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Revision 0

PERFORMANCE EVALUATION REPORT FOR SOIL VAPOR EXTRACTION OPERATIONS AT THE 200-PW-1 OPERABLE UNIT CARBON TETRACHLORIDE SITE, FISCAL YEAR 2007

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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P.O. Box 1000
Richland, Washington

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EXECUTIVE SUMMARY

Soil vapor extraction (SVE) is being used to remove carbon tetrachloride from the vadose zone at the 200-PW-1 Operable Unit (OU) (formerly designated as the 200-ZP-2 OU). The purpose of this document is to report the SVE system operating data and the effectiveness of SVE in remediating carbon tetrachloride contamination based on the existing remedial design. This report covers operations for fiscal year 2007 (FY07) (the period of October 1, 2006, through September 30, 2007) and provides a general overview of the entire operating period from February 25, 1992, through September 30, 2007. The scope of the report includes the following:

- Summary of the history of SVE operations at the 200-PW-1 OU
- Evaluation of the efficiency of operations over time
- Estimated volume of soil vapor treated
- Measured changes in carbon tetrachloride concentrations
- Calculated mass of carbon tetrachloride removed
- Recommendations for future operations and evaluations
- SVE operations cost data.

Carbon tetrachloride was found in the unconfined aquifer beneath the 200 West Area at the Hanford Site in the mid-1980s. During this time, groundwater monitoring results indicated that the carbon tetrachloride plume was widespread and that concentrations were increasing. In response to this contamination, removal of carbon tetrachloride from the vadose zone in the 200 West Area was initiated in 1992, using SVE with aboveground vapor treatment using granular activated carbon.

By March 1993, three SVE systems (located near the three primary carbon tetrachloride disposal sites) were in operation with a total capacity of 85 m^3/min. The three primary carbon tetrachloride disposal sites were the 216-Z-9 Trench, the 216-Z-1A Tile Field, and the 216-Z-18 Crib (216-Z-9, 216-Z-1A, and 216-Z-18 sites, respectively). These three sites were the subsurface infiltration facilities used from 1955 through 1973 for soil column disposal of aqueous and organic liquid wastes containing carbon tetrachloride. The SVE at the 216-Z-12 Crib (216-Z-12 site) was initiated in 1995. The 216-Z-1A, 216-Z-18, and 216-Z-12 sites are discussed together because the well fields at these sites overlap.

The operating strategy was modified in FY98, based on the results of the rebound study conducted in FY97 and the declining rate of carbon tetrachloride removal during continuous extraction operations. Rather than operating all three SVE systems continuously, only the 14.2-m^3/min system was used for carbon tetrachloride removal during FY98, FY99, and FY01 through FY07. During each of these FYs, the system typically operated from April through September, alternating between the 216-Z-9 and the 216-Z-1A/Z-18 sites (approximately 3-month periods for each site). The system was maintained in standby mode from October through March to allow time for carbon tetrachloride vapor concentrations to rebound. Operation was temporarily suspended during the entire period of FY00 as a result of higher priority remediation activities competing for limited funding. Beginning in FY03, maintenance of the 28.3-m^3/min and 42.5-m^3/min SVE systems was discontinued; surplus of these systems is pending.

The 14.2-m^3/min SVE system was operated at the 216-Z-9 well field from April through July 2007 and at the 216-Z-1A/Z-18 well field from August through September 2007. Operation of the SVE system at the 216-Z-9 well field included use of the slant well (well 299-W15-48) that was drilled beneath the 216-Z-9 Trench and completed as a vapor extraction well in FY06, and use of the three narrow-diameter wells (C4937, C4938, and C5430) that were installed on the south side of the 216-Z-9 Trench and completed as vapor extraction wells in FY07.

Carbon tetrachloride concentrations in the extracted soil vapor have decreased significantly at all three sites since initial operation of the SVE systems. Initial carbon tetrachloride concentrations in extracted soil vapor were approximately 30,000 parts per million by volume (ppmv) at the 216-Z-9 well field and 1,500 ppmv at the 216-Z-1A/Z-18 well field. In contrast, concentrations in extracted soil vapor were approximately 16 ppmv at the 216-Z-1A/Z-18 well field and 16 ppmv at the 216-Z-9 well field when active SVE was last used at these sites in FY07.

The primary source of the remaining carbon tetrachloride appears to be the relatively low-permeability zones within and overlying the Cold Creek unit. As carbon tetrachloride from these lower permeability zones migrates into the overlying and underlying higher permeability zones, it can be removed using SVE. However, the rate of removal will be controlled by the rates of carbon tetrachloride desorption and diffusion. At many monitoring locations, including locations within the higher permeability zones, the relatively low carbon tetrachloride rebound

concentrations indicate that the readily available mass (i.e., carbon tetrachloride already in the vapor phase or volatizing directly from residual nonaqueous phase liquid) has been removed. At these locations, availability of additional mass for removal is controlled by the desorption and diffusion kinetics of carbon tetrachloride adsorbed within soil particle micropores and within soil moisture.

The SVE system was operated with an average availability of 96% from April through September 2007 and extracted 280 kg (618 lb) of carbon tetrachloride. Between April 1991 (when the pilot test was conducted) and September 2007, approximately 79,164 kg (174,527 lb) of carbon tetrachloride were removed from the vadose zone. Of this total, 54,497 kg (120,145 lb) were removed from the 216-Z-9 well field and 24,667 kg (54,381 lb) from the 216-Z-1A/Z-18/Z-12 well field.

From 1991 through 1997, approximately 74,851 kg (165,017 lb) of carbon tetrachloride were removed from the vadose zone. In comparison, approximately 4,313 kg (9,509 lb) of carbon tetrachloride were removed from the vadose zone between FY98 and FY07.

Passive SVE systems were installed on eight wells in FY99 and operated from FY00 through FY07 to remove carbon tetrachloride from the vadose zone. Passive SVE is a naturally occurring process driven by barometric pressure fluctuations and is often referred to as "barometric pumping." The eight wells are located in the 216-Z-1A/Z-18 well field. Approximately 5 kg (11 lb) of carbon tetrachloride were removed from the vadose zone using passive SVE in FY07. Between October 1999 and September 2007, approximately 85 kg (187 lb) of carbon tetrachloride have been removed using passive SVE.

An updated conceptual model of the carbon tetrachloride contamination in the vadose zone has been developed as part of the remedial investigation of the 200-PW-1 OU. In general, the highest concentrations of carbon tetrachloride detected in the vadose zone have been in fine-grained layers within and overlying the Cold Creek unit. For example, samples of soil from a silt lens approximately 19.8 m (65 ft) below ground surface south of the 216-Z-9 Trench contained relatively high concentrations of carbon tetrachloride (380,000 to 390,000 µg/kg), indicative of a dense nonaqueous-phase liquid. The regions of residual carbon tetrachloride are generally limited in area, are located near the 216-Z-9 Trench and 216-Z-1A Tile Field, and are not considered to be a significant current source of groundwater contamination.

Depth-discrete groundwater sampling and analysis results, primarily from 2002 through 2006, for dissolved carbon tetrachloride suggest that as a result of past transport conditions, a significantly higher percent of the mass may be present throughout the unconfined aquifer (in dissolved and sorbed phases) than previously estimated. The current estimate is that approximately 100,000 kg (220,460 lb) of carbon tetrachloride may exist within the groundwater system. However, within the top 10 m (33 ft) of the aquifer, the lateral extent and maximum concentrations of the higher concentration carbon tetrachloride contamination have been diminishing from 2000 to 2007, indicating that a significant continuing source in the deep vadose zone or top of the aquifer is not likely.

Recommendations for SVE operations include (1) continuing operation of active and passive extraction systems, and (2) continuing development of a final remedial action determined through the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* remedial investigation/feasibility study process for the 200-PW-1 OU, which began in FY02.

During FY07, an additional SVE system was operated at the 218-W-4B Burial Ground from December 2006 through July 2007. Elevated concentrations of carbon tetrachloride were detected in trench T-07 in this burial ground during the environmental release investigation in support of waste retrieval operations for retrievably stored waste. The SVE system was operated at trench T-07 to minimize the release of carbon tetrachloride from the trench to the environment and to protect site workers. Vapor extraction was conducted in support of waste retrieval activities. The vapor extraction point was moved periodically from west to east as vapor extraction operations reduced the carbon tetrachloride concentrations and as waste retrieval progressed. The system was removed permanently to allow retrieval operations to remove the remaining waste at the west end of trench T-07.

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LIST OF TERMS

B&K	Brüel & Kjaer™ (trademark of Brüel & Kjaer North America, Inc.)
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CCU	Cold Creek unit
CPT	cone penetrometer
DNAPL	dense nonaqueous phase liquid
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERA	expedited response action
FY	fiscal year
GAC	granular activated carbon
OU	operable unit
PFP	Plutonium Finishing Plant
ppmv	parts per million by volume
PRF	Plutonium Reclamation Facility
RAO	remedial action objective
RECUPLEX	Recovery of Uranium and Plutonium by Extraction
RI/FS	remedial investigation/feasibility study
RL	U.S. Department of Energy, Richland Operations Office
SVE	soil vapor extraction
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*

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METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerels	millibecquerels	0.027	picocuries

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1.0 INTRODUCTION

Carbon tetrachloride was found in the unconfined aquifer beneath the 200 West Area at the Hanford Site in the mid-1980s. During this time, groundwater monitoring results indicated that the carbon tetrachloride plume was widespread and that concentrations were increasing. On December 20, 1990, the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology) requested that the U.S. Department of Energy (DOE), Richland Operations Office (RL) proceed with detailed planning, including non-intrusive field work, required to implement an expedited response action (ERA) for removing carbon tetrachloride contamination from the unsaturated soils in the 200 West Area. The request was based on concerns that carbon tetrachloride residing in the soils was continuing to spread to the groundwater and, if left unchecked, would significantly increase the lateral extent of groundwater contamination. The purpose of the ERA was to minimize carbon tetrachloride migration within the vadose zone and away from the carbon tetrachloride disposal sites in the 200 West Area.

The objective of the ERA, as stated in the action memorandum issued in January 1992 by EPA and Ecology (*Action Memorandum: Expedited Response Action Proposal for 200 West Area Carbon Tetrachloride Plume* [EPA and Ecology 1992]), is to mitigate the threat to site workers, public health, and the environment caused by the migration of carbon tetrachloride vapors through the soil column and into the groundwater. The ERA is an interim action taken to reduce the mass of carbon tetrachloride in the soil column beneath the 200 West Area pending final cleanup activities.

Based on the initial investigations and an engineering evaluation/cost analysis, the preferred alternative for removal of the carbon tetrachloride from the vadose zone was soil vapor extraction (SVE) followed by aboveground vapor treatment using granular activated carbon (GAC) ("Site Evaluation," in *Expedited Response Action Proposal (EE/CA & EA) for 200 West Area Carbon Tetrachloride Plume* [DOE/RL-91-32]). The SVE pilot test was conducted in 1991, and the first SVE system began full-scale operations in February 1992.

The final cleanup activities will be determined as part of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) remedial investigation/feasibility study (RI/FS) process for the 200-PW-1 Operable Unit (OU). The RI for this OU was initiated in fiscal year 2002 (FY02) and was completed in FY06 (*Remedial Investigation Report for the Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit: Includes the 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units* [DOE/RL-2006-51] [hereinafter referred to as the RI report). Draft A of the FS and the proposed plan for this OU were submitted to EPA in FY07, meeting *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 2003) Milestone M-15-45B.

1.1 REPORT PURPOSE

The purpose of this report is to evaluate the SVE system operating data and the effectiveness of the SVE in remediating the carbon tetrachloride contamination based on the existing remedial design. This report covers operations for FY07 (the time period of October 1, 2006, through September 30, 2007) and provides a general overview of the operating period from February 25, 1992, through September 30, 2006. The scope of the report includes the following:

- Summary of the history of SVE operations at the 200-PW-1 OU
- Evaluation of the efficiency of operations over time
- Estimated volume of soil vapor treated
- Measured changes in carbon tetrachloride concentrations
- Calculated mass of carbon tetrachloride removed
- Recommendations for future operations and evaluations
- SVE operations cost data.

1.2 REPORT ORGANIZATION

Detailed information on previous operating periods, and characterization data collected during the RI, can be obtained from the following reports:

- FY92 through FY01: *Performance Evaluation Report for Soil Vapor Extraction Operations at the Carbon Tetrachloride Site, February 1992 – September 2001* (BHI-00720)
- FY02: *Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Carbon Tetrachloride Site, Fiscal Year 2002* (WMP-17869)
- FY03: *Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Carbon Tetrachloride Site, Fiscal Year 2003* (WMP-21327)
- FY04: *Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Carbon Tetrachloride Site, Fiscal Year 2004* (WMP-26178)
- FY05: *Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Carbon Tetrachloride Site, Fiscal Year 2005* (WMP-30426)
- FY06: *Performance Evaluation Report for Soil Vapor Extraction Operations at the 200-PW-1 Carbon Tetrachloride Site, Fiscal Year 2006* (SGW-33746)
- *Remedial Investigation Report for the Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit: Includes the 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units* (DOE/RL-2006-51)
- *Remedial Investigation Report for 200-ZP-1 Groundwater Operable Unit* (DOE/RL-2006-24)
- *Carbon Tetrachloride Dense Non-Aqueous Phase Liquid (DNAPL) Source Term Interim Characterization Report* (DOE/RL-2006-58)
- *Carbon Tetrachloride Dense Non-Aqueous Phase Liquid (DNAPL) Source Term Interim Characterization Report Addendum* (DOE/RL-2007-22).

In this FY07 report, data from previous years are used for comparison and trending purposes. This FY07 report is divided into the following sections:

- Section 1.0: Provides introductory information, describes the purpose of this SVE report, and summarizes the FY07 activities.
- Section 2.0: Includes information on the design and location of the SVE systems, history of operations, and SVE system performance.

- Section 3.0: Discusses soil vapor monitoring during FY07 and provides information on historical monitoring activities.
- Section 4.0: Presents the conceptual models for the three primary carbon tetrachloride waste sites.
- Section 5.0: Includes information on the status of the ERA.
- Section 6.0: Presents conclusions and recommendations.
- Section 7.0: Presents costs for SVE operations from FY04 through FY07.
- Section 8.0: Provides a list of the references cited in this report.

Appendices A through E provide the data collected during operations and monitoring in FY07.

1.3 FISCAL YEAR 2007 ACTIVITIES

Activities completed during FY07 in support of SVE system operations are summarized as follows:

- The 14.2-m^3/min SVE system was operated at the 216-Z-9 well field from April through July 2007 and at the 216-Z-1A/Z-18 well field from August through September 2007. During this time, the SVE system extracted 280 kg (618 lb) of carbon tetrachloride from the vadose zone.
- Operation of the SVE system at the 216-Z-9 well field included use of the slant well (well 299-W15-48) that was drilled beneath the 216-Z-9 Trench and completed as a vapor extraction well in FY06, and use of the three narrow-diameter wells (C4937, C4938, and C5430) that were installed on the south side of the 216-Z-9 Trench and completed as vapor extraction wells in FY07.
- The passive SVE systems that were installed on eight wells in FY99 continued to operate throughout FY07. Approximately 5 kg (11 lb) of carbon tetrachloride were removed from the vadose zone using passive SVE in FY07.
- Soil vapor monitoring continued monthly throughout FY07 at wells and probes that were not on-line to the SVE system.
- The RI report that includes the 200-PW-1 OU was issued in FY07 (DOE/RL-2006-51). An updated conceptual model of the carbon tetrachloride contamination in the vadose zone was developed as part of the RI of the 200-PW-1 OU. In general, the highest concentrations of carbon tetrachloride detected in the vadose zone have been in fine-grained layers within and overlying the Cold Creek unit (CCU). For example, samples of soil from a silt lens approximately 19.8 m (65 ft) below ground surface (bgs) south of the 216-Z-9 Trench contained relatively high concentrations of carbon tetrachloride (380,000 to 390,000 µg/kg), indicative of a dense nonaqueous phase liquid (DNAPL). The regions of residual carbon tetrachloride are generally limited in area, are located near the 216-Z-9 Trench and 216-Z-1A Tile Field, and are not considered to be a significant current source of groundwater contamination. The contaminant distribution models presented in the RI report for the carbon tetrachloride waste sites are summarized in the conceptual model section of this report (Section 4.0).

- At the request of DOE Headquarters' Office of Environmental Management, the Office of Groundwater and Soil Remediation (EM-22) performed a remediation system evaluation of the SVE system at the 200-PW-1 OU in 2006 (*Hanford Operations Review Report: Feasibility Study Strategies and Remedial System Performance Improvement for the 200-ZP-1/PW-1 Operable Units at Hanford* [DOE 2007]). The remediation system evaluation team made five recommendations in Section 5.5 of their report that specifically address the use of SVE at the 200-PW-1 OU. Responses to those comments are provided in conclusions and recommendations section of this report (Section 6.0).
- During FY07, an additional SVE system was operated at the 218-W-4B Burial Ground from December 2006 through July 2007. A summary of the system operations and monitoring is included in this report.

2.0 200-PW-1 OPERABLE UNIT SOIL VAPOR EXTRACTION SYSTEM

The purpose of the ERA, as described in the action memorandum (EPA and Ecology 1992), can be summarized by four remedial action objectives (RAOs):

- Mitigate the threat to site workers
- Mitigate the threat to public health
- Mitigate the threat to the environment caused by the migration of contaminants from soil into groundwater
- Reduce the mass of carbon tetrachloride in the soil.

To meet these RAOs, the action memorandum authorized the installation and operation of SVE systems. These systems are described below.

2.1 SOIL VAPOR EXTRACTION SYSTEM DESCRIPTION

The primary active SVE system uses an applied vacuum to extract carbon tetrachloride vapor from the vadose zone. This system extracts vapor through multiple vadose zone borings at the three primary carbon tetrachloride disposal sites:

- 216-Z-9 Trench
- 216-Z-1A Tile Field
- 216-Z-18 Crib.

The SVE system is also used to extract vapor through wells at the 216-Z-12 Crib (216-Z-12 site). Hereinafter in this report, these sites will be referred to as the 216-Z-9, 216-Z-1A, 216-Z-18, and 216-Z-12 sites. The 216-Z-1A, 216-Z-18, and 216-Z-12 sites are discussed together because the well fields at these sites overlap.

The SVE system was operated at the 216-Z-9 site from April through July 2007 and at the 216-Z-1A site from August through September 2007. Passive SVE systems that use naturally occurring changes in barometric pressure to drive the extraction of vapor were installed at eight vadose zone borings and operated throughout FY07. Detailed information for both the active and passive systems is presented in the following subsections.

2.1.1 Active Soil Vapor Extraction

The active SVE system consists of the following:

- A water knockout tank to remove entrained water droplets
- A high-efficiency particulate air filter to remove entrained particulate matter, including radionuclides
- A blower to extract the soil vapor
- An air-to-air heat exchanger to cool the vapor between the blower and the GAC canisters
- A secondary water knockout tank to remove entrained water condensate from the air cooler

- GAC-filled canisters for adsorbing carbon tetrachloride
- A stack for venting the treated vapor to the atmosphere.

Following overheating of a GAC canister in June 1993, a Brüel & Kjaer™ (B&K) Type 1302 multi-gas analyzer was purchased, and manual sampling was performed to test the performance of the instrument. The B&K instrument proved to be accurate and reliable, with the added features of being able to measure several other targeted volatile organic compounds and being readily adaptable to automated operation. The B&K instrument has since been used to support 24-hour/day SVE system operations, providing automated sampling and analysis at the SVE system inlet, between GAC canisters, and at the post-treatment vent stack. The vapor flow rate is also measured at these locations.

2.1.2 Passive Soil Vapor Extraction

Passive SVE uses naturally induced pressure gradients between the subsurface and the surface to drive soil vapor to the surface. The presence of a borehole screened in the vadose zone provides a preferential pathway for flow. In general, falling atmospheric pressure causes subsurface vapor to move to the atmosphere through wells, while rising atmospheric pressure causes atmospheric air to move into the subsurface. At the carbon tetrachloride site, passive SVE systems are installed on the following selected wells: 299-W18-6L, 299-W18-7, 299-W18-10L, 299-W18-11L, 299-W18-12, 299-W18-246L, 299-W18-247L, and 299-W18-252L.

The minimum component for a passive SVE system is a well to provide the preferential pathway from the subsurface zone to the surface. On the systems designed for use at the carbon tetrachloride site, additional components include the following:

- An aboveground canister of GAC to collect the venting carbon tetrachloride
- Hoses to connect the well to the canister
- A one-way, flow-activated valve that lets soil vapor flow out through the well but prevents atmospheric air from flowing in through the well.

2.2 HISTORY OF OPERATIONS

2.2.1 Carbon Tetrachloride Waste Disposal

Carbon tetrachloride contained in aqueous and organic liquid wastes generated during plutonium-processing operations at Z Plant (currently called the Plutonium Finishing Plant [PFP]) was discharged primarily to three subsurface infiltration facilities:

- 216-Z-9 Trench from 1955 to 1962
- 216-Z-1A Tile Field from 1964 to 1969
- 216-Z-18 Crib from 1969 to 1973.

The Recovery of Uranium and Plutonium by Extraction (RECUPLEX) plutonium-processing operation was discontinued after a criticality incident in April 1962 and was replaced in May 1964 by the Plutonium Reclamation Facility (PRF). No liquid organic waste associated

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with these operations was discharged to cribs between April 1962 and May 1964. No liquid organic waste was discharged to the cribs after 1973. An estimated total of 570,000 to 920,000 kg (1,257,000 to 2,028,000 lb) of carbon tetrachloride may have been discharged to soil through these three waste sites between 1955 and 1973 (Table 2-1) (DOE/RL-91-32).

The 216-Z-12 Crib received analytical and development laboratory waste from Z Plant from 1959 to 1973 and is estimated to have received a small volume of organics, which included carbon tetrachloride (*216-Z-12 Transuranic Crib Characterization: Operational History and Distribution of Plutonium and Americium* [RHO-ST-44]).

2.2.2 Carbon Tetrachloride Well Field

The vadose zone underlying the primary carbon tetrachloride disposal sites consists of approximately 70 m (230 ft) of relatively permeable sand and gravel. This section is interrupted from a depth of 38 to 45 m (125 to 148 ft) by a less-permeable interval composed of 4 m (13 ft) of silt and sand and 3 m (10 ft) of carbonate-rich silt and sand. Because it constitutes a relatively low-flow zone, this less-permeable interval effectively divides the subsurface into two distinct zones:

- An upper zone from the ground surface to the top of the less-permeable layer
- A lower zone from the bottom of the less-permeable layer to the water table (>70 m [230 ft] bgs).

Because of its higher concentration of calcium carbonate, the less-permeable CCU (formerly called the Plio-Pleistocene unit) is informally referred to as the "caliche layer." Vapor extraction wells are screened or perforated in both the upper and lower zones, with some wells screened in the low-flow CCU interval, 38 to 45 m (125 to 148 ft) bgs.

Currently, 50 drilled wells are available for SVE (Figure 2-1). Thirteen of these wells were drilled or deepened in 1992 and 1993 and were completed as vapor extraction wells with stainless-steel casings and screens; one well (well 299-W15-223) at the north end of the 216-Z-9 site was drilled at a 45-degree incline (slant). Thirty-three existing wells, drilled between 1954 and 1978 and completed with carbon-steel casing, were adapted for vapor extraction by perforating the well casing using mechanical or jet perforators. Two of these wells at the 216-Z-9 site (wells 299-W15-84 and 299-W15-95) were deepened in 2001 and completed with stainless-steel screens and casing that extend below the perforated intervals (*Borehole Completion Report – 216-Z-9 Trench Vadose Well Deepening and Characterization* [BHI-01552]). A new well (well 299-W15-48), drilled at a 32-degree incline underneath the 216-Z-9 Trench, was completed as a vapor extraction well in 2006 (*Borehole Summary Report for Slant Well 299-W15-48 [Borehole C3427] Drilled at the 216-Z-9 Trench* [WMP-30566]). Three narrow-diameter wells (C4937, C4938, C5340) were installed on the south side of the 216-Z-9 Trench and completed as vapor extraction wells in 2007 (DOE/RL-2007-22).

Nineteen of the 50 wells have two screened or perforated open intervals, creating 69 intervals for vapor extraction. Within 17 of these 19 wells, the two open intervals are isolated by downhole packers; in the remaining 2 wells, the two open intervals are isolated by bentonite cement grout seals installed during construction. Twenty-one well intervals are available at the 216-Z-18/Z-12 well field, 21 well intervals are available at the 216-Z-1A well field, and 27 well intervals are available at the 216-Z-9 well field. Eighteen of these 69 intervals are open below the CCU layer (six at 216-Z-18/Z-12, two at 216-Z-1A, and ten at 216-Z-9). Well diameters range from 2 to

20 cm (1 to 8 in.). The SVE system extracts simultaneously from multiple wells that are open above and/or below the CCU layer. Cross-sections through the 216-Z-18/Z-12, 216-Z-1A, and 216-Z-9 well fields are shown in Figures 2-2, 2-3, and 2-4, respectively.

Currently, 127 subsurface vapor monitoring probes are installed within the vadose zone around the carbon tetrachloride sites at a depth of >2 m (6.6 ft) (Figures 2-1 through 2-4). These probes are as follows (note that one cone penetrometer [CPT] well was decommissioned and is not counted):

- In 1993, a CPT was used to install 11 small-diameter extraction or vapor monitoring wells. The deepest open interval ends 34 m (112 ft) bgs. In April 1997, one of these wells was decommissioned.
- Between 1991 and 1994, a CPT was used to install 107 subsurface vapor monitoring probes at 35 locations at the carbon tetrachloride site (Figures 2-1 through 2-4). The deepest monitoring probe installed at the vapor extraction sites using the CPT is 36 m (118 ft) bgs.
- In 1993, 10 stainless-steel tubes were strapped to the outside of the casing of four wells during well completion to enable monitoring above and below the screened intervals.

2.2.3 Carbon Tetrachloride Soil Vapor Extraction, Fiscal Years 1992 Through 2006

In April 1991, a pilot SVE system was tested at the 216-Z-1A Tile Field (DOE/RL-91-32). In February 1992, based on the results of this testing and as part of the ERA, a full-scale SVE system was installed and began extracting from wells at the 216-Z-1A Tile Field. In May 1992, two of the 216-Z-18 Crib wells were added to the system. This system originally had a design capacity of 14.2 m^3/min but was upgraded to 28.3 m^3/min in March 1993. Two additional SVE systems, one with 42.5-m^3/min capacity and the other with 14.2-m^3/min capacity, began operating in March 1993 at the 216-Z-9 Trench.

Operation of the three systems (14.2 m^3/min, 28.3 m^3/min, and 42.5 m^3/min) was temporarily suspended in June 1993 because a GAC canister overheated at the 216-Z-9 site (*Summary of Canister Overheating Incident at the Carbon Tetrachloride Expedited Response Action Site* [WHC-SD-EN-TI-203]). The 28.3-m^3/min system resumed operation at the 216-Z-1A/Z-18 well field in November 1993. The 42.5-m^3/min system resumed operation at the 216-Z-9 well field in February 1994. The 14.2-m^3/min system was moved to the 216-Z-18 well field and resumed operation in June 1994. In August 1995, SVE operations using the 14.2-m^3/min SVE system were expanded to include the 216-Z-12 site.

In FY97, a rebound study was conducted throughout the carbon tetrachloride SVE sites (*Rebound Study Report for the Carbon Tetrachloride Soil Vapor Extraction Site, Fiscal Year 1997* [BHI-01105]). The purpose of the study was to determine the increase in carbon tetrachloride vapor concentrations following temporary system shutdown. Operations of all three SVE systems (14.2 m^3/min, 28.3 m^3/min, and 42.5 m^3/min) were temporarily suspended in November 1996 and then restarted in July 1997. All three SVE systems continued to operate through September 1997.

The operating strategy was modified in FY98 based on the results of the FY97 rebound study and the declining rate of carbon tetrachloride removal during continuous extraction operations. Rather than operating all three SVE systems continuously, only the 14.2-m^3/min system was

used for carbon tetrachloride removal during FY98, FY99, and FY01 through FY07. Operation was temporarily suspended during FY00 as a result of higher priority remediation activities competing for limited funding.

During each of the operational FYs, the 14.2-m^3/min system typically operated from April through September alternately between the 216-Z-9 and the 216-Z-1A/Z-18 sites (for approximately 3 months at each site). The systems were maintained in standby mode from October through March to allow time for carbon tetrachloride vapor concentrations to rebound. Beginning in FY03, maintenance of the 28.3-m^3/min and 42.5-m^3/min SVE systems was discontinued; surplus of these systems is pending.

The masses of carbon tetrachloride removed by year, by waste site, and cumulatively are summarized in Table 2-2.

2.2.4 Carbon Tetrachloride Soil Vapor Extraction in Fiscal Year 2007

The 14.2-m^3/min SVE system was operated at two locations in FY07. The 14.2-m^3/min SVE system was operated at the 216-Z-9 well field from April through July 2007 and at the 216-Z-1A/Z-18 well field from August through September 2007. Operation of the SVE system at the 216-Z-9 well field included use of the slant well (299-W15-48) (which was completed as a vapor extraction well beneath the 216-Z-9 Trench in FY06) and the use of the three narrow-diameter wells (C4937, C4938, and C5340) that were installed on the south side of the 216-Z-9 Trench and completed as vapor extraction wells in FY07.

During FY07, an additional SVE system was operated at the 218-W-4B Burial Ground from December 2006 through July 2007, in accordance with "FY 2007 Vapor Extraction System Work Plan for Trench T-07 in the 218-W-4B Burial Ground" (attachment to the letter *Soil Vapor Extraction at the 218-W-4B Burial Ground in the 200 West Area* [DOE-RL 2006]). Elevated concentrations of carbon tetrachloride were detected in trench T-07 in this burial ground during the environmental release investigation in support of waste retrieval operations for retrievably stored waste. The SVE system was operated at trench T-07 to minimize release of carbon tetrachloride from the trench to the environment and to protect site workers. Vapor extraction was conducted in support of waste retrieval activities. The system was removed permanently to allow retrieval operations to remove the remaining waste at the west end of trench T-07.

2.3 SOIL VAPOR EXTRACTION SYSTEM PERFORMANCE

The operating data that are routinely recorded for the SVE system include carbon tetrachloride concentrations, hours of operation, applied vacuums, and system flow rates (Appendix A). These parameters are monitored at the inlet to the SVE system to represent the combined contribution of all extraction wells currently on-line. In addition, samples are periodically collected at individual wells to obtain well-specific data (Appendix B). All instruments (i.e., flow meters, vacuum gauges, and volatile organic monitors) are calibrated, and the calibration data for each instrument are retained and available for review. The volatile organic compound monitoring instruments are checked periodically with gas standards. The detection limit for carbon tetrachloride using this instrumentation is 1 part per million by volume (ppmv).

2.3.1 Concentration Changes Over Time

Carbon tetrachloride concentrations in the extracted soil vapor have decreased significantly at both the 216-Z-9 and 216-Z-1A/Z-18/Z-12 well fields during operation of SVE. This is typical of SVE operations and represents removal of the volatile contaminant readily available in the swept pore spaces. Extracted contaminant vapor concentration approaches an asymptotic level as the supply of volatile contaminant to the high-flow zone becomes limited by desorption and diffusion of carbon tetrachloride from sediment particles and soil moisture. Diffusion also controls contaminant migration from the pore spaces between sediment particles in the lower permeability/lower flow zones to pore spaces in the higher permeability/higher flow zones.

Carbon tetrachloride concentrations in soil vapor extracted from the 216-Z-9 well field using the SVE systems have declined from approximately 30,000 ppmv at startup in March 1993 to 16 ppmv in July 2007 (Figure 2-5). Carbon tetrachloride concentrations in soil vapor extracted from the 216-Z-1A/Z-18/Z-12 well field using the SVE systems have declined from approximately 1,500 ppmv at startup in February 1992 to 16 ppmv in September 2007 (Figure 2-6).

In FY07, SVE resumed on March 29, 2007, at the 216-Z-9 well field using the 14.2-m^3/min SVE system. Following an extraction strategy similar to that used in previous years, initial on-line wells were selected close to the 216-Z-9 Trench, and wells farther away from the trench were brought on-line as extraction continued. The four initial wells, used as planned, were 299-W15-82, 299-W15-9U, 299-W15-9L, and 299-15-217 (Figure 2-1). Well 299-W15-48, the slant well drilled underneath the waste site in FY06, was among the wells added to the mixture of on-line wells at 216-Z-9 on May 9, 2007. The three narrow-diameter wells installed on the south side of the 216-Z-9 site were added to the 10 wells already on-line on June 18, 2007. These three wells were characterized every 2 hours during the workday on June 18 and June 19, 2007; once on June 20, 2007; and weekly thereafter. These 13 wells were used from June 18 through August 7, 2007.

During FY07, carbon tetrachloride concentrations extracted from the 216-Z-9 well field appeared to initially increase and then to decrease with continued extraction (Figure 2-7). Concentrations increase slightly on May 9, 2007, with the addition of new extraction wells, and on June 19, 2007, with the addition of the three narrow-diameter extraction wells (Figure 2-7). These trends are similar to trends from previous years (as shown in Figure 2-8), but with lower concentrations due most likely to an overall reduced mass of carbon tetrachloride vapor to be extracted from these locations.

The characterization data for the three narrow-diameter extraction wells indicate that the carbon tetrachloride soil vapor concentrations are significantly higher from well C4937 (Figure 2-9). All three of these wells are screened from approximately 18 to 20 m (60 to 65 ft) bgs, the zone where elevated carbon tetrachloride soil concentrations were found during drilling of nearby well 299-W15-46 in FY04 (DOE/RL-2006-51). Elevated carbon tetrachloride soil concentrations also were found in well C4937 during installation, but not in wells C4938 and C5340.

The SVE operations at the 216-Z-1A/Z-18 well field resumed on August 15, 2007, using the 14.2-m^3/min SVE system. Following an extraction strategy similar to that used in previous years, extraction wells open near the depth of the CCU within the 216-Z-1A Tile Field were selected to optimize mass removal. The initial wells were wells 299-W18-165, 299-W18-167, and 299-W18-174 (Figure 2-1). The other two wells planned for initial startup (299-W18-166

and 299-W18-168) were added on-line on August 23, 2007. Two additional wells (299-W18-89 and 299-W18-248) were added on September 19, 2007; these seven wells were used through October 1, 2007.

During the first week of operations at the 216-Z-1A site in FY07, carbon tetrachloride concentrations at the system inlet were less than detectable because leaking well head gaskets allowed ambient air to dilute the vapor stream. After the gaskets were repaired, vapor extracted from the 216-Z-1A/Z-18/Z-12 well field using the active SVE system showed only very slight changes in concentration between August and September 2007 (Figure 2-7). These trends are similar to trends from FY04 through FY06, as shown in Figure 2-10; the lower concentrations in these recent years are due most likely to an overall reduced mass of carbon tetrachloride vapor to be extracted from these locations.

Although the initial (1992 through 1993) carbon tetrachloride concentrations were an order of magnitude higher at the 216-Z-9 site (30,000 ppmv) than at the 216-Z-1A site (1,500 ppmv), the concentrations at the two sites are now similar. Operation of the SVE system at the 216-Z-9 site reduced the inlet concentrations to approximately 20 to 40 ppmv each year of operation from FY97 through FY07 (Figure 2-8). At the 216-Z-1A site, operation of the SVE system appears to have reduced the inlet concentrations to approximately 10 to 25 ppmv each year of operation from FY97 through FY07 (Figure 2-10). Carbon tetrachloride concentrations in extracted soil vapor were approximately 16 ppmv at both well fields when active SVE was last used at these sites in FY07.

The passive SVE systems were maintained on eight wells open near the groundwater in the 216-Z-1A/Z-18 well field from October 1, 2006, through September 30, 2007.

2.3.2 Volume of Soil Vapor Treated

For each SVE system, the volume of soil vapor processed was calculated using the hours that the system operated and the measured flow rate of soil vapor exiting the system. The flow rate measured at the SVE system represents the combined flow from all on-line wells and may change as the selection of on-line wells changes. For a given applied vacuum, the flow produced from each well is a function of the air permeability of the soil, the open area of the screened or perforated interval, the well diameter, and the radius of influence of the well.

During FY07 operations, 2.2 million m^3 of extracted vapor were treated. Between April 1991 (pilot testing) and September 2007, 101.6 million m^3 of soil vapor were extracted and treated using the three SVE systems. This volume was extracted from two well fields, with 45.0 million m^3 extracted from the 216-Z-9 well field and 56.6 million m^3 extracted from the 216-Z-1A/Z-18/Z-12 well field.

The flow rates at individual extraction wells were estimated by apportioning the flow rates measured at the SVE systems among the on-line wells (Appendix A of BHI-00720). To estimate the flow rate at each well on each day of operation, the system flow rate was multiplied by the ratio of the well's open area to the sum of the open areas for all of the wells in operation on that system on that particular day. The daily flow rates and the number of operating hours were then used to estimate the cumulative flow from each extraction well. At the 216-Z-9 well field, an estimated 28.7 million m^3 of soil vapor were extracted from wells open above the CCU (Table 2-3), and 16.3 million m^3 of soil vapor were extracted from wells open below the CCU (Table 2-4). For the 216-Z-1A/Z-18/Z-12 well field, an estimated 36.0 million m^3 of soil vapor

were extracted from wells open above the CCU (Table 2-3), and 20.5 million m^3 were extracted from wells open below the CCU (Table 2-4).

Since system startup, 69 pore volumes of soil vapor have been extracted by the SVE systems above the CCU in the 216-Z-9 area, based on an average lateral zone of influence of 55,000 m^2 (592,000 ft^2) above the CCU in the 216-Z-9 area, an average Hanford formation thickness of 38 m (125 ft), an average porosity of 20%, and assuming a uniform distribution of flow. Similarly, for the 216-Z-1A/Z-18/Z-12 area, based on an average lateral zone of influence of 155,000 m^2 (1,668,000 ft^2), 31 pore volumes of soil vapor have been extracted by the SVE systems above the CCU.

Based on an average lateral zone of influence of 40,000 m^2 (431,000 ft^2) below the CCU in the 216-Z-9 area, an average Ringold Unit E thickness of 21 m (69 ft) in the unsaturated zone, an average porosity of 20%, and an assumed uniform distribution of flow, 97 pore volumes of soil vapor have been extracted by the SVE systems below the CCU. Similarly, for the 216-Z-1A/Z-18/Z-12 site, based on an average lateral zone of influence of 100,000 m^2 (1,076,000 ft^2), 49 pore volumes of soil vapor have been extracted by the SVE systems below the CCU.

2.3.3 Carbon Tetrachloride Mass Removed

The mass of carbon tetrachloride removed from each well field was calculated using the measured flow, concentration, and hours of operation data (Appendix A). In FY07, approximately 217 kg (478 lb) of carbon tetrachloride were removed from the 216-Z-9 well field, and 63 kg (139 lb) were removed from 216-Z-1A/Z-18 well field (Table 2-2). Between March 1993 and July 2007, approximately 54,497 kg (120,144 lb) of carbon tetrachloride were removed from the 216-Z-9 well field. Between April 1991 (when the pilot test was conducted) and September 2007, approximately 24,667 kg (54,381 lb) of carbon tetrachloride were removed from 216-Z-1A/Z-18/Z-12 well field (Table 2-2). By the end of FY07, the total mass of carbon tetrachloride removed from all sites was 79,164 kg (174,525 lb) (Table 2-2).

Carbon tetrachloride removal rates have decreased significantly between SVE startup and FY07 (Figure 2-11). The decline in mass removed in FY03 and FY04 may have resulted, in part, because the SVE system operated primarily at the 216-Z-1A well field, where less mass typically is extracted (Figure 2-12 and Table 2-2). The decline in mass removed in FY05 resulted, in part, because the SVE system was not operated, or operated on dayshift only, for approximately 77 days while the automated concentration monitoring equipment was being repaired. However, relatively high removal rates were noted during short periods in FY05. The decline in mass removed in FY06 resulted, in part, because operations at 216-Z-1A were limited to only three wells and because of the shorter duration of operations at the 216-Z-9 site (Table 2-2).

The mass removed from the 216-Z-1A/Z-18/Z-12 well field in FY07 (63 kg [139 lb]) is comparable to the mass removed in FY06 (76 kg [168 lb]) and FY05 (67 kg [148 lb]) (Table 2-2) but is less than the masses removed in FY03 and FY04. The relatively low rate of removal in FY07, relative to FY03 and FY04, partly may have been a result of the shorter duration of operations at the 216-Z-1A site.

The mass removed from the 216-Z-9 well field in FY07 (217 kg [478 lb]) is comparable to the mass removed in FY05 (295 kg [650 lb]) and higher than the masses removed in FY06, FY04, and FY03. In both FY07 and FY05, the higher mass removal resulted, in part, because

operations continued longer at the high-production area around 216-Z-9 in these FYs than in FY06, FY04, and FY03.

The SVE system efficiencies were evaluated for FY98 through FY07 by comparing the mass of carbon tetrachloride removed per volume of vapor extracted from the vadose zone (Table 2-2). As shown in Figure 2-13, SVE system efficiencies for the 216-Z-9 well field are relatively inconsistent but have declined overall from FY98 to FY07. The two significant increases both occurred during extraction following extended periods of rebound. In contrast, SVE system efficiencies for the 216-Z-1A/Z-18/Z-12 well fields have generally decreased between FY99 and FY07.

Carbon tetrachloride concentrations were monitored at the passive wells in FY07 (Appendix C). These monthly concentrations were used to calculate the mass removed from each well. This calculation assumes the following:

- The wells exhale 50% of the time.
- During out-flow, the average flow rate is one-half the maximum flow rate.
- During out-flow, the average concentration is one-half of the maximum concentration.
- The concentrations measured each month were maximum values.
- The maximum flow values were the same as used in FY01 (BHI-00720).

In FY07, the mass of carbon tetrachloride removed using the eight passive SVE wells is estimated to be approximately 5 kg (11 lb), which is the same as the mass estimated to be removed using these wells in FY06.

2.3.4 System Operation Downtime

The availability of each SVE system is evaluated by comparing the amount of actual operating time to the potential amount of operating time (scheduled outages are excluded from this calculation). Because operation of the systems is most difficult to maintain during the winter months (i.e., with the need to drain water from the extraction hoses and water knockout tanks during cold weather and potential freezing of water in the hoses), temporary suspension of operation has continued each winter since 1998. This practice also allows a rebound period each year for concentrations to increase in the vapor phase.

In FY07, the total availability of the system was 96%. Between November 1994 and September 2007, the monthly availability for all three systems averaged 89%, which is just slightly less than the objective of 90% availability. Figure 2-14 shows operational availability for FY07 and since 1994.

2.3.5 Vapor Extraction at the 218-W-4B Burial Ground

Vapor extraction from trench T-07 in the 218-W-4B Burial Ground was initiated on December 12, 2006, and continued through July 31, 2007. The following vent risers were used as extraction points:

- Vent riser T-07-8 was used on December 12, 2006, but was shut down because of high concentrations detected on the downstream side of the GAC canister.
- Vent risers T-07-4 and T-07-6 were used from December 19, 2006, through January 12, 2007.

- Vent riser T-07-8 was used from April 12, 2007, through May 30, 2007.
- Vent riser T-07-10 was used from June 4, 2007, through June 20, 2007.
- Vent riser T-07-9 was used from June 11, 2007, through July 31, 2007.

The locations of the vent risers are shown in Figure 2-15. Operations were planned to continue 24 hours/day; however, during the winter months, operations frequently were limited to dayshift because of problems with lines freezing. At least one vapor sample was collected on each day that the system was operated. The samples typically were collected in Tedlar bags at the inlet to the first GAC canister. The samples were analyzed for carbon tetrachloride, chloroform, methylene chloride, and methyl ethyl ketone using the B&K photo-acoustic gas analyzer, a field-screening instrument. The analytical results are provided in Appendix E.

The extraction point was moved to a new vent riser based on achieving carbon tetrachloride concentrations lower than 10 ppmv at the GAC inlet (or as low as possible). The maximum carbon tetrachloride concentration detected was 1,270 ppmv from vent riser T-07-8. Carbon tetrachloride concentrations are shown in Figure 2-16.

Figure 2-1. Extraction and Monitoring Wells and Deep (>2 m [>6.6 ft]) Soil Vapor Probes at the Carbon Tetrachloride Soil Vapor Extraction Sites.

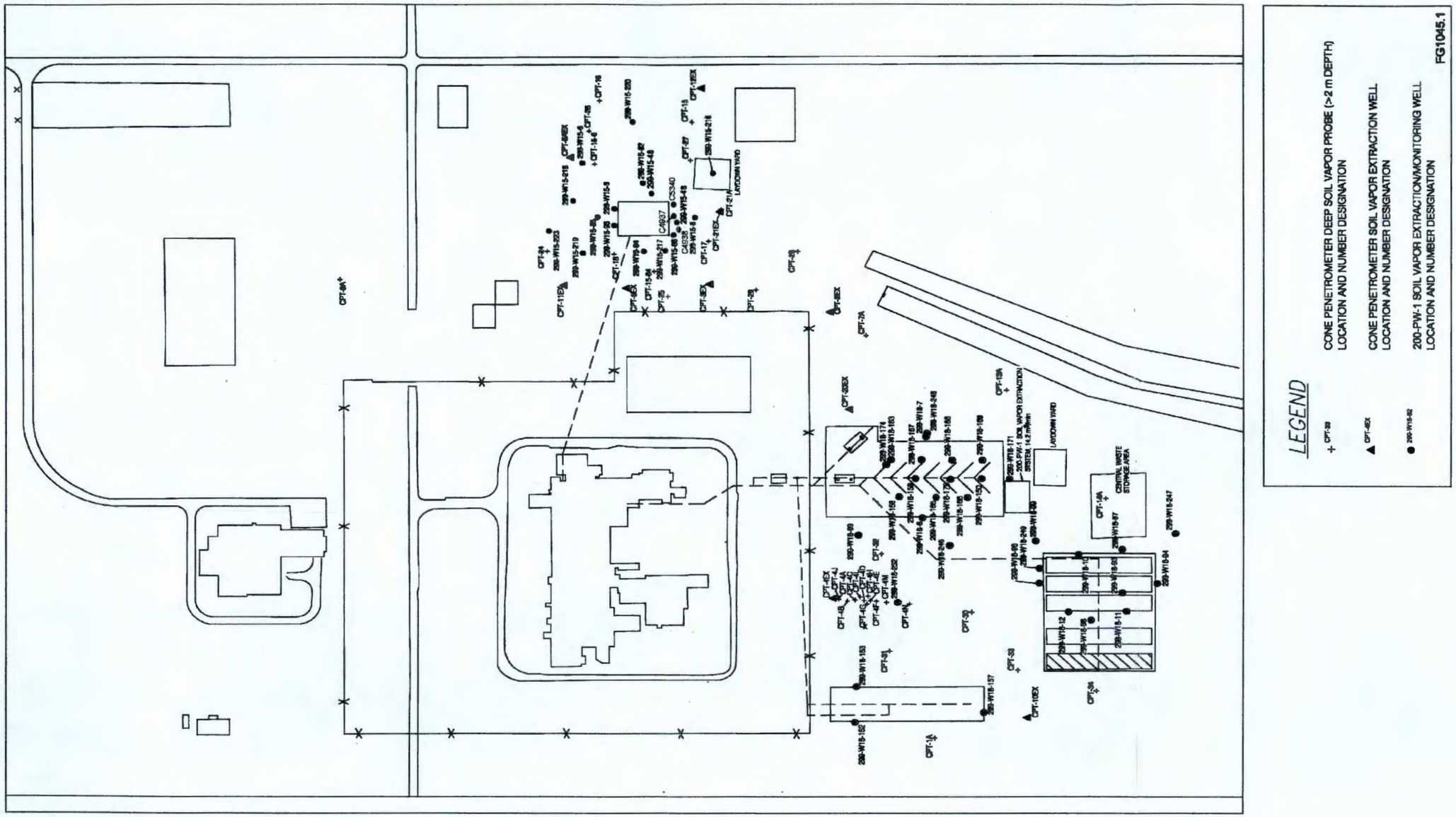
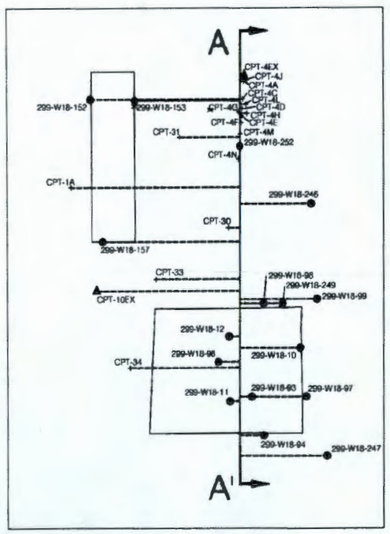
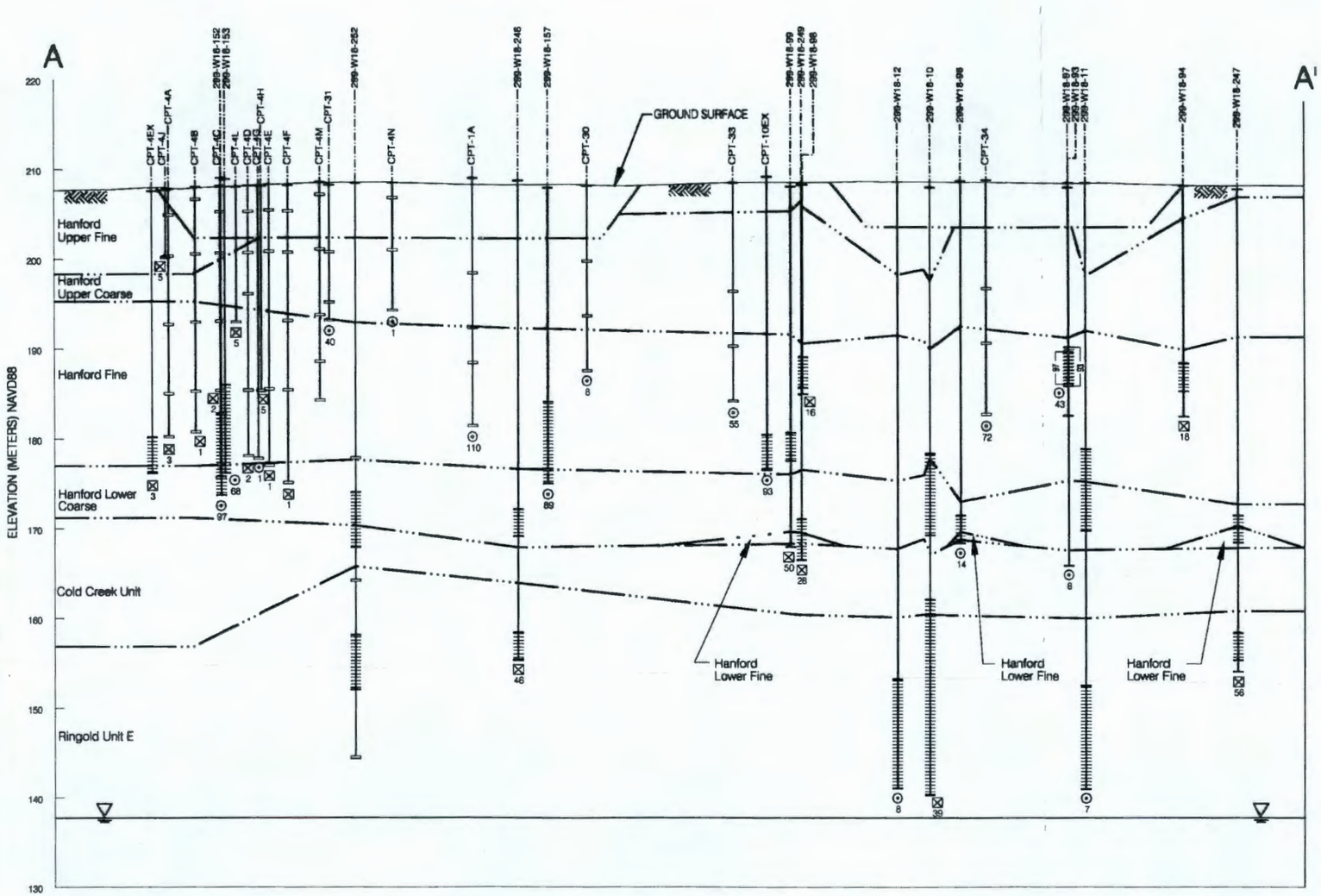


Figure 2-2. Cross-Section Through the 216-Z-18/Z-12 Well Field.



SECTION LOCATION MAP



Well is 10 meters west of cross-section

Water Table

Well is 10 meters east of cross-section

FG1045.2

Figure 2-3. Cross-Section Through the 216-Z-1A Well Field.

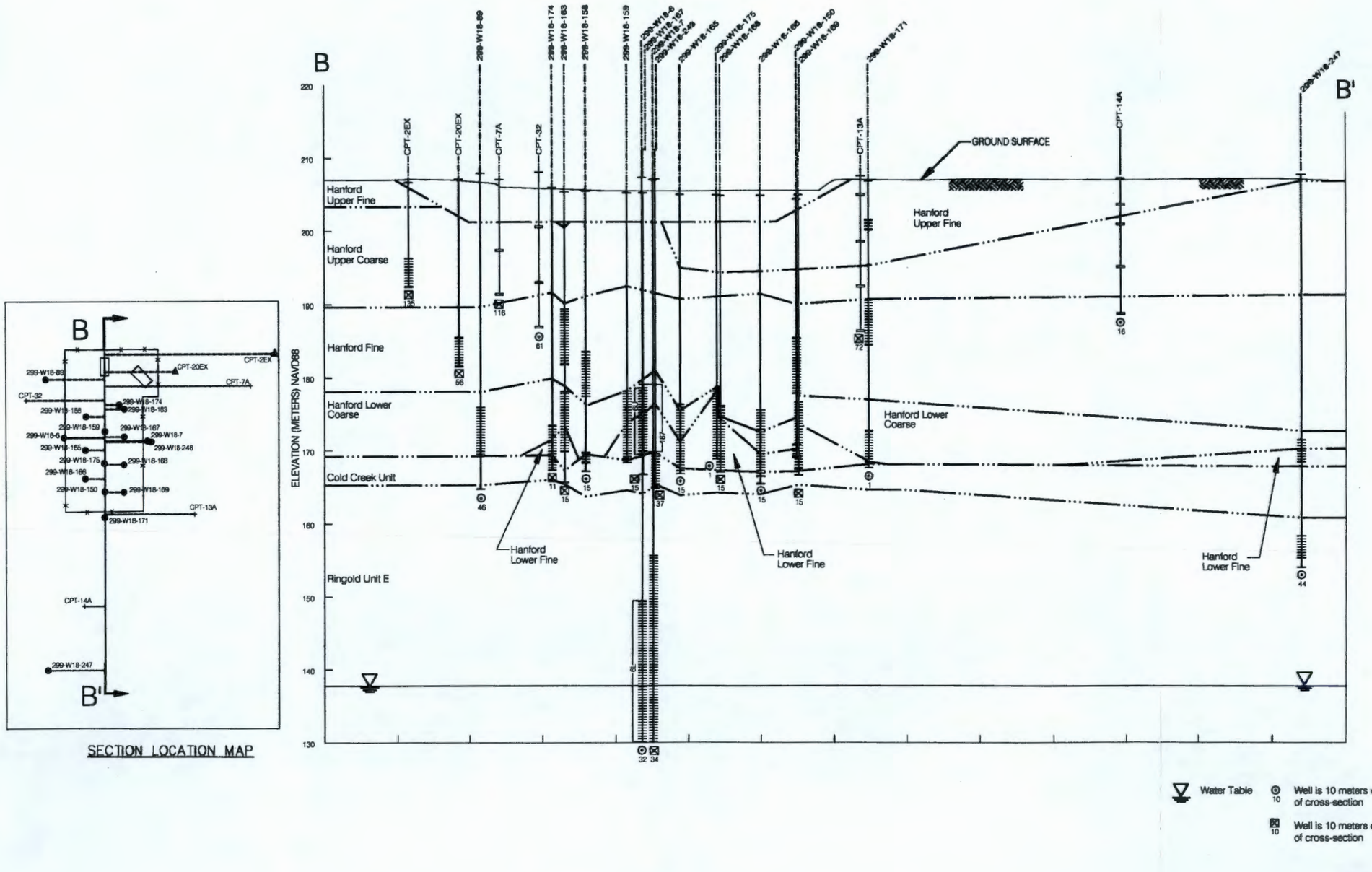
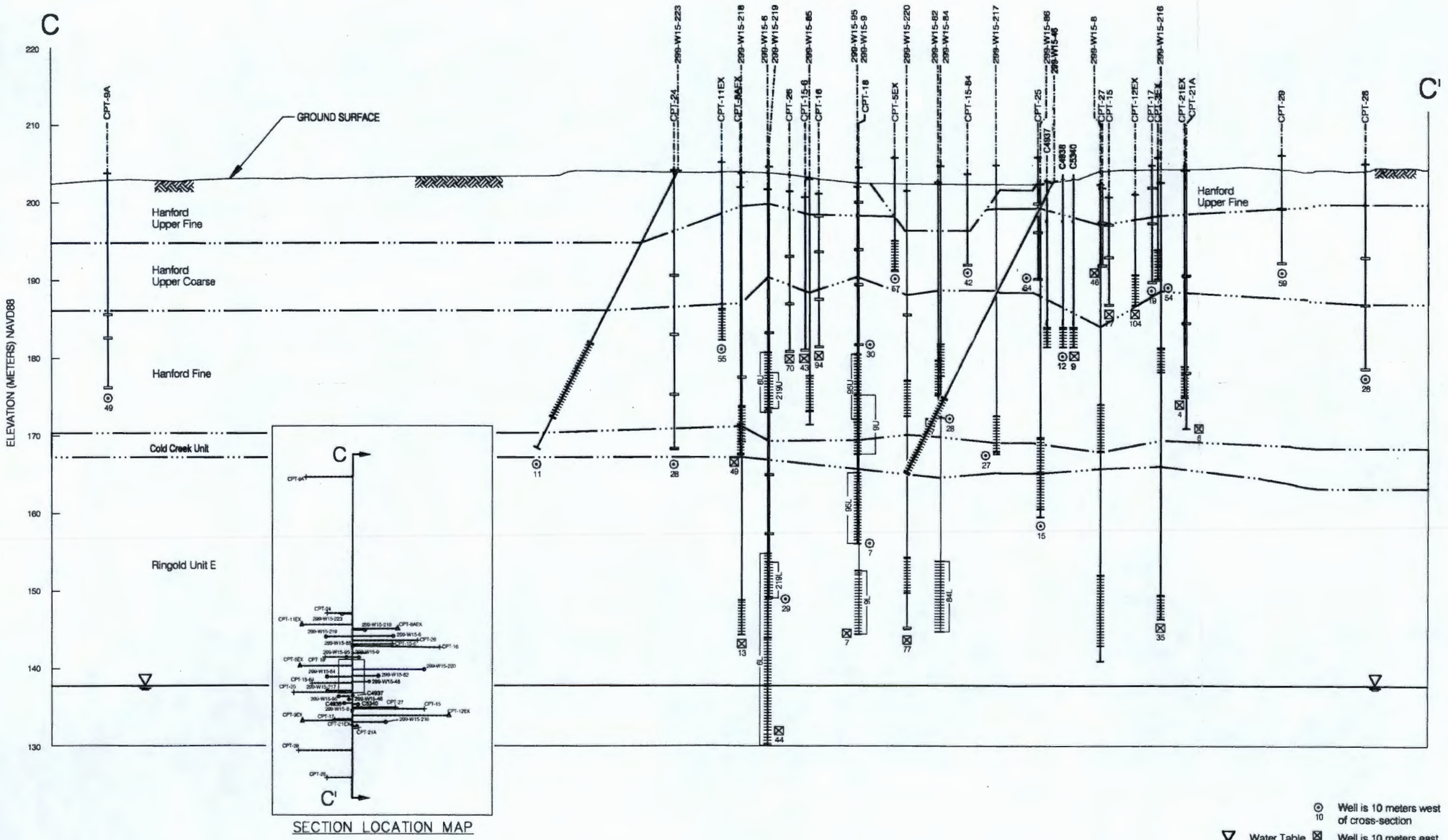


Figure 2-4. Cross-Section Through the 216-Z-9 Well Field.



FG1045.4

Figure 2-5. Daily Carbon Tetrachloride Concentrations at the 216-Z-9 Site, 1993-2007.

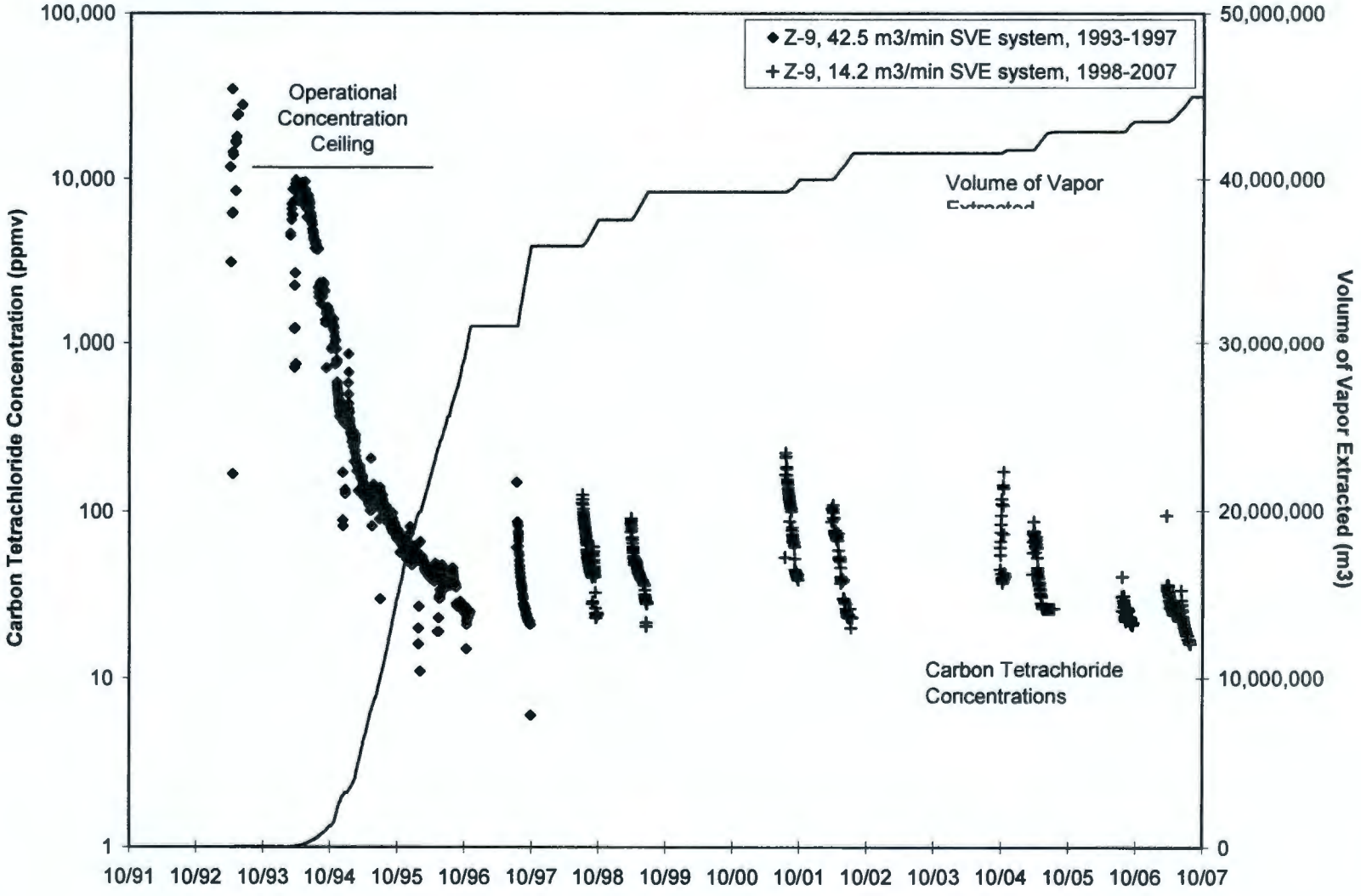


Figure 2-6. Daily Carbon Tetrachloride Concentrations at the 216-Z-1A/Z-18/Z-12 Site, 1992-2007.

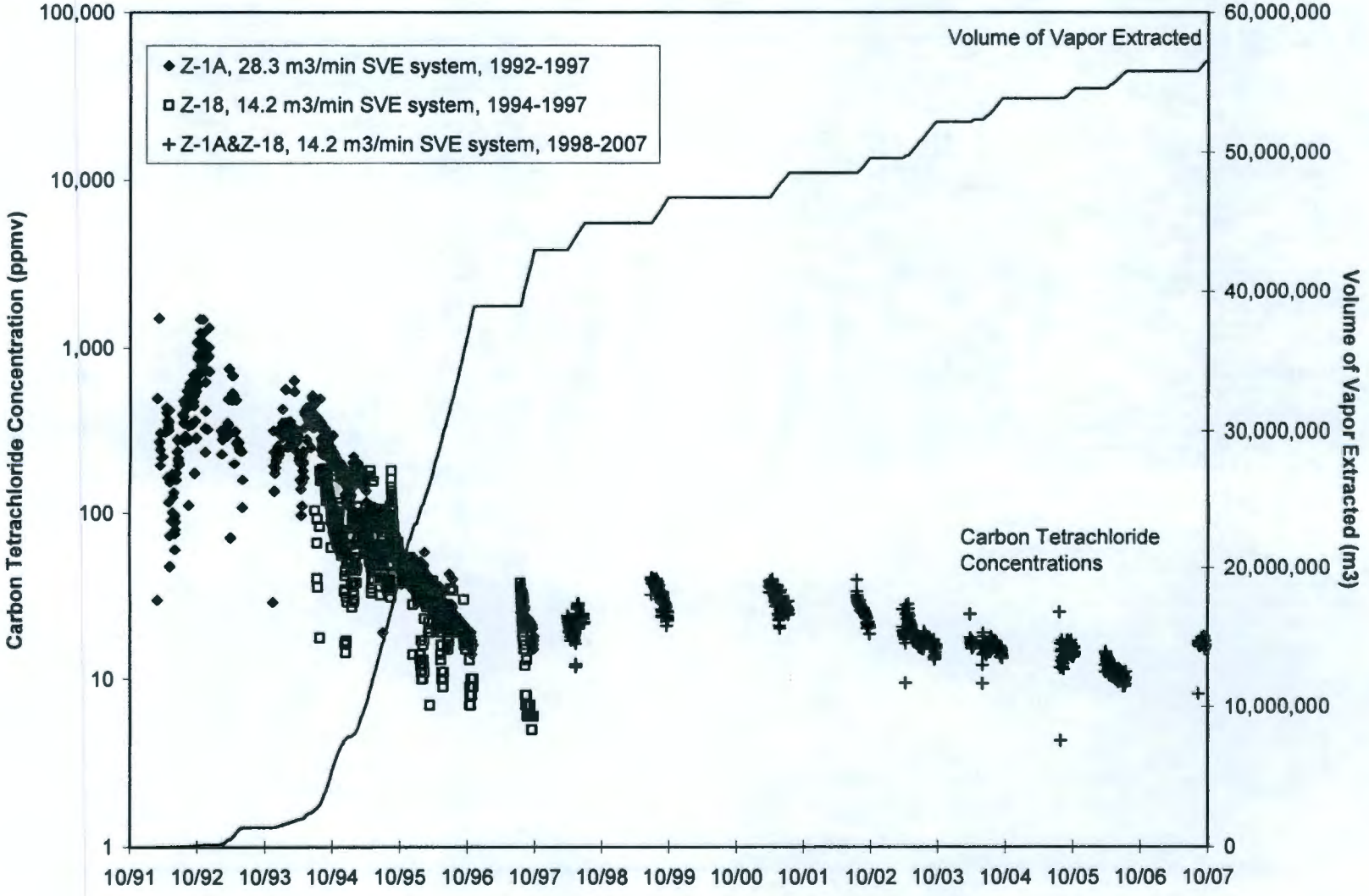


Figure 2-7. Daily Carbon Tetrachloride Concentrations and Mass Removed, Fiscal Year 2007.

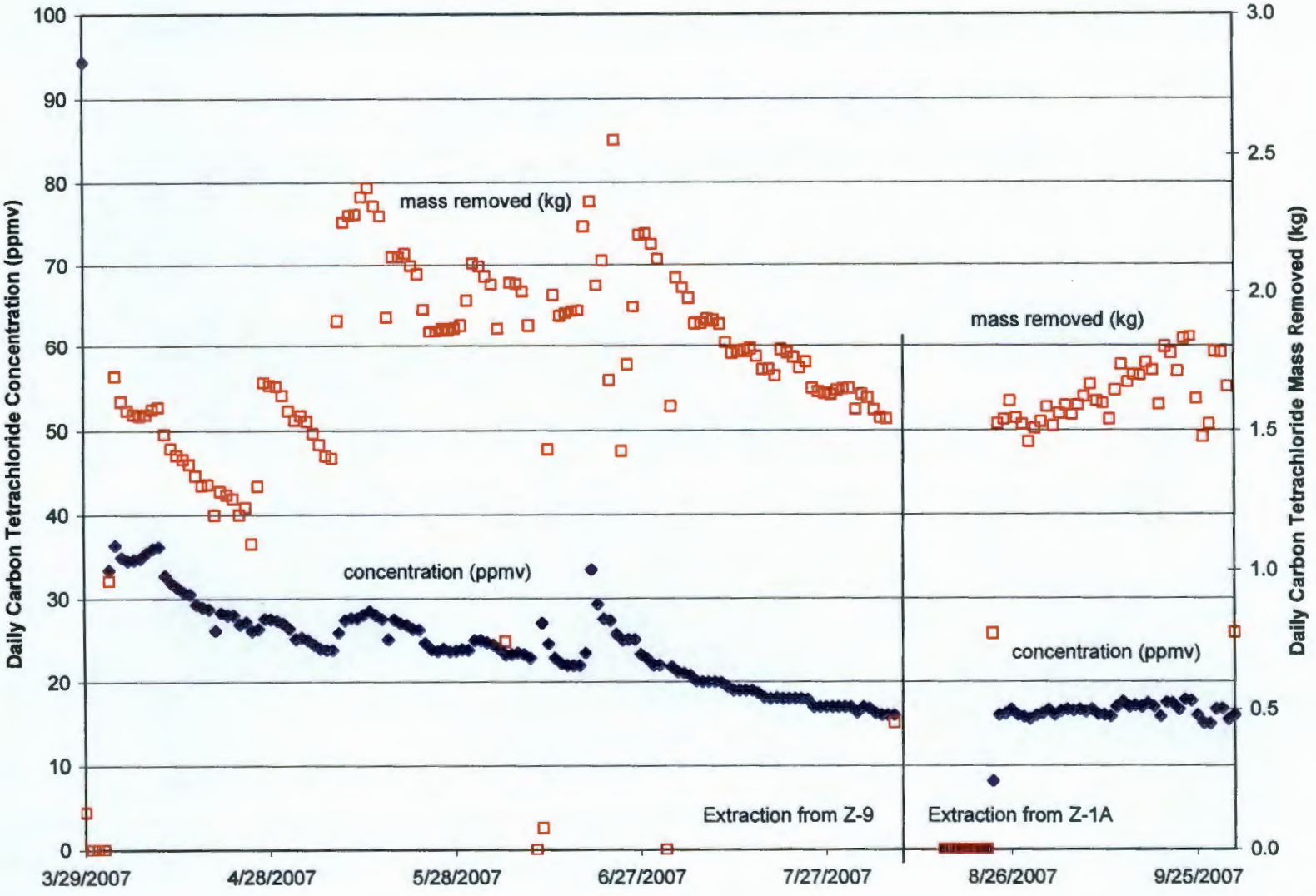


Figure 2-8. Carbon Tetrachloride Concentrations in Vapor Extracted from the 216-Z-9 Site, 1997-2007.

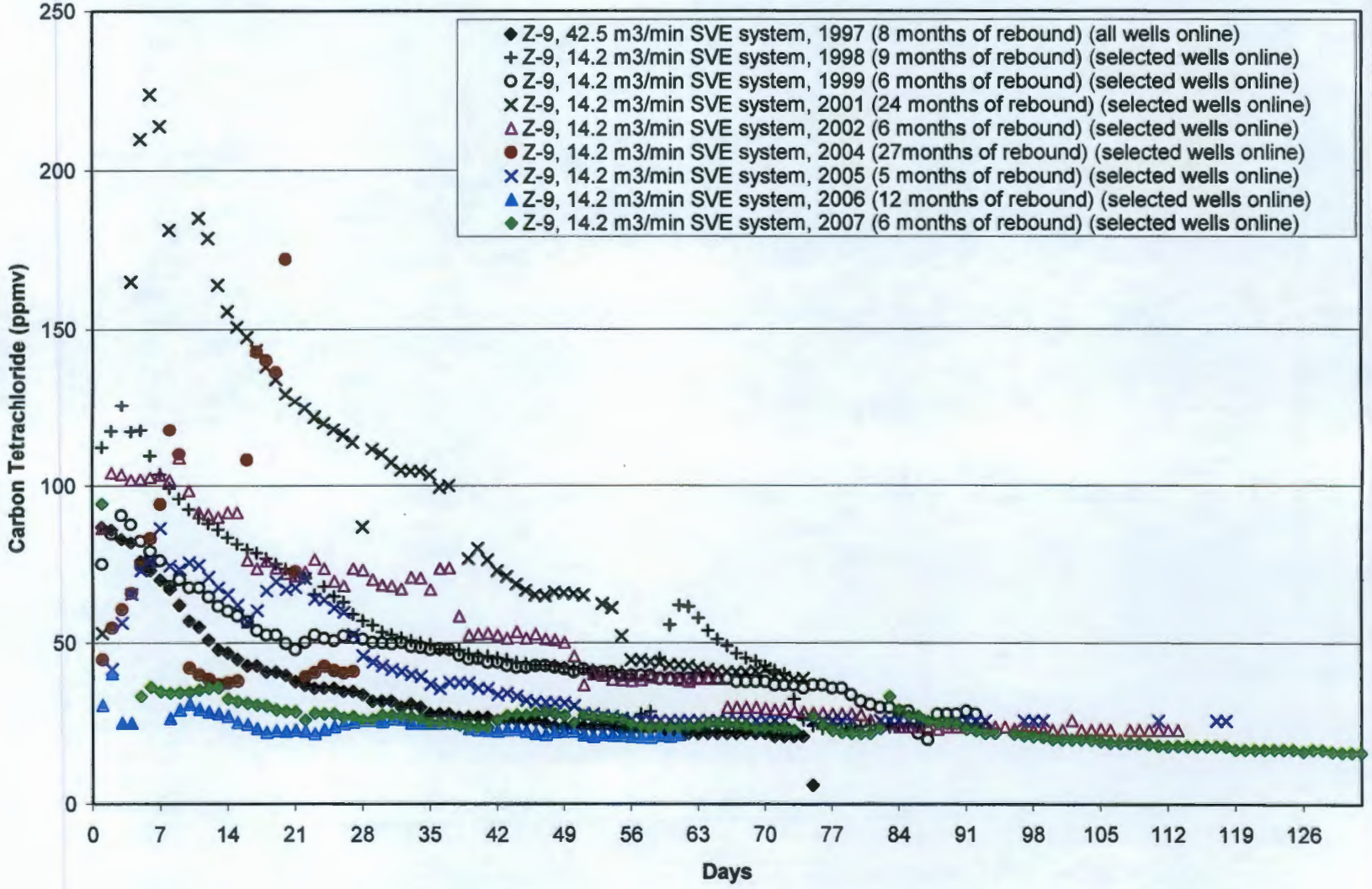


Figure 2-9. Carbon Tetrachloride Concentrations in Vapor Extracted from the Three Narrow-Diameter Wells South of the 216-Z-9 Site, 2007.

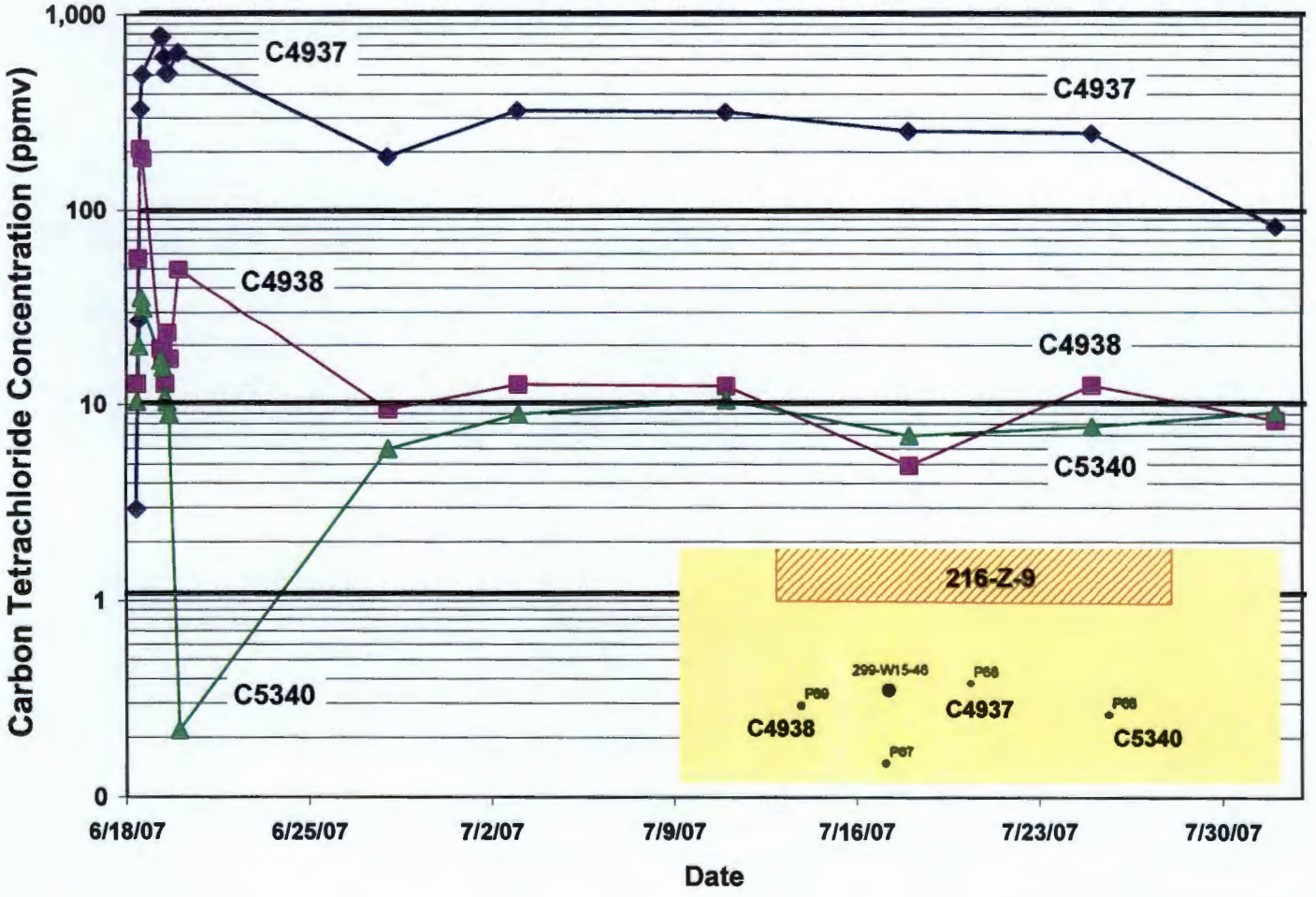


Figure 2-10. Carbon Tetrachloride Concentrations in Vapor Extracted from the 216-Z-1A Site, 1997-2007.

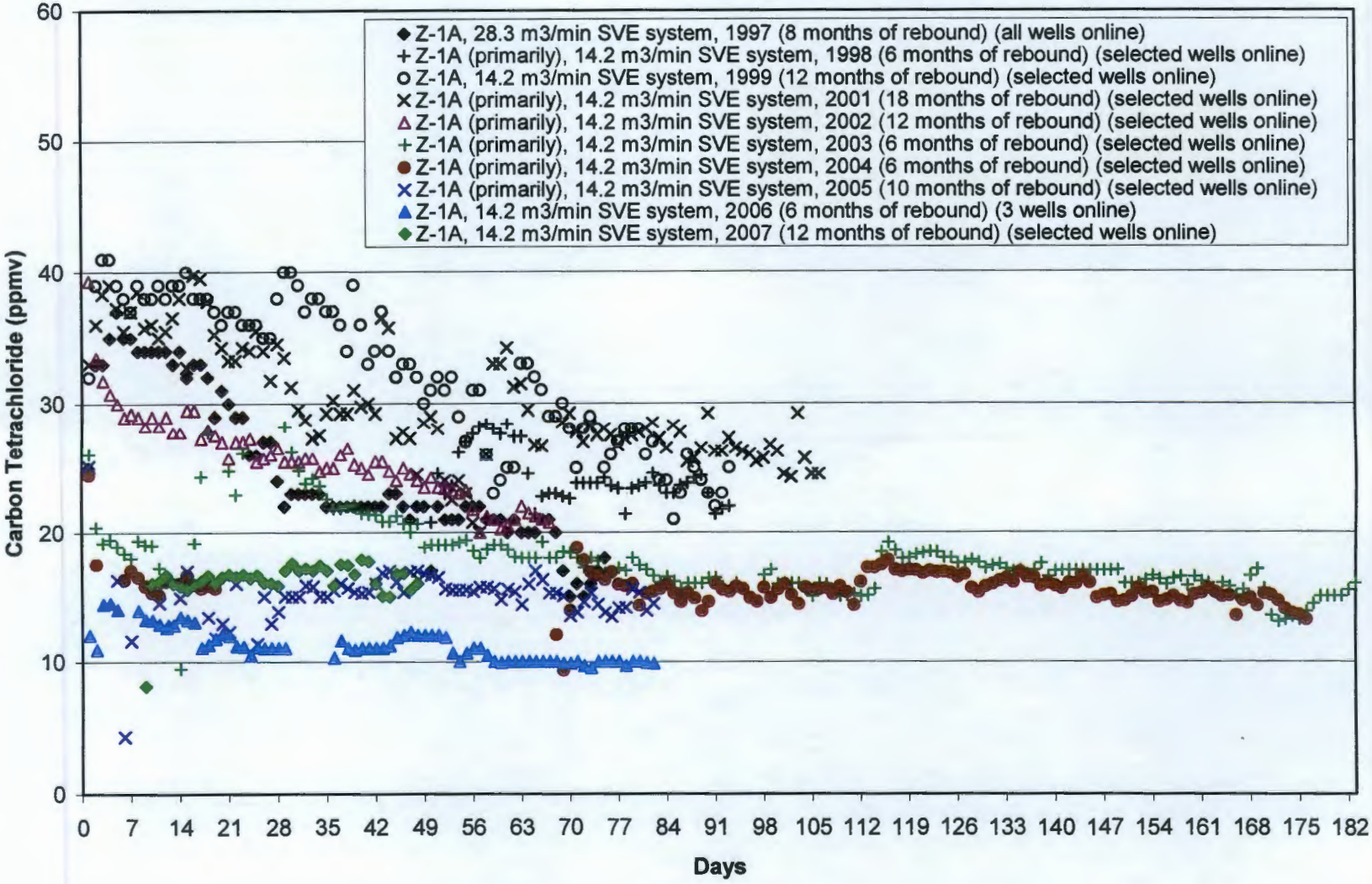


Figure 2-11. Daily Carbon Tetrachloride Mass Extracted, 1992-2007.

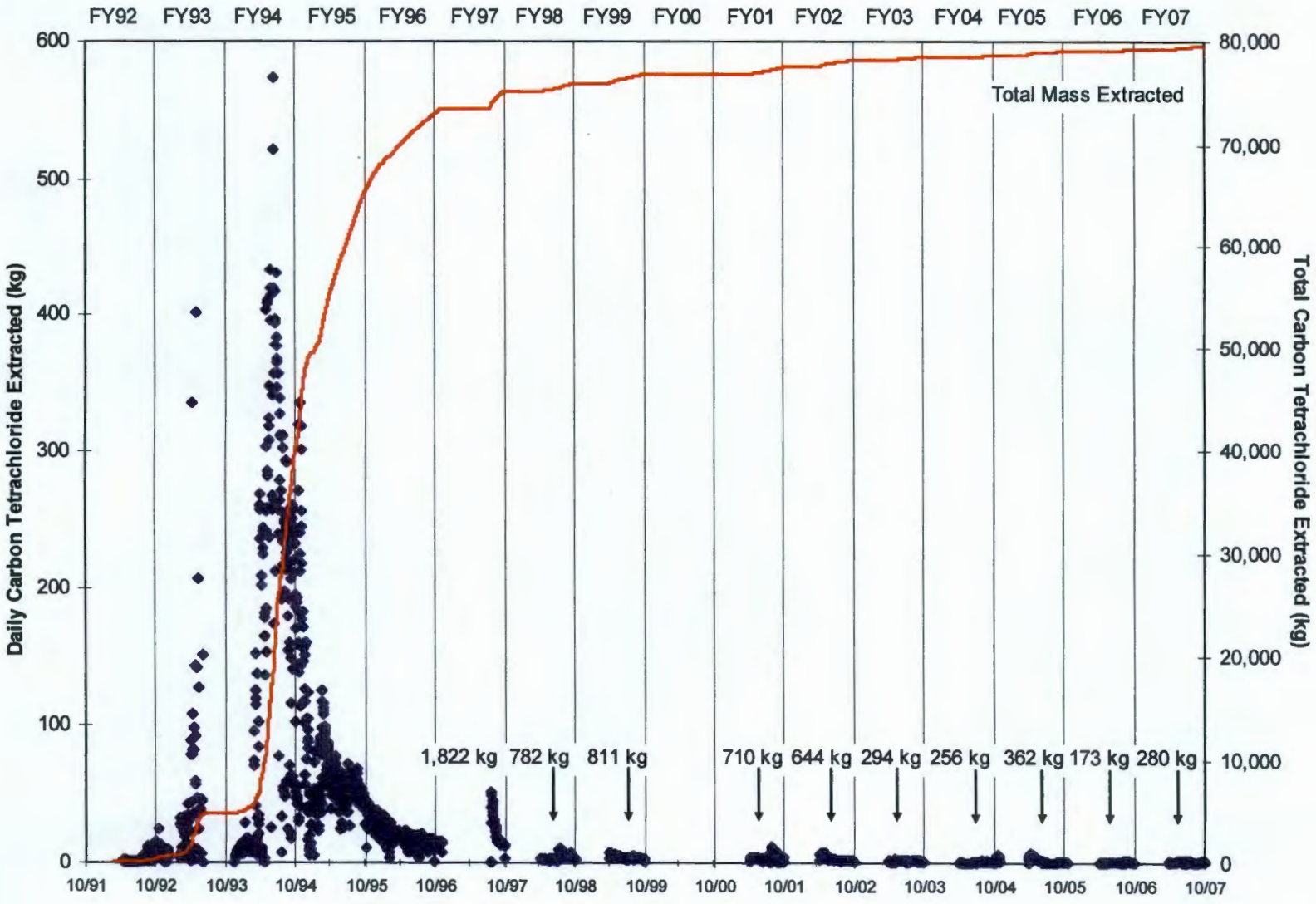


Figure 2-12. Daily Carbon Tetrachloride Mass Extracted, 2001-2007.

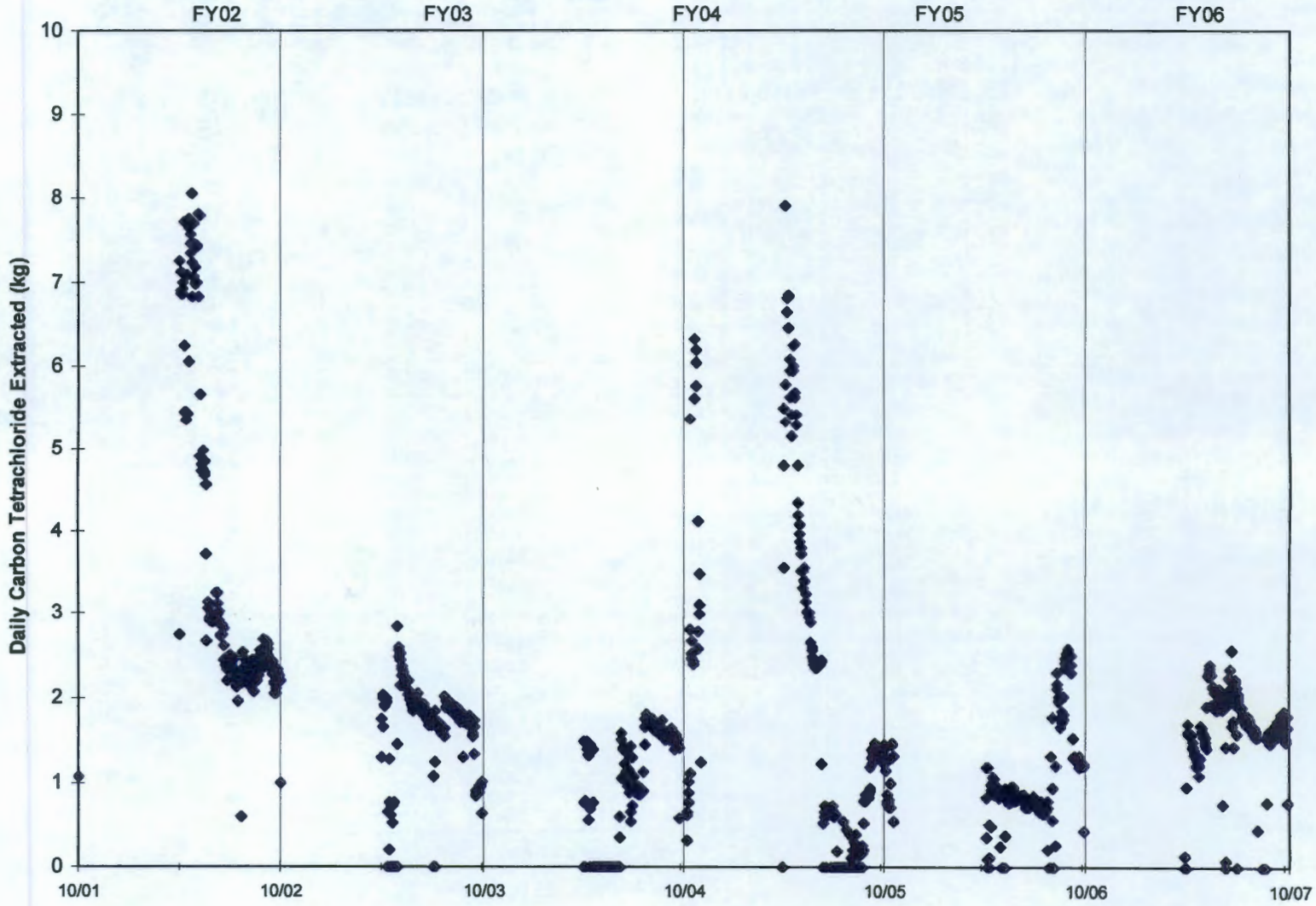
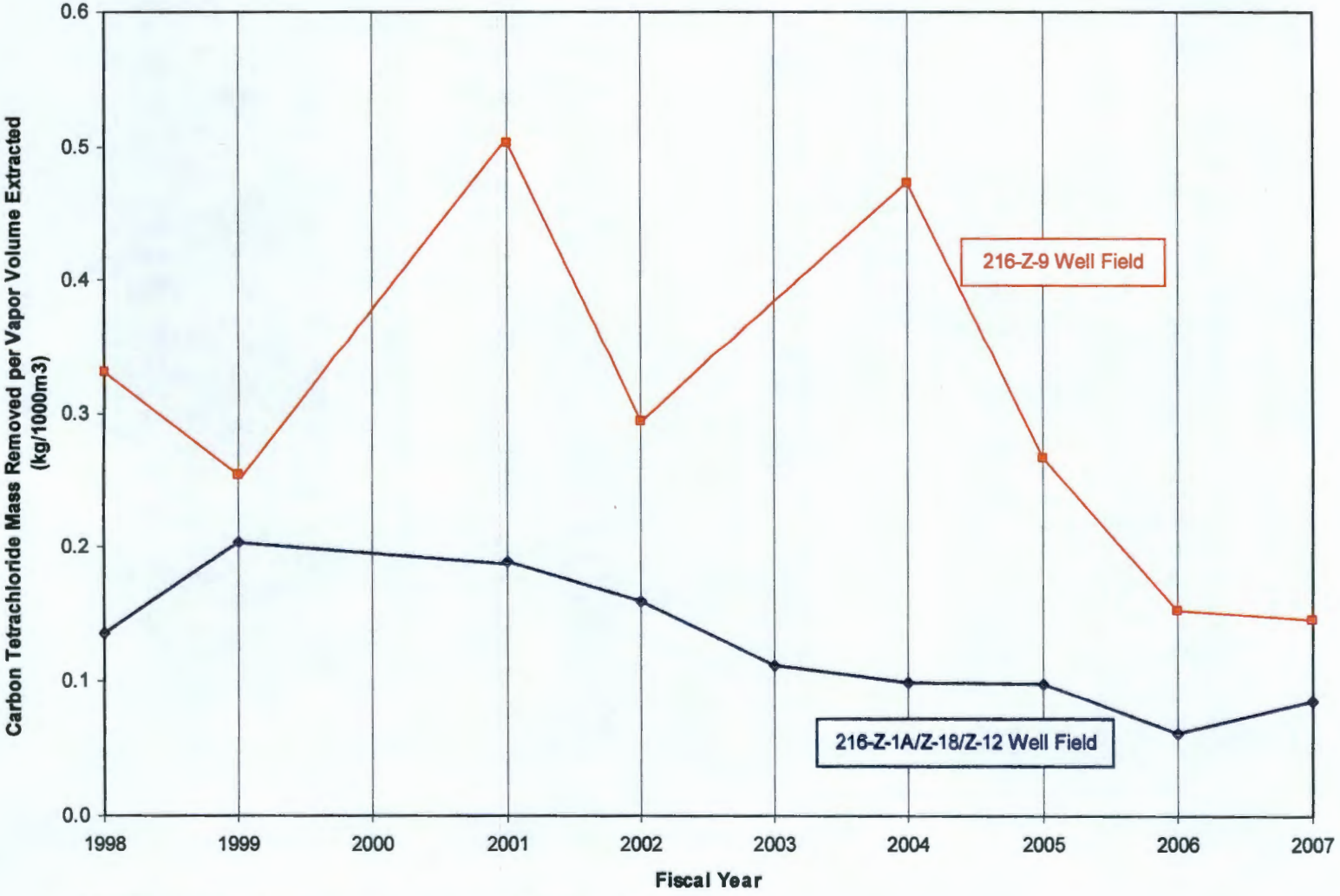


Figure 2-13. Ratio of Carbon Tetrachloride Mass Removed Per Volume of Vapor Recovered from the Vadose Zone, Fiscal Year 1998 Through Fiscal Year 2007.



NOTES: The SVE system was off-line in fiscal year 2000.
Extraction was not conducted at the 216-Z-9 well field in 2003 due to site characterization activities.

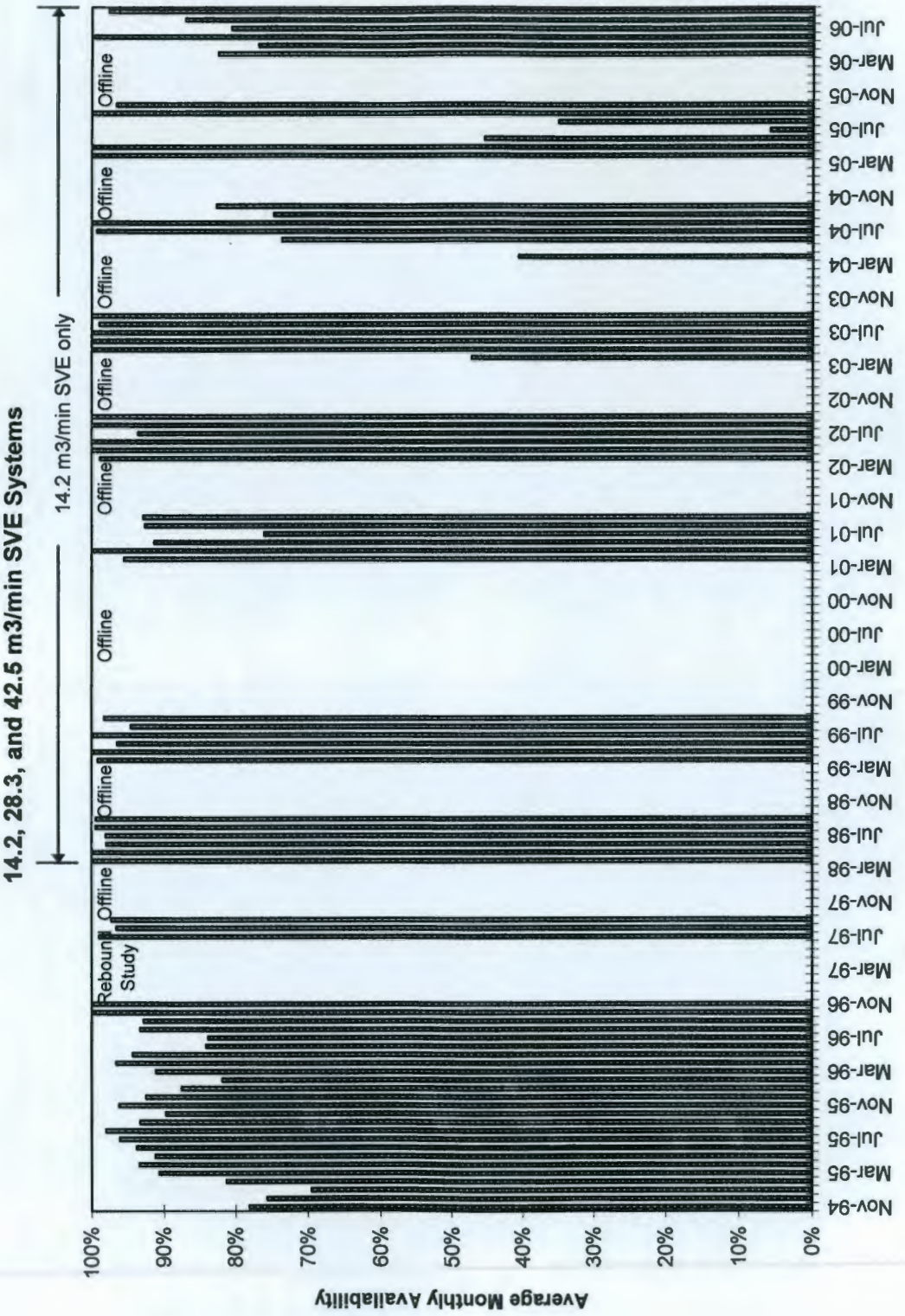


Figure 2-14. Soil Vapor Extraction System Availability.

Figure 2-15. Location of Vent Risers in the 218-W-4B Burial Ground.

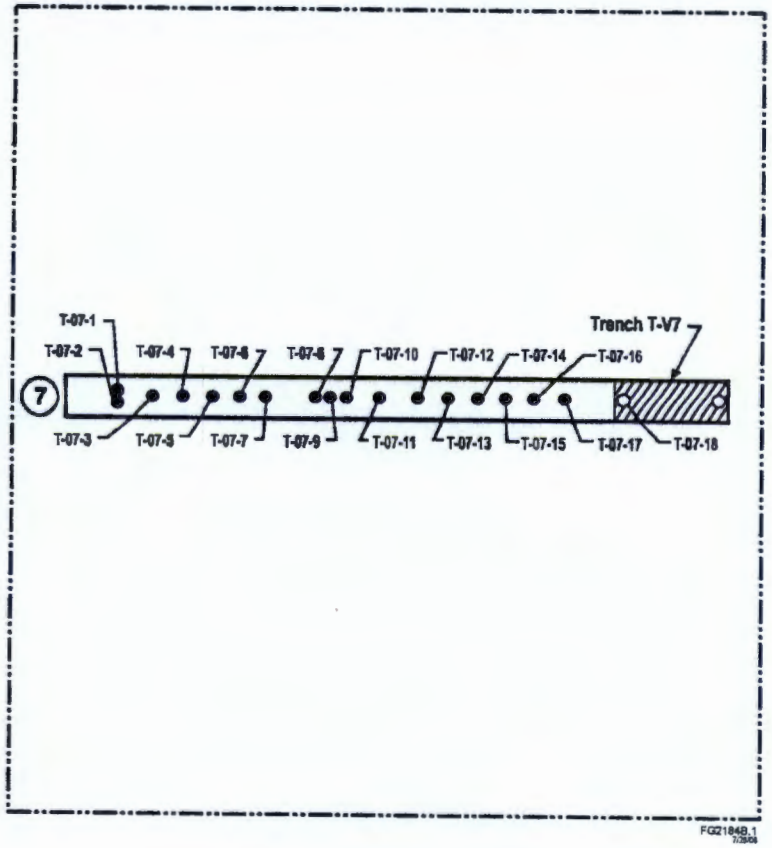


Figure 2-16. Daily Carbon Tetrachloride Concentrations in Vapor Extracted from the 218-W-4B Burial Ground.

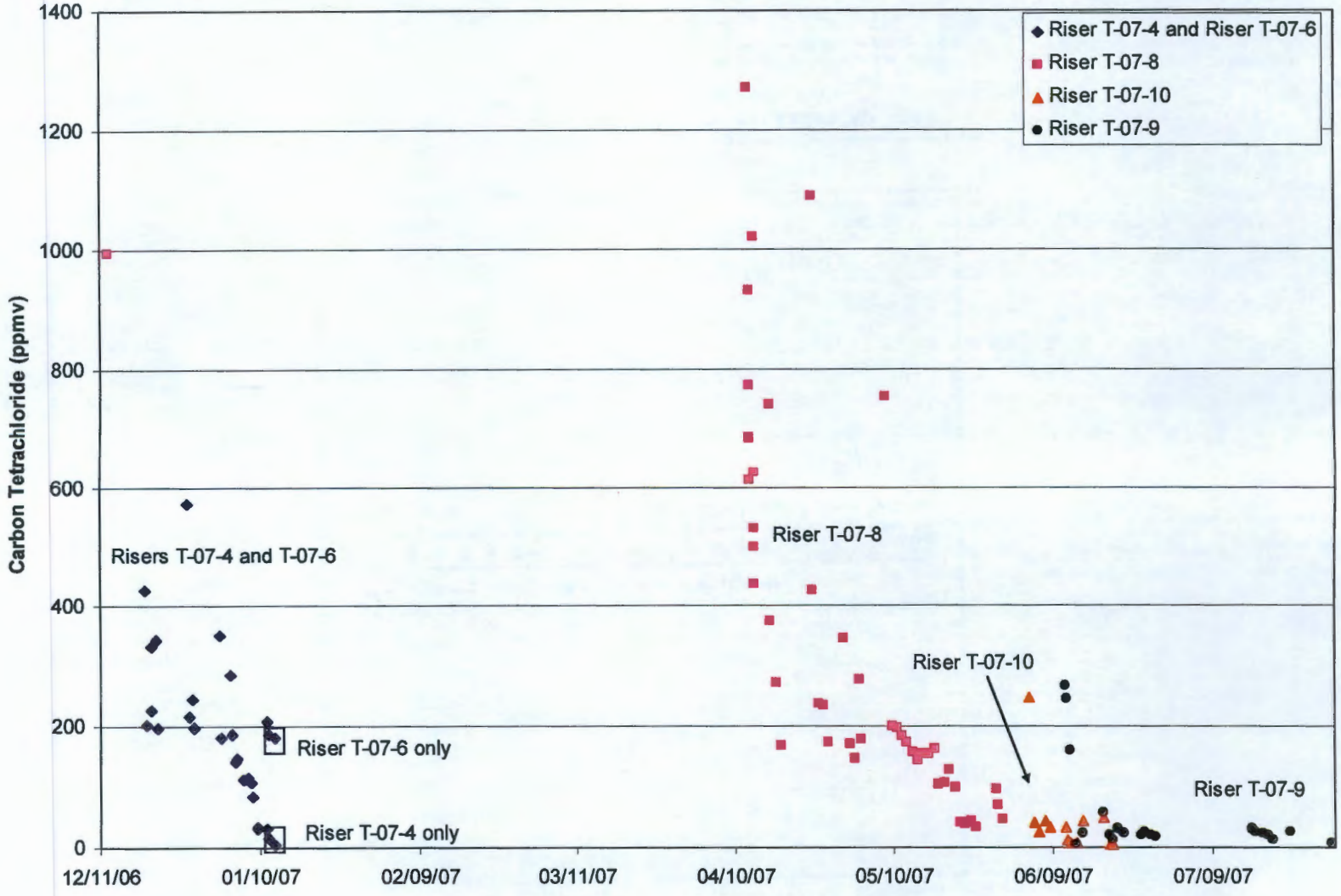


Table 2-1. Contaminant Inventory Discharged to Carbon Tetrachloride Disposal Sites.

Site	Carbon Tetrachloride		Plutonium (kg)	Americium (kg)	Total Liquid (Aqueous and Organic) (L)	Operating Dates
	(kg)	(L)				
216-Z-9	130,000 to 480,000	83,000 to 300,000	106[a]	2.5	4,090,000	1955 to 1962
216-Z-1A	270,000	170,000	57	1	5,200,000	1964 to 1969
216-Z-18	170,000	110,000	23	0.4	3,860,000	1969 to 1973
Totals	**570,000 to 920,000**	**363,000 to 580,000**	**186**	**3.9**	**13,150,000**	**1955 to 1973**

[a] 58 kg have been removed.

Table 2-2. Carbon Tetrachloride Mass Removed Using Soil Vapor Extraction.

Site	Carbon Tetrachloride Removed Each Calendar Year (kg)																	
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Total
216-Z-9	--	--	1,065	35,029	11,500	3,150	1,239	524	436	0	375	480	0	90	295	97	217	54,497
216-Z-1A/ Z-18/Z-12	140	959	2,541	8,757	7,307	2,581	583	258	375	0	335	164	294	167	67	76	63	24,667
Yearly Total	**140**	**959**	**3,606**	**43,786**	**18,807**	**5,731**	**1,822**	**782**	**811**	**0**	**710**	**644**	**294**	**257**	**362**	**173**	**280**	**79,164**
Cumulative Total	**140**	**1,099**	**4,705**	**48,491**	**67,298**	**73,029**	**74,851**	**75,633**	**76,444**	**76,444**	**77,154**	**77,798**	**78,092**	**78,349**	**78,711**	**78,884**	**79,164**	
Volume of vapor recovered per year of system operation (1,000 m^3)																		
216-Z-9	--	--	--	--	--	--	--	1,585	1,719	0	745	1,632	0	190	1,109	634	1,493	**9,106**
216-Z-1A/ Z-18/Z-12	--	--	--	--	--	--	--	1,907	1,837	0	1,776	1,030	2,637	1,678	688	1,228	734	**13,514**
Ratio of carbon tetrachloride removed per cubic meter of vapor recovered from vadose zone (kg/[1,000 m^3])																		
216-Z-9 Totals	--	--	--	--	--	--	--	**0.33**	**0.25**	**0.00**	**0.50**	**0.29**	**0.00**	**0.47**	**0.27**	**0.15**	**0.15**	
216-Z-1A/ Z-18/Z-12 Totals	--	--	--	--	--	--	--	**0.14**	**0.20**	**0.00**	**0.19**	**0.16**	**0.11**	**0.10**	**0.10**	**0.06**	**0.09**	
Weeks that the 14.2-m^3/min soil vapor extraction system operated each year																		
216-Z-9	--	--	--	--	--	--	--	13	13	0	11	16	0	4	17	9	19	102
216-Z-1A/ Z-18/Z-12	--	--	--	--	--	--	--	13	13	0	15	10	26	18	12	16	7	130

Table 2-3. Volume of Vapor Extracted from Each Extraction Well Above the Cold Creek Unit Between April 1991 and September 2007.

Z-9 Wells, March 1993-September 2007	Extracted Vapor (1,000 m^3)	Z-18/Z-12 Wells, February 1992-September 2007	Extracted Vapor (1,000 m^3)	Z-1A Wells April 1991-September 2007	Extracted Vapor (1,000 m^3)
W15-6U	150	W18-10U	660	W18-6U	190
W15-8U	100	W18-93	10	W18-87L	40
W15-9U	1,030	W18-94	0	W18-87M	20
W15-48	310	W18-96	450	W18-87U	40
W15-82	5,500	W18-97	230	W18-89	8,510
W15-84U	2,510	W18-98	0	W18-150L	240
W15-85	2,650	W18-99	160	W18-150M	40
W15-95U	920	W18-152	1,770	W18-150U	60
W15-216U	570	W18-153	480	W18-158L	230
W15-217	5,150	W18-246U	780	W18-158M	0
W15-218U	3,410	W18-249	800	W18-158U	900
W15-219U	2,790	W18-252U	1,290	W18-159	980
W15-220U	2,040			W18-163L	240
W15-223	1,560			W18-163M	60
C4937	10			W18-163U	520
C4938	10			W18-165	2,550
C5340	10			W18-166	1,380
				W18-167	1,910
				W18-168	1,980
				W18-169	150
				W18-171L	500
				W18-171M	390
				W18-171U	460
				W18-174	4,580
				W18-175	350
				W18-248	3,090
Total	**28,700**	**Total**	**6,640**	**Total**	**29,400**

Table 2-4. Volume of Vapor Extracted from Each Extraction Well Below the Cold Creek Unit Between April 1991 and September 2007.[a]

Z-9 Wells, March 1993-September 2007	Extracted Vapor (1,000 m^3)	Z-18/Z-12 Wells, February 1992-September 2007	Extracted Vapor (1,000 m^3)	Z-1A Wells April 1991-September 2007	Extracted Vapor (1,000 m^3)
W15-6L	2,400	W18-10L	2,720	W18-6L	2,360
W15-8L	130	W18-11L	240	W18-7	8,880
W15-9L	1,110	W18-12	1,040		
W15-84L	700	W18-246L	1,650		
W15-86	860	W18-252L	3,650		
W15-95L	2,010				
W15-216L	1,170				
W15-218L	3,630				
W15-219L	2,820				
W15-220L	1,470				
Total	**16,310**	**Total**	**9,290**	**Total**	**11,240**

[a] Based on soil vapor extraction using the active soil vapor extraction systems.

3.0 SOIL VAPOR MONITORING

Non-operational soil vapor monitoring data are collected at wells and probes that are not on-line to the SVE system. The objectives of monitoring the non-operational wells and probes are as follows:

- To measure carbon tetrachloride concentrations and trends near the vadose/atmosphere and vadose/groundwater interfaces to evaluate whether non-operation of the SVE system is negatively impacting the atmosphere or groundwater
- To be cognizant of carbon tetrachloride concentrations and trends near the CCU to provide an indication of concentrations that can be expected during restart of SVE operations and to support selection of on-line wells.

For each well field, the period of rebound begins when SVE operations are temporarily suspended.

Carbon tetrachloride concentrations rebound during periods of non-operation as a result of carbon tetrachloride accumulating in the pore spaces after apparent diffusion from sediment micropores, soil moisture, residual DNAPL, and/or low-permeability zones. When operations resume, initial extracted carbon tetrachloride concentrations are higher than the carbon tetrachloride concentrations at the previous shutdown. These initial concentrations will generally be lower than the initial concentrations following previous periods of rebound. However, the non-operational duration for each well field varies from year to year, which also affects the rebound concentrations.

3.1 FISCAL YEAR 2007 MONITORING

Soil vapor monitoring at off-line wells and probes was conducted in FY07 using the sampling methods developed for the rebound study in FY97 (BHI-01105). A low-flow (0.8-L/min) sampling pump was used to draw soil vapor samples from wells and probes into a 1-L Tedlar bag for analysis using a B&K multi-gas monitor. Two purge volumes were drawn before the representative sample was collected. At the wells, a tube was lowered to the target depth where the casing is perforated to minimize the volume of air to be purged. A metal filter attached to the end of the tube also served as a weight. Each well equipped with a sampling tube remained sealed at the well head throughout the monitoring period and allowed access to the sampling tubes in the wells.

Soil vapor samples were collected from approximately 30 off-line wells and probes approximately once each month. The soil vapor monitoring data for FY07 are included in Appendix D. As in previous years, soil vapor samples were analyzed primarily to monitor for carbon tetrachloride. However, samples were also analyzed for chloroform, methylene chloride, methyl ethyl ketone, and water vapor because the B&K multi-gas analyzer has been configured to monitor these constituents in support of routine operations.

Passive SVE systems are operating on eight wells in the 216-Z-1A/Z-18 well field. The eight wells are wells 299-W18-6L, 299-W18-7, 299-W18-10L, 299-W18-11L, 299-W18-12, 299-W18-246L, 299-W18-247L, and 299-W18-252L (Figure 2-1). All of the passive SVE systems are open below the CCU. During FY07, soil vapor was sampled at passive SVE wells and analyzed for carbon tetrachloride, chloroform, methylene chloride, methyl ethyl ketone, and

water vapor using a B&K multi-gas analyzer. The FY07 passive monitoring data are included in Appendix C. These data are included in the evaluation of FY07 rebound data below.

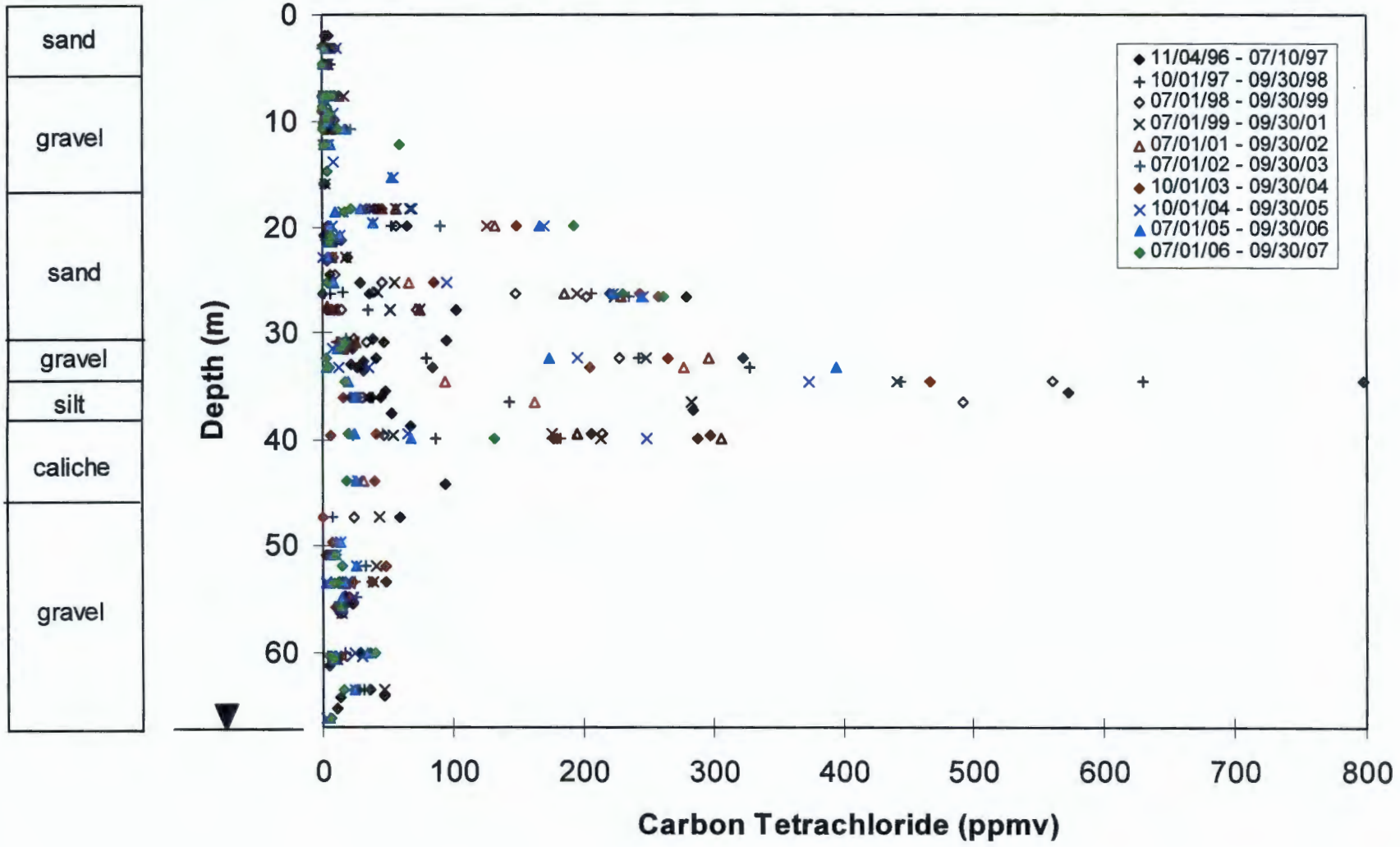
Soil vapor concentrations near the groundwater and ground surface were monitored to assess whether non-operation of the SVE system was allowing carbon tetrachloride to migrate out of the vadose zone to the atmosphere and/or to the groundwater. Monitoring was also conducted at locations near the lower permeability CCU to provide an indication of concentrations that could be expected during restart of SVE operation.

- The maximum concentration detected near the ground surface (between 2 and 10 m [7 and 33 ft] bgs) was 8 ppmv at a depth of 7.6 m (25 ft) in the 216-Z-1A/Z-18 well field (at probe CPT-32). At the 216-Z-9 well field, the maximum concentration detected near the ground surface was 1.6 ppmv at a depth of 3.1 m (10 ft) (at probe CPT-17).
- Near the groundwater (between 50 and 67 m [164 and 220 ft] bgs), the maximum concentration was 15.7 ppmv at a depth of 53.3 m (175 ft) bgs at the 216-Z-9 site (well 299-W15-219L). At the 216-Z-1A well field, the maximum concentration detected near groundwater was 39.3 ppmv at a depth of 60 m (197 ft) bgs (well 299-W18-7) (Appendix C).
- Near the CCU, at depths ranging from 25 to 45 m (82 to 148 ft) bgs, the maximum concentration detected was 262 ppmv at a depth of 26.5 m (87 ft) in the 216-Z-9 well field (at probe CPT-28). At the 216-Z-1A well field, the maximum concentration detected was 131 ppmv at a depth of 39.9 m (131 ft) bgs (well 299-W18-248).

For each period of rebound monitoring since FY97, the maximum rebound concentrations have occurred near the CCU (Figure 3-1). With the exception of FY02, FY06, and FY07, the maximum carbon tetrachloride rebound concentration has been measured at well 299-W15-217 in the 216-Z-9 well field.

Because carbon tetrachloride concentrations did not increase significantly at the near-surface probes, temporarily suspending operation of the SVE system appears to have caused minimal detectable vertical transport of carbon tetrachloride through the soil surface to the atmosphere. Because carbon tetrachloride concentrations did not increase significantly near the water table during this time, temporarily suspending operation of the SVE systems appears to have had no negative impact on groundwater quality. As in previous years, soil vapor monitoring results for FY07 suggest that the CCU is the most likely source zone for the observed carbon tetrachloride vapor.

Figure 3-1. Maximum Carbon Tetrachloride Rebound Concentrations for Fiscal Year 1997 Through Fiscal Year 2007.



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4.0 CONCEPTUAL MODEL

This section summarizes the environmental setting and the conceptual models at the primary disposal sites. Additional details are available in the following documents:

- *Carbon Tetrachloride Flow and Transport in the Subsurface of the 216-Z-9 Trench at the Hanford Site: Heterogeneous Model Development and Soil Vapor Extraction Modeling* (PNNL-15914)
- *Carbon Tetrachloride Flow and Transport in the Subsurface of the 216-Z-18 Crib and 216-Z-1A Tile Field at the Hanford Site: Multifluid Flow Simulations and Conceptual Model Update* (PNNL-16198)
- *Modeling of Carbon Tetrachloride Flow and Transport in the Subsurface of the 200 West Disposal Sites: Large-Scale Model Configuration and Local-Scale Prediction of Future Carbon Tetrachloride Distribution Beneath the 216-Z-9 Disposal Site* (PNNL-17181)
- *Remedial Investigation Report for the Plutonium/Organic-Rich Process Condensate/ Process Waste Group Operable Unit: Includes the 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units* (DOE/RL-2006-51)
- *Carbon Tetrachloride Dense Non-Aqueous Phase Liquid (DNAPL) Source Term Interim Characterization Report* (DOE/RL-2006-58)
- *Carbon-Tetrachloride Dense Non-Aqueous Phase Liquid (DNAPL) Source Term Interim Characterization Report Addendum* (DOE/RL-2007-22).

4.1 ENVIRONMENTAL SETTING

The approximately 70-m (230-ft)-thick vadose zone can be broadly divided into an upper gravel and sand interval (Hanford formation) and a lower gravel and sand interval (Ringold Formation Unit E), separated by a finer-grained, carbonate-cemented CCU at approximately 38 m (125 ft) bgs. Based on characterization results, the CCU appears to have been an accumulation zone for carbon tetrachloride. Numerical simulation results indicate that the CCU accumulated carbon tetrachloride and had a large impact on DNAPL movement and the resulting distribution of carbon tetrachloride in the subsurface (PNNL-17181). Other fine-grained zones in both the upper and lower gravel and sand intervals may also be accumulation zones. For example, high carbon tetrachloride concentrations were observed in a silt layer 19.8 m (65 ft) bgs during drilling of well 299-W15-46 on the south side of the 216-Z-9 Trench in FY04. Carbon tetrachloride may be in non-equilibrium sorption sites within intra-particle sediment pore spaces in these fine-grained units (*Hanford Soil Partitioning and Vapor Extraction Study* [BHI-00861]).

4.2 216-Z-9 CONCEPTUAL MODEL

The 216-Z-9 Trench is located in the 200 West Area, approximately 213 m (700 ft) east of the 234-5Z Building (Figure 2-1). The surface elevation of this site is approximately 201 m (660 ft). The groundwater beneath the 216-Z-9 Trench is approximately 68 m (223 ft) bgs, based on nearby well 299-W15-46 in April 2005.

The 216-Z-9 Trench consists of a 6-m (20-ft)-deep excavation with a 37-m by 27-m (120-ft by 90-ft) concrete cover. The walls of the trench slope inward and downward to the 18-m by 9-m (60-ft by 30-ft) floor space, which had a slight slope to the south. The underside of the concrete cover was paved with acid-resistant brick/tiles. The cover of the trench is supported by six concrete columns.

From July 1955 through June 1962, the 216-Z-9 Trench received all solvent and aqueous wastes from the RECUPLEX process that operated in the 234-5Z Building. The 216-Z-9 Trench received approximately 4.1 million L (1.1 million gal) of high-salt, acidic, aqueous, and organic liquid waste from the RECUPLEX process. The organic inventory discharged to the trench included 130,000 to 480,000 kg (286,600 to 1,058,219 lb) of carbon tetrachloride; 27,900 L (7,370 gal) of tributyl phosphate; 46,500 L (12,284 gal) of dibutyl butyl phosphonate; and 9,300 L (2,457 gal) of lard oil (Figure 4-1). The carbon tetrachloride, which was mixed with the other organics, was discharged to the 216-Z-9 Trench as a small, entrained fraction of process aqueous wastes and as DNAPL.

The RI report for the 200-PW-1 OU (DOE/RL-2006-51) provides details of past investigations and the RI results, including soil, soil vapor, borehole geophysical logging, and other investigations. The significant RI findings for the 216-Z-9 Trench in relation to carbon tetrachloride are summarized below:

- Soil vapor samples collected from boreholes drilled in the vicinity of the trench revealed carbon tetrachloride at concentrations up to 28,500 ppmv in 1993. This is approximately 23% of the maximum soil vapor concentration, indicating carbon tetrachloride saturation in the vadose zone.
- Soil samples from boreholes near the 216-Z-9 Trench revealed carbon tetrachloride DNAPL in soil of up to 380,000 µg/kg in well 299-W15-46 from 19.4 to 20.1 m (63.5 to 66 ft) bgs. At adjacent direct-push location C5336 (P66), the maximum carbon tetrachloride detected in soil was 390,000 µg/kg in the same silt lens. These represent the first detections of DNAPL at any location in the subsurface of the 200 West Area since the beginning of the carbon tetrachloride contamination investigation in the early 1990s.
- An SVE system has been operating near the 216-Z-9 Trench as an ERA. Between April 1991 and September 2007, 54,497 kg (120,144 lb) of carbon tetrachloride were removed by the SVE system [updated, based on this report].
- In general, the highest concentrations of carbon tetrachloride detected in the vadose zone soils have been in fine-grained layers (i.e., silts and the CCU).
- A higher percentage of the carbon tetrachloride inventory than previously estimated was likely lost to the atmosphere through evaporation during disposal. A higher percentage of the carbon tetrachloride inventory than previously estimated is present in the unconfined aquifer.
- At the 216-Z-9 Trench, the discharged effluent volume was greater than the soil-column pore volume, which indicates that the volume of effluent released was sufficient to reach the unconfined aquifer during operation of this waste site. However, based on currently available site data, including soil-moisture content measurements, the 216-Z-9 Trench is not considered to be a significant current source of groundwater contamination.

The contaminant distribution model for the 216-Z-9 Trench is presented in Figure 4-1.

4.3 216-Z-1A TILE FIELD CONCEPTUAL MODEL

The 216-Z-1A Tile Field is located in the 200 West Area approximately 153 m (500 ft) south of the 234-5Z Building, immediately south of the 216-Z-1 and 216-Z-2 Cribs and adjacent to the 216-Z-3 Crib (Figure 2-1). The surface elevation around this site is approximately 207 m (679 ft). The groundwater beneath the 216-Z-1A Tile Field is approximately 71 m (234 ft) bgs, based on nearby well 299-W18-16 on March 20, 2005.

The tile field's piping consists of 20-cm (8 in.)-diameter perforated vitrified clay pipe placed on a 1.5-m (5-ft)-deep gravel bed. The piping consists of a 79-m (260-ft)-long, north-south trunk or main pipeline with seven pairs of 21-m (70-ft) laterals spaced at 11-m (35-ft) intervals in a centered herringbone pattern. The piping system was overlaid with 15 cm (6 in.) of cobbles and 1.5 m (5 ft) of sand and gravel.

The tile field was used in this configuration from 1949 to 1959. The waste stream discharged to the adjacent 216-Z-1 and 216-Z-2 Cribs (1949 to 1952) and the 216-Z-3 Crib (1952 to 1959) overflowed to the tile field and consisted of neutral to basic (pH of 8 to 10) process waste and analytical and development laboratory waste from the Z Plant via the 241-Z-361 settling tank. The total volume of waste discharged from 1949 to 1959 was approximately 1 million L (264,000 gal.).

Before the 216-Z-1A Tile Field was reactivated in 1964, a sheet of 0.05-cm (0.02-in.)-thick polyethylene and a 30-cm (1-ft)-thick layer of sand and gravel were added, and the liquid waste discharge piping was routed directly to the central distributor pipe in the tile field. Between 1964 and 1969, a 5-cm (2-in.)-diameter, stainless-steel pipe was progressively inserted inside the central distributor pipe to divide the tile field into three operational sections (216-Z-1AA, 216-Z-1AB, and 216-Z-1AC) (*Existing Data on 216-Z Liquid Waste Sites* [RHO-LD-114]).

From 1964 to 1969, the 216-Z-1A Tile Field received approximately 5.2 million L (1.4 million gal) of liquid waste from 234-5Z (PFP), 236-Z PRF, 242-Z Waste Treatment Facility, and miscellaneous laboratory waste. The organic inventory discharged to the tile field included 270,000 kg (594,000 lb) of carbon tetrachloride; 23,900 L (6,314 gal) of tributyl phosphate; 27,500 L (7,265 gal) of dibutyl butyl phosphonate; and 11,000 L (2,906 gal) of lard oil (Figure 4-2). The carbon tetrachloride, which was mixed with the other organics, was discharged to the 216-Z-1A Tile Field as a small, entrained fraction of process aqueous wastes and as DNAPL.

The RI report (DOE/RL-2006-51) provides details of past investigations and RI results, including soil, soil vapor, borehole geophysical logging, and other investigations. The significant RI findings for the 216-Z-1A Tile Field in relation to carbon tetrachloride are summarized below:

- Soil samples from the tile field area revealed a maximum carbon tetrachloride concentration of 6,561 µg/kg in the CCU in 1993.
- A SVE system has been operating near the tile field. Between April 1991 and September 2007, 24,667 kg (54,381 lb) of carbon tetrachloride were removed by the SVE system (updated, based on this report).

- The 216-Z-1A Tile Field has not been considered to be a past source of groundwater contamination because the effluent volume discharged at this site was much less than the soil-column pore volume. However, based on the dispersed carbon tetrachloride vadose zone plume data presented in the RI, there are significant concentrations of carbon tetrachloride in the vadose zone adjacent to this site, so it is possible that this site was a past source of groundwater contamination; however, it is not a significant current source.

The refinements to the 216-Z-9 Trench contaminant distribution model regarding the presence of discontinuous silt layers apply to the 216-Z-1A Tile Field contaminant distribution model as well.

The contaminant distribution model for the 216-Z-1A Tile Field is presented in Figure 4-2.

4.4 216-Z-18 CRIB CONCEPTUAL MODEL

The 216-Z-18 Crib is located in the 200 West Area, southwest of the 216-Z-1A Tile Field (Figure 2-1). The groundwater beneath the 216-Z-18 Crib is approximately 72 m (236 ft) bgs, based on nearby well 299-W18-2 in July 2003.

The 216-Z-18 Crib consists of five separate, parallel, north/south-running trenches, each 63 m by 3 m (207 ft by 10 ft) and 5.5 m (18 ft) deep. Each crib structure has two 8-cm (3-in.)-diameter distribution pipes placed on a 0.3-m (1-ft)-thick bed of gravel at 5.2 m (17 ft) bgs, buried under an additional 0.3 m (1 ft) of gravel, covered with a membrane and sand, and then backfilled to grade. Crib piping was fed by the primary steel distribution pipe that bisected each crib. The individual trenches were operated for approximately 1 year each, beginning with Trench 3, followed by Trenches 2, 1, and 4 (in that order) (Figure 4-3).

The 216-Z-18 Crib was used as a replacement for the 216-Z-1A Tile Field to receive high-salt, acidic (pH of 1 to 2.5) aqueous liquid waste and organic liquid waste from the PFP from 1969 to 1973. The 216-Z-18 Crib received approximately 3.9 million L (1.0 million gal) of liquid waste. The organic inventory discharged to the crib included 175,000 kg (386,000 lb) of carbon tetrachloride; 16,400 L (4,332 gal) of tributyl phosphate; and 19,100 L (5,046 gal) of dibutyl butyl phosphonate (Figure 4-3). The carbon tetrachloride, which was mixed with the other organics, was discharged to the 216-Z-18 Crib as a small, entrained fraction of process aqueous wastes and as DNAPL.

The RI report (DOE/RL-2006-51) provides details of past investigations, including soil, soil vapor, borehole geophysical logging, and other investigations. The 216-Z-18 Crib conceptual site model is based on all available existing data for this waste site. The contaminant distribution model for the 216-Z-18 Crib is presented in Figure 4-3.

Figure 4-1. Contaminant Distribution Model, 216-Z-9 Trench.

200-PW-1 Operable Unit
Waste Type: Process Waste

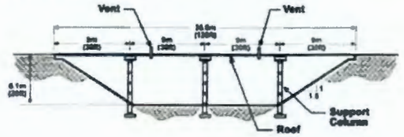
216-Z-9 Trench

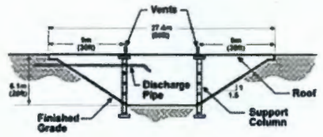
PFP Zone

History

The 216-Z-9 Trench is an enclosed, below-grade trench that was used from 1955 to 1962 for disposal of Z Plant RECUPLEX aqueous and organic liquid waste. Carbon tetrachloride was received in the aqueous phase liquid and, mixed with other organics, as a dense, non-aqueous phase liquid (DNAPL). In 1976 and 1977, the upper 0.3 m (1 ft) of the trench floor was mined to reduce the amount of plutonium in the trench; after mining, 38 to 48 kilograms (84 to 106 pounds) of plutonium were estimated to remain in the soils beneath the trench. Soil vapor extraction has been ongoing at the 216-Z-9 Trench since 1993 to remove carbon tetrachloride from the vadose zone.

CONSTRUCTION: The site is a rectangular, enclosed trench with a concrete cover supported by six columns. The trench is 18 by 9 m (60 by 30 ft) at the bottom and 6 m (21 ft) deep. The underside of the concrete cover was lined with acid resistant bricks. Two stainless steel pipes discharged effluent above the trench bottom.





WASTE VOLUME: 4,090,000 L (1,081,000 gal) (RHO-LD-114)

DURATION: 1955 to 1962

DISCHARGED INVENTORY:

Plutonium	38-48 kg (remaining) (RHO-ST-21)
Americium-241	2.5 kg (RHO-LD-114)
Carbon tetrachloride	83,000 to 300,000 L (DOE/RL-91-32)
Tributyl phosphate	27,900 L (WHC-SD-EN-TI-248)
Dibutylbutyl phosphonate	46,500 L (WHC-SD-EN-TI-248)
Lard oil	9,300 L (WHC-SD-EN-TI-248)
Nitrate	1,361,000 kg (HNF-31792)

REFERENCES:

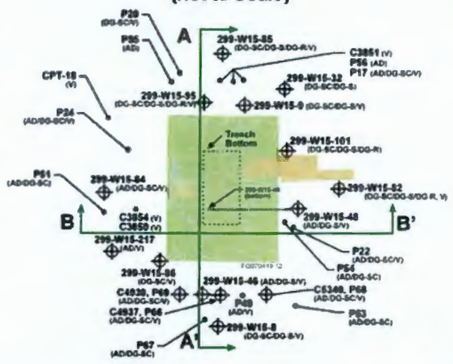
WIDS general summary reports
ARH-2915
RHO-ST-21
RHO-LD-114
PNNL-16103
PNNL-11978
DOE/RL-91-32
WHC-SD-EN-TI-248
BHI-00431
SGW-33746
HNF-31792

Basis of Knowledge (Data Types)

- Process History (PH)
- Downhole Geophysics - Spectral (DG-S)
- Downhole Geophysics - Scintillation (DG-SC)
- Downhole Geophysics - Radionuclide Logging System (DG-R)
- Soil Sampling Analytical Data (AD)
- Vapor Sampling Data (V)

Site Plan View

(not to scale)



Characterization Summary

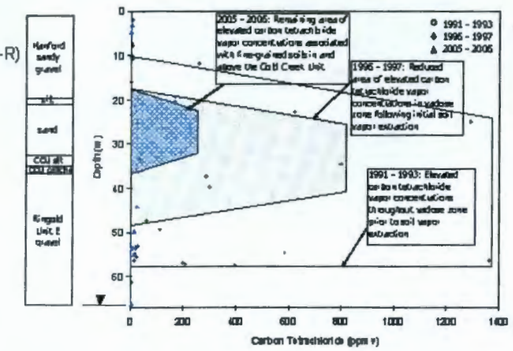
Wells were installed around the 216-Z-9 Trench beginning in the 1950s to monitor contaminant migration. Many of these wells have been geophysically logged. Characterization was conducted in 1961, 1963, and 1973 to evaluate the plutonium and americium in the trench (ARH-2915). Characterization was conducted in 1991 to 1993 to support soil vapor extraction activities. A DNAPL investigation conducted on the northeast corner of the 216-Z-9 Trench in 1995 detected no DNAPL in well 299-W15-32 (BHI-00431). Remedial investigation activities conducted at the trench included sampling from one deep well (299-W15-46) and one slant well (299-W15-48) and a phased carbon tetrachloride investigation. DNAPL was identified in a silt lens 20 m (65 ft) bgs south of the trench.

LEGEND

- Existing Borehole (data type)
- Water Table

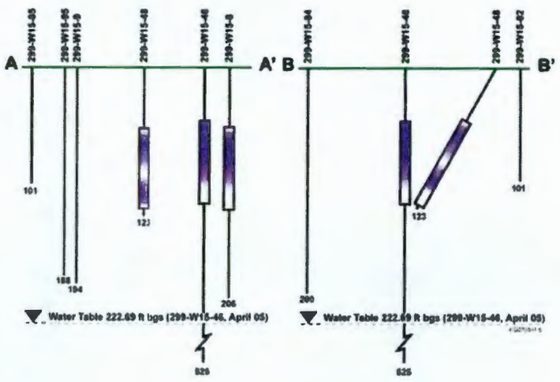
bgs = below ground surface

Carbon Tetrachloride Vapor Distribution

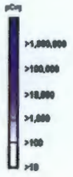


Site Section Views

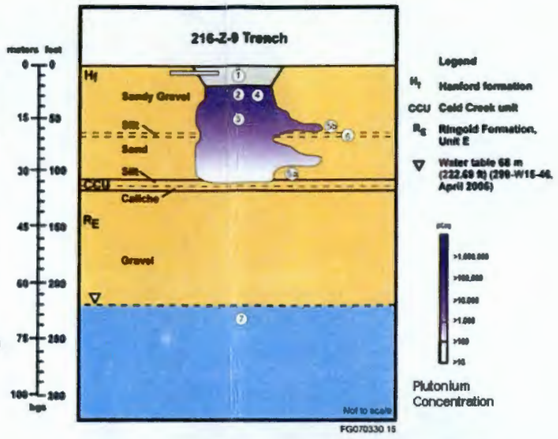
(not to scale, units in feet bgs)



Site Section View Scale. Concentrations of plutonium; no color bar on Site Section View indicates no contamination was identified in available data.



Contaminant Distribution Model



1. At the 216-Z-9 Trench, more than 4 million liters of plutonium/organic-rich process wastes were discharged between 1955 and 1962.
2. Effluent containing contaminants was discharged at the bottom of the unlined 216-Z-9 Trench. The trench floor slopes slightly to the south.
3. The wetting front and contaminants moved vertically beneath the trench. Lateral spreading of liquids is associated mainly with the Hanford gravel and sand contact, the Cold Creek unit, or fine-grained lenses in the Hanford or Ringold formations. In addition, vapor phase carbon tetrachloride migrated vertically and laterally beneath and around the trench, but has been considerably reduced by soil vapor extraction operations started in 1993 (see vapor distribution chart at left).
4. Constituents with large distribution coefficients, such as americium and plutonium, sorb to soils resulting in higher concentrations near the bottom of the trench. Concentrations generally decrease with depth. However, these contaminants were detected to depths up to 36.9 m (121 ft) bgs beneath the trench, indicating that plutonium and americium mobility was enhanced in the presence of the organic and acidic liquid wastes.
5. Carbon tetrachloride is present throughout the vadose zone beneath the 216-Z-9 Trench. As determined from sample data, carbon tetrachloride exists as vapor (5A), as a DNAPL near the Hanford gravel/sand contact on the south side (5B), and as a dissolved aqueous phase and/or sorbed phase in soil.
6. The highest concentrations of detected carbon tetrachloride are associated with silts in a thin lens at 20 m (65 ft) bgs.
7. Carbon tetrachloride has impacted the groundwater; impacts may have been associated with vapor, aqueous liquid, and/or organic liquid phases. In addition, carbon tetrachloride may have been dissolved in aqueous waste effluent from nearby facilities and subsequently been transported to groundwater. Plutonium and americium have been detected at low concentrations in the groundwater collected from one well near the trench. Older boreholes, and possibly clastic dikes, may have provided preferential pathways through the vadose zone.

200-PW-1FS.216-Z-9.08/28/07

Figure 4-2. Contaminant Distribution Model, 216-Z-1A Tile Field.

200-PW-1 Operable Unit
Waste Type: Process Waste

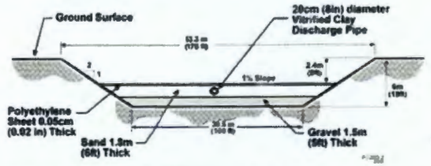
216-Z-1A Tile Field

PFP Zone

History

The 216-Z-1A Tile Field was a liquid waste site that was used to dispose of aqueous and organic liquid waste generated at the Plutonium Finishing Plant. The waste streams included overflow from the 216-Z-1, 216-Z-2, and 216-Z-3 Cribs, which received process and laboratory waste from 1949 to 1959, and 236-Z plutonium recovery waste and 242-Z americium recovery waste discharged directly to the tile field from 1964 to 1969. Carbon tetrachloride was received in the aqueous phase liquid and, mixed with other organics, as a dense, non-aqueous phase liquid (DNAPL) from 1964 to 1969. The site was deactivated in 1969 by plugging facility discharge piping to the tile field when plutonium recovery waste was diverted to the 216-Z-18 Crib. Soil vapor extraction has been ongoing at the site since 1992 to remove carbon tetrachloride from the vadose zone.

CONSTRUCTION: The 216-Z-1A Tile Field consists of a 30 m (100 ft) wide, 79 m (260 ft) long, and 5.8 m (19 ft) deep excavation. The 20-cm (8-in) diameter vitrified clay distribution pipes lie on a 1.5-m (5-ft) thick gravel bed, 4.3 m (14 ft) bgs. The distribution pipes are covered with a 1.8-m (6-ft) thick sand layer. The central distribution pipe is a continuous line without perforations; the seven pairs of lateral pipes are divided into 0.3-m (1-ft) long segments.



WASTE VOLUME: 6,200,000 L (1,600,000 gal) (RHO-LD-114)

DURATION: 1949 to 1969

ESTIMATED DISCHARGED INVENTORY:

Plutonium	57 kg (RHO-LD-114)
Americium-241	1 kg (RHO-ST-17)
Carbon tetrachloride	270,000 kg (WHC-SD-EN-TI-248)
Tributyl phosphate	23,900 L (WHC-SD-EN-TI-248)
Dibutylbutyl phosphonate	27,500 L (WHC-SD-EN-TI-248)
Lard oil	11,000 L (WHC-SD-EN-TI-248)
Nitrate	3,000 kg (DOE/RL-91-58)

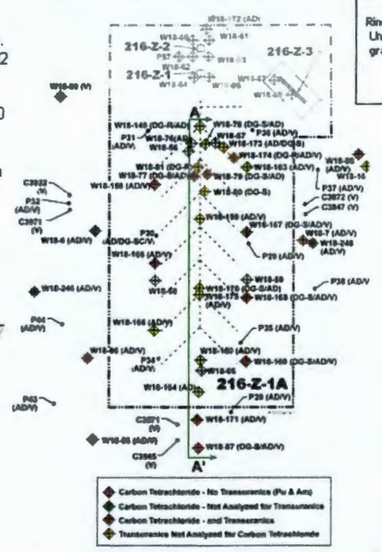
REFERENCES:
WIDS general summary reports
RHO-ST-17
RHO-LD-114
DOE/RL-91-32
WHC-SD-EN-TI-248
DOE/RL-91-58
SGW-33746
SGW-33829

Basis of Knowledge (Data Types)

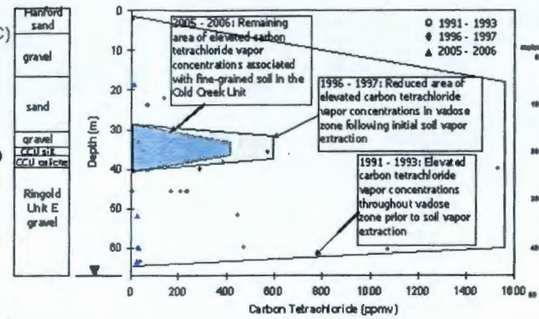
- Process History (PH)
- Downhole Geophysics - Spectral (DG-S)
- Downhole Geophysics – Scintillation (DG-SC)
- Geologic Logs (GL)
- Soil Sampling Analytical Data (AD)
- Vapor Sampling Data (V)

Site Plan View

(not to scale; all well numbers prefixed with 299-)

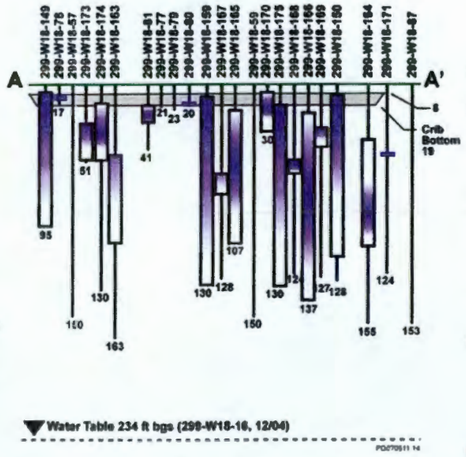


Carbon Tetrachloride Vapor Distribution



Site Section View

(not to scale; units in feet bgs)



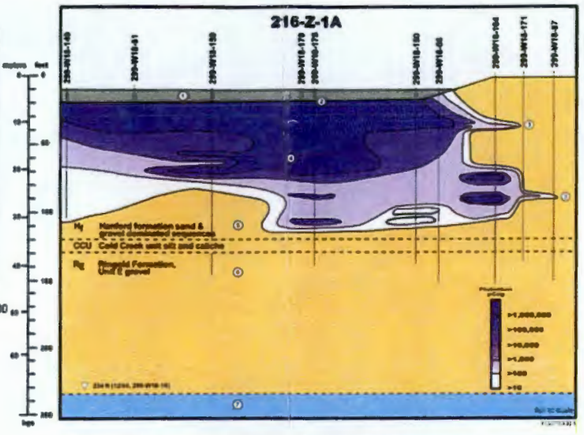
Site Section View Scale. Concentrations of plutonium; no color bar on Site Section View indicates no contamination was identified in available data.

LEGEND
- Existing Borehole (data type)
- Water Table
- bgs = below ground surface

Characterization Summary

Data collection activities have been ongoing at the 216-Z-1A Tile Field since early operations. The distribution of plutonium and americium was characterized at 16 wells at this site in the 1970s (RHO-ST-17). Also, many of the wells in and around the tile field have been geophysically logged (ARH-ST-156, SGW-33829). Characterization was conducted in 1991-1993 to support soil vapor extraction, which has been ongoing at this site since 1992. As part of the remedial investigation, information from additional characterization boreholes was used to evaluate the distribution of carbon tetrachloride and other organic contaminants.

Contaminant Distribution Model



1. Between 1964 and 1969, the 216-Z-1A Tile Field received 5.2 million liters of high-salt, acidic liquid waste containing significant inventories of plutonium and carbon tetrachloride. From 1949 to 1959, the 216-Z-1A Tile Field received 1.0 million liters of slightly basic, aqueous waste.
2. Effluent and contaminants were released to the soil at the bottom of the tile field through a herringbone arrangement of pipes.
3. The wetting front and contaminants moved vertically beneath the tile field. Lateral spreading is mainly attributed to contact with the Cold Creek unit or fine-grained lenses in the Hanford or Ringold formations. Vapor phase carbon tetrachloride exists throughout the vadose zone in the source area.
4. Constituents such as plutonium (Pu) and americium (Am), which are generally immobile in soils, sorb readily to soils, resulting in higher concentrations directly beneath the tile field. The Am and Pu concentrations generally decrease with depth. However, radionuclides were detected to depths up to 37 m, indicating that Pu and Am mobility was enhanced in the presence of carbon tetrachloride, tributyl phosphate and derivatives, and acidic liquid wastes.
5. Carbon tetrachloride initially spread throughout the vadose zone beneath and around the 216-Z-1A Tile Field. However, soil vapor extraction operations started at the site in 1992 have considerably reduced the vadose zone carbon tetrachloride inventory (see vapor distribution chart at left). Dense non-aqueous phase liquid carbon tetrachloride was not identified during the remedial investigation.
6. The highest concentration of carbon tetrachloride is associated with the fine-grained sediments of the Cold Creek unit.
7. The effluent volume discharged to the tile field suggests that groundwater may not have been directly impacted by the wetting front unless a preferential pathway is present. Carbon tetrachloride in the soil vapor phase may have reached groundwater.

200-PW-1FS.216-Z-1A.08/30/07

Figure 4-3. Contaminant Distribution Model, 216-Z-18 Crib.

200-PW-1 Operable Unit
Waste Type: Process Waste

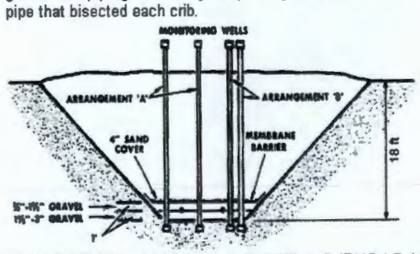
216-Z-18 Crib

PFP Zone

History

The 216-Z-18 Crib was used, as a replacement for the 216-Z-1A Tile Field, to receive high salt, acidic (pH 1 to 2.5) aqueous liquid waste and organic liquid waste from the Plutonium Finishing Plant. The waste streams included plutonium recovery waste from the 236-Z Building and americium recovery waste from the 242-Z Building. Carbon tetrachloride was received in the aqueous phase liquid and, mixed with other organics, as a dense, non-aqueous phase liquid (DNAPL). Crib structures 1 through 4 (shown numbered east to west) received waste; crib structure 5 was not used. The individual crib structures were operated for approximately 1 year each beginning with crib structure 3, followed by crib structures 2, 1, and 4, in that order. The 216-Z-18 Crib was retired in 1973 and deactivated by blanking pipelines in the 236-Z and 242-Z Buildings. Soil vapor extraction has been ongoing at the crib since 1992 to remove carbon tetrachloride from the vadose zone.

CONSTRUCTION: The 95 by 79 m (311 by 259 ft) site consists of 5 separate, parallel crib structures, each 63 m by 3 m (207 ft by 10 ft), and 5.5 m (18 ft) deep. Each crib structure has two 8-cm (3-in) diameter distribution pipes placed on a 0.3-m (1-ft) thick bed of gravel at 5.2 m (17 ft) bgs, buried under an additional 0.3 m (1 ft) of gravel, covered with a membrane and sand, and then backfilled to grade. Crib piping was fed by the primary steel distribution pipe that bisected each crib.



WASTE VOLUME: 3,860,000 L (1,020,000 gal) (RHO-LD-114)

DURATION: 1969 to 1973

ESTIMATED DISCHARGED INVENTORY:

Plutonium	23 kg (RHO-LD-114)
Americium-241	0.4 kg (DOE/RL-91-32)
Carbon tetrachloride	175,000 kg (WCH-SD-EN-TI-248)
Tributyl phosphate	16,400 kg (WCH-SD-EN-TI-248)
Dibutylbutyl phosphonate	19,100 kg (WCH-SD-EN-TI-248)
Nitrate	500,000 kg (DOE/RL-91-58)

REFERENCES:
WIDS general summary reports
RHO-LD-114
SGW-33746
WHC-SD-EN-TI-248
DOE/RL-91-32
DOE/RL-91-58

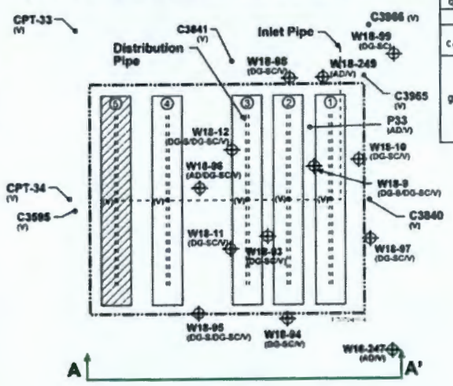
LEGEND
- Existing Borehole (data type)
- Water Table
- bgs = below ground surface

Basis of Knowledge (Data Types)

- Process History (PH)
- Downhole Geophysics - Spectral (DG-S)
- Downhole Geophysics – Scintillation (DG-SC)
- Soil Sampling Analytical Data (AD)
- Vapor Sampling Data (V)

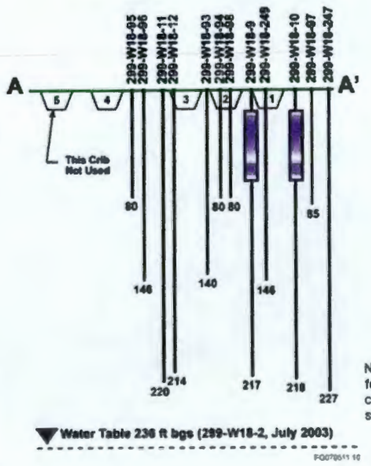
Site Plan View

(not to scale; all W18 well numbers prefixed by 299-)

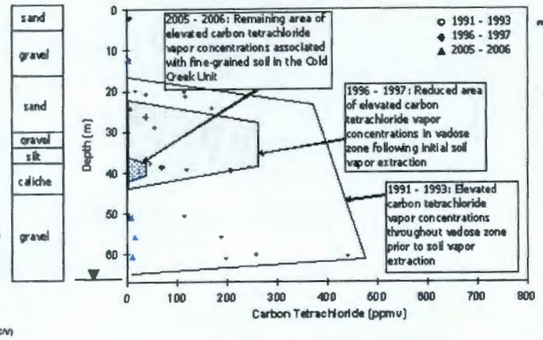


Site Section View

(not to scale, units in feet bgs)



Carbon Tetrachloride Vapor Distribution



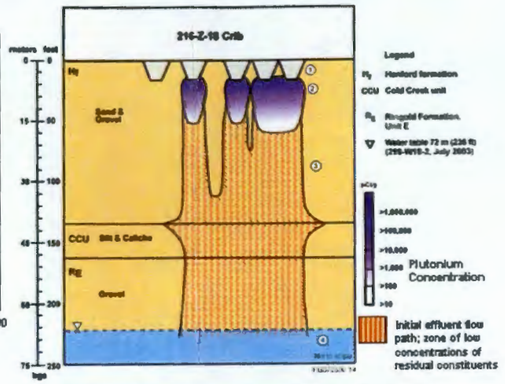
Characterization Summary

Characterization activities have been conducted at 216-Z-18 since the 1960s. Scintillation logging of site monitoring wells was conducted in 1968, 1973 and 1976. Wells 299-W18-9 and 299-W18-10 were the only wells that showed contamination above background levels; contamination was identified at about 8 to 17 m (26 to 55 ft) bgs (ARH-ST-156). Characterization was also conducted in 1992 and 1993 in support of soil vapor extraction activities. Spectral gamma logging and neutron moisture logging were conducted in 2006 at wells 299-W18-9, 299-W18-12, and 299-W18-95. Well 299-W18-9 identified plutonium and americium-241 from 7.6 to 18 m (25 to 60 ft) bgs with a maximum concentration of 400,000 pCi/g at 8.2 m (27 ft) bgs. Concentrations decreased with depth to 18 m (60 ft) bgs, where they increased to 250,000 pCi/g. Concentrations decreased to the tool detection limits below about 21 m (70 ft) bgs. Analytical soil data obtained from wells 299-W18-96, 299-W18-247, and 299-W18-249 in 1992 and 1993 did not identify significant organic chemical contamination (e.g., carbon tetrachloride was < 2 ppm). Nitrate was identified in well 299-W18-96 at 4,400 mg/kg at 25.6 m (84 ft) bgs decreasing to < 10 mg/kg at 38.1 m (125 ft) bgs. No significant concentrations of carbon tetrachloride or other volatile organic compounds were identified during soil vapor sampling conducted for the remedial investigation or soil vapor extraction operations in 2005 or 2006.

Note: Concentration profile for 299-W18-10 derived from comparison with 299-W18-9 scintillation and logging data.

Site Section View Scale. Concentrations of plutonium; no color bar on Site Section View indicates no contamination was identified in available data.

Contaminant Distribution Model



1. From 1969 to 1973, about 4 million liters of liquid waste were discharged to the 216-Z-18 Crib at a depth of about 5.2 m (17 ft) bgs. Crib operations were controlled so effluent was discharged evenly over the 4 (of 5) crib structures that received waste.
2. Liquid waste and contaminants moved through the gravel bed where the immobile radionuclides (plutonium and americium) sorbed to soils directly below the crib. Site-specific data show crib contamination extending from about 7.6 to 21 m (25 to 70 ft) bgs. Analytical sampling to date did not identify the presence of organics in soil in significant quantities. Any remaining carbon tetrachloride or other organic contaminants are likely associated with, or are directly above, the Cold Creek unit.
3. As the liquid waste continued to migrate downward, more mobile contaminants (e.g., nitrate) moved toward the groundwater. Because of the proximity of the individual crib structures to one another, subsurface intermingling of the waste streams has likely occurred. Fine-grained soils in the vadose zone slowed water movement and allowed mobile contaminants to concentrate and, to a minor extent, move laterally along the interfaces between fine-grained and coarser-grained sediments.
4. Although the overall effluent volume to each crib structure within the site was relatively low and evenly distributed throughout the crib structures, nitrate inventory was reportedly high. Analytical sample results for nitrate and soil moisture demonstrate a potential for past and/or future groundwater impacts from this site. Impacts to groundwater from organic constituents are not expected from this crib.

200-PW-1RIR.216-Z-18.08/30/07

5.0 EXPEDITED RESPONSE ACTION STATUS

The action memorandum (EPA and Ecology 1992) described the purpose of the ERA as follows:

> *The purpose of this action is to mitigate the threat to site workers, public health, and the environment caused by the migration of carbon tetrachloride vapors through the soil column and into the groundwater. The action is an interim action taken to reduce the mass of carbon tetrachloride in the soil column beneath the 200 West Area pending the final cleanup activities associated with the 200-ZP-1 and 200-ZP-2 Operable Units.*

The purpose statement above can be formulated as four RAOs:

- Mitigate the threat to site workers.
- Mitigate the threat to public health.
- Mitigate the threat to the environment caused by the migration of contaminants from the soil into groundwater.
- Reduce the mass of carbon tetrachloride in the soil.

5.1 MITIGATE THREAT TO SITE WORKERS

In the area remediated using SVE, concentrations of carbon tetrachloride vapor in the vadose zone have been significantly reduced, as measured at the SVE system inlet and at individual extraction wells and monitoring probes. However, carbon tetrachloride is still present in the vadose zone. Concentrations are typically higher in the fine-grained layers where the use of SVE has been less successful at removing carbon tetrachloride. Concentrations may also be higher in the coarse-grained layers in areas that have not been swept by the airflow pathways established through use of the existing well network. As observed during drilling of well 299-W15-46 very close to the 216-Z-9 Trench in 2003 and 2004, carbon tetrachloride vapors still may be encountered during characterization activities such as well drilling. Site workers have been protected before and during the ERA and will also be protected after the ERA through proper conduct of operations, monitoring, and the use of engineering controls and personal protective equipment. Based on the risk assessment conducted as part of the 200-PW-1 OU FS, concentrations of carbon tetrachloride and chloroform in soil gas beneath the 216-Z-1A Tile Field and the 216-Z-9 Trench are not a concern for workers (*Feasibility Study for Plutonium/ Organic-Rich Process Condensate/Process Waste Group OU, Includes 200-PW-1, 200-PW-3, and 200-PW-6* [DOE/RL-2007-27]).

5.2 MITIGATE THREAT TO PUBLIC HEALTH

Public health is protected by the use of institutional controls that prevent public access to contaminated areas and by continued environmental monitoring of those areas. The action memorandum (EPA and Ecology 1992) also identified a concern that carbon tetrachloride vapors could migrate offsite in an independent direction from groundwater flow. The primary concern was related to vapor migration to wells and agricultural areas in the Cold Creek Valley, which is west of the 200 West Area.

None of the groundwater samples collected from wells located west of the 200 West Area indicate that carbon tetrachloride vapor is migrating westward offsite. All analytical results to date have yielded nondetect results. In addition, the 200-PW-1 OU RI found that the carbon tetrachloride vapor plume in the vadose zone was located within about 75 to 150 m (250 to 500 ft) of the three primary waste disposal sites (DOE/RL-2006-51). Based on the groundwater and RI vapor data, there is no indication that carbon tetrachloride vapor is posing a threat to the public.

Use of institutional controls to limit direct public access to the site and continued monitoring of contaminated areas are still needed to ensure protection of the public health. This RAO will continue until both the vadose zone and the groundwater have been remediated.

5.3 MITIGATE THREAT TO THE ENVIRONMENT CAUSED BY MIGRATION OF CONTAMINANTS FROM THE SOIL INTO GROUNDWATER

Initiation of the ERA was based on the assumption that contamination in the vadose zone posed a continuing threat to groundwater and that if no expedited action were taken, the groundwater quality would continue to degrade. The success of the remedial action can be evaluated by comparing the potential for transport of carbon tetrachloride between the soil vapor and the groundwater before and during the remedial action using Henry's Law as a guideline. Henry's Law describes the equilibrium partitioning of a compound between the aqueous and vapor phases.

5.3.1 During Initiation of Soil Vapor Extraction

The in situ carbon tetrachloride soil vapor concentration measured near the water table during installation of well 299-W15-218 at the 216-Z-9 site in 1993 was 10,400 ppmv. The carbon tetrachloride groundwater concentration measured at the same time at well 299-W15-218 was 6,500 µg/L. At this well in 1993, the measured vapor concentration was an order of magnitude higher than the equilibrium vapor concentration (approximately 1,000 ppmv) predicted using Henry's Law and the measured groundwater concentration. In 1994, carbon tetrachloride vapor concentrations ranging from approximately 100 to 2,400 ppmv were measured during SVE operations in 216-Z-9 Trench wells with open intervals near the groundwater.

In 1994, carbon tetrachloride vapor concentrations ranging from 150 to 600 ppmv were measured during SVE operations in 216-Z-1A wells with open intervals near the groundwater. At that time, the carbon tetrachloride groundwater concentration was approximately 2,100 µg/L in well 299-W18-1. In some locations, the measured vapor concentrations were higher than the equilibrium vapor concentration (approximately 300 ppmv) predicted using Henry's Law and the measured groundwater concentration.

These evaluations using measurements made during initiation of SVE suggest that the carbon tetrachloride concentration gradient at some locations would drive carbon tetrachloride from the vadose zone to the groundwater.

5.3.2 Following Initial Soil Vapor Extraction

Carbon tetrachloride vapor concentrations measured near the groundwater during the 1996-1997 rebound study were compared to groundwater concentration data collected from nearby groundwater wells as apart of the 200-ZP-1 OU groundwater pump-and-treat project. At both

the 216-Z-9 Trench and the 216-Z-1A Tile Field, the measured vapor concentrations were an order of magnitude less than the equilibrium vapor concentrations predicted using Henry's Law and site groundwater concentrations. Based on this comparison, the carbon tetrachloride concentration gradient in 1997 would drive carbon tetrachloride from the groundwater to the vadose zone.

5.3.3 2007 Evaluation of Interim Actions

Between 1996 and 2007, the carbon tetrachloride concentrations in the upper portion of the unconfined aquifer underlying the primary carbon tetrachloride source waste sites have been reduced (Figure 5-1). This reduction likely has resulted from the dual application of SVE remediation in the vadose zone and pump-and-treat remediation in the groundwater in the vicinity of the source waste sites.

One objective for the pump-and-treat interim remediation is the reduction of the carbon tetrachloride groundwater concentration below 2,000 µg/L. This goal for groundwater has been met at both the 216-Z-1A and 216-Z-9 sites. Concentrations in groundwater near the 216-Z-9 Trench have declined from approximately 8,000 µg/L in 1997 to concentrations of 550 to 1,300 µg/L in 2007 in extraction well pair 299-W15-32/299-W15-47 (*Fiscal Year 2007 Annual Summary Report for 200-UP-1 and 200-ZP-1 Pump-and-Treat Operations* [DOE/RL-2008-02]). Concentrations in groundwater monitoring well 299-W18-1 (west of the 216-Z-1A Tile Field) declined from approximately 1,700 µg/L in 1997 to 50 µg/L in 2005. (Well 299-W18-1 was not monitored in FY06 or FY07.) A new groundwater monitoring well, 299-W18-16, was installed east of the 216-Z-1A Tile Field in FY05. The average carbon tetrachloride concentration in groundwater from this well was 315 µg/L in 2007.

Maximum carbon tetrachloride vapor concentrations measured near the groundwater during FY07 rebound monitoring and the SVE restart at the 216-Z-9 Trench ranged from 8 to 16 ppmv. These measured concentrations, which were similar to the deep vapor concentrations measured in this area in the 1996-1997 rebound study (5 to 60 ppmv), are still an order of magnitude less than the equilibrium vapor concentration (85 to 205 ppmv) predicted using Henry's Law and the 216-Z-9 Trench groundwater concentration measured in FY07.

Maximum carbon tetrachloride vapor concentrations measured near the groundwater during FY07 at the 216-Z-1A Tile Field were 39 ppmv. These measured concentrations are similar to the deep vapor concentrations measured in this area during the 1996-1997 rebound study (10 to 50 ppmv). The FY07 vapor concentrations are slightly higher than the equilibrium vapor concentration (10 ppmv) predicted using Henry's Law and the 216-Z-1A Tile Field groundwater concentration measured at well 299-W18-1 in FY05. The relatively low carbon tetrachloride concentration in groundwater west of the 216-Z-1A Tile Field may be the result, at least in part, of ingress of cleaner, treated water injected upgradient of this site as part of the pump-and-treat operations for the 200-ZP-1 OU. The FY07 vapor concentrations are slightly lower than the equilibrium vapor concentration (50 ppmv) predicted using Henry's Law and the 216-Z-1A Tile Field groundwater concentration measured at well 299-W18-16 in FY07.

The reduction of carbon tetrachloride vapor concentrations in the area remediated using SVE has reduced the threat to groundwater based on the calculation using Henry's Law. However, as carbon tetrachloride concentrations in both groundwater and the vadose zone change, the direction of contaminant movement between these media may change based on the concentration gradients.

Depth-discrete groundwater sampling and analysis results (2005 through 2006) for dissolved carbon tetrachloride suggest that a significantly higher percent of the mass may be present throughout the unconfined aquifer (in dissolved and sorbed phases) than previously estimated. The current estimate is that approximately 100,000 kg (220,460 lb) of carbon tetrachloride may exist within the groundwater system. However, the lateral extent and maximum concentrations of the higher concentration carbon tetrachloride contamination in the top 10 m (33 ft) of the aquifer have been diminishing from 2000 to 2007, indicating that a significant continuing source in the deep vadose zone or top of the aquifer is not likely.

5.4 REDUCE MASS OF CARBON TETRACHLORIDE IN THE SOIL

Two distinct phases are commonly observed during in situ remediation projects. The first phase is generally characterized by higher rates of mass removal while the readily available volatile contaminant is being removed from the higher permeability zones. With continued extraction, concentrations decrease more slowly as the supply of volatile contaminant becomes limited by desorption and diffusion of the contaminant from micropores and/or lower permeability soil. In this second phase, diffusion controls contaminant migration. The history of mass recovery using SVE at the carbon tetrachloride source cribs reflects these two phases typical to SVE operations (Figure 2-11).

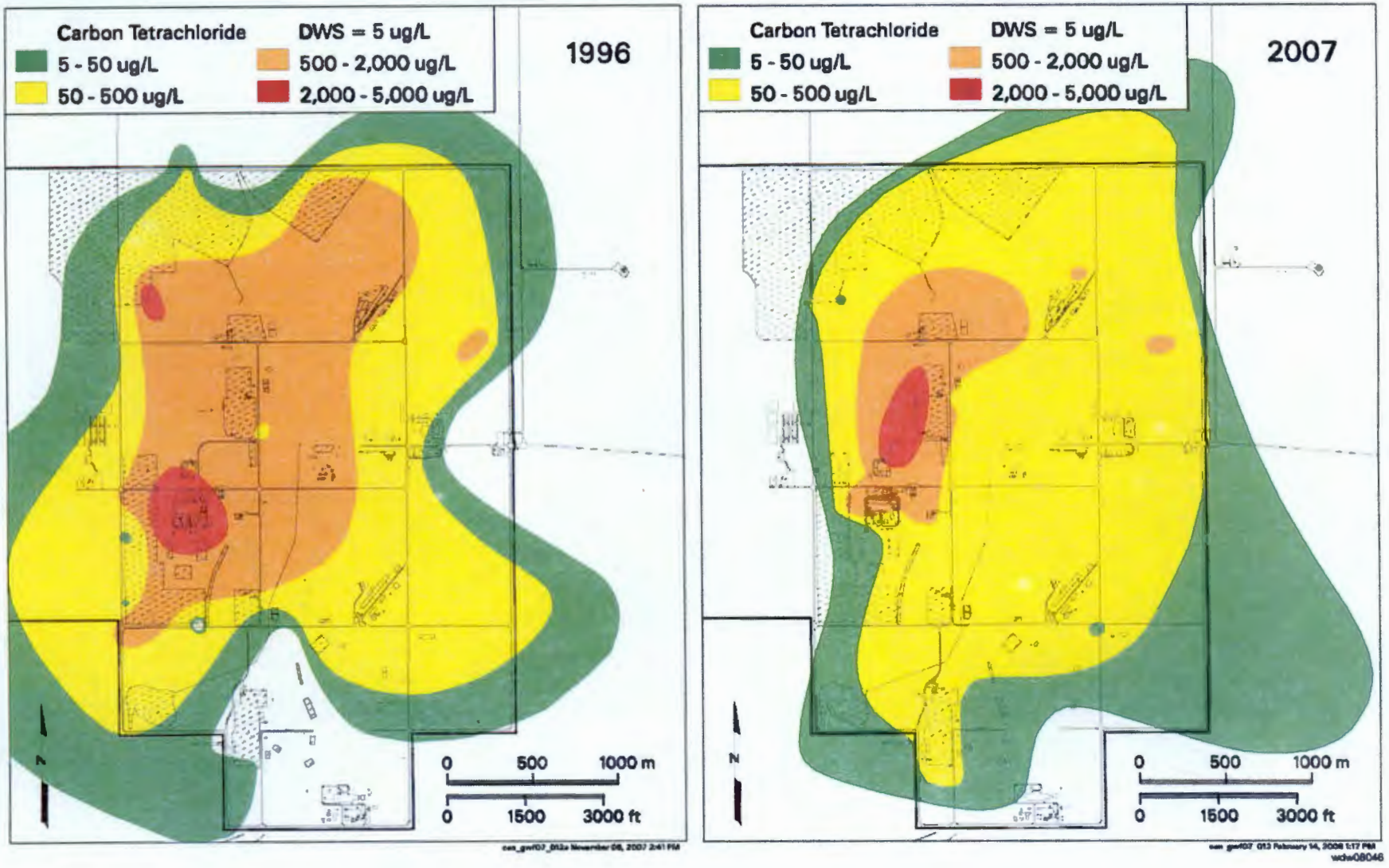
Although additional carbon tetrachloride can be recovered using SVE, the rate of removal has been decreasing. The decline in the rate of removal can be attributed primarily to the following:

- Diffusion-dominated extraction
- Reduction in SVE system capacity (i.e., from a total of 85 m^3/min to 14.2 m^3/min)
- Reduction in the yearly duration of extraction operations (i.e., from 12 months each year to 6 months each year)
- Potentially the continued use of the same airflow pathways established by using the same set of extraction wells.

When removal efficiency is considered, the mass removed per volume of vapor extracted likewise also decreases (Figure 2-13); however, only diffusion-dominated extraction is applicable to removal efficiency because the air volumes are normalized in the removal efficiency calculations. For this reason, the performance metric of kilograms of carbon tetrachloride removed per 1,000 cubic meters of vapor extracted is a good measure for the evaluation of the SVE operations. As shown in Figure 2-13, the value of this measure has been decreasing at both the 216-Z-9 and 216-Z-1A/Z-18/Z-12 carbon tetrachloride sites.

Because of the reduction of carbon tetrachloride mass in the soil, it is reasonable to conclude that the much higher percentage of extracted mass has been removed from the larger pore spaces and that the carbon tetrachloride that remains is in fine-grained layers. The characterization data support this conclusion.

Figure 5-1. Comparison of the Carbon Tetrachloride Plume Beneath the 200 West Area in the Upper Portion of the Unconfined Aquifer.[a]



[a] From *Hanford Site Groundwater Monitoring for Fiscal Year 2007* (DOE/RL-2008-01).

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6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Operation of the SVE systems between 1991 and 2007 has resulted in the removal of 79,164 kg (174,525 lb) of carbon tetrachloride from the vadose zone underlying the primary carbon tetrachloride disposal sites. Of this total mass of carbon tetrachloride removed, 280 kg (618 lb) were removed in F07.

The SVE system has been operated for approximately 6 months each year since 1998 (with the exception of the year 2000, when it was not operated). Operations during each of these years have continued to remove carbon tetrachloride from the vadose zone. Although removal rates have decreased in recent years, use of SVE still results in an annual average extraction of approximately 270 kg (595 lb) of carbon tetrachloride from the vadose zone per year (average extraction based on the FY05 through FY07 results in Table 2-2). With the readily accessible carbon tetrachloride removed, mass removal (in terms of mass removed per operation time) is more efficient with intermittent SVE operation, which allows the carbon tetrachloride vapor concentration in the higher flow zone to increase while the system is not operating.

The passive SVE systems have removed approximately 85 kg (187 lb) of carbon tetrachloride from the vadose zone between October 1999 and September 2007. Of this total mass of carbon tetrachloride removed using passive SVE systems, 5 kg (11 lb) were removed in FY07. Mass removal per year using the passive systems has remained fairly constant at 5 to 10 kg (11 to 22 lb).

Reduction in vapor concentrations and carbon tetrachloride mass during SVE operations has contributed to progress in achieving the ERA objectives of mitigating the threat to site workers, public health, and the environment caused by the migration of carbon tetrachloride vapors through the soil column and into the groundwater. Monitoring data indicate that carbon tetrachloride vapor concentrations have decreased significantly in the deep vadose zone overlying groundwater in the areas of the disposal sites. However, as carbon tetrachloride concentrations in both the deep vadose zone and the groundwater change, the direction of carbon tetrachloride movement between these media may change based on the concentration gradients. Monitoring data near the vadose zone/groundwater interface are relatively sparse.

6.2 RECOMMENDATIONS

The following recommendations are made to maximize the effectiveness of SVE operations and monitoring and to provide information to support a final Record of Decision:

- Continue operation of the active SVE system in a cyclic manner to remove carbon tetrachloride from the vadose zone. Cyclic operations (i.e., alternating operations between the 216-Z-9 and 216-Z-1A sites) are recommended because mass removal (in terms of mass removed per operation time) is more efficient with intermittent SVE operation. However, longer operating time will result in the removal of additional mass; therefore, consider operating the system for a longer duration each year to maximize the mass removal.

- Evaluate the overall condition and limitations of the existing SVE system. The SVE system currently being used is more than 10 years old. Because of the time and effort required to maintain the aging components of this system and the likelihood that SVE operations will continue, the purchase of selected new components or a new system is recommended.
- Continue operation of the passive SVE systems.
- Continue monthly monitoring.
- Evaluate the zone of influence for SVE operations using the three narrow-diameter wells on the south side of 216-Z-9, which were converted for use as vapor extraction wells and placed on-line in FY07. Understanding the extent of influence of vapor extraction through the small diameter wells will support planning for how closely these types of wells would need to be spaced to provide efficient extraction of the subsurface. This kind of information will help determine what type of SVE wells to install in the future
- Consider adding additional extraction points in the vicinities of the source cribs, including the area south of the 216-Z-9 waste site. For example, extraction rods that were installed in 1993 using a CPT could be tested for use with the SVE system. The use of additional extraction points will alter the subsurface airflow pathways. Carbon tetrachloride concentrations extracted using these new airflow pathways can be used to evaluate carbon tetrachloride remediation using SVE.

At the request of DOE Headquarters' Office of Environmental Management, the Office of Groundwater and Soil Remediation (EM-22) performed a remediation system evaluation of the SVE system at the 200-PW-1 OU in 2006 (*Hanford Operations Review Report: Feasibility Study Strategies and Remedial System Performance Improvement for the 200-ZP-1/PW-1 Operable Units at Hanford* [DOE 2007]). The remediation system evaluation team made five recommendations in Section 5.5 of their report that specifically address the use of SVE at the 200-PW-1 OU. The recommendations and responses are provided below:

1. Continue the current strategy of periodic operation of SVE.

Recommendation	**Response**
The Review Team concurs with periodic operation of the SVE system at the Z-9 Crib and Z-1A Tile Field locations. The rebound periods allow for cost-effective operation, as well as assessment of the progress in removing mass from the low-permeability zones. Based on the observed rebound concentrations, the remaining carbon tetrachloride mass is concentrated in fine-grained layers of the CCU. These units occur at depths of 35 to 45 m (115 to 148 ft), as well as units at about 20 m (66 ft) and 28 m (92 ft) below the surface, based on a plot of vertically discrete sampling results. Contaminant mass will continue to slowly diffuse out of these zones over time.	Accepted.

2. Focus SVE just above and below the CCU.

Recommendation	Response
The Review Team recommends that vapor extraction from the vadose zone be focused just above, and more importantly, below the CCU. Extraction wells with screened intervals just above or below the CCU are preferred, provided the wells are located horizontally in the contaminated area. The Project Team should consider the use of the Pneulog tool (Praxis Environmental Technologies, undated) to assess the intervals yielding air and contaminant mass to the various extraction wells. Focused air flow will minimize the effort, and cost for electricity and carbon needed to remove the available diffusing mass. Praxis Environmental Technologies can provide estimates of the mass located in diffusion-limited zones based on the rebound vapor concentrations following cessation and restart of the SVE. A description of the recommended approach, extracted from the USACE SVE and Bioventing Engineer Manual (USACE 2002), is attached as Appendix D.	Accepted in part. Soil vapor extraction has been, and will continue to be, operated on wells open above and below the CCU. Operations are also being focused on wells screened in the fine-grained layers described in comment #1 above. Use of horizontal wells, and other vapor extraction strategies, will be considered as part of the remedial design following selection of SVE as part of the Record of Decision for this operable unit.

3. Assess the contaminant loading to groundwater from vapor transport

Recommendation	Response
Based on the results of the Pneulog surveys and rebound analyses, an assessment of the impact to groundwater from carbon tetrachloride in the vadose zone should be made at each potential release area. The STOMP [Subsurface Transport Over Multiple Phases] model can be used to perform this assessment using a reasonable range of critical parameter values. The remaining carbon tetrachloride mass subject to vapor transport and subsequent dissolution in groundwater may not pose a significant threat over the time frame needed for remediation. If that is determined with reasonable certainty, based on model results for reasonable ranges of parameter values, then SVE operations can cease. The Project Team may conduct an economic analysis, as the Air Force has done at the former McClellan AFB, that considers the cost of continued SVE relative to the non-discounted, incremental cost of groundwater treatment to determine if continued SVE treatment is warranted	Accept. The Office of Groundwater and Soil Remediation (EM-22) has funded a Technical Working Group to evaluate the impact to groundwater from carbon tetrachloride in the vadose zone. Criteria for discontinuing the use of SVE will be considered as part of the remedial design following selection of SVE as part of the Record of Decision for this operable unit.

4. Reconsider use of in situ thermal treatment.

Recommendation	Response
Consideration of in situ thermal treatment for carbon tetrachloride removal within the CCU was discussed with the Review Team, with a potential cost in the tens of millions of dollars. The current cost of SVE is estimated to be less than $500,000/year. The Review Team recommends that the Project Team not pursue thermal treatment for carbon tetrachloride removal in the vadose zone at this time, until the recommendations provided herein are implemented and evaluated for efficacy. If the remaining carbon tetrachloride mass in the vadose zone does not pose a significant long-term threat to groundwater, then there is little benefit to an aggressive and expensive approach such as thermal treatment. If the remaining carbon tetrachloride mass in the vadose zone does pose a significant long-term threat to groundwater, then the relative protectiveness and cost of continued, or expanded SVE operations, should be compared to that for thermal treatment. The Review Team believes that continued SVE, and focusing SVE below the CCU, will cost effectively remove mass diffusing from the fine-grained materials. This mass would be prevented from migrating to the water table. SVE operations are far less expensive than the implementation of thermal treatment, with equal protectiveness to groundwater.	Accepted.

5. Discontinue use of the real-time analyzer for monitoring the GAC units.

Recommendation	Response
The Review Team recommends that the Project Team consider termination of the use of the autosampler and analysis system, if the system requires significant maintenance. Manual samples taken with simple instruments, such as a photo ionization detector, can be used and supplemented with TO-15 samples analyzed at a fixed laboratory.	Accepted in part. The Project Team considers that the automated analyzers are essential parts of the systems and that reverting to manual procedures would require additional manpower. Newer and less-expensive options for analyzers are currently being reviewed. The Project Team appreciates the Review Team's perspective that SVE operations need not necessarily be suspended if the automated analyzers are out of service for maintenance.

7.0 SOIL VAPOR EXTRACTION SYSTEM COST DATA

Actual project costs for the 200-PW-1 OU SVE system can be used to determine the labor costs associated with each specific activity over a given period of time. Table 7-1 provides the burdened costs, by activity, for the 200-PW-1 OU SVE system for FY07. Specific activities are described below:

- **Design:** Includes environmental and operations engineering support to design activities required to support SVE system upgrades, modifications, and other design documentation.
- **Operations and maintenance:** Represents facility supplies, labor, and craft supervision costs associated with operating and maintaining the equipment. It also includes costs associated with routine characterization of online wells and engineering support as required during the course of SVE system operations and periodic maintenance.
- **Performance monitoring:** Includes monthly soil vapor sampling, analysis, and reporting, as required by the annual SVE system operating plan. It also includes preparation of this annual performance evaluation report.
- **Project support:** Includes project management, planning, and other administrative support required during the course of SVE operations during FY07.
- **Waste management:** Represents the estimated cost for the management of GAC at the 200-PW-1 OU in accordance with applicable laws for suspect hazardous, toxic, and regulated wastes. It includes waste designation sampling and analysis.
- **Treatment system capital:** Includes activities to complete well 299-W18-253 (C4965) in the 216-Z-1A Tile Field as an SVE well.

These project costs for operation of the 200-PW-1 OU SVE system in FY07 are displayed by percent of total costs in the pie chart in Figure 7-1. Based on the FY07 costs and yearly production rates of 2.2 billion L (2.2 million m^3) of vapor treated and 280 kg (617 lb) of carbon tetrachloride removed (Table 2-2), the FY07 treatment costs equate to \$0.00043/L (\$0.43/m^3) of vapor treated and \$3.36/g (\$3,356/kg) of carbon tetrachloride removed (Figure 7-2).

Figure 7-1. Cost Breakdown for 200-PW-1 Operable Unit Soil Vapor Extraction Operations in Fiscal Year 2007.

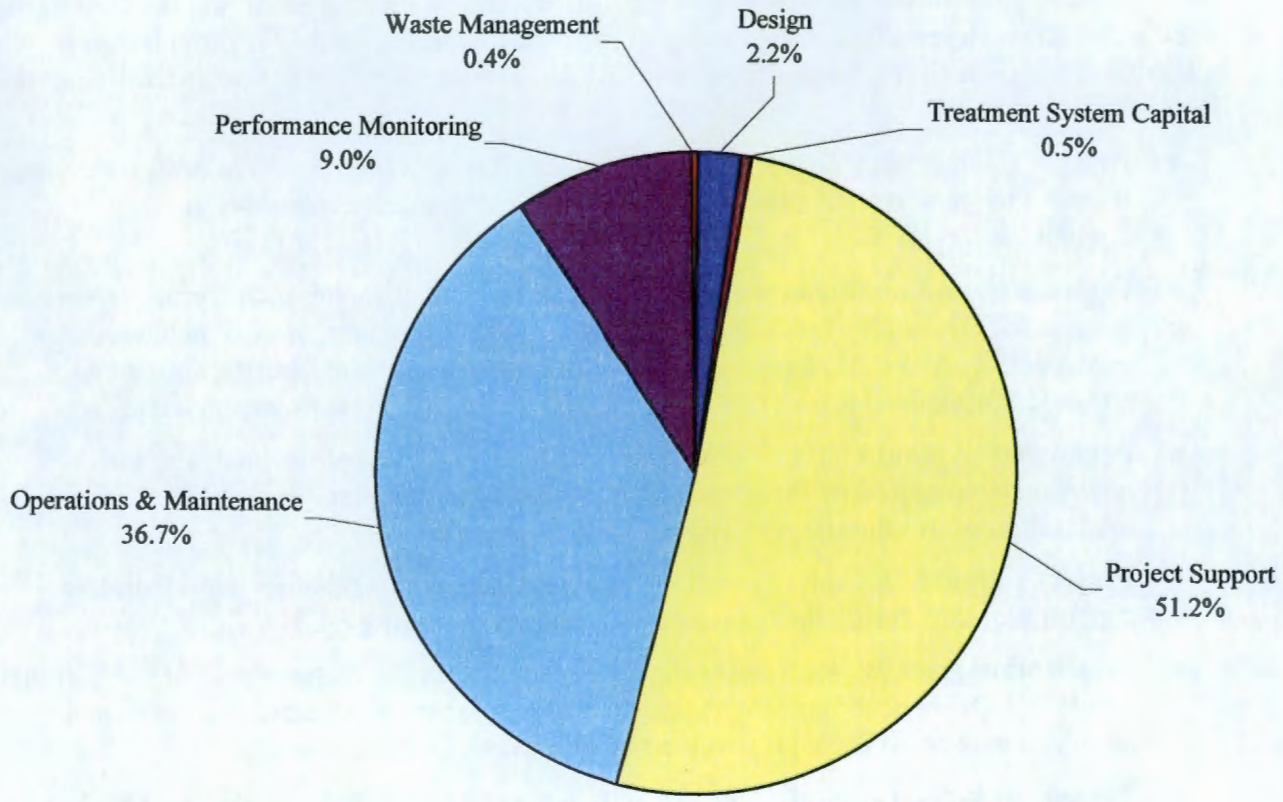

Figure 7-2. Cost for Soil Vapor Extraction Removal of Carbon Tetrachloride in Fiscal Year 2007.

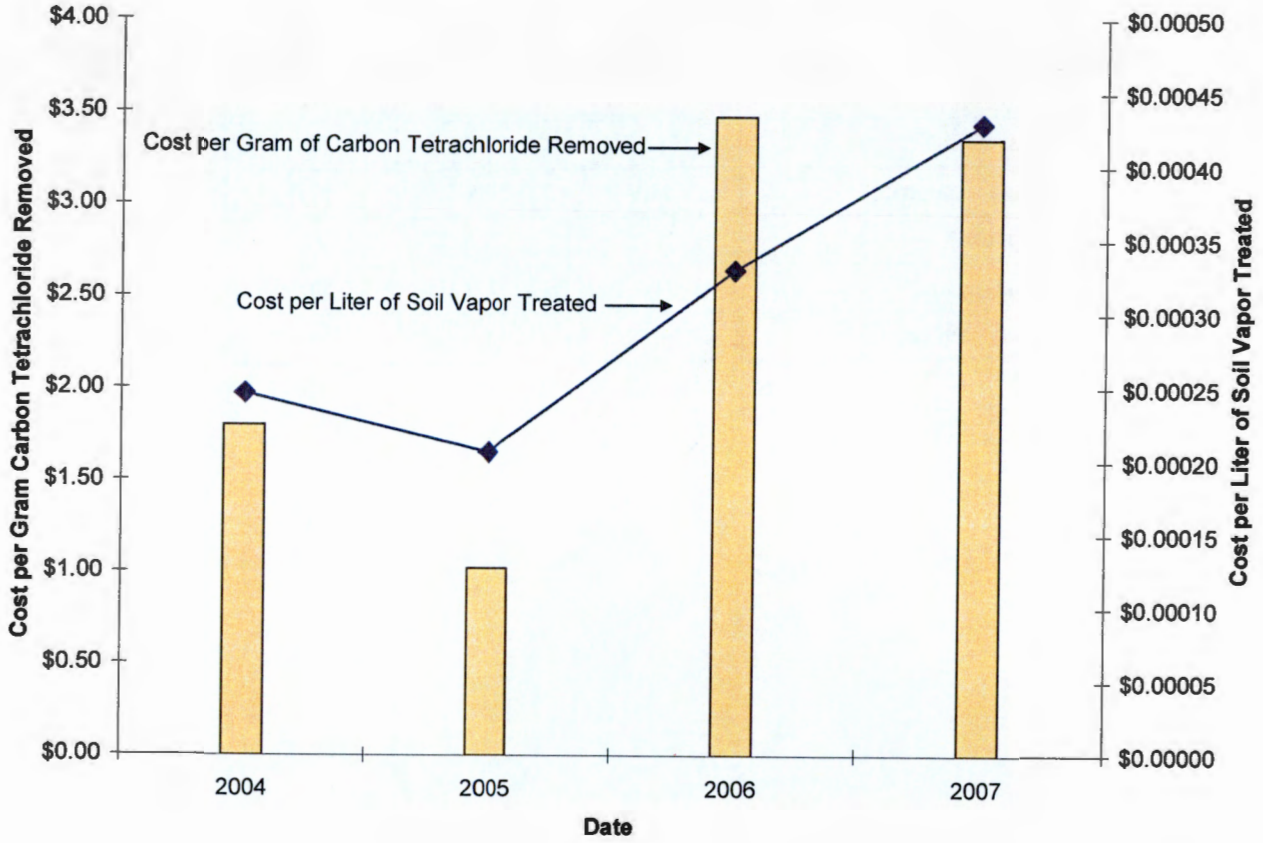

Table 7-1. Costs for Operation of 200-PW-1 Operable Unit Soil Vapor Extraction System.

Activity	Actual Costs ($1,000)			
	FY04	FY05	FY06	FY07
Design	78.9	50.9	41.7	20.7
Operations and maintenance	188.2	183.8	280.7	345.2
Performance monitoring	44.9	55.6	47.0	85.0
Project support	121.5	72.1	221.8	480.7
Waste management	27.2	7.9	10.5	3.7
Treatment system capital	--	--	--	4.3
Totals	**460.7**	**370.4**	**601.6**	**939.6**

FY = fiscal year

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APPENDIX A

FISCAL YEAR 2007 DAILY SOIL VAPOR EXTRACTION DATA

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Table A-1. Daily Soil Vapor Extraction Data. (9 sheets)

Date	Carbon Tetrachloride (ppmv)	Daily Operating Hours (hrs)	Daily Operating Hours Available (hrs)	Year-to-Date Operating Hours (hrs)	Daily Flow Rate (L/min)	Daily Volume Treated (million L)	Year-to-Date Volume Treated (million L)	Daily Mass Extracted (kg)	Year-to-Date Mass Extracted[a] (kg)
03/29/07	94.3	0.5	0.5	0.5	7,551	0.2	0.2	0.1	0.1
03/30/07		0.0	24.0	0.5	0	0.0	0.2	0.0	0.1
03/31/07		0.0	24.0	0.5	0	0.0	0.2	0.0	0.1
04/01/07		0.0	24.0	0.5	0	0.0	0.2	0.0	0.1
04/02/07	33.4	14.5	24.0	15.0	5,268	4.6	4.8	1.0	1.1
04/03/07	36.4	24.0	24.0	39.0	5,147	7.4	12.2	1.7	2.8
04/04/07	34.9	24.0	24.0	63.0	5,074	7.3	19.5	1.6	4.4
04/05/07	34.5	24.0	24.0	87.0	5,026	7.2	26.8	1.6	6.0
04/06/07	34.6	24.0	24.0	111.0	4,966	7.2	33.9	1.6	7.5
04/07/07	34.7	24.0	24.0	135.0	4,928	7.1	41.0	1.6	9.1
04/08/07	35.4	24.0	24.0	159.0	4,852	7.0	48.0	1.6	10.6
04/09/07	36.0	24.0	24.0	183.0	4,836	7.0	55.0	1.6	12.2
04/10/07	36.1	24.0	24.0	207.0	4,834	7.0	61.9	1.6	13.8
04/11/07	32.7	24.0	24.0	231.0	5,013	7.2	69.1	1.5	15.3
04/12/07	31.8	24.0	24.0	255.0	4,979	7.2	76.3	1.4	16.7
04/13/07	31.3	24.0	24.0	279.0	4,978	7.2	83.5	1.4	18.1
04/14/07	30.7	24.0	24.0	303.0	5,024	7.2	90.7	1.4	19.5
04/15/07	30.5	24.0	24.0	327.0	4,992	7.2	97.9	1.4	20.9
04/16/07	29.3	24.0	24.0	351.0	5,042	7.3	105.2	1.3	22.2
04/17/07	28.9	24.0	24.0	375.0	4,975	7.2	112.3	1.3	23.5
04/18/07	28.7	24.0	24.0	399.0	5,024	7.2	119.6	1.3	24.9
04/19/07	26.2	24.0	24.0	423.0	5,053	7.3	126.8	1.2	26.1

Table A-1. Daily Soil Vapor Extraction Data. (9 sheets)

Date	Carbon Tetrachloride (ppmv)	Daily Operating Hours (hrs)	Daily Operating Hours Available (hrs)	Year-to-Date Operating Hours (hrs)	Daily Flow Rate (L/min)	Daily Volume Treated (million L)	Year-to-Date Volume Treated (million L)	Daily Mass Extracted (kg)	Year-to-Date Mass Extracted[a] (kg)
04/20/07	28.3	24.0	24.0	447.0	5,010	7.2	134.1	1.3	27.3
04/21/07	28.0	24.0	24.0	471.0	5,008	7.2	141.3	1.3	28.6
04/22/07	28.0	24.0	24.0	495.0	4,952	7.1	148.4	1.3	29.9
04/23/07	26.9	24.0	24.0	519.0	4,921	7.1	155.5	1.2	31.1
04/24/07	27.2	24.0	24.0	543.0	4,977	7.2	162.7	1.2	32.3
04/25/07	26.1	22.5	24.0	565.5	4,944	6.7	169.3	1.1	33.4
04/26/07	26.3	22.0	24.0	587.5	5,947	7.8	177.2	1.3	34.7
04/27/07	27.6	24.0	24.0	611.5	6,692	9.6	186.8	1.7	36.4
04/28/07	27.5	24.0	24.0	635.5	6,662	9.6	196.4	1.7	38.0
04/29/07	27.3	24.0	24.0	659.5	6,694	9.6	206.0	1.7	39.7
04/30/07	27.0	24.0	24.0	683.5	6,644	9.6	215.6	1.6	41.3
05/01/07	26.4	23.8	24.0	707.3	6,640	9.5	225.1	1.6	42.9
05/02/07	25.2	24.0	24.0	731.3	6,739	9.7	234.8	1.5	44.4
05/03/07	25.3	24.0	24.0	755.3	6,764	9.7	244.5	1.6	46.0
05/04/07	25.0	24.0	24.0	779.3	6,768	9.7	254.3	1.5	47.5
05/05/07	24.5	24.0	24.0	803.3	6,705	9.7	263.9	1.5	49.0
05/06/07	24.0	24.0	24.0	827.3	6,665	9.6	273.5	1.4	50.4
05/07/07	23.8	23.8	24.0	851.0	6,595	9.4	282.9	1.4	51.8
05/08/07	23.8	24.0	24.0	875.0	6,488	9.3	292.3	1.4	53.2
05/09/07	25.9	24.0	24.0	899.0	8,078	11.6	303.9	1.9	55.1
05/10/07	27.4	24.0	24.0	923.0	9,078	13.1	317.0	2.3	57.4
05/11/07	27.6	24.0	24.0	947.0	9,103	13.1	330.1	2.3	59.7

Table A-1. Daily Soil Vapor Extraction Data. (9 sheets)

Date	Carbon Tetrachloride (ppmv)	Daily Operating Hours (hrs)	Daily Operating Hours Available (hrs)	Year-to-Date Operating Hours (hrs)	Daily Flow Rate (L/min)	Daily Volume Treated (million L)	Year-to-Date Volume Treated (million L)	Daily Mass Extracted (kg)	Year-to-Date Mass Extracted[a] (kg)
05/12/07	27.6	24.0	24.0	971.0	9,123	13.1	343.2	2.3	61.9
05/13/07	28.1	24.0	24.0	995.0	9,234	13.3	356.5	2.3	64.3
05/14/07	28.5	24.0	24.0	1,019.0	9,221	13.3	369.8	2.4	66.7
05/15/07	28.0	24.0	24.0	1,043.0	9,122	13.1	382.9	2.3	69.0
05/16/07	27.5	24.0	24.0	1,067.0	9,130	13.1	396.1	2.3	71.3
05/17/07	25.1	23.3	24.0	1,090.3	8,669	12.1	408.2	1.9	73.2
05/18/07	27.5	24.0	24.0	1,114.3	8,543	12.3	420.5	2.1	75.3
05/19/07	27.0	24.0	24.0	1,138.3	8,700	12.5	433.0	2.1	77.4
05/20/07	26.8	24.0	24.0	1,162.3	8,804	12.7	445.7	2.1	79.6
05/21/07	26.3	24.0	24.0	1,186.3	8,785	12.7	458.3	2.1	81.7
05/22/07	26.3	24.0	24.0	1,210.3	8,686	12.5	470.8	2.1	83.7
05/23/07	24.7	24.0	24.0	1,234.3	8,670	12.5	483.3	1.9	85.7
05/24/07	23.9	24.0	24.0	1,258.3	8,569	12.3	495.6	1.9	87.5
05/25/07	23.7	24.0	24.0	1,282.3	8,663	12.5	508.1	1.9	89.4
05/26/07	24.0	24.0	24.0	1,306.3	8,590	12.4	520.5	1.9	91.3
05/27/07	23.7	24.0	24.0	1,330.3	8,675	12.5	533.0	1.9	93.1
05/28/07	23.7	24.0	24.0	1,354.3	8,686	12.5	545.5	1.9	95.0
05/29/07	23.9	24.0	24.0	1,378.3	8,670	12.5	558.0	1.9	96.9
05/30/07	23.8	24.0	24.0	1,402.3	9,130	13.1	571.1	2.0	98.8
05/31/07	25.0	24.0	24.0	1,426.3	9,294	13.4	584.5	2.1	100.9
06/01/07	25.0	24.0	24.0	1,450.3	9,246	13.3	597.8	2.1	103.0
06/02/07	24.7	24.0	24.0	1,474.3	9,178	13.2	611.0	2.1	105.1

Table A-1. Daily Soil Vapor Extraction Data. (9 sheets)

Date	Carbon Tetrachloride (ppmv)	Daily Operating Hours (hrs)	Daily Operating Hours Available (hrs)	Year-to-Date Operating Hours (hrs)	Daily Flow Rate (L/min)	Daily Volume Treated (million L)	Year-to-Date Volume Treated (million L)	Daily Mass Extracted (kg)	Year-to-Date Mass Extracted[a] (kg)
06/03/07	24.5	24.0	24.0	1,4,8.3	9,155	13.2	624.2	2.0	107.1
06/04/07	24.0	22.3	24.0	1,520.5	9,265	12.4	636.6	1.9	109.0
06/05/07	23.3	8.8	24.0	1,529.3	9,692	5.1	641.7	0.7	109.7
06/06/07	23.3	24.0	24.0	1,553.3	9,621	13.9	655.5	2.0	111.8
06/07/07	23.5	24.0	24.0	1,577.3	9,533	13.7	669.3	2.0	113.8
06/08/07	23.3	24.0	24.0	1,601.3	9,475	13.6	682.9	2.0	115.8
06/09/07	22.9	22.8	24.0	1,624.0	9,572	13.1	696.0	1.9	117.7
06/10/07		0.0	24.0	1,624.0	0	0.0	696.0	0.0	117.7
06/11/07	27.0	0.8	24.0	1,624.8	10,175	0.5	696.4	0.1	117.8
06/12/07	24.6	16.3	24.0	1,641.0	9,499	9.3	705.7	1.4	119.2
06/13/07	22.9	24.0	24.0	1,665.0	9,598	13.8	719.5	2.0	121.2
06/14/07	22.2	23.8	24.0	1,688.8	9,603	13.7	733.2	1.9	123.1
06/15/07	22.0	24.0	24.0	1,712.8	9,648	13.9	747.1	1.9	125.0
06/16/07	22.0	24.0	24.0	1,736.8	9,706	14.0	761.1	1.9	126.9
06/17/07	22.0	24.0	24.0	1,760.8	9,719	14.0	775.1	1.9	128.9
06/18/07	23.5	24.0	24.0	1,784.8	10,530	15.2	790.2	2.2	131.1
06/19/07	33.4	17.0	24.0	1,801.8	10,868	11.1	801.3	2.3	133.4
06/20/07	29.3	17.3	24.0	1,819.0	10,617	11.0	812.3	2.0	135.5
06/21/07	27.5	19.0	24.0	1,838.0	10,709	12.2	824.5	2.1	137.6
06/22/07	27.3	15.0	24.0	1,853.0	10,851	9.8	834.3	1.7	139.3
06/23/07	25.7	24.0	24.0	1,877.0	10,964	15.8	850.1	2.6	141.8
06/24/07	25.0	13.8	24.0	1,890.8	10,994	9.1	859.1	1.4	143.2

Table A-1. Daily Soil Vapor Extraction Data. (9 sheets)

Date	Carbon Tetrachloride (ppmv)	Daily Operating Hours (hrs)	Daily Operating Hours Available (hrs)	Year-to-Date Operating Hours (hrs)	Daily Flow Rate (L/min)	Daily Volume Treated (million L)	Year-to-Date Volume Treated (million L)	Daily Mass Extracted (kg)	Year-to-Date Mass Extracted[a] (kg)
06/25/07	25.1	16.8	24.0	1,907.5	10,949	11.0	870.1	1.7	145.0
06/26/07	25.1	19.0	24.0	1,926.5	10,837	12.4	882.5	1.9	146.9
06/27/07	23.3	23.3	24.0	1,949.8	10,803	15.1	897.6	2.2	149.1
06/28/07	22.8	24.0	24.0	1,973.8	10,718	15.4	913.0	2.2	151.4
06/29/07	22.0	24.0	24.0	1,997.8	10,907	15.7	928.7	2.2	153.5
06/30/07	22.0	23.5	24.0	2,021.3	10,863	15.3	944.0	2.1	155.6
07/01/07		0.0	24.0	2,021.3	0	0.0	944.0	0.0	155.6
07/02/07	21.8	18.0	24.0	2,039.3	10,704	11.6	955.6	1.6	157.2
07/03/07	21.2	24.0	24.0	2,063.3	10,683	15.4	971.0	2.1	159.3
07/04/07	21.0	24.0	24.0	2,087.3	10,596	15.3	986.2	2.0	161.3
07/05/07	20.8	24.0	24.0	2,111.3	10,503	15.1	1001.3	2.0	163.3
07/06/07	20.1	24.0	24.0	2,135.3	10,367	14.9	1016.3	1.9	165.2
07/07/07	20.0	24.0	24.0	2,159.3	10,421	15.0	1031.3	1.9	167.1
07/08/07	20.0	24.0	24.0	2,183.3	10,500	15.1	1046.4	1.9	169.0
07/09/07	20.0	24.0	24.0	2,207.3	10,477	15.1	1061.5	1.9	170.9
07/10/07	19.9	24.0	24.0	2,231.3	10,423	15.0	1076.5	1.9	172.7
07/11/07	19.4	24.0	24.0	2,255.3	10,306	14.8	1091.3	1.8	174.6
07/12/07	19.0	24.0	24.0	2,279.3	10,314	14.9	1106.2	1.8	176.3
07/13/07	19.0	24.0	24.0	2,303.3	10,345	14.9	1121.1	1.8	178.1
07/14/07	19.0	24.0	24.0	2,327.3	10,356	14.9	1136.0	1.8	179.9
07/15/07	19.0	24.0	24.0	2,351.3	10,399	15.0	1151.0	1.8	181.7
07/16/07	18.7	24.0	24.0	2,375.3	10,427	15.0	1166.0	1.8	183.4

Table A-1. Daily Soil Vapor Extraction Data. (9 sheets)

Date	Carbon Tetrachloride (ppmv)	Daily Operating Hours (hrs)	Daily Operating Hours Available (hrs)	Year-to-Date Operating Hours (hrs)	Daily Flow Rate (L/min)	Daily Volume Treated (million L)	Year-to-Date Volume Treated (million L)	Daily Mass Extracted (kg)	Year-to-Date Mass Extracted[a] (kg)
07/17/07	18.1	24.0	24.0	2,399.3	10,459	15.1	1181.0	1.7	185.2
07/18/07	18.0	24.0	24.0	2,423.3	10,544	15.2	1196.2	1.7	186.9
07/19/07	18.1	23.5	24.0	2,446.8	10,565	14.9	1211.1	1.7	188.6
07/20/07	18.0	24.0	24.0	2,470.8	10,959	15.8	1226.9	1.8	190.4
07/21/07	18.0	24.0	24.0	2,494.8	10,893	15.7	1242.6	1.8	192.1
07/22/07	18.0	24.0	24.0	2,518.8	10,799	15.6	1258.1	1.8	193.9
07/23/07	18.0	23.5	24.0	2,542.3	10,792	15.2	1273.4	1.7	195.6
07/24/07	17.9	24.0	24.0	2,566.3	10,764	15.5	1288.9	1.7	197.4
07/25/07	17.0	24.0	24.0	2,590.3	10,710	15.4	1304.3	1.6	199.0
07/26/07	17.0	24.0	24.0	2,614.3	10,634	15.3	1319.6	1.6	200.7
07/27/07	17.0	24.0	24.0	2,638.3	10,587	15.2	1334.8	1.6	202.3
07/28/07	17.0	24.0	24.0	2,662.3	10,571	15.2	1350.1	1.6	203.9
07/29/07	17.0	24.0	24.0	2,686.3	10,662	15.4	1365.4	1.6	205.6
07/30/07	17.0	24.0	24.0	2,710.3	10,697	15.4	1380.8	1.6	207.2
07/31/07	17.0	24.0	24.0	2,734.3	10,716	15.4	1396.3	1.7	208.9
08/01/07	16.3	24.0	24.0	2,758.3	10,639	15.3	1411.6	1.6	210.4
08/02/07	17.0	24.0	24.0	2,782.3	10,569	15.2	1426.8	1.6	212.1
08/03/07	16.8	24.0	24.0	2,806.3	10,614	15.3	1442.1	1.6	213.7
08/04/07	16.3	24.0	24.0	2,830.3	10,679	15.4	1457.5	1.6	215.2
08/05/07	16.0	24.0	24.0	2,854.3	10,659	15.3	1472.8	1.5	216.8
08/06/07	16.0	24.0	24.0	2,878.3	10,626	15.3	1488.1	1.5	218.3
08/07/07	16.0	7.0	24.0	2,885.3	10,711	4.5	1492.6	0.5	218.8

Table A-1. Daily Soil Vapor Extraction Data. (9 sheets)

Date	Carbon Tetrachloride (ppmv)	Daily Operating Hours (hrs)	Daily Operating Hours Available (hrs)	Year-to-Date Operating Hours (hrs)	Daily Flow Rate (L/min)	Daily Volume Treated (million L)	Year-to-Date Volume Treated (million L)	Daily Mass Extracted (kg)	Year-to-Date Mass Extracted[a] (kg)
08/08/07		0.0	24.0	2,885.3	8,099	0.0	1492.6	0.0	218.8
08/09/07		0.0	24.0	2,885.3	0	0.0	1492.6	0.0	218.8
08/10/07		0.0	24.0	2,885.3	0	0.0	1492.6	0.0	218.8
08/11/07		0.0	24.0	2,885.3	0	0.0	1492.6	0.0	218.8
08/12/07		0.0	24.0	2,885.3	0	0.0	1492.6	0.0	218.8
08/13/07		0.0	24.0	2,885.3	0	0.0	1492.6	0.0	218.8
08/14/07		0.0	24.0	2,885.3	0	0.0	1492.6	0.0	218.8
08/15/07	0.0	14.5	24.0	2,899.8	10,080	8.8	1501.4	0.0	218.8
08/16/07	0.0	24.0	24.0	2,923.8	10,296	14.8	1516.2	0.0	218.8
08/17/07	0.0	24.0	24.0	2,947.8	10,490	15.1	1531.3	0.0	218.8
08/18/07	0.0	24.0	24.0	2,971.8	10,502	15.1	1546.4	0.0	218.8
08/19/07	0.0	24.0	24.0	2,995.8	10,594	15.3	1561.7	0.0	218.8
08/20/07	0.0	24.0	24.0	3,019.8	10,638	15.3	1577.0	0.0	218.8
08/21/07	0.0	24.0	24.0	3,043.8	10,581	15.2	1592.2	0.0	218.8
08/22/07	0.0	24.0	24.0	3,067.8	10,512	15.1	1607.4	0.0	218.8
08/23/07	8.1	24.0	24.0	3,091.8	10,508	15.1	1622.5	0.8	219.6
08/24/07	16.0	24.0	24.0	3,115.8	10,505	15.1	1637.6	1.5	221.1
08/25/07	16.2	24.0	24.0	3,139.8	10,490	15.1	1652.7	1.5	222.6
08/26/07	16.7	24.0	24.0	3,163.8	10,618	15.3	1668.0	1.6	224.2
08/27/07	16.0	24.0	24.0	3,187.8	10,645	15.3	1683.4	1.5	225.8
08/28/07	15.8	24.0	24.0	3,211.8	10,619	15.3	1698.6	1.5	227.3
08/29/07	15.5	24.0	24.0	3,235.8	10,358	14.9	1713.6	1.5	228.7

Table A-1. Daily Soil Vapor Extraction Data. (9 sheets)

Date	Carbon Tetrachloride (ppmv)	Daily Operating Hours (hrs)	Daily Operating Hours Available (hrs)	Year-to-Date Operating Hours (hrs)	Daily Flow Rate (L/min)	Daily Volume Treated (million L)	Year-to-Date Volume Treated (million L)	Daily Mass Extracted (kg)	Year-to-Date Mass Extracted[a] (kg)
08/30/07	16.0	24.0	24.0	3,259.8	10,419	15.0	1728.6	1.5	230.2
08/31/07	16.2	24.0	24.0	3,283.8	10,416	15.0	1743.6	1.5	231.8
09/01/07	16.6	24.0	24.0	3,307.8	10,501	15.1	1758.7	1.6	233.4
09/02/07	16.0	24.0	24.0	3,331.8	10,445	15.0	1773.7	1.5	234.9
09/03/07	16.5	24.0	24.0	3,355.8	10,424	15.0	1788.7	1.6	236.4
09/04/07	16.7	24.0	24.0	3,379.8	10,494	15.1	1803.9	1.6	238.0
09/05/07	16.5	24.0	24.0	3,403.8	10,377	14.9	1818.8	1.6	239.6
09/06/07	16.7	24.0	24.0	3,427.8	10,498	15.1	1833.9	1.6	241.2
09/07/07	16.4	24.0	24.0	3,451.8	10,891	15.7	1849.6	1.6	242.8
09/08/07	16.7	24.0	24.0	3,475.8	11,020	15.9	1865.5	1.7	244.4
09/09/07	16.1	24.0	24.0	3,499.8	10,997	15.8	1881.3	1.6	246.0
09/10/07	16.0	24.0	24.0	3,523.8	11,008	15.9	1897.1	1.6	247.6
09/11/07	15.8	24.0	24.0	3,547.8	10,722	15.4	1912.6	1.5	249.2
09/12/07	17.0	24.0	24.0	3,571.8	10,658	15.3	1927.9	1.6	250.8
09/13/07	17.6	24.0	24.0	3,595.8	10,881	15.7	1943.6	1.7	252.6
09/14/07	17.0	24.0	24.0	3,619.8	10,851	15.6	1959.2	1.7	254.2
09/15/07	17.2	24.0	24.0	3,643.8	10,915	15.7	1974.9	1.7	255.9
09/16/07	17.0	24.0	24.0	3,667.8	11,012	15.9	1990.8	1.7	257.6
09/17/07	17.4	24.0	24.0	3,691.8	11,031	15.9	2006.7	1.7	259.4
09/18/07	17.0	24.0	24.0	3,715.8	11,127	16.0	2022.7	1.7	261.1
09/19/07	15.8	24.0	24.0	3,739.8	11,093	16.0	2038.7	1.6	262.7
09/20/07	17.5	24.0	24.0	3,763.8	11,332	16.3	2055.0	1.8	264.5

Table A-1. Daily Soil Vapor Extraction Data. (9 sheets)

Date	Carbon Tetrachloride (ppmv)	Daily Operating Hours (hrs)	Daily Operating Hours Available (hrs)	Year-to-Date Operating Hours (hrs)	Daily Flow Rate (L/min)	Daily Volume Treated (million L)	Year-to-Date Volume Treated (million L)	Daily Mass Extracted (kg)	Year-to-Date Mass Extracted[a] (kg)
09/21/07	17.4	24.0	24.0	3,787.8	11,235	16.2	2071.2	1.8	266.2
09/22/07	16.7	24.0	24.0	3,811.8	11,302	16.3	2087.5	1.7	267.9
09/23/07	17.9	24.0	24.0	3,835.8	11,277	16.2	2103.7	1.8	269.8
09/24/07	17.7	24.0	24.0	3,859.8	11,420	16.4	2120.1	1.8	271.6
09/25/07	16.0	24.0	24.0	3,883.8	11,143	16.0	2136.2	1.6	273.2
09/26/07	15.0	24.0	24.0	3,907.8	10,845	15.6	2151.8	1.5	274.7
09/27/07	15.0	24.0	24.0	3,931.8	11,219	16.2	2168.0	1.5	276.2
09/28/07	16.7	24.0	24.0	3,955.8	11,750	16.9	2184.9	1.8	278.0
09/29/07	16.8	24.0	24.0	3,979.8	11,691	16.8	2201.7	1.8	279.8
09/30/07	15.5	24.0	24.0	4,003.8	11,786	17.0	2218.7	1.7	281.4
10/01/07	16.0	11.0	24.0	4,014.8	11,686	7.7	2226.4	0.8	282.2

[a] The record quantity of mass extracted is provided by project engineering and is the mass reported in this document. The data maintained by the project scientist, including the data provided in this table, are used in this document to illustrate operating trends. It has previously been documented that the project engineering and project scientist total mass removed calculations differ by less than 0.5% (Calculation No. 0200W-CA-V0019, *Mass of Carbon Tetrachloride Removed by Soil Vapor Extraction Systems*, dated June 13, 2002).

ppmv = parts per million by volume

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APPENDIX B

FISCAL YEAR 2007 SOIL VAPOR EXTRACTION WELL CHARACTERIZATION DATA

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Table B-1. 216-Z-9 Soil Vapor Extraction Well Characterization Data, Fiscal Year 2007. (11 sheets)

Z-9 Well/Interval	Date	Well Vacuum (kPa)	Flow (m^3/min)	CCl_4 (ppmv)	CCl_4 Flux (kg/day)	$CHCl_3$ (ppmv)	CH_2Cl_2 (ppmv)	MEK (ppmv)	Comment
C4937	06/18/07 09:03	On-line							
C4937	06/18/07 09:14	9.7	--	2.9	0.0	3.3	2.1	5.2	V&B flow measurements on 06/18/07 at 09:05 (averaged) 2.9 ft^3/min.
C4937	06/18/07 11:00	10.0	--	26.8	0.0	2.3	2.4	1.4	
C4937	06/18/07 13:24	7.2	0.3	333.0	0.8	3.2	0.6	2.1	V&B flow measurements on 06/18/07 at 13:20 (averaged) 1.9 ft^3/min.
C4937	06/18/07 15:08	7.2	0.3	500.0	1.2	4.8	0.8	1.8	
C4937	06/19/07 07:10	7.5	0.2	782.0	1.6	12.7	0.2	3.7	
C4937	06/19/07 09:03	7.5	0.2	773.0	1.6	11.3	2.8	3.2	
C4937	06/19/07 11:03	6.7	0.3	614.0	1.4	9.6	1.0	2.8	
C4937	06/19/07 13:04	7.0	0.3	509.0	1.2	9.1	0.6	2.7	
C4937	06/19/07 15:02	6.5	0.3	506.0	1.2	7.8	0.9	2.5	
C4937	06/20/07	6.5	0.3	647.0	1.5	9.1	1.2	3.0	V&B flow measurements on 06/20/07 at 08:35 (averaged) 14.3 ft^3/min.
C4937	06/28/07	7.0	0.3	189.0	0.4	7.1	3.8	1.3	V&B flow measurements on 06/25/07 at 13:18 (averaged) 12.3 ft^3/min.
C4937	07/03/07	7.7	0.3	328.0	0.8	3.8	1.9	2.8	V&B flow measurements on 07/2/07 at 08:20 (averaged) 8.6 ft^3/min.
C4937	07/11/07	7.5	0.3	322.0	0.7	2.5	1.8	3.2	V&B flow measurements on 07/10/07 at 10:22 (averaged) 17.6 ft^3/min.
C4937	07/18/07	7.2	0.3	257.0	0.6	1.1	2.5	3.1	V&B flow measurements on 07/17/07 at 13:27 (averaged) 16.4 ft^3/min.
C4937	07/25/07	7.7	0.3	250.0	0.6	1.2	1.3	2.7	V&B flow measurements on 07/23/07 at 10:07 (averaged) 16.0 ft^3/min.

Table B-1. 216-Z-9 Soil Vapor Extraction Well Characterization Data, Fiscal Year 2007. (11 sheets)

Z-9 Well/Interval	Date	Well Vacuum (kPa)	Flow (m^3/min)	CCl_4 (ppmv)	CCl_4 Flux (kg/day)	$CHCl_3$ (ppmv)	CH_2Cl_2 (ppmv)	MEK (ppmv)	Comment
C4937	08/01/07	7.5	0.3	82.7	0.2	0.0	1.7	1.4	V&B flow measurements on 07/30/07 (averaged) 12.8 ft^3/min.
C4937	08/06/07		--						V&B flow measurements on 08/06/07 (averaged) 15.4 ft^3/min.
C4938	06/18/07 09:03	On-line							
C4938	06/18/07 09:12	10.0	--	12.7	0.0	3.6	4.2	1.4	V&B flow measurements on 06/18/07 at 09:10 (averaged) 3.8 ft^3/min.
C4938	06/18/07 11:03	9.7	--	56.3	0.0	3.7	4.7	0.7	
C4938	06/18/07 13:27	7.2	0.3	206.0	0.5	1.5	3.5	1.7	V&B flow measurements on 06/18/07 at 13:25 (averaged) 7.8 ft^3/min.
C4938	06/18/07 15:11	7.0	0.3	186.0	0.4	0.9	2.7	1.5	
C4938	06/19/07 07:12	7.5	0.2	19.1	0.0	3.5	3.1	0.4	
C4938	06/19/07 09:06	7.5	0.2	17.5	0.0	2.8	4.6	0.9	
C4938	06/19/07 11:06	7.2	0.3	12.7	0.0	2.8	3.1	0.5	
C4938	06/19/07 13:10	7.0	0.3	23.1	0.1	2.4	3.5	0.9	
C4938	06/19/07 15:07	6.5	0.3	17.0	0.0	2.3	3.0	0.6	
C4938	06/20/07	6.7	0.3	49.4	0.1	3.7	3.0	0.9	V&B flow measurements on 06/20/07 at 08:42 (averaged) 10.1 ft^3/min.
C4938	06/28/07	7.5	0.3	9.4	0.0	1.6	2.9	0.7	V&B flow measurements on 06/25/07 at 13:23 (averaged) 8.7 ft^3/min.
C4938	07/03/07	7.7	0.3	12.6	0.0	2.2	3.0	0.7	V&B flow measurements on 07/2/07 at 08:25 (averaged) 10.5 ft^3/min.
C4938	07/11/07	7.5	0.3	12.4	0.0	1.7	3.5	1.0	V&B flow measurements on 07/10/07 at 10:30 (averaged) 13.6 ft^3/min.

Table B-1. 216-Z-9 Soil Vapor Extraction Well Characterization Data, Fiscal Year 2007. (11 sheets)

Z-9 Well/Interval	Date	Well Vacuum (kPa)	Flow (m^3/min)	CCl_4 (ppmv)	CCl_4 Flux (kg/day)	$CHCl_3$ (ppmv)	CH_2Cl_2 (ppmv)	MEK (ppmv)	Comment
C4938	07/18/07	7.0	0.3	4.9	0.0	1.5	3.6	0.9	V&B flow measurements on 07/17/07 at 13:29 (averaged) 11.2 ft^3/min.
C4938	07/25/07	7.7	0.3	12.5	0.0	1.6	2.8	0.8	V&B flow measurements on 07/23/07 at 10:01 (averaged) 12.7 ft^3/min.
C4938	08/01/07	7.7	0.3	8.3	0.0	1.6	2.8	0.7	V&B flow measurements on 07/30/07 (averaged) 12.4 ft^3/min.
C4938	08/06/07		--						V&B flow measurements on 08/6/07 (averaged) 12.6 ft^3/min.
C5340	06/18/07 09:03	On-line							
C5340	06/18/07 09:16	9.7	--	10.3	0.0	3.0	1.3	2.8	V&B flow measurements on 06/18/07 at 09:00 (averaged) 2.8 ft^3/min.
C5340	06/18/07 10:57	9.7	--	19.7	0.0	2.9	1.8	0.5	
C5340	06/18/07 13:20	6.5	0.3	35.5	0.1	3.0	2.3	0.8	V&B flow measurements on 06/18/07 at 13:15 (averaged) 9.1 ft^3/min.
C5340	06/18/07 15:05	7.0	0.2	31.4	0.1	1.9	2.4	0.9	
C5340	06/19/07 07:05	8.0	0.2	16.7	0.0	2.7	1.2	0.5	
C5340	06/19/07 09:00	7.5	0.2	15.4	0.0	2.2	2.2	0.8	
C5340	06/19/07 11:00	7.0	0.2	10.9	0.0	2.7	1.6	0.3	
C5340	06/19/07 13:00	7.0	0.3	10.2	0.0	1.6	2.1	0.9	
C5340	06/19/07 15:00	6.5	0.3	8.9	0.0	1.6	2.1	0.5	
C5340	06/20/07	6.5	0.3	0.2	0.0	1.0	1.4	0.5	V&B flow measurements on 06/20/07 at 08:30 (averaged) 8.2 ft^3/min.
C5340	06/28/07	7.5	0.3	6.0	0.0	1.1	1.9	0.6	V&B flow measurements on 06/25/07 at 13:15 (averaged) 8.7 ft^3/min.

Table B-1. 216-Z-9 Soil Vapor Extraction Well Characterization Data, Fiscal Year 2007. (11 sheets)

Z-9 Well/Interval	Date	Well Vacuum (kPa)	Flow (m^3/min)	CCl_4 (ppmv)	CCl_4 Flux (kg/day)	$CHCl_3$ (ppmv)	CH_2Cl_2 (ppmv)	MEK (ppmv)	Comment
C5340	07/03/07	7.7	0.3	8.9	0.0	1.7	1.1	0.5	V&B flow measurements on 07/2/07 at 08:15 (averaged) 7.7 ft^3/min.
C5340	07/11/07	7.5	0.3	10.5	0.0	1.6	1.5	0.7	V&B flow measurements on 07/10/07 at 10:20 (averaged) 13.4 ft^3/min.
C5340	07/18/07	7.2	0.3	6.9	0.0	1.5	2.1	0.8	V&B flow measurements on 07/17/07 at 13:25 (averaged) 10.6 ft^3/min.
C5340	07/25/07	7.5	0.3	7.7	0.0	1.3	1.3	0.6	V&B flow measurements on 07/23/07 at 09:58 (averaged) 11.3 ft^3/min.
C5340	08/01/07	7.5	0.3	9.2	0.0	1.0	1.4	0.7	V&B flow measurements on 07/30/07 (averaged) 12.9 ft^3/min.
C5340	08/06/07		--						V&B flow measurements on 08/06/07 (averaged) 12.1 ft^3/min.
W15-8L	05/21/07	6.2	0.2	16.7	0.0	2.7	1.6	0.1	
W15-8L	05/23/07	7.0	0.2	13.1	0.0	1.3	1.2	0.4	
W15-8L	05/30/07	6.2	0.3	16.4	0.0	1.1	2.1	0.6	
W15-8L	06/06/07	7.5	0.3	14.8	0.0	1.4	1.6	0.3	
W15-8L	06/13/07	6.5	0.3	16.1	0.0	1.6	2.2	0.5	
W15-8L	06/20/07	6.5	0.3	20.9	0.0	1.7	2.3	0.7	
W15-8L	06/28/07	7.0	0.3	13.6	0.0	1.3	2.1	0.5	
W15-8L	07/03/07	7.7	0.3	12.8	0.0	1.7	1.7	0.4	
W15-8L	07/11/07	7.2	0.3	15.3	0.0	1.2	2.6	0.6	
W15-8L	07/18/07	7.0	0.3	12.9	0.0	1.2	3.2	0.8	

Table B-1. 216-Z-9 Soil Vapor Extraction Well Characterization Data, Fiscal Year 2007. (11 sheets)

Z-9 Well/Interval	Date	Well Vacuum (kPa)	Flow (m^3/min)	CCl_4 (ppmv)	CCl_4 Flux (kg/day)	$CHCl_3$ (ppmv)	CH_2Cl_2 (ppmv)	MEK (ppmv)	Comment
W15-8L	07/25/07	7.5	0.3	12.7	0.0	1.4	2.1	0.5	
W15-8L	08/01/07	7.5	0.3	13.6	0.0	1.3	1.8	0.6	
W15-8U	05/09/07	5.5	0.7	72.5	0.4	2.6	2.3	0.8	
W15-8U	05/16/07	5.2	0.4	76.9	0.3	2.7	2.6	0.7	
W15-8U	05/23/07	6.7	0.6	67.5	0.3	2.8	1.3	0.4	
W15-8U	05/30/07	5.7	0.4	81.3	0.3	2.8	2.7	0.6	
W15-8U	06/06/07	7.2	0.7	57.2	0.3	2.4	2.0	0.4	
W15-8U	06/13/07	6.5	0.4	59.2	0.2	2.5	3.1	0.6	
W15-8U	06/20/07	6.2	0.5	31.8	0.2	2.0	2.4	0.8	
W15-8U	06/28/07	6.7	0.7	11.4	0.1	1.3	1.8	0.6	
W15-8U	07/03/07	7.5	0.5	9.2	0.0	1.6	1.6	0.5	
W15-8U	07/11/07	7.0	0.4	8.9	0.0	1.4	1.6	0.6	
W15-8U	07/18/07	6.7	0.5	8.7	0.0	1.4	2.9	0.9	
W15-8U	07/25/07	7.5	0.5	6.4	0.0	1.4	1.4	0.5	
W15-8U	08/01/07	7.5	0.4	7.2	0.0	1.0	1.7	0.7	
W15-9L	04/02/07	13.7	1.4	8.1	0.1	1.9	1.2	0.0	
W15-9L	04/11/07	14.9	1.4	9.9	0.1	1.5	2.0	0.2	
W15-9L	04/17/07	13.0	1.4	9.3	0.1	2.8	1.5	0.1	
W15-9L	04/26/07	13.7	1.3	8.3	0.1	1.8	2.2	0.1	
W15-9L	05/02/07	20.9	1.8	10.0	0.2	2.4	2.4	0.2	
W15-9L	05/09/07	10.0	1.2	8.7	0.1	2.3	2.1	0.2	

Table B-1. 216-Z-9 Soil Vapor Extraction Well Characterization Data, Fiscal Year 2007. (11 sheets)

Z-9 Well/Interval	Date	Well Vacuum (kPa)	Flow (m^3/min)	CCl_4 (ppmv)	CCl_4 Flux (kg/day)	$CHCl_3$ (ppmv)	CH_2Cl_2 (ppmv)	MEK (ppmv)	Comment
W15-9L	05/16/07	10.0	1.0	9.9	0.1	2.4	2.7	0.2	
W15-9L	05/23/07	9.5	1.0	9.4	0.1	2.0	2.2	0.1	
W15-9L	05/30/07	12.5	1.3	7.4	0.1	1.3	2.7	0.4	
W15-9L	06/06/07	10.5	1.1	10.0	0.1	2.1	2.3	0.1	
W15-9L	06/13/07	10.7	1.1	9.5	0.1	2.2	2.8	0.1	
W15-9L	06/20/07	9.5	1.5	7.2	0.1	1.2	2.7	0.4	
W15-9L	06/28/07	11.0	1.1	8.8	0.1	1.8	3.1	0.2	
W15-9L	07/03/07	7.2	3.6	8.6	0.3	2.2	2.7	0.1	
W15-9L	07/11/07	11.0	1.1	8.2	0.1	1.5	2.9	0.4	
W15-9L	07/18/07	10.5	1.1	7.8	0.1	1.3	3.5	0.4	
W15-9L	07/25/07	10.7	1.1	7.6	0.1	1.7	2.7	0.3	
W15-9L	08/01/07	10.7	1.2	7.6	0.1	1.1	2.7	0.4	
W15-9U	04/02/07	12.5	1.9	8.0	0.1	1.7	1.4	0.2	
W15-9U	04/11/07	13.7	1.8	10.3	0.2	1.3	2.2	0.4	
W15-9U	04/17/07	12.5	1.8	9.8	0.2	1.7	2.1	0.2	
W15-9U	04/26/07	12.7	1.7	8.5	0.1	1.5	2.3	0.3	
W15-9U	05/02/07	20.4	2.4	10.0	0.2	1.8	2.5	0.2	
W15-9U	05/09/07	9.7	1.6	1.1	0.0	0.9	1.4	0.4	
W15-9U	05/16/07	11.7	1.4	9.3	0.1	1.3	2.7	0.4	
W15-9U	05/23/07	9.2	1.4	8.7	0.1	1.6	2.1	0.2	

Table B-1. 216-Z-9 Soil Vapor Extraction Well Characterization Data, Fiscal Year 2007. (11 sheets)

Z-9 Well/Interval	Date	Well Vacuum (kPa)	Flow (m^3/min)	CCl_4 (ppmv)	CCl_4 Flux (kg/day)	$CHCl_3$ (ppmv)	CH_2Cl_2 (ppmv)	MEK (ppmv)	Comment
W15-9U	05/30/07	11.5	1.9	7.3	0.1	1.1	2.8	0.4	
W15-9U	06/06/07	10.0	1.6	8.8	0.1	1.7	2.2	0.2	
W15-9U	06/13/07	10.0	1.6	8.1	0.1	1.7	2.6	0.2	
W15-9U	06/20/07	9.0	1.9	7.4	0.1	0.6	3.5	0.9	
W15-9U	06/28/07	10.5	1.7	9.2	0.1	1.8	3.1	0.4	
W15-9U	07/03/07	7.0	3.6	8.7	0.3	2.0	2.7	0.3	
W15-9U	07/11/07	10.5	1.6	9.2	0.1	1.8	3.1	0.6	
W15-9U	07/18/07	10.2	1.6	9.6	0.1	1.7	3.9	0.6	
W15-9U	07/25/07	10.5	1.7	8.5	0.1	1.8	2.6	0.4	
W15-9U	08/01/07	10.2	1.6	8.5	0.1	1.4	2.8	0.6	
W15-48	05/09/07	5.0	5.7	10.3	0.5	1.3	2.5	0.6	
W15-48	05/16/07	12.0	2.4	10.3	0.2	1.8	2.9	0.4	
W15-48	05/23/07	11.2	2.3	11.3	0.2	2.5	2.2	0.1	
W15-48	05/30/07	16.4	3.0	10.5	0.3	1.7	2.8	0.5	
W15-48	06/06/07	12.5	2.4	10.6	0.2	2.1	2.5	0.2	
W15-48	06/13/07	12.7	2.4	10.9	0.2	2.3	3.0	0.3	
W15-48	06/20/07	11.7	2.6	8.4	0.2	1.1	3.1	0.6	
W15-48	06/28/07	13.5	2.4	8.2	0.2	2.0	2.8	0.3	
W15-48	07/03/07	13.7	2.5	10.3	0.2	2.7	2.6	0.3	
W15-48	07/11/07	13.0	2.5	10.3	0.2	2.4	3.0	0.5	

Table B-1. 216-Z-9 Soil Vapor Extraction Well Characterization Data, Fiscal Year 2007. (11 sheets)

Z-9 Well/Interval	Date	Well Vacuum (kPa)	Flow (m^3/min)	CCl_4 (ppmv)	CCl_4 Flux (kg/day)	$CHCl_3$ (ppmv)	CH_2Cl_2 (ppmv)	MEK (ppmv)	Comment
W15-48	07/18/07	13.0	2.6	10.2	0.2	2.3	4.2	0.7	
W15-48	07/25/07	13.0	2.5	9.6	0.2	2.6	2.4	0.3	
W15-48	08/01/07	13.5	2.5	9.5	0.2	2.1	2.2	0.5	
W15-82	04/02/07	12.2	0.8	0.1	0.0	1.8	0.0	0.0	
W15-82	04/11/07	13.7	0.4	1.5	0.0	1.2	0.8	0.2	
W15-82	04/17/07	18.7	0.8	2.3	0.0	1.4	1.0	0.2	
W15-82	04/26/07	12.5	0.7	1.3	0.0	1.4	1.0	0.2	
W15-82	05/02/07	19.7	0.8	1.1	0.0	1.4	1.4	0.4	
W15-86	05/09/07	3.5	0.3	25.4	0.1	1.4	2.5	0.9	
W15-86	05/16/07	6.0	1.4	42.3	0.6	2.2	3.2	0.4	
W15-86	05/23/07	6.0	1.2	40.6	0.4	1.9	2.4	0.2	
W15-86	05/30/07	6.5	1.4	40.4	0.5	1.8	3.1	0.4	
W15-86	06/06/07	6.7	1.3	40.1	0.5	1.8	2.8	0.2	
W15-86	06/13/07	7.0	1.4	38.0	0.5	2.0	3.0	0.3	
W15-86	06/20/07	5.5	1.8	26.0	0.4	1.8	3.0	0.7	
W15-86	06/28/07	6.5	1.4	32.7	0.4	1.5	3.3	0.5	
W15-86	07/03/07	7.0	1.4	32.6	0.4	1.8	3.2	0.4	
W15-86	07/11/07	6.5	1.4	32.7	0.4	1.5	3.5	0.5	
W15-86	07/18/07	6.5	1.4	30.2	0.4	1.5	3.8	0.7	
W15-86	07/25/07	6.7	1.6	28.8	0.4	1.7	2.7	0.4	

Table B-1. 216-Z-9 Soil Vapor Extraction Well Characterization Data, Fiscal Year 2007. (11 sheets)

Z-9 Well/Interval	Date	Well Vacuum (kPa)	Flow (m^3/min)	CCl_4 (ppmv)	CCl_4 Flux (kg/day)	$CHCl_3$ (ppmv)	CH_2Cl_2 (ppmv)	MEK (ppmv)	Comment
W15-86	08/01/07	7.0	1.6	28.5	0.4	1.4	2.8	0.5	
W15-95L	05/09/07	6.5	3.3	12.7	0.4	1.6	3.7	1.3	
W15-95L	05/16/07	6.2	3.0	14.4	0.4	2.0	4.2	0.5	
W15-95L	05/23/07	6.5	2.9	16.5	0.4	1.9	4.8	0.3	
W15-95L	05/30/07	7.0	3.8	16.9	0.6	1.5	5.8	0.7	
W15-95L	06/06/07	7.5	3.3	15.0	0.4	1.8	4.5	0.3	
W15-95L	06/13/07	7.5	3.2	16.8	0.5	1.9	6.0	0.4	
W15-95L	06/20/07	6.5	3.6	12.5	0.4	1.2	4.8	0.7	
W15-95L	06/28/07	7.5	3.5	14.0	0.4	1.9	4.7	0.4	
W15-95L	07/03/07	5.5	4.2	13.9	0.5	2.1	4.8	0.2	
W15-95L	07/11/07	7.5	3.2	14.6	0.4	1.8	5.8	0.6	
W15-95L	07/18/07	7.2	3.3	13.6	0.4	1.5	6.0	0.9	
W15-95L	07/25/07	7.2	3.3	13.9	0.4	1.9	5.1	0.4	
W15-95L	08/01/07	7.5	3.1	14.1	0.4	1.3	5.4	0.7	
W15-95U	05/09/07	6.5	3.3	2.4	0.1	2.0	1.3	1.2	
W15-95U	05/16/07	6.2	3.3	9.2	0.3	1.6	3.3	0.6	
W15-95U	05/23/07	6.2	3.1	5.3	0.2	1.6	2.2	0.4	
W15-95U	05/30/07	7.7	3.5	6.7	0.2	1.5	3.2	0.7	
W15-95U	06/06/07	6.7	3.6	6.1	0.2	1.6	2.5	0.4	
W15-95U	06/13/07	6.5	3.8	6.6	0.2	1.7	3.1	0.4	

Table B-1. 216-Z-9 Soil Vapor Extraction Well Characterization Data, Fiscal Year 2007. (11 sheets)

Z-9 Well/Interval	Date	Well Vacuum (kPa)	Flow (m^3/min)	CCl_4 (ppmv)	CCl_4 Flux (kg/day)	$CHCl_3$ (ppmv)	CH_2Cl_2 (ppmv)	MEK (ppmv)	Comment
W15-95U	06/20/07	6.0	3.9	2.6	0.1	1.1	2.7	0.8	
W15-95U	06/28/07	7.0	3.8	1.8	0.1	1.5	2.4	0.5	
W15-95U	07/03/07	5.5	4.3	1.6	0.1	1.9	1.7	0.3	
W15-95U	07/11/07	7.2	3.6	10.2	0.3	1.7	4.1	0.5	
W15-95U	07/18/07	6.5	3.7	4.7	0.2	1.5	3.7	0.7	
W15-95U	07/25/07	7.0	3.6	1.9	0.1	1.7	1.9	0.4	
W15-95U	08/01/07	7.0	3.6	4.7	0.2	1.2	2.5	0.6	
W15-217	04/02/07	11.7	2.4	55.0	1.2	2.4	2.0	0.0	
W15-217	04/11/07	12.5	2.1	50.3	1.0	1.9	4.5	0.3	
W15-217	04/17/07	11.2	2.4	45.6	1.0	2.4	3.3	0.2	
W15-217	04/26/07	10.5	1.9	23.1	0.4	2.1	1.9	0.1	
W15-217	05/02/07	18.4	3.0	40.5	1.1	2.6	2.7	0.2	
W15-217	05/09/07	6.5	1.1	12.8	0.1	1.1	1.9	0.7	
W15-217	05/16/07	6.2	1.2	1.0	0.0	1.9	1.0	0.3	Concentration readings believed to be in error because characterization instruments connected backwards.
W15-217	05/23/07	6.5	0.9	48.6	0.4	2.4	2.1	0.2	
W15-217	05/30/07	6.5	1.4	18.3	0.2	1.9	2.3	0.3	Well found valved out. On-line using SVE for about 5 minutes prior to sampling.
W15-217	06/06/07	7.2	0.9	47.0	0.4	2.3	2.9	0.4	
W15-217	06/13/07	7.5	1.1	41.3	0.4	2.4	3.1	0.4	

Table B-1. 216-Z-9 Soil Vapor Extraction Well Characterization Data, Fiscal Year 2007. (11 sheets)

Z-9 Well/Interval	Date	Well Vacuum (kPa)	Flow (m^3/min)	CCl_4 (ppmv)	CCl_4 Flux (kg/day)	$CHCl_3$ (ppmv)	CH_2Cl_2 (ppmv)	MEK (ppmv)	Comment
W15-217	06/20/07	6.2	1.4	25.9	0.3	1.7	3.4	0.5	
W15-217	06/28/07	7.0	1.0	28.8	0.3	1.8	3.1	0.4	
W15-217	07/03/07	7.5	1.0	25.5	0.2	2.2	2.7	0.3	
W15-217	07/11/07	7.0	0.8	26.6	0.2	2.1	3.1	0.5	
W15-217	07/18/07	7.0	1.0	22.0	0.2	1.5	4.3	0.8	
W15-217	07/25/07	7.5	1.2	3.3	0.0	1.7	0.9	0.3	
W15-217	08/01/07	7.5	1.1	3.6	0.0	1.2	1.6	0.5	
W15-223	06/18/07	3.0	1.1	13.8	0.1	2.0	2.9	0.3	
W15-223	06/20/07	2.5	1.2	10.1	0.1	1.4	2.9	0.5	
W15-223	06/28/07	8.2	2.9	8.9	0.2	1.5	2.6	0.4	
W15-223	07/03/07	8.5	3.0	7.5	0.2	1.8	2.1	0.3	
W15-223	07/11/07	8.2	2.8	6.2	0.2	1.8	2.5	0.5	
W15-223	07/18/07	8.0	2.8	5.6	0.1	1.5	3.8	0.8	
W15-223	07/25/07	8.0	2.8	4.7	0.1	1.6	2.2	0.4	
W15-223	08/01/07	7.7	2.7	5.0	0.1	1.2	2.3	0.7	

CCl_4 = carbon tetrachloride
$CHCl_3$ = chloroform
CH_2Cl_2 = methylene chloride
MEK = methyl ethyl ketone
ppmv = parts per million by volume
SVE = soil vapor extraction
V&B = vent and balance

Table B-2. 216-Z-1A Soil Vapor Extraction Well Characterization Data, Fiscal Year 2007. (2 sheets)

Z-1A Well/Interval	Date	Well Vacuum (kPa)	Flow (m^3/min)	CCl_4 (ppmv)	CCl_4 Flux (kg/day)	$CHCl_3$ (ppmv)	CH_2Cl_2 (ppmv)	MEK (ppmv)	Comment
W18-89	09/19/07	2.0	2.9	16.8	0.4	1.9	1.5	0.3	
W18-165	08/15/07	4.0	2.6	6.5	0.2	1.7	2.0	0.6	Gasket leaking.
W18-165	8/22/07	4.5	2.7	12.5	0.3	2.0	2.0	0.3	Gasket leaking.
W18-165	08/29/07	3.5	1.8	18.0	0.3	1.7	1.5	0.4	
W18-165	09/05/07	3.7	1.8	18.6	0.3	1.9	1.7	0.5	
W18-165	09/13/07	3.7	1.8	18.0	0.3	1.3	1.6	0.5	
W18-165	09/19/07	2.0	1.2	17.3	0.2	1.8	1.2	0.2	
W18-166	08/23/07	3.7	1.2	9.0	0.1	1.9	4.2	0.3	
W18-166	08/29/07	3.5	1.1	9.6	0.1	1.5	1.8	0.4	
W18-166	09/05/07	3.5	1.3	9.8	0.1	1.3	2.6	0.7	
W18-166	09/13/07	3.7	1.3	9.3	0.1	1.5	1.6	0.3	
W18-166	09/19/07	2.2	0.8	8.8	0.1	1.6	1.5	0.4	
W18-167	08/15/07	1.8	5.4	12.3	0.6	2.0	2.8	0.6	Gasket leaking.
W18-167	08/22/07	2.4	5.9	16.1	0.9	2.3	2.5	0.3	Gasket leaking
W18-167	08/29/07	1.9	5.1	17.2	0.8	2.4	2.0	0.3	
W18-167	09/05/07	1.6	4.9	18.4	0.8	2.3	2.6	0.4	
W18-167	09/13/07	2.2	4.9	20.1	0.9	2.3	2.1	0.2	
W18-167	09/19/07	1.5	3.8	20.8	0.7	2.3	1.8	0.0	
W18-168	08/23/07	2.5	0.3	8.5	0.0	2.3	2.0	0.3	

Table B-2. 216-Z-1A Soil Vapor Extraction Well Characterization Data, Fiscal Year 2007. (2 sheets)

Z-1A Well/Interval	Date	Well Vacuum (kPa)	Flow (m^3/min)	CCl_4 (ppmv)	CCl_4 Flux (kg/day)	$CHCl_3$ (ppmv)	CH_2Cl_2 (ppmv)	MEK (ppmv)	Comment
W18-168	08/29/07	1.5	0.3	23.0	0.1	2.0	2.3	0.4	
W18-168	09/05/07	1.5	0.3	26.6	0.1	1.8	3.2	0.6	
W18-168	09/13/07	2.5	0.3	26.2	0.1	1.5	2.3	0.5	
W18-168	09/19/07	1.9	0.2	28.7	0.1	1.9	2.0	0.2	
W18-174	08/15/07	3.7	0.8	12.3	0.1	1.7	2.7	0.7	
W18-174	08/22/07	4.7	0.9	10.5	0.1	2.1	2.1	0.4	
W18-174	08/29/07	3.7	0.7	9.1	0.1	1.8	1.2	0.5	
W18-174	09/05/07	4.0	0.8	9.3	0.1	1.6	2.0	0.7	
W18-174	09/13/07	4.0	0.8	8.9	0.1	1.6	1.3	0.4	
W18-174	09/19/07	2.5	0.3	7.7	0.0	1.7	1.1	0.3	
W18-248	09/19/07	2.5	0.2	35.0	0.1	1.9	1.1	0.2	

CCl_4 = carbon tetrachloride
$CHCl_3$ = chloroform
CH_2Cl_2 = methylene chloride
MEK = methyl ethyl ketone
ppmv = parts per million by volume

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APPENDIX C

FISCAL YEAR 2007 PASSIVE SOIL VAPOR EXTRACTION DATA

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Table C-1. Passive Soil Vapor Extraction Well Monitoring Data – 216-Z-1A/216-Z-18/216-Z-12 Site. (5 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
299-W18-6L	63	6	10/26/06 09:55	3.7	1.0 U	1.0 U	1.0 U	8,510	
299-W18-6L	63	6	10/26/06 09:55	3.8	1.0 U	1.0 U	1.0 U	8,410	Duplicate
299-W18-6L	63	6	11/28/06 09:58	1.4	1.0 U	1.0 U	1.0 U	4,060	
299-W18-6L	63	6	12/20/06 09:15	1.0 U	1.0 U	1.0 U	1.0 U	5,860	
299-W18-6L	63	6	01/30/07 10:26	4.8	1.0 U	1.0 U	1.1	6,450	
299-W18-6L	63	6	02/28/07 08:47	4.9	1.0 U	1.0 U	1.1	7,310	
299-W18-6L	63	6	03/21/07 17:20	8.1	1.0 U	1.0 U	1.1	7,630	
299-W18-6L	63	6	04/16/07 12:42	8.5	1.0 U	1.0 U	1.0 U	8,670	
299-W18-6L	63	6	05/30/07 12:16	11.3	1.0 U	1.0 U	1.3	12,100	
299-W18-6L	63	6	06/27/07 11:27	12.3	1.0 U	1.0 U	1.9	8,140	
299-W18-6L	63	6	06/27/07 11:27	12.1	1.0 U	1.0 U	1.9	8,660	Duplicate
299-W18-6L	63	6	07/25/07 10:43	8.2	1.0 U	1.0 U	2.4	11,600	
299-W18-6L	63	6	08/28/07 12:19	5.5	1.0 U	1.0 U	1.0 U	10,400	
299-W18-6L	63	6	09/25/07 09:05	5.2	1.0 U	1.0 U	1.0 U	8,350	
299-W18-7	60	6	10/26/06 09:40	5.6	1.0 U	1.0 U	1.0 U	7,740	
299-W18-7	60	6	11/28/06 09:40	6.0	1.0 U	1.0 U	1.0 U	3,880	
299-W18-7	60	6	12/20/06 09:01	2.1	1.0 U	1.0 U	1.0 U	5,140	
299-W18-7	60	6	01/30/07 10:05	7.8	1.0 U	1.0 U	1.0 U	5,830	
299-W18-7	60	6	02/28/07 08:30	14.1	1.0 U	1.0 U	1.3	5,680	
299-W18-7	60	6	03/21/07 17:07	11.8	1.0 U	1.0 U	1.4	9,370	
299-W18-7	60	6	04/16/07 12:30	21.1	1.0 U	1.0 U	1.5	8,520	
299-W18-7	60	6	05/30/07 12:03	39.3	1.0	1.0 U	1.0	11,400	

Table C-1. Passive Soil Vapor Extraction Well Monitoring Data – 216-Z-1A/216-Z-18/216-Z-12 Site. (5 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
299-W18-7	60	6	05/30/07 12:03	21.7	1.0 U	1.0 U	1.0	11,200	Duplicate
299-W18-7	60	6	06/27/07 10:38	18.4	1.0 U	1.0 U	1.9	8,040	
299-W18-7	60	6	07/25/07 10:12	16.3	1.0 U	1.0 U	1.6	11,100	
299-W18-7	60	6	08/28/07 12:10	9.4	1.0 U	1.0 U	1.0 U	9,950	
299-W18-7	60	6	09/25/07 08:49	3.4	1.0 U	1.0 U	1.0 U	7,840	
299-W18-10L	56	6	10/26/06 11:10	1.0 U	1.0 U	1.0 U	1.0 U	10,500	
299-W18-10L	56	6	11/28/06 10:45	1.0 U	1.0 U	1.0 U	1.0 U	4,130	
299-W18-10L	56	6	11/28/06 10:45	1.0 U	1.0 U	1.0 U	1.0 U	4,140	Duplicate
299-W18-10L	56	6	12/20/06 09:40	2.0	1.0 U	1.0 U	1.0 U	5,620	
299-W18-10L	56	6	01/30/07 11:13	12.6	1.0 U	1.0 U	1.0 U	8,460	
299-W18-10L	56	6	01/30/07 11:20	12.7	1.0 U	1.0 U	1.0 U	7,090	Duplicate
299-W18-10L	56	6	02/28/07 10:05	7.0	1.0 U	1.0 U	1.0 U	7,550	
299-W18-10L	56	6	03/21/07 17:55	13.8	1.0 U	1.0 U	1.3	7,480	
299-W18-10L	56	6	04/16/07 13:31	1.0	1.0 U	1.0 U	1.0 U	8,400	
299-W18-10L	56	6	05/30/07 12:51	5.7	1.0 U	1.0 U	1.2	10,300	
299-W18-10L	56	6	06/27/07 13:24	10.4	1.0 U	1.0 U	1.6	9,410	
299-W18-10L	56	6	07/25/07 12:16	5.1	1.0 U	1.0 U	2.0	11,300	
299-W18-10L	56	6	08/28/07 12:59	7.6	1.0 U	1.0 U	1.1	10,400	
299-W18-10L	56	6	09/25/07 10:40	2.3	1.0 U	1.0 U	1.0 U	7,960	
299-W18-10L	56	6	09/25/07 10:40	2.4	1.0 U	1.0 U	1.0 U	8,540	Duplicate
299-W18-11L	61	6	10/26/06 11:20	1.0 U	1.0 U	1.0 U	1.0 U	7,290	
299-W18-11L	61	6	11/28/06 10:53	1.0 U	1.0 U	1.0 U	1.0 U	4,140	

Table C-1. Passive Soil Vapor Extraction Well Monitoring Data – 216-Z-1A/216-Z-18/216-Z-12 Site. (5 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
299-W18-11L	61	6	12/20/06 09:47	1.0 U	1.0 U	1.0 U	1.0 U	5,480	
299-W18-11L	61	6	01/30/07 11:25	4.5	1.0 U	1.0 U	1.0 U	7,150	
299-W18-11L	61	6	02/28/07 10:20	3.4	1.0 U	1.0 U	1.0 U	7,500	
299-W18-11L	61	6	02/28/07 10:20	3.3	1.0 U	1.0 U	1.0 U	7,320	Duplicate
299-W18-11L	61	6	03/21/07 18:01	3.2	1.0 U	1.0 U	1.0 U	6,660	
299-W18-11L	61	6	04/16/07 13:37	1.0 U	1.0 U	1.0 U	1.0 U	8,820	
299-W18-11L	61	6	05/30/07 12:56	3.3	1.0 U	1.0 U	1.1	10,800	
299-W18-11L	61	6	06/27/07 13:36	4.3	1.0 U	1.0 U	1.2	9,080	
299-W18-11L	61	6	07/25/07 12:27	2.0	1.0 U	1.0 U	1.3	12,200	
299-W18-11L	61	6	08/28/07 13:07	1.0 U	1.0 U	1.0 U	1.0 U	10,400	
299-W18-11L	61	6	09/25/07 10:52	1.0 U	1.0 U	1.0 U	1.0 U	8,170	
299-W18-12	60	6	10/26/06 11:32	1.0 U	1.0 U	1.0 U	1.0 U	7,470	
299-W18-12	60	6	11/28/06 11:00	1.0 U	1.0 U	1.0 U	1.0 U	3,780	
299-W18-12	60	6	12/20/06 10:04	1.0 U	1.0 U	1.0 U	1.0 U	6,020	
299-W18-12	60	6	01/30/07 11:30	1.3	1.0 U	1.0 U	1.0 U	6,790	
299-W18-12	60	6	02/28/07 10:30	1.0 U	1.0 U	1.0 U	1.0 U	7,290	
299-W18-12	60	6	03/21/07 18:10	1.0 U	1.0 U	1.0 U	1.0 U	5,970	
299-W18-12	60	6	03/21/07 18:10	1.0 U	1.0 U	1.0 U	1.0 U	5,920	Duplicate
299-W18-12	60	6	04/16/07 13:42	1.0 U	1.0 U	1.0 U	1.0 U	8,300	
299-W18-12	60	6	05/30/07 13:03	1.0 U	1.0 U	1.0 U	1.1	9,780	
299-W18-12	60	6	06/27/07 13:41	1.4	1.0 U	1.0 U	1.3	8,980	
299-W18-12	60	6	07/25/07 12:33	1.0 U	1.0 U	1.0 U	1.7	11,500	

Table C-1. Passive Soil Vapor Extraction Well Monitoring Data – 216-Z-1A/216-Z-18/216-Z-12 Site. (5 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
299-W18-12	60	6	08/28/07 13:15	1.0 U	1.0 U	1.0 U	1.0 U	9,370	
299-W18-12	60	6	09/25/07 10:59	1.0 U	1.0 U	1.0 U	1.0 U	8,010	
299-W18-246L	52	6	10/26/06 10:07	1.7	1.0 U	1.0 U	1.0 U	8,630	
299-W18-246L	52	6	11/28/06 10:20	1.0 U	1.0 U	1.0 U	1.0 U	4,480	
299-W18-246L	52	6	12/20/06 09:21	2.0	1.0 U	1.0 U	1.0 U	5,690	
299-W18-246L	52	6	12/20/06 09:21	1.0 U	1.0 U	1.0 U	1.0 U	5,700	Duplicate
299-W18-246L	52	6	01/30/07 10:38	2.2	1.0 U	1.0 U	1.0 U	7,010	
299-W18-246L	52	6	02/28/07 09:00	5.3	1.0 U	1.0 U	1.0 U	6,410	
299-W18-246L	52	6	03/21/07 17:28	4.1	1.0 U	1.0 U	1.0 U	9,160	
299-W18-246L	52	6	04/16/07 12:54	9.6	1.0 U	1.0 U	1.0 U	9,120	
299-W18-246L	52	6	05/30/07 12:22	14.7	1.0 U	1.0 U	1.3	10,400	
299-W18-246L	52	6	06/27/07 11:37	4.6	1.0 U	1.0 U	1.9	8,490	
299-W18-246L	52	6	07/25/07 10:49	8.5	1.0 U	1.0 U	1.8	11,400	
299-W18-246L	52	6	07/25/07 10:49	9.2	1.0 U	1.0 U	2.0	11,600	Duplicate
299-W18-246L	52	6	08/28/07 12:27	9.0	1.0 U	1.0 U	1.0	10,000	
299-W18-246L	52	6	09/25/07 09:16	5.1	1.0 U	1.0 U	1.0 U	8,400	
299-W18-247L	51	6	10/26/06 11:45	1.0 U	1.0 U	1.0 U	1.0 U	7,760	
299-W18-247L	51	6	11/28/06 11:15	1.0 U	1.0 U	1.0 U	1.0 U	4,480	
299-W18-247L	51	6	12/20/06 10:11	1.0 U	1.0 U	1.0 U	1.0 U	5,720	
299-W18-247L	51	6	01/30/07 11:42	1.4	1.0 U	1.0 U	1.0 U	8,130	
299-W18-247L	51	6	02/28/07 10:40	1.0 U	1.0 U	1.0 U	1.0 U	7,820	
299-W18-247L	51	6	03/21/07 18:17	5.1	1.0 U	1.0 U	1.3	7,350	

Table C-1. Passive Soil Vapor Extraction Well Monitoring Data – 216-Z-1A/216-Z-18/216-Z-12 Site. (5 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
299-W18-247L	51	6	04/16/07 13:55	1.0 U	1.0 U	1.0 U	1.0 U	9,070	
299-W18-247L	51	6	04/16/07 13:55	1.0 U	1.0 U	1.0 U	1.0 U	9,370	Duplicate
299-W18-247L	51	6	05/30/07 13:10	1.0 U	1.0 U	1.0 U	1.5	10,700	
299-W18-247L	51	6	06/27/07 13:58	10.0	1.0 U	1.0 U	1.5	10,100	
299-W18-247L	51	6	07/25/07 12:51	5.7	1.0 U	1.0 U	1.7	12,400	
299-W18-247L	51	6	08/28/07 13:22	6.6	1.0 U	1.0 U	1.1	10,900	
299-W18-247L	51	6	09/25/07 11:05	1.0 U	1.0 U	1.0 U	1.0 U	8,080	
299-W18-252L	53	6	02/28/07 09:22	2.1	1.0 U	1.0 U	1.0 U	6,360	
299-W18-252L	53	6	03/21/07 17:35	4.5	1.0 U	1.0 U	1.0 U	8,850	
299-W18-252L	53	6	04/16/07 13:02	8.1	1.0 U	1.0 U	1.0 U	8,480	
299-W18-252L	53	6	05/30/07 12:30	12.2	1.0 U	1.0 U	2.0	10,500	
299-W18-252L	53	6	06/27/07 11:52	12.0	1.0 U	1.0 U	1.9	8,490	
299-W18-252L	53	6	07/25/07 11:01	3.7	1.0 U	1.0 U	2.1	11,200	
299-W18-252L	53	6	08/28/07 12:35	2.4	1.0 U	1.0 U	1.0 U	9,550	
299-W18-252L	53	6	08/28/07 12:35	2.7	1.0 U	1.0 U	1.2	9,660	Duplicate
299-W18-252L	53	6	09/25/07 09:33	1.1	1.0 U	1.0 U	1.0 U	7,730	

bgs = below ground surface
CCl_4 = carbon tetrachloride
$CHCl_3$ = chloroform
CH_2Cl_2 = methylene chloride
MEK = methyl ethyl ketone
ppmv = parts per million by volume
U = analyzed for but not detected; value reported is the reporting limit

Note: Well 299-W18-252L in use for cross-well seismic investigation October 2006 through January 2007.

Table C-2. Carbon Tetrachloride Concentration Standard Analyses.

CCl_4 Concentration Standard (ppmv)	CCl_4 Concentration Analyzed (ppmv)	Date Analyzed	Time Analyzed	B&K Serial Number
25.37	21.9	10/26/06	12:34	1715232
25.37	22.3	10/26/06	13:20	1715232
25.37	21.5	11/28/06	14:20	1715232
25.37	22.0	11/28/06	15:05	1715232
25.37	22.0	12/20/06	11:32	1715232
25.37	22.3	12/20/06	12:22	1715232
25.37	21.8	01/30/07	12:32	1715232
25.37	22.3	01/30/07	13:21	1715232
25.37	22.0	02/28/07	11:25	1715232
25.37	22.2	02/28/07	12:18	1715232
25.37	22.5	03/21/07	18:43	1715232
25.37	22.4	03/21/07	19:35	1715232
25.37	17.3	04/16/07	15:23	1715232
25.37	17.2	04/16/07	16:15	1715232
25.37	21.9	05/30/07	15:20	1715232
25.37	22.1	05/30/07	16:16	1715232
25.37	22.2	06/27/07	15:48	1715232
25.37	22.1	06/27/07	16:53	1715232
25.37	21.2	07/25/07	15:09	1715232
25.37	21.2	07/25/07	15:11	1715232
25.37	22.0	08/28/07	14:40	1715232
25.37	22.1	08/28/07	15:32	1715232
25.37	21.8	09/25/07	13:05	1715232
25.37	21.9	09/25/07	13:53	1715232

B&K = Brüel & Kjær (trademark of Brüel & Kjær North America, Inc., Norcross, Georgia)
CCl_4 = carbon tetrachloride
ppmv = parts per million by volume

Table C-3. Blank Analyses.

Sample Location	Sample Date	Sample Time	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)
Blank	10/26/06	12:32	1.0 U	1.0 U	1.0 U	1.0 U	7,480
Blank	10/26/06	13:22	1.0 U	1.0 U	1.0 U	1.0 U	7,960
Blank	11/28/06	14:18	1.0 U	1.0 U	1.0 U	1.0 U	3,550
Blank	11/28/06	15:07	1.0 U	1.0 U	1.0 U	1.0 U	3,610
Blank	12/20/06	11:28	1.0 U	1.0 U	1.0 U	1.0 U	4,510
Blank	12/20/06	12:24	1.0 U	1.0 U	1.0 U	1.0 U	4,440
Blank	01/30/07	12:28	1.0 U	1.0 U	1.0 U	1.0 U	5,060
Blank	01/30/07	13:23	1.0 U	1.0 U	1.0 U	1.0 U	5,190
Blank	02/28/07	11:21	1.0 U	1.0 U	1.0 U	1.0 U	5,610
Blank	02/28/07	12:20	1.0 U	1.0 U	1.0 U	1.0 U	5,690
Blank	03/21/07	18:40	1.0 U	1.0 U	1.0 U	1.0 U	6,220
Blank	03/21/07	19:36	1.0 U	1.0 U	1.0 U	1.0 U	6,150
Blank	04/16/07	15:19	1.0 U	1.0 U	1.0 U	1.0 U	7,480
Blank	04/16/07	16:17	1.0 U	1.0 U	1.0 U	1.0 U	7,500
Blank	05/30/07	15:18	1.0 U	1.0 U	1.0 U	1.0 U	10,300
Blank	05/30/07	16:18	1.0 U	1.0 U	1.0 U	1.0 U	10,200
Blank	06/27/07	15:46	1.0 U	1.0 U	1.0 U	1.0 U	9,130
Blank	06/27/07	16:55	1.0 U	1.0 U	1.0 U	1.0 U	9,120
Blank	07/25/07	15:07	1.0 U	1.0 U	1.0 U	1.0 U	11,000
Blank	07/25/07	16:03	1.0 U	1.0 U	1.0 U	1.0 U	11,000
Blank	08/28/07	14:38	1.0 U	1.0 U	1.0 U	1.0 U	10,200
Blank	08/28/07	15:34	1.0 U	1.0 U	1.0 U	1.0 U	9,670
Blank	09/25/07	13:03	1.0 U	1.0 U	1.0 U	1.0 U	7,330
Blank	09/25/07	13:55	1.0 U	1.0 U	1.0 U	1.0 U	7,620

CCl_4 = carbon tetrachloride
$CHCl_3$ = chloroform
CH_2Cl_2 = methylene chloride
MEK = methyl ethyl ketone
ppmv = parts per million by volume
U = analyzed for but not detected; value reported is the reporting limit

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APPENDIX D

FISCAL YEAR 2007 SOIL VAPOR MONITORING DATA

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Table D-1. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-1A216-Z-18/216-Z-12 Site. (8 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
CPT-4E / 25 ft	8	2	04/18/07 10:13	9.96	3.2	1.0 U	1.0 U	1.1	7,100	
CPT-4E / 25 ft	8	2	05/29/07 13:05	19.93	3.3	1.0 U	1.0 U	1.2	9,230	
CPT-4E / 25 ft	8	2	06/27/07 12:17	17.43	1.8	1.0 U	1.0 U	1.3	8,320	
CPT-4E / 25 ft	8	2	07/25/07 11:11	12.45	1.5	1.0 U	1.0 U	1.1	11,500	
CPT-4E / 25 ft	8	2	08/30/07 13:35	27.40	2.0	1.0 U	1.0 U	2.2	11,900	
CPT-4E / 25 ft	8	2	09/24/07 13:07	12.45	1.4	1.0 U	1.0 U	1.3	9,530	
CPT-32/ 25 ft	8	2	10/25/06 11:38	0.00	1.0 U	1.0 U	1.0 U	1.0 U	9,420	
CPT-32/ 25 ft	8	2	11/30/06 12:07	-2.49	1.2	1.0 U	1.0 U	1.0 U	4,680	
CPT-32/ 25 ft	8	2	12/19/06 10:13	-9.96	2.1	1.0 U	1.0 U	1.0 U	6,830	
CPT-32/ 25 ft	8	2	12/19/06 10:13	-9.96	1.7	1.0 U	1.0 U	1.0 U	6,540	Duplicate
CPT-32/ 25 ft	8	2	01/31/07 10:20	9.96	3.4	1.0 U	1.0 U	1.0 U	5,750	
CPT-32/ 25 ft	8	2	02/27/07 11:57	2.49	6.0	1.0 U	1.0 U	1.1	7,740	
CPT-32/ 25 ft	8	2	03/21/07 10:10	-7.47	5.7	1.0 U	1.0 U	1.0 U	6,510	
CPT-32/ 25 ft	8	2	04/18/07 09:50	-4.98	8.0	1.0 U	1.0 U	1.4	7,230	
CPT-32/ 25 ft	8	2	05/29/07 12:42	14.94	7.6	1.0 U	1.0 U	1.9	9,010	
CPT-32/ 25 ft	8	2	06/27/07 11:13	9.96	7.1	1.0 U	1.4	2.2	8,270	
CPT-32/ 25 ft	8	2	07/25/07 10:33	12.45	5.3	1.0 U	1.0 U	1.1	11,800	
CPT-30/ 28 ft	9	2	04/18/07 10:00	9.96	1.0 U	1.0 U	1.0 U	1.0 U	6,660	
CPT-30/ 28 ft	9	2	05/29/07 12:51	14.94	1.0 U	1.0 U	1.0 U	1.0 U	8,830	
CPT-30/ 28 ft	9	2	06/27/07 11:46	22.42	1.0 U	1.0 U	1.0 U	1.6	8,400	
CPT-30/ 28 ft	9	2	07/25/07 10:56	7.47	1.0 U	1.0 U	1.0 U	1.0 U	12,300	

Table D-1. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-1A216-Z-18/216-Z-12 Site. (8 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
CPT-13A/ 30 ft	9	2	10/25/06 15:31	2.49	3.3	1.0 U	1.0 U	1.0 U	13,700	
CPT-13A/ 30 ft	9	2	11/30/06 14:47	-9.96	2.9	1.0 U	1.0 U	1.0 U	4,990	
CPT-13A/ 30 ft	9	2	12/19/06 12:17	12.45	5.8	1.0 U	1.0 U	1.0 U	6,450	
CPT-13A/ 30 ft	9	2	01/31/07 13:22	34.87	1.6	1.0 U	1.0 U	1.0 U	6,000	
CPT-13A/ 30 ft	9	2	02/27/07 14:40	22.42	5.0	1.0 U	1.0 U	1.0 U	8,020	
CPT-13A/ 30 ft	9	2	03/21/07 12:19	2.49	2.2	1.0 U	1.0 U	1.0 U	9,080	
CPT-13A/ 30 ft	9	2	04/18/07 11:30	-59.78	1.8	1.0 U	1.0 U	1.0 U	8,320	
CPT-13A/ 30 ft	9	2	05/29/07 14:14	34.87	3.7	1.0 U	1.0 U	1.0 U	9,890	
CPT-13A/ 30 ft	9	2	06/27/07 13:17	29.89	2.4	1.0 U	1.0 U	1.0 U	10,000	
CPT-13A/ 30 ft	9	2	07/25/07 12:10	17.43	2.1	1.0 U	1.0 U	1.0 U	12,500	
CPT-13A/ 30 ft	9	2	08/30/07 16:11	42.34	3.2	1.0 U	1.0 U	2.7	15,400	
CPT-13A/ 30 ft	9	2	09/24/07 15:12	19.93	4.6	1.0 U	1.0 U	1.0 U	13,700	
CPT-7A/ 32 ft	10	2	10/25/06 10:53	-12.45	1.9	1.0 U	1.0 U	1.0 U	9,470	
CPT-7A/ 32 ft	10	2	11/30/06 11:16	0.00	2.5	1.0 U	1.0 U	1.0 U	4,370	
CPT-7A/ 32 ft	10	2	12/19/06 09:47	-14.94	2.6	1.0 U	1.0 U	1.0 U	6,860	
CPT-7A/ 32 ft	10	2	01/31/07 09:35	17.43	3.2	1.0 U	1.0 U	1.0 U	5,100	
CPT-7A/ 32 ft	10	2	02/27/07 11:16	-14.94	3.4	1.0 U	1.0 U	1.0 U	7,360	
CPT-7A/ 32 ft	10	2	03/21/07 09:39	-64.76	3.8	1.0 U	1.0 U	1.0 U	5,920	
CPT-7A/ 32 ft	10	2	04/18/07 09:20	-7.47	3.9	1.0 U	1.0 U	1.0 U	6,650	
CPT-7A/ 32 ft	10	2	05/29/07 12:07	12.45	2.7	1.0 U	1.0 U	1.0 U	8,880	
CPT-7A/ 32 ft	10	2	06/27/07 10:05	22.42	2.7	1.0 U	1.2	1.3	7,660	

Table D-1. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-1A216-Z-18/216-Z-12 Site. (8 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
CPT-7A/ 32 ft	10	2	07/25/07 10:03	4.98	2.5	1.0 U	1.1	1.0 U	11,800	
CPT-7A/ 32 ft	10	2	08/30/07 13:24	22.42	2.2	1.0	2.4	2.6	12,200	
CPT-7A/ 32 ft	10	2	09/24/07 13:00	7.47	1.9	1.0 U	1.0 U	1.2	10,000	
CPT-1A/ 35 ft	11	2	10/25/06 11:56	0.00	10.0	1.0 U	1.0 U	1.0 U	9,370	
CPT-1A/ 35 ft	11	2	11/30/06 12:21	-2.49	4.6	1.0 U	1.0 U	1.0 U	4,160	
CPT-1A/ 35 ft	11	2	12/19/06 10:30	-9.96	5.1	1.0 U	1.0 U	1.0 U	6,520	
CPT-1A/ 35 ft	11	2	01/31/07 10:40	14.94	4.4	1.0 U	1.0 U	1.0 U	5,350	
CPT-1A/ 35 ft	11	2	02/27/07 12:20	4.98	7.3	1.0 U	1.0 U	1.1	8,000	
CPT-1A/ 35 ft	11	2	03/21/07 10:26	-14.94	2.8	1.0 U	1.0 U	1.0 U	6,410	
CPT-1A/ 35 ft	11	2	04/18/07 10:20	-2.49	4.2	1.0 U	1.0 U	1.0 U	6,780	
CPT-1A/ 35 ft	11	2	05/29/07 13:15	24.91	1.2	1.0 U	1.0 U	1.0 U	9,650	
CPT-1A/ 35 ft	11	2	06/27/07 12:27	24.91	6.6	1.0 U	1.0 U	1.6	8,310	
CPT-1A/ 35 ft	11	2	07/25/07 11:17	17.43	7.2	1.0 U	1.0 U	1.6	11,600	
CPT-1A/ 35 ft	11	2	08/30/07 13:43	34.87	10.0	1.0 U	1.0 U	2.9	12,000	
CPT-1A/ 35 ft	11	2	09/24/08 13:12	14.94	12.2	1.1	1.0 U	2.0	9,210	
CPT-33/ 40 ft	12	2	04/18/07 11:45	42.34	1.5	1.0 U	1.0 U	2.3	9,070	
CPT-33/ 40 ft	12	2	05/29/07 14:28	27.40	1.8	1.0 U	1.0 U	1.9	12,000	
CPT-33/ 40 ft	12	2	06/27/07 13:49	32.38	1.4	1.0 U	1.0 U	2.7	13,200	
CPT-33/ 40 ft	12	2	07/25/07 12:44	27.40	1.3	1.0 U	1.0 U	2.5	13,800	
CPT-34/ 40 ft	12	2	04/18/07 11:55	7.47	1.2	1.0 U	1.0 U	1.3	8,580	
CPT-34/ 40 ft	12	2	05/29/07 14:33	27.40	1.4	1.0 U	1.0 U	1.6	10,300	

Table D-1. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-1A216-Z-18/216-Z-12 Site. (8 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
CPT-34/ 40 ft	12	2	06/27/07 13:53	34.87	1.1	1.0 U	1.0 U	1.9	11,500	
CPT-34/ 40 ft	12	2	07/25/07 12:48	24.91	1.1	1.0 U	1.0 U	1.5	13,200	
CPT-34/ 40 ft	12	2	08/30/07 16:17	44.83	2.8	1.0 U	1.0 U	3.4	15,200	
CPT-34/ 40 ft	12	2	09/24/07 15:17	17.43	2.3	1.0 U	1.0 U	1.9	13,800	
CPT-30/48 ft	15	2	10/25/06 11:49	0.00	1.0 U	1.0 U	1.0 U	2.1	10,800	
CPT-30/ 48 ft	15	2	11/30/06 12:13	-7.47	4.2	1.0 U	1.0 U	1.8	4,700	
CPT-30/ 48 ft	15	2	11/30/06 12:13	-7.47	5.0	1.0 U	1.0 U	2.2	4,610	Duplicate
CPT-30/ 48 ft	15	2	12/19/06 10:23	-12.45	3.1	1.0 U	1.0 U	1.4	8,060	
CPT-30/ 48 ft	15	2	01/31/07 10:30	14.94	2.9	1.0 U	1.0 U	1.7	5,750	
CPT-30/ 48 ft	15	2	02/27/07 12:07	-92.16	1.5	1.0 U	1.0 U	3.2	7,870	
CPT-30/ 48 ft	15	2	03/21/07 10:19	-107.10	1.1	1.0 U	1.0 U	3.3	6,810	
C3872/ 62.5 ft	19	2	10/25/06 11:05	-114.57	3.5	1.0 U	1.0 U	1.0 U	10,200	
C3872/ 62.5 ft	19	2	11/30/06 11:27	-4.98	5.5	1.0 U	1.0 U	1.5	4,510	
C3872/ 62.5 ft	19	2	12/19/06 09:56	-77.21	6.1	1.0 U	1.0 U	1.0	7,010	
C3872/ 62.5 ft	19	2	01/31/07 09:46	32.38	7.8	1.0 U	1.0 U	1.1	5,390	
C3872/ 62.5 ft	19	2	02/27/07 11:28	0.00	12.2	1.0 U	1.0 U	2.1	7,200	
C3872/ 62.5 ft	19	2	03/21/07 09:45	-146.95	10.1	1.0 U	1.0 U	1.7	6,100	
C3872/ 62.5 ft	19	2	04/18/07 09:25	2.49	11.5	1.0 U	1.0 U	1.9	6,760	
C3872/ 62.5 ft	19	2	05/29/07 12:16	17.43	15.2	1.0 U	1.0 U	2.6	9,130	
C3872/ 62.5 ft	19	2	06/27/07 10:20	44.83	16.8	1.0 U	1.5	3.6	8,090	
C3872/ 62.5 ft	19	2	07/25/07 10:07	-12.45	17.2	1.0 U	1.3	2.8	11,600	

Table D-1. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-1A216-Z-18/216-Z-12 Site. (8 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
CPT-1A/ 68 ft	21	2	04/18/07 10:25	19.93	6.2	1.0 U	1.0 U	1.1	6,790	
CPT-1A/ 68 ft	21	2	05/29/07 13:20	37.36	1.0 U	1.0 U	1.0 U	1.1	9,380	
CPT-1A/ 68 ft	21	2	06/27/07 12:32	34.87	1.0 U	1.6	1.1	3.3	9,290	
CPT-1A/ 68 ft	21	2	07/25/07 11:19	32.38	6.4	1.0 U	1.2	2.1	11,900	
CPT-32/ 70 ft	21	2	04/18/07 09:55	-4.98	5.2	1.0 U	1.0 U	2.1	6,640	
CPT-32/ 70 ft	21	2	05/29/07 12:46	39.85	6.0	1.0 U	1.0 U	2.6	9,210	
CPT-32/ 70 ft	21	2	06/27/07 11:14	54.80	6.4	1.0 U	1.0 U	3.3	8,270	
CPT-32/ 70 ft	21	2	07/25/07 10:36	7.47	6.3	1.0 U	1.0 U	2.5	12,400	
299-W18-152/ 101 ft	31	2	10/25/06 12:04	-423.42	13.0	1.0 U	1.0 U	1.1	12,400	
299-W18-152/ 101 ft	31	2	11/30/06 12:27	-44.83	14.4	1.0 U	1.0 U	1.8	4,640	
299-W18-152/ 101 ft	31	2	12/19/06 10:34	-97.14	13.8	1.0 U	1.0 U	1.4	6,630	
299-W18-152/ 101 ft	31	2	01/31/07 10:46	97.14	15.1	1.0 U	1.0 U	1.5	5,620	
299-W18-152/ 101 ft	31	2	02/27/07 12:25	24.91	16.3	1.0 U	1.0 U	1.9	7,860	
299-W18-152/ 101 ft	31	2	03/21/07 10:32	-251.56	13.1	1.0 U	1.0 U	1.7	6,850	
299-W18-152/ 101 ft	31	2	04/18/07 10:30	2.49	13.8	1.0 U	1.0 U	1.7	7,000	
299-W18-152/ 101 ft	31	2	04/18/07 10:30	2.49	14.8	1.0 U	1.0 U	1.9	7,560	Duplicate
299-W18-152/ 101 ft	31	2	05/29/07 13:24	72.23	12.6	1.6	2.4	2.8	9,680	
299-W18-152/ 101 ft	31	2	06/27/07 12:37	102.12	13.7	1.3	3.0	3.3	10,100	
299-W18-152/ 101 ft	31	2	07/25/07 11:23	14.94	11.8	1.4	3.2	2.6	12,700	
299-W18-167/ 106 ft	32	3	10/25/06 11:29	-174.35	1.0 U	1.0 U	1.0 U	1.0 U	6,810	
299-W18-167/ 106 ft	32	3	11/30/06 11:50	-2.49	1.0 U	1.0 U	1.0 U	1.0 U	4,650	

Table D-1. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-1A216-Z-18/216-Z-12 Site. (8 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
299-W18-167/ 106 ft	32	3	12/19/06 10:46	-87.17	1.0 U	1.0 U	1.0 U	1.0 U	6,980	
299-W18-167/ 106 ft	32	3	01/31/07 10:11	47.32	3.0	1.0 U	1.0 U	1.0 U	5,630	
299-W18-167/ 106 ft	32	3	02/27/07 11:50	14.94	1.1	1.0 U	1.0 U	1.0 U	7,590	
299-W18-167/ 106 ft	32	3	03/21/07 10:04	-271.49	1.0 U	1.0 U	1.0 U	1.0 U	6,930	
299-W18-167/ 106 ft	32	3	04/18/07 09:45	-2.49	1.0 U	1.0 U	1.0 U	1.0 U	7,350	
299-W18-167/ 106 ft	32	3	05/29/07 12:37	-2.49	1.0 U	1.0 U	1.0 U	1.0	8,620	
299-W18-167/ 106 ft	32	3	06/27/07 11:04	77.21	3.0	1.0 U	1.0 U	1.7	7,990	
299-W18-167/ 106 ft	32	3	06/27/07 11:04	77.21	3.1	1.0 U	1.0 U	1.6	8,480	Duplicate
299-W18-167/ 106 ft	32	3	07/25/07 10:29	-19.93	1.0 U	1.0 U	1.0 U	1.0 U	11,200	
CPT-4F / 109 ft	33	3	04/18/07 10:08	9.96	4.1	1.0 U	1.0 U	1.0 U	7,350	
CPT-4F / 109 ft	33	3	05/29/07 13:01	12.45	5.2	1.0 U	1.0 U	1.5	9,410	
CPT-4F / 109 ft	33	3	06/27/07 12:13	84.68	1.0 U	1.0 U	1.0 U	1.0 U	7,620	
CPT-4F / 109 ft	33	3	07/25/07 11:08	0.00	1.0 U	1.0 U	1.0 U	1.0 U	11,100	
299-W18-165/ 109 ft	33	3	10/25/06 11:22	-74.72	1.0 U	1.0 U	1.0 U	1.0 U	7,050	
299-W18-165/ 109 ft	33	3	11/30/06 11:45	-4.98	1.0 U	1.0 U	1.0 U	1.0 U	4,590	
299-W18-165/ 109 ft	33	3	12/19/06 10:41	-87.17	1.0 U	1.0 U	1.0 U	1.0 U	6,830	
299-W18-165/ 109 ft	33	3	01/31/07 10:05	47.32	2.5	1.0 U	1.0 U	1.0 U	5,360	
299-W18-165/ 109 ft	33	3	02/27/07 11:43	2.49	2.2	1.0 U	1.0 U	1.0 U	7,750	
299-W18-165/ 109 ft	33	3	03/21/07 09:58	-107.10	1.0 U	1.0 U	1.0 U	1.0 U	5,470	
299-W18-165/ 109 ft	33	3	04/18/07 09:35	-7.47	1.0 U	1.0 U	1.0 U	1.0 U	6,680	
299-W18-165/ 109 ft	33	3	05/29/07 12:31	0.00	1.0 U	1.0 U	1.0 U	1.0 U	8,550	

Table D-1. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-1A216-Z-18/216-Z-12 Site. (8 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
299-W18-165/ 109 ft	33	3	05/29/07 12:31	0.00	1.0 U	1.0 U	1.0 U	1.0 U	8,690	Duplicate
299-W18-165/ 109 ft	33	3	06/27/07 10:57	32.38	3.2	1.0 U	1.0 U	1.5	7,660	
299-W18-165/ 109 ft	33	3	07/25/07 10:25	-4.98	1.0 U	1.0 U	1.0 U	1.0 U	11,300	
299-W18-249/ 130 ft	40	3	10/25/06 15:37	-57.29	16.8	1.0 U	1.0 U	1.9	16,000	
299-W18-249/ 130 ft	40	3	11/30/06 14:55	-72.23	18.4	1.0 U	1.0 U	1.3	5,210	
299-W18-249/ 130 ft	40	3	12/19/06 12:33	-19.93	8.8	1.0 U	1.0 U	1.0 U	6,420	
299-W18-249/ 130 ft	40	3	01/31/07 13:15	231.64	19.7	1.0 U	1.0 U	1.3	5,840	
299-W18-249/ 130 ft	40	3	02/27/07 14:47	117.06	16.1	1.0 U	1.0 U	1.9	8,080	
299-W18-249/ 130 ft	40	3	03/21/07 12:26	-179.33	16.0	1.0 U	1.0 U	1.7	10,600	
299-W18-249/ 130 ft	40	3	04/18/07 11:37	34.87	15.0	1.0 U	1.0 U	1.8	8,330	
299-W18-249/ 130 ft	40	3	05/29/07 14:20	79.70	15.4	1.0 U	1.0 U	2.1	10,100	
299-W18-249/ 130 ft	40	3	06/27/07 13:31	132.01	18.1	1.0 U	1.0 U	2.6	10,500	
299-W18-249/ 130 ft	40	3	07/25/07 12:22	34.87	14.9	1.0 U	1.0 U	2.2	12,700	
299-W18-249/ 130 ft	40	3	07/25/07 12:22	34.87	16.1	1.0 U	1.0 U	2.5	12,700	Duplicate
299-W18-248/ 131 ft	40	3	10/25/06 11:11	-351.19	42.1	1.0 U	1.0 U	1.0 U	10,600	
299-W18-248/ 131 ft	40	3	11/30/06 11:36	-19.93	45.3	1.0 U	1.0 U	1.4	4,790	
299-W18-248/ 131 ft	40	3	12/19/06 10:03	-141.97	30.7	1.0 U	1.0 U	1.0 U	7,120	
299-W18-248/ 131 ft	40	3	01/31/07 09:55	74.72	52.7	1.0 U	1.0 U	1.0 U	6,040	
299-W18-248/ 131 ft	40	3	02/27/07 11:35	0.00	131.0	1.0 U	1.0 U	2.3	6,920	
299-W18-248/ 131 ft	40	3	03/21/07 09:51	-418.44	4.7	1.0 U	1.0 U	1.0 U	6,070	
299-W18-248/ 131 ft	40	3	04/18/07 09:30	-87.17	70.0	1.0 U	1.0 U	1.6	6,820	

Table D-1. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-1A216-Z-18/216-Z-12 Site. (8 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
299-W18-248/ 131 ft	40	3	05/29/07 12:24	-112.08	34.4	1.0 U	1.0 U	1.6	9,130	
299-W18-248/131 ft	40	3	06/27/07 10:32	42.34	65.9	1.0 U	1.0 U	2.3	8,070	
299-W18-248/131 ft	40	3	07/25/07 10:20	19.93	60.9	1.0 U	1.0 U	1.7	11,600	

bgs = below ground surface
CCl_4 = carbon tetrachloride
$CHCl_3$ = chloroform
CH_2Cl_2 = methylene chloride
MEK = methyl ethyl ketone
ppmv = parts per million by volume
U = analyzed for but not detected; value reported is the reporting limit

Table D-2. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-9 Site. (9 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
CPT-17/ 10 ft	3	2	10/25/06 14:39	12.45	1.2	1.0 U	1.0 U	1.0 U	11,000	
CPT-17/ 10 ft	3	2	11/30/06 13:35	-2.49	1.2	1.0 U	1.0 U	1.0 U	4,830	
CPT-17/ 10 ft	3	2	12/19/06 11:55	2.49	1.2	1.0 U	1.0 U	1.0 U	6,340	
CPT-17/ 10 ft	3	2	01/31/07 12:25	7.47	1.4	1.0 U	1.0 U	1.0 U	5,820	
CPT-17/ 10 ft	3	2	02/27/07 14:12	7.47	1.6	1.0 U	1.0 U	1.3	7,900	
CPT-17/ 10 ft	3	2	03/21/07 11:55	4.98	1.5	1.0 U	1.0 U	1.0	8,280	
CPT-17/ 10 ft	3	2	08/30/07 15:54	27.40	1.3	1.0 U	1.0 U	2.4	16,400	
CPT-17/ 10 ft	3	2	09/24/07 14:55	14.94	1.3	1.0 U	1.0 U	1.0 U	13,000	
CPT-18/ 15 ft	5	2	08/30/07 15:40	34.87	1.0 U	1.0 U	1.0 U	2.7	15,200	
CPT-18/ 15 ft	5	2	09/24/07 14:31	24.91	1.0 U	1.0 U	1.0 U	1.0 U	13,600	
CPT-27/15 ft	5	2	10/25/06 14:31	4.98	1.0 U	1.0 U	1.0 U	1.0 U	10,600	
CPT-27/15 ft	5	2	11/30/06 13:09	-14.94	1.0 U	1.0 U	1.0 U	1.0 U	5,300	
CPT-27/15 ft	5	2	12/19/06 11:25	0.00	1.0 U	1.0 U	1.0 U	1.0 U	6,420	
CPT-27/15 ft	5	2	01/31/07 11:48	22.42	1.0 U	1.0 U	1.0 U	1.0 U	5,650	
CPT-27/15 ft	5	2	02/27/07 13:28	7.47	1.0 U	1.0 U	1.0 U	1.0 U	7,820	
CPT-27/15 ft	5	2	03/21/07 11:15	-9.96	1.0 U	1.0 U	1.0 U	1.0 U	7,430	
CPT-16/ 25 ft	8	2	10/25/06 13:57	7.47	1.0 U	1.0 U	1.0 U	1.0 U	9,040	
CPT-16/ 25 ft	8	2	11/30/06 12:44	-9.96	1.0	1.0 U	1.0 U	1.0 U	4,650	
CPT-16/ 25 ft	8	2	12/19/06 11:01	-2.49	1.0 U	1.0 U	1.0 U	1.0 U	6,490	
CPT-16/ 25 ft	8	2	01/31/07 11:07	7.47	1.0 U	1.0 U	1.0 U	1.0 U	5,760	
CPT-16/ 25 ft	8	2	02/27/07 12:49	4.98	1.0	1.0 U	1.0 U	1.0 U	7,900	

Table D-2. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-9 Site. (9 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
CPT-16/ 25 ft	8	2	03/21/07 10:50	-17.43	1.0 U	1.0 U	1.0 U	1.0 U	7,300	
CPT-16/ 25 ft	8	2	08/30/07 14:00	37.36	1.0 U	1.0 U	1.0 U	1.7	12,300	
CPT-16/ 25 ft	8	2	09/24/07 13:25	14.94	1.0 U	1.0 U	1.0 U	1.1	10,200	
CPT-27/ 33 ft	10	2	08/30/07 15:06	39.85	1.0	1.0 U	1.0 U	1.7	13,400	
CPT-27/ 33 ft	10	2	09/24/07 13:58	19.93	1.0 U	1.0 U	1.0 U	1.1	12,000	
CPT-18/ 35 ft	10	2	10/25/06 14:52	4.98	1.0 U	1.0 U	1.0 U	1.0 U	11,800	
CPT-18/ 35 ft	10	2	11/30/06 13:41	-2.49	1.0 U	1.0 U	1.0 U	1.0 U	4,820	
CPT-18/ 35 ft	10	2	12/19/06 11:49	12.45	1.0 U	1.0 U	1.0 U	1.2	6,500	
CPT-18/ 35 ft	10	2	01/31/07 12:20	17.43	1.0 U	1.0 U	1.0 U	1.0 U	5,730	
CPT-18/ 35 ft	10	2	02/27/07 14:04	7.47	1.0 U	1.0 U	1.0 U	1.0 U	7,970	
CPT-18/ 35 ft	10	2	03/21/07 11:49	4.98	1.0 U	1.0 U	1.0 U	1.1	8,620	
CPT-28/ 40 ft	12	2	04/18/07 11:15	9.96	8.6	1.0 U	1.0 U	1.0 U	7,690	
CPT-28/ 40 ft	12	2	05/29/07 14:04	44.83	59.3	1.0 U	1.0 U	2.8	10,100	
CPT-28/ 40 ft	12	2	06/27/07 13:09	24.91	4.9	1.0 U	1.0 U	1.1	10,300	
CPT-28/ 40 ft	12	2	07/25/07 12:05	14.94	5.5	1.0 U	1.0 U	1.0 U	12,900	
CPT-9A/ 50 ft	15	2	10/25/06 10:36	-286.43	30.6	1.0 U	1.0 U	2.8	9,720	
CPT-9A/ 50 ft	15	2	11/30/06 11:02	-99.63	42.6	1.0 U	1.0 U	4.2	4,240	
CPT-9A/ 50 ft	15	2	12/19/06 09:37	-204.24	42.0	1.0 U	1.0 U	3.9	7,000	
CPT-9A/ 50 ft	15	2	01/31/07 09:25	19.93	43.7	1.0 U	1.0 U	3.7	5,130	
CPT-9A/ 50 ft	15	2	02/27/07 10:59	-49.81	39.5	1.0 U	1.0 U	3.6	7,000	
CPT-9A/ 50 ft	15	2	03/21/07 09:27	-254.05	27.4	1.0 U	1.0 U	2.7	5,930	
CPT-9A/ 50 ft	15	2	04/18/07 09:05	-47.32	39.7	1.0 U	1.0 U	3.5	7,900	

Table D-2. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-9 Site. (9 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
CPT-9A/ 50 ft	15	2	05/29/07 11:52	0.00	39.1	1.0 U	1.3	4.4	8,940	
CPT-9A/ 50 ft	15	2	06/27/07 09:44	9.96	43.6	1.0 U	1.8	5.2	7,740	
CPT-9A/ 50 ft	15	2	07/25/07 09:45	-67.25	37.5	1.0 U	1.1	3.4	12,200	
CPT-9A/ 50 ft	15	2	08/30/07 13:02	114.57	45.6	1.0 U	2.6	6.6	12,300	
CPT-9A/ 50 ft	15	2	09/24/07 12:38	-17.43	44.7	1.0 U	1.1	5.0	9,830	
CPT-9A/ 60 ft	18	2	10/25/06 10:30	-37.36	14.2	1.0 U	1.0 U	1.0 U	8,360	
CPT-9A/ 60 ft	18	2	11/30/06 10:55	-14.94	16.2	1.0 U	1.0 U	2.0	4,280	
CPT-9A/ 60 ft	18	2	12/19/06 09:32	-37.36	13.1	1.0 U	1.0 U	1.0 U	7,030	
CPT-9A/ 60 ft	18	2	01/31/07 09:20	2.49	13.2	1.0 U	1.0 U	1.0 U	5,670	
CPT-9A/ 60 ft	18	2	02/27/07 10:55	-4.98	7.2	1.0 U	1.0 U	1.0 U	6,580	
CPT-9A/ 60 ft	18	2	03/21/07 09:22	-47.32	10.7	1.0 U	1.0 U	1.3	5,320	
CPT-9A/ 60 ft	18	2	04/18/07 09:00	-7.47	12.9	1.0 U	1.0 U	1.3	5,810	
CPT-9A/ 60 ft	18	2	05/29/07 11:50	9.96	12.1	1.0 U	1.0 U	1.4	8,650	
CPT-9A/ 60 ft	18	2	06/27/07 09:37	14.94	12.1	1.0 U	1.0 U	2.1	7,440	
CPT-9A/ 60 ft	18	2	07/25/07 09:42	-4.98	22.0	1.0 U	1.0 U	1.8	11,900	
CPT-9A/ 60 ft	18	2	08/30/07 12:55	42.34	14.5	1.0 U	1.3	3.4	11,300	
CPT-9A/ 60 ft	18	2	09/24/07 12:36	7.47	14.9	1.0 U	1.0 U	2.0	7,810	
C4938/ 64.0 ft	20		08/30/07 11:33	24.91	78.2	1.1	2.1	7.9	14,900	
C4938/ 64.0 ft	20		09/24/07 14:15	17.43	35.7	1.0 U	1.3	11.6	11,100	
C4937/ 64.1 ft	20		08/30/07 11:37	29.89	191.0	4.0	3.2	9.9	15,600	
C4937/ 64.1 ft	20		09/24/07 14:10	17.43	101.0	1.0 U	1.3	6.9	10,900	
C5340/ 64.5 ft	20		08/30/07 11:43	22.42	48.4	1.0 U	2.0	8.4	15,700	

Table D-2. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-9 Site. (9 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
C5340/ 64.5 ft	20		09/24/07 14:22	14.94	17.3	1.0 U	1.0	5.9	11,200	
CPT-9A/ 64 ft	20	2	10/25/06 10:43	-164.39	28.1	1.0 U	1.0 U	1.9	9,930	
CPT-9A/ 64 ft	20	2	11/30/06 11:08	-42.34	32.3	1.0 U	1.0 U	2.7	4,410	
CPT-9A/ 64 ft	20	2	12/19/06 09:41	-67.25	28.9	1.0 U	1.0 U	2.3	7,100	
CPT-9A/ 64 ft	20	2	01/31/07 09:30	14.94	16.7	1.0 U	1.0 U	1.2	5,140	
CPT-9A/ 64 ft	20	2	02/27/07 11:03	-24.91	29.9	1.0 U	1.0 U	2.5	7,240	
CPT-9A/ 64 ft	20	2	03/21/07 09:30	-149.44	26.1	1.0 U	1.0 U	2.5	5,980	
CPT-9A/ 64 ft	20	2	04/18/07 09:10	-27.40	23.4	1.0 U	1.0 U	2.1	6,810	
CPT-9A/ 64 ft	20	2	05/29/07 11:57	19.93	31.4	1.0 U	1.0 U	3.3	8,790	
CPT-9A/ 64 ft	20	2	06/27/07 09:50	22.42	32.4	1.0 U	1.0 U	3.4	7,750	
CPT-9A/ 64 ft	20	2	07/25/07 09:48	-34.87	30.4	1.0 U	1.0 U	2.5	11,800	
CPT-9A/ 64 ft	20	2	08/30/07 13:07	97.14	33.1	1.0 U	1.1	4.7	12,400	
CPT-9A/ 64 ft	20	2	09/24/07 12:40	9.96	32.0	1.0 U	1.0 U	3.9	9,100	
CPT-16/ 65 ft	20	2	08/30/07 14:05	114.57	6.2	1.0 U	1.0 U	1.8	12,000	
CPT-16/ 65 ft	20	2	09/24/07 13:26	24.91	6.9	1.0 U	1.0 U	1.0 U	10,100	
CPT-21A/ 65 ft	20	2	10/25/06 15:01	-27.40	123.0	1.0 U	1.0 U	3.7	13,700	
CPT-21A/ 65 ft	20	2	11/30/06 14:31	-52.30	120.0	1.0 U	1.0 U	3.0	4,900	
CPT-21A/ 65 ft	20	2	12/19/06 12:01	12.45	123.0	1.0 U	1.0 U	2.5	6,650	
CPT-21A/ 65 ft	20	2	01/31/07 12:35	92.16	127.0	1.0 U	1.0 U	2.7	6,040	
CPT-21A/ 65 ft	20	2	02/27/07 14:17	49.81	138.0	1.0 U	1.0 U	3.9	7,950	
CPT-21A/ 65 ft	20	2	03/21/07 12:00	-44.83	101.0	1.0 U	1.0 U	3.2	8,240	
CPT-21A/ 65 ft	20	2	04/18/07 11:05	-7.47	119.0	1.0 U	1.0 U	3.5	7,030	

Table D-2. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-9 Site. (9 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
CPT-21A/ 65 ft	20	2	05/29/07 13:55	84.68	105.0	1.0 U	1.0 U	4.0	9,690	
CPT-21A/ 65 ft	20	2	06/27/07 12:58	54.80	193.0	1.0 U	1.2	4.0	9,560	
CPT-21A/ 65 ft	20	2	07/25/07 11:49	9.96	112.0	1.0 U	1.2	3.4	12,600	
CPT-21A/ 65 ft	20	2	08/30/07 15:59	186.80	160.0	1.0 U	1.5	5.6	17,700	
CPT-21A/ 65 ft	20	2	09/24/07 14:58	82.19	130.0	1.0 U	1.0 U	4.0	14,900	
CPT-24/ 70 ft	21	2	08/30/07 15:45	154.42	2.5	1.0 U	1.5	8.2	13,800	
CPT-24/ 70 ft	21	2	09/24/07 14:48	82.19	2.4	1.0 U	1.1	6.3	13,100	
CPT-18/ 75 ft	23	2	08/30/07 15:41	114.57	1.0 U	1.0 U	1.2	2.8	15,200	
CPT-18/ 75 ft	23	2	09/24/07 14:35	79.70	1.0 U	1.0 U	1.0 U	1.3	14,200	
299-W15-82/ 83 ft	25	2	10/25/06 14:22	-7.47	1.0 U	1.0 U	1.0 U	1.1	12,200	
299-W15-82/ 83 ft	25	2	11/30/06 13:05	-14.94	1.0 U	1.0 U	1.0 U	1.0 U	4,640	
299-W15-82/ 83 ft	25	2	12/19/06 11:21	-14.94	1.0 U	1.0 U	1.0 U	1.0 U	6,510	
299-W15-82/ 83 ft	25	2	01/31/07 11:40	4.98	2.3	1.0 U	1.0 U	1.0 U	5,610	
299-W15-82/ 83 ft	25	2	02/27/07 13:17	2.49	3.9	1.0 U	1.0 U	1.3	7,820	
299-W15-82/ 83 ft	25	2	03/21/07 11:10	-12.45	1.0 U	1.0 U	1.0 U	1.0 U	8,200	
299-W15-82/ 83 ft	25	2	08/30/07 15:00	27.40	1.0 U	1.0 U	1.2	2.6	12,200	
299-W15-82/ 83 ft	25	2	09/24/07 13:54	7.47	1.0 U	1.0 U	1.0 U	1.0	9,310	
CPT-21A/ 86 ft	26	2	10/25/06 15:07	-59.78	159.0	1.0 U	1.0 U	4.3	13,800	
CPT-21A/ 86 ft	26	2	11/30/06 14:28	-57.29	169.0	1.0 U	1.0 U	3.8	4,740	
CPT-21A/ 86 ft	26	2	12/19/06 12:05	4.98	164.0	1.0 U	1.0 U	3.6	6,390	
CPT-21A/ 86 ft	26	2	01/31/07 12:42	171.86	189.0	1.0 U	1.0 U	3.8	6,060	
CPT-21A/ 86 ft	26	2	02/27/07 14:26	84.68	170.0	1.0 U	1.0 U	4.1	8,100	

Table D-2. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-9 Site. (9 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
CPT-21A/ 86 ft	26	2	03/21/07 12:03	-124.54	119.0	1.0 U	1.0 U	3.2	8,400	
CPT-21A/ 86 ft	26	2	04/18/07 11:10	-27.40	161.0	1.0 U	1.0 U	3.7	7,090	
CPT-21A/ 86 ft	26	2	05/29/07 13:59	84.68	125.0	1.0 U	1.0 U	3.7	9,930	
CPT-21A/ 86 ft	26	2	06/27/07 13:00	79.70	207.0	1.0 U	1.8	5.1	9,830	
CPT-21A/ 86 ft	26	2	07/25/07 11:52	-7.47	183.0	1.0 U	1.9	4.5	13,200	
CPT-21A/ 86 ft	26	2	08/30/07 16:01	-191.78	230.0	1.0	2.5	7.1	22,100	
CPT-21A/ 86 ft	26	2	09/24/07 15:00	-338.74	190.0	1.0 U	1.4	4.8	14,600	
CPT-28/ 87 ft	27	2	10/25/06 15:14	-52.30	181.0	1.0 U	1.0 U	4.1	15,300	
CPT-28/ 87 ft	27	2	10/25/06 15:14	-52.30	189.0	1.0 U	1.0 U	4.6	15,800	Duplicate
CPT-28/ 87 ft	27	2	11/30/06 14:39	-64.76	202.0	1.0 U	1.0 U	3.8	4,820	
CPT-28/ 87 ft	27	2	12/19/06 12:12	19.93	198.0	1.0 U	1.0 U	3.2	6,550	
CPT-28/ 87 ft	27	2	01/31/07 12:55	-129.52	1.0 U	1.0 U	1.0 U	1.0 U	5,300	
CPT-28/ 87 ft	27	2	02/27/07 14:32	92.16	209.0	1.0 U	1.0 U	4.5	8,400	
CPT-28/ 87 ft	27	2	03/21/07 12:09	-112.08	119.0	1.0 U	1.0 U	3.3	8,650	
CPT-28/ 87 ft	27	2	04/18/07 11:20	19.93	182.0	1.0 U	1.0 U	3.7	7,240	
CPT-28/ 87 ft	27	2	05/29/07 14:07	97.14	147.0	1.0 U	1.0 U	3.7	9,870	
CPT-28/ 87 ft	27	2	06/27/07 13:10	97.14	262.0	1.0 U	1.0	4.1	10,200	
CPT-28/ 87 ft	27	2	07/25/07 12:03	9.96	162.0	1.0 U	1.0 U	3.8	13,200	
CPT-28/ 87 ft	27	2	08/30/07 16:06	234.13	243.0	1.0 U	1.5	6.7	15,500	
CPT-28/ 87 ft	27	2	09/24/07 15:05	99.63	232.0	1.0 U	1.5	5.4	17,600	
299-W15-8U / 103 ft	31	2	10/25/06 13:49	-615.20	2.4	1.0 U	1.0 U	1.0	9,180	
299-W15-8U / 103 ft	31	2	11/30/06 13:23	-176.84	6.1	1.0 U	1.0 U	1.0 U	4,920	

Table D-2. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-9 Site. (9 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
299-W15-8U / 103 ft	31	2	12/19/06 11:39	-224.16	1.2	1.0 U	1.0 U	1.0 U	6,440	
299-W15-8U / 103 ft	31	2	01/31/07 12:02	293.90	4.6	1.0 U	1.0 U	7.1	5,530	
299-W15-8U / 103 ft	31	2	02/27/07 13:46	181.82	14.1	1.0 U	1.0 U	6.3	7,620	
299-W15-8U / 103 ft	31	2	02/27/07 13:46	181.82	14.8	1.0 U	1.0 U	6.6	8,100	Duplicate
299-W15-8U / 103 ft	31	2	03/21/07 11:31	-1013.71	1.7	1.0 U	1.0 U	1.0 U	7,150	
299-W15-8U / 103 ft	31	2	08/30/07 15:24	415.95	1.0 U	1.0 U	1.0 U	4.2	12,700	
299-W15-8U / 103 ft	31	2	09/24/07 14:12	-528.03	1.0 U	1.0 U	1.0 U	1.5	10,700	
299-W15-217/ 114 ft	35	3	10/25/06 14:45	-42.34	1.0 U	1.0 U	1.0 U	1.0 U	5,650	
299-W15-217/ 114 ft	35	3	11/30/06 13:37	-9.96	1.0 U	1.0 U	1.0 U	1.0 U	4,750	
299-W15-217/ 114 ft	35	3	12/19/06 11:44	-19.93	1.0 U	1.0 U	1.0 U	1.0 U	6,230	
299-W15-217/ 114 ft	35	3	01/31/07 12:10	154.42	7.0	1.0 U	1.0 U	1.0 U	5,680	
299-W15-217/ 114 ft	35	3	02/27/07 13:58	59.78	16.5	1.0 U	1.0 U	1.7	7,930	
299-W15-217/ 114 ft	35	3	03/21/07 11:35	-139.48	1.0 U	1.0 U	1.0 U	1.0 U	8,370	
299-W15-217/ 114 ft	35	3	08/30/07 15:27	119.55	4.8	1.0 U	1.4	3.1	13,200	
299-W15-217/ 114 ft	35	3	08/30/07 15:27	119.55	4.6	1.0 U	1.0 U	3.1	13,100	Duplicate
299-W15-217/ 114 ft	35	3	09/24/07 14:22	9.96	1.1	1.0 U	1.0 U	1.3	8,200	
CPT-24/ 118 ft	36	3	08/30/07 15:47	303.87	19.9	1.0 U	1.6	6.6	13,900	
CPT-24/ 118 ft	36	3	09/24/07 14:49	99.63	20.9	1.0 U	1.0 U	4.9	12,700	
299-W15-220SST/ 118 ft	36	3	08/30/07 14:25	316.32	21.0	1.0 U	1.2	3.3	12,500	
299-W15-220SST/ 118 ft	36	3	09/24/07 13:42	-610.22	15.3	1.0 U	1.0 U	2.1	10,100	
299-W15-95L/ 144 ft	44	4	10/25/06 14:08	-605.24	10.0	1.0 U	1.0 U	4.0	11,100	
299-W15-95L/ 144 ft	44	4	11/30/06 12:53	-151.93	16.2	1.0 U	1.0 U	5.2	4,940	

Table D-2. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-9 Site. (9 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
299-W15-95L/ 144 ft	44	4	12/19/06 11:09	-246.58	15.3	1.0 U	1.0 U	4.9	6,670	
299-W15-95L/ 144 ft	44	4	01/31/07 11:25	204.24	16.9	1.0 U	1.0 U	5.1	5,610	
299-W15-95L/ 144 ft	44	4	02/27/07 13:04	144.46	18.0	1.0 U	1.0 U	5.7	7,680	
299-W15-95L/ 144 ft	44	4	03/21/07 11:42	-523.05	1.0 U	1.0 U	1.0 U	1.0 U	7,320	
299-W15-95L/ 144 ft	44	4	08/30/07 14:47	358.66	12.3	1.0 U	1.6	7.0	12,400	
299-W15-95L/ 144 ft	44	4	09/24/07 13:47	-600.26	12.0	1.0 U	1.0 U	6.5	9,960	
299-W15-220L/ 163 ft	50	5	08/30/07 14:15	276.47	8.5	1.0 U	1.1	3.2	12,400	
299-W15-220L/ 163 ft	50	5	09/24/07 13:38	-602.75	1.0 U	1.0 U	1.0 U	1.2	10,500	
299-W15-219L/ 175 ft	53	5	08/30/07 15:48	328.77	15.7	1.0 U	1.6	8.5	13,900	
299-W15-219L/ 175 ft	53	5	09/24/07 14:40	-495.65	1.0 U	1.0 U	1.0 U	2.0	12,000	
299-W15-219L/ 175 ft	53	5	09/24/07 14:40	-495.65	1.0 U	1.0 U	1.0 U	1.5	11,900	Duplicate
299-W15-9L/ 176 ft	54	6	10/25/06 14:15	-393.53	4.7	1.0 U	1.0 U	1.8	11,300	
299-W15-9L/ 176 ft	54	6	11/30/06 12:57	-82.19	2.3	1.0 U	1.0 U	1.0 U	4,760	
299-W15-9L/ 176 ft	54	6	12/19/06 11:14	-139.48	2.2	1.0 U	1.0 U	1.0 U	6,470	
299-W15-9L/ 176 ft	54	6	01/31/07 11:30	166.88	3.5	1.0 U	1.0 U	1.0 U	5,430	
299-W15-9L/ 176 ft	54	6	01/31/07 11:30	166.88	3.5	1.0 U	1.0 U	1.0 U	5,440	Duplicate
299-W15-9L/ 176 ft	54	6	02/27/07 13:09	102.12	7.9	1.0 U	1.0 U	2.0	7,910	
299-W15-9L/ 176 ft	54	6	03/21/08 11:06	-323.79	4.7	1.0 U	1.0 U	1.1	7,870	
299-W15-9L/ 176 ft	54	6	08/30/07 14:53	316.32	6.7	1.0 U	1.0 U	3.9	12,800	
299-W15-9L/ 176 ft	54	6	09/24/07 13:49	-393.53	6.6	1.0 U	1.0 U	2.7	10,700	
299-W15-84L/ 180 ft	55	6	08/30/07 15:33	415.95	11.0	1.0 U	1.5	6.8	12,500	
299-W15-84L/ 180 ft	55	6	09/24/07 14:26	-523.05	4.4	1.0 U	1.0 U	2.0	9,400	

Table D-2. Monitoring Data for Non-Operational Wells and Probes at the 216-Z-9 Site. (9 sheets)

Sample Location	Depth (m bgs)	Zone	Sample Date Time	Differential Pressure (Pa)	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)	Comment
299-W15-46 / 217 ft	66	6	10/25/06 13:43	-141.97	1.0 U	1.0 U	1.0 U	1.0 U	6,140	
299-W15-46 / 217 ft	66	6	11/30/06 13:17	-49.81	1.0 U	1.0 U	1.0 U	1.0 U	4,450	
299-W15-46 / 217 ft	66	6	12/19/06 11:33	-69.74	1.0 U	1.0 U	1.0 U	1.0 U	6,380	
299-W15-46 / 217 ft	66	6	01/31/07 11:55	241.60	4.0	1.0 U	1.0 U	1.0 U	5,730	
299-W15-46 / 217 ft	66	6	02/27/07 13:38	54.80	5.7	1.0 U	1.0 U	1.0 U	7,950	
299-W15-46 / 217 ft	66	6	03/21/07 11:24	-523.05	1.0 U	1.0 U	1.0 U	1.0 U	6,180	
299-W15-46 / 217 ft	66	6	03/21/07 11:26	-523.05	1.0 U	1.0 U	1.0 U	1.0 U	5,750	Duplicate
299-W15-46 / 217 ft	66	6	08/30/07 15:19	37.36	3.1	1.0 U	1.6	3.1	12,900	
299-W15-46 / 217 ft	66	6	09/24/07 14:02	-62.27	1.0 U	1.0 U	1.0 U	1.2	7,660	

bgs = below ground surface
CCl_4 = carbon tetrachloride
$CHCl_3$ = chloroform
CH_2Cl_2 = methylene chloride
MEK = methyl ethyl ketone
ppmv = parts per million by volume
U = analyzed for but not detected; value reported is the reporting limit

Table D-3. Carbon Tetrachloride Concentration Standard Analyses.
(2 sheets)

CCl_4 Concentration Standard (ppmv)	CCl_4 Concentration Analyzed (ppmv)	Date Analyzed	Time Analyzed	B&K Serial Number
25.37	21.3	10/25/06	12:52	1715232
25.37	22.5	10/25/06	15:58	1715232
200.0	186.0	10/25/06	16:04	1715232
25.37	21.5	11/30/06	15:18	1715232
25.37	23.7	11/30/06	16:23	1715232
200.0	199.0	11/30/06	16:31	1715232
25.37	22.0	12/19/06	13:55	1715232
25.37	22.5	12/19/06	15:05	1715232
200.0	192.0	12/19/06	14:54	1715232
25.37	21.9	01/31/07	13:44	1715232
25.37	22.5	01/31/07	15:02	1715232
200.0	194.0	01/31/07	14:49	1715232
25.37	21.7	02/27/07	15:49	1715232
25.37	22.0	02/27/07	16:45	1715232
200.0	204.0	02/27/07	16:54	1715232
25.37	21.7	03/21/07	13:16	1715232
25.37	22.2	03/21/07	14:18	1715232
200.0	231.0	03/21/07	14:25	1715232
25.37	20.8	04/18/07	13:50	1715232
25.37	20.5	04/18/07	14:39	1715232
200.0	NR	04/18/07	14:48	1715232
25.37	21.9	05/29/07	16:26	1715232
25.37	22.5	05/29/07	17:18	1715232
200.0	208.0	05/29/07	17:24	1715232
25.37	22.0	06/27/07	14:37	1715232
25.37	22.2	06/27/07	15:29	1715232
200.0	223.0	06/27/07	15:37	1715232
25.37	20.6	07/25/07	13:40	1715232
25.37	20.2	07/25/07	13:42	1715232
200.0	196.0	07/25/07	14:55	1715232
25.37	22.0	08/30/07	16:49	1715232

Table D-3. Carbon Tetrachloride Concentration Standard Analyses.
(2 sheets)

CCl_4 Concentration Standard (ppmv)	CCl_4 Concentration Analyzed (ppmv)	Date Analyzed	Time Analyzed	B&K Serial Number
25.37	22.0	08/30/07	16:51	1715232
200.0	233.0	08/30/07	18:01	1715232
25.37	22.3	09/24/07	15:40	1715232
25.37	22.3	09/24/07	16:48	1715232
200.0	176.0	09/24/07	16:54	1715232

B&K = Brüel & Kjær (trademark of Brüel & Kjær North America, Inc., Norcross, Georgia)
CCl_4 = carbon tetrachloride
NR = not recorded
ppmv = parts per million by volume

Table D-4. Blank Analyses.

Sample Location	Sample Date	Sample Time	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Water (ppmv)
Blank	10/25/06	12:49	1.0 U	1.0 U	1.0 U	1.0 U	7,580
Blank	10/25/06	13:22	1.0 U	1.0 U	1.0 U	1.0 U	7,930
Blank	11/30/06	15:16	1.0 U	1.0 U	1.0 U	1.0 U	5,070
Blank	11/30/06	16:25	1.0 U	1.0 U	1.0 U	1.0 U	5,190
Blank	12/19/06	13:49	1.0 U	1.0 U	1.0 U	1.0 U	2,500
Blank	12/19/06	15:08	1.0 U	1.0 U	1.0 U	1.0 U	3,210
Blank	01/31/07	13:42	1.0 U	1.0 U	1.0 U	1.0 U	5,200
Blank	01/31/07	15:06	1.0 U	1.0 U	1.0 U	1.0 U	5,320
Blank	02/27/07	15:45	1.0 U	1.0 U	1.0 U	1.0 U	7,220
Blank	02/27/07	16:49	1.0 U	1.0 U	1.0 U	1.0 U	6,880
Blank	03/21/07	13:14	1.0 U	1.0 U	1.0 U	1.0 U	7,310
Blank	03/21/07	14:20	1.0 U	1.0 U	1.0 U	1.0 U	7,750
Blank	04/18/07	13:48	1.0 U	1.0 U	1.0 U	1.0 U	6,450
Blank	04/18/07	14:41	1.0 U	1.0 U	1.0 U	1.0 U	6,430
Blank	05/29/07	16:24	1.0 U	1.0 U	1.0 U	1.0 U	9,470
Blank	05/29/07	17:22	1.0 U	1.0 U	1.0 U	1.0 U	9,420
Blank	06/27/07	14:35	1.0 U	1.0 U	1.0 U	1.0 U	9,820
Blank	06/27/07	15:31	1.0 U	1.0 U	1.0 U	1.0 U	9,010
Blank	07/25/07	13:38	1.0 U	1.0 U	1.0 U	1.0 U	11,300
Blank	07/25/07	14:47	1.0 U	1.0 U	1.0 U	1.0 U	11,400
Blank	08/30/07	16:47	1.0 U	1.0 U	1.0 U	1.2	11,500
Blank	08/30/07	17:53	1.0 U	1.0 U	1.0 U	1.6	12,100
Blank	09/24/07	15:38	1.0 U	1.0 U	1.0 U	1.0 U	1,560
Blank	09/24/07	16:50	1.0 U	1.0 U	1.0 U	1.0 U	3,730

CCl_4 = carbon tetrachloride
$CHCl_3$ = chloroform
CH_2Cl_2 = methylene chloride
MEK = methyl ethyl ketone
ppmv = parts per million by volume
U = analyzed for but not detected; value reported is the reporting limit

APPENDIX E

FISCAL YEAR 2007 VAPOR EXTRACTION DATA FOR THE 218-W-4B BURIAL GROUND

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Table E-1. Vapor Extraction from Riser T-07-4 and Riser T-07-6.

Date	Time	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)
12/19/06	10:28	426	33.8	22.3	386
12/19/06	15:23	203	8.16	7.82	2.53
12/20/06	10:05	332	11.5	14.7	4.26
12/20/06	15:00	227	10.1	6.65	2.26
12/21/06	10:05	343	11.4	15.0	3.34
12/21/06	15:05	198	9.10	4.80	1.88
12/27/06	9:30	573	13.9	31.6	4.44
12/27/06	15:05	217	9.90	5.18	1.69
12/28/06	9:30	245	10.1	7.65	1.45
12/28/06	13:45	197	9.02	3.90	1.54
01/02/07	9:30	351	9.40	16.9	2.26
01/02/07	14:00	181	8.53	4.02	1.31
01/04/07	8:30	284	9.63	10.4	1.39
01/04/07	15:40	188	7.66	3.46	1.93
01/05/07	9:00	142	6.29	1.70	0.510
01/05/07	13:20	147	6.72	1.63	0.452
01/06/07	15:55	113	5.33	1.43	0.670
01/07/07	15:00	116	7.26	1.21	0.166
01/08/07	9:00	108	5.14	1.20	0.930
01/08/07	14:15	83.4	6.48	0.92	0.890
01/09/07	9:30	30.6	3.27	1.37	2.17 (riser 4 only)
01/09/07	14:15	34.0	3.93	1.39	2.54 (riser 4 only)
01/11/07	8:30	30.9	7.39	6.38	2.34 (riser 4 only)
01/11/07	8:45	207	9.44	2.95	0.876 (riser 6 only)
01/11/07	15:30	16.7	2.36	1.19	1.88 (riser 4 only)
01/11/07	15:30	187	9.28	1.36	0.698 (riser 6 only)
01/12/07	15:30	5.94	2.02	0.95	0.711 (riser 4 only)
01/12/07	15:30	182	9.42	1.59	1.00 U (riser 6 only)

CCl_4 = carbon tetrachloride
$CHCl_3$ = chloroform
CH_2Cl_2 = methylene chloride
MEK = methyl ethyl ketone
ppmv = parts per million by volume

Table E-2. Vapor Extraction from Riser T-07-8. (2 sheets)

Date	Time	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Comment
12/12/06	14:30	994	47.9	5.85	0.649	Extraction discontinued due to high concentrations coming out of outlet and stack after GAC unit #2. Will be restarted when additional GAC units are available.
04/12/07	10:30	1,270	49.0	8.24	1.00 U	Restarted.
04/12/07	11:00	932	36.8	7.42	1.00 U	
04/12/07	12:00	773	30.9	6.60	1.00 U	
04/12/07	13:00	683	27.4	5.61	1.00 U	
04/12/07	14:30	613	24.5	53.3	1.00 U	
04/13/07	09:00	1,020	39.4	5.78	1.00 U	
04/13/07	10:00	626	25.3	4.72	1.00 U	
04/13/07	11:00	531	21.0	3.91	1.00 U	
04/13/07	12:00	501	19.8	4.29	1.00 U	
04/13/07	13:00	438	17.1	4.11	1.00 U	
04/16/07	09:30	741	28.1	5.34	1.00 U	
04/16/07	14:30	373	14.3	3.61	1.00 U	
04/17/07	14:30	271	9.48	3.02	1.00 U	
04/18/07	15:00	169	5.68	1.77	1.00 U	
04/24/07	11:30	1,090	37.4	6.80	1.00 U	
04/24/07	15:00	427	15.0	4.26	1.00 U	
04/25/07	15:00	237	7.09	2.37	1.00 U	
04/26/07	14:30	234	7.85	2.47	1.00 U	
04/27/07	13:00	174	4.90	2.47	1.00 U	
04/30/07	13:30	344	11.3	3.66	1.00 U	
05/01/07	14:00	171	4.43	2.33	1.00 U	
05/02/07	14:00	148	3.51	1.96	1.00 U	
05/03/07	09:30	277	8.48	2.41	1.00 U	
05/03/07	14:00	179	5.14	2.14	1.00 U	
05/08/07	13:00	754	23.1	5.89	1.00 U	
05/09/07	14:00	201	4.72	2.76	1.00 U	
05/10/07	14:00	197	5.22	2.64	1.00 U	
05/11/07	13:30	184	4.13	3.06	1.00 U	
05/12/07	10:30	175	4.22	2.53	1.00 U	

Table E-2. Vapor Extraction from Riser T-07-8. (2 sheets)

Date	Time	CCl_4 (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)	Comment
05/13/07	12:30	157	3.32	2.08	1.00 U	
05/14/07	13:30	146	3.41	1.99	1.00 U	
05/15/07	09:00	155	4.10	2.00	1.00 U	
05/15/07	14:00	156	3.41	2.39	1.00 U	
05/16/07	15:10	156	8.37	4.33	12.0	
05/17/07	13:34	164	9.38	4.69	13.3	
05/18/07	09:00	106	1.36	1.28	1.00 U	
05/19/07	10:00	108	1.24	1.51	0.341	
05/20/07	10:35	130	1.84	1.22	1.00 U	System shut down sometime Sunday morning/late Saturday night.
05/21/07	15:00	100	1.03	1.32	0.353	
05/22/07	09:00	41.8	2.68	0.737	1.14	
05/23/07	09:00	38.9	1.97	0.965	1.50	
05/23/07	14:45	42.1	2.44	0.987	1.21	
05/24/07	14:30	44.7	3.17	1.11	1.23	
05/25/07	08:30	35.4	2.63	0.720	0.825	
05/29/07	10:00	97.6	5.55	0.466	0.283	
05/29/07	14:30	70.9	4.54	0.974	0.774	
05/30/07	09:00	47.3	2.99	0.625	1.11	

CCl_4 = carbon tetrachloride
$CHCl_3$ = chloroform
CH_2Cl_2 = methylene chloride
GAC = granular activated carbon
MEK = methyl ethyl ketone
ppmv = parts per million by volume
U = analyzed for but not detected; value reported is the reporting limit

Table E-3. Vapor Extraction from Riser T-07-10.

Date	Time	Carbon Tetrachloride (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)
06/04/07	10:35	248	5.43	7.07	2.36
06/05/07	13:00	40.9	4.17	1.72	2.05
06/06/07	09:30	26.6	3.11	0.808	1.02
06/07/07	10:15	45.0	5.02	1.40	1.68
06/08/07	09:30	34.7	4.30	0.713	1.24
06/11/07	11:00	34.8	4.87	2.31	2.16
06/11/07	15:00	13.0	2.70	1.56	2.08
06/12/07	10:15	7.72	2.55	0.950	1.56
06/13/07	14:38	6.59	2.00	1.33	2.04
06/14/07	14:15	43.7	3.43	1.55	1.50
06/18/07	15:00	49.3	5.23	3.57	3.82
06/19/07	15:30	5.71	1.83	1.34	2.00
06/20/07	09:00	4.15	1.76	1.01	2.09

CCl_4 = carbon tetrachloride
$CHCl_3$ = chloroform
CH_2Cl_2 = methylene chloride
MEK = methyl ethyl ketone
ppmv = parts per million by volume

Table E-4. Vapor Extraction from Riser T-07-9.

Date	Time	Carbon Tetrachloride (ppmv)	$CHCl_3$ (ppmv)	MEK (ppmv)	CH_2Cl_2 (ppmv)
06/11/07	11:00	265/71.6			
06/11/07	15:00	246	5.26	1.97	1.00 U
06/12/07	10:15	160	3.40	1.15	1.00 U
06/13/07	14:38	5.15	1.13	0.577	1.47
06/14/07	14:15	23.3	3.43	1.55	1.50
06/18/07	15:00	57.8	4.67	0.914	1.70
06/19/07	15:30	20.8	2.05	1.35	1.65
06/20/07	09:00	14.2	2.44	0.756	1.07
06/21/07	08:30	30.9	2.29	1.08	1.97
06/22/07	09:00	23.9	2.95	0.813	1.30
06/25/07	15:00	21.6	2.05	0.900	1.33
06/26/07	09:00	25.5	2.90	0.360	0.204
06/27/07	09:00	21.4	2.85	0.983	0.719
06/28/07	09:30	19.4	2.04	1.08	1.54
07/16/07	10:30	32.4	4.86	1.18	1.35
07/17/07		27.0	3.35	0.865	1.35
07/18/07	14:45	22.4	3.08	1.43	3.24
07/19/07	10:00	21.0	3.25	0.647	1.16
07/20/07	08:30	13.1	2.60	0.992	1.48
07/23/07	14:30	27.2	3.82	1.87	2.58
07/31/07	08:30	7.65	2.18	1.66	1.27

CCl_4 = carbon tetrachloride
$CHCl_3$ = chloroform
CH_2Cl_2 = methylene chloride
MEK = methyl ethyl ketone
ppmv = parts per million by volume
U = analyzed for but not detected; value reported is the reporting limit

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