# 2.2 100-BC-5 Operable Unit

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This section describes groundwater flow and chemistry in the vicinity of the 100-B/C Area. 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 upgradient areas along the Columbia River and the gaps between Umtanum Ridge, Gable Butte, and Gable Mountain. 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 southern 100-B/C Area and in the western part of the interest area.

Some of the main concepts associated with the 100-BC-5 Operable Unit include the following.

- Strontium-90, hexavalent chromium, and tritium plumes are present in groundwater at levels above drinking water or aquatic standards.
- Previous assessments have not identified groundwater conditions that warrant interim remedial measures. Final decisions on groundwater cleanup will be reached in coming years.
- Most of the former waste sites have been remediated (shallow contaminated sediment has been excavated) and backfilled. Remediation is ongoing at remaining sites.
- Chromium contamination was detected in the deep vadose zone at one former waste site. The U.S. Department of Energy (DOE) is investigating alternatives for vadose zone remediation.
- All but one of the monitoring wells are screened at the top of the unconfined aquifer, which is ~34 m thick in the 100-B/C Area. One well is screened ~38 m below the water table in the Ringold upper mud unit, and has not had any detected contamination.

The following sections provide details about the operable unit activities. Sections 2.2.1 and 2.2.2 describe contaminant plumes and concentration trends for the contaminants of concern and operable unit activities, respectively. Groundwater monitoring for the *Atomic Energy Act of 1954* (AEA) is integrated fully with *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) monitoring. There are no active waste disposal facilities or *Resource Conservation and Recovery Act of 1976* sites in the 100-B/C Area.

## 2.2.1 Groundwater Contaminants

Wells in the 100-BC-5 Operable Unit are sampled for the contaminants of concern based on results of the data quality objectives process (PNNL-14287, *Data Quality Objectives Summary Report – Designing a Groundwater Monitoring and Assessment Network for the 100-BC-5 and 100-FR-3 Operable Units*): strontium-90, tritium, and hexavalent chromium. This section describes distribution and trends of the groundwater contaminants of concern and nitrate beneath the 100-BC-5 groundwater interest area.

***Plume areas (square kilometers) in the 100-BC-5 Operable Unit:***
***Chromium, 20 µg/L — 0.85***
***Strontium-90, 8 pCi/L — 0.63***
***Tritium, 20,000 pCi/L — 0.22***

#### 2.2.1.1 Strontium-90

A wedge-shaped plume of strontium-90 extends from the central 100-B/C Area north toward the Columbia River (PNNL-15670, *Hanford Site Groundwater Monitoring for Fiscal Year 2005,* Figure 2.2-3 provides a 2005 plume map). The drinking water standard is 8 pCi/L. The plume has not changed significantly for more than 10 years. Figure 2.2-3 shows strontium-90 trends in wells near the 116-B-1 Trench, the 116-C-1 Trench, and cribs in the central 100-B/C Area. The highest concentration in fiscal year (FY) 2008 was 44.7 pCi/L in well 199-B3-46, near the 116-C-1 Trench. Concentrations in FY 2008 were about the same as the previous year. Long-term trends are steady or declining.

***Strontium-90 and tritium exceeded drinking water standards in groundwater at the 100-BC-5 Operable Unit during FY 2008.***

Strontium-90 levels in four aquifer tubes exceeded the drinking water standard in FY 2008, with a maximum of 16 pCi/L in new tube C6230, sampled for the first time in September 2008. Concentration trends in the older aquifer tubes are steady to gradually declining.

Strontium-90 appears to be limited to the upper part of the unconfined aquifer. Deep well 199-B2-12 consistently has no detectable strontium-90, while its shallow counterpart, well 199-B3-47, has levels above the drinking water standard. Similarly, deep aquifer tubes C6332, AT-05-D, and AT-06-D had undetectable strontium-90 concentrations, while their shallower counterparts had concentrations above the drinking water standard.

#### 2.2.1.2 Tritium

The upper part of the unconfined aquifer beneath the 100-B/C Area is contaminated with tritium at concentrations that exceed the drinking water standard (20,000 pCi/L) in several wells (Figure 2.2-4). The distribution of tritium currently is interpreted as three separate plumes.

In the northern 100-B/C Area, only well 199-B3-47 had a tritium concentration above the drinking water standard during FY 2008 (45,000 pCi/L; Figure 2.2-5). Wells 199-B4-1 and 199-B5-2 had concentrations below the standard, though they have exceeded the standard in the past. The FY 2008 increase in well 199-B3-47 may represent the pulse of tritium seen in well 199-B5-2 in 2005 and 2006.

The northern tritium plume is detected at the Columbia River in aquifer tubes. New tube C6231 had the highest aquifer tube concentration (20,000 pCi/L) in FY 2008. Concentrations have declined in the past 10 years in nearby tube AT-06-D. In 1998, the concentration in this aquifer tube was 66,000 pCi/L and in FY 2008 18,000 pCi/L.

***Tritium concentrations exceeded the drinking water standard in three plumes in the 100-B/C Area.***

Tritium concentrations in three wells in the southern 100-B/C Area exceed the drinking water standard (Figure 2.2-6). The current interpretation is that there are two separate plumes in this region. Because the area has only three monitoring wells, these plumes are not well defined. Well 199-B8-6 (near the 118-B-1 Burial Ground) had tritium concentrations of ~29,000 pCi/L, with a flat trend over the past few years. Wells 199-B8-7 (between wells 199-B8-6 and 199-B8-8) and 199-B8-8 (in the 100-C-7 Waste Site) also had tritium levels above the standard. The wells were sampled monthly from September 2007 through January 2008, and quarterly for the rest of FY 2008 (April and July). The source of this tritium is unknown, because the nearby waste sites are not known sources of tritium. The 118-B-1 Burial Ground does not seem a likely source for the tritium in wells 199-B8-7 and 199-B8-8 because it is not upgradient of the wells. The DOE will continue to monitor the new wells for tritium and other constituents (Appendix A).

Just east of the 100-B/C Area, tritium concentrations at tube sites AT-B-5 and AT-B-7 remained elevated (~14,000 pCi/L), but were below the drinking water standard. Tritium east of the 100-B/C Area is believed to represent a plume from the 200 Area that migrated northward. Elevated tritium concentrations also were observed in well 699-72-73, east of the 100-B/C Area. The FY 2008 result was 15,000 pCi/L.

#### 2.2.1.3 Chromium

Hexavalent chromium is of potential concern to salmon and other aquatic life. The aquatic standard for hexavalent chromium is 10 µg/L. Chromium concentrations continued to be below the drinking water standard (100 µg/L for total chromium), but exceeded 10 µg/L in wells and aquifer tubes in the eastern half of the 100-B/C Area. The dimensions of this plume did not change between FY 2007 and FY 2008 (Figure 2.2-7). The highest concentration was 54.8 µg/L (hexavalent chromium) in well 199-B3-47, downgradient of the 116-B-11 Retention Basin. This result was within the range observed since 1999.

***Chromium concentrations increased in one well monitoring the 100-C-7 Waste Site in FY 2008.***

In the southern 100-B/C Area, waste site investigations discovered chromium contamination in the vadose zone at the 100-C-7 Waste Site (Figure 2.2-1). Chromium concentrations for groundwater samples from wells 199-B8-7 and 199-B8-8 initially were under 20 µg/L. The concentration increased to 49 µg/L in well 199-B8-8 in July 2008 (Figure 2.2-8), but declined in October 2008. This well will be sampled monthly in FY 2009 to monitor chromium levels.

Another waste site, 100-B-27 sodium dichromate spill, located in the northwestern 100-B/C Area, also had chromium contamination in the vadose zone. The DOE drilled a characterization borehole and collected soil and groundwater samples from this waste site (WCH-225, *Sampling and Analysis Instruction for Evaluation of Residual Hexavalent Chromium Contamination in the Subsurface Soil at 100-B-27*). Chromium levels in groundwater were low (6.5 µg/L in a filtered sample).

Deep monitoring well 199-B2-12, located adjacent to shallow well 199-B3-47, has no detectable chromium. Figure 2.2-9 illustrates the distribution of chromium concentrations with depth for the 100-B/C Area aquifer tubes and nearby wells. In FY 2008, the highest concentrations in aquifer tubes were in shallow tube AT-05-S and mid-depth tube AT-06-M (both 46 µg/L).

#### 2.2.1.4 Nitrate

DOE/RL-2005-40, *100-B/C Pilot Project Risk Assessment Report*, identified nitrate as a contaminant of concern, because of its exceedance of the drinking water standard (45 mg/L) in well 199-B3-47 in 1998 and 1999. Concentrations subsequently have decreased. The highest nitrate concentration in FY 2008 was 39.5 mg/L in well 199-B3-47, about the same as in FY 2007.

### 2.2.2 Operable Unit Activities

Groundwater sampling requirements are defined in the groundwater sampling and analysis plan (DOE/RL-2003-38, *100-BC-5 Operable Unit Sampling and Analysis Plan*) and a Tri-Party Agreement change notice (TPA-CN-182). The wells, aquifer tubes, and seeps scheduled for sampling in FY 2008 were sampled as planned (Appendix A). The DOE installed and sampled nine new aquifer tubes (in three

clusters) in FY 2008 (SGW-36398, *Installation and Sampling Analysis Instructions for Fiscal Year 2008 Aquifer Tubes*).

Groundwater sampling in FY 2009 will be modified by another Tri-Party Agreement change notice. Aquifer tube sampling requirements for FY 2009 are specified in an upcoming revision of DOE/RL-2000-59.

The DOE plans to install several new wells in the 100-B/C Operable Unit. Data from these sites will help define groundwater quality near recently characterized waste sites.

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

- ***Twenty-five wells are scheduled for quarterly to biennial sampling.***
- ***Fourteen aquifer tube sites and two seeps are scheduled for annual sampling.***
- ***Nine new aquifer tubes were installed and sampled in FY 2008. They are scheduled for annual sampling.***

**Figure 2.2-1. Facilities and Groundwater Monitoring Wells in 100-B/C Area.**

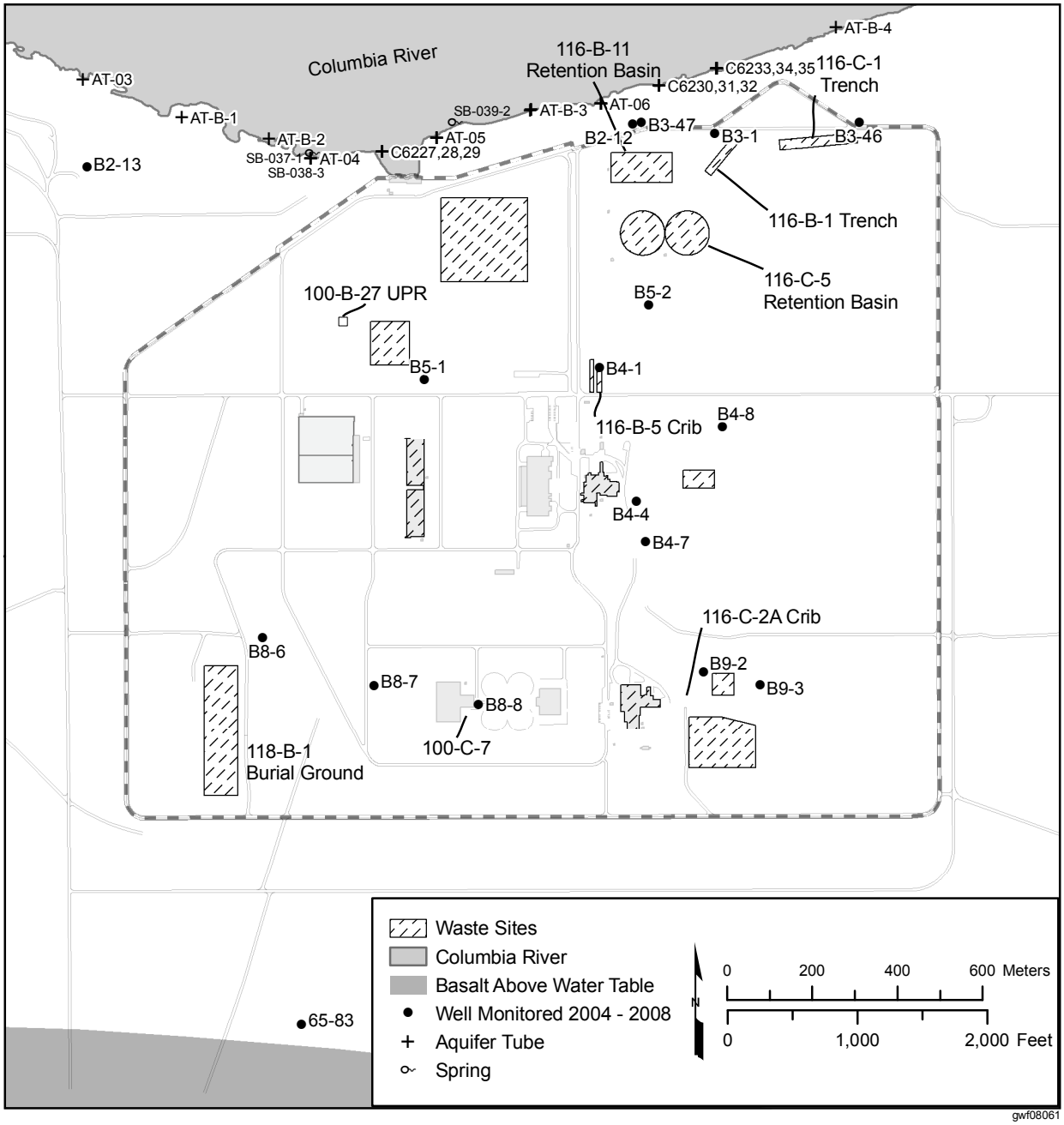


**Figure 2.2-2. 100-B/C Area Water-Table Map, March 2008.**

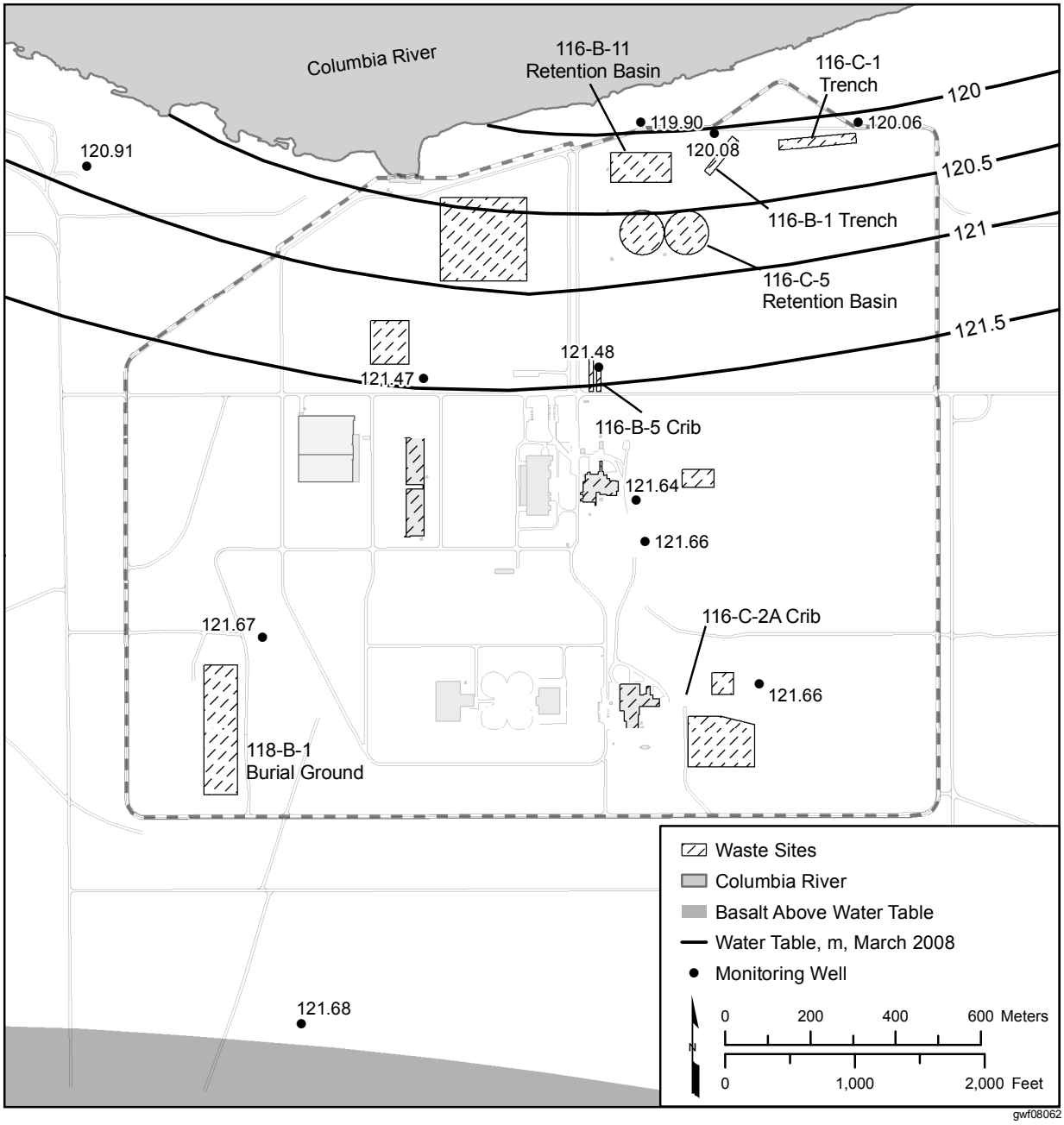


**Figure 2.2-3. Strontium-90 Concentrations in the 100-B/C Area.**

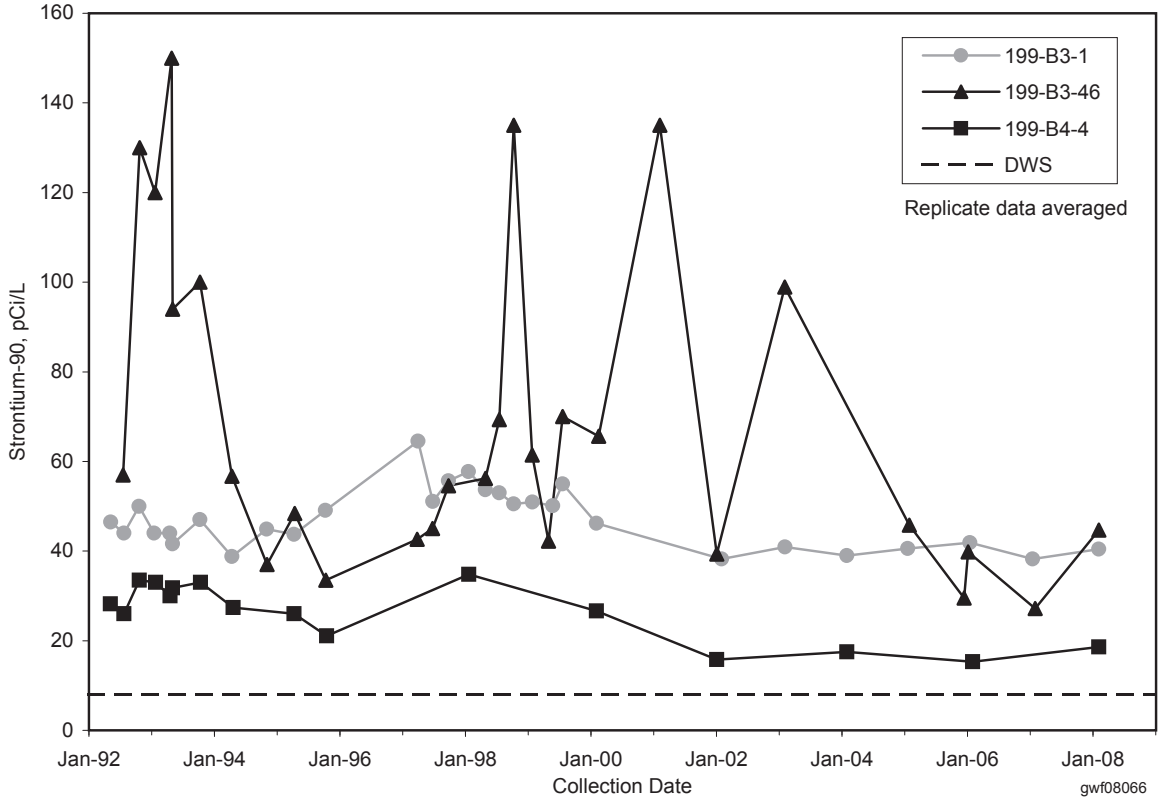


**Figure 2.2-4. Average Tritium Concentrations in 100-B/C Area, Upper Part of Unconfined Aquifer.**

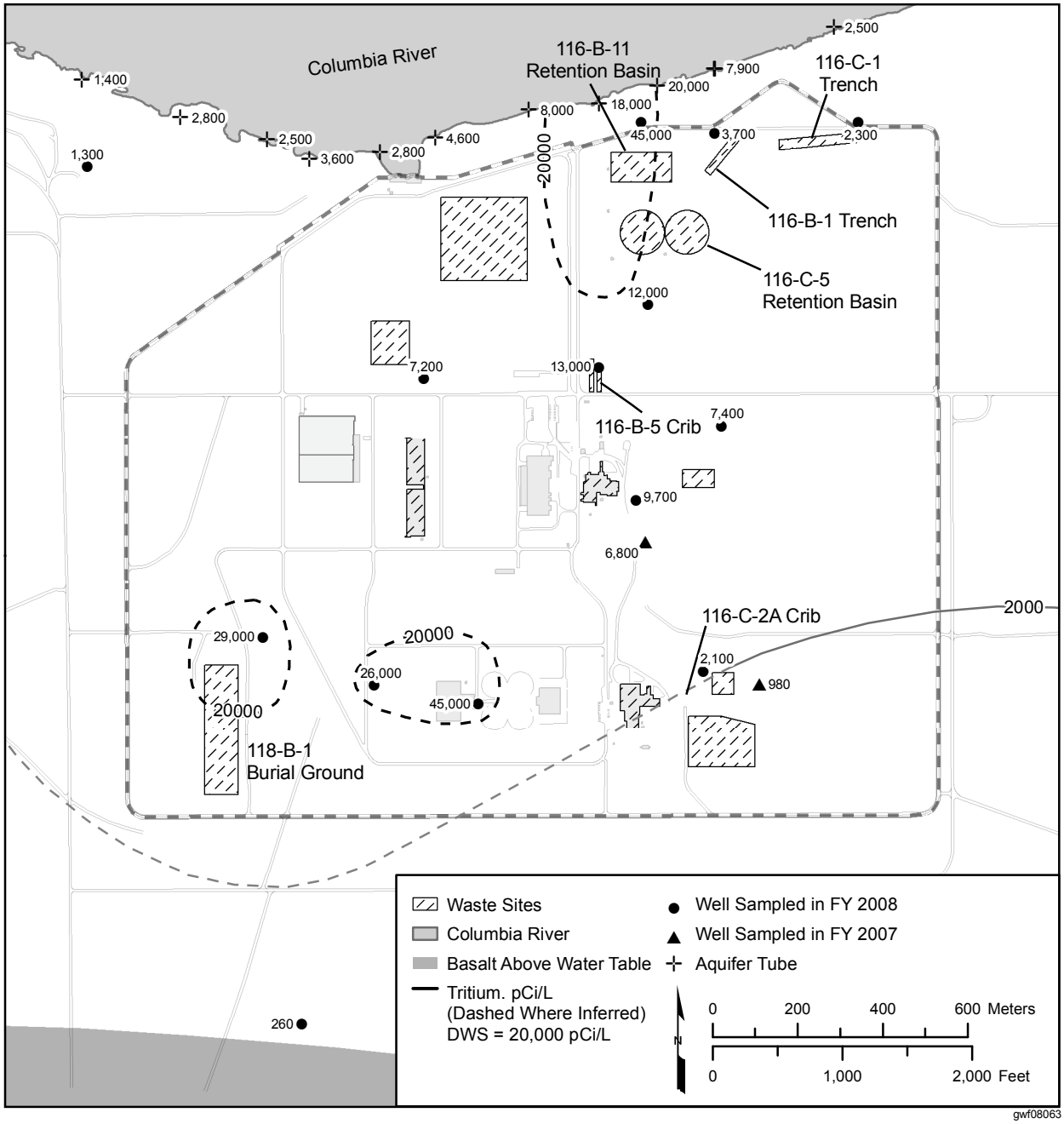


**Figure 2.2-5. Tritium Concentrations in Northern 100-B/C Area.**

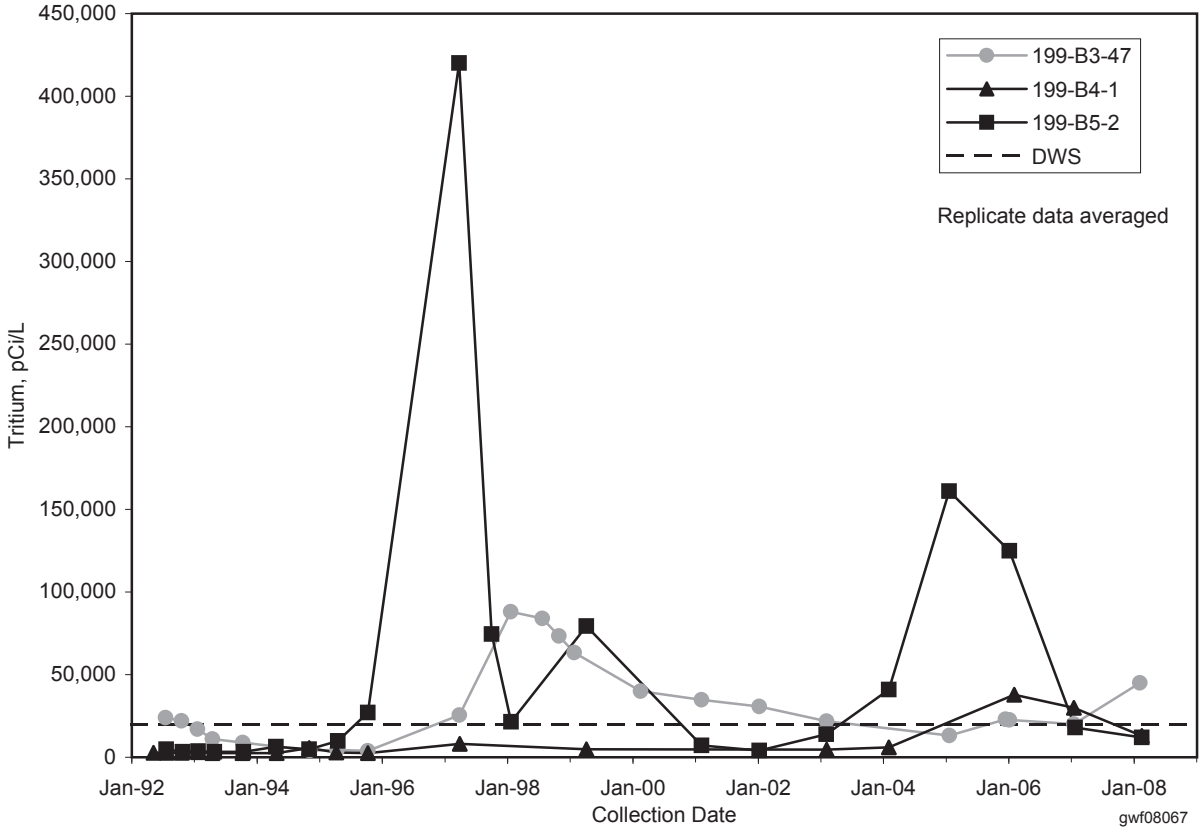



**Figure 2.2-6. Tritium Concentrations in Southern 100-B/C Area.**

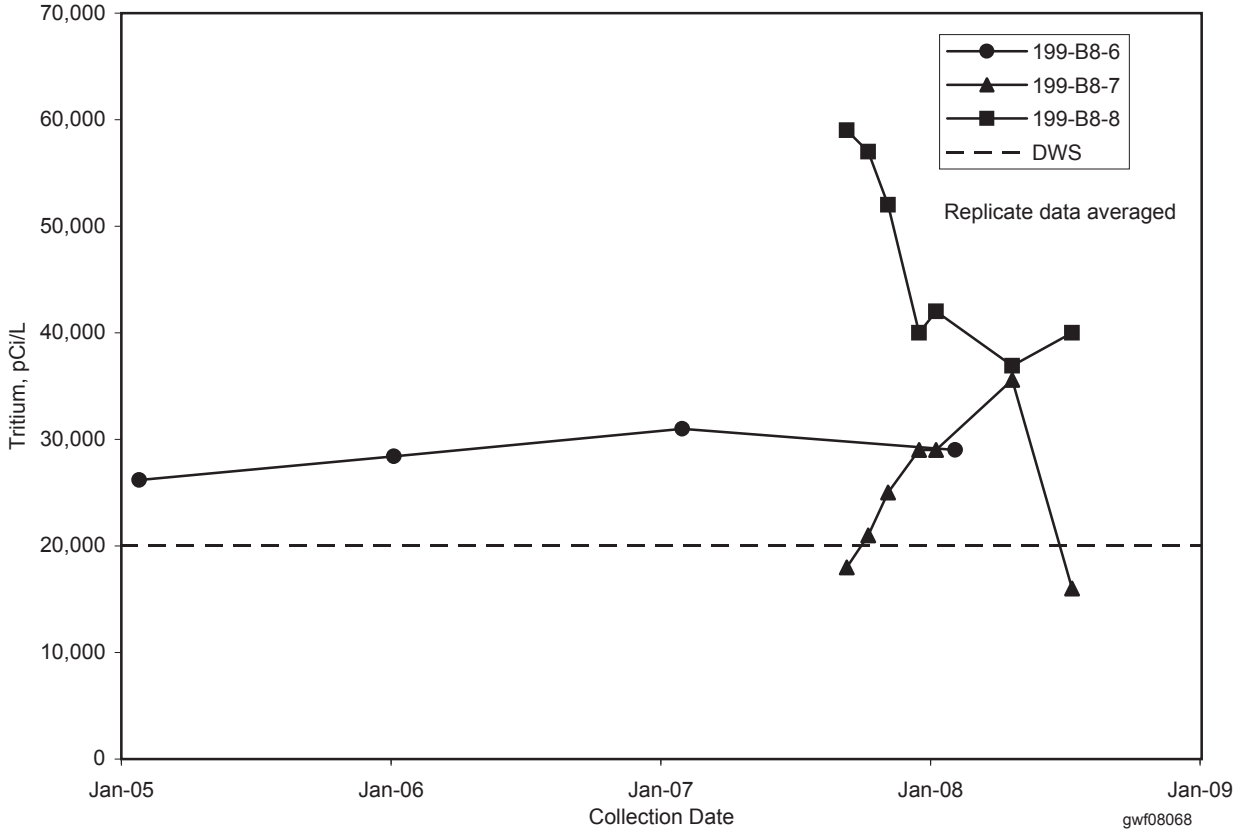


**Figure 2.2-7. Average Chromium Concentrations in 100-B/C Area, Upper Part of Unconfined Aquifer.**

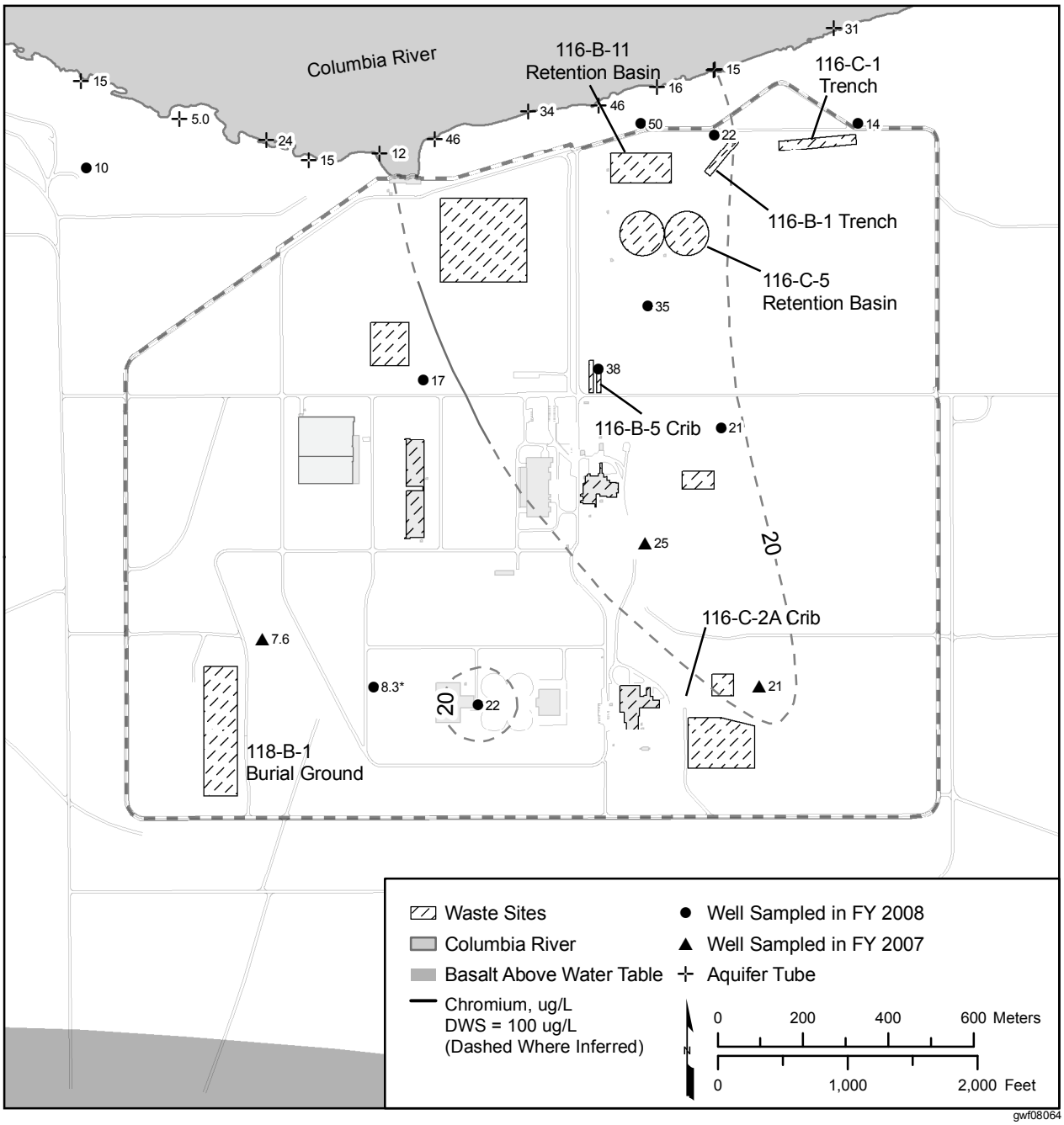


**Figure 2.2-8. Hexavalent Chromium Concentrations in Wells near the 100-C-7 Waste Site.**

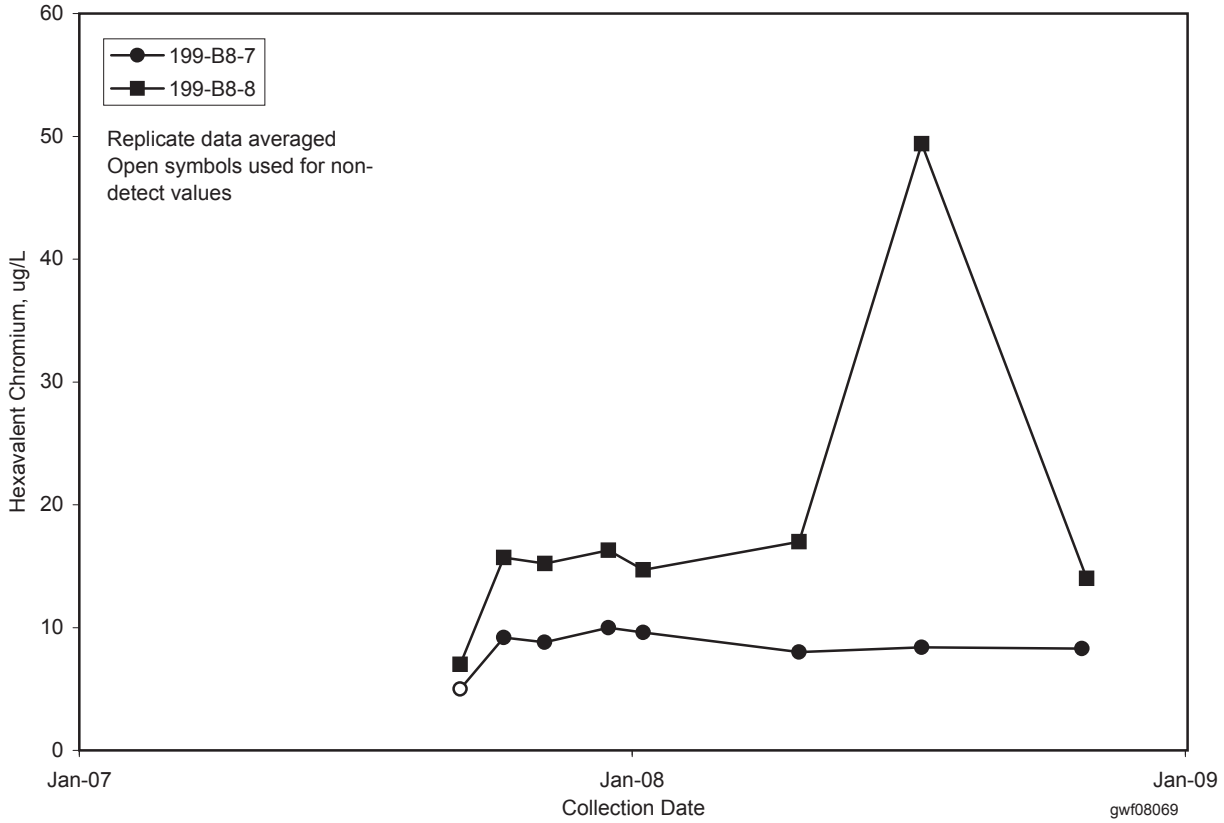
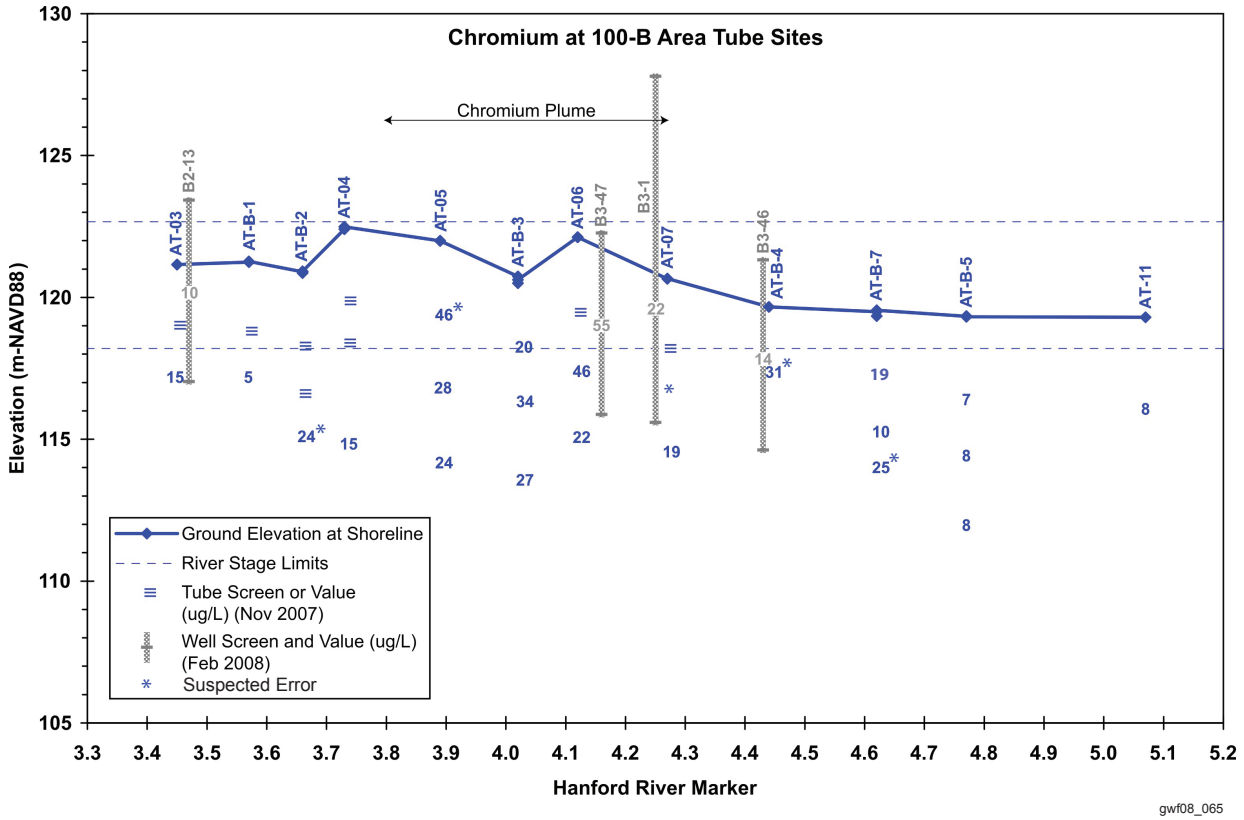



**Figure 2.2-9. Cross Section of Chromium Concentrations and Screen Elevations in Wells and Aquifer Tubes in 100 B/C Area.**



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