Appendix I

Historical Summary of the 216-T-4 Ponds and Ditches

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I1 Background

The 216-T-4 Ponds and Ditches are a system of liquid waste disposal sites that operated from 1944 to 1995. The following four separate waste sites are included in the system:

- The 216-T-4A Pond (also known as 216-T-4-1 Pond), which operated from 1944 to 1972, is located in the 200-SW-2 Operable Unit (OU).
- The 216-T-4-1 Ditch, which fed the 216-T-4A Pond from 1944 to 1972, is located in the 200-MG-1 OU and is out of the scope of this work plan.
- The 216-T-4B Pond (also known as 216-T-4-2 Pond), which replaced the 216-T-4A Pond in 1972, operated until 1995. It is located in the 200-SW-2 OU.
- The 216-T-4-2 Ditch, which replaced the 216-T-4-1 Ditch and fed the 216-T-4B Pond from 1972 to 1995, is located in the 200-SW-2 OU.

I2 History

Use of the older 216-T-4A Pond (past designations are 216-T-4-1 Pond, 216-T-4-1P, and 216-T-4 swamp) site began in November 1944 with startup of the 221-T Chemical Separations Plant. Wastewater received from the 216-T-4-1 Ditch came through a culvert under the railroad tracks and ran out into a shallow ditch cut through a natural surface depression in the desert floor. Very little vegetation was cleared from the initial site before the pond operated. The water formed an L-shaped shallow pond of approximately 6.5 ha (16 ac) according to the Waste Information Data System (WIDS). The pond received 4.25 billion L (1.12 billion gal) of liquid between November 1944 and May 1972, when it was backfilled. The site is estimated to have contained 24,000 m^3 (850,000 ft^3) of contaminated soil.

In May 1972, a dike and the new 216-T-4B Pond were constructed to prevent surface water from entering the nearby burial trenches in the 218-W-3A Burial Ground. The 216-T-4B Pond was constructed 61 m (200 ft) east of the older 216-T-4A Pond and 140 m (450 ft) east of the 218-W-3A Burial Ground.

During February 1973, Trench 27 in the 218-W-2A Landfill was dug 5.5 m (18 ft) deep. Contaminated soil, scraped 15 to 22 cm (6 to 9 in.) from the bottom of the older 216-T-4A Pond, was placed in the trench. In 1975, the bottom of the 216-T-4A Pond was seeded with grass to stabilize the surface (BHI-00178, *PUREX Plant Aggregate Area Management Study Technical Baseline Report*). Final radiation surveys of the pond bottom were generally less than 200 c/m, with isolated coarse sandy spots, less than 0.6 m (2 ft) in diameter, ranging to a maximum of 400 c/m.

The newer 241-T-4B Pond was a 6,100 m^2 (1.5 ac) site ranging from 0.9 to 1.8 m (3 to 6 ft) deep. The pond was fed by the 216-T-4-2 Ditch. It was separated from the older 216-T-4A Pond by an earthen dike, 400 m (1,300 ft) long with an average height of 0.4 m (1.5 ft).

Both the older and newer pond and ditch systems were designed to receive process cooling water from the 221-T and 224-T Buildings at T Plant via the 207-T Retention Basin, steam condensate from the 221-T Building, decontamination waste from the 2706-T Low-Level Waste Decontamination Facility, and condenser cooling water from the 242-T evaporator. These waste streams were fed into the pond system in various combinations over time. However, flow into the ditch after construction of the 216-T-4B Pond and 216-T-4-2 Ditch was low, and the liquid did not reach the pond. The pond has been considered dry since 1977 (BHI-00178). It was interim stabilized in 1995.

Figure I-1 shows the 216-T-4A Pond as it appeared in the mid-1950s. Figure I-2 shows the 216-T-4B Pond as it appeared in the 1970s. Figure I-3 shows the stabilized pond as it currently appears.

I3 Characterization Data

In the early 1990s, six boreholes were installed in the footprint of the former 216-T-4A Pond. The wells installed through the old pond/ditch areas are numbered 299-W10-180 through 299-W10-185. The boreholes were not logged, and no field data were collected. The soil samples were archived and not analyzed (WHC-SD-EN-DP-022, *T Plant Geologic and Geophysics Data Package for the 200 Aggregate Area Management Study*).

Groundwater monitoring data have been collected from wells adjacent to the former 216-T-4A Pond since 1988. Boreholes A5440 and A5010 are closest to the footprint of the former pond area. Tables I-1 and I-2 provide the groundwater monitoring data for wells 299-W10-21 (A5440) and 299-W7-4 (A5010), respectively.

A 2008 to 2010 field investigation activity inserted two direct-push technology casings (boreholes C5762 and C5763) in the 216-T-4B Pond. No sample material from these boreholes has been analyzed to date according to WIDS.

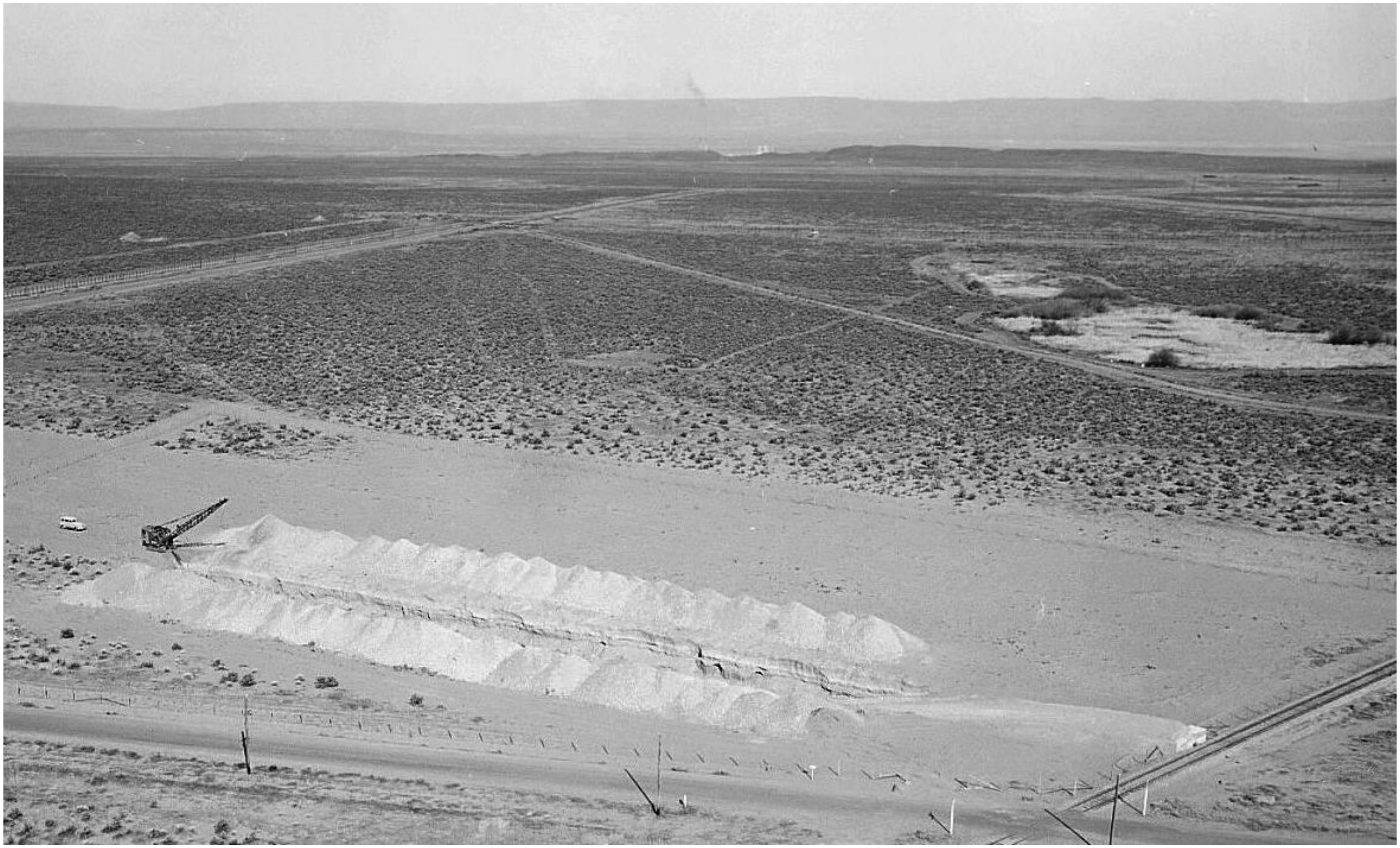
During interim stabilization, a sample of soil from within the boundaries of the original 216-T-4A Pond was obtained and analyzed. Results are presented in Table I-3.

I4 Interim Stabilization

Stabilization activities in the field began at the 216-T-4-1 Pond (216-T-4A Pond) and Ditch on February 22, 1995, and were completed on April 5, 1995. Work on the 216-T-4-2 Ditch was delayed until discharge to the ditch was eliminated. Interim stabilization resumed on June 29, 1995, and was completed on July 10, 1995. Isolation of the ditch occurred on August 29, 1995. Revegetation and marker post placement were completed on September 20, 1995 (BHI-00178).

Pre-stabilization activities consisted of mapping the site to establish site boundaries and physically preparing the 216-T-4-2 Ditch for interim stabilization. All trees were sprayed with herbicide to help minimize resprouting after interim stabilization was completed. The trees (maximum diameter was 11 cm [4 in.]) were then cut down and left in place.

During stabilization, earth moving was performed using standard equipment. Backfill was obtained from the borrow pit located east of the 218-W-4A Landfill. Some of the surface-contaminated soils were removed and consolidated in the 216-T-4-2 Ditch. Surface-contaminated areas located along the west perimeter of the 216-T-4A Pond were consolidated toward the center of the 216-T-4A Pond area, and the scraped area was successfully decontaminated. Surface soils located along the northeast portion of the pond were also consolidated in the central portion of the pond; this area was not successfully decontaminated. Excavation revealed old vegetation typical of riparian areas, which indicated that excavation was occurring inside the boundaries of the original waste disposal ponds. A soil sample was obtained, and the results are provided in Table I-3.



Note: Photo undated (circa 1954).

Figure I-1. 216-T-4A Pond in Background, Right (East) Side of Photograph, Looking North from the South End of the 218-W-2A Landfill

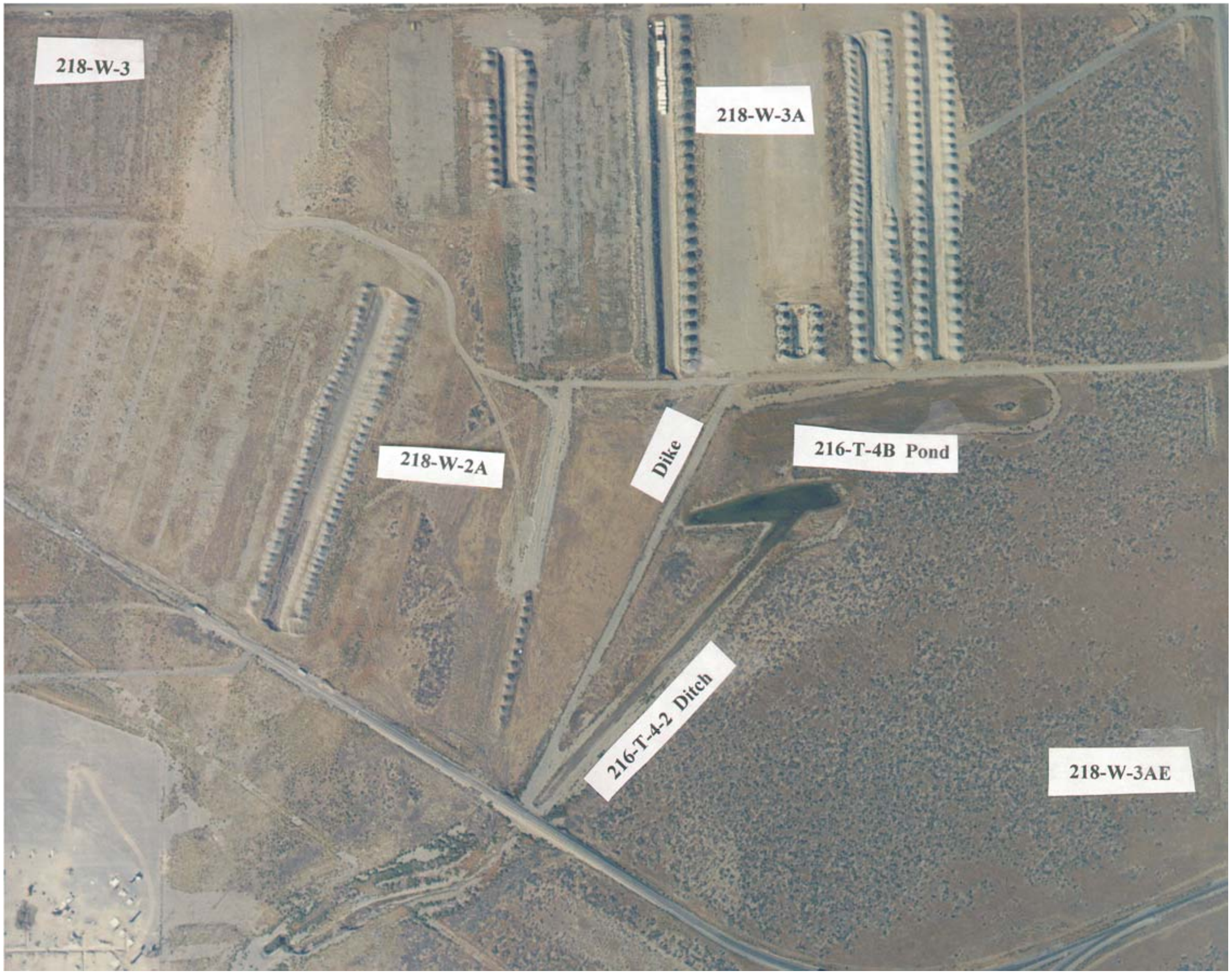


Figure I-2. 1975 Photo Showing the 216-T-4B Pond and 216-T-4-2 Ditch with Liquid

Figure I-3. Stabilized Pond with Revegetated Grasses

Table I-1. Groundwater Constituents for Well 299-W10-21 (A5440)

Standard Constituent	Standard Units	Data	Detects	Rejects	Minimum Value	Minimum Value Date	Maximum Value	Maximum Value Date
Acetone	µg/L	31	5	0	0.88	03-13-2003	2.4	09-24-2003
Alkalinity	µg/L	21	21	0	84,800	09-09-1996	106,000	09-13-2004
Aluminum	µg/L	30	10	1	7.6	09-19-2001	980	12-15-1993
Antimony	µg/L	30	1	0	3.9	03-12-2001	3.9	03-12-2001
Arsenic	µg/L	9	7	0	2	08-12-1994	2.7	08-12-1994
Barium	µg/L	30	30	0	28.4	09-13-2004	78	12-15-1993
Beryllium	µg/L	30	8	0	0.18	09-19-2001	0.96	03-17-2004
Beryllium-7	pCi/L	17	1	0	21	12-15-1995	21	12-15-1995
Bromide	µg/L	15	1	0	100	03-09-1995	100	03-09-1995
Cadmium	µg/L	30	2	0	3.5	05-26-1994	5.7	05-26-1994
Calcium	µg/L	30	30	0	58,100	09-13-2004	82,000	03-09-1999
Carbon disulfide	µg/L	31	4	0	0.24	09-13-2004	270	09-09-1996
Carbon tetrachloride	µg/L	38	37	0	29	03-16-2005	660	09-29-1999
Chloride	µg/L	34	34	0	3,200	12-15-1995	16,300	03-17-2004
Chloroform	µg/L	38	36	1	2	09-09-1996	28	09-09-1996

Table I-1. Groundwater Constituents for Well 299-W10-21 (A5440)

Standard Constituent	Standard Units	Data	Detects	Rejects	Minimum Value	Minimum Value Date	Maximum Value	Maximum Value Date
Chromium	µg/L	30	30	0	8.3	03-16-2005	69	02-22-1994
Cobalt-60	pCi/L	21	2	0	1.44	08-12-1994	1.55	03-09-1995
Copper	µg/L	30	6	0	2.2	09-24-2002	11.6	09-24-2003
Delta-BHC	µg/L	4	1	0	0.071	12-15-1993	0.071	12-15-1993
Dissolved oxygen	µg/L	8	8	0	8,490	03-13-2002	16,230	03-12-2001
Fluoride	µg/L	34	34	0	260	03-16-2005	800	08-12-1994
Gross alpha	pCi/L	25	14	0	1.25	09-08-1997	3	12-15-1993
Gross beta	pCi/L	25	25	0	15.1	03-16-2005	26.3	09-10-1998
Heptachlor	µg/L	4	1	0	0.003	08-12-1994	0.003	08-12-1994
Iodine-129	pCi/L	16	1	0	0.451	12-14-1994	0.451	12-14-1994
Iron	µg/L	30	24	0	12	12-15-1993	1,700	02-22-1994
Lead	µg/L	29	5	0	0.6	02-22-1994	1.7	02-22-1994
Magnesium	µg/L	30	30	0	19,300	09-13-2004	28,200	03-09-1999
Manganese	µg/L	30	27	0	0.74	03-09-1995	30	02-22-1994
Methylene chloride	µg/L	38	6	0	0.079	12-15-1993	22	03-12-1997

Table I-1. Groundwater Constituents for Well 299-W10-21 (A5440)

Standard Constituent	Standard Units	Data	Detects	Rejects	Minimum Value	Minimum Value Date	Maximum Value	Maximum Value Date
Nickel	µg/L	30	9	0	4.9	09-19-2001	29.9	03-16-2005
Nitrate	µg/L	34	34	0	28,000	12-15-1995	202,000	03-09-1999
Oxidation-reduction potential	mV	8	8	0	146.9	03-12-2001	172.8	03-13-2002
pH measurement	unit-less	113	113	0	6.92	12-15-1993	8.25	09-29-1999
Potassium	µg/L	30	29	0	2,230	03-09-1998	5,970	09-09-1996
Potassium-40	pCi/L	17	5	0	26.1	03-09-1995	64.4	12-15-1995
Radium	pCi/L	4	4	0	0.159	08-12-1994	0.798	12-15-1993
Selenium	µg/L	9	7	0	2	08-12-1994	3.2	02-22-1994
Silver	µg/L	30	2	0	3	03-13-2003	6.1	09-10-1998
Sodium	µg/L	30	30	0	8,500	05-26-1994	11,700	09-10-1998
Specific conductance	µS/cm	113	112	1	463	03-09-1998	701	03-09-1999
Strontium	µg/L	21	21	0	255	09-13-2004	369	09-10-1998
Sulfate	µg/L	34	34	0	21,000	12-15-1995	48,000	12-06-1996
Technetium-99	pCi/L	28	28	0	43.6	03-16-2005	91.1	09-11-1995
Tetrachloroethene	µg/L	37	13	0	0.13	02-22-1994	0.66	09-13-2004
Tin	µg/L	12	3	0	25	08-12-1994	85	05-26-1994

Table I-1. Groundwater Constituents for Well 299-W10-21 (A5440)

Standard Constituent	Standard Units	Data	Detects	Rejects	Minimum Value	Minimum Value Date	Maximum Value	Maximum Value Date
Toluene	µg/L	38	3	0	2	09-09-1996	21	09-09-1996
Total dissolved solids	µg/L	21	21	0	374,000	12-06-1996	609,000	09-10-1998
Total halogens (all)	µg/L	6	6	0	304	12-06-1996	416	09-09-1996
Total organic carbon	µg/L	111	76	0	200	09-11-1995	878	03-09-1999
Total organic halides	µg/L	105	102	2	16.4	03-16-2005	504	03-09-1999
Trichloroethene	µg/L	38	32	1	0.53	03-16-2005	7.2	09-11-1995
Tritium	pCi/L	34	34	0	497	09-13-2004	2,050	03-09-1999
Turbidity	NTU	61	61	0	0.21	03-09-1999	21	02-22-1994
Uranium	µg/L	8	8	0	1.86	09-13-2004	2.14	03-13-2003
Vanadium	µg/L	30	30	0	12	12-15-1993	40.7	09-24-2002
Zinc	µg/L	30	20	0	2.5	03-09-1998	64	12-15-1993

Note: Nondetected constituents are not included in this table. The entire data set, including nondetected constituents, may be viewed in the Hanford Environmental Information System database.

NTU = nephelometric turbidity unit

Table 1-2. Groundwater Constituents for Well 299-W7-4 (A5010)

Constituent	Units	Data	Detects	Rejects	Minimum Value	Minimum Value Date	Maximum Value	Maximum Value Date
1,1,1-Trichloroethane	µg/L	47	3	1	0.19	04-20-2007	8	03-22-1989
1,4-Dichlorobenzene	µg/L	53	1	1	10	03-11-1998	10	03-11-1998
2,4-Dinitrophenol	µg/L	26	1	1	0.83	03-11-1998	0.83	03-11-1998
4,6-Dinitro-2-methylphenol	µg/L	26	1	1	1.1	03-11-1998	1.1	03-11-1998
Acetone	µg/L	36	6	1	0.79	03-23-2006	140	03-11-1998
Alkalinity	µg/L	25	25	0	86,000	09-30-2002	116,000	03-22-2002
Alpha	pCi/L	5	3	0	1.87	05-08-1990	2.65	07-24-1989
Aluminum	µg/L	48	5	3	17.2	09-20-2001	160	05-18-1993
Americium-241	pCi/L	9	3	0	0.00402	02-03-1992	0.0128	01-24-1990
Ammonium ion	µg/L	17	4	0	40	08-11-1993	100	05-18-1993
Antimony	µg/L	68	1	1	4.1	03-13-2001	4.1	03-13-2001
Antimony-125	pCi/L	7	2	0	4.39	08-12-1991	11.4	08-07-1992
Arsenic	µg/L	31	7	0	2	05-18-1993	4.4	12-03-1993
Barium	µg/L	68	67	1	30	05-18-1993	169	05-16-2011
Beryllium	µg/L	68	5	1	0.41	09-11-1997	0.95	03-17-2004

Table 1-2. Groundwater Constituents for Well 299-W7-4 (A5010)

Constituent	Units	Data	Detects	Rejects	Minimum Value	Minimum Value Date	Maximum Value	Maximum Value Date
Beryllium-7	pCi/L	3	1	0	10.9	08-12-1991	10.9	08-12-1991
Boron	µg/L	8	7	0	11	09-13-1989	14	01-19-1990
Bromide	µg/L	22	3	0	90	02-23-1994	110	03-08-1996
Cadmium	µg/L	68	3	1	2	09-12-1995	3	09-16-1996
Calcium	µg/L	68	67	1	43,300	05-16-2011	65,900	05-16-2011
Carbon tetrachloride	µg/L	47	44	1	63	04-20-2007	740	08-11-1993
Cesium-137	pCi/L	15	4	0	2.32	02-03-1992	6.04	05-08-1992
Chloride	µg/L	48	48	0	15,800	10-03-1988	23,100	10-26-2006
Chloroform	µg/L	47	43	1	1.9	09-24-2007	9	03-11-1998
Chromium	µg/L	68	52	3	4.1	10-05-2005	230	05-18-1993
Cobalt	µg/L	62	4	1	3.3	09-15-1998	12	05-16-2011
Cobalt-60	pCi/L	15	3	0	1.05	08-12-1991	10	11-13-1991
Copper	µg/L	68	9	1	1.1	03-18-2005	90	05-16-2011
Dissolved oxygen	µg/L	21	21	0	8,870	09-20-2001	9,950	04-20-2007
Europium-155	pCi/L	3	1	0	3.64	08-12-1991	3.64	08-12-1991

Table 1-2. Groundwater Constituents for Well 299-W7-4 (A5010)

Constituent	Units	Data	Detects	Rejects	Minimum Value	Minimum Value Date	Maximum Value	Maximum Value Date
Fluoride	µg/L	48	40	0	177	05-16-2011	900	11-13-1991
Gross alpha	pCi/L	38	23	0	0.555	11-13-1991	3.19	08-07-1992
Gross beta	pCi/L	43	43	0	5.62	05-08-1992	22.1	03-12-1997
Hexavalent chromium	µg/L	2	1	0	5.62	10-15-2004	5.62	10-15-2004
Iodine-129	pCi/L	14	1	0	0.424	02-23-1994	0.424	02-23-1994
Iron	µg/L	68	51	1	15	05-18-1993	8,990	05-16-2011
Lead	µg/L	63	10	0	0.6	08-11-1993	6	05-08-1992
Magnesium	µg/L	68	67	1	14,000	09-24-2007	22,100	12-29-1988
Manganese	µg/L	68	31	1	0.61	03-18-2005	590	05-16-2011
Methylene chloride	µg/L	47	12	1	0.17	12-03-1993	42	03-11-1998
Nitrate	µg/L	48	48	0	25,500	05-16-2011	106,000	09-16-1996
Nitrite	µg/L	44	1	1	219	05-16-2011	219	05-16-2011
Oxidation-reduction potential	mV	12	12	0	145	09-20-2001	218.1	03-22-2002
Phenol	µg/L	49	1	2	3	02-04-1993	3	02-04-1993
Phosphorus	µg/L	1	1	0	39.1	10-15-2004	39.1	10-15-2004

Table 1-2. Groundwater Constituents for Well 299-W7-4 (A5010)

Constituent	Units	Data	Detects	Rejects	Minimum Value	Minimum Value Date	Maximum Value	Maximum Value Date
Plutonium-239/240	pCi/L	10	2	0	0.00101	08-12-1991	0.00736	02-03-1992
Potassium	µg/L	68	62	1	2,600	12-03-1993	5,630	09-16-1996
Radium	pCi/L	19	8	0	0.00146	08-07-1992	0.363	09-13-1989
Selenium	µg/L	36	7	0	2	08-11-1993	5	10-03-1988
Silicon	µg/L	8	8	0	15,700	03-22-1989	17,400	09-13-1989
Silver	µg/L	68	3	1	3	12-03-1993	16.4	09-24-2007
Sodium	µg/L	68	67	1	6,880	09-24-2007	11,000	09-16-1996
Specific conductance	µS/cm	186	186	0	277	10-03-1988	532	03-14-1995
Strontium	µg/L	42	42	0	167	09-24-2007	287	05-16-2011
Sulfate	µg/L	48	48	0	28,200	04-20-2007	37,600	10-10-2000
Technetium-99	pCi/L	26	26	0	7.3	05-16-2011	81.2	12-29-1988
Tetrachloroethene	µg/L	47	14	1	0.18	03-08-1996	0.6	03-14-1995
Tin	µg/L	36	1	1	51	09-12-1995	51	09-12-1995
Toluene	µg/L	45	1	1	0.054	03-08-1996	0.054	03-08-1996
Total carbon	µg/L	11	11	0	21,600	12-29-1988	26,000	05-08-1992

Table 1-2. Groundwater Constituents for Well 299-W7-4 (A5010)

Constituent	Units	Data	Detects	Rejects	Minimum Value	Minimum Value Date	Maximum Value	Maximum Value Date
Total halogens (all)	µg/L	4	4	0	357	09-16-1996	480	09-16-1996
Total organic carbon	µg/L	151	49	2	120	09-20-2001	730	10-05-2005
Total organic halides	µg/L	151	142	9	31.2	04-20-2007	1,540	07-24-1989
Trichloroethene	µg/L	46	26	1	0.45	04-20-2007	3.5	09-12-1995
Tritium	pCi/L	46	26	0	283	03-22-1989	850	10-03-1988
Turbidity	NTU	82	78	4	0.09	03-15-1999	304	05-16-2011
Uranium	pCi/L	7	7	0	1.02	05-08-1990	1.61	12-29-1988
Uranium	µg/L	25	25	0	0.224	05-18-1993	4.11	08-12-1991
Vanadium	µg/L	68	54	1	11	08-11-1993	56	05-16-2011
Zinc	µg/L	68	42	1	1.6	12-03-1993	8,600	05-16-2011
Zinc-65	pCi/L	1	1	0	6.11	08-12-1991	6.11	08-12-1991
Zirconium/niobium-95	pCi/L	1	1	0	8.84	08-12-1991	8.84	08-12-1991

Note: Nondetected constituents are not included in this table. The entire data set, including nondetected constituents, may be viewed in the Hanford Environmental Information System database.

NTU = nephelometric turbidity unit

Table I-3. Soil Sample Results for 216-T-4 Pond Bottoms during Interim Stabilization (Analyzed for Radionuclides Only in April 1995)

Customer/Environmental Analytical Laboratory Identification	Gross Radionuclide Soil Screening	Passed/Failed Screening?	Gamma-Ray Energy Analysis Soil Screening Report
T4 100 1S/EAL00273	Strontium-90, 1.7 pCi/g	Failed	K-40, 6.2E+01 pCi/g Cs-137. 1/8E+02 pCi/g
T4 100 2S/EAL00273	Not screened	Not screened	Cs-137, 2.6E+02 pCi/g
T4 100 1N/EAL00272	Strontium-90, 12 pCi/g	Failed	K-40, 6.2E+01 pCi/g Cs-137, 1.8E+02 pCi/g

Notes:

A passed screen indicates that the soil sample contained less than 200 pCi/g total radioactivity of which less than 20 pCi/g is from alpha-emitting radionuclides. For conservatism, a failed screen may also have one or more of the following characteristics: the sum of the total gamma activity detected in the soil is above 5 pCi/g; beta emission from the bulk sample is found above the natural Hanford Site soil background (corresponding to approximately 5 pCi/g of strontium-90 or 100 pCi/g of technetium-99); or alpha emission from the bulk soil is found above the natural Hanford Site soil background (corresponding to approximately 10 pCi/g of Am-241). Naturally occurring radionuclides common to Hanford Site soil, tritium, and carbon-14 are not included in the screening measurement.

The following radionuclides were analyzed and not detected: Be-7, Co-57, Co-60, Ru/Rh-106, Sb-125, I-129, Cs-134, Cs-137, Ce-144, Eu-152, Eu-154, Eu-155, Th-232 daughters, U-235, U-238, U-238 daughters, Np-237, Pu-239, Pu-240, and Am-241.

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The common zone containing the 216-T-4-1 and 216-T-4-2 Ditches was partially consolidated. Soils located along the southern perimeter of this surface zone were scraped and consolidated over the 216-T-4-1 Ditch. An approximate area of 2,000 m^2 (0.5 ac) was successfully decontaminated.

The remaining area was backfilled with 46 to 61 cm (18 to 24 in.) of uncontaminated soil. Approximately 15,300 m^3 (22,600 yd^3) of soil was placed in the 216-T-4-1 Pond and 216-T-1 and 216-T-4-2 Ditches.

I5 References

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