2.2 100-BC-5 Operable Unit

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The scope of this section is the 100-BC-5 groundwater interest area, which includes the 100-BC-5 Operable Unit (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 2.2-1 shows facilities, wells, and shoreline monitoring sites in the 100-B/C Area.

Groundwater enters the 100-B/C Area from the Columbia River and the gap between Umtanum Ridge and Gable Butte and through Gable Gap to the southeast (see Figure 2.1-3 in Section 2.1). Groundwater flows primarily to the north beneath the 100-B/C Area and discharges to the Columbia River (Figure 2.2-2). The hydraulic gradient is very flat in the south 100-B/C Area and in the west part of the interest area (see Figure 2.1-3 in Section 2.1).

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 requirements under the *Atomic Energy Act of 1954* are completely integrated with CERCLA monitoring. There are no active waste disposal facilities or *Resource Conservation and Recovery Act* (RCRA) sites in the 100-B/C Area.

Strontium-90 and tritium exceeded drinking water standards in groundwater at the 100-BC-5 Operable Unit during FY 2004. Both contaminants are limited to the upper aquifer and are not detected in deep wells.

2.2.1 Groundwater Contaminants

Wells in the 100-BC-5 Operable Unit are sampled annually to biennially for the contaminants of concern: strontium-90, tritium, and hexavalent chromium. Contaminants of concern were determined based on results of the data quality objectives process (PNNL-14287). This section describes distributions and trends for the contaminants of concern plus nitrate and technetium-99 beneath the 100-BC-5 groundwater interest area.

2.2.1.1 Strontium-90

The strontium-90 plume beneath 100-B/C Area is wedge-shaped, with an apex in the central 100-B/C Area, extending and spreading north toward the Columbia River (Figure 2.2-3). The plume has not changed significantly in over 10 years.

Strontium-90 concentrations continued to exceed the 8-pCi/L drinking water standard in several wells. In most wells, the concentrations vary but are not increasing or decreasing overall. The maximum strontium-90 concentration in fiscal year (FY) 2004 was 39 pCi/L in well 199-B3-1, near the 116-B-1 trench. Well 199-B3-46 typically has higher concentrations (e.g., 98.9 pCi/L in FY 2003), but it was not sampled in FY 2004 (see Section 2.2.2).

Strontium-90 is limited to the top of the aquifer. None is detected in deeper well 199-B2-12.

Twelve aquifer tubes were sampled for strontium-90 in FY 2004. Strontium-90 was detected only in tubes 07-D, 11-D, and 14-D (all <0.6 pCi/L). These tubes are the deepest

Groundwater monitoring in the 100-BC-5 groundwater interest area includes integrated CERCLA and AEA monitoring:

- ***Sixteen wells, twelve aquifer tube sites, and two seeps were sampled as scheduled; two wells were not sampled as scheduled (see Appendix A).***
- ***The sampling and analysis plan was revised and approved in FY 2004 for implementation in FY 2005.***

in their multi-depth clusters and the shallower tubes were not sampled for strontium-90. Typically only the tubes with the highest specific conductance, usually the deep tubes, are sampled for laboratory analyses. This practice gives the highest concentration of most contaminants, but because strontium-90 is limited to the top of the aquifer in the 100-B/C Area, the deep samples may have missed the highest concentrations of that less mobile contaminant. Data from previous years include some strontium-90 measurements from mid-level tubes 05-M and 06-M, with results from 13 to 17 pCi/L. In FY 2005, all tube depths will be analyzed for strontium-90.

Two shoreline seeps were sampled for strontium-90. Seep 037-1 had no detectable strontium-90 in October and November 2003. Seep 39-2 had 4.04 pCi/L strontium-90 in October 2003.

2.2.1.2 Tritium

A tritium plume with concentrations above 2,000 pCi/L underlies the north 100-B/C Area and extends west and east of the area boundaries (Figure 2.2-4). In most wells, tritium concentrations have been declining since 1997 or 1998.

Plume areas (square kilometers) above the drinking water standard at the 100-BC-5 Operable Unit:

Strontium-90 — 0.86
****Tritium — 0.16***

****Excludes plume from 200-BP-5 Operable Unit.***

In FY 2004, tritium concentrations exceeded the 20,000-pCi/L drinking water standard in one well and one aquifer tube in the 100-B/C Area, but one well historically above the standard was not sampled. The tritium concentration rose above the standard for the first time since 1999 in well 199-B5-2, located between the former B Reactor and the 116-C-5 retention basin. The new value remained far below a 1997 peak value (Figure 2.2-5). Well 199-B3-47, a well near the Columbia River that typically exceeds the standard, was not sampled in FY 2004 (Section 2.2.2). The maximum tritium concentration in aquifer tubes in FY 2004 was 20,100 pCi/L in new tube AT-B-7-M, northeast of the main 100-B/C Area. Tube 06-D, near well 199-B3-47, was just below the drinking water standard at 19,700 pCi/L (Figure 2.2-6). Tritium concentrations have shown an overall decline at this tube site since sampling began in 1997. Tritium in seeps ranged from 3,190 to 5,850 pCi/L in October and November 2003.

A sharp decrease in tritium and specific conductance in well 199-B5-1 may indicate dilution of groundwater with fresh water (Figure 2.2-7). The well is located in the west-central 100-B/C Area and is not near other monitoring wells or liquid waste sites. Water is pumped from the Columbia River to a reservoir and filter plant southwest of well 199-B5-1.

Well 199-B8-6, near the 118-B-1 burial ground in southwest 100-B/C Area, was not scheduled for sampling in FY 2004 but had tritium concentrations above the drinking water standard in 1998 to 2002. The well will be sampled in FY 2005.

Well 699-72-73, east of the 100-B/C Area (see Figure 2.1-2 in Section 2.1 for well location) has elevated tritium that migrated from the 200 East Area and moved through Gable Gap (see Figure 2.1-5 in Section 2.1). The tritium concentration in well 699-72-73 peaked at over 20,000 pCi/L in 2001 and was 16,300 pCi/L in FY 2004 (Figure 2.2-8). New aquifer tubes east of the 100-B/C Area had tritium concentrations at or near 20,000 pCi/L in FY 2004. Well 699-72-73 and the aquifer tubes also had elevated nitrate and technetium-99 from the 200 East Area plume.

Chromium exceeded the 10-µg/L aquatic standard in several 100-B/C wells and aquifer tubes. Concentrations are steady or declining.

2.2.1.3 Chromium

Chromium concentrations have remained below the 100-µg/L drinking water standard in the 100-B/C Area in recent years. In FY 2004, chromium concentrations ranged from undetected to 19.1 µg/L, exceeding the 10 µg/L aquatic standard in five wells. Wells 199-B4-1 and 199-B4-47 typically exceed 20 µg/L (~35 µg/L in FY 2003) but were not sampled in FY 2004 (Section 2.2.2). The wells will be sampled in the future. Chromium trends in monitoring wells in the 100-B/C Area tend to be flat or declining.

Dissolved chromium in aquifer tubes along the 100-B/C shoreline exceeded the 10-µg/L aquatic standard in 6 tubes, and was >20 µg/L in 3 tubes. The highest concentrations were at tube sites 05 and 06 (Figure 2.2-9). The maximum concentration was 28.1 µg/L in tube 05-D.

Dissolved chromium in seep samples ranged from 1.5 to 16.9 µg/L in October and November 2003.

Tritium, nitrate, and technetium-99 are detected in wells and aquifer tubes east of the 100-B/C Area. This contamination most likely migrated from the 200 East Area.

2.2.1.4 Nitrate

Nitrate is not a contaminant of concern in the 100-BC-5 Operable Unit and relatively few wells were sampled for this constituent in FY 2004. Concentrations continued to be below the 45-mg/L drinking water standard and were highest (>20 mg/L) in wells monitoring the north 100-B/C Area. Aquifer tubes in this region had lower nitrate concentrations than nearby wells.

Well 699-72-73, located between 100-B/C and 100-K Areas, had a nitrate concentration of 27.4 mg/L in October 2003. Like tritium, the source of this nitrate is believed to be the 200 East Area. Aquifer tubes AT-B-5-D and 14-D, also located east of the main 100-B/C Area, had nitrate concentrations of ~25 and 29 mg/L in FY 2004.

The nitrate concentration in well 699-72-92, west of the 100-B/C Area (see Figure 2.1-2 in Section 2.1 for well location) was 23 mg/L in FY 2004, comparable with past data. The source of this nitrate is unknown.

2.2.1.5 Technetium-99

Technetium-99 is not a contaminant of concern for the 100-BC-5 Operable Unit. It was detected in the 100-B/C Area groundwater in the early 1990s at levels generally less than 100 pCi/L (drinking water standard is 900 pCi/L) but has not been analyzed since then. Several wells in the 600 Area between the 100-B/C and 100-K Areas are routinely monitored for technetium-99, and those wells detected levels of 110 to 130 pCi/L in FY 2004. Technetium-99 also was analyzed in aquifer tubes east of the main 100-B/C Area. The maximum concentration in an aquifer tube in FY 2004 was 124 pCi/L in tube 14-D. Like tritium and nitrate, technetium-99 in this region is believed to have a source in the 200 East Area.

2.2.2 Operable Unit Monitoring

A record of decision has not yet been developed for the 100-BC-5 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 pilot-scale test ecological risk investigation was started in FY 2004, which will serve as a prototype for the other reactor areas. 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-2003-38, Rev. 0, as revised in unit manager's meetings and documented in Fruchter 2004[a]) specified annual sampling of 12 wells, 12 aquifer tube sites, and 2 seeps and biennial sampling of 13 wells (Appendix A). Of these, 18 wells and all of the aquifer tube sites and seeps were scheduled for sampling in FY 2004. Two wells (199-B3-46 and 199-B3-47) were not sampled. The sampling and analysis plan called for sampling these wells at various depths with a special sampling device. The work was delayed into FY 2005. Tritium was not analyzed in one

(a) Letter report PNNL-LTR-040317-1BC5 from J.S. 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.

aquifer tube and strontium-90 was not analyzed in three wells and two aquifer tubes because of scheduling errors. The impact of these omissions is minimal because the plumes could be defined without these data.

Fourteen new aquifer tubes at six 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.

The sampling and analysis plan was revised in FY 2004 (DOE/RL-2003-38, 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.

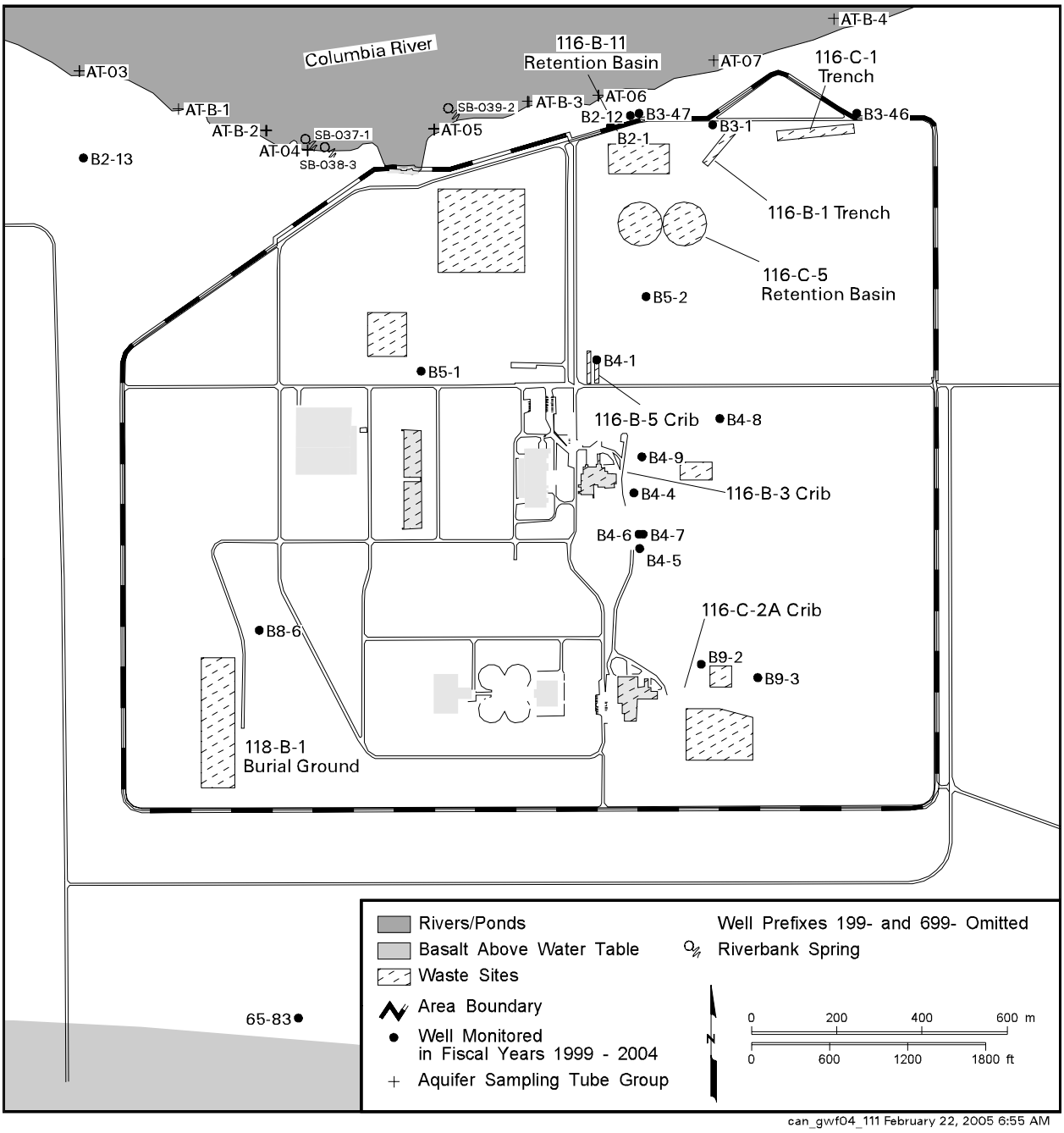

Figure 2.2-1. Groundwater Monitoring Wells in the 100-B/C Area

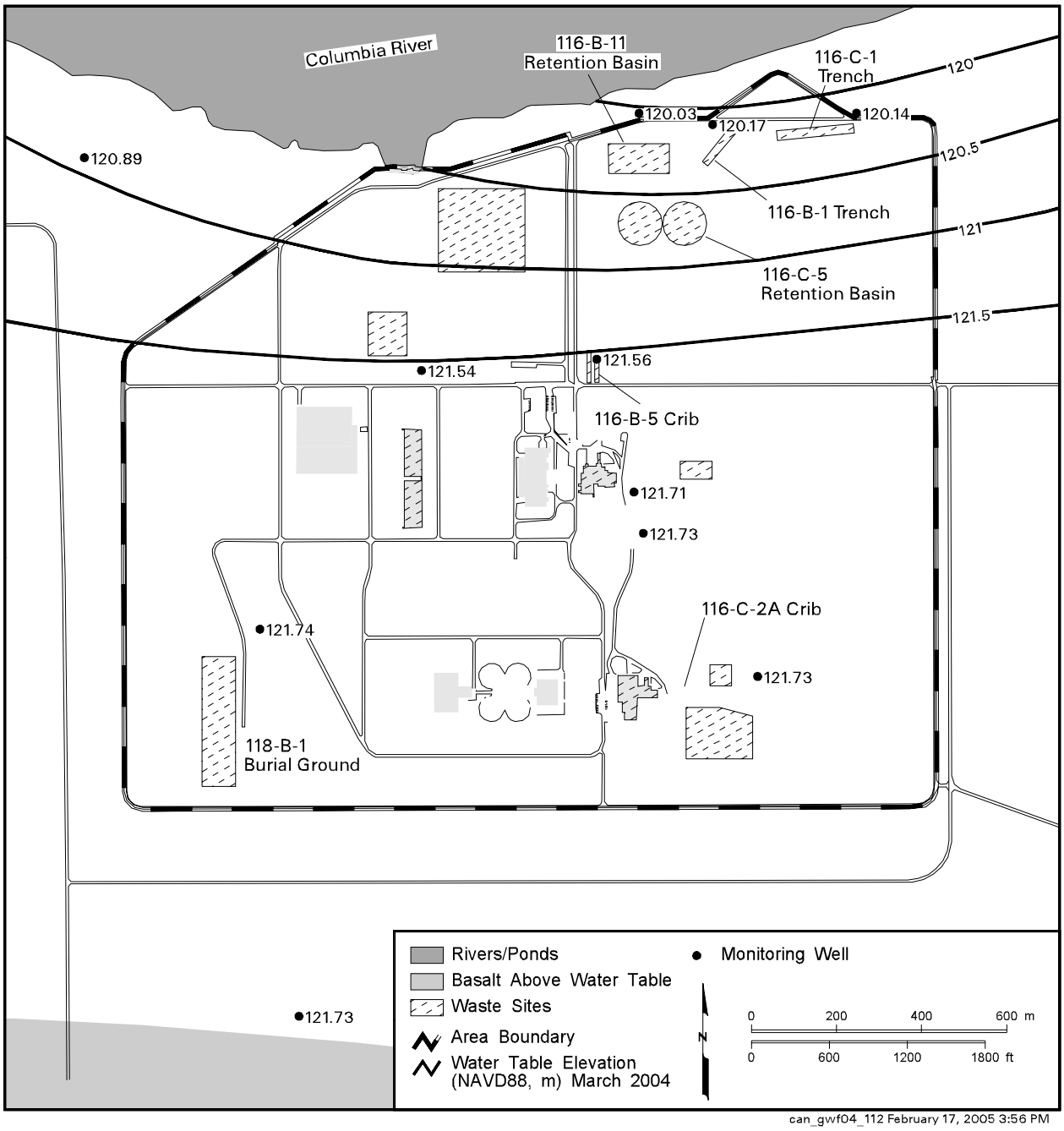

Figure 2.2-2. 100-B/C Area Water-Table Map, March 2004

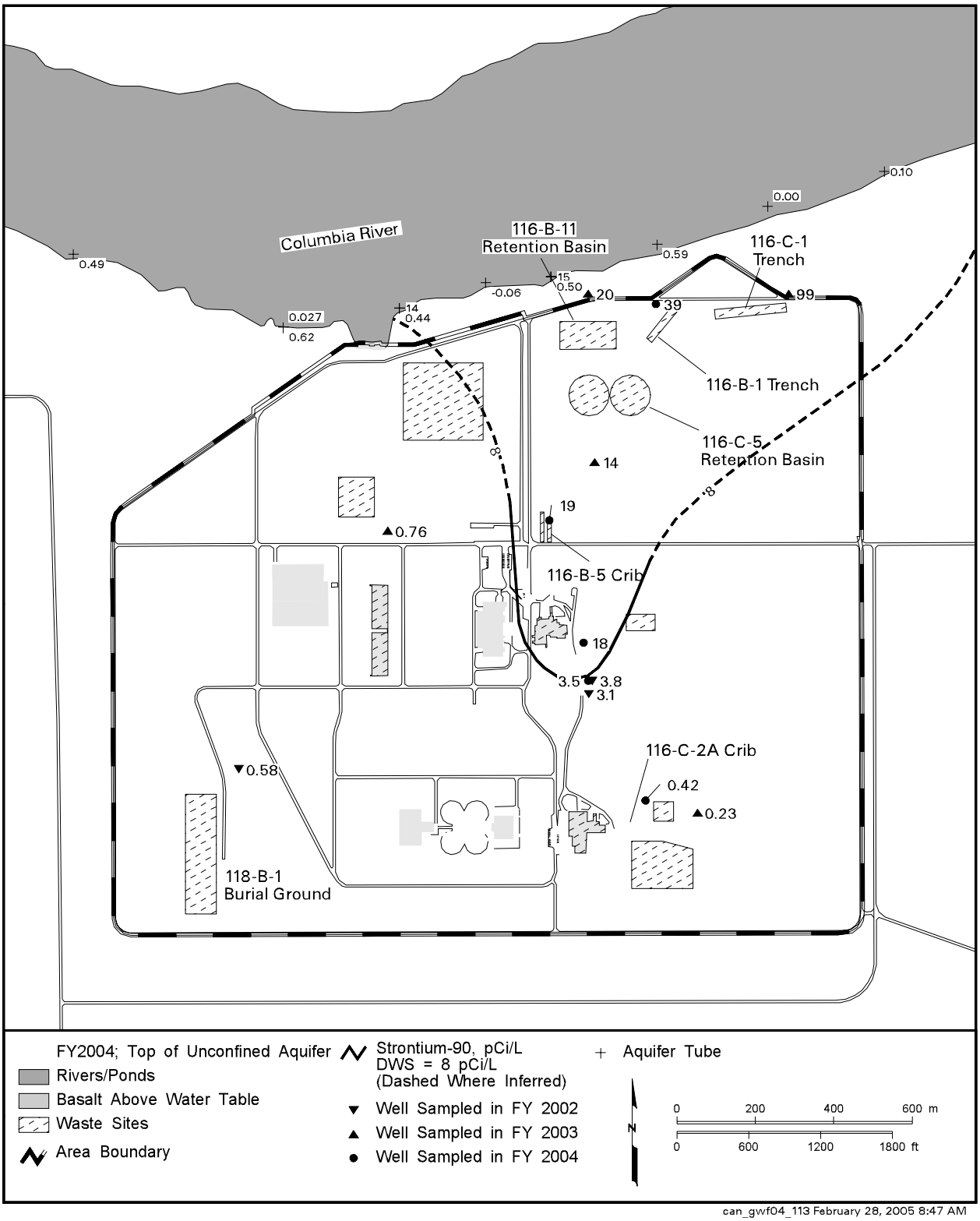

Figure 2.2-3. Average Strontium-90 Concentrations in the 100-B/C Area, Top of Unconfined Aquifer

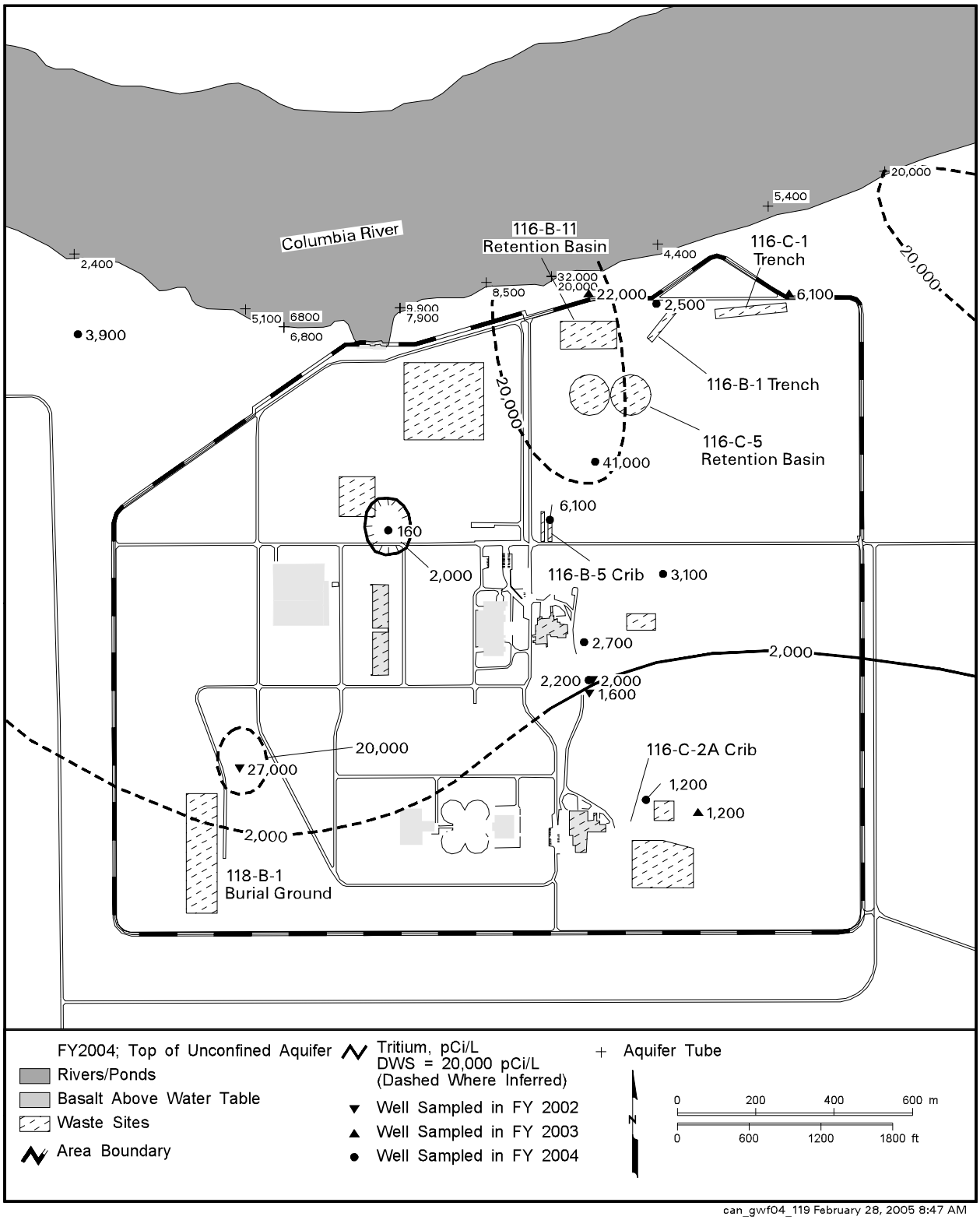

Figure 2.2-4. Average Tritium Concentrations in the 100-B/C Area, Top of Unconfined Aquifer

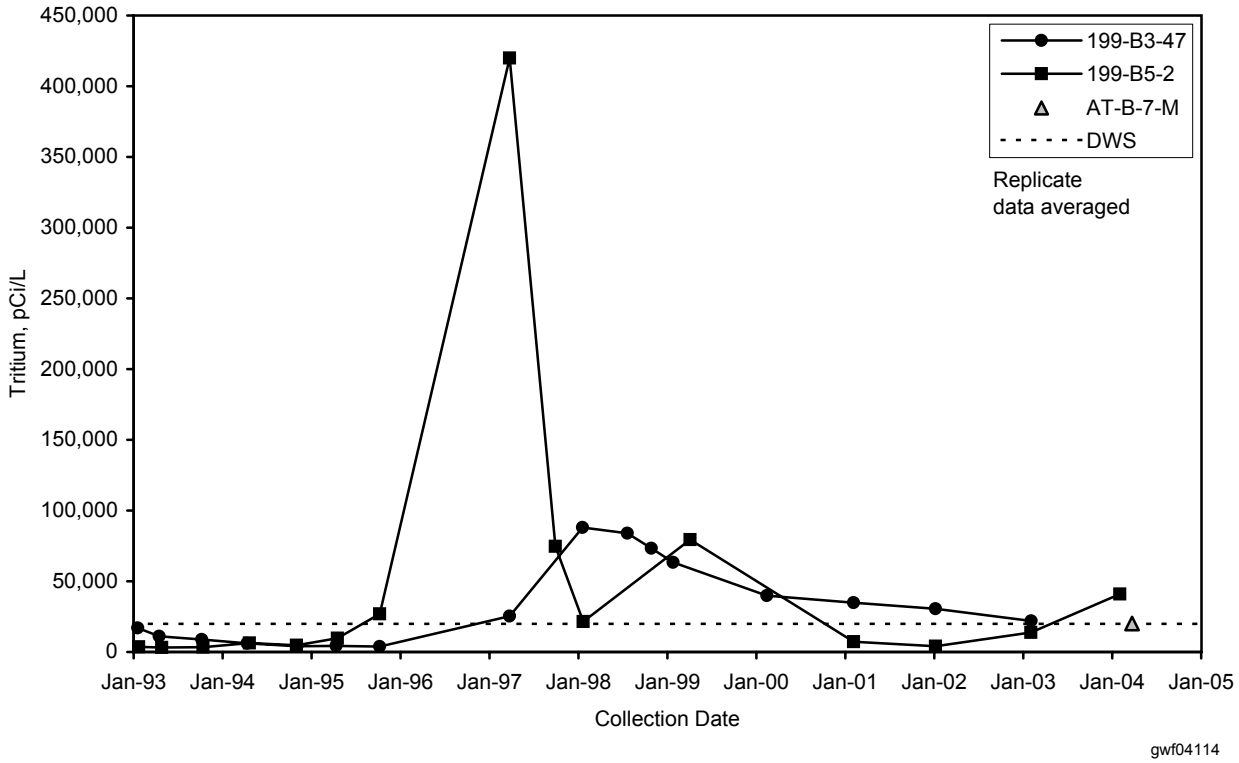

Figure 2.2-5. Tritium Concentrations in North 100-B/C Area

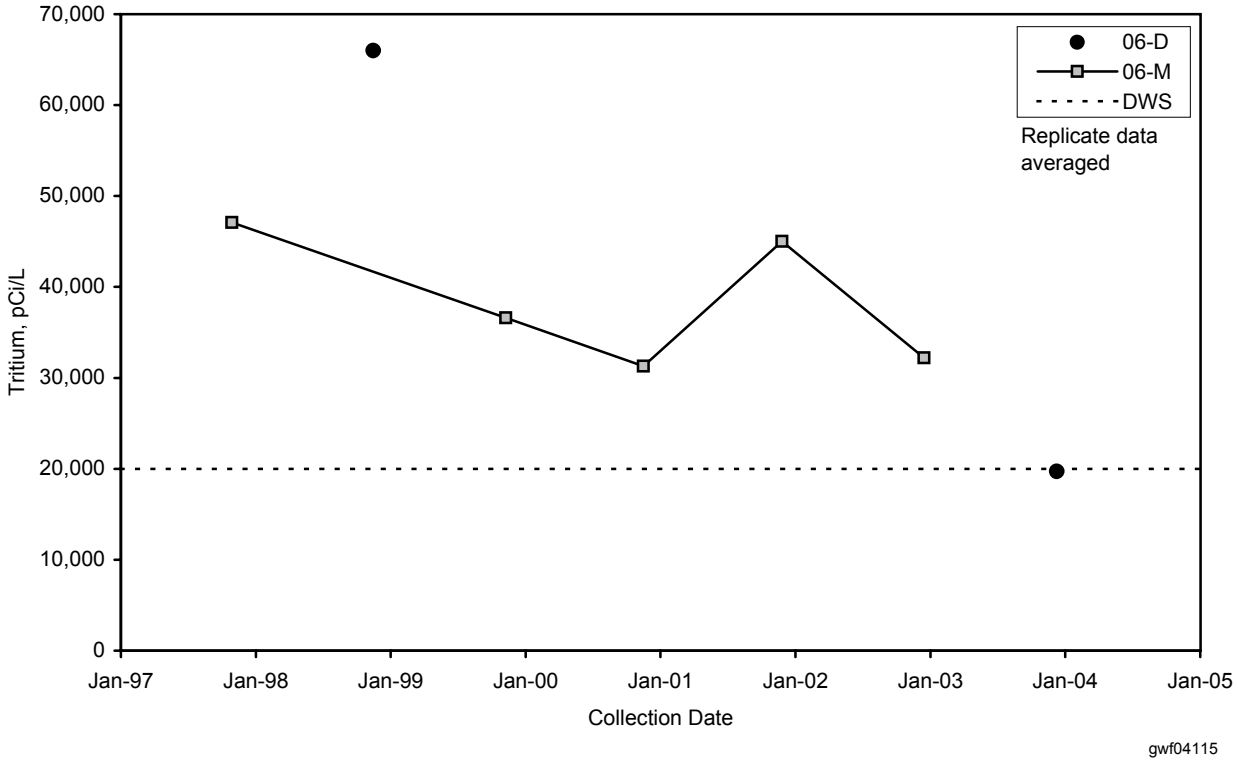

Figure 2.2-6. Tritium Concentrations at Aquifer Tube Site 6

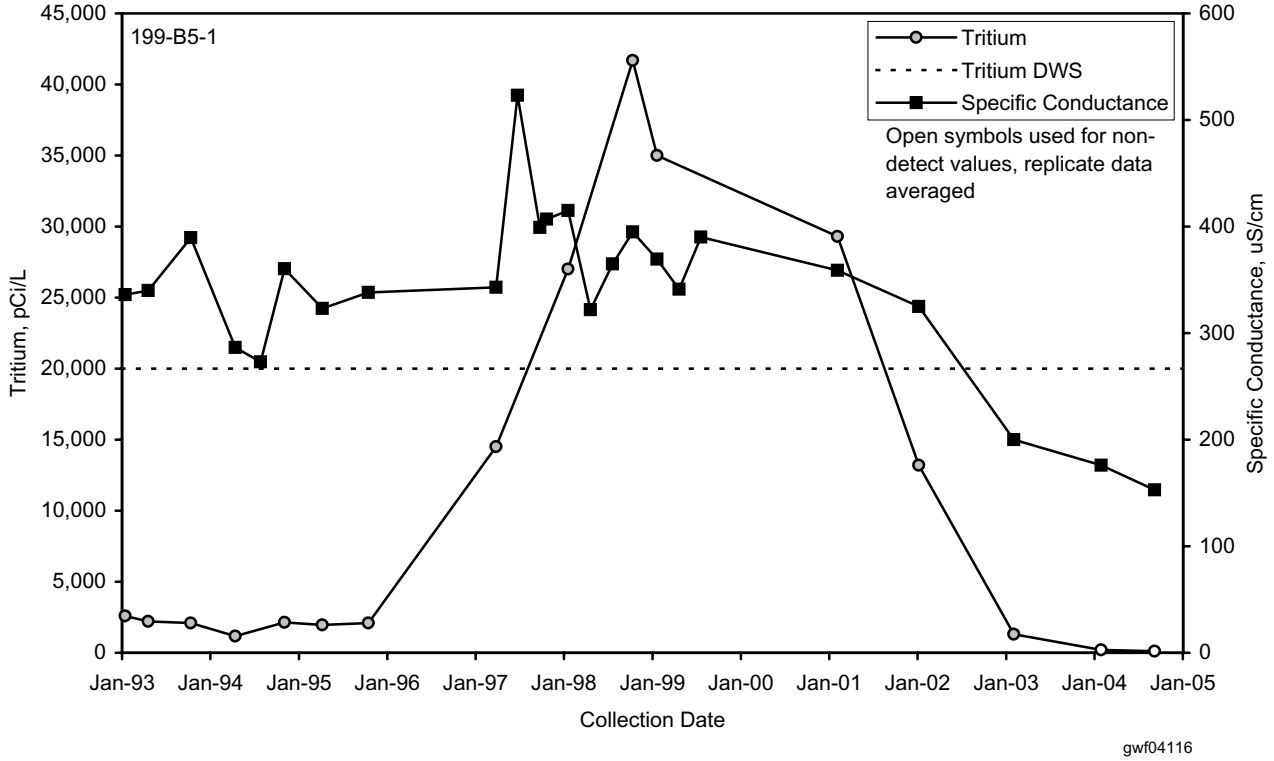

Figure 2.2-7. Tritium Concentrations and Specific Conductance in Well 199-B5-1, West-Central 100-B/C Area

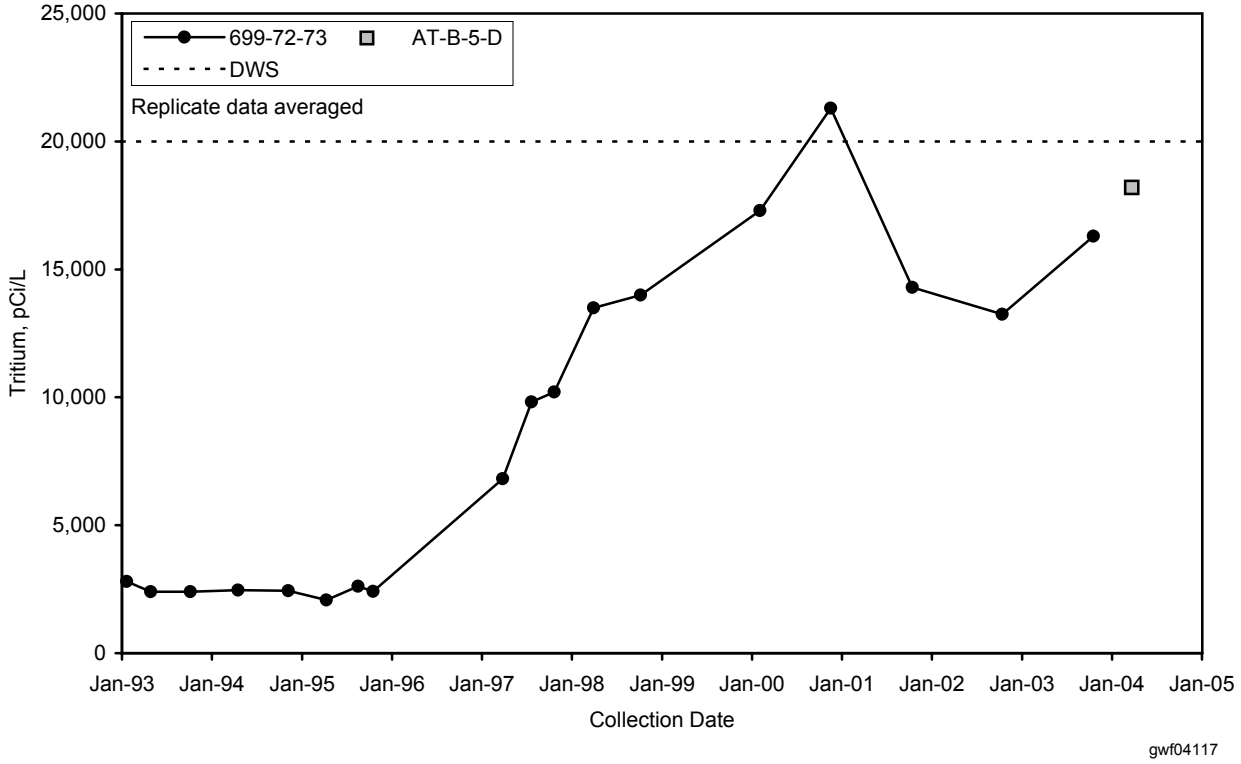

Figure 2.2-8. Tritium Concentrations East of 100-B/C Area

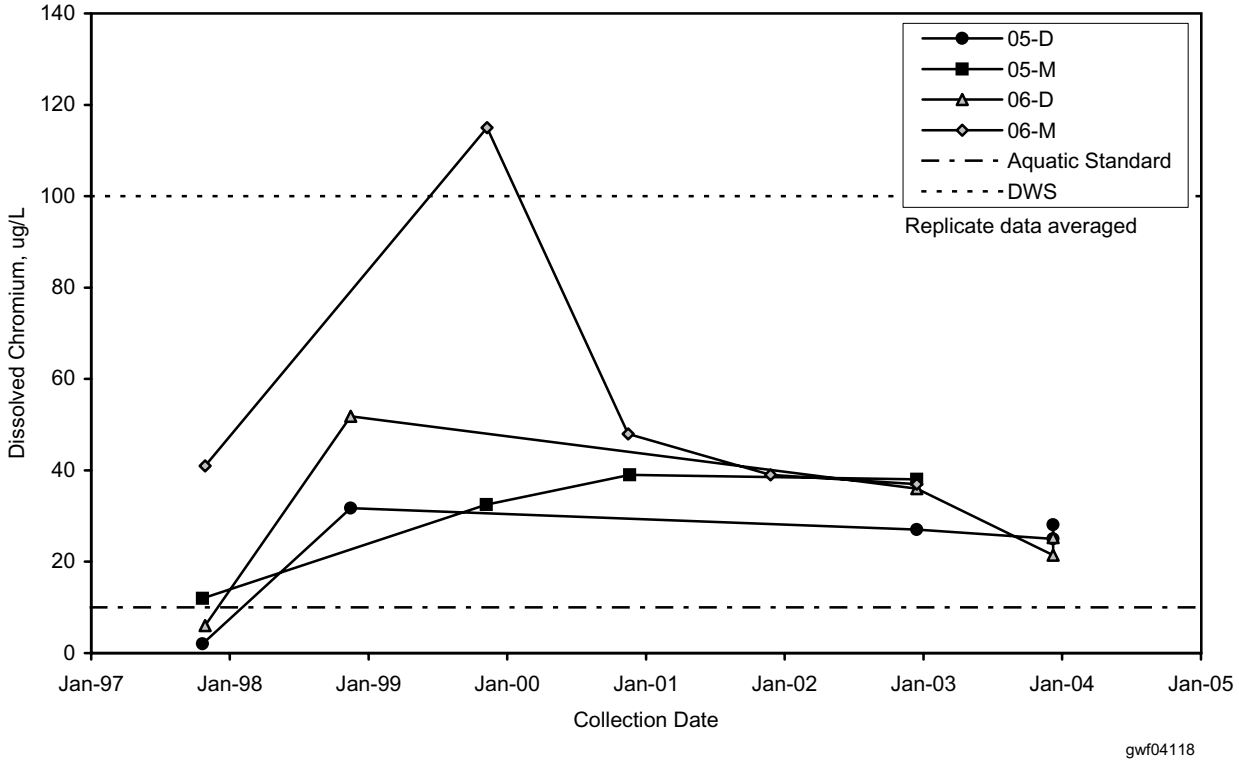

Figure 2.2-9. Chromium Concentrations at Aquifer Tubes at 100-B/C Area