2.7 100-FR-3 Operable Unit

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The scope of this section is the 100-FR-3 groundwater interest area, which encompasses the 100-FR-3 Operable Unit and a large section of the 600 Area north of Gable Mountain (see Figure 2.1-1 in Section 2.1). The Groundwater Performance Assessment Project (groundwater project) defined "groundwater interest areas" informally to facilitate scheduling, data review, and interpretation. Figure 2.7-1 shows facilities, wells, and shoreline monitoring sites in the 100-F Area.

Groundwater flows primarily to the east and southeast beneath the 100-F Area (Figure 2.7-2). Movement of the nitrate plume indicates flow to the south-southeast.

The remainder of this section describes contaminant plumes and concentration trends for the contaminants of concern under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA). Groundwater monitoring for the *Atomic Energy Act of 1954* (AEA) is integrated fully with CERCLA monitoring. Most of the former waste sites in the 100-F Area have been excavated and backfilled. There are no active waste disposal facilities or *Resource Conservation and Recovery Act* (RCRA) sites in the 100-F Area.

A nitrate plume extends from the central 100-F Area south into the 600 Area.

2.7.1 Groundwater Contaminants

This section describes the distribution and trends of the contaminants of concern for the 100-FR-3 Operable Unit: nitrate, strontium-90, tritium, trichloroethene, uranium, and hexavalent chromium.

2.7.1.1 Nitrate

A large nitrate plume with concentrations above the 45-mg/L drinking water standard extends from the 100-F Area southward (see Figure 2.1-6 in Section 2.1). The interpretation of the plume between the 100-F Area and Gable Mountain is uncertain because many of the wells have not been sampled for nitrate routinely. In fiscal year (FY) 2004, well 699-62-31 (located ~4 kilometers south of the 100-F Area; see Figure 2.1-2 in Section 2.1) was sampled for the first time in 10 years. The nitrate concentration was 102 mg/L, twice the levels detected in 1991 to 1993, indicating that the plume has moved farther south than previously known.

Wells in the main 100-F Area continued to show levels of nitrate that exceeded the drinking water standard. The highest nitrate concentration in the 100-F Area was 166 mg/L in well 199-F7-3, which is in the southwest 100-F Area. Concentrations rose gradually in this well from 1996 to 2003, but declined slightly in FY 2004 (Figure 2.7-3). Most wells in 100-F Area have decreasing or steady trends in nitrate (e.g., well 199-F8-4 in Figure 2.7-3).

Aquifer tubes south of the main 100-F Area had elevated nitrate concentrations. The maximum value, 52.7 mg/L, was from tube 75-M. This was the only tube in the 100-FR-3 interest area with a result above the drinking water standard.

Groundwater monitoring in the 100-FR-3 groundwater interest area includes integrated CERCLA and AEA monitoring:

- ***Nine wells, twenty-two aquifer tubes, and three seeps are sampled annually.***
- ***Twenty-nine wells are sampled biennially; fourteen of these were scheduled in FY 2004.***
- ***All wells were sampled as scheduled.***
- ***Seven aquifer tube sites and two seeps were not sampled (see Appendix A).***

2.7.1.2 Strontium-90

Strontium-90 concentrations continued to exceed the 8-pCi/L drinking water standard beneath a portion of the 100-F Area around the 116-F-14 retention basin and nearby disposal trenches (Figure 2.7-4). The plume has not changed significantly in over 10 years.

Plume areas (square kilometers) above the drinking water standard at the 100-FR-3 Operable Unit:

Nitrate — 17.65
Strontium-90 — 0.16
Trichloroethene — 2.37

Well 199-F5-1 continued to have the highest strontium-90 concentrations at 22.6 pCi/L in FY 2004 (Figure 2.7-5). The peak in concentrations in the mid to late 1990s was caused by higher-than-average water levels, which mobilized strontium-90 in the lower vadose zone and increased concentrations in groundwater. Strontium-90 concentrations continued to decline in FY 2004. Strontium-90 exceeded the drinking water standard in two other wells in FY 2004: 199-F5-44 (8.36 pCi/L) and 199-F5-46 (11.3 pCi/L) (Figure 2.7-5).

Well 199-F5-3 historically had strontium-90 concentrations in the hundreds. The well no longer produces enough water to sample, despite numerous attempts to clean and develop it. It was removed from the sampling schedule during FY 2004.

Like other 100-F Area contaminants, strontium-90 appears to be limited to the shallow portion of the aquifer. No strontium-90 is detected in deep well 199-F5-43B, while adjacent well 199-F5-43A typically detects 2 to 4 pCi/L of strontium-90.

Strontium-90 was analyzed in samples from four aquifer tubes and was detected in two of them: 64-D (1.23 pCi/L) and 65-S (0.77 pCi/L). Both sites are adjacent to the strontium-90 plume in the aquifer. Only one depth at each tube site was selected for laboratory analyses in FY 2004. At aquifer tube site 64, this practice may have missed the highest concentrations of strontium-90, which is concentrated higher in the aquifer. The revised sampling and analysis plan calls for sampling all tube depths for strontium-90.

Trichloroethene exceeds the drinking water standard in southwest 100-F Area.

2.7.1.3 Tritium

Tritium concentrations exceed 2,000 pCi/L beneath the south 100-F Area, but have remained below the 20,000-pCi/L drinking water standard in all wells since FY 2003. The plume extends southward into the 600 Area (see Figure 2.1-5 in Section 2.1), but its axis strikes approximately southeast instead of south like the nitrate plume.

Concentrations of tritium are declining and ranged from undetected to 8,240 pCi/L in FY 2004. The highest concentration was in well 199-F8-3, located near the 118-F-6 burial ground.

2.7.1.4 Trichloroethene

Trichloroethene concentrations in the southwest 100-F Area typically exceed the 5-µg/L drinking water standard (Figure 2.7-6). The maximum concentration in FY 2004 was 19 µg/L in well 199-F7-1, which showed a gradually increasing trend since FY 2000 (Figure 2.7-7). Concentrations also exceeded the standard in nearby wells 199-F7-3 and 699-77-36.

Farther north, trichloroethene is detected in several wells and concentrations in well 199-F7-2 hover around the drinking water standard (5.8 µg/L in FY 2004).

Gross alpha concentrations increased in two wells, indicating possible increases in uranium.

Trichloroethene has been detected in several wells located far west of the 100-F Area. Wells 699-71-52 and 699-83-47 have consistently detected ~2 to 3 µg/L trichloroethene in recent years (see Figure 2.1-2 in Section 2.1 for well locations). Other wells west of the 600 Area have shown no detectable trichloroethene.

No trichloroethene was detected in aquifer tubes or spring 207-1 in FY 2004.

2.7.1.5 Uranium and Gross Alpha

Gross alpha is monitored in the 100-FR-3 Operable Unit to screen for uranium. All gross alpha results for FY 2004 were below the 15-pCi/L drinking water standard. Gross alpha concentrations increased sharply in wells 199-F5-46 (located near the former F Reactor)

and 199-F8-4 (in southeast 100-F Area) (Figure 2.7-8). The cause of these increases in different parts of the area is unknown. Beginning in FY 2005, uranium will be monitored in these and nearby wells.

2.7.1.6 Hexavalent Chromium

Dissolved chromium concentrations continued to be above background in several wells in the east 100-F Area, but were below the 100-µg/L drinking water standard in FY 2004. Concentrations are typically highest in wells near the former retention basins and disposal trenches. Dissolved chromium increased sharply in well 199-F5-6 to 98 µg/L, just below the standard (Figure 2.7-9). Nearby well 199-F5-44 has shown an increasing chromium trend over the last 10 years, but concentrations remained much lower than in 199-F5-6, possibly because well 199-F5-44 is closer to the Columbia River. Chromium will be sampled annually in well 199-F5-6 to continue tracking its trend.

The chromium concentration in one well increased sharply and was near the drinking water standard in FY 2004.

About 4 kilometers west of the 100-F Area, chromium continued to be above background levels in well 699-83-47. The concentration in FY 2004 was 28 µg/L, part of a gradually decreasing trend. This well also detects trichloroethene, as discussed in Section 2.7.1.4.

Chromium concentrations in aquifer tubes were generally low, but exceeded the 10-µg/L aquatic standard in tubes 72-D and 75-M, located south of the main 100-F Area. The maximum concentration in FY 2004 was 13.9 µg/L.

2.7.2 Operable Unit Monitoring

A record of decision has not yet been developed for the 100-FR-3 Operable Unit, and no active remediation of groundwater is underway. Monitoring contaminant conditions has continued since the initial remedial investigation and while waste site remedial actions are conducted. A focused feasibility study, which looks at remedial action alternatives for groundwater, will start in FY 2005.

The sampling and analysis plan that was in effect during FY 2004 (DOE/RL-2003-49, Rev. 0, as revised in unit manager's meetings and documented in Fruchter 2004[a]) specified annual sampling of 9 wells, 22 aquifer tube sites, and 3 seeps and biennial sampling of 29 wells (Appendix A).

All of the wells scheduled for sampling in FY 2004 were sampled; some additional wells not required to be sampled in FY 2004 also were sampled. Well 199-F5-6 was sampled with a standard pump instead of the Spyder sampling assembly. Multi-depth Spyder sampling was delayed until FY 2005.

Until groundwater remediation decisions are made for the 100-FR-3 Operable Unit, the groundwater project will continue to monitor contaminant plumes and trends.

Seven of 22 aquifer tube sites were not sampled because the tubes had been destroyed, could not be located, or were under water at the time of sampling (see Appendix A). The list of tubes to be monitored was revised accordingly for future years.

All three seeps were sampled in November 2003. However, two of them had low specific conductance, indicating they were primarily river water, and no additional analyses were performed. The other tube, 207-1, was sampled as scheduled, but alkalinity was not analyzed.

Twelve new aquifer tubes at four tube sites were installed in FY 2004 as proposed in the original sampling and analysis plan. The addition of the new tubes improved monitoring coverage at the shoreline and will continue to aid in defining plumes and tracking contaminant trends.

(a) Letter PNNL-LTR-040317-1BC5 from JS Fruchter, Pacific Northwest National Laboratory, to Recipients of Sampling and Analysis Plan, *Page Changes for 100-BC-5 and 100-FR-3 Groundwater Sampling and Analysis Plans*, dated March, 17, 2004.

The sampling and analysis plan was revised in FY 2004 (DOE/RL-2003-49, Rev. 1) for implementation in FY 2005. The overall approach to monitoring remains the same, but sampling frequency and constituents were modified in some wells to reflect data collected and evaluated after publication of the first plan.

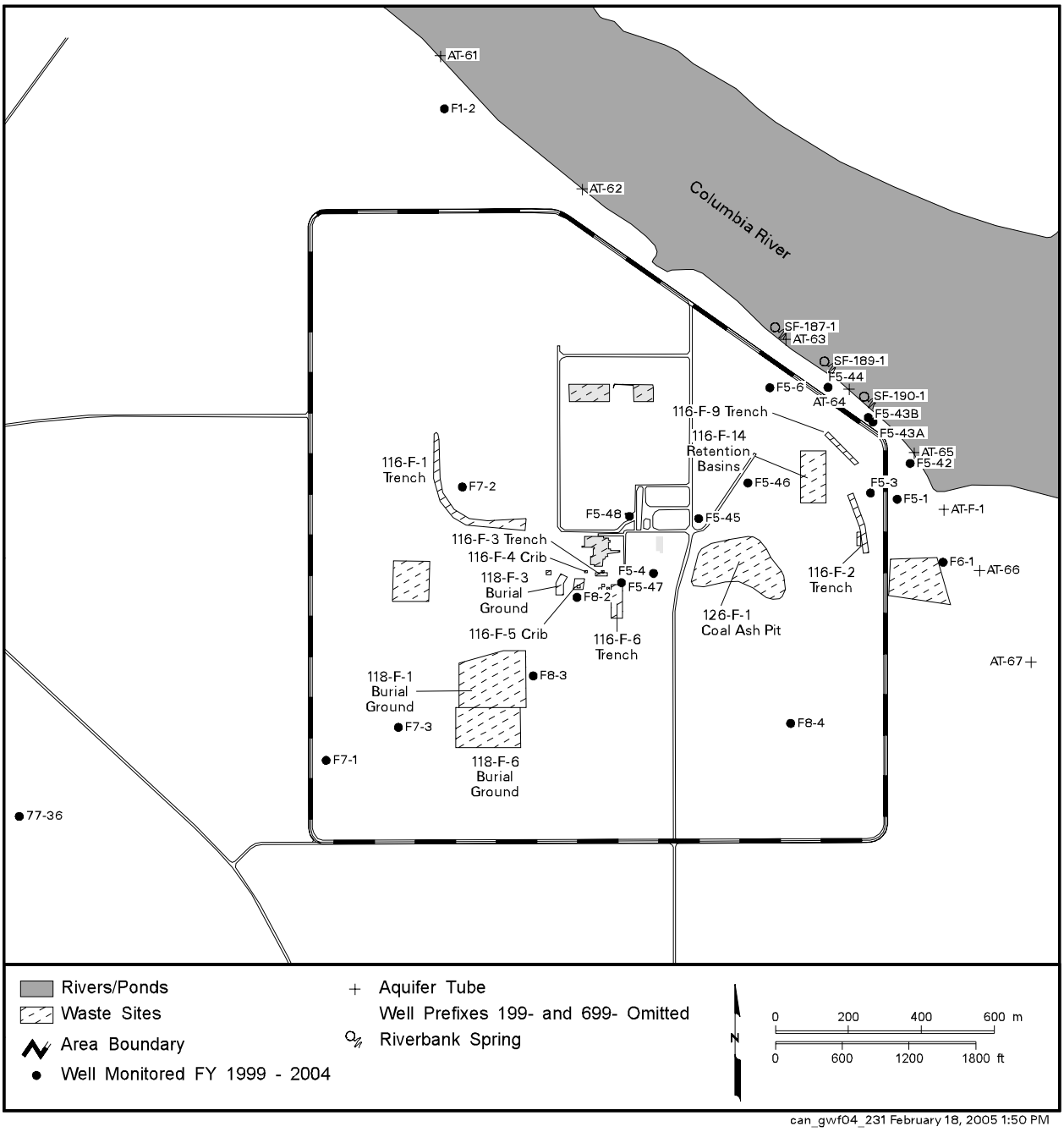


Figure 2.7-1. Groundwater Monitoring Wells in the 100-F Area

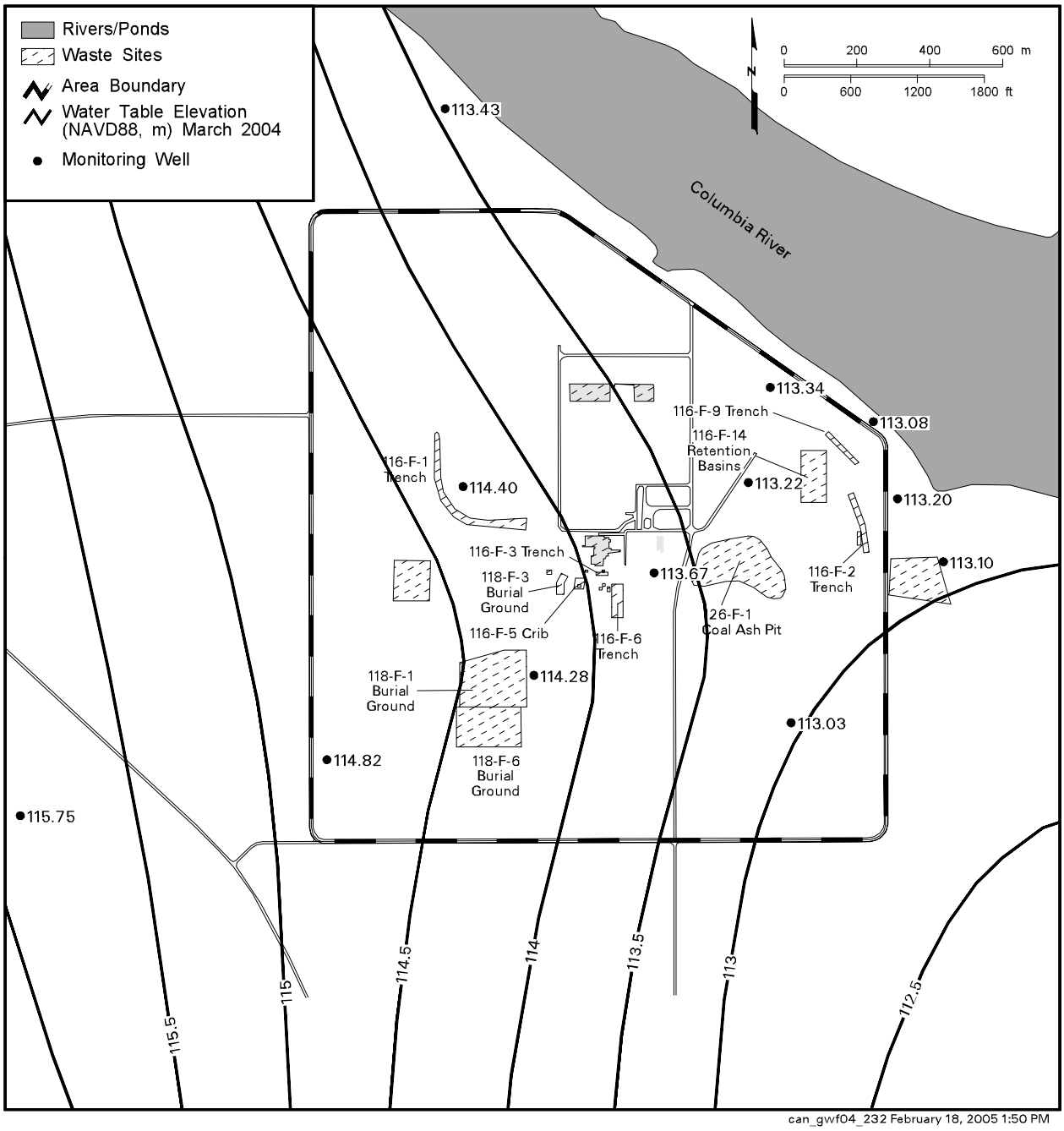


Figure 2.7-2. 100-F Area Water-Table Map, March 2004

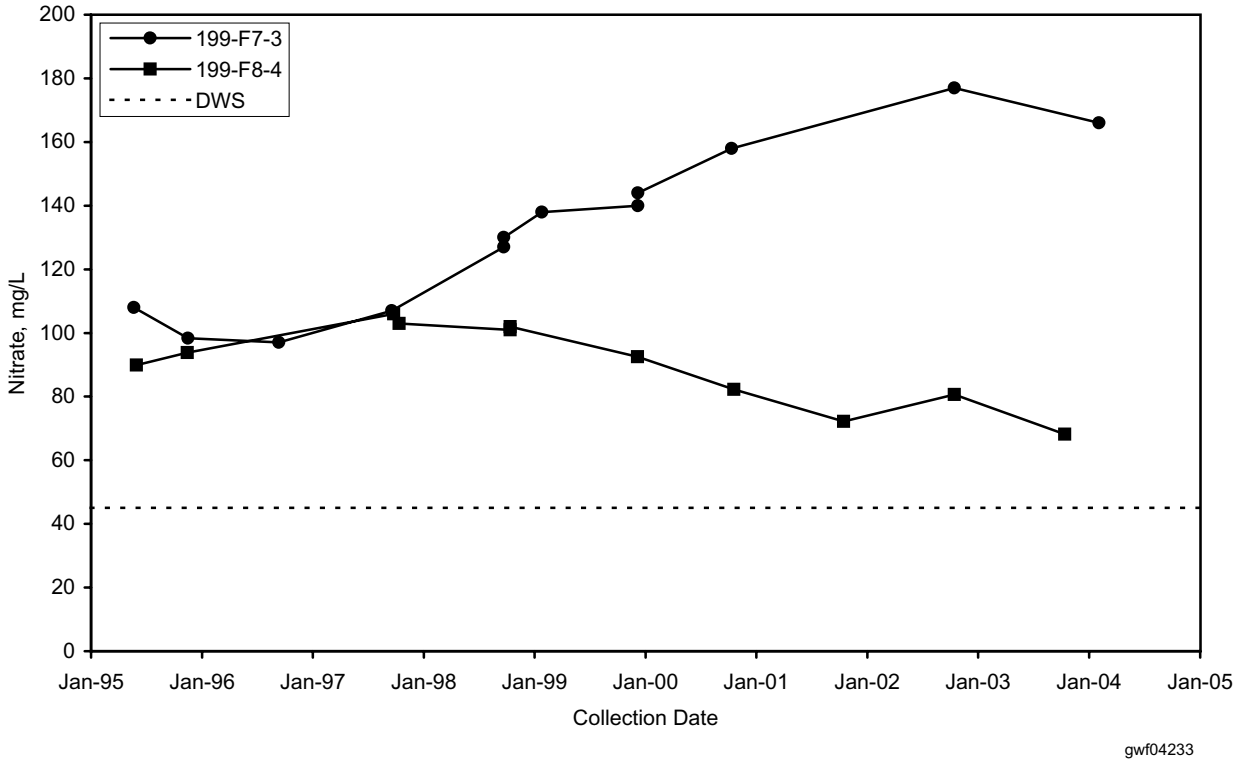


Figure 2.7-3. Nitrate Concentrations in Southeast (Well 199-F8-4) and Southwest (Well 199-F7-3) 100-F Area

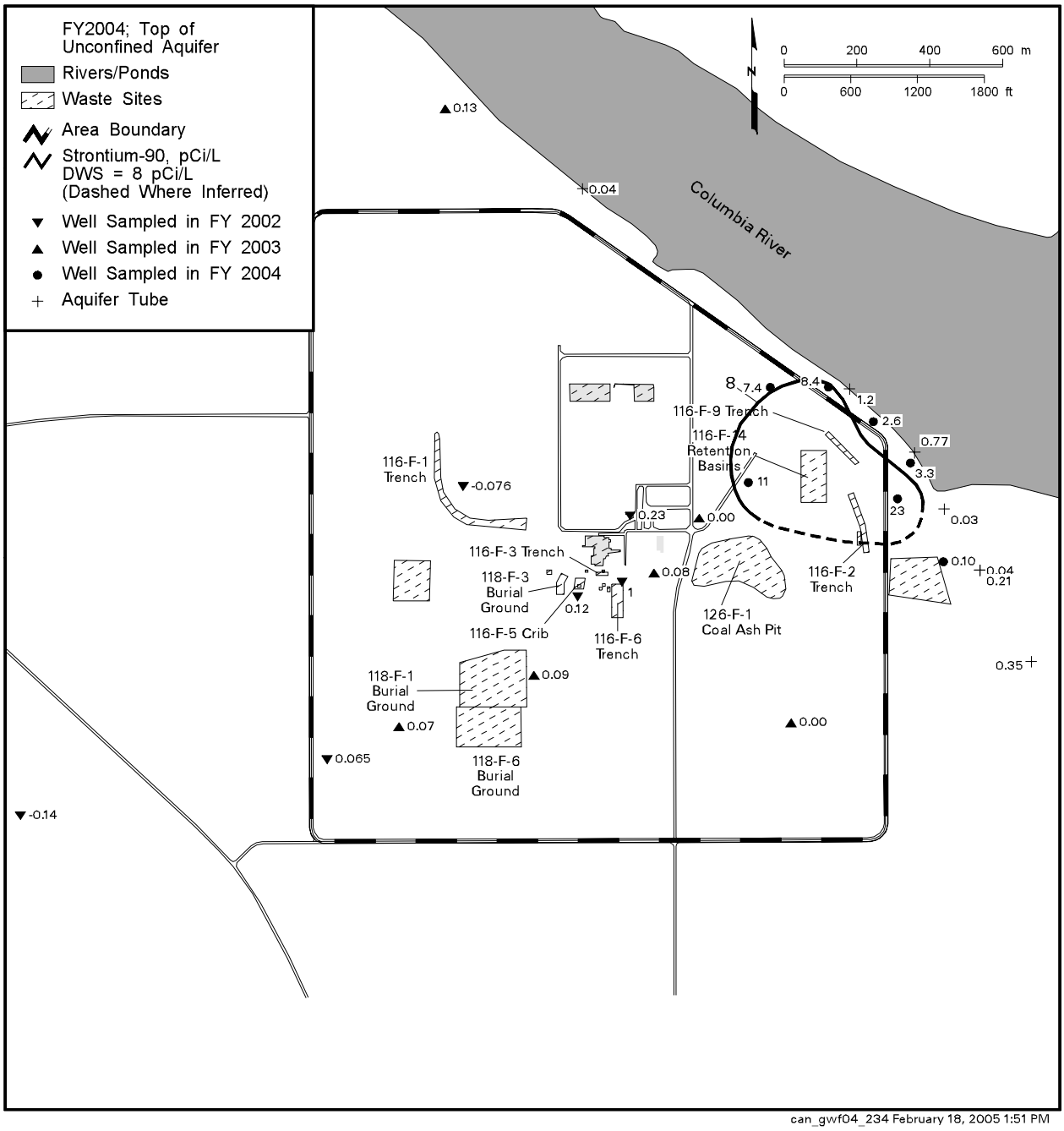
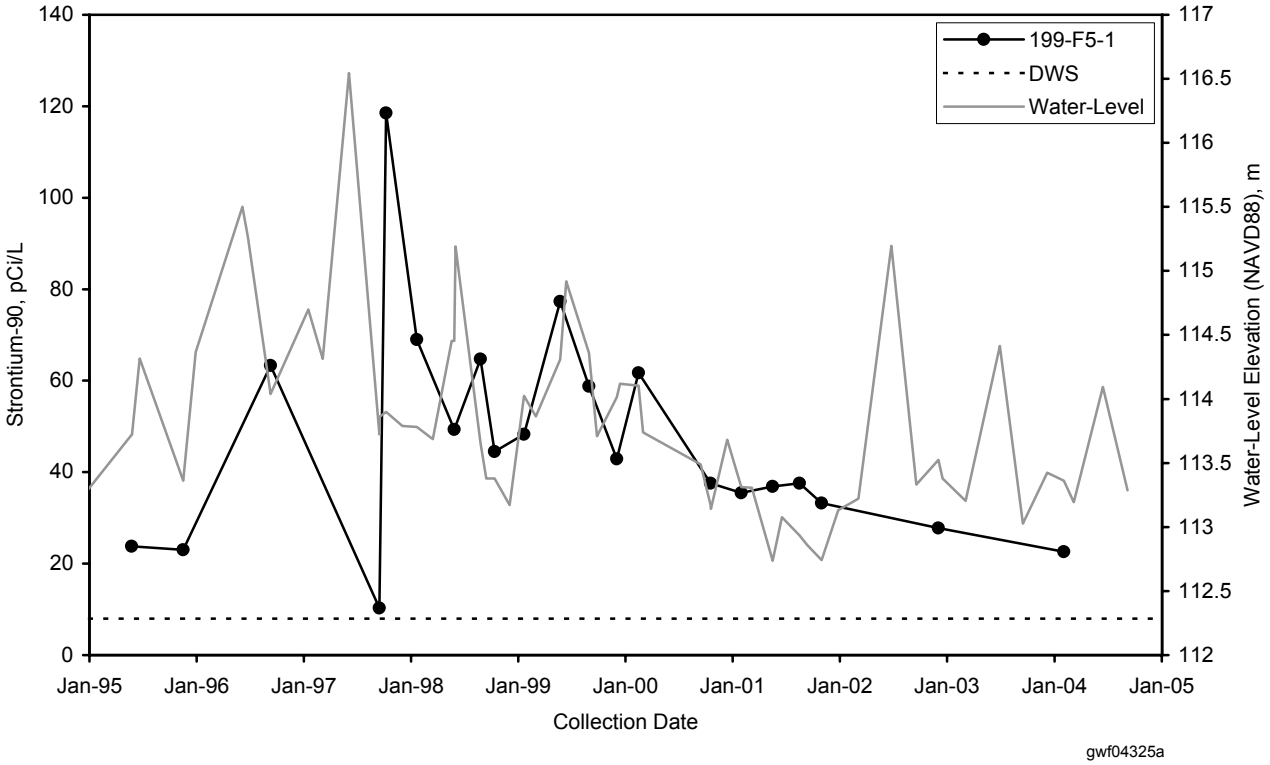


Figure 2.7-4. Average Strontium-90 Concentrations in the 100-F Area, Top of Unconfined Aquifer



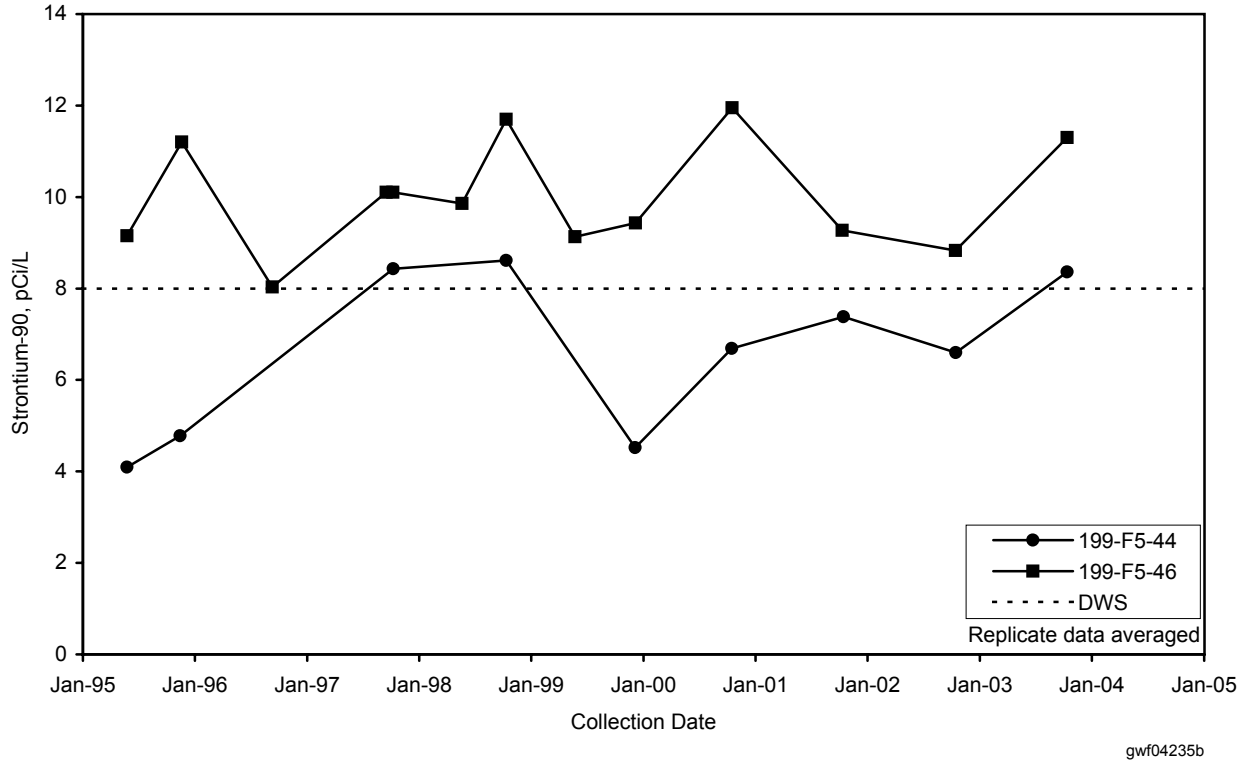


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Figure 2.7-5. Strontium-90 Concentrations Near the 116-F-14 Retention Basins

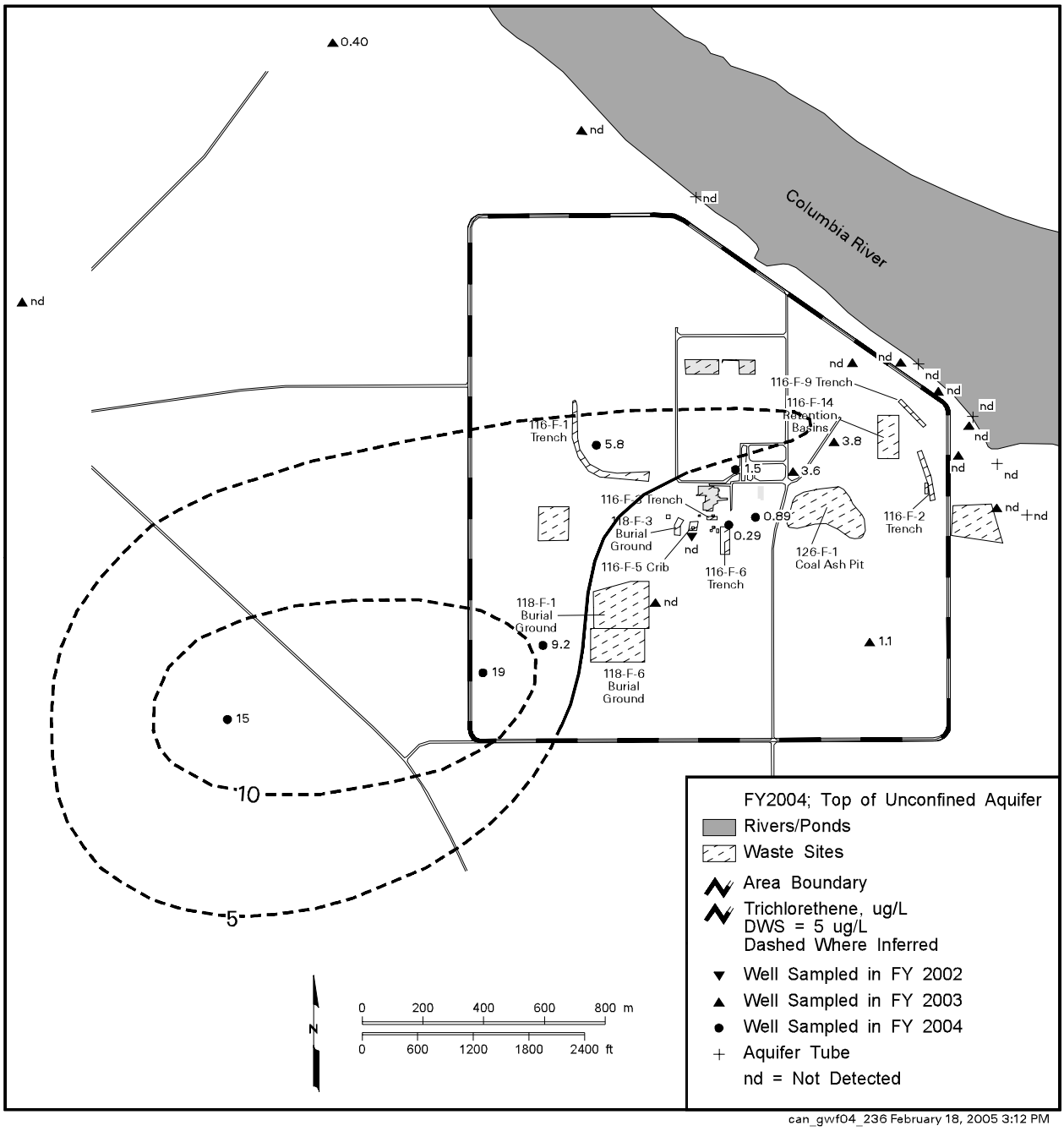

Figure 2.7-6. Average Trichloroethene Concentrations in the 100-F Area, Top of Unconfined Aquifer

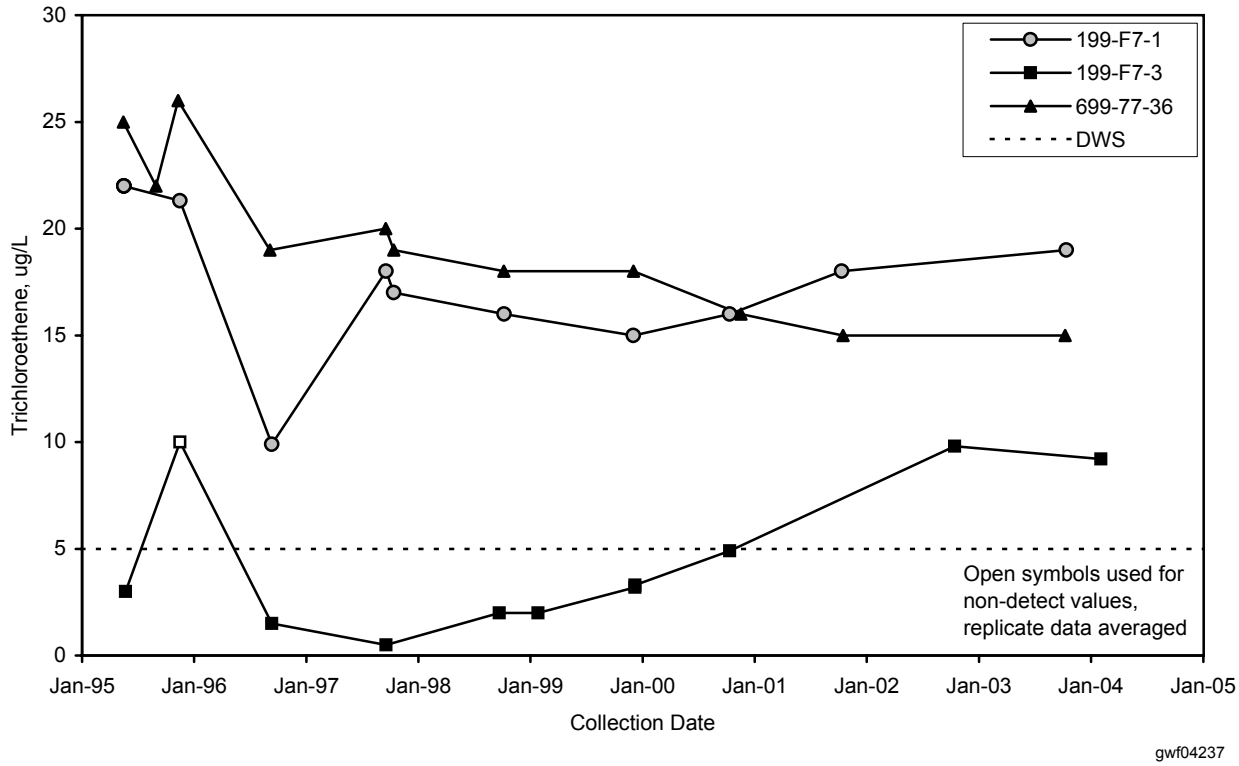

Figure 2.7-7. Trichloroethene Concentrations in the Southwest 100-F Area

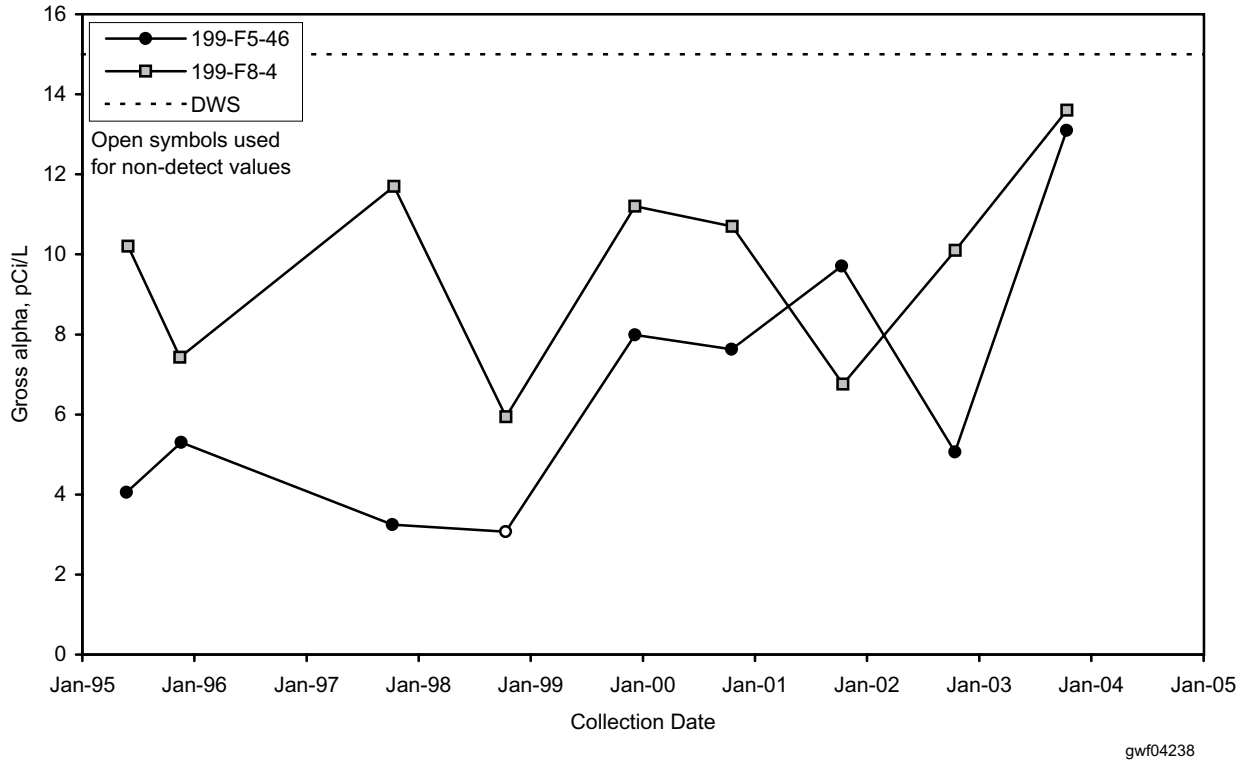

Figure 2.7-8. Gross Alpha Concentrations in Well 199-F5-46, Near the 100-F Reactor Building, and Well 199-F8-4, Southeast 100-F Area

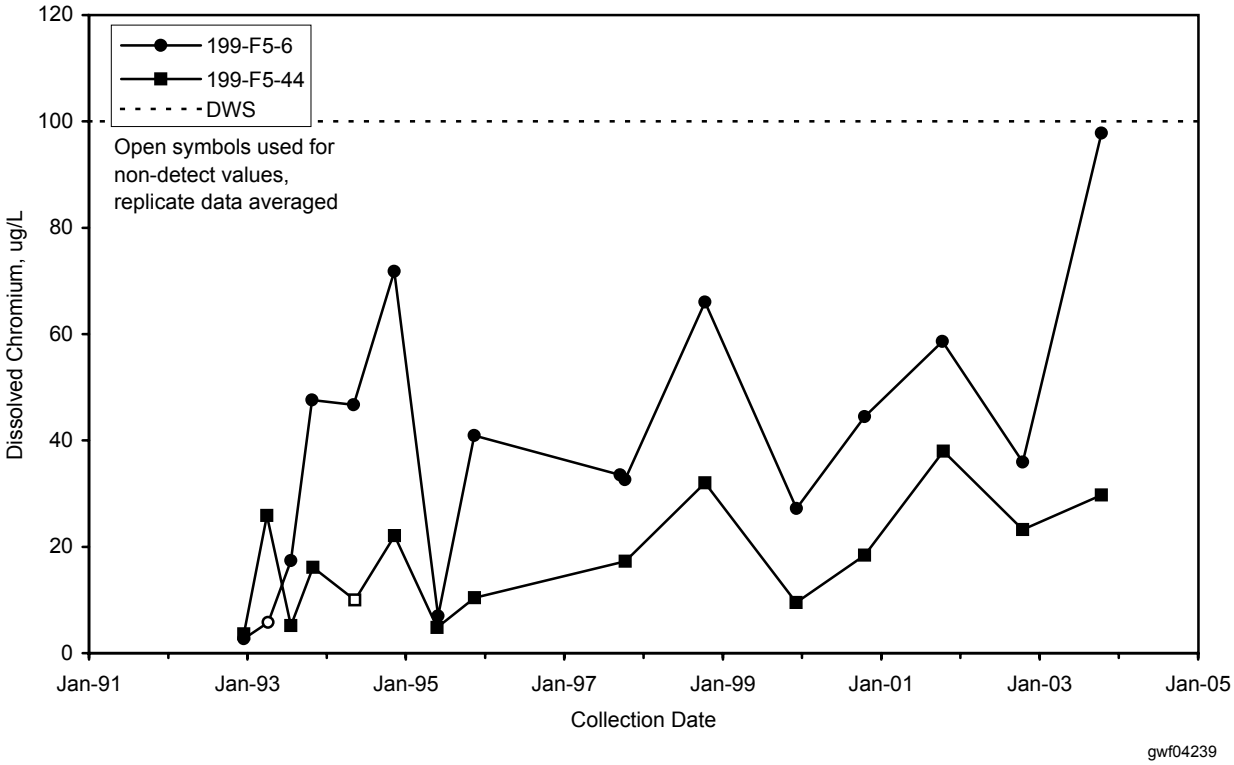

Figure 2.7-9. Chromium Concentrations in Wells 199-F5-6 and 199-F5-44, Northeast 100-F Area