200-PO

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200-PO Overview

This chapter summarizes groundwater sampling for the 200-PO groundwater interest area for calendar year 2013. Groundwater monitoring in 200-PO is performed to meet *Atomic Energy Act of 1954* (AEA), *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), *Resource Conservation and Recovery Act of 1976* (RCRA), and *Washington Administrative Code* (WAC) requirements. The 200-PO interest area includes the CERCLA 200-PO-1 operable unit (OU), seven RCRA units (216-A-29 Ditch, 216-A-36B Crib, 216-A-37-1 Crib, 216-B-3 Pond, Nonradioactive Dangerous Waste Landfill [NRDWL], Integrated Disposal Facility [IDF], and Waste Management Area [WMA] A-AX [single-shell tanks]), and one state regulated landfill (Solid Waste Landfill [SWL]). For purposes of CERCLA groundwater monitoring, the 200-PO-1 OU is informally divided into the near field area, which includes the former operational areas within and near the 200 East Area, and the far field area, which includes wells downgradient of the near field area, aquifer tubes along the Columbia River, and generally comprises areas where site operations did not occur (Figure PO.1). CERCLA sampling wells within the far field region have been grouped into several sub-areas including the BC Cribs, southeast transect, river transect, basalt confined aquifer, and the general far field (DOE/RL-2003-04 Rev. 1 and TPA-CN-205). Table PO.1 summarizes some key facts about 200-PO.

Groundwater sampling within the interest area is directed by the sampling and analysis plans, permits, Tri-Party Agreement (Ecology et al., 1989) change notices, and other documents that identify groundwater monitoring requirements. A recently completed CERCLA remedial investigation (DOE/RL-2009-85 Rev. 1) identified tritium, iodine-129, nitrate, strontium-90, technetium-99, tetrachloroethene (PCE), trichloroethene (TCE), and uranium as final contaminants of potential concern (COPCs) for the 200-PO-1 OU.

Groundwater within the 200-PO interest area has been contaminated primarily by releases from cribs, pipelines, ponds, single shell tanks, and trenches associated with Plutonium-Uranium Extraction (PUREX) and B Plant operations. Active groundwater remediation is not currently being conducted within 200-PO. Groundwater beneath the interest area primarily occurs in an unconfined aquifer consisting of Hanford formation and Ringold Formation sands and gravels (Figure PO.2). However, due to the large extent and overall thickness of the aquifer (up to 215 meters), it includes localized semiconfined and confined intervals within deeper portions of the aquifer as well. The depth to the water table is more than 91 meters near the southern boundary of the 200 East Area, and it varies in depth to near zero meters below ground surface at the Columbia River. Detailed discussions of geology and hydrogeology within the 200-PO interest area are provided in DOE/RL-2009-85, DOE/RL-2011-118, and PNNL-12261.

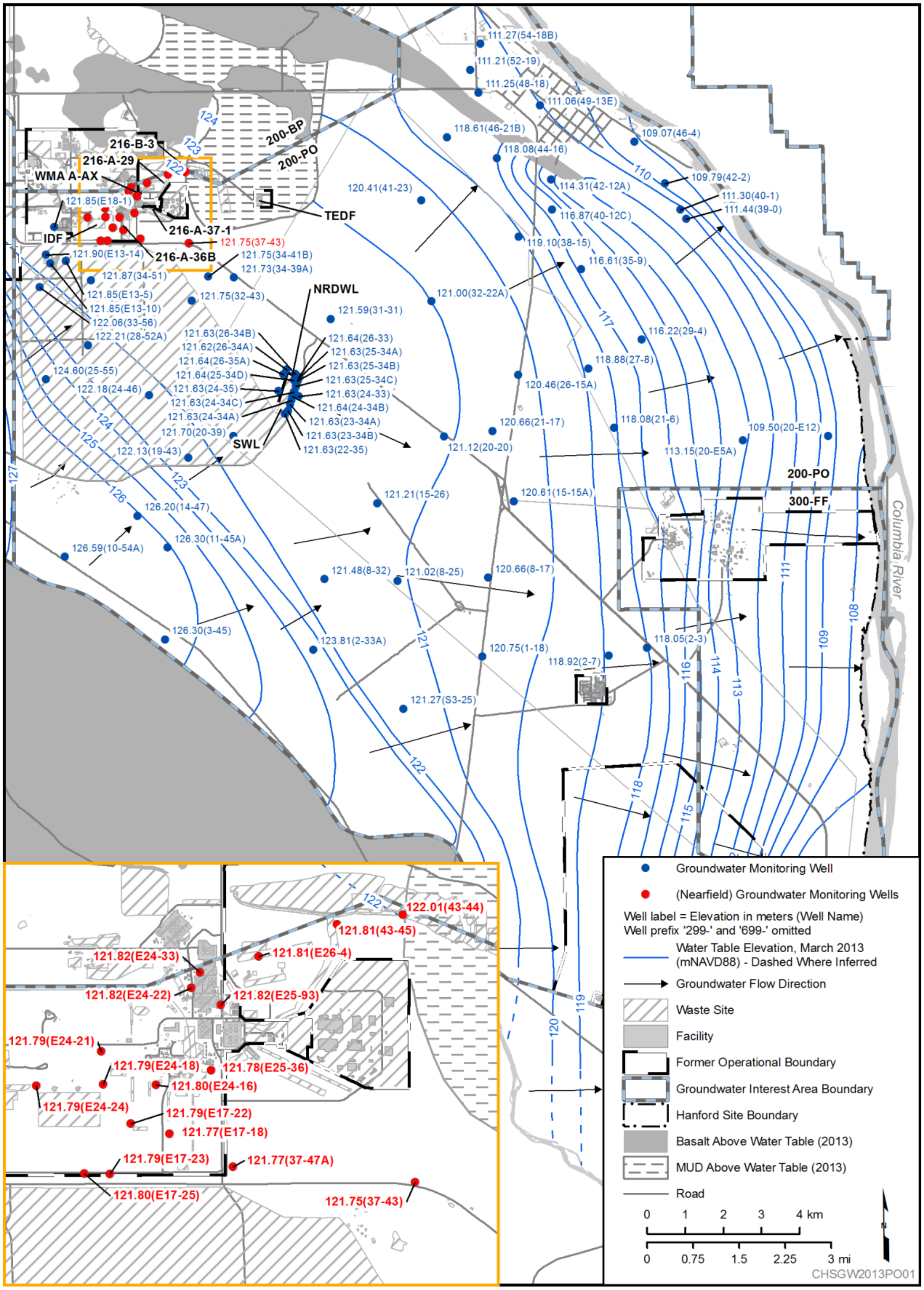

Figure PO.1 200-PO Overview with Groundwater Flow

Table PO.1 200-PO-1 at a Glance

PUREX Plant Operations:	**1956 to 1972 (Plutonium Separation) 1983 to 1989 (Plutonium Separation)**		
2013 Groundwater Monitoring			
Contaminant	**Drinking Water Standard**	**Maximum Concentration**	**Plume Area* (km^2)**
Tritium	20,000 pCi/L	490,000 µg/L (299-E17-19)	83.4
Iodine-129	1 pCi/L	9.1 pCi/L (299-E17-19)	52.1
Nitrate	45 mg/L	126 mg/L (299-E17-19)	3.71
Strontium-90	8 pCi/L	15 pCi/L (299-E17-14)	0.01
Technetium-99	900 pCi/L	4,200 pCi/L (299-E25-93)	0.03
Uranium	30 µg/L	58.8 µg/L (299-E25-36)	0.02

* Estimated area at a concentration greater than the listed drinking water standard.

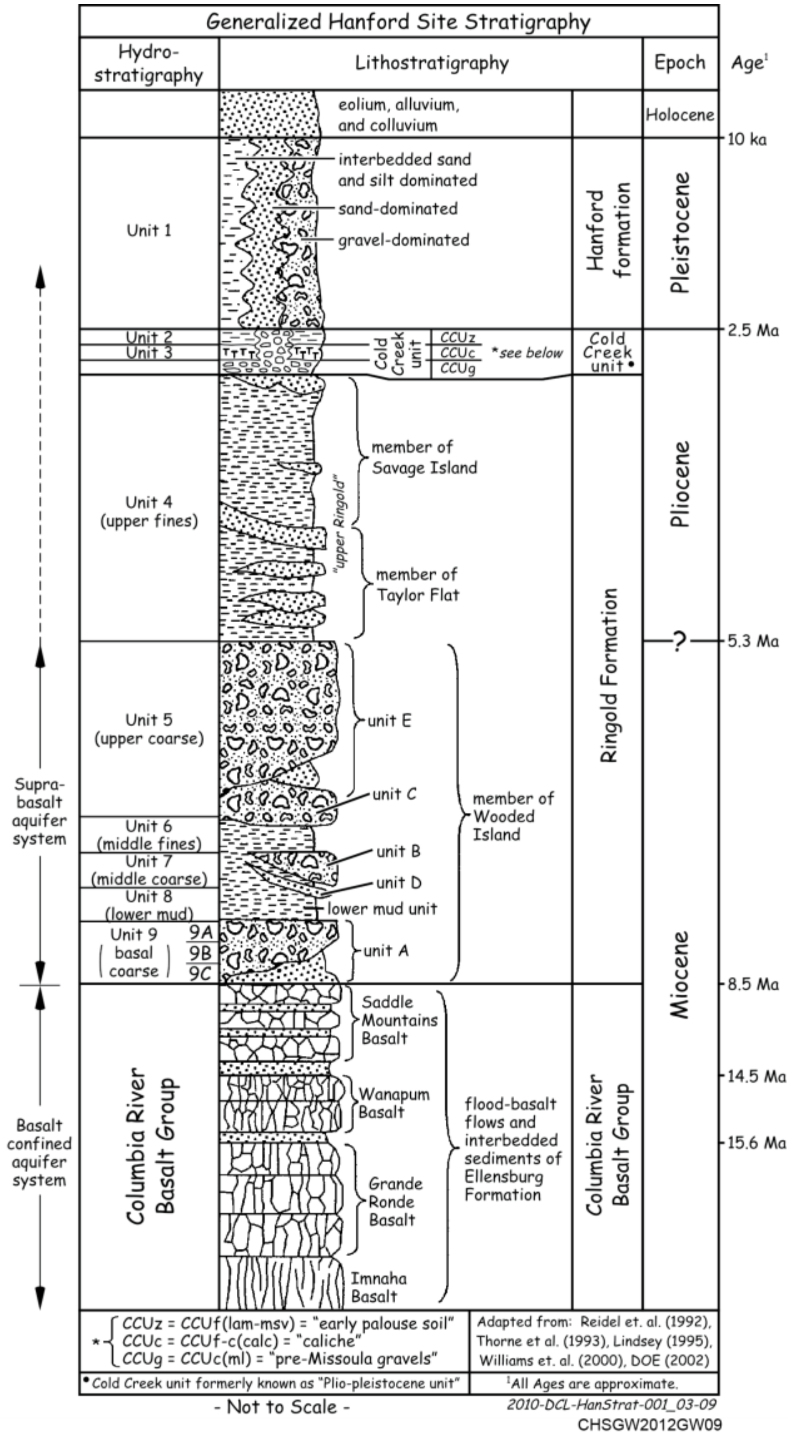

Figure PO.2 200-PO Geology

200-PO CERCLA Activities

Groundwater monitoring under CERCLA is described in the Sampling and Analysis Plan (SAP)(DOE/RL-2003-04 Rev. 1), as amended by TPA-CN-205, and DOE/RL-2007-31 Rev. 0, as amended by TPA-CN-2-253. Wells and aquifer tubes (Figure PO.3) are generally sampled annually or triennially (every three years). Aquifer tube sampling for 200-PO was revised per the SAP for Aquifer Sampling Tubes (DOE/RL-2000-59). Table A.17 of Appendix A lists monitoring wells, constituents, and sampling status for 2013. Table C.2 of Appendix C lists aquifer tubes sampled in 2013.

A remedial investigation (RI) for the 200-PO-1 OU was completed in 2008. The results of the RI are provided in DOE/RL-2009-85 Rev. 1. The report recommended that the OU should advance to the next step in the CERCLA process, which is a feasibility study (FS) to develop alternatives to remediate the groundwater contamination. The remedial investigation identified tritium, iodine-129, nitrate, stronitum-90, technetium-99, PCE, TCE, and uranium as final COPCs. PCE and TCE were only detected at very low (laboratory estimated) concentrations (below the drinking water standard [DWS]) in far field region wells near the NRDWL and the SWL. Details regarding 2013 groundwater for each of these COPCs are described in the following sections of the report. A remedial investigation addendum is currently underway to update the risk assessment for the 200-PO-1 OU based on additional groundwater data collected since the RI was completed.

Plume areas measured from 2003 through 2013 for tritium, iodine-129, nitrate, uranium, and technetium-99 are presented on Figure PO.4. A change in calculated plume area occurred for some contaminants (e.g, nitrate) between 2011 and 2012 due to calculation of areas by interest area boundary starting in 2012, instead of calculation by source area prior to 2012. These COPCs, except technetium-99, are primarily associated with PUREX operations that discharged liquid effluents to the cribs and ditches in the southern part of the 200 East Area from 1956 to 1972, and 1983 to 1988. Technetium-99 within 200-PO has primarily been detected above the DWS near WMA A-AX. Groundwater is monitored within the unconfined aquifer, Ringold confined aquifer, and the basalt confined aquifer.

In 2013, one well was decommissioned (299-E25-236) due to casing corrosion issues and one well (699-S12-3) became sample dry.

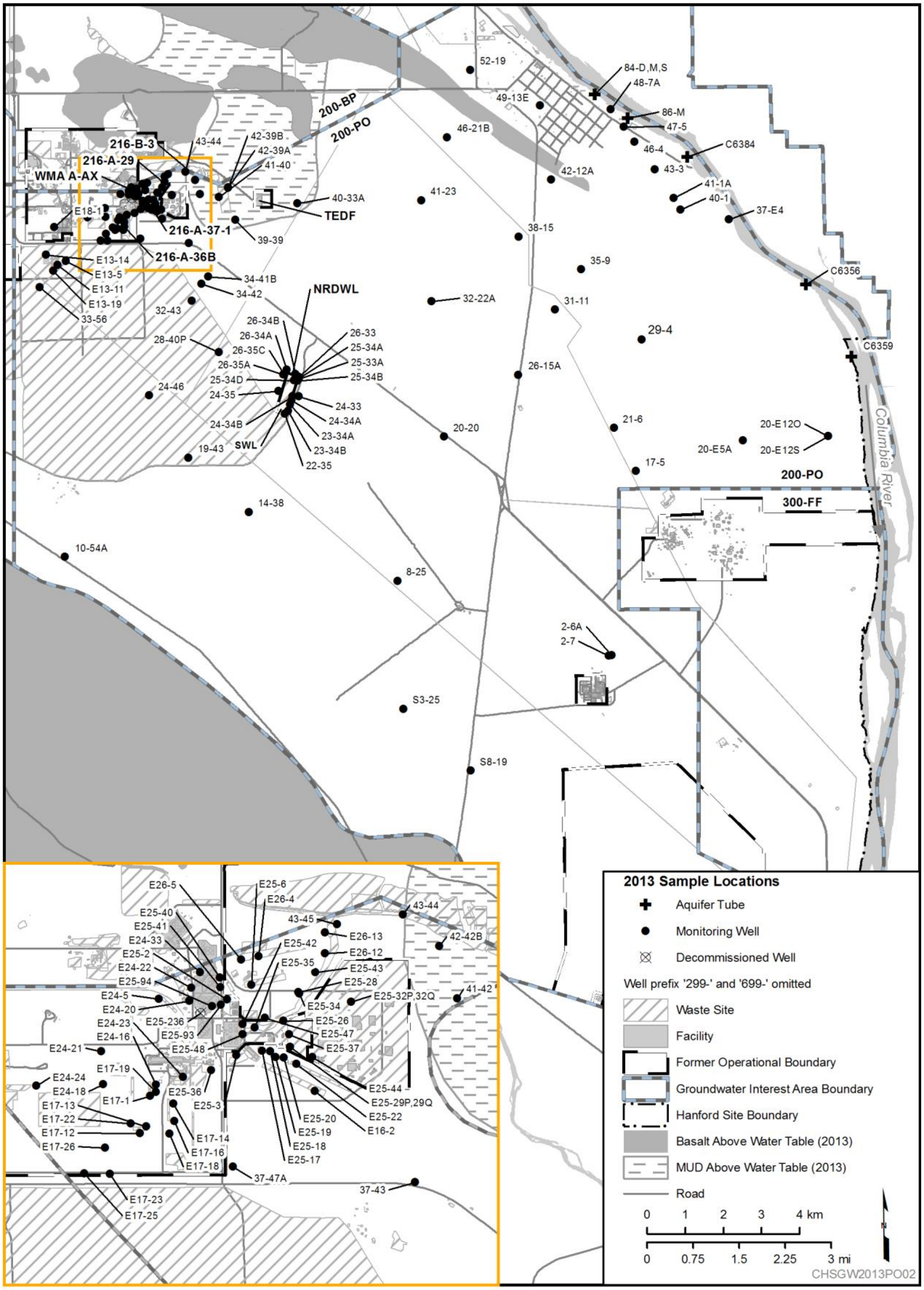

Figure PO.3 200-PO 2013 Sampling Locations

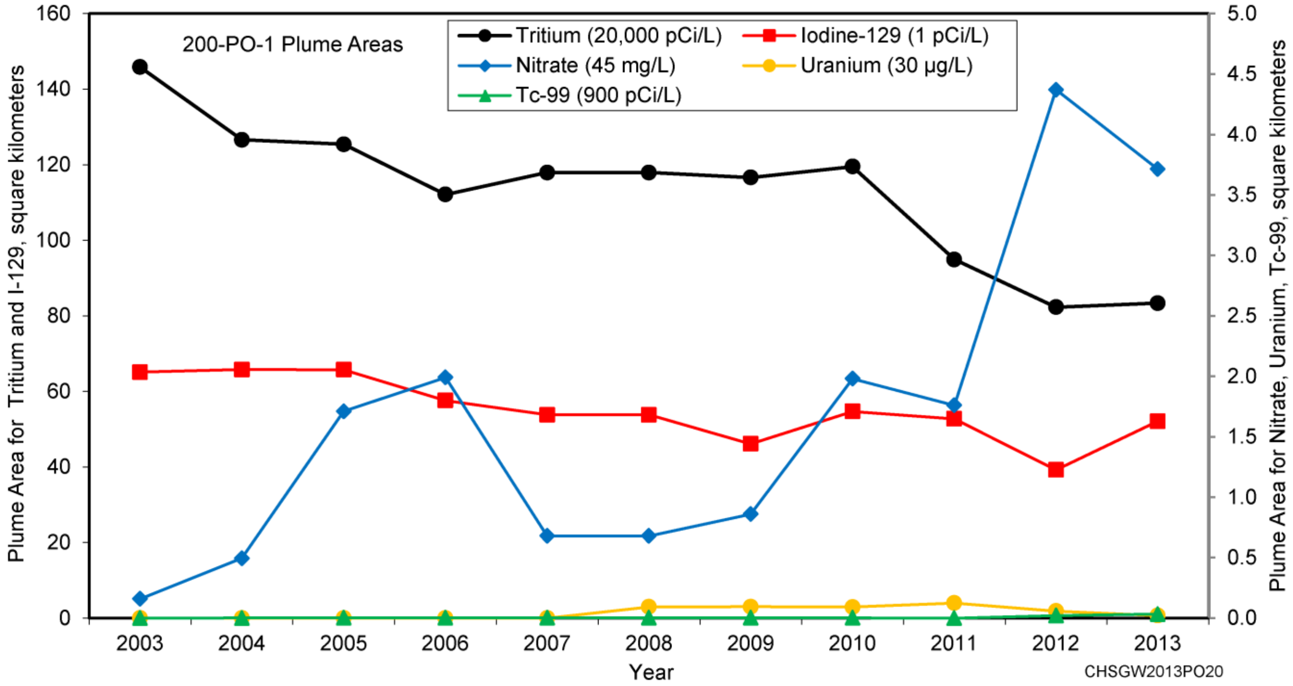

Figure PO.4 200-PO 2013 Plume Areas

200-PO Tritium

Tritium contamination in groundwater is found at a concentration greater than the 20,000 pCi/L DWS in a large plume within 200-PO from the 200 East Area to the Columbia River (Figure PO.5). The highest current and historical concentrations have been detected near the PUREX cribs and trenches, which were the major sources of this contaminant. The tritium plume continues to migrate across the far field area and discharge into the Columbia River to the east (Figure PO.5). The continued attenuation in the far field region is due to dispersion and radioactive decay of tritium, but concentrations near the PUREX cribs and trenches remain up to 25 times the DWS of 20,000 pCi/L.

The 2013 20,000 pCi/L and 200,000 pCi/L interpolated plume intervals are generally consistent with the 2012 plume (presented in DOE/RL-2013-22, Map PO.3). The tritium plume has decreased in size by approximately 57 percent since 1996. In 2013, the highest concentrations of tritium in the near field area were 490,000 pCi/L in well 299-E17-19 (near the 216-A-36B Crib), 430,000 pCi/L in well 299-E17-14 (near the 216-A-36B Crib), and 420,000 pCi/L in well 299-E17-1 (near the 216-A-10 Crib) (Figure PO.6). The highest concentration of tritium detected during 2013 from the far field was 1,000,000 pCi/L for a sample collected in October at well 699-13-3A. The tritium in well 699-13-3A originated at the 618-11 Burial Ground and is discussed in more detail in the 300-FF section.

An area of lower tritium concentrations identified in the far field region near the Energy Northwest complex (Figure PO.5) is hypothesized to be due to a zone of lower hydraulic conductivity material in the unconfined aquifer, where the water table is within the upper portion of the Ringold Formation, which has a greater degree of local cementation. The zone of lower hydraulic conductivity has resulted in groundwater flow, and tritium contamination moving around this area.

A key well that is used to define the tritium plume between the 200 East and far field area is well 699-31-31. From 1992 to 2000, the tritium concentrations in the well consistently exceeded the DWS. After 2000, concentrations of tritium detected in the well were approximately one order of magntitude lower than the concentration detected in 2000. The reason for the decrease in the concentration of tritium in the well is not known, but the integrity of the well seal allowing in leakage and diluting concentrations within the well is one possible cause. Considering this well helps define the extent of the tritium plume between the 200 East Area and the far field area, and the uncertainty of the data representativeness, a replacement well for 699-31-31 is recommended.

Wells screened (or casings perforated) in the middle or lower portions of the unconfined aquifer had tritium results ranging from non-detect to 11,000 pCi/L (well 299-E25-29Q) in the near field region in 2013, and from non-detect to 57,000 pCi/L (well 699-37-E4) in the far field region. The concentrations of tritium detected in well 699-37-E4 were similar to the concentration detected during the last triennial sampling for the well in 2010 of 62,000 pCi/L. Similar concentrations in the upper part of the unconfined aquifer are detected near well 699-37-E4. Tritium has been detected above the DWS in well 699-37-E4 since sampling for tritium began in the well in 1990. From 1990 to 1995, the concentration of tritium in well 699-37-E4 increased; concentrations of tritium have decreased since 1996.

In 2013 tritium concentrations in wells screened in the Ringold confined aquifer ranged from non-detect to 14,000 pCi/L in near field well 699-42-42B and 34,000 pCi/L in far field well 699-41-40. Both wells are located near B Pond. The concentration detected in 2013 in well 699-41-40 is consistent with the last triennial sample which had a tritium concentration of 36,000 pCi/L . Tritium has been detected above the DWS in well 699-41-40 since sampling began at this well in 1990. From 1990 to 2010, the tritium concentration in well 699-41-40 has decreased from 226,000 pCi/L to 34,000 pCi/L. There is no unconfined aquifer at this well location. A portion of the tritium plume above the DWS extends east of the 200 Area beneath the lower mud unit (Figure PO.5).

Six wells screened in the basalt confined aquifer are sampled triennially within 200-PO. No samples from these wells were scheduled or collected from the basalt confined aquifer in 2013. Tritium has been detected intermittently at low concentrations below the DWS in samples collected from these wells, with the exception of well 699-42-40C located near the 216-B-3 Pond. Tritium in well 699-42-40C has been detected since 1982 (Figure PO.7) up to a maximum concentration of 8,320 pCi/L in 1993. Since 1993 concentrations in well 699-42-40C have decreased.

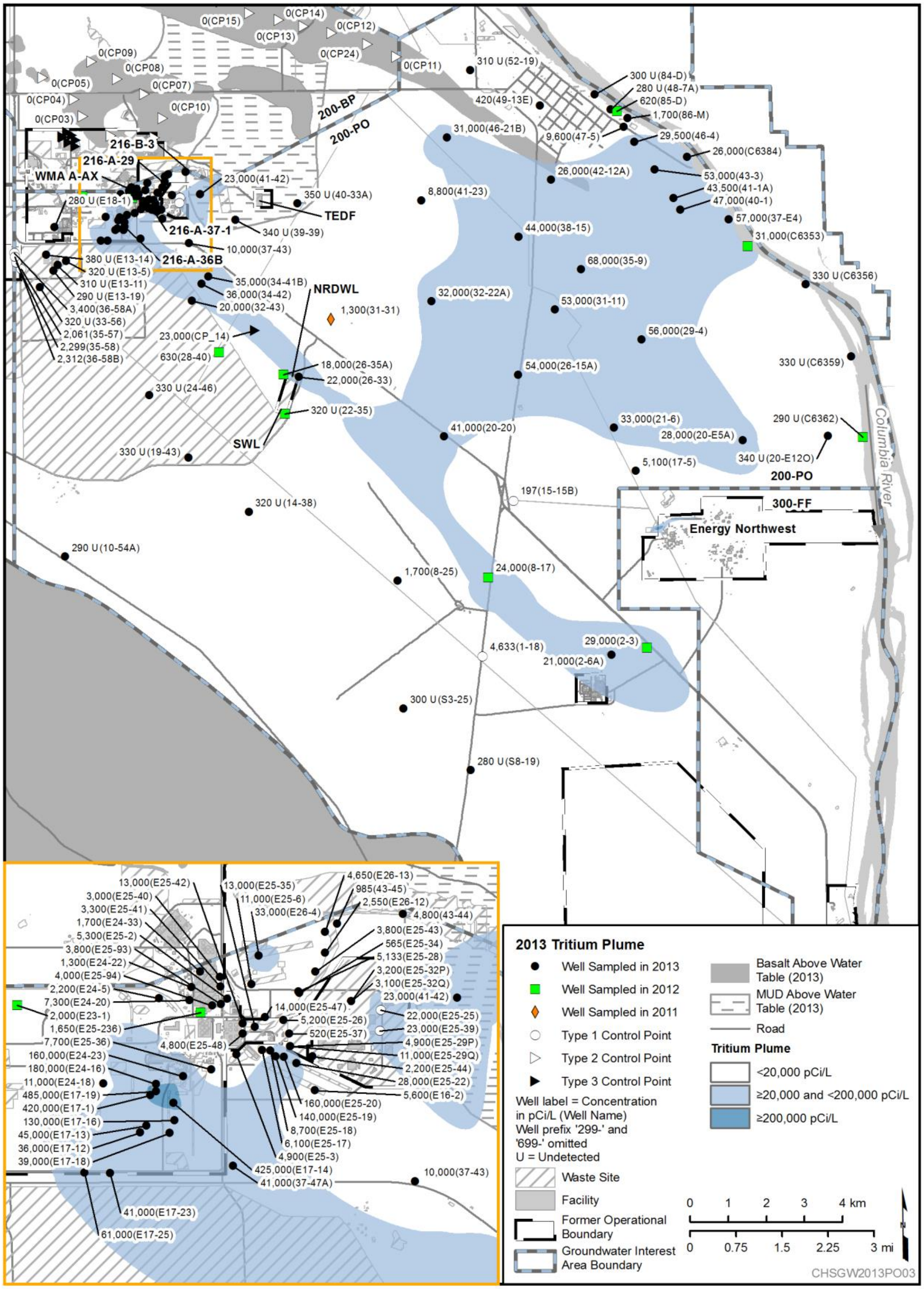

Figure PO.5 200-PO 2013 Tritium Plume

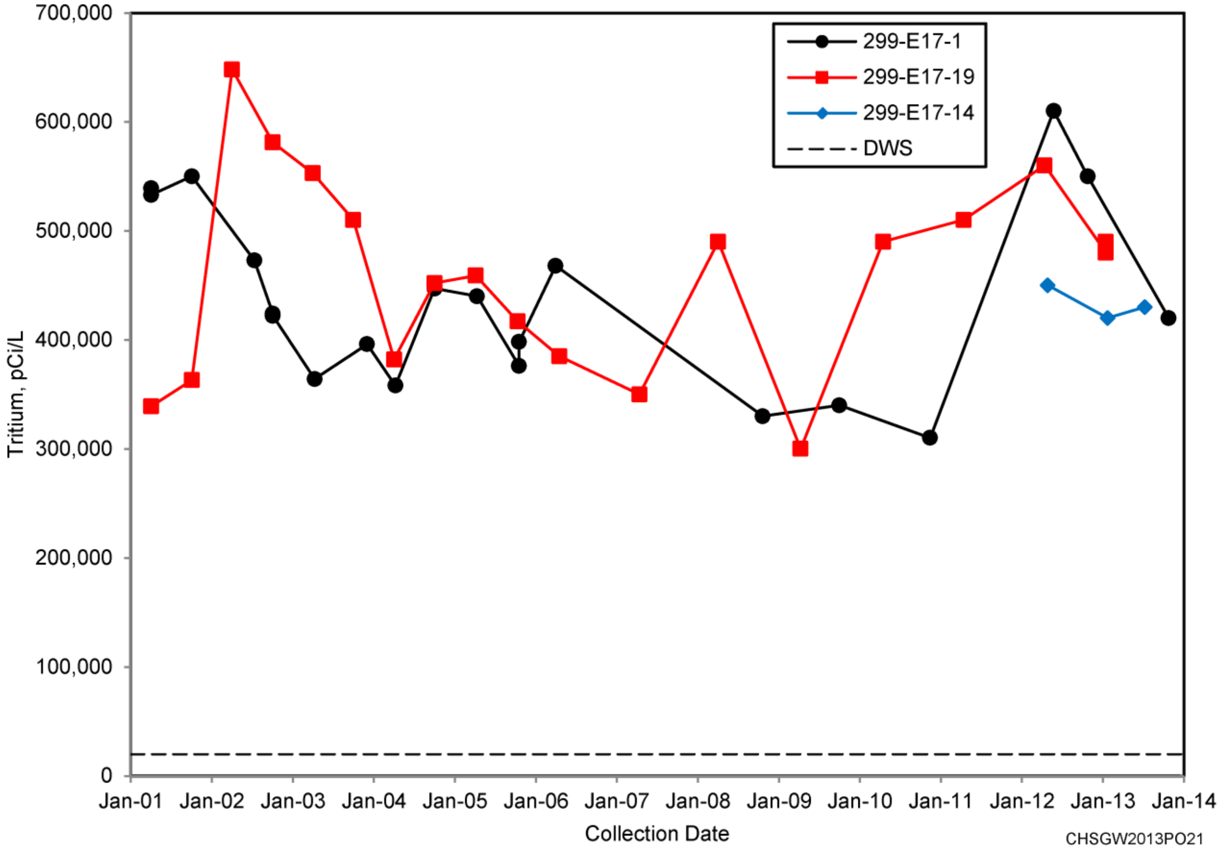

Figure PO.6 200-PO Tritium Data for Wells 299-E17-1, 299-E17-19, and 299-E17-14

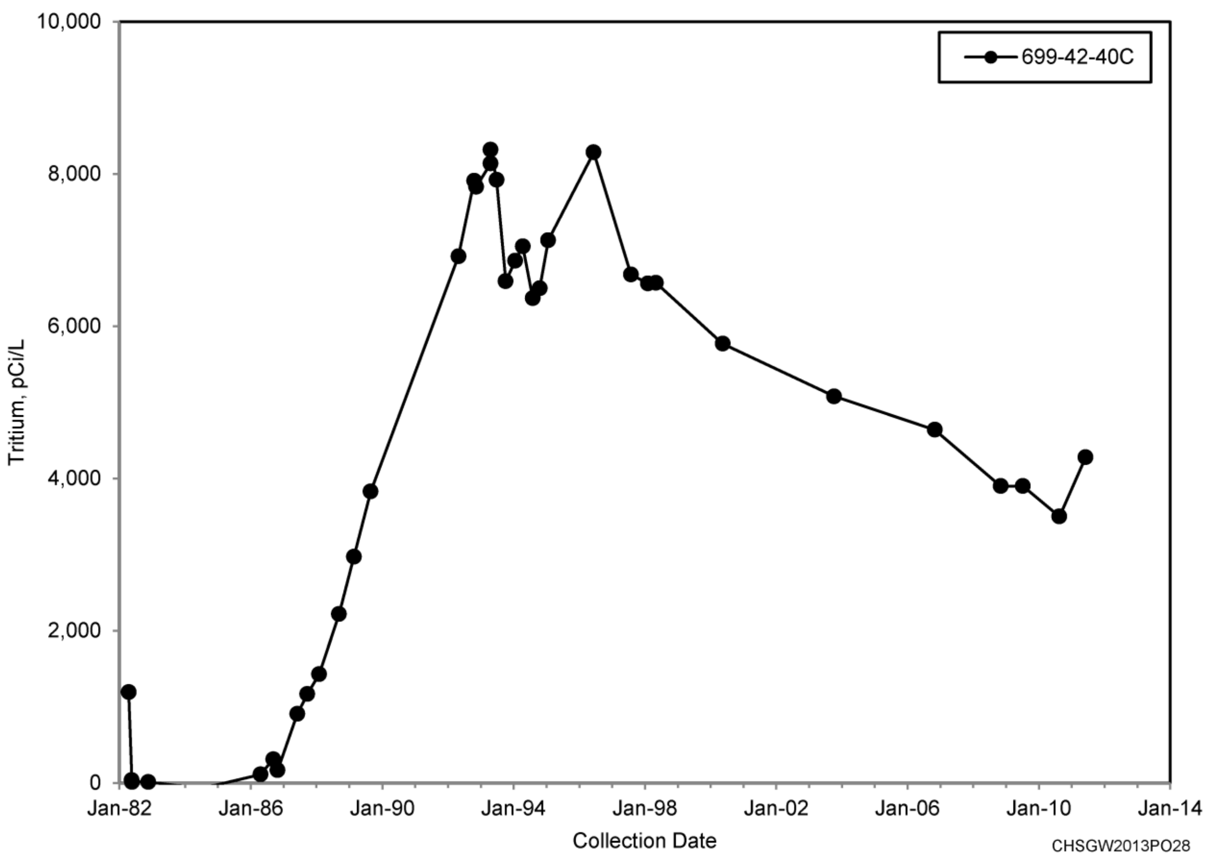

Figure PO.7 200-PO Tritium Data for Basalt-Confined Well 699-42-40C

200-PO Iodine-129

Iodine-129 at a concentration greater than the 1 pCi/L DWS is found in a relatively dispersed plume that covers a large area within 200-PO (Figure PO.8). The highest current and historical concentrations have been detected near the PUREX cribs and trenches. The 2013 interpolated plume extent above the 1 pCi/L concentration differs from the 2012 plume presented in DOE/RL-2013-22 in the following areas:

- The interpolated 2013 extent of the 1 pCi/L concentrations generally extends farther north in the far field region between wells 699-41-23 and 699-46-21B. The more northerly extent is supported by higher concentrations in both wells compared to 2012 (5.3 pCi/L in well 699-41-23 in 2013 versus 2.4 pCi/L in 2012, and 0.5 pCi/L in well 699-46-21B in 2013 versus not detected in 2012).
- The 2013 interpolated extent of the plume above 1 pCi/L extends farther south of 699-20-20 compared to 2012, which is supported by a higher concentration detected in 2013 (3.2 pCi/L) than 2012 (2.3 pCi/L).

Iodine-129 concentrations detected in near field wells in 2013 ranged from non-detect to 9.1 pCi/L. The highest concentrations in 2013 were detected near the PUREX cribs and trenches, 216-A-29 Ditch, 216-B-3 Pond, and WMA A-AX. None of the detected concentrations exceeded the DOE derived concentration standard of 330 pCi/L (Table 5 of DOE-STD-1196-2011). In 2013, the highest concentrations of iodine-129 were detected in wells 299-E17-19 (9.1 pCi/L) and 299-E17-14 (8.72 pCi/L), located near the 216-A-36B crib. Iodine-129 concentrations in well 299-E17-19 have been relatively stable since sample collection started in 1992 and concentrations in well 299-E17-14 generally decreased since sample collection started in 1990 (Figure PO.9), most likely due to downgradient migration. In the far field, the highest concentrations of iodine-129 detected were more than five times the DWS in wells 699-32-22A (5.52 pCi/L) and 699-41-23 (5.25 pCi/L).

Similar to tritium, a key well that is used to define the iodine-129 plume between the 200 East and far field area is well 699-31-31. From 1992 to 1998, the iodine-129 concentrations in the well intermittently exceeded the DWS. After 1998, concentrations of iodine-129 decreased to between non-detect and relatively low detected values below the DWS. The reason for the decrease in the concentration of iodine-129 in the well is not known, but the integrity of the well seal allowing in leakage and diluting concentrations within the well is one possible cause. Considering this well helps define the extent of the iodine-129 plume between the 200 East Area and the far field area, and the uncertainty of the data representativeness, a replacement well for 699-31-31 is recommended.

Within the middle and lower part of the unconfined aquifer, iodine-129 was detected in three wells in the near field region at concentrations above the DWS (1.9 pCi/L in well 299-E25-28 located near the 216-A-29 ditch; and 1.1 and 4.48 pCi/L in wells 299-E25-29Q and 299-E25-32Q, respectively, located near the 216-A-30, 216-A-37-1, and 216-A-37-2 cribs). Iodine-129 was detected during 2013 in one monitoring well screened in the middle and lower part of the unconfined aquifer in the far-field region at a concentration of 1.21 pCi/L (well 699-31-11)(Figure PO.8).

The Ringold confined aquifer is monitored near the 216-B-3 Pond and the Treated Effluent Disposal Facility in 200-PO. In 2013, iodine-129 was detected at one well above the DWS (2.2 pCi/L in well 699-42-42B near the 216-B-3 Pond).

No samples for iodine-129 were scheduled or collected from the wells screened in the basalt confined aquifer beneath 200-PO in 2013. The wells are sampled triennially and the next scheduled sampling will occur in 2014. Iodine-129 was only detected at very low concentrations from basalt wells in the early to mid-1990s except well 699-42-40C located near the 216-B-3 Pond. Iodine-129 concentrations in well 699-42-40C have been intermittently detected at low concentrations (below the 1 pCi/L DWS) since sampling began in 1988. The last detection was a concentration of 0.29 pCi/L in 2010. The highest concentration detected in the well was 0.36 pCi/L in 1996. Since 2000, the only detections of iodine-129 in the basalt confined wells beneath 200-PO have been in well 699-42-40C.

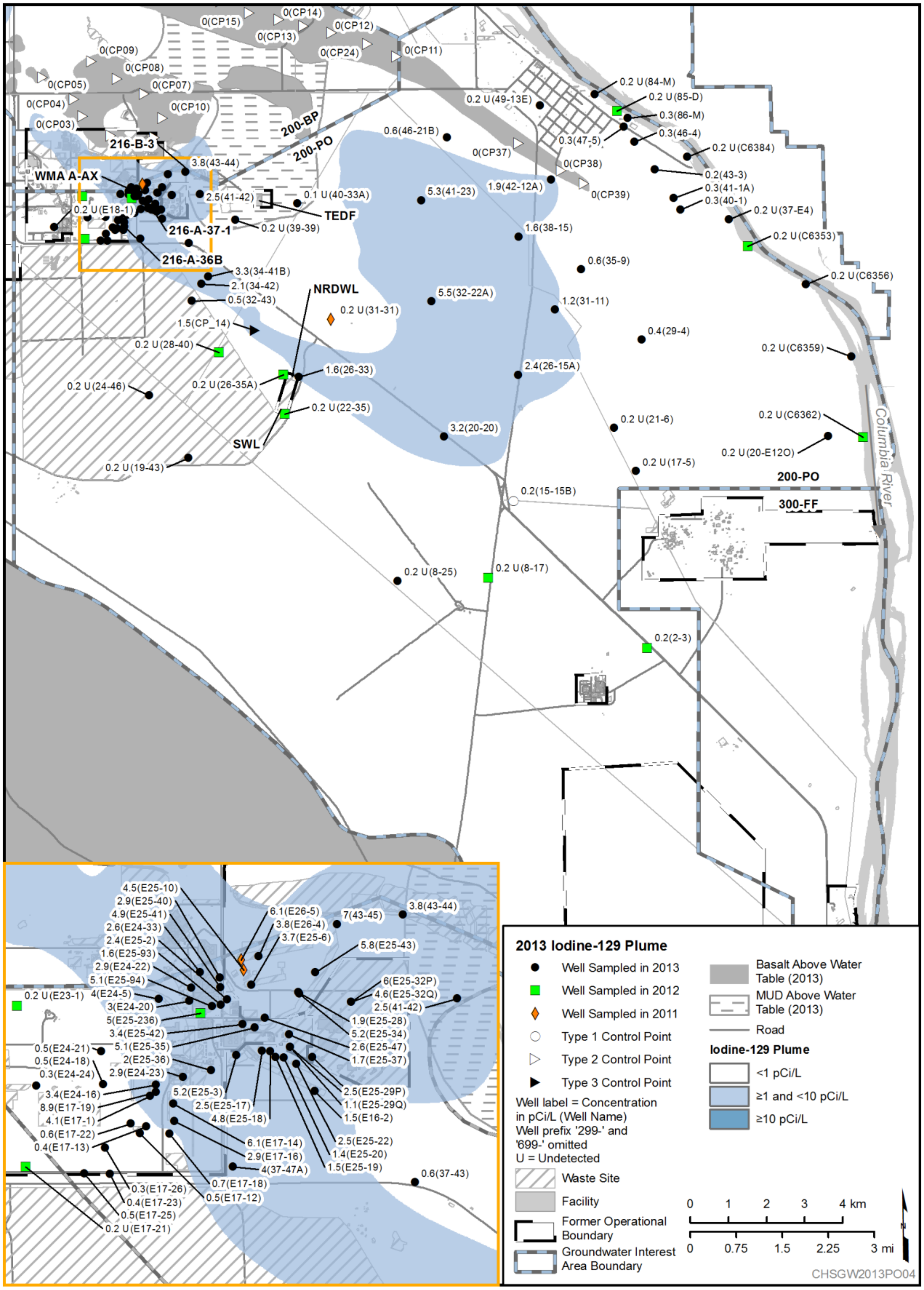

Figure PO.8 200-PO 2013 Iodine-129 Plume

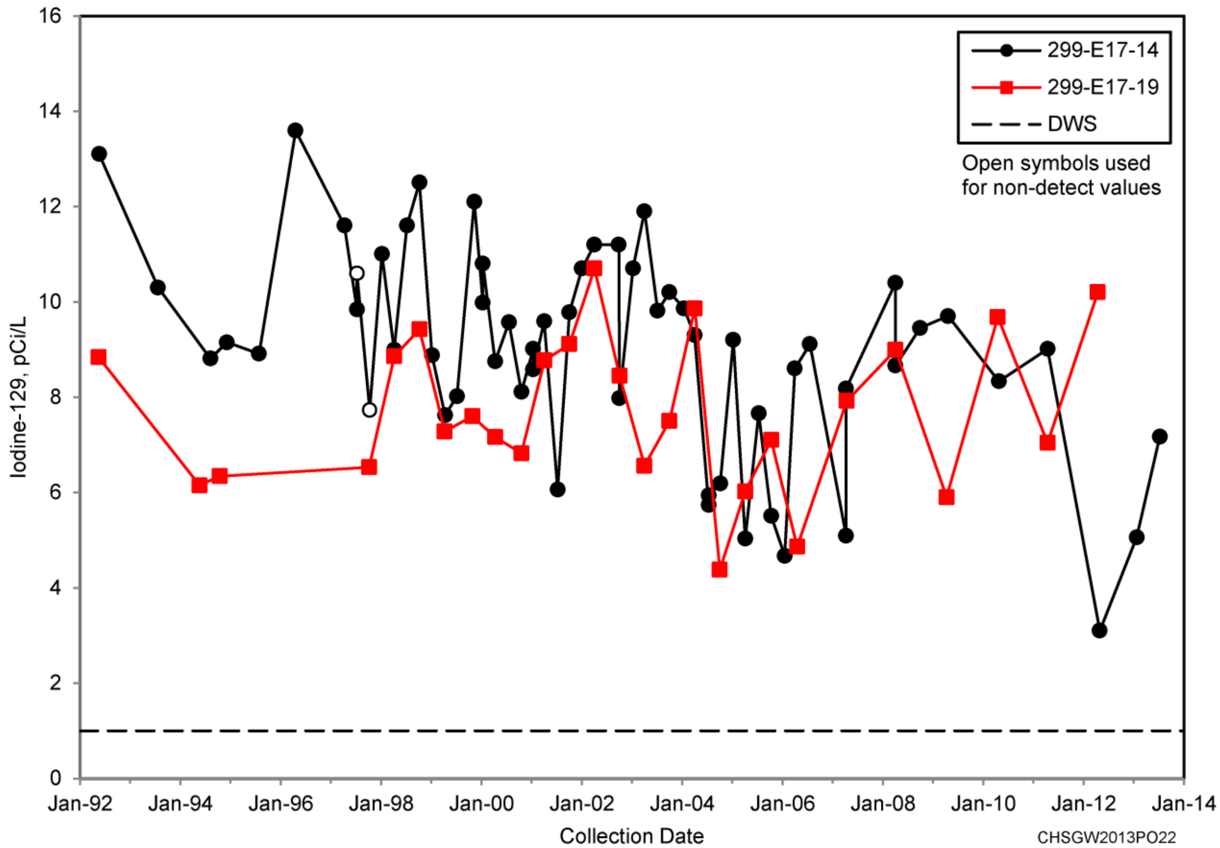

Figure PO.9 200-PO Iodine-129 Data for Wells 299-E17-14, and 299-E17-19

200-PO Nitrate

The highest historical concentrations of nitrate in 200-PO have been detected near the PUREX cribs and trenches. The extent of nitrate at concentrations greater than the 45 mg/L DWS is relatively small within the 200-PO interest area (Figure PO.10). Historically, the nitrate plume was relatively large, but most concentrations within the far field region have mostly decreased below the 45 mg/L DWS equivalent. The 2013 interpolated plume is generally consistent with the 2012 plume presented in Figure PO.5 of DOE-RL-2013-22. Comparing the 2013 plume (Figure PO.10) to the 2012 plume reveals the following notable change:

- The interpolated extent of the 45 mg/L concentrations is farther south near the IDF in the 200 East Area. The 2013 interpolation is supported by concentrations greater than 45 mg/L in wells 299-E17-25 and 299-E17-26 in 2013 that were less than 45 mg/L in 2012.

The highest nitrate concentrations in 200-PO from samples collected during 2013 were 126 mg/L at well 299-E17-19, located downgradient of the 216-A-10 crib, and 113 mg/L from well 299-E17-14, located downgradient of the 216-A-36B crib (Figure PO.11). Many of the wells near the PUREX Cribs, including 299-E17-1, 299-E17-16, 299-E17-18, 299-E24-16, 299-E25-17 and 699-37-47A in the southeastern portion of the 200 East Area, have exhibited increasing nitrate concentrations since approximately 2004 (e.g., wells 299-E25-17 and 699-37-47A, Figure PO.12). The cause of the increase in nitrate concentrations in this area may be the result of changing groundwater flow conditions related to the cessation of wastewater discharges at B Pond, water table elevation decreases in the 200 East Area, and/or a vadose zone source. Only one well in the far field region had a concentration detected above the 45 mg/L DWS in 2013 (concentrations of 115 mg/L and 116 mg/L in well 699-13-3A). The source of the nitrate detected in this well is the 618-10 burial ground (see 300-FF section).

For the wells screened (or casings perforated) in the middle to lower portions of the unconfined aquifer in the near field region, nitrate did not exceed 45 mg/L in 2013 and concentrations above that level appear to be found within the upper 10 meters of the aquifer. The maximum 2013 nitrate concentration in the deeper portion of the aquifer was 33.6 mg/L in well 699-37-E4 located in the far field region. Within the near field region, the highest nitrate concentration detected in 2013 in the deeper portion of the aquifer was 28.8 mg/L in well 299-E25-29Q. Nitrate was not detected in 2012 in the main water supply well for the 400 Area (well 499-S1-8J), which is located within the far field region which is screened in the the unconfined aquifer.

Nitrate was detected, in 2013, in one well within the Ringold Formation confined aquifer above 45 mg/L at a concentration of 92.5 mg/L (well 699-39-39).

No samples for nitrate were scheduled or collected from the wells screened in the basalt confined aquifer in 2013 beneath 200-PO. The wells are sampled triennially and the next scheduled sampling will occur in 2014. Nitrate in five of the basalt confined wells has been detected intermittently at relatively low concentrations. In well 699-42-40C, located near the the 216-B-3 Pond, nitrate has been detected consistently in samples collected since 1992 (Figure PO.13) up to a maximum concentration of 6.24 mg/L. Concentrations of nitrate within the basalt confined aquifer near the river (well 699-S11-E12AP), were detected above 45 mg/L in three samples from 1985, but concentrations have decreased since that time (Figure PO.13).

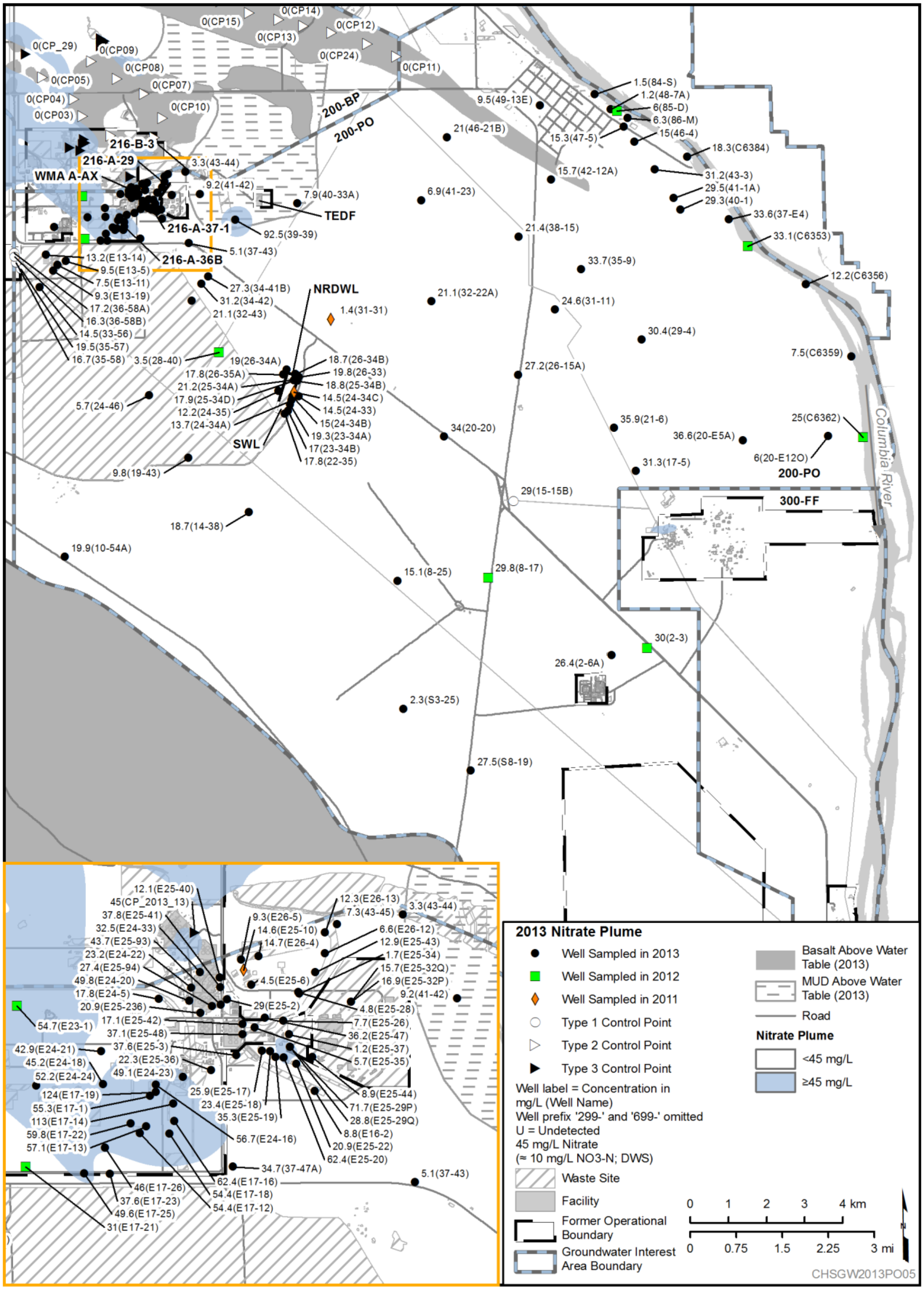

Figure PO.10 200-PO 2013 Nitrate Plume

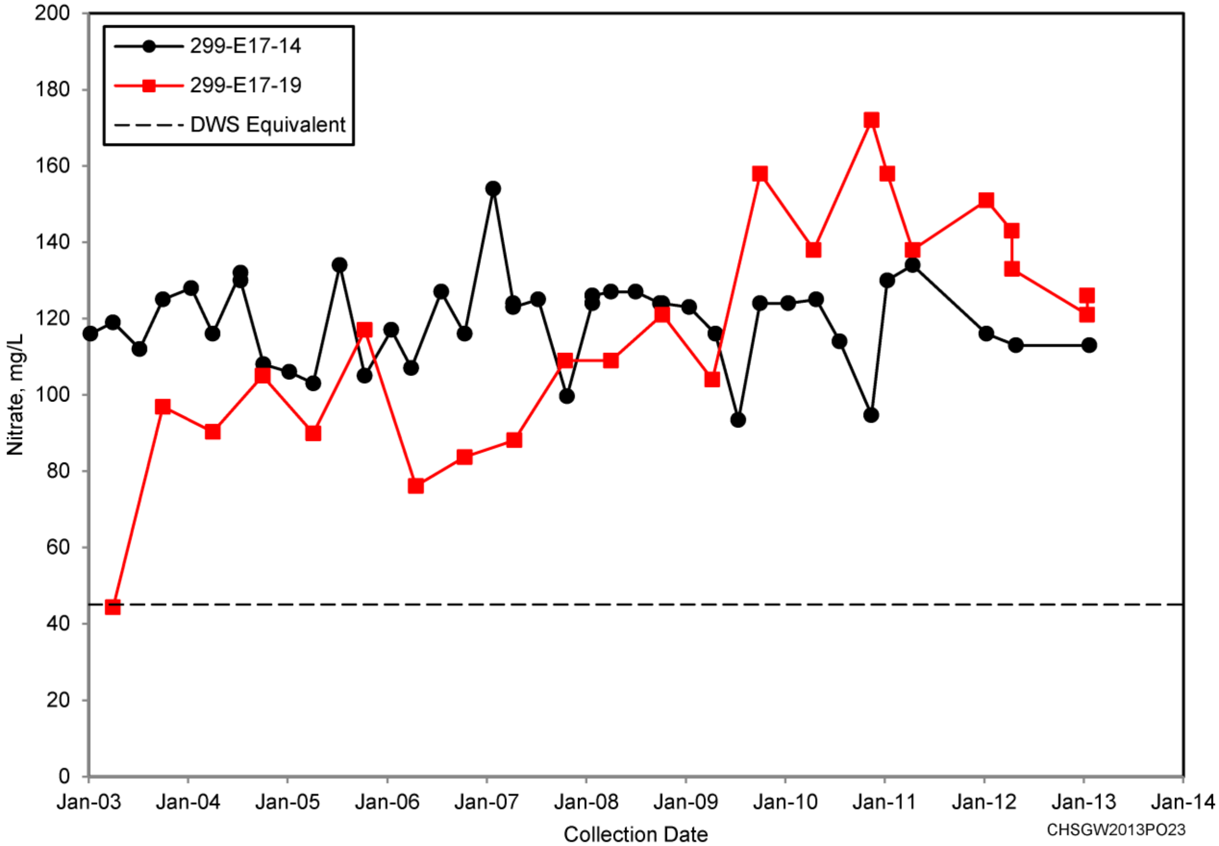

Figure PO.11 200-PO Nitrate Data for Wells 299-E17-14, and 299-E17-19

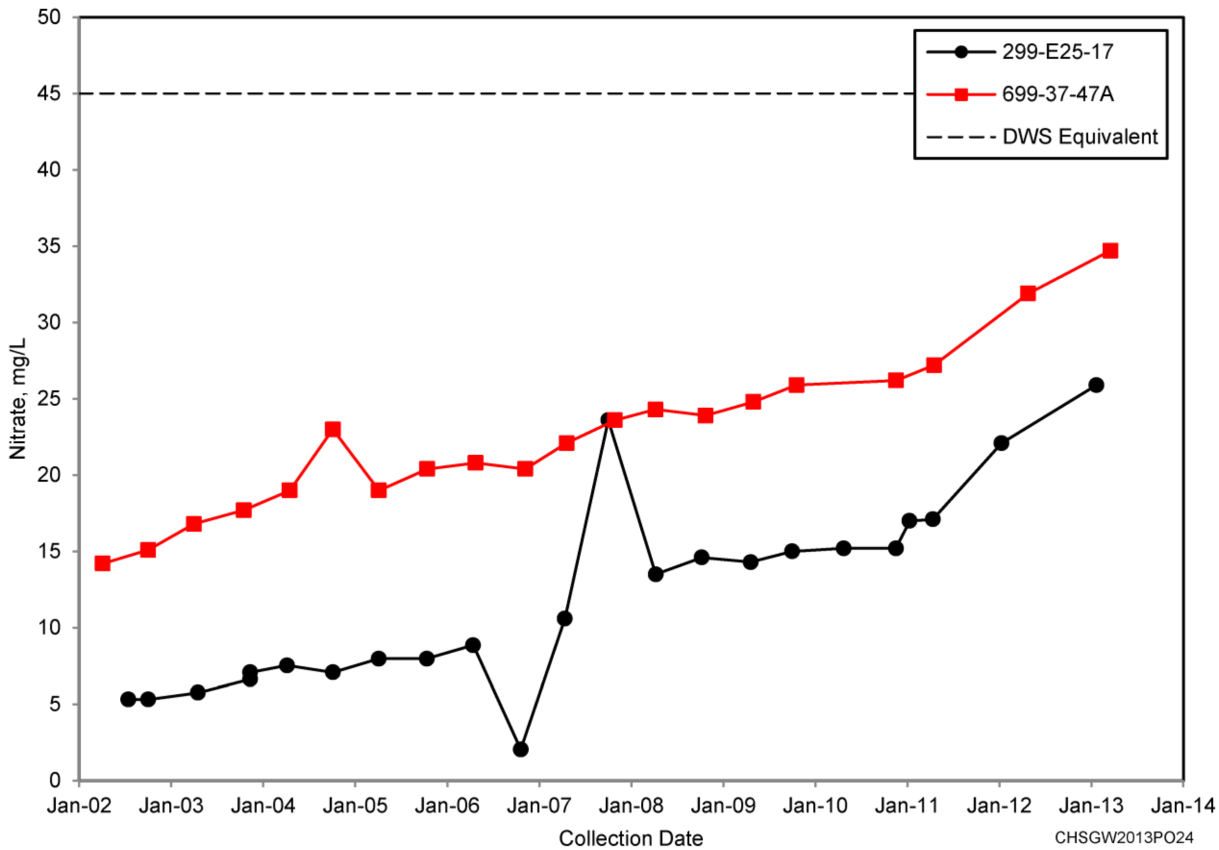

Figure PO.12 200-PO Nitrate Data for Wells 299-E25-17, and 699-37-47A

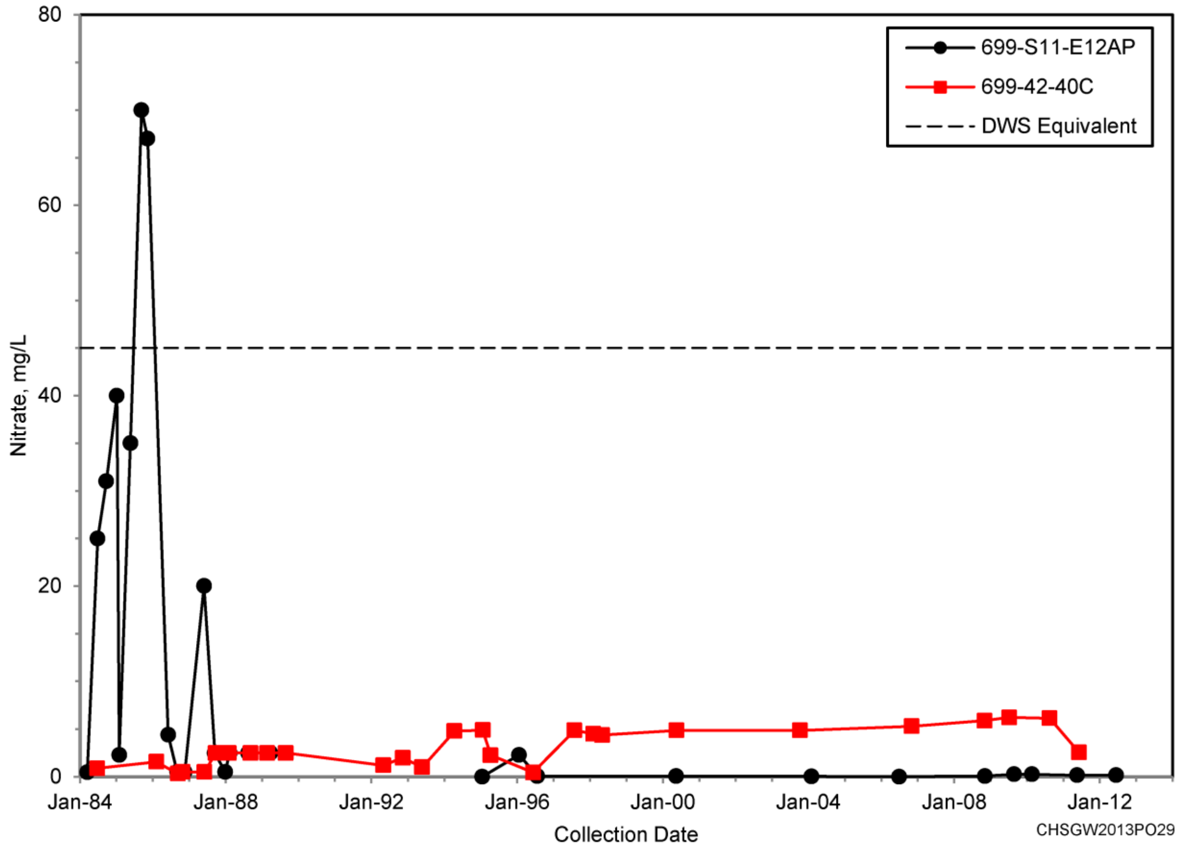

Figure PO.13 200-PO Nitrate Data for Basalt-Confined Wells 699-S11-E12AP and 699-42-40C

200-PO Strontium-90

Strontium-90 has historically been detected in relatively small areas at concentrations greater than the DWS of 8 pCi/L near the 216-A-5, 216-A-10, and 216-A-36B cribs. A small plume remains near the 216-A-36B crib (Figure PO.14). Concentrations of strontium-90 near the 216-A-5 and 216-A-10 cribs have only exceeded the 8 pCi/L DWS in one sampling event in one well (299-E24-16 at a concentration of 8.19 pCi/L in 2004). Concentrations in the well have historically ranged from 5.2 to 7.8 pCi/L.

Strontium-90 was detected above the DWS of 8 pCi/L during 2013 in 200-PO in only one well; 299-E17-14 near the 216-A-36B Crib. Since sampling was started for strontium-90 in this well in 1988, the general concentration trend has been relatively stable, ranging from 11 pCi/L to 30 pCi/L (Figure PO.15), suggesting a potential for continuing contribution from the vadose zone. The 2013 result for 299-E17-14 was 15 pCi/L; the same as the 2012 result.

In 2013, strontium-90 was detected in other wells near the PUREX cribs and trenches within the 200-PO near field region, but at concentrations below the DWS. These included 4.8 pCi/L in well 299-E24-16 and between 1.1 to 2.8 pCi/L in five other wells (299-E13-11, 299-E17-1, 299-E17-19, 299-E24-23, and 299-E25-94). Strontium-90 was detected in one far field well, 299-E13-11, located near the BC cribs and trenches, at a concentration of 2.4 pCi/L.

The middle or deep unconfined aquifer wells were not analyzed for strontium-90 with the exception of the three water supply wells in the 400 Area (499-S0-7, 499-S0-8, and 499-S1-8J). Strontium-90 was not detected in 2012;

the most recent samples collected from these wells. The Ringold confined aquifer wells were not analyzed for strontium-90.

Strontium-90 is not currently required to be analyzed for in the seven basalt confined aquifer wells (TPA-CN-205). Strontium-90 was sampled intermittently in the wells from the mid-1990s to 2011. During that time, strontium-90 was detected in two samples from well 699-42-40C (located near the 216-B-3 Pond), and one sample in well 699-S11-E12AP (located southwest of the 400 Area). None of the three detections were above the 8 pCi/L DWS.

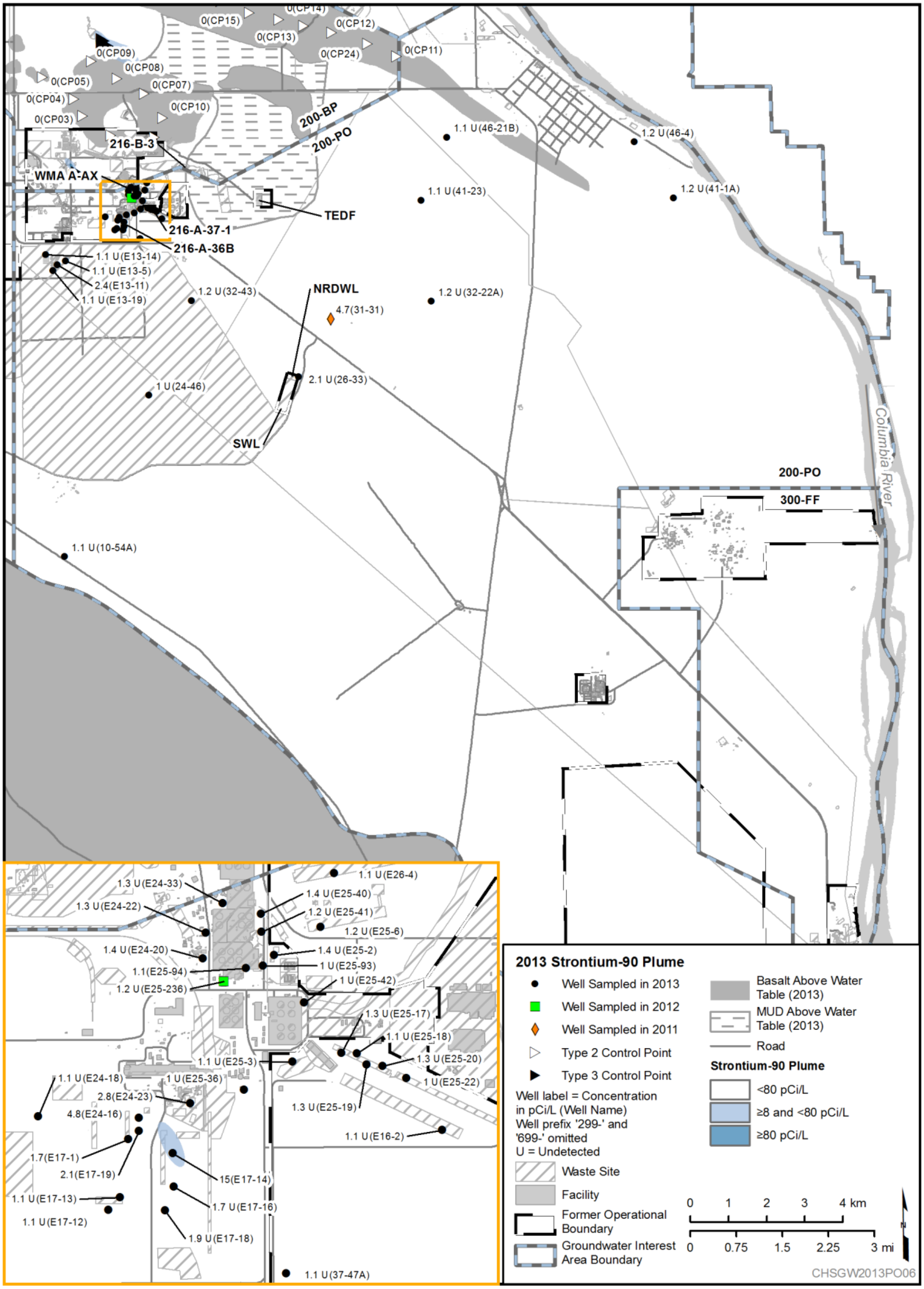

Figure PO.14 200-PO 2013 Strontium-90 Plume

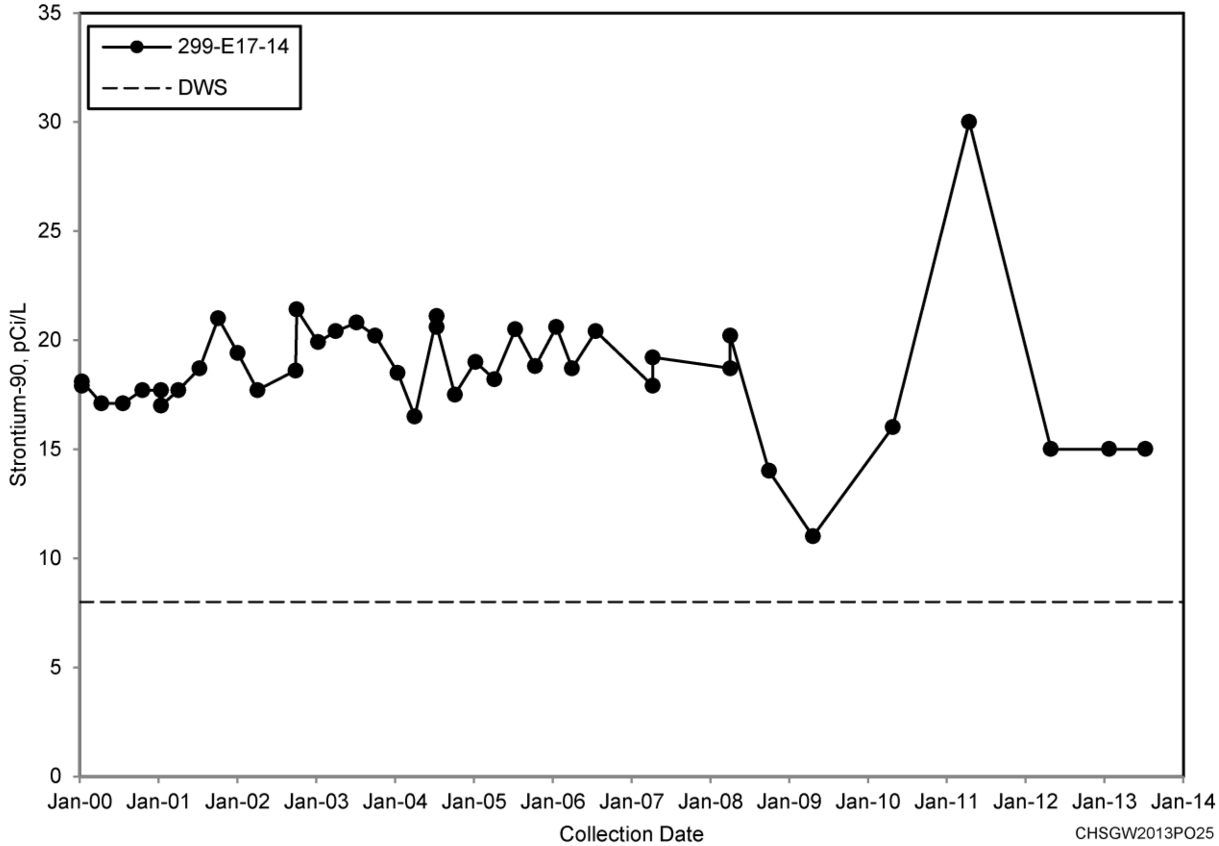

Figure PO.15 200-PO Strontium-90 Data for Well 299-E17-14

200-PO Technetium-99

Technetium-99 has historically been detected in one relatively small area in the 200-PO near field region around WMA A-AX (Figure PO.16). This plume appears to have sources both in WMA C (in 200-BP) and in WMA A-AX (in 200-PO). WMA A-AX is hydraulically downgradient of WMA C. Concentrations greater than the 900 pCi/L DWS have been detected in groundwater near WMA A-AX since 2003. The 2013 interpolated plume extent above the 900 pCi/L concentration differs from the 2012 plume presented in Map PO.7 of DOE/RL-2013-22 in the following respect:

- The interpolated 2013 extent of the 900 pCi/L concentration from WMA C extends to the southwestern upgradient portion of WMA A-AX as defined by well 299-E24-22. The detections above the 900 pCi/L concentration southeast and downgradient of WMA A-AX are inferred to be associated with WMA A-AX rather than WMA-C. This interpretation is supported by a concentration of technetium-99 in well 299-E24-33 (Figure PO.16) that was less than 900 pCi/L in 2012 and 2013. Well 299-E24-33 is located between the two WMAs. Well 299-E25-41, located along the northeast side of WMA A-AX, also exhibits an increasing trend for technetium-99.

In 2013, technetium-99 was detected above a concentration of 900 pCi/L at three wells near WMA A-AX (299-E25-93 and 299-E25-236 located downgradient of WMA A-AX and 299-E24-22 located upgradient of WMA A-AX and downgradient of WMA C) . Concentrations above the 900 pCi/L DWS have been detected in well 299-E25-93 since the well was drilled in 2003 and have declined with time (Figure PO.17), with 2013 detections ranging from 650 to 4,200 pCi/L. Concentrations in well 299-E25-236 first exceeded the DWS in 2012. Only one sample was collected in 2013 and due to casing corrosion identified in 2012, the well was decommissioned in July 2013. Concentrations of technetium-99 in well 299-E24-22 (Figure PO.17) have been increasing since 2011. Concentrations detected in 2013 ranged from 730 to 1,400 pCi/L.

In the far field region to the east and southeast of the 200 East Area, technetium-99 was detected at concentrations ranging from non-detect to 120 pCi/L (well 699-13-13A), similar to the results from 2012. Well 699-13-3A is co-sampled with 300-FF and the well is associated with the 618-11 Burial Ground site. In 2013, technetium-99 was detected in two aquifer tubes in 200-PO, which monitor groundwater adjacent to the Columbia River. A concentration of 52 pCi/L was detected in aquifer tube C6384 (a decrease from the 73 pCi/L detection from 2012), and a concentration of 10.5 pCi/L in aquifer tube 86-M (similar to the prior sample result in 2007 of 7.1 pCi/L).

In the Ringold confined aquifer, technetium-99 was monitored in one well (699-42-42B located near the 216-B-3 Pond) in 2012. Technetium-99 was not detected in this well.

Basalt confined aquifer wells are not currently required to be analyzed for technetium-99 (TPA-CN-205) beneath 200-PO. Basalt confined wells were analyzed intermittently from 1988 to 2012 with only three very low concentration detections (one in 1988 [13.2 pCi/L in well 699-42-40C], one in 1994 [0.44 pCi/L in well 699-S11-E12AP], and one in 1995 [0.32 pCi/L in well 299-E16-1]).

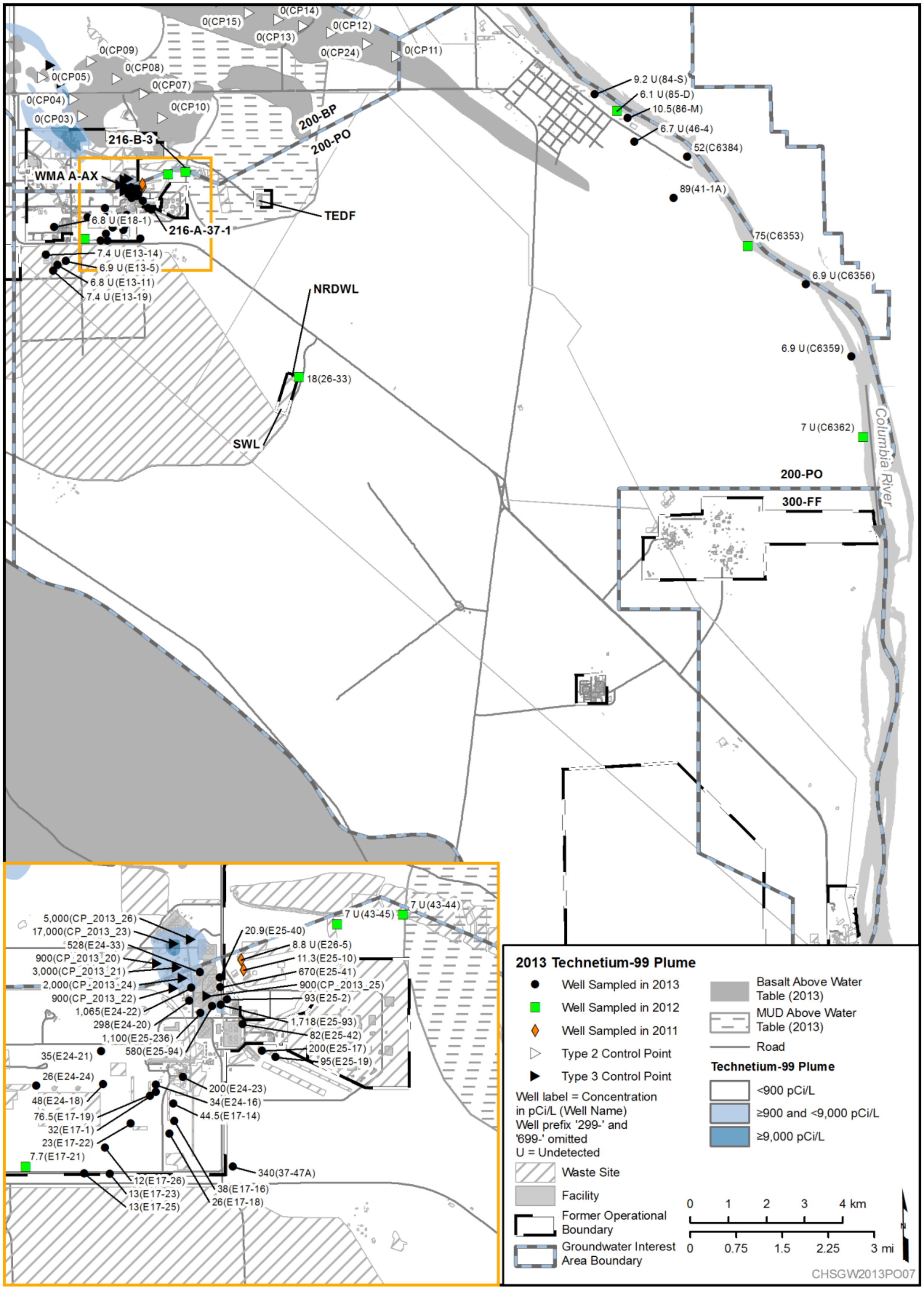

Figure PO.16 200-PO 2013 Technetium-99 Plume

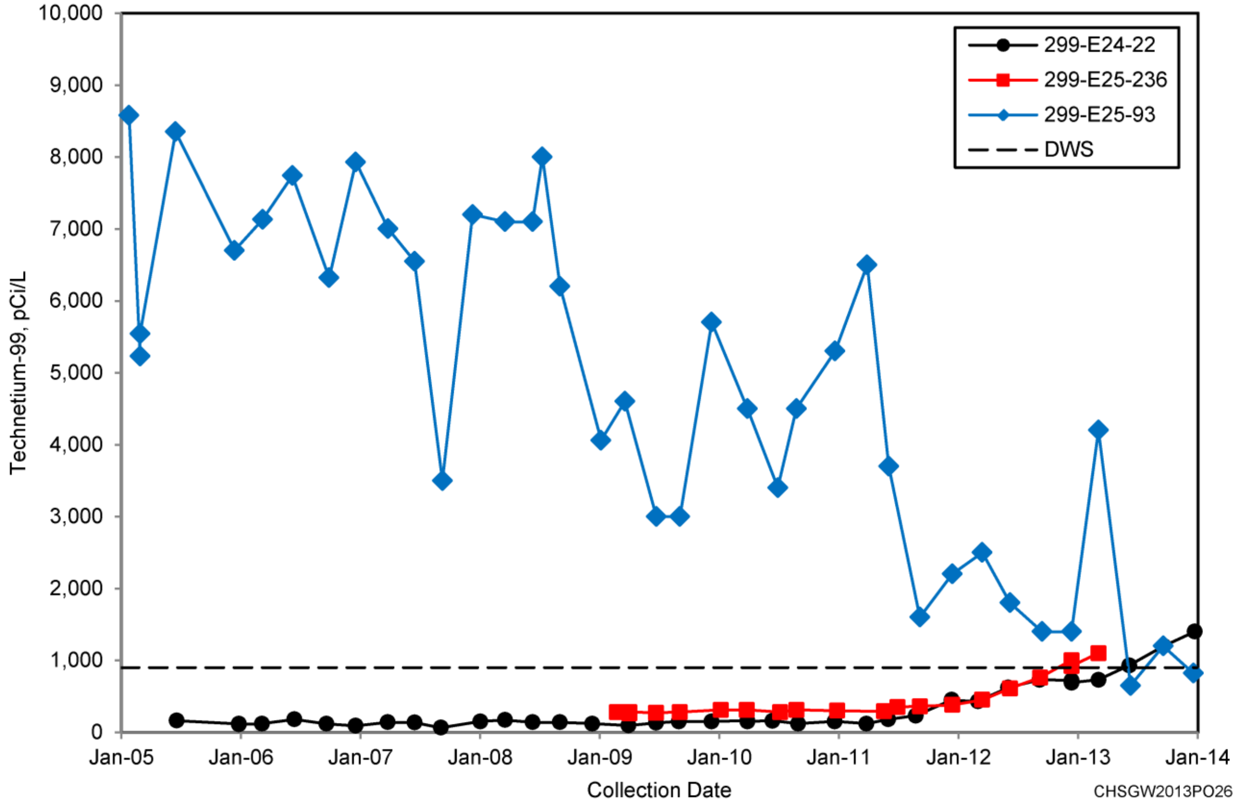

Figure PO.17 200-PO Technetium-99 Data for Wells 299-E24-22, 299-E25-236 and 299-E25-93

200-PO Uranium

Uranium has been identified historically as a relatively small plume (Figure PO.18) near the PUREX Cribs and trenches in the near field area and adjacent to the 618-10 burial ground located in the far field area (which is currently part of 300-FF).

In 2013, a concentration of uranium above the 30 µg/L DWS was detected in one well (299-E25-36 at a concentration of 58.5 µg/L compared to 59.9 µg/L in 2012). Uranium in well 299-E17-14 was detected above the DWS in 2012 at 36.9 µg/L and was detected at a concentration of 29.2 µg/L in 2013. The concentration of uranium in the third well detected above the DWS in 2012, 299-E24-23, was detected below the DWS in 2013 at a concentration of 3.0 µg/L. These wells are located near the PUREX cribs and trenches in the near field region. Uranium concentrations at well 299-E25-36 had been generally increasing since the late 1980s, but the concentration has been decreasing since 2010 (Figure PO.19). Uranium remains somewhat mobile in groundwater at 200-PO and the concentration changes observed are consistent with continued slow migration of uranium away from source areas. Uranium concentrations at well 299-E17-14 have been generally increasing since the early 1990s, with concentrations near the 30 µg/L DWS since 2006 (Figure PO.19).

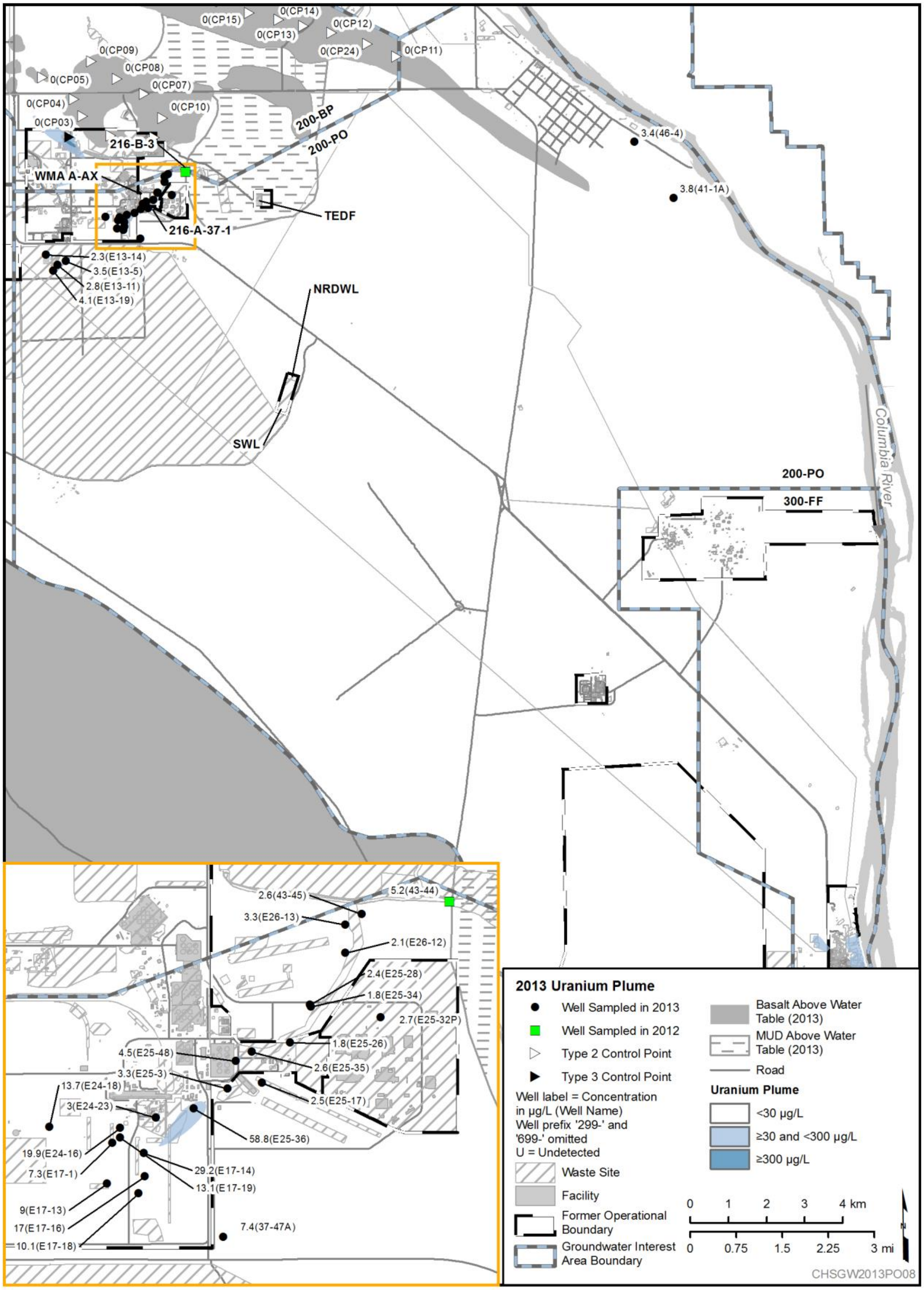

Figure PO.18 200-PO 2013 Uranium Plume

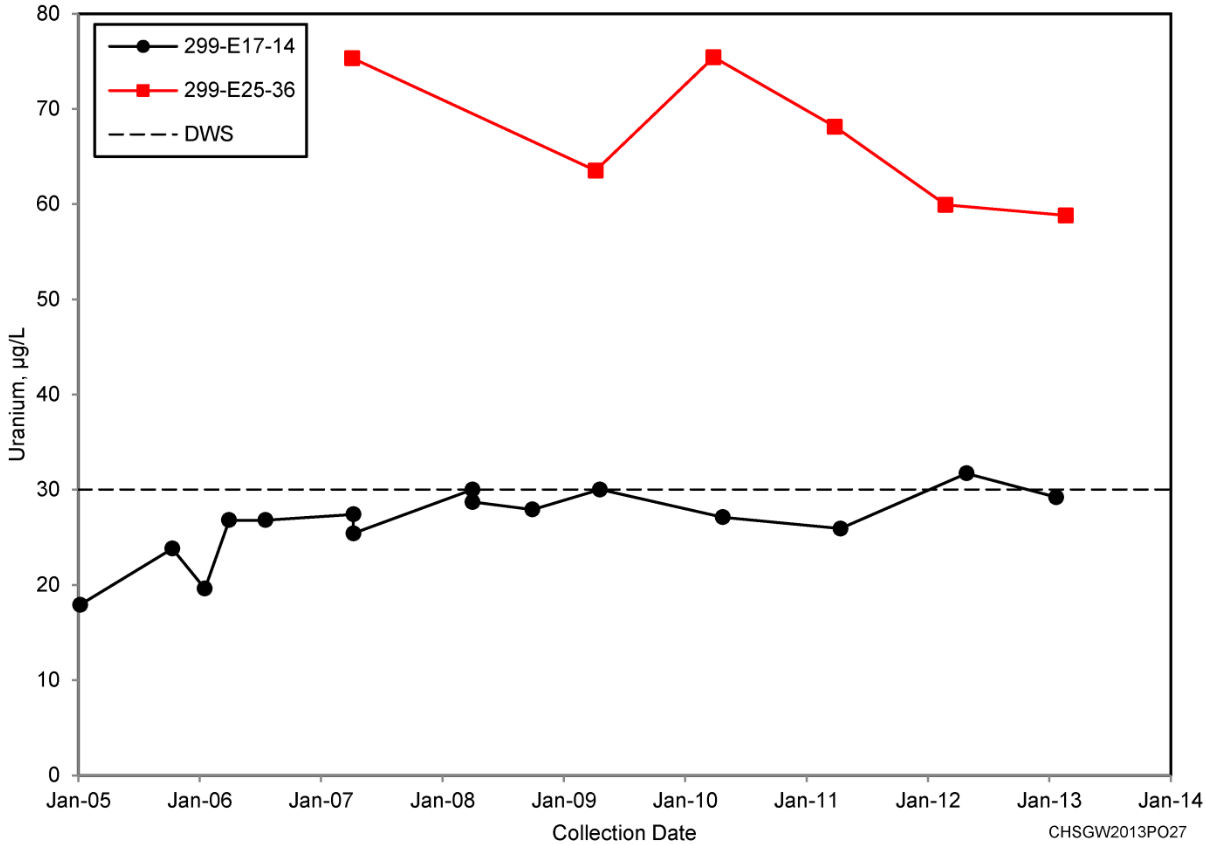

Figure PO.19 200-PO Uranium Data for Wells 299-E17-14 and 299-E25-36

200-PO Tetrachloroethene (PCE)

In 2013, tetrachloroethene (PCE) was detected in one sample each from two wells (699-24-33 and 699-24-34B) downgradient of the SWL, at concentrations of 1.1 and 1.0 µg/L, respectively. The two samples were "J" qualified by the laboratory. The laboratory "J" flag indicates that the value is estimated and the detection is uncertain, and the value reported is less than the reported detection limit (RDL) or practical quantitation limit (PQL), but greater than or equal to the method detection limit (MDL). Low-level detections of PCE were common in these wells and others near SWL before about 2007, but most results since then have been near or below detection limits.

200-PO Trichloroethene (TCE)

Trichloroethene (TCE) was only detected in two wells (699-10-54A and 699-S6-E4L) within 200-PO in 2013. Well 699-S6-E4L is primarily sampled as part of 300-FF in the vicinity of the 618-11 burial ground. TCE has been sampled in well 699-10-54A since 2006. The 2013 sample was the first detection of TCE in this well. The 2013 result was flagged "Q" related to issues with laboratory quality control samples, therefore the result may not be representative. Results for the SWL wells, 699-22-35, 699-23-34B, 699-24-33, 699-24-34A, 699-24-34B, 699-24-35 and 699-26-35A were flagged because the laboratory holding time was exceeded before the samples were analyzed.

200-PO AEA Monitoring

AEA monitoring for the 200-PO interest area is implemented through the CERCLA SAP (DOE/RL-2003-04 Rev. 1, as amended by TPA-CN-205). Additional AEA monitoring is described in RPP-PLAN-26534, *Integrated Disposal Facility Operational Monitoring Plan to Meet DOE Order 435.1*. Specific AEA monitoring that is part of the CERCLA SAP (DOE/RL-2003-04) includes monitoring of three water supply wells (499-S1-8J, 499-S0-7, and 499-S0-8) in the Hanford 400 Area. Well 499-S1-8J is the main water supply well, but occasionally wells 499-S0-7 and 499-S0-8 are used for water supply. Wells selected for AEA monitoring are shown in Figure PO.20.

400 Area. The 400 Area is located 16.2 kilometers southeast of 200 East Area. The 400 Area includes the Fast Flux Test Facility (FFTF), ancillary facilities, and waste sites. Monitoring is conducted to provide information on the potential impact of site-wide contamination (primarily tritium, nitrate, and iodine-129) on the water supply wells, which provide drinking water and emergency supply water for the 400 Area (Section 8.2.4 of DOE/RL-2011-119).

The wells have been sampled annually since 2009 for AEA monitoring including gamma scan, gross alpha, gross beta, iodine-129, strontium-90, technetium-99, and tritium, as well as additional analytes including ammonium, anions, metals (including uranium), and volatile organic compounds. However, sampling for the three wells was delayed until early 2014 due to coordination issues with the FFTF.

Elevated levels of tritium associated with the groundwater plume originating in the 200 East Area were identified in the 400 Area water supply wells. Well 499-S1-8J has lower tritium levels because it is screened at a greater depth (top of screen 61 meters below the water table) than the other two water supply wells (19 and 9 meters, respectively) (Figure PO.21). In the most recent sampling event from 2012, tritium was measured at levels below the DWS (20,000 pCi/L) in all three water supply wells. The maximum tritium concentration of 12,000 pCi/L in 2012 was detected in well 499-S0-8 during September 2012. Although tritium levels in wells 499-S0-7 and -8 have increased over the past two years, the concentrations remain below the DWS and are substantially lower than historical concentrations observed in these wells (e.g., greater than 80,000 pCi/L in the early to mid-1980s) (Figure PO.21).

Other constituents detected in samples collected from the 2012 sampling event included copper, gross alpha, gross beta, nitrate, technetium-99, thallium, and tritium. All of these constituents, except for gross beta, nitrate, and tritium, were found in relatively low concentrations, and all below DWSs. The gross beta results ranged up to 21 pCi/L in well 499-S0-8, which is the highest value that has been detected in this well. The next highest gross beta value detected in well 499-S0-8 was 14.9 pCi/L in 1988. Tritium (a beta emitter) also increased in this well from 2,700 pCi/L in 2011 to 12,000 pCi/L in 2012.

Integrated Disposal Facility (IDF). The IDF consists of an expandable, double-lined landfill with approximately 0.07 square kilometers (0.027 square miles) of liner. The landfill is divided into two distinct cells: (1) the east cell for the disposal of low-level radioactive waste, and (2) the west cell for the disposal of mixed waste. The landfill is not yet in use. It is a permitted RCRA facility and has additional groundwater sampling requirements under the AEA, as described in RPP-PLAN-26534. The plan describes sampling of two upgradient wells (299-E18-1 and 299-E24-24) and five downgradient wells (299-E17-22, 299-E17-23, 299-E17-25, 299-E17-26, and 299-E24-21) semiannually for gross alpha, gross beta, iodine-129, and technetium-99. However, in 2013 the wells were only sampled annually for these constituents. Gross alpha was detected in four of the wells (299-E17-22, 299-E17-23, 299-E17-26, and 299-E24-21) at concentrations ranging from 3.3 pCi/L (well 299-E17-23) to 4.8 pCi/L (well 299-E17-22), which is consistent with previous detections in these wells. Gross beta was detected in all of the wells at concentrations ranging from 7.7 pCi/L (well 299-E18-1) to 43 pCi/L (well 299-E24-21). The gross beta concentrations detected were higher than in 2012 in all of the wells except 299-E18-1. Iodine-129 concentrations ranged from non-detect (well 299-E18-1) to 0.63 pCi/L (well 299-E17-22). Technetium-99 concentrations ranged from non-detect (well 299-E18-1) to 35 pCi/L (well 299-E24-21).

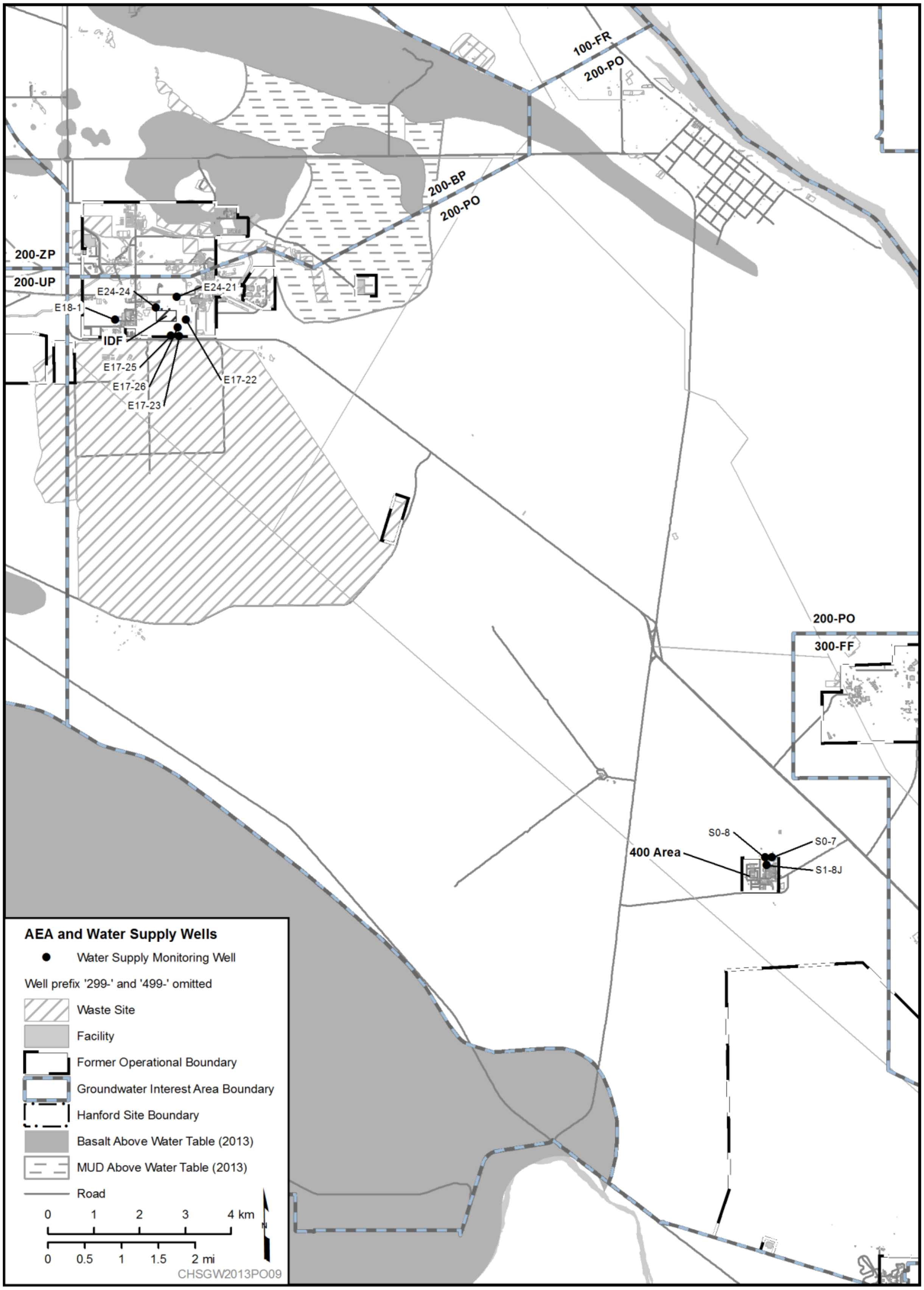

Figure PO.20 200-PO AEA Monitoring and Water Supply Well Locations

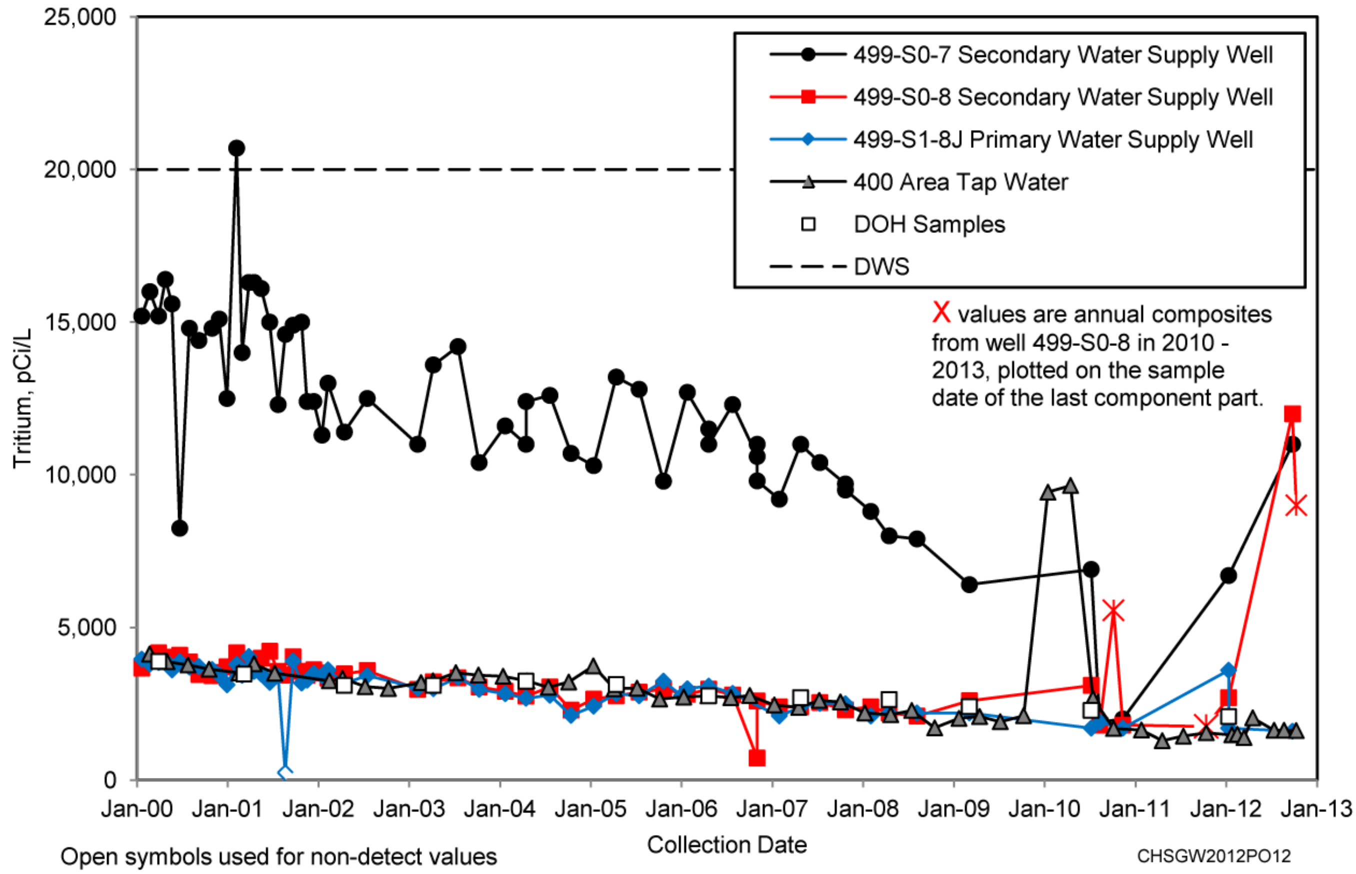

Figure PO.21 200-PO Tritium Data for Wells 499-S0-7, 499-S0-8, and 499-S1-8J and 400 Area Tap Water

200-PO RCRA – Introduction

The following describes the results of monitoring at seven individual waste management/disposal facilities within the 200-PO interest area, conducted in accordance with RCRA regulations (216-A-29, 216-A-36B, 216-A-37-1, 216-B-3, IDF, NRDWL, and WMA A-AX; Figure PO.1). Interim status groundwater quality assessment monitoring is conducted at WMA A-AX (40 CFR 265.93[d], as referenced by WAC 173-303-400). Interim status detection monitoring for indicator parameter evaluation is conducted at five sites: 216-A-29, 216-A-36B, 216-A-37-1, 216-B-3, and NRDWL (40 CFR 265.92, as referenced by WAC 173-303-400). The IDF is not operational but is monitored as incorporated into the Hanford Facility RCRA Permit (WA7890008967) to obtain baseline information.

200-PO RCRA – WMA A-AX

The WMA A-AX is located in the southeast quarter of the 200 East Area (Figure PO.22), and consists of ten underground storage tanks. Five of the ten single-shell tanks are assumed or confirmed to have leaked. Significant uncertainty is associated with the extent of contaminant migration from the tanks. Although none of the releases have been attributed with dangerous waste groundwater contamination, the site is in an interim-status assessment program because an indicator parameter, specific conductance, exceeded the critical mean value in 2005. The elevated specific conductance is associated with elevated nitrate at well 299-E25-9. In 2013, nitrate continued to exceed the DWS in well 299-E25-93 and increased above the DWS in well 299-E24-20. Nitrate in well 299-E24-20 exceeded the DWS previously in 2005, 2008, and 2010.

The well network was sampled quarterly to assess if dangerous waste/dangerous waste constituents are present in the groundwater, and if so the extent and rate of migration of the dangerous waste/dangerous waste constituents. In 2013, the wells were monitored in accordance with PNNL-15315. All of the wells were sampled quarterly, as required, during 2013 (Table B.67, Appendix B), with the following exceptions:

- Well 299-E25-236 was decommissioned on June 25, 2013, due to casing corrosion that was identified in November 2012 (DOE/RL-2013-22).
- The September sampling event was delayed for well 299-E25-94 until November because of a safety-related work stoppage on flush mount wells with electric pumps. The well was sampled by bailer in November, since that stop work was still in effect at that time.

Appendix B (Table B.67) includes a list of WMA A-AX wells and constituents monitored, and it indicates if the wells were sampled as scheduled. Results for the assessment parameters are provided in Table B.69 of Appendix B.

A television survey performed in 2012 identified accelerated casing corrosion in well 299-E25-236. The accelerated corrosion was observed above the water table in a zone between 80.2 and 81.48 meters below ground surface. Black staining was observed downward along the interior casing to the water table at 89 meters below ground surface. As a result the well was decommissioned in June 2013, and consequently was only sampled in 1 of 4 quarters in 2013. A replacement well is planned.

The WMA A-AX remained in assessment monitoring in accordance with 40 CFR 265.93[d], as referenced by WAC 173-303-400 during 2013. A revised assessment plan is recommended in order to review current conditions that may have contributed to the casing degradation at this well.

The groundwater flow direction in the unconfined aquifer is most likely to the southeast, based on slightly higher hydraulic heads to the northwest, the orientation of a southeast trending paleochannel in the area (DOE/RL-2011-118, Appendix E), and the configuration of the major contamination plumes. Due to uncertainty in the water table gradient in this area, and the high hydraulic conductivity of the Hanford sediments, the groundwater flow rate is indeterminate. Additional gradient network evaluation near WMA A-AX is currently ongoing to provide greater certainty in calculations of groundwater flow in this area. The depth of the water column in monitoring wells ranges from 1.3 to 11.7 meters. These wells all have adequate water columns in the screened interval for continued sampling (Table B.68, Appendix B).

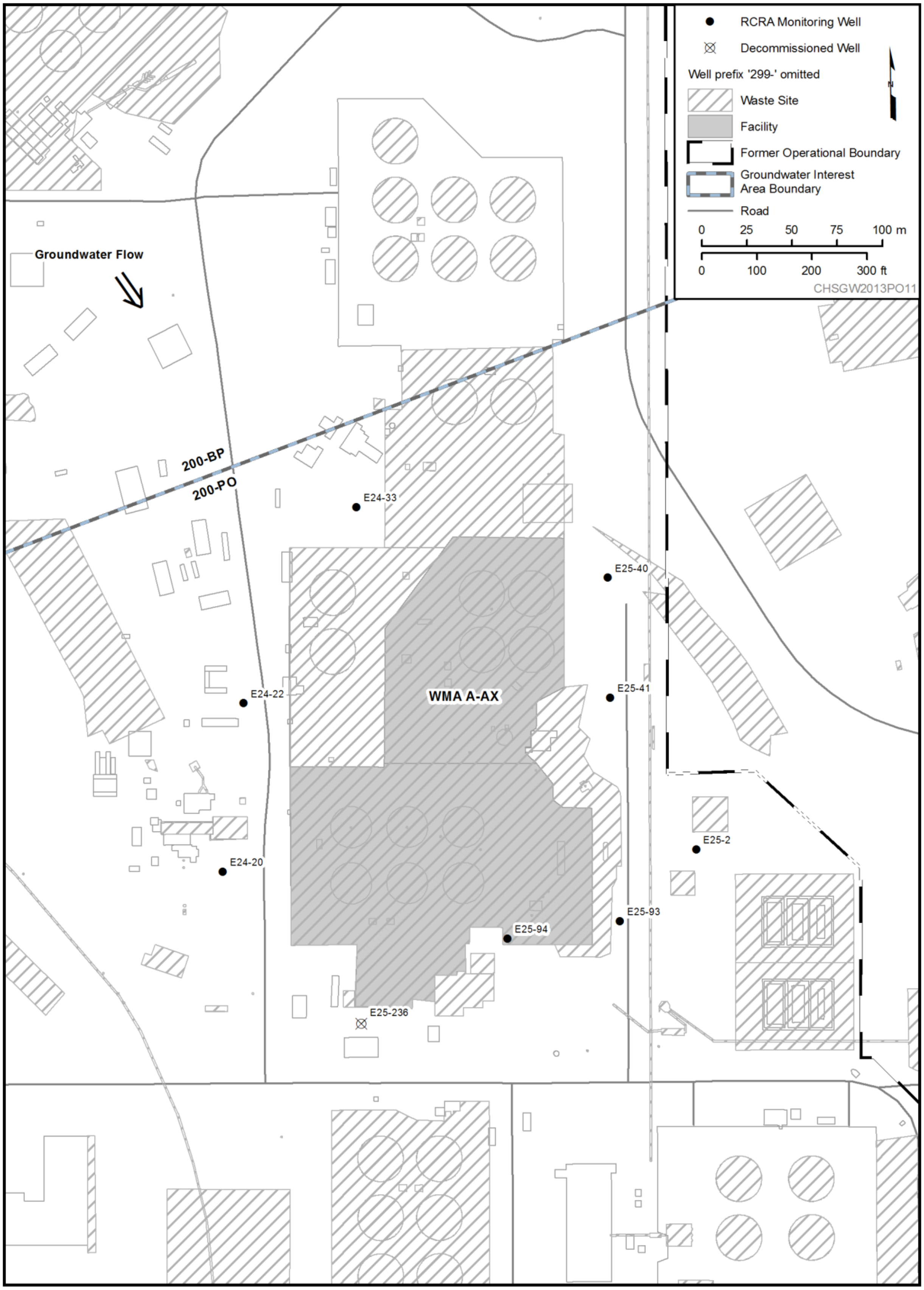

Figure PO.22 200-PO RCRA WMA A-AX Monitoring Well Locations

200-PO RCRA – 216-A-36B Crib

The 216-A-36B Crib is located in the southeastern portion of the 200 East Area (Figure PO.23) and is 7 meters deep, 150 meters long, and 2.3 to 3.4 meters wide at the base; the sides slope at 1:1.5. The crib was originally part of the 180 meter long 216-A-36 Crib which received PUREX effluent from September 1965 through March 1966. In March 1966, the northernmost 30 meters of the crib were isolated and a grout barrier was established between it and the southern portion of the crib, now known as 216-A-36B. 216-A-36B was operational from March 1966 through October 1972, and it was reactivated in November 1982 for the PUREX Plant restart. It was permanently removed from service in August 1987. The site received discharges of PUREX ammonia scrubber distillate totaling 2.9×10^8 liters.

Since January 2011, the 216-A-36B Crib has been monitored under interim status regulations to determine if dangerous waste constituents have impacted groundwater (DOE/RL-2010-93). Revision 1 of the plan was released in June 2011 to provide more detail pertaining to the constituent list and sampling frequency. Before 2011, the 216-A-36B Crib, along with two other PUREX Cribs (216-A-10 and 216-A-37-1), were monitored in a RCRA interim status groundwater quality assessment program. However, the 216-A-10 Crib was officially closed March 30, 2010, and was removed from Part A of the Hanford Facility Dangerous Waste Permit (WA7890008967). The two remaining cribs, 216-A-36B and 216-A-37-1, will remain in RCRA interim status but were returned to indicator evaluation programs because groundwater constituents detected were not dangerous wastes or dangerous waste constituents. Other nearby cribs also received PUREX waste (e.g., 216-A-45 Crib); however, these other cribs are not regulated as RCRA treatment, storage, and disposal units, but are monitored under CERCLA through the 200-PO-1 OU instead.

The 216-A-36B Crib network groundwater wells were monitored in 2013 semiannually for the RCRA indicator parameters of total organic carbon (TOC), total organic halides (TOX), pH, and specific conductance. Wells are also monitored annually for water quality parameters including alkalinity, anions (chloride, sulfate, and nitrate), metals (including calcium, magnesium, potassium, and sodium), phenols, temperature, and turbidity. Water level measurements are also collected semiannually. One upgradient well (299-E17-19) and three downgradient wells (299-E17-14, 299-E17-16, and 299-E17-18) are monitored for the site (Figure PO.23; Table B.19, Appendix B). Sampling details and site history are provided in DOE/RL-2010-93.

Sampling Results. The sampling was conducted as planned in 2013. No exceedances of the 2013 critical mean for specific conductance, TOC, or TOX were detected (Table B.21, Appendix B). Details regarding calculation of the critical mean values are provided in ECF-Hanford-13-0013 Rev. 1, *Calculation of Critical Means for Calendar Year 2013 RCRA Groundwater Monitoring.*

Two exceedances of the lower bound of pH were detected in 2013, during the January 2013 sampling event in well 299-E17-16 and during the July sampling event in well 299-E17-18. In both cases, verification sample results were collected and results of the verification samples were within the 2013 critical mean range for pH, and therefore the site remains in interim status detection monitoring.

Groundwater quality constituents monitored for the site include chloride, iron, manganese, nitrate, phenols, sodium, and sulfate. Samples for analyses of alkalinity, calcium, magnesium, and potassium are collected to support charge balance calculations for the calcium-bicarbonate type groundwater. The primary constituent of interest at the 216-A-36B Crib is nitrate because it is a breakdown product of nitric acid, which was disposed to the nearby 216-A-10 Crib. Nitrate concentrations in all four wells continue to exceed the DWS, and these exceedances are associated with a relatively large Central Plateau nitrate plume (Figure PO.10). A summary of water quality parameters is provided in Table B.22 of Appendix B.

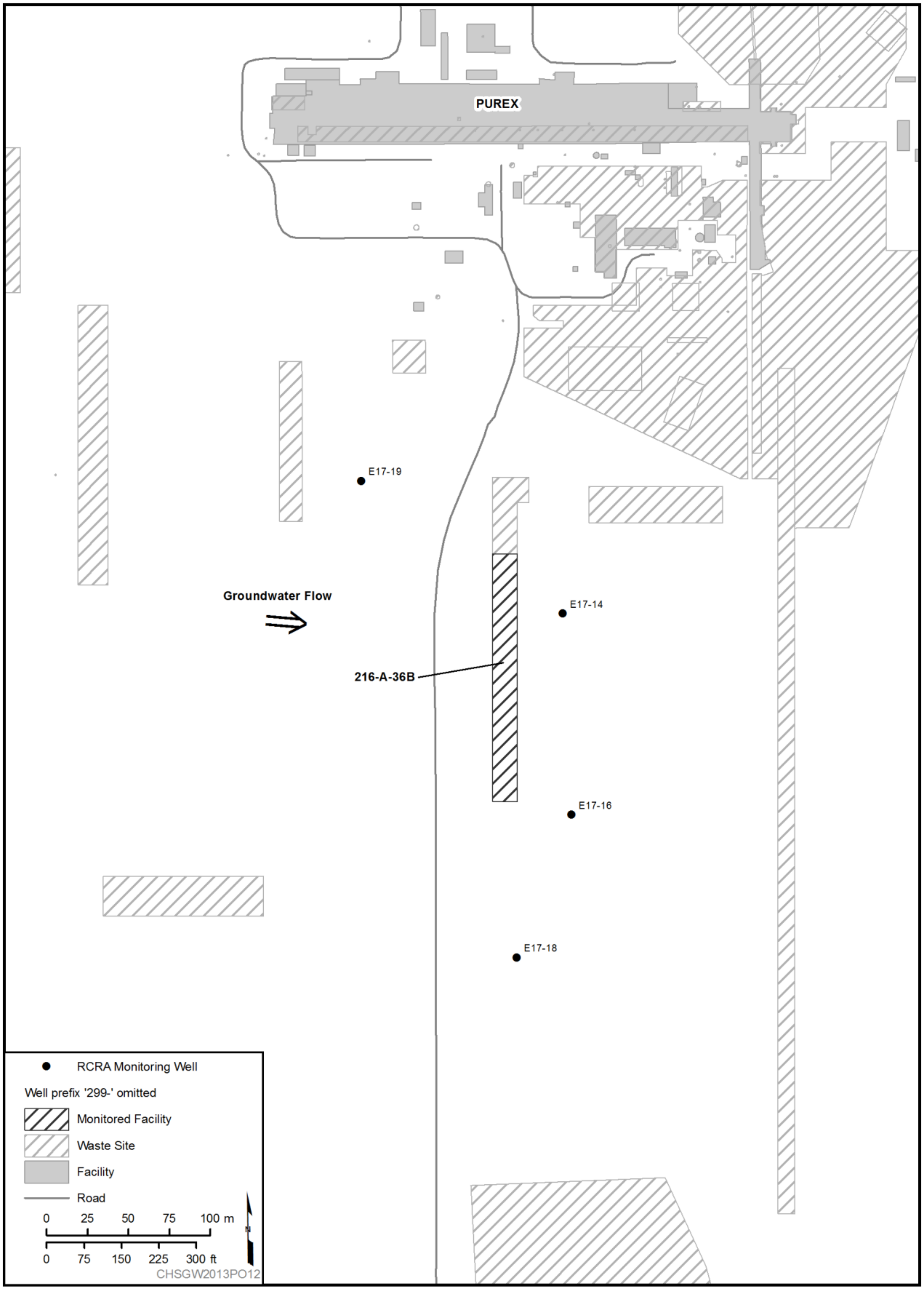

Figure PO.23 200-PO RCRA 216-A-36B Monitoring Well Locations

Water-Level and Well Network Evaluation. Beginning in 2008, efforts have been undertaken to improve the accuracy of the water level measurements and resultant estimates of groundwater gradient near the PUREX plant and associated waste sites. The results of these efforts, which include vertical offset surveys of well casings and high resolution water level measurements, are provided in Section 3.2 of DOE/RL-2011-01. The results of the data collection and analysis effort indicate the groundwater flow direction changed near the PUREX Cribs and IDF slightly during 2012. Trend-surface analysis of water-level measurements from June 16, 2008, through March 18, 2011, indicated an average hydraulic gradient magnitude of 2.2×10^{-5} ($\pm 0.3 \times 10^{-5}$) meters per meter with a northeast direction (64 (±12) degrees azimuth). Measurements between June 20, 2011, and December 31, 2012, indicated an average hydraulic gradient magnitude of 2.4×10^{-5} ($\pm 0.2 \times 10^{-5}$) meters per meter with an easterly direction (95 (±5) degrees azimuth), indicating a change in flow from east-northeast to east. The well network for the trend-surface analyses extended from the west side of IDF to east and southeast of the 216-A-36B Crib. The trend-surface analysis results, indicating an east flow direction, represent the average hydraulic gradient beneath this region. However, near the edge of the study area, the groundwater flow appears to be rotating toward the southeast. Therefore, near the 216-A-36B Crib the groundwater flow direction is less certain, and may be southeast. Additional data collection efforts continue to better define hydraulic gradients near the PUREX cribs area. The groundwater flow rate is calculated to range between 0.001 and 0.7 meters per day (Table B.1 in Appendix B).

Based on the current groundwater flow interpretations, the 216-A-36B Crib well network is capable of meeting the groundwater monitoring objectives to determine if groundwater has been impacted with dangerous waste constituents. Table B.20 in Appendix B summarizes water-level information for the 216-A-36B monitoring network.

200-PO RCRA – 216-A-37-1 Crib

The 216-A-37-1 Crib is located east of the 200 East Area (Figure PO.24) and is 5.2 meters deep, 213 meters long, and 33 meters wide at the base; the sides slope at 1:1. The crib was operational from March 1977 through April 1989 and was used for percolation of 242-A evaporator process condensate to the soil column. The crib received spent halogenated and non-halogenated solvents and ammonia. During its operational life, the 216-A-37-1 Crib received a total of 3.7×10^{8} liters of process condensate.

Since January 2011, the 216-A-37-1 Crib has been monitored under interim status regulations to determine if dangerous waste constituents have impacted groundwater (DOE/RL-2010-92). Revision 1 of the plan was released in June 2011 to provide more detail pertaining to the constituent list and sampling frequency. Before 2011, the 216-A-37-1 Crib, along with two other PUREX Cribs (216-A-10 and 216-A-36B), were monitored in a RCRA interim status groundwater quality assessment program. However, the 216-A-10 Crib was officially closed March 30, 2010, and was removed from Part A of the Hanford Facility Dangerous Waste Permit (WA7890008967). The two remaining cribs, 216-A-36B and 216-A-37-1, will remain in RCRA interim status but were returned to indicator evaluation programs because groundwater constituents detected were not dangerous wastes or dangerous waste constituents. Other nearby cribs also received PUREX waste (e.g., 216-A-45 Crib); however, these other cribs are not regulated as RCRA treatment, storage, and disposal units, but are monitored under CERCLA through the 200-PO-1 OU instead.

The 216-A-37-1 Crib network groundwater wells are monitored semiannually for RCRA indicator parameters of TOC, TOX, pH, and specific conductance, as well as temperature and turbidity. Wells are also monitored annually for water quality parameters including alkalinity, anions (chloride and sulfate), metals (including calcium, iron, manganese, magnesium, potassium, and sodium), and phenols. Water level measurements are also collected semiannually. Sampling details and site history are described in DOE/RL-2010-92. One upgradient well (299-E25-47) and three downgradient wells (299-E25-17, 299-E25-19, and 299-E25-20) are monitored for the site (Figure PO.24; Table B.23, Appendix B).

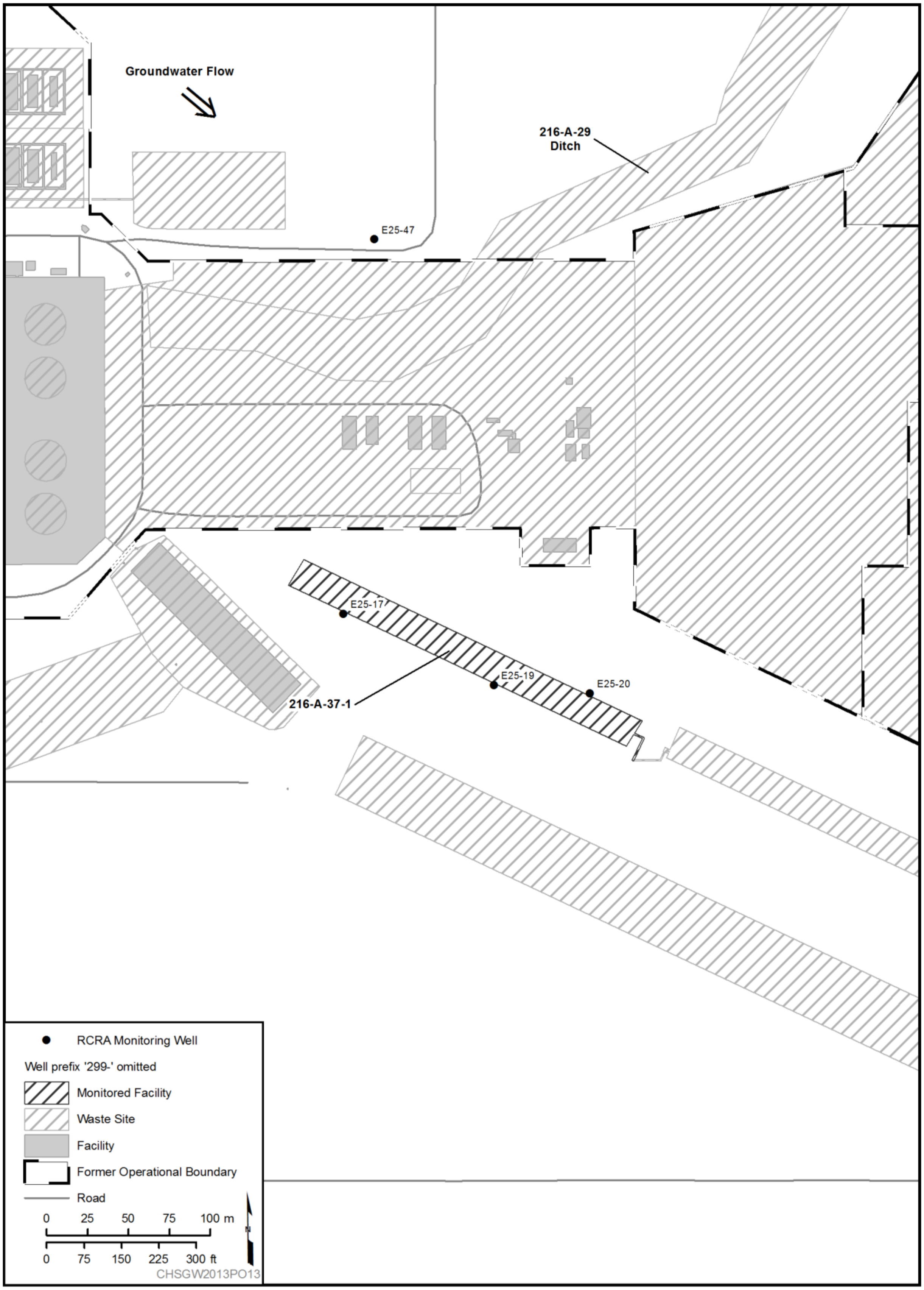

Figure PO.24 200-PO RCRA Facility 216-A-37-1 Monitoring Well Locations

Sampling Results. The sampling events were conducted as planned in 2013. RCRA indicator parameters did not exceed the 2012 critical mean values for specific conductance, TOC, and TOX (Table B.25, Appendix B). Details regarding calculation of the critical mean values are provided in ECF-Hanford-13-0013 Rev. 1, *Calculation of Critical Means for Calendar Year 2013 RCRA Groundwater Monitoring*.

The mean of the quadruplicate pH measurements in downgradient well 299-E25-19 from the July 2013 sampling event was below the critical mean range. Verification sampling was initially delayed until September due to a stop work on wells with electrical submersible pumps. The initial attempt at verification sampling in September 2013 was unsuccessful due to binding of the pump shaft during sampling. Successful verification sampling was performed in November 2013. The average of two sets of quadruplicate pH measurements were within the 2013 critical mean range, and therefore the site remains in interim status detection monitoring.

The highest specific conductance in 2013 was detected in downgradient well 299-E25-17. The highest TOC concentrations for 2013 were detected in downgradient well 299-E25-19. The highest TOX concentrations were detected in upgradient well 299-E25-47.

Groundwater quality constituents monitored for the site include chloride, iron, manganese, phenols, sodium, and sulfate (Table B.26 in Appendix B). Samples for analyses of alkalinity, calcium, magnesium, and potassium are collected to support charge balance calculations for the calcium-bicarbonate type groundwater. Manganese continues to intermittently exceed the secondary DWS in wells 299-E25-19 and 299-E25-20.

Water-Level and Well Network Evaluation. Near the 216-A-37-1 Crib, groundwater flow is estimated to be toward the southeast. Flow directions are influenced by a northwest-southeast trending paleochannel with high permeability Hanford formation sediments near the crib, the Ringold lower mud unit at the water table east of the 200 East Area, and the higher water table elevations to the west and north. These flow directions are supported mainly by the distribution of plumes emanating from near these cribs and recent efforts to improve the accuracy of water-level measurements in the southeastern portion of the 200 East Area (see 200-PO - 216-A-36B section). The gradient magnitude is assumed to be similar to the nearby IDF and 216-A-36B Crib, which is 2.4×10^{-5} meters per meter (see 200-PO - 216-A-36B section), and the groundwater flow rate ranges between 0.001 and 0.36 meters per day (Table B.1 in Appendix B). Additional gradient network evaluation near 216-A-37-1 is currently being conducted to provide greater certainty in calculations of groundwater flow in this area.

Based on the currently groundwater flow interpretations, the 216-A-37-1 Crib well network is capable of meeting the groundwater monitoring objectives to determine if groundwater has been impacted with dangerous waste constituents. Table B.24 in Appendix B summarizes water-level data for the monitoring network.

200-PO RCRA – 216-A-29 Ditch

The 216-A-29 Ditch is located just east of the 200 East area fence line (Figure PO.25) and is planned for closure. It is a regulated unit because it received nonradioactive dangerous waste regulated by 40 CFR 261, *Identification and Listing of Hazardous Waste*, after November 19, 1980. The 216-A-29 Ditch is regulated as a surface impoundment, as defined in WAC 173-303-400. The ditch was excavated to convey liquid effluent from the PUREX chemical sewer to the B Pond and was placed in service in November 1955. Flow from the chemical sewer (low-level contaminants) was continuous, with an average flow of 3,671 liters per minute. The 216-A-29 Ditch received continuous discharge of corrosive waste and potentially hazardous spilled chemical materials from the PUREX Plant. The most significant chemical discharges included acidic and caustic effluents associated with backwashing for the regeneration of demineralizer columns. The ditch also received spills from the PUREX Plant chemical sewer (low-level contamination). A complete, estimated inventory of materials discharged to the 216-A-29 Ditch is provided in WHC-SD-EN-AP-045, Appendix A.

The 216-A-29 Ditch is currently backfilled with material from the ditch sides and spoils piles in the bottom. The portion of the 216-A-29 Ditch inside the 200 East Area security fence was brought to grade with clean material. The portion of the ditch outside of the 200 East Area security fence was topped with clean material in a series of 11 terraces progressing down the length of the ditch. Both areas have been revegetated and appropriately signed (the 216-A-29 Ditch is an underground radioactive material area).

In accordance with WAC 173-303-400 and 40 CFR 265.92, the 216-A-29 Ditch network groundwater wells are monitored semiannually for RCRA indicator parameters of TOC, TOX, pH, and specific conductance. Wells are also monitored annually for water quality parameters including alkalinity, anions (chloride, fluoride, sulfate, nitrate, and nitrite), metals (including calcium, iron, manganese, magnesium, potassium sodium), oxidation/reduction potential, phenols, temperature, and turbidity. Water level measurements are collected semiannually. Sampling details and site history are described in DOE/RL-2008-58. The current monitoring well network includes three upgradient wells (299-E26-12, 299-E26-13, 699-43-45) and six downgradient wells (299-E25-26, 299-E25-28, 299-E25-32P, 299-E25-34, 299-E25-35, and 299-E25-48) (Figure PO.25; Table B.15, Appendix B). Historically, well 699-43-45 has served as an upgradient well for the 216-A-29 Ditch. With the continual shift in groundwater flow direction from the southwest to the southeast, this well is no longer upgradient of the unit. Wells 299-E26-12 and 299-E26-13, which have always been included in the network, became the new upgradient wells starting in 2011.

The monitoring network was sampled as planned in 2013 with the following exceptions. One sample event (originally planned for April) was delayed for well 299-E25-26 as a result of pump issues and work restrictions because of overhead power lines. Prior to the delayed sampling event in September, the well had not been successfully sampled since 2009; despite several unsuccessful attempts to sample the well. In the March sampling event, quadruplicate measurements of pH and specific conductance were not collected for well 299-E25-34. The well was re-sampled in July for collection of the quadruplicate samples.

Sampling Results. As shown in Table B.17 of Appendix B, no exceedances of the critical mean for pH or TOC were detected during 2013.

The critical mean for specific conductance was exceeded in downgradient wells 299-E25-35 and 299-E25-48 during both 2013 sampling events. The critical mean for specific conductance in well 299-E25-35 has been exceeded since the early 1990s and has been exceeded in well 299-E25-48. A groundwater assessment for the specific conductance detected was performed in the early 1990s as described in WHC-SD-EN-EV-032, Rev. 0. The assessment concluded that the specific conductance exceedance at the site was caused by elevated calcium, sodium, and sulfate.

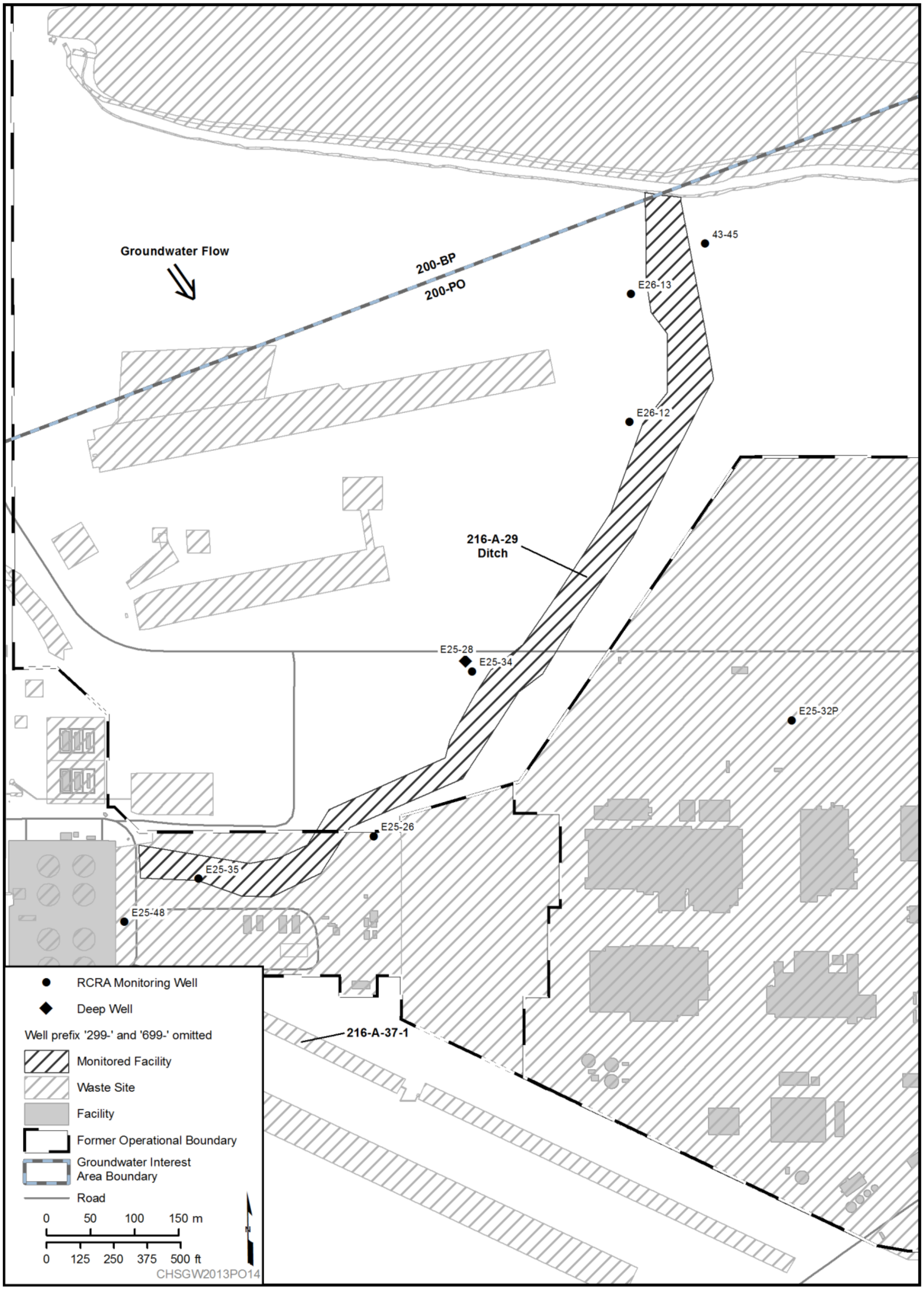

Figure PO.25 200-PO RCRA Facility 216-A-29 Monitoring Well Locations

Due to the number of non-detects in upgradient wells, a 2013 critical mean was not calculated for the total organic halides. In lieu of a critical mean, sampling results were compared to the laboratory limit of quantitation (LOQ). The mean of quadruplicate samples collected from well 299-E25-48 for the April 2013 sampling event exceeded the second quarter LOQ for TOX sampling results. Verification sampling for TOX in the well was conducted in June 2013. Results from two sets of quadruplicate measurements for TOX from the June 2013 were below the second quarter LOQ and therefore the site remained in interim status detection monitoring. The two detections that contributed to the TOX critical mean exceedance in April were later rejected after a data review process.

Samples for analyses of alkalinity, anions (chloride, fluoride, nitrate, nitrite, and sulfate), and metals (calcium, magnesium, and potassium) are collected to support charge balance calculations for groundwater, if needed (Table B.18 in Appendix B). Iron has intermittently exceeded the secondary DWS in well 299-E25-32P, but did not exceed the secondary DWS in 2013. The most recent exceedance in well 299-E25-32P prior to 2012 was in 1995. Similarly, manganese continues to exceed the secondary DWS intermittently in well 299-E25-19, with the last exceedance in 1995, but did not exceed the DWS in 2013.

Water-Level and Well Network Evaluation. Near the north end of the ditch and immediately west and north of the 216-A-29 Ditch and the adjacent 216-B-3 Pond, flow in the unconfined aquifer is south to southwest (Figure 2-4, DOE/RL-2008-59). Further east of the 216-A-29 Ditch, groundwater flow is more generally to the southeast. The magnitude of the water table gradient at the 216-A-29 Ditch is assumed to be similar to that at the PUREX Cribs and IDF at 2.4×10^{-5} meters per meter (see 200-PO, 216-A-36B section) with a southeastern flow direction interpreted from plume maps. Based on the current groundwater flow interpretation, the current network was capable of monitoring the 216-A-29 Ditch throughout 2013. The average flow velocities range from 0.001 to 0.004 meters per day (Table B.1, Appendix B). Similar to the 216-A-37-1 Crib and WMA A-AX, additional gradient network evaluation near 216-A-29 is currently ongoing to provide greater certainty in calculating groundwater flow direction in this area. Table B.16 of Appendix B summarizes water-level data for the monitoring network.

200-PO RCRA – 216-B-3 Pond

The inactive 216-B-3 Pond was located east of the 200 East Area (Figure PO.26). The location was within a natural topographic depression. During operations, the pond covered approximately 40 acres with a depth of up to 6.1 meters. Total discharge to the pond since 1945 is estimated to have exceeded 1.0×10^{12} liters (260 billion gallons) (PNNL-15479). Waste streams sent to the pond during active operations included steam condensate and process cooling water from the 221-B Building; 284-E Powerhouse water; 244-AR and 244-CR Vaults cooling water; 242-A Evaporator cooling water; 202-A Building process cooling water; condenser cooling water and air sampling vacuum pumps seal cooling water; 241-BY Tank Farm condenser cooling water; Waste Encapsulation and Storage Facility cooling water; 241-AY and 242-AZ surface condenser; chemical storage and makeup tank overflows; and demineralizer recharge effluents. Several hazardous, nonradioactive discharges reached the 216-B-3 Pond through the 216-A-29 Ditch. Associated compounds included demineralizer regenerate; aqueous makeup tank heels; off-specification batches; N cell prestart testing (oxalic acid, nitric acid, hydrogen peroxide, calcium nitrate); potassium permanganate; sodium carbonate solution; hydrazine solution; potassium hydroxide; sodium nitrate, sodium hydroxide; cadmium nitrate; and sodium nitrite. The B Pond is classified as a treatment, storage, and disposal unit because it received dangerous waste after implementation of dangerous waste regulations. The dangerous waste received came from three primary sources: corrosive and dangerous waste resulting from regeneration of demineralizer columns at PUREX, spills of dangerous or mixed waste from PUREX and other facilities, and off-specification chemical makeups at PUREX. The last known reportable discharge of chemical waste, sodium nitrite, occurred in 1987.

In accordance with WAC 173-303-400 and 40 CFR 265.92, the 216-B-3 Pond network groundwater wells are monitored semiannually for RCRA indicator parameters of TOC, TOX, pH, and specific conductance. Wells are also monitored annually for water quality parameters including chloride, iron (unfiltered), manganese (unfiltered), phenols, sodium, and sulfate. Water level measurements are also collected semiannually. Sampling details and site history are described in DOE/RL-2008-59. The well network in 2013 consists of one upgradient (699-44-39B) and three downgradient wells (699-42-42B, 699-43-44, and 699-43-45) (Figure PO.26; Table B.27, Appendix B). The wells were sampled semiannually, as required, during 2013.

Sampling Results. As shown in Table B.29 in Appendix B, no exceedances of the critical mean for pH, specific conductance, or TOX were detected at the site in 2013. With respect to TOC, no exceedances of the 2013 critical mean were detected for sampling events specific to the 216-B-3 Pond. However, well 699-43-45 is also sampled as part of the 216-A-29 RCRA monitoring network. During the October sampling event for the 216-A-29 Ditch, the TOC detected in well 699-43-45 was above the critical mean for the 216-B-3 Pond. TOC results from October were generally high for samples collected at Hanford. Verification results are pending for the October 2013 exceedances of the 216-B-3 Pond TOC critical mean.

Groundwater quality constituents monitored for the site include chloride, iron (unfiltered), manganese (unfiltered), phenols, sodium (unfiltered), and sulfate (Table B.30 in Appendix B). No groundwater quality constituents exceeded the respective DWS in 2013. Additional contaminants of interest monitored for the site include arsenic (filtered and unfiltered), cadmium (filtered and unfiltered), and nitrate.

Samples for analyses of alkalinity, anions (chloride, fluoride, nitrate, nitrite, and sulfate), and metals (calcium, magnesium, and potassium) are collected to support charge balance calculations for groundwater, if needed. Additional supporting constituents monitored for the site include dissolved oxygen, temperature, and turbidity.

Water-Level and Well Network Evaluation. The monitoring network, as defined in DOE/RL-2008-59, consists of one upgradient and three downgradient wells, based on a groundwater flow direction to the west (see Section 2.4 of DOE/RL-2008-59). The 2013 flow rate is estimated to be 0.006 meter per day to the southwest. The network well screens range from 0.6 to 5.5 meters into the aquifer. These current network wells have adequate water columns in the screened interval available for sampling (Table B.28 in Appendix B).

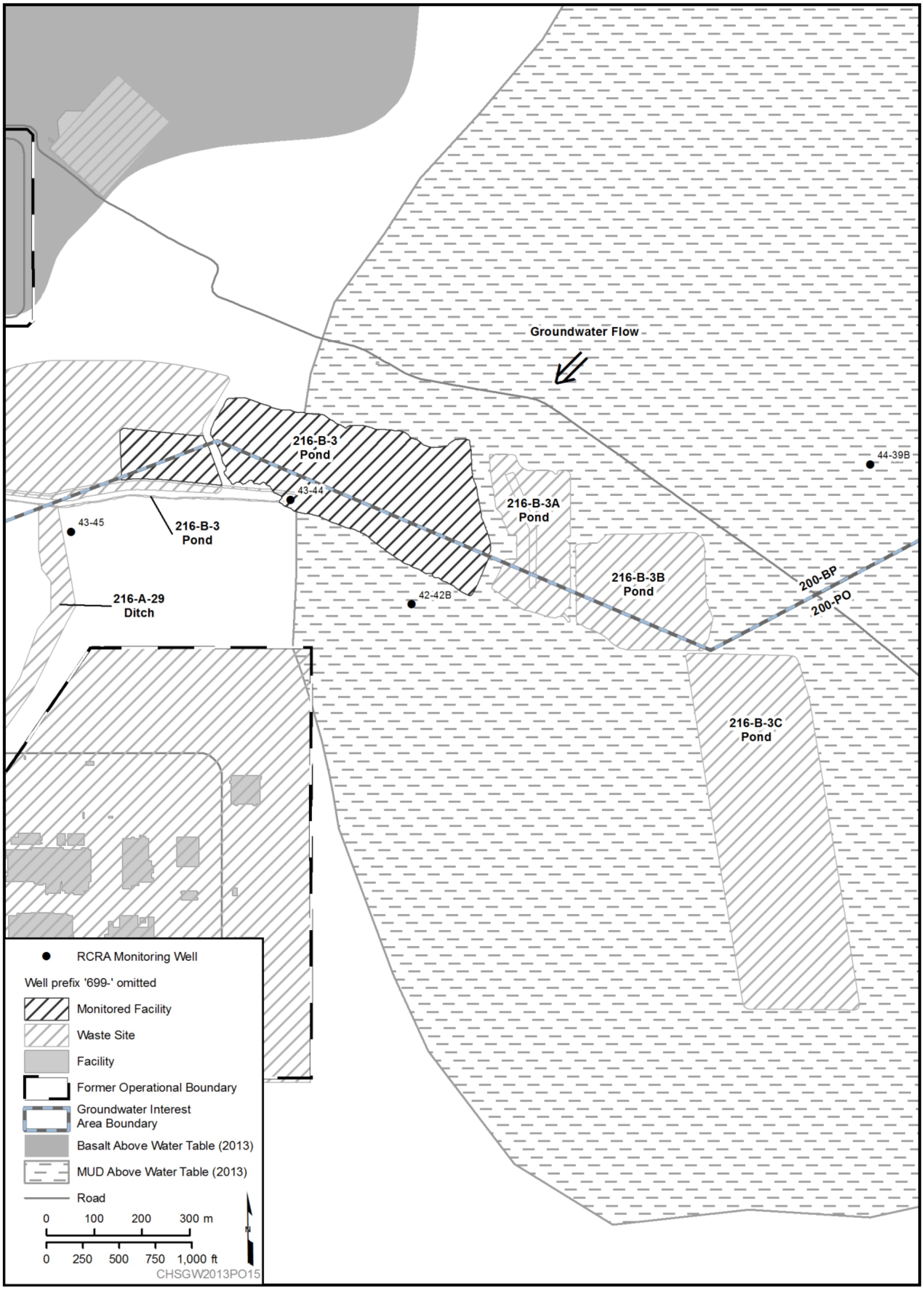

Figure PO.26 200-PO RCRA Facility 216-B-3 Monitoring Well Locations

200-PO RCRA – Integrated Disposal Facility (IDF)

The IDF consists of an expandable, double-lined landfill with approximately 0.07 square kilometers (0.027 square miles) of liner. The landfill is divided into two distinct cells: (1) the east cell for the disposal of low-level radioactive waste, and (2) the west cell for the disposal of mixed waste. The landfill is not yet in use.

Construction of the first phase for IDF was completed in April 2006 (Figure PO.27). DOE submitted a Part B RCRA Permit application to Washington State Department of Ecology (Ecology), which was incorporated into the Hanford Facility RCRA Permit (WA7890008967) on April 9, 2006. The start date for IDF operations has not been determined. IDF is currently monitored as part of a detection monitoring program as described in Section III.11.E.1.b of 10-EMD-0080. The wells are monitored annually for the following indicator parameters: chromium (filtered), pH, specific conductance, TOC, and TOX. In addition, groundwater is monitored for supplemental constituents of alkalinity, anions, metals, and turbidity. Based on the current easterly groundwater flow direction, the monitoring network consists of two upgradient wells (299-E18-1 and 299-E24-24), one side-gradient well (299-E24-21) and four downgradient wells (299-E17-22, 299-E17-23, 299-E17-25, and 299-E17-26) (Figure PO.27; Table B.41, Appendix B). Since the facility is not yet operational, the current monitoring objective is to collect baseline groundwater information. All seven network wells were sampled as scheduled during 2013.

Sampling Results. A summary of the 2013 indicator parameter results is provided in Table B.43 of Appendix B. No upgradient/downgradient comparisons are required because the facility is not yet in use. With respect to the supplemental constituents, nitrate exceeded the DWS during 2013 in four wells at the IDF (299-E17-22, 299-E17-25, 299-E17-26, and 299-E24-24), and the results are comparable to previous years. The maximum nitrate concentration was 59.8 mg/L in well 299-E17-22. This well is in the regional 200 East Area nitrate plume. Vanadium concentrations measured in the IDF network wells ranged from 7.3 µg/L in well 299-E18-1 to 23.2 µg/L in well 299-E17-25. These concentrations exceeded the Model Toxics Control Act (MTCA) Method B value for vanadium in groundwater of 1.1 µg/L.

Water-Level and Well Network Evaluation. Beginning in 2008, data collection efforts were started to improve the accuracy of the water-level measurements so that the groundwater flow direction beneath the PUREX Cribs and the nearby IDF could be evaluated in greater detail (Section 3.2 of DOE/RL-2011-01).

The results of the data collection and analysis effort indicate the groundwater flow direction changed near the PUREX cribs and IDF slightly during 2012. Trend-surface analysis of water-level measurements from June 2008 through March 2011 indicated an average hydraulic gradient magnitude of 2.2×10^{-5} ($\pm 0.3 \times 10^{-5}$) meters per meter with a east-northeast direction (64 (±12) degrees azimuth). Measurements between June 2011 and December 2012, indicated an average hydraulic gradient magnitude of 2.4×10^{-5} ($\pm 0.2 \times 10^{-5}$) meters per meter with an eastern direction (95 (±5) degrees azimuth), a calculated change in flow direction from east-northeast to east.

The interpreted hydraulic gradient of 2.4×10^{-5} meters per meter toward the east (95 (±5) degrees azimuth) is believed to be representative for the IDF. The groundwater flow rate is estimated to range from 0.005 to 0.02 meters per day (Table B.1, Appendix B). The interpreted groundwater flow direction has changed since the network was initially planned (i.e., it was formerly toward the southeast); however, based on current groundwater flow interpretations, the monitoring network is still considered adequate. Work is currently underway to continue to better define groundwater flow in the area of IDF and the PUREX cribs. Table B.42 in Appendix B summarizes water-level data for this facility.

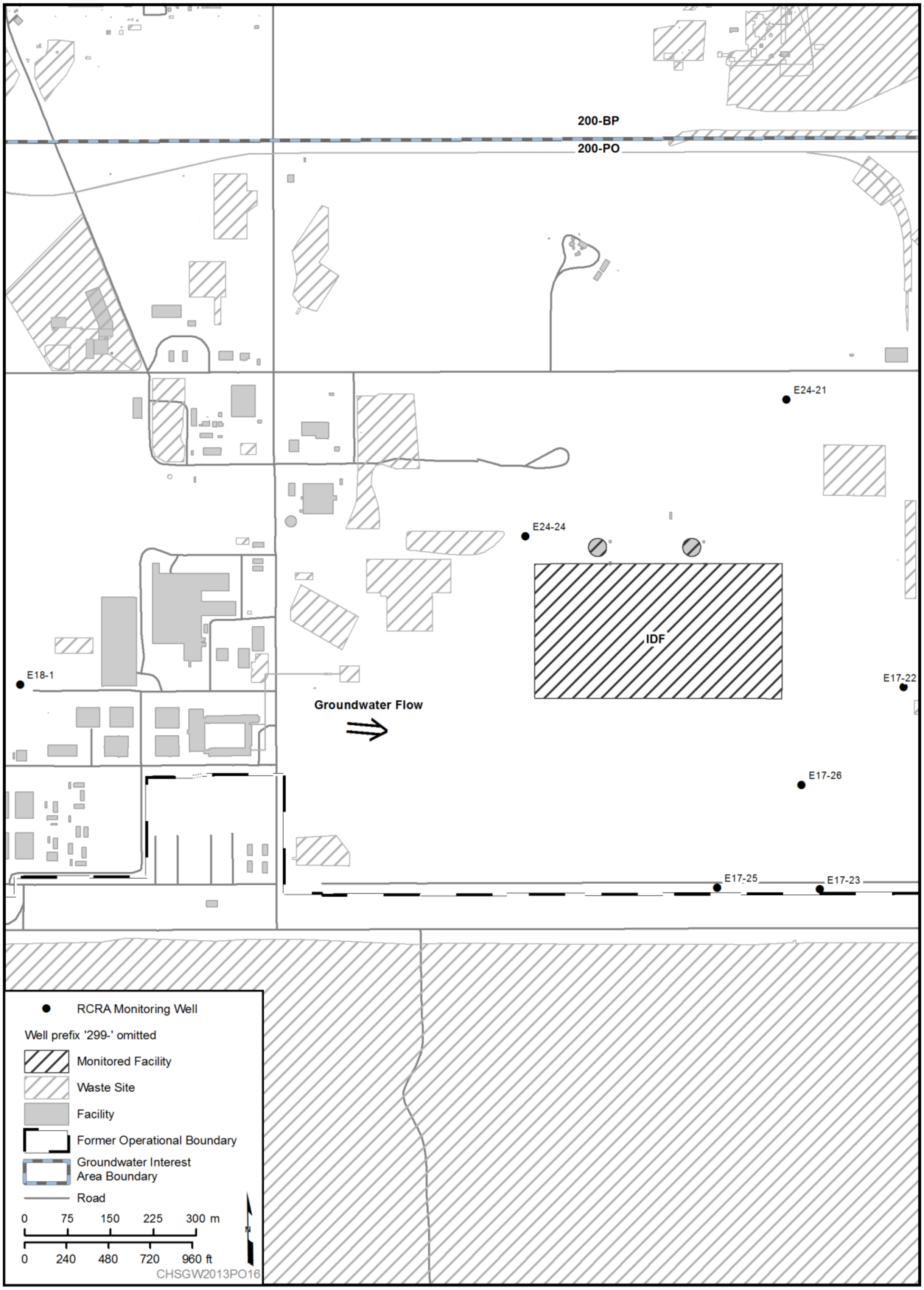

Figure PO.27 200-PO RCRA Facility IDF Monitoring Well Locations

200-PO RCRA – NRDWL

The NRDWL is located southeast of the 200 East Area next to the SWL (Figure PO.28). The landfill has an area of 0.045 square kilometers (0.017 square miles) consisting of 19 parallel unlined trenches, each approximately 122 meters long, 4.9 meters wide at the base, and 4.6 meters deep. The landfill received chemical waste, asbestos, and nonhazardous waste between 1975 and 1985.

The NRDWL is underlain by approximately 40 meters of surface and subsurface materials above the water table (vadose zone), which is composed of sand, silty-sandy gravel, and gravel of the Hanford formation. The uppermost aquifer below the water table consists of approximately 9 meters of additional Hanford formation, 8 meters of the Cold Creek unit (a pre-Missoula gravel deposit), and 6 meters of undifferentiated Ringold Formation sandy gravel. Below the 6 meters of Ringold Formation sandy gravel is a low-permeability unit composed of silt and silty sand that forms the base of the unconfined aquifer locally. Detailed geology of the 200 East Area is shown in Figure PO.2.

The objective of RCRA monitoring at the NRDWL is to determine if dangerous waste constituents from the landfill have contaminated groundwater (40 CFR 265.92, as referenced by WAC 173-303-400) through an interim status indicator evaluation monitoring program. The groundwater sampling well network and associated monitoring constituents are described in PNNL-12227 and associated PNNL interim change notice ICN-PNNL-12227 R0.1, *Interim Change Notice to the Groundwater Monitoring Plan for the Nonradioactive Dangerous Waste Landfill*. During 2010, a new combination RCRA groundwater monitoring plan was released for NRDWL and SWL to combine the two units under one monitoring plan (DOE/RL-2010-28). The new monitoring plan includes changes to the existing well system, including one new downgradient and two new upgradient wells to be installed to monitor the effects of volatile organic compounds (VOCs) from soil vapor in the vadose zone. Until the three new wells are installed, the NRDWL will continue to be monitored under its current groundwater monitoring plan (PNNL-12227).

Per PNNL-12227, the monitoring well network (Figure PO.28 and Table B.63, Appendix B) consists of two upgradient wells within the top of the unconfined aquifer (699-26-34A and 699-26-35A), four downgradient wells within the top of the unconfined aquifer (699-25-34A, 699-25-34B, 699-25-34D, and 699-26-33), one upgradient well within the low permeability unit that forms the base of the unconfined aquifer (699-26-35C), one downgradient well within the low permeability unit that forms the base of the unconfined aquifer (699-25-33A), and one sidegradient well (699-26-34B). Quadruplicate samples are not collected for wells 699-25-33A and 699-26-35C, and results from these wells are not used for statistical comparisons with or calculations of critical mean values. The NRDWL groundwater wells are monitored semiannually for RCRA indicator parameters of TOC, TOX, pH, specific conductance, and site specific parameters of VOCs and nitrate. Wells are monitored annually for the water quality parameters of chloride, iron, manganese, phenols, sodium, and sulfate.

Sampling Results. The wells were sampled as required during 2013. As shown in Table B.65 of Appendix B no exceedances of the critical mean for TOC or TOX were detected in 2013. The mean of the quadruplicate specific conductance measurements in downgradient wells 699-25-34A, 699-25-34B, and 699-25-34D from the January and July sampling events exceeded the critical mean. A groundwater assessment performed in 2001 related to critical mean exceedances of specific conductance concluded elevated specific conductance at the site was due to non-dangerous waste constituents bicarbonate, sulfate, calcium, and magnesium. Since the late 1980s, concentrations of common cations (e.g., calcium, magnesium) have increased along with specific conductance in these three wells, and considering the results of the previous assessment, the site remains in interim status detection monitoring. Higher specific conductance measurements than those recorded in 2013 were recorded in 2002, 2003, and 2005 in well 699-25-34D; 1999, 2002 2005, 2006, and 2011 in well 699-25-34A; and 1999, 2003, 2005, 2009, 2011, and 2012 in well 699-24-34B.

The pH in well 699-26-33 exceeded the critical mean range in the July sampling event in 2013. Verification sampling was completed in August, and the results were within the 2013 critical mean range. Therefore the site remains in interim status detection monitoring.

Only one VOC (carbon tetrachloride in one sample from well 699-25-34A) was detected. The detection of carbon tetrachloride was "J" qualified by the analytical laboratory. The laboratory "J" flag indicates that the value is estimated and the detection is uncertain, and the value reported is less than the RDL or PQL, but greater than or equal to the MDL. The highest nitrate result was 21.4 mg/L in well 699-25-34A, which is consistent with site-wide nitrate in the area.

Water-Level and Well Network Evaluation. From 2011 to March 2013, efforts were undertaken to improve the accuracy of the water level measurements and resultant estimates of groundwater gradient near the NRDWL/SWL. The efforts included vertical offset surveys of well casings, high resolution water level measurements, and consideration of barometric effects. The results from the data collection and analysis yielded an average hydraulic gradient from January 2011 to March 2013 of 3.3×10^{-5} meters per meter and a flow direction of 101 degrees azimuth (southeasterly). This flow direction generally agrees with the southeastward flow direction inferred from historical plume migration in this area, and hydraulic head differences in the NRDWL/SWL area compared to the 200 East area. For example, during 2012, the average water-level elevation near NRDWL/SWL (121.66 meters, NAVD88 for April 2012) was 0.14 meters lower than the average elevation in the 200 East Area (121.80 meters, NAVD88 for April 2012), yielding a regional hydraulic gradient magnitude of 1.8×10^{-5} meters per meter. The wells continue to be located appropriately to accomplish the objectives of the interim status detection monitoring program.

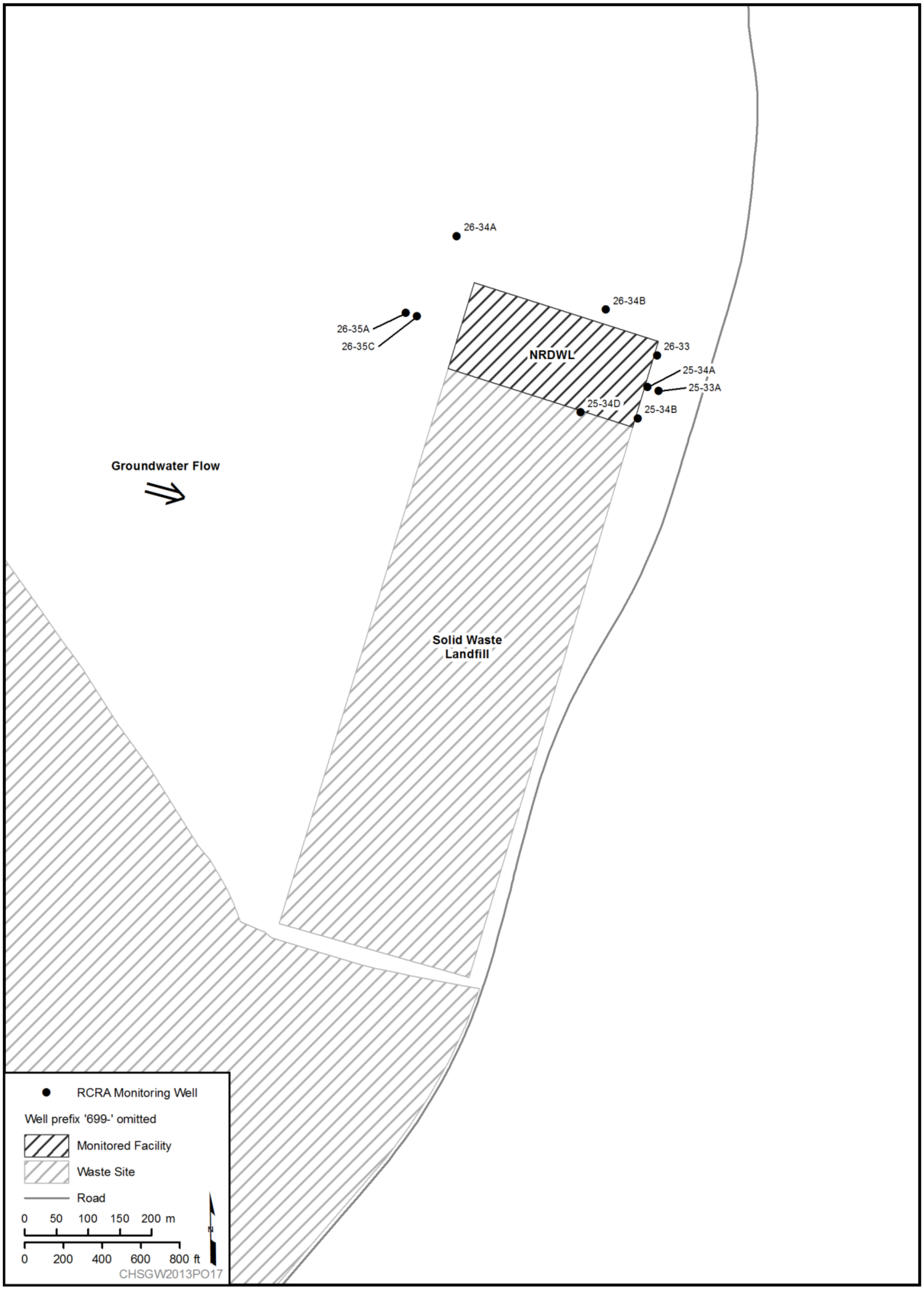

Figure PO.28 200-PO RCRA Facility NRDWL Monitoring Well Locations

200-PO WAC Monitoring: Solid Waste Landfill (SWL)

The SWL is located south of and adjacent to the NRDWL (Figure PO.29). The landfill is regulated by Ecology in accordance with WAC 173-350, which requires monitoring of leachate, soil gas, and groundwater. Per the groundwater monitoring plan, PNNL-13014, and WAC 173-304 constituents and site-specific constituents (including selected VOCs and filtered arsenic) are analyzed in groundwater samples collected quarterly. Compliance is determined by comparing results from downgradient monitoring wells with statistically derived background threshold values (BTVs) from upgradient wells.

In 2013, the monitoring well network consisted of two upgradient wells (699-24-35 and 699-26-35A) and six downgradient wells (699-22-35, 699-23-34A, 699-23-34B, 699-24-33, 699-24-34A, and 699-24-34B) (Table B.90 in Appendix B). Wells 699-24-34C and 699-25-34C that were part of the original network described in PNNL-13014 became sample dry prior to 2013 and can no longer be sampled. In addition, well 699-23-34A became sample dry in October 2013 and can no longer be sampled; therefore, it was only sampled 3 out of the 4 quarterly sampling events. DOE notified Ecology that well 699-23-34A became sample dry in January 2014.

Per PNNL-13014, the wells are sampled quarterly for ammonium, chemical oxygen demand, chloride, iron (filtered), manganese (filtered), nitrate, nitrite, pH, specific conductance, sulfate, temperature, total coliform, TOC, and zinc (filtered) per WAC-173-304-490. The wells are also sampled for arsenic (filtered) and VOCs. Note that SWL is currently regulated by WAC 173-350. However, WAC 173-350 was not yet promulgated at the time that PNNL-13014 was written in 2000, so the plan was written in accordance with WAC 173-304.

Sampling Results. The results of the leachate, soil gas, and groundwater monitoring are reported annually in a separate report. (*Hanford Site Solid Waste Landfill Annual Monitoring Report, October 2012 through September 2013*).

Leachate and Soil Vapor Monitoring. A leachate collection system (lysimeter) underlying one set of double trenches within SWL is sampled quarterly; therefore, results are not necessarily representative of total leachate volume or chemistry by all the trenches in the landfill.

Some of the inorganic analytes were detected, but the VOCs were generally not detected. Some of the leachate results, including dissolved iron, dissolved manganese, arsenic and total dissolved solids exceeded WAC 173-200 standards; however, the fact that contaminants are above compliance levels in the leachate does not necessary mean they are present in the same concentrations in the groundwater.

The soil gas monitoring network consists of eight shallow monitoring stations located around the perimeter of the SWL (a ninth station was damaged beyond repair in a fire event). Each monitoring station consists of two dedicated soil-gas probes driven to depths of about 2.7 and 4.6 meters, respectively. The soil gas is monitored quarterly to determine concentrations of carbon dioxide and methane. The soil gas is also analyzed for several key VOCs: methylene chloride, 1,1-dichloroethane, chloroform, 1,1,1-trichloroethane, carbon tetrachloride, trichloroethene, 1,1,2-trichloroethane, and tetrachloroethene. During 2013, soil gas at the SWL was analyzed in March, June, and August. The concentrations for the VOCs, methane, and carbon dioxide continue to be consistent with results from previous monitoring.

Groundwater Monitoring Results. Groundwater monitoring results for the analytes listed in the sampling plan per WAC 173-304-490 are summarized in Table PO.2 and detailed in Table B.91 of Appendix B. Results are summarized below.

Ammonium: Ammonium did not exceed the BTV of 90 µg/L in 2013 with concentrations ranging from less than 1.8 µg/L (non-detect) to 12.1 µg/L. Historically, ammonium has been detected intermittently, and has only exceeded the BTV one time in well 699-24-34A in 2009.

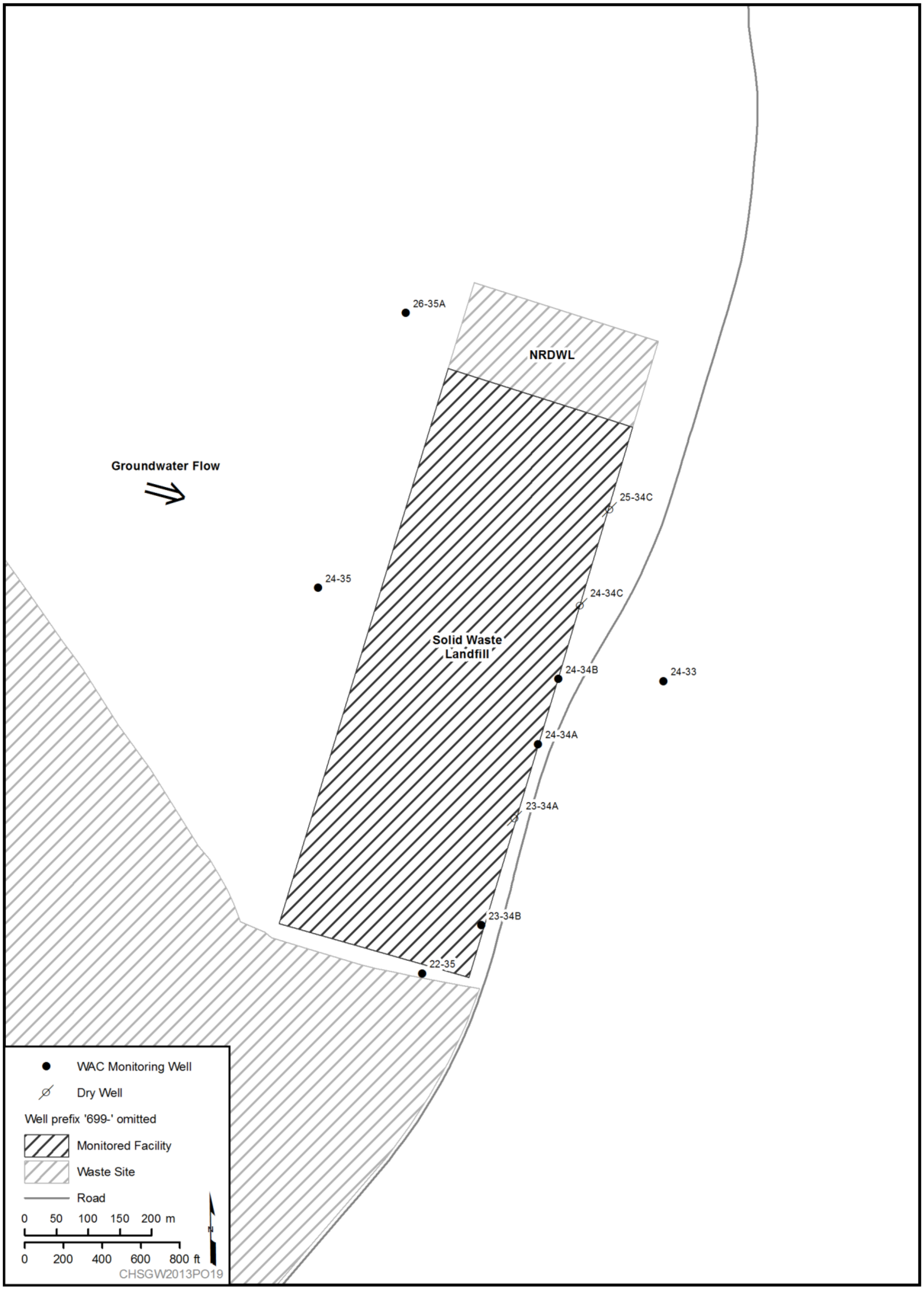

Figure PO.29 200-PO WAC Facility SWL Monitoring Well Locations

Table PO.2 200-PO Solid Waste Landfill Groundwater Monitoring Results

Constituent (unit)	Background Threshold Value	2013 Range	2013 Exceedance?	Wells Exceeded
Ammonium (µg/L)	90	< 1.8 to 12.1	No	--
Chemical Oxygen Demand (µg/L)	10,000	< 10,000 to 12,000	Yes	699-24-34A
Chloride (µg/L)	7,820	5,5,20 to 6,890	No	--
Coliform Bacteria (colonies/100 mL)	1	< 1 to 276	Yes	699-22-35, 699-24-34A, 699-24-35 (upgradient)
pH	6.68 to 7.84	6.55 to 7.45	Yes	699-23-34B
Iron – dissolved (µg/L)	174	< 19 to 80.6	No	--
Manganese (µg/L)	27.5	< 4	No	--
Nitrate (µg/L)	29,000	11,700 to 20,100	No	--
Nitrite (µg/L)	165	< 125 to 765	Yes	699-22-35, 699-23-34A, 699-23-34B, 699-24-33, 699-24-34A, 699-24-34B,
Specific Conductance (µS/cm)	583	515 to 847	Yes	699-22-35, 699-24-33, 699-23-34A, 699-23-34B, 699-24-34A, 699-24-34B
Sulfate (µg/L)	47,200	39,200 to 48,600	Yes	699-23-34A
Temperature (degrees C)	20.7	17.5 to 21.6	Yes	699-23-34B
Total Organic Carbon (µg/L)	842	217 to 1,990	Yes	699-22-35, 699-23-34A, 699-23-34B, 699-24-33, 699-24-34A, 699-24-34B, 699-24-35 (upgradient), 699-26-35A (upgradient)
Zinc – Dissolved (µg/L)	42.3	< 5 to 26.2	No	--

Chemical Oxygen Demand (COD): In 2013, chemical oxygen demand (COD) ranged from <10 (non-detect) to 12 mg/L. COD exceeded the BTV in 2013 in one downgradient well, 699-24-34A, in the July sampling event at a concentration of 12 mg/L. Since sampling began per PNNL-13014 in January 2001, COD has exceeded the BTV intermittently in 9 of the 10 network wells, including both of the upgradient wells (699-24-35 and 699-26-35A).

Chloride: Chloride concentrations detected in 2013 ranged from 5.52 to 6.89 mg/L, below the BTV of 7.82 mg/L. Since the current sampling plan was implemented at SWL in 2001, chloride has exceeded the BTV intermittently in all 10 of the network well.

Coliform bacteria: Coliform bacteria concentrations in 2013 ranged from <1 colony/mL (non-detect) to 276 colony/mL. Coliform bacteria was detected above the BTV in the July sampling event from well 699-24-34A, and in the October sampling event in well 699-24-34A and 699-24-35 (with a maximum detected concentration in 2013 of 276 colony/mL). Since sampling began per PNNL-13014 in January 2001, COD has exceeded the BTV intermittently in 9 of the 10 network wells, including both of the upgradient wells (699-24-35 and 699-26-35A).

Iron (filtered): In 2013, dissolved (filtered) iron concentrations ranged from <19 µg/L (non-detect) to 80.6 µg/L, which were all below the BTV. Only two iron results from well 699-22-35 (at a concentration of 259 µg/L in 2011) and in well 699-24-34A at a concentration of 211 µg/L in 2004, have exceeded the BTV.

Manganese (filtered): Dissolved (filtered) manganese was not detected in the SWL wells at the reporting limit of 4 µg/L. The reporting limit in 2013 was well below the BTV of 27.5 µg/L. Concentrations of dissolved manganese in the SWL wells have never been detected above the BTV since sampling was initiated under the current sampling plan in 2001. The maximum concentration detected was 17.9 µg/L in 2004 in well 699-24-34A.

Nitrate: In 2013, nitrate concentrations were detected at concentrations ranging from 11.7 to 20.1 mg/L. Since 2001, the highest nitrate concentration detected in the SWL well network was 20.4 mg/L in well 699-23-34A in 2011. The detected concentrations have been below the BTV of 29.0 mg/L. The SWL is near the southwestern extent of elevated nitrate concentrations that emanated from 200 East sources. Concentrations of nitrate detected in the SWL have been consistent with the regional interpretation of nitrate groundwater impacts.

Nitrite: Nitrite concentrations detected at the SWL in 2013 ranged from non-detect to a maximum concentration of 765 mg/L in well 699-22-35. In 2013, concentrations exceeded the BTV in each of the 8 network wells during the January sampling event, but were detected below the BTV in the other quarterly sampling events. Since sampling began per the current sampling plan in 2001, nitrite has exceeded the BTV intermittently in 8 of the 10 network wells, including both of the upgradient wells (699-24-35 and 699-26-35A).

pH: In 2013, pH measurements ranged from 6.55 to 7.45. The pH measurements did not exceed the upper bound BTV of 7.84. The pH measurements were less than the lower bound BTV of 6.68 in 3 of the 4 quarterly samples in well 699-23-34B, and in the January sampling event for wells 699-24-34A, 699-24-34B, and upgradient well 699-24-35. Historically, pH measurements have exceeded the lower bound of the BTV intermittently in 6 of the 10 network wells including upgradient well 699-24-35, and have only been detected once above the upper bound BTV in well 699-25-34C in 2003.

Specific Conductance: In 2013, specific conductance was field measured at concentrations ranging from 515 to 847 µS/cm. Similar to 2012, specific conductance exceeded the BTV in all six downgradient wells, but not in either of the two upgradient wells. In 2013, four of the six downgradient wells (as compared to five of the six downgradient wells in 2012) had specific conductance that exceeded the 700 µS/cm limit of WAC 246-290-310. Elevated specific conductance is principally caused by an increase of bicarbonate concentration in the groundwater at the SWL (Section 3.4 of DOE/RL-94-143). Since sampling began per the current sampling plan in 2001, specific conductance has exceeded the BTV intermittently in 6 of the 10 network wells, including upgradient wells 699-24-35.

Sulfate: Sulfate ranged in concentration from 39.2 to 48.6 mg/L during 2013. Sulfate exceeded the BTV in two downgradient wells, 699-23-34A (second and third quarter sampling events) and 699-24-34B (second quarter sampling event) in 2012. In 2013, sulfate exceeded the BTV in only one sample from third quarter from well 699-23-34A. Since 2000, sulfate has intermittently exceeded the BTV in 9 of the 10 network wells.

Temperature: In 2013, only one temperature measurement in the third quarter (July) from well 699-23-34B exceeded the BTV of 20.7 degrees Celsius. Excluding that one measurement, temperatures ranged from 17.5 to 20.0 degrees Celsius. Since 2000, the temperature has been measured one time above the BTV in downgradient wells 699-23-34A, 699-24-33, 699-24-34C, 699-24-34B, and 699-23-34B, two times in well 699-24-34A, and three times in well 699-22-35.

Total Organic Carbon (TOC): In 2013, TOC concentrations ranged from 217 to 1,990 µg/L. TOC exceeded the BTV in the downgradient network wells in October. Since 2000, TOC has been detected in all of the network wells ranging from 3 times in well 699-24-34C (sample dry since 2001) to 19 times in well 699-23-34B.

Zinc (filtered): In 2013, dissolved zinc concentrations ranged from <5 µg/L (not detected) to 26.2 µg/L; all below the BTV of 42.3 µg/L. Since 2000, dissolved (filtered) zinc has not been detected above the BTV of 42.3 µg/L.

Site Specific Parameters: Additional site specific parameters monitored for the SWL include filtered arsenic and volatile organic compounds (VOCS). Filtered arsenic was detected in 2013 from well samples at concentrations ranging from 0.63 to to 3.97 µg/L. in 2013, arsenic concentrations did not exceed the MTCA Method A value of 5 µg/L, ranging in concentration from 0.63 to 3.97 µg/L. Since 2000, filtered arsenic has been detected above the MTCA Method A value of 5 µg/L in three samples from three downgradient wells in 2012 (during second quarter sampling in wells 699-24-35 and 699-23-34B; and third quarter sampling in well 699-23-34A).The highest value detected in 2013 was 3.97 µg/L compared to 5.93 µg/L in 2012.

One VOC (tetrachloroethene) was detected in two samples at low concentrations that were “J” qualified by the laboratory at a concentration of 1.1 µg/L in the October sample from well 699-24-34B, and at a concentration of 1 µg/L in the October sample from well 699-24-33. In 2012, the following VOCs were detected at low concentrations that were all ”J” qualified: chloroform, PCE, 1,1,1-trichloroethane, acetone, toluene, xylenes (total). The laboratory “J” flag indicates that the value is estimated and the detection is uncertain, and the value reported is less than the RDL or PQL, but greater than or equal to the MDL.

Since 2000, twenty VOCs have been detected in samples collected from the SWL monitoring network (Table PO.3). Five of the VOCs (1,1,1-trichloroethane; 1,1-dichloroethane; chloroform, tetrachloroethene; and trichloroethene) have been detected most frequently since 2000. A large number of the detections were “J” qualified values. These constituents have generally decreased in concentration since sampling began in 2000 (e.g. 1,1,1-trichloroethane in Figure PO.29)

Water-Level and Well Network Evaluation.From 2011 to March 2014, efforts were undertaken to improve the accuracy of the water level measurements and resultant estimates of groundwater gradient near the NRDWL/SWL. The efforts included vertical offset surveys of well casings, high resolution water level measurements, and consideration of barometric effects. The results from the data collection and analysis yielded an average hydraulic gradient from January 2011 to March 2013 of 3.3×10^{-5} meters per meter and a flow direction of 101 degrees azimuth (southeast). This flow direction generally agrees with the southeastward flow direction inferred from historical plume migration in this area, and hydraulic head differences in the NRDWL/SWL area compared to the 200 East area. For example, during 2012, the average water-level elevation near NRDWL/SWL (121.66 meters, NAVD88 for April 2012) was 0.14 meter lower than the average elevation in the 200 East area (121.80 meters, NAVD88 for April 2012), yielding a regional hydraulic gradient magnitude of 1.8×10^{-5} meters per meter. It is recommended that a replacement well for 699-23-34A (which is now sample dry) be installed.

Table PO.3 Summary of VOCs in Solid Waste Landfill Monitoring Wells Detected at Least One Time

Constituent	Number of Detections	Number of J Qualified Detections	Number of Non-detects
1,1,1-Trichloroethane	327	148	203
1,1,2,2-tetrafluoropropane	1	0	0
1,1-Dichloroethane	248	231	282
1,1-Dichloroethene	20	20	326
1,2-Dichloroethane	3	3	527
1,4-Dichlorobenzene	21	19	512
1,4-Dioxane	1	1	253
2-Butanone	1	1	480
4-Methyl-2-pentanone	1	1	480
Acetone	72	60	409
Benzene	1	1	550
Carbon tetrachloride	17	16	513
Chloroform	125	124	405
cis-1,2-Dichloroethylene	1	1	529
Ethylbenzene	1	1	471
Methylene chloride	59	47	460
Tetrachloroethene	347	209	183
Toluene	23	23	528
Trichloroethene	301	289	229
Xylenes (total)	2	2	479

Note: Summarizes sampling from 2000 through 2013

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