2.8 1100-EM-1

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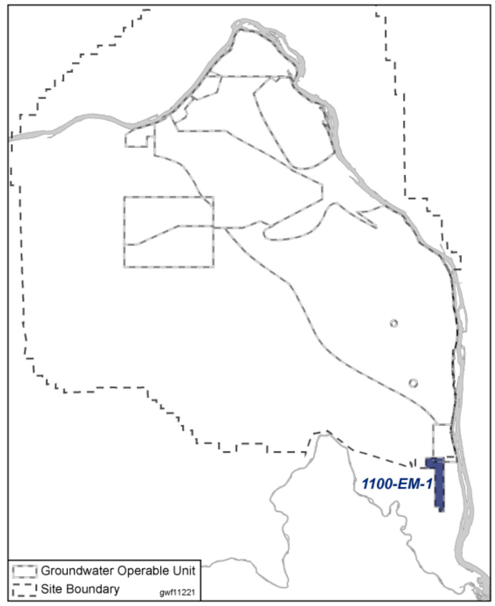
The 1100-EM-1 groundwater interest area includes the former 1100-EM-1 Operable Unit in the southern portion of the Hanford Site and the Richland North Area, south of the Hanford Site. Figure 2.8-1 shows the groundwater monitoring wells in the portion of the interest area near the former operable unit. Figure 2.1-4 in Section 2.1 shows the locations of wells in the western part of the interest area.



The former 1100-EM-1 Operable Unit includes the inactive Horn Rapids Landfill.[1] Originally a borrow pit for sand and gravel, the landfill was used from the late 1940s to the 1970s for disposal of office and construction waste, asbestos, sewage sludge, fly ash, and reportedly numerous drums of unidentified organic liquids (DOE/RL-90-18, *Phase I Remedial Investigation Report for the Hanford Site 1100-EM-1 Operable Unit*; DOE/RL-92-67, Draft B, *Final Remedial Investigation/Feasibility Study-Environmental Assessment Report for the 1100-EM-1 Operable Unit, Hanford*). The landfill extends over 0.2 square kilometer of generally flat terrain. Following cleanup of 1100-EM-1 and related source operable units, DOE transferred ownership of a portion of the property in 1100-EM-1 to the Port of Benton.

The Richland North Area includes the City of Richland North Well Field and Recharge Ponds. The City of Richland pumps water from the Columbia River into the recharge ponds. The river water percolates to the groundwater, and the groundwater is then pumped through surrounding wells for municipal use during peak demand periods (WHC-MR-0033, *Recharge to the North Richland Well Field*). The Richland North Area also includes the AREVA NP, Inc. nuclear fuel production facility, which is southwest (upgradient) of the inactive Horn Rapids Landfill (Figure 2.8-1).

Groundwater beneath the northern part of 1100-EM-1 is monitored under CERCLA to assess the performance of natural attenuation in breaking down volatile organic compounds (TPA-CN-163, *Change Notice for Modifying Approved Documents Work Plans in Accordance with TPA Action Plan, Section 9.0 Documentation and Records, PNNL-12220, "Sampling and Analysis Plan Update*

1100-EM-1 at a Glance

Operations included industrial and automotive activities (1954–1985), and a landfill (1950s–1970)			
2011 Groundwater Monitoring			
Contaminant	**Drinking Water Standard**	**Maximum Concentration**	**Plume Area[a] (km^2)**
Trichloroethene	5 µg/L	< 1 µg/L	0
Nitrate	45 mg/L	302[b]	Not calculated[b]
Uranium	30 µg/L	26.4[b]	Not calculated[b]
Remediation			
Waste Sites (final action): 100% complete[c]. Groundwater (final action): Monitored natural attenuation. Final record of decision: 1993.			

a. Estimated area above drinking water standard.
b. From offsite sources.
c. Waste sites with status of closed, interim closed, no action, not accepted, or rejected.

[1] DOE's former Horn Rapids Landfill was located on the Hanford Site. The similarly named Horn Rapids Sanitary Landfill (formerly the Richland Landfill) is a separate facility that remains active and is used to dispose the City of Richland's residential waste.

for Groundwater Monitoring – 100-EM-1 Operable Unit"). Groundwater samples from three wells are analyzed for trichloroethene and its degradation products, which include 1,1-dichloroethene and vinyl chloride. Additional wells and constituents are monitored in the larger interest area to detect Hanford Site contaminants and contaminants originating from offsite sources. This monitoring currently is not governed by a specific sampling and analysis plan.

Groundwater beneath 1100-EM-1 flows primarily west to east and discharges to the Columbia River (Figure 2.8-2). In the northeastern portion of the region, groundwater flows to the northeast. In the Richland North Area, groundwater flow from the west is diverted to the northeast and southeast around a recharge mound beneath Richland's recharge ponds. The unconfined aquifer is recharged by water from the Yakima River, by infiltration of agricultural irrigation in the area between the Yakima and Columbia Rivers, and by natural precipitation. Water for agricultural irrigation is mainly extracted from the Columbia River.

None of the wells in 1100-EM-1 penetrate the full thickness of the Hanford and Ringold formations; however, wells in the nearby 300 Area suggest that the sediments above the basalt are up to 53 meters thick. The thickness of the unconfined aquifer in this area is approximately 5.6 to 9 meters, with all but the upper few meters residing in the Ringold Formation unit E (Section 2.1 and Appendix E). A silt- and clay-dominated facies form a local, laterally extensive upper aquitard that is up to 10 meters thick. Most of the wells used to monitor trichloroethene have screen intervals that penetrate the upper 4.5 to 7.5 meters of the unconfined aquifer and cross the water table.

2.8.1 Trichloroethene

Historically, trichloroethene-contaminated groundwater was found upgradient and downgradient of the inactive Horn Rapids Landfill. A review of available information indicated that trichloroethene contamination moved into the Hanford Site's 1100 Area via groundwater. AREVA, a facility adjacent to the landfill, has investigated soil and groundwater contamination as an independent action in accordance with WAC 173-340, which is discussed in the *2006 Annual RCRA Report – Groundwater Quality Assessment Program* (E06-02-2006). The past use of organic solvents at the AREVA lagoon area was the only documented record of trichloroethene occurrence or use near the contaminant plume identified during 1100-EM-1 RI/FS (DOE/RL-92-67). Trichloroethene was used during the installation, repair, and cleaning of lagoon liners at various times from 1978 through 1988 (for bonding overlapping liner sections together). While the Horn Rapids Landfill was alleged to have received drummed waste solvents (DOE/RL-90-18), soil vapor surveys, geophysical investigations, and trenching activities during the RI/FS did not reveal evidence of a trichloroethene source at the landfill (DOE/RL-92-67).

Trichloroethene concentrations continued to be below detection limits in 2011.

During 2011, trichloroethene concentrations in 1100-EM-1 continued to be less than the detection limit of 1.0 µg/L. Potential breakdown products of trichloroethene also remained undetected at a detection limit of 1.0 µg/L during 2011.

The City of Richland monitors groundwater quarterly in the upper portion of the unconfined aquifer for chemical constituents at their Horn Rapids Sanitary Landfill (formerly the Richland Landfill), approximately 1 kilometer south of the Hanford Site boundary on Highway 240. Various chlorinated hydrocarbons (e.g., tetrachloroethene, trichloroethene, and vinyl chloride), while exceeding drinking water standards in several of the city's monitoring wells, show signs of natural attenuation (*Horn Rapids Landfill Environmental Monitoring Report Calendar Year 2011* [City of Richland, 2012]). During 2011, chlorinated hydrocarbons were below their respective minimum detection limits at Hanford Site well 699-S31-1, which is northeast of the city's sanitary landfill.

2.8.2 Tritium

Tritium concentrations are above background in 1100-EM-1 groundwater, but the maximum concentration in 2011 was only 2 percent of the drinking water standard.

The Hanford Site tritium plume that originates in the 200 Area extends southeast through the 600 Area and into the 300 Area at levels below the 20,000 pCi/L drinking water standard (Figure 2.8-3). The leading edge of the sitewide tritium plume is closely monitored because of its proximity to the City of Richland's North Well Field. A representative background level of tritium in Hanford Site groundwater is 142 pCi/L (95th percentile; DOE/RL-96-61). Although tritium levels were above background in several 1100-EM-1 wells in 2011, these levels are far below the drinking water standard. Well 699-S34-E10 had the maximum tritium concentration in 2011 (380 pCi/L) and has shown an increasing trend in recent years (Figure 2.8-4). This well is southeast of AREVA and northwest of the Richland North Well Field, and no known sources of tritium contamination lie upgradient of the well. Tritium concentrations are lower between this well and the 200 East Area plume edge in the 300 Area. Consequently, the tritium is not believed to be caused by Hanford Site sources. The following factors limit migration of the tritium plume into the eastern portion of 1100-EM-1:

- Groundwater generally flows from west to east between the Yakima River, a recharge source, and the Columbia River.
- Artificial recharge from agricultural irrigation in the western and central portions of 1100-EM-1 south of the Hanford Site further contributes to the eastward and northeastward flow.
- Groundwater flow is directed radially outward from the elevated groundwater levels beneath Richland's recharge ponds.

These factors produce converging groundwater flow lines in the 300 Area where groundwater discharges to the Columbia River (Figure 2.8-2). Section 2.7 discusses tritium in groundwater in the 300 Area.

2.8.3 Nitrate

Nitrate concentrations are above the drinking water standard of 45 mg/L throughout much of 1100-EM-1 (Figure 2.8-5). The leading edge of the plume at the 45 mg/L contour in the 300 Area did not advance significantly in 2011. Nitrate contamination in this area has likely resulted from industrial and agricultural uses off the Hanford Site and migrated to the northeast. Agricultural uses include fertilizer applications to the irrigated fields west of 1100-EM-1. Some of the highest nitrate levels occur near the offsite AREVA facility and the inactive Horn Rapids Landfill. Nitrate data for the AREVA wells are reported in E06-09-004, *2011 Annual Groundwater Report*. The highest concentration in an AREVA well in 2011 was 234 mg/L, a decrease from 307 mg/L in 2010. The highest concentrations in Hanford Site wells in 2011 were approximately 300 mg/L in wells 699-S31-E10A and -E10C, slightly lower than in 2010 (Figure 2.8-6).

Elevated nitrate concentrations continue to be measured but are related to offsite industrial and agricultural activities.

Nitrate concentrations in aquifer tube AT-3-8-S in the southern 300 Area exceeded the drinking water standard in 2011 (79.2 mg/L in March; 45.2 mg/L in December).

2.8.4 Gross Alpha and Uranium

Elevated levels of gross alpha and uranium occur downgradient of the AREVA facility, near the former Horn Rapids Landfill. Gross alpha data for the AREVA wells are reported in Table 3 of E06-09-004. During 2011, several wells downgradient of the AREVA facility showed gross alpha levels higher than the 15 pCi/L drinking water standard, with the maximum observed concentrations of 98.1 and 82 pCi/L in duplicate samples from well SPC-GM-8 collected in June 2011. Gross alpha is largely attributed to uranium from fuels manufacturing activities at the facility. The uranium concentrations in well SPC-GM-8 in June were 40.5 and 61.4 µg/L, lower than peak levels seen in 2009 (Figure 2.8-7).

A small uranium plume in 1100-EM-1 originated at an offsite facility.

Uranium contamination from AREVA has been detected in 1100-EM-1 wells. Uranium concentrations in wells 699-S31-E10A and –E10C, adjacent to the former Horn Rapids Landfill, and 699-S28-E12, farther downgradient, have increased since the early 1990s (Figure 2.8-7). There was no increase between 2010 and 2011 in the two wells closest to the landfill, but there was an increase in the downgradient well showing continued movement of the contaminant at levels below the drinking water standard (30 µg/L).

2.8.5 CERCLA Groundwater Activities

The 1100-EM-1 Groundwater Operable Unit, including the inactive Horn Rapids Landfill, was placed on the National Priorities List (40 CFR 300, Appendix B) in 1989 and was delisted from the National Priorities List (40 CFR 300, Appendix B) in 1996. The results of the CERCLA investigation are presented in the final RI study (DOE/RL-92-67). EPA/ROD/R10-93/063 established natural attenuation as the remedial action alternative for the trichloroethene plume. Site characterization was conducted to evaluate natural attenuation as a remedial action alternative at the Horn Rapids Landfill during the RI/FS in the late 1980s and early 1990s (DOE/RL-90-18; DOE/RL-92-67). The degradation of trichloroethene by microbial action may result in the formation of organic compounds such as 1,1-dichloroethene and vinyl chloride. These degradation products also pose a risk to human health and the environment and are, therefore, monitored in groundwater at the operable unit. Since implementation of the selected remedy, concentrations of trichloroethene have declined dramatically and have been below the detection limit from 2008 to 2011. To date, degradation products have not been detected.

DOE/RL-2006-20, published in November 2006, stated that the plume mass and concentration have been adequately reduced to be protective of human health and the environment. The review also stated that groundwater monitoring is no longer necessary, but continues, indicating that trichloroethene levels are below the drinking water standard.

In June 2007, TPA-CN-163 was approved which reduced the groundwater monitoring requirements to annual monitoring and analysis of trichloroethene at three of the original network wells (699-S28-E12, 699-S31-E10A, and 699-S31-E10C). All three of the wells were sampled as scheduled in 2011 (Appendix A).

Figure 2.8-1. Facilities and Groundwater Monitoring Wells in 1100-EM-1

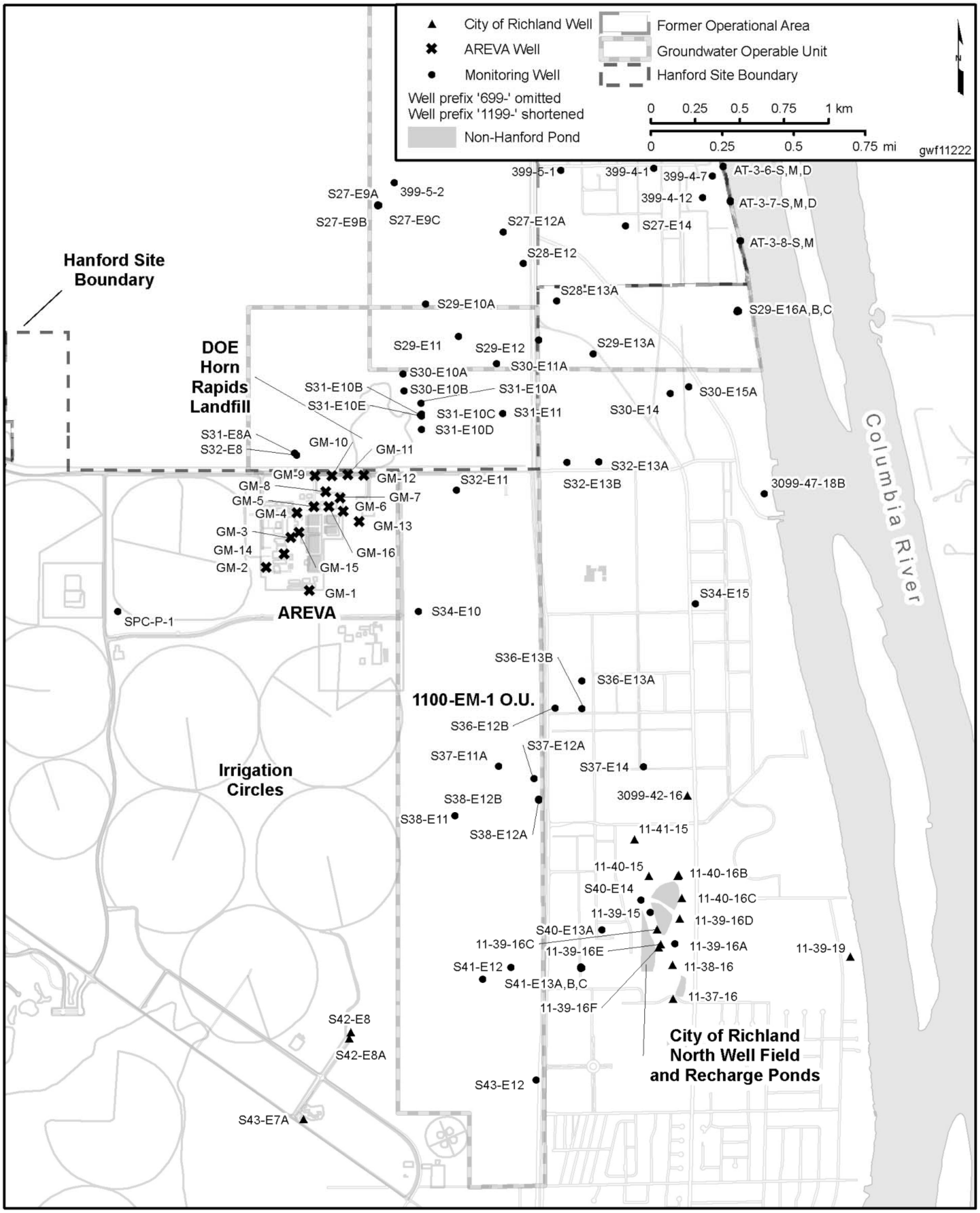


Figure 2.8-2. 1100-EM-1 Water Table, March 2011

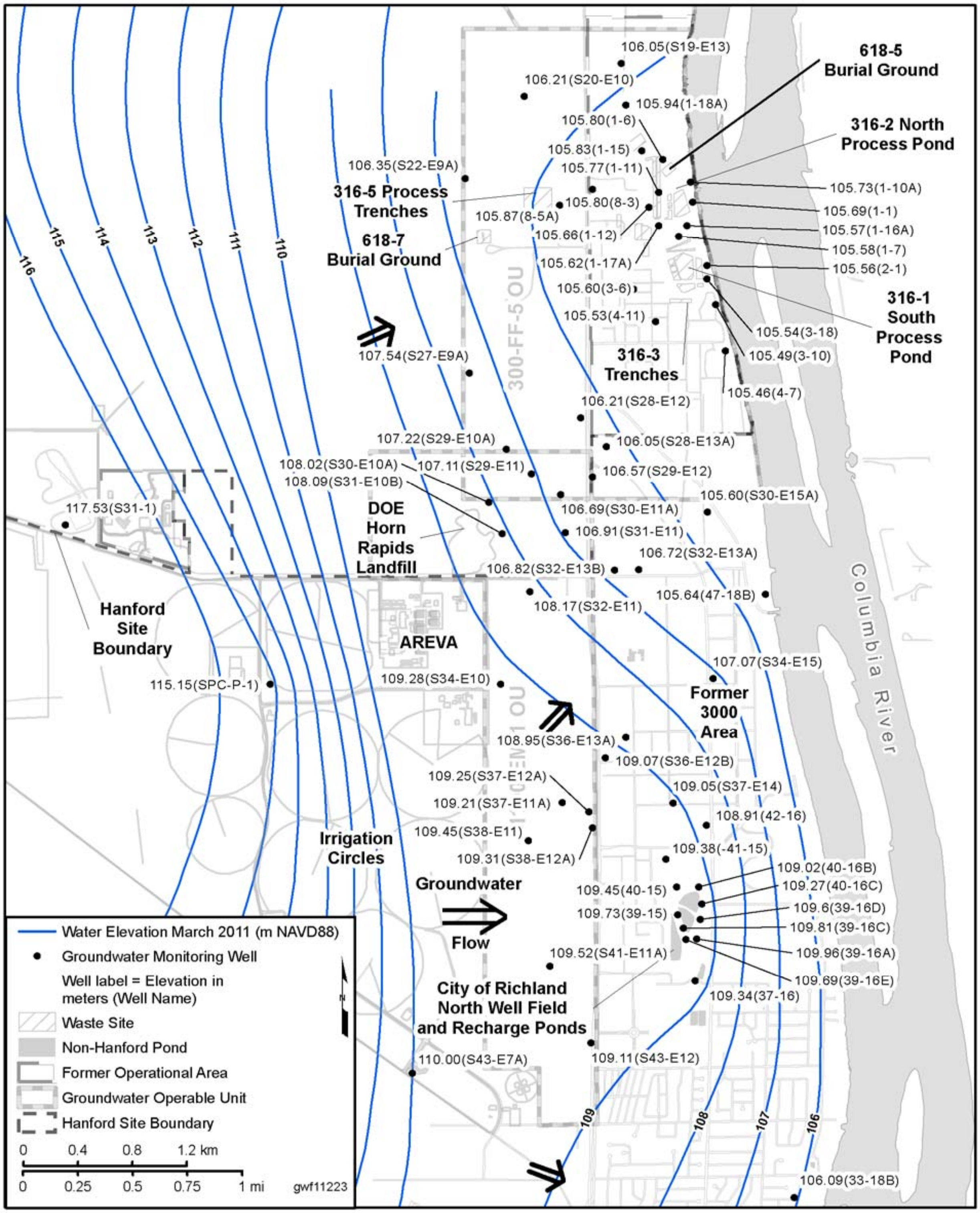


Figure 2.8-3. Average Tritium Concentrations in 1100-EM-1, Upper Part of Unconfined Aquifer, 2011

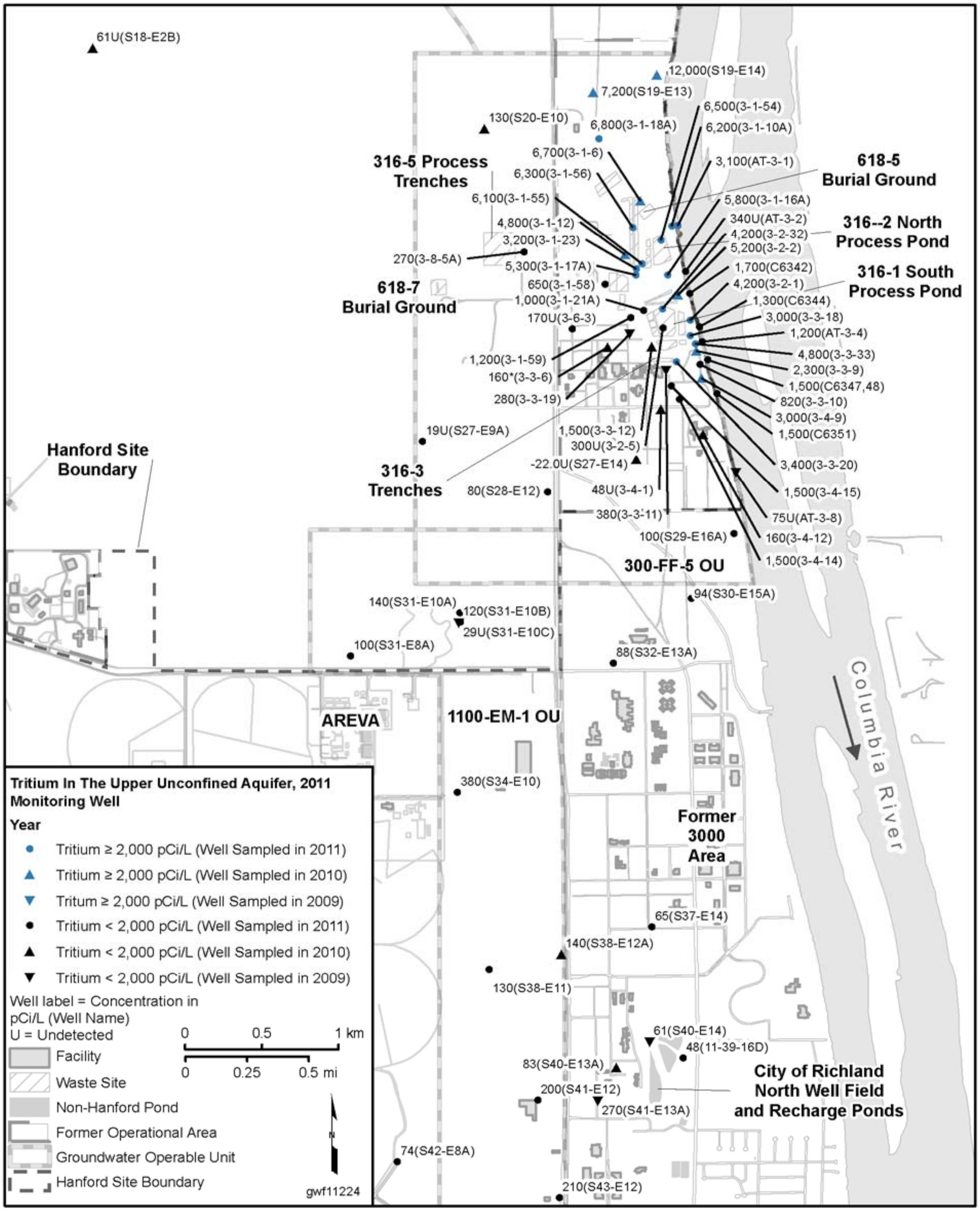


Figure 2.8-4. Tritium Trends in Well 699-S34-E10

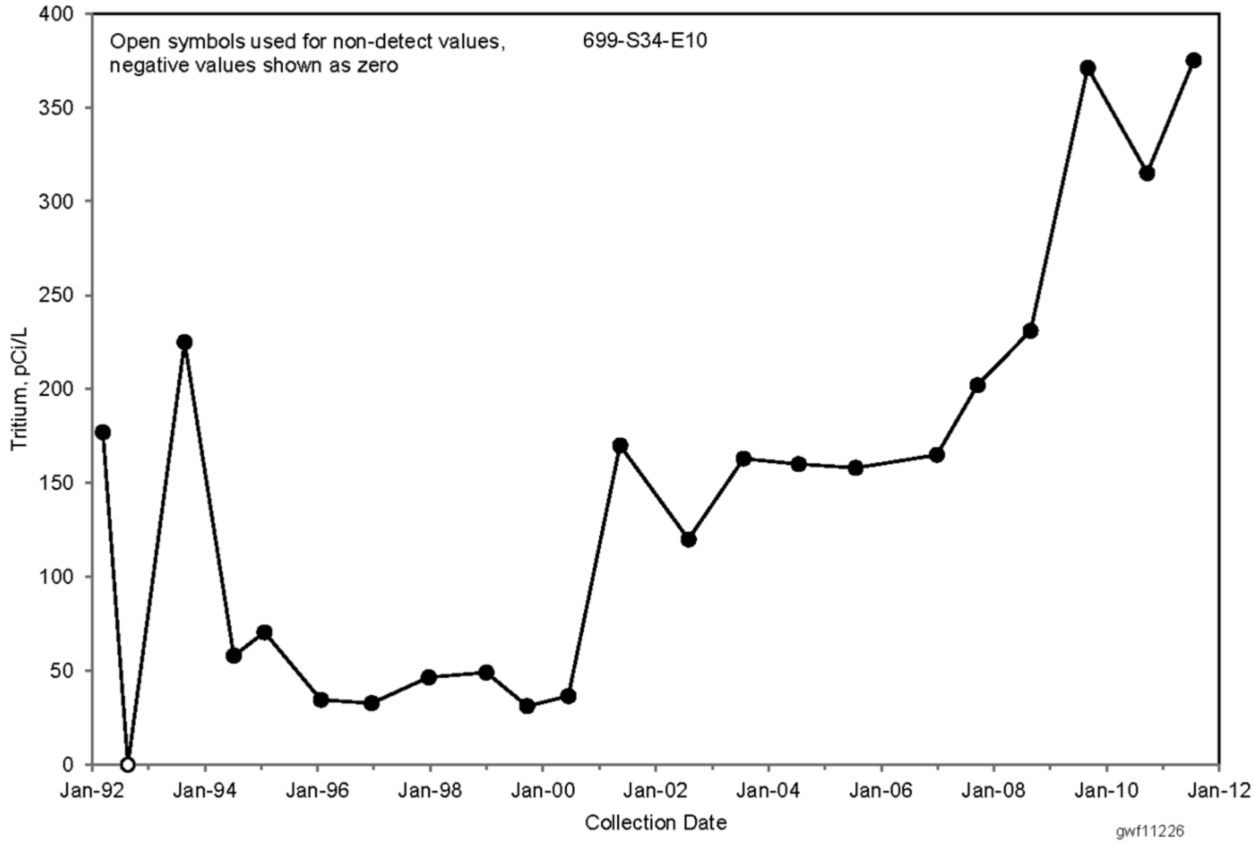


Figure 2.8-5. Average Nitrate Concentrations in 1100-EM-1, Upper Part of Unconfined Aquifer, 2011

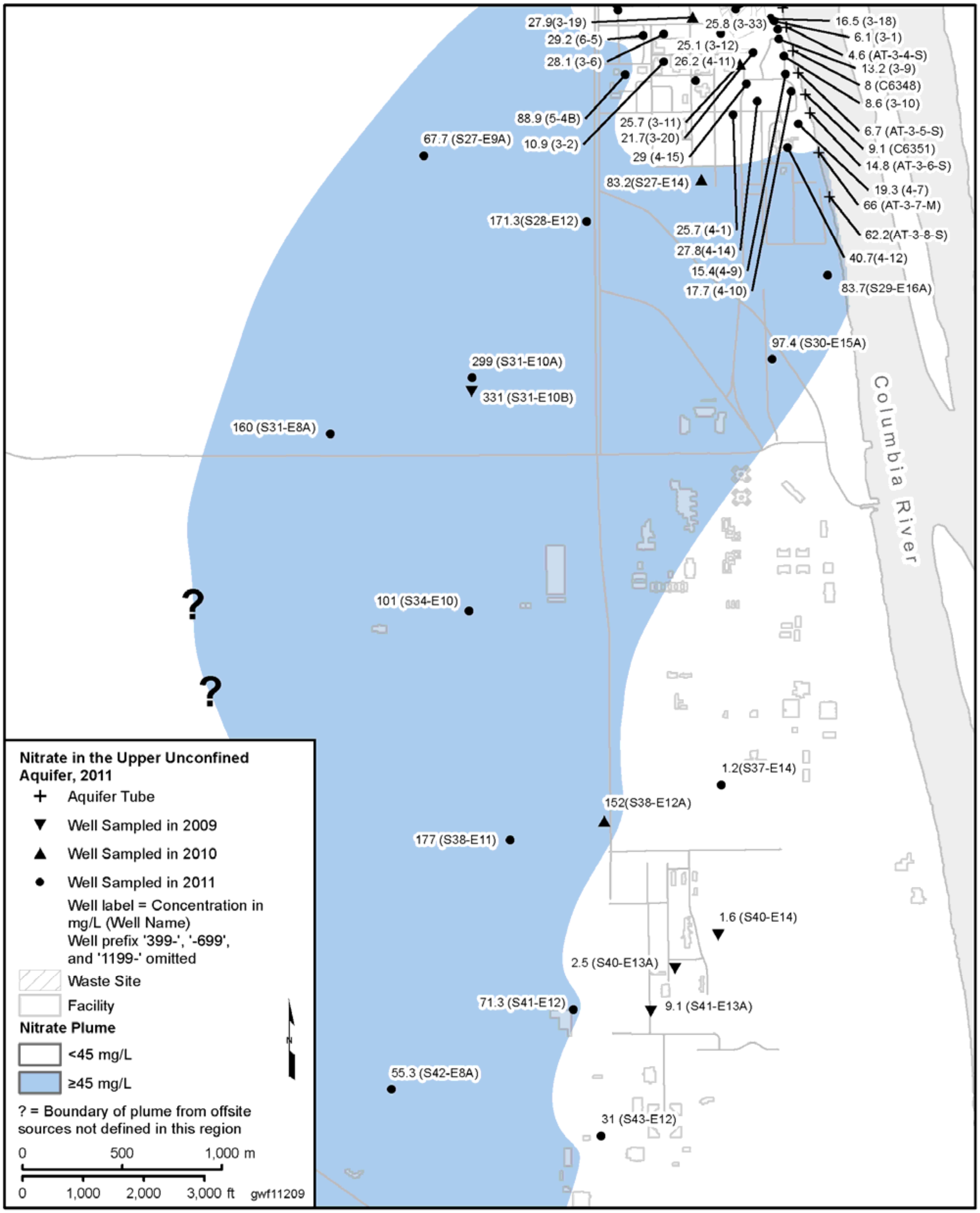


Figure 2.8-6. Nitrate Trends in 1100-EM-1 Monitoring Wells

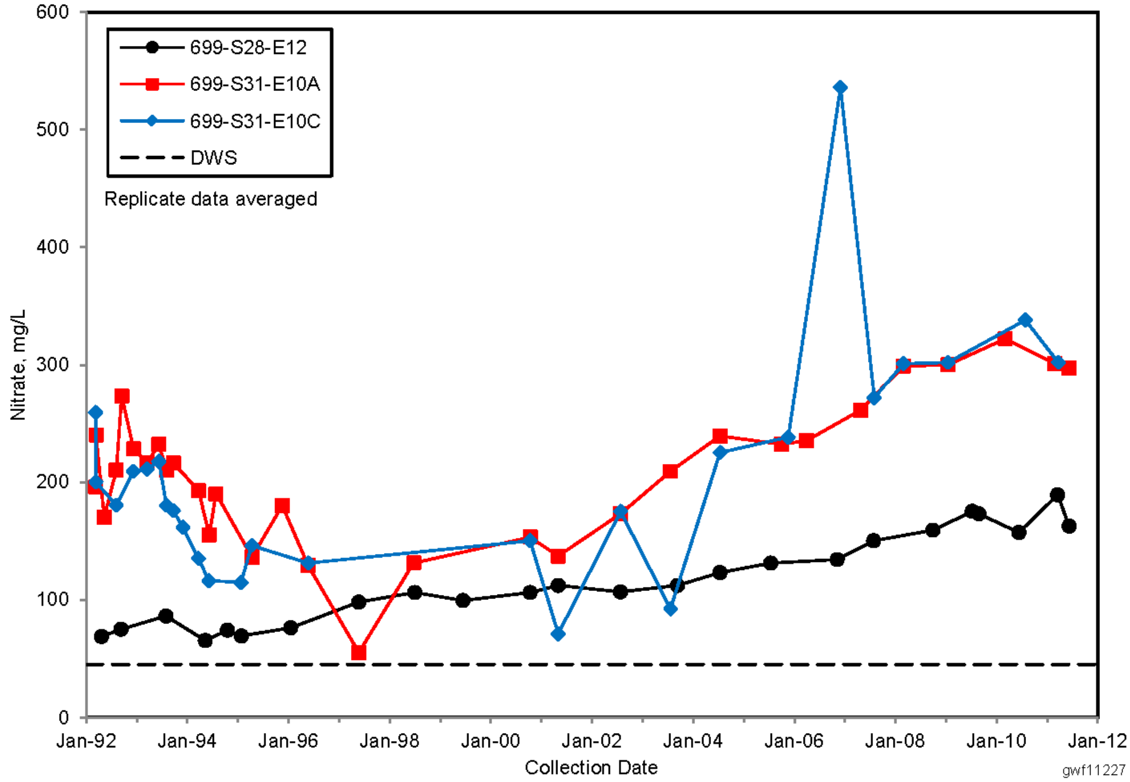


Figure 2.8-7. Uranium Trends in 1100-EM-1 Monitoring Wells