2.8 200-ZP-1 Operable Unit

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The 200-ZP-1 Operable Unit discussion includes the northern and central parts of the 200 West Area and the western 600 Area. This region is informally termed the 200-ZP-1 groundwater interest area (see Figure 1.0-1 in Section 1.0). The groundwater interest areas are defined to facilitate scheduling, data review, and interpretation. Figure 2.8-1 shows facilities and wells in this region. Groundwater is monitored to assess the performance of an interim action pump-and-treat system for carbon tetrachloride contamination, to track other contaminant plumes, and to support four *Resource Conservation and Recovery Act* (RCRA) units and the State-Approved Land Disposal Site. Data from facility-specific monitoring are also integrated into the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) groundwater investigations. The contamination plumes routinely mapped in this area are carbon tetrachloride, chloroform, trichloroethene, nitrate, chromium, fluoride, tritium, iodine-129, technetium-99, and uranium. Other contaminants are detected but at lower levels or in less extensive areas. Results of analyses of these contaminants and updates of other activities are discussed in this section.

Carbon tetrachloride is the primary contaminant of concern in the 200-ZP-1 Operable Unit.

Groundwater in the north portion of the 200 West Area predominantly flows toward the east-northeast but is locally influenced by the 200-ZP-1 Operable Unit pump-and-treat system and effluent discharges to the State-Approved Land Disposal Site (Figure 2.8-2). The water table in the 200 West Area was raised by past discharge of wastewater and the aquifer is still re-equilibrating after the termination of discharges. The flow direction in the north part of the operable unit has changed ~35 degrees over the past decade from a north-northeast direction to a more eastward direction, but the changes from year to year are becoming less apparent as the natural groundwater levels are approached.

Flow in the central part of the 200 West Area (the south part of the 200-ZP-1 Operable Unit) is strongly influenced by the operation of the 200-ZP-1 Operable Unit pump-and-treat remediation system. This system extracts water from ten extraction

Groundwater monitoring in the 200-ZP-1 groundwater interest area includes the following monitoring activities:

CERCLA Monitoring (Appendix A)

- ***Sixty-three wells are sampled quarterly to biennially.***
- ***Several quarterly samples were missed and four were delayed until October 2007.***
- ***In FY 2007, five new wells were installed.***

Facility Monitoring (Appendix B)

- ***Seven wells are sampled semiannually for Low-Level Waste Management Area 3.***
- ***Ten wells are sampled semiannually for Low-Level Waste Management Area 4.***
- ***Sixteen wells are sampled quarterly to semiannually for Waste Management Area T. One quarterly sample was missed.***
- ***Sixteen wells are sampled quarterly to semiannually for Waste Management Area TX-TY.***
- ***Twelve wells are sampled quarterly to semiannually for the State-Approved Land Disposal Site. One semiannual sample was missed.***

The groundwater flow direction has changed ~35 degrees over the past decade, but the changes from year to year are becoming less apparent as the natural groundwater levels are approached.

wells in the vicinity of the 216-Z cribs and trenches and west of Waste Management Area TX-TY shown on Figure 2.8-1, removes carbon tetrachloride and other volatile organic compounds, then re-injects the water into the aquifer to the west of the area. A small groundwater mound is associated with the injection wells, and a region of draw down is associated with the extraction wells, causing flow to converge on the extraction zone from all directions. The re-injection wells, which are due west of the Low-Level Waste Management Area 4, have also affected groundwater flow and contaminant concentrations beneath this facility (see Section 2.8.2.1 and Appendix B). A more aggressive pump-and-treat system, which is currently in the conceptual stage, will affect these areas even more significantly (see Section 2.8.2). During the fiscal year, two of the extraction wells, located west of Waste Management Area TX-TY and containing significant technetium-99, were outfitted with a resin to remove the technetium-99 prior to re-injection (see Section 2.8.2.3).

The remainder of this section describes contaminant plumes and concentration trends for the contaminants of concern, summarizes the status of groundwater remediation efforts, and discusses the results of monitoring of specific facilities under CERCLA, RCRA, state permits, and the *Atomic Energy Act* (AEA).

2.8.1 Groundwater Contaminants

Groundwater contaminants of concern discussed in this section are defined in the 200-ZP-1 remedial investigation/feasibility study work plan (DOE/RL-2003-55) and DOE/RL-2006-24. The contaminants of concern, their preliminary target action levels, and summary of detection statistics are listed in Table 2.8-1.

Plume areas (square kilometers) above the drinking water standard at the 200-ZP-1 Operable Unit:

****Carbon tetrachloride — 10.1***
Chromium — 0.05
Iodine-129 — 0.69
Nitrate — 5.9
Technetium-99 — 0.08
Trichloroethene — 0.44
Tritium — 0.75
Uranium — 0.09
****Also includes portion of plume beneath 200-UP-1 Operable Unit.***

2.8.1.1 Carbon Tetrachloride

Carbon tetrachloride contamination is found at levels greater than the drinking water standard (5 µg/L) in the groundwater under most of the 200 West Area (Figure 2.8-3). The main sources are three of the 216-Z cribs and trenches that received waste from the Plutonium Finishing Plant. The maximum carbon tetrachloride levels in groundwater were found in extraction well 299-W15-44, which had the highest concentration in a single sample (4,900 µg/L) and extraction well 299-W15-34, which had the highest average concentration (2,600 µg/L) during FY 2007. These wells are located southwest of Waste Management Area TX-TY.

Significant features of the carbon tetrachloride plume in the upper part of the aquifer include:

- Highest average carbon tetrachloride concentrations (2,608 µg/L) in the 200 West Area in FY 2007 occurred in extraction well 299-W15-34 (screened through the upper ~18 meters of the aquifer). This value is down from an average of 3,300 µg/L in FY 2006, and represents a continuing decrease in concentrations since the period 2001-2002.
- An area of carbon tetrachloride at levels >2,000 µg/L extends north to the vicinity of Waste Management Area TX-TY. The carbon tetrachloride contamination reaches the north part of Waste Management Area TX-TY where concentrations in well 299-W15-765 (screened through the upper 10.7 meters of the aquifer) averaged 1,925 µg/L in FY 2007 compared with 2,800 µg/L in FY 2006.

- The most recent analyses of carbon tetrachloride in well 699-48-71, located north of the northeast corner of 200 West Area, continue to show contamination increasing very gradually in this region northeast of the 200 West Area (Figure 2.8-4). Carbon tetrachloride in this well reached 42 µg/L in an average of two June 2007 samples (The average depicted in Figure 2.8-3 includes a low concentration of 20 µg/L from January 2007).
- The extent of carbon tetrachloride at the drinking water standard (5 µg/L) shown in Figure 2.8-3 did not change appreciably from that of FY 2006, but some zones of higher concentrations diminished during FY 2007. For example, the 50-µg/L contour interval in FY 2007 roughly coincides with the FY 2006 100-µg/L contour in most areas of 200-ZP-1, except the extreme northwest part of 200 West Area where concentrations remained mostly unchanged. The 1,000-µg/L contour that intersected the eastern boundary of Low-Level Waste Management Area 4 during FY 2006 has retreated to the eastward by about 100 meters. However, the area where concentrations remained >2,000 µg/L west of Waste Management Area TX-TY remained about the same as in FY 2006.
- Carbon tetrachloride is the primary constituent of concern for the 200-ZP-1 interim action record of decision (ROD 1995a). The target for remediation is the area with concentrations >2,000 µg/L in the vicinity of the 216-Z cribs and trenches. It is important to emphasize that the depiction of the extent of carbon tetrachloride in Figure 2.8-3 is the extent of contamination near the upper part of the aquifer, but the three-dimensional extent is considerably more complex. Ongoing drilling of new deep wells continues to indicate that the highest concentrations in some areas are found deeper in the aquifer. Some wells thus far completed to lower depths of the aquifer indicate high concentrations of carbon tetrachloride (>3,500 µg/L) 15 to 20 meters below the water table, especially beneath the disposal trenches. New characterization wells drilled in the last few years are helping to resolve the carbon tetrachloride extent downgradient and vertically within the suprabasalt aquifer (Figures 2.8-5, 2.8-6, and 2.8-7). Remediation activities and more details on the vertical contaminant distribution are summarized in Section 2.8.2.

Carbon tetrachloride contamination is found at levels greater than the drinking water standard (5 µg/L) in the groundwater under most of the 200 West Area.

Depth-discrete data for groundwater and soils in 19 wells were evaluated in the 200-ZP-1 remedial investigation report (DOE/RL-2006-24). Additional wells were drilled in FY 2007 that added to these data. Figures 2.8-6 and 2.8-7 illustrate the plume geometry in the vertical plane. Note that the contamination occurs at increasing depth to the east of the known source areas and relatively low concentrations are seen at the water table in the east-central part of the 200 West Area. Along the downgradient plume extent, recharge from natural infiltration and less-contaminated former waste water discharges may have contributed to reduced carbon tetrachloride concentrations in the upper portion of the unconfined aquifer. Also, the volume of discharges may have introduced significant vertical head, driving contamination deeper into the aquifer. The extent of carbon tetrachloride contamination deeper in the aquifer indicates that a significantly greater mass of carbon tetrachloride is present in the unconfined aquifer than previously calculated.

The maximum trichloroethene concentration detected in FY 2007 routine monitoring was 21 µg/L in the November sample from well 299-W15-50, north of the 216-Z-9 trench.

2.8.1.2 Trichloroethene

Trichloroethene is detected at levels above the drinking water standard (5 µg/L) in the 200-ZP-1 Operable Unit. The main trichloroethene plume extends north and northeast from the vicinity of the 216-Z cribs and trenches, the 216-Z-9 trench

in particular. The maximum trichloroethene concentration detected in FY 2007 routine monitoring was 21 µg/L in the November sample from well 299-W15-50, north of the 216-Z-9 trench. This result is down from 27 µg/L in FY 2006. Well 299-W15-50 is screened ~7.6 to 18.3 meters below the water table and, thus, is not shown in Figure 2.8-8 because the figure focuses only on the upper portion of the aquifer. The size and configuration of the plume seen in Figure 2.8-7 is nearly identical to that of FY 2006. However, concentrations throughout the plume are slightly lower or unchanged in general. The most noticeable decline is in the western portion of Waste Management Area T (e.g., well 299-W10-4). The minor exception to this trend is the area near T Plant in the northwest portion of 200 West Area, where wells 299-W11-7 (11 µg/L) and 299-W11-37 (average 3.75 µg/L) show slight upward trends, with average concentrations higher in FY 2007 than in FY 2006.

Depth-discrete sampling for new wells drilled during FY 2007 contained chloroform, with the highest concentration of 86 µg/L found in well 299-W11-86 at a depth of 133 meters.

2.8.1.3 Chloroform

Average chloroform concentrations in the 200-ZP-1 wells remained below the 80-µg/L drinking water standard (the standard is defined for total trihalomethane) during FY 2007. Depth-discrete sampling for new wells drilled during FY 2007 showed chloroform at depth in the aquifer. The maximum chloroform in new well 299-W11-48, located north of Waste Management Area T, was 260 µg/L at 25 and 27 meters below the water table. The maximum chloroform found in new well 299-W11-86, east of T Plant, was 86 µg/L at 47 meters below the water table. Well 299-W10-33, completed near the bottom of the unconfined aquifer in September 2007 produced an average concentration of chloroform of 19.5 µg/L, with a maximum of 46 µg/L. Possible chloroform sources include biodegradation of carbon tetrachloride and sanitary sewer discharges to the 2607-Z tile field.

2.8.1.4 Nitrate

Nitrate concentrations in well 299-W10-27 on the northeast corner of Waste Management Area TX-TY increased in FY 2007.

Nitrate continued to be present in groundwater at concentrations above the drinking water standard (45 mg/L) beneath much of the 200-ZP-1 Operable Unit (Figure 2.8-9). The maximum concentration in this vicinity during FY 2007 was 3,810 mg/L in well 299-W10-4 near the 216-T-36 crib, south of Waste Management Area T. The average nitrate concentration in well 299-W10-4 was 2,264 mg/L for FY 2007, somewhat lower than in FY 2006. Multiple sources of nitrate probably exist in this area, including the cribs near Waste Management Area T and the 216-Z crib and trench disposal facilities.

Of three new wells with depth-discrete data, well 299-W11-86 had the highest nitrate concentration detected, with a concentration of 108 mg/L at a depth of 141 meters. This same well had a carbon tetrachloride concentration of 486 µg/L at a depth of 133 meters.

2.8.1.5 Chromium

Chromium contamination is found at levels above the drinking water standard (100 µg/L) in the immediate vicinity of Waste Management Areas T and TX-TY (Figure 2.8-9). Chromium at lower levels extends downgradient toward or past the 200 West Area boundary. Hexavalent chromium is included in this discussion because it is the most soluble and mobile form under Hanford aquifer conditions. Thus, all chromium in filtered groundwater samples is assumed to be soluble hexavalent chromium (see Appendix C).

Two areas of chromium contamination are shown on Figure 2.8-10. One is a small area centered on well 299-W14-13, east of Waste Management Area TX-TY. In

FY 2007, the maximum chromium concentration in well 299-W14-13 was 715 µg/L and the annual average was 660 µg/L, down from an annual average of 725 µg/L in FY 2006. The second area is larger and associated with Waste Management Area T and adjacent past-practice disposal facilities. There the highest average chromium concentration was 475 µg/L in well 299-W10-4, located southwest of the waste management area, down from 550 µg/L during the previous year. The chromium contamination at Waste Management Area T extends from well 299-W10-4 to the downgradient wells, although there are no wells within the tank farm to ensure continuation of the plume. Chromium near Waste Management Area T is discussed in more detail in Section 2.8.3.3 and near Waste Management Area TX-TY in Section 2.8.3.4.

Well 299-W14-13 had the highest chromium results in 200-ZP-1 Operable Unit at 715 µg/L.

2.8.1.6 Fluoride

Fluoride contamination at levels greater than the primary drinking water standard (4 mg/L) have occurred in a local area around Waste Management Area T in the past. In FY 2007, no water-table well exceeded this value, but well 299-W10-23 had the highest yearly average of 3.9 mg/L. The highest single fluoride result occurred northeast of Waste Management Area T in well 299-W11-48, which produced a maximum of 5.6 mg/L at ~12.2 meters below the water table. Several wells surrounding this tank farm have average concentrations above the secondary standard of 2 mg/L. Another area of anomalous concentrations (but all below the drinking water standard) occurs along the eastern edge of Waste Management Area TX-TY. Well 299-W14-11 produced an average of 1.4 mg/L in FY 2007. No trends are indicated in this area. Release of lanthanum fluoride used in the bismuth phosphate process is a possible cause of this contamination.

2.8.1.7 Tritium

Tritium contamination at levels greater than the drinking water standard (20,000 pCi/L) in the 200-ZP-1 Operable Unit is mainly restricted to a plume extending northeast from waste disposal facilities in the vicinity of Waste Management Areas T and TX-TY. Multiple potential sources of tritium exist in this vicinity. In addition, tritium from permitted discharges at the State-Approved Land Disposal Site is found in the groundwater (Figure 2.8-11). Tritium at the State-Approved Land Disposal Site is discussed in Section 2.8.3.5.

The highest tritium concentration was in a well east of Waste Management Area TX-TY where concentrations averaged 1.51 million pCi/L.

The tritium plume retains the same general configuration as in FY 2006, with the exception of the region southwest of Waste Management Area TX-TY. In this area, the 2,000-pCi/L contour has retreated to the north and east of extraction wells 299-W15-34, 299-W15-35 and 299-W15-43. The highest tritium concentrations in water-table wells remained at well 299-W14-13, located east of Waste Management Area TX-TY, where the concentration in FY 2007 ranged from 1.28 to 1.76 million pCi/L, with an average of 1.51 million pCi/L. These levels are down slightly from FY 2006. Tritium levels in the 200-ZP-1 Operable Unit continue on a downward trend in most wells in the network.

2.8.1.8 Iodine-129

Iodine-129 is found in the 200-ZP-1 Operable Unit that has origins in the vicinity of Waste Management Area TX-TY (Figure 2.8-12). The highest iodine-129 concentration detected during routine sampling in FY 2007 was in well 299-W14-13, where the concentration averaged 38.3 pCi/L, which is an increase from FY 2006 levels. Elevated iodine-129 is also found locally near the Waste Management Area T (see Section 2.8.3.3). Determining the extent of iodine-129 contamination is difficult

because the detection limit is often near, or above the drinking water standard of 1.0 pCi/L. In the past, the laboratory had problems analyzing for iodine-129 when significant concentrations of technetium-99 were present resulting in unusually high detection limits. This problem has been fixed so that the presence of high technetium-99 concentrations did not increase the detection limit for iodine-129 in FY 2007. See Section 1.8 for a more detailed discussion of iodine-129 analyses.

Technetium-99 within the 200-ZP-1 Operable Unit is found above the drinking water standard (900 pCi/L) downgradient of Waste Management Areas T and TX-TY.

2.8.1.9 Technetium-99

Technetium-99 within the 200-ZP-1 Operable Unit is found at levels significantly above the drinking water standard (900 pCi/L) on the east (downgradient) side of Waste Management Area T and centered on two areas in the vicinity of Waste Management Area TX-TY (Figure 2.8-13). Well 299-W11-39, near the northeast corner of Waste Management Area T, continued to produce the highest concentration in samples collected near the water table in this area with values in FY 2007 averaging 21,000 pCi/L. However, well 299-W11-46, which is screened between 6 and 12 meters below the water table, showed technetium-99 concentrations that averaged 96,850 pCi/L in FY 2007 with a maximum concentration of 113,000 pCi/L. This was up significantly from FY 2006 (maximum 63,200 pCi/L). Technetium-99 contamination around Waste Management Areas T and TX-TY is discussed in greater detail in Sections 2.8.3.3 and 2.8.3.4.

2.8.1.10 Uranium

The highest uranium result from groundwater in the 200-ZP-1 Operable Unit was found in well 299-W11-37, northeast of the 221-T building (see Figure 2.8-1). This well averaged a uranium concentration of 55.8 µg/L during FY 2007, but levels have been decreasing since FY 2001. This is the only well to exceed the drinking water standard (30 µg/L) in 200-ZP-1 Operable Unit during FY 2007. The next highest results were observed near the western edge (upgradient) of Low-Level Waste Management Area 4. Wells 299-W15-15, 299-W18-21, and 299-W18-23 produced average concentrations of 7.9, 20.7, and 9.0 µg/L, respectively.

Only one well exceeded the drinking water standard (30 µg/L) for uranium in the 200-ZP-1 Operable Unit.

2.8.1.11 Other Contaminants of Concern

Other contaminants of concern (Table 2.8-1) that were detected in groundwater at concentrations above the preliminary target action levels are discussed in this section. Antimony was reported as detected in several wells at levels above the drinking water standard (6 µg/L) in FY 2007. However, antimony results have been problematic. Detections are typically very close to the reported detection limit and sporadic. Most detections in FY 2007 and previous years, are believed to be false positives. In well 699-48-77D, antimony from a filtered sample was reported as detected at 43.6 µg/L, but the unfiltered sample from the same event was below detection. A result of 33.9 µg/L was also reported in February 2007 in a filtered sample from well 299-W10-28, but all results before and since have been below detection.

Arsenic was detected at levels above the 10-µg/L drinking water standard only in one well (299-W10-4) during FY 2007. The maximum concentration detected was 10.3 µg/L. This value is slightly lower than the previous year's maximum. The subsequent sample was below the drinking water standard. New well 299-W10-33 produced the next highest result at 8.29 µg/L in an unfiltered sample, but the average of several results in this well was only 2.2 µg/L. The Hanford groundwater background for arsenic is 11.8 µg/L (95th percentile) (DOE/RL-96-61).

Iron was present at levels above the 300-µg/L secondary drinking water standard in only three wells during FY 2007. The highest concentration (2,600 µg/L) was observed in an unfiltered sample from well 699-48-77A at the State-Approved Land Disposal Site. A filtered sample from the same event was below detection (<33 µg/L). Well 299-W14-19 produced a result of 384 µg/L in a filtered sample in February 2007. This result far exceeds any result before or since, and is suspected as an analytical error or particulate material. Iron is a naturally occurring component of the aquifer sediment and is found in well materials; thus, elevated iron levels in unfiltered samples due to particulate material are not surprising. Background iron concentration for Hanford Site groundwater is 55.3 µg/L (DOE/RL-96-61).

Manganese was detected at levels above the 50-µg/L secondary drinking water standard in filtered and unfiltered samples from several 200-ZP-1 wells in FY 2007. The highest concentration reported was 678 µg/L from well 299-W11-47. Elevated manganese values in the first few years of sampling are not uncommon for new wells at the Hanford Site, probably due to reaction of groundwater with freshly crushed rock surfaces. Background manganese concentration for Hanford Site groundwater is 2.2 µg/L (DOE/RL-96-61).

Methylene chloride was detected at levels above the drinking water standard (5 µg/L) in five wells in the 200-ZP-1 Operable Unit during FY 2007. The highest result reported was from well 299-W11-48 at 9.3 µg/L. Methylene chloride (dichloromethane) could be a degradation product or impurity in carbon tetrachloride (tetrachloromethane) but is also a common laboratory contaminant. Tetrachloroethene is often detected at levels below the drinking water standard (5 µg/L) in the 200-ZP-1 Operable Unit. In FY 2007, one well (299-W13-1) had a result 6.4 µg/L, which is identical with the result in this well in FY 2007. The well has a history of detections for this constituent, but at levels significantly below the maximum result for FY 2007.

2.8.2 Operable Unit Activities

Within the 200-ZP-1 Operable Unit, interim actions have been implemented for remediation of carbon tetrachloride, chloroform, and trichloroethene in the vicinity of the 216-Z liquid waste disposal units (216-Z cribs and trenches). Remediation of other groundwater contaminants will be determined through the remedial investigation/feasibility study process per Section 5.5 of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989). The most recent update of the status of the remediation is provided by SGW-34328.

Two pump-and-treatment systems and a vapor extraction system have been installed as interim actions to treat groundwater contamination in the 200 Areas.

2.8.2.1 Status of Five-Year Review of Action Items

The U.S. Department of Energy (DOE) published the second CERCLA five-year review in November 2006 (DOE/RL-2006-20). This document provided a comprehensive evaluation of the status of groundwater and source operable unit investigations and cleanup actions. Findings for the 200 Area National Priority List site that are pertinent to the 200-ZP-1 Operable Unit include the following summary statement:

"Two pump-and-treatment systems and a vapor extraction system have been installed as interim actions to treat groundwater contamination in the 200 Areas. The 200-ZP-1 Groundwater Operable Unit has a pump-and-treatment system to remove carbon tetrachloride from the groundwater. This system was designed to address only the most concentrated portion of the shallow portion of the plume and will be

Treatment options for technetium-99 centered on performing a treatability test at wells 299-W15-44 and 299-W15-765 using a Purolite-resin ion exchange column.

expanded through the CERCLA remedial investigation/feasibility study process to address the deeper portion of the plume. A protectiveness determination for the pump-and-treat interim remedy is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process."

Several issues and actions related to the 200-ZP-1 Operable Unit were identified:

- **Issue 13**. There is less than adequate deep groundwater monitoring data downgradient of T Tank Farm to define the nature and extent of technetium-99 contamination. Further characterize the technetium-99 groundwater plume near T Tank Farm.
  - **Action 13-1.** Complete a data quality objective process and sampling plan to further characterize the technetium-99 groundwater plume near T Tank Farm (due date March 2007).
  - **Response.** The data quality objectives Summary Report (WMP-28389, Rev. 0) was issued October 2007; the sampling and analysis plan (DOE/RL-2006-46) was issued August 2006.
- **Issue 14**. The recent expansion of the 200-ZP-1 extraction well network near the TX-TY Tank Farm may result in technetium-99 contamination being pulled into the 200-ZP-1 treatment system. Treatment options for groundwater contaminated with technetium-99 need to be assessed.
  - **Action 14-1**. Assess treatment options to address technetium-99 near T Tank Farm (due date September 2007).
  - **Response.** Treatment options for technetium-99 at the T Tank Farm centered on performing treatment at wells 299-W11-45 and 299-W11-46. These two wells have been converted to extraction wells. Groundwater is pumped to the Effluent Treatment Facility in 200 East Area for treatment. System operations began in September 2007.
- **Issue 16**. Efficiency and effectiveness of the 200-ZP-1 pump-and-treat system could be increased by increasing the pumping rate to fully utilize the treatment capacity.
  - **Action 16-1**. Increase the pump size in 200-ZP-1 extraction wells 299-W15-45 and 299-W15-47 (due date March 31, 2007).
  - **Response.** Specific capacity versus remaining wetted length of screen for both wells suggested that production only at well 299-W15-47 could benefit from installation of a larger pump. A 15-horsepower pump replaced the original 10 horsepower and yielded an additional 8 liters/minute for a total extraction rate of 235 liters/minute.

Remediation of other groundwater contaminants will be determined through the remedial investigation/ feasibility study process

- **Issue 17**. Efficiency of the carbon tetrachloride remediation could be increased by increasing the use of the 200-PW-1 (formerly the 200-ZP-2) vapor extraction system. The soil-vapor extraction system is in limited operation. Expanding the soil-vapor extraction operations should be evaluated.
  - **Action 17-1**. Evaluate expanding the soil-vapor extraction operations. Specifically review converting former groundwater extraction well 299-W15-32 to a soil-vapor extraction well (due date March 2007).
  - **Response.** An evaluation of soil vapor extract operations was conducted and it was agreed that the system could be expanded. Well 299-W15-32

was converted for soil-vapor extraction operations in FY 2006 and is ready for connection to the soil-vapor extraction system. Additional wells will be added to the system in the future.

2.8.2.2 CERCLA Investigations

A *Remedial Investigation/Feasibility Study Work Plan for the 200-ZP-1 Groundwater Operable Unit* (DOE/RL-2003-55) was prepared in FY 2004 and implemented in FY 2005. The remediation investigation report (DOE/RL-2006-24) was published in October 2006 and the Draft A feasibility study/proposed plan was completed in September 2007 (DOE/RL-2007-28, Draft A; DOE/RL-2007-33, Draft A).

Work on the Draft A feasibility study for the 200-ZP-1 Operable Unit is ongoing to finalize the document. The feasibility study will include the detailed risk assessment. In FY 2006, potential remediation methods for the 200-ZP-1 Operable Unit were screened (PNNL-15954). The screening considered the eight major contaminants and used a generalized conceptual model of the lateral extent and depth of contamination. A data quality objectives report (WMP-28324) was prepared for investigation of the extent of deep groundwater contamination in the eastern part of the 200 West Area. This report proposed the installation of five new deep groundwater monitoring wells.

2.8.2.3 Interim Action for Carbon Tetrachloride

The current pump-and-treat system is operating in the 200-ZP-1 Operable Unit to contain and capture the high concentration portion of the carbon tetrachloride plume located north of the Plutonium Finishing Plant. The contaminants originating from discharges to the 216-Z-9, 216-Z-1A and 216-Z-18 cribs have migrated north and east of the waste sites. The pump-and-treat system was implemented as an interim remedial measure in three phases starting in 1996.

The remedial action objectives for the pump-and-treat system are to capture the high concentration area of the carbon tetrachloride plume to reduce contaminant mass and to gather information to support future remedial investigation/feasibility study decisions (ROD 1995a). The high concentration plume is defined by the 2,000- to 3,000-µg/L-plume contour, which was initially centered beneath the Plutonium Finishing Plant and related waste sites. In 2005, concentrations of carbon tetrachloride exceeding the 2,000-µg/L remedial action goal were reported at wells west of the TX and TY Tank Farms. Four monitoring wells were converted to extraction wells and connected to the 200-ZP-1 pump-and-treat system. Pumping began there in late July 2005 and continued through FY 2006. A tenth well, 299-W15-6, was added on September 28, 2006.

The interim remedial action objectives for the 200-ZP-1 Operable Unit (ROD 1995a) are:

- ***Reduce contamination in the area of highest concentration of carbon tetrachloride.***
- ***Prevent further movement of these contaminants from the highest concentration area.***
- ***Provide information that will lead to development of a final remedy that will protect human health and the environment.***

EPA specified enhancements needed for the system in their 5-year review (EPA 2001). The record of decision for the interim remedial measure states the high concentration portion of the plume corresponds to the area within the 2,000- to 3,000-µg/L contour of carbon tetrachloride.

Over 498 million liters of carbon tetrachloride contaminated groundwater were treated in FY 2007 and 755.2 kilograms of carbon tetrachloride were removed.

Carbon tetrachloride mass was reduced in the area of highest concentrations through pumping and treating over 498 million liters from ten groundwater extraction wells in FY 2007. The average extraction rate during FY 2007, factoring in all down time, was 950 liters/minute, compared to an average pumping rate of 810 liters/minute in FY 2006 and the remedial action target pumping rate of 568 liters/minute. Most of the increase is attributed to the steady operation of the extraction system. Processing rates of up to 1,300 liters/minute were achieved for significant periods of time. Figure 2.8-14 shows the current concentrations of carbon tetrachloride in the vicinity of the 200-ZP-1 pump-and-treat system.

An existing well, 299-W15-6 at the 216-Z-9 trench, was converted for extraction and brought online in late September 2006. This well is screened deeper in the unconfined aquifer above the Ringold Formation lower mud unit and was operated throughout FY 2007. The original purpose of pumping at this well was to evaluate dense nonaqueous phase liquid within the deep unconfined aquifer near the suspected waste site source areas. Although dense nonaqueous phase liquid was not encountered, extraction has continued with the goal of reducing contaminant mass.

Carbon tetrachloride mass was extracted at an average rate of 950 liters/minute, compared to an average pumping rate of 810 liters/minute in FY 2006 and the remedial action target pumping rate of 568 liters/minute.

Carbon tetrachloride concentrations ranged from a low value of 270 µg/L at extraction well 299-W15-36 to a high value of 3,400 µg/L at extraction well 299-W15-40. Concentrations at the pump-and-treat system's influent tank averaged 1,600 µg/L during the first half of FY 2007, a slight decrease from 2,096 µg/L in FY 2006. Treatment resulted in the removal of 755.2 kilograms of carbon tetrachloride from the 498 million liters of extracted groundwater in FY 2007. Since starting the pump-and-treat system in August 1994, over 10,953 kilograms of carbon tetrachloride have been removed from almost 3.69 billion liters of groundwater.

The most recent estimates of carbon tetrachloride inventories are given in DOE/RL-2006-58. The current estimate is between 570,000 and 920,000 kilograms of carbon tetrachloride discharged to the three primary waste sites, 216-Z-9, 216-Z-1A, and 216-Z-18. DOE/RL-2007-22, source term addendum report, presented an estimate of carbon tetrachloride in the unconfined aquifer. The dissolved carbon tetrachloride is estimated to be 55,900 to 64,600 kilograms, with 44,500 to 51,400 kilograms sorbed to the aquifer sediments. An estimated 13,700 to 15,800 kilograms of carbon tetrachloride has degraded to chloroform below the water table.

Extraction wells have been sampled for technetium-99 to monitor plume movement and to ascertain if the pump-and-treat system is being affected by radiological contamination that could require changes to operations. Unlike past years where technetium-99 concentrations in injected water did not exceed 200 pCi/L, concentrations in FY 2007 rose to 640 pCi/L in November 2006. Monthly analytical results from the treatment system's influent and effluent tanks indicate that technetium-99 is not being removed during the treatment process.

A treatability test of the Purolite resin-based ion exchange system to remove the technetium-99 started in late April 2007 at extraction wells.

To alleviate the increasing technetium-99 concentrations in the system, an ion exchange treatability test using the Purolite resin-based system was installed to remove the technetium-99. The ion exchange system was started in late April 2007 at extraction wells 299-W15-44 and 299-W15-765. A failed pipe connection delayed start of routine testing until July 2007, but the system ran uninterrupted for the remainder of the fiscal year.

The technetium-99 injected historically has served as an unintentional tracer and has been detected at wells downgradient from the injection wells. In well

299-W15-15 at Low-Level Waste Management Area 4, technetium-99 concentrations rose from 18.5 pCi/L in 1994 to 170 pCi/L in 2004 and to 327 pCi/L in July 2007. Simultaneously, carbon tetrachloride concentrations declined from 1,400 µg/L to a maximum of 3.6 µg/L in the same time period.

Concentrations of carbon tetrachloride at all baseline plume wells have continued to decline from previous years and three of the five wells in the baseline area were routinely below the 2,000-µg/L remedial action goal.

Carbon tetrachloride concentrations at all baseline plume wells have continued to decline from previous years and three of the five wells in the baseline area were routinely below the 2,000-µg/L remedial action goal. Concentrations in well 299-W15-36, the southernmost active extraction well, ranged between 270 and 450 µg/L in FY 2007. Wells 299-W15-34, 299-W15-40, 299-W15-44, and 299-W15-765 occasionally yielded carbon tetrachloride concentrations above 2,000 µg/L in FY2007. Wells 299-W15-43, 299-W15-45 and 299-W15-47 were usually above 1,000 µg/L.

Carbon tetrachloride concentrations at two of the four extraction wells that began operation in FY 2005 are consistently above the 2,000-µg/L remedial action goal. Extraction wells 299-W15-40 and 299-W15-765 each exceeded 3,000 µg/L (3,000 and 3,400 µg/L, respectively) on one or two occasions in the first 4 months of FY 2007, but did not maintain concentrations above 3,000 µg/L for the remainder of the year. Well 299-W15-43, the most westerly of the converted extraction wells, averaged ~1,500 µg/L. The capture zones for these wells have not yet exceeded the contoured plume.

Monitoring wells have shown declines in concentrations reflecting those observed at baseline extraction wells. Well 299-W15-1, located upgradient of extraction well 299-W15-34, averaged above 2,000 µg/L. Monitoring wells 299-W15-7 and 299-W15-11, remained at or well below the 2,000-µg/L remedial action goal. These data indicate that the area around the extraction wells is being remediated by the pump-and-treat system.

Carbon tetrachloride concentrations in upgradient monitoring wells 299-W15-30 and 299-W15-31A declined to around 360 µg/L at the end of FY 2007. Monitoring well 299-W15-49, located west of well 299-W15-45, exhibited a declining trend, from 270 to 170 µg/L in FY 2007. Correspondingly, technetium-99 trends increased to 65 to 101 pCi/L in these monitoring wells throughout the fiscal year. The declining carbon tetrachloride trends along with the increasing technetium-99 trends at these wells show the influence of the injection system in driving contaminated groundwater toward the extraction wells.

Deep aquifer monitoring at well 299-W13-1, located east of the remediation system, revealed an oscillating trend of carbon tetrachloride concentrations ranging between 1,600 and 2,100 µg/L in FY 2007. The well was screened at a depth of 121 to 130 meters based on elevated concentrations of carbon tetrachloride. The Ringold lower mud unit was expected at ~131-meter depth but a only a limited fining of sediments was observed. Well 299-W11-87 replaced well 299-W11-86, which was damaged during construction and yielded a concentration of 1,700 µg/L. The well is screened to monitor the aquifer directly above the Ringold lower mud unit. Wells 299-W14-71 and 299-W14-72, located south and west of well 299-W13-1, yielded carbon tetrachloride concentrations between 500 and 1,000 µg/L. Well 699-45-69C, located east of 200 West Area, yielded a vertical profile of carbon tetrachloride that suggested concentrations greater than 5-µg/L had passed this location for at least at one interval ~119 meters below ground surface (groundwater is ~90 meters below ground surface).

Regional water levels indicate groundwater flow in the vicinity of the pump-and-treat system is to the east-northeast. Because of draw down, the water level declined 0.21 meter in well 299-W15-49 to 0.40 meter at well 299-W15-39, and averaging at 0.24 meter for 16 wells within the area of remediation in FY 2007. For wells outside the extraction wells capture zone, the average water-level decline was 0.24 meter/year. Well 299-W14-14 declined by 0.21 meter/year whereas wells 299-W15-33 and 299-W13-1 increased by 0.04 meter/year and 0.12 meter/year, respectively. For wells 299-W15-38 and 299-W15-39, located close to extraction wells, water-level declines of 0.40 meter/year were observed. These wells are downgradient of well 299-W15-47.

2.8.2.4. Pump-and-Treat for Technetium-99

Regional water levels declined and indicated groundwater flow is to the east-northeast in the vicinity of the 200-ZP-1 pump-and-treat system.

The technetium-99 concentration in well 299-W11-39, located east (downgradient) of the Waste Management Area T, increased from ~4,400 pCi/L when it was first sampled in February 2001 to 23,500 pCi/L in August 2007. Well 299-W11-25B was drilled east of Waste Management Area T and ~6 meters from existing well 299-W11-39 in early 2005. The objective of the borehole was to determine the vertical distribution of contaminants in the unconfined aquifer at the location of well 299-W11-39. Borehole 299-W11-25B was drilled to the top of the Ringold Formation lower mud unit (~51 meters below the water table) and groundwater was sampled throughout the unconfined aquifer. High concentrations of technetium-99 were found during drilling. The highest technetium-99 concentration was about 182,000 pCi/L at ~10 meters below the water table. The technetium-99 concentration rapidly decreased to less than about 40,000 pCi/L at 15 meters below the water table but remained greater than about 20,000 pCi/L throughout the deeper part of the aquifer (PNNL-15670).

Well 299-W11-25B was damaged during construction and was replaced with well 299-W11-46 located about 3 meters away. Well 299-W11-46 was screened between 6 and 12 meters below the water table, the zone that contained the highest concentrations of technetium-99 found in well 299-W11-25B. The replacement well was first sampled in August 2005. Between then and August 2007, the technetium-99 concentration increased steadily from 36,000 pCi/L to 113,000 pCi/L.

Well 299-W11-45 was drilled about 80 meters east (downgradient) from well 299-W11-46 and to a depth of about 56 meters below the water table in late 2005. The purpose of well 299-W11-45 was to delineate the lateral extent of the high technetium-99 concentrations found in borehole 299-W11-25B. Well 299-W11-45 also was sampled with depth during drilling and technetium-99 concentration just over 15,000 pCi/L was noted at about 10 meters below the water table. The technetium-99 concentration dropped below the drinking water standard of 900 pCi/L at about 15 meters below the water table and remained less than 900 pCi/L throughout the deeper part of the aquifer. Well 299-W11-45 was completed and screened between 8.5 and 13 meters below the water table (PNNL-15670).

In September 2007, wells 299-W11-45 and 299-W11-46 were converted to groundwater extraction wells in an attempt to remove the very high technetium-99 concentrations from the aquifer. The wells initially pumped at a combined rate of 102 liters/minute but this was increased to about 182 liters/minute in October 2007. The extracted water is sent to the Effluent Treatment Facility for removal of contaminants. The first sampling of the wells after extraction began was October 2007; the technetium-99 concentration in well 299-W11-45 was 16,000 pCi/L and the technetium-99 concentration in well 299-W11-46 was 18,000 pCi/L.

2.8.2.5 Carbon Tetrachloride and Chloroform Attenuation Parameters

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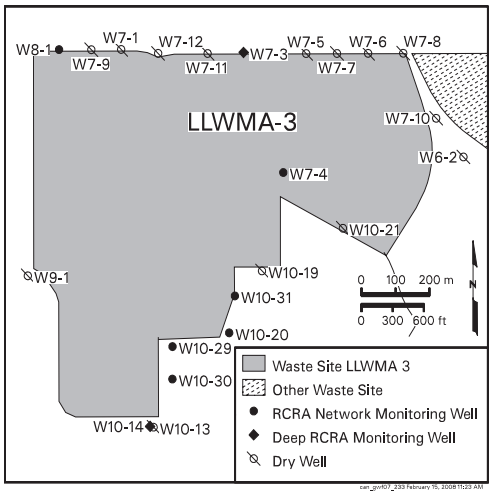
To support upcoming remediation decisions for the carbon tetrachloride plume in 200 West Area, more information is needed to assess the fate and transport of contamination. Parameters describing porosity, sorption, and physical degradation have the largest influence on predicted plume behavior. Researchers from Pacific Northwest National Laboratory are conducting a study of attenuation parameters under DOE's Environmental Management (EM-22) program (http://www.hanford.gov/cp/gpp/science/em21.cfm). Results of the new project will improve the ability to predict future movement of the plume. This effort will help define how much active remediation may be needed and estimate where the plume will eventually stabilize - key factors in determining the most appropriate remedy for the plume. During FY 2007, four minerals were selected and mineral surface experiments were initiated.

2.8.3 Facility Monitoring

This section describes results of monitoring individual facilities such as treatment, storage, or disposal units including two tank farm waste management areas (Waste Management Areas T and TX-TY). Groundwater at some of these facilities is monitored under the requirements of RCRA for hazardous waste constituents and AEA for radionuclides including source, special nuclear, and by-product materials. Data for facility-specific monitoring are also integrated into the CERCLA groundwater investigations. Groundwater data for these facilities are available in the Hanford Environmental Information System (HEIS 1994) and on the data files accompanying this report. Additional information including well and constituent lists, maps, flow rates, and statistical tables are included in Appendix B. This section summarizes results of statistical comparisons, assessment studies, and other developments for FY 2007.

2.8.3.1 Low-Level Waste Management Area 3



Groundwater at Low-Level Waste Management Area 3 continued to be monitored under RCRA and AEA in FY 2007. Under 40 CFR 265.93(b) as referenced by WAC 173-303-400, the well network was sampled semiannually for RCRA indicator and site-specific parameters (PNNL-14859; see Appendix B). All seven wells in the network were sampled as scheduled during FY 2007, except that quadruplicate results for indicator parameters were not received for two wells in the second semiannual event. New wells 299-W10-29, 299-W10-30, and 299-W10-31 were first sampled in October 2006.

The water table continued to decline in Low-Level Waste Management Area 3 monitoring wells during FY 2007 in response to the greatly reduced discharge of wastewater to surface facilities around the 200 West Area. The groundwater flow in this portion of the 200 West Area is to the east-northeast based on the March 2007 water-level data (Figure 2.8-2), measurements, with a calculated gradient of 0.0016 and a range in hydraulic conductivity values of 2.5 to 10 meters/day (PNNL-14753), the estimated flow rate at Low-Level Waste Management Area 3 is 0.04 to 0.16 meter/day (see Appendix B).

Emplacement of new upgradient wells has been postponed until the effects of the proposed expanded pump-and-treat activities in the 200 West Area have been evaluated.

Previously designated upgradient wells 299-W10-19, 299-W10-20, and 299-W10-21 are now dry because of declines in the water table. Nitrate and carbon tetrachloride routinely exceeded drinking water standards in these wells. Flow and monitoring data collected since RCRA monitoring was instituted in the 1980s indicate that these constituents are from plumes originating from sources to the south (see update in Appendix B). Since then, changes in flow directions have left Low-Level Waste Management Area 3 with no monitoring wells on the upgradient (west) side. For this reason, statistical upgradient/downgradient comparisons have been suspended until background statistics can be re-established. Emplacement of new upgradient wells has also been postponed until the effects of the proposed expanded pump-and-treat activities in the 200 West Area have been evaluated (see Section 2.8.2.2). No suitable upgradient wells are available for use in the interim.

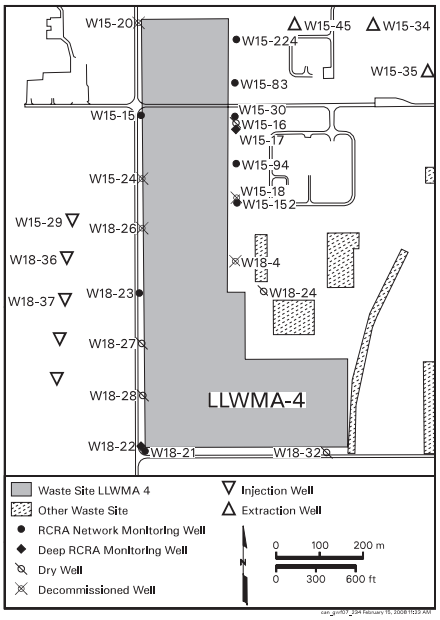
Performance assessment monitoring of radionuclides at Low-Level Waste Management Area 3 is designed to complement RCRA detection monitoring and is aimed specifically at monitoring radionuclide materials that are not regulated under RCRA. The current goal of performance assessment monitoring at Low-Level Waste Management Area 3 is to gather data to assess changes in concentrations at downgradient wells and to provide sufficient supporting information from upgradient wells to interpret the changes. Under the current monitoring plan (DOE/RL-2000-72), technetium-99, iodine-129, tritium, and uranium are monitored specifically for performance assessment.

Contaminants detected in groundwater at Low-Level Waste Management Area 3 include the following:

- Technetium-99 concentrations are all <20 pCi/L and generally show steady or declining trends. Historically, the highest concentrations were in well 299-W10-20, located on the south edge of Low-Level Waste Management Area 3. Although this well is currently downgradient of part of the burial ground, it was initially designated an upgradient well when flow was toward the north and has likely been affected by contaminant sources to the south. Well 299-W10-20 went dry in FY 2006. During FY 2007, the highest technetium-99 result (15.5 pCi/L) occurred in well 299-W7-4. The technetium-99 distribution in the 200-ZP-1 Operable Unit is discussed in Section 2.8.1.9.
- Uranium concentrations at Low-Level Waste Management Area 3 were <2 μg/L (maximum 1.79 μg/L in well 299-W7-4).
- Iodine-129 was not detected during FY 2007 and has not been detected in any wells currently in use at Low-Level Waste Management Area 3.
- Low levels of tritium were detected in only two wells, 299-W8-1 (53.5 pCi/L) and 299-W7-3 (19.6 pCi/L), in FY 2007.
- Carbon tetrachloride and associated trichloroethene and chloroform concentrations in Low-Level Waste Management Area 3 wells are consistent with those seen in regional plumes. Only carbon tetrachloride was detected at levels above the drinking water standard. The highest concentration was 220 μg/L in well 299-W10-31 (the sample was collected in October 2006). Both wells 299-W10-31 and 299-W7-4 display downward trends in carbon tetrachloride and chloroform.
- The nitrate distribution at Low-Level Waste Management Area 3 is consistent with regional plumes, as discussed in Section 2.8.1.4. The maximum

concentration during FY 2007 (40.7 mg/L) was found in well 299-W8-1. Before going dry in FY 2006, well 299-W10-20 had a concentration of 58.9 mg/L.

2.8.3.2 Low-Level Waste Management Area 4



Groundwater at Low-Level Waste Management Area 4 is monitored under RCRA and AEA. Under 40 CFR 265.93(b) as referenced by WAC 173-303-400, the well network was sampled semiannually for RCRA indicator and site-specific parameters (PNNL-14859; see Appendix B for a table and map of well locations). New downgradient well locations had been identified and prioritized under the Tri-Party Agreement Milestone M-24, but impending, accelerated pump-and-treat activities have postponed the drilling of new wells in 200 West Area until the effects of the proposed expanded pump-and-treat system are evaluated.

The groundwater flow in this portion of the 200 West Area is interpreted to be generally to the east, based on water-table contours. The flow direction is affected to a large degree by the 200-ZP-1 pump-and-treat system, which has extraction wells to the east and injection wells to the west of this RCRA site. The gradient is steeper and has a component to the northeast in the north part of the area and is somewhat less steep with a component to the southeast in the south part of the area. The generalized flow direction based on the March 2007 water table for the 200 West Area (Figure 2.8-2), was east-northeast in the northern portion of the facility, to slightly south of east in the southern portion. The average hydraulic gradient is 0.004. With a range in hydraulic conductivity values of 10 to 25 meters/day, the estimated flow rate at Low-Level Waste Management Area 4 using these values is ~0.4 to 1.0 meter/day (see Appendix B).

The general groundwater flow to the east at Low-Level Waste Management Area 4 is largely affected by injection wells to the west and extraction wells to the east.

As in previous years, downgradient wells 299-W15-30, 299-W15-83, 299-W15-94, and 299-W15-224 continued to exceed the statistical comparison value for total organic halides in all samples during FY 2007. Well 299-W15-30 is a replacement for well 299-W15-16, which has gone dry. DOE previously reported the exceedance of the statistical comparison value in well 299-W15-16 (now dry) to the U.S. Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) in August 1999. The elevated total organic halide concentrations are consistent with observed levels of carbon tetrachloride from Plutonium Finishing Plant operations (see Section 2.8.1.1 and 2.8.2) although more data are needed from the newer wells to establish trends. Carbon tetrachloride concentrations display downward trends in all wells in the network for which historical data are available. During FY 2007, the highest concentration was in well 299-W15-94 at 830 µg/L. This was down from 1,200 µg/L in FY 2006. Known sources of carbon tetrachloride include the 216-Z-9 trench, 216-Z-1A tile field, and 216-Z-18 crib (DOE/RL-2006-20). Based on historical groundwater monitoring and interpretations of carbon tetrachloride plumes in the 200 West Area (e.g., DOE/RL-92-16), these liquid disposal facilities were determined to be the overwhelming sources of this contaminant in 200 West Area groundwater. A further discussion of chlorinated-compounds contamination beneath Low-Level Waste Management Area 4 is found in Appendix B.

The other indicator parameters, pH, specific conductance and total organic carbon did not exceed the comparison values for FY 2007. Statistical comparison values for use in FY 2008 are listed in Appendix B.

Performance assessment monitoring of radionuclides at Low-Level Waste Management Area 4 is designed to complement the RCRA detection monitoring. The current goal of performance assessment monitoring at Low-Level Waste Management Area 4 is to gather data to assess changes in concentrations at downgradient wells and to provide sufficient supporting information from upgradient wells to interpret the changes. Under the current monitoring plan (DOE/RL-2000-72), technetium-99, iodine-129, tritium, and uranium are monitored specifically for performance assessment.

Contaminant characteristics at Low-Level Waste Management Area 4 include the following:

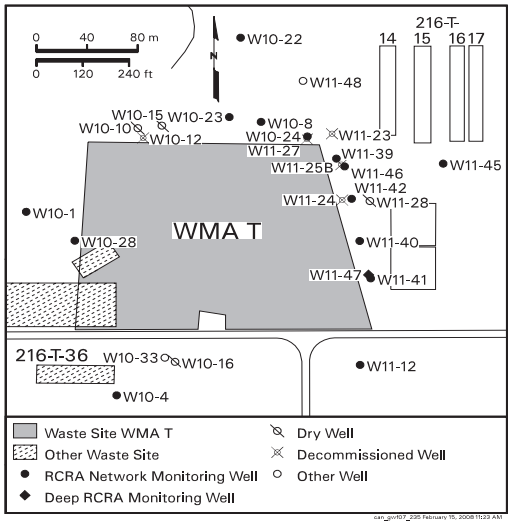
- Technetium-99 concentrations increased in several wells during FY 2007, particularly wells 299-W15-15 (327 pCi/L), 299-W18-21 (343 pCi/L), and 299-W18-23 (440 pCi/L) on the west (upgradient) side of Low-Level Waste Management Area 4. Technetium-99 concentrations also increased in upgradient wells 299-W15-30 (92 pCi/L), 299-W15-152 (199 pCi/L; highest downgradient result) and 299-W15-224 (144 pCi/L). Wells upgradient of Waste Management Area TX-TY were converted to extraction wells for the pump-and-treat system in mid-2005. Shortly thereafter, technetium-99 concentrations in those wells began increasing, reaching >1,000 pCi/L in two of those wells (299-W15-44 and 299-W15-765) by the beginning of 2006. The resulting increases in technetium-99 concentration in the injection water, coupled with a 20 to 25% increase in injection volume from the addition of new extraction wells, could be responsible for the increases in technetium-99 concentration in wells at Low-Level Waste Management Area 4. However, the increases in technetium-99 concentration at the beginning of 2007 are fairly abrupt and occur over a wide area suggesting that other factors also may be involved.
- Uranium concentrations are highest, but also declining, in upgradient wells 299-W15-15 (8.33 μg/L), 299-W18-23 (9.89 μg/L), and 299-W18-21 (21.3 μg/L; highest in the network for FY 2007). The highest uranium concentrations at downgradient locations occurred in well 299-W15-152 (2.16 μg/L). No ongoing trends are apparent in downgradient wells, partly because of the limited period of data collection in the newer wells.
- Iodine-129 was not detected in Low-Level Waste Management Area 4 wells during FY 2007.
- Tritium concentrations were highest in downgradient well 299-W15-83 at 1,910 pCi/L and display an upward trend in this well and adjacent well 299-W15-30 (1,000 pCi/L). Upgradient well 299-W18-23 (1,830 pCi/L) and downgradient well 299-W15-152 (1,750 pCi/L) show downward trends in tritium concentrations.
- Nitrate continued to exceed the drinking water standard at all monitoring wells in Low-Level Waste Management Area 4 except downgradient well 299-W15-17 (26 mg/L) and deep well 299-W18-22 (18.6 mg/L). The highest concentration in FY 2007 was in upgradient well 299-W18-23 (152 mg/L). This well and wells 299-W15-30 (97 mg/L) and 299-W18-21 (145 mg/L) exhibit upward trends in nitrate. This contamination is not believed to be related to waste disposal at the burial grounds. Some of the nitrate contamination is related to injection of 200-ZP-1 treated water upgradient of the burial ground. The treatment system does not remove nitrate from the water.

Nitrate continued to exceed the drinking water standard at all monitoring wells at Low-Level Waste Management Area 4 except two.

- Concentrations of carbon tetrachloride, trichloroethene and chloroform are consistent with regional plumes as shown in Sections 2.8.1.1, 2.8.1.2, and 2.8.1.3. The highest concentration of carbon tetrachloride during FY 2007 occurred in well 299-W15-94 (830 µg/L). All wells in the network with results above detection show decreasing trends of this constituent. Chloroform and trichloroethene concentrations remained below the drinking water standard. Only two wells, 299-W15-83 and 299-W15-94, produced trichloroethene concentrations above detection limits.

2.8.3.3 Waste Management Area T

Waste Management Area T is located in the north-central part of the 200 West Area and consists of the T Tank Farm with its ancillary equipment (e.g., diversion boxes and pipelines). The tank farm contains twelve 2-million-liter tanks and four 208,000-liter tanks constructed between 1943 and 1944. Seven of the tanks in the waste management area are known or suspected to have leaked (RPP-23405, Rev. 1). This section describes groundwater monitoring at Waste Management Area T. A well location map and a table of wells and analytes for this waste management area are included in Appendix B.



The objective of RCRA groundwater monitoring at Waste Management Area T is to assess the extent and rate of movement of dangerous waste in groundwater that have a source from the waste management area (40 CFR 265.93(d) as referenced by WAC 173-303-400). The groundwater assessment plan for Waste Management Area T is PNNL-15301. In addition to monitoring dangerous waste constituents for RCRA assessment, the site is monitored for CERCLA and AEA purposes. Waste Management Area T was originally placed in RCRA assessment monitoring because of elevated specific conductance in downgradient well 299-W10-15 (WHC-SD-EN-AP-132). This area remains in assessment because of continued elevated contaminants observed in downgradient wells.

Dangerous waste constituents found in groundwater near Waste Management Area T in FY 2007 are chromium and nitrate. These constituents probably originate from more than one source including the waste management area. Other constituents found near the waste management area in FY 2007 include carbon tetrachloride, trichloroethene, tritium, technetium-99, and cobalt-60. The carbon tetrachloride and trichloroethene do not appear to be from Waste Management Area T and are discussed in Sections 2.8.1.1 and 2.8.1.2. Most of the tritium is believed to be part of a regional plume, although a contribution from Waste Management Area T cannot be ruled out. The technetium-99 plume, located east (downgradient) of the T Tank Farm, is attributed, at least in part, to the tank farm.

The carbon tetrachloride and trichloroethene contamination does not appear to be from Waste Management Area T.

Calculated average linear groundwater flow velocities at Waste Management Area T range from 0.002 to 0.25 meter/day with most values <0.1 meter/day. Groundwater flow direction beneath the waste management area is to the east between 85 and 98 degrees from north as determined by trend surface analyses (PNNL-13378; PNNL-14113) and the most current water-table map (Figure 2.8-2).

The monitoring network for Waste Management Area T includes fourteen wells that are sampled quarterly and two wells sampled semiannually. All samples

were collected as scheduled in FY 2007 except the first quarter sample from well 299-W11-47. Well 299-W11-47 was not sampled because of mechanical difficulties. In September 2007, downgradient wells 299-W11-45 and 299-W11-46 were converted to extraction wells to remove technetium-99 from the aquifer east of Waste Management Area T.

In September 2007, downgradient wells 299-W11-45 and 299-W11-46 were converted to extraction wells to remove technetium-99 from the aquifer east of Waste Management Area T.

Two new monitoring wells were installed in FY 2007 as part of the 200-ZP-1 technetium-99 characterization at T Tank Farm. The first new well (299-W11-48) was constructed in July 2007 and was screened between 10 and 38 meters below the water table. Well 299-W11-48 is located north of the northeast corner of the Waste Management Area. The purpose of the well was to bound the northern extent of the technetium-99 plume located east of the Waste Management Area.

The second new well (299-W10-33) was started in June 2007 and completed in October 2007. This well is located south of the western part of the Waste Management Area and was screened between 49 and 55 meters below the water table. The purpose of this well was to determine whether high concentrations of technetium-99 existed deep in the aquifer in the area near the 216-T-36 crib and the 216-T-7 crib and tile field. Nether of the new wells are part of the Waste Management Area T monitoring network. However, both new wells were sampled during drilling and the data collected during drilling are discussed in the following paragraphs.

A data quality objectives process document, *T Area Technetium-99 Data Quality Objectives Summary Report* (WMP-28389), describes the locations of additional new wells needed to further delineate the technetium-99 plume located east of Waste Management Area T.

A plume map depicting the FY 2007 average chromium concentration in wells in the uppermost part of the aquifer near the Waste Management Area T is shown in Figure 2.8-10. The map shows that the chromium plume extends from the west and southwest part of the waste management area to northeast of the waste management area. The highest average chromium concentration in the upper part of the aquifer during FY 2007 was in well 299-W10-4 (average 470 µg/L) located at the southwest corner of the waste management area. The chromium concentration in upgradient well 299-W10-28, which had been above the drinking water standard for the past four years, decreased to an average concentration of 94 µg/L during FY 2007. The chromium concentration in the upper part of the aquifer also exceeded the drinking water standard in three downgradient wells.

The highest average chromium concentration found at Waste Management Area T was 641 µg/L.

The highest average chromium concentration found at Waste Management Area T was 641 µg/L (up from 290 µg/L during the previous year) in well 299-W11-46, completed deeper in the aquifer between 6 and 12 meters below the water table. The chromium concentration in adjacent well 299-W11-39, screened at the water table was 150 µg/L. Chromium in well 299-W11-45, located ~80 meters downgradient of well 299-W11-46 and completed between 8.5 and 13 meters below the water table, averaged 100 µg/L. These concentrations show that the chromium plume at Waste Management Area T extends relatively deep in the aquifer and laterally to at least 80 meters downgradient of the waste management area.

A fluoride plume extends from the southwest to the north and east of Waste Management Area T. The extent of the plume remained almost unchanged from the previous year. The highest fluoride concentrations measured in FY 2007 at Waste Management Area T were 4.4 and 4.3 mg/L in wells 299-W10-23 and 299-W10-8,

located north of the Waste Management Area (the drinking water standard for fluoride is 4 mg/L).

A local nitrate plume sits within the regional nitrate plume and beneath Waste Management Area T (Figure 2.8-9). The plume retains the same general configuration as in FY 2006. The highest average nitrate concentrations were in upgradient wells 299-W10-28 and 299-W10-4. More than one source, including the Waste Management Area T, probably contributed to the nitrate plume beneath the waste management area, but the higher upgradient concentrations indicate greater contributions from other sources. A discussion of nitrate contamination in the north central part of 200 West Area is given in Section 2.8.1.4.

The highest average nitrate concentrations were in upgradient well 299-W10-28 (1,977 mg/L) and well 299-W10-4 (2,896 mg/L).

Tritium exceeded the interim drinking water standard (20,000 pCi/L) in one well at Waste Management Area T. The average FY 2007 tritium concentration in well 299-W11-12, located at the southeast corner of the waste management area, was 38,000 pCi/L down slightly from 44,000 pCi/L during the previous year. The tritium concentration has been slowly decreasing in this well since 1998. The source of the tritium is thought to be farther south near the TX and TY Tank Farms (Figure 2.8-11).

A technetium-99 plume is located along the east (downgradient) side of Waste Management Area T (Figure 2.8-13). The highest technetium-99 concentrations in the upper part of the aquifer are in downgradient well 299-W11-39 at the northeast corner of the waste management area, where the average technetium-99 concentration was 22,000 pCi/L in FY 2007, slightly less than 24,000 pCi/L during the previous year. Technetium-99 also exceeds the drinking water standard in all other downgradient, water-table wells (Figure 2.8-15). The first indication of technetium-99 contamination in groundwater at Waste Management Area T was in well 299-W11-27, located at the northeast corner of the T Tank Farm, in late 1995 coincident with the cessation of surface water disposal in the 200 West Area. Discussions in PNNL-11809 suggest that the technetium-99 had arrived at well 299-W11-27 by the early 1990s, but was masked by dilution with water from a leaking water line located immediately adjacent to the well and the technetium-99 concentration became detectable only after surface water disposal was stopped. Detailed discussions of the history of groundwater contamination at Waste Management Area T can be found in PNNL-11809, PNNL-15837, PNNL-15301, PNNL-13928, and DOE/ORP-2008-01.

The technetium-99 concentration increased throughout the year in well 299-W11-46 to a maximum of 113,000 pCi/L.

Figure 2.8-16 shows the technetium-99 concentration versus time in three downgradient wells that are screened below the water table at Waste Management Area T. Well 299-W11-46 is located adjacent to well 299-W11-39 and screened between 6 and 12 meters below the water table. The well is the replacement well for well 299-W11-25B, which had 181,000 pCi/L technetium-99 at 10 meters below the water table when it was drilled in 2005. The technetium-99 concentration increased throughout the year in well 299-W11-46 to a maximum of 113,000 pCi/L. This compares to the average of 22,700 pCi/L in the adjacent well 299-W11-39 and shows that the highest technetium-99 concentrations in the area are below the screened interval in well 299-W11-39.

Well 299-W11-45 is located about 80 meters downgradient of well 299-W11-46 and screened between 8.5 and 13 meters below the water table; technetium-99 averaged 21,225 pCi/L in the well during FY 2007. The concentrations in this well show that the technetium-99 plume found east of the waste management area extends to at least 80 meters downgradient of the waste management area.

Iodine-129 exceeded the drinking water standard (1 pCi/L) in two of the deeper wells east of Waste Management Area T

Iodine-129 exceeded the drinking water standard (1 pCi/L) in two of the deeper wells east of Waste Management Area T throughout the year. The iodine-129 concentration remained fairly steady at 3 to 3.3 pCi/L in well 299-W11-45 but increased steadily from 6.6 to 13.6 pCi/L throughout FY 2007 in well 299-W11-46. Iodine-129 was not detected in any downgradient water-table well. Cobalt-60 was also found in well 299-W11-46 throughout FY 2007, the concentrations were between 24 and 34 pCi/L, less than the 100 pCi/L drinking water standard.

Manganese exceeded the secondary drinking water standard of 50 µg/L in wells 299-W11-39 (65.5 µg/L) and 299-W11-47 (85.8 µg/L). Well 299-W11-47 is a fairly new well and elevated manganese is common in new wells. The manganese concentration has been decreasing in well 299-W11-47 since it was drilled in March 2006. The reason for the elevated manganese in well 299-W11-39 is not known.

The pH exceeded 8.5 in three of the four quarters in FY 2007 in well 299-W10-24 (pH ranged from 8.46 to 8.7). The pH commonly slightly exceeds 8.5 in this well.

Wells 299-W10-33 and 299-W11-48 were drilled in calendar year 2007 to the top of the Ringold Formation lower mud unit. Well 299-W10-33 is screened between 49 and 55 meters below the water table and well 299-W11-48 is screened between 10 and 38 meters below the water table. Both wells were sampled with a pump at several depths during drilling. Figure 2.8-17 shows the distribution of contaminants with depth in both wells. Chromium exceeded the drinking water standard at ~5 meters below the water table in well 299-W10-33 and between 30 and 40 meters below the water table in well 299-W11-48. Carbon tetrachloride also exceeded the drinking water standard throughout most of the drilled depth in both wells. Technetium-99 is below the drinking water standard throughout the entire drilled depth of both wells.

Well 299-W10-33 is located near well 299-W10-4. The latter well has had extremely high concentrations of most major cations and anions since at least 2000. The concentrations of major cations (Figure 2.8-18) and anions (Figure 2.8-19) in well 299-W10-33 are also extremely high although not as high as in well 299-W10-4. Apparently, brackish water sampled in well 299-W10-4 (salinity of 3,274 mg/L) extends to well 299-W10-33 (salinity of 2,147 mg/L). (Most wells at Waste Management Area T have salinities of ~1,400 mg/L or less.) The source of the high ion concentrations is probably one or more of the past-practice disposal facilities west of the waste management area.

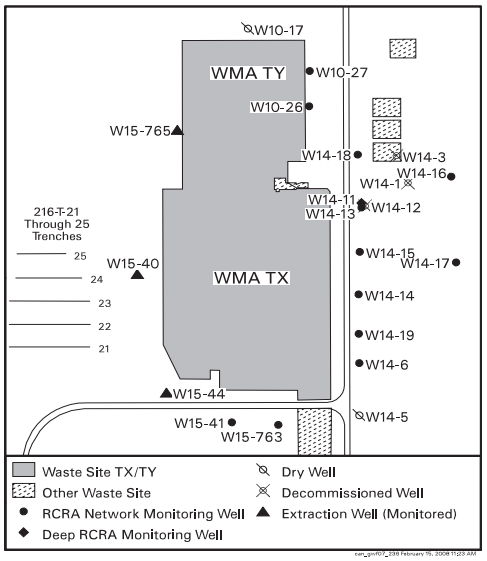
In 2005 and 2006, consultants to CH2M Hill Hanford Group, Inc. performed a series of surface geophysical surveys to map subsurface contaminant distribution beneath the T Tank Farm and surrounding area (RPP-RPT-28955). One tool used was high-resolution resistivity surveys. One of the surveys used 17 groundwater wells around the periphery of the tank farm as electrodes. Because the wells are in direct contact with the saturated zone, the results of the survey were interpreted to be at the depth of the water table.

The results of the survey showed four areas of low resistivity (high conductivity) at the water table (RPP-RPT-28955). The low resistivity is most likely associated with high nitrate concentration. One low-resistivity area is located beneath the disposal facilities west and southwest of Waste Management Area T. (The surveys using surface electrode arrays showed vadose zone contamination extending to groundwater in this area.) The contaminant plume in this area is reflected in the high salinity found in wells 299-W10-4 and 299-W10-33.

The second low-resistivity area is located at the northeast corner of the waste management area in the area of wells 299-W11-39, 299-W11-46, and 299-W11-42 where nitrate concentrations were on the order of 300 to 900 mg/L during 2007. The third low-resisitivity area is between well 299-W10-22 and 299-W10-23, north of the waste management area. Well 299-W11-48 was drilled through the eastern part of this area during FY 2007 and found relatively moderate nitrate concentrations between 100 and 200 mg/L near the water table. The final area of low resistivity at the groundwater is inside the tank farm fence and west of wells 299-W11-41 and 299-W11-47. Nitrate concentration in these wells was very high and between ~700 and 800 mg/L during 2007. The contamination in these wells may be related to the low resistivity area to the west.

2.8.3.4 Waste Management Area TX-TY

Waste Management Area TX-TY is located in the north-central part of the 200 West Area and consists of the TX and TY Tank Farms and ancillary equipment (e.g., diversion boxes and pipelines). The tank farms contain twenty-four 2.9-million-liter tanks constructed between 1944 and 1952. Twelve of the tanks in the waste management area are known or suspected to have leaked. A well location map and a table of wells and analytes for this waste management area are shown in Appendix B.



Waste Management Area TX-TY was originally placed in RCRA assessment monitoring (40 CFR 265.93(d) as referenced by WAC 173-303-400) because of elevated specific conductance in downgradient wells 299-W10-27 and 299-W14-12 (WHC-SD-EN-AP-132). The groundwater assessment plan for Waste Management Area TX-TY was updated in FY 2007 (PNNL-16005) to incorporate information obtained from new wells drilled since the most recent Interim Change Notice to the previous plan (PNNL-12072-ICN-1). The objective of RCRA groundwater monitoring at Waste Management Area TX-TY is to assess the extent and rate of movement of dangerous waste in groundwater that have a source from the waste management area. In addition to monitoring dangerous waste constituents for RCRA assessments, the site is monitored for AEA and CERCLA.

The monitoring network for Waste Management Area TX-TY includes 16 wells that are sampled quarterly. All upgradient wells for the waste management area were converted to extraction wells for the 200-ZP-1 pump-and-treat system in July 2005. Groundwater flow direction varies beneath the waste management area due to influences from the pump-and-treat operation. In the north part of the waste management area, groundwater flow is changing from eastward to westward due to the recently converted extraction wells. South of Waste Management Area TX-TY, groundwater flow direction is toward extraction wells located south or southwest of the waste management area.

Dangerous waste constituents found beneath Waste Management Area TX-TY in FY 2007 are chromium and nitrate.

Dangerous waste constituents found in groundwater near Waste Management Area TX-TY in FY 2007 are chromium and nitrate. Other constituents found near the waste management area in 2007 include carbon tetrachloride, trichloroethene, tritium, technetium-99, and iodine-129. The carbon tetrachloride and trichloroethene are attributed to Plutonium Finishing Plant operations and are discussed in Sections 2.8.1.1 and 2.8.1.2.

Twelve of the tanks in Waste Management Area TX-TY are known or suspected to have leaked.

Nitrate concentrations exceeded the drinking water standard (45 mg/L) in all wells in the Waste Management Area TX-TY monitoring network in FY 2007. Figure 2.8-9 shows a plume map for nitrate in the area. Overall, the nitrate concentrations remain fairly steady in most wells at the waste management area.

The highest average nitrate concentration at the waste management area during FY 2007 was 720 mg/L in well 299-W10-27. The highest nitrate concentrations at the waste management area for the previous several years has been in well 299-W14-13, located south of well 299-W10-27. It is unlikely that the nitrate plume at well 299-W14-13 has moved north to well 299-W10-27 because nitrate concentration in well 299-W10-26, located between wells 299-W10-27 and 299-W14-13, is lower than in the two adjacent wells. Nitrate has been increasing in well 299-W10-27 since the end of 2005.

The nitrate concentration increased in well 299-W14-15, located south of well 299-W14-13. The FY 2007 average nitrate concentration was 160 mg/L, up from an average of 107 mg/L in FY 2006. The concentrations of technetium-99 and iodine-129 also increased in well 299-W14-15 in FY 2007 and probably the contaminant plumes previously found in well 299-W14-13 are now encroaching on well 299-W14-15.

Much of the nitrate contamination at Waste Management Area TX-TY is attributed to Plutonium Finishing Plant operations as well as past-practice disposal to cribs and trenches in the area.

Much of the nitrate contamination at Waste Management Area TX-TY is attributed to Plutonium Finishing Plant operations as well as past-practice disposal to cribs and trenches in the area. Some nitrate contamination also may be from Waste Management Area TX-TY, although distinguishing the different sources is extremely difficult. More discussion of nitrate in north-central 200 West Area is given in Section 2.8.1.4.

Chromium was detected above the drinking water standard (100 µg/L) in two wells at Waste Management Area TX-TY during FY 2007. The annual average chromium concentration in well 299-W14-13 was 660 µg/L during the year, down from 740 µg/L during FY 2006. The chromium concentration has been elevated in this well since it was drilled in 1998 and was elevated in the early 1990s in adjacent but now dry well 299-W14-12. The chromium contamination in the area is accompanied by elevated concentrations of nitrate, iodine-129, technetium-99, and tritium.

Well 299-W14-11 is located next to well 299-W14-13 but is screened between 11.6 and 14.6 meters below the water table. The annual average chromium concentration in the well was below the drinking water standard and was 76 µg/L during the year, but the last sample collected in FY 2007 contained 111 µg/L chromium. This indicates that substantial chromium may exist deeper in the aquifer than indicated by wells screened at the water table, although the highest concentrations appear to be near the water table in the area.

The chromium contamination in the area is accompanied by elevated concentrations of nitrate, iodine-129, technetium-99, and tritium.

Well 299-W14-15 is located south of well 299-W14-13. The annual average chromium concentration in the well was 77 µg/L in FY 2007, but the chromium concentration increased throughout the year to 121 µg/L during the fourth quarter. The increase in chromium was accompanied by increases in iodine-129, nitrate, technetium-99, and tritium (Figure 2.8-20) suggesting that the contaminant plumes previously found in well 299-W14-13 are moving south to well 299-W14-15, possibly due to changes made to the 200-ZP-1 pump-and-treat system west and south of the waste management area. The source for the chromium is assumed to be Waste Management Area TX-TY because no alternative sources have been identified.

A small tritium plume exists along the east-central part of Waste Management Area TX-TY (Figure 2.8-11). The tritium concentration exceeded the drinking

water standard (20,000 pCi/L) in three wells in the area. The highest average tritium concentration was 1.5 million pCi/L in well 299-W14-13 during the fiscal year, which was down slightly from 1.7 million pCi/L during the previous year although concentrations have remained fairly stable since FY 2002. The average tritium concentration in the adjacent well, 299-W14-11 (screened from 11.6 to 14.6 meters below the water table), was 127,425 pCi/L. The tritium concentrations in these two wells indicate that the highest concentrations are near the water table in this area.

The tritium concentrations in well 299-W14-15, located south of well 299-W14-13, also exceeded the drinking water standard during the year with an average concentration of 97,000 pCi/L, up from 54,000 pCi/L during the previous year (Figure 2.8-20). The source for the high tritium in the area could be Waste Management Area TX-TY, the 242-T evaporator, the 216-T-19 crib and tile field (which received evaporator condensate from the 242-T evaporator), the 216-T-26 through 216-T-28 cribs, or a combination of these potential sources.

The annual average technetium-99 concentration was 6,658 pCi/L in well 299-W14-13 and 2,325 pCi/L in deeper well 299-W14-11. Both concentrations are down somewhat from the previous year

Technetium-99 exceeded the interim drinking water standard (900 pCi/L) in both wells in the well pair 299-W14-11 and 299-W14-13 at Waste Management Area TX-TY in FY 2007. The annual average technetium-99 concentration was 6,700 pCi/L in well 299-W14-13 and 2,325 pCi/L in deeper well 299-W14-11. Both concentrations are down somewhat from the previous year and continue to indicate that the highest technetium-99 concentrations are near the water table in that area, similar to chromium, nitrate, iodine-129, and tritium. The technetium-99 concentration also exceeded the drinking water standard in well 299-W14-15, located south of the wells 299-W14-13 and 299-W14-11. The average concentration was 1,700 pCi/L during the year, up from 940 pCi/L during the previous year. The source for the technetium-99 in these wells east of the waste management area could be the waste management area itself or one of the past-practice disposal facilities in the area or both.

Technetium-99 is also found at levels above the drinking water standard in wells south and west of the waste management area (Figure 2.8-13). Technetium-99 in these wells is thought to be drawn to the wells from beneath the TX and TY Tank Farms by extraction for the 200-ZP-1 pump-and-treat. Figure 2.8-21 shows the technetium-99 concentration versus time for four wells. Wells 299-W15-44 and 299-W15-765 were put into service as extraction wells for 200-ZP-1 Operable Unit in July 2005 and the technetium concentration began to increase in these wells shortly thereafter.

The highest iodine-129 concentration measured at the waste management area during the reporting period was 45.4 pCi/L in the August 2007

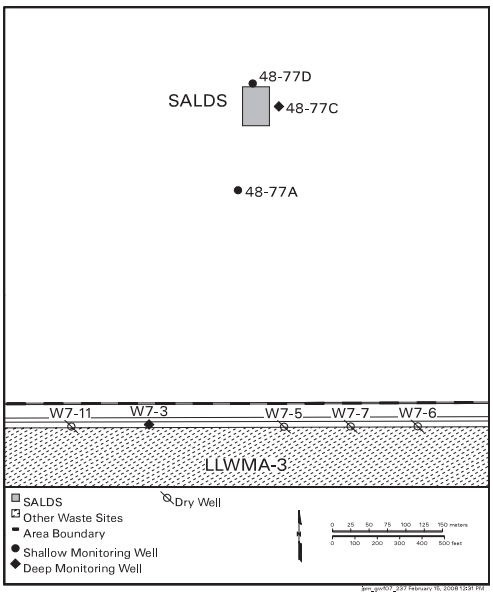
Iodine-129 was detected in three wells at Waste Management Area TX-TY during FY 2007. The highest iodine-129 concentration measured at the waste management area during the reporting period was 45.4 pCi/L in the August 2007 sample from well 299-W14-13. The average iodine-129 concentration in adjacent and deeper screened well 299-W14-11 was 4.8 pCi/L indicating that the iodine-129 contamination resides near the water table, similar to the other contaminants in the area. Iodine-129 also was detected in well 299-W14-15, located south of well 299-W14-13. The iodine-129 concentration in this well increased throughout the year from 2.08 pCi/L in November 2006 to 6.89 pCi/L in August 2007.

Manganese exceeded the secondary drinking water standard of 50 µg/L in well 299-W10-27 where the average FY 2007 concentration was 276 µg/L. The manganese concentration has been high in this well since it was first sampled in 2001 although the concentration has decreased dramatically since that time. It is common for new wells on the Hanford Site to have elevated manganese values during the first few years of sampling, but the elevated manganese in this well has persisted. The reason for the elevated manganese is not known.

Nickel-63 was found in well 299-W15-763 in August 2006 at 57.1 pCi/L. As a result, nickel-63 was added to the sampling schedule for the former upgradient wells at Waste Management Area TX-TY (now extraction wells for 200-ZP-1 pump-and-treat), selected wells between the waste management area and the pump-and-treat wells, and in downgradient wells 299-W14-13 and 299-W14-11. In FY 2007, the nickel-63 concentrations in the wells most affected by the pump-and-treat operation were very low between 4 and 8 pCi/L. The nickel concentrations in well 299-W14-13 were between 363 and 836 pCi/L and concentrations in well 299-W14-11 were between 63 and 163 pCi/L. One-twenty-fifth of the derived concentration guide (equivalent to 4 mrem or the drinking water standard for gross beta) for nickel-63 is 12,000 pCi/L, larger than the detected concentrations at the waste management area.

2.8.3.5 State-Approved Land Disposal Site

The Hanford Site 200 Area Effluent Treatment Facility processes contaminated aqueous waste from Hanford Site facilities. The treated wastewater occasionally contains tritium, which is not removed by the Effluent Treatment Facility, and is discharged to the 200 Area State-Approved Land Disposal Site. During FY 2007, 13.9 million liters of water were discharged to the State-Approved Land Disposal Site as compared to 15.7 million liters in FY 2006.



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 operations in December 1995. Groundwater monitoring requirements are described in the site monitoring plan (PNNL-13121). Groundwater monitoring for tritium only was conducted in 11 wells around the facility (Appendix B). The permit stipulates requirements for groundwater monitoring and establishes enforcement limits for concentrations of 15 constituents in three additional wells immediately surrounding the facility (Appendix B).

Wells immediately surrounding the facility were sampled four times in FY 2007. Tritium tracking wells were sampled either annually or semi-annually. Many of the wells south of the State-Approved Land Disposal Site in the tritium-tracking network have gone dry. Water-level measurements in the three wells nearest the State-Approved Land Disposal Site indicated a small localized groundwater mound beneath the site as a result of discharges. This mound results in radial flow outward a short distance before the regional northeastward flow predominates. This condition also places several wells south of the State-Approved Land Disposal Site hydraulically downgradient of the facility.

During FY 2007, 13.9 million liters of water were discharged to the State-Approved Land Disposal Site.

Average tritium concentrations decreased in two of three State-Approved Land Disposal Site proximal wells during FY 2007 compared with FY 2006 (Figure 2.8-22).

Concentrations of all chemical constituents with permit limits were within those limits during all of FY 2007. Acetone, benzene, chloroform and tetrahydrofuran were below method detection limits in all samples. Detectable concentrations of lead and

copper (maximum 1.69 and 3.29 µg/L, respectively) were reported at well 699-48-77A. Concentrations of major anions and cations continued at below-background levels observed prior to operation of the facility. The low concentrations are due to dilution by the otherwise clean water discharged to the State-Approved Land Disposal Site.

For all wells, the hydraulic head in March 2007 had declined an average of 0.25 meter from April 2006 level, or an annual decrease of 0.27 meter/year. The 200-UP-1 pump-and-treat system resumed in April 2007 and water from that system is discharged to the State-Approved Land Disposal Site. As a result, water levels are expected to increase in that area in the future. Water levels at the State-Approved Land Disposal Site proximal wells have declined at more rapid rates than outlying wells within the tritium-tracking system because discharge volumes decreased after cessation of the 200-UP-1 pump-and-treat system in January 2005. Numerical flow-and-transport modeling of the State-Approved Land Disposal Site was last conducted in August 2004, as required by the permit (PNNL-14898).

Table 2.8-1. Contaminants of Concern in all Wells in the 200-ZP-1 Groundwater Interest Area, FY 2007 (DOE/RL-2003-55)

Constituent	Filtered	Number of Wells, 2007	Number of Results	Detects	Rejects	Preliminary Target Action Level	Action Level Source	Results Above Standard	Wells Above Standard
1,1,1-Trichloroethane, ug/L	N	73	259	4		200	MCL		
1,1,1-Trichloroethane, ug/L	Y	1	2			200	MCL		
1,2-Dichloroethane, ug/L	N	73	259	1		5	CRDL		
1,2-Dichloroethane, ug/L	Y	1	2			5	CRDL		
2-Butanone, ug/L	N	73	306	8		4,800	CLARC		
2-Butanone, ug/L	Y	1	2			4,800	CLARC		
2-Pentanone, 4-Methyl, ug/L	N	73	259			640	CLARC		
2-Pentanone, 4-Methyl, ug/L	Y	1	2			640	CLARC		
Acetone, ug/L	N	73	307	20		800	CLARC		
Acetone, ug/L	Y	1	2			800	CLARC		
Antimony, ug/L	N	12	59	25		10	CRDL		
Antimony, ug/L	Y	72	259	3		10	CRDL	3	3
Arsenic, ug/L	N	5	52	50		10	CRDL		
Arsenic, ug/L	Y	11	30	18		10	CRDL	2	1
Benzene, ug/L	N	73	342	9		5	CRDL		
Benzene, ug/L	Y	1	2			5	CRDL		
Cadmium, ug/L	N	14	66	2		5	MCL		
Cadmium, ug/L	Y	72	261			5	MCL		
Carbon disulfide, ug/L	N	73	259	42		800	CLARC	1	1
Carbon disulfide, ug/L	Y	1	2			800	CLARC		
Carbon tetrachloride, ug/L	N	72	469	423	1	3	CRDL	407	59
Carbon tetrachloride, ug/L	Y	1	7	7		3	CRDL	7	1
Carbon-14, pCi/L	N	1	1			2,000	MCL		
Cesium-137, pCi/L	N	23	36			60	MCL		
Chlorobenzene, ug/L	N	37	195	1		100	MCL		
Chlorobenzene, ug/L	Y	1	2			100	MCL		
Chloroform, ug/L	N	73	466	419		7	CLARC	331	38
Chloroform, ug/L	Y	1	7	7		7	CLARC	4	1
Chromium, ug/L	N	12	59	52		100	MCL	6	3
Chromium, ug/L	Y	72	259	222		100	MCL	31	11
cis-1,2-Dichloroethene, ug/L	N	68	201	3		70	MCL		
Cresol (total):						80	CLARC		
2-Methylphenol (cresol, o-), ug/L	N	15	18						
3+4 Methylphenol (cresol, m+p), ug/L	N	15	18						
Cyanide, ug/L	N	2	9	1		200	MCL		
Ethylbenzene, ug/L	N	71	246	2		700	MCL		
Ethylbenzene, ug/L	Y	1	2			700	MCL		

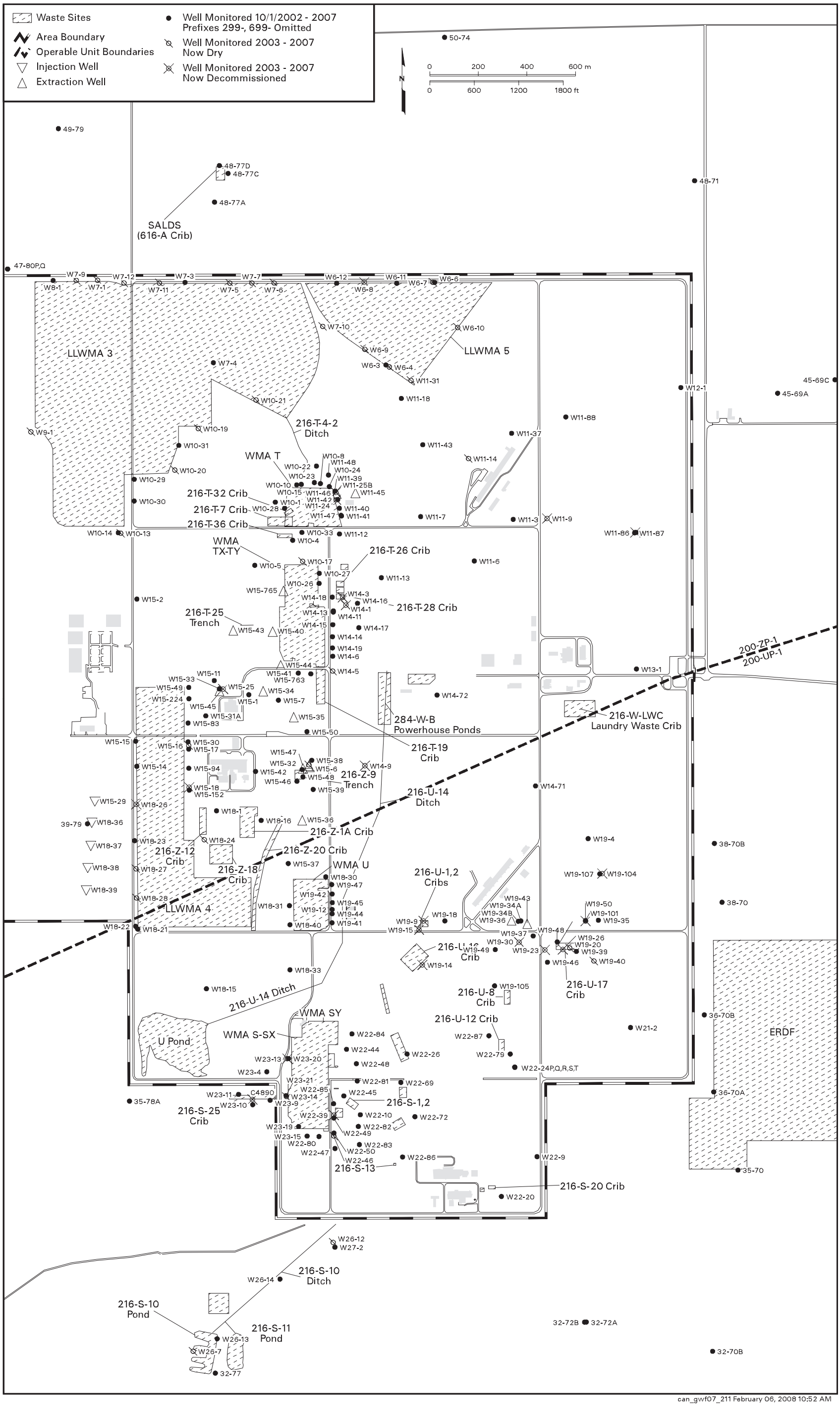
Table 2.8-1. (contd)

Constituent	Filtered	Number of Wells, 2007	Number of Results	Detects	Rejects	Preliminary Target Action Level	Action Level Source	Results Above Standard	Wells Above Standard
Fluoride, ug/L	N	90	420	418		4,000	MCL	8	4
Fluoride, ug/L	Y	2	2	2		4,000	MCL		
Hexavalent Chromium, ug/L	N	15	63	46		48	CLARC	12	3
Hexavalent Chromium, ug/L	Y	2	2			48	CLARC		
Iodine-129, pCi/L	N	60	185	20		1	MCL	20	6
Iodine-129, pCi/L	Y	1	2			1	MCL		
Iron, ug/L	N	12	59	37		300	2nd MCL	4	2
Iron, ug/L	Y	72	259	123		300	2nd MCL	1	1
Lead, ug/L	N	7	59	20		15	MCL		
Lead, ug/L	Y	19	35	1		15	MCL		
Magnesium, ug/L	N	12	59	59			TBD		
Magnesium, ug/L	Y	72	259	257	1		TBD		
Manganese, ug/L	N	14	66	57		50	2nd MCL	31	4
Manganese, ug/L	Y	72	261	111	1	50	2nd MCL	20	5
Mercury, ug/L	N	3	13	1		2	MCL		
Mercury, ug/L	Y	18	33	1		2	MCL		
Methylene chloride, ug/L	N	73	300	21		5	MCL	6	4
Methylene chloride, ug/L	Y	1	2	1		5	MCL	1	1
n-Butylbenzene, ug/L	N	1	6			320	CLARC		
Neptunium-237, pCi/L	N	1	1			15	MCL		
Nickel, ug/L	N	12	59	55		320	CLARC		
Nickel, ug/L	Y	72	259	71		320	CLARC		
Nitrate, ug/L	N	91	503	498	5	12,400	Background	461	84
Nitrate, ug/L	Y	3	8	8		12,400	Background	8	3
Nitrite, ug/L	N	89	411	40	71	3,268	MCL	7	3
Nitrite, ug/L	Y	1	1			3,268	MCL		
Pentachlorophenol, ug/L	N	15	18				TBD		
Phenol (total):							TBD		
2,3,4,6-Tetrachlorophenol, ug/L	N	15	17						
2,4,5-Trichlorophenol, ug/L	N	15	17						
2,4,6-Trichlorophenol, ug/L	N	15	17						
2,4-Dichlorophenol, ug/L	N	15	18						
2,4-Dimethylphenol, ug/L	N	15	17						
2,4-Dinitrophenol, ug/L	N	15	17						
2,6-Dichlorophenol, ug/L	N	15	17						
2-Chlorophenol, ug/L	N	15	17						
2-Nitrophenol, ug/L	N	15	18						
Dinoseb(2-secButyl-4,6-dinitrophenol), ug/L	N	15	17						

Table 2.8-1. (contd)

Constituent	Filtered	Number of Wells, 2007	Number of Results	Detects	Rejects	Preliminary Target Action Level	Action Level Source	Results Above Standard	Wells Above Standard
4,6-Dinitro-2-methylphenol, ug/L	N	15	17						
4-Chloro-3-methylphenol, ug/L	N	15	17						
4-Nitrophenol, ug/L	N	15	17						
Phenol, ug/L	N	15	18				TBD		
Phosphate, ug/L	N	7	79				TBD		
Selenium, ug/L	N	3	13	5		50	MCL		
Selenium, ug/L	Y	3	13	6		50	MCL		
Selenium-79, pCi/L	N	1	1				MCL		
Silver, ug/L	N	10	20	6		80	CLARC		
Silver, ug/L	Y	72	259	42		80	CLARC		
Strontium-90, pCi/L	N	22	78	2		8	MCL		
Strontium-90, pCi/L	Y	1	2			8	MCL		
Technetium-99, pCi/L	N	77	396	339	3	900	MCL	109	16
Technetium-99, pCi/L	Y	2	7	3		900	MCL		
Tetrachloroethene, ug/L	N	73	303	88		5	CRDL	1	1
Tetrachloroethene, ug/L	Y	1	7			5	CRDL		
Toluene, ug/L	N	73	342	5		1,000	MCL		
Toluene, ug/L	Y	1	2			1,000	MCL		
trans-1,2-Dichloroethylene, ug/L	N	68	200	1		100	MCL		
Trichloroethene, ug/L	N	73	471	342		5	CRDL	187	22
Trichloroethene, ug/L	Y	1	7	4		5	CRDL	1	1
Tritium, pCi/L	N	87	348	282	1	20,000	MCL	36	9
Tritium, pCi/L	Y	1	2	1		20,000	MCL		
Uranium, ug/L	N	38	146	146		30	MCL	2	1
Uranium, ug/L	Y	5	16	16		30	MCL		
Vanadium, ug/L	N	12	59	59		112	CLARC		
Vanadium, ug/L	Y	72	259	248		112	CLARC		
Xylenes (total), ug/L	N	73	259	1		10,000	MCL		
Xylenes (total), ug/L	Y	1	2			10,000	MCL		

Shaded areas are groups of constituents with a single preliminary target action level.
CLARC = Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulation (Ecology 2001).
CRDL = Contract-required detection limit.
MCL = Maximum contaminant level.
TBD = To be determined.



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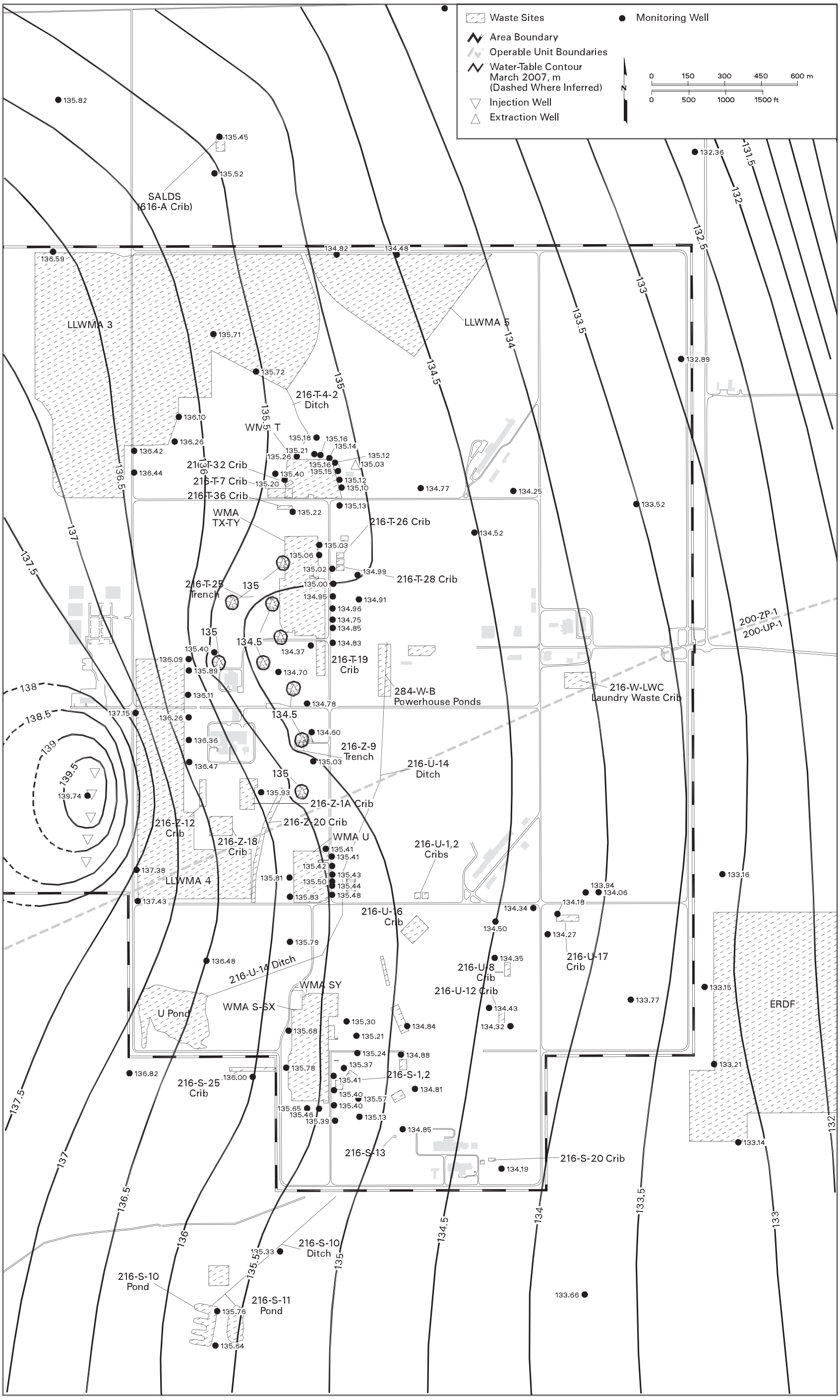
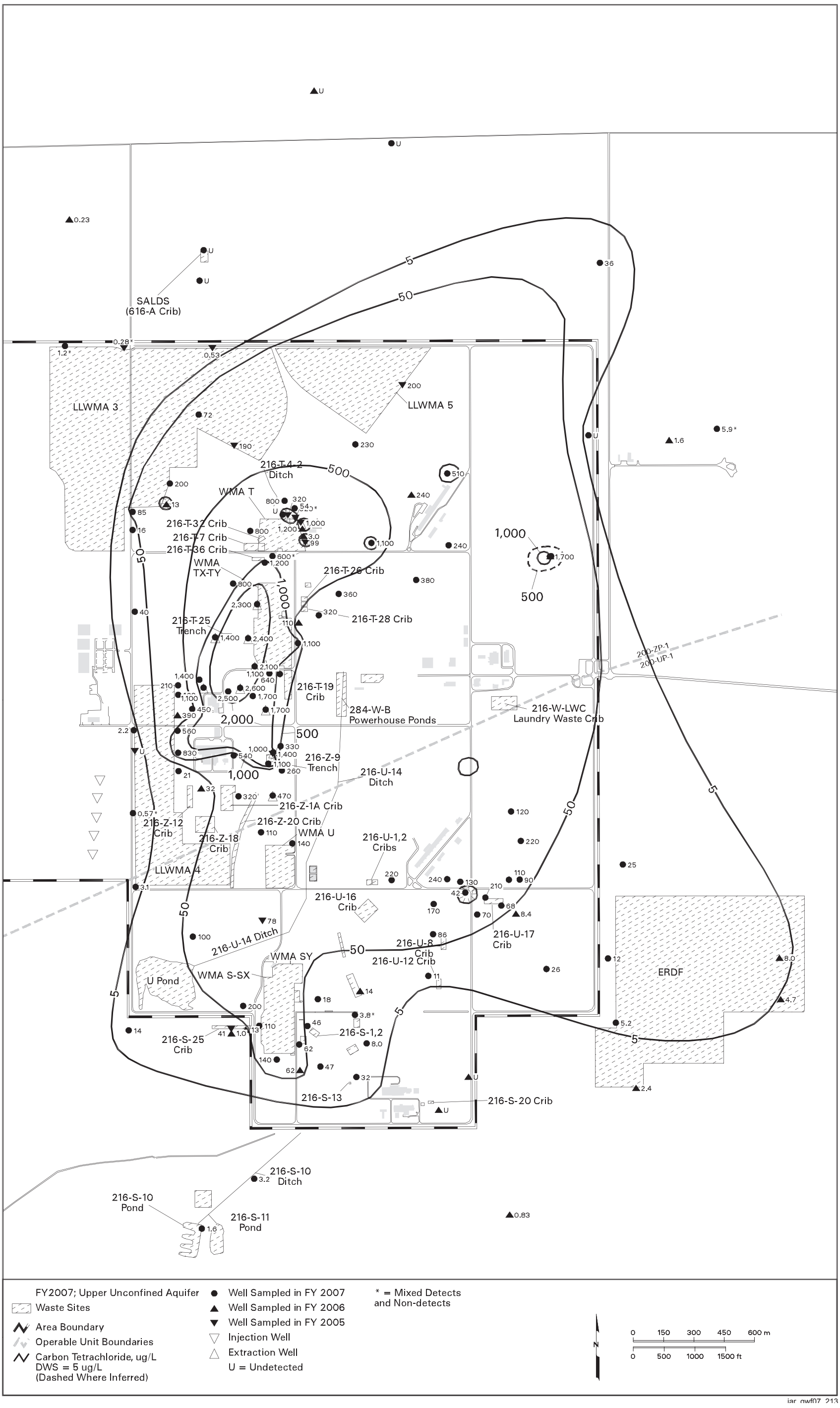
2.8-1. Groundwater Monitoring Wells in 200 West Area



2.8-2. 200 West Area Water-Table Map, March 2007



2.8-3. Average Carbon Tetrachloride Concentrations in 200 West Area, Upper Part of Unconfined Aquifer

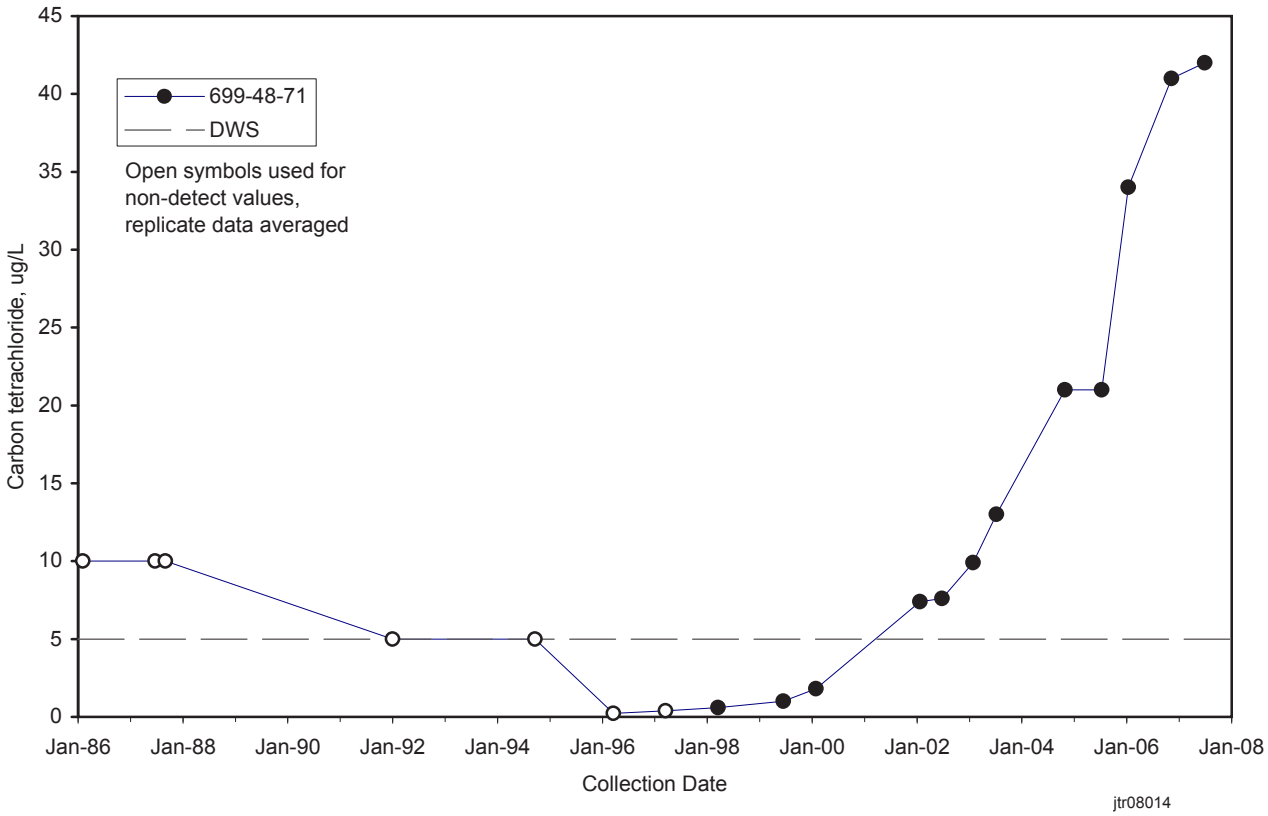


Figure 2.8-4. Carbon Tetrachloride Concentration at Well 699-48-71, Northeast of the 200 West Area

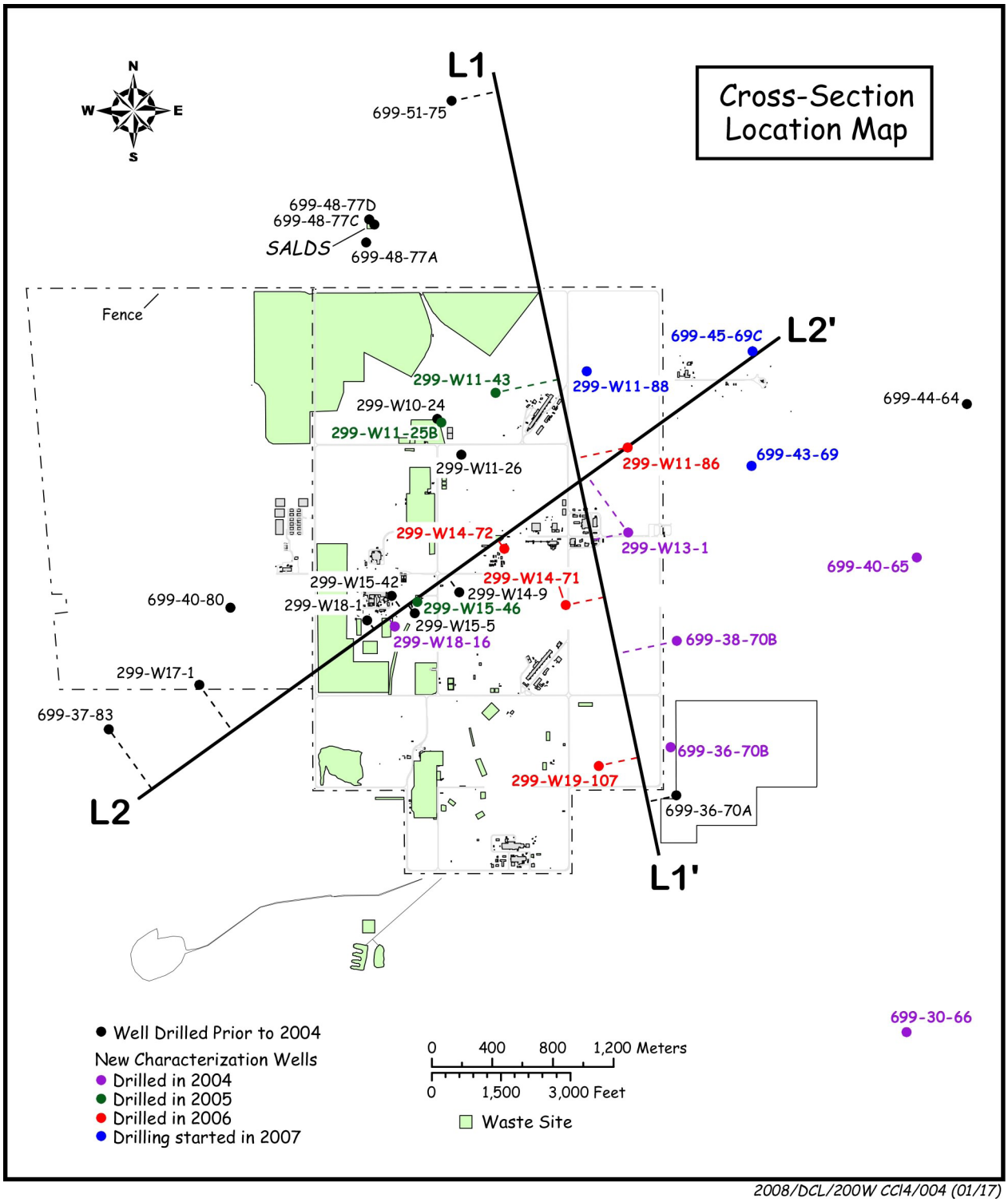


Figure 2.8-5. Location of Cross Sections Shown in Figures 2.8-6 and 2.8-7 Including Wells Used for Interpretation

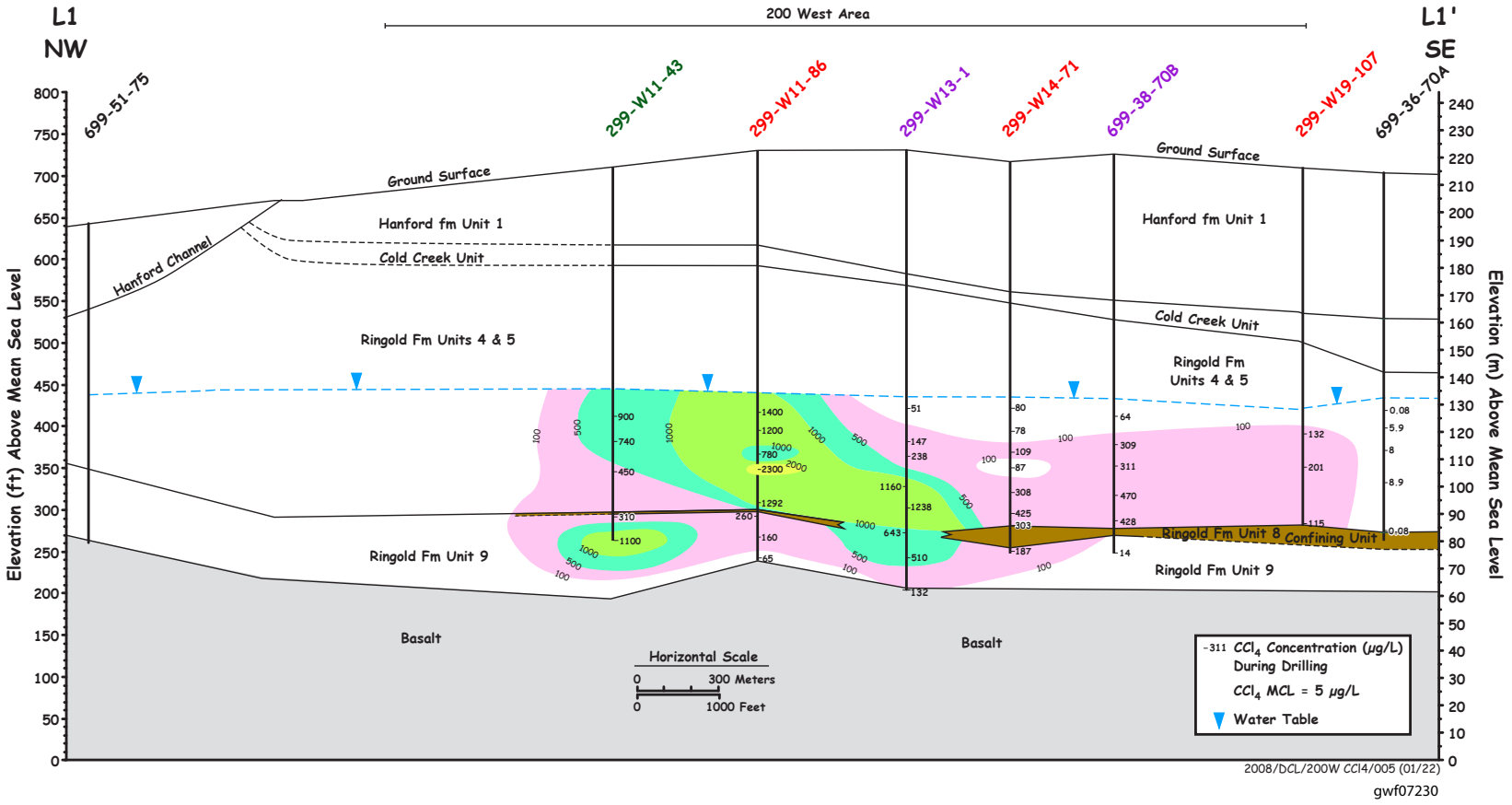


Figure 2.8-6. Hydrogeologic Cross Section for Wells with Depth-Discrete Carbon Tetrachloride Concentration Data, Northwest to Southeast (modified from DOE/RL-2006-24)

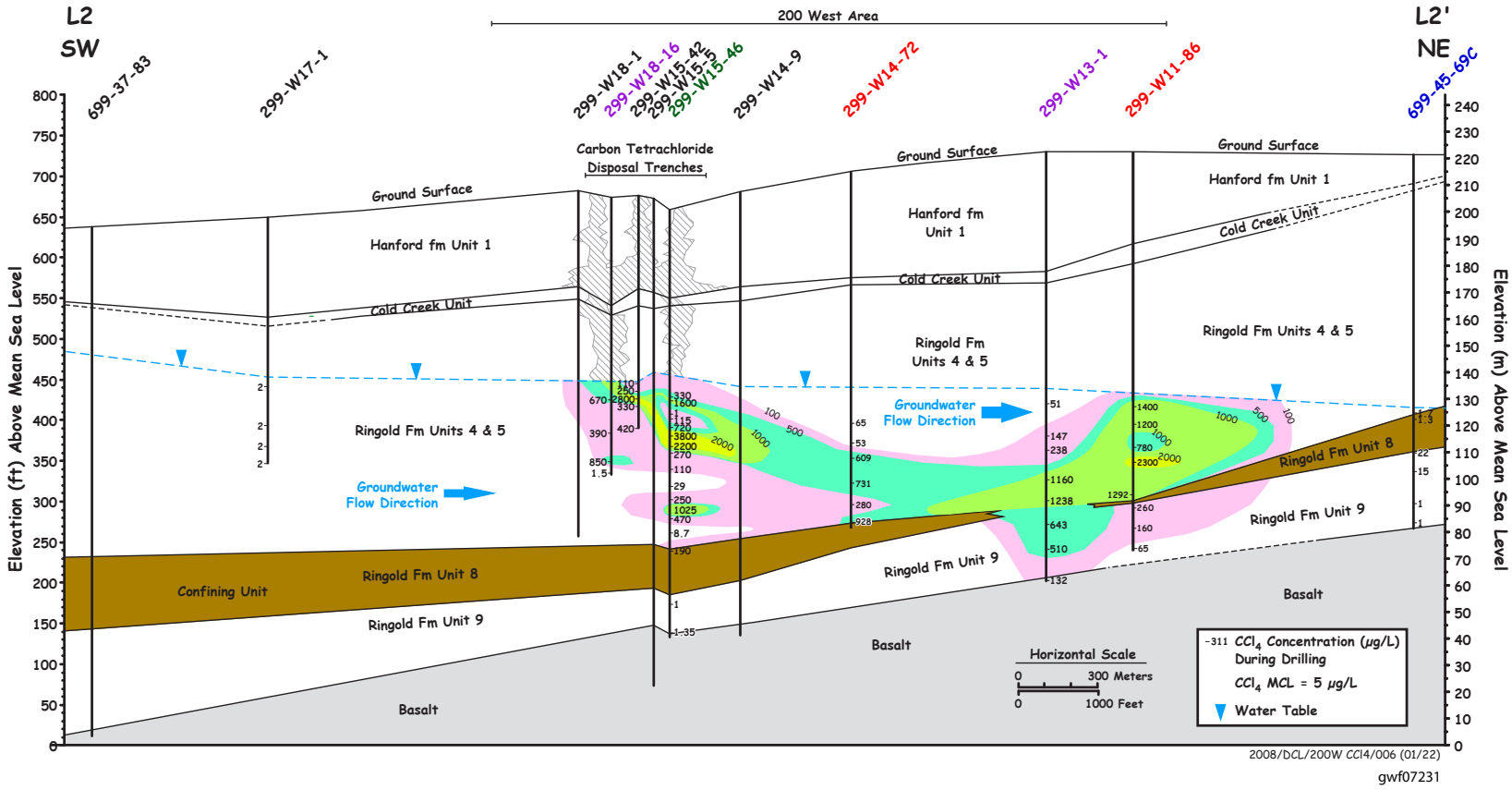


Figure 2.8-7. Hydrogeologic Cross Section for Wells with Depth-Discrete Carbon Tetrachloride Concentration Data, Southwest to Northeast (modified from DOE/RL-2006-24)

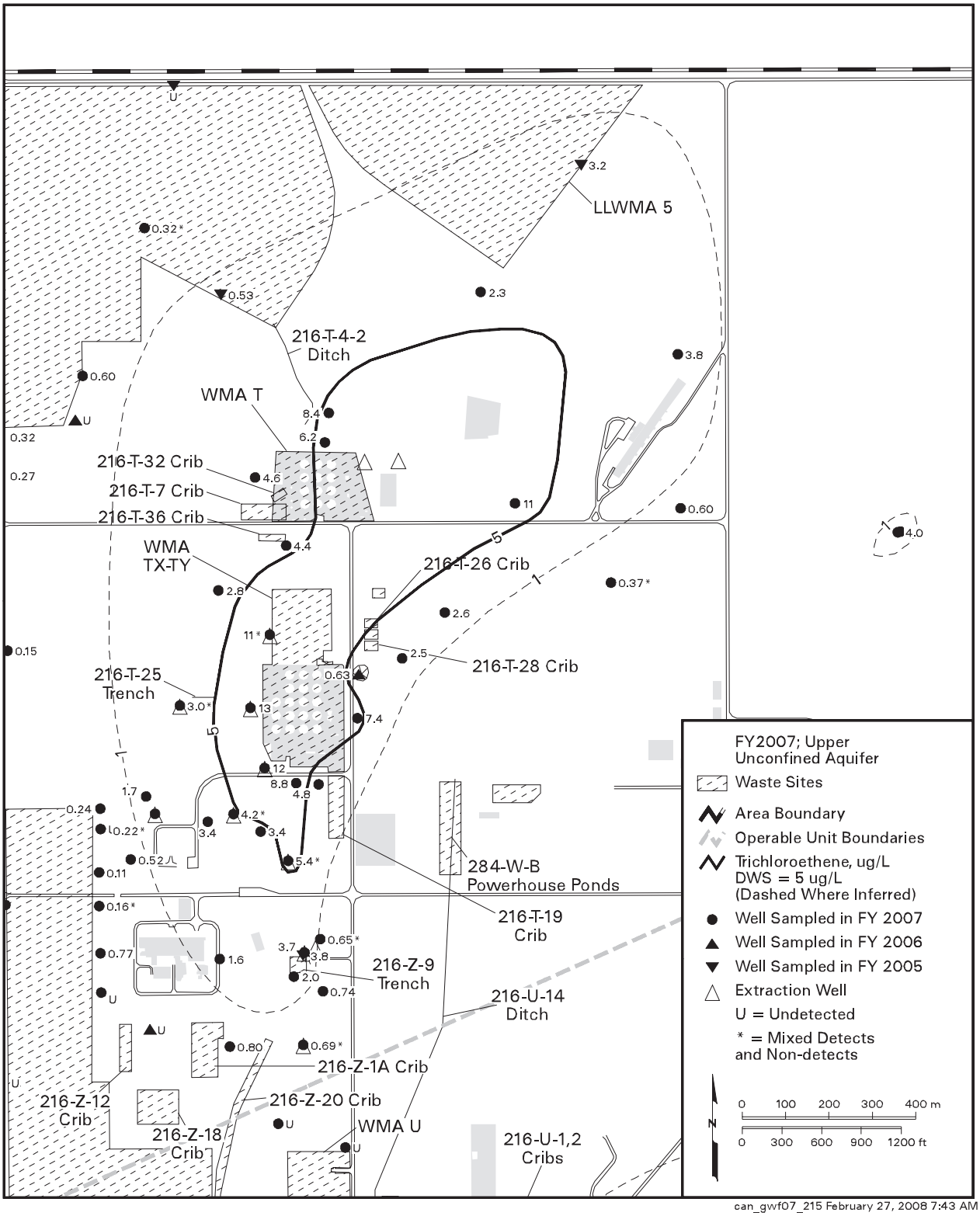


Figure 2.8-8. Average Trichloroethene Concentrations in Central and North 200 West Area, Upper Part of Unconfined Aquifer

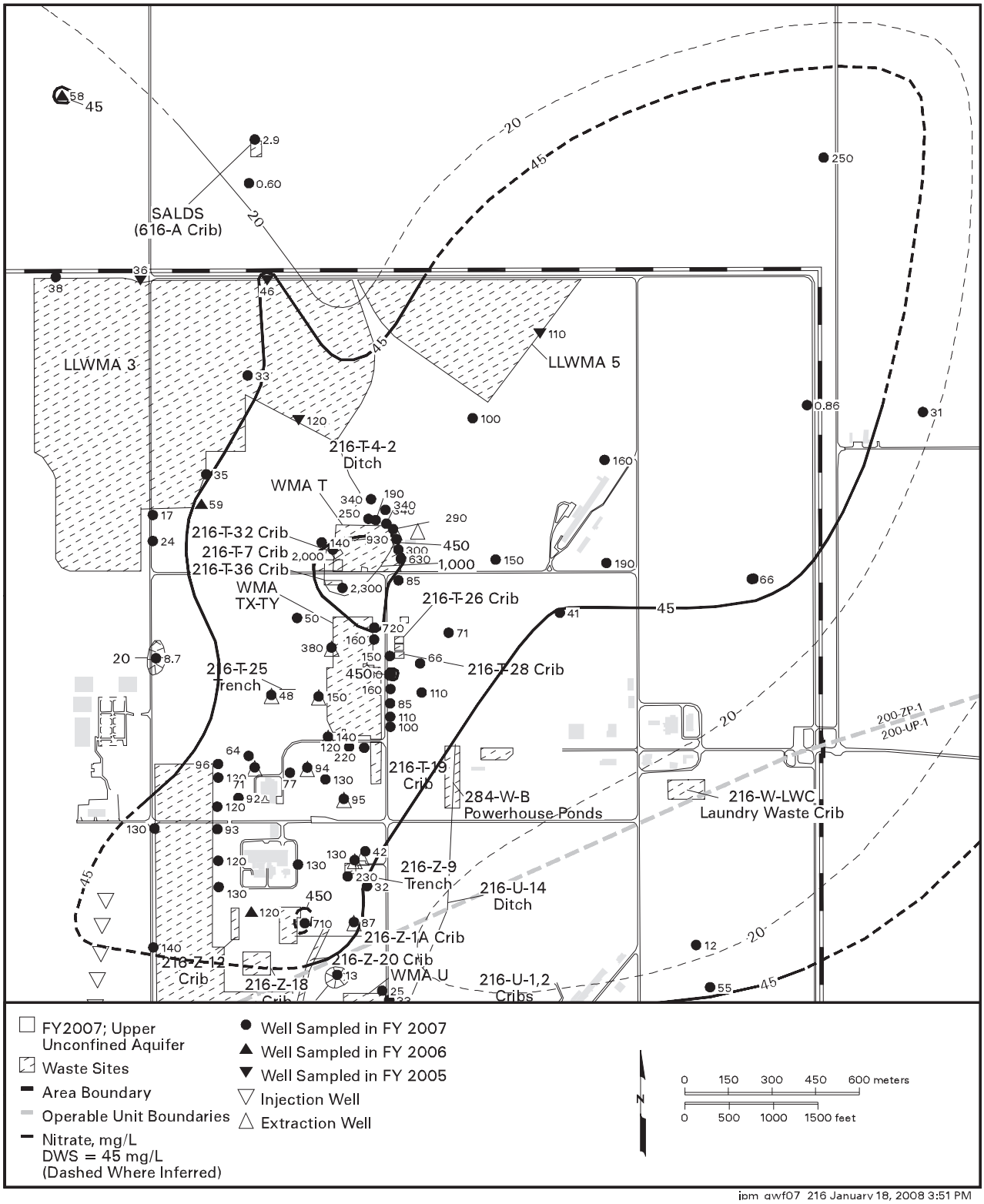


Figure 2.8-9. Average Nitrate Concentrations in Central and North 200 West Area, Upper Part of Unconfined Aquifer

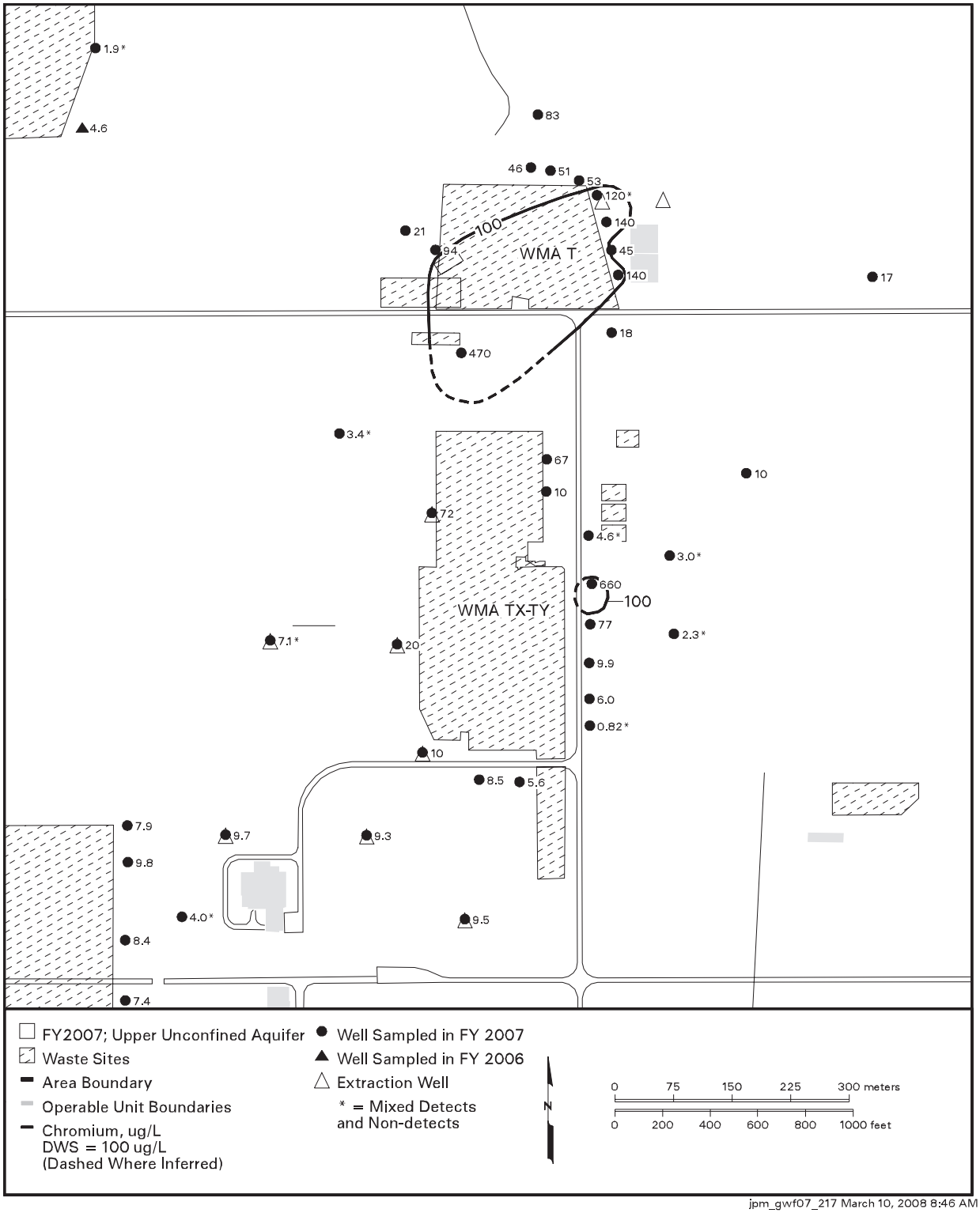


Figure 2.8-10. Average Chromium Concentrations Near Waste Manangement Areas T and TX-TY, Upper Part of Unconfined Aquifer

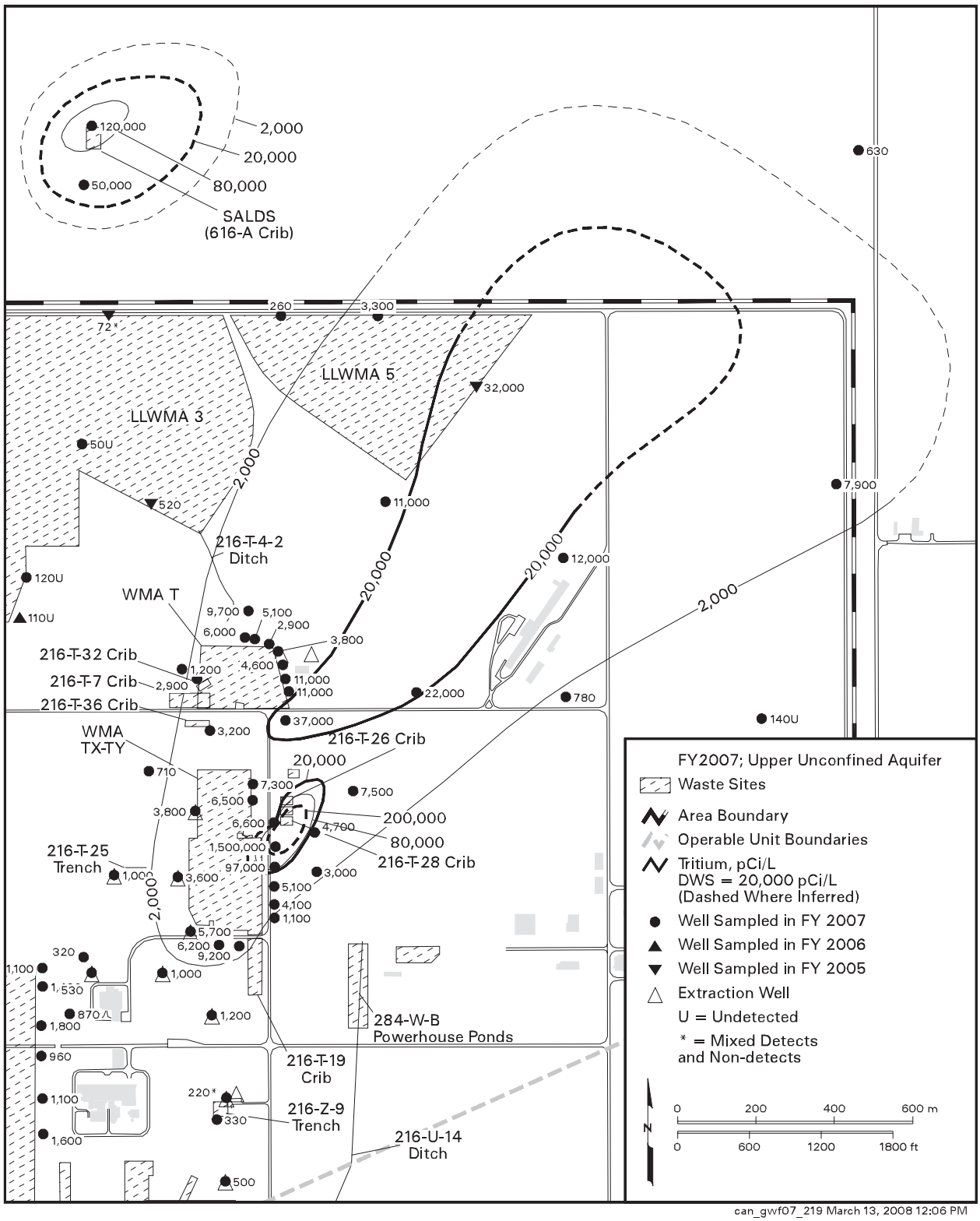


Figure 2.8-11. Average Tritium Concentrations in North 200 West Area, Upper Part of Unconfined Aquifer

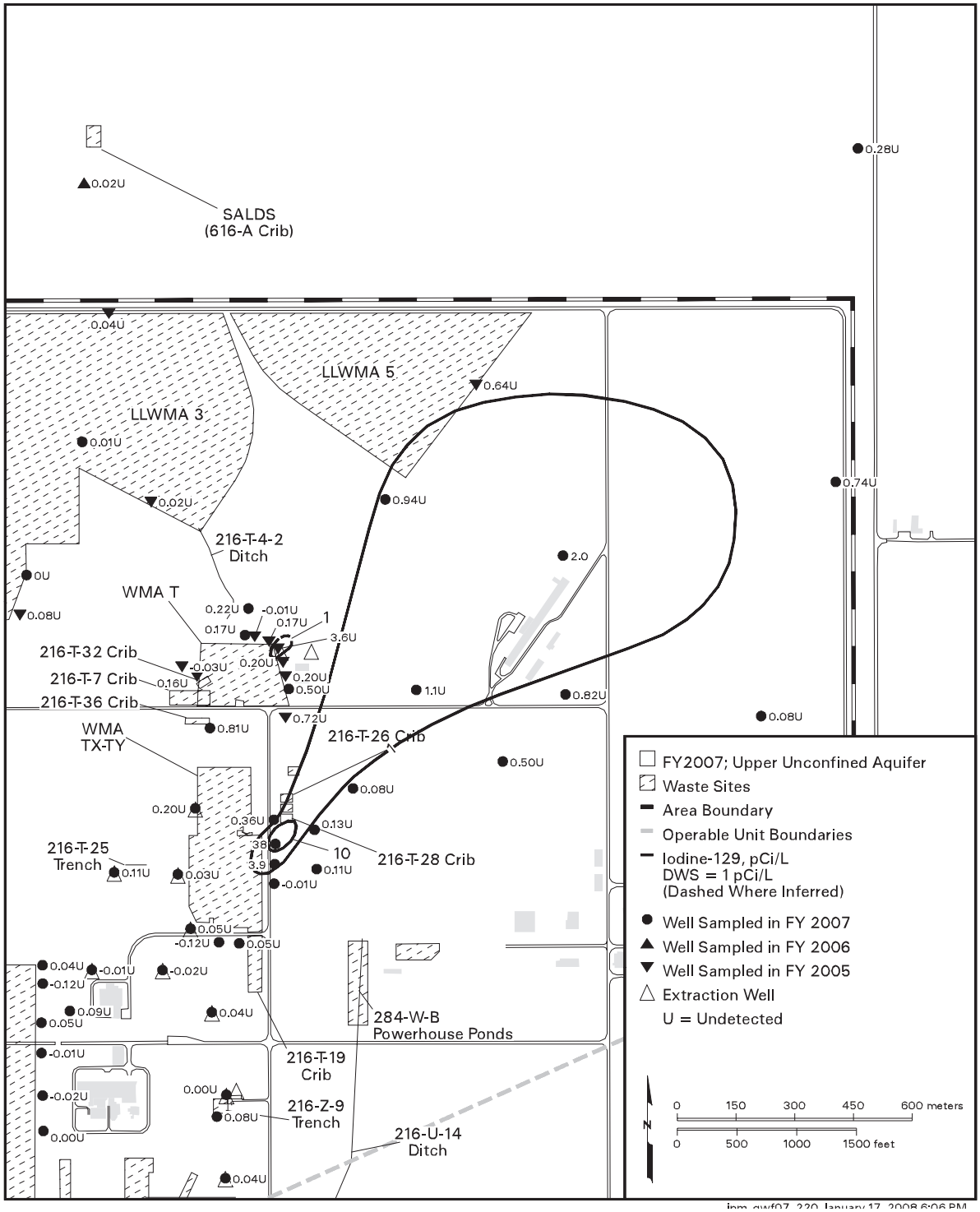


Figure 2.8-12. Average Iodine-29 Concentrations in North 200 West Area, Upper Part of Unconfined Aquifer

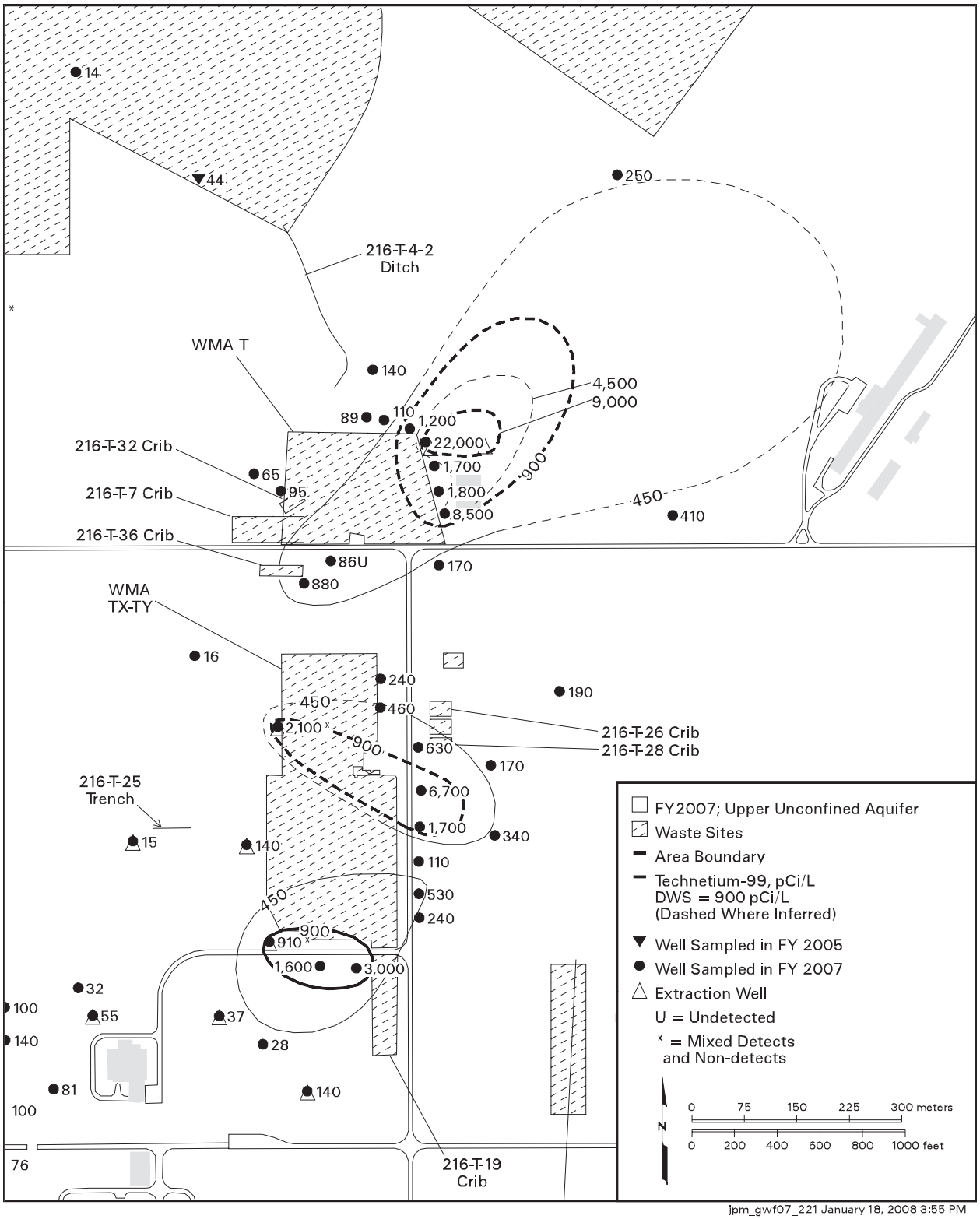


Figure 2.8-13. Average Technetium-99 Concentrations in North 200 West Area, Upper Part of Unconfined Aquifer

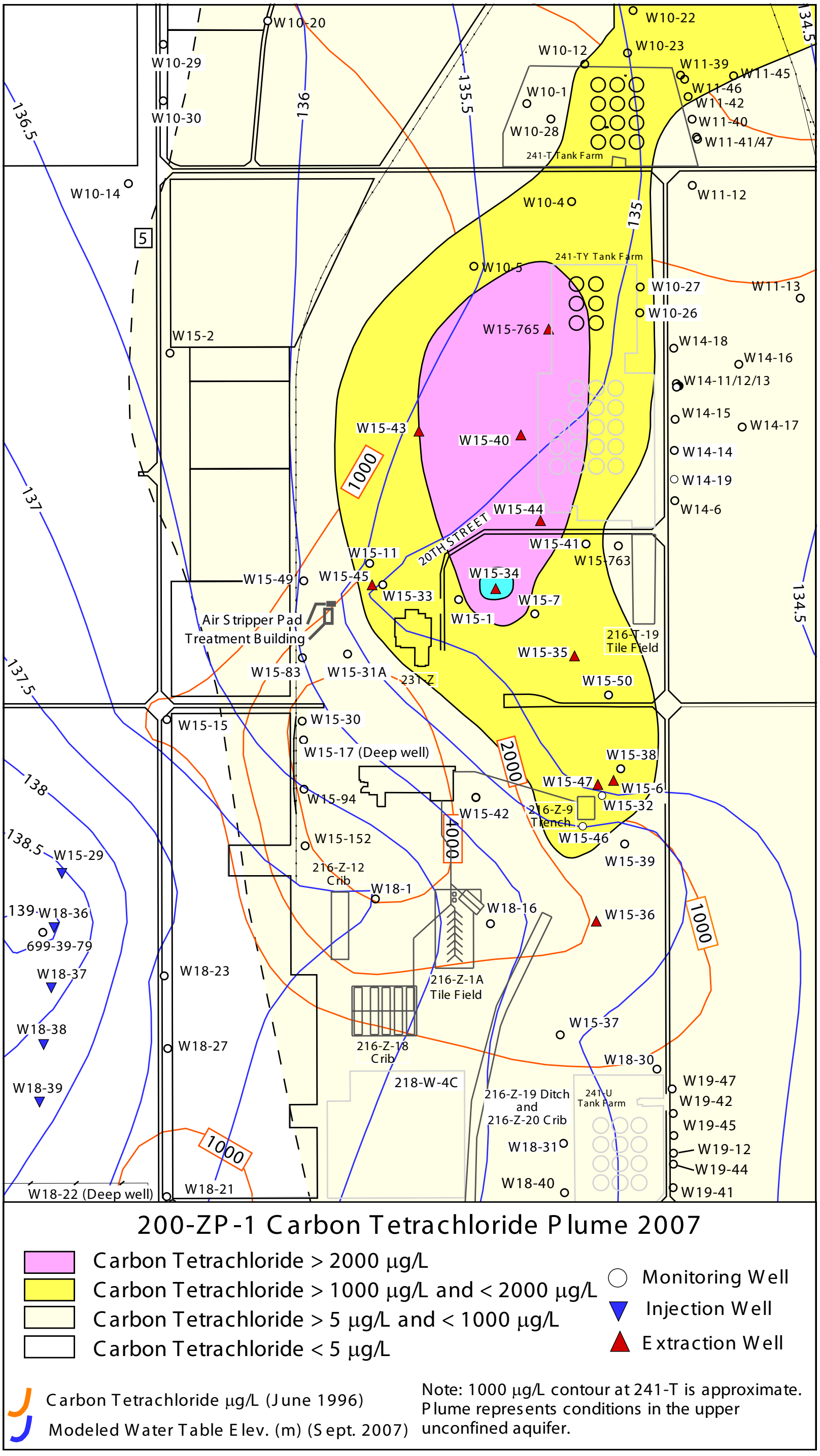


Figure 2.8-14. 200-ZP-1 Pump-and-Treat Map for Carbon Tetrachloride

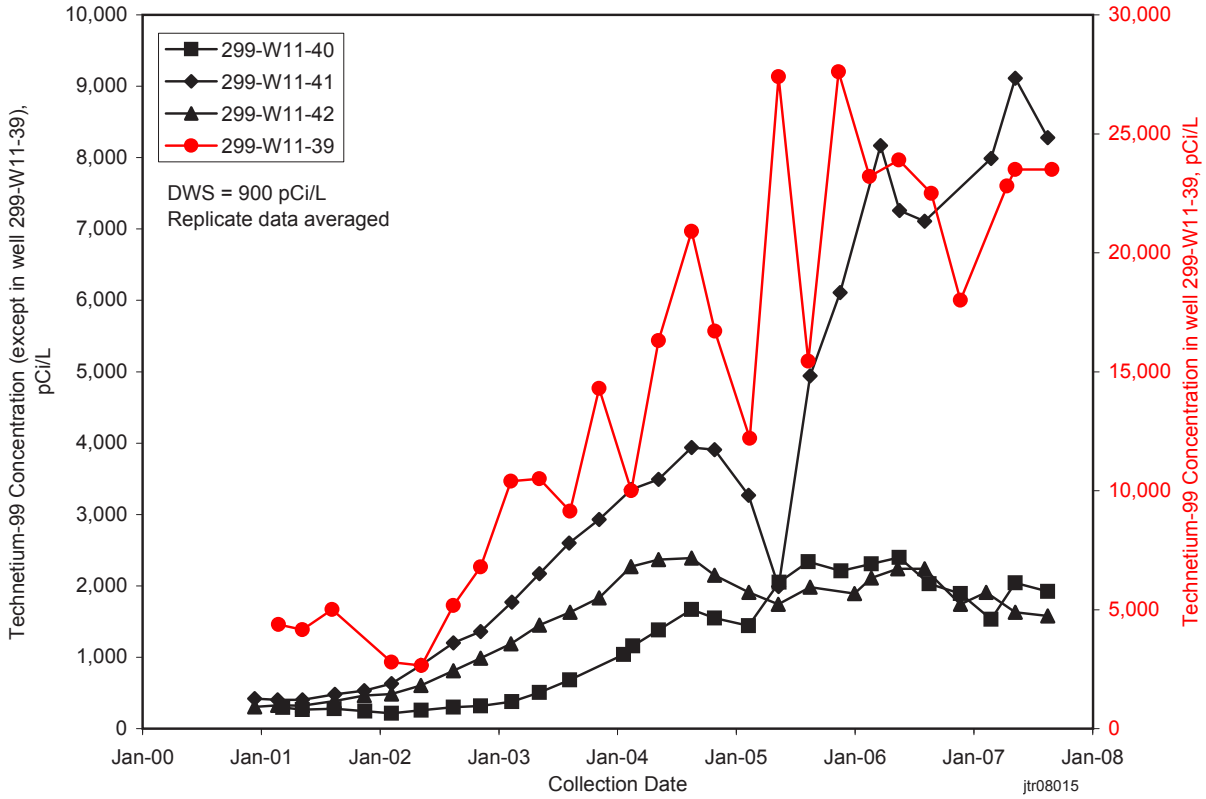


Figure 2.8-15. Technetium-99 Concentrations in Selected Downgradient Water-Table Wells at Waste Management Area T

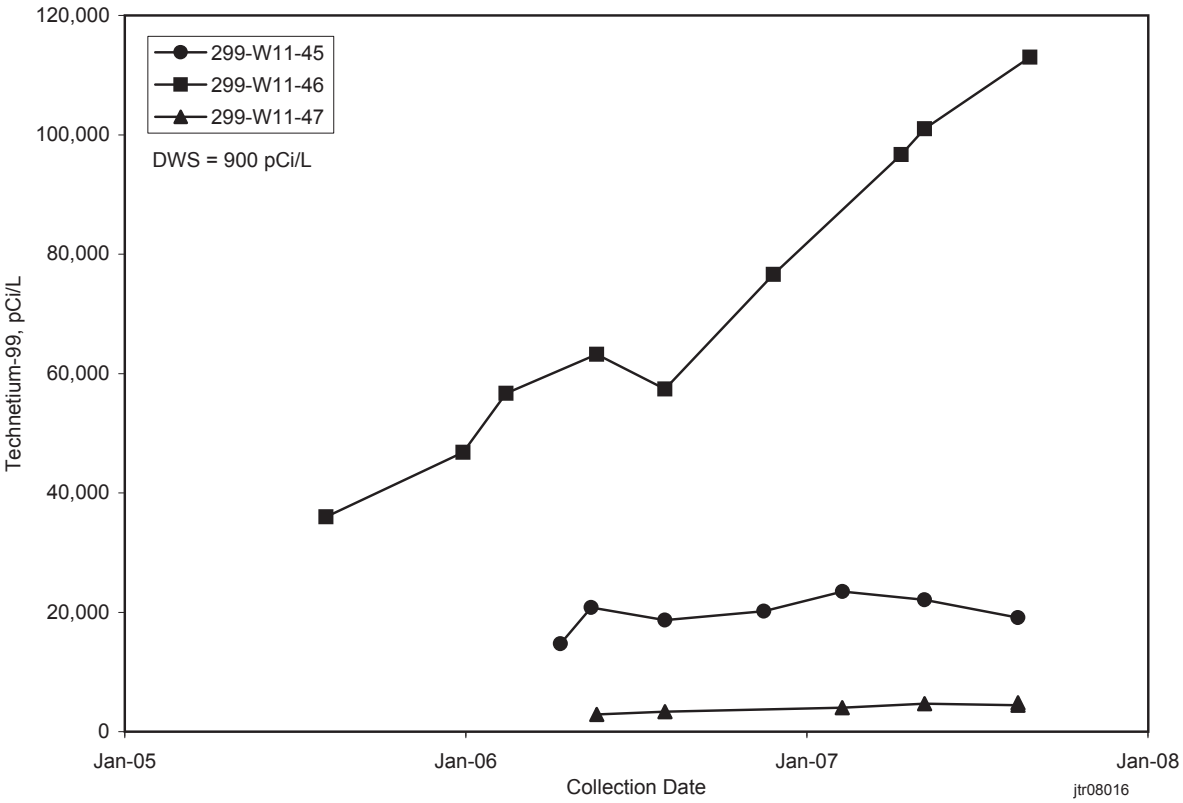


Figure 2.8-16. Technetium-99 Concentrations in Selected Downgradient Wells at Waste Management Area T (screened below the water table)

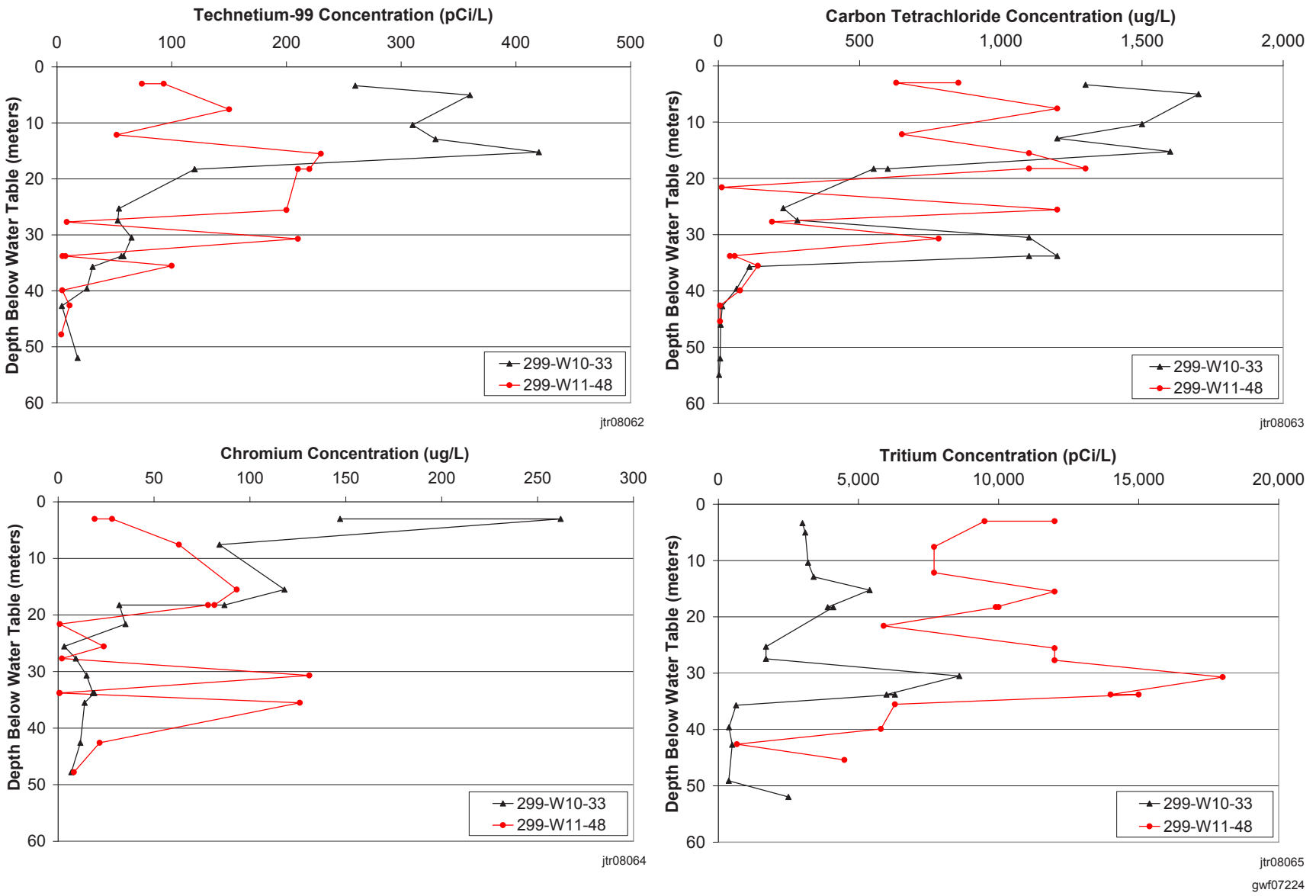


Figure 2.8-17. Concentrations with Depth of Contaminants in New Wells 299-W10-33 and 299-W11-48 (data collected during drilling)

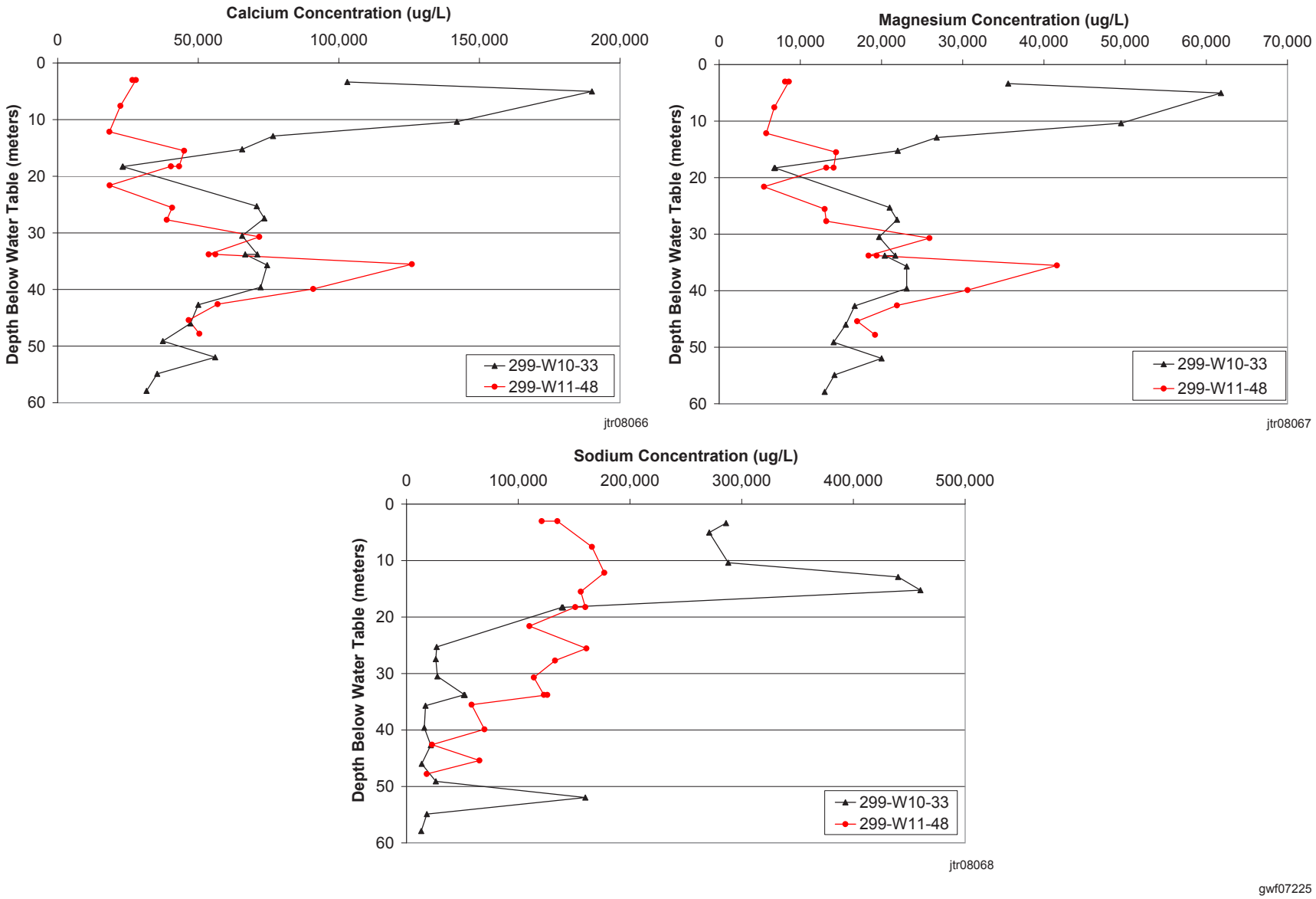


Figure 2.8-18. Major Metal Concentrations versus Depth in New Wells 299-W10-33 and 299-W11-48

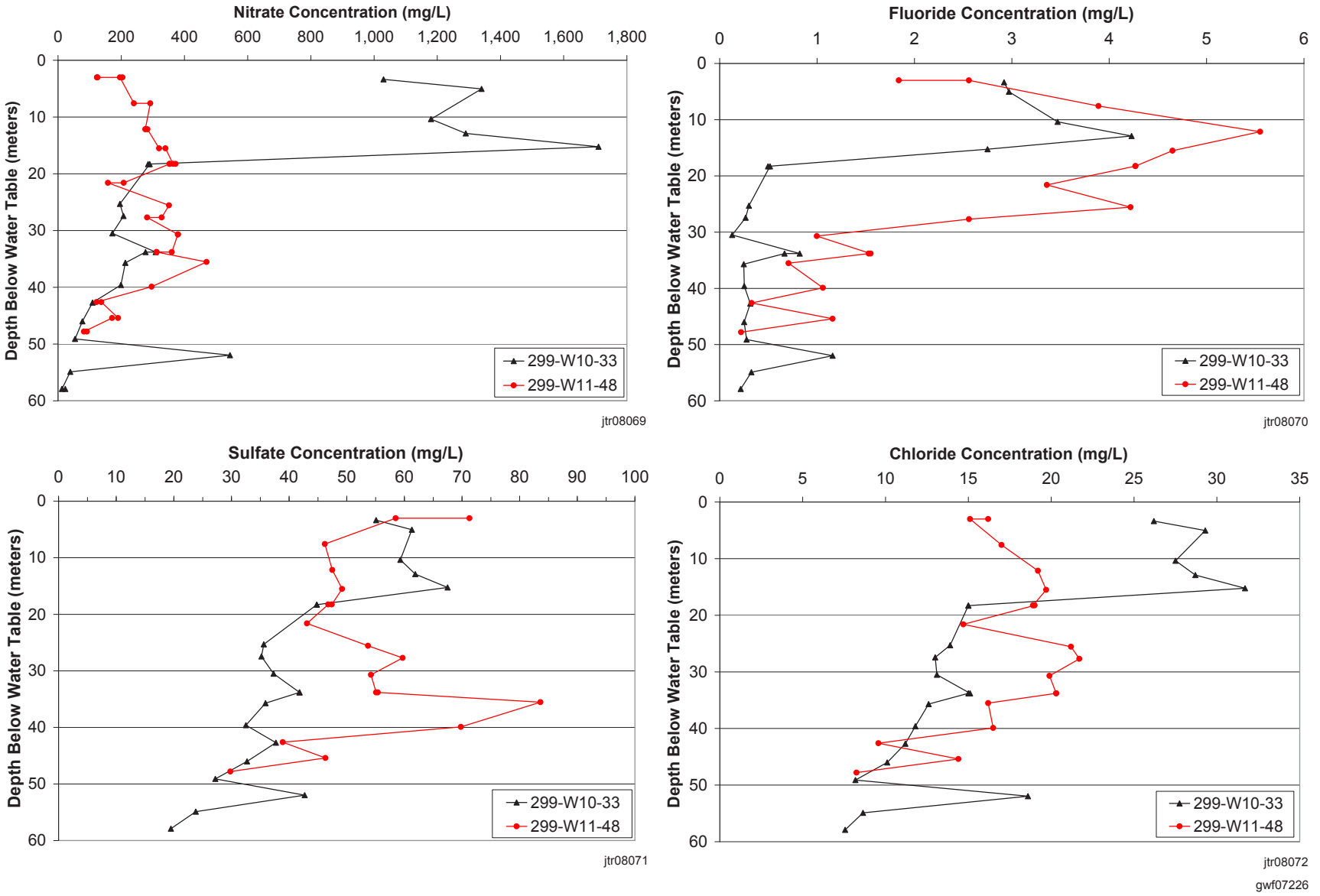
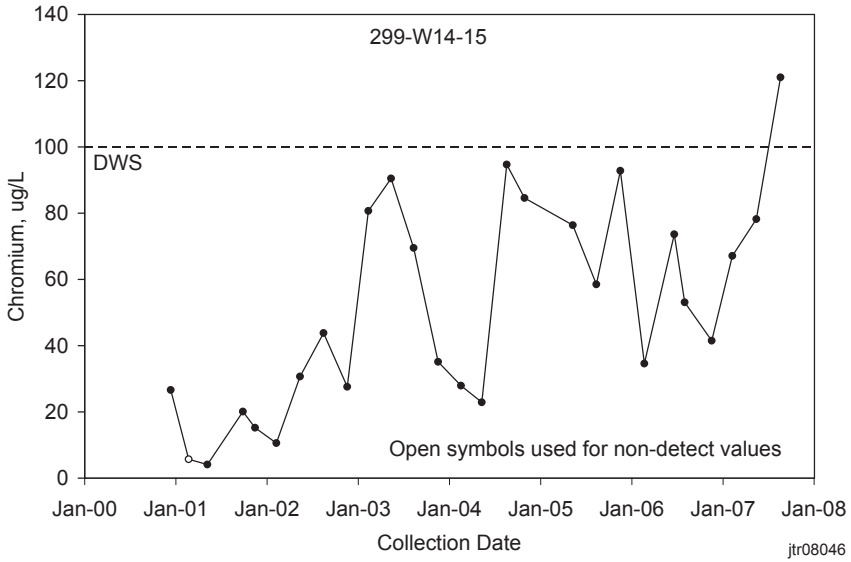
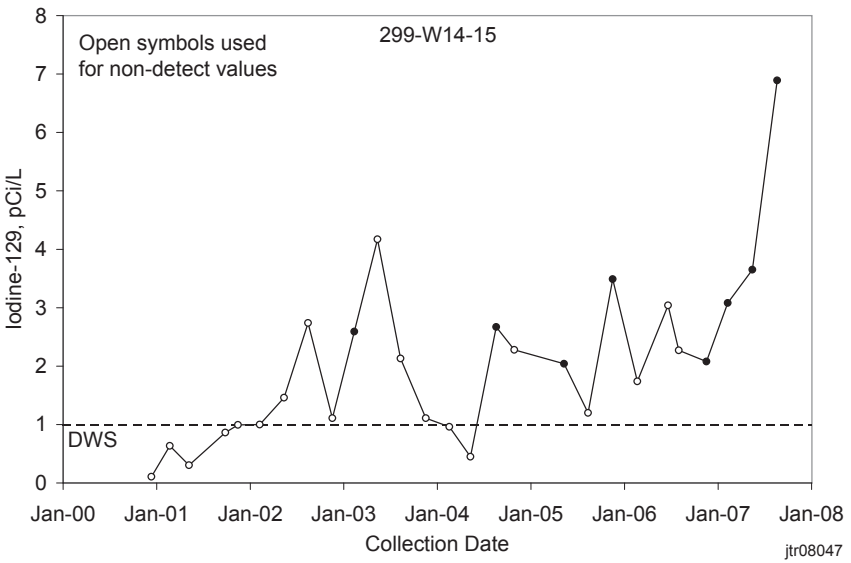
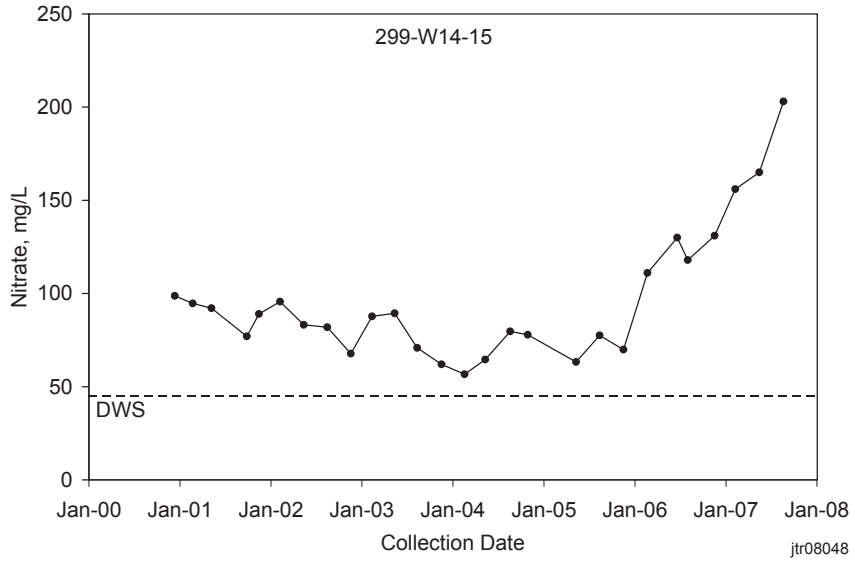


Figure 2.8-19. Anion Concentrations versus Depth in New Wells 299-W10-33 and 299-W11-48







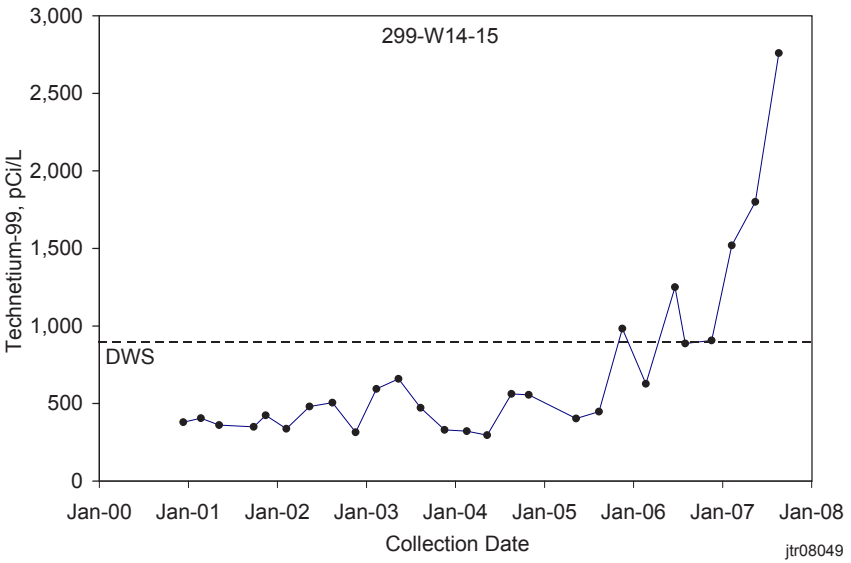


Figure 2.8-20. Concentrations of Selected Contaminants in Well 299-W14-15, Waste Management Area TX-TY

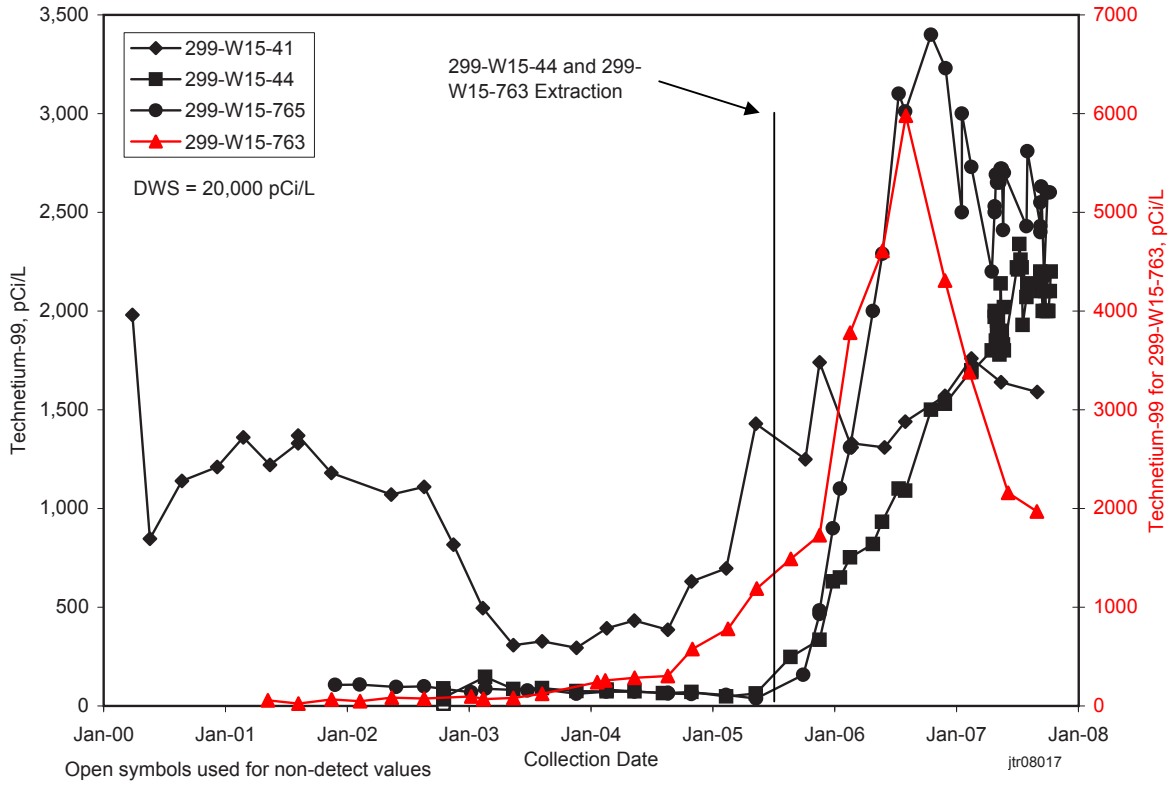


Figure 2.8-21. Technetium-99 Concentrations versus Time for Four Wells at Waste Management Area TX-TY Influenced by the 200-ZP-1 Pump-and-Treat System (wells 299-W15-44 and 299-W15-763 are extraction wells)

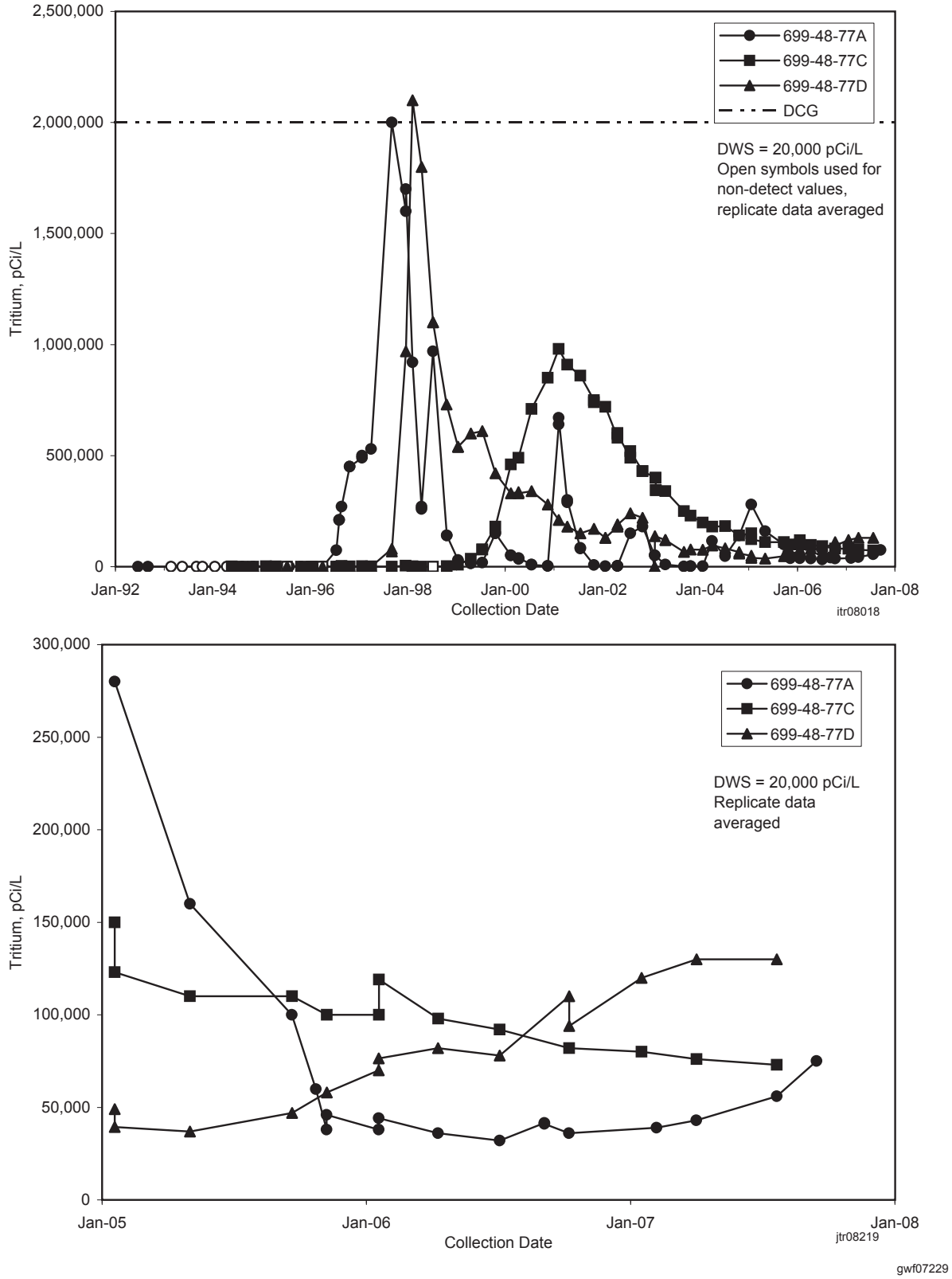


Figure 2.8-22. Tritium Concentrations in Wells Monitoring the State-Approved Land Disposal Site