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Appendix A

Supporting Information

M. J. Hartman

This appendix lists supplemental information for waste disposal facilities on the Hanford Site requiring groundwater monitoring and regulated under the Washington Administrative Code (WAC) (Figure A.1). Most of these are regulated under the *Resource Conservation and Recovery Act of 1976* (RCRA) (WAC 173-303), on which this appendix is focused. Three treated effluent disposal facilities (WAC 173-216), one solid waste landfill (WAC 173-304), and various groundwater operable units (*Comprehensive Environmental Response, Compensation, and Liability Act of 1980* [CERCLA]) are also included. Exceedance of drinking water standards and derived concentration guides are also discussed for each geographic region. Information required by the regulations (e.g., assessing the adequacy of the monitoring networks) is included for each RCRA unit.

Table A.1 lists the monitoring status for RCRA facilities at the end of fiscal year 1999. Estimates of groundwater velocity, and supporting data, are shown for RCRA sites in Table A.2. Table A.3 lists wells exceeding drinking water standards for each regulated unit during fiscal year 1999.

The supplemental information includes tables of wells, constituents, and statistical evaluations (Table A.4 through A.51) and maps of well locations (Figures A.2 through A.23). The tables provide references to applicable monitoring plans. Wells that are sampled jointly with other RCRA units or to meet the requirements of other regulations or U.S. Department of Energy (DOE) orders are noted in the "other networks" column.

A.1 100 B/C Area

The 100 B/C Area continued to be monitored in accordance with CERCLA (100-BC-5 Operable Unit) and the *Atomic Energy Act of 1954*. The CERCLA well network and constituent list were revised in fiscal year 1999 and are documented in Federal Facility Agreement and Consent Order Change Control Form No. M-15-99-03, dated July 14, 1999. Sampling schedules and analyte selection are coordinated to meet the requirements of both regulations.

Monitoring wells in the 100 B/C Area are sampled biannually to quarterly. Strontium-90 and tritium exceeded their interim drinking water standards locally. Gross beta also exceeded its standard, corresponding to the wells with high strontium-90. Chromium exceeded the maximum contaminant level in two wells, nitrate in one well. No radiological contaminants were detected at levels above the derived concentration guides.

A.2 100 K Area

Regulatory compliance issues related to groundwater in the 100 K Area include monitoring associated with the KE and KW Fuel Storage Basins and CERCLA environmental restoration activities.

A.2.1 KW and KE Fuel Storage Basins

Groundwater monitoring in fiscal year 1999 indicated there were no new leaks from these basins. DOE monitors groundwater around these facilities to ensure compliance with requirements for nuclear fuel and waste storage facilities (DOE Order 5400.1 [IV]9b). The regulatory basis for monitoring these facilities is

further described in the Hanford Site environmental monitoring plan (DOE/RL-91-50, Rev. 2). The implementation of these monitoring and reporting requirements is contained in a groundwater monitoring and assessment plan (WHC-SD-EN-AP-174).

A.2.2 100-KR-4 Operable Unit

The environmental restoration contractor continued to operate a pump-and-treat system for chromium in 100 K Area in fiscal year 1999. The system is an interim action in response to a 1996 record of decision (ROD 1996a).

The specific objectives of the pump-and-treat system are to protect aquatic receptors in the Columbia River bottom substrate from contaminants in groundwater entering the Columbia River, protect human health by preventing exposure to contaminants in the groundwater, and provide information leading to a final remedy. The performance evaluation and annual summary reports indicated that the pump-and-treat system reduces contaminant flux to the Columbia River by creating a hydraulic barrier that extends along the length of the trench. The extraction wells and treatment system capture and remove contaminants from the groundwater passing between the trench and the river that otherwise would enter the Columbia River. Institutional controls prevent access to groundwater, thereby protecting human health. Water-level, contaminant, system treatment cost and efficiency, and geologic data all serve to provide the decision basis for the future final remedy. This area is discussed in more detail in Section 2.3 of the main text.

CERCLA characterization of groundwater contamination also continued in fiscal year 1999. The groundwater monitoring schedule consists predominantly of annual sampling of wells, with analyses for anions, metals, and radiological indicators (BHI-00916). 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. DOE/RL-96-90 and DOE/RL-96-84 describe sampling and monitoring required as part of the interim action.

A.2.3 Drinking Water Standards and Derived Concentration Guides

In fiscal year 1999, strontium-90 exceeded the 1,000-pCi/L derived concentration guide in well 199-K-109A, near the 116-KE-2 crib. Tritium exceeded the 2 million pCi/L derived concentration guide in well 199-K-30. Wells downgradient of the KW and KE Reactors exceeded the drinking water standards for tritium, strontium-90 (and gross beta), carbon-14, and nitrate. Chromium exceeded the 100-µg/L maximum contaminant level near the KE Reactor and the 116-K-2 liquid waste disposal trench. Trichloroethylene exceeded the 5-µg/L maximum contaminant level near the KW Reactor. Two wells upgradient of KE Reactor exceeded the 0.1 mg/L limit for nickel. Single samples exceeded the maximum contaminant levels for cadmium and thallium in filtered samples from wells 199-K-34 and 199-K-36, respectively. Isolated exceedances of secondary limits for iron, manganese, and nickel also were observed.

A.3 100 N Area

Regulatory compliance of the groundwater in the 100 N Area includes RCRA monitoring, CERCLA environmental restoration activities, and a National Pollutant Discharge Elimination System permit under the *Federal Water Pollution Control Act*.

A.3.1 RCRA Units

The 1301-N, 1324-N/NA, and 1325-N liquid waste disposal facilities are monitored in accordance with RCRA interim status indicator evaluation programs (40 CFR 265, WAC 173-303-400). During fiscal year 1999, upgradient and downgradient wells were sampled twice for contamination indicator parameters (pH, specific conductance, total organic carbon, and total organic halides) and once for groundwater quality and site-specific parameters (Table A.4 and Figure A.2). The critical mean values for indicator parameters were all revised in December 1999 for evaluating the data from September 1999 and from fiscal year 2000

(Tables A.5 through A.7). The new values are based on recent data (1997 through 1999) from the upgradient wells.

At the 1301-N facility, total organic carbon in downgradient well 199-N-3 exceeded the critical mean value in January, March, and September 1999. Washington State Department of Ecology (Ecology) was notified in February 1999. Because no organic constituents of concern have been identified in 1301-N waste or sediment, the contamination is assumed to come from another source, and the site remains in indicator evaluation status.

Specific conductance in wells 199-N-59, 199-N-72, and 199-N-73 downgradient of the 1324-N/NA site continued to exceed the critical mean value in fiscal year 1999. A groundwater quality assessment indicated that the high specific conductance is caused by the non-hazardous constituents sulfate and sodium (WHC-SD-EN-EV-003, Rev. 1). Because an assessment has already been completed and non-hazardous constituents caused the high conductance, no further action was needed.

Concentrations of total organic carbon in one downgradient well (199-N-59) continued to exceed the critical mean value in March 1999 at the 1324-N/NA site. Ecology has agreed that the contamination is from another source so assessment monitoring is not required. In accordance with Ecology's instruction, a detection monitoring program continues for this site. Total organic carbon data from September 1999 did not exceed the revised critical mean value.

The revised critical mean value for specific conductance at the 1325-N facility was lower than the previous value, and two of the downgradient wells exceeded the revised mean in September 1999. DOE notified Ecology and submitted an assessment report that concluded the exceedance did not indicate contamination from the facility (see Section 2.4 of the main text).

Of the dangerous waste constituents or byproduct discharged to these facilities, only nitrate exceeded the maximum contaminant level, and the sources are unclear (see Section 2.4.3 of main text). The 1301-N and 1325-N facilities have contaminated the groundwater with tritium and strontium-90, but radionuclides are not monitored as part of the RCRA program at these facilities. The 1324-N/NA site has contaminated groundwater with sulfate and sodium, which are not dangerous waste constituents. Table A.3 lists constituents that exceeded drinking water standards in fiscal year 1999.

The closure plans for these facilities were revised and incorporated into a modification of the Hanford Site RCRA Permit (Ecology 1994). The modification became effective in fiscal year 1999. Remedial actions will be integrated with the 100-NR-1 and 100-NR-2 Operable Units. The closure plan (DOE/RL-96-39) states that RCRA monitoring during and after closure activities will continue, according to the existing interim status monitoring plan (WHC-SD-EN-AP-038, Rev. 2). The current well networks adequately monitor the sites, and there are no plans to modify the networks in fiscal year 2000.

A.3.2 100-NR-2 Operable Unit

A pump-and-treat system for strontium-90 continued to operate in 100 N Area in fiscal year 1999. The environmental restoration contractor operates the system in response to an action memorandum[(a)] and a record of decision signed in September 1999 (Ecology 1999).

(a) Letter from D. Butler (Washington State Department of Ecology) and R. F. Smith (U.S. Environmental Protection Agency) to R. Izatt (U.S. Department of Energy, Richland Operations Office, Richland, Washington) dated September 23, 1994, "Action Memorandum: N-Springs Expedited Response Action Cleanup Plan, U.S. Department of Energy, Hanford Site, Richland, Washington."

The goals of this pump-and-treat system are to:

- reduce strontium-90 contamination flux from the groundwater to the Columbia River
- evaluate commercially available treatment options for strontium-90
- provide data necessary to set demonstrable strontium-90 groundwater cleanup standards.

The system met these goals in fiscal year 1999 (see Section 2.4.1 of the main text). The pump-and-treat operation is successfully intercepting and capturing groundwater containing elevated concentrations of strontium-90, and preventing that groundwater from discharging into the Columbia River. The pump-and-treat program collects hydraulic monitoring data, contaminant monitoring data, and treatment system operation data to assess treatment system performance, and to provide the basis for selecting the final remedy.

National Priorities List Agreement/Change Control Form No. 113, dated March 25, 1997, specifies performance monitoring requirements for the N Springs pump-and-treat system. The basic requirement is to sample the process influent and effluent streams monthly for strontium-90 analysis and to place the analytical results in a database to which the regulator has access. An update to the original monitoring plan (i.e., BHI-00164, Rev. 1) identifies and summarizes all current groundwater monitoring being conducted in the 100 N Area (BHI-01165).

The remedial investigation for the 100-NR-2 Operable Unit also collected groundwater data in fiscal year 1999. Monitoring results, along with information gained by operating the pump-and-treat system, will be used to support selection of a final remediation alternative for the operable unit. Federal Facility Agreement and Consent Order Change Control Form No. M-15-96-08, signed on October 9, 1996, lists the wells and analyses to be performed to satisfy groundwater monitoring requirements for the 100-NR-2 Operable Unit (CERCLA) and the 1301-N, 1325-N, and 1324-N/NA facilities (RCRA).

The Sitewide Environmental Surveillance Project collects riverbank seepage annually. Authority for this activity comes from DOE orders for environmental monitoring. The results are presented in an annual report (e.g., Section 4.2 in PNNL-11795). The Near-Facility Environmental Monitoring Program, which is also mandated primarily by DOE orders, conducts additional groundwater and surface water monitoring. Samples are collected from 13 near-river well casings, which have been driven into the shoreline gravels, and also from a near-river monitoring well. The monitoring supports activities for waste management and environmental restoration and helps determine the effectiveness of effluent treatment and control practices. Results are presented annually (e.g., HNF-EP-0573-6).

A.3.3 Pollution Permit

Until May 1999, the National Pollutant Discharge Elimination System permit required that 100 N Area well 199-N-8T be sampled quarterly for ammonium, chromium, grease, iron, oil, and temperature. The original purpose of this sampling was to monitor the effects of effluent discharge that was associated with the 1301-N and 1325-N facilities at a near-river location. Because neither facility has been in operation since 1991, the permit was revised to eliminate this requirement.

A.3.4 Drinking Water Standards and Derived Concentration Guides

Strontium-90 continued to exceed the 1,000-pCi/L derived concentration guide in well 199-N-67. Nitrate, strontium-90 (and gross beta), sulfate, and tritium continued to exceed maximum contaminant levels or drinking water standards in the 100 N Area. Filtered manganese exceeded its secondary maximum contaminant level in two wells. Filtered chromium exceeded its maximum contaminant level in one well completed in a locally confined unit.

A.4 100 D Area

RCRA and CERCLA govern groundwater monitoring in the 100 D Area. CERCLA environmental restoration activities include remedial investigations and performance monitoring associated with the groundwater interim action pump-and-treat system.

A.4.1 120-D-1 Ponds

The 120-D-1 ponds well network (Table A.8 and Figure A.3) was sampled once in fiscal year 1999. After that, Ecology implemented modification E of the Hanford Site RCRA Permit (Ecology 1994) and the site was clean closed. This means that all dangerous waste or dangerous waste constituents or residues associated with the operation of the ponds have been removed. The closure plan (DOE/RL-92-71, Rev. 2) is a demonstration of clean closure, and there are no requirements for a landfill cover, postclosure care, or further groundwater monitoring.

Statistical evaluations of indicator parameter data indicated that the ponds have had no adverse impact on groundwater quality. Mercury is the only listed waste that may have been discharged to these ponds and was never detected in any of the downgradient monitoring wells. Chromium and nitrate from upgradient sources exceeded maximum contaminant levels (see Table A.3).

A.4.2 100-HR-3 Operable Unit

The extraction well network in the northern region of the 100 D Area continued to operate through fiscal year 1999. The purpose for the interim remedial action is to decrease the amount of hexavalent chromium that is entering the Columbia River via groundwater. The key documents that pertain to this interim action are the record of decision to proceed (ROD 1996b) and the performance monitoring plan (DOE/RL-96-84).

The specific objectives of the pump-and-treat system are to protect aquatic receptors in the river bottom from contaminants in groundwater entering the Columbia River, protect human health by preventing exposure to contaminants in the groundwater, and provide information leading to a final remedy. The performance evaluation and annual summary reports indicated that the pump-and-treat reduces contaminant flux to river by creating a hydraulic barrier that extends parallel along the length of the trench. The extraction wells and treatment system capture and remove contaminants from the groundwater passing between the trench and the river that otherwise would enter the Columbia River. Institutional controls prevent access to groundwater, thereby protecting human health. Water-level, contaminant, system treatment cost and efficiency, and geologic data collected in support of the project all serve to provide the decision basis for the future final remedy. It is discussed in more detail in Section 2.5 of the main text.

Groundwater monitoring in other 100-HR-3 wells in 100 D Area also continued during fiscal year 1999. The list of wells to be sampled and the analyses to be performed have been agreed on and are described in National Priorities List Agreement/Change Control Form No. 107, dated November 20, 1996. Most wells are sampled annually, and the samples are analyzed for anions, metals, and radiological indicators. DOE/RL-96-90 and DOE/RL-96-84 describe monitoring required as part of the interim action.

The U.S. Environmental Protection Agency (EPA), Ecology, and DOE signed an amended record of decision for the 100-HR-3 Operable Unit in October 1999 (ROD 1999). The amendment adds a requirement for implementing in situ redox manipulation to remediate the chromium plume in the southwestern 100 D Area. The goal of this treatment system is to reduce concentrations of hexavalent chromium to 20 μg/L or less in compliance wells, which are yet to be determined. A design report/work plan is being prepared to define groundwater monitoring requirements.

A.4.3 Drinking Water Standards and Derived Concentration Guides

Nitrate and chromium exceeded the maximum contaminant levels or drinking water standards during

fiscal year 1999 in a fairly broad area. Strontium-90 and tritium exceeded interim standards in one well in the central 100 D Area and another well in the northern 100 D Area; tritium contamination that migrates from the 100 N Area is present in the southwestern 100 D Area at levels above the drinking water standard. No radiological constituents exceeded the derived concentration guides.

A.5 100 H Area

RCRA and CERCLA govern groundwater monitoring in the 100 H Area. Environmental restoration activities under CERCLA include remedial investigations and performance monitoring associated with the groundwater interim action pump-and-treat system.

A.5.1 183-H Solar Evaporation Basins

This RCRA unit continued to be monitored under a final status corrective-action program during fiscal year 1999 (WAC 173-303-645). The location was incorporated into the Hanford Site RCRA Permit (Ecology 1994) in 1998. Groundwater remediation is integrated with the 100-HR-3 Operable Unit, where remediation for chromium is under way. While the pump-and-treat system is operating, RCRA monitoring consists of annual sampling of four wells for chromium, fluoride, nitrate, technetium-99, and uranium (PNNL-11573; Table A.9 and Figure A.4). The wells were sampled in November 1998.

The current monitoring network was designed to accommodate groundwater flow imposed by the pump-and-treat system. The network remains adequate, and no changes are planned for fiscal year 2000.

A.5.2 100-HR-3 Operable Unit

The extraction and injection well networks in the 100 H Area continued to operate through fiscal year 1999.

The purpose for the interim action is to decrease the amount of hexavalent chromium that is entering the Columbia River via groundwater movement. The key documents that pertain to this interim action are the record of decision to proceed (ROD 1996a) and the remedial action work plan (DOE/RL-96-84).

The specific objectives of the pump-and-treat system are to protect aquatic receptors in the river bottom substrate from contaminants in groundwater entering the Columbia River, protect human health by preventing exposure to contaminants in the groundwater, and provide information leading to a final remedy. The performance evaluation and annual summary reports indicated that the pump-and-treat system reduces contaminant flux to the river by creating a hydraulic barrier that extends parallel along the length of the trench. The extraction wells and treatment system capture and remove contaminants from the groundwater passing between the trench and the river that otherwise would enter the Columbia River. Institutional controls prevent access to groundwater thereby protecting human health. Water-level, contaminant, system treatment cost and efficiency, and geologic data all serve to provide the decision basis for the future final remedy. The interim action is discussed in more detail in Section 2.6 of the main text.

Groundwater monitoring in other 100-HR-3 wells in the 100 H Area also continued during fiscal year 1999. The list of wells to be sampled and the analyses to be performed have been agreed on and are described in National Priorities List Agreement/Change Control Form No. 107, dated November 20, 1996. Most wells are sampled annually, and the samples are analyzed for anions, metals, and radiological indicators. During fall 1998, aquifer sampling tubes and riverbank seepage were sampled. DOE/RL-96-90 and DOE/RL-96-84 describe additional monitoring that is required as part of the interim action.

A.5.3 Drinking Water Standards and Derived Concentration Guides

Maximum contaminant levels were exceeded in the 100 H Area for the following constituents during fiscal year 1999: chromium and nitrate throughout the 100 H Area, gross beta near the former 183-H

solar evaporation basins and 107-H retention basins, strontium-90 near the former 107-H retention basins, and uranium near the former 183-H basins. In all cases, the fiscal year 1999 values exceeded the limits by relatively small margins. Another contaminant of concern, technetium-99, remained below the 900-pCi/L standard in fiscal year 1999. No radiological constituents exceeded the derived concentration guides.

A.6 100 F Area

CERCLA (100-FR-3 Operable Unit) and the *Atomic Energy Act of 1954* govern groundwater monitoring in the 100 F Area. The CERCLA monitoring network and constituent list were revised in fiscal year 1999 and are documented in Federal Facility Agreement and Consent Order Change Control Form No. M-15-99-02, dated July 14, 1999. The Hanford Groundwater Monitoring Project coordinates sampling schedules and analyte selection to meet the requirements of both regulations. Wells are sampled biannually to quarterly.

Nitrate exceeds its maximum contaminant level beneath most of the 100 F Area and downgradient. Gross beta, strontium-90, trichloroethylene, tritium, and uranium also exceeded standards locally. No radiological constituents exceeded the derived concentration guides.

A.7 200 West Area

RCRA, CERCLA, and state dangerous waste regulations govern groundwater monitoring in the 200 West Area. Groundwater is monitored at eight RCRA sites and two groundwater operable units.

A.7.1 Waste Management Area S-SX

This RCRA site continued to be monitored under an interim status assessment program during fiscal year 1999. DOE initiated the assessment program in response to a directive from Ecology in 1996. The directive cited anomalous trends in technetium-99 and high specific conductance as primary reasons for the assessment. An assessment plan was submitted in August 1996 (WHC-SD-EN-AP-191). A report on the results of the assessment (PNNL-11810) concluded that this waste management area contributed to groundwater contamination. Accordingly, investigation of the rate and extent of the contamination is required. Current monitoring wells and constituents are listed in Table A.10. Well locations are shown in Figure A.5. Three new wells were installed in 1999 to improve spatial coverage and to replace wells going dry. Additional wells are needed to replace upgradient wells that will be dry in 2000 and in the following years. However, any new drilling for fiscal year 2000 is subject to funding availability.

The rate of movement (see Table A.2) and extent of contamination at this site are discussed in Section 2.8 of the main text.

A.7.2 Waste Management Area T

This RCRA site continued to be monitored under an interim status assessment program during fiscal year 1999 (Table A.11 and Figure A.6). Waste management areas T and TX-TY began assessment monitoring in November 1992 because of high specific conductance in downgradient wells (WHC-SD-EN-AP-132). Assessment findings (PNNL-11809) indicated that contaminants in well 299-W10-15 are a result of sources outside the waste management area. There is strong evidence, however, that contaminants observed in well 299-W11-27, which include chromium, cobalt-60, nitrate, technetium-99, and tritium, are a result of sources within the waste management area, so assessment work has continued. The plume detected in well 299-W11-27 has reached well 299-W11-23, located to the east of 299-W11-27, apparently as a result of changed groundwater flow direction at Waste Management Area T.

The rate of groundwater flow (see Table A.2) and the extent of contamination at this site is discussed in Section 2.8.

The current network of wells is inadequate for assessment monitoring. A minimum of two and probably three new wells are needed along the eastern margin of the waste management area. Two have been proposed, one between wells 299-W11-23 and 299-W11-24, and one between wells 299-W11-24 and 299-W11-12. However, the evidence from the technetium-99 plume (PNNL-11809) indicates that an appropriate well spacing is ~35 meters. Thus, two new wells between 299-W11-24 and 299-W11-12 would be appropriate. In addition, there is inadequate upgradient coverage because of the change in groundwater flow direction.

A.7.3 Waste Management Area TX-TY

This RCRA unit continued to be monitored under an interim status assessment program during fiscal year 1999 (Table A.12 and Figure A.6). Waste Management Area TX-TY began assessment monitoring in November 1991 because of high specific conductance in wells 299-W10-17 and 299-W14-12 (WHC-SD-EN-AP-132). The exceedance in well 299-W14-12 was accompanied by elevated cobalt-60, iodine-129, technetium-99, and tritium. Assessment results (PNNL-11809) indicated that contaminants in well 299-W10-17 are a result of sources outside the waste management area. Assessment results for well 299-W14-12 indicate that the contamination is consistent with a source within the waste management area, though upgradient sources are also possible. Because there was no direct evidence for upgradient sources, assessment continues at the site. Well 299-W15-40 was drilled near the 216-T-25 trench in fiscal year 1999 to evaluate its potential role in providing the observed contamination. Results indicate that the trench is not the source of contamination.

The rate of groundwater flow (see Table A.2) and the extent of contamination at this site is discussed in Section 2.8.

The well network is inadequate for assessment monitoring. The average distance between monitoring wells along the southeastern margin of the waste management area is ~70 meters, and a plume could pass through undetected. In addition, because well 299-W14-12 is expected to go dry, there are no wells located at intermediate or farther distances to track plume movement, and there are no upgradient wells for the northern portion of the waste management area (TY Tank Farm).

A.7.4 Waste Management Area U

Monitoring continued in accordance with RCRA interim status indicator evaluation requirements in fiscal year 1999. The site is sampled quarterly because contaminant concentrations fluctuate rapidly and because of the evidence that low levels of technetium-99 from the waste management area are contaminating groundwater. Quarterly sampling provides assurance that changes will be detected rapidly. The wells are sampled for a broader suite of constituents than specified under the RCRA interim status requirements (Table A.13 and Figure A.5).

Indicator parameter data from upgradient wells were statistically evaluated, and values from downgradient wells were compared to values established from the upgradient wells. Two downgradient wells (299-W18-30 and 299-W19-42) continue to exceed the critical mean value of total organic halides during the first and second quarter of fiscal year 1999. The exceedance is caused by an upgradient source of carbon tetrachloride, and a letter of notification and assessment report were submitted to Ecology in August 1998.

Field specific conductance in two new downgradient wells (299-W19-41 and 299-W19-42) exceeded the critical mean value in December 1998 and February 1999. However, laboratory analyses and relationships between cations/anions and specific conductance did not support the field measurements. Verification sampling was not necessary. Anomalous, high field measurements were attributed to a bad batch of calibration solution and the problem was corrected.

The critical range for pH was exceeded in one downgradient well (299-W19-12) during February 1999. This well was a pre-RCRA well that has had

higher pH historically. A new groundwater monitoring plan is being prepared, recommending that this well be replaced by a new RCRA standard well and during the interim, this well will be used for information only. Background levels were re-established to reflect this change.

Critical mean values were revised in December 1999 based on recent upgradient data (Table A.14). The revised values were applied to data from August 1999. Recent specific conductance values in the upgradient wells have been lower and have had less variability than in the past, so the revised critical mean value is lower. Consequently, downgradient well 299-W19-41 exceeded the revised critical mean in August 1999. An assessment plan is being prepared.

The well network generally is adequate for detection monitoring. Well 299-W19-12, an older non-RCRA well, is being used temporarily to fill a gap in the downgradient network between wells 299-W19-41 and 299-W19-42. This well is used for indication only and a replacement well has been proposed. The upgradient network will be reduced to one well within the next year when the water level in well 299-W18-25 drops too low for sampling.

Only carbon tetrachloride and gross beta exceeded maximum contaminant levels in fiscal year 1999. The carbon tetrachloride is discussed above. The gross beta is caused by technetium-99, which is present in the downgradient wells at concentrations below its 900-pCi/L drinking water standard.

A.7.5 216-S-10 Pond and Ditch

During fiscal year 1999, this facility continued to be monitored semiannually under a RCRA interim status indicator evaluation program (Table A.15 and Figure A.7). Statistical evaluation of indicator parameter data from downgradient wells indicates that the site is not impacting groundwater. Because downgradient well 299-W26-10 could not be sampled during this fiscal year, background concentrations were re-established using the fiscal year 1999 network of one upgradient and two shallow downgradient wells (Table A.16). A new well was installed for use beginning in fiscal year 2000.

Sample results that exceeded drinking water standards and maximum contaminant levels are presented in Table A.3. Chromium remains elevated above the 100-μg/L standard in upgradient well 299-W26-7. Because the upgradient well is located adjacent to the 216-S-10 pond (see Figure A.7), it is unclear if the elevated chromium is from an upgradient source or from past discharges to the pond. To assess the chromium source further, a proposal is being drafted to reclassify this well as a downgradient well and replace it with a new upgradient well in calendar year 2000.

Currently the 216-S-10 pond and ditch are monitored by only one upgradient well and two shallow downgradient wells because other wells have gone dry. The groundwater monitoring network is not adequate for RCRA interim status monitoring. One new downgradient well (299-W26-13) is being installed downgradient of the pond and will provide groundwater data for the continued evaluation of the elevated chromium. Two additional wells, one upgradient and one downgradient, are proposed for installation in calendar year 2000.

A.7.6 216-U-12 Crib

This RCRA unit continued to be monitored under an interim status assessment program in fiscal year 1999. Assessment monitoring began in 1993 because of high specific conductance in two downgradient wells (299-W22-41 and 299-W22-42) (WHC-SD-LEF-EV-001). In fiscal year 1999, network monitoring wells were sampled quarterly for constituents of interest (Table A.17 and Figure A.8).

Based on the results of the assessment investigation (PNNL-11574), the site remains in interim status assessment monitoring because of continued elevated levels of nitrate and technetium-99. However, the

objective of the assessment monitoring, rather than delineating the existing plumes, is focused on (1) determining whether the flux of constituents into the groundwater is increasing, staying the same, or decreasing; (2) monitoring the known constituents until a near-term interim corrective action is defined; and (3) monitoring until a final status plan is implemented. The rate of groundwater flow (see Table A.2) and the extent of contamination at this site is discussed in Section 2.8.

The crib will not receive additional effluents and is scheduled, according to provisions of the Hanford Site RCRA Permit (Ecology 1994), to be closed under RCRA final status regulations in 2005.

Currently the 216-U-12 crib is monitored by only one upgradient well (299-W22-43) and two downgradient wells (299-W22-79, and 699-36-70A). Declining water levels have rendered downgradient wells 299-W22-41 and 299-W22-42 dry in the past year (both wells last sampled in March 1999). The groundwater monitoring network is not adequate for RCRA interim status monitoring. One new well, 299-W22-79, was installed in calendar year 1998 to replace the downgradient wells projected to go dry (PNNL-12127). The upgradient well, 299-W22-43, is now projected to go dry before the end of calendar year 2000. Two additional wells, one upgradient and one downgradient, are proposed for installation in calendar year 2000.

Sample results that exceeded drinking water standards and maximum contaminant levels are presented in Table A.3. Nitrate, which had a source at this crib, remained elevated above the 45-mg/L standard in all downgradient wells.

A.7.7 Low-Level Waste Management Area 3

This RCRA site continued to be monitored under interim status indicator evaluation requirements. Groundwater monitoring wells were sampled twice in fiscal year 1999 (Table A.18 and Figure A.9). Indicator parameter data from upgradient wells were statistically evaluated, and values from downgradient wells were compared to values established from the upgradient wells. Critical mean values for the contamination indicator parameters were not exceeded in any of the wells monitoring this waste management area. Tables A.19 and A.20 list revised critical mean values.

The network continues to adequately monitor this waste management area. Several of the groundwater monitoring wells are approaching the point where representative sampling will no longer be possible because of the declining water table. Additional well installations are planned in calendar year 2000.

A.7.8 Low-Level Waste Management Area 4

Wells are sampled semiannually for contamination indicator parameters in accordance with RCRA interim status regulations (Table A.21 and Figure A.10). Background concentrations for the general contamination indicator parameters were re-established during the second quarter of fiscal year 1999 because the influence of a nearby pump-and-treat system is causing a reversal in the groundwater flow direction. The critical mean value for total organic halides was exceeded in one downgradient well (299-W15-16) in January and July 1999. This well used to be an upgradient well, and the exceedance is believed to be caused by carbon tetrachloride from an upgradient source.

Updated critical mean values are listed in Table A.22. However, indicator parameters will not be evaluated statistically until groundwater flow stabilizes. Meanwhile, wells are sampled semiannually to determine when flow stabilizes and to maintain continuity in the database.

This monitoring network is marginally adequate to detect releases from Low-Level Waste Management Area 4. Additional monitoring wells may be necessary in the future, as the water level continues to decline and to provide greater downgradient coverage. There are tentative plans to change the designation of this waste management area so that it will no longer be a RCRA facility. If this change occurs, additional

monitoring wells will not be installed, and groundwater monitoring will defer to surveillance monitoring.

A.7.9 200-UP-1 Operable Unit

The environmental restoration contractor continued to operate a pump-and-treat system in fiscal year 1999 (Figure A.11).

The interim action objectives (ROD 1997) include the following:

- reduce contamination in the areas of highest concentration of technetium-99 and uranium to below 10 times (480 mg/L) the cleanup level under the *Model Toxics Control Act* (WAC 173-340) for uranium, and 10 times (9,000 pCi/L) the maximum contaminant level for technetium-99
- reduce potential adverse human health risks through reduction of contaminant mass
- prevent further movement of these contaminants from the highest concentration area
- provide information that will lead to the development and implementation of a final remedy that will be protective of human health and the environment.

As of July 1999, the high concentration portions of the technetium-99 and uranium plumes were hydraulically contained. However, they were not remediated to the levels required by the interim action objectives (ROD 1997). Significant progress was made in reducing the size and concentrations of the technetium plume. Less progress has been made in remediating the uranium plume because of its tendency to sorb to the soil. Section 2.8.3 of the main text discusses groundwater remediation in more detail.

A.7.10 200-ZP-1 Operable Unit

The pump-and-treat system continued to operate in fiscal year 1999 (Figure A.12). 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). Section 2.8.3 of the main text discusses groundwater remediation in more detail.

The interim action objectives (ROD 1995) include the following:

- prevent further movement of contamination from the highest concentration area of the plume (i.e., containing carbon tetrachloride inside of 2,000 to 3,000 μg/L contour)
- reduce contamination in the area of highest carbon tetrachloride concentrations
- provide information that will lead to development of a final remedy that will be protective of human health and the environment.

Data through fiscal year 1999 indicate that the plume center (greater than 3,000 μg/L) is moving primarily in a northerly and easterly direction toward the four northernmost extraction wells. The concentrations of carbon tetrachloride east of the extraction wells may be decreasing, as indicated by a decrease in concentrations in monitoring well 299-W14-9 (from ~100 μg/L in mid-1997 to ~20 μg/L at the end of fiscal year 1999). However, the area of the 4,000 μg/L contour has apparently increased in size since 1996. Spreading of the 4,000 μg/L contour is attributed to the effects of pumping.

A.7.11 State-Approved Land Disposal Site

A state waste discharge permit (WAC 173-216) requires groundwater monitoring at this site. The permit was granted in June 1995, and the site began to operate in December 1995. Groundwater monitoring for tritium only is conducted in 17 wells near the facility (Table A.23 and Figure A.13). The permit stipulates requirements for groundwater monitoring and establishes enforcement limits for concentrations of 16 constituents in 3 additional wells immediately surrounding the facility and in background well 299-W8-1 (see Table A.23).

During fiscal year 1999, groundwater monitoring wells immediately downgradient of the facility continued to reflect discharges of high levels of tritium to the facility that occurred from 1996 through 1998. Quantities of tritium discharged to the facility during fiscal year 1999 have been minimal. No permit enforcement limits were exceeded during fiscal year 1999. Evaluation of the well network indicates that well coverage is currently adequate to satisfy groundwater monitoring requirements.

A.7.12 Environmental Restoration Disposal Facility

This facility is a landfill authorized by CERCLA that is designated to meet RCRA requirements of Subpart N, 40 CFR 264. The groundwater monitoring network consists of one upgradient and three downgradient wells that are sampled semiannually (Table A.24). In addition, the facility has a system to collect and remove leachate that helps evaluate whether the liner system is performing within design standards. The groundwater protection plan for this landfill is published in BHI-00079 and the sampling plan for groundwater monitoring is documented in BHI-00873.

Monitoring wells for this facility were sampled twice in fiscal year 1999. Groundwater data collected from the monitoring network indicate that the facility is not contaminating groundwater.

A.7.13 Drinking Water Standards and Derived Concentration Guides

The highest tritium concentration in the 200 West Area was slightly below the derived concentration guide in fiscal year 1999 in well 299-W14-2. This well, located near Waste Management Area TX-TY and associated facilities, exceeded the derived concentration guide in fiscal year 1998. Total uranium analyses of samples from wells near U Plant that indicate the derived concentration guides for uranium-234 and uranium-238 were exceeded. Iodine-129, technetium-99, and tritium were found at levels above the interim drinking water standards in the 200 West Area. Uranium was found at levels above its proposed maximum contaminant level. Nitrate, carbon tetrachloride, chloroform, chromium, fluoride, manganese, nickel, and trichloroethylene were detected at levels above the maximum contaminant levels.

A.8 200 East Area

Regulatory compliance issues related to groundwater in the 200 East Area include monitoring for RCRA and CERCLA requirements. There is also one state regulated disposal unit in this region.

A.8.1 Waste Management Area A-AX

This RCRA site continued to be monitored under an interim status indicator evaluation program in fiscal year 1999. Wells were sampled twice for indicator and site-specific parameters (Table A.25 and Figure A.14). Indicator parameter data from upgradient wells were statistically evaluated, and values from downgradient wells were compared to those established from the upgradient wells. The indicator parameters (specific conductance, total organic carbon, pH, and total organic halides) did not exceed critical mean values during fiscal year 1999. Table A.26 updates the critical mean values based on recent upgradient data.

Because of uncertainty in flow directions, the well network for this site may not be adequate for RCRA monitoring. The aquifer ranges from 2.2 to 4.5 meters thick in RCRA network wells. The rate of water-table decline has increased from 9.1 centimeters per year in 1997 to 30.5 centimeters per year in 1999. If this rate continues, three of the RCRA compliant wells at Waste Management Area A-AX will become unusable in 6 years.

A.8.2 Waste Management Area B-BX-BY

RCRA assessment monitoring continued at this waste management area in fiscal year 1999. Exceedances of the critical mean value for specific conductance in February 1996 at well 299-E33-32 initiated

assessment monitoring. An assessment monitoring plan (WHC-SD-ENV-AP-002) was issued in September 1996, followed by an assessment investigation. Results indicated that tank waste from this waste management area had reached the groundwater (PNNL-11826). The assessment program is continuing to investigate the rate of movement and extent of groundwater contamination at this site (see Section 2.9.1 and Table A.2). Wells are monitored at least quarterly, and in some cases, monthly.

For fiscal year 1999, iodine-129, nitrate, technetium-99, and uranium exceeded maximum contaminant levels or drinking water standards in RCRA compliant wells, with corresponding exceedances of gross beta and gross alpha standards. A further discussion of contaminant trends can be found in Section 2.9.1.

Originally, the RCRA groundwater monitoring network was designed for groundwater flow toward the northwest, based on regional plume maps. This method was used to determine flow direction because the water table is almost flat in the immediate area of the farms. As part of the ongoing studies, a series of steps are being taken to refine water-level measurements to allow a better determination the approximate flow direction based on the local gradient. Although the aquifer is thin through this area, ranging from 2 to 3 meters for RCRA compliant wells, it is anticipated that these wells can be used for at least 5 years.

In fiscal year 1999, the monitoring network was expanded to include surrounding wells (Table A.27 and Figure A.15). Some of these wells are RCRA compliant, while others are older wells installed to monitor past-practice waste disposal sites. The choice of monitoring wells is reviewed either monthly or quarterly to track contamination moving through the site. One new well, 299-E33-44, was installed in fiscal year 1998 on the eastern side of BX Tank Farm in support of the assessment work. A discussion of results from monitoring this well can be found in Section 2.9.1. Two new wells will be drilled in fiscal year 2000 to provide monitoring coverage in the southwestern corner of the site.

A.8.3 Waste Management Area C

This RCRA site continued to be monitored under an interim status indicator evaluation program in fiscal year 1999. Monthly sampling began in fiscal year 1999 to assess the potential impact of waste removal and sluicing of tank contents. In addition, the required detection sampling was conducted twice for indicator and site-specific parameters (Table A.28 and Figure A.14). Indicator parameter data from upgradient wells were statistically evaluated. Values from downgradient wells were compared to values established from the upgradient wells. The indicator parameters (specific conductance, total organic carbon, pH, and total organic halides) did not exceed critical mean values during fiscal year 1999. Table A.29 lists revised critical mean values based on recent data from upgradient wells.

Currently, the well network for this site appears to comply only marginally with the required placement of groundwater monitoring wells because of changes and uncertainty in the direction of flow (see Section 2.9.2).

A.8.4 PUREX Cribs

The 216-A-10, 216-A-36B, and 216-A-37-1 cribs were monitored under a RCRA assessment program in fiscal year 1999 (Table A.30 and Figure A.16). The sites are monitored together because they have similar hydrogeology and waste constituents. The groundwater monitoring plan (PNNL-11523) was changed from an indicator parameter evaluation program to a groundwater quality assessment program because of evidence of contamination. Combining these cribs into one RCRA groundwater monitoring area saves sampling and analysis costs because the number of near-field wells is reduced.

Many of the far-field wells that formerly were sampled annually are now sampled every 3 years. These wells mainly track the extent and flow rate of the extensive iodine-129, nitrate, and tritium plumes that change very little in a 3-year period. This change was incorporated in two updates of the groundwater monitoring

plan along with corrections to inappropriate procedural references (PNNL-11523 R0.1 and R0.2).

The rate and extent of contamination are discussed in Sections 2.9.2.1 through 2.9.2.7 of the main text. Knowledge of the groundwater flow direction and flow rate in the southeastern portion of the 200 East Area did not change significantly during fiscal year 1999 (see Table A.2). Therefore, the combined near-field and far-field monitoring well networks are adequate to continue to monitor both the extent and rate of flow of the contaminant plumes emanating from the PUREX cribs.

During fiscal year 1999, iodine-129, gross beta, manganese, nitrate, strontium-90, and tritium continue to exceed interim drinking water standards or maximum contaminant levels in areas downgradient of the PUREX cribs (see Table A.3). Strontium-90, a beta emitter, and gross beta exceed the interim drinking water standards only in well 299-E17-14, which is near the 216-A-36B crib. Elevated manganese is found in wells 299-E25-19 and 299-E25-17 (both near the 216-A-37-1 crib). However, manganese exceeded the 50-μg/L maximum contaminant level only in well 299-E25-19. Iodine-129, nitrate, and tritium are major plumes that extend beyond the near-field monitoring well network at the PUREX cribs. These more extensive plumes are monitored by the far-field monitoring well network.

A.8.5 216-B-3 Pond

In fiscal year 1999, groundwater monitoring at B Pond continued under an interim status indicator evaluation program. The RCRA site was monitored under an assessment program from 1990 until January 1998 because of elevated total organic halides in two downgradient wells (699-43-41E and 699-43-41F). Assessment results (PNNL-11604) concluded that no hazardous waste constituents had affected groundwater quality beneath B Pond despite erratic, low levels of total organic halides. Groundwater beneath the site apparently has been affected by tritium and nitrate from past discharges to B Pond. The site was returned to an indicator evaluation program.

The current network includes eight downgradient wells and one upgradient well (Table A.31 and Figure A.17). One new well was drilled near the end of fiscal year 1999 that will be added to the network during fiscal year 2000. The network is designed to intercept potential contamination entrained in groundwater at some distance from the facility (e.g., well 699-44-39B) and contamination potentially entering groundwater from the vadose zone near the facility (e.g., well 699-42-42B). With the addition of the new well in 2000, the network is adequate to detect potential contamination from the facility.

Statistical evaluations of indicator parameters in fiscal year 1999 indicated the site has not adversely affected groundwater quality. All replicate averages for contamination indicator parameters were below critical mean values or limits of quantitation during fiscal 1999. Table A.32 lists critical mean values.

A.8.6 216-A-29 Ditch

This RCRA unit continued to be monitored under an interim status indicator evaluation program in fiscal year 1999 (Table A.33 and Figure A.16). Indicator parameter data from upgradient wells were statistically evaluated, and values from downgradient wells were compared to values established from the upgradient wells. All replicate averages for contamination indicator parameters were below critical mean values or limits of quantitation during fiscal year 1999. Critical mean values are listed in Table A.34.

The groundwater monitoring plan was revised in fiscal year 1999 (PNNL-13047). The current network is adequate for detection monitoring.

A.8.7 216-B-63 Trench

In fiscal year 1999, RCRA monitoring continued to provide no evidence that dangerous non-radioactive constituents from the site have entered groundwater. The well network was sampled twice for the indicator parameters pH, specific conductance, total organic carbon, and total organic halides (Table A.35 and Figure A.18). All replicate averages for contamination

indicator parameters were below critical mean values or limits of quantitation during fiscal year 1999. Critical mean values are listed in Table A.36. The network is considered adequate.

A.8.8 Liquid Effluent Retention Facility

This RCRA facility is subject to final status monitoring and is included in the Hanford Site RCRA Permit (Ecology 1994). Until the final status plan is approved by the regulators, groundwater is monitored under the existing interim status plan (WHC-SD-EN-AP-024).

In fiscal year 1999, groundwater monitoring provided no evidence that dangerous, non-radioactive constituents from the site have entered the groundwater. The RCRA indicator parameters are pH, specific conductance, total organic carbon, and total organic halides (Table A.37 and Figure A.19). Specific conductance in two downgradient wells (299-E26-9 and 299-E26-10) exceeded the critical mean value in January 1999. DOE notified Ecology and submitted a groundwater quality assessment plan and report in March 1999. The plan concluded that the Liquid Effluent Retention Facility was not the source of the high specific conductance and detection monitoring should continue.

In June 1999, downgradient well 299-E26-9 was removed from the monitoring network because it went dry. In September 1999, Ecology directed DOE to continue the current monitoring using three wells (one upgradient and two downgradient) for 18 months. During this period, an alternative method of monitoring should be identified. Background conditions were re-established to reflect the most recent site conditions (Table A.38).

A.8.9 Low-Level Waste Management Area 1

Groundwater monitoring under interim status requirements continued at this RCRA site in fiscal year 1999. The well network was sampled twice for indicator and site-specific parameters (Table A.39 and Figure A.20). Downgradient monitoring well 299-E33-34 exceeded the critical mean for specific conductance in samples from December 1998 and June 1999. This exceedance appears to be related to the nitrate plume and is not related to Low-Level Waste Management Area 1. A letter of notification was submitted to Ecology on March 18, 1999. Because no waste has been placed in the northern portion of this site and there is a known nitrate plume from an upgradient source, no further action is necessary. Critical mean values were updated based on recent upgradient data (Table A.40).

The groundwater monitoring network for Low-Level Waste Management Area 1 is adequate for the RCRA requirements. No new wells are planned for this area.

A.8.10 Low-Level Waste Management Area 2

This RCRA site continued in RCRA interim status indicator evaluation in fiscal year 1999. Wells were sampled twice for indicator and site-specific parameters (Table A.41 and Figure A.18). Statistical evaluations for this area determined that upgradient well 299-E34-7 exceeded the critical mean for specific conductance. The major contributors to the increase are sulfate and calcium. The source of these constituents is not known. However, there is only 0.6 meter of water remaining in this well, which is completed at the top of basalt, and the increase may be related to the basalt chemistry. An additional exceedance occurred in the quadruplicate average for total organic halides at well 299-E34-3 in January 1999. The average result of 42 μg/L is above the critical mean value of 21 μg/L. Two of the four reported results (30.4 and 131 μg/L) are probably erroneous and have been flagged in the database. The quadruplicate average from April 1999 (2.75 μg/L) is well below the critical mean value. Table A.42 updates the critical mean values based on recent data from the upgradient wells.

The monitoring network for Low-Level Waste Management Area 2 is adequate to detect releases from the facility. However, the continued water-level decline may cause additional wells to go dry. Monitoring wells in this area are all completed at the top of basalt and if more wells become dry, alternatives to groundwater monitoring may be required to detect contamination from this facility.

A.8.11 200 Areas Treated Effluent Disposal Facility

A state waste discharge permit (WAC 173-216) governs groundwater sampling and analysis in the three monitoring wells at this facility (Table A.43 and Figure A.17). The constituent list and frequency of sampling are specified in the permit. Wells were sampled quarterly during fiscal year 1999, but may be reduced to semiannually during fiscal year 2000 when a new permit is issued.

No permit criteria for constituents in groundwater were exceeded in fiscal year 1999. The groundwater monitoring network serves to demonstrate that effluent from the facility is not taking a direct route to the uppermost aquifer and to differentiate the potential effects of the facility from those of the 216-B-3 pond facility. The well configuration is adequate for this purpose.

A.8.12 200-PO-1 Operable Unit

This groundwater operable unit, which encompasses the area of the tritium plume southeast of the 200 East Area, has the same monitoring objectives as monitoring for the *Atomic Energy Act of 1954* (surveillance) and RCRA (PUREX cribs assessment). See Section A.8.4 for additional discussion.

A.8.13 200-BP-5 Operable Unit

This groundwater operable unit, which encompasses the northern portion of 200 East Area, has the same monitoring objectives as the *Atomic Energy Act of 1954* (surveillance). See Section A.8.14 for additional discussion.

A.8.14 Drinking Water Standards and Derived Concentration Guides

Tritium was detected at levels above the 2 million pCi/L derived concentration guide at one well south of the PUREX Plant. Tritium contamination at levels above the 20,000-pCi/L interim drinking water standard was found throughout much of the 200 East Area. Strontium-90 was detected at levels above the 1,000-pCi/L derived concentration guide in two wells near the 216-B-5 injection well. Strontium-90 contamination was found at levels above the 8-pCi/L interim drinking water standard in several wells near the 216-B-5 injection well and in one well south of the PUREX Plant. The following constituents also were detected at levels above standards in the 200 East Area: aluminum, cesium-137, cyanide, iodine-129, manganese, nitrate, sulfate, technetium-99, and uranium.

A.9 400 and 600 Areas

This section discusses compliance issues for the 400 Area process ponds, 400 Area water supply wells, Nonradioactive Dangerous Waste Landfill, and Solid Waste Landfill.

A.9.1 400 Area

The 4608 B/C ponds (also called the 400 Area process ponds), are regulated under WAC-173-216. The permit, issued on August 1, 1996, and modified on February 10, 1998, defines groundwater enforcement limitations (Table A.44 and Figure A.21). Groundwater quality met permit conditions in fiscal year 1999.

The water supply in the 400 Area, which comes from wells, is also monitored to maintain compliance with drinking water standards. Tritium was detected at levels above the 20,000-pCi/L standard in the backup water supply wells for this area. Because the backup water supply wells are seldom used, however, the monthly water supply sampling indicates that tritium in the drinking water is maintained at a level below the 4-mrem/yr dose equivalent standard.

A.9.2 Nonradioactive Dangerous Waste Landfill

This RCRA site continued to be monitored under an interim status indicator evaluation program in fiscal year 1999 (Table A.45 and Figure A.22). Statistical evaluations indicated the site has not adversely affected groundwater quality. Table A.46 updates critical mean values based on recent data from upgradient wells. The groundwater monitoring plan for the landfill was rewritten during fiscal year 1999 (PNNL-12227) to update the operating procedures and bring the plan up to date with the current monitoring well network and constituents monitored. It is pending approval from government regulators.

Groundwater flow direction and rate did not change significantly during fiscal year 1999, and the wells in the network are still functioning. Therefore, the monitoring well network is adequate to fulfill the needs of the current groundwater monitoring plan.

A.9.3 Solid Waste Landfill

State dangerous waste regulations (WAC 173-304) govern groundwater monitoring at this landfill. The final closure plan for the site has not been implemented. Wells are sampled quarterly for constituents specified in WAC 173-304 plus the site-specific constituents chlorinated hydrocarbons and tritium (Table A.47 and Figure A.22).

Statistical evaluations of the constituents specified in WAC 173-304 for landfills (Tables A.48 and A.49) revealed that three exceeded their background threshold levels during fiscal year 1999:

(1) Specific conductance exceeded its 550-µS/cm threshold level in 9 of the 10 wells in the monitoring network.

(2) Sulfate exceeded its 51.5-mg/L threshold level in 2 of the 10 wells.

(3) Filtered zinc exceeded its 34-µg/L threshold level in one well.

Tritium exceeded its interim drinking water standard at many of the monitoring wells on the eastern side of the landfill, but the source is upgradient. Six chlorinated hydrocarbons exceeded WAC 173-200 groundwater quality criteria in at least one well of the monitoring network. They are as follows, with the numbers of wells having exceedances and the WAC limit:

- Carbon tetrachloride (3) (0.3 µg/L)
- 1,1-dichloroethane (8) (1.0 µg/L)
- 1,2-dichloroethane (2) (0.5 µg/L)
- Tetrachloroethylene (10) (0.8 µg L)
- Trichloroethylene (3) (3.0 µg/L)
- 1,1,1-trichloroethane (10) (0.2 µg/L).

The monitoring network for the Solid Waste Landfill has two upgradient wells and eight downgradient wells and is adequate for meeting the requirements of WAC 173-304.

A.9.4 Drinking Water Standards and Derived Concentration Guides

No radionuclides exceeded derived concentration guides in the 600 Area. Contamination from other operational areas impacted the 600 Area at levels that exceeded the interim drinking water standards or maximum contaminant levels, as discussed in Section 2.0. Contamination from 600 Area sources at levels exceeding standards includes strontium-90 near Gable Mountain Pond, uranium in the vicinity of the 618-10 burial ground and 316-4 crib, and chromium in the southern Central Plateau and southwest of the 200 West Area. Nitrate concentrations that exceeded the maximum contaminant level were found upgradient of the operational areas and probably result from offsite agriculture.

Nitrate exceeded the 45 mg/L maximum contaminant level in the 400 Area. Tritium from upgradient sources exceeded the drinking water standard.

A.10 300 and Richland North Areas

Groundwater in these areas is monitored for one RCRA site and the 300-FF-5 and 1100-EM-1 groundwater operable units.

A.10.1 316-5 Process Trenches

This RCRA site continued to be monitored with a final status corrective-action network. The objective of groundwater monitoring during the corrective-action period is to monitor the trend of the constituents of concern to confirm that they are naturally attenuating, as expected by the CERCLA record of decision for the 300-FF-5 Operable Unit (ROD 1996b). A proposed groundwater monitoring plan for corrective action calls for samples from the same wells as in the compliance period, but with fewer independent samples from each well during each sampling period (i.e., four to one). Also, each well showing an exceedance of one of the constituents of concern will be sampled quarterly to better follow the trends of contaminant concentration. The other wells in the network will continue to be sampled semiannually. The proposed plan is still being reviewed by the regulator.

Until the proposed plan is implemented, the final status compliance monitoring program (WHC-SD-EN-AP-185) remains in effect (Table A.50 and Figure A.23). This plan calls for four independent groundwater samples from each network well (eight) during each semiannual sampling period (i.e., 64 well trips per year). The monitoring network for the 316-5 process trenches includes two wells upgradient and six wells downgradient. One of the upgradient wells and three of the downgradient wells monitor the bottom of the unconfined aquifer, and one upgradient well and three downgradient wells monitor the unconfined aquifer near the water table. The monitoring network has eight wells and is adequate to ensure that the 316-5 process trenches complies with a RCRA final status corrective-action network and the current groundwater monitoring plan (WHC-SD-EN-AP-185).

Uranium, trichloroethylene, and cis-1,2-dichloroethylene continued to exceed concentration limits specified in the permit (Table A.51). Uranium, gross alpha, and tetrachloroethylene exceeded maximum contaminant levels in one or more wells monitoring near the water table (see Table A.3). Cis-1,2-dichloroethylene and trichloroethylene exceeded standards in one downgradient well that monitors the base of the unconfined aquifer. Concentrations of uranium and various volatile organics rose sharply in 1995 after the large quantities of relatively clean waste cooling water ceased to be discharged to the 316-5 process trenches. However, since that time, concentrations of those constituents have begun a slight downward trend as was expected.

A.10.2 300-FF-5 Operable Unit

Groundwater in this operable unit is monitored to assess whether the contaminants of concern (uranium, trichloroethylene, and cis-1,2-dichloroethylene) are naturally diminishing over time. The remedial action is an interim action that involves imposing restrictions on the use of the groundwater until these contaminants meet health-based criteria (ROD 1996b). This is an interim action because there are other constituents (e.g., tritium) migrating into the unit that have not yet been fully addressed and because a portion of the unit is overlaid by uncharacterized waste sites in the 300-FF-2 Operable Unit. A final action decision for the 300-FF-5 Operable Unit will be made after these issues have been addressed.

An operation and maintenance plan for the 300-FF-5 Operable Unit (DOE/RL-95-73) identifies tasks necessary to verify the effectiveness of the remedial action. The plan describes the monitoring program and administrative tasks that are part of the remedial action. The routine operation and maintenance activities include groundwater and river monitoring.

As discussed in Section A.10.1, the constituents of concern actually increased in concentration in the groundwater of the 300-FF-5 Operable Unit immediately after discharges from the process sewers to the

316-5 process trenches stopped. The previously lower concentrations in the groundwater were apparently due to the dilution of the constituents by the large quantities of relatively clean waste cooling water. When the trenches ceased to be used and the dilution no longer occurred, the concentrations rose to the high levels discovered in 1995-1997. More recently the constituents of concern have begun to decrease in concentration slightly, as was predicted (ROD 1996a).

A.10.3 1100-EM-1 Operable Unit

The 1100-EM-1 Operable Unit contains the Horn Rapids Landfill. Results of the CERCLA investigation for this operable unit are presented in the final remedial investigation study (DOE/RL-92-67, Draft B) 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 trichloroethylene, its breakdown products (vinyl chloride and 1,1-dichloroethene), and nitrate in wells downgradient of the Horn Rapids Landfill, as recommended in the sampling plan (DOE/RL-95-50), which was updated in 1999 (PNNL-12220). Pacific Northwest National Laboratory has been responsible for groundwater monitoring at the 1100-EM-1 Operable Unit since 1997. Five years of monitoring are now complete (1995 to 1999), and the data will be reviewed to evaluate the progress of natural attenuation of trichloroethylene (DOE/RL-95-80). Although not specified in the record of decision, chromium is monitored annually in one well downgradient of the 1171 Building.

Trichloroethylene levels did not exceed 5 µg/L at the point of compliance wells 699-S27-E12A, 699-S28-E13A, and 699-S29-E13A in fiscal year 1999. These wells form a line downgradient of the Horn Rapids Landfill that is approximately perpendicular to the prevailing path of the trichloroethylene plume.

A.10.4 Drinking Water Standards and Derived Concentration Guides

No radiological constituents in 300 Area groundwater were detected at levels above their derived concentration guides in fiscal year 1999. Uranium exceeded the proposed maximum contaminant level in much of the eastern part of the 300 Area. Trichloroethylene and cis-1,2-dichloroethylene were found at levels above standards in the deeper part of the unconfined aquifer system at one well (399-1-16B). Trichloroethylene was detected in 22 other wells in the upper portion of the unconfined aquifer of the central and southern parts of the 300 Area, but only wells 399-1-16B and 399-4-1 exceeded the maximum contaminant level. Tetrachloroethylene was detected at 12 wells in the 300 Area, but exceeded its standard in only one well in the upper part of the unconfined aquifer southeast of the 316-5 process trenches. Nitrate exceeded its maximum contaminant level at four wells in the southern portion of the 300 Area.

In the Richland North Area, fluoride, nitrate, and trichloroethylene were detected in groundwater at concentrations above their respective maximum contaminant levels. High levels of gross alpha suggest that uranium may also have been above its standard during fiscal year 1999. Likely sources of these constituents include offsite industry and agriculture.

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Table A.1. RCRA Interim and Final Status Groundwater Monitoring Projects, September 1999

TSD Units, date initiated	Interim Status TSD Unit Groundwater Monitoring		Final Status TSD Unit Groundwater Monitoring			Regulations	Year Scheduled for Part B or Closure
	Indicator Parameter Evaluation[a]	Groundwater Quality Assessment, date initiated	Detection Evaluation	Compliance Evaluation	Corrective Action, date initiated		
1301-N LWDF, December 1987			X[b]			40 CFR 265.93(b) WAC 173-303-400	1999[c]
1324-N/NA LWDF, December 1987			X[b]			40 CFR 265.93(b) WAC 173-303-400	1999[c]
1325-N LWDF, December 1987			X[b]			40 CFR 265.93(b) WAC 173-303-400	1999[c]
120-D-1 ponds, April 1992	X, clean closed in FY 1999					40 CFR 265.93(b) WAC 173-303-400	1999[d]
183-H solar evaporation basins, June 1985					X, 1998	40 CFR 264 WAC 173-303-645(10)	1994[c]
WMA S-SX, October 1991		X, 1996				40 CFR 265.93(d) WAC 173-303-400	>2000[c]
WMA T, February 1990		X, 1993				40 CFR 265.93(d) WAC 173-303-400	>2000[c]
WMA TX-TY, September - October 1991		X, 1993				40 CFR 265.93(d) WAC 173-303-400	>2000[c]
WMA U, October 1990	X					40 CFR 265.93(b) WAC 173-303-400	>2000[c]
216-S-10 pond and ditch, August 1991	X					40 CFR 265.93(b) WAC 173-303-400	>2000[c]
216-U-12 crib, September 1991		X, 1993				40 CFR 265.93(d) WAC 173-303-400	>2000[c]

Table A.1. (contd)

TSD Units, date initiated	Interim Status TSD Unit Groundwater Monitoring		Final Status TSD Unit Groundwater Monitoring			Regulations	Year Scheduled for Part B or Closure
	Indicator Parameter Evaluation[a]	Groundwater Quality Assessment, date initiated	Detection Evaluation	Compliance Evaluation	Corrective Action, date initiated		
LLWMA 3, October 1988	X					40 CFR 265.93(b) WAC 173-303-400	TBD[e,f]
LLWMA 4, October 1988	X					40 CFR 265.93(b) WAC 173-303-400	TBD[e,f]
WMA A-AX, February 1990	X					40 CFR 265.93(b) WAC 173-303-400	>2000[c]
WMA B-BX-BY, February 1990		X, 1996				40 CFR 265.93(d) WAC 173-303-400	>2000[c]
WMA C, February 1990	X					40 CFR 265.93(b) WAC 173-303-400	>2000[c]
PUREX cribs[g] 1988		X, 1997				40 CFR 265.93(d) WAC 173-303-400	>2000[c]
216-B-3 pond, November 1988	X					40 CFR 265.93(b) WAC 173-303-400	2000[c]
216-A-29 ditch, November 1988	X					40 CFR 265.93(b) WAC 173-303-400	2000[c]
216-B-63 trench, August 1991	X					40 CFR 265.93(b) WAC 173-303-400	>2000[c]
LERF, July 1991			X, 1998[h]			40 CFR 265.93(b) WAC 173-303-400	1998[e]
LLWMA 1, September 1988	X					40 CFR 265.93(b) WAC 173-303-400	TBD[g,h]
LLWMA 2, September 1988	X					40 CFR 265.93(b) WAC 173-303-400	TBD[g,h]

Table A.1. (contd)

TSD Units, date initiated (associated [CERCLA] groundwater operable units)	Interim Status TSD Unit Groundwater Monitoring		Final Status TSD Unit Groundwater Monitoring			Regulations	Year Scheduled for Part B or Closure
	Indicator Parameter Evaluation[a]	Groundwater Quality Assessment, date initiated	Detection Evaluation	Compliance Evaluation	Corrective Action, date initiated		
NRDWL, October 1986	X					40 CFR 265.93(b) WAC 173-303-400	>2000[c]
316-5 process trenches, June 1985					X, 1998	40 CFR 264 WAC 173-303-645(10)	1996[c,i]

(a) Specific parameters (pH, specific conductance, total organic carbon, and total organic halides) used to determine if a facility is affecting groundwater quality. Exceeding the established limits means that additional evaluation and sampling are required (i.e., groundwater quality assessment). An X in the assessment column indicates whether an evaluation was needed or an assessment was required.
(b) Monitored according to interim status plan as specified in closure plans.
(c) Closure/postclosure plan; TSD unit will close under final status.
(d) Closure plan approved in fiscal year 1999; facility groundwater monitoring not required after clean closure.
(e) Part B permit; TSD unit scheduled to operate under final status regulations beginning in year indicated.
(f) Facility Part B permit and final status groundwater monitoring plan contingent on completion of solid waste environmental impact statement.
(g) 216-A-10, -A-36B, and -A-37-1 combined into one RCRA monitoring unit. RCRA monitoring will be performed according to interim status groundwater quality assessment requirements.
(h) Will monitor groundwater under interim status until final status groundwater monitoring plan is approved.
(i) Closure plan pending Ecology approval.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980.
LERF = Liquid effluent retention facility.
LLWMA = Low-level waste management area.
LWDF = Liquid waste disposal facility.
NRDWL = Nonradioactive Dangerous Waste Landfill.
PUREX = Plutonium-uranium extraction (plant).
RCRA = Resource Conservation and Recovery Act of 1976.
TBD = To be determined.
TSD = Treatment, storage, or disposal (unit).
WMA = Waste management area.
> = Beyond the year 2000.

Table A.2. Estimates of Groundwater Flow Rates at Hanford Site Facilities

Site	Flow Direction	Flow Rate (m/d)	Method	Hydraulic Conductivity (m/d) (source)	Effective Porosity[a]	Gradient[b]	Comments
1301-N LWDF	NW	0.045 to 0.82	Darcy	6.1 to 37 (PNL-8335)	0.1 to 0.3	0.0022	Gradient calculated between wells 199-N-34 and 199-N-2.
1324-N/NA	NW	0.086 to 1.6	Darcy	6.1 to 37 (PNL-8335)	0.1 to 0.3	0.0042	Gradient calculated between wells 199-N-72 and 199-N-26.
1325-N LWDF	N	0.021 to 0.38	Darcy	6.1 to 37 (PNL-8335)	0.1 to 0.3	0.0010	Gradient calculated between wells 199-N-28 and 199-N-81.
120-D-1 ponds	NW	0.0021 to 0.22	Darcy	1.2 to 40 (WHC-SD-EN-DP-043)	0.1 to 0.3	0.00055	Gradient calculated between wells 199-D5-13 and 199-D8-4.
183-H solar evaporation basins	E	0.12 to 3.2	Darcy	15 to 140 (PNL-6728)	0.1 to 0.3	0.0023	Gradient calculated between wells 199-H3-2B and 199-H4-12B. Flow meter in wells 199-H4-7 and 199-H3-2A (Section 3.3 in DOE/RL-96-01).
		0.65 to 4.9	Flow meter				
WMA S-SX	ESE	0.0023 to 0.43	Darcy	0.43 to 27 (WHC-SD-EN-DP-042)	0.1 to 0.3	0.0016	Lower bound for hydraulic conductivity and velocity.
		0.07 to 0.14	Contaminant travel time (PNNL-12114)				Average gradient calculated from wells 299-W23-13 and 299-W22-45 at S Tank Farm and wells 299-W23-14 and 299-W22-39 at SX Tank Farm.
WMA T	E	0.04 to 0.13	Darcy	10 (WHC-SD-EN-TI-147)	0.1 to 0.3	0.0013	Lower bound for hydraulic conductivity and velocity. Gradient calculated between wells 299-W10-12 and 299-W11-27.
WMA TX-TY	E (north half) S or SW (south half)	0.2 to 0.6	Darcy	55 (WHC-SD-EN-DP-042)	0.1 to 0.3	0.001	Lower bound for hydraulic conductivity and velocity. Gradient calculated between wells 299-W15-12 and 299-W15-4.
WMA U	E	0.028 to 0.52	Darcy	6 to 37 (WHC-SD-EN-DP-042)	0.1 to 0.3	0.0014	Lower bound for hydraulic conductivity and velocity. Gradient calculated between wells 299-W18-31 and 299-W19-32.
216-S-10 pond	ESE	0.04 to 4.8	Darcy	10 (WHC-SD-EN-DP-052) 12 to 150 (BNWL-1709)	0.1 to 0.3	0.0011 to 0.0032	Gradient increases to the south. Gradients calculated between wells 299-W26-8 and average of wells 299-W26-10 and 299-W26-12 (north) and wells 299-W26-7 and 299-W26-9 (south).
216-U-12 crib	ESE, changing to E	0.03 to 0.1	Darcy	6.2 (see comments)	0.1 to 0.3	0.00165	Hydraulic conductivity is geometric mean of values in WHC-MR-0208. Gradient calculated between wells 299-W22-43 and 299-W22-79.

Table A.2. (contd)

Site	Flow Direction	Flow Rate (m/d)	Method	Hydraulic Conductivity (m/d) (source)	Effective Porosity[a]	Gradient[b]	Comments
LLWMA 3	NE	0.0001 to 0.13	Darcy	0.02 to 9.8 (PNL-6820)	0.1 to 0.3	0.0013	
LLWMA 4	E	0.2 to 0.6	Darcy	24 (PNL-6820)	0.1 to 0.3	0.0025	
SALDS	Radial to NE	0.03 to 5.8	Darcy	3.5 to 36.3 (WHC-SD-C018H-RPT-003)	0.25[c]	0.0018 to 0.004	Higher gradient was calculated between wells 699-48-77A and 699-48-77D.
WMA A-AX	E?	0.5 to 0.7	Darcy	2,005 to 2,519 (WHC-SD-EN-TI-019)	0.3	~0.00008	Gradient calculated between wells 299-E25-41 and 299-E24-20. Flow direction unclear because of flat water table.
WMA B-BX-BY	SW?	0.9	Darcy	1,615 (WHC-SD-EN-TI 019)	0.3	~0.00017, September 1999	Gradient calculated between wells 299-E33-33 and 299-E33-42. Flow direction is not well known; based on current contamination migration and water table.
WMA C	SW	0.7 to 1.4	Darcy	1,067 to 2,073 (WHC-SD-EN-TI-019)	0.3	0.00021, September 1999	Gradient calculated between wells 299-E27-7 and 299-E27-13. Flow direction inferred from hydrographs.
216-A-10 crib 216-A-36B	SE	0.004 to 0.60	Darcy	60 to 3,000 (WHC-SD-EN-TI-019; PNNL-11515)	0.1 to 0.3	~0.00002	Gradient estimated from regional water-level contours.
216-A-37-1 crib	SW	~0.018 to 0.18	Darcy	18 to 60 (WHC-SD-EN-DP-047; PNNL-11515)	0.1 to 0.3	~0.0003	Gradient estimated from regional water-level contours.
216-B-3 pond	Radial	0.01 to 19.2	Darcy; plume migration	1 to 640 (WHC-SD-EN-EV-002; PNL-10195)	0.1 to 0.3	~0.003	Gradient calculated between wells 699-44-42 and 699-43-45 (March 1999).
216-A-29 ditch	WSW	~0.02 to ~0.07	Darcy	18 (WHC-SD-EN-DP-047)	0.1 to 0.3	~0.0004	
216-B-63 trench	W	0.01 to 0.1	Darcy	52 to 200 (WHC-SD-EN-EV-002)	0.1 to 0.3	~0.00004	
LERF	W	0.04 to 6.0	Darcy	6.1 to 120 (PNNL-11620)	0.1 to 0.3	0.002 to 0.005	
LLWMA 1	NW	≤0.5	Darcy	73 to 760 (PNL-6820)	0.1 to 0.3	≤0.00006	Uncertainty with gradient and rate of flow. Flow direction inferred from plume maps.

Table A.2. (contd)

Site	Flow Direction	Flow Rate (m/d)	Method	Hydraulic Conductivity (m/d) (source)	Effective Porosity[a]	Gradient[b]	Comments
LLWMA 2	W	~0.06 to ~0.8	Darcy	430 to 2,000 (PNL-6820)	0.1 to 0.3	~0.00004	Gradient calculated between wells 299-E27-16 and 299-E27-9.
200 Area TEDF	SSW	0.004	Darcy	1.1 (WHC-SD-EN-ES-004)	0.25[c]	~0.001	
NRDWL	62 to 90° E of N (based on water-level data); 125° E of N (based on plume and regional water-table maps)	See estimated below for SWL	NA	NA	NA	NA	See Section 17.0 in DOE/RL-91-03, Section 5.2 in DOE/RL-93-88, and WHC-EP-0021 for direction of flow.
SWL	96±28° E of N to 139±15° E of N (based on water-level data); 125° E of N (based on plume maps)	1.2 to 1.8	Darcy	NA	NA	NA	See WHC-EP-0021 for Darcy velocity. See Section 18.0 in DOE/RL-91-03; Section 19 in DOE/RL-92-03, DOE/RL-93-09; Section 5.3 in DOE/RL-93-88; Section 5.2 in DOE/RL-94-136 for direction of flow.
		6	Recent plume movement				
		>30	Tracer tests				See HW-60601 for tracer tests. Hydraulic gradient during tracer test was higher than in 1997.
316-5 process trenches	SE	31 (DOE/RL-89-14)	Movement of PCE spill				
	S	0.35 to 105	Darcy	150 to 15,000 (PNL-6716)	0.1 to 0.3	0.0007	Gradient from Plate 2.

(a) Effective porosity assumed to be between 0.1 and 0.3, a representative range for the unconfined aquifer system.
(b) March 1999 unless noted otherwise.
(c) RHO-ST-42, RHO-RE-ST-12, PNNL-11801.
LERF = Liquid effluent retention facility.
LLWMA = Low-level waste management area.
LWDF = Liquid waste disposal facility.
NA = Not applicable.
NRDWL = Nonradioactive Dangerous Waste Landfill.
PCE = Tetrachloroethylene.
RCRA = Resource Conservation and Recovery Act of 1976.
SALDS = State-Approved Land Disposal Site.
SWL = Solid Waste Landfill.
TEDF = Treated Effluent Disposal Facility.
WMA = Waste management area.

Table A.3. Monitoring Results Exceeding Maximum Contaminant Levels or Drinking Water Standards (Regulated Units listed in alphanumeric order)[a]

Constituent, units	Filter	Well Name	Upgradient/ Downgradient	Number of Exceedances	Maximum Result	MCL or DWS[b] Level
			100 N Area			
Gross beta, pCi/L	N	199-N-105A	Down	3	3,770	50
	N	199-N-3	Down	1	1,980	50
Nitrate, µg/L	N	199-N-2	Down	1	51,000	45,000
	N	199-N-81	Down	1	52,000	45,000
Nitrogen in Nitrate, µg/L	N	199-N-2	Down	1	20,200	10,000
	N	199-N-59	Down	3	22,900	10,000
	N	199-N-81	Down	1	11,300	10,000
Strontium-90, pCi/L	N	199-N-105A	Down	3	1,870	8
	N	199-N-28	Down	1	85.8	8
	N	199-N-3	Down	3	1,170	8
	N	199-N-34	Up	1	54.9	8
	N	199-N-57	Up	1	14.6	8
	N	199-N-81	Down	2	1,210	8
	Y	199-N-81	Down	1	1,220	8
Tritium, pCi/L	N	199-N-105A	Down	3	23,800	20,000
	N	199-N-28	Down	1	25,800	20,000
	N	199-N-32	Down	2	32,600	20,000
	N	199-N-34	Up	1	24,100	20,000
			120-D-1 Ponds			
Chromium, µg/L	N	199-D5-13	Up	1	317	100
	N	199-D8-5	Down	1	228	100
	Y	199-D5-13	Up	2	366	100
	Y	199-D8-4	Down	1	101	100
	Y	199-D8-5	Down	3	251	100
	Y	199-D8-6	Down	1	107	100
Hexavalent Chromium, µg/L	Y	199-D5-13	Up	3	416	100
Nitrogen in Nitrate, µg/L	N	199-D5-13	Up	2	19,000	10,000
	N	199-D8-4	Down	2	15,500	10,000
	N	199-D8-6	Down	1	16,500	10,000
			183-H Solar Evaporation Basins			
Chromium, µg/L	N	199-H4-12C	Down	1	244	100
	N	199-H4-3	Down	1	168	100
	Y	199-H4-12A	Down	1	132	100
	Y	199-H4-12C	Down	1	201	100
	Y	199-H4-3	Down	1	150	100
Gross beta, pCi/L	N	199-H4-3	Down	1	63.5	50
Hexavalent Chromium, µg/L	Y	199-H4-12C	Down	2	200	100
	Y	199-H4-3	Down	2	204	100
Nitrogen in Nitrate, µg/L	N	199-H4-12A	Down	1	31,900	10,000
	N	199-H4-3	Down	1	22,700	10,000
	N	199-H4-7	Down	1	10,500	10,000
Uranium, µg/L	N	199-H4-12A	Down	1	33.1	20
	N	199-H4-3	Down	1	21.3	20
			216-B-63 Ditch			
Iodine-129, pCi/L	N	299-E33-33	Down	3	4.07	1
	N	299-E33-36	Down	4	6.5	1

Table A.3. (contd)

Constituent, units	Filter	Well Name	Upgradient/ Downgradient	Number of Exceedances	Maximum Result	MCL or DWS[b] Level
			216-S-10 Pond			
Carbon tetrachloride, µg/L	N	299-W26-12	Down	1	6	5
Chromium, µg/L	Y	299-W26-7	Up	1	175	100
Nickel, µg/L	Y	299-W27-2	Down	1	121	100
			216-U-12 Crib			
Carbon tetrachloride, µg/L	N	699-36-70A	Down	1	7	5
Iodine-129, pCi/L	N	299-W22-42	Down	1	9.31	1
Nitrate, µg/L	N	699-36-70A	Down	1	110,000	45,000
Nitrogen in Nitrate, µg/L	N	299-W22-41	Down	2	4,5800	10,000
	N	299-W22-42	Down	3	25,100	10,000
	N	299-W22-79	Down	3	18,000	10,000
	N	699-36-70A	Down	3	26,000	10,000
Nitrogen in Nitrite and Nitrate, µg/L	N	699-36-70A	Down	1	24,600	10,000
Tritium, pCi/L	N	299-W22-42	Down	3	49,200	20,000
	N	299-W22-79	Down	2	22,300	20,000
	N	699-36-70A	Down	3	95,000	20,000
			316-5 Trenches			
cis-1,2-Dichloroethylene, µg/L	N	399-1-16B	Down	8	180	70
Gross alpha, pCi/L	N	399-1-17A	Down	2	67.3	15
Tetrachloroethylene, µg/L	N	399-1-16A	Down	1	7	5
Trichloroethylene, µg/L	N	399-1-16B	Down	2	6	5
Uranium, µg/L	N	399-1-10A	Down	6	61.1	20
	N	399-1-16A	Down	7	111	20
	N	399-1-17A	Down	6	166	20
			400 Area			
Nitrogen in Nitrate, µg/L	N	699-2-7	Down	4	20,800	10,000
Tritium, pCi/L	N	499-S0-7	ND	1	20,200	20,000
	N	499-S0-8	ND	4	33,800	20,000
	N	699-2-6A	Down	1	22,300	20,000
	N	699-8-17	Up	2	68,400	20,000
			Low-Level Waste Management Area 1			
Gross beta, pCi/L	N	299-E32-10	Down	3	413	50
	N	299-E33-34	Down	2	1,410	50
	N	299-E33-35	Up	3	441	50
Nitrogen in Nitrate, µg/L	N	299-E28-26	Up	2	10,900	10,000
	N	299-E32-10	Down	3	17,700	10,000
	N	299-E32-2	Down	2	11,600	10,000
	N	299-E32-3	Down	2	11,300	10,000
	N	299-E32-6	Down	2	11,400	10,000
	N	299-E33-34	Down	2	44,600	10,000
	N	299-E33-35	Up	3	20,500	10,000
Technetium-99, pCi/L	N	299-E33-34	Down	1	3,210	900
	N	299-E33-35	Up	2	1,720	900
Uranium, µg/L	N	299-E33-34	Down	1	21.1	20

Table A.3. (contd)

Constituent, units	Filter	Well Name	Upgradient/ Downgradient	Number of Exceedances	Maximum Result	MCL or DWS[b] Level
		Low-Level Waste Management Area 2				
Nitrogen in Nitrate, µg/L	N	299-E34-7	Up	2	17,200	10,000
		Low-Level Waste Management Area 3				
Carbon tetrachloride, µg/L	N	299-W10-13	Up	1	9	5
	N	299-W10-19	Up	1	89	5
	N	299-W10-20	Up	1	1,300	5
	N	299-W10-21	Up	1	400	5
	N	299-W6-2	Down	1	130	5
	N	299-W7-4	Down	1	450	5
	N	299-W7-5	Down	1	110	5
	N	299-W8-1	Down	1	6	5
Nitrogen in Nitrate, µg/L	N	299-W10-19	Up	1	19,500	10,000
	N	299-W10-20	Up	1	25,400	10,000
	N	299-W10-21	Up	1	45,600	10,000
	N	299-W6-2	Down	1	10,900	10,000
	N	299-W7-4	Down	1	21,500	10,000
	N	299-W7-5	Down	1	13,800	10,000
Trichloroethylene, µg/L	N	299-W10-21	Up	1	7	5
		Low-Level Waste Management Area 4				
Cadmium, µg/L	Y	299-W18-26	Up	1	10.8	5
Carbon tetrachloride, µg/L	N	299-W15-15	Up	7	510	5
	N	299-W15-16	Down	4	5,800	5
	N	299-W15-17	Down	2	9	5
	N	299-W15-18	Down	4	1,900	5
	N	299-W18-21	Up	6	200	5
	N	299-W18-23	Up	2	190	5
	N	299-W18-24	Down	3	1,400	5
	N	299-W18-26	Up	5	120	5
	N	299-W18-27	Up	5	410	5
	N	299-W18-32	Up	2	13	5
Gross alpha, pCi/L	N	299-W18-21	Up	2	16.5	15
Nitrogen in Nitrate, µg/L	N	299-W15-15	Up	2	20,300	10,000
	N	299-W15-16	Down	2	16,500	10,000
	N	299-W15-18	Down	2	23,100	10,000
	N	299-W18-21	Up	4	18,200	10,000
	N	299-W18-23	Up	1	11,600	10,000
	N	299-W18-24	Up	2	18,100	10,000
	N	299-W18-26	Up	1	17,600	10,000
Trichloroethylene, µg/L	N	299-W15-16	Down	2	6	5
		Nonradioactive Dangerous Waste Landfill				
Tritium, pCi/L	N	699-25-34A	Down	2	80,800	20,000
	N	699-25-34B	Down	2	78,800	20,000
	N	699-25-34D	Down	2	75,700	20,000
	N	699-26-33	Down	2	85,600	20,000
	N	699-26-34A	Up	2	73,200	20,000
	N	699-26-34B	Down	3	81,700	20,000
	N	699-26-35A	Up	4	73,700	20,000
	N	699-26-35C	Up	2	31,100	20,000

Table A.3. (contd)

Constituent, units	Filter	Well Name	Upgradient/ Downgradient	Number of Exceedances	Maximum Result	MCL or DWS[(b)] Level
		Plutonium-Uranium Extraction (PUREX) Cribs				
Gross beta, pCi/L	N	299-E17-14	Down	4	110	50
Iodine-129, pCi/L	N	299-E17-1	Down	1	9.76	1
	N	299-E17-14	Down	4	12.5	1
	N	299-E17-17	Down	3	9.41	1
	N	299-E17-19	Down	2	9.42	1
	N	299-E17-9	Down	2	11.1	1
	N	299-E24-16	Down	4	12.2	1
	N	299-E24-18	Up	1	1.54	1
	N	299-E25-17	Down	1	3.49	1
	N	299-E25-19	Down	2	1.91	1
	N	299-E25-31	Up	1	2.8	1
	N	699-37-47A	Down	1	2.48	1
Nitrogen in Nitrate, µg/L	N	299-E17-1	Down	2	22,000	10,000
	N	299-E17-14	Down	4	26,900	10,000
	N	299-E17-19	Down	2	22,400	10,000
	N	299-E17-9	Down	2	43,300	10,000
Strontium-90, pCi/L	N	299-E17-14	Down	4	17.2	8
Tritium, pCi/L	N	299-E17-1	Down	2	919,000	20,000
	N	299-E17-14	Down	4	901,000	20,000
	N	299-E17-17	Down	3	285,000	20,000
	N	299-E17-19	Down	2	730,000	20,000
	N	299-E17-9	Down	2	3,870,000	20,000
	N	299-E24-16	Down	4	385,000	20,000
	N	299-E24-18	Up	2	93,800	20,000
	N	299-E25-19	Down	4	174,000	20,000
	N	699-37-47A	Down	2	36,000	20,000
		State-Approved Land Disposal Site				
Carbon tetrachloride, µg/L	N	299-W8-1	ND	1	6	5
	N	699-48-77C	Down	2	7	5
Tritium, pCi/L	N	699-48-77A	Down	3	140,000	20,000
	N	699-48-77C	Down	3	77,000	20,000
	N	699-48-77D	Down	5	730,000	20,000
		Solid Waste Landfill				
Tetrachloroethylene, µg/L	N	699-23-34A	Down	1	10	5
	N	699-23-34B	Down	1	7	5
	N	699-24-33	Down	1	11	5
	N	699-24-34A	Down	1	9	5
	N	699-24-34B	Down	1	9	5
	N	699-24-34C	Down	1	9	5
	N	699-25-34C	Down	2	7	5
Tritium, pCi/L	N	699-24-33	Down	4	49,300	20,000
	N	699-24-34C	Down	4	49,700	20,000
	N	699-25-34C	Down	5	72,000	20,000
	N	699-26-35A	Up	4	73,700	20,000
		Waste Management Area A-AX				
Chromium, µg/L	Y	299-E24-19	Down	6	2,820	100
	Y	299-E25-46	Down	1	131	100
Iodine-129, pCi/L	N	299-E24-19	Down	2	5.14	1
	N	299-E24-20	Down	1	4.54	1
	N	299-E25-40	Up	2	6.65	1
	N	299-E25-41	Up	2	4.7	1
	N	299-E25-46	Down	2	4.39	1
Nickel, µg/L	Y	299-E24-19	Down	6	883	100

Table A.3. (contd)

Constituent, units	Filter	Well Name	Upgradient/ Downgradient	Number of Exceedances	Maximum Result	MCL or DWS[b] Level
		Waste Management Area B-BX-BY				
Cadmium, µg/L	Y	299-E33-7	Down	1	5.4	5
Cyanide, µg/L	N	299-E33-7	Down	4	291	200
Gross alpha, pCi/L	N	299-E33-13	Down	10	37.2	15
	N	299-E33-18	Down	9	100	15
	N	299-E33-26	Down	3	31.7	15
	N	299-E33-38	Down	4	68.9	15
	N	299-E33-44	Down	12	201	15
	N	299-E33-5	Down	3	41	15
Gross beta, pCi/L	N	299-E33-13	Down	12	1,220	50
	N	299-E33-15	Down	1	59.4	50
	N	299-E33-16	Down	5	700	50
	N	299-E33-18	Down	9	476	50
	N	299-E33-26	Down	3	1,080	50
	N	299-E33-31	Down	13	609	50
	N	299-E33-32	Down	11	434	50
	N	299-E33-34	Down	2	1,410	50
	N	299-E33-35	Down	3	441	50
	N	299-E33-38	Down	3	2,460	50
	N	299-E33-41	Down	12	532	50
	N	299-E33-42	Down	12	763	50
	N	299-E33-44	Down	10	2,140	50
	N	299-E33-5	Down	3	2,220	50
	N	299-E33-7	Down	8	2,620	50
	N	299-E33-8	Down	5	541	50
	N	699-50-53A	Down	1	80.8	50
	Y	299-E33-8	Down	1	452	50
Iodine-129, pCi/L	N	299-E28-8	Down	2	3.54	1
	N	299-E33-15	Down	1	3.88	1
	N	299-E33-17	Down	2	6.54	1
	N	299-E33-18	Down	1	5.86	1
	N	299-E33-20	Down	2	5.25	1
	N	299-E33-21	Down	2	3.81	1
	N	299-E33-26	Down	1	4.95	1
	N	299-E33-31	Down	1	4.37	1
	N	299-E33-32	Down	3	4.11	1
	N	299-E33-33	Up	3	4.07	1
	N	299-E33-36	Up	4	6.5	1
	N	299-E33-41	Down	1	4.53	1
	N	299-E33-42	Down	1	4.92	1
	N	299-E33-43	Down	3	4.31	1
	N	299-E33-44	Down	1	4.56	1
	N	299-E33-8	Down	1	4.48	1
Nitrogen in Nitrate, µg/L	N	299-E33-13	Down	12	58,700	10,000
	N	299-E33-15	Down	4	71,100	10,000
	N	299-E33-16	Down	5	116,000	10,000
	N	299-E33-17	Down	5	49,500	10,000
	N	299-E33-18	Down	8	31,600	10,000
	N	299-E33-20	Down	3	50,500	10,000
	N	299-E33-26	Down	4	39,400	10,000
	N	299-E33-31	Down	13	26,300	10,000
	N	299-E33-32	Down	11	15,900	10,000
	N	299-E33-34	Down	2	44,600	10,000
	N	299-E33-35	Down	3	20,500	10,000
	N	299-E33-38	Down	4	47,900	10,000
	N	299-E33-42	Down	12	16,200	10,000
	N	299-E33-44	Down	12	31,100	10,000

Table A.3. (contd)

Constituent, units	Filter	Well Name	Upgradient/ Downgradient	Number of Exceedances	Maximum Result	MCL or DWS[b] Level
	N	299-E33-5	Down	2	42,300	10,000
	N	299-E33-7	Down	8	85,100	10,000
	N	299-E33-8	Down	6	17,200	10,000
	N	699-49-57A	Down	1	26,000	10,000
	N	699-50-53A	Down	1	37,000	10,000
Technetium-99, pCi/L	N	299-E33-13	Down	12	3,660	900
	N	299-E33-16	Down	5	2,200	900
	N	299-E33-18	Down	6	1,490	900
	N	299-E33-26	Down	4	3,750	900
	N	299-E33-31	Down	13	1,860	900
	N	299-E33-32	Down	4	1,210	900
	N	299-E33-34	Down	1	3,210	900
	N	299-E33-35	Down	2	1,720	900
	N	299-E33-38	Down	4	5,750	900
	N	299-E33-41	Down	9	1,450	900
	N	299-E33-42	Down	12	1,730	900
	N	299-E33-44	Down	12	4,700	900
	N	299-E33-5	Down	3	5,000	900
	N	299-E33-7	Down	8	6,850	900
	N	299-E33-8	Down	5	1,560	900
	N	699-49-57A	Down	1	2,470	900
	Y	299-E33-8	Down	1	1,300	900
Uranium, µg/L	N	299-E33-13	Down	12	63.7	20
	N	299-E33-18	Down	9	186	20
	N	299-E33-26	Down	4	45.8	20
	N	299-E33-34	Down	1	21.1	20
	N	299-E33-38	Down	4	119	20
	N	299-E33-41	Down	9	25.3	20
	N	299-E33-44	Down	12	350	20
	N	299-E33-5	Down	3	85.6	20
	Y	299-E33-13	Down	3	66.3	20
	Y	299-E33-18	Down	2	156	20
	Y	299-E33-26	Down	1	28.3	20
	Y	299-E33-38	Down	1	60.3	20
	Y	299-E33-41	Down	2	25.2	20
	Y	299-E33-44	Down	1	214	20
	Y	299-E33-5	Down	1	52.5	20
Waste Management Area C						
Gross beta, pCi/L	N	299-E27-13	Down	1	50.8	50
	N	299-E27-14	Up	12	180	50
Iodine-129, pCi/L	N	299-E27-12	Down	1	4.27	1
	N	299-E27-13	Down	1	3.93	1
	N	299-E27-14	Up	1	2.91	1
	N	299-E27-15	Down	1	3.47	1
	N	299-E27-7	Up	1	4.54	1
Waste Management Area S-SX						
Carbon tetrachloride, µg/L	N	299-W23-15	Down	1	120	5
Gross alpha, pCi/L	N	299-W23-7	Down	1	128	15
Gross beta, pCi/L	N	299-W22-45	Down	5	649	50
	N	299-W22-46	Down	4	1,500	50
	N	299-W23-7	Down	1	993	50
Nitrogen in Nitrate, µg/L	N	299-W22-46	Down	1	10,100	10,000
	N	299-W23-14	Up	3	20,600	10,000

Table A.3. (contd)

Constituent, units	Filter	Well Name	Upgradient/ Downgradient	Number of Exceedances	Maximum Result	MCL or DWS[b] Level
Technetium-99, pCi/L	N	299-W22-45	Down	5	1,760	900
	N	299-W22-46	Down	4	3,760	900
Tritium, pCi/L	N	299-W22-39	Down	4	24,800	20,000
	N	299-W22-46	Down	4	41,700	20,000
	N	299-W23-14	Up	4	325,000	20,000
Uranium, µg/L	N	299-W23-7	Down	1	74.3	20
		Waste Management Area T				
Carbon tetrachloride, µg/L	N	299-W10-24	Down	6	1,600	5
Chromium, µg/L	Y	299-W10-23	Down	4	153	100
	Y	299-W10-24	Down	4	115	100
	Y	299-W10-4	Up	4	192	100
	Y	299-W10-8	Down	3	115	100
	Y	299-W11-23	Down	2	129	100
Fluoride, µg/L	N	299-W10-12	Down	1	4,290	4000
	N	299-W10-24	Down	2	4,960	4000
	N	299-W10-4	Up	4	5,250	4000
Gross alpha, pCi/L	N	299-W11-27	Down	1	90.1	15
Gross beta, pCi/L	N	299-W10-12	Down	2	77.5	50
	N	299-W10-23	Down	4	106	50
	N	299-W10-24	Down	7	972	50
	N	299-W10-4	Up	4	106	50
	N	299-W10-8	Down	4	115	50
	N	299-W11-12	Down	4	71.7	50
	N	299-W11-23	Down	5	2,460	50
	N	299-W11-24	Down	2	70.7	50
	N	299-W11-27	Down	1	2,050	50
	N	299-W11-28	Down	4	122	50
	Y	299-W10-24	Down	2	221	50
Methylenechloride, µg/L	N	299-W10-24	Down	1	8	5
Nitrogen in Nitrate, µg/L	N	299-W10-1	Up	2	36,100	10,000
	N	299-W10-12	Down	2	85,600	10,000
	N	299-W10-22	Down	5	17,400	10,000
	N	299-W10-23	Down	4	132,000	10,000
	N	299-W10-24	Down	10	120,000	10,000
	N	299-W10-4	Up	4	186,000	10,000
	N	299-W10-8	Down	4	89,300	10,000
	N	299-W11-12	Down	4	28,100	10,000
	N	299-W11-23	Down	5	23,400	10,000
	N	299-W11-24	Down	2	63,400	10,000
	N	299-W11-27	Down	1	16,300	10,000
	N	299-W11-28	Down	4	41,300	10,000
	Y	299-W11-24	Down	1	57,000	10,000
Technetium-99, pCi/L	N	299-W10-24	Down	4	3,660	900
	N	299-W11-23	Down	5	8,540	900
	N	299-W11-27	Down	2	7,010	900
Trichloroethylene, µg/L	N	299-W10-24	Down	4	11	5
Tritium, pCi/L	N	299-W10-12	Down	1	21,700	20,000
	N	299-W10-23	Down	4	25,500	20,000
	N	299-W10-24	Down	5	29,300	20,000
	N	299-W10-4	Up	2	23,700	20,000
	N	299-W10-8	Down	3	23,600	20,000
	N	299-W11-12	Down	4	71,500	20,000

Table A.3. (contd)

Constituent, units	Filter	Well Name	Upgradient/ Downgradient	Number of Exceedances	Maximum Result	MCL or DWS[(b)] Level
	N	299-W11-24	Down	3	28,200	20,000
	N	299-W11-28	Down	4	41,100	20,000
	Y	299-W10-24	Down	3	29,600	20,000
Waste Management Area T, Assessment Wells						
Carbon tetrachloride, µg/L	N	299-W10-19	Down	1	89	5
	N	299-W10-20	Down	1	1,300	5
	N	299-W10-21	Down	1	400	5
	N	299-W6-2	Down	1	130	5
Gross beta, pCi/L	N	299-W6-10	Up	2	83.2	50
	Y	299-W11-31	Down	1	118	50
Nitrogen in Nitrate, µg/L	N	299-W10-19	Down	1	19,500	10,000
	N	299-W10-20	Down	1	25,400	10,000
	N	299-W10-21	Down	1	45,600	10,000
	N	299-W6-10	Up	2	27,000	10,000
	N	299-W6-2	Down	1	10,900	10,000
	N	299-W6-4	Down	2	19,600	10,000
	N	299-W6-9	Down	2	14,600	10,000
	Y	299-W11-31	Down	1	30,000	10,000
Trichloroethylene, µg/L	N	299-W10-21	Down	1	7	5
Tritium, pCi/L	N	299-W6-10	Up	2	49,400	20,000
	N	299-W6-4	Down	1	21,700	20,000
	Y	299-W11-31	Down	1	52,500	20,000
Waste Management Area TX-TY						
Carbon tetrachloride, µg/L	N	299-W14-14	Down	7	920	5
	N	299-W15-4	Down	3	460	5
	N	299-W15-40	Down	1	950	5
Chromium, µg/L	Y	299-W14-13	Down	4	433	100
Gross alpha, pCi/L	N	299-W14-12	Down	1	26.4	15
Gross beta, pCi/L	N	299-W10-17	Down	4	101	50
	N	299-W10-18	Down	1	52.5	50
	N	299-W10-26	Down	1	55.3	50
	N	299-W14-13	Down	4	1,510	50
	N	299-W14-14	Down	4	117	50
	N	299-W14-2	Down	3	468	50
	N	299-W14-5	Down	4	91.5	50
	N	299-W14-6	Down	3	58.5	50
	N	299-W15-12	Down	2	245	50
	N	299-W15-4	Down	4	418	50
	Y	299-W14-14	Down	1	135	50
Iodine-129, pCi/L	N	299-W14-13	Down	2	31.1	1
	N	299-W14-2	Down	3	47.4	1
Nickel, µg/L	Y	299-W10-18	Down	3	360	100
Nitrogen in Nitrate, µg/L	N	299-W10-17	Down	4	52,400	10,000
	N	299-W10-18	Down	3	18,500	10,000
	N	299-W10-26	Down	5	19,900	10,000
	N	299-W14-12	Down	1	131,000	10,000
	N	299-W14-13	Down	4	78,500	10,000
	N	299-W14-14	Down	5	51,000	10,000
	N	299-W14-2	Down	4	19,300	10,000
	N	299-W14-5	Down	4	48,600	10,000
	N	299-W14-6	Down	4	20,100	10,000

Table A.3. (contd)

Constituent, units	Filter	Well Name	Upgradient/ Downgradient	Number of Exceedances	Maximum Result	MCL or DWS[b] Level
	N	299-W15-12	Down	2	37,100	10,000
	N	299-W15-4	Down	4	29,800	10,000
	N	299-W15-40	Down	4	32,300	10,000
Technetium-99, pCi/L	N	299-W14-12	Down	1	6,200	900
	N	299-W14-13	Down	4	5,130	900
	N	299-W14-2	Down	2	1,450	900
	N	299-W15-4	Down	1	982	900
Trichloroethylene, µg/L	N	299-W14-14	Down	4	10	5
	N	299-W15-40	Down	1	15	5
Tritium, pCi/L	N	299-W10-17	Down	3	27,200	20,000
	N	299-W14-12	Down	1	1,170,000	20,000
	N	299-W14-13	Down	4	2,000,000	20,000
	N	299-W14-2	Down	4	1,970,000	20,000
	N	299-W15-12	Down	2	29,900	20,000
	N	299-W15-4	Down	1	21,400	20,000
Waste Management Area U						
Carbon tetrachloride, µg/L	N	299-W18-30	Down	5	610	5
	N	299-W19-41	Down	1	290	5
	N	299-W19-42	Down	2	510	5
Gross beta, pCi/L	N	299-W19-12	Down	4	78.4	50
	N	299-W19-31	Down	1	57.4	50
	N	299-W19-41	Down	4	148	50
	N	299-W19-42	Down	3	124	50
Treated Effluent Disposal Facility						
Gross beta, pCi/L	N	699-40-36	Down	1	130	50

(a) Samples collected between October 1, 1998 and September 30, 1999. Primary maximum contaminant levels and interim drinking water standards. Excludes constituents where the detection limit is greater than the standard.
(b) MCL = Maximum contaminant level.
DWS = Drinking water standard.
ND = Not determined.

Table A.4. Monitoring Wells and Constituents for 100 N Area Units (adapted from WHC-SD-EN-AP-038, Rev. 2)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
1301-N Liquid Waste Disposal Facility					
199-N-2[64]	Top of unconfined	Semiannual	Semiannual	PRE	100-NR-2, ERA
199-N-3[64]	Top of unconfined	Semiannual	Semiannual	PRE	100-NR-2, ERA, Surveillance
199-N-34[83]	Top of unconfined	Semiannual	Semiannual	PRE	Surveillance
199-N-57[87]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
199-N-105A[95]	Unconfined	Semiannual	--	RCRA[(a)]	ERA
1324-N/NA Liquid Waste Disposal Facilities					
199-N-59[87]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
199-N-71[91]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
199-N-72[91]	Top of unconfined	Semiannual	Semiannual	RCRA	--
199-N-73[91]	Top of unconfined	Semiannual	Semiannual	RCRA	--
199-N-77[92(b)]	Bottom of unconfined	Semiannual	Semiannual	RCRA	--
1325-N Liquid Waste Disposal Facility					
199-N-28[83(b)]	Top of unconfined	Semiannual	Semiannual	PRE	Surveillance
199-N-32[83]	Top of unconfined	Semiannual	Semiannual	PRE	100-NR-2, Surveillance
199-N-41[84]	Top of unconfined	Semiannual	Semiannual	PRE	Surveillance
199-N-74[91]	Top of unconfined	Semiannual	Semiannual	RCRA	100-NR-2, Surveillance
199-N-81[93]	Top of unconfined	Semiannual	Semiannual	RCRA	100-NR-2, Surveillance

Contamination Indicator Parameters	Site-Specific Parameters	
pH (field)	Alkalinity[(c)]	ICP metals (filtered)[(c)]
Specific conductance (field)	Anions[(c)]	Turbidity
Total organic carbon	Gross alpha[(d)]	
Total organic halides		

(a) Extraction well; screened over entire thickness of aquifer.
(b) Used for supplemental information; no statistical evaluations.
(c) Annually for 1301-N and 1325-N liquid waste disposal facilities.
(d) Gross alpha required for wells 199-N-59 and 199-N-77 only.
Bold italic = Upgradient wells.
Superscript = Year of installation.
ERA = Expedited response action.
ICP = Inductively coupled plasma emission spectroscopy.
PRE = Well not constructed to RCRA standards.
RCRA = Well constructed to RCRA standards.

Table A.5. Critical Mean Values for 1301-N Liquid Waste Disposal Facility[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	10	9	4.7815	537.69	237.05	1,726.5	1,726.5
Field pH	10	9	5.2912	7.969	0.356	[5.99, 9.94]	[5.99, 9.94]
Total organic carbon, µg/L	10	9	4.7815	623.625	350.836	2,383.0	2,383.0
Total organic halides,[b] µg/L	9	8	5.0420	6.162	3.377	24.1	24.1

(a) Based on semiannual sampling events from September 1997 to September 1999 for upgradient wells 199-N-57 and 199-N-34.
(b) Excluding suspect data collected on September 30, 1997 from well 199-N-57.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 20 comparisons.

Table A.6. Critical Mean Values for 1324-N/NA Liquid Waste Disposal Facilities[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	5	4	8.1216	305.25	18.694	471.6	471.6
Field pH	5	4	9.7291	8.162	0.095	[7.15, 9.17]	[7.15, 9.17]
Total organic carbon,[b] µg/L	5	4	8.1216	237.25	180.157	1,840.1	1,840.1
Total organic halides, µg/L	5	4	8.1216	7.334	2.286	27.7	27.7

(a) Based on semiannual sampling events from September 1997 to August 1999 for upgradient well 199-N-71.
(b) Critical mean calculated from values reported below vendor's specified method detection limit.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 16 comparisons.

Table A.7. Critical Mean Values for 1325-N Liquid Waste Disposal Facility[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	5	4	8.1216	349.75	13.621	470.9	470.9
Field pH	5	4	9.7291	8.163	0.149	[6.57, 9.76]	[7.46, 8.79][b]
Total organic carbon, µg/L	5	4	8.1216	307.5	156.774	1,702.3	1,702.3
Total organic halides, µg/L	5	4	8.1216	6.185	2.375	27.3	27.3

(a) Based on semiannual sampling events from September 1997 to September 1999 for upgradient well 199-N-74.
(b) Values calculated using data collected from August 1995 to September 1999 because the critical range calculated using limited data is too large to be meaningful.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 16 comparisons.

Table A.8. Monitoring Wells and Constituents for 120-D-1 Ponds (adapted from WHC-SD-EN-AP-048)

Well	Hydrogeologic Unit Monitored	Sampling Frequency[a]	Water-Level Measurement	Well Standard	Other Networks
199-D5-13[91]	Top of unconfined	Semiannual	Semiannual	RCRA	100-HR-3, Surveillance
199-D8-4[91]	Top of unconfined	Semiannual	Semiannual	RCRA	100-HR-3
199-D8-5[91]	Top of unconfined	Semiannual	Semiannual	RCRA	100-HR-3
199-D8-6[91]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance

Contamination Indicator Parameters	Site-Specific Parameters	
pH (field)	Alkalinity	ICP metals (filtered)
Specific conductance (field)	Anions	Mercury (filtered)
Total organic carbon	Gross alpha	Tritium
Total organic halides	Gross beta	Turbidity (field)

(a) Through March 1999. Site clean closed. No further RCRA monitoring required.
Bold italic = Upgradient well.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = Well constructed to RCRA standards.

Table A.9. Monitoring Wells and Constituents for 183-H Solar Evaporation Basins (adapted from PNNL-11573)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
199-H4-3[74]	Top of unconfined	Annual	Semiannual	PRE	IRA, Surveillance
199-H4-7[86(a)]	Top of unconfined	Annual	Semiannual	RCRA	IRA, Surveillance
199-H4-12A[86(a)]	Top of unconfined	Annual	Semiannual	RCRA	IRA
199-H4-12C[86]	Mid-depth unconfined	Annual	Semiannual	RCRA	IRA

Dangerous Waste Constituents	Site-Specific Parameters	
Chromium (filtered)	Alkalinity	pH
Nitrate	Anions	Specific conductance
Fluoride	ICP metals (filtered)	Turbidity
Technetium-99		
Uranium		

(a) Extraction well.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
IRA = Interim response action.
PRE = Well not constructed to RCRA standards.
RCRA = Well constructed to RCRA standards.

Table A.10. Monitoring Wells and Constituents for Waste Management Area S-SX (adapted from WHC-SD-EN-AP-191)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-W22-39[91]	Top of unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-W22-44[91]	Top of unconfined	Quarterly	Quarterly	RCRA	--
299-W22-45[92]	Top of unconfined	Quarterly	Quarterly	RCRA	--
299-W22-46[91]	Top of unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-W22-48[99]	Top of unconfined	Quarterly	Quarterly	RCRA	--
299-W22-49[99]	Top of unconfined	Quarterly	Quarterly	RCRA	--
299-W22-50[99]	Top of unconfined	Quarterly	Quarterly	RCRA	--
299-W23-7[69]	Top of unconfined	Quarterly	Quarterly	PRE	Surveillance
299-W23-9[72]	Top of unconfined	Quarterly	Quarterly	PRE	--
299-W23-13[90]	Top of unconfined	Quarterly	Quarterly	RCRA	--
299-W23-14[91]	Top of unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-W23-15[91]	Top of unconfined	Quarterly	Quarterly	RCRA	Surveillance

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Anions	Strontium-90
Specific conductance	Cesium-137	Technetium-99
Total organic carbon	Gross alpha	Tritium
Total organic halides	Gross beta	Turbidity
	Hexavalent chromium	Uranium
	ICP metals (filtered)	Volatile organic compounds

Bold italic = Upgradient wells.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
PRE = Well not constructed to RCRA standards.
RCRA = Well constructed to RCRA standards.

Table A.11. Monitoring Wells and Constituents for Waste Management Area T (adapted from WHC-SD-EN-AP-012, Rev. 1 and WHC-SD-EN-AP-132)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-W6-2[87(a)]	Top of unconfined	Semiannual	Semiannual	RCRA	LLWMA 3, Surveillance
299-W6-4[91(a)]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-W6-9[92(a)]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-W6-10[92]	Unconfined	Semiannual	Semiannual	RCRA	--
299-W10-1[47]	Unconfined	Semiannual	Semiannual	PRE	Surveillance
299-W10-2[51]	Unconfined	Semiannual	Semiannual	PRE	--
299-W10-4[52]	Unconfined	Quarterly	Quarterly	PRE	Surveillance
299-W10-8[73]	Top of unconfined	Quarterly	Quarterly	PRE	--
299-W10-12[74]	Top of unconfined	Semiannual	Semiannual	PRE	Surveillance
299-W10-19[92(a)]	Top of unconfined	Semiannual	Semiannual	RCRA	LLWMA 3
299-W10-20[93(a)]	Top of unconfined	Semiannual	Semiannual	RCRA	LLWMA 3
299-W10-21[93(a)]	Top of unconfined	Semiannual	Semiannual	RCRA	LLWMA 3
299-W10-22[94]	Unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-W10-23[98]	Unconfined	Quarterly	Quarterly	RCRA	--
299-W10-24[98]	Unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-W11-7[51]	Unconfined	Semiannual	Semiannual	PRE	--
299-W11-12[53]	Unconfined	Quarterly	Quarterly	PRE	--
299-W11-23[73]	Top of unconfined	Quarterly	Quarterly	PRE	--
299-W11-24[73]	Top of unconfined	Quarterly	Quarterly	PRE	--
299-W11-27[91]	Top of unconfined	Quarterly	Quarterly	RCRA	--
299-W11-28[91]	Top of unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-W11-30[92]	Unconfined	Semiannual	Semiannual	RCRA	200-ZP-1
299-W11-31[92(a)]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-W15-12[73]	Unconfined	Semiannual	Semiannual	PRE	--

Contamination Indicator Parameters	Site-Specific Parameters[(b)]	
pH	Anions	Strontium-90
Specific conductance	Gamma scan (cesium-137, cobalt-60)	Technetium-99
Total organic carbon	Gross alpha	Total dissolved solids
Total organic halides	Gross beta	Tritium
	ICP metals (filtered)	Turbidity
	Iodine-129	Volatile organic compounds

(a) Wells used for expanded assessment monitoring.
(b) Constituent list varies by well.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
LLWMA = Low-level waste management area.
PRE = Well not constructed to RCRA standards.
RCRA = Well constructed to RCRA standards.

Table A.12. Monitoring Wells and Constituents for Waste Management Area TX-TY (adapted from WHC-SD-EN-AP-012, Rev. 1 and WHC-SD-EN-AP-132)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-W10-17[91]	Top of unconfined	Quarterly	Quarterly	RCRA	--
299-W10-18[90]	Top of unconfined	Quarterly	Quarterly	RCRA	--
299-W10-26[99]	Unconfined	Quarterly	Quarterly	RCRA	--
299-W14-2[55]	Unconfined	Quarterly	Quarterly	PRE	--
299-W14-5[74]	Unconfined	Quarterly	Quarterly	PRE	--
299-W14-6[74]	Unconfined	Quarterly	Quarterly	PRE	--
299-W14-12[91]	Top of unconfined	Quarterly	Quarterly	RCRA	--
299-W14-13[99]	Unconfined	Quarterly	Quarterly	RCRA	--
299-W14-14[99]	Unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-W15-4[56]	Unconfined	Quarterly	Quarterly	PRE	200-ZP-1
299-W15-22[91]	Top of unconfined	Dry	Dry	RCRA	--
299-W15-40[99]	Unconfined	Quarterly	Quarterly	RCRA	--

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity	Iodine-129
Specific conductance	Anions	Strontium-90[(a)]
Total organic carbon	Gamma scan (cesium-137, cobalt-60)	Technetium-99
		Total dissolved solids
	Gross alpha	Tritium
	Gross beta	Turbidity
	ICP metals (filtered)	Volatile organic compounds[(a)]

(a) Limited wells.
Bold italic = Upgradient well.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
PRE = Well not constructed to RCRA standards.
RCRA = Well constructed to RCRA standards.

Table A.13. Monitoring Wells and Constituents for Waste Management Area U (adapted from WHC-SD-EN-AP-012, Rev. 1)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-W18-25[90]	Top of unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-W18-30[91]	Top of unconfined	Quarterly	Quarterly	RCRA	200-ZP-1
299-W18-31[91]	Top of unconfined	Quarterly	Quarterly	RCRA	--
299-W19-12[83(a)]	Top of unconfined	Quarterly	Quarterly	PRE	--
299-W19-31[90]	Top of unconfined	Dry[(b)]	Dry[(b)]	RCRA	Surveillance
299-W19-41[99]	Top of unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-W19-42[99]	Top of unconfined	Quarterly	Quarterly	RCRA	Surveillance

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity	Iodine-129[(c)]
Specific conductance	Anions	Phenols[(d)]
Total organic carbon	Gamma scan[(c)]	Technetium-99
Total organic halides	Gross alpha	Total dissolved solids
	Gross beta	Tritium
	ICP metals (filtered)	Turbidity

(a) Used for supplemental information; no statistical evaluations.
(b) Last sampled December 1998.
(c) Wells 299-W19-41 and 299-W19-42 only.
(d) Annually.
Bold italic = Upgradient wells.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
PRE = Well not constructed to RCRA standards.
RCRA = Well constructed to RCRA standards.

Table A.14. Critical Mean Values for Waste Management U[(a)]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	10	9	4.7815	218.175	10.870	272.7	272.7
Field pH	10	9	5.2912	8.088	0.112	[7.46, 8.71]	[7.46, 8.71]
Total organic carbon,[(b)] µg/L	10	9	4.7815	465.250	125.069	1,092.5	1,153.7
Total organic halides, µg/L	10	9	4.7815	32.938	25.438	160.5	160.5

(a) Data collected from August 1998 to August 1999 for upgradient wells 299-W18-25 and 299-W18-31.
(b) Upgradient/downgradient comparison value is the limit of quantitation discussed in Appendix B.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 20 comparisons.

Table A.15. Monitoring Wells and Constituents for 216-S-10 Pond and Ditch (adapted from WHC-SD-EN-AP-018)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-W26-7[91]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-W26-8[90]	Top of unconfined	Dry[(a)]	NA	RCRA	Surveillance
299-W26-9[90]	Top of unconfined	Dry[(b)]	NA	RCRA	--
299-W26-10[91]	Top of unconfined	Dry[(c)]	NA	RCRA	--
299-W26-12[91]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-W27-2[92(d)]	Base of unconfined	Semiannual	Semiannual	RCRA	Surveillance

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity	ICP metals (filtered)
Specific conductance	Anions	Phenols
Total organic carbon	Gross alpha	Turbidity
Total organic halides	Gross beta	

(a) Well dry; last sampled March 1998.
(b) Well dry; last sampled June 1999.
(c) Well dry; last sampled March 1999.
(d) Used for supplemental information; no statistical evaluation.
Bold italic = Upgradient wells.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
NA = Not applicable.
RCRA = Well constructed to RCRA standards.

Table A.16. Critical Mean Values for 216-S-10 Pond and Ditch[(a)]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	5	4	7.5288	276.6	5.504	322.0	322.0
Field pH	5	4	9.0292	8.101	0.089	[7.22, 8.98]	[7.22, 8.98]
Total organic carbon,[(b)] µg/L	5	4	7.5288	274.45	111.93	1,197.6	1,197.6
Total organic halides, µg/L	5	4	7.5288	5.584	2.175	23.5	23.5

(a) Data collected from December 1996 to December 1997 for upgradient well 299-W26-7, except for total organic carbon that was collected from December 1995 to December 1997.
(b) Critical mean calculated from values reported below vendor's specified method detection limit.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 12 comparisons.

Table A.17. Monitoring Wells and Constituents for 216-U-12 Crib (adapted from WHC-SD-EN-AP-019 and WHC-SD-EN-AP-108)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-W22-40[90]	Top of unconfined	Removed	NA	RCRA	Surveillance
299-W22-41[90]	Top of unconfined	Dry[(a)]	NA	RCRA	--
299-W22-42[90]	Top of unconfined	Dry[(a)]	NA	RCRA	--
299-W22-43[90]	Top of unconfined	Quarterly	Quarterly	RCRA	--
299-W22-79[98]	Top of unconfined	Quarterly	Quarterly	RCRA	--
699-36-70A[94]	Top of unconfined	Quarterly	Quarterly	RCRA	ERDF

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity	Iodine-129[(b)]
Specific conductance	Anions	Technetium-99
Total organic carbon	Gross alpha	Total dissolved solids
Total organic halides	Gross beta	Tritium
	ICP metals (filtered)[(b)]	Turbidity

(a) Well is dry; last sampled March 1999.
(b) Analyzed annually.
Bold italic = Upgradient well.
Superscript = Year of installation.
ERDF = Environmental Restoration Disposal Facility.
ICP = Inductively coupled plasma emission spectroscopy.
NA = Not applicable.
RCRA = Well constructed to RCRA standards.

Table A.18. Monitoring Wells and Constituents for Low-Level Waste Management Area 3 (adapted from WHC-SD-EN-AP-015)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-W6-2[87]	Top of unconfined	Semiannual	Semiannual	RCRA	WMA T, Surveillance
299-W7-1[87]	Top of unconfined	Semiannual	Semiannual	RCRA	SALDS
299-W7-2[87]	Top of unconfined	Dry	Dry	RCRA	--
299-W7-3[87]	Deep unconfined	Semiannual	Semiannual	RCRA	SALDS
299-W7-4[87]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-W7-5[87]	Top of unconfined	Semiannual	Semiannual	RCRA	SALDS, Surveillance
299-W7-6[87]	Top of unconfined	Semiannual	Semiannual	RCRA	SALDS, Surveillance
299-W7-7[89]	Top of unconfined	Semiannual	Semiannual	RCRA	SALDS
299-W7-8[89]	Top of unconfined	Semiannual	Semiannual	RCRA	SALDS, Surveillance
299-W7-9[90]	Top of unconfined	Semiannual	Semiannual	RCRA	SALDS
299-W7-10[90]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-W7-11[91]	Top of unconfined	Semiannual	Semiannual	RCRA	SALDS, Surveillance
299-W7-12[91]	Top of unconfined	Semiannual	Semiannual	RCRA	SALDS, Surveillance
299-W8-1[87]	Top of unconfined	Semiannual	Semiannual	RCRA	SALDS, Surveillance
299-W9-1[87]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-W10-13[87]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-W10-14[87]	Deep unconfined	Semiannual	Semiannual	RCRA	--
299-W10-19[92]	Top of unconfined	Semiannual	Semiannual	RCRA	WMA T
299-W10-20[93]	Top of unconfined	Semiannual	Semiannual	RCRA	WMA T, Surveillance
299-W10-21[93]	Top of unconfined	Semiannual	Semiannual	RCRA	WMA T, Surveillance

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity	Mercury (filtered)
Specific conductance	Anions	Phenols
Total organic carbon	Gross alpha	Tritium
Total organic halides	Gross beta	Turbidity
	ICP metals (filtered)	Volatile organic compounds
	Lead (filtered)	

Bold italic = Upgradient wells.
Superscript = Year of installation.
RCRA = Well constructed to RCRA standards.
SALDS = State-Approved Land Disposal Site.
WMA = Waste management area.

Table A.19. Critical Mean Values for Low-Level Waste Management Area 3 (area not affected by upgradient contamination)[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	9	8	5.3168	445.472	24.948	585.3	585.3
Field pH	9	8	5.9119	8.287	0.226	[6.88, 9.69]	[6.88, 9.69]
Total organic carbon,[b,c] µg/L	8	7	5.7282	169.062	49.945	472.5	1,153.7
Total organic halides, µg/L	8	7	5.7282	9.10	7.137	52.5	52.5

(a) Data collected from December 1994 to September 1995 for upgradient wells 299-W9-1 and 299-W10-13. Critical means calculated for area not impacted by upgradient source of contamination.
(b) Critical means calculated from values reported below vendor's specified method detection limit.
(c) Upgradient/downgradient comparison value is the limit of quantitation discussed in Appendix B.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 28 comparisons.

Table A.20. Critical Mean Values for Low-Level Waste Management Area 3 (area affected by upgradient contamination)[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	11[b]	10	5.0494	561.296	54.4	848.2	848.2
Field pH	15	14	4.8656	8.059	0.316	[6.47, 9.65]	[6.47, 9.65]
Total organic carbon,[c,d] µg/L	15	14	4.4995	336.9167	126.77	926.0	1,153.7
Total organic halides, µg/L	13[b]	12	4.7168	784.492	374.522	2,617.7	2,617.7

(a) Data collected from March 1997 to March 1998 for upgradient wells 299-W10-19, 299-W10-20, and 299-W10-21. Critical means calculated for area impacted by upgradient source of contamination.
(b) Excluded outliers.
(c) Critical means calculated from values reported below vendor's specified method detection limit.
(d) Upgradient/downgradient comparison value is the limit of quantitation discussed in Appendix B.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 40 comparisons.

Table A.21. Monitoring Wells and Constituents for Low-Level Waste Management Area 4 (adapted from WHC-SD-EN-AP-015)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-W15-15[87]	Top of unconfined	Semiannual	Semiannual	RCRA	200-ZP-1
299-W15-16[87]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-W15-17[87]	Deep unconfined	Semiannual	Semiannual	RCRA	--
299-W15-18[87]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-W15-19[89]	Top of unconfined	Dry	Dry	RCRA	200-ZP-1, Surveillance
299-W15-20[89]	Top of unconfined	Dry	Dry	RCRA	--
299-W15-23[90]	Top of unconfined	Dry	Dry	RCRA	--
299-W15-24[89]	Top of unconfined	Dry	Dry	RCRA	--
299-W18-21[87]	Top of unconfined	Semiannual	Semiannual	RCRA	200-ZP-1
299-W18-22[87]	Deep unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-W18-23[87]	Top of unconfined	Semiannual	Semiannual	RCRA	200-ZP-1
299-W18-24[87]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-W18-26[89]	Top of unconfined	Dry	Dry		--
299-W18-27[91]	Top of unconfined	Semiannual	Semiannual	RCRA	200-ZP-1
299-W18-28[91]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-W18-29[91]	Perched zone	Dry	Dry	RCRA	--
299-W18-32[92]	Top of unconfined	Dry	Dry	RCRA	200-ZP-1

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity	Mercury (filtered)
Specific conductance	Anions	Phenols
Total organic carbon	Gross alpha	Tritium
Total organic halides	Gross beta	Turbidity
	ICP metals (filtered)	Volatile organic compounds
	Lead (filtered)	

Bold italic = Upgradient wells.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = Well constructed to RCRA standards.

Table A.22. Critical Mean Values for Low-Level Waste Management Area 4[(a)]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	16	15	4.2395	377.156	68.587	676.9	676.9
Field pH	16	15	4.5857	7.958	0.130	[7.34, 8.57]	[7.34, 8.57]
Total organic carbon,[(b)] µg/L	16	15	4.2395	543.438	236.054	1,575.0	1,575.0
Total organic halides, µg/L	16	15	4.2395	262.510	199.616	1,134.8	1,134.8

(a) Based on semiannual sampling events from July 1997 to January 1998 for upgradient wells 299-W15-15, 299-W18-21, 299-W18-23, and 299-W18-26.
(b) Critical means calculated using data below vendor's specified method detection limit.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 28 comparisons.

Table A.23. Monitoring Wells, Constituents, and Enforcement Limits for State-Approved Land Disposal Site (adapted from WHC-SD-C018H-PLN-004, Rev. 1)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Well Standard	Other Networks
299-W6-6	Top of unconfined	Annual	RCRA	Surveillance
299-W6-7	Top of unconfined	Annual	RCRA	Surveillance
299-W6-8	Top of unconfined	Semiannual	RCRA	--
299-W6-11	Top of unconfined	Annual	RCRA	--
299-W6-12	Top of unconfined	Annual	RCRA	Surveillance
299-W7-1	Top of unconfined	Semiannual	RCRA	LLWMA 3
299-W7-3	Top of unconfined	Annual	RCRA	LLWMA 3
299-W7-5	Top of unconfined	Annual	RCRA	LLWMA 3, Surveillance
299-W7-6	Top of unconfined	Semiannual	RCRA	LLWMA 3, Surveillance
299-W7-7	Top of unconfined	Annual	RCRA	LLWMA 3
299-W7-8	Top of unconfined	Annual	RCRA	LLWMA 3, Surveillance
299-W7-9	Top of unconfined	Annual	RCRA	LLWMA 3
299-W7-11	Top of unconfined	Semiannual	RCRA	LLWMA 3, Surveillance
299-W7-12	Top of unconfined	Annual	RCRA	LLWMA 3, Surveillance
299-W8-1[(a)]	Top of unconfined	Quarterly	RCRA	LLWMA 3, Surveillance
699-48-71	Unconfined	Annual	PRE	Surveillance
699-48-77A[(a)]	Confined Ringold unit E; upper	Quarterly	RCRA	--
699-48-77C[(a)]	Confined Ringold unit E; mid to lower	Quarterly	RCRA	Surveillance
699-48-77D[(a)]	Confined Ringold unit E; upper	Quarterly	RCRA	Surveillance
699-49-79	Top of unconfined	Annual	PRE	--
699-51-75	Confined Ringold(?)	Annual	PRE	--

Constituent	Enforcement Limit (µg/L)	Constituent	Enforcement Limit (µg/L)
Acetone	160	Lead, total	50
Ammonia	1,100	Mercury, total	2
Benzene	5	pH	6.5 - 8.5 pH units
Cadmium, total	10	Strontium-90	Monitor only
Chloroform	6.2	Sulfate	250,000
Copper, total	70	Tetrahydrofuran	100
Gross alpha	Monitor only	Total dissolved solids	500,000
Gross beta	Monitor only	Tritium	Monitor only

(a) Monitored for full constituent list. Other wells analyzed for tritium only.
Bold italic = Upgradient well.
LLWMA = Low-level waste management area.
PRE = Well not constructed to RCRA standards.
RCRA = Well constructed to RCRA standards.

Table A.24. Monitoring Wells and Constituents for Environmental Restoration Disposal Facility (adapted from BHI-00873)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
699-35-66A[57]	Top of unconfined	Semiannual	Semiannual	PRE	Surveillance
699-36-67[96]	Top of unconfined	Semiannual	Semiannual	RCRA	--
699-36-70[94]	Top of unconfined	Semiannual	Semiannual	RCRA	216-U-12
699-37-68[96]	Top of unconfined	Semiannual	Semiannual	RCRA	--

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity	ICP metals (filtered)
Specific conductance	Anions	Iodine-129
Turbidity	Arsenic (filtered)	Radium
	Carbon-14	Technetium-99
	Carbon tetrachloride	Total dissolved solids
	Gross alpha	Total organic halides
	Gross beta	Uranium

Bold italic = Upgradient well.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
PRE = Well not constructed to RCRA standards.
RCRA = Well constructed to RCRA standards.

Table A.25. Monitoring Wells and Constituents for Waste Management Area A-AX (adapted from WHC-SD-EN-AP-012, Rev. 1)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-E24-19[89]	Top of unconfined	Semiannual	Quarterly	RCRA	Surveillance
299-E24-20[91]	Top of unconfined	Semiannual	Quarterly	RCRA	Surveillance
299-E25-2[55(a)]	Top of unconfined	--	Quarterly	PRE	--
299-E25-40[89]	Top of unconfined	Semiannual	Quarterly	RCRA	--
299-E25-41[89]	Top of unconfined	Semiannual	Quarterly	RCRA	Surveillance
299-E25-46[92]	Top of unconfined	Semiannual	Quarterly	RCRA	Surveillance

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Anions	Low-level gamma
Specific conductance	Gross alpha	Phenols
Total organic carbon	Gross beta	Technetium-99
Total organic halides	ICP metals (filtered)	Tritium
	Iodine-129	Turbidity

(a) Used for supplemental information; no statistical evaluations.
Bold italic = Upgradient wells.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
PRE = Well not constructed to RCRA standards.
RCRA = Well constructed to RCRA standards.

Table A.26. Critical Mean Values for Waste Management Area A-AX[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	6[b]	5	6.8688	313.50	29.838	534.9	534.9
Field pH	8	7	6.0818	8.066	0.182	[6.89, 9.24]	[6.89, 9.24]
Total organic carbon, µg/L	8	7	5.4079	724.375	168.522	1,691.0	1,691.0
Total organic halides,[c,d] µg/L	8	7	5.4079	2.552	0.791	7.1	17.9

(a) Based on semiannual sampling events from February 1998 to June 1999 for upgradient wells 299-E25-40 and 299-E25-41.
(b) Outlier excluded.
(c) Critical mean calculated from values reported below vendor's specified method detection limit.
(d) Upgradient/downgradient comparison value is the limit of quantitation discussed in Appendix B.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 20 comparisons.

Table A.27. Monitoring Wells and Constituents for Waste Management Area B-BX-BY[a] (adapted from WHC-SD-EN-AP-012, Rev. 1 and WHC-SD-ENV-AP-002)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-E28-8[57]	Unconfined	Quarterly	Quarterly	PRE	--
299-E33-5[55]	Unconfined	Quarterly[b]	Quarterly	PRE	Surveillance
299-E33-7[55]	Unconfined	Quarterly[c]	Quarterly	PRE	Surveillance
299-E33-8[53]	Unconfined	Quarterly[b]	Quarterly	PRE	--
299-E33-13[53]	Unconfined	Quarterly[c]	Quarterly	PRE	Surveillance
299-E33-15[53]	Unconfined	Quarterly	Quarterly	PRE	--
299-E33-16[53]	Unconfined	Quarterly	Quarterly	PRE	--
299-E33-17[53]	Unconfined	Quarterly	Quarterly	PRE	--
299-E33-18[50]	Unconfined	--	Quarterly	PRE	Surveillance
299-E33-21[57]	Unconfined	Quarterly	Quarterly	PRE	--
299-E33-27[70]	Unconfined	Quarterly[b]	Quarterly	PRE	--
299-E33-28[87]	Unconfined	Quarterly[b]	Quarterly	RCRA	LLWMA 1
299-E33-29[87]	Unconfined	Quarterly[b]	Quarterly	RCRA	--
299-E33-31[89]	Unconfined	Quarterly[b]	Quarterly	RCRA	--
299-E33-32[89]	Unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-E33-33[89]	Unconfined	Quarterly	Quarterly	RCRA	216-B-63 trench, Surveillance
299-E33-35[90]	Unconfined	Quarterly[b]	Quarterly	RCRA	LLWMA 1, Surveillance
299-E33-36[90]	Unconfined	Quarterly	Quarterly	RCRA	216-B-63 trench, Surveillance
299-E33-38[91]	Unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-E33-39[91]	Unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-E33-41[91]	Unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-E33-42[91]	Unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-E33-43[91]	Unconfined	Quarterly	Quarterly	RCRA	--
299-E33-44[98]	Unconfined	Quarterly[c]	Quarterly	RCRA	--

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Anions (nitrate, nitrite)	Low-level gamma (cobalt-60)
Specific conductance	Cyanide	Strontium-90
Total organic carbon	Gross alpha	Technetium-99
Total organic halides	Gross beta	Tritium
	ICP metals (filtered)	Turbidity
	Iodine-129	Uranium

(a) Well list varies, depending on assessment requirements and changes in contaminant conditions.
(b) Not sampled entire year.
(c) Sampled monthly for selected constituents only. Subject to monthly revision.
Bold italic = Upgradient wells.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
LLWMA = Low-level waste management area.
PRE = Well not constructed to RCRA standards.
RCRA = Well constructed to RCRA standards.

Table A.28. Monitoring Wells and Constituents for Waste Management Area C[a] (adapted from WHC-SD-EN-AP-012, Rev. 1)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-E27-7[82(b)]	Top of unconfined	Semiannual	Quarterly	PRE	Surveillance
299-E27-12[89]	Top of unconfined	Semiannual	Quarterly	RCRA	--
299-E27-13[89]	Top of unconfined	Semiannual	Quarterly	RCRA	--
299-E27-14[89]	Top of unconfined	Semiannual	Quarterly	RCRA	Surveillance
299-E27-15[89]	Top of unconfined	Semiannual	Quarterly	RCRA	Surveillance

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Anions	Phenols
Cyanide	Gross alpha	Technetium-99
Specific conductance	Gross beta	Total uranium
Strontium-90	ICP metals (filtered)	Tritium
Total organic carbon	Iodine-129	Turbidity
Total organic halides	Low-level gamma	

(a) Sampling increased January 1999 to monthly with limited constituent list to provide adequate temporal coverage for surface sluicing activities at Tank C-106.
(b) Used for supplemental information; no statistical evaluation.
Bold italic = Upgradient wells.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
PRE = Well not constructed to RCRA standards.
RCRA = Well constructed to RCRA standards.

Table A.29. Critical Mean Values for Waste Management Area C[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	4[b]	3	11.9838	349.812	15.202	553.5	553.5
Field pH	6	5	7.6037	8.345	0.072	[7.76, 8.93]	[7.76, 8.93]
Total organic carbon,[c] µg/L	5[b]	4	8.1216	516.25	128.871	1,662.9	1,662.9
Total organic halides,[c,d] µg/L	6	5	6.5414	3.021	1.076	10.6	17.9

(a) Based on semiannual sampling events from February 1997 to June 1999 for upgradient well 299-E27-14.
(b) Outliers removed.
(c) Critical mean calculated from values reported below vendor's specified method detection limit.
(d) Upgradient/downgradient comparison value is the limit of quantitation discussed in Appendix B.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 16 comparisons.

Table A.30. Monitoring Wells and Constituents for PUREX Cribs 216-A-10, 216-A-36B, and 216-A-37-1 (adapted from PNNL-11523)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
Upgradient Wells					
299-E24-18[88]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-E25-31[87]	Top of unconfined	Semiannual	Semiannual	RCRA	--
Near-Field Wells – 216-A-10 Crib					
299-E17-1[55]	Top of unconfined	Semiannual	Semiannual	PRE	--
299-E17-19[88]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-E24-16[88]	Top of unconfined	Quarterly	Quarterly	RCRA	Surveillance
Near-Field Wells – 216-A-36B Crib					
299-E17-9[68]	Top of unconfined	Semiannual	Semiannual	PRE	Surveillance
299-E17-14[88]	Top of unconfined	Quarterly	Quarterly	RCRA	Surveillance
299-E17-17[88]	Top of unconfined	Semiannual	Semiannual	RCRA	--
Near-Field Wells – 216-A-37-1 Crib					
299-E25-17[76]	Top of unconfined	Semiannual	Semiannual	PRE	--
299-E25-19[76]	Top of unconfined	Quarterly	Quarterly	PRE	Surveillance
699-37-47A[96]	Top of unconfined	Semiannual	Semiannual	RCRA	--
Far-Field Wells					
57 wells	Unconfined	Triannual[(a)]	Triannual[(a)]	RCRA, PRE	Sitewide

Contamination Indicator Parameters	Site-Specific Parameters	
pH[(b)]	Alkalinity	ICP metals (filtered)
Specific conductance[(b)]	Ammonium ion	Iodine-129[(b)]
Temperature[(b)]	Anions[(b)]	Phenols
Turbidity[(b)]	Arsenic (filtered)	Strontium-90
	Gross alpha	Tritium[(b)]
	Gross beta	

(a) Some far-field wells sampled annually.
(b) Far-field wells analyzed for these constituents only.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
PRE = Well not constructed to RCRA standards.
PUREX = Plutonium-uranium extraction (plant).
RCRA = Well constructed to RCRA standards.

Table A.31. Monitoring Wells and Constituents for 216-B-3 Pond (adapted from WHC-SD-EN-AP-013)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-E26-11[89]	Bottom of uppermost	Semiannual	Semiannual	RCRA	LERF, Surveillance
299-E32-4[87]	Top of uppermost	Semiannual	Semiannual	RCRA	LLWMA 1
699-40-39	Lower uppermost	Semiannual	Semiannual	RCRA	--
699-41-42[92]	Top of uppermost	Semiannual	Semiannual	RCRA	--
699-42-39B[91]	Lower uppermost	Semiannual	Semiannual	RCRA	--
699-42-42B[88]	Top of uppermost	Semiannual	Semiannual	RCRA	--
699-43-41G[91]	Top of uppermost	Semiannual	Semiannual	RCRA	--
699-43-45[89]	Top of uppermost	Semiannual	Semiannual	RCRA	216-A-29 ditch
699-44-39B[92]	Top of uppermost	Semiannual	Semiannual	RCRA	Surveillance

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity	ICP metals (filtered)[(a)]
Specific conductance	Anions[(a)]	Phenols[(a)]
Total organic carbon	Gross alpha	Turbidity
Total organic halides	Gross beta	

(a) Analyzed annually.
Bold italic = Upgradient well.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
LERF = Liquid Effluent-Retention Facility.
LLWMA = Low-level waste management area.
RCRA = Well constructed to RCRA standards.

Table A.32. Critical Mean Values for 216-B-3 Pond[(a)]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	15	14	4.4445	417.667	7.215	450.8	450.8
Field pH	15	14	4.8903	7.704	0.262	[6.40, 9.01]	[6.40, 9.01]
Total organic carbon,[(b,c)] µg/L	15	14	4.4445	174.150	123.011	738.8	1,153.7
Total organic halides,[(b,c)] µg/L	14	13	4.5400	3.980	2.242	14.5	17.9

(a) Based on semiannual sampling events from January 1994 to January 1997 for upgradient well 299-E32-4.
(b) Critical means calculated from values reported below vendor's specified method detection limit.
(c) Upgradient/downgradient comparison value is the limit of quantitation discussed in Appendix B.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 36 comparisons.

Table A.33. Monitoring Wells and Constituents for 216-A-29 Ditch (adapted from WHC-SD-EN-AP-045, Rev. 0-A and WHC-SD-EN-EV-032)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-E25-26[85]	Upper unconfined	Semiannual	Quarterly	RCRA	--
299-E25-28[86]	Deep unconfined	Semiannual	Quarterly	RCRA	--
299-E25-32P[88]	Top of unconfined	Semiannual	Quarterly	RCRA	Surveillance
299-E25-34[88]	Top of unconfined	Semiannual	Quarterly	RCRA	--
299-E25-35[88]	Top of unconfined	Semiannual	Quarterly	RCRA	Surveillance
299-E25-48[92]	Top of unconfined	Semiannual	Quarterly	RCRA	--
299-E26-12[91]	Top of unconfined	Semiannual	Quarterly	RCRA	--
299-E26-13[91]	Top of unconfined	Semiannual	Quarterly	RCRA	--
699-43-43[88]	Top of unconfined	Semiannual	Quarterly	RCRA	216-B-3 pond
699-43-45[89]	Top of unconfined	Semiannual	Quarterly	RCRA	216-B-3 pond

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity	ICP metals (filtered)[(a)]
Specific conductance	Anions	Turbidity
Total organic carbon		
Total organic halides		

(a) Analyzed annually.
Bold italic = Upgradient wells.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = Well constructed to RCRA standards.

Table A.34. Critical Mean Values for 216-A-29 Ditch[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	8	7	5.9757	207.50	22.003	347.0	347.0
Field pH	8	7	6.6987	8.364	0.238	[6.68, 10.05]	[7.26, 9.39][b]
Total organic carbon, µg/L	8	7	5.9757	467.03	150.309	1,419.7	1,419.7
Total organic halides,[c] µg/L	8	7	5.9757	4.951	1.985	17.5	17.9

(a) Data collected from January 1998 to October 1998 for upgradient wells 699-43-43 and 699-43-45.
(b) Values calculated using data collected from October 1997 to April 1999 (wells 699-43-43 and 699-43-45) because the critical range calculated using only four quarters of data is too large to be meaningful.
(c) Upgradient/downgradient comparison value is the limit of quantitation discussed in Appendix B.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 36 comparisons.

Table A.35. Monitoring Wells and Constituents for 216-B-63 Trench (adapted from WHC-SD-EN-AP-165)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-E27-8[87]	Top of unconfined	Semiannual	Quarterly	RCRA	LLWMA 2
299-E27-9[87]	Top of unconfined	Semiannual	Quarterly	RCRA	LLWMA 2
299-E27-11[89]	Top of unconfined	Semiannual	Quarterly	RCRA	LLWMA 2
299-E27-16[90]	Top of unconfined	Semiannual	Quarterly	RCRA	--
299-E27-17[91]	Top of unconfined	Semiannual	Quarterly	RCRA	LLWMA 2, Surveillance
299-E27-18[92]	Top of unconfined	Semiannual	Quarterly	RCRA	--
299-E27-19[92]	Top of unconfined	Semiannual	Quarterly	RCRA	--
299-E33-33[90]	Top of unconfined	Semiannual	Quarterly	RCRA	WMA B-BX-BY, Surveillance
299-E33-36[90]	Top of unconfined	Semiannual	Quarterly	RCRA	WMA B-BX-BY
299-E33-37[90]	Top of unconfined	Semiannual	Quarterly	RCRA	Surveillance
299-E34-8[90]	Top of unconfined	Semiannual	Quarterly	RCRA	Surveillance
299-E34-10[91]	Top of unconfined	Semiannual	Quarterly	RCRA	LLWMA 2, Surveillance

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity[a]	ICP metals (filtered)[a]
Specific conductance	Anions[a]	Phenols[a]
Total organic carbon	Gross alpha	Turbidity
Total organic halides	Gross beta	

(a) Analyzed annually.
Bold italic = Upgradient wells.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
LLWMA = Low-level waste management area.
RCRA = Well constructed to RCRA standards.
WMA = Waste management area.

Table A.36. Critical Mean Values for 216-B-63 Trench[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	18[b]	17	4.371	360.889	23.830	467.9	467.9
Field pH	20	19	4.572	8.029	0.179	[7.19, 8.87]	[7.19, 8.87]
Total organic carbon, µg/L	20	19	4.267	474.375	200.588	1,351.5	1,351.5
Total organic halides,[c] µg/L	20	19	4.267	3.520	1.549	10.3	17.9

(a) Based on semiannual sampling events from November 1997 to April 1999 for upgradient wells 299-E27-8, 299-E27-9, 299-E27-11, 299-E27-17, and 299-E34-10.
(b) Excluded outliers.
(c) Upgradient/downgradient comparison value is the limit of quantitation discussed in Appendix B.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 48 comparisons.

Table A.37. Monitoring Wells and Constituents for Liquid Effluent Retention Facility (adapted from WHC-SD-EN-AP-024)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-E26-9[87]	Top of unconfined	Semiannual[a]	Quarterly[a]	RCRA	Surveillance
299-E26-10[90]	Top of unconfined	Semiannual	Quarterly	RCRA	Surveillance
299-E26-11[89]	Top of unconfined	Semiannual	Quarterly	RCRA	216-B-3 pond, Surveillance
299-E35-2[87]	Top of unconfined	Semiannual	Quarterly	RCRA	Surveillance

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity[b]	ICP metals (filtered)[b]
Specific conductance	Ammonium[b]	Phenols[a]
Total organic carbon	Anions[b]	Temperature
Total organic halides	Gross alpha[b]	Turbidity
	Gross beta[b]	Volatile organic compounds

(a) Well dry in June 1999.
(b) Analyzed annually.
Bold italic = Upgradient well.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = Well constructed to RCRA standards.

Table A.38. Critical Mean Values for Liquid Effluent Retention Facility[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	6	5	6.1384	382.833	9.617	446.6	446.6
Field pH	6	5	7.1464	8.131	0.092	[7.42, 8.85]	[7.42, 8.85]
Total organic carbon,[b] µg/L	5	4	7.5287	362.00	191.788	1,943.7	1,943.7
Total organic halides,[b] µg/L	4	3	10.8688	3.15	1.912	26.4	26.4

(a) Based on semiannual sampling events from July 1997 to June 1999 for upgradient well 299-E26-11.
(b) Critical means calculated from values reported below vendor's specified method detection limit.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 12 comparisons.

Table A.39. Monitoring Wells and Constituents for Low-Level Waste Management Area 1 (adapted from WHC-SD-EN-AP-015)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-E28-26[87]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-E28-27[87]	Top of unconfined	Semiannual	Semiannual	RCRA	WMA B, Surveillance
299-E28-28[90]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-E32-2[87]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-E32-3[87]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-E32-4[87]	Top of unconfined	Semiannual	Semiannual	RCRA	216-B-3 pond
299-E32-5[89]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-E32-6[91]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-E32-7[91]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-E32-8[91]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-E32-9[91]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-E32-10[92]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-E33-28[87]	Top of unconfined	Semiannual	Semiannual	RCRA	WMA B
299-E33-29[87]	Top of unconfined	Semiannual	Semiannual	RCRA	WMA B
299-E33-30[87]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-E33-34[90]	Top of unconfined	Semiannual	Semiannual	RCRA	WMA B
299-E33-35[90]	Top of unconfined	Semiannual	Semiannual	RCRA	WMA B, Surveillance

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity	Lead (filtered)
Specific conductance	Anions	Mercury (filtered)
Total organic carbon	Gross alpha	Phenols
Total organic halides	Gross beta	Tritium
	ICP metals (filtered)	Turbidity

Bold italic = Upgradient wells.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = Well constructed to RCRA standards.
WMA = Waste management area.

Table A.40. Critical Mean Values for Low-Level Waste Management Area 1[a]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	27[b]	26	4.1774	390.259	53.332	617.1	617.1
Field pH	28	27	4.4138	7.968	0.216	[7.00, 8.94]	[7.00, 8.94]
Total organic carbon,[c] µg/L	28	27	4.1542	465.625	263.589	1,580	1,580
Total organic halides,[d] µg/L	27[b]	26	4.1774	3.132	1.891	11.2	17.9

(a) Based on semiannual sampling events from December 1997 to June 1999 for upgradient wells 299-E28-26, 299-E28-27, 299-E28-28, 299-E32-4, 299-E33-28, 299-E33-29, and 299-E33-35.
(b) Excluding outlier or data exceeding the holding time requirement.
(c) Critical mean calculated from values reported below vendor's specified method detection limit.
(d) Upgradient/downgradient comparison value is the limit of quantitation discussed in Appendix B.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 68 comparisons.

Table A.41. Monitoring Wells and Constituents for Low-Level Waste Management Area 2 (adapted from WHC-SD-EN-AP-015)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
299-E27-8[87]	Top of unconfined	Semiannual	Semiannual	RCRA	216-B-63 trench
299-E27-9[87]	Top of unconfined	Semiannual	Semiannual	RCRA	216-B-63 trench
299-E27-10[90]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-E27-11[89]	Top of unconfined	Semiannual	Semiannual	RCRA	216-B-63 trench
299-E27-17[91]	Top of unconfined	Semiannual	Semiannual	RCRA	216-B-63 trench, Surveillance
299-E34-2[87]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-E34-3[87]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-E34-4[87]	Top of unconfined	Dry	Dry	RCRA	--
299-E34-5[87]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-E34-6[87]	Top of unconfined	Dry	Dry	RCRA	--
299-E34-7[89]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-E34-9[91]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
299-E34-10[91]	Top of unconfined	Semiannual	Semiannual	RCRA	216-B-63 trench, Surveillance
299-E34-11[92]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-E34-12[92]	Top of unconfined	Semiannual	Semiannual	RCRA	--
299-E35-1[89]	Top of unconfined	Dry	Dry	RCRA	--

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity	Mercury (filtered)
Specific conductance	Anions	Phenols
Total organic carbon	Gross alpha	Polychlorinated biphenyls
Total organic halides	Gross beta	Tritium
	ICP metals (filtered)	Turbidity
	Lead (filtered)	

Bold italic = Upgradient wells.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = Well constructed to RCRA standards.

Table A.42. Critical Mean Values for Low-Level Waste Management Area 2[(a)]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	7	6	7.0210	448.321	46.78	799.4	799.4
Field pH	12	11	5.4261	8.0246	0.126	[7.31, 8.74]	[7.31, 8.74]
Total organic carbon, µg/L	12	11	4.9785	554.375	253.489	1,867.9	1,867.9
Total organic halides,[(b,c)] µg/L	12	11	4.9785	3.013	1.148	9.0	17.9

(a) Data collected from January 1998 to April 1999 for upgradient wells 299-E27-10, 299-E34-3, and 299-E34-7, except for specific conductance that included data collected in the same period for upgradient wells 299-E27-10 and 299-E34-3.
(b) Critical mean calculated from values below vendor's specified method detection limit.
(c) Upgradient/downgradient comparison value is the limit of quantitation discussed in Appendix B.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 48 comparisons.

Table A.43. Monitoring Wells, Constituents, and Enforcement Limits for 200 Areas Treated Effluent Disposal Facility (adapted from WHC-SD-EN-WP-012, Rev. 1)

Well	Hydrogeologic Unit	Sampling Frequency	Well Standard	Other Networks
699-40-36[92]	Ringold confined	Quarterly	RCRA	--
699-41-35[92]	Ringold confined	Quarterly	RCRA	--
699-42-37[92]	Ringold confined	Quarterly	RCRA	--

Constituent[(a)]	Enforcement Limit (µg/L)
Cadmium	5
Cyanide	50
Lead	10
Total trihalomethanes	66
Trichloroethane	5
pH	6.5 - 8.5 pH units

(a) Also monitored for ICP metals, anions, trace metals, volatile and semivolatile organic compounds, total petroleum hydrocarbons, ammonia, alkalinity, specific conductance, total dissolved solids, turbidity, total organic carbon, oil and grease, gross alpha, gross beta, radium-226, and radium-226/228. No enforcement limits for those constituents.
Bold italic = Upgradient well.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = Well constructed to RCRA standards.

Table A.44. Monitoring Wells, Constituents, and Enforcement Limits for 400 Area Process Ponds (specified in state waste discharge permit)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
699-2-6A[97]	Unconfined aquifer	Quarterly	Annual	RCRA	--
699-2-7[78]	Unconfined aquifer	Quarterly	Annual	PRE	--
699-8-17[50]	Unconfined aquifer	Quarterly	Semiannual	PRE	--

Constituent	Enforcement Limit (μg/L)[a,b]
Cadmium (unfiltered)	10
Chromium (unfiltered)	50
Lead (unfiltered)	50
Manganese (unfiltered)	50
Mercury (unfiltered)	2
pH	Monitor only
Specific conductance	Monitor only
Sulfate	Monitor only
Temperature	Monitor only
Total organic carbon	Monitor only
Turbidity	Monitor only

(a) Defined as the average of four quarterly measurements from a well. Average to be calculated using the four most recent quarterly measurements from a well.
(b) Enforcement limit in groundwater shall be met in point-of-compliance well 699-2-7.

Bold italic = Upgradient well.
Superscript = Year of installation.
ICP = Inductively coupled plasma emission spectroscopy.
PRE = Well not constructed to RCRA standards.
RCRA = Well constructed to RCRA standards.

Table A.45. Monitoring Wells and Constituents for Nonradioactive Dangerous Waste Landfill (adapted from WHC-SD-EN-AP-026)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
699-25-33A[87]	Top of LPU[(a)]	Semiannual	Semiannual	RCRA	--
699-25-34A[86]	Top of unconfined	Semiannual	Semiannual	RCRA	--
699-25-34B[86]	Top of unconfined	Semiannual	Semiannual	RCRA	--
699-25-34D[92]	Top of unconfined	Semiannual	Semiannual	RCRA	--
699-26-33[86]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance, DOH
699-26-34A[92]	Top of unconfined	Semiannual	Semiannual	RCRA	--
699-26-34B[92]	Top of unconfined	Semiannual	Semiannual	RCRA	--
699-26-35A[86]	Top of unconfined	Quarterly	Quarterly	RCRA	SWL
699-26-35C[87]	Top of LPU[(a)]	Semiannual	Semiannual	RCRA	--

Contamination Indicator Parameters	Site-Specific Parameters	
pH	Alkalinity	Tritium
Specific conductance	ICP metals (filtered)	Turbidity
Total organic carbon	Phenols	Volatile chlorinated hydrocarbons
Total organic halides		

(a) Low-permeability unit in upper Ringold Formation.
Bold italic = Upgradient wells.
Superscript = Year of installation.
DOH = Washington State Department of Health.
ICP = Inductively coupled plasma emission spectroscopy.
RCRA = Well constructed to RCRA standards.
SWL = Solid Waste Landfill.

Table A.46. Critical Mean Values for Nonradioactive Dangerous Waste Landfill[(a)]

Constituent, unit	n	df	t_c	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Specific conductance, µS/cm	11	10	4.8092	452.89	29.427	600.7	600.7
Field pH	11	10	5.2814	7.450	0.164	[6.55, 8.35]	[6.55, 8.35]
Total organic carbon,[(b)] µg/L	11	10	4.8092	308.682	242.278	1,597.7	1,597.7
Total organic halides,[(b,c)] µg/L	11	10	4.8092	4.278	2.054	14.6	17.9

(a) Data collected based on semiannual sampling events from August 1997 to February 1999 for upgradient wells 699-26-34A and 699-26-35A.
(b) Critical means calculated from values reported below vendor's specified method detection limit.
(c) Upgradient/downgradient comparison value is the limit of quantitation discussed in Appendix B.
df = Degrees of freedom (n-1).
n = Number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 28 comparisons.

Table A.47. Monitoring Wells and Constituents for Solid Waste Landfill (adapted from WHC-SD-EN-AP-043)

Well	Hydrogeologic Unit Monitored	Sampling Frequency	Water-Level Measurement	Well Standard	Other Networks
699-22-35[93]	Top of unconfined	Quarterly	Quarterly	RCRA	Surveillance
699-23-34A[87]	Top of unconfined	Quarterly	Quarterly	RCRA	--
699-23-34B[93]	Top of unconfined	Quarterly	Quarterly	RCRA	--
699-24-33[48]	Top of unconfined	Quarterly[(a)]	Quarterly	PRE	--
699-24-34A[87]	Top of unconfined	Quarterly	Quarterly	RCRA	--
699-24-34B[87]	Top of unconfined	Quarterly	Quarterly	RCRA	--
699-24-34C[87]	Top of unconfined	Quarterly	Quarterly	RCRA	Surveillance
699-24-35[87]	Top of unconfined	Quarterly	Quarterly	RCRA	--
699-25-34C[87]	Top of unconfined	Quarterly	Quarterly	RCRA	--
699-26-35A[86]	Top of unconfined	Quarterly	Quarterly	RCRA	NRDWL

Parameters/Constituents Required by WAC 173-304-490		Site-Specific Parameters	
Ammonia as nitrogen	Nitrate	Gross alpha	1,1,1-Trichloroethane
Chemical oxygen demand	Nitrite	Gross beta	Trichloroethylene
Chloride	pH	Total organic halides	Tritium
Specific conductance	Sulfate		
Dissolved iron	Temperature		
Dissolved zinc	Total coliform		
Manganese	Total organic carbon		

(a) Well sampled for supporting data.
Bold italic = Upgradient wells.
Superscript = Year of installation.
NRDWL = Nonradioactive Dangerous Waste Landfill.
PRE = Well not constructed to RCRA standards.
RCRA = Well constructed to RCRA standards.

Table A.48. Sampling Results for Required Constituents[a] at Solid Waste Landfill

Constituent, unit	Tolerance Interval[b]	Date	Well 699-22-35	Well 699-23-34A	Well 699-23-34B	Well 699-24-34A
Temperature, °C	21.0	December 1998	18.1	17.9	17.4	17.3
		February 1999	17.3	18.0	17.6	18.1
		May 1999	18.5	19.0	18.2	19.0
		August 1999	18.4	18.8	19.3	--
Specific conductance, µS/cm	550	December 1998	801[c,d]	613[c,d]	714[c,d]	581[c,d]
		February 1999	809[c,d]	663[c,d]	747[c,d]	630[c,d]
		May 1999	826[c,d]	675[c,d]	766[c,d]	641[c,d]
		August 1999	822[c]	686[c]	772[c]	--
Field pH	[6.2, 8.46]	December 1998	6.8	6.7	6.8	6.8
		February 1999	7.1	6.7	6.9	6.6
		May 1999	6.8	6.6	6.7	6.6
		August 1999	7.0	6.7	6.8	--
Total organic carbon, µg/L	1,154	December 1998	330	390	588	368
		February 1999	250	965	901	565
		May 1999	<220	480	580	355
		August 1999	455	315	342	498
Chloride, µg/L	9.045	December 1998	5,190	5,680	6,360	5,840
		February 1999	5,790	5,270	5,645	5,540
		May 1999	5,430	5,280	5,560	5,420
		August 1999	5,620	5,540	5,570	5,700
Nitrate, µg/L	33,800	December 1998	14,900	12,400	13,900	12,100
		February 1999	15,600	11,700	15,100	12,700
		May 1999	13,700	10,500	13,500	11,600
		August 1999	15,500	11,700	15,200	12,300
Nitrite, µg/L	109	December 1998	<70	<70	<70	<70
		February 1999	<70	<70	<70	<70
		May 1999	<70	<70	<70	<70
		August 1999	<70	<70	<70	<70
Ammonium, µg/L	165	December 1998	<37	<37	<37	<37
		February 1999	<37	<37	<37	<37
		May 1999	<37	<37	<37	<37
		August 1999	<37	<37	<37	<37
Sulfate, µg/L	51,500	December 1998	49,300	45,600	56,400[c]	44,500
		February 1999	56,400[c]	43,900	54,650[c]	42,500
		May 1999	54,200[c]	43,600	53,200[c]	40,900
		August 1999	56,100[c]	46,400	55,000[c]	44,600
Iron, filtered, µg/L	137	December 1998	89.4	44.9	71.1	90.5
		February 1999	51.3	38.9	46.5	47.1
		May 1999	84.3	65.5	78.0	91.1
		August 1999	51.1	70.4	58.8	117.0
Zinc, filtered, µg/L	34	December 1998	13.9	6.7	8.8	6.1
		February 1999	3.9	6.6	5.0	3.7
		May 1999	7.4	9.3	7.4	12.2
		August 1999	6.6	10.4	4.9	25.8
Manganese, filtered, µg/L	11	December 1998	9.2	4.8	6.1	4.5
		February 1999	3.9	4.2	3.4	2.9
		May 1999	5.7	5.2	6.3	5.6
		August 1999	4.8	5.1	5.1	5.0

Table A.48. (contd)

Constituent, unit	Tolerance Interval[b]	Date	Well 699-22-35	Well 699-23-34A	Well 699-23-34B	Well 699-24-34A
Chemical oxygen demand, µg/L	5,000	December 1998	<3,820	<3,820	<3,820	<3,820
		February 1999	<3,820	<3,820	<3,820	<3,820
		May 1999	33,000[c,e]	<3,820	25,000[c,e]	26,000[c,e]
		August 1999	<3,820	<3,820	<3,820	<3,820
Coliform bacteria, most probable number	16	December 1998	0	0	0	0
		February 1999	0	0	0	0
		May 1999	0	0	0	0
		August 1999	0	0	0	0

			Well 699-24-34B	Well 699-24-34C	Well 699-24-35	Well 699-25-34C	Well 699-26-35A
Temperature, °C	21.0	December 1998	18.3	18.1	16.9	18.8	19.8
		February 1999	17.8	18.7	17.1	18.5	19.4
		May 1999	19.0	19.2	17.8	19.9	19.6
		August 1999	19.5	19.3	18.9	19.6	20.1
Specific conductance, µS/cm	550	December 1998	612[c,d]	638[c,d]	510[c,d]	576[c,d]	454[d]
		February 1999	632[c,d]	672[c,d]	538[c,d]	593[c,d]	471[d]
		May 1999	645[c,d]	684[c,d]	553[c,d]	601[c,d]	484[d]
		August 1999	663[c]	708[c]	565[c,d]	616[c]	507
Field pH	[6.2,8.46]	December 1998	6.7	7.1	6.9	7.2	7.3
		February 1999	6.7	7.0	7.1	7.4	7.5
		May 1999	6.7	6.9	7.0	7.2	7.4
		August 1999	6.7	7.1	6.9	7.3	7.3
Total organic carbon, µg/L	1,154	December 1998	458	292	525	203	532
		February 1999	290	600	328	155	538
		May 1999	360	400	390	330	430
		August 1999	488	465	342	505	348
Chloride, µg/L	9.045	December 1998	5,910	7,090	5,520	7,230	7,040
		February 1999	5,650	6,890	5,640	7,430	7,120
		May 1999	5,360	6,310	5,220	7,000	7,100
		August 1999	5,540	6,620	5,840	6,520	7,500
Nitrate, µg/L	33,800	December 1998	12,800	19,300	11,200	21,800	21,600
		February 1999	12,700	18,500	12,000	20,800	22,700
		May 1999	11,600	16,200	10,900	19,500	19,700
		August 1999	12,200	16,700	11,300	18,100	21,000
Nitrite, µg/L	109	December 1998	<70	<70	<70	<70	<70
		February 1999	<70	<70	<70	<70	<70
		May 1999	<70	<70	<70	<70	<70
		August 1999	<70	<70	<70	<70	<70
Ammonium, µg/L	165	December 1998	<37	<37	<37	<37	<37
		February 1999	<37	<37	<37	<37	<37
		May 1999	<37	<37	<37	<37	<37
		August 1999	<37	<37	<37	<37	<37
Sulfate, µg/L	51,500	December 1998	44,300	45,100	45,700	43,550	41,800
		February 1999	43,100	42,000	45,000	41,500	39,400
		May 1999	41,000	40,000	42,400	39,300	36,800
		August 1999	44,000	42,700	44,100	39,200	40,100

Table A.48. (contd)

Constituent, unit	Tolerance Interval[b]	Date	Well 699-24-34B	Well 699-24-34C	Well 699-24-35	Well 699-25-34C	Well 699-26-35A
Iron, filtered, µg/L	137	December 1998	56.4	76.4	56.8	49.9	38.4
		February 1999	33.0	53.1	36.0	31.2	34.7
		May 1999	77.9	103	57.8	54.1	55.2
		August 1999	70.3	70.6	44.7	39.6	37.9
Zinc, filtered, µg/L	34	December 1998	6.7	36.2[c]	12.4	10.1	8.6
		February 1999	4.4	10.5	4.8	7.9	5.1
		May 1999	9.9	8.7	6.2	11.2	9.5
		August 1999	14.6	13.5	11.2	6.6	6.6
Manganese, filtered, µg/L	11	December 1998	4.7	5.1	4.4	4.4	4.5
		February 1999	2.1	4.9	1.8	2.3	3.4
		May 1999	5.3	5.7	4.8	5.0	4.1
		August 1999	4.4	4.5	4.0	<3	4.5
Chemical oxygen demand, µg/L	5,000	December 1998	<3,820	<3,820	<3,820	<3,820	<3,820
		February 1999	<3,820	<3,820	<3,820	<3,820	<3,820
		May 1999	25,000[c,e]	24,000[c,e]	41,000[c,e]	50,000[c,e]	38,000[c,e]
		August 1999	<3,820	<3,820	<3,820	<3,820	<3,820
Coliform bacteria, most probable number	16	December 1998	0	0	0	0	0
		February 1999	0	0	0	0	0
		May 1999	0	0	0	0	0
		August 1999	0	0	0	0	0

(a) WAC 173-304.
(b) Numbers obtained from Table A.49, background threshold value column.
(c) Exceeding background threshold values.
(d) Field measurements were suspect; values reported were laboratory analysis results.
(e) Suspect data.
< = Data values less than the method detection limit; number given is the respective limit.

Table A.49. Results of Lilliefors Test for Normality and Background Threshold Values for Solid Waste Landfill

Constituent, unit	Test Statistic, Raw Data	Test Statistic, Log Value	Upper Tolerance Limit	Background Threshold Value[a]
Temperature, °C	0.115 ns	NA	21.0[b]	21.0
Specific conductance, µS/cm	0.162 s	0.207 s	550[c]	550
Field pH Field pH[d]	0.140 ns 0.089 ns	NA NA	[5.7, 8.75][b] [6.2, 8.46][b]	[6.2, 8.46]
Total organic carbon, µg/L	0.191 s	0.181 s	750[c] 1,568[e]	1,568
Chloride, µg/L	0.104 ns	NA	9,045[b]	9,045
Nitrate, µg/L	0.168 s	0.195 s	33,800[c]	33,800
Nitrite, µg/L	NC	NC	109[e]	109
Ammonium, µg/L	NC	NC	100[c] 165[e]	165
Sulfate, µg/L	0.179 s	0.190 s	51,500[c]	51,500
Iron, filtered, µg/L	NC	NC	78[c] 137[e]	137
Zinc, filtered, µg/L	NC	NC	34[c] 19[e]	34
Manganese, filtered, µg/L	NC	NC	11[c] 2.3[e]	11
Coliform, most probable number	NC	NC	16[c] 3.7[f]	16
Chemical oxygen demand, µg/L	NC	NC	5,000[g]	5,000

(a) Background threshold value for each constituent is the larger of the upper tolerance limit or the applicable limit of quantitation.
(b) Based on normal distribution.
(c) Maximum value reported.
(d) Outliers removed.
(e) Based on limit of quantitation discussed in Appendix B.
(f) Based on method detection limit.
(g) Based on laboratory practical quantitation limit.
NA = Not applicable.
NC = Not calculated; insufficient measured values.
ns = Not significant at 0.05 level of significance.
s = Significant at 0.05 level of significance.

Table A.50. Monitoring Wells and Constituents for 316-5 Process Trenches (adapted from WHC-SD-EN-AP-185)

Well	Hydrogeologic Unit Monitored	Sampling Frequency[a]	Water-Level Measurement	Well Standard	Other Networks
399-1-10A[86]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
399-1-10B[91]	Bottom of unconfined	Semiannual	Semiannual	RCRA	Surveillance
399-1-16A[86]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
399-1-16B[87]	Bottom of unconfined	Semiannual	Semiannual	RCRA	Surveillance
399-1-17A[86]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance, DOH
399-1-17B[86]	Bottom of unconfined	Semiannual	Semiannual	RCRA	Surveillance
399-1-18A[86]	Top of unconfined	Semiannual	Semiannual	RCRA	Surveillance
399-1-18B[87]	Bottom of unconfined	Semiannual	Semiannual	RCRA	Surveillance

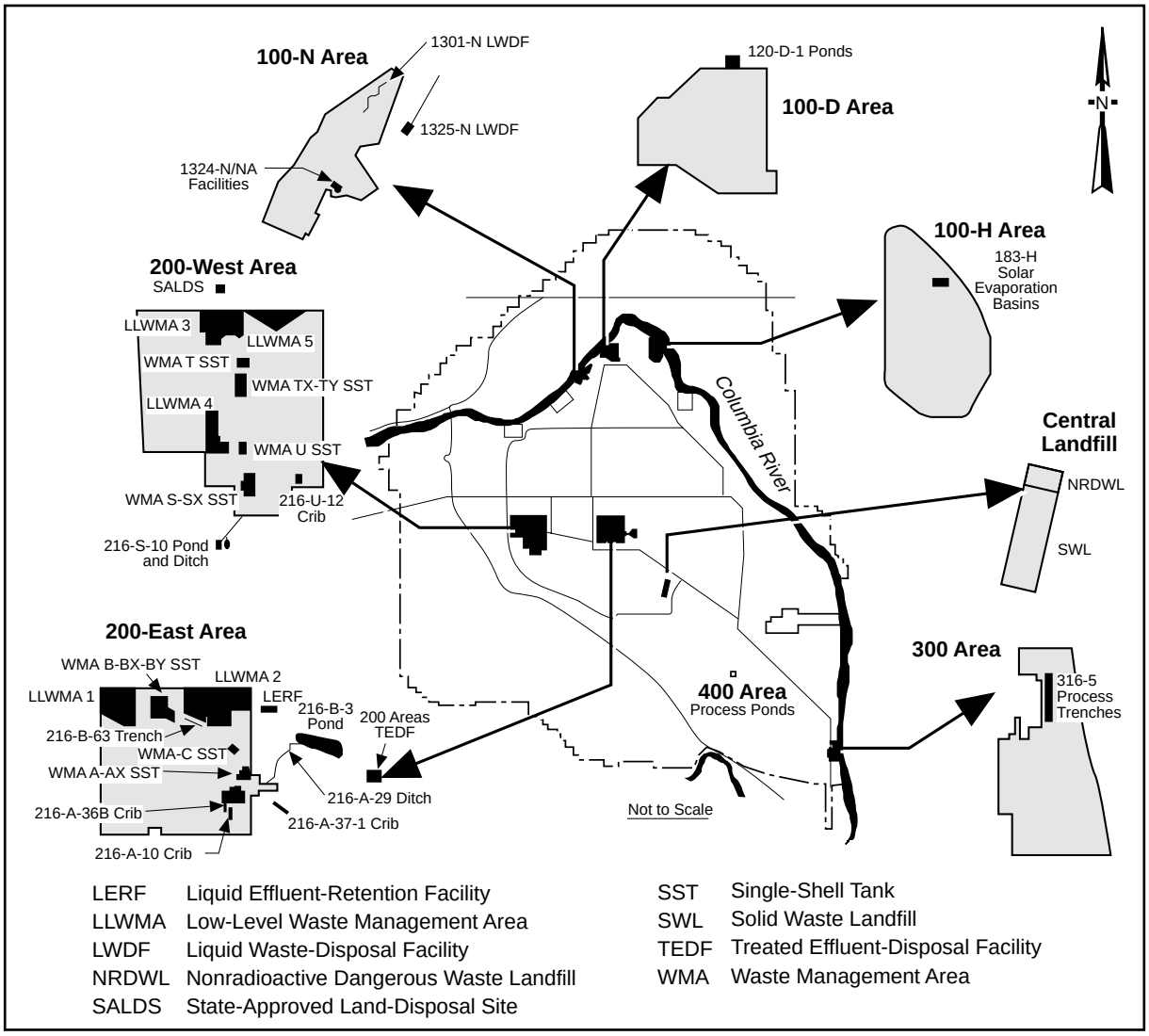
Field-Measured Parameters	Site-Specific Parameters	
pH	cis-Dichloroethylene	Trichloroethylene
Specific conductance	Tetrachloroethylene	Uranium
Total organic carbon	Thallium	
Total organic halides		

(a) Sampled and measured monthly for 4 months for each semiannual sampling period.
Bold italic = Upgradient wells.
Superscript = Year of installation.
DOH = Washington State Department of Health.
RCRA = Well constructed to RCRA standards.

Table A.51. Summary of Groundwater Sampling Results for 316-5 Process Trenches

Sampling Time	Constituent of Concern	Concentration Level (µg/L)	Well Exceeding Concentration Limit (Range, µg/L)
December 1998, January, February, March, June, July, August, September 1999	Trichloroethylene	5	399-1-16B[a] (4 - 6)
	cis-1,2-Dichloroethylene	70	399-1-16B (120 - 180)
	Uranium	20	399-1-10A[a] (23.6 - 61.1) 399-1-16A (52.3 - 111) 399-1-17A (88.8 - 166)

(a) Excluded outliers.



RG98120214.13

Figure A.1. Regulated Units on the Hanford Site Requiring Groundwater Monitoring

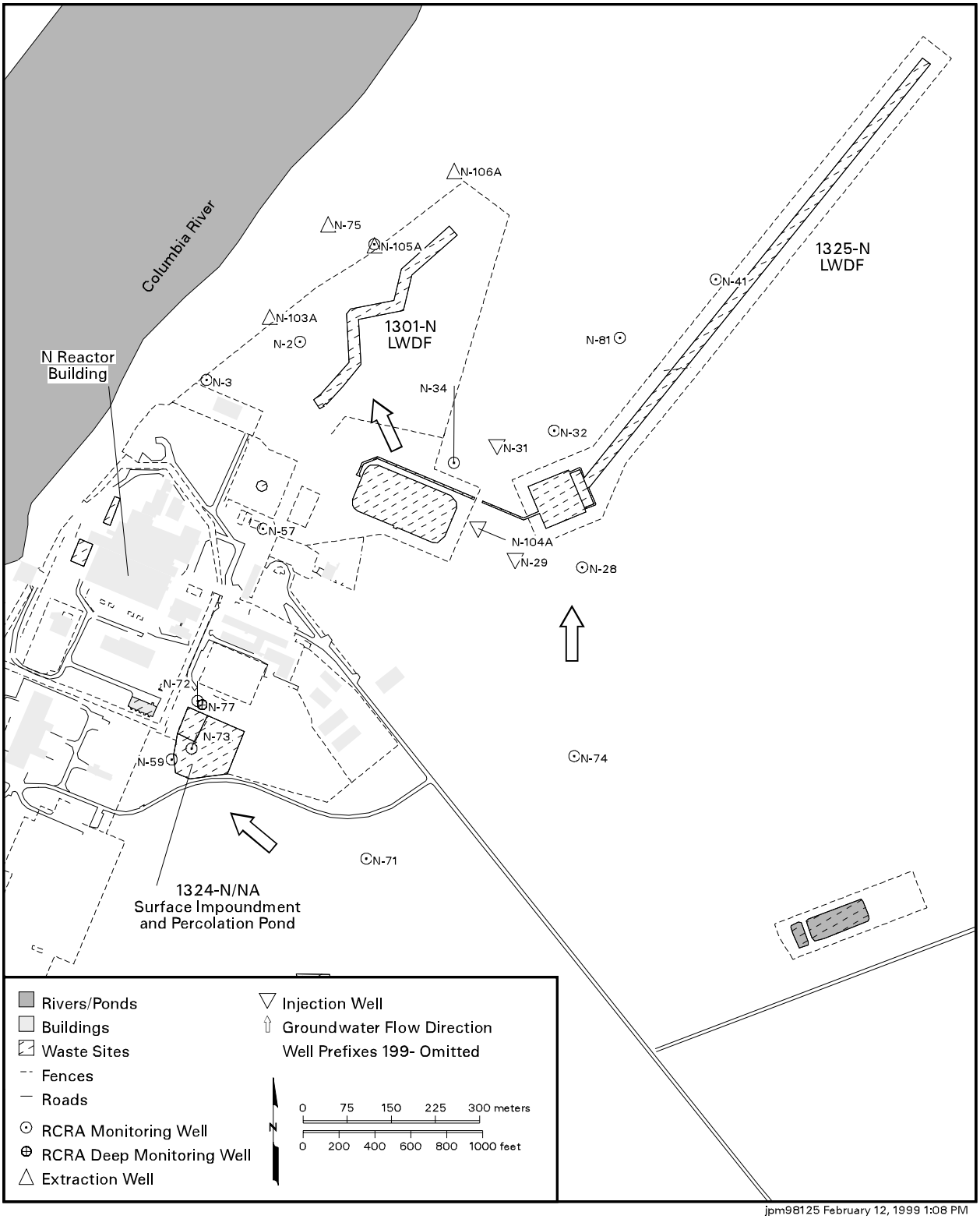


Figure A.2. Monitoring Well Locations for 100 N Area

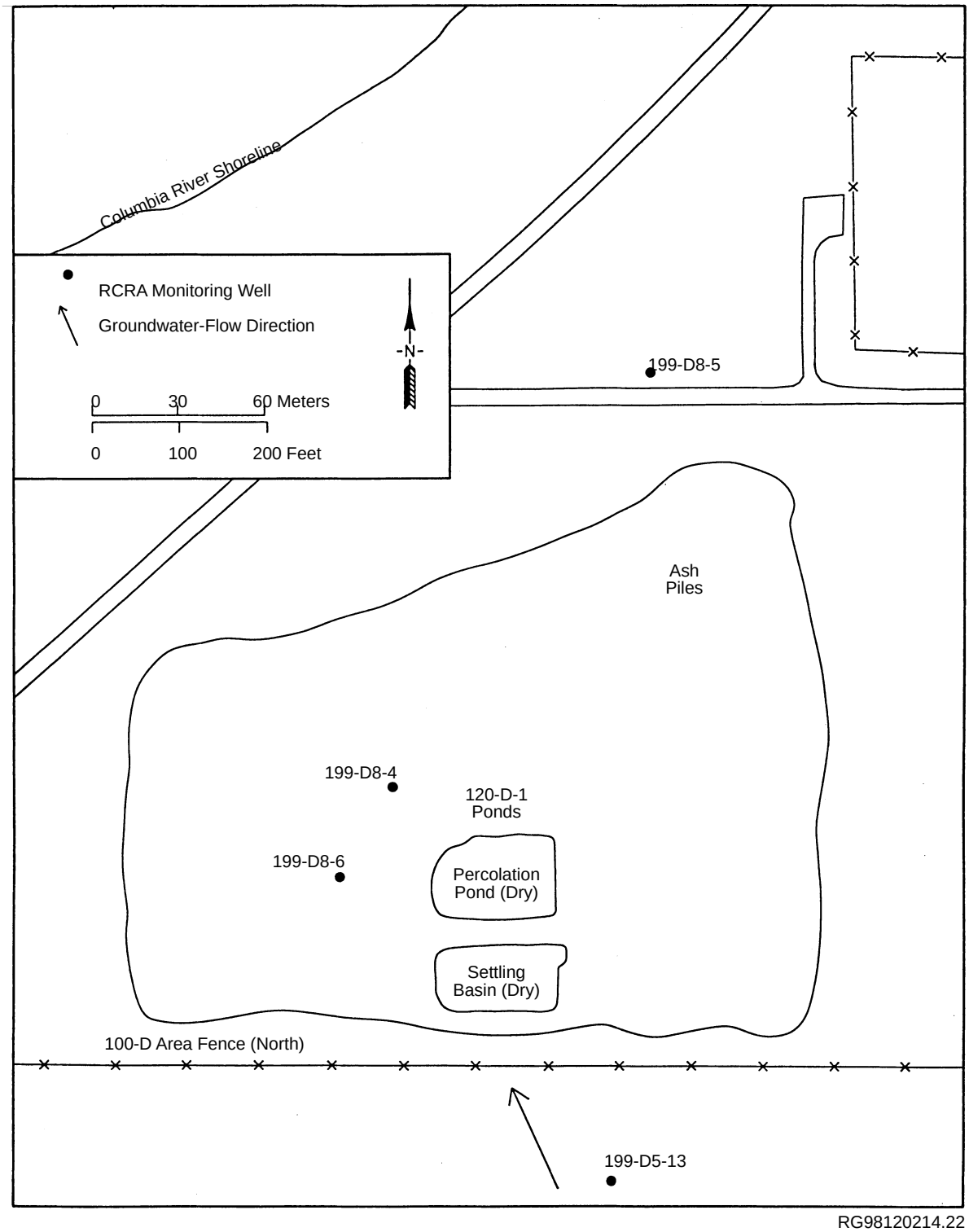


Figure A.3. Monitoring Well Locations for 120-D-1 Ponds

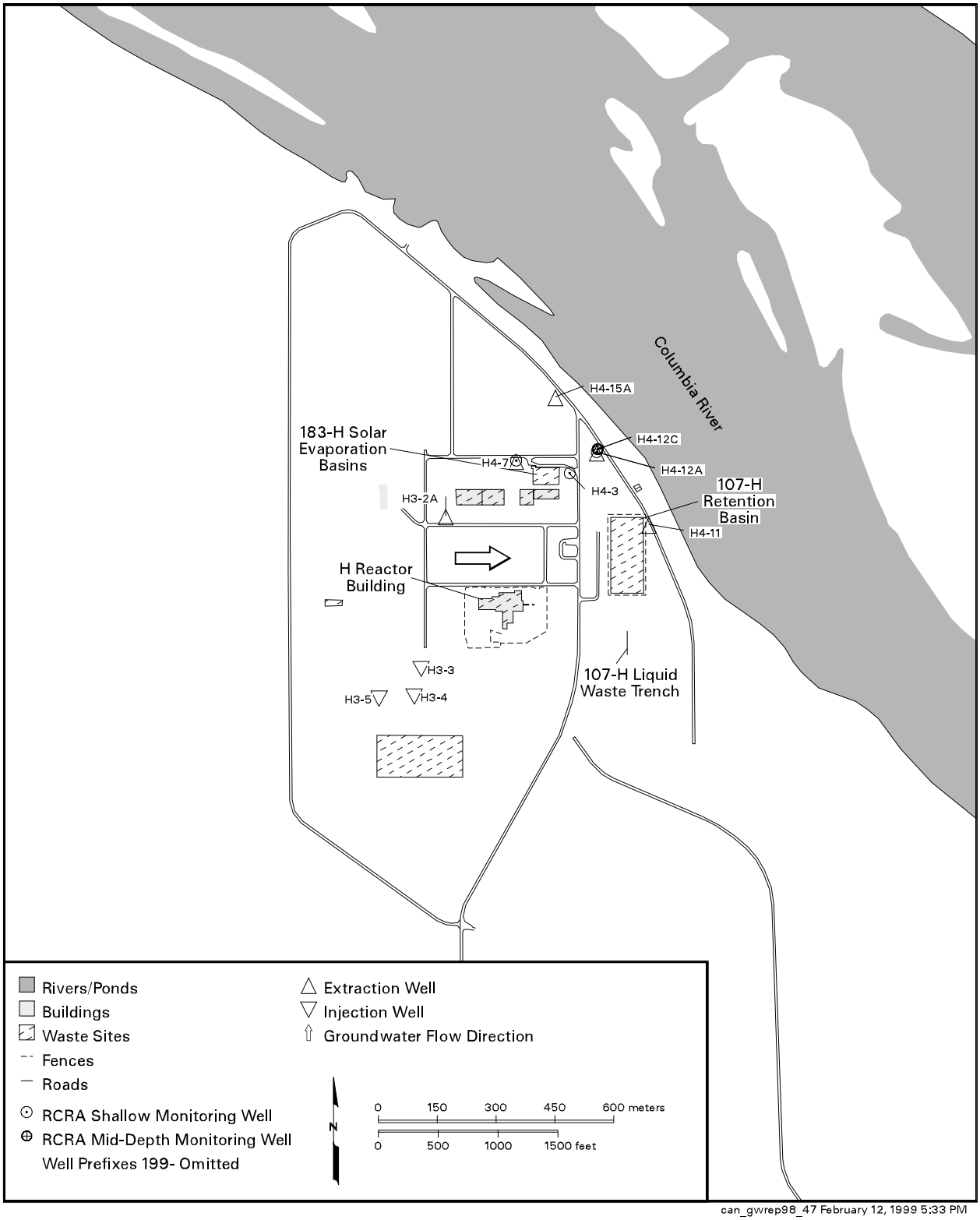


Figure A.4. Monitoring Well Locations for 183-H Solar Evaporation Basins

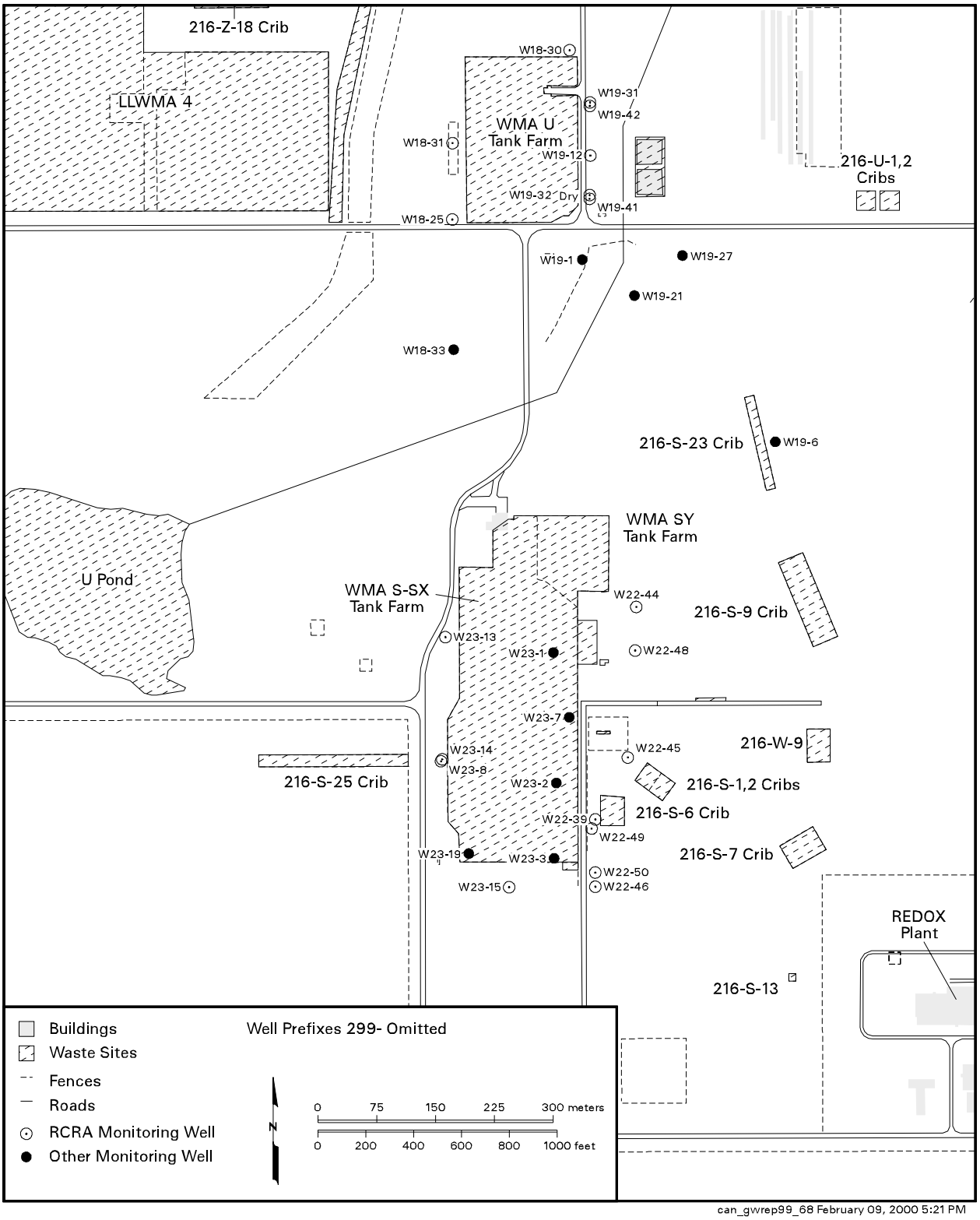


Figure A.5. Monitoring Well Locations for Waste Management Areas S-SX and U

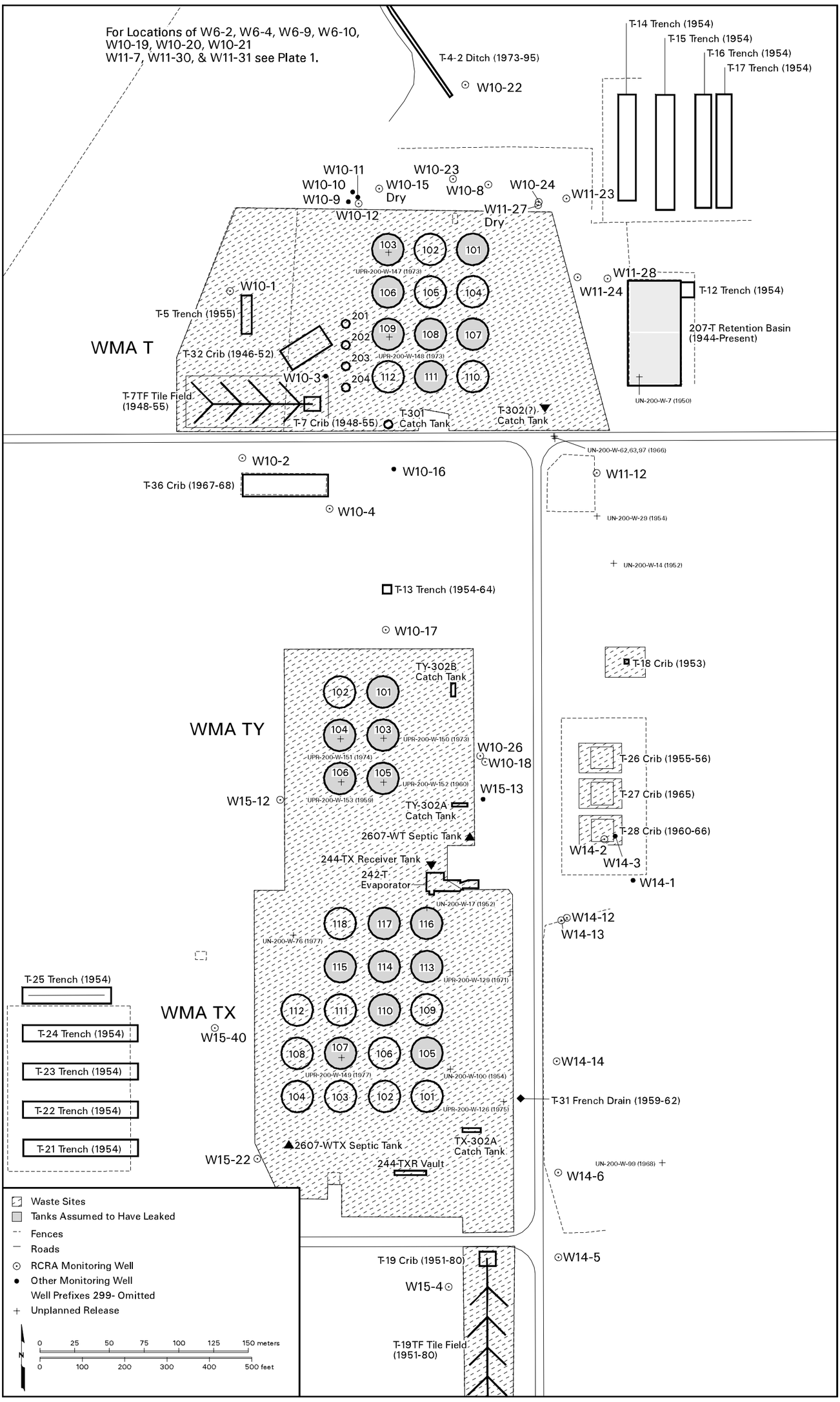


Figure A.6. Monitoring Well Locations for Waste Management Areas T and TX-TY

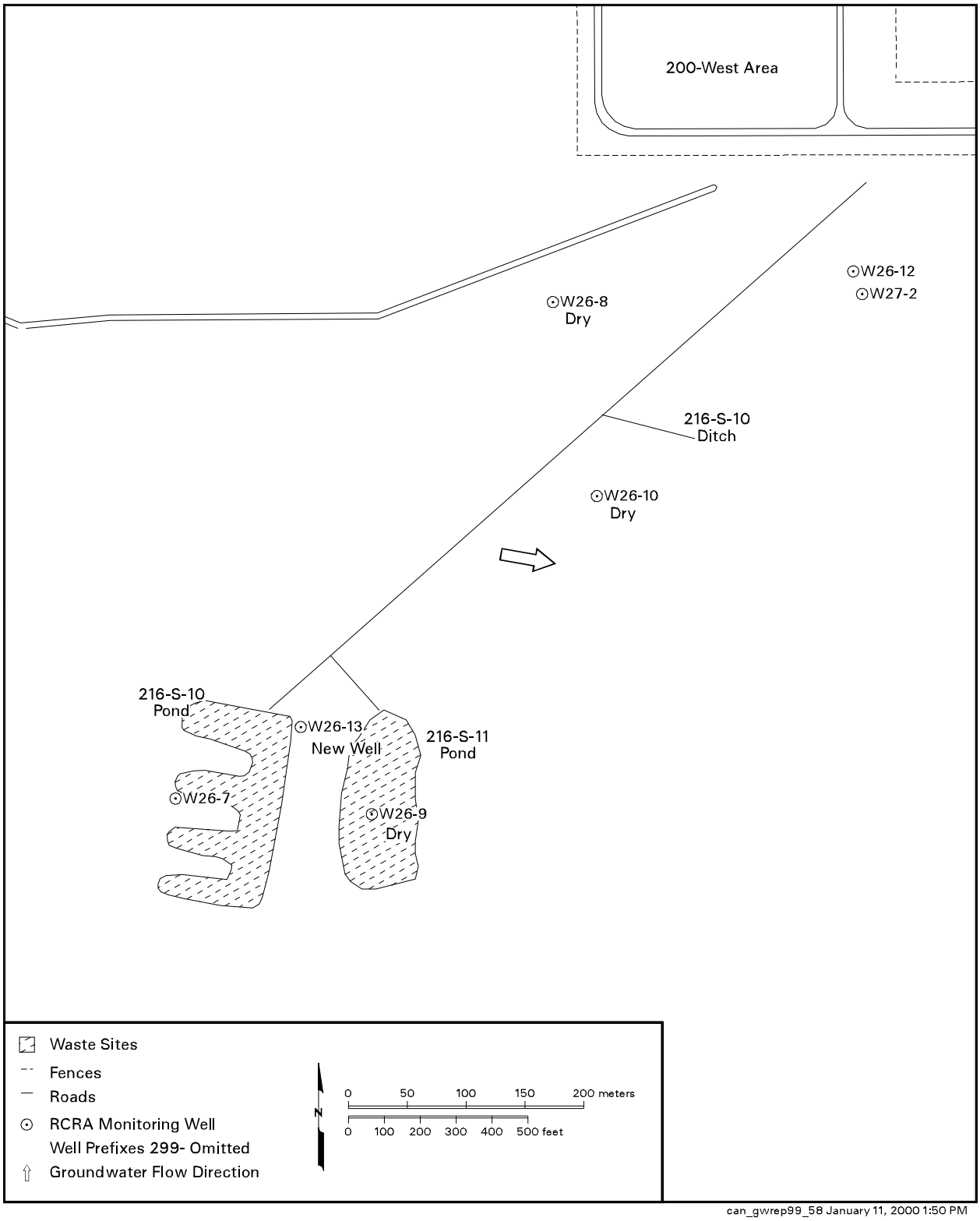


Figure A.7. Monitoring Well Locations for 216-S-10 Pond and Ditch

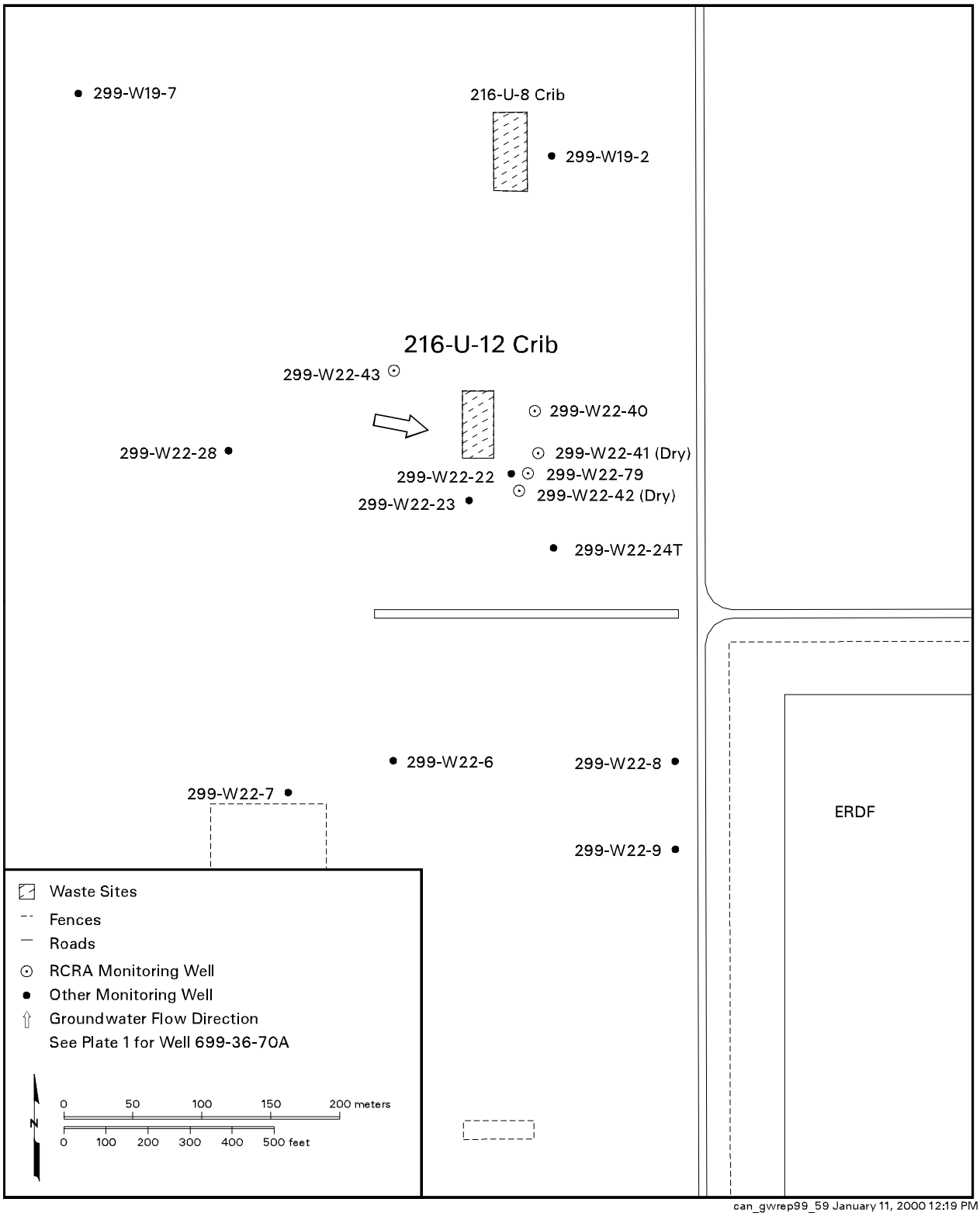


Figure A.8. Monitoring Well Locations for 216-U-12 Crib

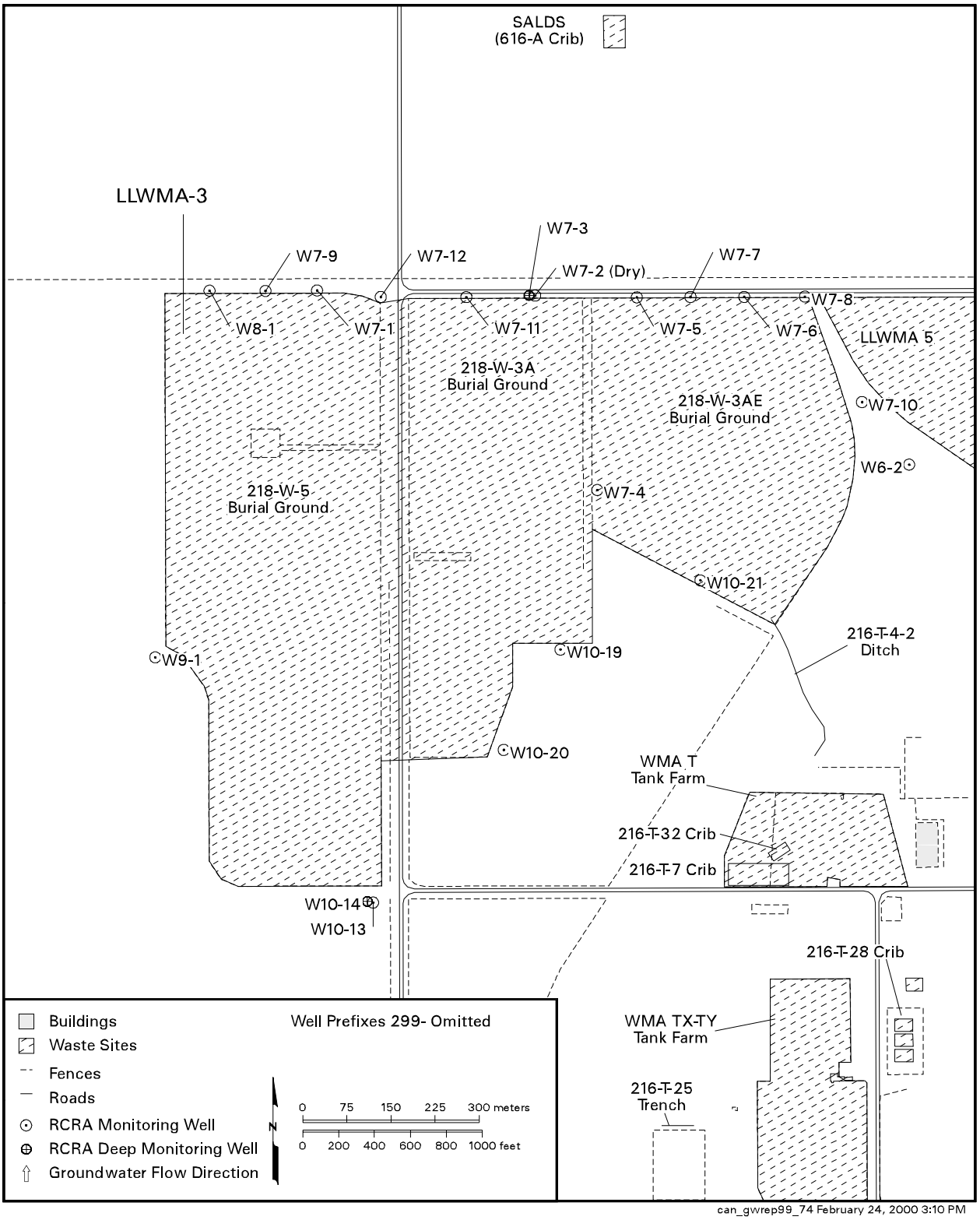


Figure A.9. Monitoring Well Locations for Low-Level Waste Management Area 3

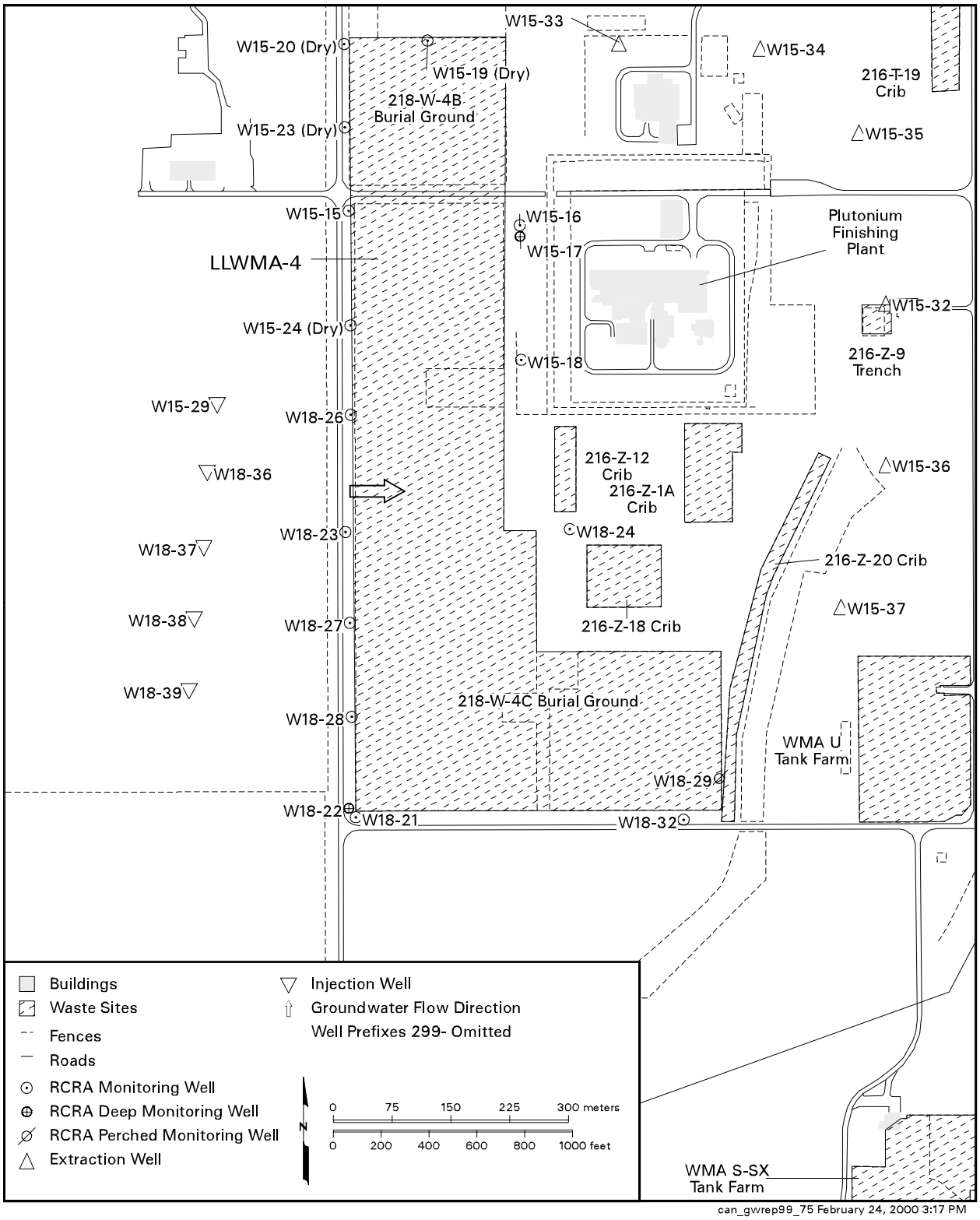


Figure A.10. Monitoring Well Locations for Low-Level Waste Management Area 4

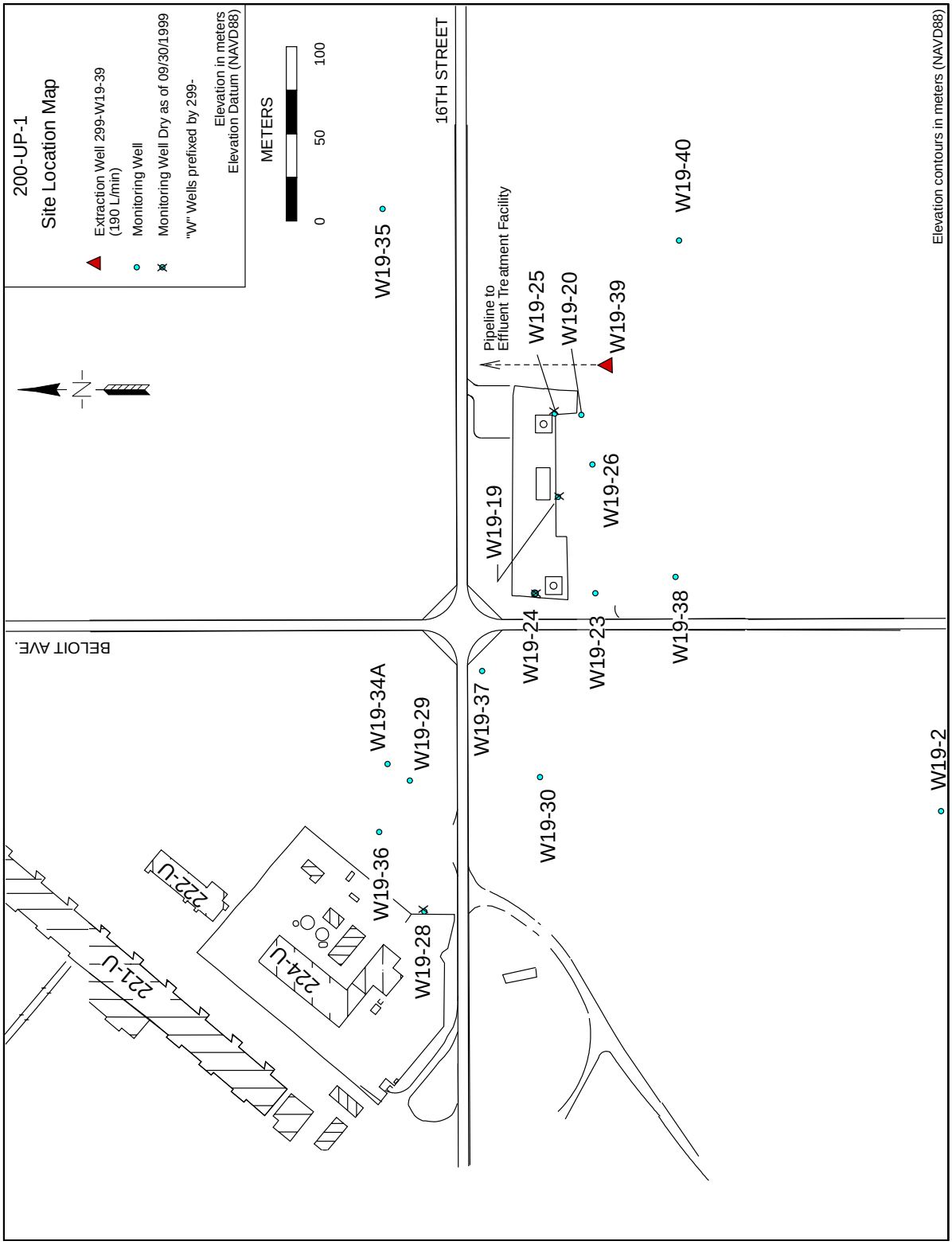


Figure A.11. Well Locations for 200-UP-1 Groundwater Operable Unit

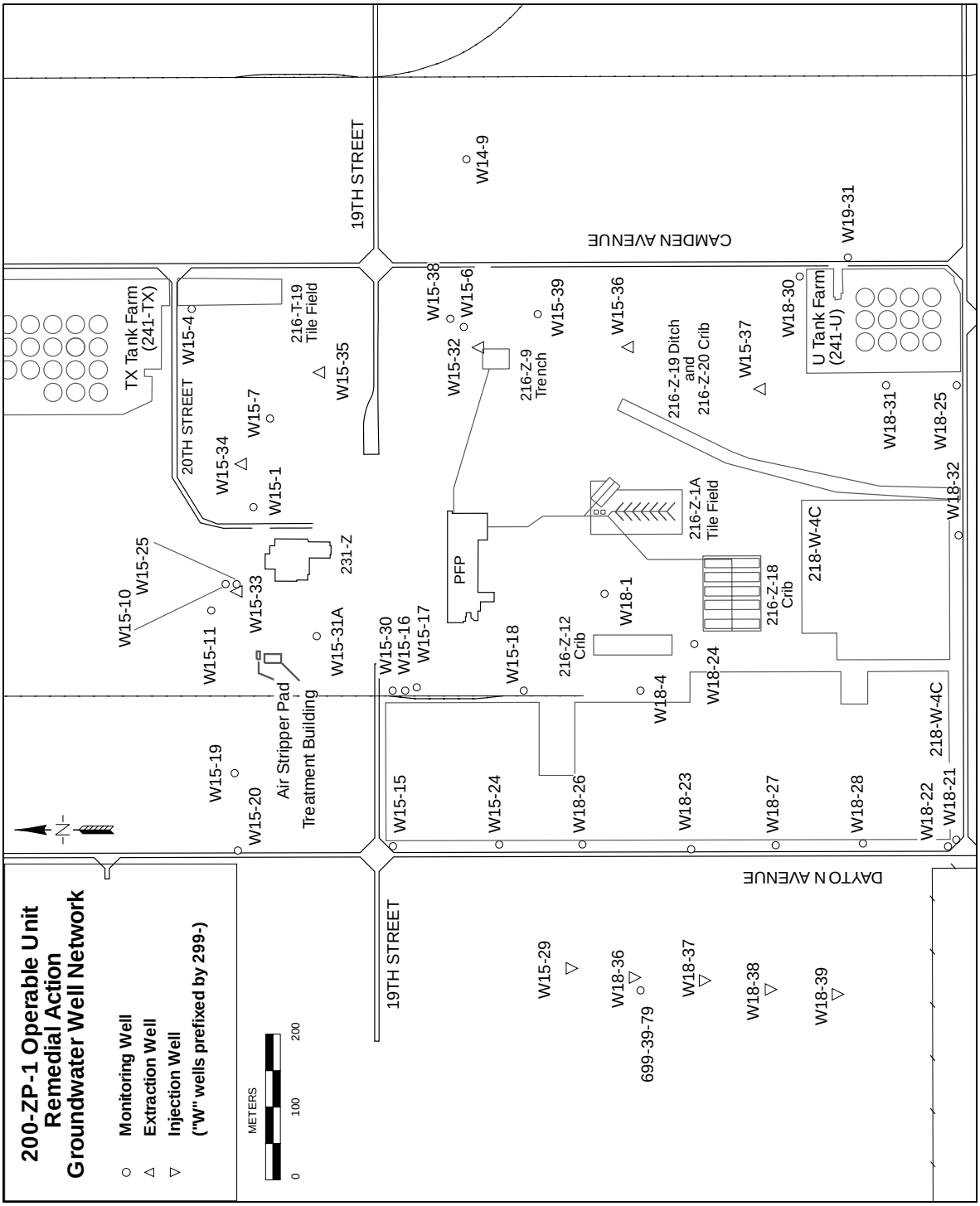


Figure A.12. Well Locations for 200-ZP-1 Groundwater Operable Unit

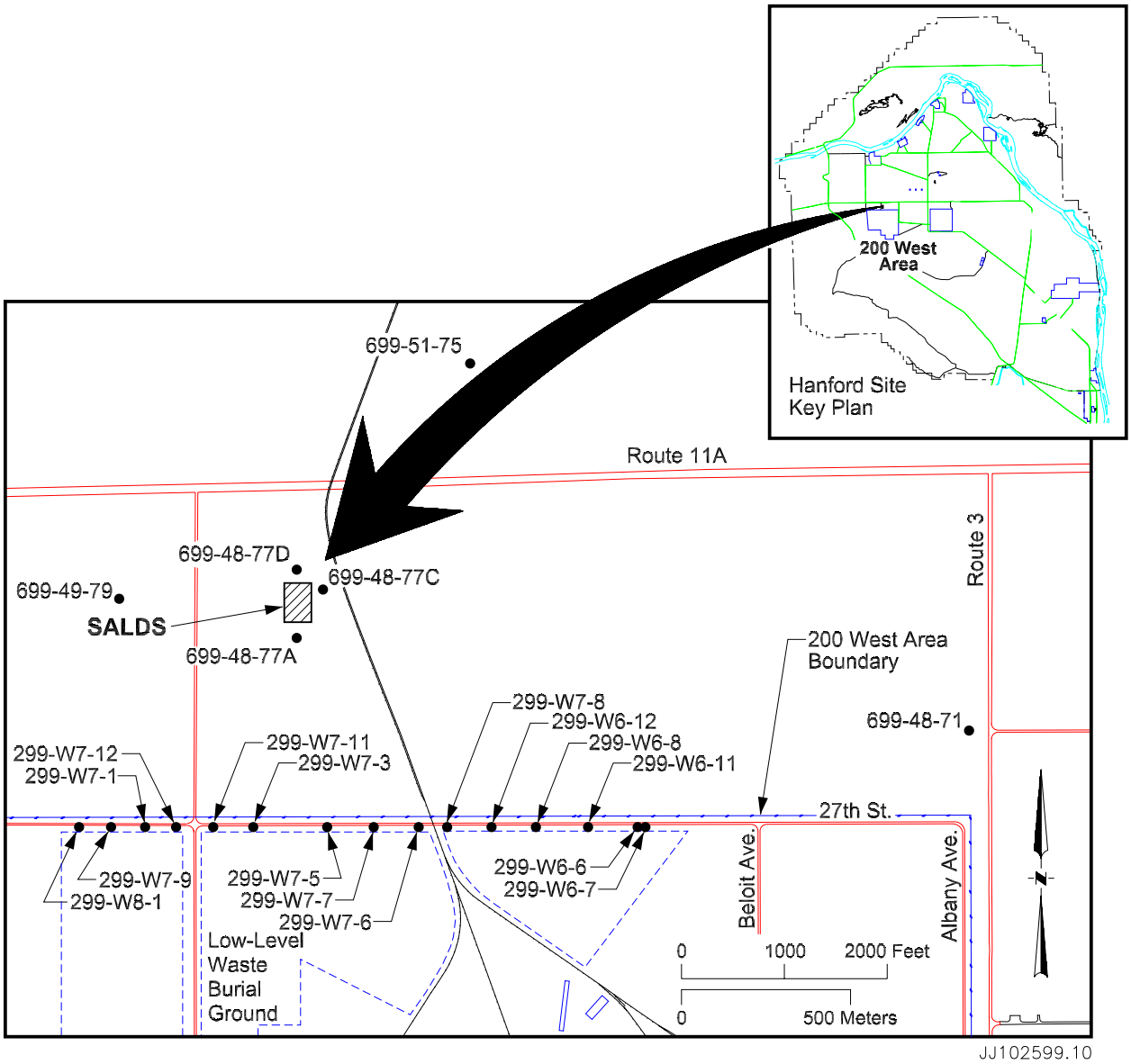


Figure A.13. Monitoring Well Locations for State-Approved Land Disposal Site

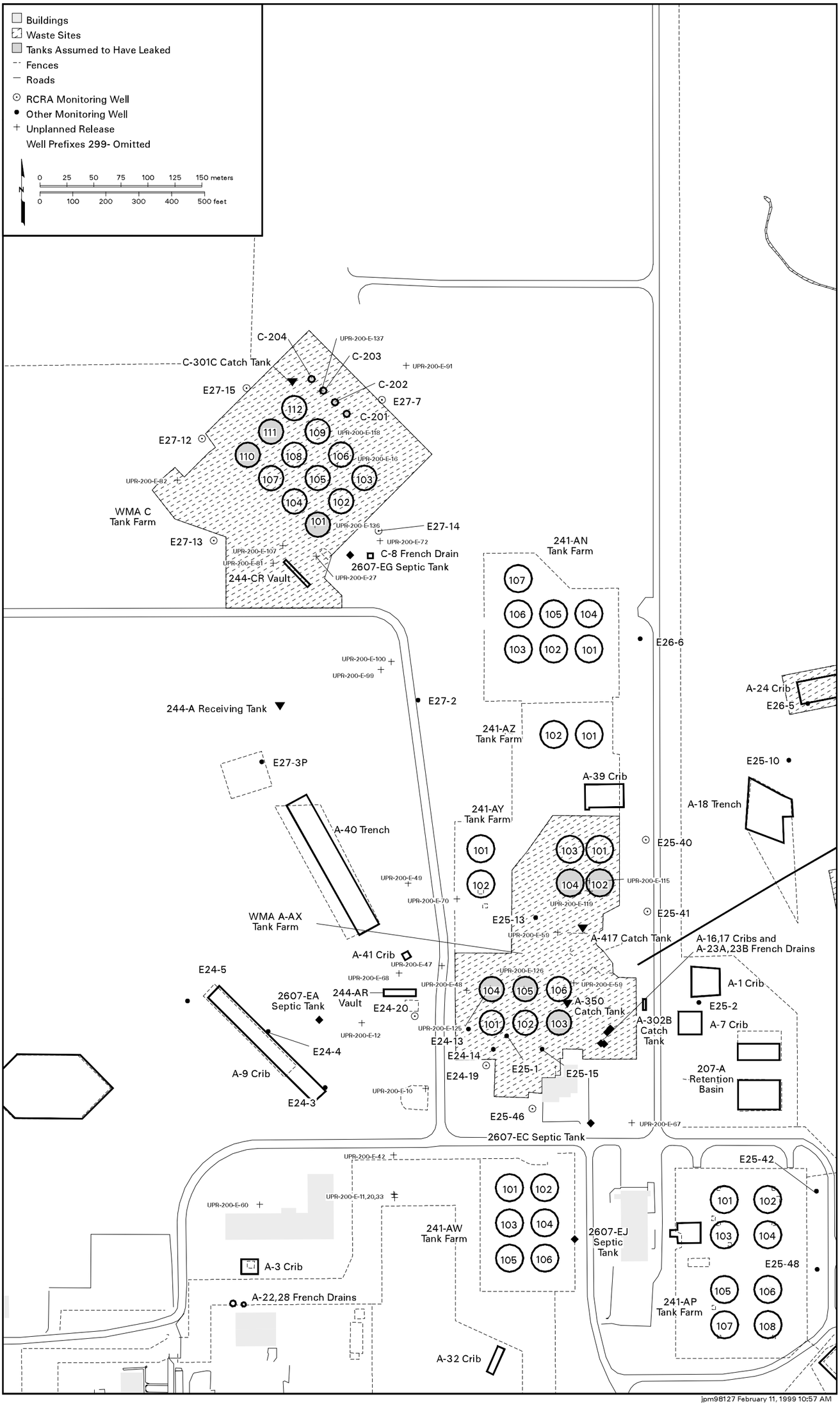


Figure A.14. Monitoring Well Locations for Waste Management Areas A-AX and C

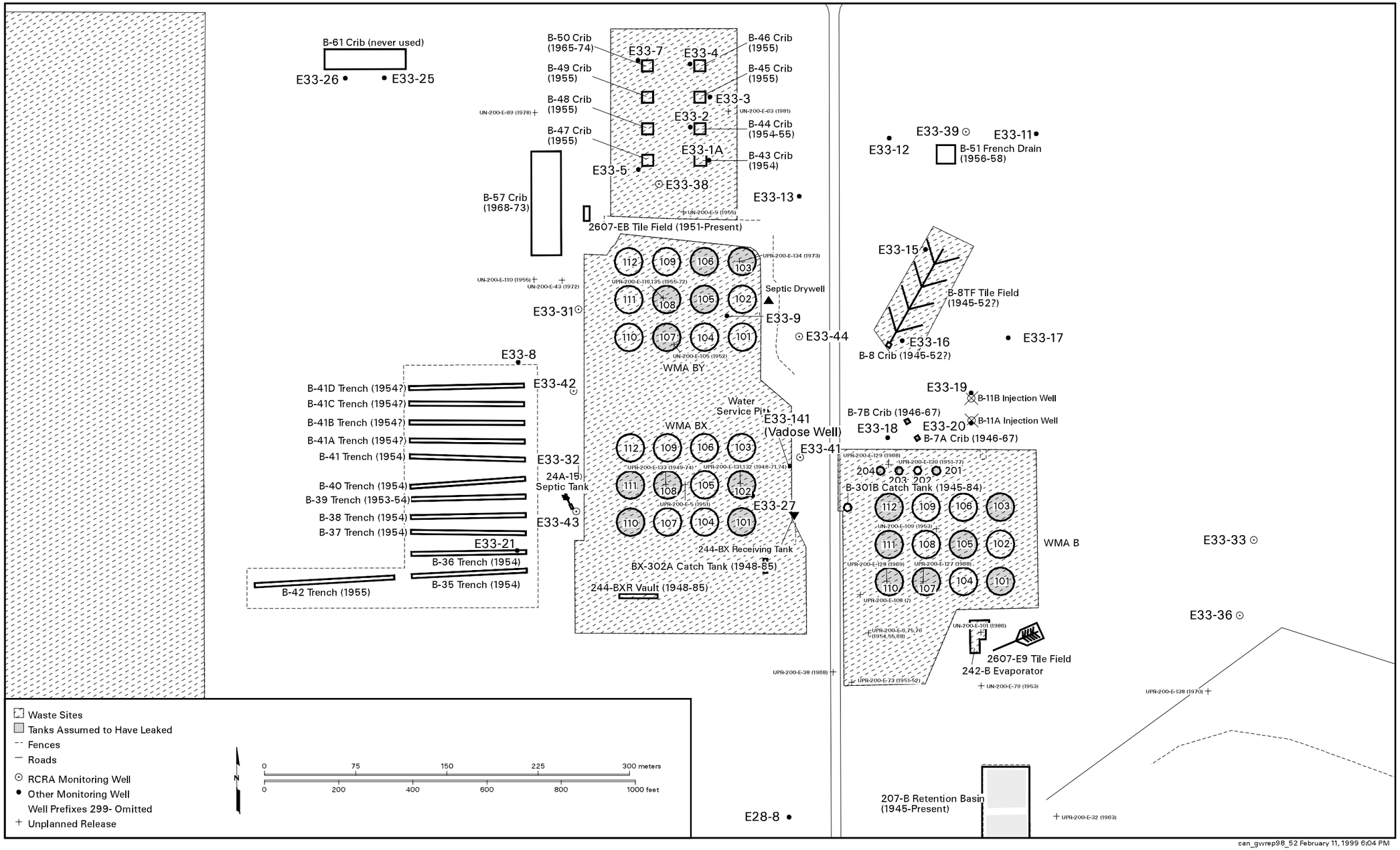


Figure A.15. Monitoring Well Locations for Waste Management Area B-BX-BY

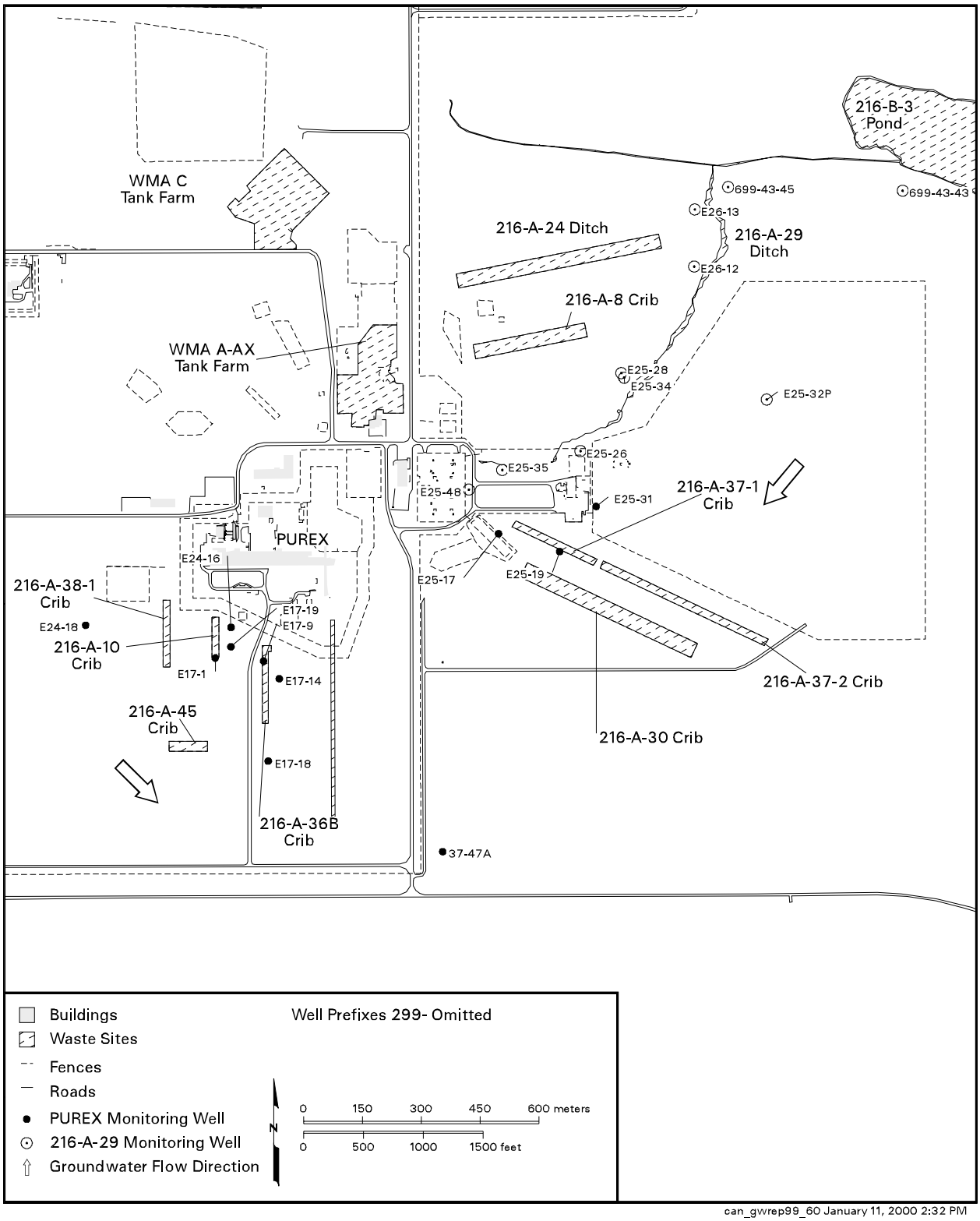


Figure A.16. Monitoring Well Locations for PUREX Cribs and 216-A-29 Ditch

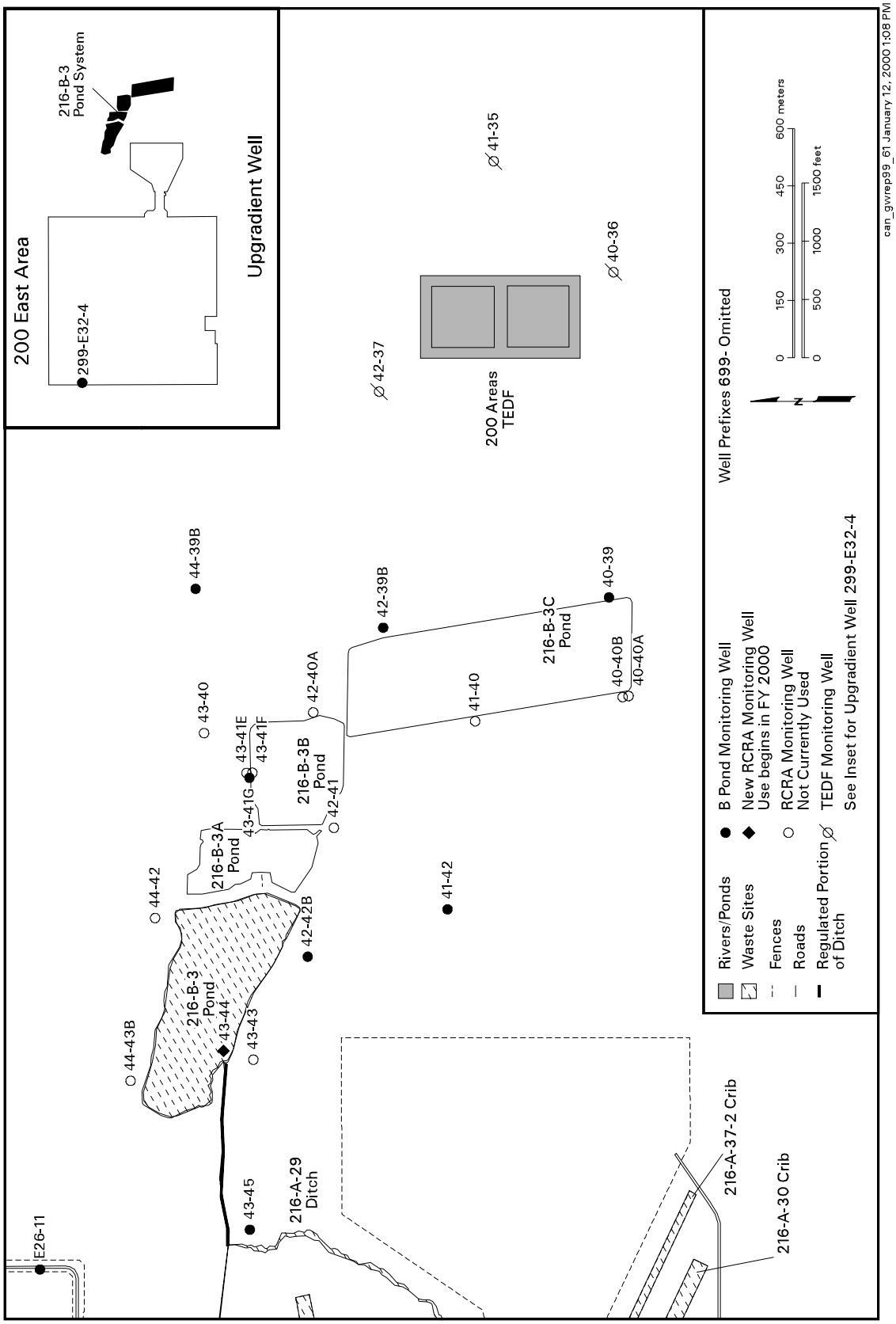


Figure A.17. Monitoring Well Locations for 216-B-3 Pond and 200 Areas Treated Effluent Disposal Facility

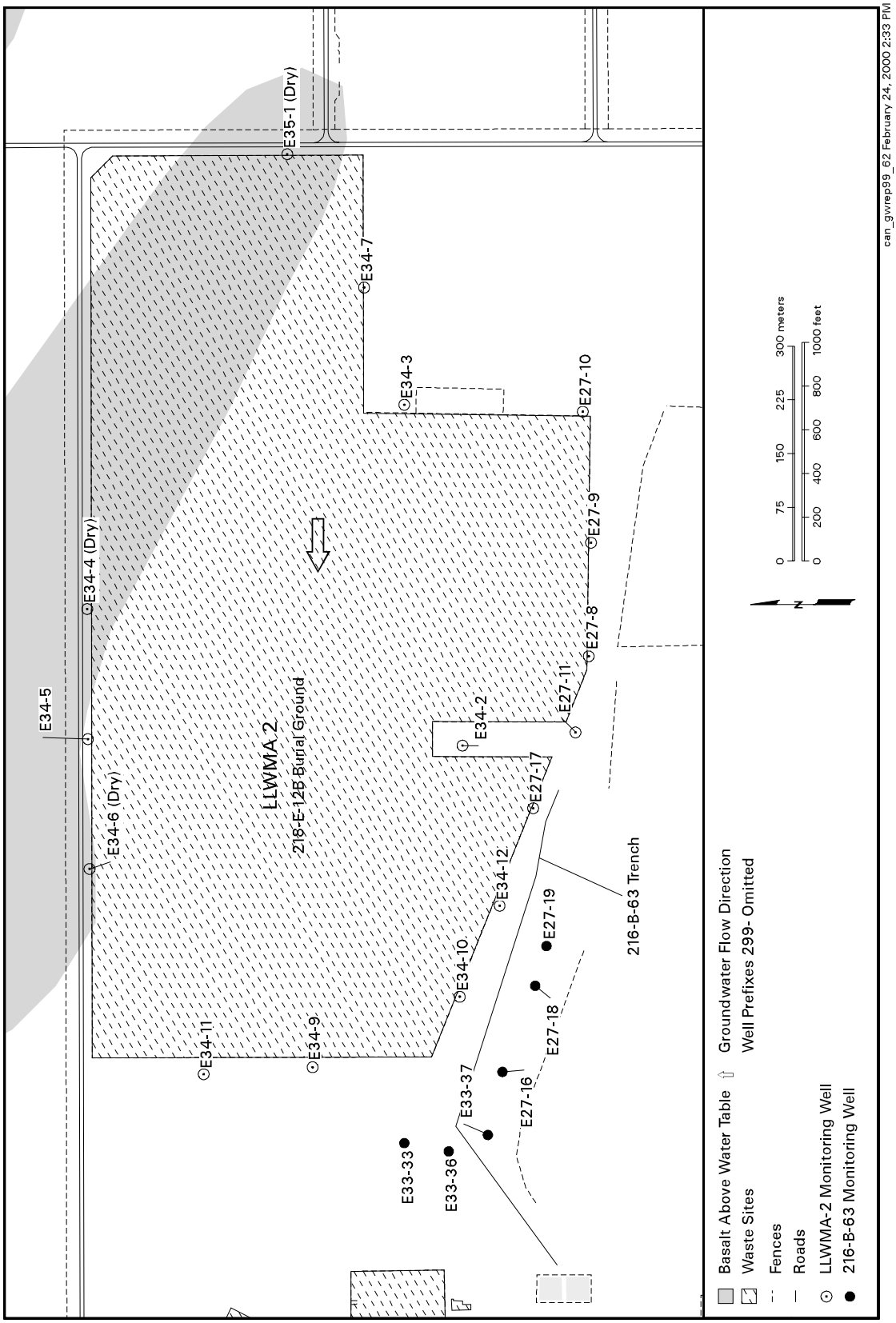


Figure A.18. Monitoring Well Locations for 216-B-63 Trench and Low-Level Waste Management Area 2

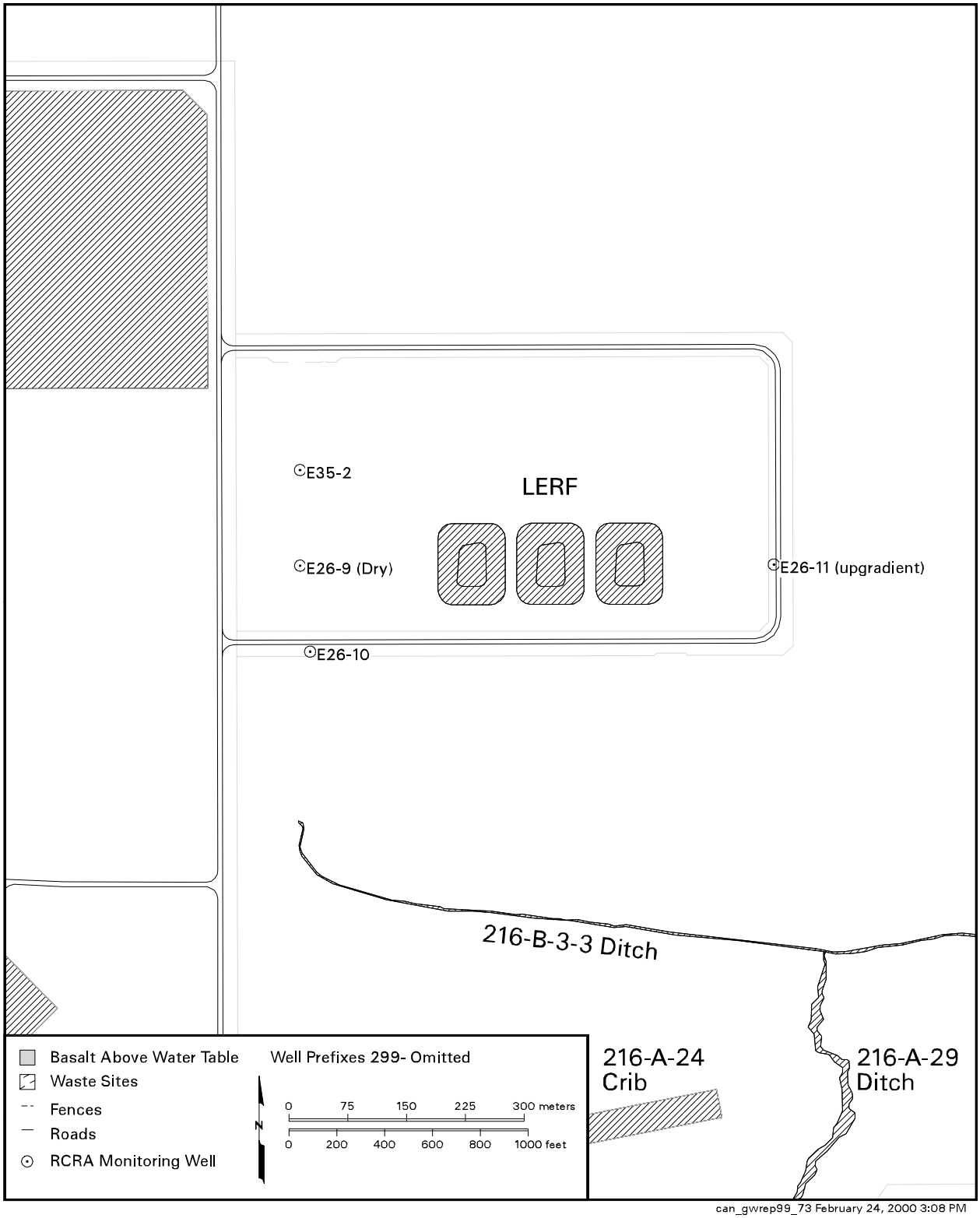


Figure A.19. Monitoring Well Locations for Liquid Effluent Retention Facility

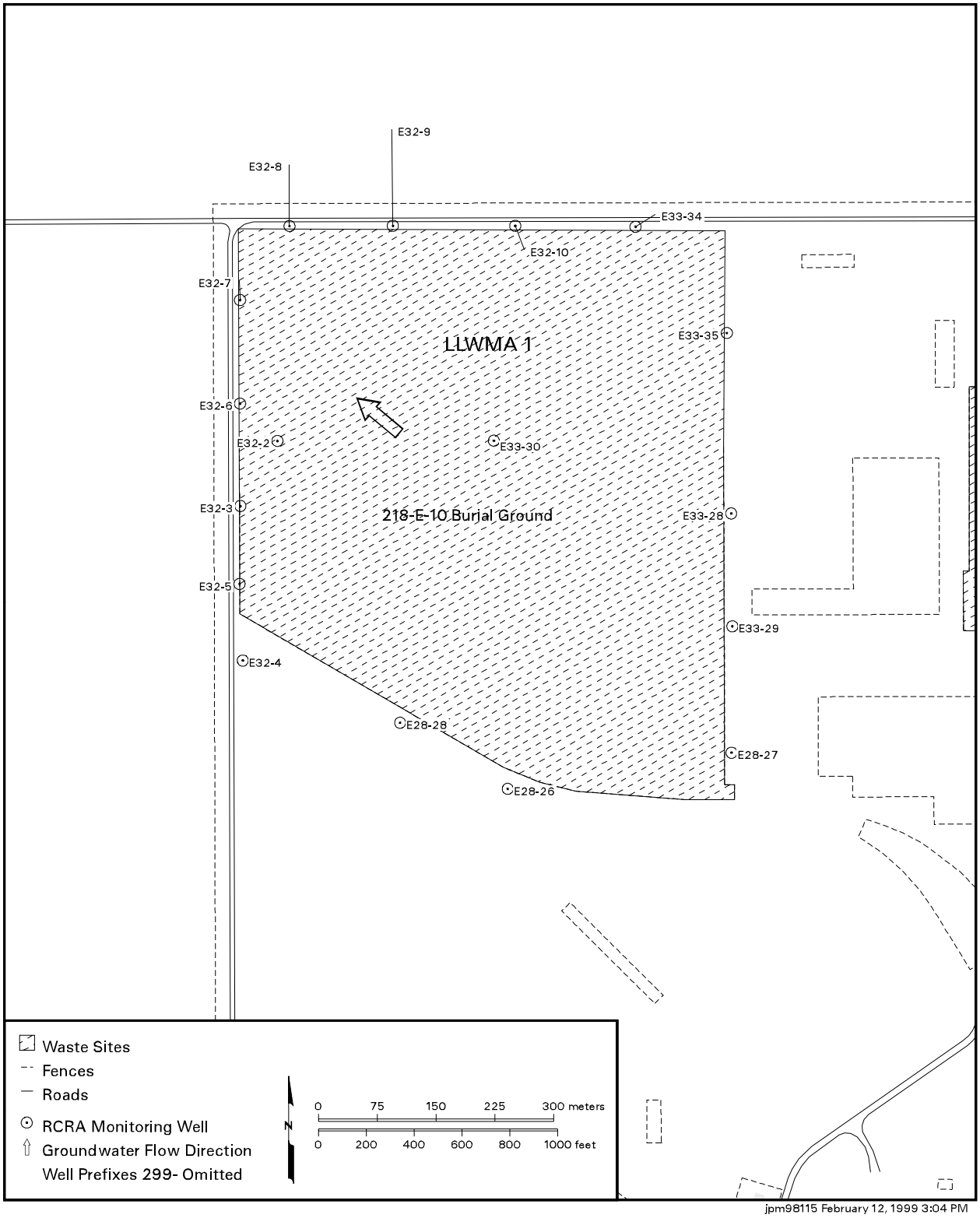


Figure A.20. Monitoring Well Locations for Low-Level Waste Management Area 1

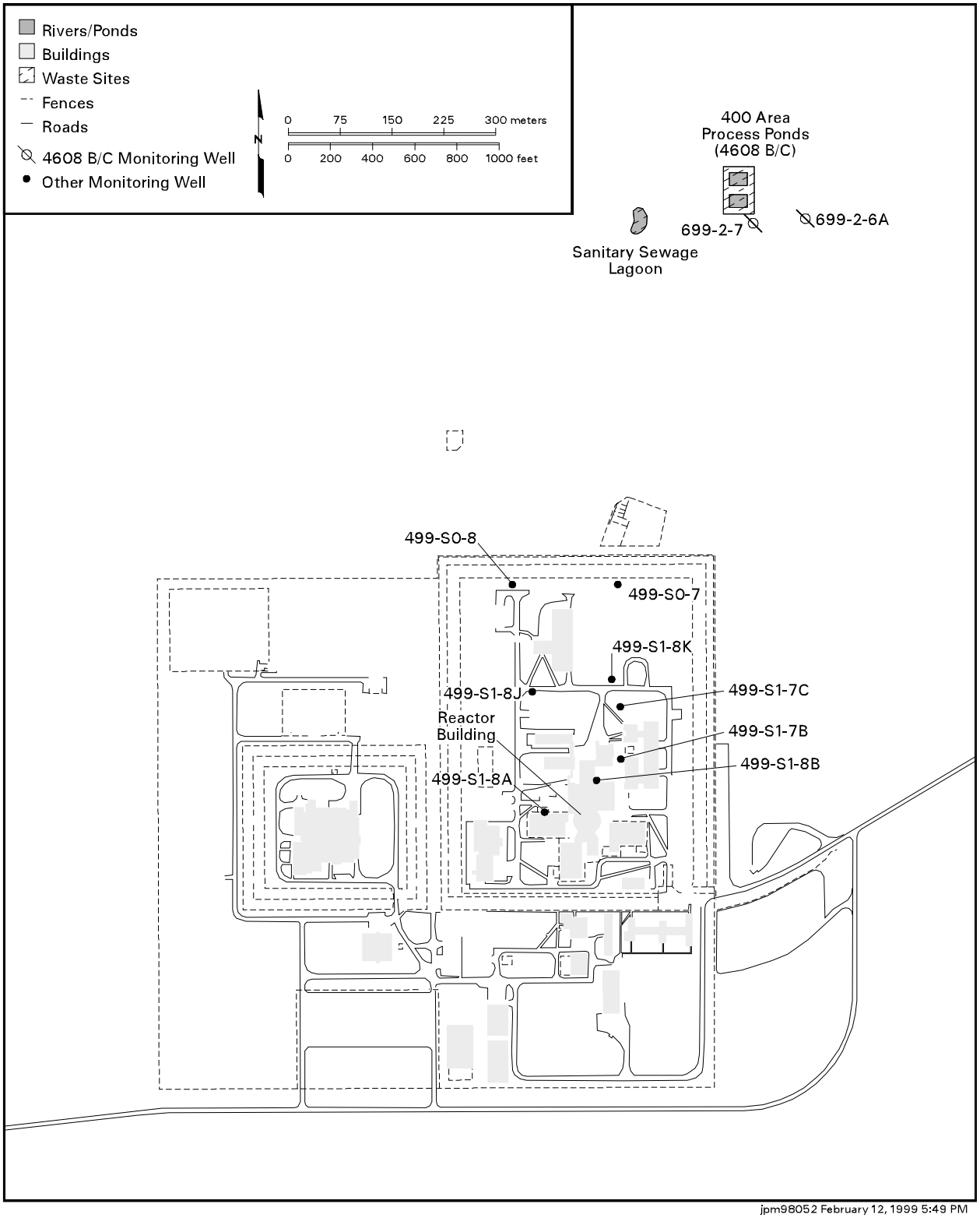


Figure A.21. Monitoring Well Locations for 400 Area Process Ponds

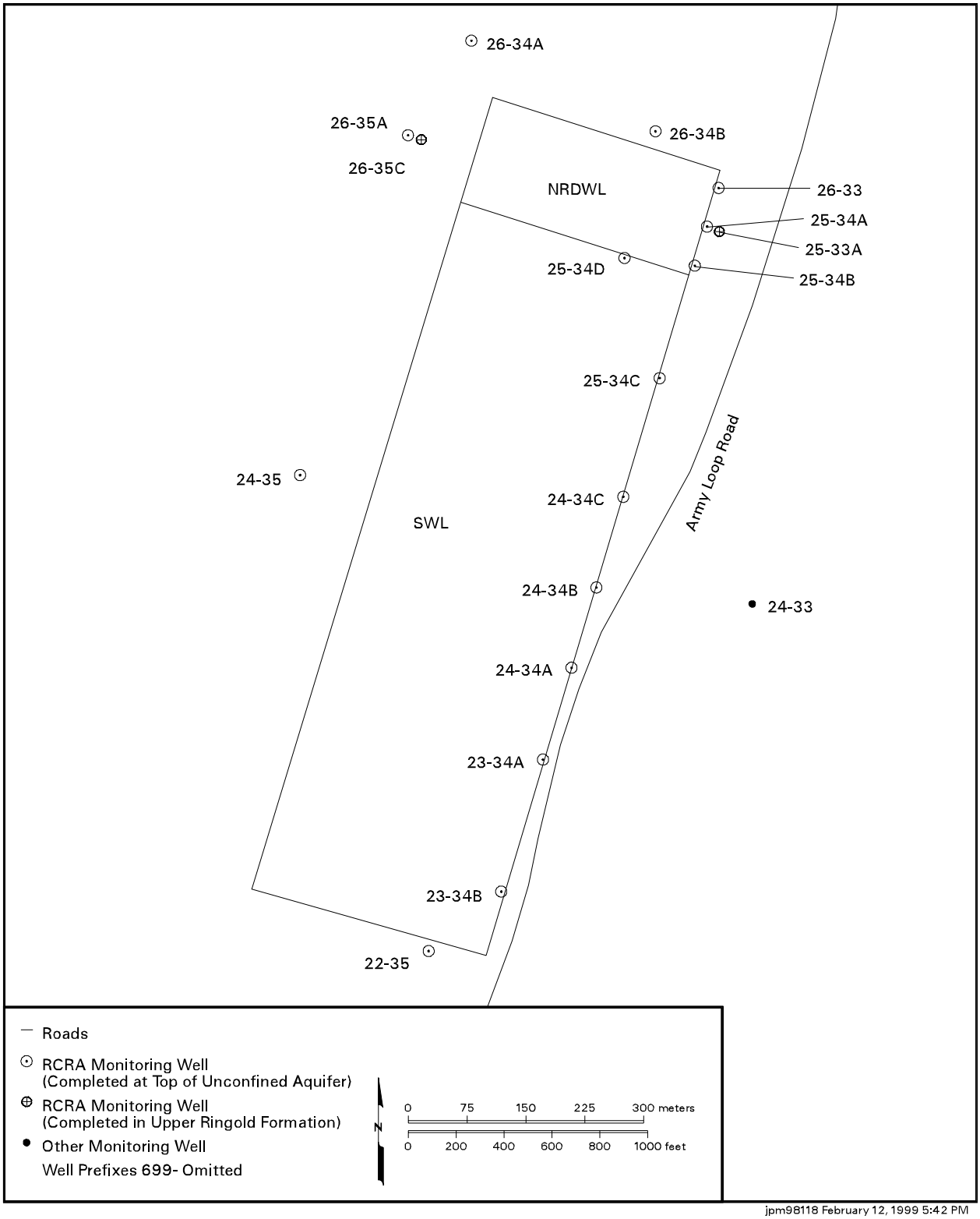


Figure A.22. Monitoring Well Locations for Nonradioactive Dangerous Waste Landfill and Solid Waste Landfill

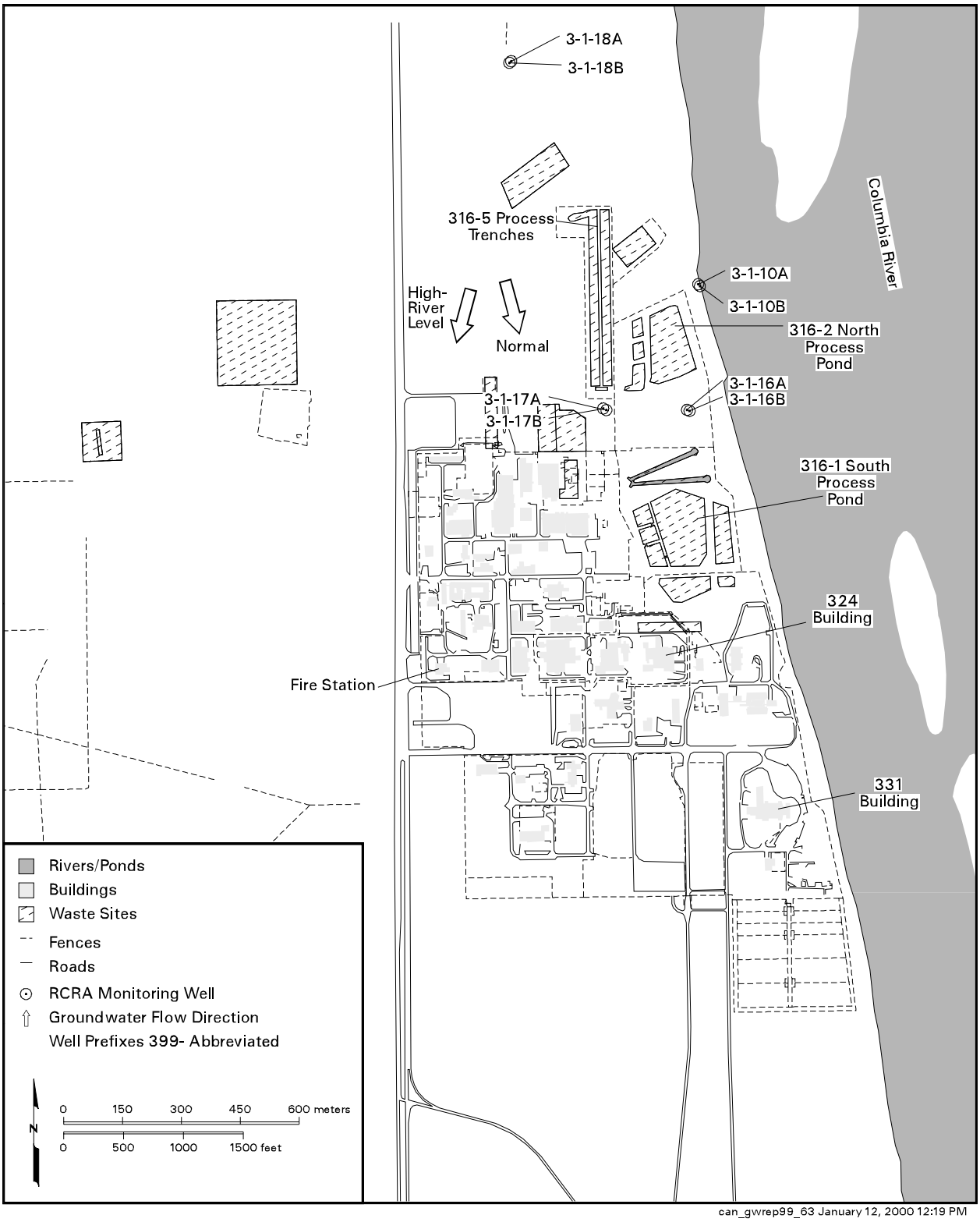


Figure A.23. Monitoring Well Locations for 316-5 Process Trenches