

1100-EM

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1100-EM Overview

The 1100-EM groundwater interest area includes the former 1100-EM-1 operable unit (OU) and the Richland North Area (Figure EM.1). The former 1100-EM-1 OU includes the inactive Horn Rapids Landfill¹. 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](#)). Following cleanup of 1100-EM-1 and related source OUs, the U.S. Department of Energy (DOE) transferred ownership of a portion of the property 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 which is then pumped through surrounding wells for municipal use during peak demand periods ([WHC-MR-0033](#)). The Richland North Area also includes the AREVA NP, Inc. nuclear fuel production facility, which is southwest (upgradient) of the inactive Horn Rapids Landfill.

Although the 1100-EM-1 OU was removed from the National Priorities List (NPL) ([40 CFR 300, Appendix B](#)) in 1996, groundwater monitoring for the OU continues under CERCLA to assess the performance of natural attenuation in breaking down volatile organic compounds (VOCs) ([TPA-CN-163](#); [PNNL-12220](#)). Groundwater samples from three wells are analyzed for TCE 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 including nitrate, tritium, and uranium. This monitoring was not described by a specific sampling and analysis plan until publication of DOE/RL-2012-59, *Surveillance Groundwater Monitoring On the Hanford Site*, in 2013. The monitoring wells in 1100-EM were scheduled for sampling in December 2013. That sampling was delayed until January 2014 because of resource limitations, and the results of that sampling event are included in the discussions of this section of the 2013 annual report. Some key facts about 1100-EM are provided in Table EM.1.

Groundwater beneath 1100-EM and Richland North flows primarily west to east and discharges to the Columbia River (Figure EM.2). 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, and by natural precipitation.

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 (Figure EM.3). A silt- and clay-dominated facies forms a local, laterally extensive upper aquitard up to 10 meters thick.

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 it used to dispose the City of Richland's residential waste.

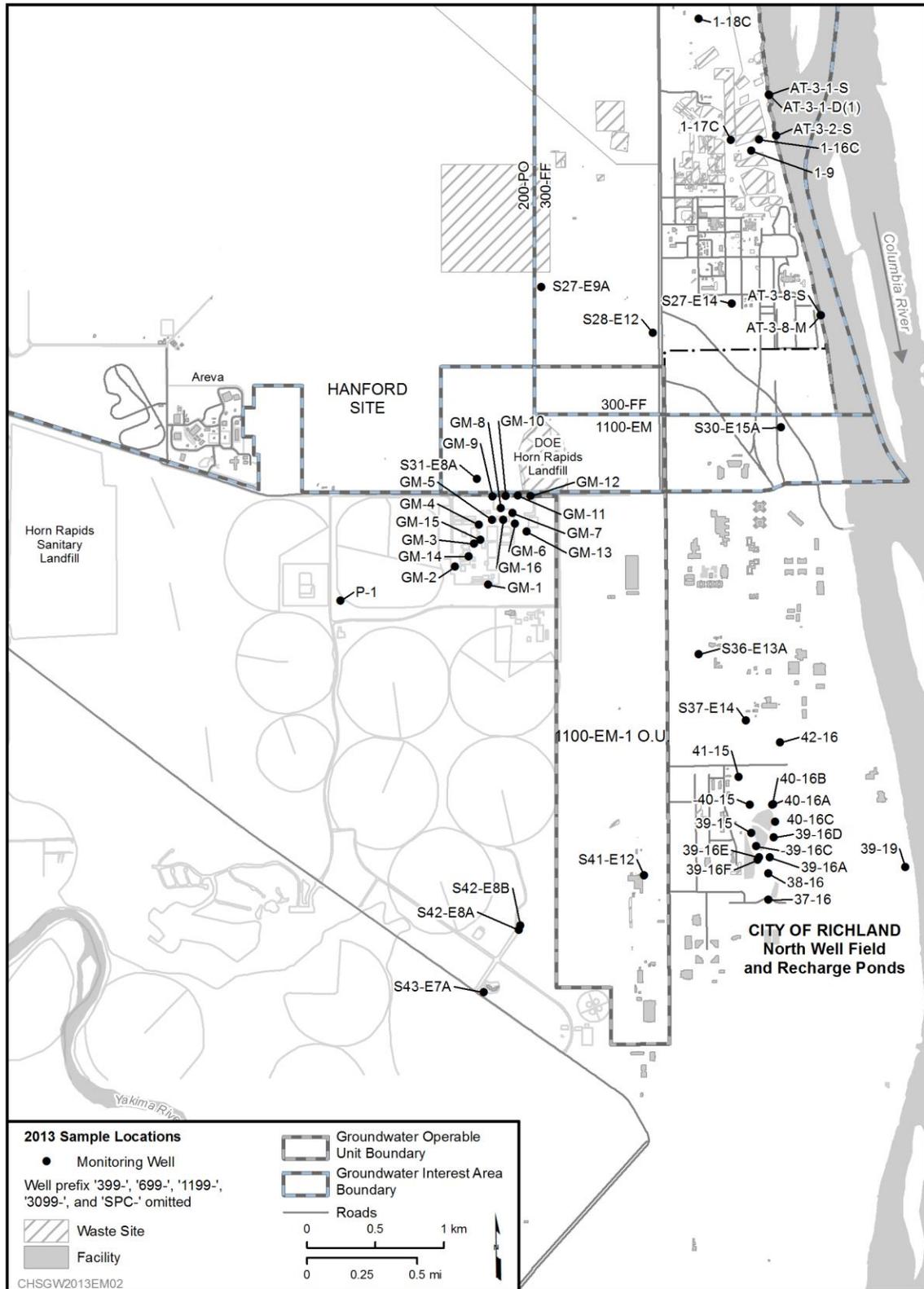


Figure EM.1 1100-EM 2013 Sampling Locations

Table EM.1 1100-EM at a Glance

Operations included industrial and automotive activities (1954–1985), and a landfill (1950s–1970)			
2013^a Groundwater Monitoring			
Contaminant	Drinking Water Standard	Maximum Concentration	Plume Area^b (km²)
Trichloroethene	5 µg/L	0.71 µg/L (699-S31-E10A)	0
Nitrate	45 mg/L ^c	205 mg/L (699-S31-E10C)	Not calculated ^c
Uranium	30 µg/L	27.0 µg/L (699-S31-E10C)	Not calculated ^c
Remediation			
Waste Sites (final action): 100% complete ^d . Groundwater (final action): Monitored natural attenuation. Final record of decision: 1993.			

- a. December 2013 scheduled samples were collected January 2014
b. Estimated area at a concentration greater than the water quality standard.
c. 45 mg/L as NO₃ is equivalent to the drinking water standard of 10 mg/L as N. Nitrate in 1100-EM is from offsite sources.
d. Sites with status of closed, interim closed, no action, not accepted, or rejected.

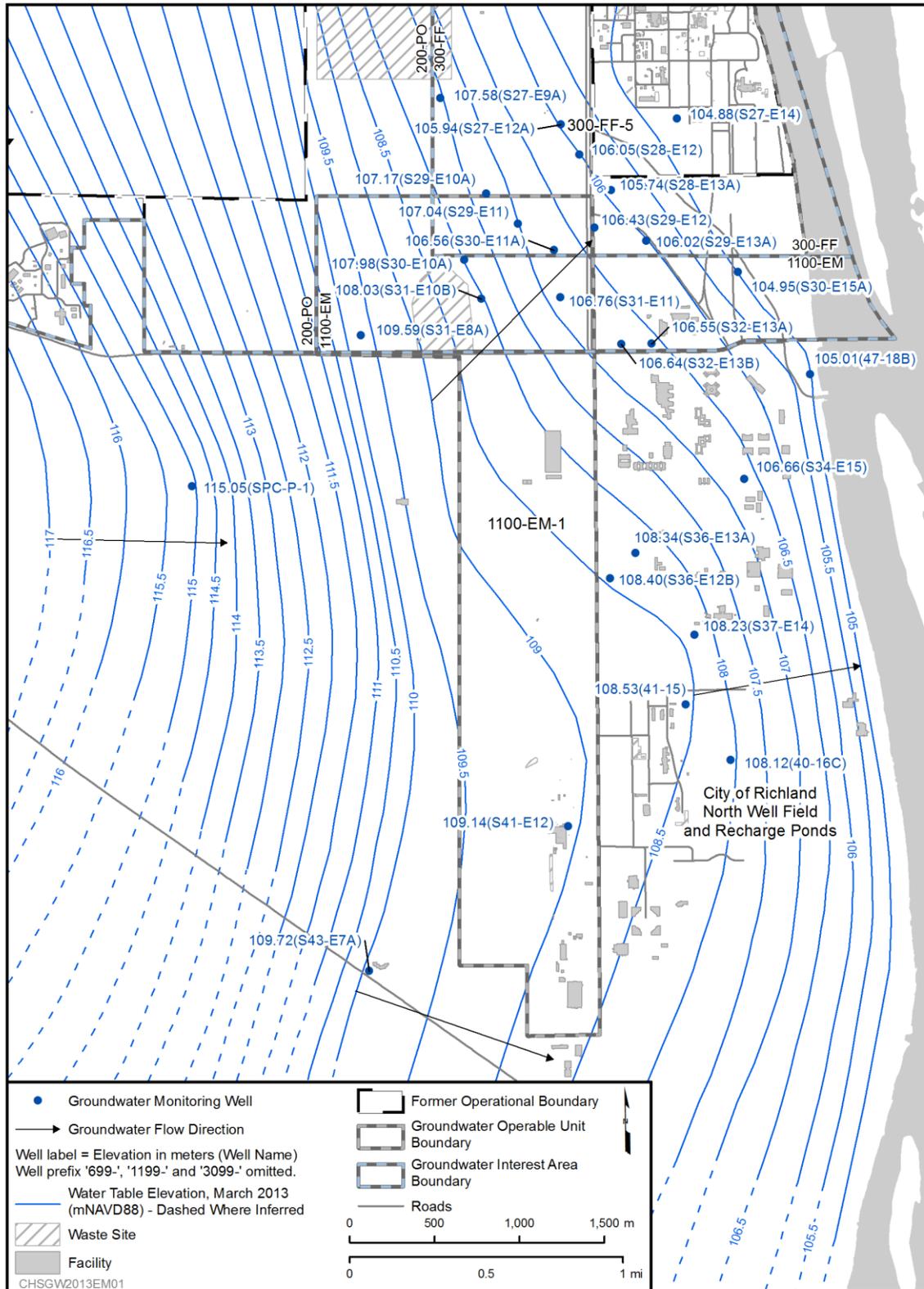


Figure EM.2 1100-EM Overview Map with Water Table

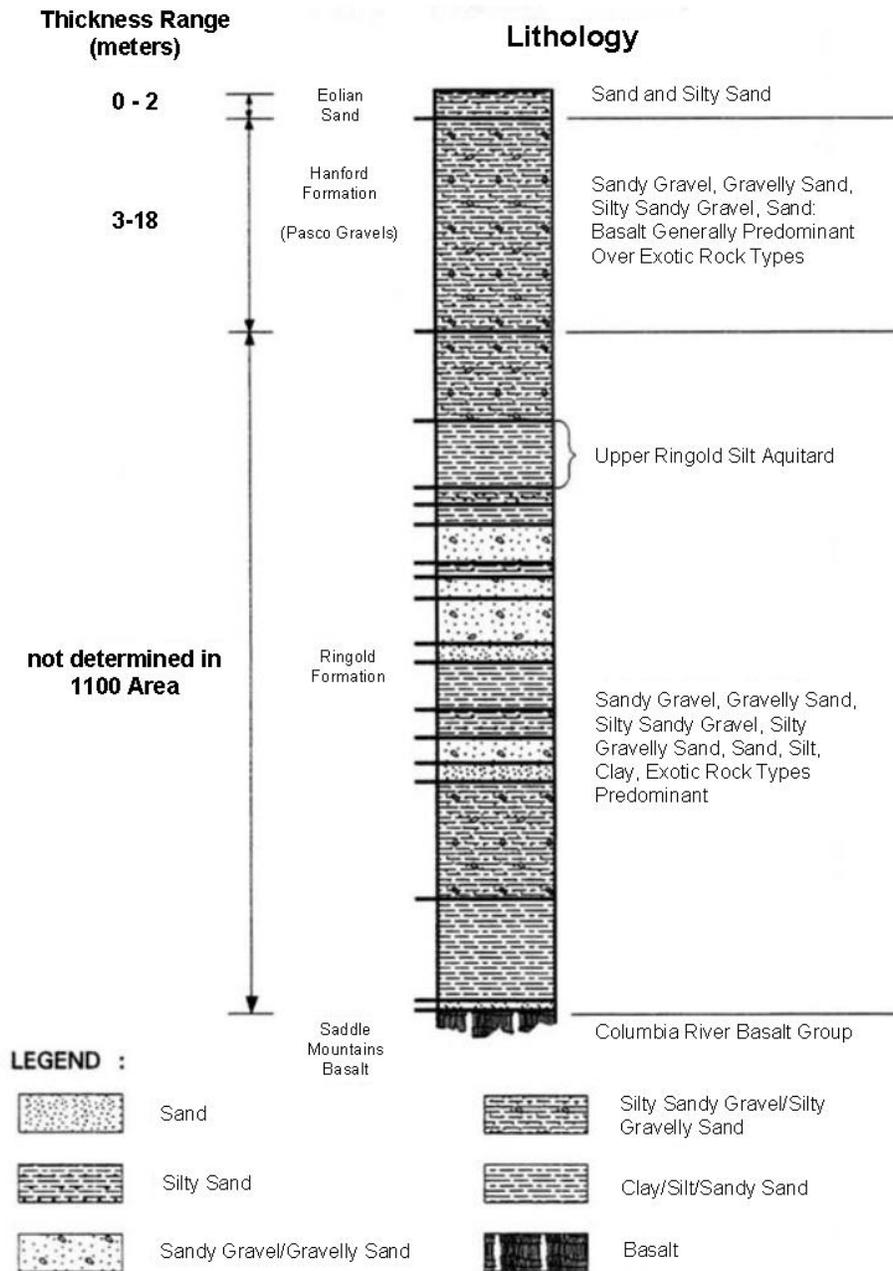


Figure EM.3 1100-EM Lithology

1100-EM CERCLA Activities

The 1100-EM-1 OU, including the inactive Horn Rapids Landfill, was placed on the [NPL](#) in 1989 and was withdrawn from the list in 1996. The results of the CERCLA investigation were presented in the final remedial investigation (RI)/feasibility study (FS) ([DOE/RL-92-67](#)). *Record of Decision for the USDOE Hanford 1100 Area Final Remedial Action* ([EPA/ROD/R10-93/063](#)) established natural attenuation as the remedial action alternative for the TCE plume. The second CERCLA five-year review ([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 and that groundwater monitoring was no longer necessary. The third five-year review ([DOE/RL-2011-56](#)) states that the remedy remains protective of human health and the environment. In June 2007, [TPA-CN-163](#) was approved, which reduced the groundwater monitoring requirements to annual monitoring and analysis of TCE at three of the original network wells (699-S28-E12, 699-S31-E10A, and 699-S31-E10C; Figure EM.1).

The three wells in the 1100-EM-1 OU monitoring network (Table A.13 of Appendix A) were scheduled to be sampled in December 2013 but sampling was delayed until early January 2014. The data from that sampling event are included in the discussions of this section.

1100-EM Trichloroethene (TCE)

Historically, TCE contaminated groundwater was found upgradient and downgradient of the inactive Horn Rapids Landfill. A review of available information indicated that TCE 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](#), "Model Toxics Control Act—Cleanup." The investigation is discussed in E06-02-2006. The past use of organic solvents at the AREVA lagoon area was the only documented record of TCE occurrence or use near the contaminant plume identified during the 1100-EM-1 RI/FS ([DOE/RL-92-67](#)).

TCE was used to bond overlapping liner sections together during the installation, repair, and cleaning of lagoon liners at various times from 1978 through 1988. While the Horn Rapids Landfill is thought to have received drummed waste solvents ([DOE/RL-90-18](#)), soil vapor surveys, geophysical investigations, and trenching activities during the RI/FS, the landfill did not reveal evidence of a TCE source ([DOE/RL-92-67](#)).

During January 2014, TCE concentrations in the three 1100-EM-1 CERCLA network wells continued to be less than or near the usual detection limit of 1.0 µg/L and have declined since the 1990s (Figure EM.4). The maximum concentration was 0.71 µg/L in 699-S31-E10A. Potential breakdown products of TCE (1,1-dichloroethene and vinyl chloride) remained below the detection limit of 1.0 µg/L.

The City of Richland monitors groundwater quarterly for chemical constituents in the upper portion of the unconfined aquifer at the 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, TCE, and vinyl chloride), while exceeding drinking water standards (DWS) in several of the city's monitoring wells, show signs of natural attenuation (City of Richland, 2012, Horn Rapids Landfill Environmental Monitoring Report Calendar Year 2011).

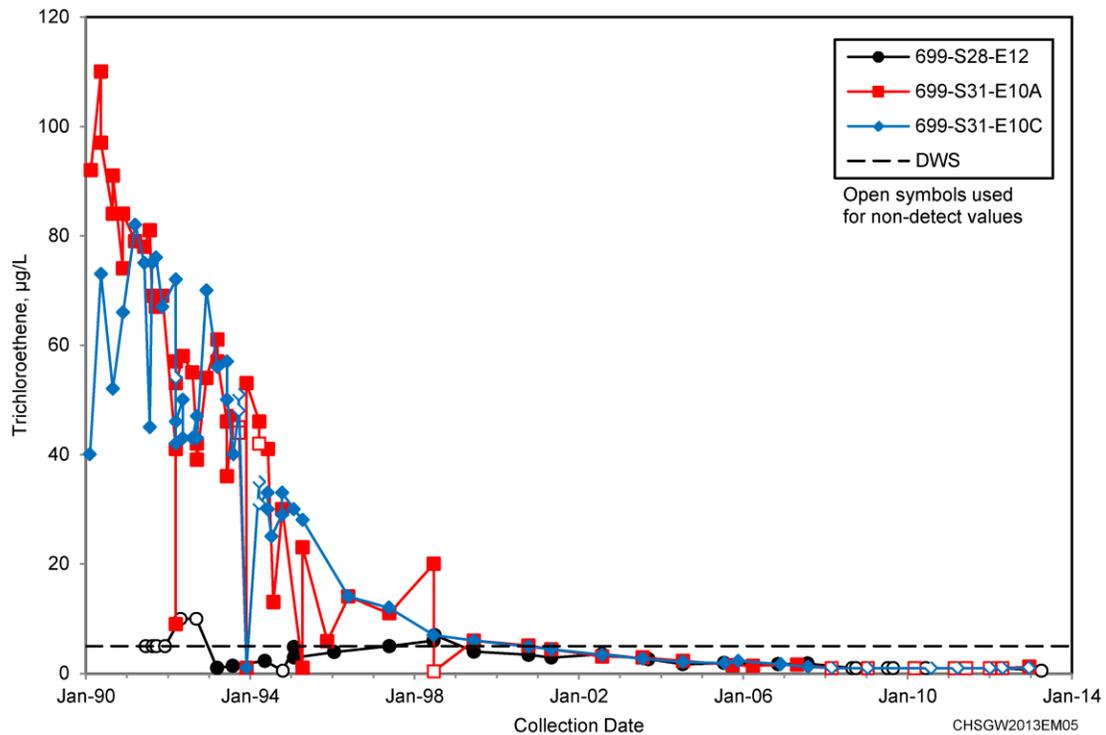


Figure EM.4 Trichloroethene Data in 1100-EM-1 Compliance Wells

1100-EM Tritium

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 DWS. The leading edge of the site-wide tritium plume is monitored annually because of its proximity to the City of Richland's North Well Field (Figure EM.5). A representative background level of tritium in Hanford Site groundwater is 142 pCi/L (95th percentile [DOE/RL-96-61]). The maximum tritium concentration in 2013 (January 2014) was 129 pCi/L in 699-S41-E12.

Elevated tritium concentration in groundwater is found to the north of 1100-EM in the 300-FF groundwater interest area. Because groundwater flow in the 1100-EM and 300-FF groundwater interest areas is generally west to east, the tritium plume found to the north of 300 Area does not migrate southward toward 1100-EM.

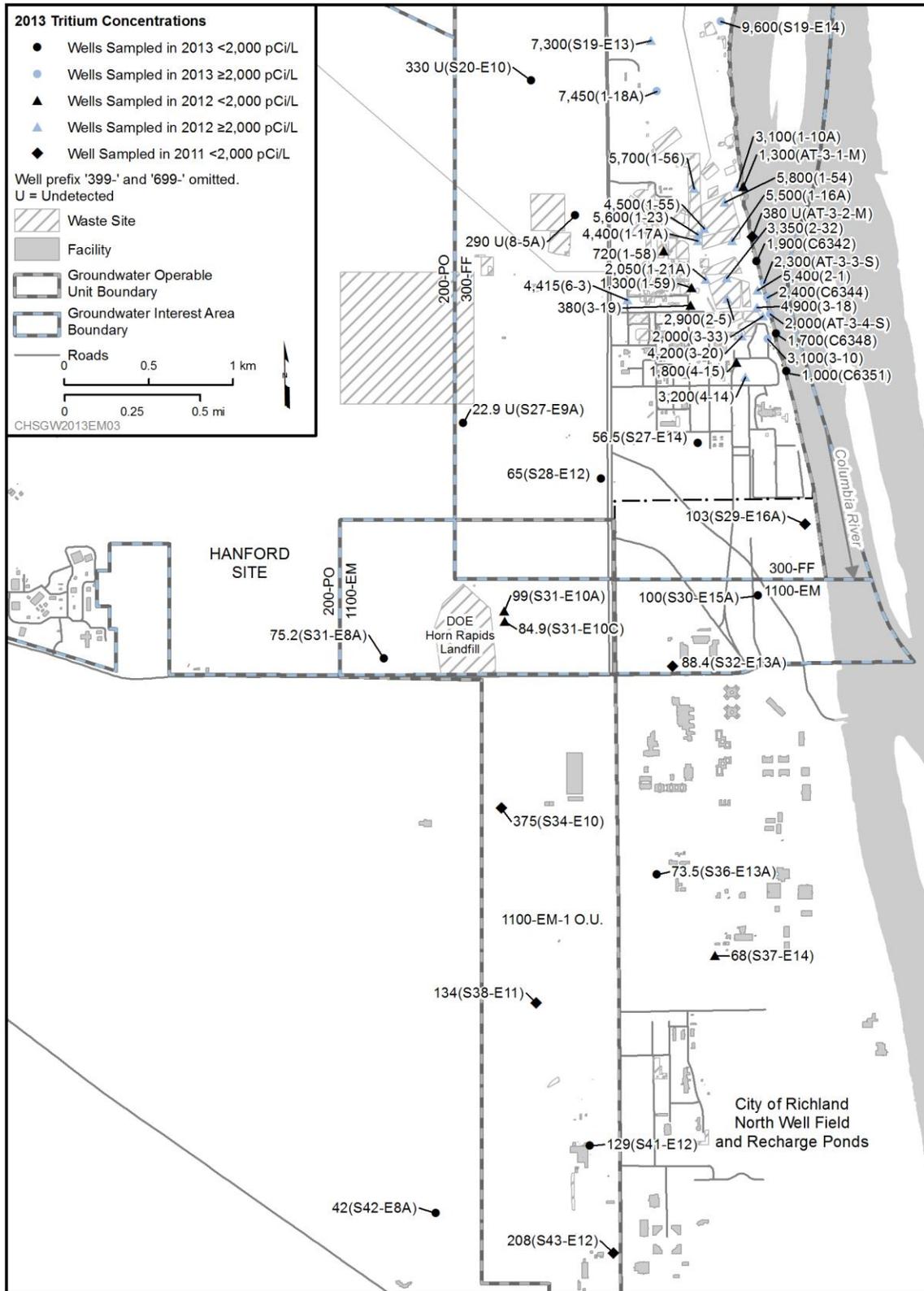


Figure EM.5 2013 Tritium Concentrations in 1100-EM, Richland North, and the 300 Area

1100-EM Nitrate

Nitrate concentrations are above 45 mg/L throughout much of 1100-EM and Richland North (Figure EM.6). Nitrate contamination in this area has likely resulted from industrial and agricultural uses off the Hanford Site and migrated to the northeast into the 300 Area. Agricultural uses include fertilizer applications to the irrigated fields west of 1100-EM. The highest concentrations in 1100-EM wells on the Hanford Site in 2013 (January 2014) were 204 and 205 mg/L in 699-S31-E10A and 699-S31-E10C, respectively. Concentrations have been declining since 2010 (Figure EM.7). The wells are located downgradient of AREVA and the inactive Horn Rapids Landfill.

Nitrate concentrations measured in aquifer tubes AT-3-7-M and AT-3-8-S in the southern 300 Area are variable, ranging from <10 mg/L to 88 mg/L (Figure EM.8).

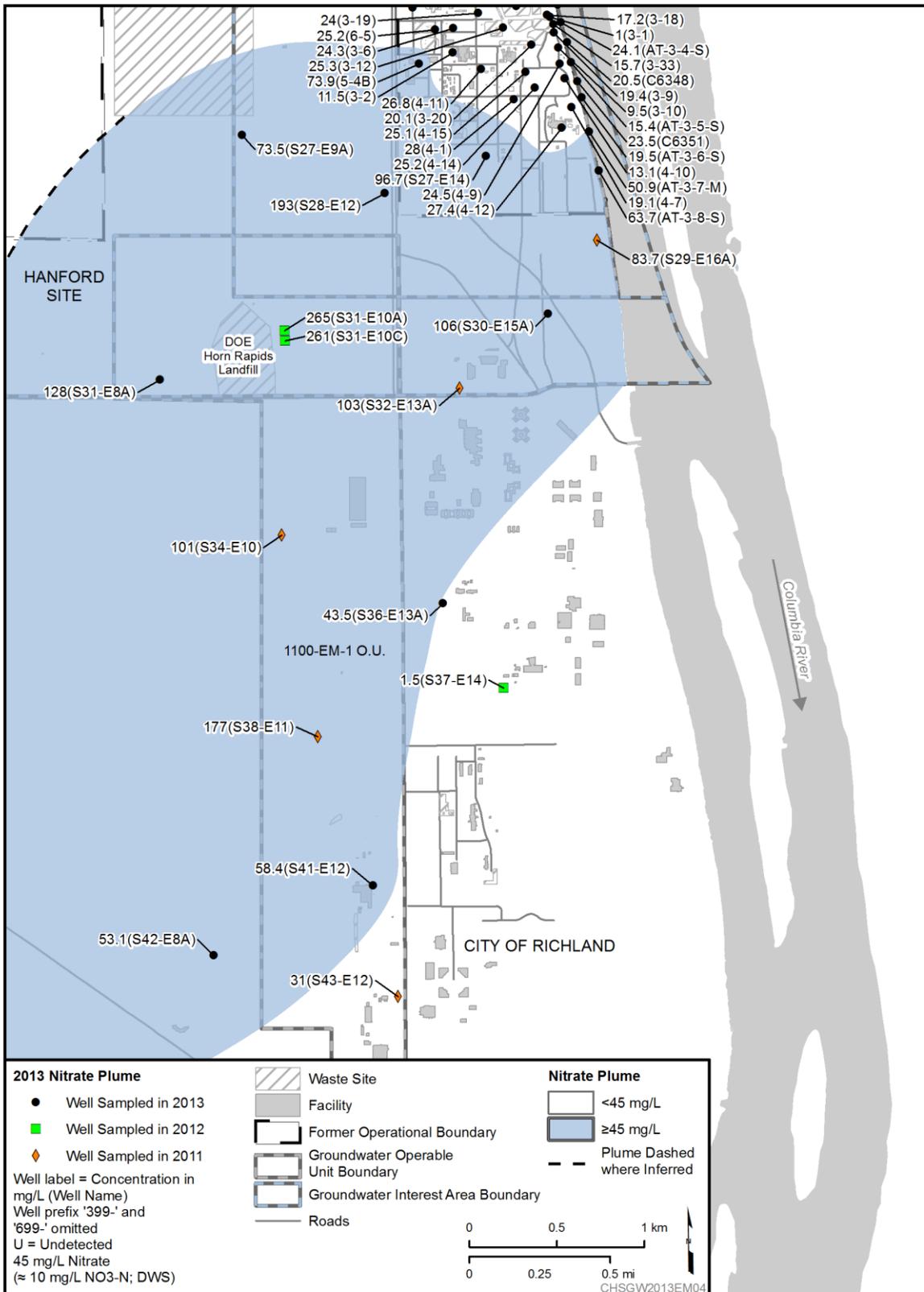


Figure EM.6 2013 Nitrate Plume in 1100-EM, Richland North, and the 300 Area

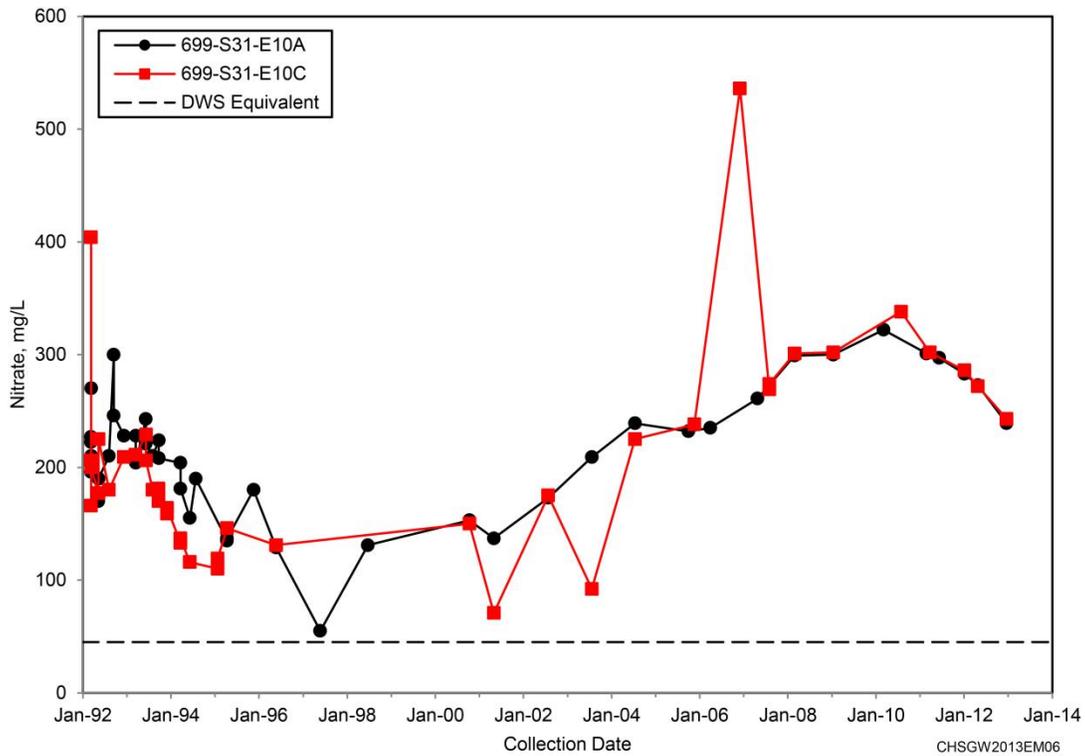


Figure EM.7 1100-EM Nitrate Data for Wells 699-S31-E10A and 699-S31-E10C

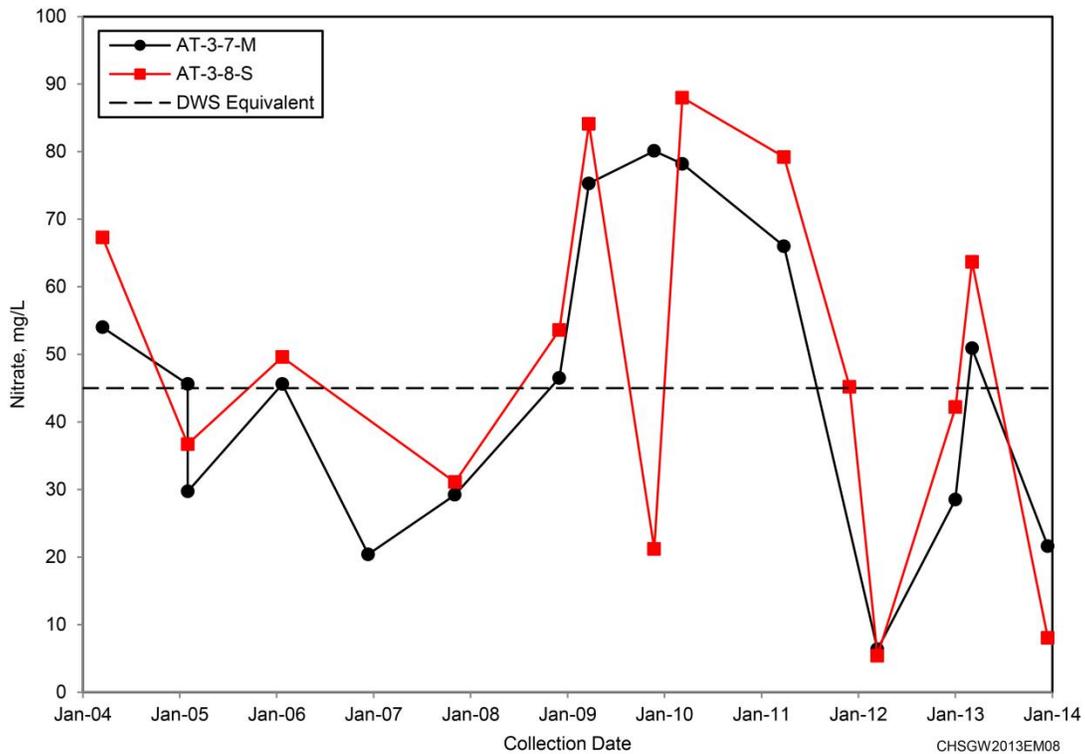


Figure EM.8 1100-EM Nitrate Data for Aquifer Tubes AT-3-7-M and AT-3-8-S

1100-EM Uranium

Elevated concentrations of uranium occur downgradient of the AREVA facility. The maximum uranium concentration in an AREVA well in 2013 was 36.5 $\mu\text{g/L}$ (E06-09-006, 2013 Annual Groundwater Report Areva, Richland, Washington).

Uranium concentrations in Hanford Site wells downgradient from AREVA exceeded the 30 $\mu\text{g/L}$ DWS for the first time in 2012 but were slightly below the standard in January 2014 (Figure EM.9).

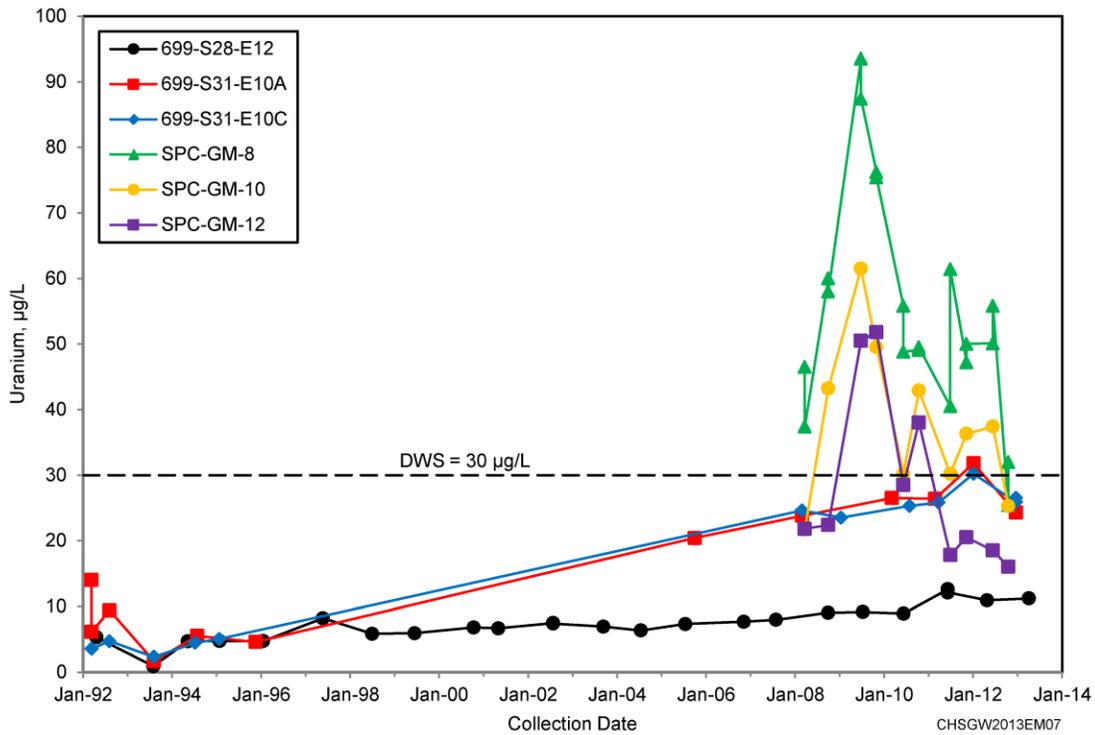


Figure EM.9 1100-EM Uranium Data for Wells Downgradient of AREVA and Inactive Horn Rapids Landfill