3.0 Vadose Zone

D. G. Horton

Vadose zone monitoring, using leachate and soil-gas sampling, occurred at three areas on the Hanford Site in fiscal year (FY) 2008. Leachate and soil-gas monitoring continued at the Environmental Restoration Disposal Facility (ERDF) and the Solid Waste Landfill. Also, soil-gas monitoring at the carbon tetrachloride expedited-response-action site continued during FY 2008.

The Tank Farm Vadose Zone Project installed several direct push boreholes in the C and TY Tank Farms for subsurface characterization of unplanned releases and future geophysical surveys. The Tank Farm Vadose Zone Project also completed surface geophysical exploration at Waste Management Areas (WMA) TX-TY and S-SX to map subsurface contaminant distribution. An interim surface barrier was placed over tank 241-T-106 to reduce infiltration through the 1973 leak from that tank. These monitoring and characterization efforts are summarized in the following sections.

3.1 Leachate Monitoring at the Environmental Restoration Disposal Facility

R. L. Weiss and T. A. Lee

The ERDF facility receives radioactive and mixed waste generated during waste management and remediation activities at the Hanford Site. WCH-295, *Groundwater and Leachate Monitoring and Sampling at the ERDF, CY 2007*, was published in FY 2008 and provides the results of groundwater and leachate monitoring and sampling at the ERDF during calendar year 2007. Groundwater results are discussed in Section 2.9; this section summarizes the vadose zone results and any impacts the vadose zone might have on groundwater.

Approximately 398,456 tons of remediation waste were placed in the ERDF in calendar year 2007.

The ERDF began operation in July 1996. The location of the ERDF is shown on Figure 2.9-1. Throughout calendar year 2007, ~398,456 t of remediation waste were disposed at the facility. The facility currently operates six disposal cells. Each disposal cell was constructed with a double liner system to collect leachate from natural precipitation and water added as a dust suppressant. The collected leachate is sent to the Effluent Treatment Facility. The liners deliver the leachate to sumps beneath the cells where the leachate is sampled. A composite sample of leachate was collected in June and December 2007 from the sumps associated with the upper liners of cells 1 through 6. The samples were analyzed for selected metals, anions, selected organic compounds, total dissolved solids, gross alpha, gross beta, and selected radionuclides. The analyses provide data for leachate delisting analyses and to assess whether additional analytes should be added to the routine ERDF groundwater-monitoring program.

The composite leachate samples contained detectable concentration of common metals, anions, and mobile radionuclides. Constituents generally increasing in concentration include gross alpha and uranium. The following is a summary of analytes discussed in WHC-295.

- Bromide, which had been detected in recent years, was not detected in leachate samples in calendar year 2007.

- Chromium concentrations began declining in calendar year 2007. The chromium concentration averaged 29 µg/L in December 2006 and 16.5 µg/L in December 2007.
- Potassium concentrations were steady at ~23,400 µg/L in December 2007.
- Uranium concentrations, which have increased over the past 3 years, reached a new maximum concentration of 2,130 µg/L in June 2007.
- Nitrate concentrations remained steady in calendar year 2007, averaging ~ 360 mg/L.
- Specific conductance remained steady during calendar year 2007.
- Total dissolved solids, which had been increasing throughout 2006, remained steady during calendar year 2007, averaging ~2,100,000 µg/L.
- Gross alpha concentrations continued to increase, averaging ~2,840 pCi/L in June 2007.
- Gross beta concentrations, which had been increasing through calendar year 2006, remained steady in 2007, with a concentration of ~875 pCi/L in December 2007.

Groundwater monitoring data for gross alpha, gross beta, and uranium were examined to determine whether the leachate from the ERDF has affected groundwater. Uranium concentrations in groundwater remained steady. Gross alpha concentrations in groundwater showed a slight long-term decrease and gross beta concentrations showed an increase in most downgradient wells. Gross alpha and gross beta in groundwater will be closely monitored in the future but, based on the calendar year 2007 leachate concentrations, no additional analytes will be recommended for the groundwater-monitoring program.

3.2 Leachate and Soil-Gas Monitoring at the 600 Area Central Landfill

Summarized by D. G. Horton

The Solid Waste Landfill is a disposal facility in the center of the Hanford Site (part of the Central Landfill illustrated on Figure 2.1-1). The Solid Waste Landfill covers an area of ~26.7 ha and began operating in 1973 to receive nonhazardous, nonradioactive sanitary waste generated from Hanford Site operations. The Solid Waste Landfill stopped receiving waste in 1996 and an interim cover, consisting of 0.6 to 1.2 m of soil, was placed over all trenches. Current monitoring at the Solid Waste Landfill consists of sampling groundwater, soil-gas, and leachate. Section 2.11 discusses recent groundwater-monitoring results. This section summarizes leachate and soil-gas monitoring results. The results are sent annually to Washington State Department of Ecology (Ecology) with the most recent report covering the period July 2007 to June 2008 (09-AMCP-0010).

The Solid Waste Landfill consists of single trenches and double trenches. One of the double trenches overlies a lined basin lysimeter designed to collect leachate generated by infiltration through the overlying refuse. This lysimeter covers an area of ~88 m^2. A discharge pipe continuously drains leachate by gravity flow from the basin to a nearby collection pump. However, leachate collected from this lysimeter

may not be representative of leachate drainage throughout the entire landfill area. Since all other trenches are unlined, the lysimeter only collects leachate from one of the double trenches and is located under one of the newer trenches built after implementation of regulations restricting land disposal practices. The lysimeter, however, provides some indication of the rate of infiltration and some of the potential contaminants released to the vadose zone beneath the site.

Leachate is collected from the Solid Waste Landfill every 10 to 14 days and tested quarterly.

Leachate is collected from the basin lysimeter every 10 to 14 days. Figure 3.0-1 shows the rate of leachate generated over the past 10 years. Between 1999 and 2003, the generation rate was consistently between 4 and 8 L/day. However, during the July 2003 through June 2004 and July 2004 through June 2005 reporting periods, the average generation rates increased significantly to ~19 L/day. This increase mainly was attributed to above average rainfall recorded at the Hanford Site.

For the reporting period July 2007 through June 2008, ~2,500 L of leachate was generated, for a daily average of 6.8 L. This was an ~21% decrease in leachate generation from the previous year, when the daily average was ~8.7 L/day. The decrease is attributed mainly to below normal precipitation recorded at the Hanford Site during October and December 2007. (The average yearly precipitation at the Hanford Meteorology Station is 17.3 cm for the period 1947 to 2004 [PNNL-15160, *Hanford Site Climatological Summary 2004 with Historical Data*].) The Hanford Meteorological Station recorded 0.53 cm of precipitation in October and 1.35 cm in December 2007.

Leachate is sampled and tested quarterly for indicator parameters listed in WAC 173-304-490 and annually for site-specific constituents, which cover a range of metals and organics. Concentrations measured during July 2007 to June 2008 are similar to previous concentrations and did not identify any areas of concern. Some of the indicator parameters and some organic constituents and metals in the leachate continued to exceed WAC 173-200 groundwater quality criteria and/or WAC 246-290-310 drinking water standards. Section 2.11.3.7 discusses groundwater at the Solid Waste Landfill. Table 3.0-1 shows analytical results for key constituents in Solid Waste Landfill leachate.

Soil-gas at the Solid Waste Landfill is monitored to demonstrate that the air quality performance standards are met. The soil-gas monitoring uses eight shallow monitoring stations located around the perimeter of the landfill. Each station consists of two soil-gas probes at depths of ~2.75 and 4.6 m. Soil-gas is monitored quarterly to determine concentrations of carbon dioxide, methane, and several key volatile organic compounds. During the reporting period between July 2007 and June 2008, concentrations were consistent with concentrations for soil-gas monitoring during previous years. Carbon dioxide concentrations were consistent with previous data. Carbon dioxide concentrations are lower when atmospheric pressure is rising and higher when atmospheric pressure is low. Methane concentrations were either low or not detected. The volatile organic constituents were at or below the detection limits.

3.3 Carbon Tetrachloride Monitoring and Remediation

V. J. Rohay

Soil-vapor extraction is being used to remove carbon tetrachloride from the vadose zone in the 200 West Area. The U.S. Environmental Protection Agency and Ecology authorized the U.S. Department of Energy to initiate this remediation in 1992 as a *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) expedited response action. This section summarizes FY 2008 activities associated with the carbon tetrachloride removal. A report containing detailed results of FY 2008 activities will be published in FY 2009. Previous reports document historic monitoring results (e.g., BHI-00720; WMP-17869; WMP-21327; WMP-26178; WMP-30426; SGW-33746; DOE/RL-2008-01, Section 3.3). SGW-37111, *Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Operable Unit Carbon Tetrachloride Site, Fiscal Year 2007*, describes the soil-vapor extraction system and the well fields. Figure 3.0-2 shows locations of soil-vapor extraction wells. Well 299-W18-253 was completed at the 216-Z-1A Tile Field in FY 2008 for use with the extraction system.

The 14.2 m^3/min soil-vapor extraction system was operated at the 216-Z-1A Well Field from April 1 through June 23, 2008. The soil-vapor extraction system was operated at the 216-Z-9 Well Field from July 1 through October 6, 2008. The system was maintained in standby mode from September 29, 2007 through March 31, 2008. The 28.3 and 42.5 m^3/min soil-vapor extraction systems did not operate and were not maintained during FY 2008. Temporarily suspending soil-vapor extraction operations at each well field allows the carbon tetrachloride concentrations to recharge and be more economically extracted when operations resume. Section 3.3.1 discusses the results of the FY 2008 soil-vapor extraction in more detail.

To track the effectiveness of the remediation effort, soil-vapor concentrations of carbon tetrachloride were monitored at the inlet to the soil-vapor extraction system and at individual on-line extraction wells during the 6-month operating period. To assess the impact of the soil-vapor extraction system on subsurface concentrations, soil-vapor concentrations of carbon tetrachloride were monitored at off-line wells and probes during the entire fiscal year (Section 3.3.2). Remediation efforts during FY 2008 also included passive soil-vapor extraction (Section 3.3.3).

3.3.1 Soil-Vapor Extraction

Soil-vapor extraction is removing carbon tetrachloride from the vadose zone in the 200 West Area.

During FY 2008, soil-vapor extraction began April 1, 2008 at the 216-Z-1A Well Field. On-line wells were selected within the perimeter of the 216-Z-1A Tile Field. Extraction wells open near the less-permeable Cold Creek unit, where the highest carbon tetrachloride concentrations have been detected consistently in the past, were selected to optimize mass removal of contaminant. Initial carbon tetrachloride concentrations measured at the soil-vapor extraction inlet during the first week of operation were approximately 16 ppmv (maximum concentration was 18 ppmv) (Figure 3.0-3). These concentrations are comparable to the initial concentrations (approximately 16 ppmv) measured during the second week of operations when the soil-vapor extraction system last operated at this site in FY 2007 (measurements during the first week of operations in 2007 were not representative).

During FY 2008, soil-vapor extraction began July 1, 2008 at the 216-Z-9 Well Field. Initial extraction was from wells close to the 216-Z-9 Trench. As extraction continued, additional wells near the trench and farther away from the trench were

brought online. Extraction wells open near the less-permeable Cold Creek unit, which consistently has the highest carbon tetrachloride concentrations, were selected to optimize mass removal of contaminant. Extraction wells open near the groundwater also were selected. Carbon tetrachloride concentrations measured at the soil-vapor extraction inlet during the first week of operation were approximately 24 ppmv (maximum concentration was 25 ppmv) (Figure 3.0-3). These concentrations are slightly lower than the initial concentrations (approximately 36 ppmv) measured during the first week of operations when the soil-vapor extraction system last operated at this site in FY 2007 (excluding the concentration of 94 ppmv measured on the first day of operations in FY 2007). Three narrow-diameter wells (C4937, C4938, and C5340) were installed using a direct-push technology on the south side of the 216-Z-9 Trench for the 200-PW-1 Operable Unit remedial investigation. These wells were used for soil-vapor extraction in FY 2007. From September 29 through October 6, 2008, soil-vapor extraction and pressure monitoring was conducted at these wells to evaluate the zone of influence achieved by extraction through these narrow diameter wells.

As of September 2008, ~79,400 kg of carbon tetrachloride had been removed from the vadose zone since extraction operations started in 1991 (Table 3.0-2). The mass of carbon tetrachloride removed was 216 kg in FY 2008. The performance evaluation report (SGW-37111) provides the amount of carbon tetrachloride removed per year between 1991 and 2007.

Approximately 79,400 kg of carbon tetrachloride have been removed from the vadose zone since extraction operations started in 1991.

3.3.2 Monitoring at Off-Line Wells and Probes

During FY 2008, soil-vapor concentrations of carbon tetrachloride were monitored near the ground surface, near the Cold Creek unit (~40 m below ground surface [bgs]), and near groundwater (~66 m bgs). Soil-vapor concentrations were monitored near the ground surface and groundwater to evaluate if nonoperation of the soil-vapor extraction system negatively affects the atmosphere or groundwater. The maximum concentration detected near the ground surface (between 2 and 10 m bgs) was 7 ppmv. Near the groundwater (between 53 and 66 m bgs), the maximum concentration was 17 ppmv.

Soil-vapor concentrations also were monitored above and within the Cold Creek unit to provide an indication of concentrations that could be expected during restart of the soil-vapor extraction system. The maximum concentration detected near the Cold Creek unit (between 25 and 44 m bgs) was 244 ppmv in soil-vapor probe CPT-28 (27 m bgs), ~90 m south of the 216-Z-9 Trench. This location may be beyond the zone of influence of the soil-vapor extraction system. Within the 216-Z-9 Well Field, the maximum carbon tetrachloride concentration detected near the Cold Creek unit was 22 ppmv at soil-vapor probe CPT-24 (36 m bgs). Approximately 200 m north of the 216-Z-9 Trench, the maximum carbon tetrachloride concentration detected was 45 ppmv at soil-vapor probe CPT-9A (15 m bgs).

At the 216-Z-1A Well Field, the maximum carbon tetrachloride concentration detected near the Cold Creek unit was 223 ppmv at well 299-W18-165 (33 m bgs).

The maximum carbon tetrachloride concentrations detected in the vadose zone overlying the Cold Creek unit (between 11 and 23 m bgs) were 598 ppmv at well C4938 and 562 ppmv at well C4937 (both 20 m bgs) near the 216-Z-9 Trench.

The temporary suspension of soil-vapor extraction in FY 2008 appears to have caused minimal detectable vertical transport of carbon tetrachloride through the soil surface to the atmosphere. Data collected during suspension of soil-vapor

The temporary suspension of soil-vapor extraction in FY 2008 appears to have caused minimal transport of carbon tetrachloride through the soil to the atmosphere and appears to have had no negative impact on groundwater quality.

extraction show carbon tetrachloride concentrations did not increase significantly at the near-surface monitoring probes. Carbon tetrachloride concentrations did not increase significantly near the water table during that time, which indicates suspending operations of the soil-vapor extraction system did not negatively impact groundwater quality.

3.3.3 Passive Soil-Vapor Extraction

Passive soil-vapor extraction is a remediation technology that uses naturally induced pressure gradients between the subsurface and the ground surface to drive soil-vapor to the surface. In general, falling atmospheric pressure causes subsurface vapor to move to the atmosphere through wells, whereas rising atmospheric pressure causes atmospheric air to move into the subsurface. Passive soil-vapor extraction systems are designed to use this phenomenon to remove carbon tetrachloride from the vadose zone.

Passive soil-vapor extraction systems were installed at the end of FY 1999 at eight wells open near the vadose-groundwater interface at the 216-Z-1A/216-Z-12/216-Z-18 Well Field. The passive systems have check valves that only allow soil-vapor flow out of the borehole (i.e., one-way movement), and canisters holding granular activated carbon that adsorbs carbon tetrachloride upstream of the check valves before the soil-vapor is vented to the atmosphere. The check valve prohibits flow of atmospheric air into the borehole during a reverse barometric pressure gradient, which tends to dilute and spread carbon tetrachloride vapors in the subsurface.

The wells are sampled periodically upstream of the granular activated carbon canisters when atmospheric pressure is falling and the wells are venting. During FY 2008, the maximum carbon tetrachloride concentrations ranged from 14 to 55 ppmv at the four wells (299-W18-6, 299-W18-7, 299-W18-246, and 299-W18-252) in the vicinity of the 216-Z-1A Tile Field. The maximum carbon tetrachloride concentrations ranged from 4 to 20 ppmv at the four wells (299-W18-10, 299-W18-11, 299-W18-12, and 299-W18-247) in the vicinity of the 216-Z-18 Crib.

3.4 Tank Farm Vadose Zone Activities

D. A. Myers and D.L. Parker

The Vadose Zone Integration Program is responsible for implementing the Tank Farm *Resource Conservation and Recovery Act of 1976* Corrective Action Program through field characterization, laboratory analyses, technical analyzes, risk assessment for past tank leaks, and installation of interim measures to reduce the threat from contaminants until permanent solutions can be found. In FY 2008, several direct push boreholes were installed for soil sampling and geophysical logging in the C and TY Tank Farms (Section 3.4.1). Surface geophysical exploration at WMA TX-TY was completed and a well-to-well geophysical survey of the SX Tank Farm was conducted (Section 3.4.2). Section 3.4.3 describes the Interim Surface Barrier completed over a portion of the 241-T Tank Farm to reduce the infiltration of precipitation through the remnants of the 1973 release from tank 241-T-106. Section 3.4.4 briefly describes geophysical logging.

3.4.1 Direct Push Boreholes and Sampling

The hydraulic hammer unit was deployed in two tank farms during FY 2008 to evaluate subsurface contamination in the vadose zone. Nine pushes were made in

the C Tank Farm to investigate past unplanned release sites associated with diversion boxes and pipelines in and adjacent to that farm. The hydraulic hammer unit was deployed at eight sites in the TY Tank Farm to assess the extent of contamination in support of a proposed interim barrier. The sites were identified from previous investigations of subsurface resistivity (RPP-RPT-38320, *Surface Geophysical Exploration of the TX and TY Tank Farms at the Hanford Site*), and from historical records of tank leaks (RPP-15808, *Subsurface Conditions Description of the U Waste Management Areas*). Table 3.0-3 provides the locations where direct push was used in the single-shell tank farms. The table also shows the purpose of the probe holes and the number of electrodes installed in each hole.

A multi-level sampler, developed for investigation of the Plutonium Finishing Plant trenches, was used at all sites to collect samples of potentially contaminated sediments for laboratory analysis. In addition, the hydraulic hammer unit was used to place deeply buried electrodes at 10 of the investigated sites. These electrodes will be used during a future deployment of Surface Geophysical Exploration in the tank farms. The analytical results will be used to support placement of a proposed interim barrier over all or part of the TY Tank Farm and the Phase 2 (tank farm closure) investigation of the C Tank Farm.

3.4.2 Surface Geophysical Exploration

Surface geophysical exploration (a combination of surface deployed geophysical techniques) was applied in WMA TX-TY (RPP-RPT-38320) during FY 2008. Also, surface geophysical exploration was conducted to support a proposed interim barrier in the SX Tank Farm using dry wells and adjacent groundwater monitoring wells. The primary tool applied through surface geophysical exploration is pole-pole electrical resistivity; other tools include electro-magnetic induction, magnetic gradiometry, and ground-penetrating radar. These latter tools are used to help define the presence and distribution of buried infrastructure, so that those features may be taken into account during the analysis of resistivity data. The depth to which the resistivity measurements interrogate the subsurface is determined by the distance between electrode pairs (the further apart, the deeper the interrogation). Because resistivity is an indirect measure of several subsurface phenomena (e.g., moisture distribution, saline contaminants, and soil texture), the more separated the electrode pairs, the lower the resolution of the analysis. The resistivity data are mathematically analyzed through a process known as inversion to provide a best estimate of the distribution of resistivity anomalies. Surface geophysical exploration provides a means of extrapolating direct measurements taken by sampling, logging, or other means to provide a cost-effective overview of large areas that may have been impacted by a variety of waste management practices. It is recognized that there are inherent difficulties with surface geophysical exploration in infrastructure-rich environments, such as tank farms. The FY 2009 work will be directed to address these difficulties by continuing to deploy buried electrodes.

In WMA TX-TY (RPP-RPT-38320), the surface geophysical exploration analytical results will assist the design of an interim surface barrier, including definition of areas that will be confirmed using direct push sampling. Figure 3.0-4 provides an isometric, composite view of the WMA. The figure shows areas of high conductance (low resistivity) in the vadose zone. These areas likely correspond to areas of high concentrations of nitrate and associated contaminants.

In WMA S-SX (RPP-RPT-38322, *Surface Geophysical Exploration of the S and SX Tank Farms at the Hanford Site*), a well-to-well resistivity survey was completed

to aid in the design of a proposed interim surface barrier over appropriate portions of the 241-SX Tank Farm. Figure 3.0-5 shows identified resistivity anomalies in the 241-SX Tank Farm. Because of the length of the electrodes, well-to-well surveys are not interpreted as 3-dimensional plumes. The figure shows a resistivity anomaly that generally corresponds to known tank leak locations.

3.4.3 Interim Barrier

In 1973, tank 241-T-106 leaked ~435,000 L of waste into the surrounding soil (RPP-23752, *Field Investigation Report for Waste Management Areas T and TX-TY*). Contamination from this leak is present in the vadose zone beneath the T Tank Farm. The T Tank Farm Interim Surface Barrier was installed to decrease infiltration of water into the area of contamination (decrease the potential for further contaminant migration) and to serve as a barrier demonstration project (Figure 3.0-6). Construction of the T Tank Farm Interim Surface Barrier was completed in March 2008. The barrier is about 6,575 m^2 and consists of about 0.6 to 0.9 m of engineered fill covered by a geotextile and a spray applied polyurea/polyurethane (RPP-ENV-33430, *RPP NEPA Screening Form and Categorical Exclusion for the 241-T-106 Interim Infiltration Barrier*).

The effectiveness of the T Tank Farm Interim Surface Barrier to reduce vadose zone moisture is being assessed through a barrier-monitoring program (PNNL-16538, *T Tank Farm Interim Surface Barrier Demonstration – Vadose Zone Monitoring*). A solar-powered and remotely controlled system was installed to monitor soil-water conditions continuously at four locations beneath the barrier and outside the barrier footprint, as well as site meteorological conditions. Each location has a capacitance probe with multiple sensors, multiple heat-dissipation units, and a neutron probe access tube. The principal variables monitored are soil-water content and soil-water pressure. Soil temperature, precipitation, and air temperature also are measured.

PNNL-17306, *T Tank Farm Interim Surface Barrier Demonstration—Vadose Zone Monitoring FY07 Report*, reports prebarrier data. A future FY 2008 monitoring report will provide post-barrier data.

3.4.4 Geophysical Logging

Geophysical logging of selected dry wells in the T Tank Farm was conducted to support the assessment of the interim surface barrier placed over the site of the 1973 release from tank 241-T-106. Interpreted results of those logs have not yet been received.

Table 3.0-1. Analytical Results for Key Constituents in Leachate at the Solid Waste Landfill.

Parameter[a]	Results by Quarter				GWQC[c]	MCL[d]
	3rd 2007	4th 2007	1st 2008	2nd 2008[b]		
Indicator Parameters						
Ammonia as N (mg/L)	1.23	0.338	0.373	NT	NA	NA
Chemical Oxygen Demand (mg/L)	214	200	230	NT	NA	NA
Specific Conductivity (µS/cm)	2,050	1,840	2,000	NT	NA	700
Dissolved Iron (µg/L)	119	364	7910	NT	300	300
Dissolved Manganese (µg/L)	1,480	1,510	1,710	NT	50	50
Dissolved Zinc (µg/L)	381	<8.0	<4.0	NT	5,000	5,000
pH	6.83	6.76	7.23	NT	6.5 - 8.5	NA
Total Organic Carbon (mg/L)	72.6	61.9	3.21	NT	NA	NA
Site-Specific Parameters						
Total Dissolved Solids (mg/L)	NT	NT	1,440	NT	500	500[e]
Total Organic Halides (µg/L)	NT	NT	671	NT	NA	NA
Arsenic (µg/L)	NT	17.5	65.3	NT	0.05	10
Barium (µg/L)	NT	463	492	NT	1,000	2,000
Cadmium (µg/L)	NT	<1.0	<4.0	NT	10	5
Chloride (mg/L)	203	200	196	NT	250	25
Copper (µg/L)	NT	1.72	<4.0	NT	1,000	NA
Fluoride (mg/L)	<1.21	<0.606	0.18	NT	4	4
Nickel (µg/L)	NT	109	106	NT	NA	100
Selenium (µg/L)	NT	11.6	3.43	NT	10	50
Sulfate (mg/L)	<14.1	7.07	7.12	NT	250	25
1,1-Dichloroethane (µg/L)	NT	NT	<1.0	NT	1	NA
1,1,1-Trichloroethane (µg/L)	NT	NT	<1.0	NT	200	200
1,4-Dioxane (µg/L)	NT	NT	26	NT	7	NA
1,4-Dichlorobenzene (µg/L)	NT	NT	12	NT	4	NA
Carbon Tetrachloride (µg/L)	NT	NT	<1.0	NT	0.3	5
Chloroform (µg/L)	NT	NT	<1.0	NT	7	NA
Methylene Chloride (µg/L)	NT	NT	<1.0	NT	5	NA
Tetrachloroethene (µg/L)	NT	NT	<1.0	NT	NA	NA
Trichloroethene (µg/L)	NT	NT	<1.0	NT	NA	NA

[a] Units as provided in analytical results report.
[b] Leachate was not tested for indicator parameters during the second quarter of calendar year 2008 because of an scheduling oversight.
[c] Groundwater Quality Criteria from WAC 173-200, "Water Quality Standards for Ground Waters of the State of Washington."
[d] Maximum Contaminant Levels from WAC 246-290, "Public Water Supplies."
[e] Required only when specific conductivity exceeds 700 µS/cm.

NT = not tested.
NA = not applicable.

Table 3.0-2. Carbon Tetrachloride Inventory Removed by Vapor Extraction from Primary Disposal Sites.

Well Field	Mass Removed Using Soil-Vapor Extraction, April 2008 to September 2008 (kg)	Mass Removed Using Soil-Vapor Extraction, 1991 to September 2008 (kg)
216-Z-1A 216-Z-18	105 *	24,772 *
216-Z-9	111	54,608
Total	**216**	**79,380**
* Reported as a combined value for 216-Z-1A and 216-Z-18 Well Fields because they overlap.		

Table 3.0-3. Locations of Direct Push Holes in the C and TY Tank Farms in Fiscal Year 2008.

Well ID	Northing (m)	Easting (m)	Elevation (m amsl)	Purpose	Electrode Installation Depth (m bgs)
Direct Push Probe Holes at the 241-CR-151 Diversion Box in the C Tank Farm					
C6391	136474.3	575115.2	203.51	Logging	No electrode
C6393	136465.8	575119.7	203.722	Logging	No electrode
C6394	136464.8	575120	203.672	Sampling	No electrode
C6395	136469.7	575110.6	203.651	Logging	15 & 44
C6397	136482.4	575125.4	203.072	Logging	No electrode
C6399	136478	575130.1	203.028	Logging	15 & 65
C6401	136470	575134.8	203.131	Logging	No electrode
C6403	136480.7	575142.7	202.694	Logging	No electrode
C6405	136487.8	575117.7	203.113	Logging	No electrode
Direct Push Probe Holes in the TY Tank Farm					
C6913	136413.7	566792.4	205.351	Logging	15 & 28
C6915	136403.7	566786.3	205.373	Logging	15 & 29
C6917	136377.7	566795.7	205.418	Logging	15 & 23
C6919	136364.1	566774.3	205.37	Logging	15 & 29
C6921	136363.8	566732.1	205.056	Logging	14 & 28
C6923	136389.2	566718.3	204.835	Logging	15 & 28
C6925	136432.7	566747	205.086	Logging	15 & 28
C6927	136431.7	566765.1	205.233	Logging	15 & 30

amsl = above mean sea level.
bgs = below ground surface.

Figure 3.0-1. Leachate Collection Volumes at the Solid Waste Landfill.

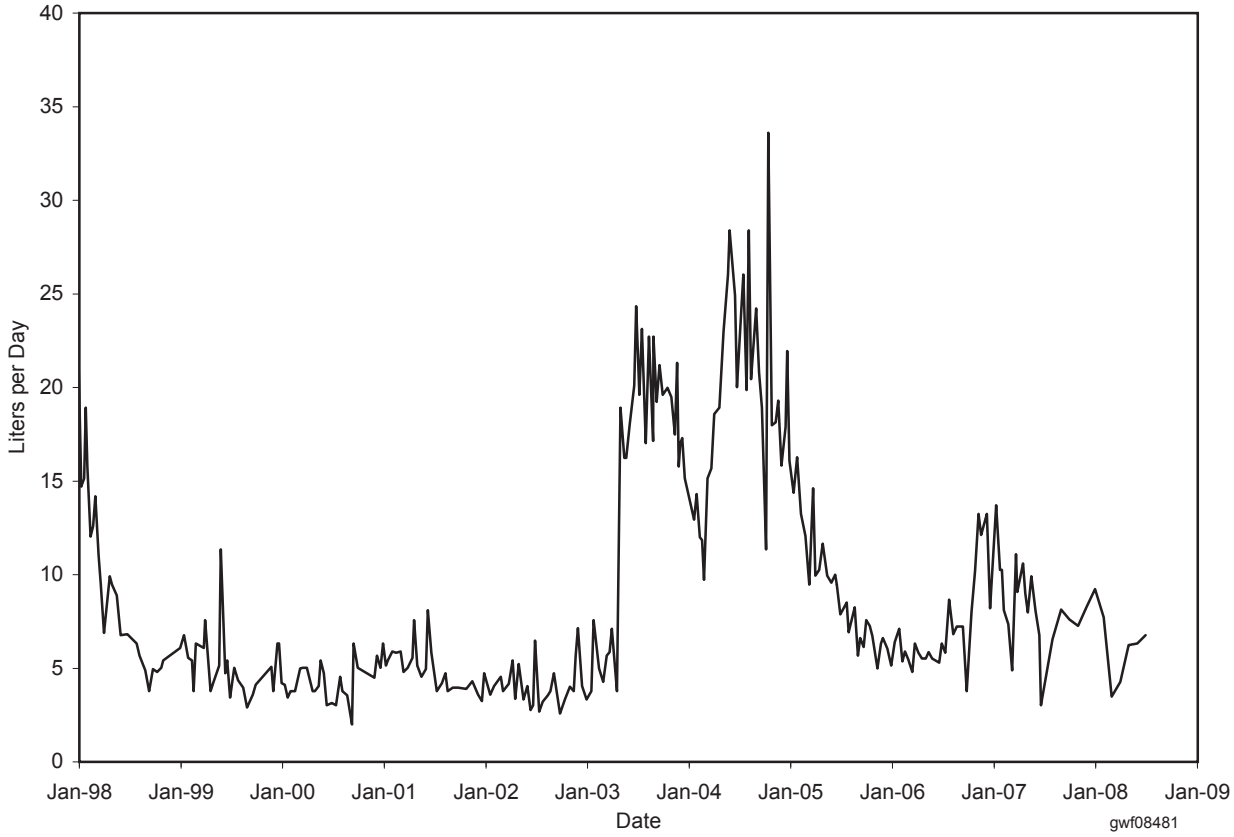


Figure 3.0-2. Locations of Carbon Tetrachloride Soil-Vapor-Extraction Wells at 216-Z-1A/216-Z-12/216-Z-18 and 216-Z-9 Well Fields.

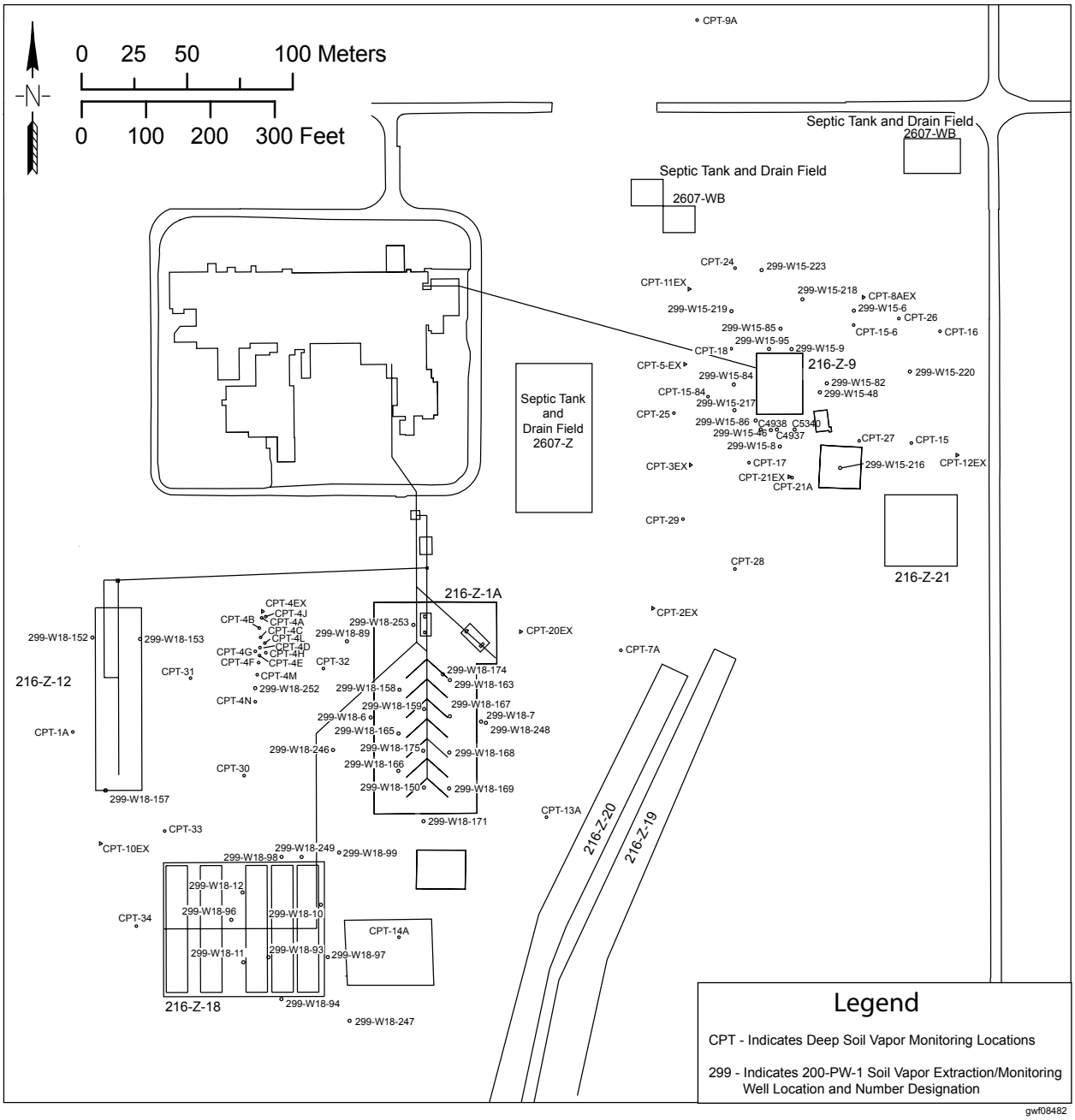


Figure 3.0-3. Time Series Concentrations and Mass of Carbon Tetrachloride in Soil Vapor Extracted from 216-Z-1A/216-Z-12/216-Z-18 and 216-Z-9 Well Fields.

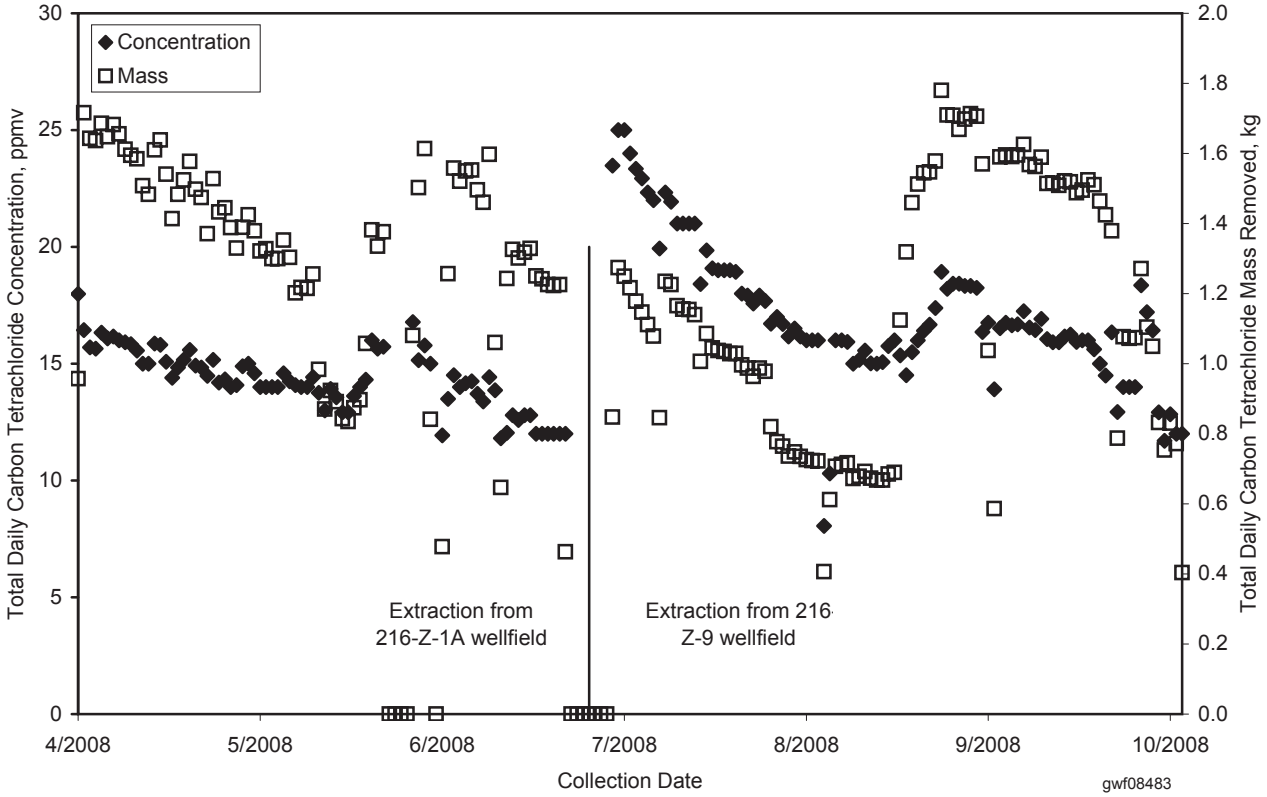
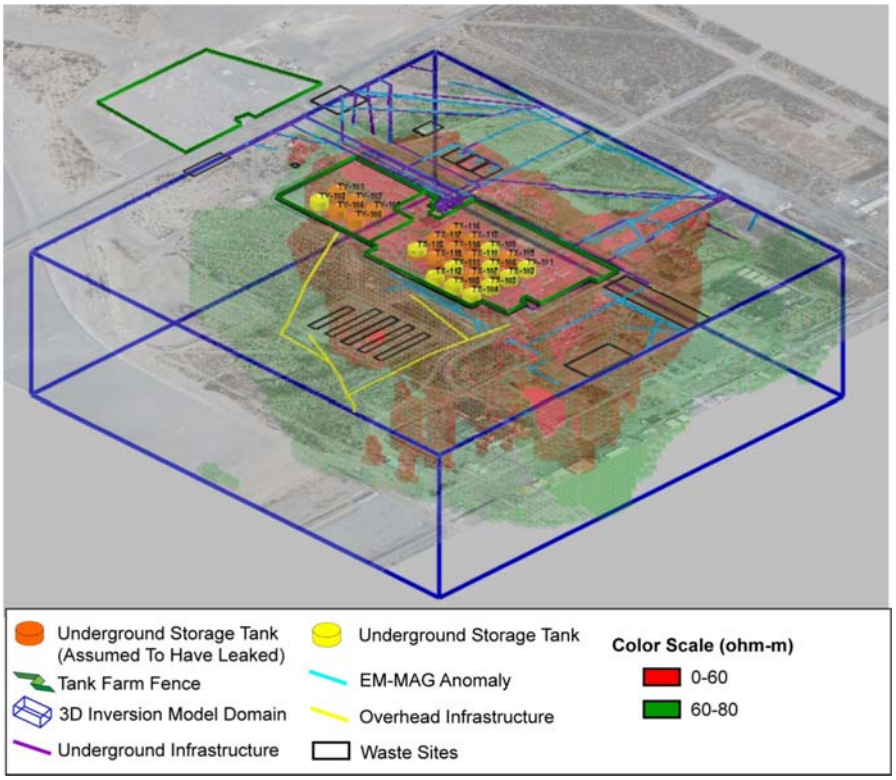
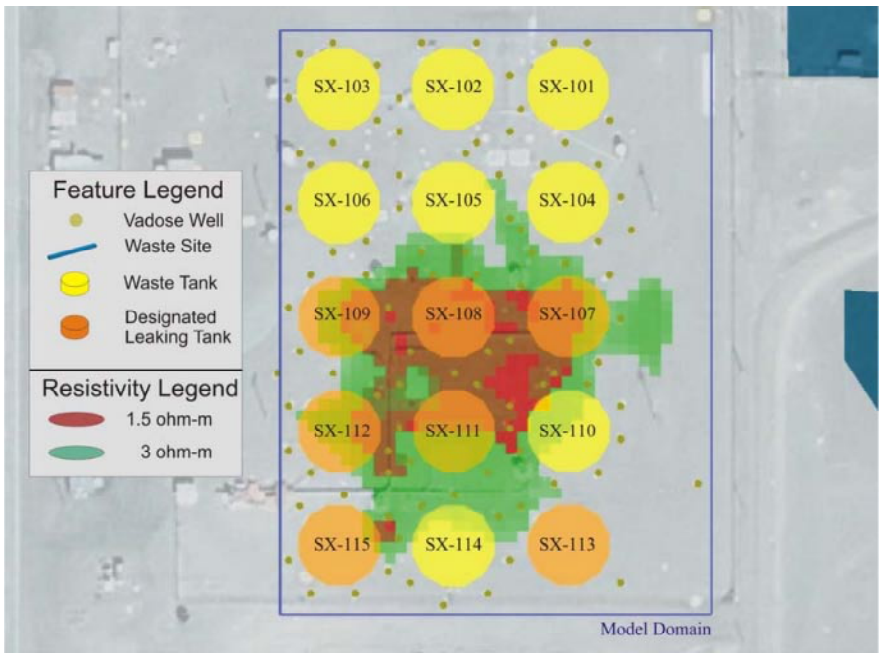


Figure 3.0-4. Isometric Plot of Resistivity Anomalies, WMA TX-TY and Vicinity.



RPP-RPT-38320, *Surface Geophysical Exploration of the TX and TY Tank Farms at the Hanford Site.*

Figure 3.0-5. Map of Resistivity Anomalies, 241-SX Tank Farm.



RPP-RPT-38322, *Surface Geophysical Exploration of the S and SX Tank Farms at the Hanford Site.*

Figure 3.0-6. Aerial Photo of the Interim Surface Barrier, 241-T Tank Farm.

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