2.10 200-BP-5 Operable Unit

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The scope of this section is the 200-BP-5 groundwater interest area, which includes the 200-BP-5 Operable Unit (Figure 2.1-1). This operable unit includes several *Resource Conservation and Recovery Act* (RCRA) units and *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) past-practice sites in the north part of the 200 East Area and extends to the north to Gable Gap. Figures 2.10-1 and 2.10-2 show facilities and wells in this operable unit. The south part of the 200 East Area lies within the 200-PO-1 Operable Unit and is discussed in Section 2.11. The boundary between the two operable units is shown in Figure 2.10-1.

Technetium-99 is the contaminant of greatest concern in the 200-BP-5 Operable Unit owing to its mobility and broad areal extent of contamination. Groundwater is monitored in this operable unit to define the regional extent of technetium-99 and other significant contaminants across the operable unit as well as the local extent of contamination

Groundwater monitoring in the 200-BP-5 Operable Unit includes CERCLA, RCRA, and AEA monitoring:

CERCLA Monitoring

- ***CERCLA sampling was interrupted in the first part of the fiscal year during preparation of a sampling and analysis plan and waste control plan for the 200-BP-5 Operable Unit.***
- ***Following approval of these plans, limited sampling resumed late in fiscal year 2003.***
- ***Sampling of all nine wells at the 216-B-5 injection well site was completed.***
- ***Sampling of eight wells at Gable Mountain Pond was completed.***
- ***One well could not be sampled at Gable Mountain Pond because it is dry (see Appendix A).***
- ***Sampling of six wells in Gable Gap area north of the 200 East Area was completed.***
- ***Two wells could not be sampled in fiscal year 2003 at Gable Gap because of mechanical problems (see Appendix A).***

RCRA Monitoring

- ***Twenty-six wells are sampled quarterly to semiannually at Waste Management Area B-BX-BY.***
- ***Twelve wells are sampled quarterly to semiannually at the 216-B-63 trench.***
- ***Seventeen wells are sampled semiannually at Low-Level Waste Management Area 1.***
- ***Twelve wells are sampled semiannually at Low-Level Waste Management Area 2.***
- ***Two wells are sampled semiannually at the Liquid Effluent Retention Facility.***
- ***Five wells are sampled quarterly at Waste Management Area C.***
- ***All RCRA wells were sampled as scheduled (see Appendix B).***

AEA Monitoring

- ***Twenty-six wells are sampled quarterly to semiannually at Waste Management Area B-BX-BY.***
- ***Seventeen wells are sampled semiannually at Low-Level Waste Management Area 1.***
- ***Twelve wells are sampled semiannually at Low-Level Waste Management Area 2.***
- ***Five wells are sampled quarterly at Waste Management Area C.***
- ***Wells are sampled annually to triennially within the 200-BP-5 Operable Unit for constituents related to general water chemistry.***
- ***Six guard wells are sampled annually at Gable Gap.***
- ***Wells are sampled annually to triennially in the upper basalt-confined aquifers (see Section 2.14.1).***

associated with specific RCRA units in the area. Other contaminants of concern for this operable unit include tritium, uranium, iodine-129, cobalt-60, cyanide, strontium-90, cesium-137, plutonium-239/240, and nitrate.

Technetium-99 is the contaminant of greatest concern in the 200-BP-5 Operable Unit.

The small differences in water-table elevation across the operable unit make it difficult to determine the direction of groundwater flow from water-table maps (Figure 2.1-3). Techniques used to determine groundwater flow in the 200-BP-5 Operable Unit consist of plume and contaminant trend plots, water-level trend surface analysis, water-level hydrographs for multiple wells, and in situ flow measurements at groundwater wells. These techniques have been applied extensively in an effort to understand the direction of groundwater flow around the RCRA units in the 200-BP-5 Operable Unit and are discussed in more detail later in Section 2.10.3. General inferences regarding groundwater flow direction based on plume configurations (especially tritium, nitrate, iodine-129, and technetium-99) are also discussed in Section 2.10.1.

Groundwater currently entering the 200 East Area from the west divides and flows to the Columbia River along two separate paths: one to the southeast and one to the northwest though Gable Gap. The water table has been declining following the decrease in liquid effluent discharges to the soil in the 200 East Area. However, during fiscal year 2003, the water-level decline has diminished throughout the 200 East Area, and water levels actually increased in some areas.

Section 2.10.1 provides general information regarding geometry of contaminant plumes and concentration trends for contaminants of concern. Specific information regarding contaminant distribution for RCRA units within the 200-BP-5 Operable Unit is presented in Section 2.10.3.

2.10.1 Groundwater Contaminants

This section describes the distribution of groundwater contaminants of concern in the 200-BP-5 Operable Unit. Specific information is provided for several CERCLA units (the 216-B-5 reverse well, BY cribs, and Gable Gap area) as well as general information regarding regional contaminant distribution.

2.10.1.1 Tritium

Tritium contamination is widespread throughout the northwest part of the 200 East Area. The contamination extends north through the gap between Gable Mountain and Gable Butte toward the Columbia River and southeast through the 200-PO-1 Operable Unit (Figure 2.10-3). Tritium contamination from the 200-BP-5 Operable Unit has declined greatly because of natural decay and dispersion. The highest concentrations are in the south part of the 200 East Area and represent contamination from the 200-PO-1 Operable Unit that moved to the northwest under past flow conditions. A number of waste disposal facilities contributed to the plume.

The tritium plume extends northward through Gable Gap, but concentrations declined in fiscal year 2003.

Tritium concentrations in the 200-BP-5 Operable Unit have declined since 1990. Wells in the vicinity of the 216-B-5 injection well had concentrations of tritium below the drinking water standard in fiscal year 2003.

Tritium at levels above the drinking water standard can be found between Gable Mountain and Gable Butte and extends to the northwest (Figure 2.10-3). Concentrations in monitoring well 699-61-62 in Gable Gap continued to decline with a measured value for fiscal year 2003 of 24,000 pCi/L (see Figures 2.1-2 and 2.10-2 for locations of 600 Area wells). Tritium concentrations in wells 699-60-60 and 699-64-62 have also declined somewhat and were at levels of 28,000 and 21,000 pCi/L, respectively, in fiscal year 2003. Well 699-72-73, located between the 100-B/C and 100-K Areas, exceeded the drinking water standard for the first time in fiscal year 2001 but declined to 14,000 pCi/L in fiscal year 2002 and 13,000 pCi/L in fiscal year 2003.

Tritium values have increased recently at the south end of Waste Management Area B-BX-BY. The maximum average tritium value in this region in fiscal year 2003 was 19,000 pCi/L in well 299-E33-334.

2.10.1.2 Nitrate

A nitrate plume originating in the 200 East Area extends beyond the boundary fence line northwest towards the Columbia River (Figure 2.10-4). The plume within the 200 East Area has two parts: (1) a west plume that extends through the west portion of Low-Level Waste Management Area 1 and (2) an east plume extending from the BY and surrounding cribs toward the northwest. The two plumes join northwest of the 200 East Area and extend through the gap between Gable Butte and Gable Mountain to the Columbia River at levels less than the drinking water standard (45 mg/L).

The highest nitrate concentrations are in the vicinity of the BY and 216-B-8 cribs.

The west part of the nitrate plume, extending through Low-Level Waste Management Area 1, appears to be a portion of a larger plume extending from the 200-PO-1 Operable Unit. This plume apparently moved to the northwest under past flow conditions during the period of high discharge to 200 East Area facilities and B Pond.

The highest nitrate concentrations are in the vicinity of the BY and 216-B-8 cribs. High concentrations of nitrate are associated with the cobalt-60, cyanide, and technetium-99 plume originating from the BY cribs. The highest nitrate concentrations measured in fiscal year 2003, however, were found in well 299-E33-16, near the 216-B-8 crib, where the fiscal year 2003 average concentration was 585 mg/L. The ratio of nitrate to technetium-99 in well 299-E33-16 is high compared to the ratio of nitrate to technetium-99 in wells near the BY cribs, indicating an additional nitrate source in the area (PNNL-14187).

Nitrate continued to be detected in wells monitoring Gable Mountain Pond at levels above the drinking water standard in fiscal year 2003 (Figure 2.10-4). The highest nitrate concentration measured in fiscal year 2003 was a value of 163 mg/L reported for well 699-53-47B.

2.10.1.3 Iodine-129

Contamination from iodine-129 is present throughout the west portion of the 200-BP-5 Operable Unit. Like the tritium plume, the iodine-129 plume extends to the northwest toward the Gable Mountain/Gable Butte gap and southeast through the 200-PO-1 Operable Unit (Figure 2.10-5). Unlike tritium, however, levels greater than the iodine-129 drinking water standard (1 pCi/L) have not passed the gap between Gable Mountain and Gable Butte. A band of elevated iodine-129 concentrations (~5 pCi/L) extends through Waste Management Area B-BX-BY to the northeast corner of Low-Level Waste Management Area 1. Interpretation of the iodine-129 configuration in this area is complicated by elevated detection limits that result from interference of technetium-99. In addition, the current laboratory reporting system produced some values reported as not detected at levels greater than the drinking water standard (1 pCi/L).

Plume areas (square kilometers) above the drinking water standard at the 200-BP-5 Operable Unit:

Iodine-129 — 4.93
Nitrate — 4.37
Strontium-90 — 0.68
Technetium-99 — 2.20
**Tritium — 4.04*
Uranium — 0.19

**Includes entire plume through Gable Gap.*

2.10.1.4 Technetium-99

A plume of technetium-99 extends from the area of the BY cribs and Waste Management Area B-BX-BY to beyond the 200 East north boundary to the northwest (Figure 2.10-6). A significant portion of the plume is to the north and is interpreted to represent early releases of technetium-99 from the BY cribs. Detection of technetium-99 at levels lower than the 900 pCi/L drinking water standard north of the gap between Gable Mountain and Gable Butte indicates that in the past technetium-99 moved north into, and through, the gap.

Technetium-99 was not routinely measured in groundwater prior to the late 1980s, limiting the information on historical trends. Thus, there is considerable uncertainty in the extent of technetium-99 contamination. Interpretation of the exact configuration and extent of the technetium-99 plume north of the 200 East Area is also complicated by the variable concentrations seen in wells that are relatively close together (see Figure 2.1-2 for

A plume of technetium-99 extends from the area of the BY cribs to beyond the 200 East north boundary. The plume has moved through Gable Gap at levels below the drinking water standards.

600 Area well locations). For example, concentrations of technetium-99 less than the drinking water standard were consistently detected in well 699-49-55A since the early 1990s (16 pCi/L in fiscal year 2001). This well was used as the injection well in 1995 for pump-and-treat operations and has had very low technetium-99 values since then.

Six wells were successfully sampled in the Gable Gap area late in fiscal year 2003. Five of these wells showed an increase in technetium-99 while one had a slight decrease. Well 699-49-57A has higher and increasing concentrations (4,850 pCi/L in fiscal year 2003 versus 3200 pCi/L in fiscal year 2001) as shown in Figure 2.10-7.

Well 699-52-57, located north of well 699-49-57A, had consistently low technetium-99 concentrations (<90 pCi/L) throughout the 1990s; however, the water table fell below the screen in 1999 so the well can no longer be sampled. A review of well construction and logging information suggests that this well was not drilled to the top of the basalt and may lie in an erosional window where the Elephant Mountain Member has been removed, thereby juxtaposing the unconfined aquifer in the Hanford formation and the upper basalt-confined aquifer in the Rattlesnake interbed. DOE/RL-2001-49 proposed that well 699-52-57 be deepened, if possible, to permit sampling activities to continue at this location and to obtain additional geological information.

DOE/RL-2001-49 proposed that an additional monitoring well be installed south of Gable Gap and on the west margin of the technetium-99 plume (see DOE/RL-2001-49 for specific location). This well will serve to better define plume extent and geometry and is needed to replace wells in Gable Gap that have gone dry (e.g., wells 699-52-57, 699-52-54, 699-50-53A, and 699-50-53B). Installation of new wells in this area is also important from a hydrogeological standpoint because additional wells will provide information regarding groundwater flow (based on the gradient of the water table) and will help to better define the elevation of the top of the basalt in this area and the geometry of the anticlinal structure in the gap. The latter information is needed to support predictions of future groundwater flow through the gap.

In the late 1990s, rising technetium-99 concentrations were seen in the BY crib area in wells 299-E33-7 and 299-E33-38 (Figure 2.10-7). During late 1997 and 1998, technetium-99 increased sooner in well 299-E33-7 than in well 299-E33-38. In early 1999, the trends for both wells began to track together and reached an apparent maximum in late 2000. These trends may indicate southward movement of the contaminant plume beginning in the late 1990s, or they may reflect pervasive transport of contamination from the vadose zone at the BY cribs and relatively recent breakthrough into the saturated zone. In particular, the high concentration of technetium-99 in well 299-E33-38 (average of 9,800 pCi/L in fiscal year 2003) suggests a continuing source of contamination from the BY cribs to groundwater. A general correlation of concentration trends for technetium-99, nitrate, cobalt-60, and cyanide in wells 299-E33-7 and 299-E33-38 and local distribution of these constituents suggests that the primary source of technetium-99 contamination is related to past discharges of ferrocyanide waste to the BY cribs.

2.10.1.5 Cobalt-60 and Cyanide

Cobalt-60 and cyanide continue to be detected in a number of wells in the 200-BP-5 Operable Unit. Cobalt-60 has a relatively short half-life (5.3 years), and is currently only found at levels less than the drinking water standard (100 pCi/L). Cyanide is also a minor contaminant but is found at levels above the drinking water standard (200 µg/L). These constituents are useful for distinguishing contaminant groups and contaminant sources. Cyanide and cobalt-60 are generally found together in this area.

The maximum cyanide concentrations in this area in fiscal year 2003 were 232 µg/L from well 299-E33-38 and 275 µg/L from well 299-E33-7, both located in the BY cribs. Cyanide contamination trends in these wells are similar to those of technetium-99 and nitrate and appear to be related to past discharges of ferrocyanide waste to the BY cribs.

The highest cobalt-60 values in fiscal year 2003 also were detected in wells monitoring the BY cribs, and the cribs are believed to be the source of this contamination. The highest cobalt-60 concentrations in fiscal year 2003 was in well 299-E33-7, located in the north part of the BY cribs, where the December 2002 result was 48.4 pCi/L. Well 299-E33-38, located in the south part of the cribs, had a maximum cobalt-60 value of 45.4 pCi/L, also for December 2002.

2.10.1.6 Uranium

Uranium contamination in the 200-BP-5 Operable Unit is limited to three isolated areas:

- Wells monitoring Waste Management Area B-BX-BY.
- Wells near the 216-B-5 injection well.
- Wells 299-E28-21 and 299-E28-18 at the 216-B-62 crib.

Many wells in all three of these areas exceeded the drinking water standard (30 µg/L) during fiscal year 2003.

Waste Management Area B-BX-BY. The largest uranium plume in the 200 East Area may have sources at Waste Management Area B-BX-BY. Currently, the highest uranium concentrations in the 200-BP-5 Operable Unit are found within and to the east of the BY Tank Farm (Figure 2.10-8). The contamination is present in a narrow northwest-southeast band but is increasing to the south along the west side of Waste Management Area B-BX-BY. Current interpretation is that the plume likely originates from a release at tank BX-102 (RPP-10098; PNNL-14187). In fiscal year 2003, the highest concentrations were detected in wells 299-E33-9 and 299-E33-44, with annual average concentrations of 450 and 330 µg/L, respectively. Section 2.10.4.1 includes additional discussion of uranium at Waste Management Area B-BX-BY.

216-B-5 Injection Well. Uranium contamination is associated with the cesium-137, plutonium, and strontium-90 contamination found at the former 216-B-5 injection well. Sampling of wells at this site resumed in fiscal year 2003 following publication of a revised sampling and analysis plan (DOE/RL-2001-49) and a plan (DOE/RL-2003-30) for disposal of derived waste such as gloves and paper wipes. The highest uranium concentration detected in fiscal year 2003 at this site was 62.4 µg/L in well 299-E28-23, located only ~1 meter from the injection well. A uranium value of 43.2 µg/L also was reported for well 299-E28-6, located south of the injection well, in fiscal year 2003.

216-B-62 Crib. Uranium was detected consistently at levels slightly above the drinking water standard (30 µg/L) in wells monitoring the 216-B-62 crib, located west of B Plant. Uranium concentrations were over 200 µg/L in the mid-1980s, but declined to current levels by the early 1990s. The maximum uranium concentration at the 216-B-62 crib was 32 µg/L in well 299-E28-18, which was last sampled in fiscal year 2001. Uranium also has been found along the west side of Low-Level Waste Management Area 1, but no wells exceeded the drinking water standard in fiscal year 2003. The uranium detected near Low-Level Waste Management Area 1 probably originated at the 216-B-62 crib.

Uranium contamination in the 200-BP-5 Operable Unit is limited to three isolated areas: Waste Management Area B-BX-BY and surrounding cribs, 216-B-5 injection well, and 216-B-62 crib.

2.10.1.7 Cesium-137 and Strontium-90

Cesium-137 and strontium-90 have relatively low mobility and are generally found near their source. Several wells near the 216-B-5 injection well have had elevated concentrations of strontium-90. Four wells (299-E28-2, 299-E28-23, 299-E28-24, and 299-E28-25) had concentrations of strontium-90 above the drinking water standard (8.0 pCi/L) in fiscal year 2003. Two of the wells have had concentrations greater than the U.S. Department of Energy (DOE) derived concentration guide (1,000 pCi/L) in past years and in fiscal year 2003 (Figure 2.10-9). The highest strontium-90 concentration was reported for well 299-E28-23, which averaged 5,655 pCi/L in fiscal year 2003. Strontium-90 also exceeded the DOE derived concentration guide in well 299-E28-25, which averaged 1,940 pCi/L in fiscal year 2003.

Well 299-E28-23 near the 216-B-5 injection well has concentrations of cesium-137 greater than the drinking water standard (200 pCi/L) but less than the DOE derived concentration guide (3,000 pCi/L). In fiscal year 2003, an average value of 1,135 pCi/L was reported for this well, which is somewhat lower than previous years. All other wells sampled at this site had cesium-137 concentrations below the drinking water standard in fiscal year 2003.

Wells near the 216-B-5 injection well have elevated concentrations of low-mobility contaminants including cesium-137, plutonium, and strontium-90.

Strontium-90 concentrations showed a declining trend in 1997, 2000, and 2003 versus a rising trend before fiscal year 1999 in several wells near Gable Mountain Pond. Strontium-90 was detected in groundwater at levels above the DOE derived concentration guide in the only well that was sampled at Gable Mountain Pond in fiscal year 2000, but was below it in fiscal year 2003. The concentration in the sample from that well, 699-53-47A, was 806 pCi/L in fiscal year 2003 versus 1,210 pCi/L in fiscal year 2000 (Figure 2.10-10).

2.10.1.8 Plutonium

Plutonium-239 and plutonium-240 were detected in past years in samples taken from several wells near the 216-B-5 injection well. Plutonium contamination is relatively immobile and, therefore, is found only near the source, which was the injection well. The highest reported plutonium concentration in fiscal year 2003 was for well 299-E28-23, which had a filtered value of 19.4 pCi/L and an unfiltered value of 74.8 pCi/L. Thus, the unfiltered value for this well exceeded the DOE derived concentration guide for plutonium (30 pCi/L), but the filtered value was below it. Other wells sampled at the 216-B-5 injection well site were well below the DOE derived concentration guide.

2.10.1.9 Other Constituents

Several other constituents exceeded drinking water standards in the 200-BP-5 Operable Unit in fiscal year 2003. A maximum of 51.1 µg/L was reported for filtered antimony versus the drinking water standard of 6 µg/L. This may be a laboratory analytical problem since there are no known sources of antimony in the 200-BP-5 Operable Unit. A maximum value of filtered nickel of 133 µg/L has also been reported, which has a drinking water standard of 100 µg/L. It is possible that this may be related to steel corrosion within wells. Numerous measurements of gross alpha and gross beta exceeding their drinking water standard have also been reported during fiscal year 2003 and are related to radionuclide contaminants discussed in the preceding sections.

2.10.2 CERCLA Groundwater Monitoring

CERCLA monitoring requirements in the 200-BP-5 Operable Unit have recently been defined in DOE/RL-2001-49. Specific CERCLA units include the 216-B-5 injection well site, the BY cribs, and Gable Mountain. Specific monitoring information regarding these units are discussed above (Section 2.10.1).

CERCLA monitoring resumed in late fiscal year 2003 following approval of a sampling and analysis plan.

CERCLA monitoring activities have been interrupted for the past several years in the 200-BP-5 Operable Unit because of waste management issues. Sampling activities were resumed in late fiscal year 2003 following approval of a sampling and analysis plan (DOE/RL-2001-49) and waste control plan (DOE/RL-2003-30). CERCLA sampling was successfully conducted at nine wells at the 216-B-5 injection well site, eight wells at Gable Mountain Pond, and six wells in the Gable Gap area north of the 200 East Area.

Wells completed above the basalt in the vicinity of Gable Mountain Pond are becoming difficult to sample because of declining water levels. Sampling was attempted at nine wells late in fiscal year 2003 (see Appendix A for wells sampled and Figure 2.10-2 for well locations). Samples were obtained from eight wells, but well 699-53-48B was determined to be dry.

2.10.3 RCRA Groundwater Monitoring

The 200-BP-5 Operable Unit contains six RCRA sites with groundwater monitoring requirements: Waste Management Area B-BX-BY, the 216-B-63 trench, Low-Level Waste Management Areas 1 and 2, the Liquid Effluent Retention Facility, and Waste Management Area C. This section summarizes results of statistical comparisons, assessment studies, and other developments for fiscal year 2003. RCRA groundwater data are available in the Hanford Environmental Information System and on the data files accompanying this report.

2.10.3.1 Waste Management Area B-BX-BY

Single-shell tank farms B, BX, and BY, located in the northwest part of the 200 East Area, comprise Waste Management Area B-BX-BY (see Appendix B). The site was placed in a RCRA groundwater quality assessment program in 1996 when specific conductance at a downgradient well became elevated above the critical mean. This section discusses the local hydrogeology of the waste management area, including the rate and direction of flow, and contaminant monitoring related to RCRA assessment activities. A total of 26 wells were successfully sampled at this unit in fiscal year 2003. RCRA constituent results are presented in this section. A more complete discussion of all contaminants at the B, BX, and BY Tank Farms can be found in Section 2.10.4.1.

Water levels stopped declining across Waste Management Area B-BX-BY during fiscal year 2003. Some wells have even shown a distinct increase in water level.

The hydraulic gradient is nearly flat across Waste Management Area B-BX-BY, making it difficult to determine upgradient versus downgradient wells from water elevations. A detailed discussion of this problem can be found in PNNL-12086, PNNL-13116, PNNL-13022, and PNNL-13078. Because the potential error exceeds the difference in elevation across the waste management area, water-elevation data should not be used alone to interpret flow directions (PNNL-13022; PNNL-13023; PNNL-13116). Consequently, flow directions were estimated at Waste Management Area B-BX-BY using in situ flow techniques such as the colloidal borescope (PNNL-13404; Narbutovskih et al. 2002). The results of these studies suggested a southerly flow direction across the waste management area. The direction of groundwater flow tends to be southwest from the BY cribs across the north BY Tank Farm and south to southeast through the BX and B Tank Farms.

In addition, the flow rate is close to stagnant under the BY Tank Farm (PNNL-13788). Conversely, in situ flow measurements indicate flow south of the waste management area is quite high. The calculated flow rate using the Darcy equation is ~0.8 meter per day for fiscal year 2003. For a complete discussion, see PNNL-14187 and Narbutovskih et al. 2002. Presently, the unconfined aquifer in the north is <1.75 meters thick and >4 meters thick along the south boundary. Water levels stopped declining across the site during fiscal year 2003. Some wells have even shown a distinct increase in water level as shown in Figure 2.10-11. The cause of these changes in water level is currently under investigation.

A 1998 RCRA assessment report (PNNL-11826) concluded that nitrate levels observed above the drinking water standard (45 mg/L) in well 299-E33-41 during 1997 were from residual waste in the vadose zone related to a tank farm leak in 1951. This residual waste had been driven to the groundwater by recent fresh water flooding from broken water lines. Since then, concentrations of nitrate with some nitrite, a little cyanide, and other tank-associated contaminants were found rising beneath and around the BY Tank Farm. A further investigation was conducted to identify the source of this contamination and to determine the rate and extent of groundwater contamination associated with the Waste Management Area B-BX-BY (PNNL-13022). The results of this investigation, presented in PNNL-SA-39825 and PNNL-14187, show that the contamination observed in downgradient wells around Waste Management Area B-BX-BY is due, primarily, to vertical movement of residual waste left in the soil under the tank farms. Although the source of the water driver and vadose zone migration pathways are not clearly understood, the water driver appears to be related, in part, to long-term steady-state recharge from natural precipitation. At this time, it has been reasonably established that the contamination found downgradient in the groundwater at Waste Management Area B-BX-BY is from local, residual soil plumes associated with past tank farm operations.

The contamination observed in downgradient wells around Waste Management Area B-BX-BY is due, primarily, to vertical movement of residual waste left in the soil under the tank farms.

Current contaminant trends across the site for fiscal year 2003 appear to be related to recent variations in the rate of water level changes (see Section 2.10.4.1). As shown in Figure 2.10-11, water levels have either ceased to drop or have actually increased since the summer of 2002. This change appears to have caused perturbations in contaminant trends although a concrete connection cannot be made. In general, contaminants trends of nitrate tended to decrease during 2001 after peak values were observed at the end of 2000 to early 2001. However, during the latter part of 2002 and throughout 2003, nitrate levels fluctuated slightly or were steady. If water levels resume dropping, recognizable contaminant patterns may once again develop.

2.10.3.2 216-B-63 Trench

Sampling results for the 216-B-63 trench have historically supported the interpretation that the facility has not affected groundwater. The results from the current fiscal year, in which 12 wells were successfully sampled, continue to sustain this view. Of the results reported, only two sampling events at two network wells indicate a statistical exceedance has occurred. Wells 299-E33-33 and 299-E33-36 exceeded the critical mean for total organic carbon early in 2003. The exceedances occurred at a time when a series of anomalously high total organic carbon results were reported across the Hanford Site. Preliminary results indicate that laboratory error may have contributed to the elevated results.

The non-hazardous constituents that had been rising in concentration slowly and persistently over a decade have, in most instances, stabilized or have declined in concentration. Wells in the 216-B-63 trench network have calcium and magnesium results that are either lower than or approximately the same concentration as last year. A significant exception to this trend is the nearly simultaneous increase in sulfate concentration throughout the network. This phenomenon, however, is not restricted solely to this facility but is instead wide spread in the 200 East Area. Sodium was higher in only one well.

Sampling results for the 216-B-63 trench have historically supported the interpretation that the facility has not affected groundwater.

The monitoring well network that rings the 216-B-63 trench is shared with both the Low-Level Burial Ground Waste Management Area 2 and the B-BX-BY Tank Farms. Samples are gathered twice a year in spring and fall (see Appendix B). Due to the low hydraulic gradient and the highly transmissive media in 200 East Area, the rate of groundwater movement near the 216-B-63 trench is low, approximating 0.1 meter per day (see Appendix B).

2.10.3.3 Low-Level Waste Management Area 1

Groundwater monitoring under interim status requirements continued at this RCRA site in fiscal year 2003. The well network was sampled twice for indicator and site-specific parameters (see Appendix B). All 17 wells were successfully sampled during both samplings.

An application was submitted to the Washington State Department of Ecology (Ecology) in June 2002 to incorporate the low-level burial grounds into the Hanford Facility RCRA Permit (Ecology 1994). This would have the effect of changing the groundwater monitoring requirements for the burial grounds from interim status monitoring to final status monitoring. As part of the application, new groundwater monitoring constituents and statistical evaluations are proposed. Workshops with Ecology to address this application are in progress.

The groundwater gradient in this part of the 200 East Area is almost flat making the determination of groundwater flow direction difficult. Based on contaminant plumes, the flow direction appears to have been to the northwest in recent years. Past analysis of water-level data also indicate flow toward the northwest. Trend surface analysis was performed on water levels collected during four different months (December 2002, March 2003, June 2003, and July 2003). The flow directions ranged from northwest to east-southeast. The calculated gradient is ~0.00006 with flow rate estimates ranging from ~0.01 to 1.6 meter per day (see Appendix B). The data suggest that the flow direction is dynamic due to the influence of minor relative water level variation between wells. For this reason, no attempt will be made to update the interim status designation of upgradient and downgradient wells until a stable flow direction is re-established.

Specific conductance continued to exceed the statistical upgradient/downgradient comparison value (critical mean) in downgradient well 299-E33-34, with values ranging from 1,048 to 1,195 μS/cm. In fiscal year 2002, well 299-E32-10 also exceeded the statistical comparison value, but it did not exceed the value in fiscal year 2003 because the comparison value was updated to a higher value. The exceedance is related to the nitrate plume from an upgradient source, not the Low-Level Waste Management Area 1. DOE notified Ecology in 1999. Because no waste has been placed in the north portion of the site and there is a nitrate plume from an upgradient source, no further action is necessary. Statistical comparison values to be used for indicator parameters in fiscal year 2004 are listed in Appendix B.

RCRA monitoring at Low-Level Waste Management Areas 1 and 2 indicates the sites have not affected groundwater quality.

2.10.3.4 Low-Level Waste Management Area 2

Groundwater monitoring under interim status requirements continued at this RCRA site in fiscal year 2003. The well network was sampled twice for indicator and site-specific parameters (see Appendix B). Of the 12 wells in the network, sampling was successful at 11 for both sampling rounds. One well, 299-E34-3, was declared sample-dry due to declining water levels and was removed from the network.

An application was submitted to Ecology in June 2002 to incorporate the low-level burial grounds in to the Hanford Facility RCRA Permit (Ecology 1994). This would have the effect of changing the groundwater monitoring requirements for the burial grounds from interim status monitoring to final status monitoring. As part of the application, new groundwater monitoring constituents and statistical evaluations are proposed. No new wells were proposed, in spite of wells going dry, because the water-table elevation is receding below the top of the basalt. Where basalt is present above the water table, it is impossible to monitor the unconfined aquifer. Deeper aquifers are isolated from the burial grounds by the low-permeability basalts. Workshops with Ecology to address this application are in progress.

The groundwater gradient in this part of the 200 East Area is almost flat making the determination of groundwater flow direction difficult. Groundwater flow appears to be generally to the west based on small differences in head at wells along the south boundary of Low-Level Waste Management Area 2. Trend surface analysis performed on fiscal year 2002 data indicated flow generally to the southwest; however, no realistic flow direction could be determined from trend surface analysis of fiscal year 2003 data due to further flattening of the water table. For this reason, no attempt will be made to update the statistical tests until a stable flow direction is evident. The basalt surface above the water table in the north part of Low-Level Waste Management Area 2 constrains possible flow directions for the unconfined aquifer. However, it is possible that the flow is influenced by continued drainage of the unsaturated sediment and recharge flowing down the basalt surface to the saturated aquifer sediment. The gradient calculated from wells along the south boundary of the burial ground is 0.00003. The estimated flow rate at Low-Level Waste Management Area 2, using this gradient, is 0.04 to 0.6 meter per day (see Appendix B).

Levels of specific conductance, total organic carbon, and total organic halides in an upgradient well at Low-Level Waste Management Area 2 are elevated. The source is unknown.

Statistical evaluations for this area determined that upgradient well 299-E34-7 continued to exceed the statistical comparison value (critical mean or limit of quantitation) for specific conductance, total organic carbon, and total organic halides. The major contributors to the elevated specific conductance are sulfate, chloride, nitrate, and calcium. The source of the elevated specific conductance is not known. The increase in specific conductance appears to have leveled off during fiscal year 2003.

The cause of the elevated levels of total organic carbon and total organic halides is also not known. Total organic carbon levels declined slightly from fiscal year 2002. The fiscal year 2003 average total organic carbon concentration was 5,100 µg/L. The average total organic halide concentration was 22.6 µg/L, slightly higher than in fiscal year 2002. Fiscal year 2003 samples from well 299-E34-7 were analyzed for an extensive list of constituents and other possible contaminants identified in 40 CFR 264, Appendix IX. The only organic constituent detected was a low level (0.076 µg/L) of Endrin aldehyde in the October 2002 sample. This is an impurity or breakdown product of the pesticide Endrin that has not been sold in the United States since the 1980s. There is no drinking water standard for Endrin aldehyde, but the standard for Endrin is 2 µg/L. Endrin aldehyde was not detected in the April 2003 sample. Total analytical results for petroleum hydrocarbon and oil and grease were also non-detect for the fiscal year 2003 samples. Because of the anomalous chemistry in this upgradient well, it is not used in the statistical upgradient/downgradient comparisons. Appendix B lists the statistical comparison values based on data for the other designated upgradient wells.

There are indications that some of the elevated constituents seen in well 299-E34-7 are beginning to impact wells farther southwest, well 299-E27-10 and possibly well 299-E27-9. Sulfate, chloride, nitrate, and calcium are all increasing in these wells but remain at lower concentrations than seen in well 299-E34-7. The concentrations in well 299-E27-10 are higher than in well 299-E27-9, indicating the plume is spreading toward the southwest and west. The concentrations in well 299-E27-10 started rising in 1995 at about the same time as well 299-E34-7 but do not show the sudden increase seen in well 299-E34-7 in about 1997. The nitrate trend for these three wells is shown in Figure 2.10-12 as an example of the increases.

2.10.3.5 Liquid Effluent Retention Facility

The Liquid Effluent Retention Facility is an active, lined facility that is identified in the Hanford Facility RCRA Permit (Ecology 1994). A letter from Ecology directed DOE to discontinue statistical evaluation of groundwater sample results effective January 14, 2001. Since that time, DOE has continued to sample according to WHC-SD-EN-AP-024 and has explored alternative approaches to monitoring groundwater at the facility to measure compliance with hazardous waste regulations.

The Liquid Effluent Retention Facility is monitored by two wells.

Two wells were successfully sampled semiannually at the Liquid Effluent Retention Facility in fiscal year 2003 (see Appendix B). Results for specific conductance and sulfate have been rising in concentration since 1994 mirroring a regional trend. No other contamination indicator parameters have shown increases over the fiscal year.

2.10.3.6 Waste Management Area C

Located in the northeast part of the 200 East Area, Waste Management Area C consists of the C Tank Farm, the 244-CR vault, ancillary waste transfer lines, and seven diversion boxes (see Appendix B). The following paragraphs describe a summary of monitoring specific to RCRA-regulated constituents and the local hydrogeology of the waste management area. The current state of groundwater contamination associated with this tank farm is further described in Section 2.10.4.4.

A general flow direction to the southwest has been established for this site using in situ flow measurements, plume tracking, and water elevations corrected for borehole deviations from vertical (PNNL-13788). Hydrographs show that the flow direction is still to the southwest, which is consistent with the regional water-table map (PNNL-14187). When the monitoring network was designed, flow was believed to be due west. Three new downgradient wells and one new upgradient well were installed in fiscal year 2003 to improve the capability of the detection network to monitor the site (see Section 5 and Appendix B).

The estimated groundwater flow rates calculated using the Darcy equation range from 1.2 to 2.3 meters per day (see Appendix B). Based on these estimates of flow rate, the groundwater could flow as much as 800 meters per year. The rate of water table decline beneath Waste Management Area C was about 0.3 meter last year. If this rate continues, wells from the original network should be usable for at least 6 years.

Waste Management Area C continued to be monitored under an interim status indicator evaluation program in fiscal year 2003. Five wells were sampled quarterly at the request of Ecology due to rising trends in sulfate and nitrate detected in both upgradient and downgradient wells. In addition, the required detection sampling was conducted twice for indicator and site-specific parameters (see Appendix B).

During fiscal year 2003, the site was monitored with the original configuration of wells (see Appendix B). Because the upgradient well was experiencing variable specific conductance values, no upgradient/downgradient comparisons could be made for this indicator parameter for fiscal year 2003. Initial sampling that was undertaken during installation indicates that the new upgradient well will give stable results. This new well is scheduled for the required four RCRA sampling events in fiscal year 2004. Results from these four events will be used to calculate a new critical mean for specific conductance. Upgradient/downgradient comparisons will begin during fiscal year 2005. The indicator parameters (pH, total organic carbon, and total organic halide) did not exceed the upgradient/downgradient comparison values in downgradient wells during fiscal year 2003.

Because the upgradient well was experiencing variable specific conductance values, no upgradient/ downgradient comparisons could be made for fiscal year 2003 at Waste Management Area C.

2.10.4 AEA Monitoring

This section describes AEA monitoring conducted at the single-shell tank farms and low-level burial grounds in the 200-BP-5 Operable Unit. Results of AEA monitoring conducted in the 600 Area in fiscal year 2003 (primarily the Gable Gap guard wells) are described in Section 2.10.1.

2.10.4.1 Waste Management Area B-BX-BY

The following discussion describes the current state of groundwater contamination associated with Waste Management Area B-BX-BY. Groundwater monitoring at Waste Management Area B-BX-BY has identified several distinct groups of contaminants based on chemical associations, spatial relationships, historic plume movement, knowledge of process chemistry, and characteristic chemical ratios of contaminant concentrations (PNNL-SA-39825; PNNL-14187; PNNL-13116). A plume consisting of nitrate, nitrite, technetium-99, and uranium is located under and east of the BY Tank Farm. Recent assessment studies, based on pattern matching of trend plots and chemical fingerprinting using the ratio of nitrate to technetium-99, suggest most of the groundwater contamination in the vicinity of Waste Management Area B-BX-BY is related to vertical infiltration of residual waste from the vadose zone (PNNL-14187). This waste appears to be driven to the unconfined aquifer by natural precipitation and ruptures of nearby fresh water lines. Past releases from the waste management area have left pockets of contaminated soil in the vadose zone, which are, most likely, the sources of this groundwater contamination (PNNL-SA-39825; PNNL-14187).

Another plume with low levels of nitrate associated with relatively high tritium (close to or exceeding the drinking water standard of 20,000 pCi/L) is found along the south border of the waste management area. Movement through the vadose zone from a tritium-rich perched water zone located ~4.6 meters above the water table under the B and BX Tank Farm is probably the cause of this contamination (RPP-10098; PNNL-14187). Tritium concentrations generally continued to increase in this plume during fiscal year 2003, but at a slower rate than in previous years. Maximum levels exceeded the drinking water standard (20,000 pCi/L) this year on the southwest corner of the BX Tank Farm at 20,600 pCi/L in August 2003. Farther to the north under the BY cribs, a plume containing high levels of nitrate, cyanide, cobalt-60, and technetium-99 is most likely from the highly contaminated soil under the BY cribs.

Concentrations of nitrate, technetium-99, cyanide, and uranium have continued to decrease or stabilize during fiscal year 2003 as illustrated by the technetium-99 trends shown in Figure 2.10-13. This decrease in contaminant variations during the last year may be due to one of several causes. Measures were taken at the surface of the farm with the placement of earthern berms to avoid surface run off from impacting and interacting with the contaminated subsurface soil. We may be seeing the effect of these precautions in reducing the infiltration driving contamination to the groundwater. Alternatively, the variations observed in the water levels may be causing movement of water in the aquifer, affecting contaminant trends. Results from further monitoring should provide insight to understand these current trends.

In general, contaminant trends of nitrate, technetium-99, cyanide, and uranium have continued to decrease or stabilize during fiscal year 2003.

The historical discharge of effluent to the ground in and around Waste Management Area B-BX-BY has resulted in complex patterns of groundwater contamination. The highest level of technetium-99 was located beneath the BY cribs to the north and is attributed to discharges to the cribs in the mid-1950s. The technetium-99 was associated with high concentrations of nitrate, cyanide, and some cobalt-60. This contamination forms a plume that is moving southward, affecting the groundwater under the north part of Waste Management Area B-BX-BY. Elevated uranium with technetium-99, nitrate, and nitrite is found locally beneath the BY Tank Farm while a small tritium plume is located along the south margin of the waste management area. Residual waste from the waste management area is, most likely, contributing to the nitrate, technetium-99, uranium, tritium, and other contamination in the vicinity of the BY and BX Tank Farms (PNNL-SA-39825; PNNL-14187). Quarterly monitoring of the groundwater at Waste Management Area B-BX-BY will continue.

2.10.4.2 Low-Level Waste Management Area 1

Performance assessment monitoring of radionuclides at Low-Level Waste Management Area 1 is designed to complement the 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 1 is to gather data to assess changes in concentrations at downgradient wells using statistical tests and to provide sufficient supporting information from upgradient wells to interpret the changes. Under the current monitoring plan (DOE/RL-2000-72), only technetium-99 is monitored specifically for performance assessment.

Section 2.10.3.3 discusses chemical constituents monitored under RCRA requirements at Low-Level Waste Management Area 1. There is no evidence that Low-Level Waste Management Area 1 has contaminated groundwater with radionuclides or hazardous constituents.

Contaminant characteristics for radionuclides at Low-Level Waste Management Area 1 include the following:

- Technetium 99 concentrations continued to be elevated in several wells (299-E33-34, 299-E32-10, 299-E33-35) near the northeast corner of Low-Level Waste Management Area 1. Concentrations in 2003 (maximum of 7,150 pCi/L in well 299-E33-34) were lower than the maximum concentration seen in 2001 (8,170 pCi/L in well 299-E33-34). This contamination is from facilities to the east, primarily the BY cribs, and the reduction in contamination is likely due to changing groundwater flow directions.
- Uranium values have stabilized between 90 and 100 µg/L at well 299-E33-34 in the northeast corner of the waste management area after an increase in 2002. This is associated with a relatively recent plume originating in the vicinity of Waste Management Area B-BX-BY. The uranium plume has impacted other wells surrounding this part of the waste management area, but concentrations are not as high.
- Uranium levels are increasing in a number of wells on the west side of Low-Level Waste Management Area 1, including downgradient wells 299-E32-2 and 299-E32-7, but remained below the drinking water standard (30 µg/L). A maximum of 21.5 µg/L was detected in well 299-E32-2. Comparable or higher concentrations have been seen in past years in wells farther south, so it is likely that the increases indicate a shift in preexisting plumes and not new contamination from the waste management area.
- Iodine-129 contamination in this area is consistent with regional plumes and believed to be from upgradient liquid waste facilities, not related to the burial grounds.
- Tritium contamination is also believed to be from regional plumes, not related to the burial grounds. Tritium concentrations were less than the drinking water standard in fiscal year 2003.

There is no evidence that Low-Level Waste Management Areas 1 or 2 have contaminated groundwater with radionuclides or hazardous constituents.

2.10.4.3 Low-Level Waste Management Area 2

Performance assessment monitoring of radionuclides at Low-Level Waste Management Area 2 is designed to complement the 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 2 is to gather data to assess changes in concentrations at downgradient wells using statistical tests 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, and uranium are monitored specifically for performance assessment.

Section 2.10.3.4 discusses chemical constituents monitored under RCRA requirements at Low-Level Waste Management Area 2. There is no evidence that Low-Level Waste Management Area 2 has contaminated groundwater with radionuclides or hazardous constituents.

Contaminant characteristics for radionuclides at Low-Level Waste Management Area 2 include the following:

- Iodine-129 concentrations are <5 pCi/L in Low-Level Waste Management Area 2 wells. The levels are consistent with the regional iodine-129 plume and do not appear to be related to a burial ground source.
- Uranium concentrations in Low-Level Waste Management Area 2 samples are <5 µg/L and do not indicate a burial ground source.
- Technetium-99 concentration is increasing in well 299-E27-10 southeast of Waste Management Area 2, where the concentration reached 59 pCi/L in 2003. This

contamination is believed to be from past disposal of liquid waste in the 200 East Area and unrelated to Low-Level Waste Management Area 2. Other wells in the monitoring network have lower technetium-99 concentrations.

- Tritium contamination is found at levels less than the drinking water standard. The tritium concentrations are consistent with regional plumes.

2.10.4.4 Waste Management Area C

Specific conductance continued to increase in upgradient well 299-E27-7 (596 µS/cm) and cross-gradient well 299-E27-14 (678 µS/cm). The increase in specific conductance is due primarily to rising sulfate and calcium along with some nitrate and chloride (PNNL-14187). Sulfate dominates with the highest value found in well 299-E27-14 at 142 mg/L in September 2003 (drinking water standard = 250 mg/L). There has been a tendency since the mid-to-late 1990s for sulfate and calcium to increase along the basalt subcrop to the north (PNNL-13404). This distribution pattern may be due to leaching of sediment above the basalt with subsequent transport from the subcrop as the water level declines in the area (PNNL-14187). This rising sulfate/calcium trend seen at C Tank Farm may be related to these increases seen further north.

Low levels of cyanide that have recently been found in the groundwater at Waste Management Area C suggest that the source may be related to residual tank-related vadose zone waste.

In June 2003, nitrate rose above the drinking water standard of 45 to 46.5 mg/L on the south side of the waste management area. Nitrate concentrations have been primarily increasing along with the sulfate in all wells except upgradient well 299-E27-7. Levels in this well decreased from a maximum of 27.4 mg/L in January 2002 to 19.5 mg/L in September 2002. The current trend appears to be stable with a value of 21.7 mg/L in September 2003. Since about 1999, technetium-99 has followed a trend similar to nitrate in this upgradient well, reaching a maximum of 2,760 pCi/L also in January 2002 then declining sharply to the current value of 39 pCi/L in September 2003 (Figure 2.10-14). The lack of correlation between the sulfate and the technetium-99 concentrations in this upgradient well along with the sharp increase and decrease in technetium-99 and nitrate suggests the technetium-99 has a different source than the more regional sulfate/calcium chemistry. Technetium-99 concentrations continued to increase with the nitrate downgradient at Waste Management Area C and ranged from 2,200 pCi/L on the south side of C Tank Farm to 1,400 pCi/L to the southwest at the end of fiscal year 2003.

The use of chemical ratios can be useful to correlate groundwater contamination to possible sources and to differentiate sources of contamination in one well compared to that observed in other wells. The nitrate to technetium-99 ratio in upgradient well 299-E27-7 was 48 in November 2000. At the technetium-99 peak, it dropped to 9.9 in January 2002 as the technetium-99 rose more rapidly than the nitrate (Figure 2.10-14). When the contaminant levels dropped nearly back to those seen in November 2000, the ratio increased to 36 in September 2002. As discussed in PNNL-14187, a similar low ratio of nitrate to technetium-99 (<10) is seen downgradient on the southwest side of the farm. In general, nitrate to technetium-99 ratios lower than 10 suggest the source may be related to residual tank waste in the vadose zone. The low levels of cyanide (<18 µg/L) that have recently been found in the groundwater at this site also suggest the source may be related to residual tank-related vadose zone waste. The C Tank Farm is the only known local source for cyanide (HNF-SD-WM-TI-740).

Another possibility is that the contamination may be related to the upgradient 216-B-3-1 ditch. As part of a continuous ditch system connected to the 216-B-63 trench, this ditch was decommissioned in 1964 after an accidental release of mixed fission products from the PUREX Plant was discharged directly to the 216-B-3-1 ditch (DOE/RL-89-28). However, the sharp rise and fall of the contaminant peak at well 299-E27-7 indicates a short travel distance from the point of entry into the groundwater. Also, there was no cyanide associated with this accidental release. Further insight into the source of the technetium-99 may be possible when data from four new fiscal year 2003 wells are available (see Chapter 5 and Appendix B).

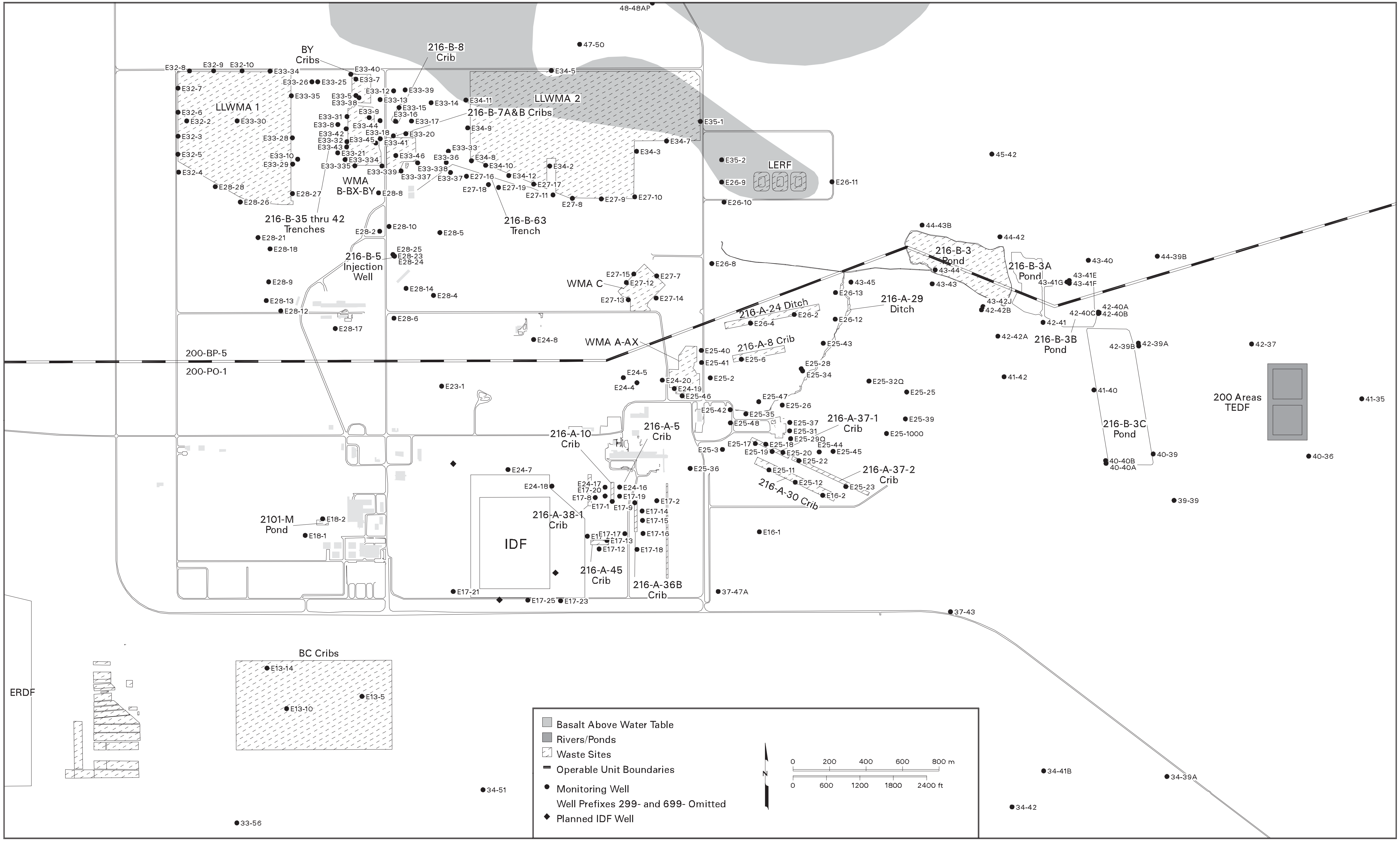

Figure 2.10-1. Groundwater Monitoring Wells in the 200 East Area

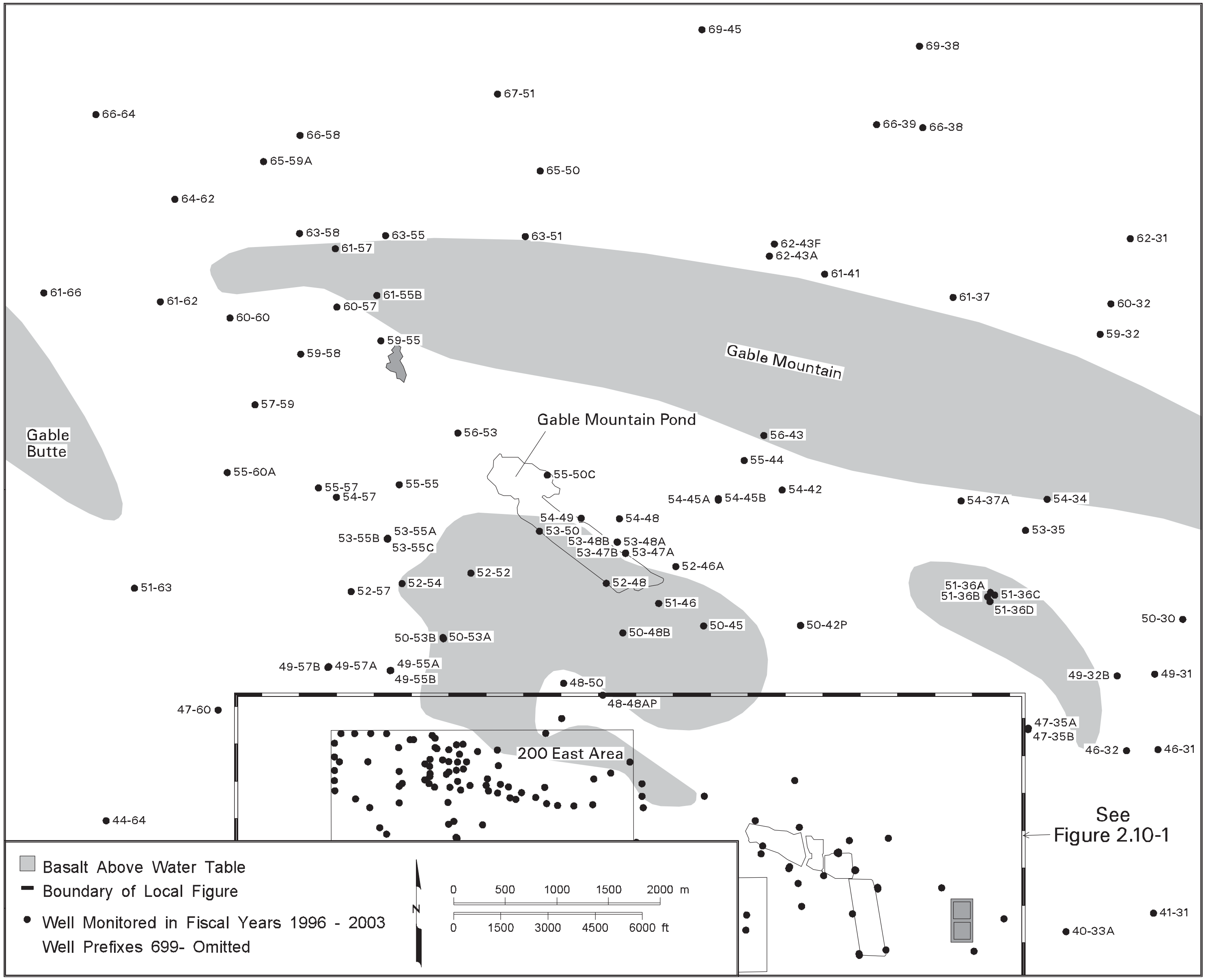

Figure 2.10-2. Groundwater Monitoring Wells Located in the 600 Area Associated with the 200-BP-5 Operable Unit

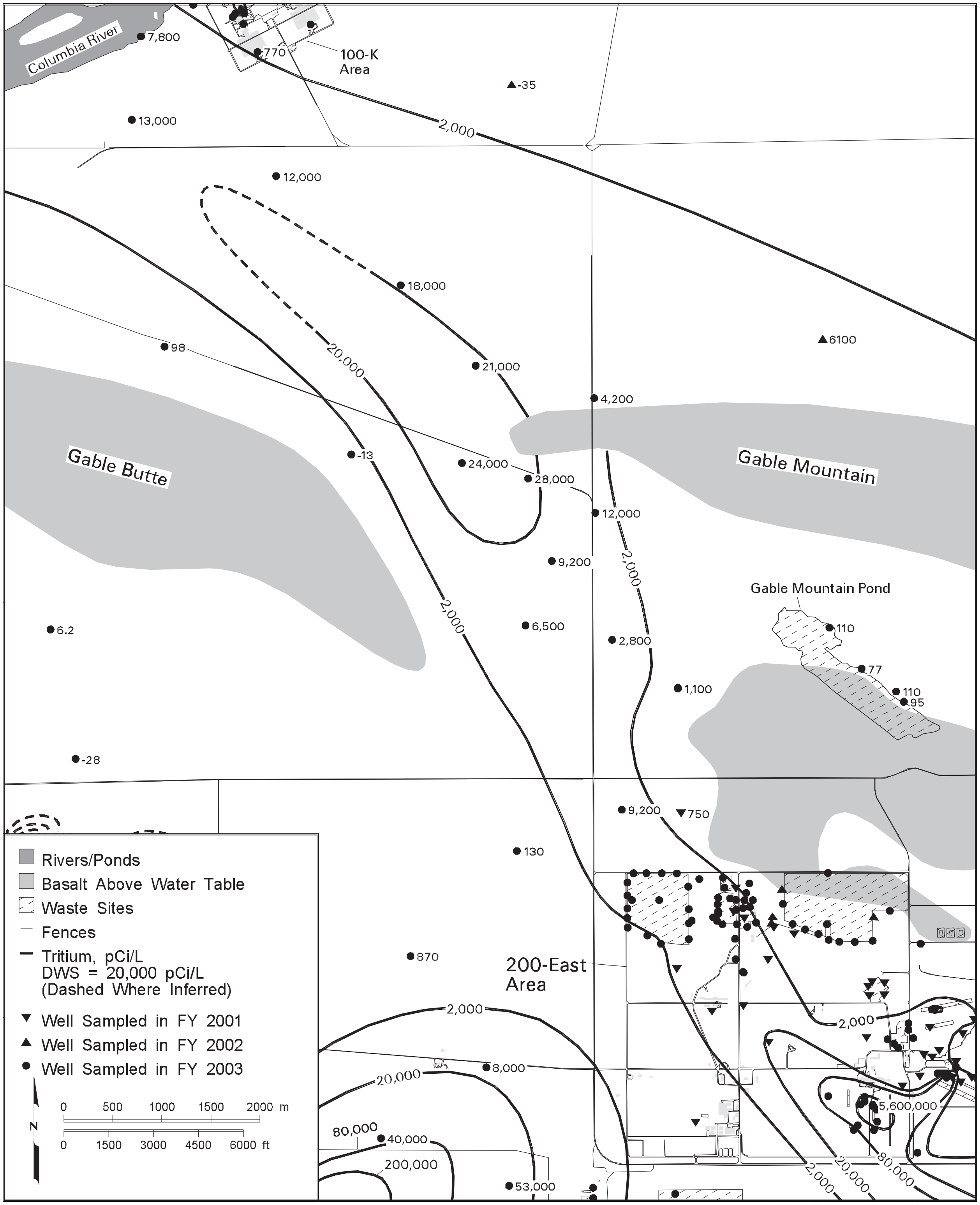

Figure 2.10-3. Average Tritium Concentrations in the 200-BP-5 Operable Unit and Vicinity, Top of Unconfined Aquifer

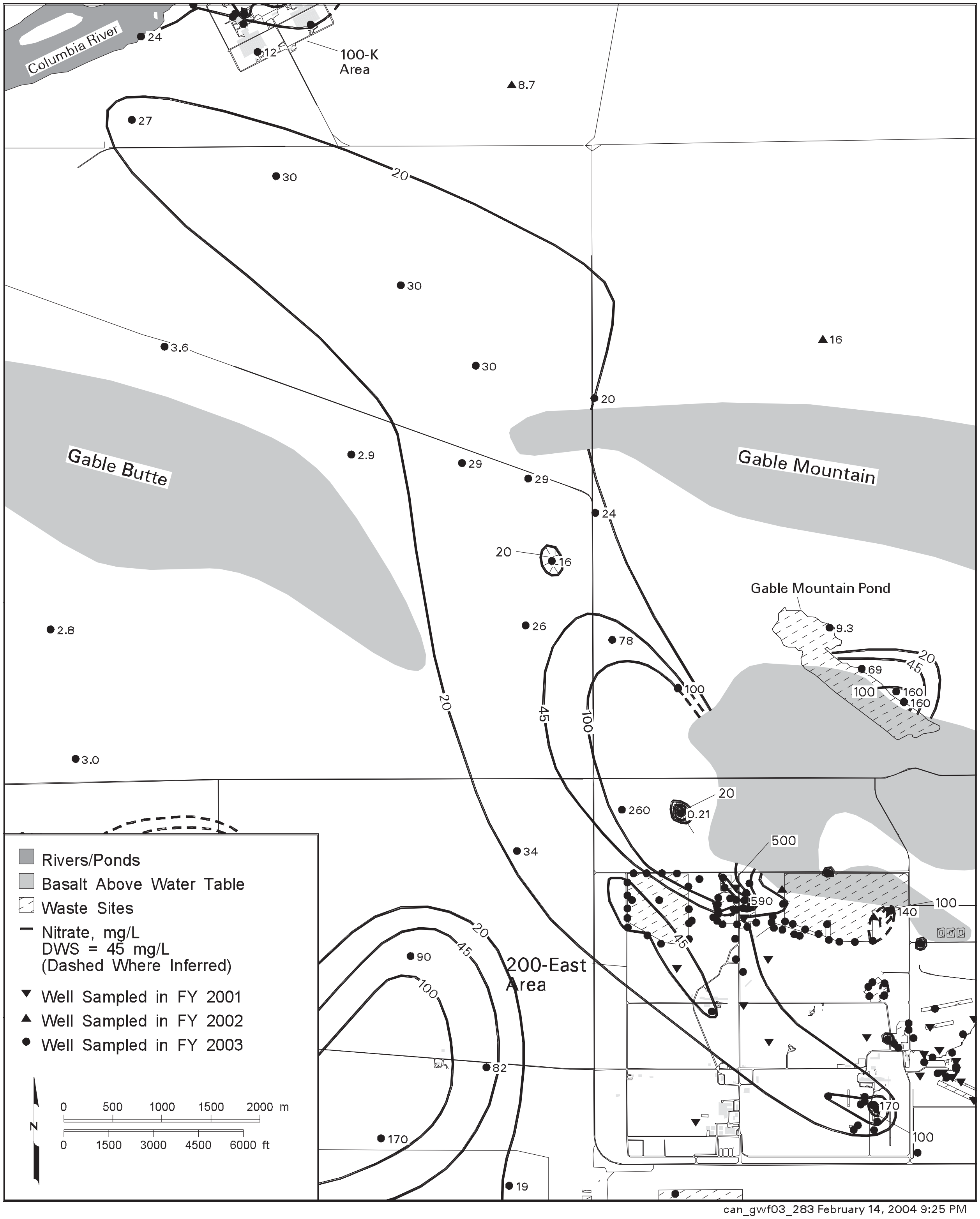

Figure 2.10-4. Average Nitrate Concentrations in the 200-BP-5 Operable Unit and Vicinity, Top of Unconfined Aquifer

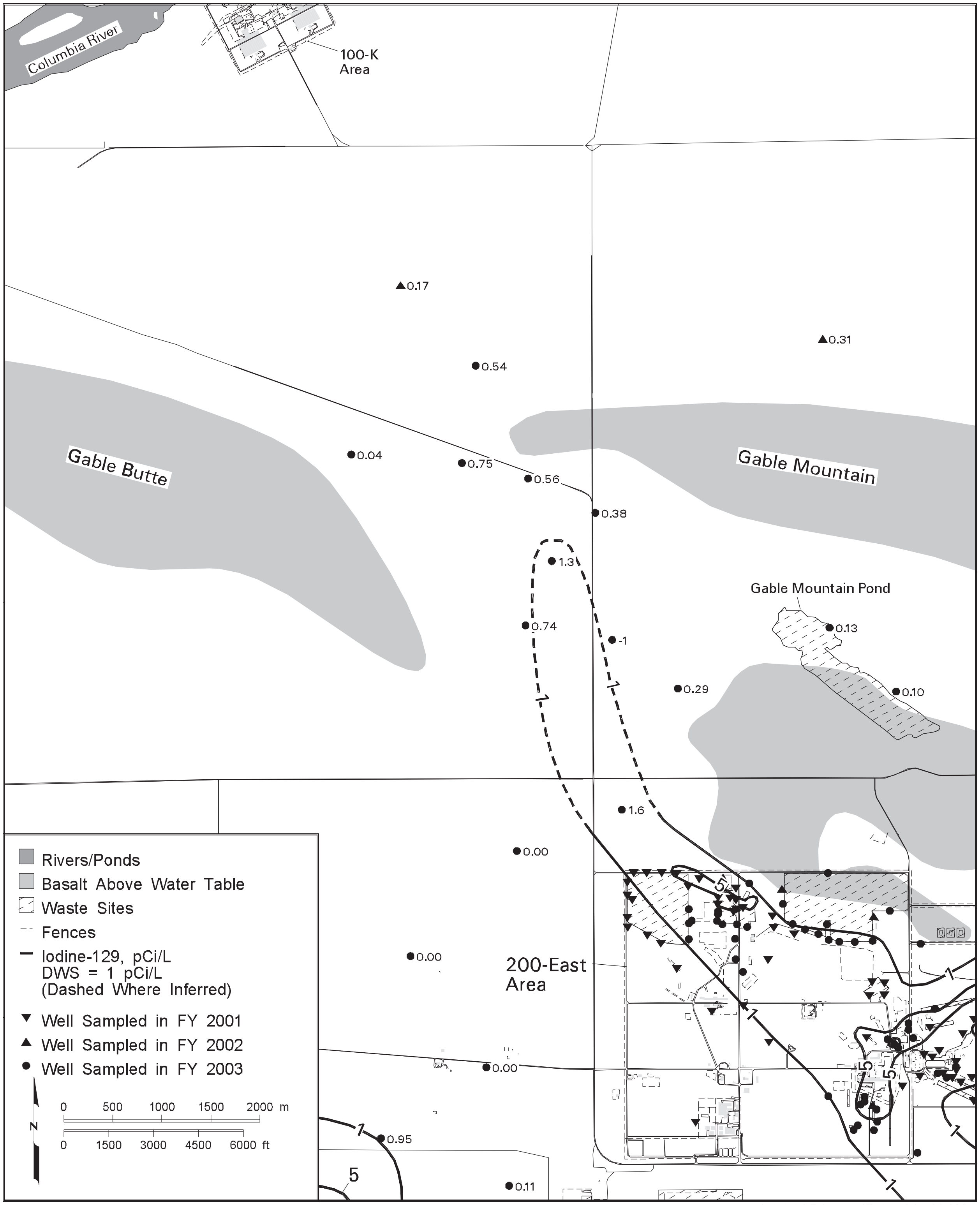

Figure 2.10-5. Average Iodine-129 Concentrations in the 200-BP-5 Operable Unit and Vicinity, Top of Unconfined Aquifer

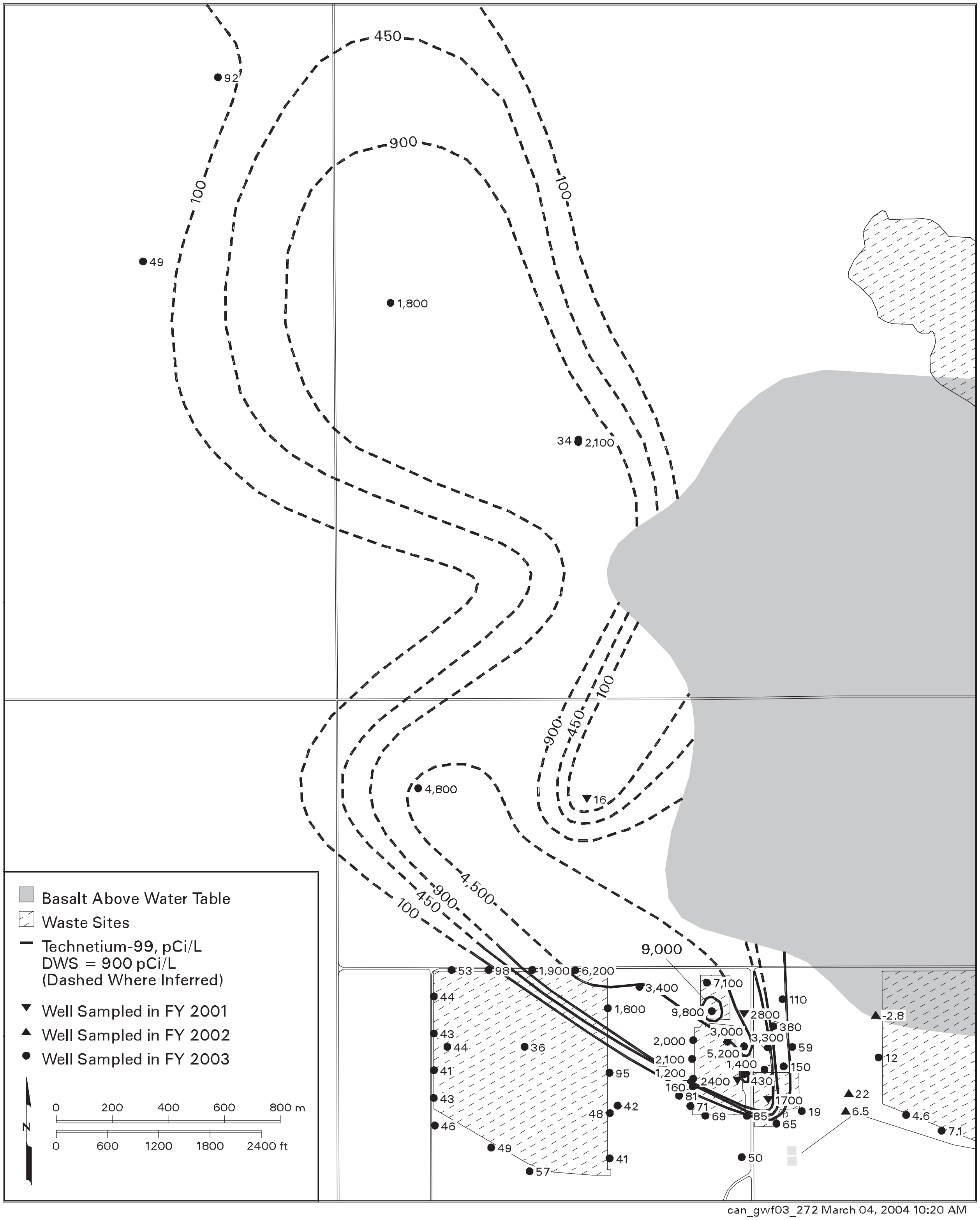

Figure 2.10-6. Average Technetium-99 Concentrations in the North 200 East Area, Top of Unconfined Aquifer

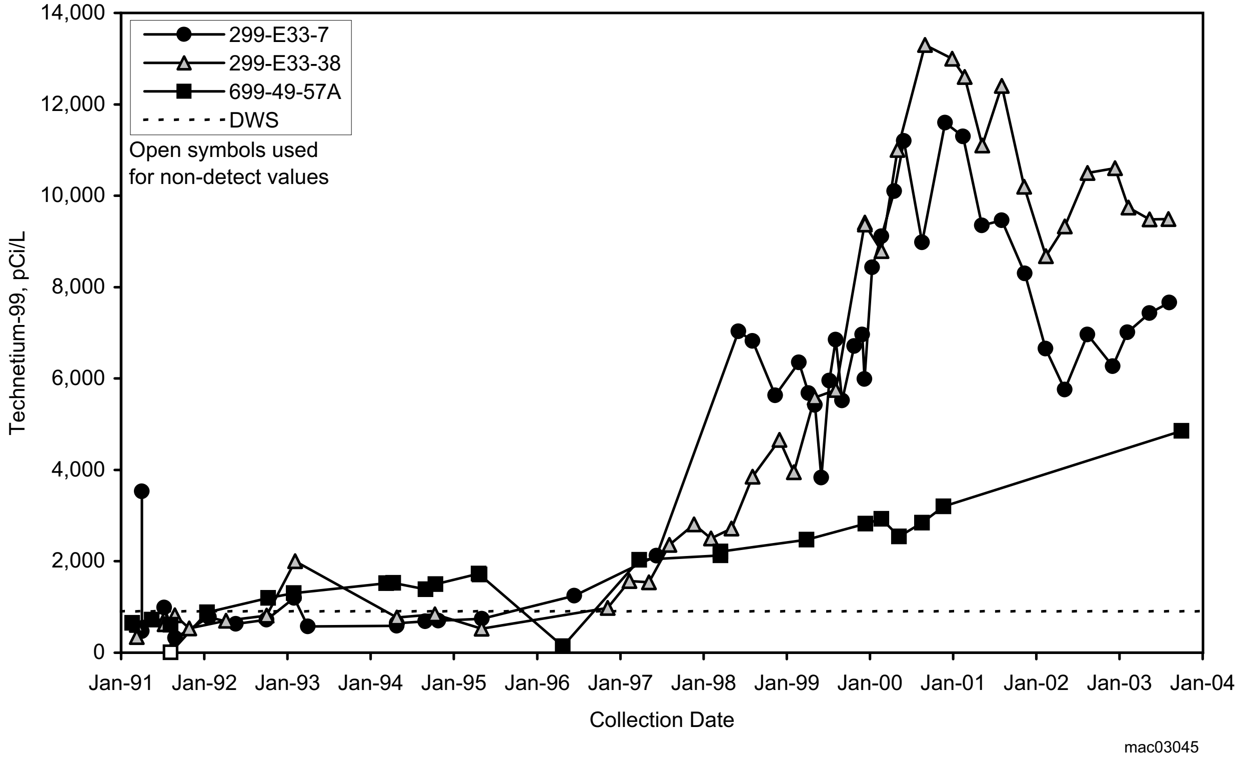

Figure 2.10-7. Technetium-99 Concentrations in Wells 299-E33-7 and 299-E33-38 at the BY Cribs and Well 699-49-57A North of 200 East Area

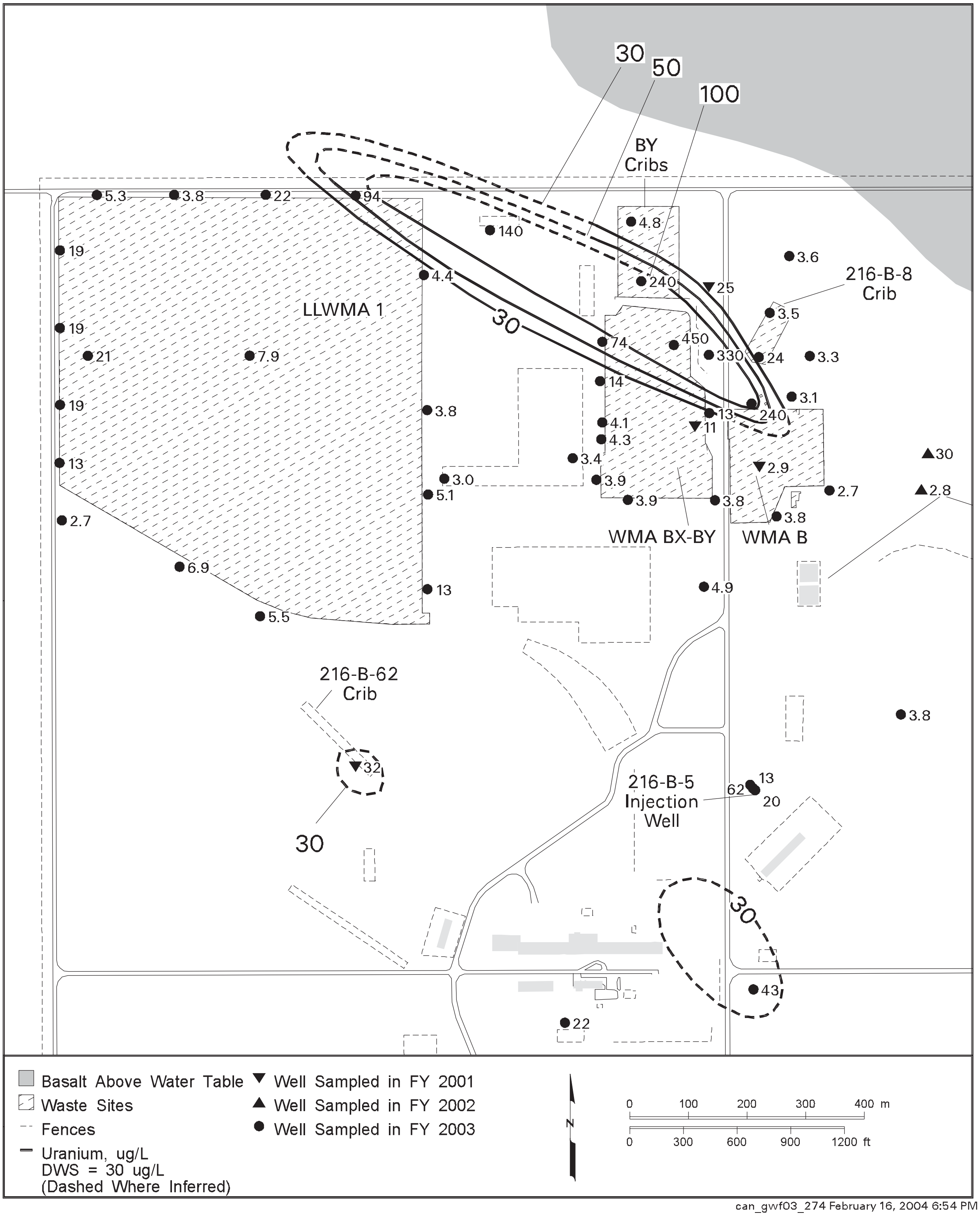

Figure 2.10-8. Average Uranium Concentrations in the Vicinity of BY Cribs, Top of Unconfined Aquifer

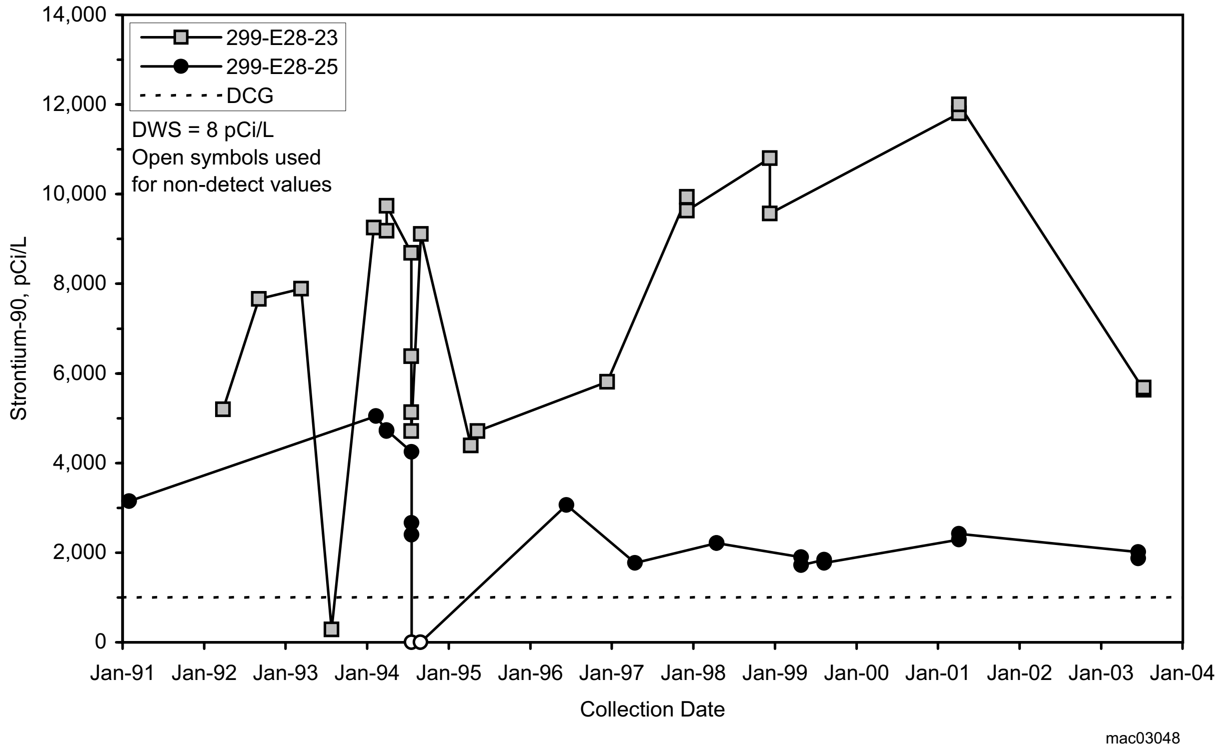

Figure 2.10-9. Strontium-90 Concentrations in Wells 299-E28-23 and 299-E28-25 at the 216-B-5 Injection Well Site

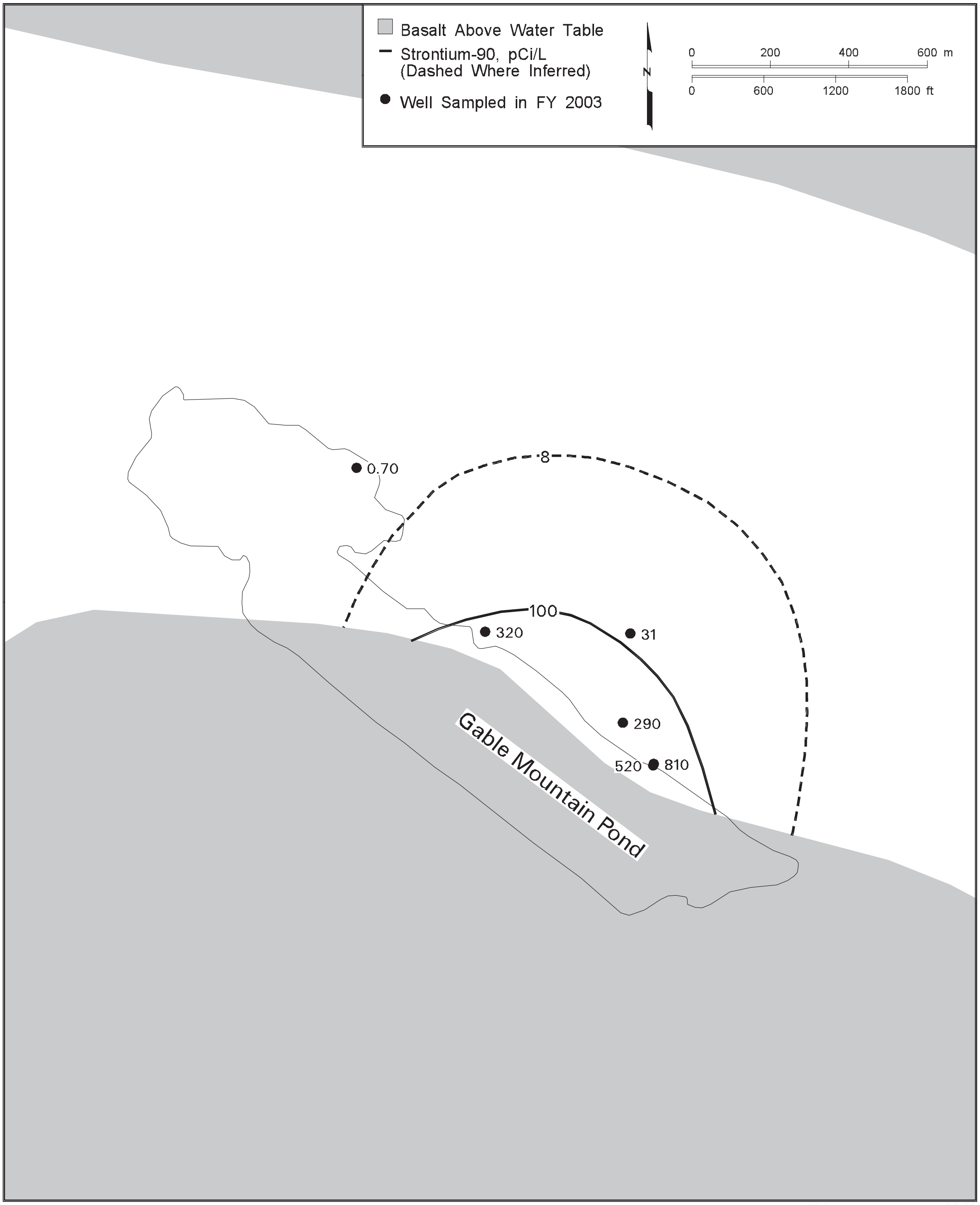

Figure 2.10-10. Strontium-90 Concentrations at Gable Mountain Pond, Top of Unconfined Aquifer

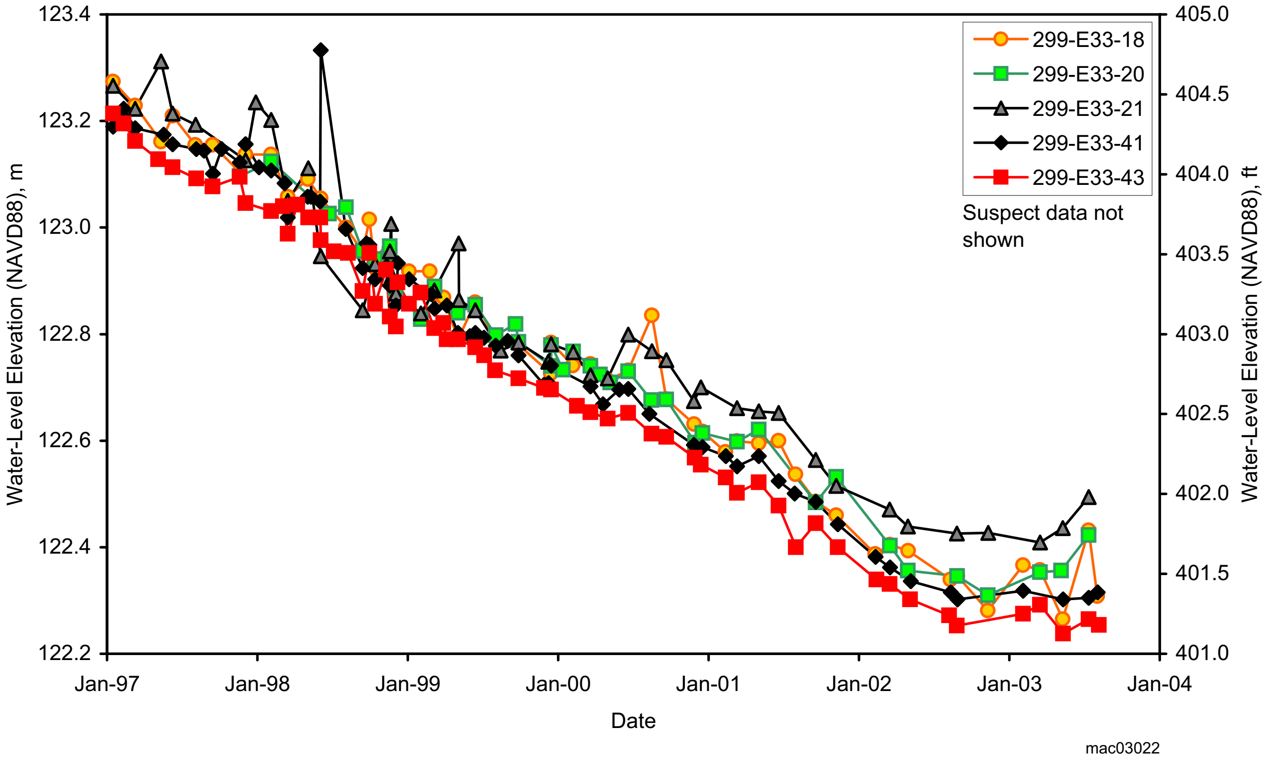

Figure 2.10-11. Hydrograph for Wells at Waste Management Area B-BX-BY Showing the Distinct Increase in Water Levels

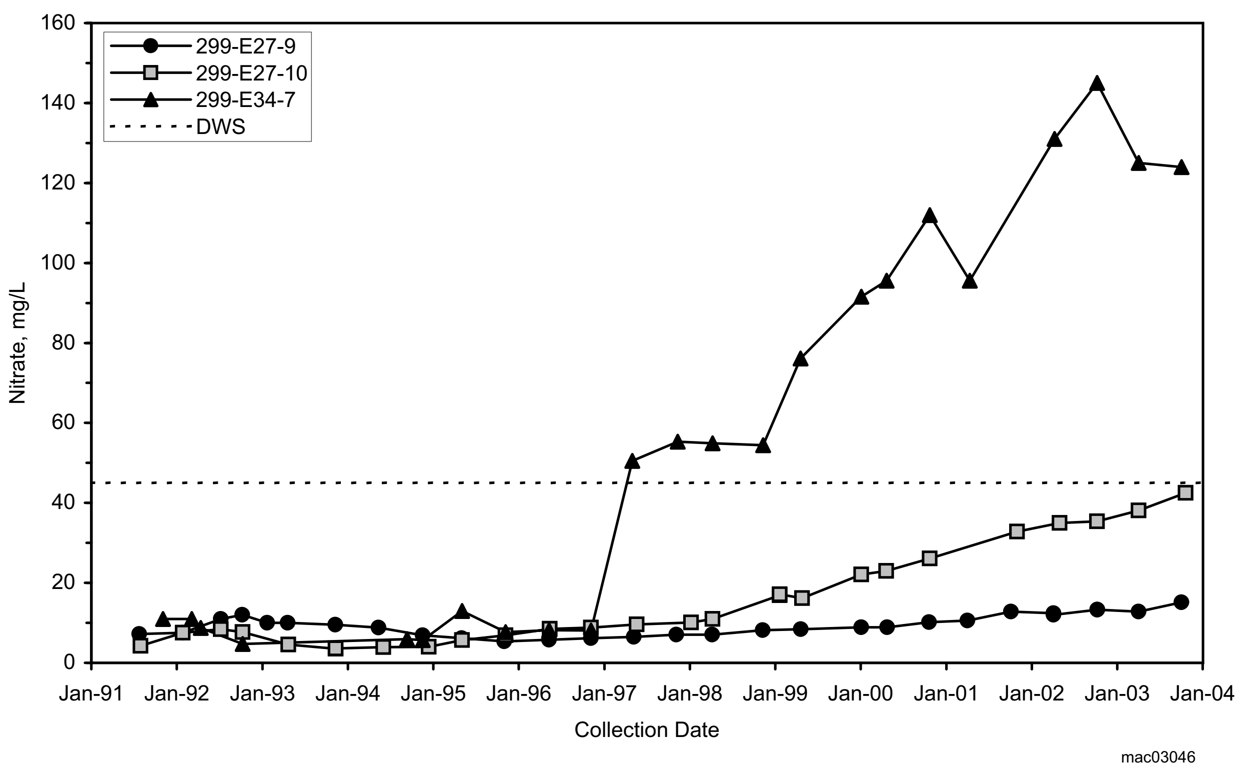

Figure 2.10-12. Nitrate Concentrations in Low-Level Waste Management Area 2 Wells 299-E34-7, 299-E27-10, and 299-E27-9

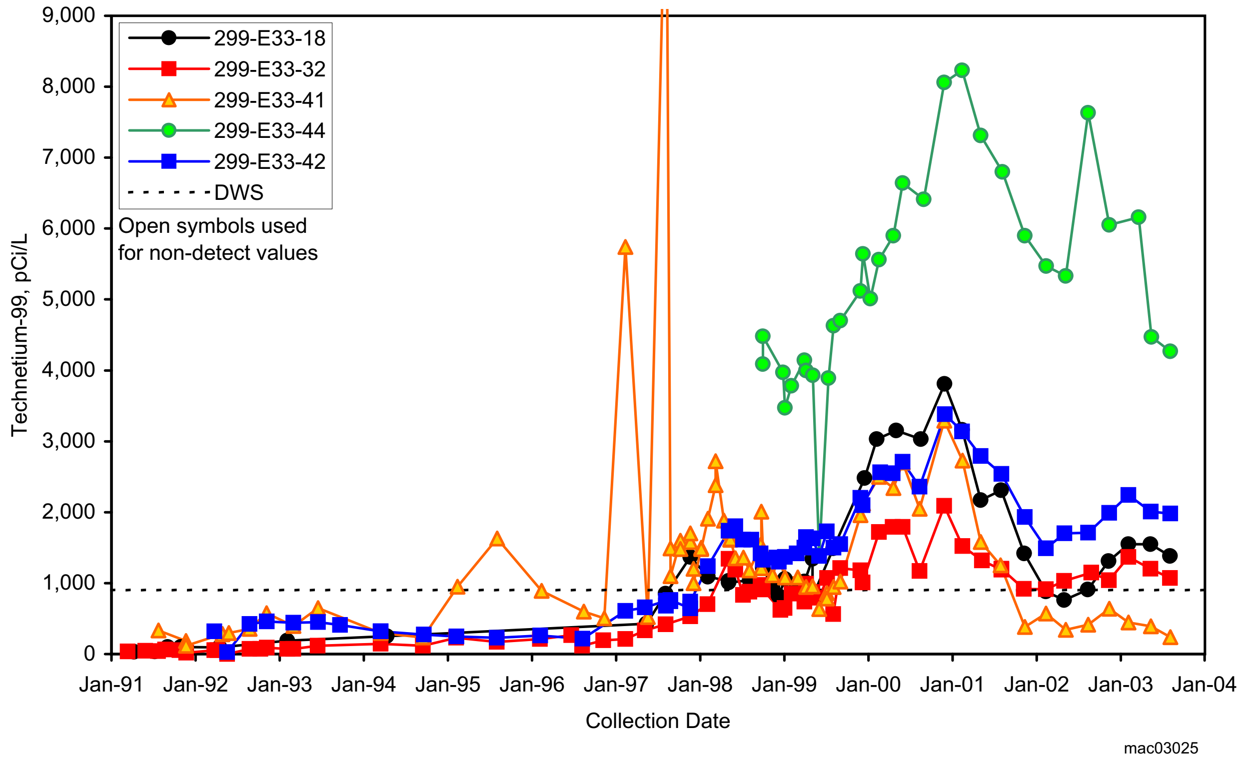

Figure 2.10-13. Trend Plots of Technetium-99 Concentrations at Waste Management Area B-BX-BY

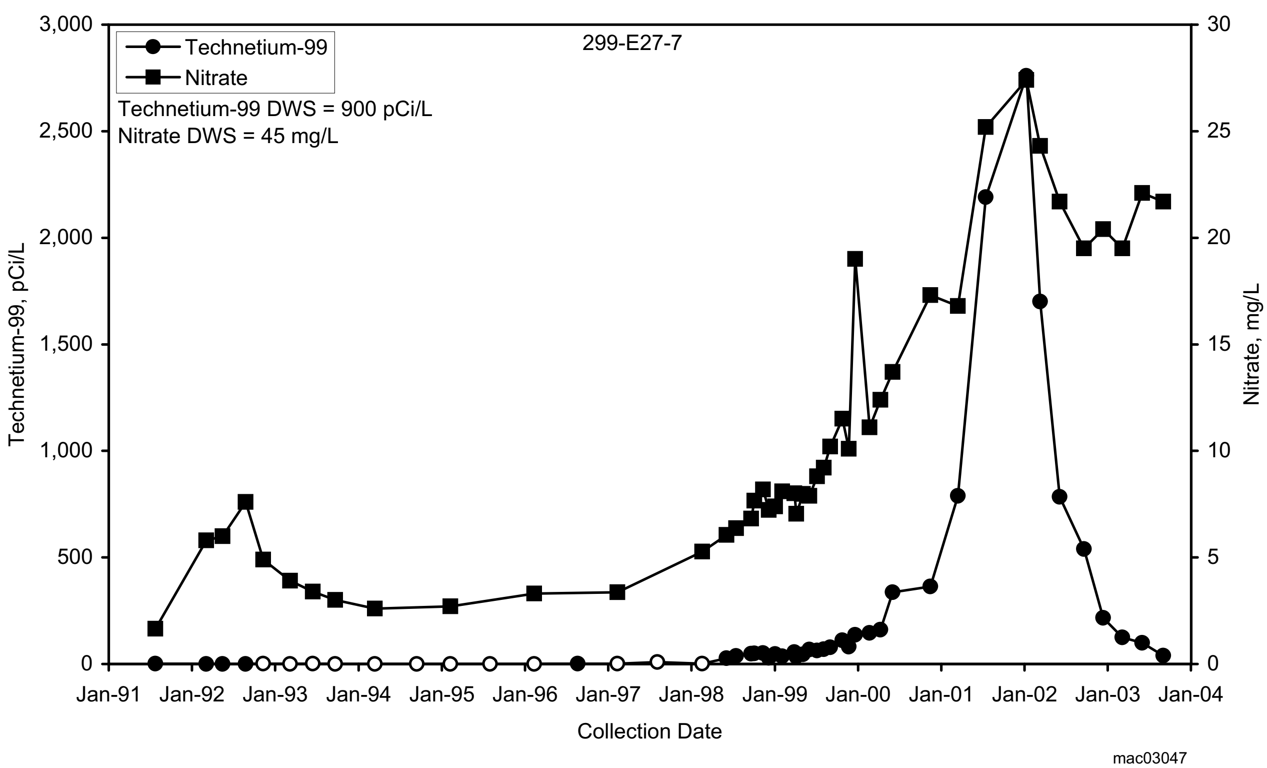

Figure 2.10-14. Technetium-99 Concentrations Compared to Nitrate Concentrations for Upgradient Well 299-E27-7 at Waste Management Area C