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 1.0-1 in Section 1.0). The "groundwater interest areas" are informal designations 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 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 south 100-B/C Area and in the west part of the interest area.

Strontium-90 and tritium exceeded drinking water standards in groundwater at the 100-BC-5 Operable Unit during FY 2007.

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 of the *Atomic Energy Act* (AEA) 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.

2.2.1 Groundwater Contaminants

Wells in the 100-BC-5 Operable Unit are sampled quarterly to biennially for the contaminants of concern based on results of the data quality objectives process (PNNL-14287): 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.

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 (see Figure 2.2-3 in PNNL-15670). The drinking water standard is 8 pCi/L. The plume has not changed significantly in over 10 years. The highest concentrations in FY 2007 were 37 pCi/L in well 199-B3-47 near the 116-B-11 retention basin and 38 pCi/L in well 199-B3-1 near the 116-C-1 trench. These levels were about the same as the previous year. Long-term trends are steady or declining.

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

- ***Twenty-five wells are sampled quarterly to biennially.***
- ***Fourteen aquifer tube sites and two seeps are scheduled for sampling annually. One tube was not sampled in FY 2007 (see Appendix A).***

Plume areas (square kilometers) at the 100-BC-5 Operable Unit:
Chromium, 20 µg/L — 0.82
Strontium-90, 8 pCi/L — 0.63
Tritium, 20,000 pCi/L — 0.23

Strontium-90 is 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 AT-05-D and AT-06-D had undetectable strontium-90 concentrations while their mid-depth counterparts had concentrations ~9 pCi/L in FY 2007. The shallow tubes at these sites had much higher levels of strontium-90 in FY 2007 than expected (26 pCi/L at tube AT-05-S and 45 pCi/L at AT-06-S). All tubes at site AT-05 and two tubes at site AT-06 were sampled again in November 2007 (FY 2008). Results will help determine whether the FY 2007 results were representative.

2.2.1.2 Tritium

The upper part of the unconfined aquifer beneath the 100-B/C Area is contaminated with tritium that exceeds the drinking water standard (20,000 pCi/L) in several wells (Figure 2.2-3). The distribution of tritium currently is interpreted as three separate plumes with levels above the drinking water standard.

One plume with concentrations above the drinking water standard extends from the 116-B-5 crib to the Columbia River. Wells 199-B4-1 and 199-B5-2, both located downgradient of the 116-B-5 crib, have shown spikes in tritium concentration in recent years (Figure 2.2-4). In FY 2007, concentrations declined from their peak values. The cause of these and previous spikes is unknown. This tritium plume is detected at the Columbia River in aquifer tubes. Tube AT-06-D had the highest concentration (17,000 pCi/L) in an aquifer tube in FY 2007. Concentrations have declined in the past 10 years; in 1998, the concentration in this aquifer tube was 66,000 pCi/L.

A second area where tritium concentrations exceed the drinking water standard is near the former 118-B-1 burial ground in the southwest 100-B/C Area. The burial ground has been excavated. The tritium plume in groundwater is poorly defined because there is only one monitoring well near the burial ground, well 199-B8-6 (Figure 2.2-5). The concentration in 2007 was 31,000 pCi/L, about the same as the previous 2 years. DOE drilled a borehole to help characterize the contamination in the vadose zone beneath the site and collected grab samples of groundwater before filling in the borehole. The maximum tritium concentration in the soil was 39,900 pCi/g at ~17 meters below land surface. Concentrations dropped three orders of magnitude in the soil between that depth and the water table at 25 meters, where tritium concentration was 42 pCi/g. Groundwater samples had 813 and 908 pCi/L tritium. Thus, it appears the tritium from the burial ground has moved downgradient and no longer remains in groundwater directly beneath the burial ground. Well 199-B8-6 will continue to be monitored for tritium.

Two new wells in the south-central 100-B/C Area contained elevated levels of tritium.

A third tritium plume was detected in two new wells in the south-central 100-B/C Area in FY 2007. Wells 199-B8-7 and 199-B8-8 were sampled in September 2007 and well 199-B8-8 contained 59,000 pCi/L tritium (Figure 2.2-3). 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 these wells because the wells are not downgradient. DOE will continue to monitor the new wells for tritium and other constituents (see Appendix A).

Well 199-B5-1, in the west-central 100-B/C Area, had very low tritium concentrations and specific conductance from 2004 through 2006. A fire hydrant leak

was discovered and repaired during FY 2006. The tritium concentration increased to 6,400 pCi/L in FY 2007.

Tritium concentrations from tube sites AT-B-5 and AT-B-7, located just east of the 100-B/C Area, remained elevated but below the drinking water standard (~17,000 pCi/L). Tritium east of the 100-B/C Area is believed to represent a plume from the 200 Areas that migrated northward. Elevated tritium also is observed in well 699-72-73, east of the 100-B/C Area. The FY 2007 result was 16,000 pCi/L.

2.2.1.3 Chromium

Hexavalent chromium is of potential concern to salmon and other aquatic life. Fall Chinook salmon and steelhead spawning areas have been recorded downstream and toward the center of the river channel, but not in areas along the 100-B/C Area shoreline. Shoreline areas provide rearing habitat for young salmon and steelhead, as well as for many of the other species of fish in the Columbia River (DOE/RL-2005-40). The aquatic standard for hexavalent chromium is 10 µg/L.

Chromium concentrations continued to be below the drinking water standard (100 µg/L), but exceeded 10 µg/L in wells and aquifer tubes in the east half of the 100-B/C Area (Figure 2.2-6). The highest concentration in a well was 64 µg/L in an unfiltered sample from well 199-B3-47, downgradient of the 116-B-11 retention basin. A filtered sample had a slightly lower concentration, 55 µg/L. These results are within the range observed since 1999. Deep monitoring well 199-B2-12, located adjacent to 199-B3-47, has no detectable chromium.

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

Figure 2.2-7 illustrates chromium concentrations with depth in the aquifer for the 100-B/C aquifer tubes and nearby wells. The highest concentrations in FY 2007 were in mid-depth tubes, with a maximum of 51 µg/L in AT-06-M.

Like tritium, chromium concentrations increased in well 199-B5-1 after several years of groundwater dilution from a leaking water line (Figure 2.2-8). The January 2007 result was 11 µg/L. Specific conductance rose to 328 µS/cm, which is comparable to levels before the dilution occurred. Based on observations at other sites with water leaks, it may take several years for contaminants like chromium to rebound completely. The source of formerly high chromium levels in this well is unknown. It could be known sources to the east but could be recently discovered sites like 100-C-7, south of this well.

In the southern 100-B/C Area, waste site investigations discovered chromium contamination in the vadose zone at the 100-C-7 site (see Figure 2.2-1 for location). Two boreholes were drilled at the site to sample sediment and groundwater. They were completed as groundwater monitoring wells 199-B8-7 and 199-B8-8, which will be monitored until the waste site is remediated. Initial chromium results for groundwater samples from the wells ranged from undetected to 11 µg/L.

Another waste site, 100-B-27, located in the northwest 100-B/C Area, also had chromium contamination in the vadose zone. DOE plans to drill a characterization borehole and collect soil and groundwater samples from this waste site (WCH-00225).

2.2.1.4 Nitrate

The *100-B/C Pilot Project Risk Assessment Report* (DOE/RL-2005-40) identified nitrate as a contaminant of concern based on its exceedance of the 45-mg/L drinking

water standard in well 199-B3-47 in 1998 and 1999. Concentrations subsequently decreased. Although the groundwater sampling and analysis plan (DOE/RL-2003-38) does not list nitrate as a contaminant of concern, it is monitored as a supporting parameter. The highest nitrate concentration in FY 2007 was 39 mg/L in well 199-B3-47, an increase from the previous few years (Figure 2.2-9). Nearby aquifer tube AT-06-M had a nitrate concentration of 28.4 mg/L in 2007.

Well 699-72-73, located between 100-B/C and 100-K Areas, had a nitrate concentration of 24.7 mg/L in 2007. Aquifer tubes east of the main 100-B/C Area also had somewhat elevated nitrate concentrations (26.6 and 25.2 mg/L in AT-14-D and AT-B-5-D, respectively). Like tritium, the source of this nitrate is believed to be the 200 East Area.

2.2.2 Operable Unit Activities

The groundwater sampling and analysis plan (DOE/RL-2003-38) specified annual sampling of 9 wells, 14 aquifer tube sites, and 2 seeps and biennial sampling of 14 wells (Appendix A). Of these, 16 wells and all of the aquifer tube sites and seeps were scheduled for sampling in FY 2007. Two new wells near the 100-C-7 waste site were added to the sampling schedule in September 2007. Tri-Party Agreement Change Notice (TPA-CN-182) documented this change to the sampling schedule. All of the wells, both seeps, and all but one of the aquifer tube sites were sampled as scheduled. Tube AT-12-D, located between 100-B/C and 100-K Areas, has not been sampled since 1997. It was sampled in November 2007 (FY 2008). Tubes on either side of it (AT-11 and AT-13) were sampled in FY 2007.

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

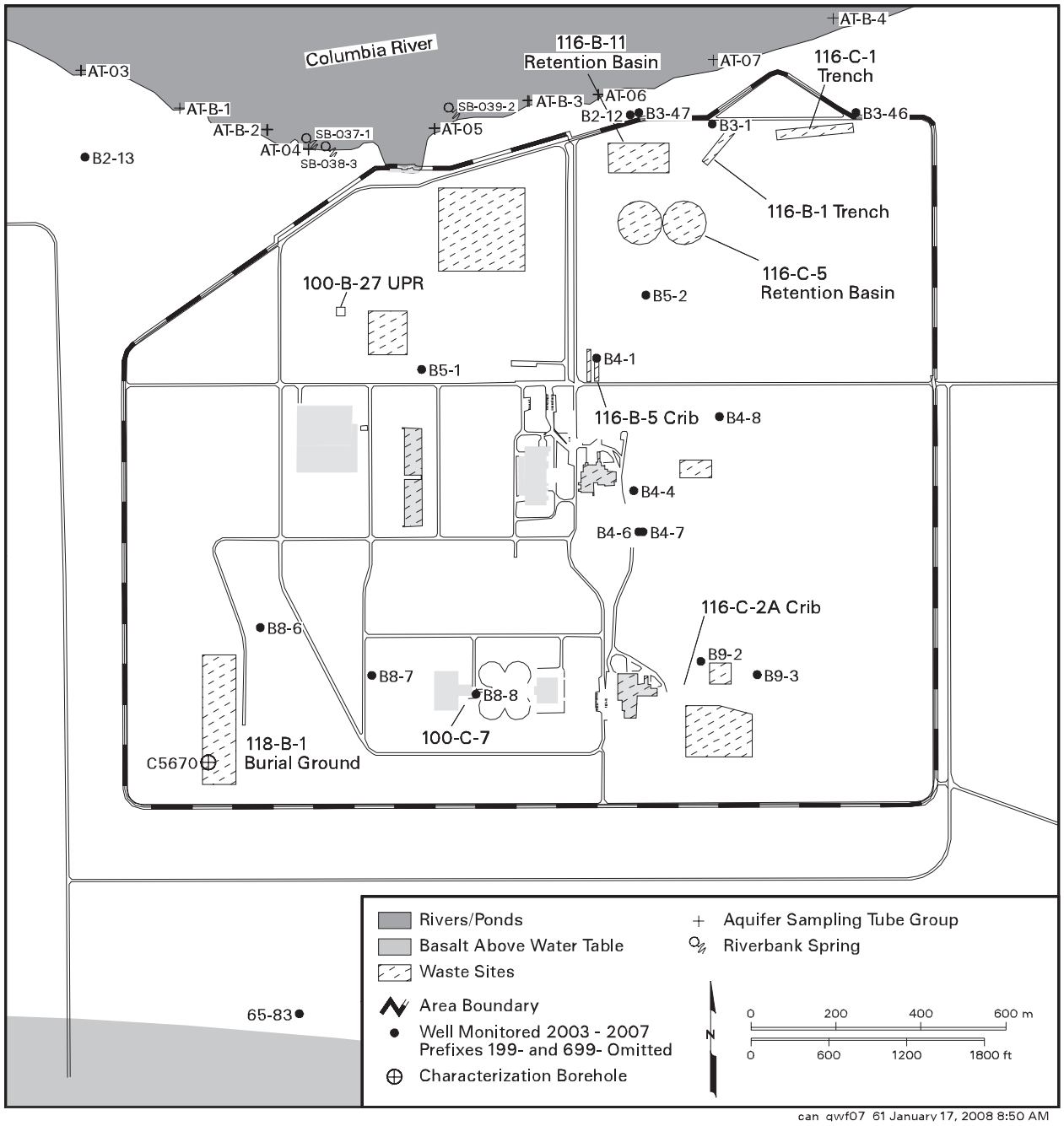

Figure 2.2-1. Groundwater Monitoring Wells in 100-B/C Area

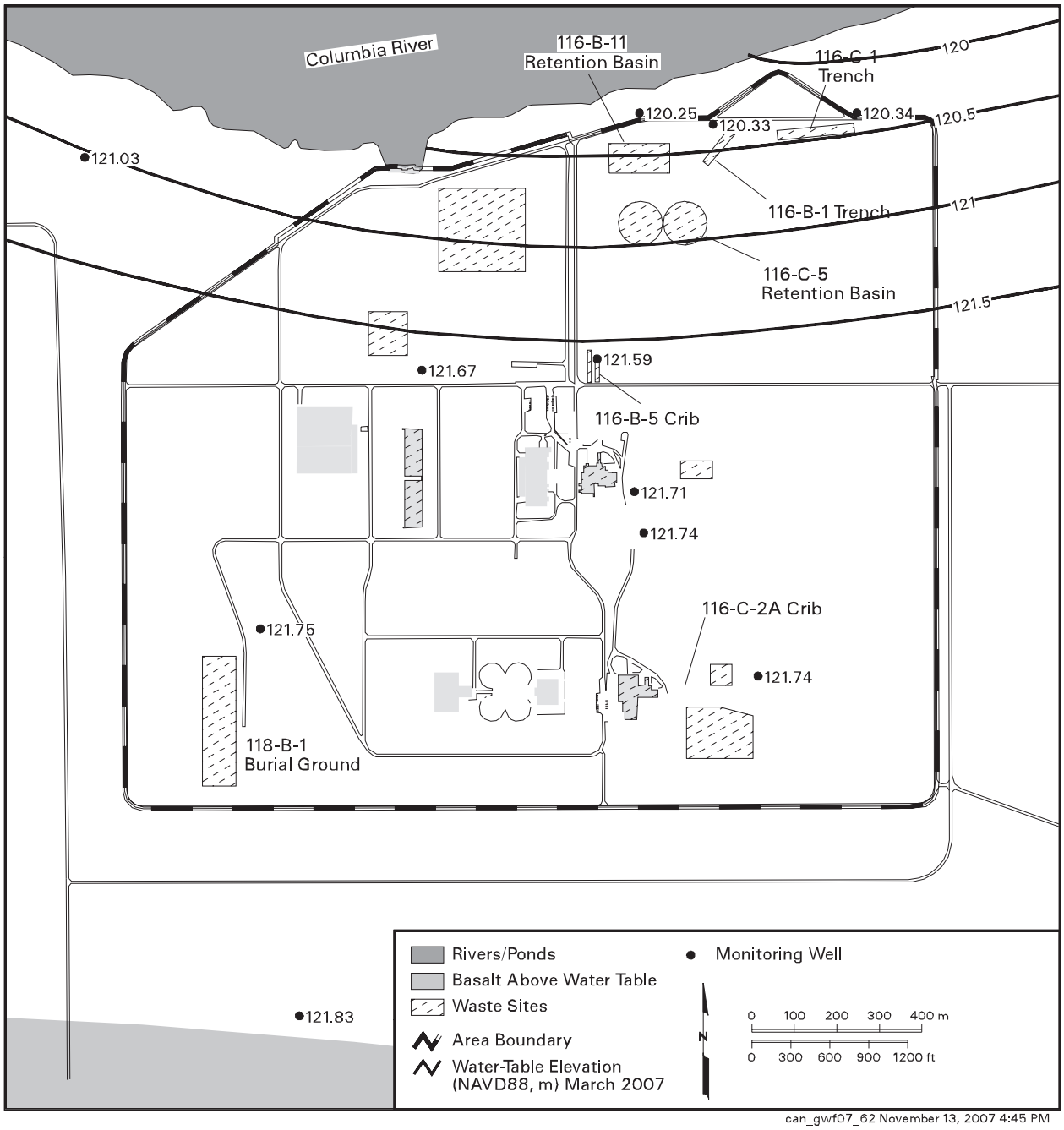

Figure 2.2-2. 100-B/C Area Water-Table Map, March 2007

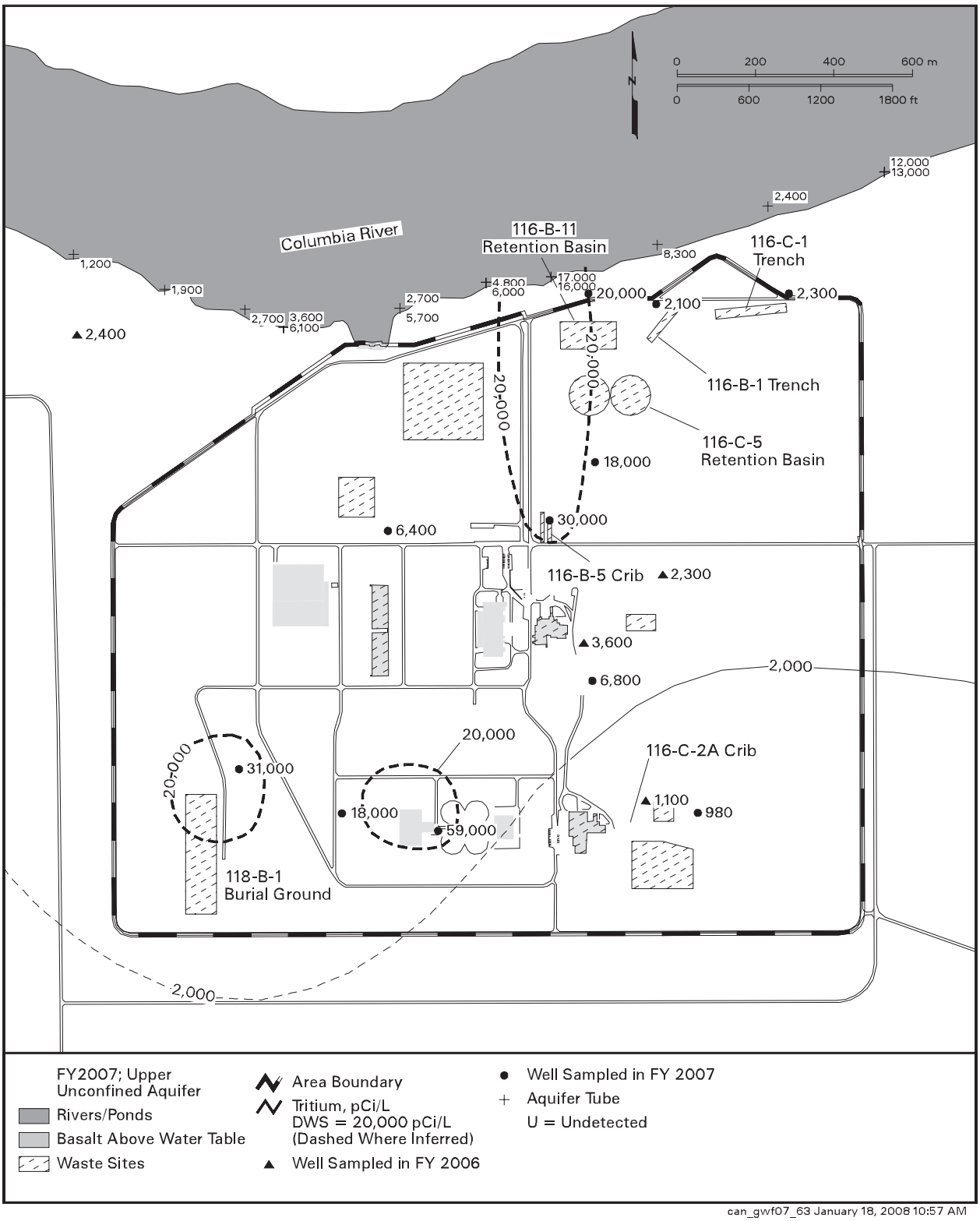

Figure 2.2-3. Average Tritium Concentrations in 100-B/C Area, Upper Part of Unconfined Aquifer

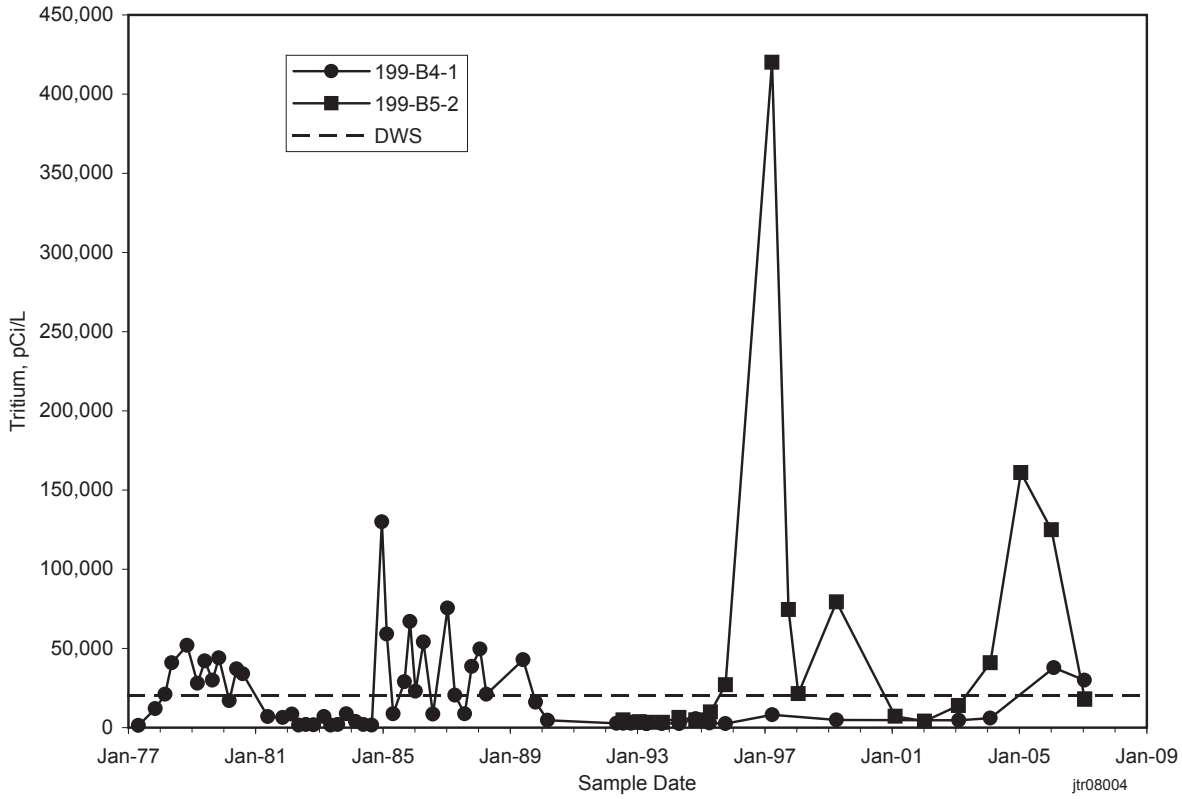

Figure 2.2-4. Tritium Concentrations Downgradient of the 116-B-5 Crib

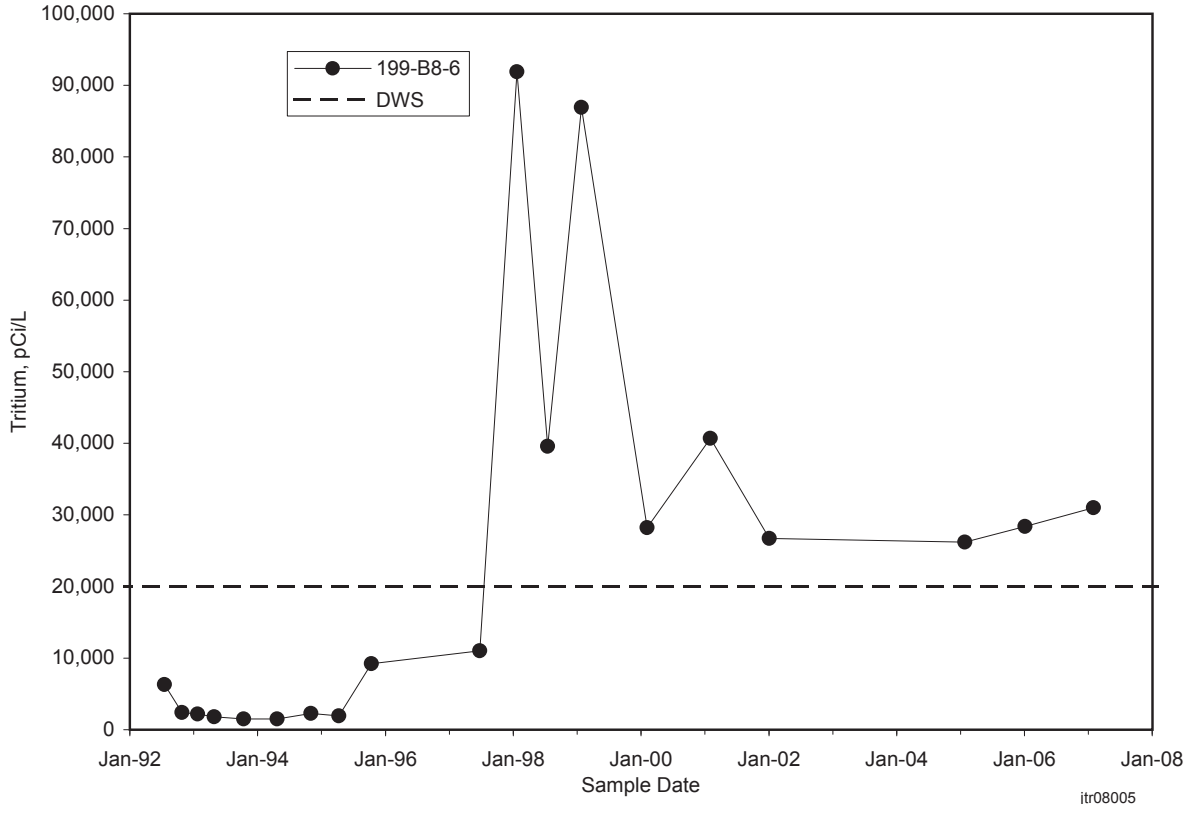

Figure 2.2-5. Tritium Concentrations Downgradient of the 118-B-1 Burial Ground

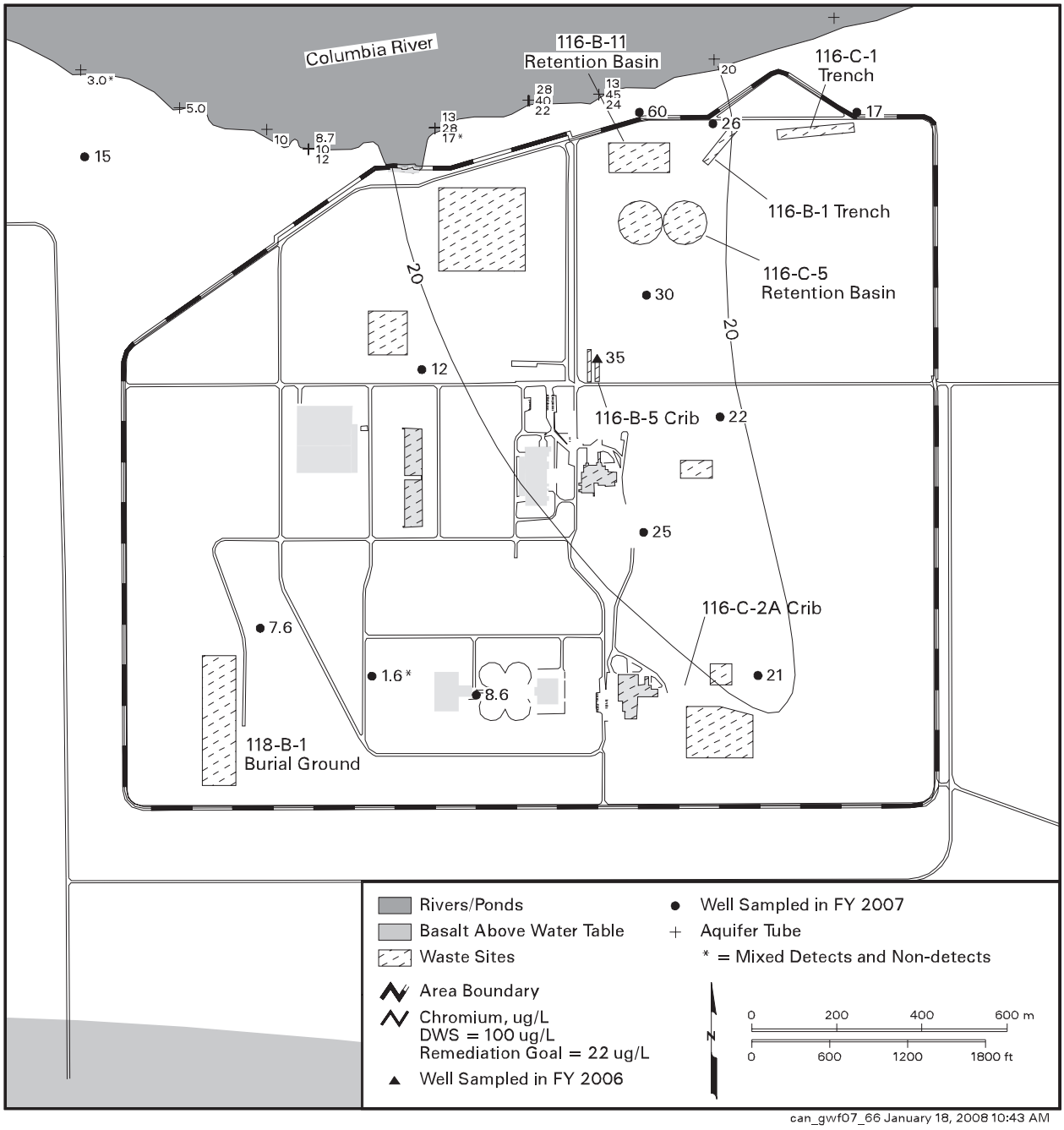

Figure 2.2-6. Average Chromium Concentrations in 100-B/C Area, Upper Part of Unconfined Aquifer

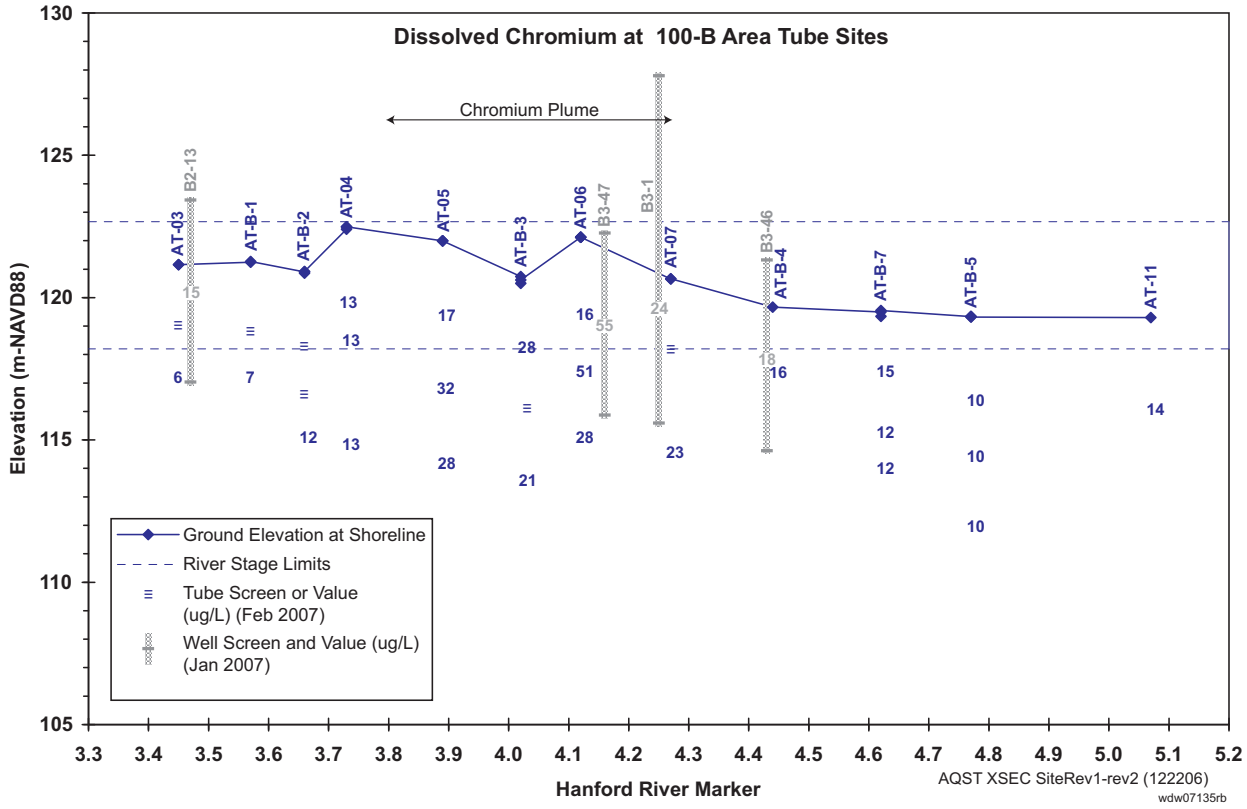

Figure 2.2-7. Sample Elevations and Chromium Concentrations in Wells and Aquifer Tubes in 100-B/C Area (modified from SGW-35028)

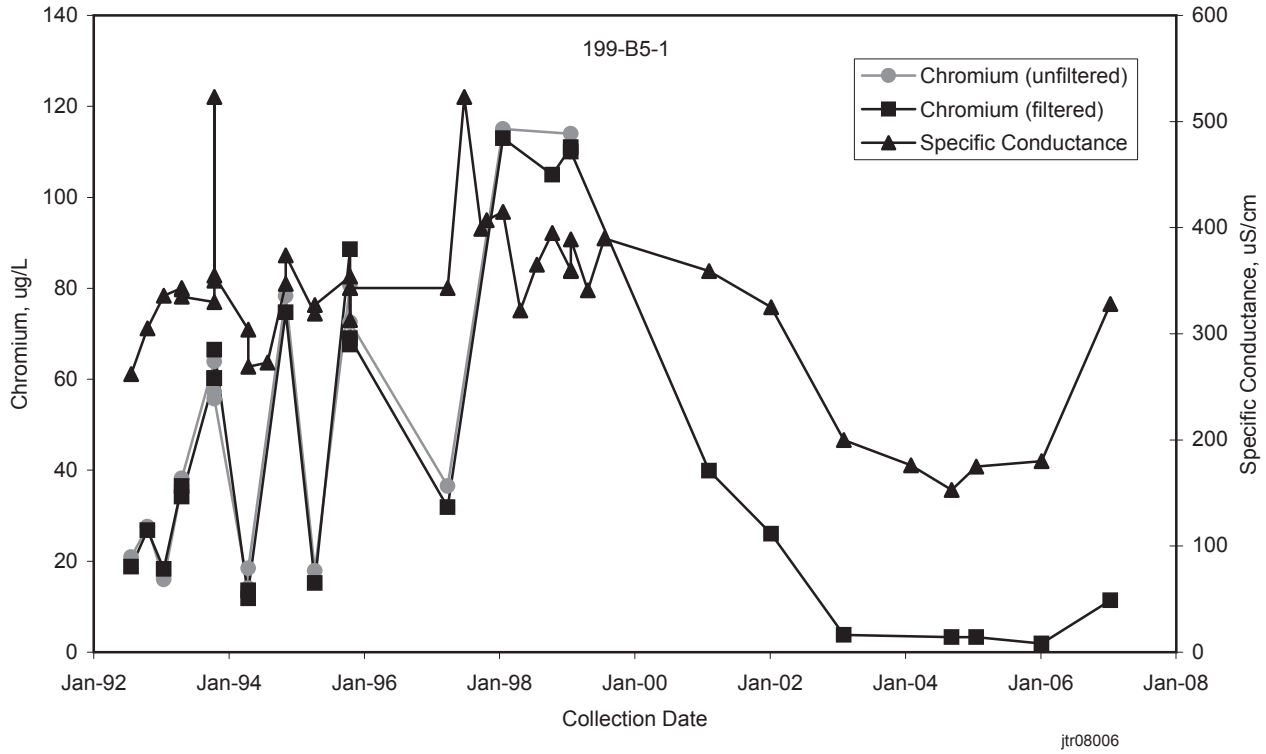

Figure 2.2-8. Chromium Concentrations and Specific Conductance in Well 199-B5-1, Northwest 100-B/C Area

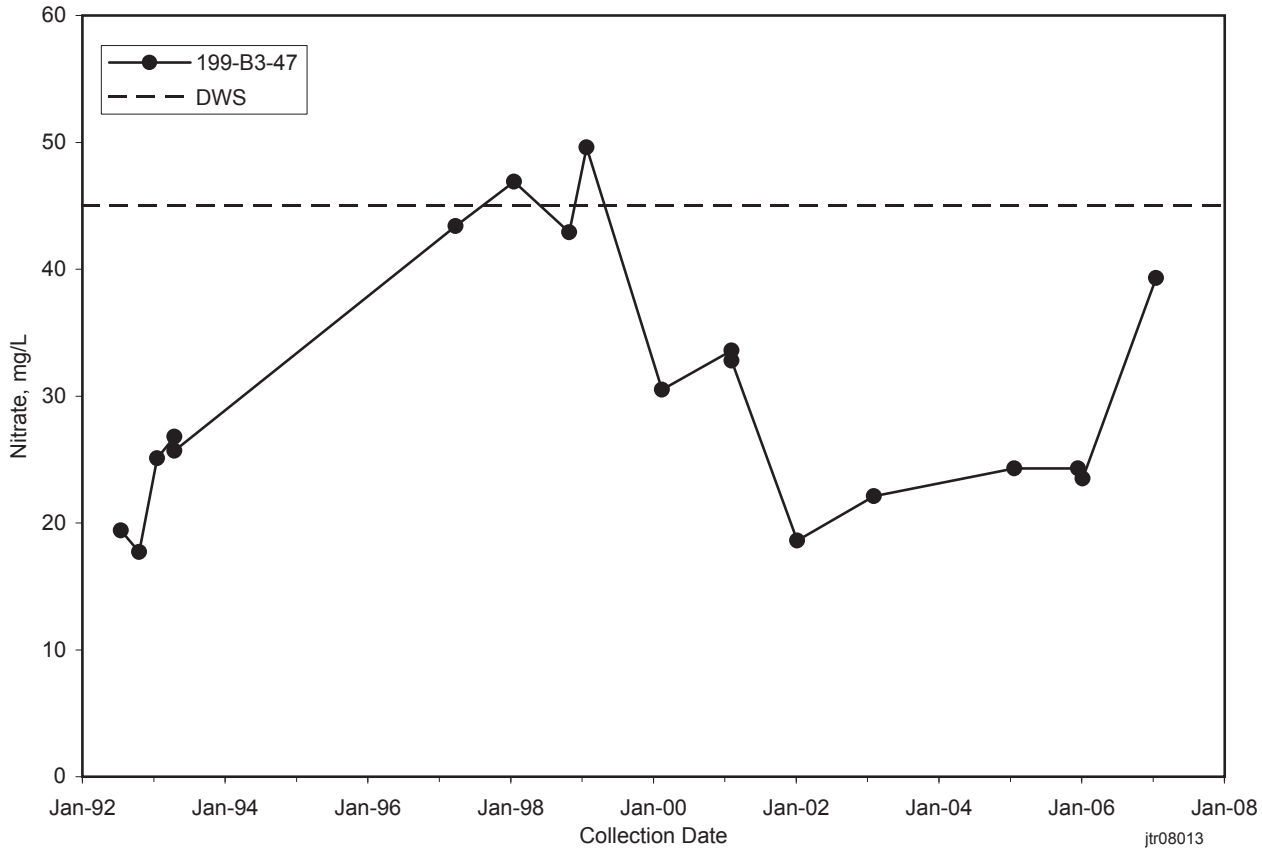

Figure 2.2-9. Nitrate Concentrations Downgradient of the 116-B-11 Retention Basin