contamination from the high concentration portion of the carbon tetrachloride plume and to reduce contaminant mass (ROD 1995). Sampling and analysis for groundwater is controlled by DOE/RL-2002-17.

Results of the interim action are summarized annually (DOE/RL-2003-58). The 200-ZP-1 pump-and-treat system made measurable progress toward meeting its specific objectives in fiscal year 2003. The high concentration portion of the carbon tetrachloride plume continues to move toward the extraction wells and appears to be hydraulically contained based on the contaminant plume maps, contaminant trends, and hydraulic capture analysis.

Section 2.8 of the main text discusses groundwater remediation. Table A.16 provides groundwater monitoring parameters for the 200-ZP-1 Operable Unit. Wells that were not sampled for at least one scheduled event during fiscal year 2003 for the 200-ZP-1 Operable Unit are included in Table A.2. Well 299-W18-24 went dry during fiscal year

2003 (after it was sampled for the 200-ZP-1 Operable Unit) and another well, 299-W15-16, has an estimated 2 years of life. However, well 299-W15-30 is ~15 meters from well 299-W15-16 and is screened over the same general interval and will replace it. Sampling at 299-W15-30 has been added in fiscal year 2004 to establish a contaminant concentration correlation between the two wells.

A.10 300-FF-5 Operable Unit

The 300-FF-5 Operable Unit is located in the 300 Area and two satellite areas to the northwest of the 300 Area (Figure 2.12-2). Groundwater monitoring for the operable unit is based on a record of decision for the 300-FF-1 and 300-FF-5 Operable Units (ROD 1996b) and the *Explanation of Significant Difference for the 300-FF-5 Record of Decision* (EPA 2000). The selected remedy for groundwater contamination, as stated in the record of decision, is (a) continued monitoring of groundwater that is contaminated above health-based levels to ensure that concentrations continue to decrease; and (b) institutional controls to ensure that groundwater use is restricted to prevent unacceptable exposures to groundwater contamination. Groundwater monitoring is conducted under an operations and maintenance plan (DOE/RL-95-73), which describes the implementation plans for the “attenuation by natural processes” portion of the selected remedy, and a sampling and analysis plan (DOE/RL-2002-11) that is based on the rationale and strategy of the operations and maintenance plan. During fiscal year 2003, the 300-FF-5 Operable Unit was monitored according to two groundwater monitoring plans. As part of a 2-year trial demonstration of improved intrawell monitoring, PNNL-13645 was the guiding document. Also, an older plan (WHC-SD-EN-AP-185) provides the compliance portion of the monitoring. The objectives of the plan are to (a) monitor contaminants that are above health-based risk levels to ensure that concentrations continue to decrease and (b) implement institutional controls to ensure that groundwater use is restricted to prevent unacceptable exposures (ROD 1996b; EPA 2000). All wells in the network were sampled as scheduled in fiscal year 2003.

Discussion of groundwater contamination at the 300-FF-5 Operable Unit is provided in Section 2.12.

A.11 1100-EM-1

The 1100-EM-1 Operable Unit contains DOE's inactive Horn Rapids Landfill. Results of the CERCLA investigation for this operable unit are presented in the final remedial investigation study (DOE/RL-92-67) and the record of decision (ROD 1993). The selected remedy for groundwater is monitored natural attenuation of volatile organic compounds, with institutional controls on drilling of new water supply wells. Monitoring includes analysis for trichloroethene, its breakdown products (e.g., vinyl chloride and 1,1-dichloroethene), and nitrate in wells downgradient of DOE's inactive Horn Rapids Landfill, as recommended in the sampling plan (PNNL-12220). A list of the required wells and constituents are provided in Table A.18. Although some delays in sampling occurred due to operational circumstances (e.g., fire danger), all wells in the 1100-EM-1 network were sampled the planned number of times and for all scheduled constituents in fiscal year 2003. Analytical results for this sampling are discussed in Section 2.13. All monitoring wells were sampled as scheduled during fiscal year 2003.

Discussion of groundwater contamination at the 1100-EM-1 Operable Unit is provided in Section 2.13.

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Table A.1. Summary of Groundwater Remediation at CERCLA Operable Units

Operable Unit	Startup Date	Contaminant	Objectives	Progress at End of Fiscal Year 2003
100-KR-4 (Pump-and-Treat)	1997	Hexavalent chromium	(a) Protect aquatic receptors in the river bottom substrate from contaminants in groundwater entering the Columbia River; (b) Protect human health by preventing exposure to contaminants in the groundwater; and (c) Provide information that will lead to the final remedy (ROD 1996a).	Decreases chromium to river; 213 kilograms removed, 2.07 billion liters treated since startup.
100-NR-2 (Pump-and-Treat)	1995	Strontium-90	(a) Reduce strontium-90 contaminant flux from the groundwater to the Columbia River; (b) Evaluate commercially available treatment options for strontium-90; and (c) Provide data necessary to set demonstrable strontium-90 groundwater cleanup standards (Ecology and EPA 1994; ROD 1999a).	Diverts strontium-90 from river; insignificant aquifer cleanup; 1.45 curies removed, 869 million liters treated, ~12 curies naturally decayed since 1996.
100-HR-3 (100-D Area Pump-and-Treat)	1997	Hexavalent chromium	(a) Protect aquatic receptors in the river bottom substrate from contaminants in groundwater entering the Columbia River; (b) Protect human health by preventing exposure to contaminants in the groundwater; and (c) Provide information that will lead to the final remedy (ROD 1996a).	Two additional extraction wells added; decreases chromium to river; 161 kilograms removed, 921 million liters treated since startup.
100-HR-3 (100-D Area In Situ Redox)	1999	Hexavalent chromium	(a) Protect aquatic receptors in the river substrate from contamination in groundwater entering the Columbia River; (b) Protect human health by preventing exposure to contaminants in the groundwater, and (c) Provide information that will lead to the final remedy (ROD 1999b).	Barrier complete; decreases chromium concentration downgradient of barrier.
100-HR-3 (100-H Area Pump-and-Treat)	1997	Hexavalent chromium	(a) Protect aquatic receptors in the river bottom substrate from contaminants in groundwater entering the Columbia River; (b) Protect human health by preventing exposure to contaminants in the groundwater; and (c) Provide information that will lead to the final remedy (ROD 1996a).	Decreases chromium to river; 34 kilograms removed, 936 million liters treated since startup; overall decrease in concentrations.
200-ZP-1 (Pump-and-Treat)	1994	Carbon tetrachloride	(a) Prevent further movement of contaminants from the highest concentration area of the plume (i.e., carbon tetrachloride inside the 2,000- to 3,000- $\mu\text{g}/\text{L}$ contour); (b) Reduce contamination in area of highest carbon tetrachloride concentrations; and (c) Provide information that will lead to a final remedy (ROD 1995).	Prevents high-concentration portion of plume from spreading; 7,668 kilograms removed, 2.1 billion liters treated since startup; heart of plume contained.

Table A.1. (contd)

Operable Unit	Startup Date	Contaminant	Objectives	Progress at End of Fiscal Year 2003
200-ZP-1 (Soil-Vapor Extraction)	1992	Carbon tetrachloride	Not applicable	78,100 kilograms removed since startup; concentrations decreased, preventing movement to groundwater.
200-UP-1 (Pump-and-Treat)	1995	Technetium-99	(a) Reduce contamination in areas of highest concentration to below 480 µg/L for uranium, and 9,000 pCi/L for technetium-99; (b) Reduce potential human health risks through reduction of contaminant mass; (c) Prevent further movement of contaminants from the highest concentration area; and (d) Provide information that will lead to a final remedy (ROD 1997).	102 grams technetium-99 removed since startup; concentrations at remedial action objective in extraction well.
		Uranium		180 grams uranium removed since startup; concentrations remained above remedial action objective.
300-FF-5	Not applicable	Uranium and chlorinated hydrocarbons	(a) Monitor contaminants above health-based risk levels to ensure that concentrations continue to decrease and (b) Implement institutional controls to ensure that groundwater use is restricted to prevent unacceptable exposures (ROD 1996b).	Uranium above and trichloroethene below target levels. Work in progress to determine trends in levels.
1100-EM-1	Not applicable	Volatile organic compounds	(a) Attain trichloroethene concentrations <5 µg/L at point of compliance and (b) Protect environmental receptors in surface water by reducing groundwater concentrations to safe levels (ROD 1993).	Trichloroethene <5 µg/L at compliance point. Monitoring trends.

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act.*

Table A.2. Wells Not Sampled as Scheduled for CERCLA Facilities, Fiscal Year 2003

<u>Well</u>	<u>Schedule</u>	<u>Operable Unit</u>	<u>Comments</u>
199-D4-23	02/01/03	100-HR-3-D	Electrical problem; one quarter missed
199-D4-31	02/01/03	100-HR-3-D	Electrical problem; one quarter missed
199-D4-39	02/01/03	100-HR-3-D	Pump problem; one quarter missed
199-D4-48	02/01/03	100-HR-3-D	Electrical problem; one quarter missed
199-D4-7	02/01/03	100-HR-3-D	Electrical problem; one quarter missed
199-D4-85	02/01/03	100-HR-3-D	Pump problem; one quarter missed
199-K-114A	01/01/03	100-KR-4	Pump problem; one month missed
199-K-130	04/01/03	100-KR-4	Scheduling error; one month missed
199-K-18	06/01/03	100-KR-4	Pump problem; one month missed
SK-057-3	11/10/02	100-KR-4	Seep; not flowing
299-W10-13	03/01/03	200-ZP-1	Dry
299-W19-14	01/01/03	200-UP-1	Dry
299-W23-14	01/01/03	200-UP-1	Dry
299-W26-12	01/01/03	200-UP-1	Dry
299-W6-2	01/01/03	200-ZP-1	Dry
299-W6-2	07/01/03	200-ZP-1	Dry
299-W6-7	01/01/03	200-ZP-1	Dry
299-W7-8	03/01/03	200-ZP-1	Dry
699-31-31	01/01/03	200-PO-1	Access road needs repair; annual sample missed
699-S11-E12AP	None	200-PO-1	Basalt-confined aquifer; inadvertently scheduled triennially.
699-49-55A	09/01/03	200-BP-5	Pump problem; annual sample missed
699-53-48B	07/01/03	200-BP-5	Dry
699-53-55B	09/01/03	200-BP-5	Pump problem; annual sample missed
699-63-90	01/01/03	100-BC-5	Sampled, but some constituents missed

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act.*

Table A.3. Maximum Concentrations of Constituents by Groundwater Interest Area, Fiscal Year 2003

Constituent	Drinking Water Standard	100-BC-5	100-FR-3	100-HR-3-D	100-HR-3-H	100-KR-4	100-NR-2	1100-EM-1	200-BP-5	200-PO-1	200-UP-1	200-ZP-1	300-FF-5
1,1,1-trichloroethane	200 µg/L									2.6			
1,1,2-trichloroethane	5 µg/L							0.19				0.76	
1,1-dichloroethene	7 µg/L									0.19			
1,2-dichloroethane	5 µg/L		0.29								1.4	0.87	0.13
1,4-dichlorobenzene	75 µg/L									0.27		0.19	
Antimony, filtered	6 µg/L		31.5	30.8				29.8	51.1	44.8	31.1	29.2	
Arsenic, filtered	50 µg/L								7.6	9.2	8.7	4.1	
Barium, filtered	2,000 µg/L	53.3	109	175	128	59.9	243	116	116	162	344	308	82.3
Benzene	5 µg/L											0.35	0.073
Beryllium, filtered	4 µg/L	1	0.65	1.8	2.7	1	1.2	0.5	1.4	1.6	1.1	1.1	0.99
Cadmium, filtered	5 µg/L	3.3	3.9	3.4			3.1		4.6	3.3	3.1	3.2	
Carbon tetrachloride	5 µg/L									0.29	690	6,200	0.35
Carbon-14	2,000 pCi/L					20,900	15.4						
Cesium-137	200 pCi/L								1,170				
Chloroform, filtered	100 µg/L		1.1			1	7.2	4.4		0.46	20	31	3
Chromium	100 µg/L	44.6	82	4,540	145	535	168		54.9	6,250	204	592	7.3
cis-1,2-dichloroethene	70 µg/L							48 ^(a,b)				0.09	160
Cobalt-60	100 pCi/L								48.4				
Cyanide	200 µg/L								275			6.4	
Ethylbenzene	700 µg/L											0.29	
Fluoride	4,000 µg/L	510	720	450	450	490	1,000	4,300 ^(b,c)	980	1,300	700	4,300	520
Gross alpha	15 pCi/L	2.99	10.1	3.94	72.4	7.14	3.07	77 ^(b,c)	324	10.7	13.9	6.73	43.9
Gross beta	50 pCi/L	221	51.1	466	183	3,590	16,000	34.7 ^(b,c)	12,100	79.7	71,200	4,390	97.5
Hexavalent chromium	100 µg/L	46	90	5440	154	542	17.1				209	10.3	
Iodine-129	1 pCi/L								3.65	11.9	35.3	36.7	
Mercury, filtered	2 µg/L											0.12	
Methylene chloride	5 µg/L		0.31				0.37	5.4		4.2	7	18	1.8

Table A.3. (contd)

Constituent	Drinking Water Standard	100-BC-5	100-FR-3	100-HR-3-D	100-HR-3-H	100-KR-4	100-NR-2	1100-EM-1	200-BP-5	200-PO-1	200-UP-1	200-ZP-1	300-FF-5
Nickel, filtered	100 µg/L			416	21.6	28.8	17		133	864	120	328	41.6
Nitrate	45,000 µg/L	27,900	177,000	107,000	474,000	195,000	228,000	261,000 ^(b,c)	735,000	170,000	1,930,000	2,160,000	134,000
Nitrite	3,300 µg/L			7550		135	299	42.7	1120	233	460	361	69
Plutonium-238	30 pCi/L								0.619				
Plutonium-239/240	30 pCi/L								74.8				
Selenium, filtered	50 µg/L										5.7		
Strontium-90	8 pCi/L	98.9	27.8	7.06	23.2	2,440	8,000		5,680	21.4	53.6	1.29	4.03
Technetium-99	900 pCi/L	46.7			986	85.4		27	10,600	287	188,000	11,117	319
Tetrachloroethene	5 µg/L							0.26		2.2		1.4	0.48
Toluene	1,000 µg/L									0.89		0.37	
trans-1,2-dichloroethene	100 µg/L												0.54
Trichloroethene	5 µg/L		9.8			11		27 ^(a,b)		0.88	11	18	7.2
Tritium	20,000 pCi/L	32,200	11,500	29,700	6,210	1,270,000	31,400	250.98	27,600	5,570,000	634,000	2,170,000	3,670,000
Uranium	30 µg/L			3.58	119			18	554	7.19	1190	367	235

(a) City of Richland data; not in HEIS.

(b) From offsite contaminant source.

(c) Framatome ANP data; not in HEIS.

Note: Values flagged with "U," "R," and "Y" are excluded from this table.

HEIS = Hanford Environmental Information System.

Table A.4. Monitoring Wells and Constituents for the 100-BC-5 Operable Unit (adapted from PNNL-13326 and Change Control Form M-15-00-07)

<u>Well</u>	<u>Unit Monitored</u>	<u>Well Standard</u>	<u>Sampling Frequency</u>	<u>Sampled as Planned^(a)</u>
199-B2-12	Confined Ringold	WAC	A	Yes
199-B3-1	Top of unconfined	PRE	A	Yes
199-B3-46	Top of unconfined	WAC	A	Yes
199-B3-47	Top of unconfined	WAC	A	Yes
199-B4-1	Top of unconfined	PRE	BA-odd	Yes
199-B4-2	Top of unconfined	PRE	A	Yes
199-B4-4	Top of unconfined	PRE	BA-even	NA
199-B4-5	Top of unconfined	WAC	BA-even	NA
199-B4-7	Top of unconfined	WAC	BA-even	NA
199-B5-1	Top of unconfined	PRE	A	Yes
199-B5-2	Top of unconfined	WAC	A	Yes
199-B8-6	Top of unconfined	WAC	BA-even	NA
199-B9-2	Top of unconfined	WAC	BA-even	NA
199-B9-3	Top of unconfined	WAC	BA-odd	Yes
699-63-90	Unconfined	PRE	A	Yes
699-65-72	Unconfined	PRE	BA-odd	Yes
699-65-83	Top of unconfined	PRE	BA-even	NA
699-66-64	Top of unconfined	PRE	BA-odd	Yes
699-67-86	Top of unconfined	PRE	BA-even	NA
699-72-73	Unconfined	PRE	A	Yes
699-72-92	Top of unconfined	PRE	BA-even	NA
Seep 037-1	Shoreline	--	A	Yes
Seep 039-2	Shoreline	--	A	No

<u>Field Parameters</u>	<u>Laboratory Analyses</u>	
pH	Anions	Gross beta
Specific conductance	Metals (Filtered)	Strontium-90 ^(b)
Turbidity	Gross alpha	Tritium
Hexavalent chromium ^(c)		

(a) See Table A.2 for more information.

(b) Required for wells 199-B3-47 and 199-B5-1 only; however, all wells were sampled for strontium-90 in fiscal year 2003.

(c) Selected wells only (199-B3-47 and 199-B5-1 in fiscal year 2003).

A = Annually.

BA-even = Biennially, even fiscal years.

BA-odd = Biennially, odd fiscal years.

NA = Not applicable (not scheduled for sampling in fiscal year 2003).

PRE = Pre-Resource Conservation and Recovery Act.

WAC = Washington Administrative Code.

Table A.5. Monitoring Wells and Constituents for the 100-FR-3 Operable Unit (adapted from PNNL-13327 and Change Control Form M-15-01-06)

Well	Unit Monitored	Well Standard	Sampling Frequency	Sampled as Planned ^(a)
199-F1-2	Top of unconfined	WAC	A	Yes
199-F5-1	Top of unconfined	PRE	A	Yes
199-F5-4	Top of unconfined	PRE	BA-odd	Yes
199-F5-6	Top of unconfined	PRE	A	Yes
199-F5-42	Top of unconfined	WAC	A	Yes
199-F5-43A	Top of unconfined	WAC	A	Yes
199-F5-43B	Confined Ringold	WAC	A	Yes
199-F5-44	Top of unconfined	WAC	A	Yes
199-F5-45	Top of unconfined	WAC	Q (nitrate); BA-odd (other)	Yes
199-F5-46	Top of unconfined	WAC	Q (hexavalent chromium); A (other)	Yes
199-F5-47	Top of unconfined	WAC	BA-even	NA
199-F5-48	Top of unconfined	WAC	BA-even	NA
199-F6-1	Top of unconfined	WAC	A	Yes
199-F7-1	Top of unconfined	PRE	BA-even	NA
199-F7-2	Top of unconfined	WAC	BA-even	NA
199-F7-3 ^(a)	Top of unconfined	WAC	BA-odd	Yes
199-F8-2	Top of unconfined	PRE	BA-even	NA
199-F8-3	Top of unconfined	WAC	BA-odd	Yes
199-F8-4	Top of unconfined	WAC	A	Yes
699-71-30	Top of unconfined to confined Ringold	PRE	BA-odd	Yes
699-77-36 ^(a)	Top of unconfined to confined Ringold	PRE	BA-even	NA
699-81-38 ^(a)	Top of unconfined to confined Ringold	PRE	BA-odd	Yes
699-83-47	Top of unconfined	PRE	BA-even	NA
699-84-35A	Confined Ringold	PRE	BA-odd	Yes
Seep 187-1	Shoreline	—	A	No
Seep 190-4	Shoreline	—	A	No
Seep 207-1	Shoreline	—	A	Yes
<u>Field Parameters</u>		<u>Laboratory Analysis</u>		
pH		Anions	Hexavalent chromium ^(b)	
Specific conductance		Metals (filtered)	Strontium-90	
Temperature		Gross alpha	Tritium	
Turbidity		Gross beta	Volatile organics ^(c)	

(a) See Table A.2 for more information.

(b) Hexavalent chromium analyzed in well 199-F5-46 only.

(c) Volatile organics required in selected wells only. However, in fiscal year 2003 the analysis was run in all wells and seeps.

A = Annually.

BA-even = Biennially, even fiscal years.

BA-odd = Biennially, odd fiscal years.

NA = Not applicable (not scheduled for sampling in fiscal year 2003).

PRE = Pre-Resource Conservation and Recovery Act.

WAC = Washington Administrative Code.

Table A.6. Monitoring Wells and Constituents for 100-HR-3-D Interim Action Monitoring for 100-D Pump-and-Treat System (from DOE/RL-96-90 as modified by DOE/RL-96-84)

<u>Well</u>	<u>Chromium</u>	<u>Strontium-90 and Tritium</u>	<u>Sampled as Scheduled</u>
Extraction Wells^(a)			
199-D8-53	Q	SA	Yes
199-D8-54A	Q	SA	Yes
199-D8-68	Q	SA	Yes
199-D8-72	Q	SA	Yes
Compliance Wells			
199-D8-69	M	A	Yes
199-D8-70	M	A	Yes

(a) Operational sampling outside scope of groundwater project; data not in HEIS.

HEIS = Hanford Environmental Information System.

M = Monthly.

Q = Quarterly.

SA = Semiannually.

Table A.7. 100-HR-3-D Long-Term Monitoring Parameters (from Change Control Form 107 as modified^(a))

<u>Well</u>	<u>Field Chromium</u>	<u>Field Sulfate</u>	<u>Other^(b)</u>	<u>Sampled as Scheduled</u>
199-D2-6	Q	Q	A	Yes
199-D3-2	Q	Q	A	Yes
199-D4-13	Q	Q	A	Yes
199-D4-14	Q	Q	A	Yes
199-D4-15	M	M	A	Yes
199-D4-19	Q	Q	A	Yes
199-D4-20	Q	Q	A	Yes
199-D4-22	Q	Q	A	Yes
199-D4-23	Q	Q	A	Yes
199-D5-13	Q	--	A	Yes
199-D5-14	Q	--	A	Yes
199-D5-15	Q	--	A	Yes
199-D5-16	Q	--	A	Yes
199-D5-17	--	--	A	Yes
199-D5-18	--	--	B-03	Yes
199-D5-19	--	--	B-04	--
199-D5-20	Q	--	A	Yes
199-D5-36	Q	Q	A	Yes
199-D5-37	Q	Q	A	Yes
199-D5-38	M	M	A	Yes
199-D5-39	M	M	A	Yes
199-D5-40	Q	Q	A	Yes
199-D5-41	Q	Q	A	Yes
199-D5-42	Q	Q	A	Yes
199-D5-43	M	M	A	Yes
199-D5-44	Q	Q	A	Yes
199-D8-4	--	--	A	Yes
199-D8-5	--	--	A	Yes
199-D8-54B	--	--	A	Yes
199-D8-55	Q	--	A	Yes
699-93-48A	--	--	B-04	--
699-96-49	--	--	B-03	Yes
699-97-51A	--	--	A	Yes
Shoreline Seeps				
SD-102-1	--	--	A	No; dry
SD-110-1	--	--	A	Yes
SD-110-2	--	--	A	No ^(c)
SD-98-1	--	--	A	Yes

(a) Letter FH-0205249 from RT Wilde (Fluor Hanford, Inc.) to JS Fruchter (Pacific Northwest National Laboratory), *Revised FY 2003 Sampling Schedule for Groundwater Remediation Monitoring*, dated November 11, 2002.

(b) Metals (filtered/unfiltered), anions, gross alpha, gross beta, and tritium.

(c) See Section A.3 for more information.

B-03 = Biennially, fiscal year 2003.

B-04 = Biennially, fiscal year 2004.

A = Annually.

M = Monthly.

Q = Quarterly.

Table A.8. 100-HR-3-D Interim Action Monitoring for Redox System (DOE/RL-99-51)

Well	Frequency		Sampled as Scheduled
	Field ^(a)	Laboratory ^(b)	
Barrier Performance Wells			
199-D4-1	Q	A	Yes
199-D4-4	Q	A	Yes
199-D4-5	Q	A	Yes
199-D4-6	Q	A	Yes
199-D4-7	Q	A	One quarter missed; electrical problem
199-D4-13	Q	A	Yes ^(c)
199-D4-14	Q	A	Yes ^(c)
199-D4-19	Q	A	Yes ^(c)
199-D4-26 ^(d)	Q	A	Yes
199-D4-31 ^(d)	Q	A	One quarter missed; electrical problem
199-D4-32 ^(d)	Q	A	Yes
199-D4-48 ^(d)	Q	A	One quarter missed; electrical problem
199-D4-62 ^(d)	Q	A	Yes
199-D4-78 ^(d)	Q	A	Yes
Compliance Wells			
199-D4-23	Q	A	One quarter missed; electrical problem
199-D4-38	Q	A	Yes
199-D4-39	Q	A	One quarter missed; pump problem
199-D4-83	Q	A	Yes
199-D4-84	Q	A	Yes
199-D4-85	Q	A	One quarter missed; pump problem
199-D4-86	Q	A	Yes
Monitoring Wells			
199-D2-6	Q	A	Yes
199-D3-2	Q	A	Yes
199-D4-15	M ^(e)	A	Yes
199-D4-20	Q	A	Yes
199-D4-22	Q	A	Yes
199-D4-36 ^(d)	Q	A	Yes
199-D5-36	Q	A	Yes
199-D5-38	M ^(e)	A	Yes
199-D5-39	M ^(e)	A	Yes
199-D5-40	Q	A	Yes ^(c)
199-D5-43	M ^(e)	A	Yes
Aquifer Sampling Tubes and River Substrate Tubes			
166-D-1	A	--	No yield
166-D-2	A	--	Yes
166-D-3	A	--	Yes
166-D-4	A	--	No yield
TDP-39	A	--	Not sampleable
DD-39	A	--	Yes
DD-41	A	--	Yes
DD-42	A	--	Yes
DD-43	A	--	Yes
DD-44	A	--	Yes

(a) Hexavalent chromium and sulfate. DOE/RL-99-51 also specifies dissolved oxygen, which was not scheduled for the Redox project in fiscal year 2003.

(b) Metals (filtered/unfiltered) and anions. DOE/RL-99-51 also specifies alpha, beta, and tritium, which were not scheduled for the Redox project in fiscal year 2003.

(c) Scheduled under 100-HR-3 long-term monitoring; data apply to both projects.

(d) Wells not listed in monitoring plan but were sampled for redox project.

(e) DOE/RL-99-51 specifies quarterly sampling; increased to monthly to track rapid changes.

A = Annually.

M = Monthly.

Q = Quarterly.

Table A.9. 100-HR-3-H Interim Action Monitoring Parameters for 100-H Pump-and-Treat System
(from DOE/RL-96-90 as modified by DOE/RL-96-84)

<u>Well</u>	<u>Chromium</u>	<u>Co-Contaminants^(a)</u>	<u>Sampled as Scheduled</u>
Extraction Wells^(b)			
199-H3-2A	Q	SA	Yes
199-H4-7	Q	SA	Yes
199-H4-11	Q	SA	Yes
199-H4-12A	Q	SA	Yes
199-H4-15A	Q	SA	Yes
199-H4-65	Q	SA	Yes
Injection Wells			
199-H3-3	--	--	
199-H3-4	--	--	
199-H3-5	--	--	
Compliance Wells			
199-H4-4	M	A	Yes
199-H4-5	M	A	Yes
199-H4-63	M	A	Yes
199-H4-64	M	A	Yes
Performance Wells			
199-H4-3	--	SA	Yes
199-H4-6	--	SA	Yes
199-H4-8	--	SA	Yes
199-H4-10	--	SA	Yes
199-H4-12B	--	SA	Yes
199-H4-12CS	--	SA	Yes
199-H4-16	--	SA	Yes
199-H4-17	--	SA	Yes
199-H4-18	--	SA	Yes
199-H4-45	--	SA	Yes
199-H4-46	--	SA	Yes
199-H4-48	--	SA	Yes
199-H4-49	--	SA	Yes
199-H5-1A	--	SA	Yes

(a) Nitrate, strontium-90, technetium-99, tritium, and uranium.

(b) Operational sampling outside scope of groundwater project; data not in the Hanford Environmental Information System database.

A = Annually.

M = Monthly.

Q = Quarterly.

SA = Semiannually.

Table A.10. 100-HR-3-H Long-Term Monitoring (from Change Control Form 107 as modified^(a))

<u>Well</u>	<u>Frequency^(b)</u>	<u>Sampled as Scheduled</u>
199-H3-2A	A	Yes
199-H3-2C	B-03	Yes
199-H4-10	A	Yes
199-H4-12C	A	Yes
199-H4-13	A	Yes
199-H4-14	B-03	Yes
199-H4-16	B-03	Yes
199-H4-17	B-03	Yes
199-H4-18	A	Yes
199-H4-3	A	Yes
199-H4-4	A	Yes
199-H4-45	A	Yes
199-H4-46	B-03	Yes
199-H4-47	B-04	--
199-H4-48	B-04	--
199-H4-49	B-04	--
199-H4-5	A	Yes
199-H4-6	B-03	Yes
199-H4-63	A	Yes
199-H4-64	A	Yes
199-H4-8	B-03	Yes
199-H4-9	B-04	--
199-H5-1A	B-04	--
199-H6-1	A	Yes
699-91-46A	B-04	--
699-96-43	B-03	Yes
699-97-43	B-04	--
SH-144-1	A	Yes
SH-145-1	A	Yes
SH-150-1	A	Yes
SH-152-2	A	Yes
SH-153-1	A	Yes

(a) Letter FH-0205249 from RT Wilde (Fluor Hanford, Inc.) to JS Fruchter (Pacific Northwest National Laboratory), *Revised FY 2003 Sampling Schedule for Groundwater Remediation Monitoring*, dated November 11, 2002.

(b) Metals (filtered/unfiltered), anions, gross alpha, gross beta, and tritium.

A = Annually.

B-03 = Biennially, fiscal year 2003.

B-04 = Biennially, fiscal year 2004.

FY = Fiscal year.

Table A.11. 100-KR-4 Interim Action Monitoring for 100-K Pump-and-Treat System
(from DOE/RL-96-90 as modified by DOE/RL-96-84, Rev. 0-A)

<u>Well</u>	<u>Chromium</u>	<u>Strontium-90 and Tritium</u>	<u>Sampled as Scheduled</u>
Extraction Wells			
199-K-113A	Q	SA	Yes
199-K-115A	Q	SA	Yes
199-K-116A	Q	SA	Yes
199-K-119A	Q	SA	Yes
199-K-120A	Q	SA	Yes
199-K-125A	Q	SA	Yes
199-K-126A ^(a)	Q	SA	Yes
199-K-127A	Q	SA	Yes
199-K-129A	Q	SA	Yes
Injection Wells			
199-K-121A	--	--	
199-K-122A	--	--	
199-K-123A	--	--	
199-K-124A	--	--	
199-K-128A			
Compliance Wells			
199-K-18	M	A	Missed one month; pump problem
199-K-20	M	A	Yes
199-K-112A	M	A	Missed one month; pump problem
199-K-114A	M	A	Missed one month; pump problem
199-K-117A	M	A	Yes
199-K-130A	M	A	Yes
Performance Wells			
199-K-19	SA	--	Yes
199-K-21	SA	--	Yes
199-K-22	SA	--	Yes
199-K-37	SA	--	Yes

(a) Converted to an extraction well during fiscal year 2003.

A = Annually.

M = Monthly.

Q = Quarterly.

SA = Semiannually.

Table A.12. 100-KR-4 Long-Term Monitoring (from Wilde 2002^[a])

<u>Well</u>	<u>Quarterly</u>	<u>Other</u>	<u>Sampled as Scheduled</u>
199-K-106A	--	BA-04 ^(b)	Yes
199-K-107A	Chromium	A ^(b)	Yes
199-K-108A	Chromium	A ^(b)	Yes
199-K-109A	Strontium-90	A ^(b)	Yes
199-K-11	--	BA-03 ^(b)	Yes
199-K-110A	--	BA-04 ^(b)	--
199-K-111A	--	A ^(b,c)	Yes
199-K-18	--	A ^(b)	Yes
199-K-19	--	A ^(b)	Yes
199-K-20	--	A ^(b)	Yes
199-K-21	--	A ^(b)	Yes
199-K-22	--	A ^(b)	Yes
199-K-23	--	BA-03 ^(b)	Yes
199-K-27	Strontium-90	BA-04 ^(b)	Yes; BA list also
199-K-30	Strontium-90	BA-03 ^(b)	Yes
199-K-31	--	A ^(b)	Yes
199-K-32A	--	A ^(b,c)	Yes
199-K-32B	--	A ^(b)	Yes
199-K-33	--	A ^(b,c)	Yes
199-K-34	--	BA ^(b,c)	Yes
199-K-35	--	BA-03 ^(b)	Yes; carbon-14 also
199-K-36	Chromium	A ^(b,d)	Yes
199-K-37	--	A ^(b)	Yes
699-70-68	--	BA-04 ^(b)	--
699-73-61	--	BA-04 ^(b)	--
699-78-62	--	BA-04 ^(b)	--
SK-057-3	--	A ^(b)	No
SK-077-1	--	A ^(b)	Yes
SK-082-2	--	A ^(b)	Yes

(a) Letter FH-0205249 from RT Wilde, Flour Hanford, Inc. to JS Fruchter, Pacific Northwest National Laboratory, *Revised FY 2003 Sampling Schedule for Groundwater Remediation Monitoring*, dated November 11, 2002.

(b) Metals (filtered/unfiltered), anions, gross alpha, gross beta, gamma, and tritium.

(c) As in (b), plus carbon-14.

(d) As in (b), plus mercury.

A = Annually.

B-03 = Biennially, fiscal year 2003.

B-04 = Biennially, fiscal year 2004.

Table A.13. 100-NR-2 Long-Term Monitoring (from Wilde 2002^(a))

<u>Well</u>	<u>Frequency</u>	<u>Constituents</u>	<u>Sampled as Scheduled</u>
199-N-14	SA	Anions, metals, beta, strontium-90, tritium	Yes
199-N-16	A	Anions, metals, oil/grease, tributyl phosphate, beta, strontium-90	Yes
199-N-17	--	--	Decommissioned
199-N-18	A	Oil/grease, tributyl phosphate	Yes
199-N-2	A	Anions, metals, beta, strontium-90, tritium	Yes
199-N-21	A	Anions, metals	Yes
199-N-27	A	Anions, metals, alpha, gamma, tritium	Yes
199-N-3	SA	Anions, metals, beta, strontium-90, tritium	Yes
199-N-32	SA	Anions, metals, beta, gamma, strontium-90, tritium	Yes
199-N-50	A	Beta, tritium	Yes
199-N-51	A	Beta, tritium	Yes
199-N-54	--	--	Decommissioned
199-N-64	A	Anions, metals, beta, strontium-90, tritium	Yes
199-N-67	SA	Anions, metals, alpha, beta, strontium-90	Yes
199-N-70	A	Anions, metals, alpha, beta, gamma, strontium-90, tritium	Yes
199-N-74	A	Metals, alpha, beta, gamma	Yes
199-N-75	SA	Anions, metals, beta, strontium-90, tritium	Yes
199-N-76	SA	Anions, metals, beta, gamma, strontium-90, tritium	Yes
199-N-80	A	Anions, metals, alpha, beta, gamma, strontium-90, tritium	Yes
199-N-81	A	Anions, metals, beta, strontium-90, tritium	Yes
199-N-92A	A	Anions, metals, beta, strontium-90, tritium	Yes
199-N-96A	A	Anions, metals, beta, strontium-90, tritium	Yes
199-N-99A	A	Anions, metals, beta, strontium-90, tritium	Yes

(a) Letter FH-0205249 from RT Wilde, Fluor Hanford, Inc. to JS Fruchter, Pacific Northwest National Laboratory, *Revised FY 2003 Sampling Schedule for Groundwater Remediation Monitoring*, dated November 11, 2002.

A = Annually.

SA = Semiannually.

Table A.14. Monitoring Wells and Constituents for the 200-BP-5 Operable Unit (DOE/RL-2001-49)

Well	Anions	Cyanide	Gamma	I-129	Sr-90	Tc-99	Tritium	Uranium	Pu	Sampled in Fiscal Year 2003 ^(a)
299-E27-7	A					A				Yes
299-E27-14	A					A				Yes
299-E27-15	A					A				Yes
299-E28-2			A	A	A	A	A		A	Yes
299-E28-5			A		A			A	A	Yes
299-E28-6			A		A			A	A	Yes
299-E28-8			A		A	A		A	A	Yes
299-E28-17	A		A		A			A	A	Yes
299-E28-18				A				A		No
299-E28-21								A		No
299-E28-23			A		A			A	A	Yes
299-E28-24			A		A			A	A	Yes
299-E28-25			A		A			A	A	Yes
299-E28-26	A					A		A		Yes
299-E28-27	A		A	A	A	A		A	A	Yes
299-E32-4	A			A		A	A			Yes; no I-129
299-E32-6	A					A				Yes
299-E32-9	A			A		A				Yes; no I-129
299-E32-10		A	A			A		A		Yes; no gamma
299-E33-7	A	A	A	A		A		A		Yes
299-E33-12 ^(b)						T				No
299-E33-13		A				A		A		No
299-E33-15	A					A				Yes
299-E33-16	A			A		A		A		Yes; no I-129
299-E33-18				A		A		A		Yes; no I-129
299-E33-26		A	A			A		A		Yes
299-E33-28	A					A				Yes
299-E33-30	A					A				Yes
299-E33-34	A	A	A	A		A	A	A		Yes; no I-129
299-E33-35	A	A				A		A		Yes; no cyanide
299-E33-38	A	A	A	A		A		A		Yes; no I-129
299-E33-39	A			A		A	A			Yes
299-E33-41						A		A		Yes
299-E33-42				A		A		A		Yes; no I-129
299-E33-43				A		A		A		Yes
299-E33-44			A			A		A		Yes
299-E33-46	A					A		A		No
299-E33-338						A		A		Yes
699-43-40				T			T			No
699-45-42				T			T			No
699-47-60	A			A		A	A			Yes
699-49-55A	A	A	A	A		A	A			No; see Table A.2
699-49-57A	A	A	A	A		A	A	A		Yes
699-49-57B ^b			T			T				No
699-50-53A	A	A	A	A		A				No
699-53-47A	A				A					Yes
699-53-47B	T				T					Yes
699-53-48A	T				T					Yes
699-53-48B					T					No; dry
699-53-55A						T				Yes

Table A.14. (contd)

<u>Well</u>	<u>Anions</u>	<u>Cyanide</u>	<u>Gamma</u>	<u>I-129</u>	<u>Sr-90</u>	<u>Tc-99</u>	<u>Tritium</u>	<u>Uranium</u>	<u>Pu</u>	<u>Sampled in Fiscal Year 2003^(a)</u>
699-53-55B						T				No; see Table A.2
699-53-55C	A	A	A	A		A	A			Yes
699-54-45A	T									No
699-54-45B	T									No
699-54-48						T				Yes
699-54-49	T					T				Yes
699-55-50C	A			A	A	A	A			Yes
699-55-57	A	A	A	A		A				Yes
699-55-60A	A	A	A	A		A	A			Yes; no gamma
699-57-59	A			A		A	A			Yes
699-59-58	A			A		A	A			Yes
699-60-60	T			T		T	T			Yes
699-61-62	T			T	T	T	T			Yes
699-61-66	T			T		T	T			Yes
699-64-62	T					T	T			Yes
699-65-50						T				No
699-65-72							T			Yes
699-66-58						T	T			No
699-66-64						T	T			Yes; No Tc-99
699-70-68						T	T			Yes
699-72-73	T					T	T			Yes
699-73-61							T			No

(a) Sampling commenced following approval of sampling and analysis plan and waste control plan in May 2003, so not all wells or constituents were scheduled for sampling in fiscal year 2003. Some wells/constituents listed here were sampled for other operable units or waste management areas.

(b) Basalt-confined aquifer.

A = Annually.

T = Triennially.

Table A.15. Monitoring Wells and Constituents for the 200-PO-1 Operable Unit (PNNL-14111^{la})

Well	Alkalinity	Alpha	Anions	Arsenic	Beta	Gamma	I-129	ICP	Sr-90	Tc-99	TOC	TOX	Tritium	Uranium	VOA	Sampled as Planned
299-E13-5		A	A		A	A	A	A	A				A			Yes
299-E13-14		A	A		A	A		A	A				A	A		Yes
299-E16-2			T	T			T						T			NA
299-E17-9			T	T			T						T			NA
299-E17-14			T	T			T						T			NA
299-E17-18			T	T			T						T			NA
299-E17-19			T	T			T						T			NA
299-E18-1			T	T			T	T					T			NA
299-E23-1			T	T			T						T			NA
299-E24-5			T	T			T						T			NA
299-E24-18			T	T			T						T			NA
299-E24-20			T	T			T						T			NA
299-E25-3			T	T			T						T			NA
299-E25-6		T	T	T	T	T	T			T			T	T		NA
299-E25-17			T	T			T						T			NA
299-E25-18			T	T			T						T			NA
299-E25-19			T	T			T						T			NA
299-E25-20			T	T			T						T			NA
299-E25-22			T	T			T						T			NA
299-E25-28 ^b			T	T			T						T			NA
299-E25-29P			T	T			T						T			NA
299-E25-29Q			T	T			T						T			NA
299-E25-32P			T	T			T						T			NA
299-E25-32Q	T		T	T			T	T					T			NA
299-E25-34			T	T			T						T			NA
299-E25-35			T	T			T						T			NA
299-E25-36			T	T			T						T			NA
299-E25-37			T	T			T						T			NA
299-E25-41			T	T			T						T			NA
299-E25-42			T	T			T						T			NA
299-E25-43			T				T						T			NA
299-E25-44							T						T			NA
299-E25-46			T				T						T			NA
299-E25-47			T				T						T			NA
499-S0-7			A													Yes
499-S0-8			A													Yes
699-1-18			T										T			NA

Table A.15. (contd)

Well	Alkalinity	Alpha	Anions	Arsenic	Beta	Gamma	I-129	ICP	Sr-90	Tc-99	TOC	TOX	Tritium	Uranium	VOA	Sampled as Planned
699-2-3			T				T						T			NA
699-8-17																NA
699-8-25			T				T						T			NA
699-10-54A		A	A		A								A			Yes
699-10-E12	A	A	A		A	A		A	A		A	A	A			Yes
699-14-38			T					T					T			NA
699-17-5	T	T	T		T	T	T	T	T	T			T		T	NA
699-19-43			T				T	T					T			NA
699-20-20		T	T		T	T	T	T		T			T			NA
699-20-E5A			T										T			NA
699-20-E12O			A										A			Yes
699-20-E12S ^(b)	T		T										T			NA
699-21-6			T				T						T			NA
699-22-35			T				T						T			NA
699-24-34C			T				T						T			NA
699-24-46			A										A			Yes
699-26-15A			T				T						T			NA
699-26-33			A										A			Yes
699-26-35A			T				T						T			NA
699-27-8			T				T						T			NA
699-28-40			T				T	T					T			NA
699-29-4			T				T						T			NA
699-31-11			T				T						T			NA
699-31-31			A										A			No ^(e)
699-31-31P ^(b)			T				T						T			NA
699-33-42			T				T	T					T			NA
699-33-56			T					T					T			Yes
699-34-41B			A				A						A			Yes
699-34-42			T				T						T			NA
699-35-9			T				T						T			NA
699-37-43			T				T						T			NA
699-37-47A			T	T			T						T			NA
699-37-E4	T		T				T	T					T			NA
699-38-15			T				T						T			NA
699-39-39			T				T						T			NA
699-40-1			T				T						T			NA

Table A.15. (contd)

Well	Alkalinity	Alpha	Anions	Arsenic	Beta	Gamma	I-129	ICP	Sr-90	Tc-99	TOC	TOX	Tritium	Uranium	VOA	Sampled as Planned
699-40-33A			T				T						T			NA
699-41-1A			A										A			Yes
699-41-23			A										A			Yes
699-41-40 ^(c)	T	T	T		T		T						T			NA
699-42-12A			T				T						T			NA
699-42-39A			T				T						T			NA
699-42-39B ^(c)	T		T				T						T			NA
699-42-41			T	T			T						T			NA
699-42-42B	T		T				T						T			NA
699-43-3			T				T						T			NA
699-43-43			T	T			T						T			NA
699-43-45			T	T			T						T			NA
699-46-4			A										A			Yes
699-46-21B			A										A			Yes
699-47-5			T				T						T			NA
699-48-7A													T			NA
699-49-13E		T	T		T	T	T						T			NA
699-50-28B			T				T						T			NA
699-52-19			T										T			NA
699-S3-25			T										T			NA
699-S3-E12			A										A			Yes
699-S6-E14A		T	T		T	T							T			NA
699-S6-E14A		T	T		T	T							T			NA
699-S11-E12AP ^(d)			A										A			No ^(e)
699-S12-3			T										T			NA
699-S19-E13			A										A			Yes
699-S19-E14			T										T			NA

(a) In fiscal year 2003, the 200-PO-1 operable unit monitoring wells were the far-field wells sampled for Plutonium-Uranium Extraction Plant cribs. Those wells were listed in PNNL-14111 under the project names “2PO1-C” and “2PO1-S.”

(b) Deep unconfined aquifer

(c) Confined Ringold Formation aquifer

(d) Basalt-confined aquifer

(e) See Table A.2.

A = Annually.

ICP = Inductively coupled plasma emission spectroscopy.

NA = Not applicable; not scheduled for sampling in fiscal year 2003.

T = Triennially (unless otherwise noted, not scheduled for fiscal year 2003).

TOC = Total organic carbon.

TOX = Total organic halides.

VOC = Volatile organic compounds.

Table A.16. Monitoring Wells and Constituents for the 200-UP-1 Operable Unit (DOE/RL-2002-10)

Well	Anions	Arsenic	Cadmium	I-129	ICP	Sr-90	Tc-99	Tritium	Uranium	VOA	Sampled as Planned
299-W15-37	A	A	A						A	A	Yes
299-W18-15	S	S							S	S	Yes
299-W18-21	A	A							A	A	Yes
299-W18-30	A	A		A					A	A	Yes
299-W18-33	S	S						S	S	S	Yes
299-W19-4	B			B			B		B	B	Yes
299-W19-9	A	A		A			A		A	A	Yes
299-W19-14	B	B		B			B	B	B	B	No; dry
299-W19-20	A		A	A			A		A	A	Yes ^(a)
299-W19-35	A		A	A			A		A	A	Yes
299-W19-36	A			A			A		A	A	Yes
299-W19-37	A		A	A			A		A	A	Yes
299-W19-39	A			A			A		A	A	Yes
299-W19-40	A			A			A	A	A	A	Yes
299-W19-43	S			S			S		S	S	Yes
299-W19-46 ^(b)	Q			Q			Q	Q	Q	Q	Yes
299-W22-9	B			B		B	B	B	B	B	Yes
299-W22-20	A			A		A	A	A	A	A	Yes
299-W22-26	A		A	A				A	A	A	Yes
299-W22-45	A		A	A		A		A	A	A	Yes
299-W22-46	A			A		A	A	A	A	A	Yes
299-W22-48	S	S	S	S		S		S	S	S	Yes
299-W22-49	S		S	S		S	S	S	S	S	Yes
299-W23-4	S	S						S	S	S	Yes
299-W23-9	A						A	A	A	A	Yes
299-W23-10	S						S	S	S	S	Yes
299-W23-14	A	A	A				A	A	A	A	No; dry
299-W23-15	S						S	S	S	S	Yes
299-W26-12	B			B			B	B	B	B	No; dry
299-W26-13	B			B				B	B	B	Yes
699-32-62	B			B	B			B			Yes
699-32-72A	B			B				B		B	Yes
699-35-66A	B			B	B			B		B	Yes ^(c)
699-35-70	B			B				B		B	Yes
699-35-78A	A	A							A	A	Yes
699-36-61A	A			A	A			A			Yes
699-36-70A	A			A			A	A	A	A	Yes
699-38-65	A			A				A			Yes
699-38-68A	B			B			B	B	B	B	Yes
699-38-70	A			A			A	A	A	A	Yes
699-40-62	B			B			B	B	B	B	Yes

(a) Sampled as planned in January 2003, then went dry.

(b) New well.

(c) This well scheduled biennially for 200-UP-1 in fiscal year 2004; however, it was sampled for another project in fiscal year 2003.

A = Annually.

B = Biennially; scheduled for fiscal year 2003.

ICP = Inductively coupled plasma emission spectroscopy.

S = Semiannually.

VOC = Volatile organic compounds.

Table A.17. Monitoring Wells and Constituents for the 200-ZP-1 Operable Unit (DOE/RL-2002-17)

Well	Anions	Arsenic	Cadmium	I-129	ICP	Sr-90	Tc-99	Tritium	Uranium	VOA	Sampled as Planned
299-W6-2	S		S	S				S		S	No; dry
299-W6-7	A		A	A				A		A	No; dry
299-W6-10	A		A	A				A	A	A	Yes
299-W7-4	A									A	Yes
299-W7-7	A							A		A	Yes
299-W7-8	B							B		B	No; dry
299-W7-12	B							B		B	Yes
299-W8-1	B							B		B	Yes
299-W10-1	A	A			A			A		A	Yes
299-W10-4	S	S		S	S		S	S		S	Yes
299-W10-5	A		A		A		A	A		A	Yes
299-W10-13	B									B	No; dry
299-W10-19	A		A							A	Yes
299-W10-20	B									B	Yes
299-W10-21	A		A					A		A	Yes
299-W10-22	S			S	S		S	S	S	S	Yes
299-W10-23	A	A	A	A	A		A	A	A	A	Yes
299-W11-3	S			S				S	S	S	Yes
299-W11-6	S			S					S	S	Yes
299-W11-7	A	A	A	A	A		A		A	A	Yes
299-W11-10	S									S	Yes
299-W11-13	S	S	S	S	S		S	S		S	Yes
299-W11-18	A		A	A	A		A	A	A	A	Yes
299-W11-37	S			S				S	S	S	Yes
299-W12-1	A			A				A		A	Yes
299-W14-14	A		A	A	A		A	A		A	Yes
299-W15-1	S									S	Yes
299-W15-2	A						A			A	Yes
299-W15-7	S						S			S	Yes
299-W15-11	S						S	S		S	Yes
299-W15-15	A		A							A	Yes
299-W15-16	A		A		A					A	Yes
299-W15-31A	S									S	Yes
299-W15-32 ^(a)	A		A		A					A	Yes
299-W15-33 ^(a)	A									A	Yes
299-W15-34 ^(a)	A						A			A	Yes
299-W15-35 ^(a)	A				A		A			A	Yes
299-W15-36 ^(a)	A									A	Yes
299-W15-38	A				A					A	Yes
299-W15-39	A									A	Yes
299-W15-40	S		S		S		S	S		S	Yes
299-W15-41	A		A				A	A		A	Yes
299-W15-42	Q				Q		Q			Q	Yes
299-W15-43	Q						Q			Q	Yes
299-W15-765	Q									Q	New well; sampled twice in FY 2003
299-W18-1	A		A							A	Yes
299-W18-23	A		A							A	Yes
299-W18-24	A		A						A	A	Yes
299-W18-27	A		A						A	A	Yes
699-39-79	B		B							B	Yes
699-43-89	B	B	B	B	B	B	B	B	B	B	Yes

Table A.17. (contd)

<u>Well</u>	<u>Anions</u>	<u>Arsenic</u>	<u>Cadmium</u>	<u>I-129</u>	<u>ICP</u>	<u>Sr-90</u>	<u>Tc-99</u>	<u>Tritium</u>	<u>Uranium</u>	<u>VOA</u>	<u>Sampled as Planned</u>
699-44-64	B			B			B	B	B		Yes
699-45-69A	B			B						B	Yes
699-47-60	B			B	B		B	B	B	B	Yes
699-48-71	S			S				S	S	S	Yes
699-48-77A	B							B		B	Yes
699-55-60A	B			B	B		B	B	B	B	Yes

(a) Extraction well.

A = Annually.

B = Biennially.

ICP = Inductively coupled plasma emission spectroscopy.

Q = Quarterly.

S = Semiannually.

Table A.18. Monitoring Wells and Constituents for the 300-FF-5 Operable Unit (DOE/RL-2002-11)

Well	Alkalinity	Alpha	Anions	Beta	Gamma	I-129	Metals	Sr-90	Tritium	Uranium	Semi-VOA	VOA	Sampled as planned
399-1-1	S		S							S		S	Yes
399-1-2	S		S							S		S	Yes
399-1-6	S		S							S		S	Yes
399-1-7	S									S		S	Yes
399-1-8	S									S		S	Yes
399-1-10A	S		S							S		S	Yes
399-1-10B	S								S	S		S	Yes
399-1-11	S									S		S	Yes
399-1-12	S									S		S	Yes
399-1-15	S	S		S						S		S	Yes
399-1-16A	S		S							S		S	Yes
399-1-16B	S									S		S	Yes
399-1-17A	S	S	S	S					S	S		S	Yes
399-1-17B	S									S		S	Yes
399-1-18A	S		S										Yes
399-1-18B	S								S				Yes
399-1-21A	S								S	S		S	Yes
399-1-21B	S									S		S	Yes
399-2-1	S									S		S	Yes
399-2-2	S									S		S	Yes
399-3-2	S											S	Yes
399-3-6	S		S						S	S		S	Yes
399-3-10	S									S		S	Yes
399-3-11	S	S	S	S				S	S	S		S	Yes
399-3-12	S		S						S	S		S	Yes
399-4-1	S		S						S	S		S	Yes
399-4-9	S		S						S	S		S	Yes
399-4-12	S		S						S	S		S	Yes
399-5-4B	S								S			S	Yes
399-8-5A	S	S	S	S					S	S		S	Yes
699-12-2C	S	Q	S	Q	Q	S	A		Q	Q		A	Yes except I-129 only once
699-13-0A	S	Q	S	Q	Q	S	A		Q	Q		A	Yes
699-13-1E	S	Q	S	Q	Q	S	A		Q	Q		A	Yes
699-13-2D	S	Q	S	Q	Q	S	A		Q	Q		A	Yes

Table A.18. (contd)

<u>Well</u>	<u>Alkalinity</u>	<u>Alpha</u>	<u>Anions</u>	<u>Beta</u>	<u>Gamma</u>	<u>I-129</u>	<u>Metals</u>	<u>Sr-90</u>	<u>Tritium</u>	<u>Uranium</u>	<u>Semi-VOA</u>	<u>VOA</u>	<u>Sampled as planned</u>
699-13-3A	S	Q	S	Q	Q	S	A		Q	Q		A	Yes
699-S6-E4A	S	S	S	S	S		S		S	S	S	S	Yes
699-S6-E4B	S	A		A	A				A	A			Yes
699-S6-E4D	S	A		A	A				A	A			Yes
699-S6-E4E	S	A		A	A				A	A			Yes
699-S6-E4K	S	S	S	S	S		S		S	S	S	S	Yes
699-S6-E4L	S	S	S	S	S		S		S	S	S	S	Yes

A = Annually.

Q = Quarterly.

S = Semiannually.

VOA = Volatile organic analysis.

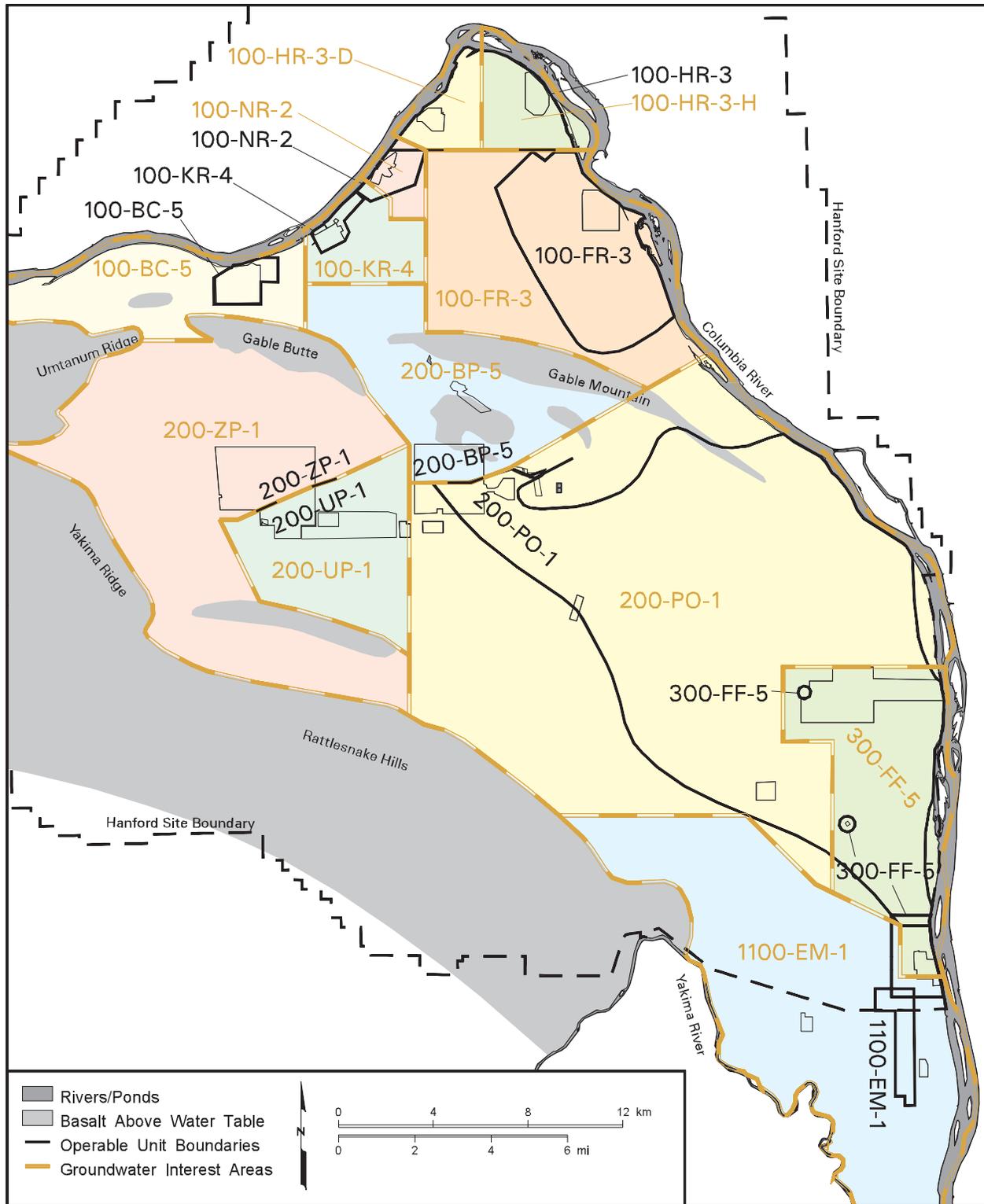
Table A.19. Monitoring Wells and Constituents for the 1100-EM-1 Operable Unit (PNNL-12220)

<u>Well</u>	<u>Frequency^(a)</u>	<u>Sampled as Planned</u>
699-S27-E12A	A	Yes
699-S28-E12	A	Yes
699-S28-E13A	A	Yes
699-S29-E10A	A	Yes
699-S29-E11	A	Yes
699-S29-E12	A	Yes
699-S29-E13A	A	Yes
699-S30-E10A	A	Yes
699-S30-E10B	A	Yes
699-S30-E11A	A	Yes
699-S31-E10A	A	Yes
699-S31-E10C	A	Yes
699-S31-E10D	A	Yes
699-S31-E11	A	Yes
699-S41-E12 ^(b)	A	Yes

(a) Anions and volatile organic analysis except where noted.

(b) Chromium only.

A = Annually.



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Figure A.1. Groundwater Operable Units and Groundwater Interest Areas on the Hanford Site