Sparton Technology, Inc.
Former Coors Road Plant
Remedial Program

2003 Annual Report

S. S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

May 28, 2004

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S. S. PAPADOPULOS & ASSOCIATES, INC.
ENVIRONMENTAL & WATER-RESOURCE CONSULTANTS

May 28, 2004

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Subject: Sparton Technology, Inc. Former Coors Road Plant Remedial Program
2003 Annual Report

Gentlemen:

On behalf of Sparton Technology, Inc. (Sparton), S. S. Papadopulos & Associates, Inc. (SSP&A) is pleased to submit the subject report. The report presents data collected at Sparton's former Coors Road Plant during the operation of the remedial systems in 2003, and evaluations of these data to assess the performance of the systems. This document was prepared by SSP&A with the assistance of with Metric Corporation, Inc.

I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based upon my inquiry of either the person or persons who manage the system and/or the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I further certify, to the best of my knowledge and belief, that this document is consistent with the applicable requirements of the Consent Decree entered among the New Mexico Environment Department, the U.S. Environmental Protection Agency, Sparton

Technology, Inc., and others in connection with Civil Action No. CIV 97 0206 LH/JHG, United States District Court for the District of New Mexico. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If you have any questions concerning the report, please contact me.

Sincerely,

S. S. PAPADOPULOS & ASSOCIATES, INC.

Stavros S. Papadopulos, PhD, PE
Founder & Senior Principal

cc: Secretary, Sparton Technology, Inc., c/o Ms. Susan Widener
Ms. Terri Donahue, Controller, Sparton Technology, Inc.
Ms. Susan Widener
Mr. James B. Harris
Mr. Tony Hurst (2 copies)
Mr. Gary L. Richardson

Sparton Technology, Inc.
Former Coors Road Plant
Remedial Program

2003 Annual Report

Prepared For:

Sparton Technology, Inc.
Rio Rancho, New Mexico

Prepared By:

S. S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants
In Association with:
Metric Corporation, Albuquerque, New Mexico

May 28, 2004

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Executive Summary

Sparton Technology, Inc. agreed to implement remedial measures at its former Coors Road Plant in Albuquerque, New Mexico under the terms of a Consent Decree entered on March 3, 2000. These remedial measures consist of: (a) the installation and operation of an off-site containment system; (b) the installation and operation of a source containment system; and (c) the operation of an on-site, 400-cfm SVE system for an aggregate period of one year. The goals of these remedial measures are: (a) to control hydraulically the migration of the off-site plume; (b) to control hydraulically any potential source areas that may be continuing to contribute to groundwater contamination at the on-site area; (c) to reduce contaminant concentrations in vadose-zone soils in the on-site area and thereby reduce the likelihood that these soils remain a source of groundwater contamination; and (d) in the long-term, restore the groundwater to beneficial use.

The installation of the off-site containment system, consisting of a containment well near the leading edge of the plume, an off-site treatment system, an infiltration gallery in the Arroyo de las Calabacillas, and associated conveyance and monitoring components, began in late 1998 and was completed in early May 1999. The off-site containment well began operating on December 31, 1998; except for brief interruptions for maintenance activities or due to power outages, the well has operated continuously since that date; the year 2003 was the fifth full year of operation of this well. The source containment system, consisting of a containment well immediately downgradient from the site, an on-site treatment system, six on-site infiltration ponds, and associated conveyance and monitoring components, was installed during 2001 and began operating on January 3, 2002; the year 2003 was the second year of operation of this well. The 400-cfm SVE system had operated for a total of about 372 days between April 10, 2000 and June 15, 2001 and thus met the length-of-operation requirements of the Consent Decree; monitoring conducted in the Fall of 2001 indicated that the system had also met its performance goals, and the system was dismantled in May 2002.

During 2003, considerable progress was made towards achieving the goals of the remedial measures:

- The off-site containment well continued to operate throughout the year at an average rate of 225 gpm, sufficient to contain the plume;
- The pumped water was treated and returned to the aquifer through the infiltration gallery. The concentrations of constituents of concern in the treated water met all the requirements of the Groundwater Discharge Permit for the site. Chromium concentrations in the influent to the treatment system remained at levels that did not require treatment;
- The source containment system that began operating on January 3, 2002 continued to operate throughout 2003 at an average rate of 52 gpm;

- Groundwater monitoring was conducted as specified in Attachment A to the Consent Decree. Water levels in all accessible wells and/or piezometers, and the Corrales Main Canal were measured quarterly. Samples were collected for water-quality analyses from monitoring wells at the frequency specified in the Consent Decree and analyzed for VOCs and total chromium;

- Samples were obtained from the influent and effluent of the treatment plants for the off-site and source containment systems, and the infiltration gallery and infiltration pond monitoring wells at the frequency specified in the Groundwater Discharge Permit. All samples were analyzed for VOCs, total chromium, iron, and manganese;

- The groundwater flow and transport model that was developed in 1999 to simulate the hydrogeologic system underlying the site was recalibrated and used to simulate TCE concentrations in the aquifer from start-up of the off-site containment well in December 1998 through November 2003 and to predict concentrations in November 2004.

The off-site containment well continued to provide hydraulic control of the contaminant plume throughout the year. The source containment well that began operating in early 2002 quickly developed a capture zone that controls any potential on-site sources that may be contributing to groundwater contamination, and maintained this capture zone throughout 2003.

The extent of groundwater contamination, as defined by the extent of the TCE plume, did not change significantly during 2003. The TCA plume ceased to exist during 2003; there were no wells with TCA concentrations above the maximum allowable concentration in groundwater set by the NMWQCC.

Changes in concentrations observed in monitoring wells since the implementation of the current remedial measures indicate that contaminant concentrations in the on-site area decreased significantly. There were no discernible patterns in the changes that occurred in off-site wells; however, the persistence of high concentrations of contaminants in the water pumped from containment well CW-1 since the beginning of its operation, and the concentration history of well MW-60 indicate the presence of high concentration areas upgradient from the off-site containment well. This conclusion continues to be confirmed by the results of model recalibration efforts during the last several years. In contrast, the concentrations in the source containment well CW-2 have begun to decline since September 2003, indicating that concentrations within the capture zone of this well are declining.

The off-site and source containment wells operated at a combined average rate of 277 gpm during 2003. A total of about 145 million gallons of water were pumped from the wells. This total pumpage represents about 13 percent of the initial volume of contaminated groundwater (pore volume). The total volume of water pumped since the beginning of the current remedial operations on December 1998 is 630 million gallons and represents 56 percent of the initial pore volume.

Approximately 660 kg (1,450 lbs) of contaminants consisting of 620 kg (1,360 lbs) of TCE, 38 kg (84 lbs) of DCE, and 3.1 kg (6.7 lbs) of TCA were removed from the aquifer by the two containment wells during 2002. The total mass that was removed since the beginning of the of the current remedial operations is 2,710 kg (5,980 lbs) consisting of 2,560 kg (5,640 lbs) of TCE, 145 kg (320 lbs) of DCE, and 6.7 kg (15 lbs) of TCA. This represents about 35 percent of the total dissolved contaminant mass (35 percent of the TCE, 32 percent of the DCE, and 22 percent of the TCA mass) currently estimated to have been present in the aquifer prior to the testing and operation of the off-site containment well.

The remedial systems were operated with only minor difficulties during 2003. Except for a 5-day shut-down of the source containment system was caused by a power outage in March, both containment systems operated essentially continuously. The wellheads of monitoring wells MW-60, MW-70, and MW-71R were replaced to repair damages and/or accommodate residential construction requirements at their location. Well MW-52, which had been dry since November 2002, was replaced with well MW-52R in June 2003, and well MW-52 was plugged in September 2003.

Plans for next year include continuing the operation of the off-site and source containment systems and the collection of monitoring data as required by the Consent Decree and the permits controlling groundwater discharge and air emissions. Recalibration of the flow and transport model against data collected in 2004 and improvement of the model will continue next year. The MW-71R pump-and-treat system proposed to assess the severity of the problem associated with the detection of contaminants in the Deep Flow Zone monitoring well MW-71R, will be implemented upon receipt of regulatory agency approval of the Work Plan that was submitted in January 2004. Data collected from this operation will be evaluated to determine appropriate action.

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List of Acronyms

3rdFZ	Third depth interval of the Lower Flow Zone
CMS	Corrective Measure Study
cfm	cubic feet per minute
cm^2/s	centimeter square per second
DCE	1,1-Dichloroethylene
DFZ	Deep Flow Zone below the 4800 - foot clay
ft	foot or feet
ft MSL	feet above Mean Sea Level
ft^3	cubic feet
ft/d	feet per day
ft/yr	feet per year
ft^2/d	feet squared per day
g/cm^3	grams per cubic centimeter
gpd	gallons per day
gpm	gallons per minute
IM	Interim Measure
kg	Kilogram
LLFZ	Lower Lower Flow Zone
lbs	Pounds
MCL	Maximum Contaminant Level
MSL	Mean Sea Level
Metric	Metric Corporation
mg/m^3	milligrams per cubic meter
µg/L	micrograms per liter
NMED	New Mexico Environmental Department
NMEID	New Mexico Environmental Improvement Division
NMWQCC	New Mexico Water Quality Control Commission
ppmv	parts per million by volume
RFI	RCRA Facility Investigation
rpm	revolutions per minute
Sparton	Sparton Technology, Inc.
SSP&A	S. S. Papadopulos & Associates, Inc.
SVE	Soil Vapor Extraction
TCA	1,1,1-Trichloroethane
TCE	Trichloroethylene
UFZ	Upper Flow Zone
ULFZ	Upper Lower Flow Zone
USEPA	United States Environmental Protection Agency
USF	Upper Santa Fe Group
USGS	United States Geological Survey
VOC	Volatile Organic Compound

REPORT

Section 1
Introduction

The former Coors Road Plant of Sparton Technology, Inc. (*Sparton*) is located at 9621 Coors Boulevard NW (the west side of the boulevard), Albuquerque, New Mexico, north of Paseo del Norte and south of the Arroyo de las Calabacillas (see Figure 1.1). Investigations conducted between 1983 and 1987 at and around the plant revealed that past waste management activities had resulted in the contamination of on-site soils and groundwater and that contaminated groundwater had migrated beyond the boundaries of the facility to downgradient, off-site areas.

In 1988, the United States Environmental Protection Agency (*USEPA*) and Sparton negotiated an Administrative Order on Consent, which became effective on October 1, 1988. Under the provisions of this Order, Sparton implemented in December 1988 an Interim Measure (*IM*) that consisted of an on-site, eight-well groundwater recovery and treatment system. The initial average recovery rate of the system was about 1.5 gallons per minute (*gpm*); however, the recovery rate began declining within a few years due to a regional decline in water levels. As a result, the system was shut-down and permanently taken out of service on November 16, 1999.

In 1998 and 1999, during settlement negotiations associated with lawsuits brought by the USEPA, the State of New Mexico, the County of Bernalillo, and the City of Albuquerque, Sparton agreed to implement a number of remedial measures and take certain actions, including: (a) the installation, testing, and continuous operation of an off-site extraction well designed to contain the contaminant plume; (b) the replacement of the on-site groundwater recovery system by a source containment well designed to address the release of contaminants from potential on-site source areas; (c) the operation of a 400 cubic feet per minute (*cfm*) capacity on-site soil vapor extraction (*SVE*) system for a total operating time of one year over a period of eighteen months; (d) the implementation of a groundwater monitoring plan; (e) the assessment of aquifer restoration; and (f) the implementation of a public involvement plan. Work Plans for the implementation of the measures and actions agreed upon by the parties were developed and included in a Consent Decree entered by the parties on March 3, 2000 [Consent Decree, 2000; S. S. Papadopulos & Associates, Inc. (*SSP&A*), 2000a, 2000b, 2000c; and Chandler, 2000].

The off-site containment well was installed and tested in late 1998. Based on the test results, a pumping rate of about 225 gpm was determined to be adequate for containing the off-site plume (SSP&A, 1998), and the well began operating at approximately this rate on December 31, 1998. An air stripper for treating the pumped water and an infiltration gallery for returning the treated water to the aquifer were constructed in the spring of 1999, and the well was connected to these facilities in late April 1999. In 2000, due to chromium concentrations that exceeded the permit requirements for the discharge of the treated water, a chromium reduction process was added to the treatment system and began operating on December 15, 2000; however, chromium concentrations declined in 2001 and the process was discontinued on October 31, 2001. The year 2003 constitutes the fifth year of operation of the off-site containment system.

Throughout 1999 and 2000, Sparton applied for and obtained approvals for the different permits and work plans required for the installation of the source-containment system. The Construction Work Plan for the system was approved on February 20, 2001, and construction began soon after that date. The installation of the system was completed by the end of 2001, and the system began operating on January 3, 2002. Thus, the year 2003 constitutes the second year of operation of the source containment system.

SVE systems of different capacities were operated at the Sparton facility between April and October 1998, and between May and August 1999. The 400-cfm SVE system was installed in the spring of 2000 and operated for an aggregate of about 372 days between April 10, 2000 and June 15, 2001, meeting the one-year operation requirement of the Consent Decree. The performance of the system was evaluated by conducting two consecutive monthly sampling events of soil gas in September and October 2001, after a 3-month shut-off period. The results of these two sampling events, which were presented in the Final Report on the On-Site Soil Vapor Extraction System [Chandler and Metric Corporation (*Metric*), 2001] and on Table 4.7 of the 2001 Annual Report (SSP&A, 2002), indicated that TCE concentrations at all monitoring locations were considerably below the 10 parts per million by volume (*ppmv*) remediation goal of the Consent Decree. Based on these results, the operation of the SVE system was permanently discontinued by dismantling the system and plugging the vapor recovery well and vapor probes in May 2002.

The purpose of this 2003 Annual Report is to:

- provide a brief history of the former Sparton plant and affected areas downgradient from the plant,
- summarize remedial and other actions taken by the end of 2003,
- present the data collected during 2003 from operating and monitoring systems, and
- provide the interpretations of these data with respect to meeting remedial objectives.

This report was prepared on behalf of Sparton by SSP&A in cooperation with Metric. Background information on the site, the implementation of remedial actions, and initial site conditions, as they existed prior to the implementation of the remedial actions agreed upon in the Consent Decree, are discussed in Section 2; a brief summary of operations during 1999 through 2002 is included in this section. Issues related to the year-2003 operation of the off-site and source containment systems are discussed in Section 3. Data collected to evaluate system performance and to satisfy permit or other requirements are presented in Section 4. Section 5 presents the interpretations of the data and discusses the results with respect to the performance and the goals of the remedial systems. A description of the site's groundwater flow and transport model that was developed in 1999 (see 1999 Annual Report, SSP&A, 2001), modifications to the model based on data collected during 2003, and predictions made using this model are presented in Section 6. Section 7 summarizes the report and discusses future plans. References cited in the report are listed in Section 8.

Section 2
Background

2.1 Description of Facility

The site of Sparton's former Coors Road plant is an approximately 12-acre property located in northwest Albuquerque, on Coors Boulevard NW. The property is about one-quarter mile south of the Arroyo de las Calabacillas, about three-quarters of mile north of the intersection of Coors Boulevard and Paseo del Norte, and about one-half mile west of the Rio Grande (see Figure 1.1). The property sits on a terrace about 60 feet (*ft*) above the Rio Grande floodplain. An irrigation canal, the Corrales Main Canal, is within a few hundred feet from the southeast corner of the property. About one-quarter mile west of the property, the land rises approximately 150 ft forming a hilly area with residential properties.

The plant consisted of a 64,000-square-foot manufacturing and office building and of several other small structures that were used for storage or as workshops (see Figure 2.1). Manufacturing of electronic components, including printed-circuit boards, at the plant began in 1961 and continued until 1994. Between 1994 and the end of 1999, Sparton operated a machine shop at the plant in support of manufacturing at the company's Rio Rancho plant and other locations. The property was leased to Melloy Dodge in October 1999. During 2000 and early 2001, the tenant made modifications and renovations to the property to convert it to an automobile dealership and began operating it as a dealership on April 23, 2001.

2.2 Waste Management History

The manufacturing processes at the plant generated two waste streams that were managed as hazardous wastes: a solvent waste stream and an aqueous metal-plating waste stream. Waste solvents were accumulated in an on-site concrete sump (see Figure 2.1) and allowed to evaporate. In October 1980, Sparton discontinued using the sump and closed it by removing remaining wastes and filling it with sand. After that date, Sparton began to accumulate the waste solvents in drums and disposed of them off-site at a permitted facility.

The plating wastes were stored in a surface impoundment (see Figure 2.1), and wastewater that accumulated in the impoundment was periodically removed by a vacuum truck for off-site disposal at a permitted facility. Closure of the former impoundment and sump area occurred in December 1986 under a New Mexico State-approved closure plan. The impoundment was backfilled, and an asphaltic concrete cap was placed over the entire area to divert rainfall and surface-water run on, and thus to minimize infiltration of water into the subsurface through this area.

2.3 Hydrogeologic Setting

The Sparton site lies in the northern part of the Albuquerque Basin. The Albuquerque Basin is one of the largest sedimentary basins of the Rio Grande rift, a chain of linked basins that extend south from central Colorado into northern Mexico. Fill deposits in the basin are as much as 15,000 ft thick. The deposits at the site have been characterized by borings advanced for 87 monitoring and production wells, and by a 1,505-foot-deep boring (the Hunter Park I Boring) advanced by the United States Geological Survey (USGS) about 0.5 mile north of the facility on the north side of the Arroyo de las Calabacillas (Johnson and others, 1996).

The fill deposits in the upper 1,500 ft of the subsurface consist primarily of sand and gravel with minor amounts of silt and clay. The near-surface deposits consist of less than 200 ft of Quaternary alluvium associated with terrace, arroyo fan, and channel and floodplain deposits. These deposits are saturated beneath the facility and to the east of the facility toward the Rio Grande, but are generally unsaturated to the west of the site. Two distinct geologic units have been mapped in the saturated portion of these deposits: Recent Rio Grande deposits, and a silt/clay unit (see Figure 2.2). The Recent Rio Grande deposits occur to the east of the facility adjacent to the Rio Grande. These deposits consist primarily of pebble to cobble gravel and sand, and sand and pebbly sand. These deposits are Holocene-age and are up to 70-feet thick. Beneath the facility, and in an approximately 1,500-foot-wide band trending north from the facility, a silty/clay unit has been mapped between an elevation of about 4,965 ft above mean sea level (*ft MSL*) and 4,975 ft MSL. This unit, which is referred to as the 4970-foot silt/clay unit, represents Late-Pleistocene-age overbank deposits. The areal extent of the unit at and in the vicinity of the Sparton site is shown in Figure 2.3. [Additional information on this unit is presented in Appendix A to both the 1999 and 2000 Annual Reports (SSP&A, 2001a; 2001b).] Holocene-age arroyo fan and terrace deposits, which are primarily sand and gravel, overlie this unit.

The water table over much of the site occurs within the deposits of the Pliocene-age Upper Santa Fe Group (USF). These deposits, to an elevation of 4,800 ft MSL, consist primarily of sand with lenses of sand and gravel and silt and clay. The lithologic descriptions of these deposits are variable, ranging from "sandy clay," to "very fine to medium sand," to "very coarse sand, to small pebble gravel." Most of the borings into this unit were advanced using the mud-rotary drilling technique, and as a result, it has not been possible to map the details of the geologic structure. The sand and gravel unit is primarily classified as USF2 lithofacies assemblages 2 and 3 (Hawley, 1996). Locally, near the water table, in some areas, the sands and gravels are classified as USF4 lithofacies assemblages 1 and 2. Lithofacies 2 represents basin-floor alluvial deposits that are primarily sand with lenses of pebble sand and silty clay. Lithofacies 3 represents basin-floor, overbank, and playa and lake deposits that are primarily interbedded sand and silty clay with lenses of pebbly sand.

At an elevation of approximately 4,800 ft MSL, a 2- to 3-foot thick clay layer is encountered. This clay, which is referred to as the 4800-foot clay unit (see Figure 2.2), likely represents lake deposits. This clay unit was encountered in borings for six wells (MW-67, MW-71, MW-71R, CW-1, OB-1, and OB-2) installed during site investigations and remedial actions. The unit was also encountered in the USGS Hunter Park I Boring which is located about 0.5 mile north of the Sparton Site on the north side of the Arroyo de las Calabacillas. The nature of the depositional environment (i.e. lake deposits), and the fact that that the unit has been encountered in every deep well drilled in the vicinity of the site, as well as at the more distant USGS boring, indicate that the unit is areally extensive. The deposits of the Santa Fe Group immediately below the 4800-foot clay are similar to those above the clay.

A total of 88 wells and were installed at the site to define hydrogeologic conditions and the extent and nature of groundwater contamination and to implement and monitor remedial actions; of these wells, 16 have been plugged and abandoned. The locations of the remaining 72 wells are shown in Figure 2.3.

The off-site containment well, CW-1, and two associated observation wells, OB-1 and OB2, were drilled to the top of the 4800-foot clay unit and were screened across the entire saturated thickness of the aquifer above the clay unit. The source containment well, CW-2, was drilled to a depth of 130 feet and equipped with a 50-foot screen from the water table to total depth. The monitoring wells have short screened-intervals (5 to 30 ft) and, during past investigations, were classified according to their depth and screened interval. Wells screened across, or within 15 ft of, the water table were referred to as Upper Flow Zone (*UFZ*) wells. Wells screened 15-45 and 45-75 ft below the water table were referred to as Upper Lower Flow Zone (*ULFZ*) and Lower Lower Flow Zone (*LLFZ*) wells, respectively. Wells completed below the 4800-foot clay unit were referred to as Deep Flow Zone (*DFZ*) wells. At cluster well locations where an ULFZ or LLFZ well already existed, wells screened at a somewhat deeper interval were referred to as LLFZ or Third Flow Zone (*3rdFZ*) wells, regardless of the depth of their screened-interval with respect to the water table.

The completion flow zone, location coordinates, and measuring point elevation of all existing wells are presented on Table 2.1; their screened intervals are summarized in Table 2.2. In Figure 2.4, the screened interval of each well is projected onto a schematic cross-section through the site to show its position relative to the flow zones defined above. (Monitoring wells screened in the DFZ [MW-67 and MW-71R], wells screened across the entire aquifer above the 4800-foot clay [CW-1, OB-1 and OB-2], and infiltration gallery monitoring wells [MW-74, MW-75, and MW-76] are not included in this figure.) The screened intervals in three of the monitoring wells shown on Figure 2.4 are inconsistent with the completion flow zones listed on Table 2.1 and which were defined at the time of well construction. These monitoring wells are: MW-32, which is listed in Table 2.1 as a LLFZ well but is shown on Figure 2.4 as a ULFZ well; and MW-49 and MW-70 which are listed on Table 2.1 as 3rdFZ wells but are shown on Figure 2.4 as LLFZ wells. In the evaluations of water-level and water-quality data for the flow zones, MW-32 is treated as a ULFZ well, and MW-49 and MW-70 are treated as LLFZ wells.

Data collected from these wells indicate that the thickness of the saturated deposits above the 4800-foot clay ranges from about 180 ft at the Site to about 160 ft west of the Site and averages about 170 ft. Outside the area underlain by the 4970-foot silt/clay unit, groundwater occurs under unconfined conditions; however, in the area where this unit is present, it provides confinement to the underlying saturated deposits; the water table in this area occurs within the

Late-Pleistocene-age arroyo fan and terrace deposits that overlie the 4970-foot silt/clay unit and is considerably higher than the potentiometric surface of the underlying confined portion of the aquifer.

Analyses of data from aquifer tests conducted at the Site (Harding Lawson Associates, 1992; SSP&A, 1998, 1999) indicate that the hydraulic conductivity of the aquifer is in the range of 25 to 30 feet per day (*ft/d*), corresponding to a transmissivity of about 4,000 to 5,000 feet squared per day (*ft^2/d*). A transmissivity of about 4,000 ft^2/d, corresponding to a hydraulic conductivity of about 25 ft/d, is also indicated by the response of water levels to long-term pumping from the off-site containment well CW-1. Analyses of the water levels measured quarterly in observation wells OB-1 and OB-2, and in monitoring wells within 1,000 ft of the off-site containment well, indicate that the response of these wells to the long-term pumping from CW-1 is best explained with a transmissivity of 4,000 ft^2/d; that is, a transmissivity of 4,000 ft^2/d produces the smallest residual between calculated and measured water levels in these wells.

Water-level data indicate that the general direction of groundwater flow is to the northwest with gradients that generally range from 0.0025 to 0.006. The direction of groundwater flow beneath the Sparton site, however, in the part of the aquifer underlain by the 4970-foot silt/clay unit, is to the west-southwest and the water table has a steeper gradient ranging from 0.010 to 0.016. Vertical flow is downward with an average gradient of about 0.002. Groundwater production from the deeper aquifers and a reduction in the extent of irrigated lands in the vicinity of the Site have resulted in a regional decline of water levels. Until a few years ago, this regional decline averaged about 0.65 foot per year (*ft/yr*); however, the rate of decline has slowed down and averaged about 0.35 ft/yr during the last several years (see well hydrographs presented in Figure 2.5).

2.4 Site Investigations and Past Remedial Actions

In 1983, several groundwater monitoring wells were installed around the impoundment and sump area to determine whether there had been a release of constituents of concern from the impoundment or the sump. Analytical results from groundwater samples taken from these wells indicated concentrations of several constituents above New Mexico State standards.

Since this initial finding in 1983, several investigations were conducted to define the nature and extent of the contamination, and to implement remedial measures; these investigations continued through 1999. The results of the investigations indicate that the primary constituents of concern found in on-site soils and in both on-site and off-site groundwater are volatile organic compounds (VOCs), primarily trichloroethene (*TCE*), 1,1,1-trichloroethane (*TCA*) and its abiotic transformation product 1,1-dichloroethene (*DCE*). Of these constituents, TCE has the highest concentrations and is the constituent that has been used to define the extent of groundwater contamination. DCE has been detected at low concentrations relative to TCE in groundwater, but it has the second largest plume extent. Groundwater contamination by TCA is primarily limited to the facility and its immediate vicinity. Various metals have also been detected in both soil and groundwater samples. Historically, chromium has the highest frequency of occurrence at elevated concentrations.

During the period 1983 to 1987, Sparton worked closely with the New Mexico Environmental Improvement Division (*NMEID*), the predecessor to the New Mexico Environment Department (*NMED*). Several investigations were conducted during this period (Harding and Lawson Associates, 1983; 1984; 1985). In 1987, when it became apparent that contaminants had migrated beyond plant boundaries, the USEPA commenced negotiations with Sparton to develop an Administrative Order on Consent. This Order was signed and became effective on October 1, 1988. Under the provisions of this Order, Sparton implemented an IM in December 1988. The IM consisted of groundwater recovery through eight on-site wells (PW-1, MW-18, and MW-23 through MW-28), and treatment of the recovered water in an on-site air stripper (see Figure 2.1). The purpose of this IM was to remove contaminants from areas of high concentration in the UFZ. Due to the regional decline of water levels, the total discharge rate from the IM system dropped to less than 0.25 gpm by November 1999. As a result, the system was shut-down and taken permanently out of service on November 16, 1999. Groundwater production from this system, during its 11-year operation, is summarized on Table 2.3. A total of 4.4 million gallons of water were recovered during the 11-year operation period, as shown on this table.

From 1988 through 1990, horizontal and vertical delineation of the groundwater plume continued under the October 1, 1988 Order on Consent. On July 6, 1990, the first draft of the RCRA Facility Investigation (*RFI*) report was submitted to USEPA; the final RFI was issued on May 20, 1992 (Harding Lawson Associates, 1992) and approved by USEPA on July 1, 1992. A draft Corrective Measures Study (*CMS*) report was submitted to USEPA on November 6, 1992. The report was revised in response to USEPA comments, and a draft Final CMS was issued on May 13, 1996; the draft was approved, subject to some additional revisions, by USEPA on June 24, 1996. The Revised Final CMS was issued on March 14, 1997 (HDR Engineering, Inc., 1997). Nine additional monitoring wells (MW-65 through MW-73) were installed between 1996 and 1999 to delineate further the groundwater plume.

The investigations conducted at the site included several soil-gas surveys to determine the extent of groundwater contamination and to characterize vadose zone soil contamination and its potential impacts on groundwater quality. The results of soil-gas surveys conducted in 1984, 1985, 1987, and 1991 were reported in the RFI and the CMS. Additional soil-gas investigations to characterize vadose zone contamination were conducted between April 1996 and February 1997 (Black & Veatch, 1997). This work included the installation and sampling of a six-probe vertical vapor probe cluster in the source area, five vapor sampling probes at various radial distances from the former sump area, and vapor sampling of nine on-site and four off-site UFZ monitoring wells that are screened across the water table. The locations of the vapor probes (VP-1-6 and VR-1 through VR-5) and of the sampled on-site monitoring wells are shown in Figure 2.6; the locations of the sampled off-site monitoring wells MW-48, MW-57, and MW-61 are shown on Figure 2.3. The fourth off-site monitoring well, MW-37, which became dry and was plugged in 2002, was located near its replacement well MW-37R. The area where TCE concentrations in soil-gas exceeded 10 ppmv was determined from the results of this investigation (see Figure 2.7).

Following this investigation, a SVE pilot test was conducted on February 27 and 28, 1997 (Black & Veatch, 1997). The test was conducted on vapor recovery well VR-1 using an AcuVac System operating at a flow of 65 cfm at a vacuum of 5 inches of water.

Based on the results of this pilot test, an AcuVac System was installed at the site in the spring of 1998 and operated at a flow rate of 50 cfm on vapor recovery well VR-1 from April 8, 1998 to October 20, 1998 (195 days). Influent and effluent concentrations measured during the operation of the system are shown in Figure 2.8. As shown in this figure, influent TCE concentrations dropped from about 18,000 milligrams per cubic meter (*mg/m^3*), or about 4,000 ppmv, during the first day of operation, to about 150 mg/m^3 (34 ppmv) in about 120 days. Trend lines determined by analysis of the data (see Figure 2.8) indicate that influent TCE concentration was probably as low as 75 mg/m^3 (17 ppmv) prior to the shut-down of the system after 195 days of operation. The mass of TCE removed during this operation of the SVE system was calculated to be about 145 kilograms (kg) or 320 pounds (lbs).

2.5 Implementation of Current Remedial Actions

Based on settlement negotiations that led to the March 3, 2000 Consent Decree, Sparton agreed to implement the following remedial measures: (a) installation and operation of an off-site containment system designed to contain the contaminant plume; (b) replacement of the on-site groundwater recovery system by a source containment system designed to address the release of contaminants from potential on-site source areas; and (c) operation of a robust SVE system for a total operating time of one year over a period of eighteen months.

Implementation of the off-site containment system, as originally planned, was completed in 1999. A chromium reduction process was added to the treatment component of the system in 2000. Chromium treatment ceased in 2001 because the chromium concentration in the influent dropped below the New Mexico groundwater standard. The system currently consists of:

- A containment well (CW-1) installed near the leading edge of the TCE plume;
- An off-site treatment system for the water pumped by CW-1, consisting of an air stripper housed in a building;
- An infiltration gallery installed in the Arroyo de las Calabacillas for returning treated water to the aquifer;
- A pipeline for transporting the treated water from the treatment building to the gallery;
- A piezometer, PZG-1, with an horizontal screen placed near the bottom of the gallery, for monitoring the water level in the gallery; and
- Three monitoring wells (MW-74, MW-75, and MW-76) for monitoring potential water-quality impacts of the gallery.

The location of these components of the off-site containment system is shown in Figure 2.9.

The containment well was installed in August 1998, and aquifer tests were conducted on the well and evaluated in December (SSP&A, 1998). The well began operating at a design rate of 225 gpm on December 31, 1998. During the testing of the well and during its continuous operation between December 31, 1998 and April 14, 1999, the groundwater pumped from the well was discharged into a sanitary sewer without treatment. Installation of the air stripper, the infiltration gallery, and other components of the system (except the chromium reduction process) was completed in early April, 1999. The containment well was shut-down on April 14, 1999 to install a permanent pump and to connect the well to the air stripper. Between April 14 and May 6, 1999, the well operated intermittently to test the air stripper and other system components. The tests were completed on May 6, 1999, and the well was placed into continuous operation. Due to increases in chromium concentrations in the influent to, and hence in the effluent from, the air stripper, a chromium reduction process was added to the treatment system on December 15, 2000. Chromium concentrations, however, declined during 2001 and the chromium reduction process was removed on November 1, 2001. The off-site containment system is now operating with all other system components functioning.

All permits and approvals required for the implementation of the source containment system were obtained between May 1999 and February 2001. The installation of the system began soon after the approval of the Construction Work Plan for the system in February 2001, and completed in December 2001. The system was tested in December 2001 and placed into operation on January 3, 2002. The system consists of:

- A source containment well (CW-2) installed immediately downgradient of the Site;
- An on-site treatment system for the water pumped by CW-2, consisting of an air stripper housed in a building;
- Six on-site infiltration ponds for returning the treated water to the aquifer;
- Pipelines for transporting the pumped water to the air stripper and the treated water to the ponds; and
- Three monitoring wells (MW-17, MW-77, and MW-78) for monitoring the potential water-quality impacts of the ponds.

The layout of the system is shown in Figure 2.10. The chromium concentrations in the influent to, and hence in the effluent from, the air stripper meets the New Mexico water-quality standard for groundwater and, therefore, treatment for chromium is not necessary.

An AcuVac SVE system was installed on vapor recovery well VR-1 (see Figure 2.6) in the spring of 1998 and operated between April 8 and October 20, 1998. Additional SVE operations at this location with the AcuVac system at 50 cfm and with a 200-cfm Roots blower occurred in 1999 between May 12 and June 23 and between June 28 and August 25, respectively. An additional 200-cfm Roots blower was installed in 2000, and the SVE system was operated at

400 cfm between April 10, 2000 and June 15, 2001. The total operating time during this period, 371 days and 13 hours, and the results of the performance monitoring conducted after the shut-down of the system met the requirements of the Consent Decree for the termination of the SVE operations at the site. The system was, therefore, dismantled, and the recovery well and vapor probes associated with the system were plugged in May 2002.

2.6 Initial Site Conditions

Initial site conditions as referred to in this report represent hydrogeologic and soil-gas conditions as they existed prior to the implementation of the current remedial measures (the installation and operation of the off-site containment well, the 1999-2001 operation of SVE systems, and the installation of the source containment system).

2.6.1 Hydrogeologic Conditions

2.6.1.1 Groundwater Levels

The elevation of water levels in monitoring wells, based on measurements made in November 1998, is presented on Table 2.4. These data were used to prepare maps showing the configuration of the water levels at the site prior to the implementation of the current remedial measures.

Water-level data from UFZ and ULFZ well pairs indicate that UFZ wells screened above or within the 4970-foot silt/clay unit (most of the UFZ wells on the Sparton site) have a water level that is considerably higher than that in the adjacent ULFZ wells that are screened below this unit. These water-level differences range from less than one foot near the western and southwestern limit of the unit to more than 10 feet north and northeast of the Sparton site. Outside the area underlain by the 4970-foot silt/clay unit, however, the water-level difference between UFZ and ULFZ well pairs is 0.2 foot or less. A schematic cross-section illustrating this relationship between UFZ and ULFZ water levels is shown in Figure 2.11.

In early interpretations of water-level data, including those presented in the 1999 and 2000 Annual Reports (SSP&A, 2001a; 2001b), separate water-level maps were prepared using data from UFZ, ULFZ and LLFZ wells, without taking into consideration the above discussed relationship between the water levels in UFZ and ULFZ wells. Since the 2001 Annual Report (SSP&A, 2002), however, this relationship has been taken into consideration, and water level conditions at the site and its vicinity are presented in three maps depicting: (1) the water table above the 4970-foot silt/clay unit underlying the Sparton site and at the area north of the site, based on water-level data from UFZ wells screened above or within the silt/clay unit (referred to as the "on-site water table"); (2) the combined UFZ/ULFZ water levels based on data from UFZ and ULFZ wells outside the area underlain by the silt/clay unit (using the average water level at UFZ/ULFZ well pair locations) and ULFZ wells screened below this unit; and (3) the LLFZ water levels based on data from LLFZ wells.

The elevation of the on-site water table in November 1998 is shown in Figure 2.12. The corresponding water-level elevations in the UFZ/ULFZ and LLFZ are shown in Figures 2.13 and 2.14, respectively. These water-level maps indicate that in the off-site areas downgradient from the site, the direction of groundwater flow is generally to the northwest with a gradient of approximately 0.0025. On-site, the direction of flow is also northwesterly in both the UFZ/ULFZ and the LLFZ; however, the gradients are steeper, approximately 0.005 in the UFZ/ULFZ and 0.006 in the LLFZ. The on-site water table is affected by the on-site groundwater recovery system, which was operating during the November 1998 water-level measurements, and the presence of the 4970-foot silt/clay unit; the direction of flow changes from westerly north of the site to southwesterly on the site, with gradients that range from 0.01 to 0.016.

2.6.1.2 Groundwater Quality

The concentrations of TCE, DCE, and TCA in groundwater samples obtained from monitoring wells during the Fourth Quarter 1998 sampling event are summarized on Table 2.5. Also included on this table are data obtained on September 1, 1998 from the off-site containment well, CW-1, and the nearby observation wells, OB-1 and OB-2, and from temporary wells, TW-1 and TW-2, drilled in early 1998 at the current location of MW-73 and sampled on February 18 and 19, 1998, respectively. For each of the compounds reported on Table 2.5, concentrations that exceed the more stringent of its Maximum Contaminant Level (*MCL)* for drinking water or its maximum allowable concentration in groundwater set by the New Mexico Water Quality Control Commission (*NMWQCC*) are highlighted.

These concentration data were used to prepare maps showing the horizontal extent of the TCE, DCE and TCA plumes as they existed in November 1998, prior to the beginning of pumping from the off-site containment well. The procedures presented in the Work Plan for the Off-Site Containment System were used in preparing these maps (SSP&A, 2000a). The horizontal extent of the TCE plume (in November 1998) is shown in Figure 2.15 and the extent of the DCE and TCA plumes is shown in Figures 2.16 and 2.17, respectively. The extent of these plumes forms a basis for evaluating the effectiveness of the remedial actions that have been implemented at the site.

2.6.1.3 Pore Volume of Plume

TCE is the predominant contaminant at the Sparton site and has the largest plume. Calculation of the initial volume of water contaminated above MCLs, referred to as the pore volume of the plume, was therefore based on the horizontal and vertical extent of the TCE plume.

In preparing the plume maps presented in the previous section (Figures 2.15 through 2.17), the completion zone of monitoring wells was not considered; that is, data from an UFZ well at one location was combined with data from an ULFZ or LLFZ well at another location. At well cluster locations, the well with the highest concentration was used, regardless of its completion zone. As such, the horizontal extent of the TCE plume shown in Figure 2.15

represents the envelop of the extent of contamination at different depths, rather than the extent of the plume at a specific depth within the aquifer.

To estimate the initial pore volume of the plume, three separate maps depicting the horizontal extent of the TCE plume were prepared using water-quality data from UFZ, ULFZ, and LLFZ monitoring wells. The concentrations measured in the fully penetrating containment well CW-1 and observation wells OB-1 and OB2 were assumed to represent average concentrations present in the entire aquifer above the 4800-foot clay, and these data were used in preparing all three maps. An estimate of the horizontal extent of TCE contamination at the top of the 4800-foot clay was also made by preparing a fourth plume map using the data from the containment well and the two observation wells, and data from two temporary wells that obtained samples from about 30-35 feet above the top of the clay during the construction of DFZ wells MW-67 (July 1996) and MW-71 (June 1998). [These four TCE plume maps were presented in Appendix B to both the 1999 and the 2000 Annual Reports (SSP&A, 2001a; 2001b).]

The extent of the plume based on UFZ wells was assumed to represent conditions at the water table; based on the elevation of the screened intervals in ULFZ and LLFZ wells (see Figure 2.4), the extent of the plume estimated from ULFZ wells was assumed to represent conditions at an elevation of 4,940 ft MSL, and that estimated from LLFZ wells conditions at an elevation of 4,900 ft MSL. The extent of the plume at the top of the clay was assumed to represent conditions at an elevation of 4,800 ft MSL. The area of the TCE plumes at each of these four horizons was calculated. Using these areas, the thickness of the interval between horizons, and a porosity of 0.3, the pore volume was estimated to be approximately 150 million cubic feet (ft^3), or 1.13 billion gallons, or 3,450 acre-ft.[1]

2.6.1.4 Dissolved Contaminant Mass

As discussed in both the 1999 and 2000 Annual Reports (SSP&A, 2001a; 2001b), calculations of the initial dissolved contaminant mass based on a plume-map approach, such as the one used above to estimate the initial pore volume (Section 2.6.1.3), significantly underestimate the dissolved contaminant mass present in the aquifer underlying the site. The calibration of the numerical transport model that was developed for the site and its vicinity (see Section 6.2.3) was, therefore, used to provide an estimate of the initial contaminant mass. During the calibration process of this model, the initial TCE concentration distribution within each model layer is adjusted, in a manner consistent with the initial concentrations observed in monitoring wells, until computed concentrations of TCE in the pumped water closely match the observed concentrations. Based on the calibration of the model against 1999 through 2003 water-quality data, the initial dissolved TCE mass is currently estimated to be (see Table 6.1) about 7,340 kg (16,190 lbs). Using this estimate, and ratios of TCE mass to DCE and TCA mass determined from plume-map based estimates, the initial masses of dissolved DCE and TCA are

[1] The features of the commercially available mapping program Surfer 7.0 (copyright © 1999, Golden Software, Inc.) were used in generating the plume maps and in calculating plume areas and pore volumes.

estimated to be approximately 450 kg (985 lbs) and 30 kg (65 lbs), respectively. Thus, the total mass of dissolved contaminants is currently estimated to be about 7,820 kg (17,240 lbs).

2.6.2 Soil Gas Conditions

A supplemental vadose zone characterization was conducted between March 15 and May 5, 1999, which included installation and sampling of eight additional vapor probes, VP-7 through VP-14 (see Figure 2.6) and resampling of 15 vapor monitoring points that had exhibited soil-gas concentrations greater than 10 ppmv during the initial characterization. The results of the supplemental investigation are presented in Figure 2.18, with the approximate 10 ppmv TCE plume limit delineated. The extent of the TCE plume presented in this figure represents the initial conditions prior to the resumption of soil vapor extraction remedial actions in 1999.

2.7 Summary of the 1999 through 2002 Operations

During 1999 through 2002, significant progress was made in implementing and operating the remedial measures Sparton agreed to implement under the terms of the Consent Decree entered on March 3, 2000. These remedial measures resulted in the containment of the plume at the site, the removal of a significant amount of mass from the plume of groundwater contamination, and a significant reduction in soil-gas concentrations in the on-site source areas.

The remedial measures undertaken in 1999 through 2002 included the following:

- Between December 31, 1998 and April 14, 1999, and from May 6, 1999 through December 31, 2002, the off-site containment well was operated at a rate sufficient to contain the plume. The air stripper for treating the pumped water and the infiltration gallery for returning the treated water to the aquifer were constructed in the spring of 1999. These systems were connected to the containment well and tested between April 14 and May 6, 1999. A chromium reduction process was added to the off-site treatment system on December 15, 2000 to control chromium concentrations in the air stripper effluent and thus meet discharge permit requirements for the infiltration gallery; the process was discontinued on November 1, 2001 after chromium concentrations in the influent decreased to levels that no longer required treatment.

- A 50-cfm AcuVac SVE system was operated at vapor recovery well VR-1 from May 12 through June 23, 1999, and a 200-cfm Root blower system was operated at this well from June 28 to August 25, 1999. A second 200-cfm Root blower was added to the system in the Spring of 2000, and the 400-cfm SVE system operated for a total of 372 days between April 10, 2000 and June 15, 2001 meeting the length-of-operation requirement of the Consent Decree. The results of the performance monitoring that was conducted in September and October 2001 indicated that the system had met the termination criteria specified in the Consent Decree, and the system was dismantled in May 2002.

- The source containment system, consisting of a containment well immediately downgradient from the site, an on-site treatment system, six on-site infiltration ponds, and associated conveyance and monitoring components, was installed and tested during 2001. Operation of the system began on January 3, 2002, and the system operated thoughout the remainder of the year at a rate sufficient for containing any potential sources that may remain at the site.

- Groundwater monitoring was conducted as specified in Attachment A to the Consent Decree. Water levels in accessible monitoring wells, the containment well, observation wells, piezometers, and the Corrales Main Canal were measured quarterly. Samples were collected for water-quality analyses from monitoring wells and from the influent and effluent of the air stripper at the frequency specified in the Consent Order. Water samples were analyzed for TCE, DCE, TCA and other constituents, as required by the Consent Decree and the Groundwater Discharge Permit.

- A groundwater flow and transport model of the hydrogeologic system underlying the site was developed in 2000. The model was calibrated against data available at the end of 1999, and again against data available at the end of each subsequent year, and used to simulate TCE concentrations in the aquifer from the start-up of the containment well in December 1998 through November 2002 and to predict TCE concentrations in November 2003. Plans were made to continue the calibration and improvement of the model during 2003.

A total of about 460 million gallons of water, corresponding to an average rate of about 219 gpm, were pumped from the off-site containment well between the start of its operation and the end of 2002. Evaluation of quarterly water-level data indicated that containment of the contaminant plume was maintained throughout each year.

The source containment well began operating on January 3, 2002 and during the remainder of the year it pumped a total of about 25 million gallons of water, corresponding to an average rate of 49 gpm. Evaluation of quarterly water-level data indicated that the well developed a capture zone that prevents the off-site migration of contaminants from the site

The total volume of water pumped by both the off-site and source containment wells between the start of the off-site containment well operation and the end of 2002 was about 485 million gallons, and represents about 43 percent of the initial volume of contaminated groundwater (pore volume).

The total mass of contaminants that was removed by the off-site containment well between the start of its operation and the end of 2002 was about 1,990 kg (4,370 lbs) and consisted of 1,885 kg (4,160 lbs) of TCE, 98 kg (215 lbs) of DCE, and 2.0 kg (4.4 lbs.) of TCA. An additional 71 kg (155 lbs) of contaminants consisting of about 60 kg (130 lbs) of TCE, 9.7 kg (21 lbs) of DCE, and 1.6 kg (3.5 lbs.) of TCA were removed from the aquifer by the source containment well during 2002, its first year of operation. Thus, the total mass of contaminants removed from the aquifer by both wells between the start of the off-site containment well operation on December 1998 and the end of 2002 was about 2,060 kg (4,530 lbs) consisting of

1,950 kg ((4,290 lbs) of TCE, 105 kg (235 lbs) of DCE, and 3.6 kg (7.9 lbs) of TCA. This removed mass represents about 26 percent of the contaminant mass (27 percent of the TCE, 23 percent of the DCE, and 12 percent of the TCA mass currently estimated to have been present in the aquifer prior to the operation of the off-site containment well.

The operation of the soil vapor extraction systems at vapor recovery well VR-1 in 1999 and 2000 had a measurable impact on soil-gas concentrations at the site. The 1999 SVE operations had reduced TCE concentrations in soil gas below 10 ppmv at all but one of the monitored locations. Soil-gas was not monitored during the 2000 and 2001 operation of the 400-cfm system. The system was shut-down on June 15, 2001 and performance monitoring was conducted near the end of 2001, three months after the shut-down. The results of this monitoring indicated that soil gas concentrations at all monitoring locations were considerably below the 10 ppmv termination criterion for the system, and the system was dismantled in May 2002.

The remedial systems were operated with only minor difficulties during 1999 through 2002. In 1999, the metering pump adding anti-scaling chemicals to the influent to the off-site air-stripper was not operating correctly. This problem was solved in December 1999 by replacing the pump. Also, chromium concentrations in the influent to, and hence in the effluent from, the air stripper increased from 20 µg/L at system start-up to 50 µg/L by May 1999, and fluctuated near this level, which is the discharge permit limit for the infiltration gallery, throughout the remainder of 1999 and during 2000. To solve this problem, a chromium reduction process was added to the treatment system on December 15, 2000; the process was discontinued on November 1, 2001 after chromium concentrations declined to levels that no longer required treatment. Another problem was the continuing presence of contaminants in the DFZ monitoring well MW-71. During 2001, an investigation was conducted on the well and the well was plugged. Based on the results of the investigation, a replacement well, MW-71R located about 30 feet south of the original well, was installed in February 2002. Samples collected from the replacement well during 2002 indicated the continuing presence of contaminants in the Deep Flow Zone. Three on-site and two off-site water table monitoring wells that were dry for the last several years were plugged in May 2002. Other minor problems during these years included the occasional shutdown of the off-site system due to failures of the monitoring or paging systems, and the discharge pump starter. Appropriate measures were taken to address these problems.

Section 3
System Operations - 2003

3.1 Monitoring Well System

Well MW-52, which had been dry since November 2002, was replaced with well MW-52R in June 2003, and well MW-52 was plugged in September 2003. The wellhead on MW-60 was damaged by truck traffic on March 3, 2003 during the construction of a residence on the lot where it is located; the location of the well is now on the driveway to the residence, and the wellhead was replaced in July 2003 to accommodate the driveway. The wellhead on MW-71R was also replaced in May 2003 to accommodate a new driveway. The wellhead on well MW-70 was damaged and replaced in July 2003.

3.2 Containment Systems

3.2.1 Off-Site Containment System

Except for some minor interruptions, the off-site containment well CW-1 operated continuously during 2003. Five maintenance activities, twelve false alarms, six power outages and two low levels in the chemical feed tank caused a total of 25 short duration shutdowns. The net operating period for the system during 2003 constituted 99.8 percent of the available time.

3.2.2 Source Containment System

Except for some interruptions, the source containment well CW-2 also operated continuously during 2003. Three maintenance activities and three power outages caused a total of six short duration shutdowns. A power outage that occurred in March 2003, at a time when the electronic monitoring system was in the shop for repairs, resulted in an inadvertent 5-day shutdown of the source containment system. The net operating period for the system during 2003 constituted 98.4 percent of the available time.

The rapid infiltration ponds performed well during 2003. Only two ponds (Pond 1 and 4) were used. The amount of water evaporating from the ponds was estimated to be about 1 percent of the discharged water, that is, about 0.5 gpm.

3.3 Problems and Responses

Minimal problems were experienced with the operation of the off-site and source containment systems during 2003. Except for the 5-day shut-down of the source containment system due to damage caused by a power outage in March, both systems essentially operated continuously.

Section 4
Monitoring Results - 2003

The following data were collected in 2003 to evaluate the performance of the operating remedial systems and to meet the requirements of the Consent Decree and of the permits for the site:

- Water-level and water-quality data from monitoring wells;
- Data on containment well flow rates; and
- Data on the quality of the influent to and effluent from the water-treatment systems.

4.1 Monitoring Wells

4.1.1 Water Levels

The depth to water was measured quarterly during 2003 in all accessible monitoring wells, the off-site and source containment wells, the two observation wells, the piezometer installed in the infiltration gallery, and the Corrales Main Canal near the southeast corner of the Sparton property. The quarterly elevations of the water levels, calculated from these data, are summarized on Table 4.1.

4.1.2 Water Quality

Monitoring wells within and in the vicinity of the plume were sampled at the frequency specified in the Groundwater Monitoring Program Plan (Attachment A to Consent Order). The samples were analyzed for VOCs (primarily for determination of TCE, DCE, and TCA concentrations), and for total chromium (unfiltered, and occasionally filtered, samples). The results of the analysis of the samples collected from these monitoring wells during all sampling events conducted in 2003, and for all of the analyzed constituents, are presented in Appendix A-1. Data on TCE, DCE and TCA concentrations, in samples collected during the Fourth Quarter of 2003 (November 2003), are summarized on Table 4.2. Samples were also obtained quarterly from the infiltration gallery monitoring wells (MW-74, MW-75, and MW-76) and from the infiltration pond monitoring wells (MW17, MW-77, and MW-78); these samples were analyzed for VOCs (primarily TCE, DCE, and TCA), total chromium, iron, and manganese, as specified in the Groundwater Discharge Permit for the infiltration gallery and the infiltration ponds. The results of the analysis of these samples are presented in Appendix A-2; data on TCE, DCE and TCA concentrations in the Fourth Quarter of 2003 (November 2003) samples from these wells are also included on Table 4.2. For each of the compounds reported on Table 4.2 and in Appendix A, concentrations that exceed the more stringent of its MCL for drinking water or its maximum allowable concentration in groundwater set by NMWQCC are highlighted.

4.2 Containment Systems

4.2.1 Flow Rates

4.2.1.1 Off-Site Containment Well

The flow rate of the off-site containment well during 2003 was monitored with a totalizer meter that also measured the instantaneous flow rate of the well. The meter was read at irregular frequencies. The intervals between meter readings ranged from less than a day to about seventeen days, and averaged about five days. The totalizer and instantaneous discharge rate data collected from these flow meter readings are presented in Appendix B-1. Also included in this appendix are the average discharge rate between readings and the total volume pumped between the start of continuous pumping on December 31, 1998 and the time of the measurement, calculated from the totalizer meter readings.

The average monthly discharge rate and the total volume of water pumped from the off-site containment well during each month of 2003, as calculated from the totalizer data, are summarized on Table 4.3 (a). As indicated on this table, approximately 118 million gallons of water, corresponding to an average rate of 225 gpm, were pumped in 2003.

4.2.1.2 Source Containment Well

The flow rate of the source containment well since the start of its operation on January 3, 2002 was monitored with a totalizer meter that also measured the instantaneous flow rate of the well. This meter was also read at irregular frequencies. The intervals between meter readings ranged from about one day to fourteen days, and averaged about five days. The totalizer and instantaneous discharge rate data collected from these flow meter readings are presented in Appendix B-2. Also included in this appendix are the average discharge rate between readings and the total volume pumped between the start of continuous pumping on January 3, 2002 and the time of the measurement, calculated from the totalizer meter readings.

The average monthly discharge rate and the total volume of water pumped from the source containment well during each month of 2003, as calculated from the totalizer data, are summarized on Table 4.3 (b). As indicated on this table, approximately 27 million gallons of water, corresponding to an average rate of 52 gpm, were pumped in 2003.

4.2.2 Influent and Effluent Quality

4.2.2.1 Off-Site Containment System

During 2003, the influent[2] to and effluent from the treatment plant for the off-site containment system was sampled monthly. These monthly samples were analyzed for VOCs

[2] The "discharge from the containment wells" is the "influent" to the treatment systems; therefore, the two terms are used interchangeably in this report.

(primarily TCE, DCE, and TCA), total chromium, iron, and manganese. The results of these influent and effluent sample analyses are presented in Appendix C-1. Concentrations of TCE, DCE, TCA, and total chromium in samples collected during 2003 are summarized on Table 4.4 (a). For each of the compounds shown on Table 4.4 (a), concentrations that exceed the more stringent of its MCL for drinking water or its maximum allowable concentrations in groundwater set by NMWQCC are highlighted. Data on TCE, DCE, and TCA concentrations for the November sample of influent are also included in Table 4.2, as the Fourth Quarter concentrations in CW-1, and were used in the preparation of the plume maps discussed in the next section.

4.2.2.2 Source Containment System

During 2003, the influent to and effluent from the treatment plant for the source containment system was sampled monthly. These monthly samples were analyzed for VOCs (primarily TCE, DCE, and TCA), total chromium, iron, and manganese. The results of these influent and effluent sample analyses are presented in Appendix C-2. Concentrations of TCE, DCE, TCA, and total chromium in samples collected during 2003 are summarized on Table 4.4 (b). For each of the compounds shown on Table 4.4 (b), concentrations that exceed the more stringent of its MCL for drinking water or its maximum allowable concentrations in groundwater set by NMWQCC are highlighted. Data on TCE, DCE, and TCA concentrations for the November sample of influent are also included in Table 4.2, as the Fourth Quarter concentrations in CW-2, and were used in the preparation of the plume maps discussed in the next section.

Section 5
Evaluation of Operations - 2003

The goal of the off-site containment system is to control hydraulically the migration of the plume in the off-site area and, in the long-term, restore the groundwater to beneficial use. The goal of the source containment system is to control hydraulically, within a short distance from the site, any potential source areas that may be continuing to contribute to groundwater contamination at the on-site area. This section presents the results of evaluations based on data collected during 2003 of the performance of the off-site and source containment systems with respect to their above stated goals.

5.1 Hydraulic Containment

The quarterly water-level elevation data presented in Table 4.1 were used to evaluate the performance of both the off-site and source containment wells with respect to providing hydraulic containment for the plume and potential on-site source areas. Maps of the elevation of the on-site water table and of the water levels in the UFZ/ULFZ and the LLFZ during each of the four rounds of water-level measurements during 2003 are shown in Figures 5.1 through 5.12. Also shown in these figures are: (1) the limit of the capture zones of the containment wells in the UFZ/ULFZ or the LLFZ, as determined from the configuration of the water levels; and (2) the extent of the TCE plume based on previous year's (November 2002) water-quality data from monitoring wells. (The November 2002 extent of the plume is used as representative of the area that should have been contained during 2003.)

As shown in Figures 5.1, 5.4, 5.7, and 5.10, the pumping from the source containment well CW-2 has a small effect on the on-site water table contours. Well CW-2 is screened between an elevation of 4968.5 and 4918.5 ft MSL. The sand-pack extends about ten feet above the top of the screen, to an elevation of about 4978.5 ft MSL. The top of the 4970-foot silt/clay at this location is also at an elevation of about 4968.5 ft MSL. Most of the water pumped from the well, therefore, comes from the ULFZ and LLFZ underlying the 4970-foot silt/clay unit. The pumping water level in CW-2 is about 4957 ft MSL, more than 10 ft below the top of the silt/clay unit; thus, the direct contribution of water from the aquifer above the silt/clay unit into the well is by leakage through the sand pack, and is controlled by the elevation of the top of the silt/clay unit at the well location. In preparing the water–table maps for the on-site area, the elevation of the water table at the location of CW-2 was, therefore, assumed to be near the top of the 4970-foot silt/clay, that is, at an elevation of 4968.5 ft MSL. A similar condition exists at the location of infiltration pond monitoring wells MW-77 and MW-78. These two monitoring wells are equipped with 30-foot screens that span across the silt/clay unit, and thus allow water to flow from the on-site water table into the underlying ULFZ. The effects of this downward flow were also considered in preparing the water table maps.

The water table maps (Figures 5.1, 5.4, 5.7, and 5.10) also indicate that the treated groundwater infiltrating from the infiltration ponds has created a water-table mound in the pond area. Comparison of the 2003 water table elevations with those that prevailed prior to the operation of CW-2 and of the infiltration ponds indicates that water levels in monitoring wells close to the ponds have risen by one foot or more; the highest rise of the water table, about 8 ft, occurs in the vicinity of wells MW-21 and MW-27. The water levels in monitoring wells along or near the limits of the silt/clay unit, however, continued to decline due to the off-setting effects of regional declining trends. These changes in water levels have resulted in steeper gradients, and hence, faster flow rates, both horizontally and vertically. These faster flow rates and the flushing effects of the infiltrating water expedite the migration of contaminants remaining above the 4970-foot silt/clay unit into the capture zones of the source and off-site containment wells.

The figures showing the water levels within the UFZ/ULFZ (Figures 5.2, 5.5, 5.8, and 5.11) and the LLFZ (Figures 5.3, 5.6, 5.9, and 5.12) indicate that the source containment well has developed a capture zone that controls any potential on-site source areas that may be contributing to groundwater contamination. The capture zone of the well in both the UFZ/ULFZ and the LLFZ is wider than predicted during its design[3]. As also shown in these figures, the limits of the off-site containment well capture zone during 2003 were beyond the extent of the plume. Hydraulic containment of the plume was, therefore, maintained throughout the year.

5.2 Groundwater Quality

Plots showing temporal changes in the concentrations of TCE, DCE, and TCA were prepared for a number of on-site and off-site wells to evaluate long-term water-quality changes at the Sparton site. Plots for on-site wells are shown in Figure 5.13 and plots for off-site wells in Figure 5.14. The concentrations in the on-site wells (Figure 5.13) indicate a general decreasing trend; in fact, the data from wells MW-9 and MW-16, which have the longest record, suggest that this decreasing trend may have started before 1983. A significant decrease in concentrations occurred in well MW-16 during 1999 through 2001. This well is located near the area where the SVE system was operating during those years, and it is apparent that the SVE operations affected the concentrations in the well. The TCE concentration in the well increased from 6 µg/L in November 2001 to 22 µg/L in November 2002, but then declined again to 5 µg/L in November 2003.

During the design[3] of the source containment well CW-2, the northern limit of its capture zone was predicted to be located near the southern boundary of the infiltration ponds. Due to concern about potential source areas outside this predicted capture zone, monitoring well MW-72 (see Figure 2.3 for well location) was installed in late February 1999. Under the terms of the Consent Decree[3], the conditions for monitoring this well were based on the results of the first sampling of the well:

> *If the TCE concentration in the sample is less than or equal to 1,000 µg/l, the well will be designated as a piezometer (PZ-2). . . . No further sampling of the well*

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[3] S. S. Papadopulos & Associates, Inc., 2000, **Work Plan for the Installation of a Source Containment System**, Attachment F to the Consent Decree in City of Albuquerque et al. v. Sparton Technology, Inc., Civil action No. CV 07 0206, in the U. S. District Court for the District of New Mexico, filed March 3, 2000.

will be required. However, if the TCE concentration in the sample from the well is higher than 1,000 µg/l, the well will be designated as a monitoring well (MW-72), and in addition to being monitored quarterly for water levels, it will be sampled semi-annually for a period of five years. . . .

The water quality data to be collected from the well, and annual evaluations of these data will be included in the site's Annual Reports. After five years of data collection, Sparton will submit a Source Containment Investigation Report presenting the results of the investigation and discussing whether the source containment system needs to be modified.

The first sampling of the well in March 1999 indicated a TCE concentration of 1,800 µg/L and, therefore, the well was scheduled for semi-annual sampling for a period of five years (starting in May 1999). The samples collected in 2003 completed the 5-year semi-annual sampling period. A plot of the TCE, DCE, and TCA concentrations detected in the semi-annual samples from this well is included in Figure 5.13. The May 1999 sample had the same TCE concentration, 1,800 µg/L, as that of the March 1999 sample; in November 1999, the TCE concentration had declined to 1,200 µg/L. During 2000 and early 2001, the TCE concentration in the well increased reaching 4,100 and 4,200 µg/L in duplicate samples collected in May 2001; however, the November 2001 sample had 2,900 µg/L of TCE. Samples collected in May and November 2002 remained at about the same level, 2,700 µg/L and 2,800 µg/L, respectively. During 2003, the concentration of TCE in samples from this well declined to 1,700 µg/L in May and to 680 µg/L in November. A similar trend was also followed by DCE and TCA concentrations. The concentrations of DCE declined from a peak of 600 µg/L in May 2001 to 57 µg/L in November 2003; similarly, TCA concentrations declined from a peak of 160 µg/L in May 2001 to 5.7 µg/L in November 2003.

As stated earlier, the capture zone of the source containment well CW-2 is wider than predicted during the design of the well. Thus, monitoring well MW-72 is located within or along the limit of the capture zone of CW-2 (see Figures 5.2, 5.5, 5.8, and 5.11). The location of MW-72 relative to the capture zone of CW-2, and the declining concentration trends observed in samples from the well during the last two-and-a-half years indicate that there are no significant source areas upgradient of the well, and that, therefore, the source containment system does not need to be modified. Beginning with November 2004, the well will be sampled at an annual frequency. This evaluation of the water-quality data from well MW-72 is the Source Containment Investigation Report specified in the Consent Decree.

The concentrations in most off-site wells also had a decreasing trend since the mid-1990s. Of the six wells shown in Figure 5.14, concentrations in wells MW-55, MW-56, MW-58 and MW-61 appear to have peaked between 1995 and 1997, and then began to decline; however, some leveling, and even some trend reversal, has been occurring during the last four years. In well MW-48, this trend reversal occurred in mid 1999; TCE concentration in this well increased from 28 µg/L in both November 1998 and May 1999 to 99 and 95 µg/L in duplicate samples collected in November 2002, and declined to 62 µg/L in November 2003. Concentrations of

TCE in well MW-60 had increased from low μg/L levels in 1993 to a high of 11,000 μg/L in November 1999 and then declined to 2,900 μg/L in November 2000; however, during the last three years (November 2001, 2002, and 2003) TCE concentrations increased again to 3,700, 7,100, and 13,000 μg/L, respectively. These changes in the concentrations of off-site wells are to be expected as contaminated water within the plume is migrating toward the off-site containment well.

One of the two DFZ wells, MW-67 of the MW-48/55/56/67 cluster, continued to be free of any contaminants in 2003 as it has been since its installation in July 1996. The other DFZ well, MW-71 near the MW-60/61 cluster, had been problematic since its installation in June 1998, and its recompletion in October 1998 (see 1999 Annual Report [SSP&A, 2001a] for a detailed discussion of the history of this well). A purge test and the deviation survey were conducted on the well in July and September 2001 to investigate its behavior. Based on the results of these tests (see SSP&A and Metric, 2002), the well was plugged in October 2001and a replacement well, MW-71R, was installed in February 2002 about 30 feet south of the original well (see Figure 2.3 for location); the well was equipped with a 5-foot screen installed 20 feet below the screen of the original well (see Table 2.2 for elevation of screened interval).

The first sample from the replacement well, obtained in February 2002, had a TCE concentration of 130 μg/L; samples collected in April, May, August, and November 2002 had TCE concentrations of 150, 160, 190, and 180 μg/L, respectively. These results were discussed with representatives of USEPA and NMED in a conference call on November 17, 2002, and an agreement was reached that a decision on further action be postponed until the well had been sampled for a complete year (until February 2003). The February 2003 sample from the well also had 180 μg/L of TCE. (The May, August, and November 2003 samples from this well had TCE concentrations of 190, 210, and 190 μg/L, respectively.) Based on this result, Sparton proposed to pump the well and, after treatment, re-inject the pumped water in the unsaturated zone at a location south of the well; this proposal was included in the 2002 Annual Report (SSP&A, 2003). In their review comments of the 2003 Annual Report[4], USEPA/NMED requested that a Work Plan be submitted with details on the proposed MW-71R pump-and-treat system. Such a Work Plan[5] was prepared and submitted to USEPA/NMED on January 14, 2004. Implementation of the system will begin upon receipt of agency approval of the Work Plan.

The Fourth Quarter (November) 2003 water-quality data presented in Table 4.2 were used to prepare concentration distribution maps showing conditions near the end of 2003. The horizontal extent of the TCE plume and the concentration distribution within the plume in November 2003, as determined from the monitoring well data, is shown on Figure 5.15. Also shown on this figure are the approximate areas of origin of the water pumped by the off-site containment well during the last five years and from the source containment well during the last

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[4] Letter dated November 7, 2003 from Charles A. Barnes, Project Coordinator, USEPA, Region 6, and John Kieling, NMED, to Tony Hurst of Hurst Engineering Services, Project Coordinator for Sparton Technology, Inc.

[5] SSP&A and Metric, 2004, Sparton Technology, Inc. Former Coors Road Plant Remedial Program, Work Plan For The Proposed MW-71R Pump-And-Treat System, January 14.

two years. [Particle tracking analysis (see Section 6.1.4) with the calibrated model of the site was used to determine these areas of origin.] The horizontal extent of the DCE and TCA plumes, and the concentration distribution within these plumes in November 2003 are shown in Figures 5.16 and 5.17, respectively. The extent of the TCE plume in November 2003 (Figure 5.15) is similar to that in November 2002, except that concentrations on the Sparton property are generally lower.

The leading edge of the DCE plume (Figure 5.16) extends to monitoring well MW-65. Until 2002, DCE concentrations in this well had been below detection limits or below its MCL. DCE concentrations above the MCL of 5 μg/L for this compound first occurred in this well in February 2002 (5.4 μg/L); DCE concentrations increased since then and reached 47 μg/L in November 2003. Given the direction of groundwater flow (see Figures 5.1 through 5.12), the concentrations in MW-65 may represent a separate DCE plume connected to MW-62. This issue, however, is irrelevant as the entire area of DCE contamination is within the capture zones of the containment wells.

As the concentrations of TCA presented in Figure 5.17 indicate, a TCA plume (defined as the area with concentrations exceeding the more stringent of the federal or state allowable limits in groundwater) did not exist in November 2003. None of the monitoring wells had a TCA concentration above the 60 μg/L maximum allowable concentration in groundwater set by the NMWQCC. The highest TCA concentration in November 2003 was 49 μg/L and occurred in well MW-60.

Changes that occurred between November 1998 (prior to the implementation of the current remedial activities) and November 2003 in the TCE, DCE, and TCA concentrations at monitoring wells that were used for plume definition and sampled during both sampling events are shown in Figures 5.18, 5.19, and 5.20. Also shown on these figures is the extent of the plumes in November 1998 and November 2003. (Changes in monitoring wells MW-72, MW-77, and MW-78, and containment well CW-2, which were installed after November 1998 are also included in these figures; the changes in these wells are between their first sampling after installation and November 2003.) The largest increase in TCE and DCE concentrations occurred in off-site well MW-60 (5300 and 250 μg/L, respectively); the largest decrease of these constituents occurred in on-site well MW-26 (6439 and 587 μg/L, respectively). The largest increase in TCA occurred in off-site well MW-46 (36 μg/L), and the largest decrease in on-site well MW-23 (690 μg/L). Significant decreases in the concentration of all three constituents occurred in the on-site area. The only on-site well where an increase occurred since 1998 in all three constituents is MW-19. An increase in TCE and DCE also occurred in infiltration pond monitoring well MW-77, but this increase is relative to the first sampling of the well in November 2001; the November 2003 concentrations of these constituents in MW-77 were lower than in November 2002. There are no discernible patterns in the changes that occurred in off-site wells, concentrations increased in some wells, decreased at others, or remained unchanged (mostly non-detect wells). The persistence of the high concentrations that have been observed in the water pumped from containment well CW-1 since the beginning of its operation, and concentrations at well MW-60, however, indicate the presence of high concentration areas upgradient from the off-site containment well. This conclusion is confirmed by the model calibration results discussed in Section 6. In contrast, the concentrations in the source containment well CW-2 have begun to decline since September 2003, indicating that concentrations within the capture zone of this well are declining.

5.3 Containment Systems

5.3.1 Flow Rates

A total of about 145 million gallons of water, corresponding to an average pumping rate of about 277 gpm, were pumped during 2003 from the off-site and source containment wells [see Table 4.3 (a)]. The total volume pumped from both wells since the beginning of remedial pumping in December 1998 is about 630 million gallons (see Figure 5.22), and represents approximately 56 percent of the initial plume pore volume reported in Subsection 2.6.1.3 of this report. The volume pumped from each well and the average flow rates are discussed below.

5.3.1.1 Off-Site Containment Well

The volume of water pumped from the off-site containment well during each month of 2003 is shown on Table 4.3 (b); a plot of the monthly production is presented in Figure 5.21. Based on the total volume of water pumped during the year (approximately 118 million gallons), the average discharge rate for the year was 225 gpm. The well was operated 99.8 percent of the time available during the year, thus the average operating discharge rate was also about 225 gpm.

Since the beginning of its operation in December 1998, the off-site containment well pumped a total of about 580 million gallons of water from the aquifer. (This total includes 1.7 million gallons pumped during the testing and the first day of operation of the well in December 1998.) This represents approximately 51 percent of the initial plume pore volume reported in Subsection 2.6.1.3 of this report. A cumulative plot of the volume of water pumped from the off-site containment well is presented in Figure 5.22.

5.3.1.2 Source Containment Well

The volume of water pumped from the source containment well during each month of 2003 is shown on Table 4.3 (c); a plot of the monthly production is presented in Figure 5.21. Based on the total volume of water pumped during the year (approximately 27 million gallons), the average discharge rate for the year was 52 gpm. The well was operated 98.4 percent of the time available during the year, thus the average operating discharge rate was about 53 gpm.

Since the beginning of its operation in January 3, 2002, the source containment well pumped a total of 52 million gallons of water from the aquifer. This represents approximately 4.6 percent of the initial plume pore volume reported in Subsection 2.6.1.3 of this report. A cumulative plot of the volume of water pumped from the off-site containment well is presented in Figure 5.22.

5.3.2 Influent and Effluent Quality

5.3.2.1 Off-Site Containment System

The concentrations of TCE, DCE, TCA, and total chromium in the influent to and effluent from the off-site air stripper during 2003, as determined at the beginning of each month, are presented on Table 4.4 (a). Plots of the TCE, DCE, and total chromium concentrations in the influent are presented in Figure 5.23.

The concentrations of TCE in the influent during 2003 remained fairly steady, fluctuating within a narrow range of 1,200 to 1,300 µg/L. An exception was the December sample which had a concentration of 1,500 µg/L; however, the concentration declined to 1,200 µg/L by early January 2004. The average TCE concentration for the year was about 1,270 µg/L. The concentrations of DCE and TCA also fluctuated within a relatively narrow range and averaged about 70 µg/L and less than 5 µg/L, respectively. As in the case of TCE, the highest concentrations of DCE and TCA were in the December sample, 88 µg/L and 5.6 µg/L, respectively. Throughout the year, total chromium concentrations in the influent were below the 50 µg/L maximum allowable concentration in groundwater set by NMWQCC and averaged about 25 µg/L.

The concentrations of TCE, DCE, and TCA in the air stripper effluent were below the detection limit of 1 µg/L throughout 2003. Total chromium concentrations in the effluent were essentially the same as those in the influent, and below the 50 µg/L maximum allowable concentration in groundwater set by NMWQCC.

5.3.2.2 Source Containment System

The 2003 concentrations of TCE, DCE, TCA, and total chromium in the influent to and effluent from air stripper for the source containment system, as determined at the beginning of each month, are presented on Table 4.4 (b). Plots of the TCE, DCE, and total chromium concentrations in the influent are presented in Figure 5.23.

The concentrations of TCE in the influent during 2003 rose from a range of 410-450 µg/L at the beginning of the year to 560 µg/L in September and then declined to about 400 µg/L by the end of the year. The average TCE concentration for the year was about 470 µg/L. The concentrations of DCE and TCA fluctuated during the year within a relatively narrow range and averaged about 60 µg/L and 10 µg/L , respectively. Throughout the year, total chromium concentrations in the influent were below the 50 µg/L maximum allowable concentration in groundwater set by NMWQCC and averaged about 30 µg/L.

The concentrations of TCE, DCE, and TCA in the air stripper effluent were below detection limits throughout the year. As expected from the influent concentrations, total chromium concentrations in the effluent were also below the 50 µg/L maximum allowable concentration in groundwater set by NMWQCC.

5.3.3 Origin of the Pumped Water

5.3.3.1 Off-Site Containment Well

The approximate areas of origin of the water pumped from the off-site containment well during each of the last five years are shown in Figure 5.15. The approximately 580 million gallons of groundwater that have been removed from the aquifer by the off-site containment well represent water that was in storage around the well within an approximately cylindrical volume with an average radius of about 720 feet and a height equal to the saturated thickness of the aquifer above the 4800-foot clay[6]. Because of the regional gradient, the well is not at the center of the area of origin, but it is off-centered toward the downgradient direction and the area is slightly elliptical. Also, because the water table is declining, the source of some of the pumped water is vertical drainage from the water table rather than purely horizontal flow. Therefore, the storage volume from which the pumped water is derived has a smaller area near the water table than in the deeper horizons of the aquifer. The area shown in Figure 5.15 represents the horizon where the area is the largest.

5.3.3.2 Source Containment Well

The approximate areas of origin of the water pumped from the source containment well during the last two years are also shown in Figure 5.15. About 40 feet of the screen of the source containment well is open to the aquifer below the 4970-foot silt/clay. Over this 40-foot screened interval, the approximately 52 million gallons of groundwater that have been removed from the aquifer by the source containment would represent water that was in storage around the well within an approximately cylindrical volume having an average radius of about 430 feet (assuming a porosity of 0.3). The area determined by particle tracking analysis (see Section 6.1.4) and shown in Figure 5.15 is slightly elliptical with an average radius of about 390 feet; this indicates that the well is capturing water over a larger thickness than the interval screened below the 4970-foot silt/clay.

5.3.4 Contaminant Mass Removal

A total of about 660 kg (1,450 lbs) of contaminants, consisting of about 620 kg of TCE (1,360 lbs), 38 kg of DCE (84 lbs), and 3.1 kg of TCA (6.7 lbs), were removed by the two containment wells during 2003 [see Table 5.1 (a)]. The total mass removed by the containment wells since the beginning of operations in December 1998 is about 2,710 kg (5,980 lbs), consisting of about 2,560 kg (5,640 lbs) of TCE, 145 kg (320 lbs) of DCE, and 6.7 kg (15 lbs) of TCA. This represents about 35 percent of the total dissolved contaminant mass, 35 percent of the TCE, 32 percent of the DCE, and 22 percent of the TCA mass, currently estimated to have been present in the aquifer prior to the testing and operation of the off-site containment system (see Section 2.6.1.4). The mass removal rates by each well are discussed below.

[6] A porosity of 0.3 and an average saturated thickness of 160 ft were used in estimating the radius of the cylinder.

5.3.4.1 Off-Site Containment Well

The monthly mass removal rates of TCE, DCE, and TCA by the off-site containment well during the 2003 were estimated using the monthly discharge volumes presented on Table 4.3 (b) and the concentration of these compounds shown on Table 4.4 (a). These monthly removal rates are summarized on Table 5.1 (b) and plotted in Figure 5.24. As shown on Table 5.1 (b), about 600 kg (1,330 lbs) of contaminants, consisting of about 570 kg (1,250 lbs) of TCE, 32 kg (70 lbs) of DCE, and 2.1 kg (4.6 lbs) of TCA were removed by the off-site containment well during 2003.

A plot showing the cumulative mass removal by the off-site containment well, including 1.3 kg (3 lbs) removed during the December 1998 testing and operation of the well, is presented in Figure 5.25. By the end of 2003 the off-site containment well had removed a total of approximately 2,580 kg (5,700 lbs) of contaminants, consisting of approximately 2,450 kg (5,410 lbs) of TCE, 130 kg (280 lbs) of DCE, and 4.1 kg (9.1 lbs) of TCA. This represents about 33 percent of the total dissolved contaminant mass, 33 percent of the TCE, 29 percent of the DCE, and 14 percent of the TCA mass, currently estimated to have been present in the aquifer prior to the testing and operation of the off-site containment system (see Section 2.6.1.4).

5.3.4.2 Source Containment Well

The monthly mass removal rates of TCE, DCE, and TCA by the source containment well during the 2003 were estimated using the monthly discharge volumes presented on Table 4.3 (c) and the concentration of these compounds shown on Table 4.4 (b). These monthly removal rates are summarized on Table 5.1 (c) and plotted in Figure 5.24. As shown on Table 5.1 (c), about 56 kg (120 lbs) of contaminants, consisting of about 49 kg (110 lbs) of TCE, 6.5 kg (14 lbs) of DCE, and 1.0 kg (2.2 lbs) of TCA were removed by the source containment well during 2003.

A plot showing the cumulative mass removal by the source containment well since the beginning of its operation on January 3, 2002 is presented in Figure 5.25. The total mass of contaminants removed by the well by the end of 2003 was 130 kg (280 lbs), consisting of 110 kg (240 lbs) of TCE, 16 kg (36 lbs) of DCE, and 2.6 kg (5.7 lbs) of DCA. This represents about 1.7 percent of the total dissolved contaminant mass, about 1.5 percent of the TCE, about 3.6 percent of the DCE, and about 8.7 percent of the TCA mass, currently estimated to have been present in the aquifer prior to the testing and operation of the off-site containment system (see Section 2.6.1.4).

5.4 Site Permits

5.4.1 Off-Site Containment System

The infiltration gallery associated with the off-site containment system is operated under State of New Mexico Groundwater Discharge Permit DP-1184. This permit requires monthly sampling of the treatment system effluent, and the quarterly sampling of the infiltration gallery monitoring wells MW-74, MW-75 and MW-76. The samples are analyzed for TCE, DCE, TCA, chromium, iron, and manganese. The concentrations of these constituents must not exceed the maximum allowable concentrations for groundwater set by NMWQCC, and the results of the analyses must be reported quarterly.

All sample analysis results during 2003 met the Groundwater Discharge Permit requirements, and as required, the results were reported quarterly to the NMED Groundwater Bureau.

No violation notices were received during 2003 for activities associated with the operation of the off-site containment system

5.4.2 Source Containment System

The rapid infiltration ponds associated with the source containment system are also operated under State of New Mexico Groundwater Discharge Permit DP-1184, and are subject to the above stated requirements of this permit. The monitoring wells for this system are MW-17, MW-77 and MW-78. The data collected from the system met the requirements of the Groundwater Discharge Permit throughout 2003.

The air stripper associated with the source containment system is operated under Albuquerque/Bernalillo County Authority-to-Construct Permit No. 1203. This permit specifies emission limits for total VOCs, TCE, DCE, and TCA. Emissions from the air stripper are calculated annually by using influent water-quality concentrations and the air stripper blower capacity. The calculated emissions are reported to the Albuquerque Air Quality Division on March 15 every year, as required by the permit.

The requirements of Permit No. 1203 were met throughout 2003. No violation notices were received during 2003 for activities associated with operation of the source containment system.

5.5 Contacts

During 2003 Baird Swanson (NMED Groundwater Bureau) made four routine visits to the site to obtain split samples from monitoring well MW-71R.

On May 29, 2003, a Draft Fact Sheet was e-mailed to EPA/NMED for review and approval. Response to the Draft Fact Sheet has not been obtained from EPA/NMED. As a result, during 2003 a Fact Sheet was not mailed to property owners located above the plume and adjacent to the treated water discharge pipeline.

Section 6
Groundwater Flow and Transport Model

This section describes a numerical groundwater and contaminant transport model of the aquifer system underlying the Sparton site and its vicinity. This model was developed following the general outline described in Task 3 of the "Work Plan for the Assessment of Aquifer Restoration" (SSP&A, 1999), which is incorporated as Appendix D in the Consent Order. The development of the model is described in the 1999 Annual Report (SSP&A, 2001a).

The groundwater flow model was revised this year in an attempt to represent better water levels at the Sparton site in wells completed above the 4970-foot silt/clay unit and to use the most recent version of MODFLOW. The revisions that were made to the model include the following:

- The model domain was extended to the southeast so as to include the Rio Grande,
- The Rio Grande was represented with the MODFLOW river package that allows the simulation of infiltration of surface water into the groundwater system,
- The no-flow boundary on the southeastern boundary of the model domain was removed as the Rio Grande now serves as the southeastern boundary condition,
- MODFLOW-2000 (Harbaugh and others, 2000) was used for the groundwater flow simulations instead of MODFLOW96 (Harbaugh and McDonald, 1996),
- The flow and transport models were recalibrated.

This flow model has been calibrated to water-level data obtained from a period prior to the operation of the off-site containment well and to water-level data collected during operation of the off-site containment well. The flow model is coupled with the solute transport simulation code MT3D^{99} for the simulation of constituents of concern underlying the site (Zheng and SSP&A, 1999). The model has been used to simulate TCE concentrations in the aquifer from start-up of the off-site containment well in December 1998 through December 2004.

6.1 Groundwater Flow Model

6.1.1. Structure of Model

The model area and model grid are presented in Figure 6.1. The overall model dimensions are 12,800 ft by 7,300 ft. The model consists of 88 rows and 133 columns. The fine model area consists of uniform discretization of 50 ft, covering an area of 4,100 ft by 2,600 ft. The grid spacing is gradually increased to 200 ft towards the limits of model domain. The model grid is aligned with principal axes corresponding to the approximate groundwater flow direction and plume orientation (45° clockwise rotation).

The model consists of 13 layers. The vertical discretization used in the model is shown in Figure 6.2. Layers 1 through 11 correspond to the surficial aquifer. Layer 1 is 15 ft thick, layer 2 is 5 ft thick, layers 3 through 7 are 10 ft thick, layers 8 and 9 are 20 ft thick, and layers 10 and 11 are 40 ft thick. Layer 12 is a 4-foot-thick unit that represents the 4800-foot clay unit. Layer 13 represents the upper 100 ft of the aquifer underlying the 4800-foot clay unit. The vertical discretization was selected to minimize vertical numerical dispersion.

6.1.1.1 Boundary Conditions

The northeast and southwest model boundaries are specified as no-flow boundaries. The rationale for no-flow boundaries on the northeast and southwest boundaries is that these boundaries are oriented approximately parallel to the direction of groundwater flow. The boundary on the southeast is the Rio Grande. The northwest model domain boundary is a constant head boundary (Figure 6.1). The procedure used to estimate heads on the constant head boundaries is described in the 2001 Annual Report. This procedure captures the regional water decline that has been observed at the Site over the past decade (Figure 6.3). The method incorporates the following assumptions:

- the water levels from the ULFZ and LLFZ wells are best represented by a planar surface;
- the water levels vary linearly with depth;
- the coefficients of the plane of best-fit vary linearly over time; and
- the head drop across the 4800-foot silt/clay unit is about 6 ft.

6.1.1.2 Hydraulic Properties

Four different geologic zones are specified within the model domain:

- Holocene channel and flood plain deposits, also referred to as Recent Rio Grande deposits;
- The 4970-foot silt/clay unit;
- Sands of the Upper Santa Fe Group, Late-Pleistocene channel and flood plain deposits, and Late-Pleistocene and Holocene arroyo fan and terrace deposits, collectively referred to as the sand unit; and
- The 4800-foot clay unit.

The sand unit is primarily classified as USF2 facies assemblages 2 and 3 (Hawley, 1996). Locally, near the water table, in some areas, the sands and gravels are classified as USF4 facies assemblages 1 and 2. In areas where the 4970-foot silt/clay unit is present, the sands and gravels overlying this unit are Late-Pleistocene arroyo fan and terrace deposits. The 4970-foot silt/clay unit represents Late-Pleistocene overbank deposits. The 4800-foot clay unit is included in the USF2.

The specific storage of all model units was specified at 2 x 10^{-6} ft^{-1} consistent with the value specified in the USGS model of the Albuquerque Basin (Kernodle, 1998). The specific yield of the sand unit and the Recent Rio Grande deposits was specified as 0.20.

The spatial extent of the recent Rio Grande deposits and the 4970-foot silt/clay unit are shown in Figure 6.1. The following table summarizes the estimates of hydraulic properties:

Hydrogeologic Zone	Hydraulic Conductivity, ft/d		Specific Yield	Specific Storage, ft^{-1}	Model Layers in which zone is present
	Horizontal	Vertical			
Sand unit above 4970-silt/clay unit	39*	0.2*	0.2	2 x 10^{-6}	1,2
Sand unit above 4970-silt/clay unit near southeastern extent	20*	0.2*	0.2	2 x 10^{-6}	1,2
4970-foot silt/clay unit	16*	0.00006*		2 x 10^{-6}	3
Recent Rio Grande deposits	91*	0.008*	0.2	2 x 10^{-6}	1-6
Sand unit	25	0.1	0.2	2 x 10^{-6}	3-11,13
4800-foot clay unit	0.017	0.00002		2 x 10^{-6}	12

* Values that were changed during this year's recalibration.

6.1.1.3 Sources and Sinks

The groundwater sinks in the model domain are the off-site containment well CW-1, the source containment well CW-2, and eight on-site shallow wells (PW-1, MW-18, and MW-23 through MW-28) that are, or were, used for remedial extraction. The off-site containment well has been in operation since December 31, 1998 with a brief shut down in April 1999. The average annual pumping rate between 1999 and 2002 varied between 216 gpm and 221 gpm. The average pump rate in 2003 was 225 gpm. The pumping at CW-1 is distributed across model layers 5 through 11 and is apportioned based on layer transmissivities. The discharge from well CW-1 to the infiltration gallery is simulated using wells injecting into layer 2. The discharge flow is distributed across the area of the gallery.

The source containment well, CW-2, began operation in January 2002. The well operated at an average rate of 49 gpm in 2002 and 52 gpm in 2003. Ninety-nine percent of the treated water from this well is assumed to infiltrate back to the aquifer from the six on-site infiltration ponds based on consumptive use calculations. Only two ponds are used for infiltration at any given time; during 2002 the treated discharge from the well was rotated among the ponds, but during 2003 discharge was only to ponds 1 and 4 (see Figure 2.10 for pond locations).

The shallow extraction wells were operated from December 1988 to November 1999. Total extraction rates from the wells declined with time. The average pump rate was 0.26 gpm in 1999. Since discharge from the shallow extraction wells was to the city sewer, infiltration of this water was not simulated in the model. Infiltration of precipitation is considered to be negligible due to high evapotranspiration and low precipitation.

Recharge within the modeled area was assumed to occur from the Arroyo de las Calabacillas, the Corrales Main Canal, irrigated fields and the Rio Grande. The recharge rate for the arroyo and the canal was estimated in the model calibration process described below. The calibrated recharge rate from the arroyo and the canal was 19 ft/yr. Recharge from the irrigated fields east of the Corrales Main Canal was simulated at a rate of 1.1 ft/yr. Recharge was applied to the highest layer active within the model. The resulting total recharge rates within the modeled area were 141 gpm from the arroyo, 8 gpm from the canal, and 24 gpm from irrigated fields.

Infiltration from the Rio Grande was simulated with the MODFLOW river package. The water level in the Rio Grande was estimated from the USGS 7.5 minute topographic map for the Los Griegos, New Mexico quadrangle. The ratio of the vertical hydraulic conductivity of the sediments beneath the river to the thickness of these sediments was a parameter in the model calibration process. The calibrated ratio of the vertical hydraulic conductivity to the thickness was 0.1 day^{-1}. The model calculated infiltration rates from the Rio Grande range from about 400 gpm in 1998 to 440 gpm in 2003.

6.1.2 Model Calibration

The groundwater flow model was recalibrated to obtain better estimates of the hydraulic properties of the 4970-foot silt/clay unit, the sand unit above the 4970-foot silt clay unit, and the recent Rio Grande deposits. Six sets of water-level data were used as calibration targets in the model recalibration: average water levels in 1998 (refer to Table 2.4), average annual water levels in 1999 (refer to Table 4.1 of 1999 Annual Report), average water levels in 2000 (refer to Table 4.1 of 2000 Annual Report), average water levels in 2001 (refer to Table 4-1 of 2001 Annual Report), average water levels in 2002 (refer to Table 4-1 of 2002 Annual Report) and average water levels in 2003 (refer to Table 4-1).

The changes that were made to model parameters as the result of the recalibration conducted are the following:

- The horizontal hydraulic conductivity and vertical hydraulic conductivity of the sand unit above the 4970-foot silt/clay unit, with the exception of a small area along the southeastern margin of the region where this unit exists, were changed to 39 and 0.2 ft/d, respectively. Along the southeastern margin of the 4970-foot silt/clay unit, horizontal hydraulic conductivity and vertical hydraulic conductivity were specified as 20 and 0.2 ft/d, respectively.

- The horizontal and vertical hydraulic conductivity of the 4970-foot silt/clay unit was changed to 16 and 0.00006 ft/d, respectively.
- The horizontal and vertical hydraulic conductivity of the recent Rio Grande deposits were changed to 91 and 0.008 ft/day, respectively.

6.1.3 Transient Simulation – January 1998 to December 2003

The calibrated groundwater model was used to simulate groundwater levels in the aquifer system underlying the former Sparton site and its vicinity from January 1998 prior to the startup of containment well CW-1 until December 2003. Annual stress periods were used in the transient simulation, and the pumping rates specified for the containment wells CW-1 and CW-2 were those specified on Table 4.2. The calculated water levels at the end of this simulation, representing December 2003, for the water table (UFZ), ULFZ, and LLFZ are shown in Figures 6.4 to 6.6.

The groundwater levels measured between November 1998 and November 2003 at each of the monitoring wells at the former Sparton site and its vicinity were compared to model simulated water levels. Measured water levels were compared to calculated water levels in the model layer corresponding to the location of the screened interval of the monitoring well. When the screened interval of a monitoring well spanned more than one model layer, the measured water levels were compared to the average of the calculated water levels in the layers penetrated by the well.

The correspondence between measured and model-calculated water levels was evaluated using both qualitative and quantitative measures. Scatter plots of observed versus calculated water levels were used to provide a visual comparison of the fit of model to the measured water level data. For a calibrated model, the points on the scatter plot should be randomly and closely distributed about the straight line that represents an exact match between the calculated and observed groundwater levels. The scatter plot shown in Figure 6.7 is a plot of measured versus calculated water levels for all of the water level data collected between January 1998 and November 2003. This scatter plot visually illustrates the excellent comparison between model calculated water levels and observed water levels.

The quantitative evaluation of the model simulation consisted of examining the residuals between the 313 measured and calculated water levels from the monitoring wells at the former Sparton site and its vicinity. The residual is defined as the observed water level minus the calculated water level. To quantify model error, three statistics were calculated for the residuals: the mean of the residuals, the mean of the absolute value of the residuals, and the sum of squared residuals. The mean of the residuals is 0.1 ft, the mean of the absolute value of the residuals is 0.8 feet, and the sum of squared residuals is 344 ft^2. The minimum residual is -4.4 feet and the maximum residual is 2.6 feet. The absolute mean residual of 0.8 feet is considered acceptable since the observed water-level measurements applied as calibration targets have a total range of 27 feet, and seasonal fluctuations of water levels are on the order of several feet. The residuals at each monitoring well for each monitoring period and the calibration statistics are presented in Appendix D.

6.1.4 Capture Zone Analysis

The capture zones of containment wells CW-1 and CW-2 in November 2003 were calculated using particle tracking. The particle tracking was applied to the calculated November 2003 water levels, assuming that these water levels represented a steady-state condition. The particle tracking was carried out using the PATH3D computer code (Zheng, 1991).

The calculated capture zones of containment wells CW-1 and CW-2 in the water table (UFZ), the ULFZ, and the LLFZ are presented in Figures 6.4, 6.5, and 6.6, respectively. Also shown in these figures is the extent of the TCE plume in November 2002. These model results confirm the water-level-data based evaluation of the capture zone of the containment well shown in Figures 5.10 through 5.12. It should be noted that Figure 6.6 represents the water levels in the middle of model layer 8 which corresponds to an elevation of 4,910 ft MSL (see Figure 6.2). This is an elevation 8.5 ft below the bottom of the screen in well CW-2; thus, the capture zone of this well shown in Figure 6.6 represents the area through which water moves upward and is captured by CW-2. Particle tracking analysis was also used to determine the aquifer area from which the water pumped during 1999, 2000, 2001, 2002, and 2003 originated. The area of origin of the water pumped from the aquifer in each of these years is shown in Figure 5.15.

In the 1999 Annual Report, the travel time between the former Sparton facility and the off-site containment well CW-1 was estimated as 20 years using particle tracking. This calculation assumed that the off-site containment well is operating continuously, and that water levels remain at their 1999 conditions throughout the 20-year travel period. A similar calculation was performed this year to estimate the travel time from the center of the Sparton property (a point near monitoring well MW-26) to the source containment well CW-2, and the travel time from a point downgradient from and outside the capture zone of CW-2 to the off-site containment well CW-1. These travel times were calculated as 1.5 and 15 years, respectively. This calculation assumed that both the off-site and the source containment wells are operating continuously at their current pumping rates and that water levels remain at their 2003 conditions throughout the 15-year period.

6.2 Solute Transport Model

A solute transport model is linked to the groundwater flow model to simulate the concentration of constituents of concern at the site. The three-dimensional contaminant transport simulation code $MT3D^{99}$ (Zheng and SSP&A, 1999) was applied for this study. The model was used to simulate TCE concentrations in the aquifer from December 1998 through December 2004.

Model input parameters were specified based on available data, and the TCE concentrations in the model domain at the start of the simulation period were estimated from November 1998 measured concentration data. The model was calibrated by adjusting the initial TCE concentration distribution in the aquifer, in a manner consistent with available data, until a reasonable match was obtained between the calculated and measured TCE concentrations, and the calculated and measured TCE mass removal at both containment wells, CW-1 and CW2, throughout their respective period of operation. Once the model was calibrated, the model was used to predict TCE concentrations in the aquifer between January 2004 and December 2004. No attempt was made to simulate DCE and TCA. Generally, DCE is detected at monitoring wells where TCE is detected, but DCE concentrations are much lower than TCE concentrations. Downgradient of the facility, between the facility and the off-site containment well, DCE concentrations are typically only 3 to 6 percent of the TCE concentrations. During 2003, DCE was about 6 percent of the total mass of chlorinated volatile organic compounds extracted by CW-1 and 14 percent of those extracted by CW-2.

The other constituent of concern, TCA, has been detected at concentrations greater than the 60 μg/L maximum allowable concentration in groundwater set by the NMWQCC, primarily in monitoring wells at the facility; TCA has been detected at levels above 60 μg/L in only one off-site well, MW-46. In the latest sampling round conducted in November 2003, none of the monitoring wells had TCA concentrations that exceeded 60 μg/L. The limited distribution of TCA and the reduction in its concentrations are the result of the abiotic transformation of TCA to acetic acid and DCE; a transformation that occurs relatively rapidly when TCA is dissolved in water. Only about 20 percent of TCA degrades to DCE, the rest degrades to acetic acid (Vogel and McCarty, 1987). The current concentrations of TCA and DCE in monitoring wells at the facility indicate that it is not likely that DCE concentrations will increase significantly in the future as the result of TCA degradation.

6.2.1 Transport Parameters

A number of aquifer and chemical properties are required as input parameters for the contaminant transport simulation. The required aquifer properties are porosity, bulk density, and dispersivity. The required chemical properties are: (1) the fraction organic carbon, (2) the organic-carbon partition coefficient for the organic compound being simulated, and (3) the effective diffusion coefficient. The following table summarizes the transport parameters:

Transport Parameters	Value Specified for all Units
Porosity	0.3
Longitudinal dispersivity	25 ft
Transverse horizontal dispersivity	0.25 ft
Transverse vertical dispersivity	0.025 ft
Bulk density	1.56 g/cm^3
Fraction organic carbon content	< 0.0001
Organic-carbon partition coefficient for TCE	97 L/kg
Effective diffusion coefficient	2.3×10^{-4} ft^2/day

The rationale for choosing these transport parameters is described in the 2000 Annual Report (SSP&A, 2001b).

The retardation coefficient for TCE can be estimated using data on the organic-carbon content, effective porosity, and bulk density of the aquifer materials, and the organic-carbon partition coefficient for TCE. Because the value of the fraction organic-carbon content is very small and the calculated retardation coefficient is small, a retardation coefficient of unity was used in the transport simulations presented in this report.

6.2.2 Initial Concentration Distribution

The initial TCE distribution was generated based on the November 1998 measured concentration data. An interpolated concentration distribution was created for each flow zone and the base of the contaminated zone using linear kriging of the log values of concentration. The zones for which concentration distributions were generated are the following:

- the upper flow zone (UFZ), corresponding to concentrations at the water table;
- the upper lower flow zone (ULFZ), corresponding to concentrations at an elevation of 4,940 ft MSL;
- the lower lower flow zone (LLFZ), corresponding to an elevation of 4920 ft MSL at the facility and an elevation of 4,900 ft MSL west of the facility; and
- the base of the contaminated zone, corresponding to top of 4800-foot clay west of facility and an elevation of 4,910 ft MSL at the facility.

The concentration distributions generated for these four zones were used as the basis for specifying initial concentrations at each node in the model domain. The concentrations generated for a given flow zone were assumed to represent concentrations on an approximately horizontal surface. These surfaces generally did not coincide with the node centers of the model grid and, therefore, the initial concentration at a given node was calculated by vertical linear interpolation of the log values of concentration corresponding to the overlying and underlying surfaces.

The concentration distribution for the UFZ was assumed to represent concentration at the water table as estimated based on November 1998 water levels at wells screened within the UFZ. The concentration distribution for the ULFZ was assumed to represent concentrations on a horizontal surface at an elevation of 4,940 ft MSL. The concentration distribution for the LLFZ was assumed to represent concentrations on a horizontal surface at an elevation of 4,920 ft MSL at the facility and at an elevation of 4,900 ft MSL west of the facility. The concentration distribution for the bottom zone was assumed to represent concentrations on a horizontal surface at an elevation of 4,910 ft MSL at the facility and at an elevation of 4,800 ft MSL west of the facility. The 4,910 ft MSL elevation at the facility is based on no detections of TCE in monitoring wells MW-38, MW-39, MW-40, and MW-70. A processor was developed to generate one horizontal concentration distribution for each model layer, representing the initial contaminant distribution for the transport model.

6.2.3 Model Calibration

Calibration of the transport model has consisted of adjustment of the initial contaminant concentration distribution, which is of the TCE concentrations prior to startup of off-site containment well CW-1, to achieve a reasonable match between calculated and observed TCE concentrations and mass removal at containment wells CW-1 and CW-2. The model was initially calibrated in 2000 when the model was developed (1999 Annual Report), the model was recalibrated in 2001, 2002 and 2003 (2000 Annual Report, 2001 Annual Report, and 2002 Annual Report, respectively), and again this year. A better representation of the TCE distribution prior to startup of the containment systems has been obtained with each model calibration effort.

The concentration distributions calculated with the procedures described in the previous section resulted in an underestimation of the total TCE mass extracted at well CW-1 in the initial model calibration effort in 2000. The likely reason for the underestimation of the TCE mass is that the kriging procedure leads to an underestimation of TCE concentrations along the centerline of the plume. The procedure for estimating the initial TCE distribution was modified by adding a number of control points along the center line of the plume to the monitoring well data for use in estimating the concentration distributions in each flow zone. The concentrations specified at the control points were the parameters varied during the model calibration process.

The calibration process has resulted in good agreement between observed and calculated TCE mass removal from containment wells CW-1 and CW-2, and between observed and calculated concentrations at CW-1and CW-2 (Figure 6.8). The observed and calculated TCE mass removal and TCE concentrations at CW-1 and CW-2 are tabulated below:

Date	Cumulative TCE mass removed, kg		Concentration at CW-1, µg/L		Concentration at CW-2, µg/L	
	Measured	Calculated	Measured	Calculated	Measured	Calculated
December 31, 1998	1.3	2.2	190	407		
January 3, 2000	359	412	860	1027		
January 2, 2001	822	863	1,200	1071		
January 3, 2002	1,340	1354	1,100	1202	1,100	1072
January 3, 2003	1,944	1967	1,300	1257	450	516
January 6, 2004	2,560	2564	1,200	1237	380	300

The initial mass and the maximum TCE concentrations within each model layer, under the recalibrated initial concentration distribution specified in the model, are summarized on Table 6.1. The estimated initial mass of TCE is 7,342 kg (16,152 lbs). The estimate of the mass of TCE in the aquifer prior to startup of the containment wells has changed from 2,180 kg (4,800 lbs) in the initial model calibration (1999 Annual Report), to 3,100 kg (6,840 lbs) after the first recalibration (2000 Annual Report), to 3,300 kg (7,280 lbs) after the second recalibration (2001 Annual Report), to 4,650 kg (12,250 lbs) after the third recalibration (2002 Annual Report).

The mass estimate based on this year's recalibration is 7,342 kg, a sixty percent increase from last year's estimate of mass. This significant increase in mass is the result of now assuming that a continuous zone with TCE concentrations greater than 5,000 ug/L exists from downgradient of CW-2 to downgradient of MW-60. Previously, the initial TCE concentration distribution had an area along the center line of the plume between CW-2 and CW-1 with TCE concentrations less than 5,000 ug/L. This estimate of the initial TCE distribution was driven in large part by the measured concentrations at MW-46, which have been less than 5,000 ug/L since 1992. The information gained from the operation of CW-1 has indicated that it is probable that

TCE concentrations along the center line of the plume are much higher than 5,000 ug/L. A continuous zone with high TCE concentrations extending from just downgradient of the source area to the leading edge of the plume is also consistent with releases occurring over an extended period of time at the Sparton site.

A comparison of calculated to observed concentrations of TCE at all monitoring wells for all samples analyzed between November 1998 and November 2003 is presented in Figure 6.9. Also presented in Figure 6.9 is a comparison of calculated to observed concentrations of TCE for all samples analyzed in November 2003. The general agreement between observed and computed concentrations is reasonable given the uncertainty of the initial contaminant distribution.

6.2.4 Predictions of TCE Concentrations in 2004

The groundwater transport model was applied to predict TCE concentrations through December 2004 after 72 months of pumping at well CW-1, and after 36 months of pumping at CW-2. The off-site containment well CW-1 was assumed to pump at an average rate of 225 gpm, and the source containment well CW-2 was assumed to pump at an average rate of 53 gpm in 2004. The TCE concentrations calculated for December 2003 are specified as the initial conditions for the predictive groundwater transport model.

The predicted TCE concentrations in November 2004 are presented in Figure 6.10. The concentration distribution is based on the maximum TCE concentration simulated within any given layer. A mass removal of 542 kg (1,192 lbs) of TCE by containment well CW-1 and 24 kg (53 lbs) from containment well CW-2 is predicted for the period of January 2004 to December 2004. The calculated TCE concentration at well CW-1 in December 2004 is 1,184 μg/L, and the calculated TCE concentration at CW-2 in December 2004 is 170 μg/L. The calibrated initial (November 1998) TCE concentration used in the transport model, the calculated TCE concentrations in November 2000, November 2002, and November 2003, and the predicted TCE concentrations for November 2004 are presented in Figure 6.11.

6.3 Future Simulations

The accuracy of this modeling effort will be evaluated again during the next 12 months based on the concentrations measured at the containment well and the monitoring wells. As new data are collected, the initial conditions and parameters in the model will be adjusted as necessary to improve the model.

Section 7
Conclusions and Future Plans

7.1 Summary and Conclusions

Sparton Technology, Inc. agreed to implement remedial measures at its former Coors Road Plant in Albuquerque, New Mexico under the terms of a Consent Decree entered on March 3, 2000. These remedial measures consist of: (a) the installation and operation of an off-site containment system; (b) the installation and operation of a source containment system; and (c) the operation of an on-site, 400-cfm SVE system for an aggregate period of one year. The goals of these remedial measures are: (a) to control hydraulically the migration of the off-site plume; (b) to control hydraulically any potential source areas that may be continuing to contribute to groundwater contamination at the on-site area; (c) to reduce contaminant concentrations in vadose-zone soils in the on-site area and thereby reduce the likelihood that these soils remain a source of groundwater contamination; and (d) in the long-term, restore the groundwater to beneficial use.

The installation of the off-site containment system, consisting of a containment well near the leading edge of the plume, an off-site treatment system, an infiltration gallery in the Arroyo de las Calabacillas, and associated conveyance and monitoring components, began in late 1998 and was completed in early May 1999. The off-site containment well began operating on December 31, 1998; except for brief interruptions for maintenance activities or due to power outages, the well has operated continuously since that date; the year 2003 was the fifth full year of operation of this well. The source containment system, consisting of a containment well immediately downgradient from the site, an on-site treatment system, six on-site infiltration ponds, and associated conveyance and monitoring components, was installed during 2001 and began operating on January 3, 2002; the year 2003 was the second year of operation of this well. The 400-cfm SVE system had operated for a total of about 372 days between April 10, 2000 and June 15, 2001 and thus met the length-of-operation requirements of the Consent Decree; monitoring conducted in the Fall of 2001 indicated that the system had also met its performance goals, and the system was dismantled in May 2002.

During 2003, considerable progress was made towards achieving the goals of the remedial measures:

- The off-site containment well continued to operate throughout the year at an average rate of 225 gpm, sufficient to contain the plume;

- The pumped water was treated and returned to the aquifer through the infiltration gallery. The concentrations of constituents of concern in the treated water met all the requirements of the Groundwater Discharge Permit for the site. Chromium concentrations in the influent to the treatment system remained at levels that did not require treatment;

- The source containment system that began operating on January 3, 2002 continued to operate throughout 2003 at an average rate of 52 gpm;

- Groundwater monitoring was conducted as specified in Attachment A to the Consent Decree. Water levels in all accessible wells and/or piezometers, and the Corrales Main Canal were measured quarterly. Samples were collected for water-quality analyses from monitoring wells at the frequency specified in the Consent Decree and analyzed for VOCs and total chromium;

- Samples were obtained from the influent and effluent of the treatment plants for the off-site and source containment systems, and the infiltration gallery and infiltration pond monitoring wells at the frequency specified in the Groundwater Discharge Permit. All samples were analyzed for VOCs, total chromium, iron, and manganese;

- The groundwater flow and transport model that was developed in 1999 to simulate the hydrogeologic system underlying the site was recalibrated and used to simulate TCE concentrations in the aquifer from start-up of the off-site containment well in December 1998 through November 2003 and to predict concentrations in November 2004.

The off-site containment well continued to provide hydraulic control of the contaminant plume throughout the year. The source containment well that began operating in early 2002 quickly developed a capture zone that controls any potential on-site sources that may be contributing to groundwater contamination, and maintained this capture zone throughout 2003.

The extent of groundwater contamination, as defined by the extent of the TCE plume, did not change significantly during 2003. The TCA plume ceased to exist during 2003; there were no wells with TCA concentrations above the maximum allowable concentration in groundwater set by the NMWQCC.

Changes in concentrations observed in monitoring wells since the implementation of the current remedial measures indicate that contaminant concentrations in the on-site area decreased significantly. There were no discernible patterns in the changes that occurred in off-site wells; however, the persistence of high concentrations of contaminants in the water pumped from containment well CW-1 since the beginning of its operation, and the concentration history of well MW-60 indicate the presence of high concentration areas upgradient from the off-site containment well. This conclusion continues to be confirmed by the results of model recalibration efforts during the last several years. In contrast, the concentrations in the source containment well CW-2 have begun to decline since September 2003, indicating that concentrations within the capture zone of this well are declining.

The off-site and source containment wells operated at a combined average rate of 277 gpm during 2003. A total of about 145 million gallons of water were pumped from the wells. This total pumpage represents about 13 percent of the initial volume of contaminated groundwater (pore volume). The total volume of water pumped since the beginning of the current remedial operations on December 1998 is 630 million gallons and represents 56 percent of the initial pore volume.

Approximately 660 kg (1,450 lbs) of contaminants consisting of 620 kg (1,360 lbs) of TCE, 38 kg (84 lbs) of DCE, and 3.1 kg (6.7 lbs) of TCA were removed from the aquifer by the two containment wells during 2002. The total mass that was removed since the beginning of the of the current remedial operations is 2,710 kg (5,980 lbs) consisting of 2,560 kg (5,640 lbs) of TCE, 145 kg (320 lbs) of DCE, and 6.7 kg (15 lbs) of TCA. This represents about 35 percent of the total dissolved contaminant mass (35 percent of the TCE, 32 percent of the DCE, and 22 percent of the TCA mass) currently estimated to have been present in the aquifer prior to the testing and operation of the off-site containment well.

The remedial systems were operated with only minor difficulties during 2003. Except for a 5-day shut-down of the source containment system was caused by a power outage in March, both containment systems operated essentially continuously. The wellheads of monitoring wells MW-60, MW-70, and MW-71R were replaced to repair damages and/or accommodate residential construction requirements at their location. Well MW-52, which had been dry since November 2002, was replaced with well MW-52R in June 2003, and well MW-52 was plugged in September 2003.

7.2 Future Plans

Both the off-site and source containment systems will continue to operate at the average discharge rates that have been maintained during the last several years. The source containment system will also continue to operate at the average rate that was maintained in 2003. Based on the performance of the rapid infiltration ponds during 2002 and 2003, part of the pond area may be converted to other uses; however, if this happens, Sparton will retain the legal right to recover all of the original pond area, if necessary.

Data collection will continue in accordance with the Groundwater Monitoring Program Plan and site permits, and as necessary for the evaluation of the performance of the remedial systems. As additional data are being collected, calibration and improvement of the flow and transport model developed to assess aquifer restoration will continue.

Monitoring well MW-35, which has been dry for the last several years, will be plugged and abandoned. Adequate water-level and water-quality data are provided by well MW-34 upgradient from MW-35, and by wells MW-36 and MW44 downgradient from MW-35; therefore, replacement of well MW-35 is not necessary. Monitoring wells MW-13, MW-33, MW-36, and MW-57 had too little water to be sampled in November 2003; however, they continue to provide water-level data. These wells will be observed for the next year or more prior to deciding whether to plug or replace them.

The sampling frequency of well MW-72, which has been sampled semi-annually for the last five years, will be reduced to annually.

Upon approval of the Work Plan for the proposed MW-71 pump-and-treat system (SSP&A and Metric, 2004), the system will be implemented and operated in accordance with the Work Plan.

Regulatory agencies will continue to be kept informed of any significant milestones or changes in remedial system operations. The goal of the systems will continue to be the return of the contaminated groundwater to beneficial use.

Section 8
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FIGURES

FIGURES

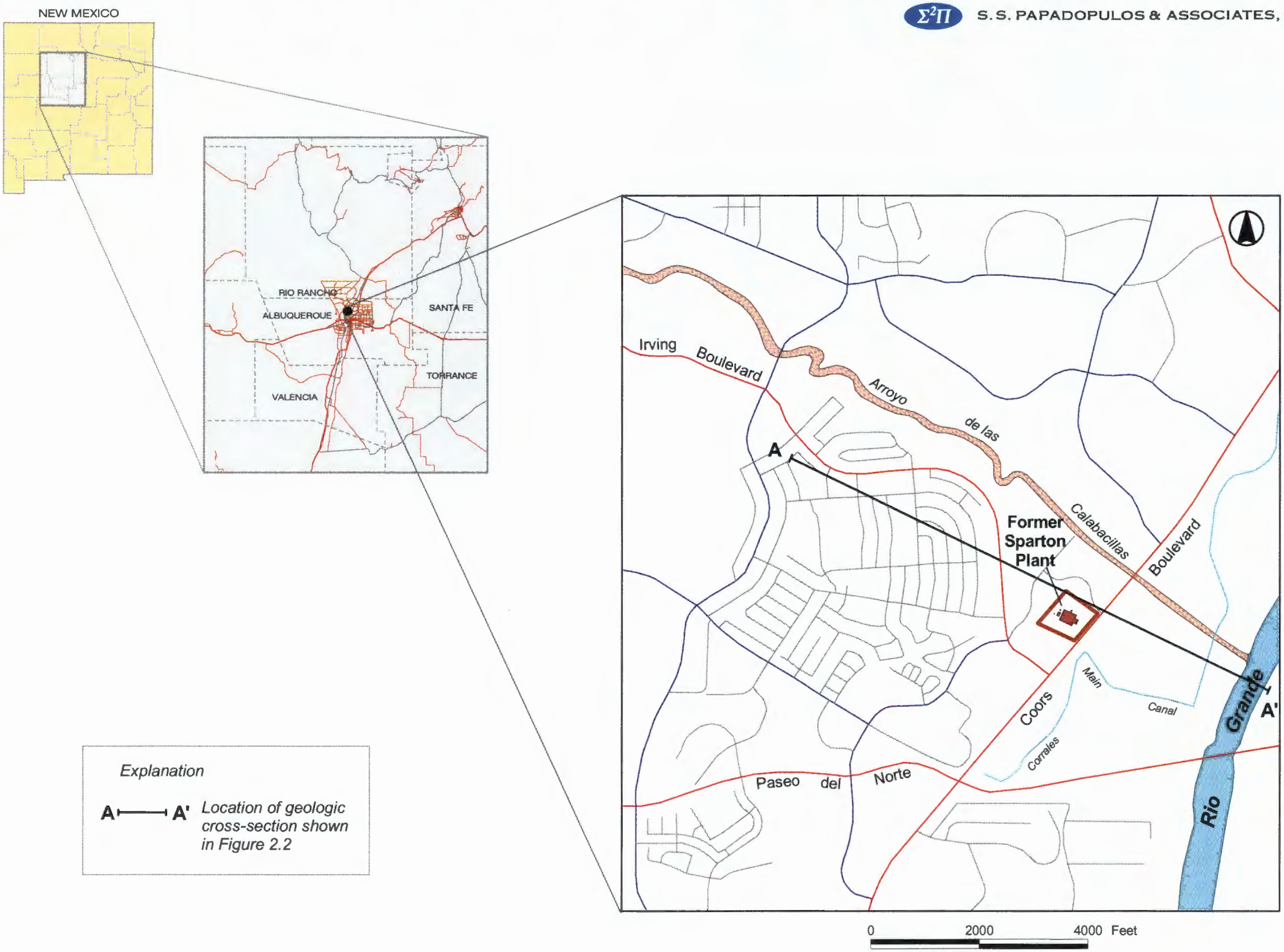


Figure 1.1 Location of the Former Sparton Coors Road Plant

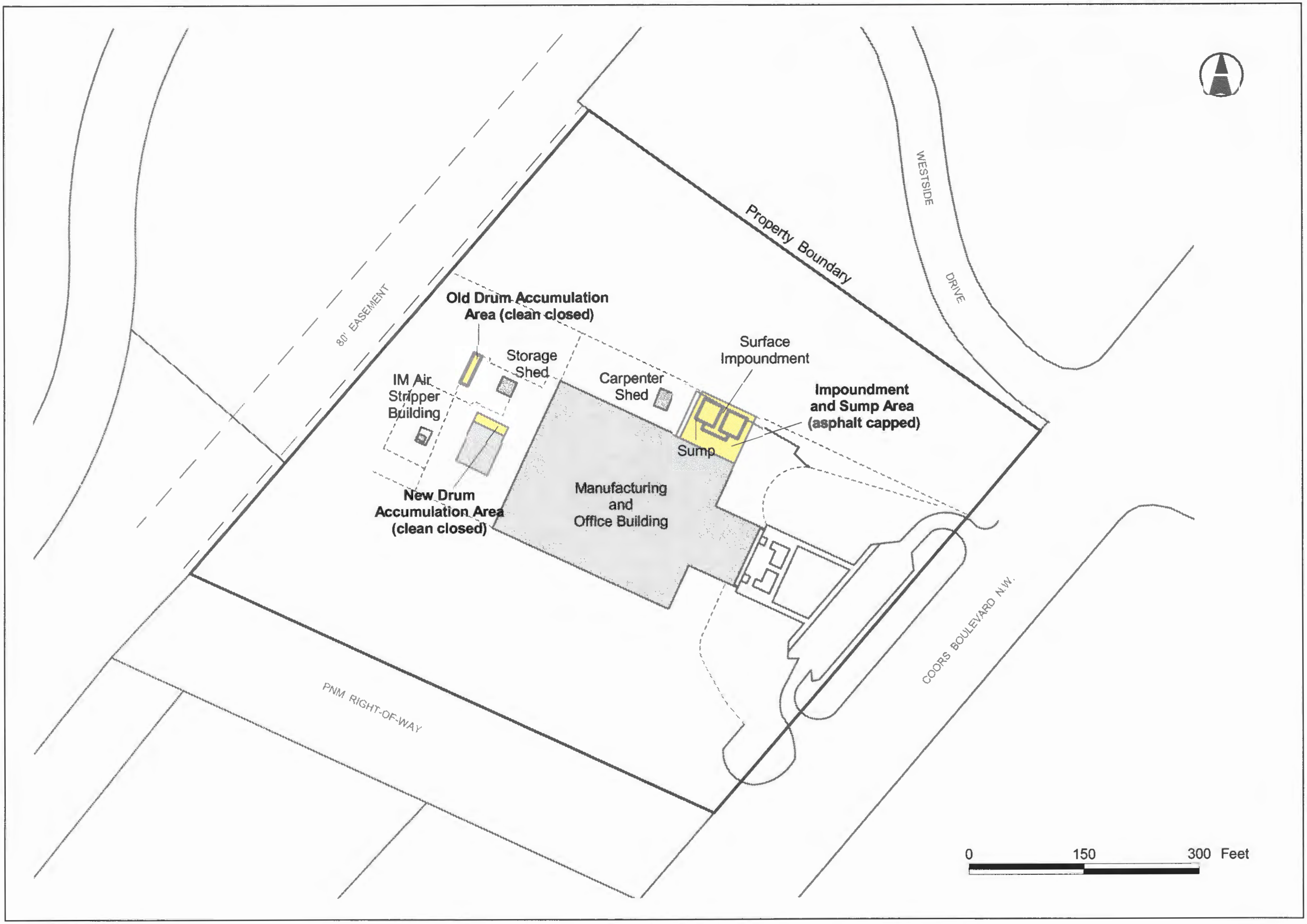
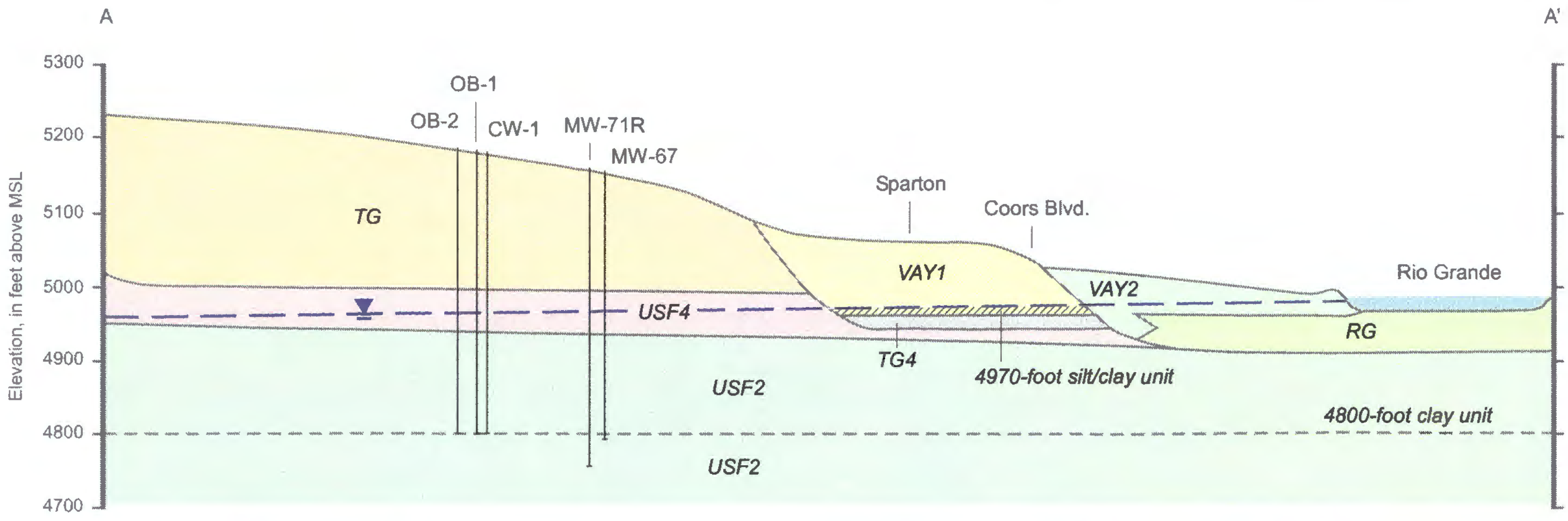


Figure 2.1 The Former Sparton Coors Road Plant



Vertical Exaggeration 5x

Note: See Figure 1.1 for location of cross section

Explanation

RG	Holocene channel and flood plain deposits
VAY2	Holocene arroyo fan and terrace deposits
VAY1	Late Pleistocene arroyo fan and terrace deposits
TG4	Late Pleistocene channel and flood plain deposits, upper portion is the 4970-foot silt/clay unit
TG	Middle Pleistocene undifferentiated deposits
USF4	Pliocene Upper Santa Fe Group Western Basin fluvial facies
USF2	Pliocene Upper Santa Fe Group Rio Grande facies

Figure 2.2 Geologic Cross Section Showing Shallow Deposits

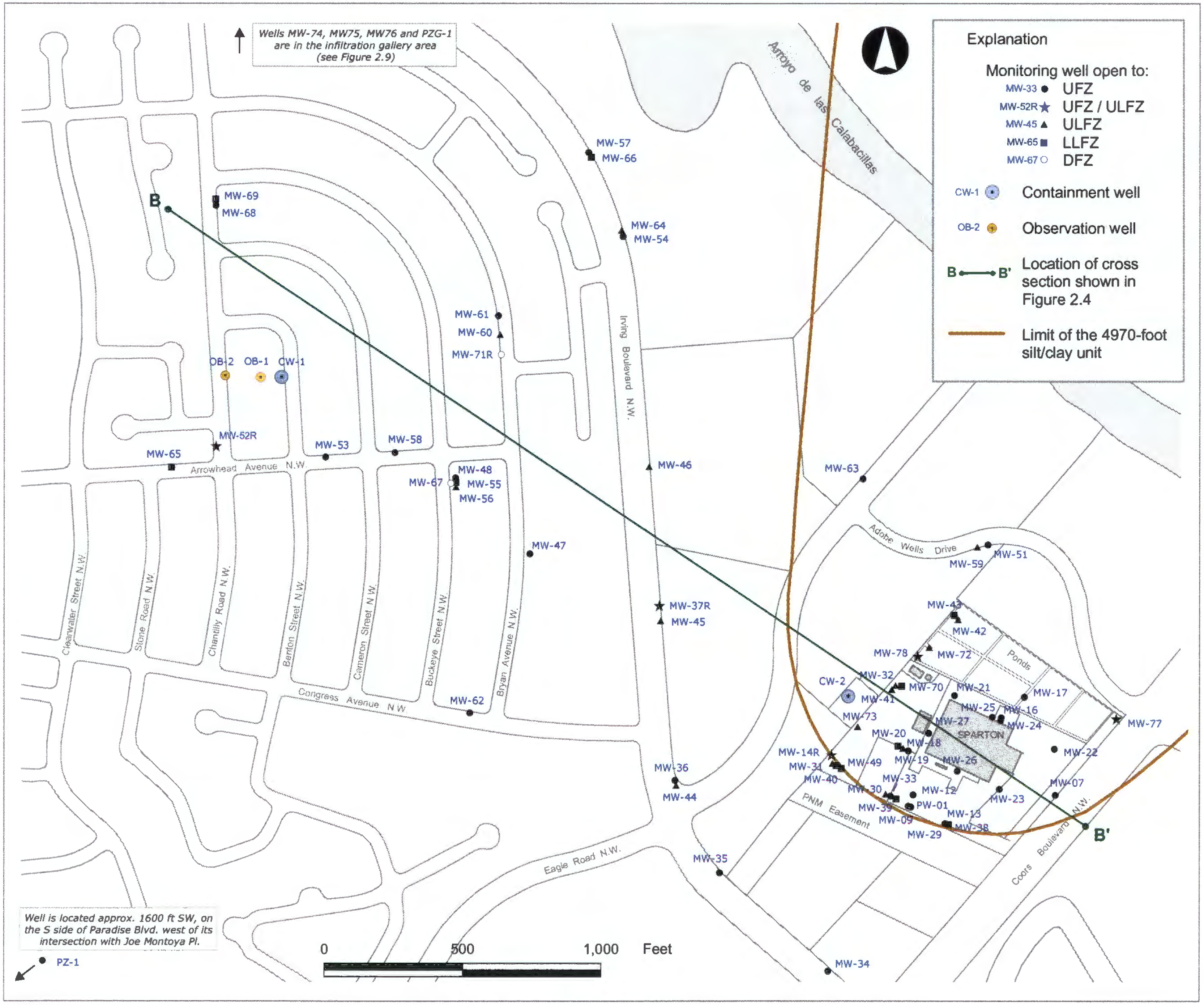


Figure 2.3 Location of Wells

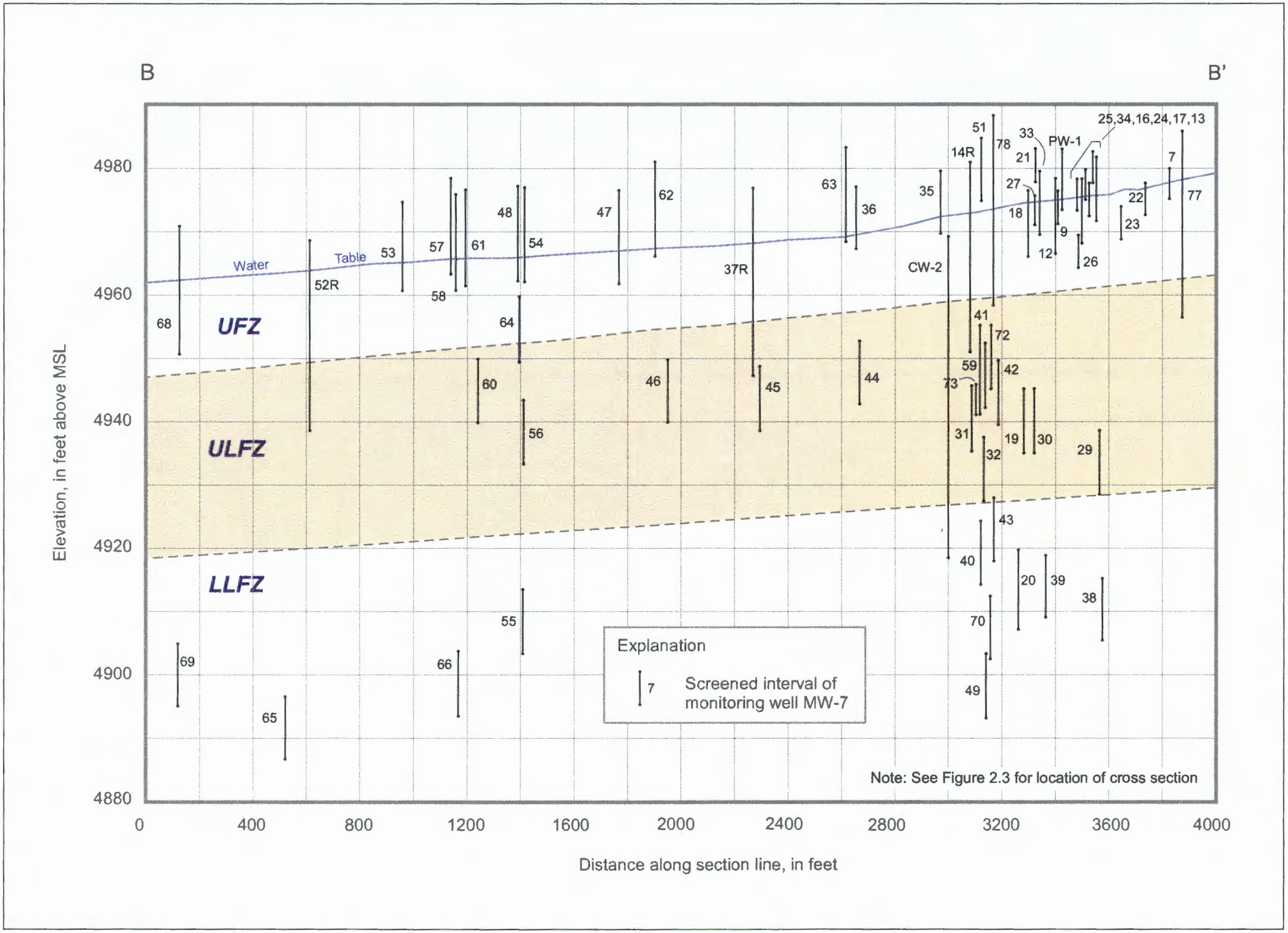


Figure 2.4 Screened Interval of Monitoring Wells and Relation to Flow Zones

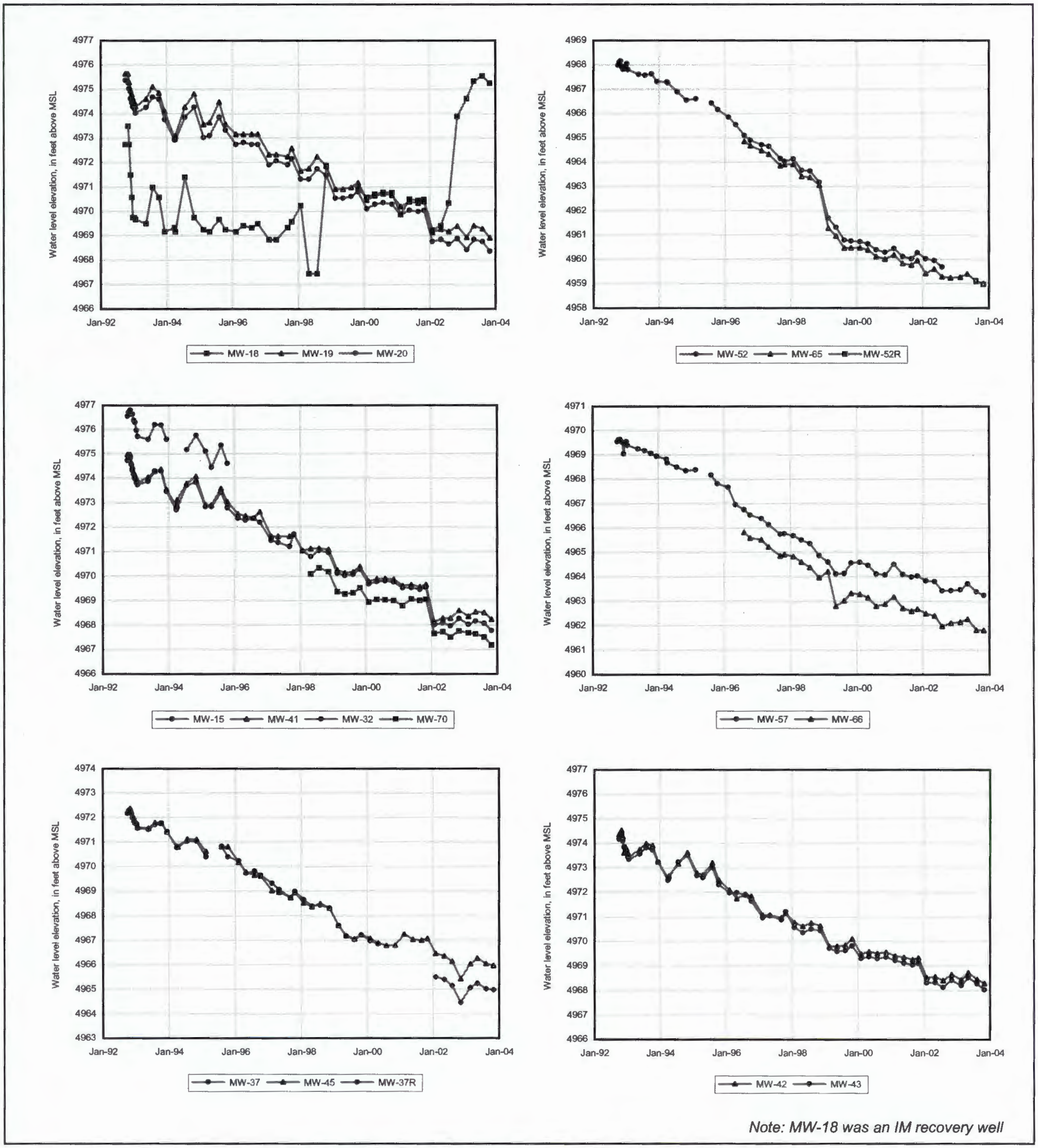


Figure 2.5 Monitoring Well Hydrographs

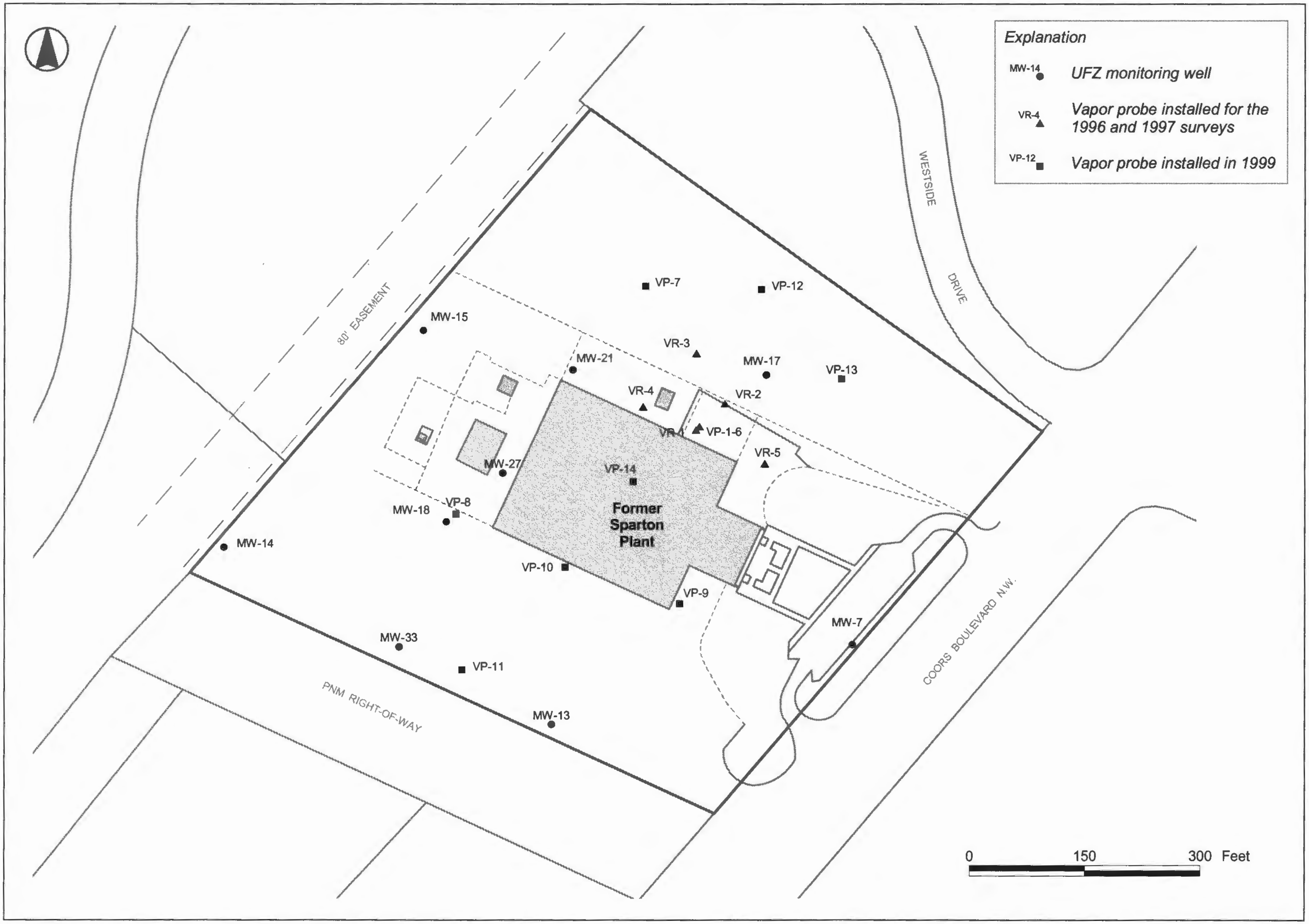


Figure 2.6 Location of Vapor Probes and On-Site Monitoring Wells Used in Vadose Zone Characterizations

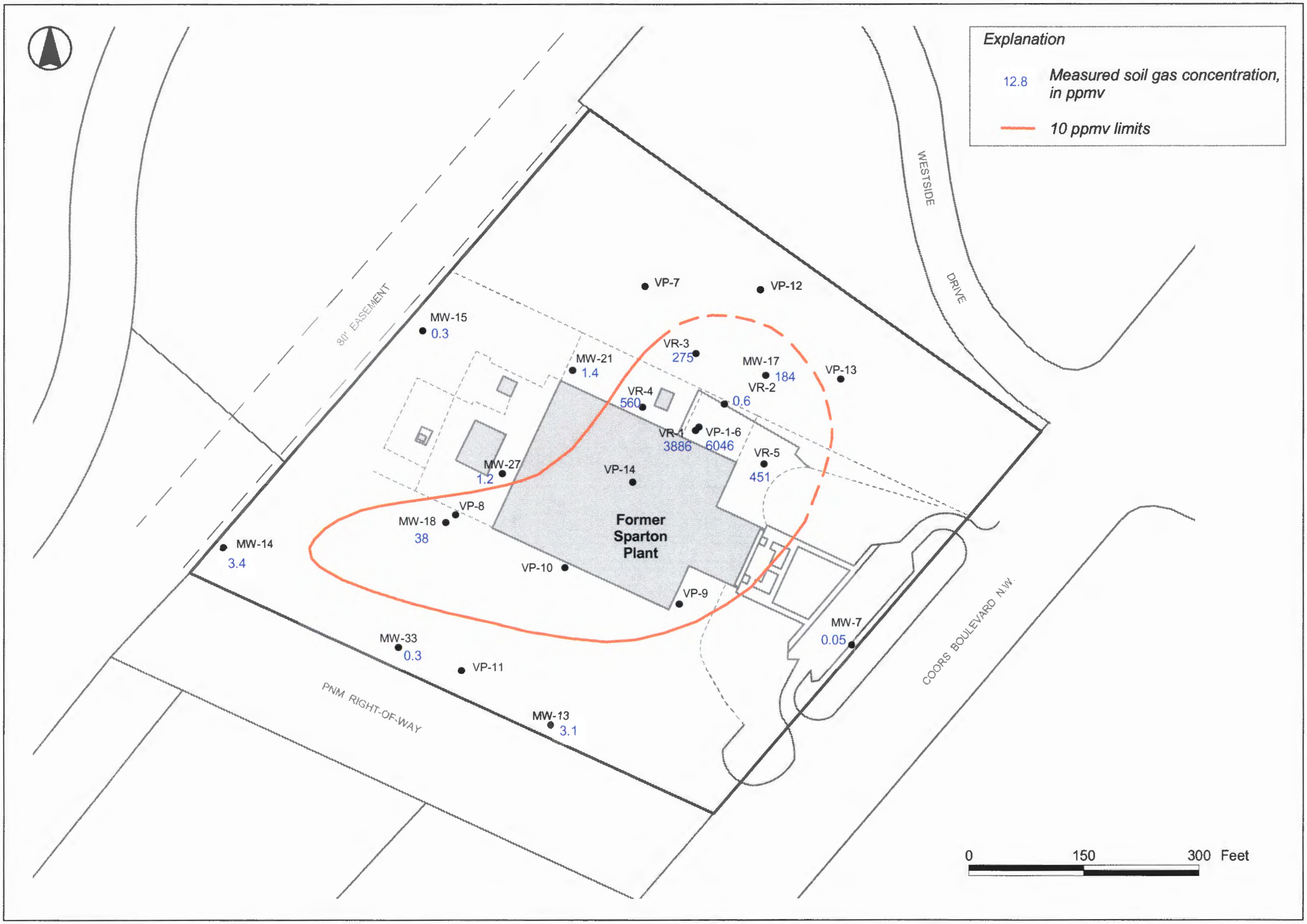


Figure 2.7 TCE Concentrations in Soil Gas - April 1996 - February 1997 Survey

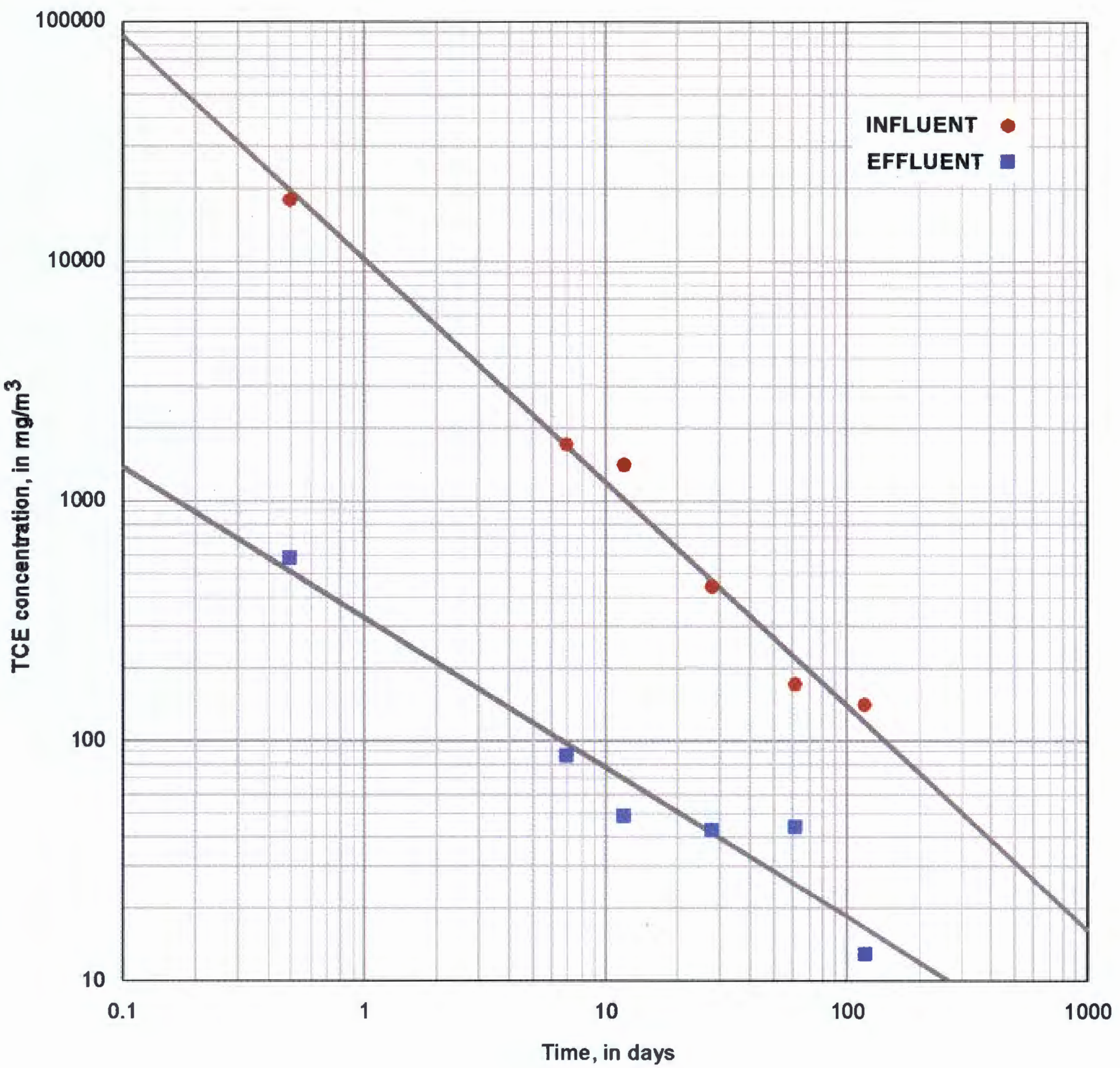


Figure 2.8 Influent and Effluent Concentrations - SVE Operation
April 8 - October 20, 1998

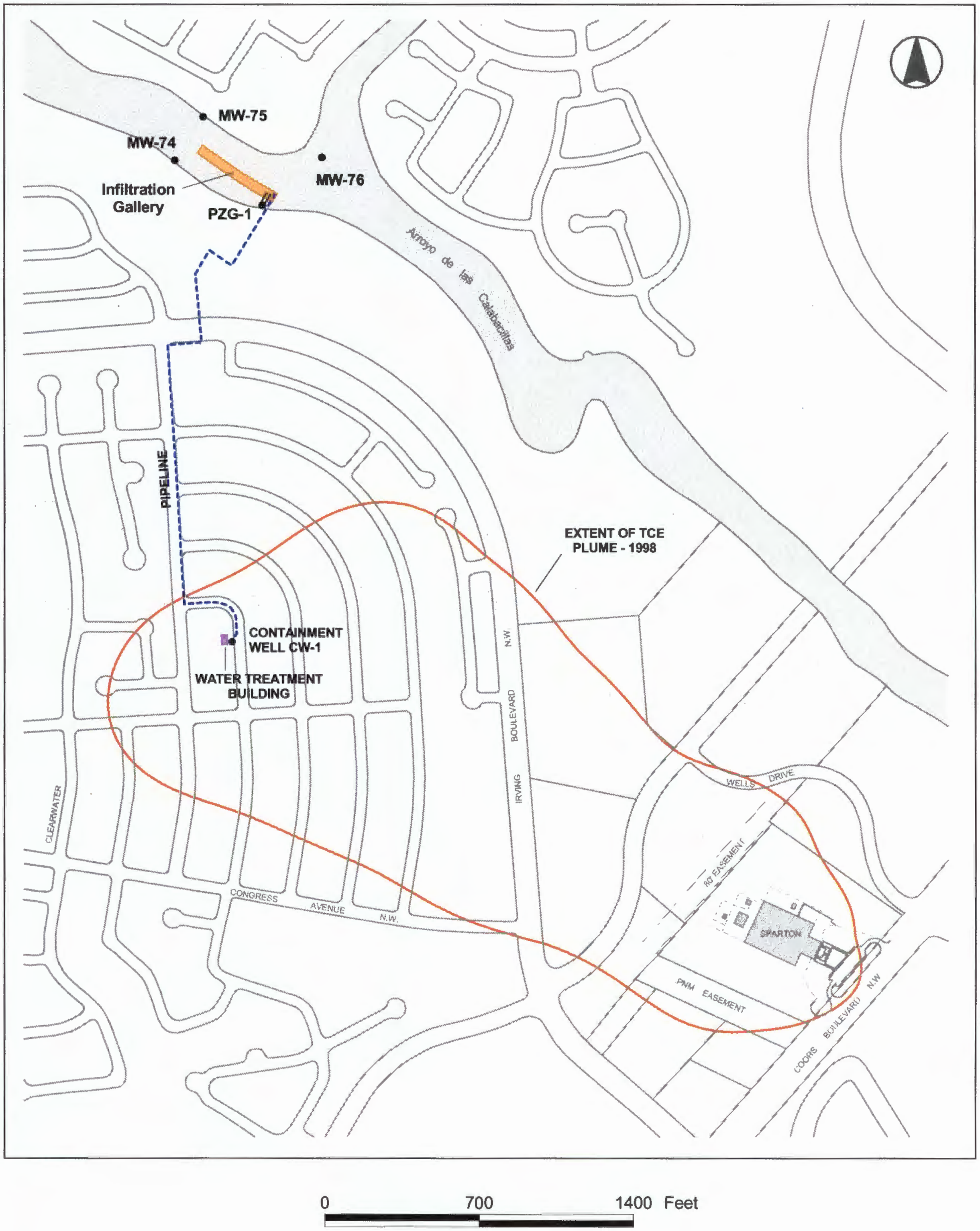


Figure 2.9 Layout of the Off-Site Containment System Components

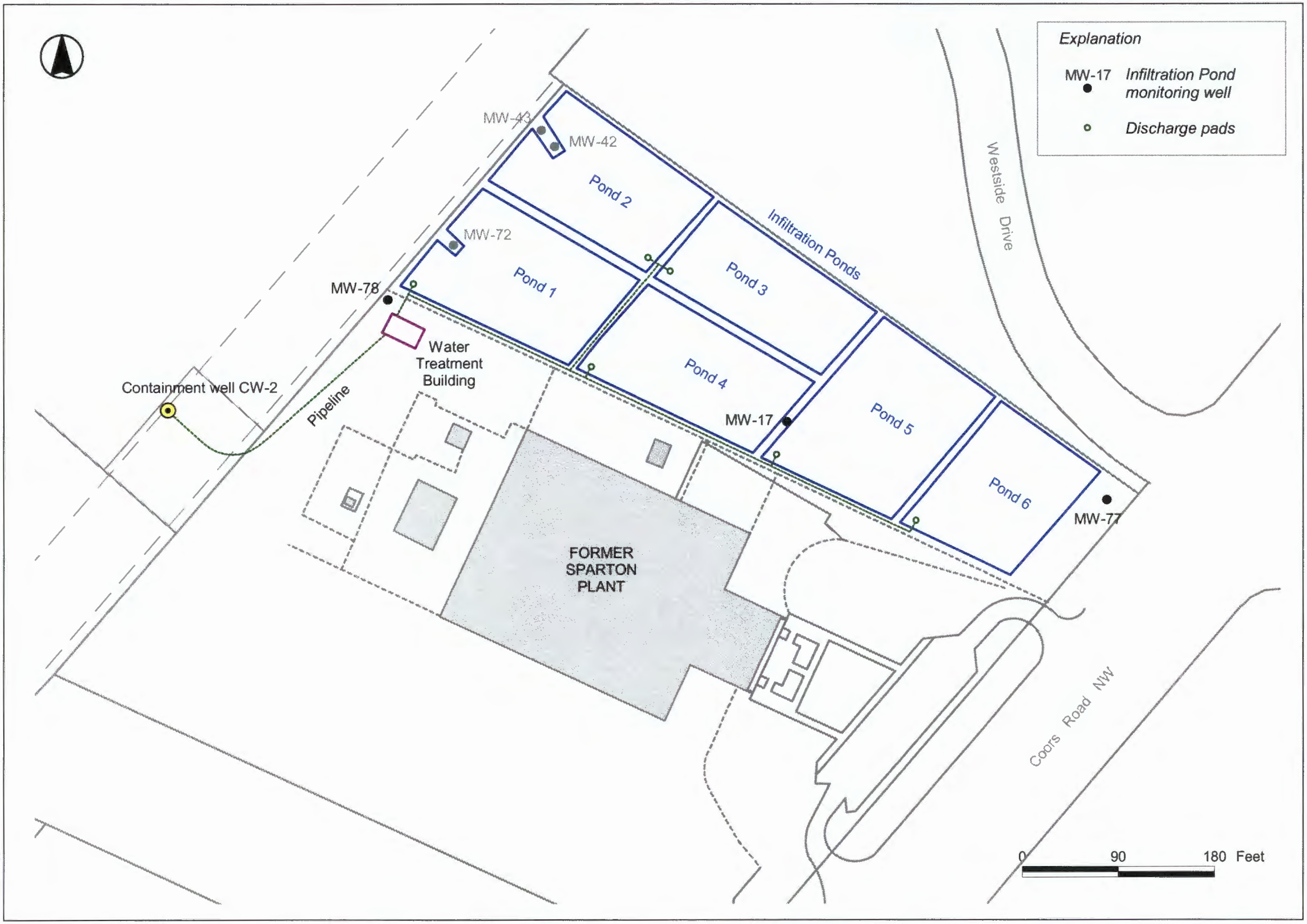


Figure 2.10 Layout of the Source Containment System Components

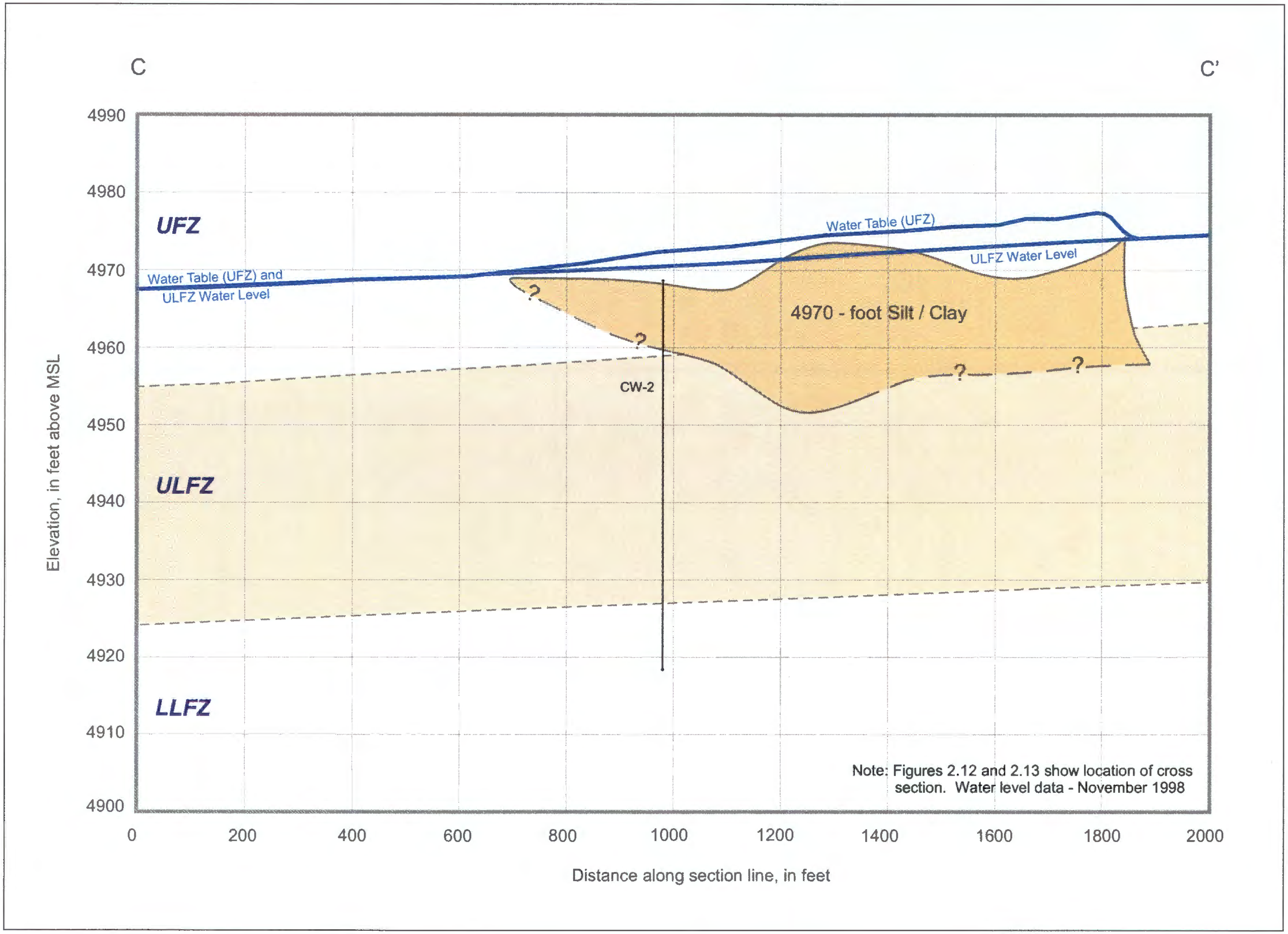


Figure 2.11 Schematic Cross-Section of the UFZ and ULFZ Water Levels

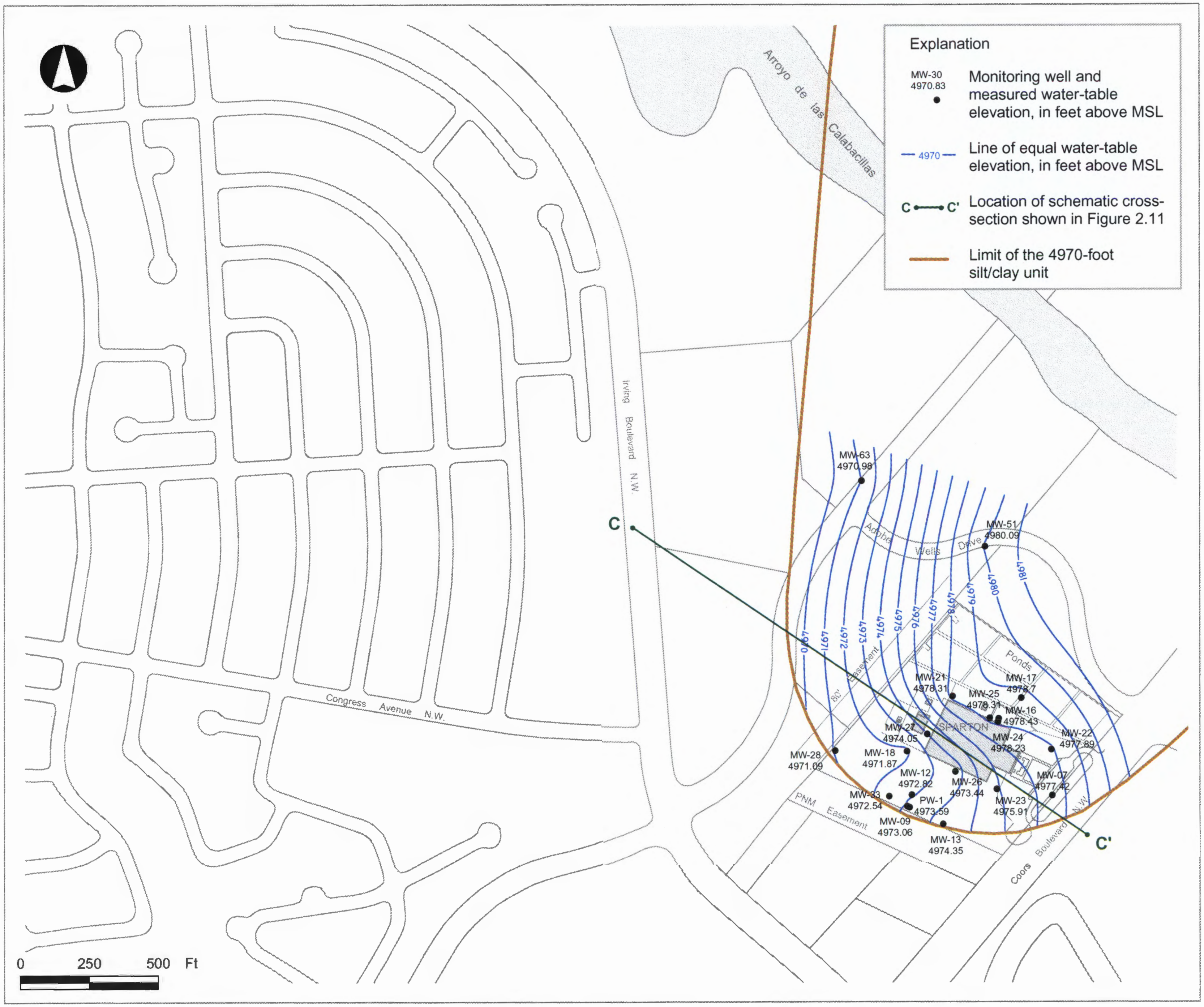


Figure 2.12 Elevation of the On-Site Water Table - November 1998

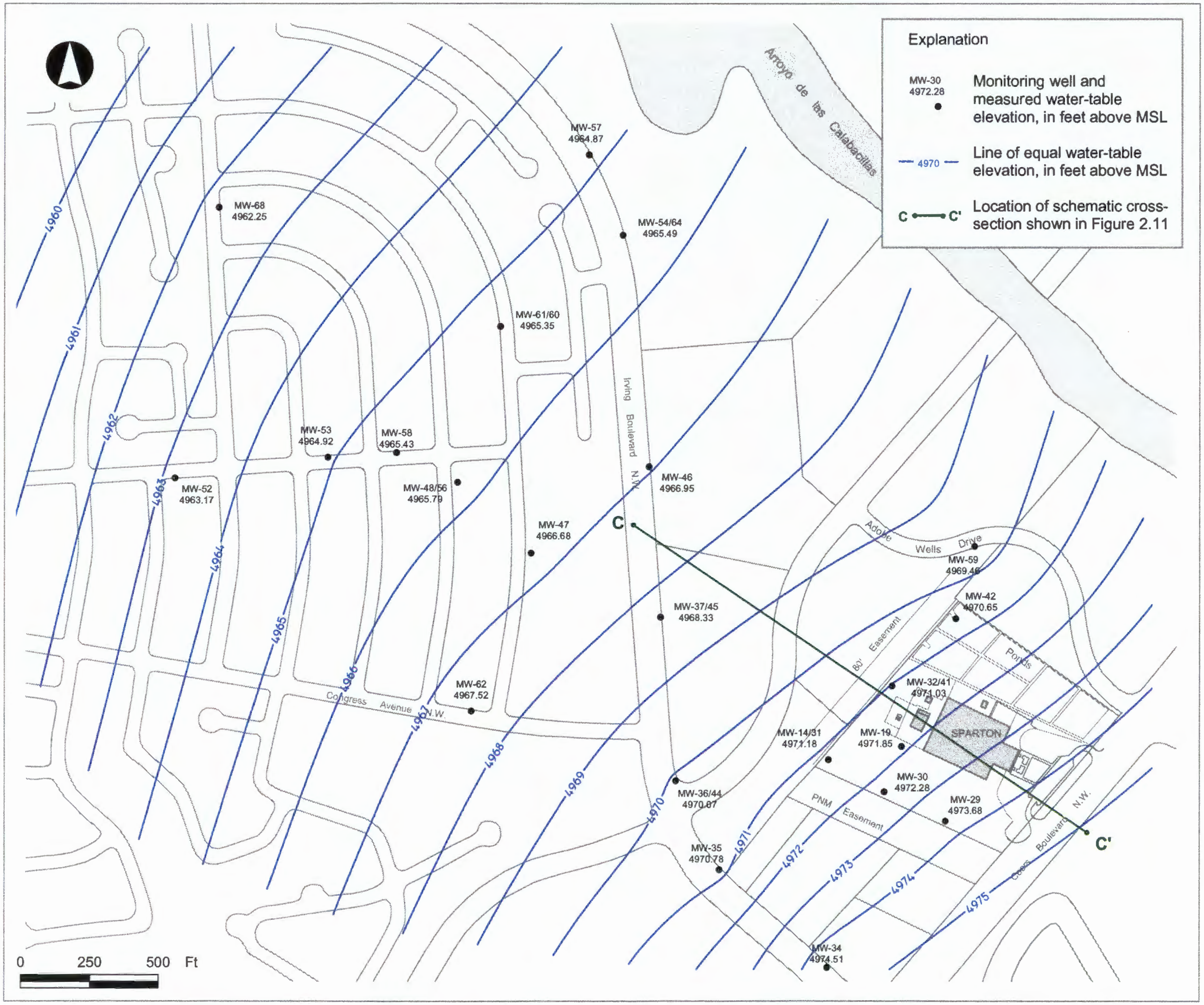


Figure 2.13 Elevation of the Water Levels in the UFZ/ULFZ - November 1998

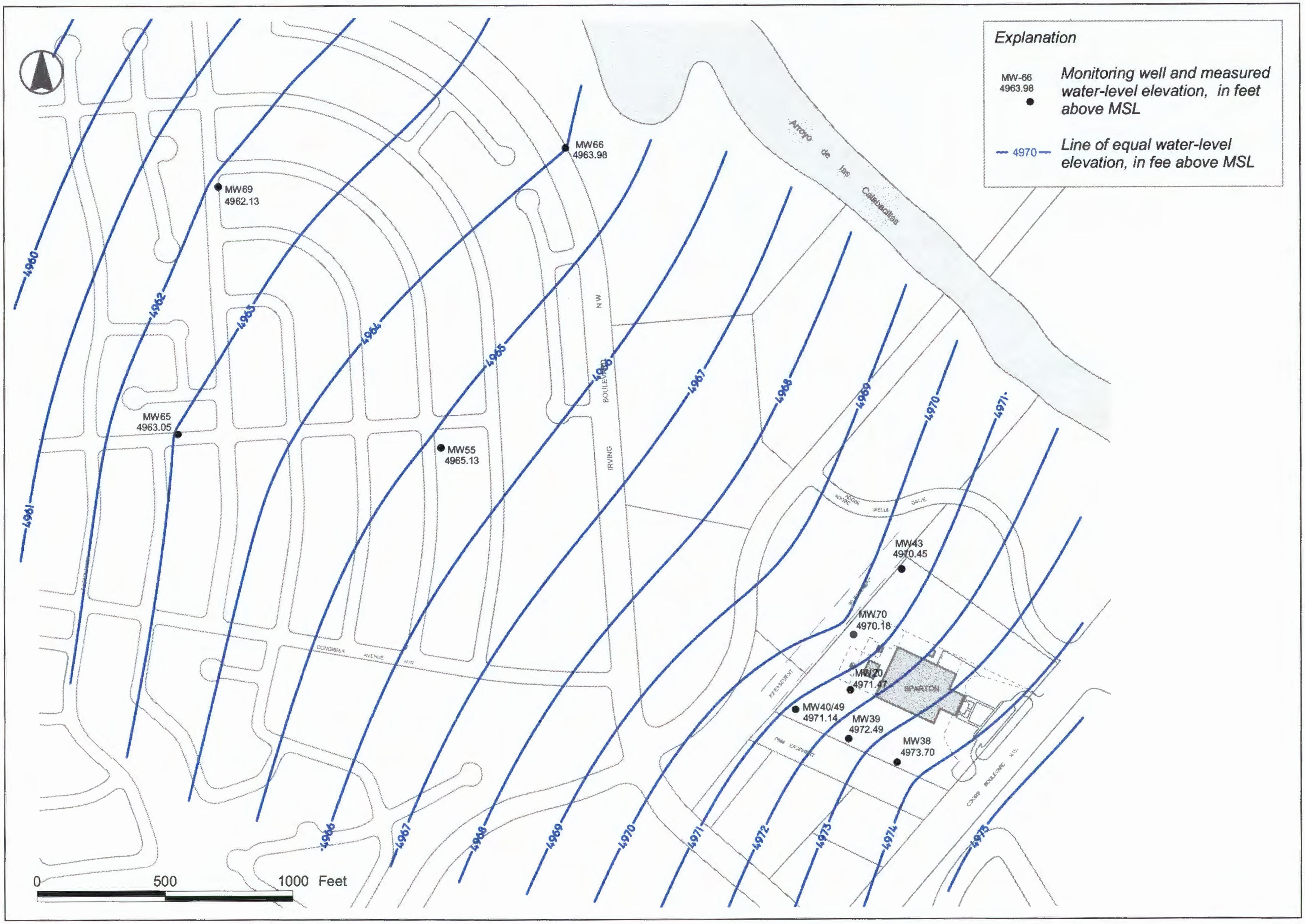


Figure 2.14 Elevation of the Water Levels in the LLFZ - November 1998

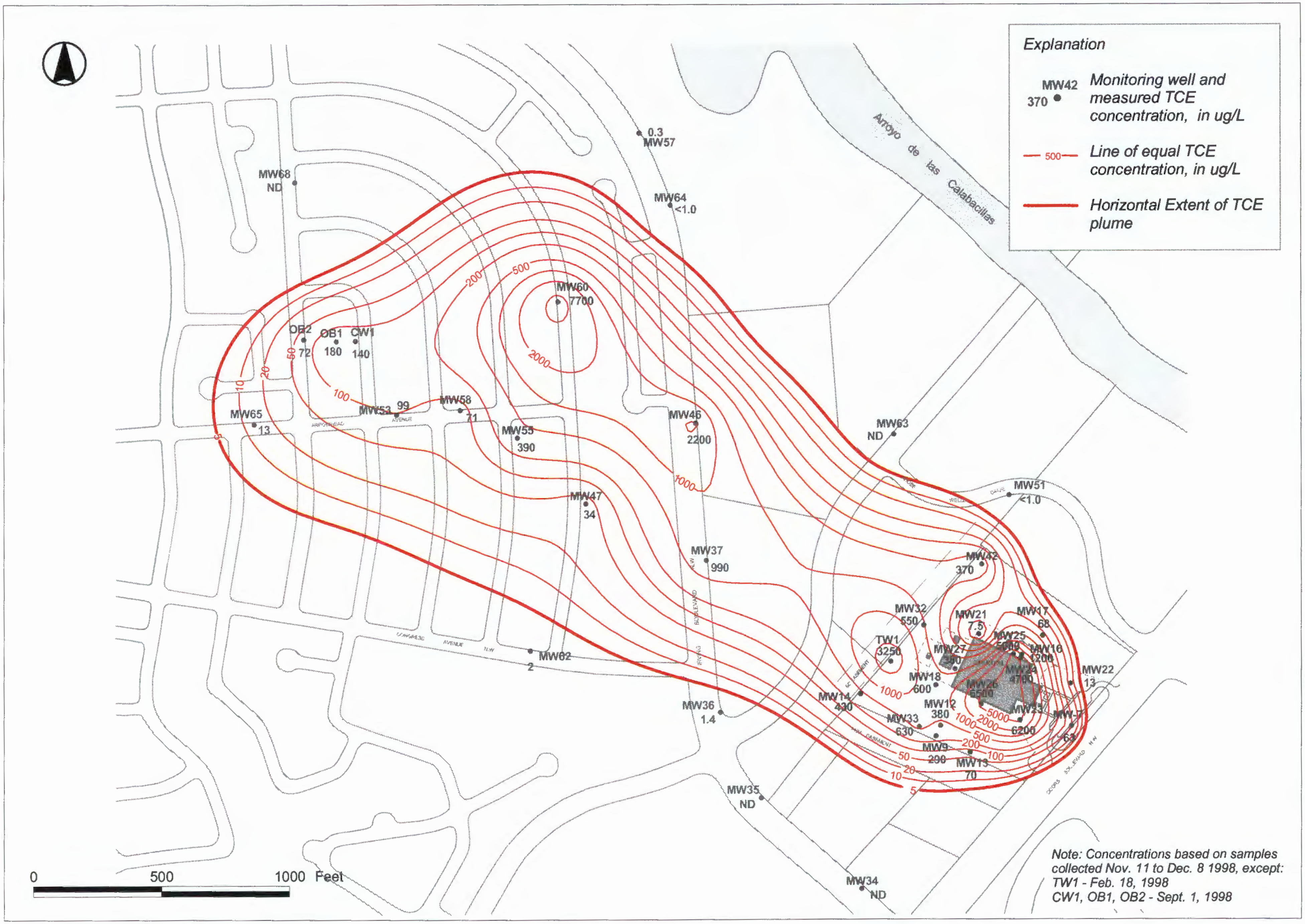


Figure 2.15 Horizontal Extent of TCE Plume - November 1998

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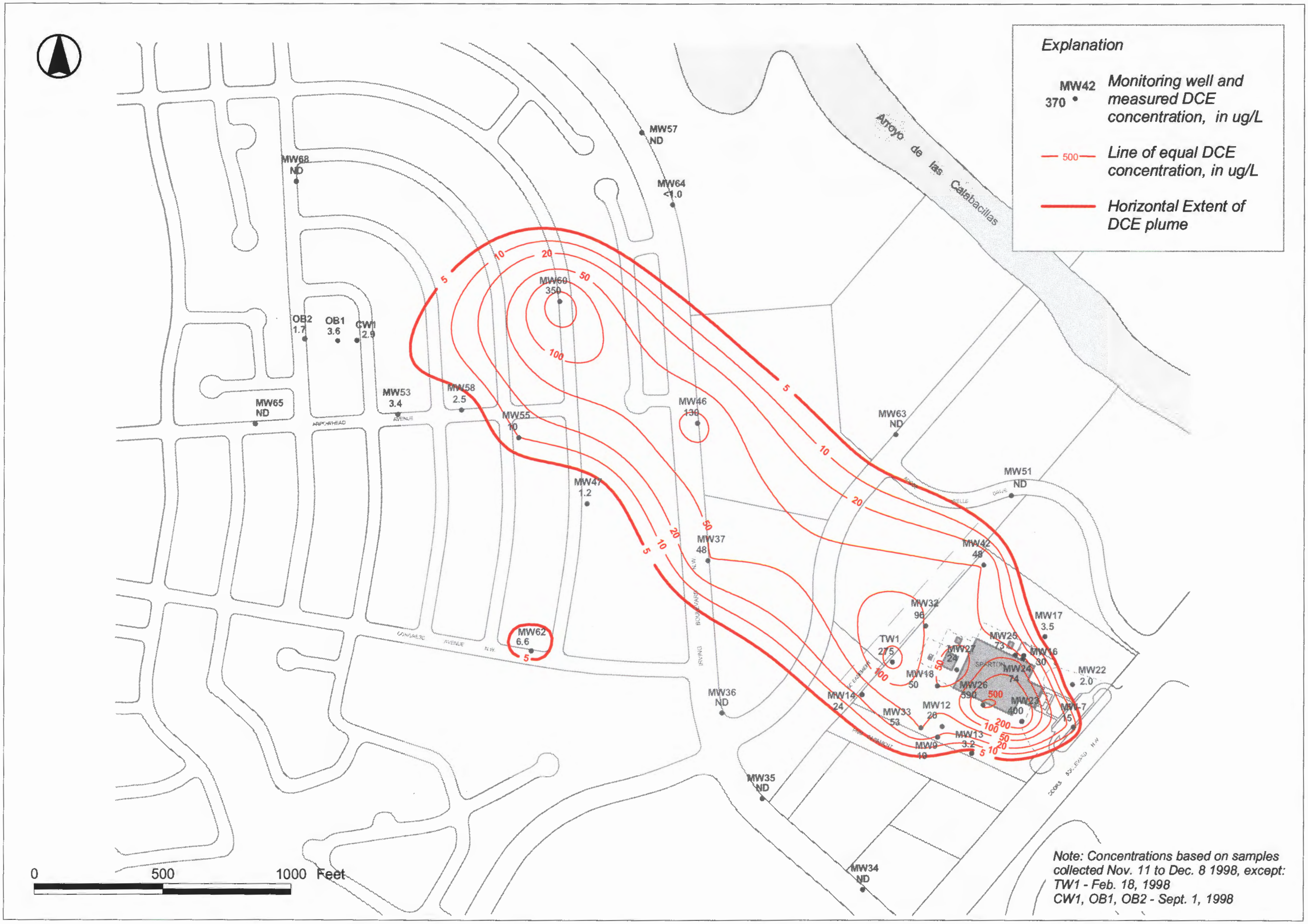


Figure 2.16 Horizontal Extent of DCE Plume - November 1998

Figure 2.17 Horizontal Extent of TCA Plume - November 1998

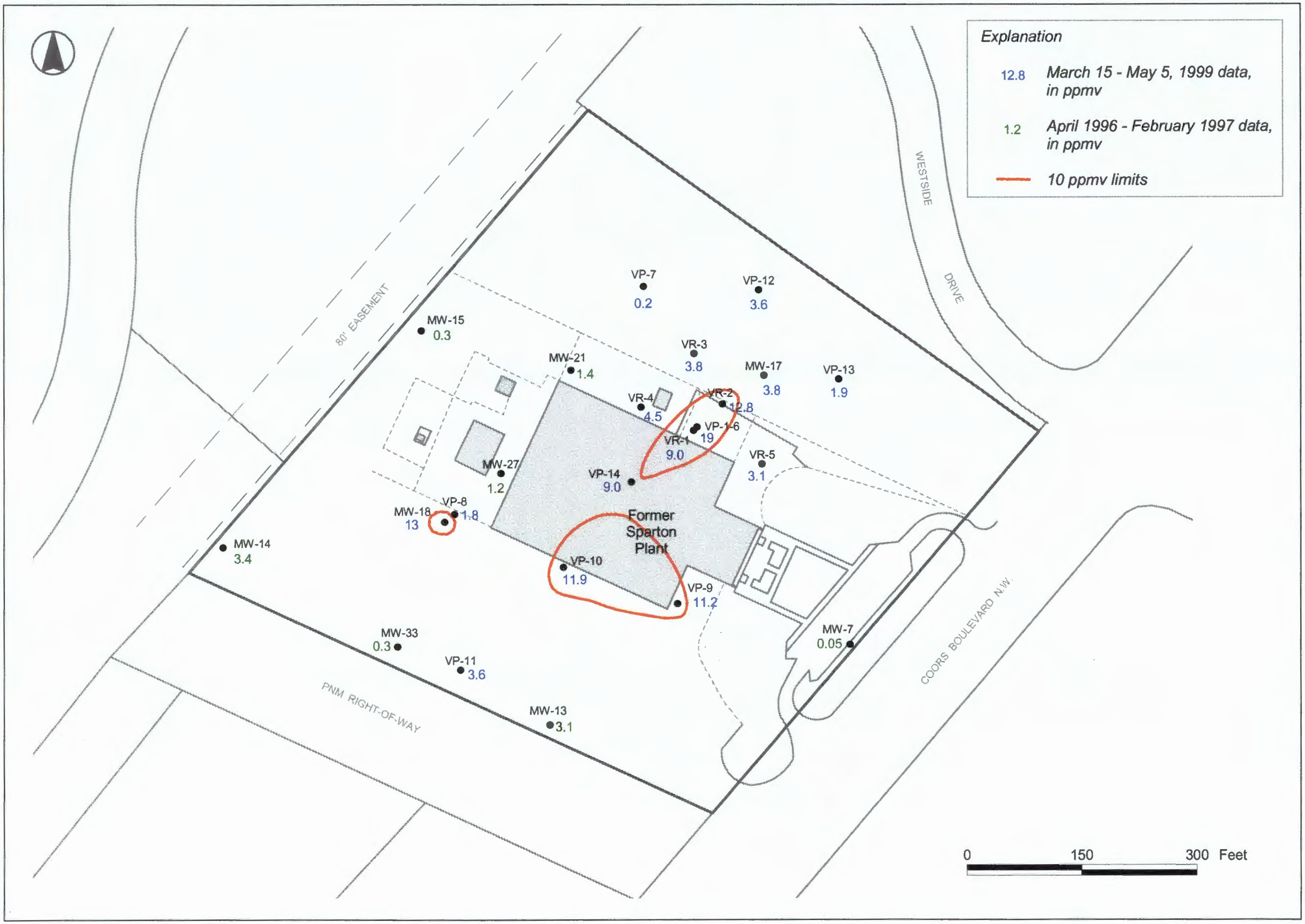


Figure 2.18 TCE Soil Gas Concentrations Prior to the 1999 Resumption of SVE System Operations

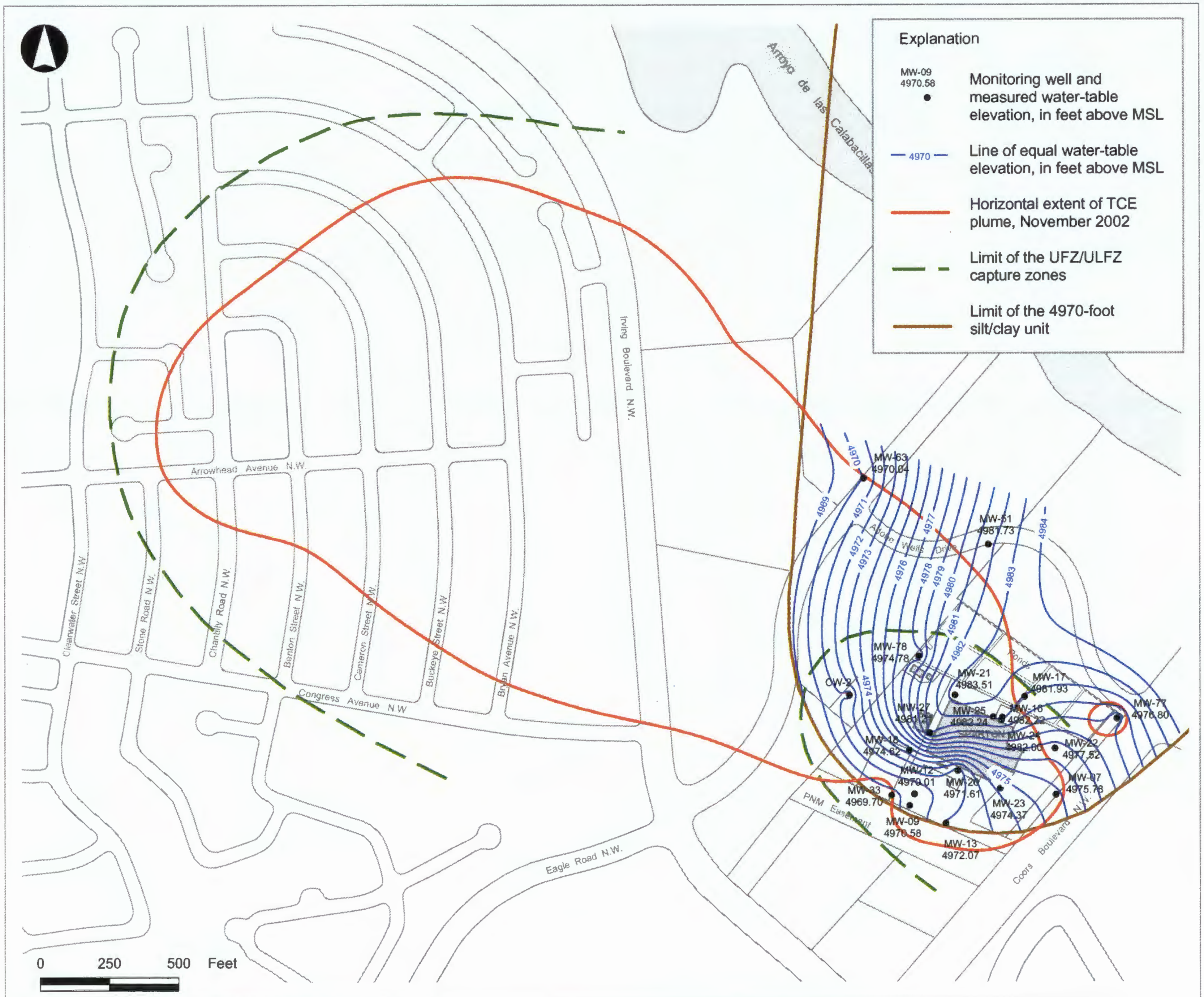


Figure 5.1 Elevation of the On-Site Water Table - February 18, 2003

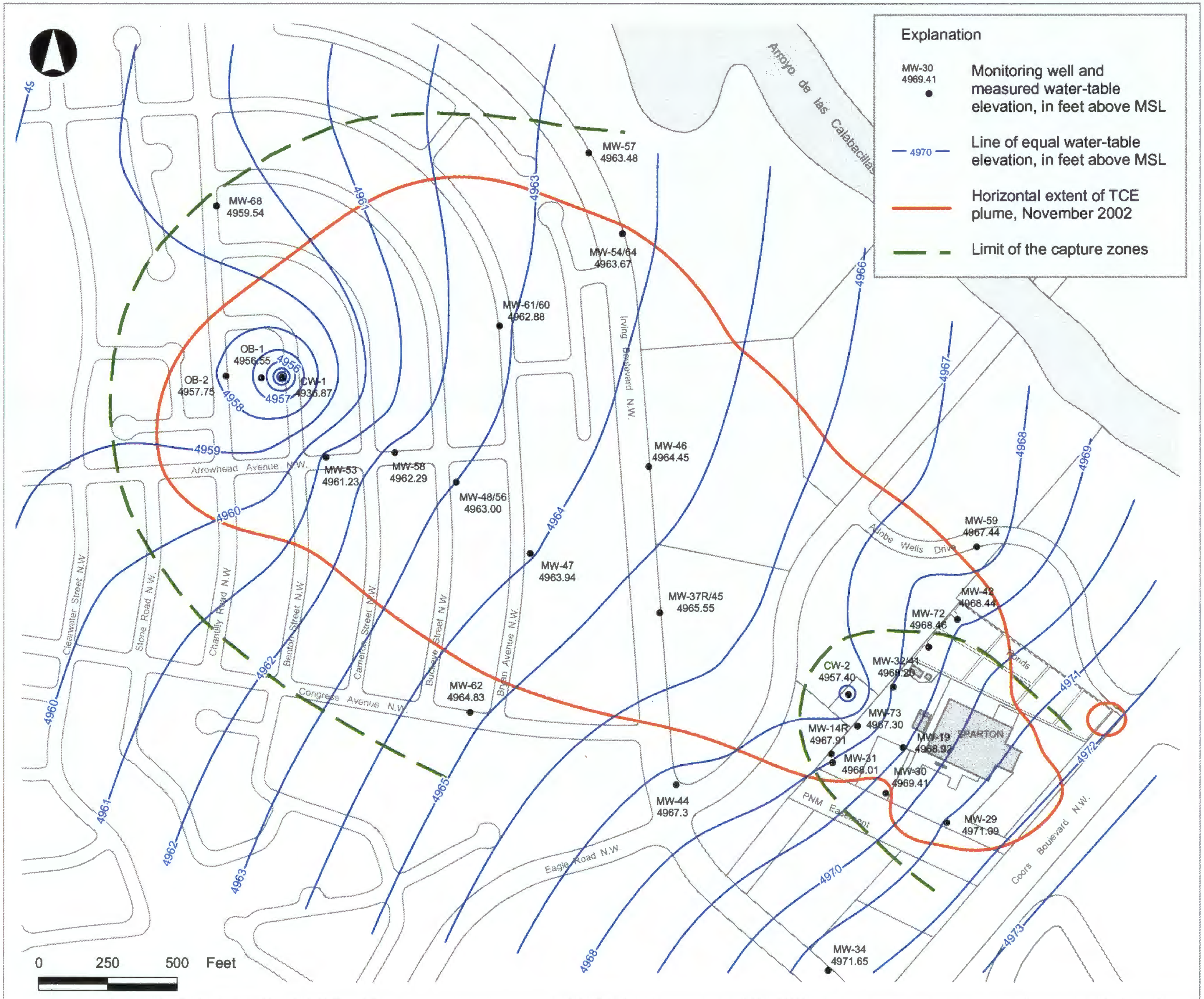


Figure 5.2 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - February 18, 2003

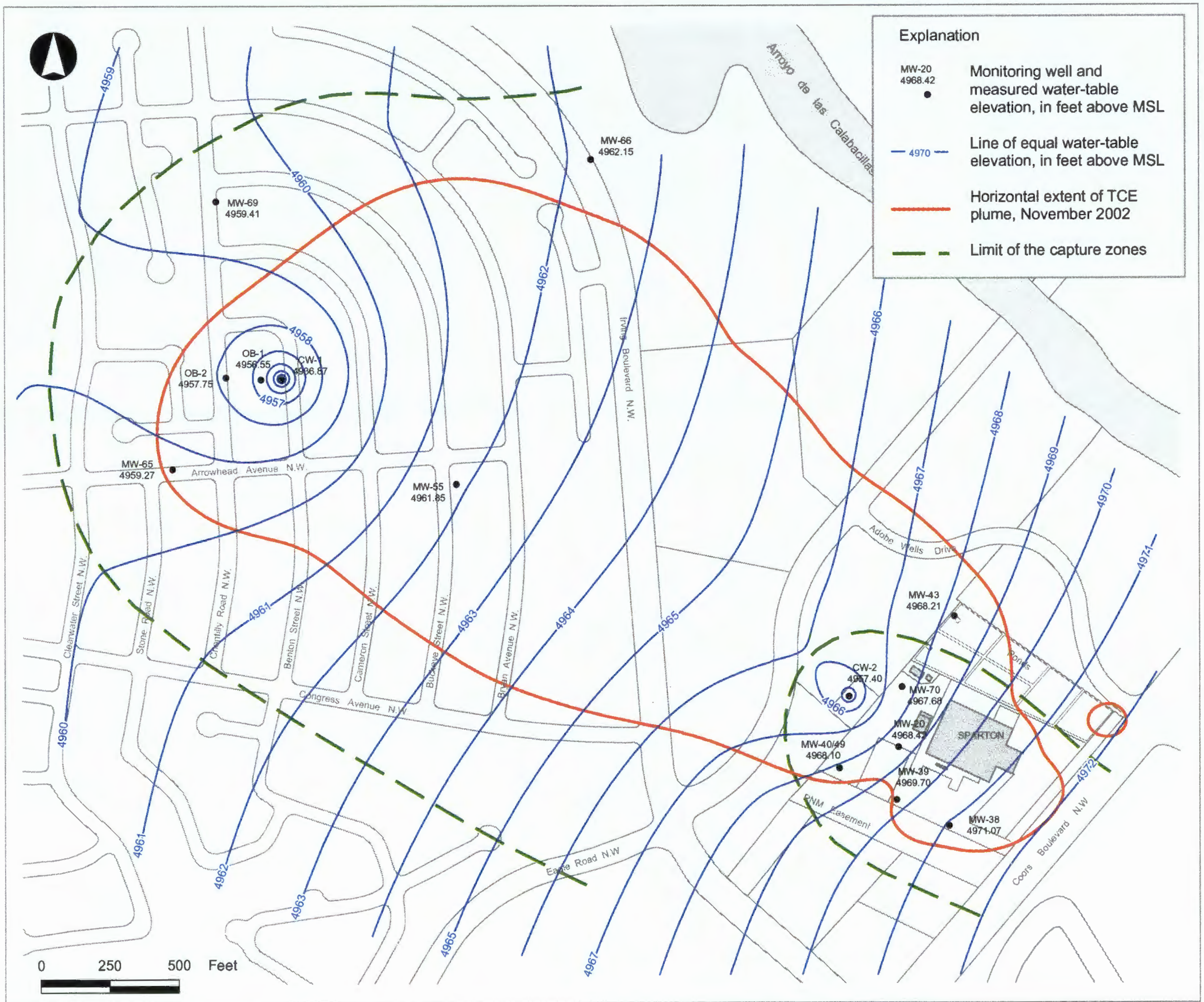


Figure 5.3 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - February 18, 2003

Figure 5.4 Elevation of the On-Site Water Table - May 8, 2003

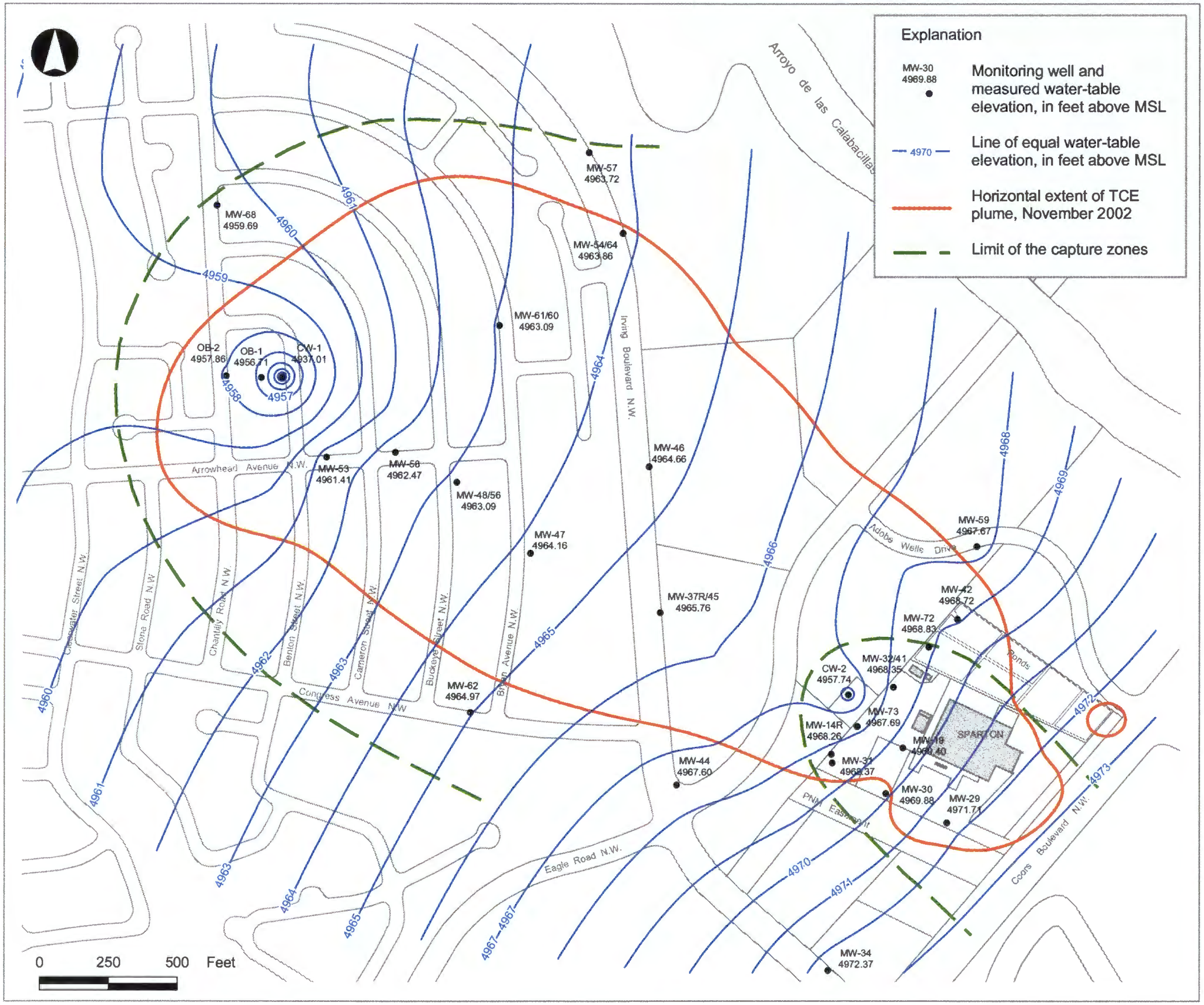


Figure 5.5 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - May 8, 2003

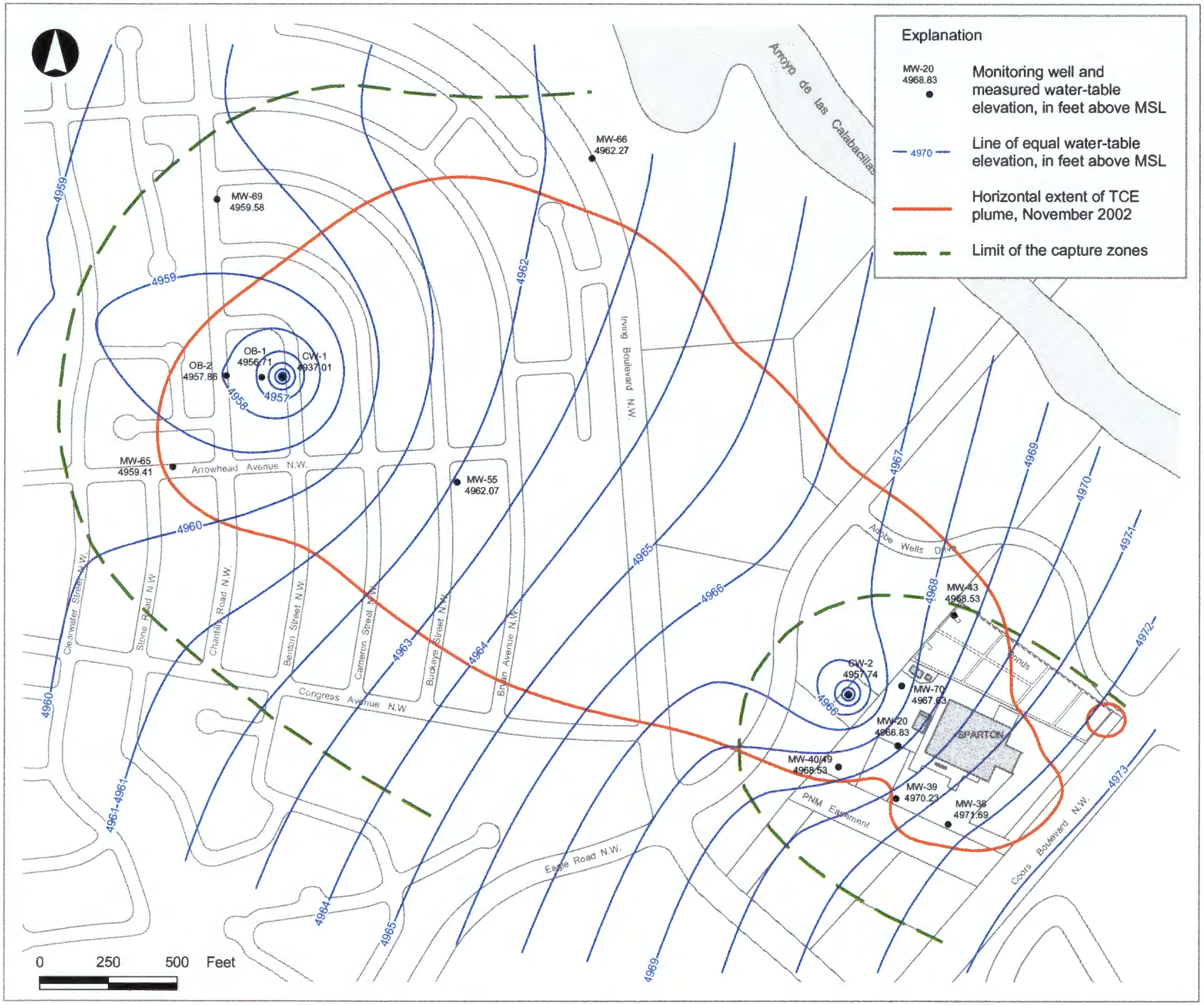


Figure 5.6 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - May 8, 2003

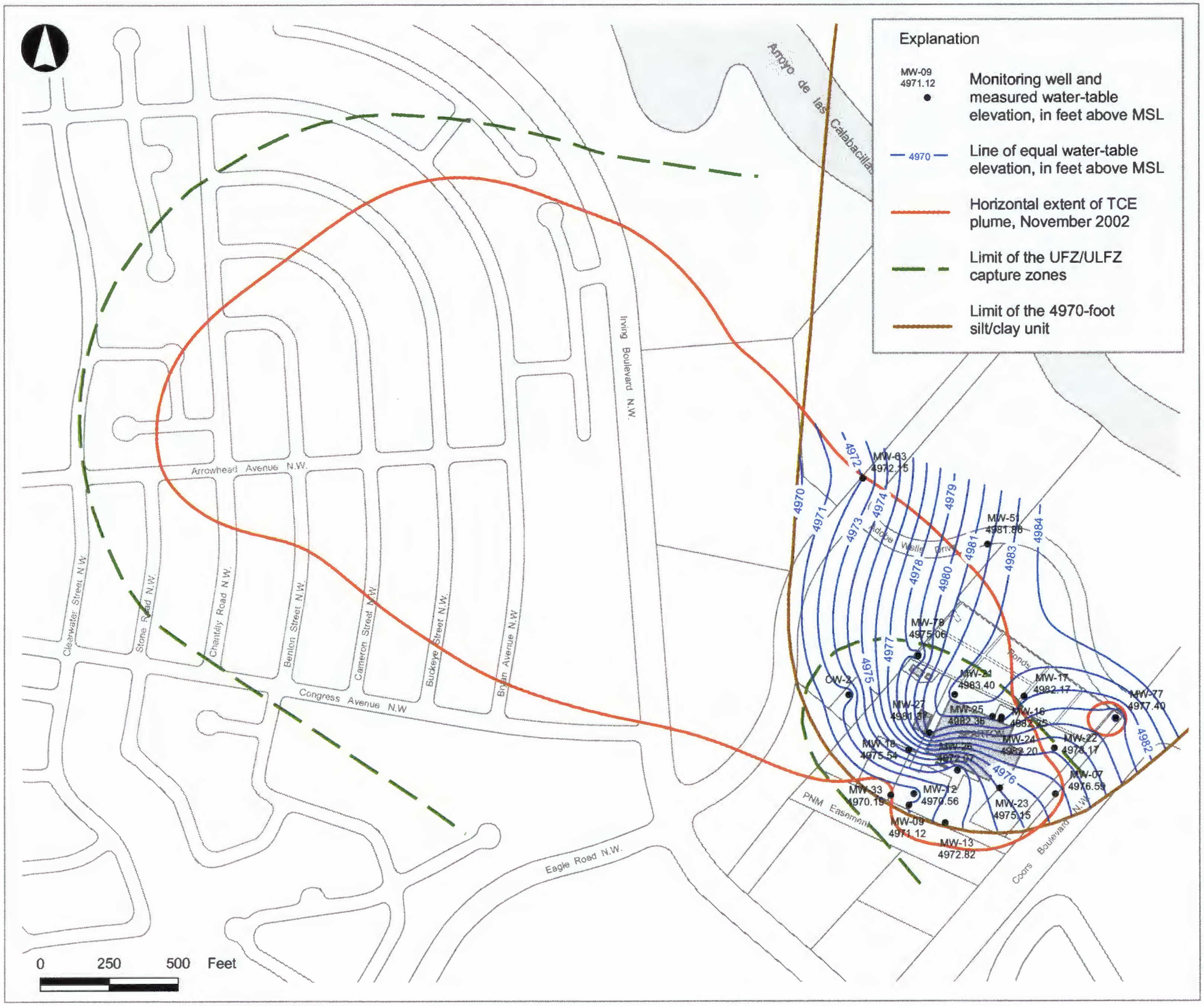


Figure 5.7 Elevation of the On-Site Water Table - August 12, 2003

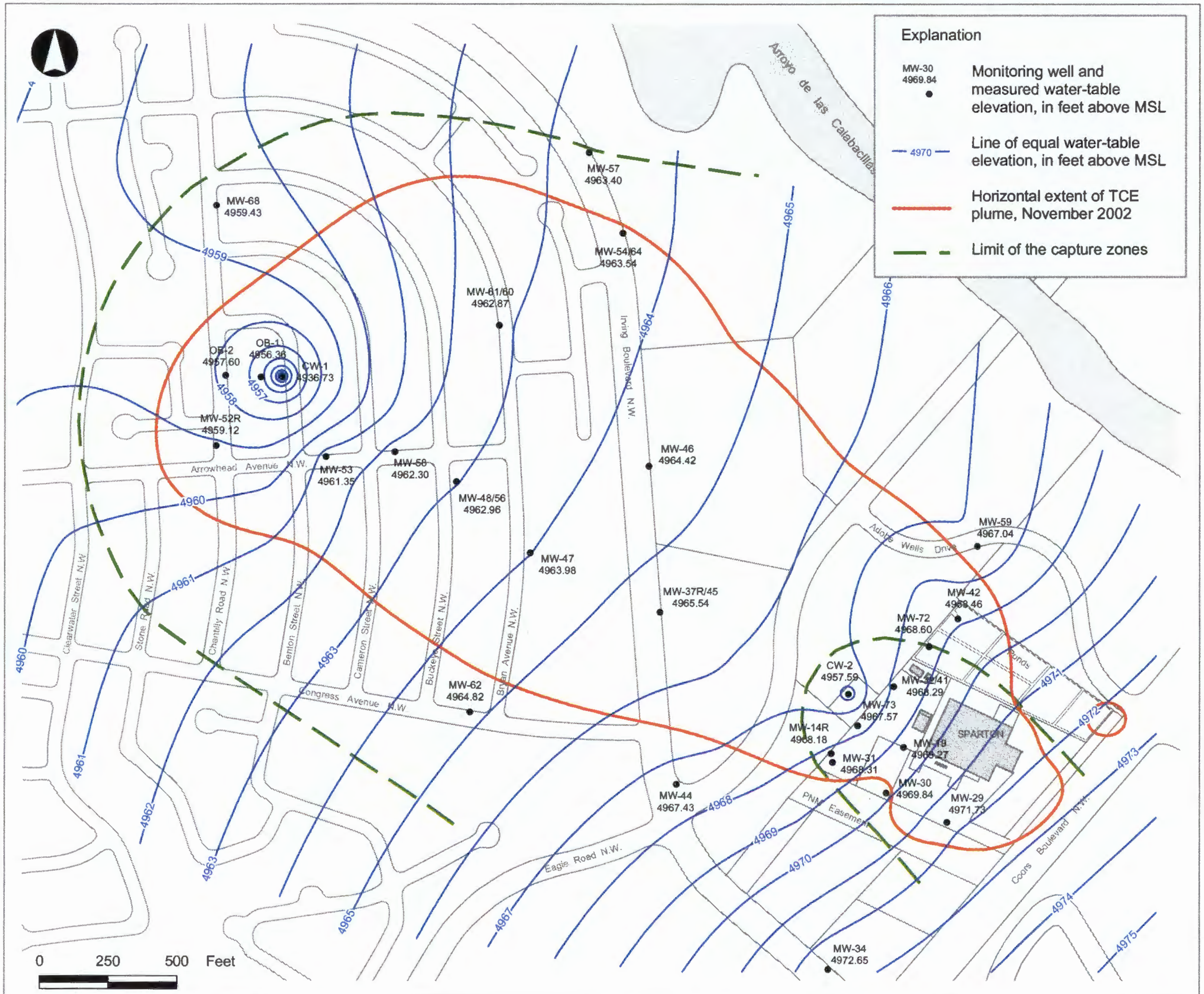


Figure 5.8 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - August 12, 2003

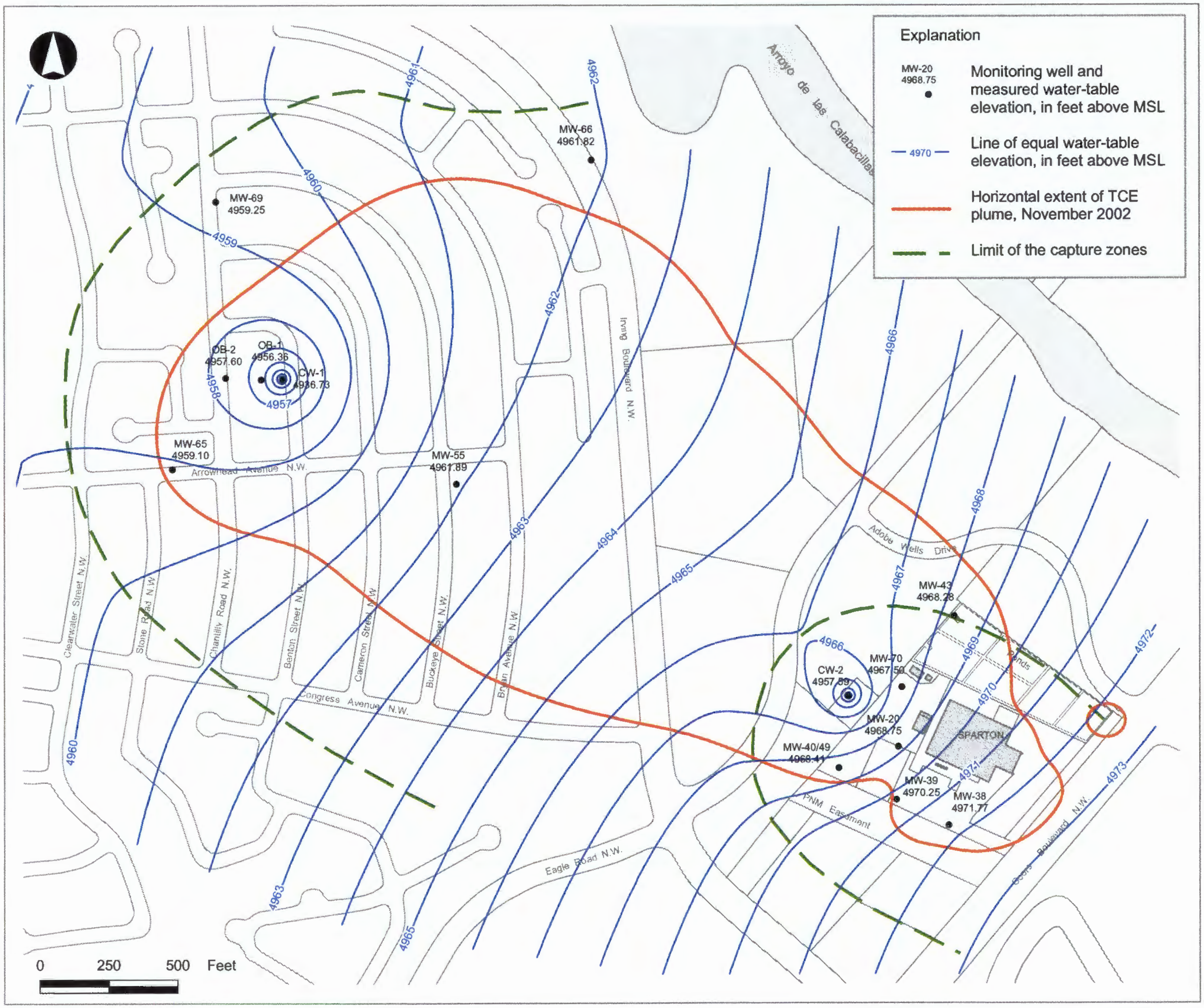


Figure 5.9 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - August 12, 2003

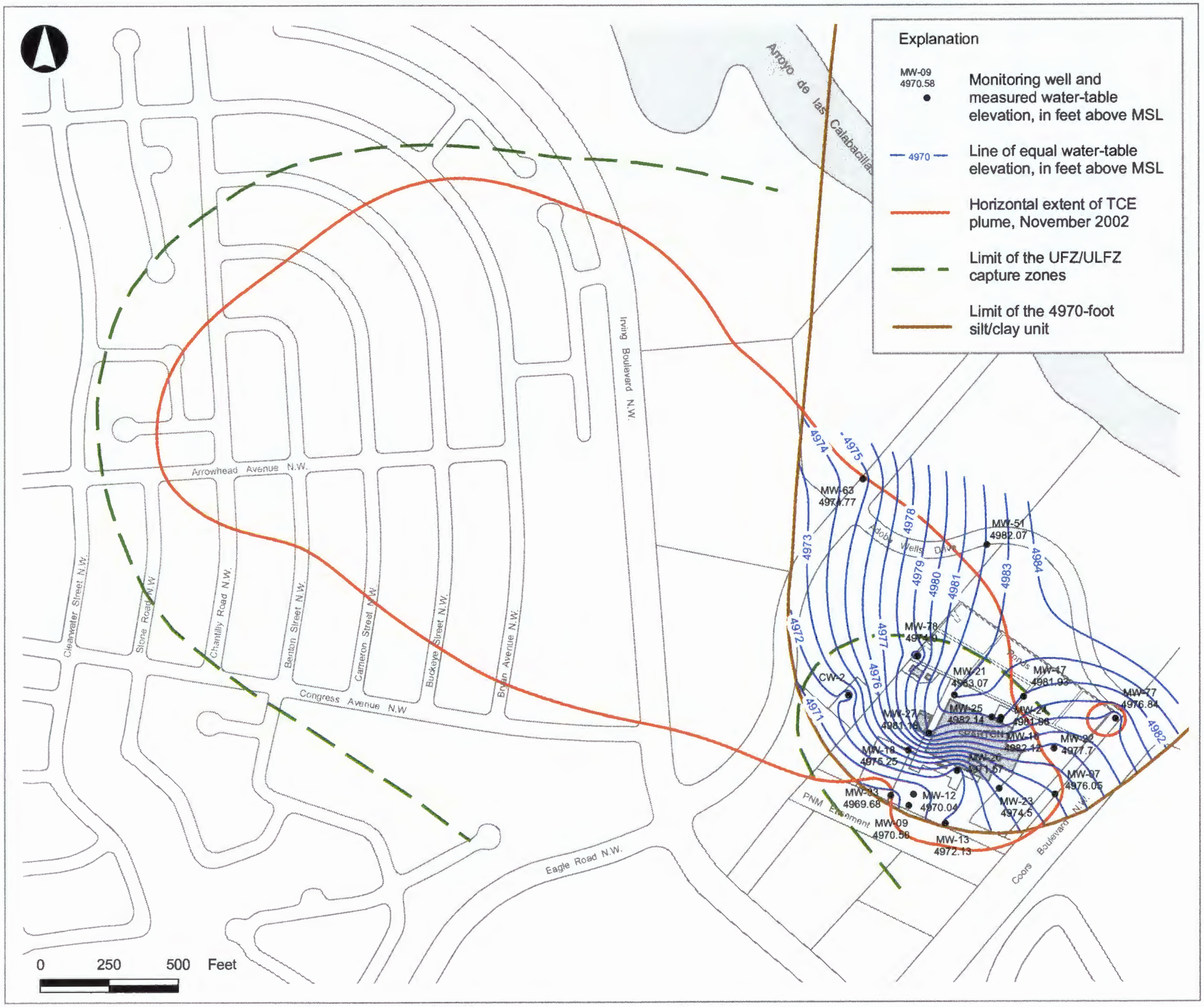


Figure 5.10 Elevation of the On-Site Water Table - November 3, 2003

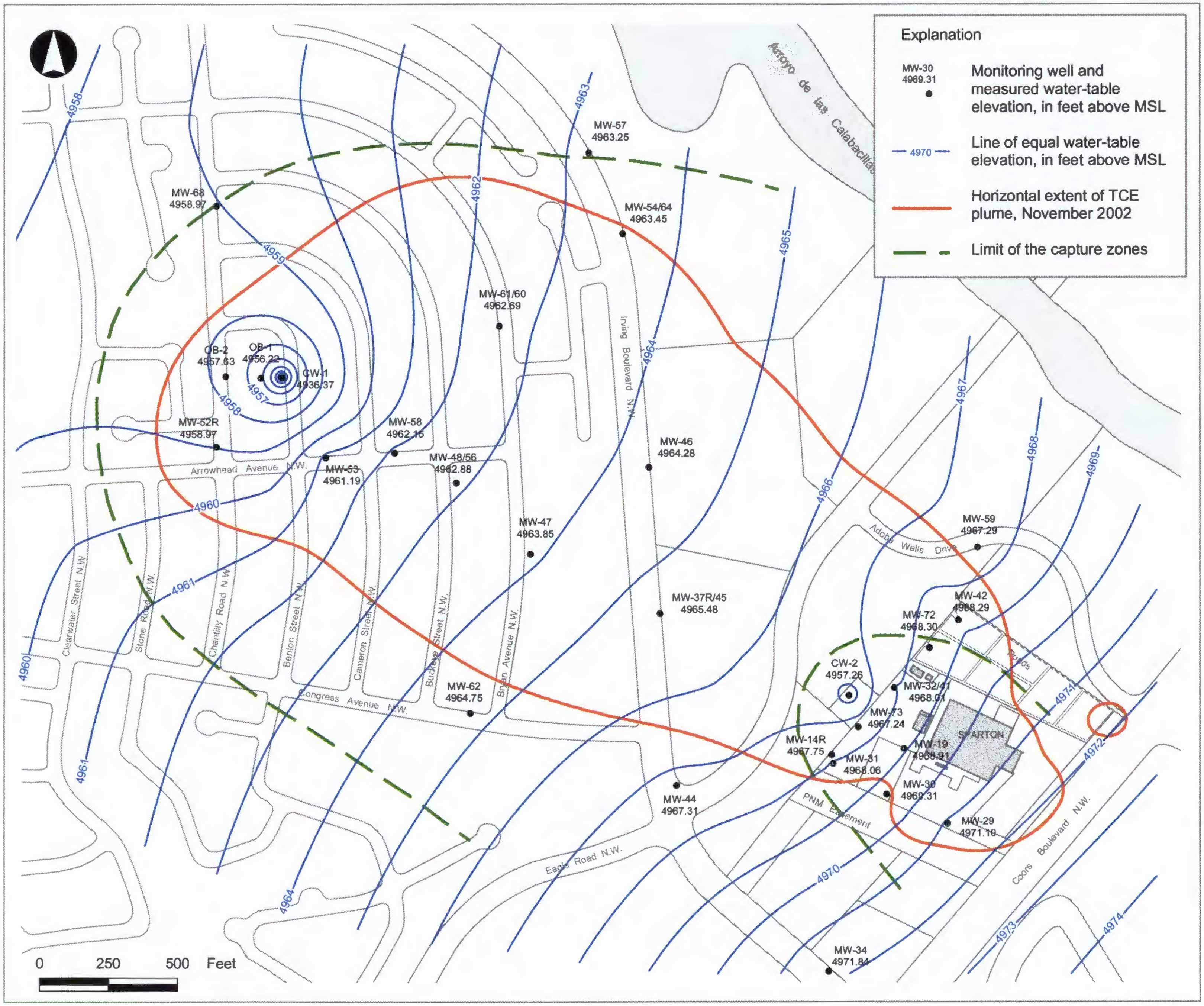


Figure 5.11 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - November 3, 2003

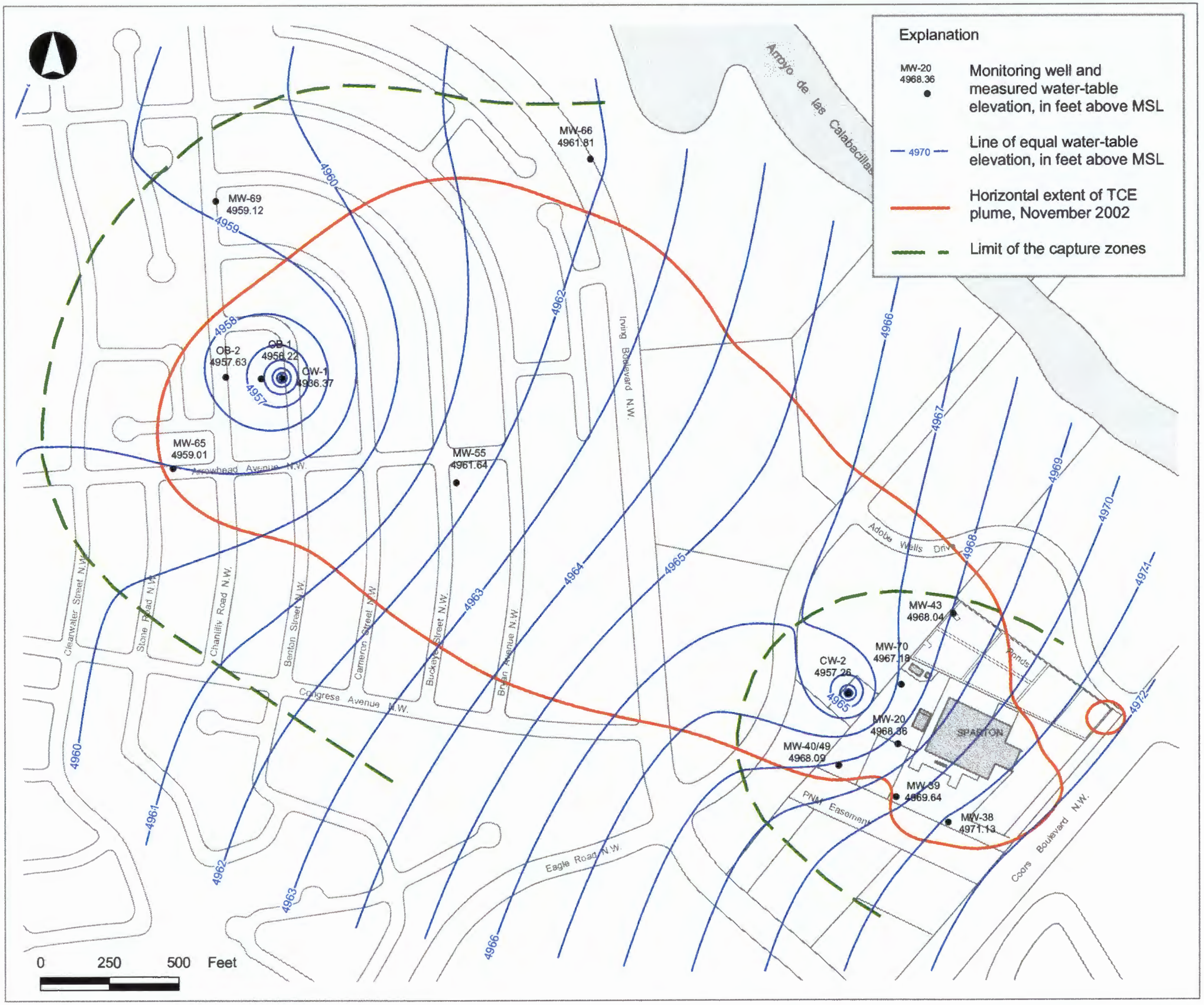


Figure 5.12 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - November 3, 2003

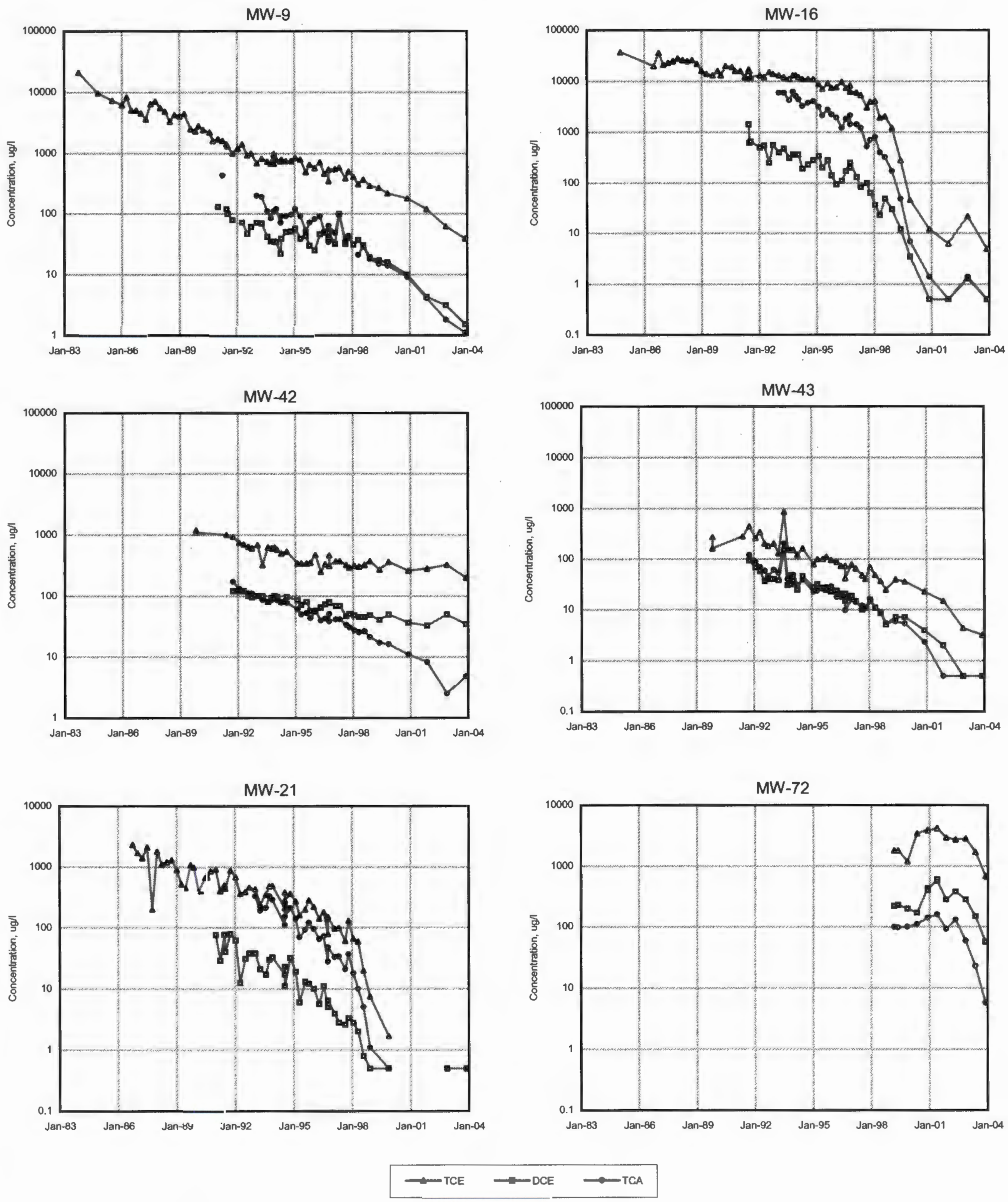


Figure 5.13 Contaminant Concentration Trends in On-Site Monitoring Wells

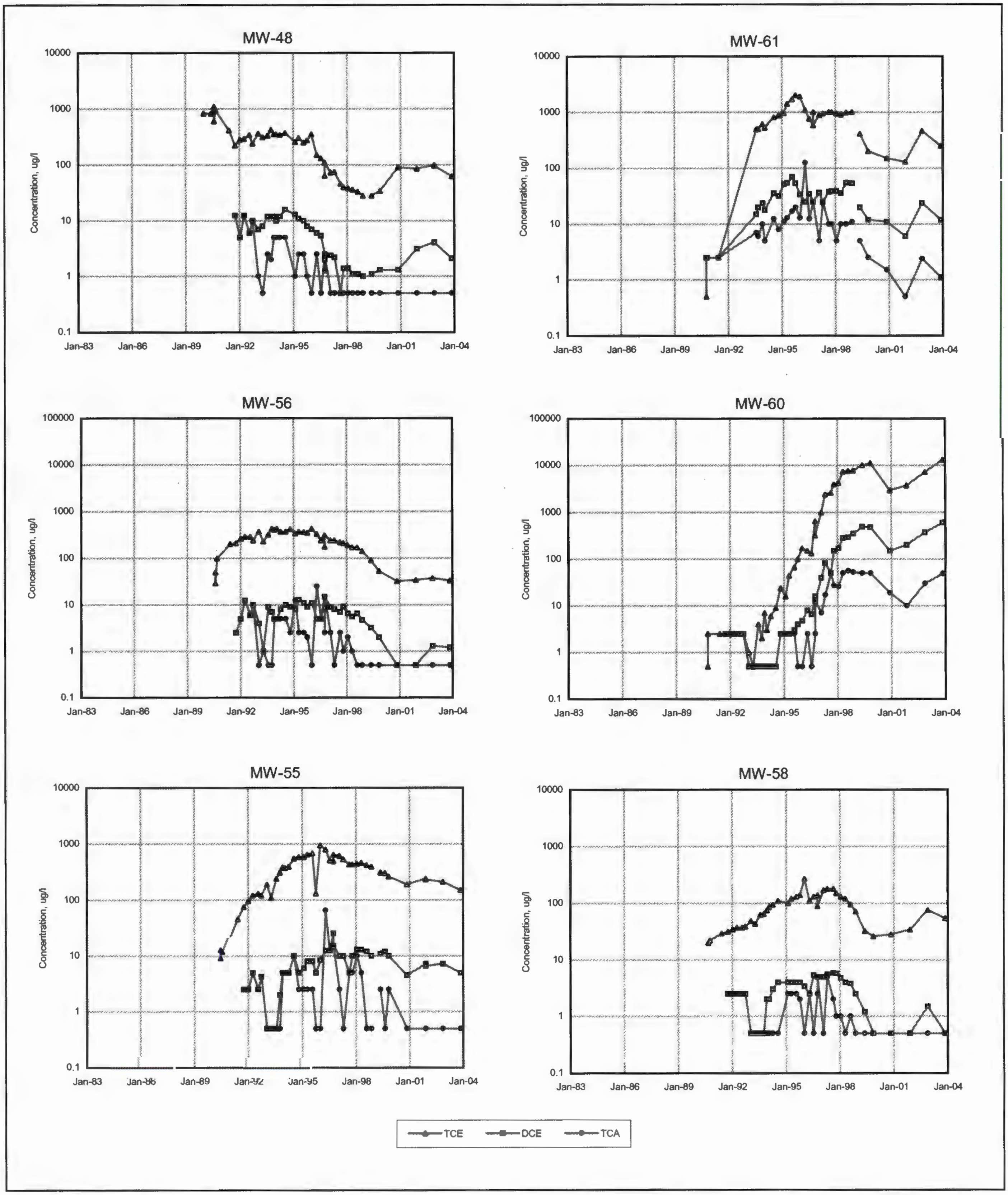


Figure 5.14 Contaminant Concentration Trends in Off-Site Monitoring Wells

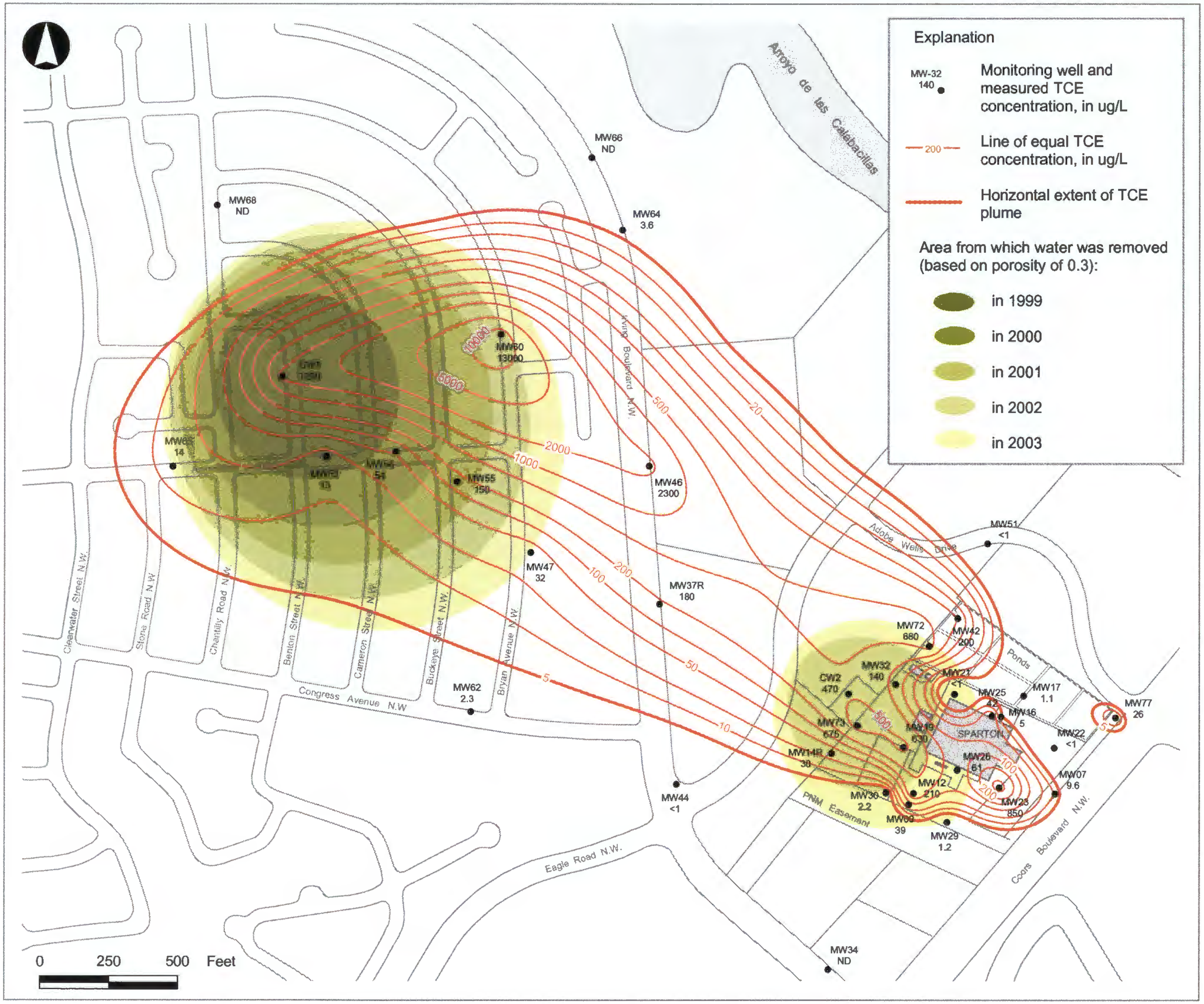


Figure 5.15 Horizontal Extent of TCE Plume - November 2003

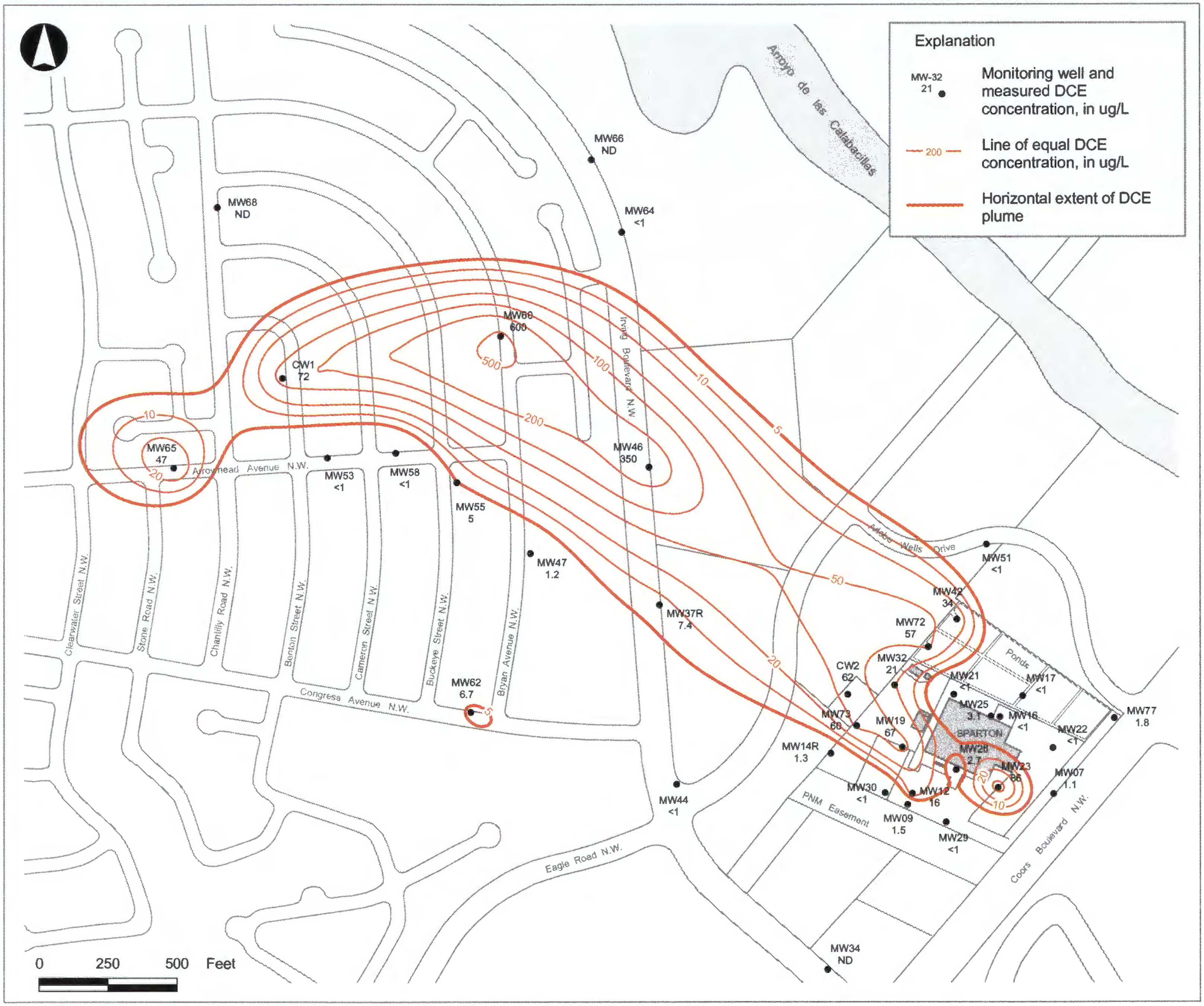


Figure 5.16 Horizontal Extent of DCE Plume - November 2003

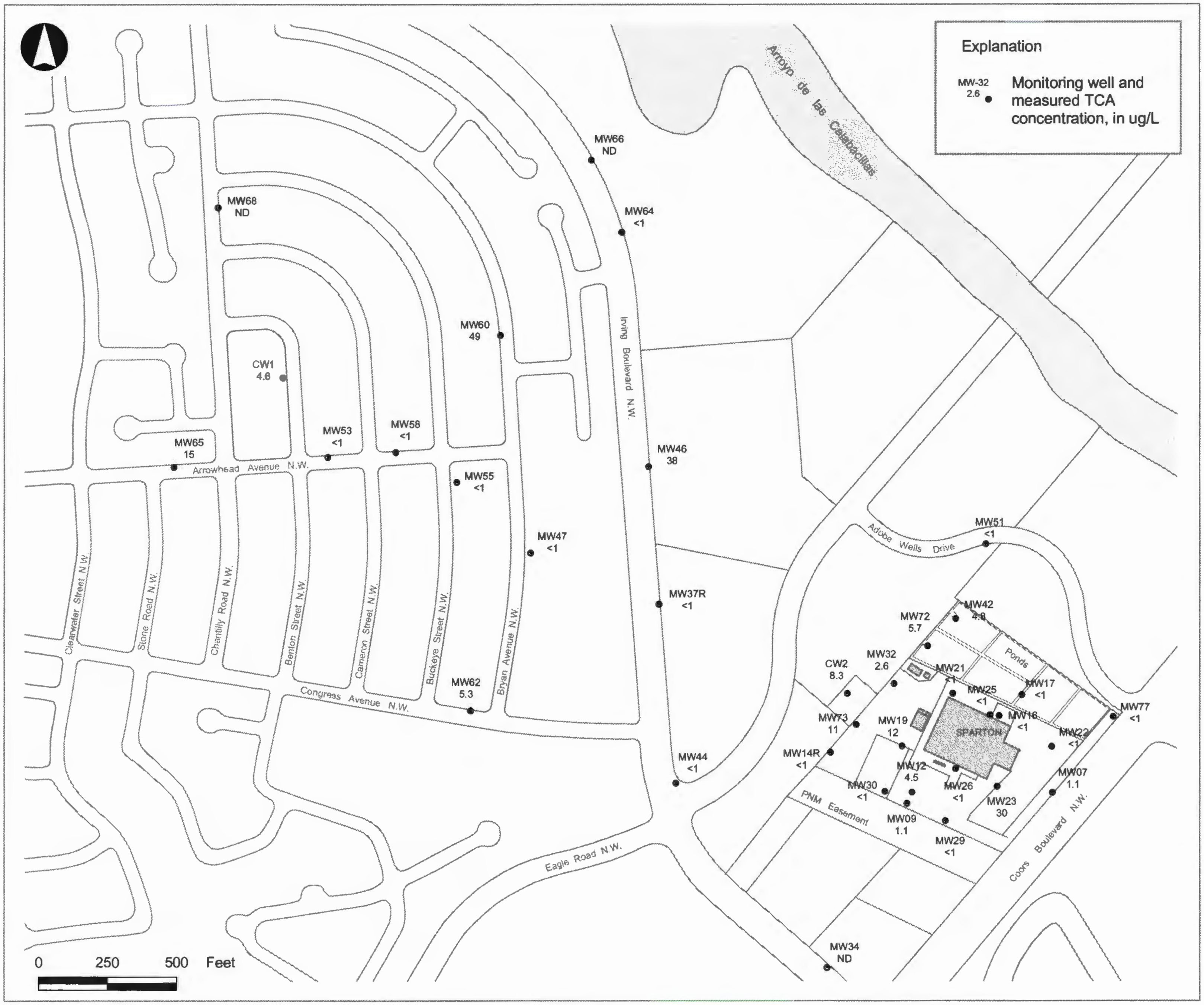


Figure 5.17 Maximum Concentrations of TCA in Wells - November 2003

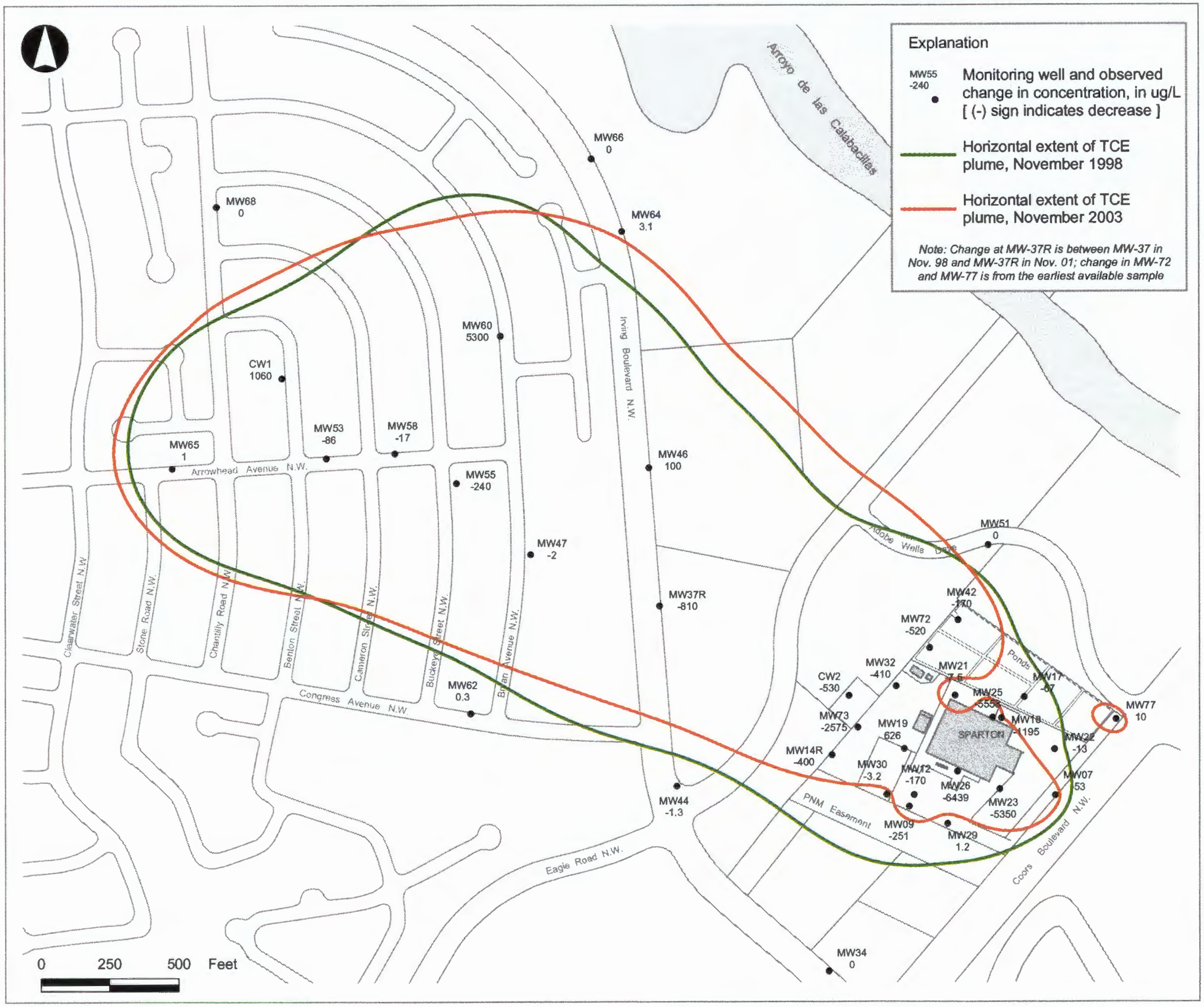


Figure 5.18 Changes in TCE Concentrations at Wells Used for Plume Definition - November 1998 to November 2003

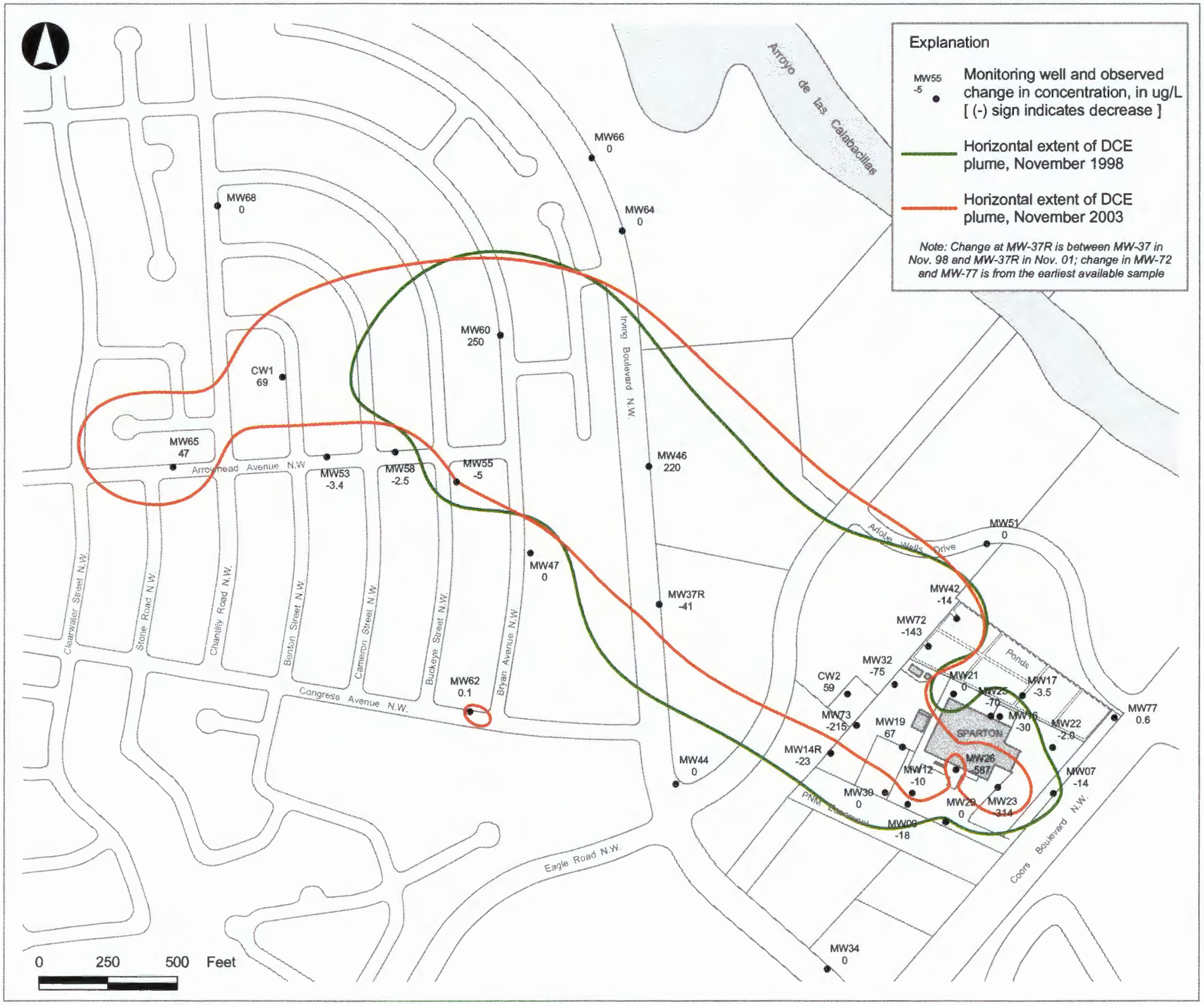


Figure 5.19 Changes in DCE Concentrations at Wells Used for Plume Definition - November 1998 to November 2003

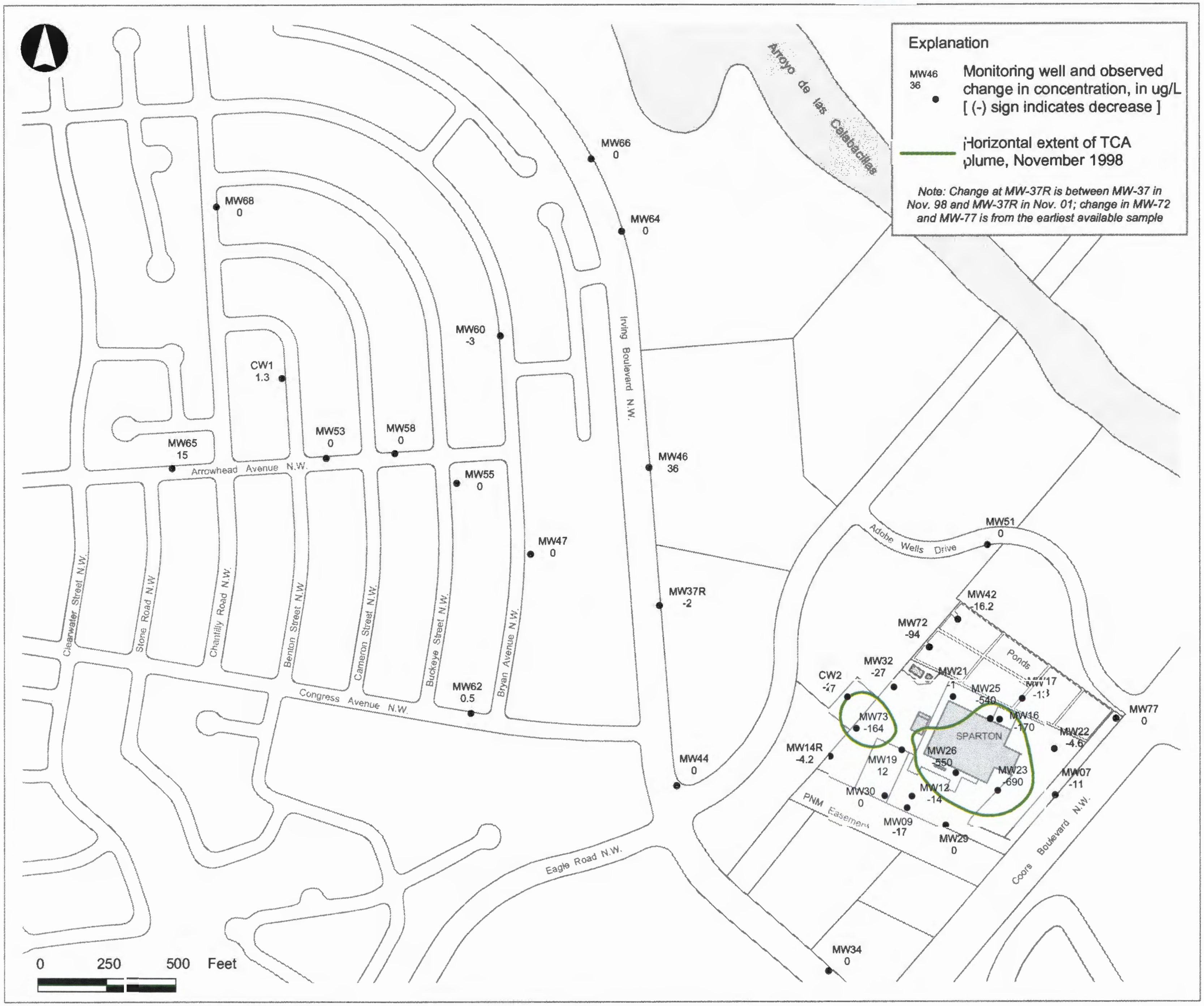


Figure 5.20 Changes in TCA Concentrations at Wells Used for Plume Definition - November 1998 to November 2003

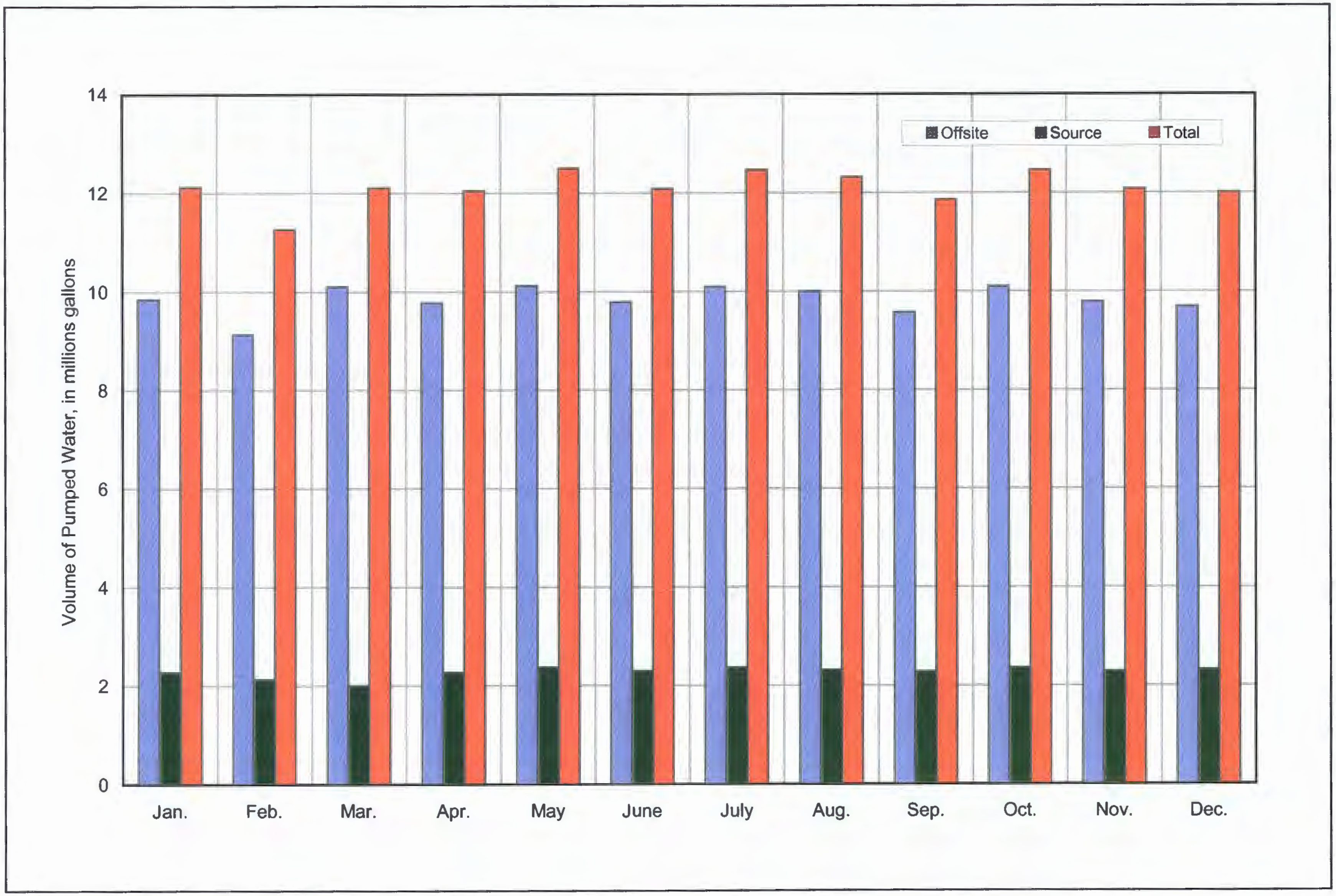


Figure 5.21 Monthly Volume of Water Pumped by the Off-Site and Source Containment Wells - 2003

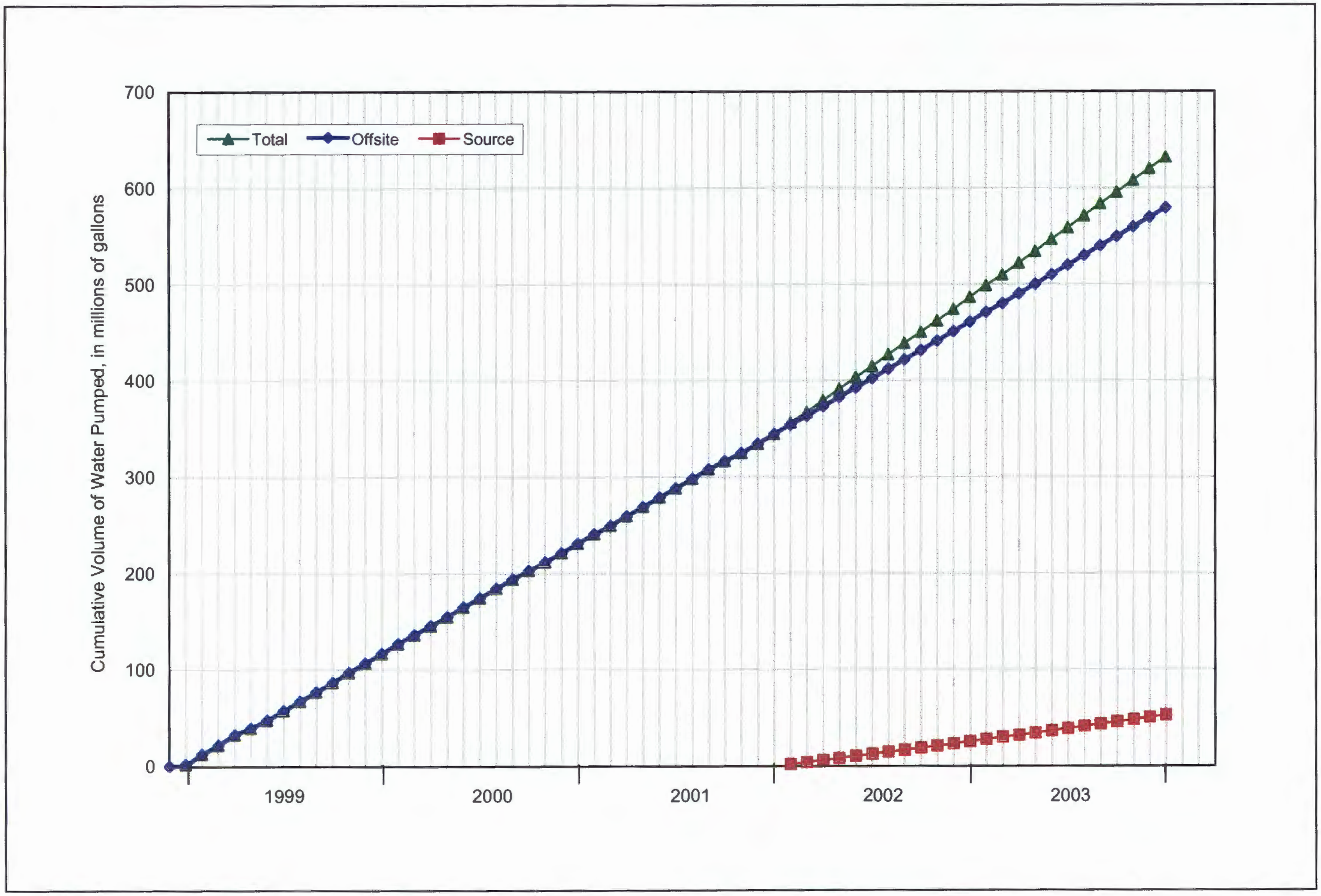


Figure 5.22 Cumulative Volume of Water Pumped by the Off-Site and Source Containment Wells

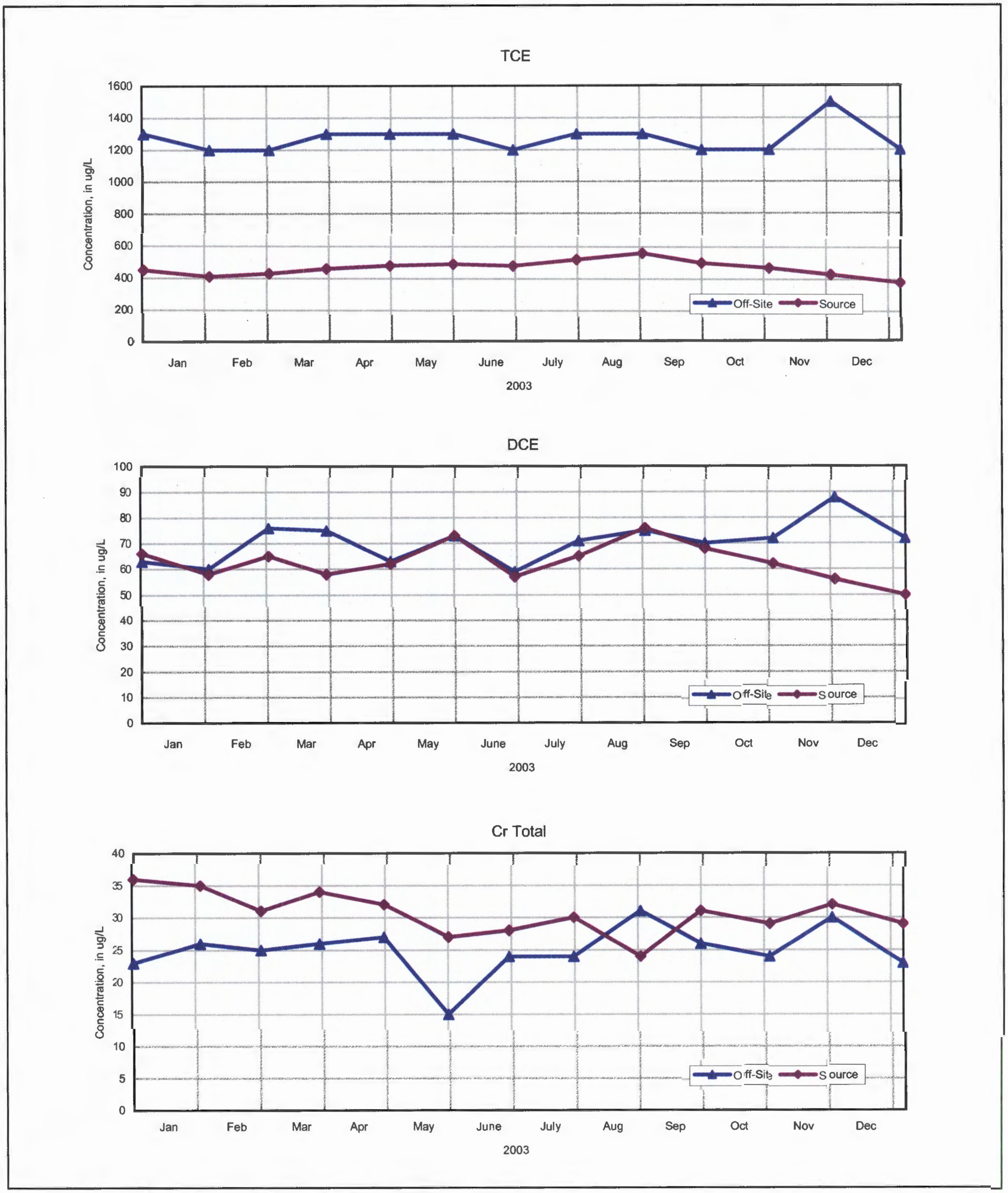


Figure 5.23 Source and Off-Site Containment Systems - TCE, DCE and Total Chromium Concentrations in the Influent - 2003

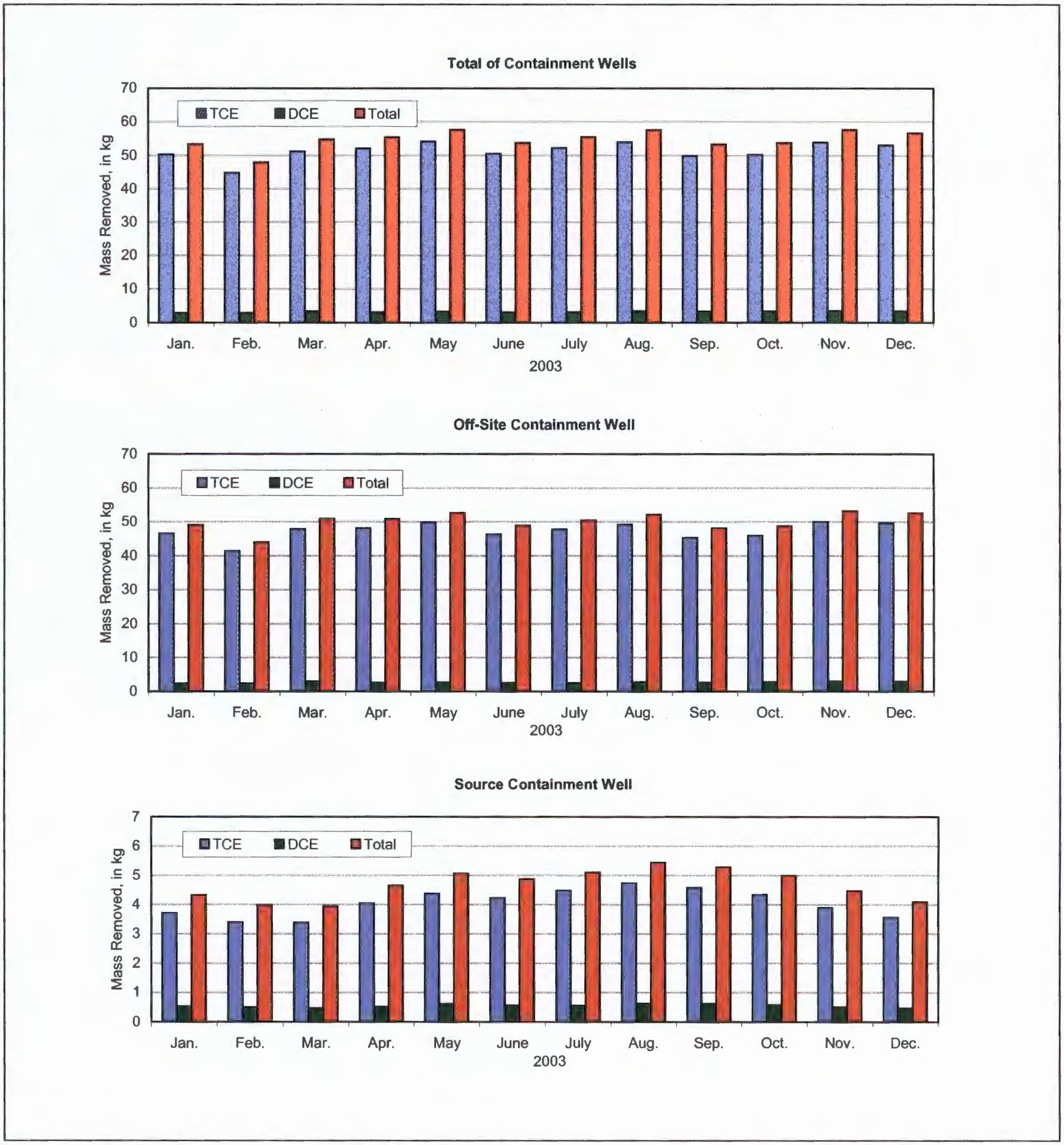


Figure 5.24 Monthly Contaminant Mass Removal by the Containment Wells - 2003

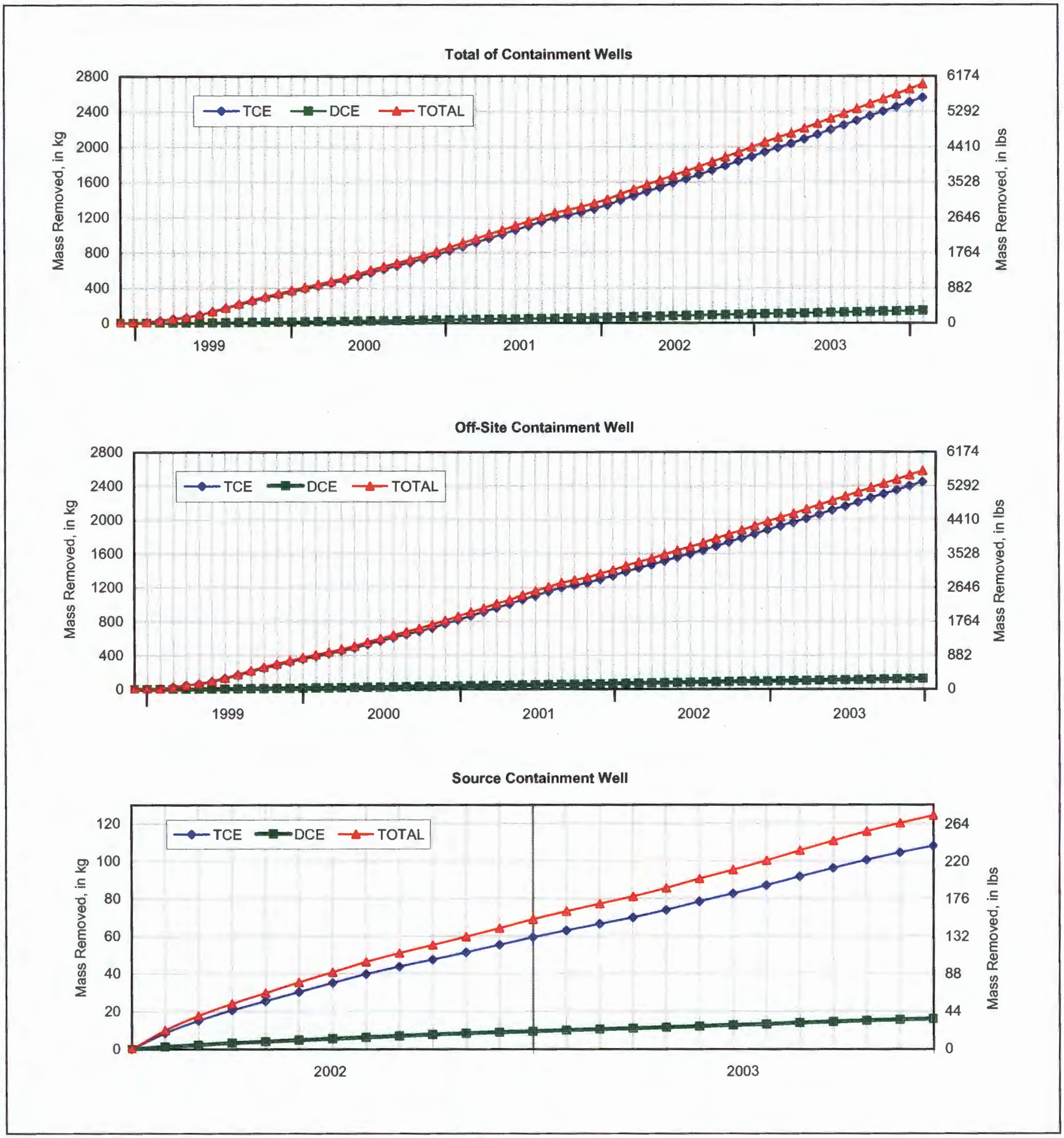


Figure 5.25 Cumulative Containment Mass Removal by the Source and Off-Site Containment Wells

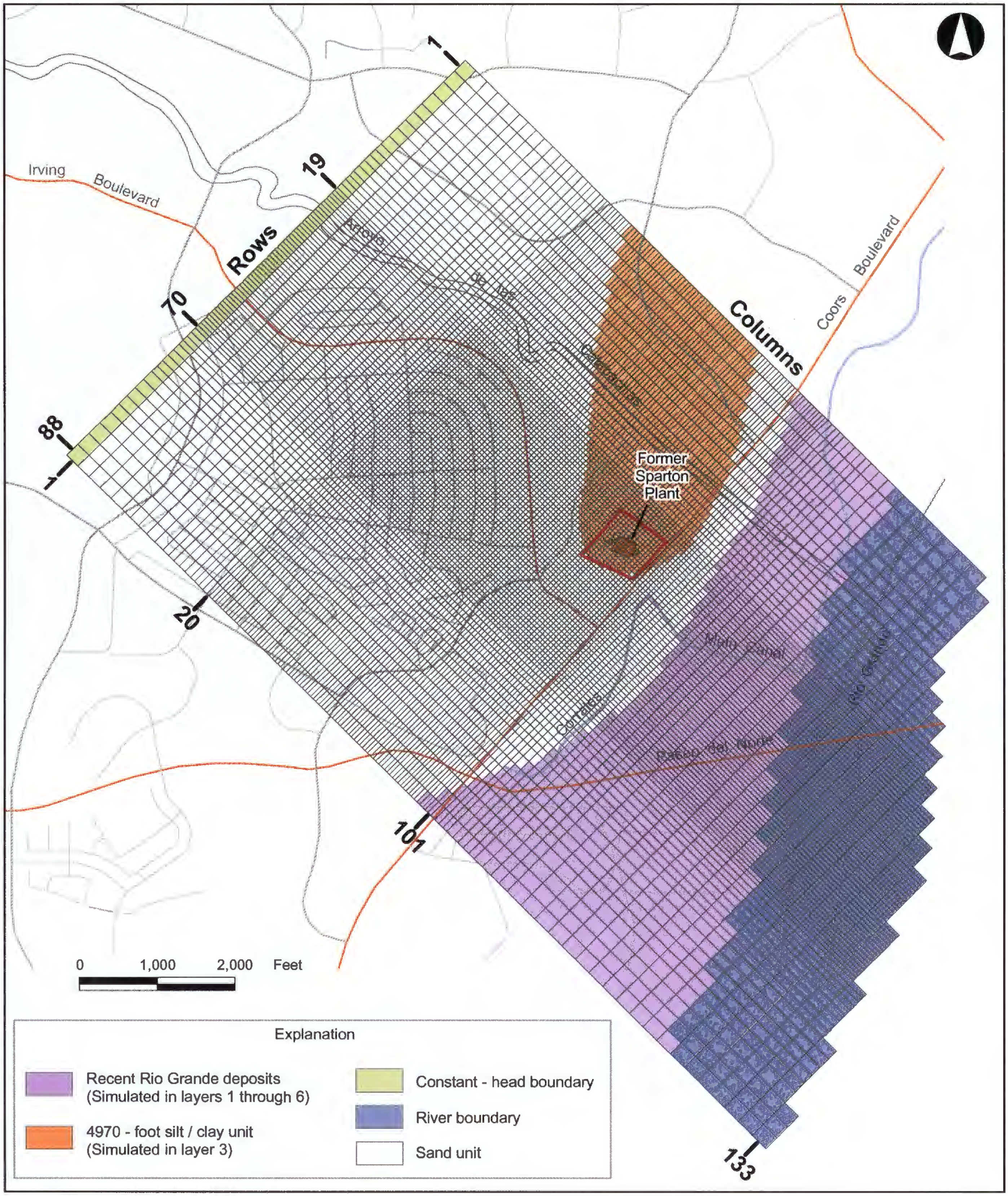


Figure 6-1 Model Grid, Hydraulic Property Zones and Boundary Conditions

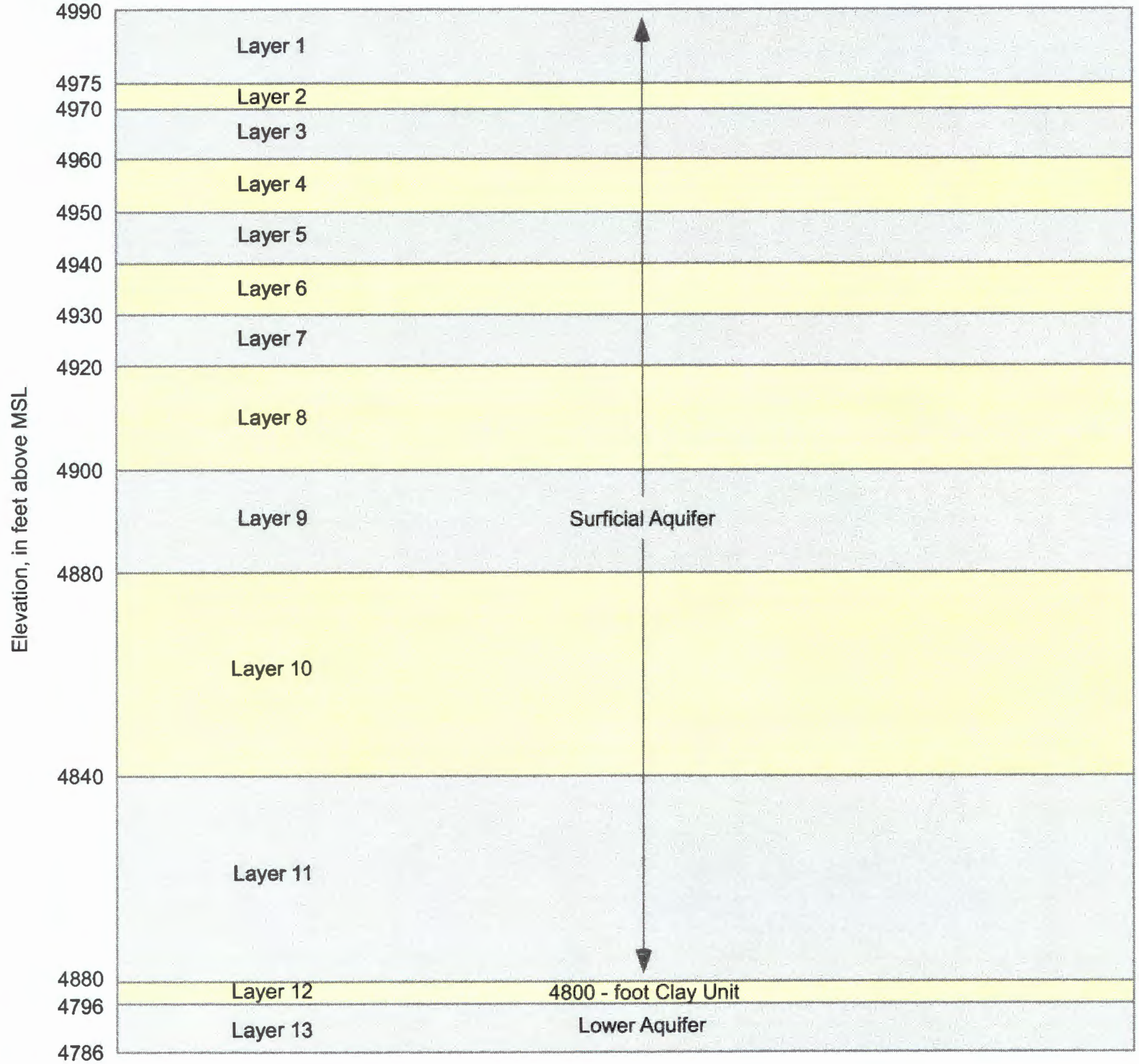
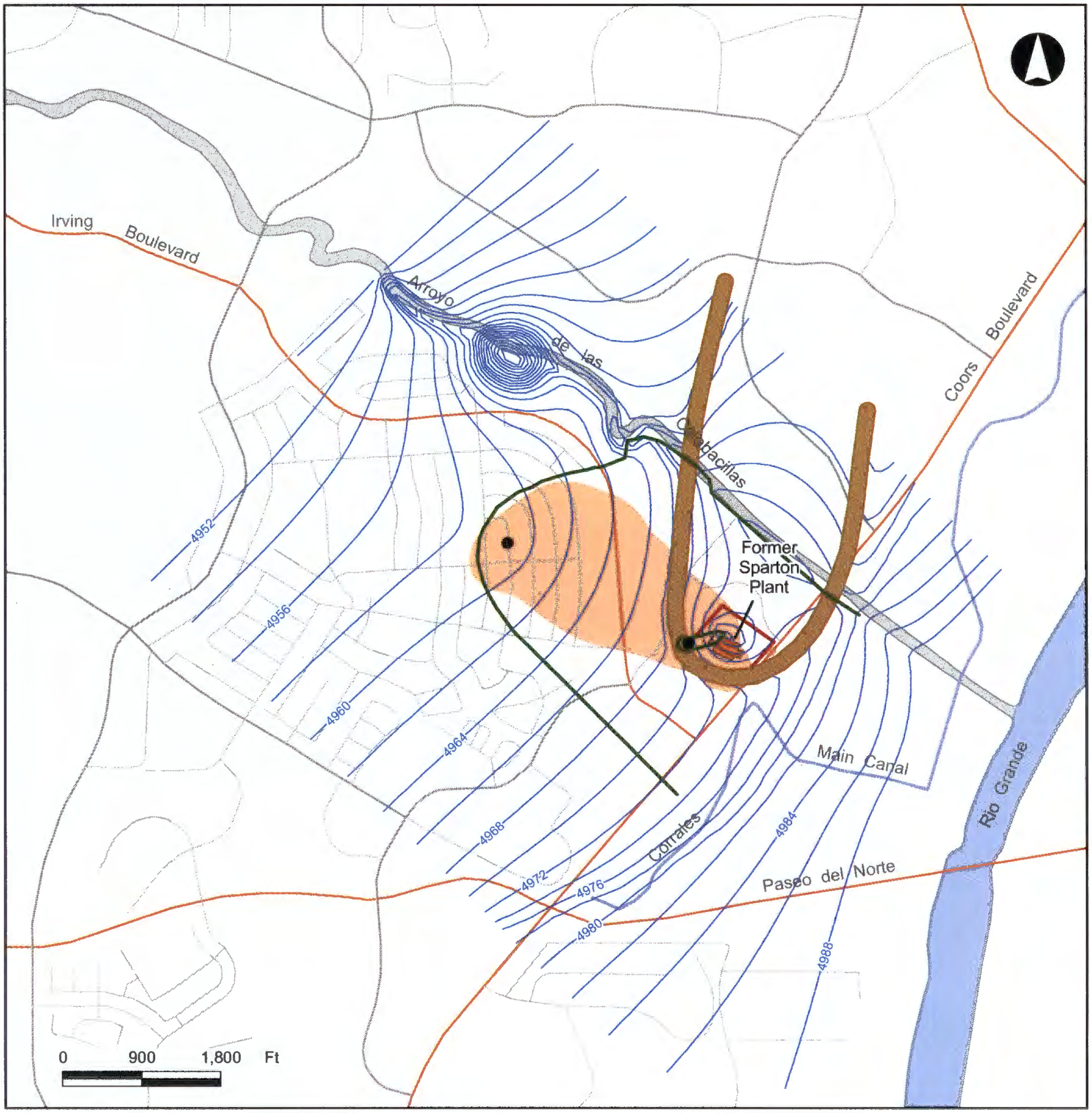


Figure 6.2 Model Layers



Explanation

- Containment Well
- 4968 Line of equal water-level elevation, in feet above MSL
- Limit of the capture zones
- Approximate extent of 4970-foot silt/clay unit
- Horizontal extent of TCE plume, November 2002

Figure 6-4 Calculated Water Table (UFZ) and Comparison of the Calculated Capture Zone to the TCE Plume Extent

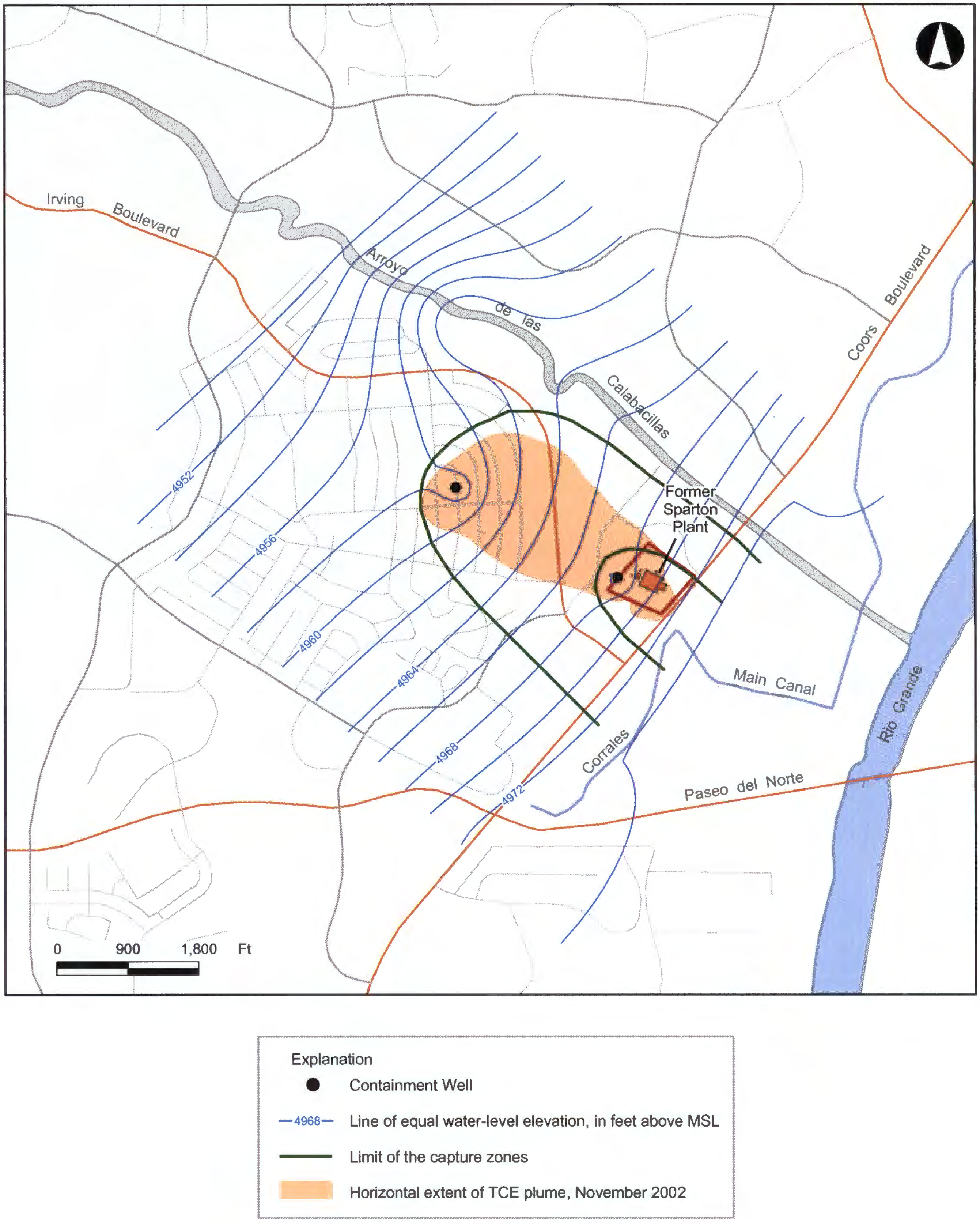
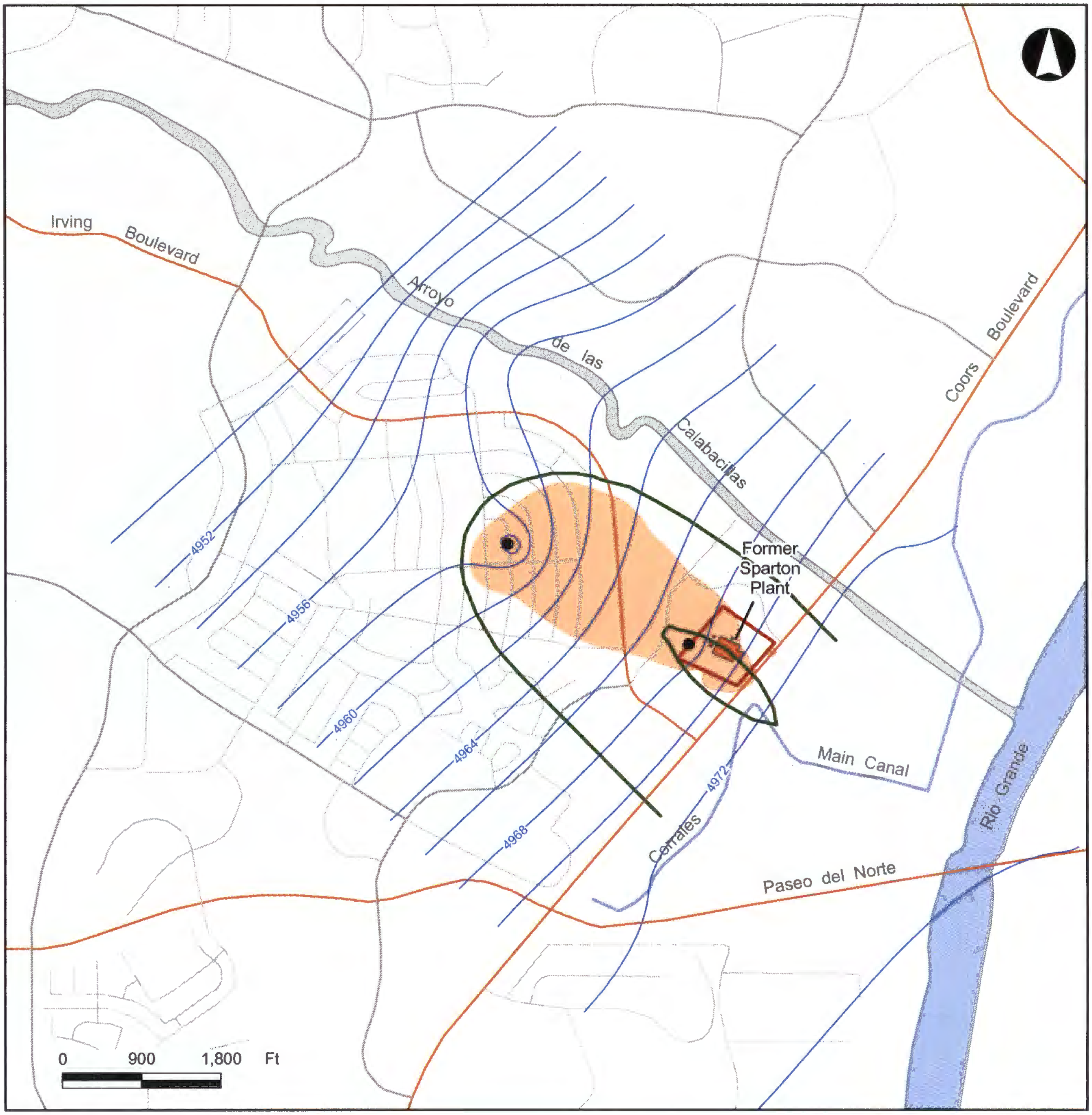


Figure 6-5 Calculated Water Levels in the ULFZ and Comparison of the Calculated Capture Zone to the TCE Plume Extent



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- Limit of the capture zones
- Horizontal extent of TCE plume, November 2002

Figure 6-6 Calculated Water Levels in the LLFZ and Comparison of the Calculated Capture Zone to the TCE Plume Extent

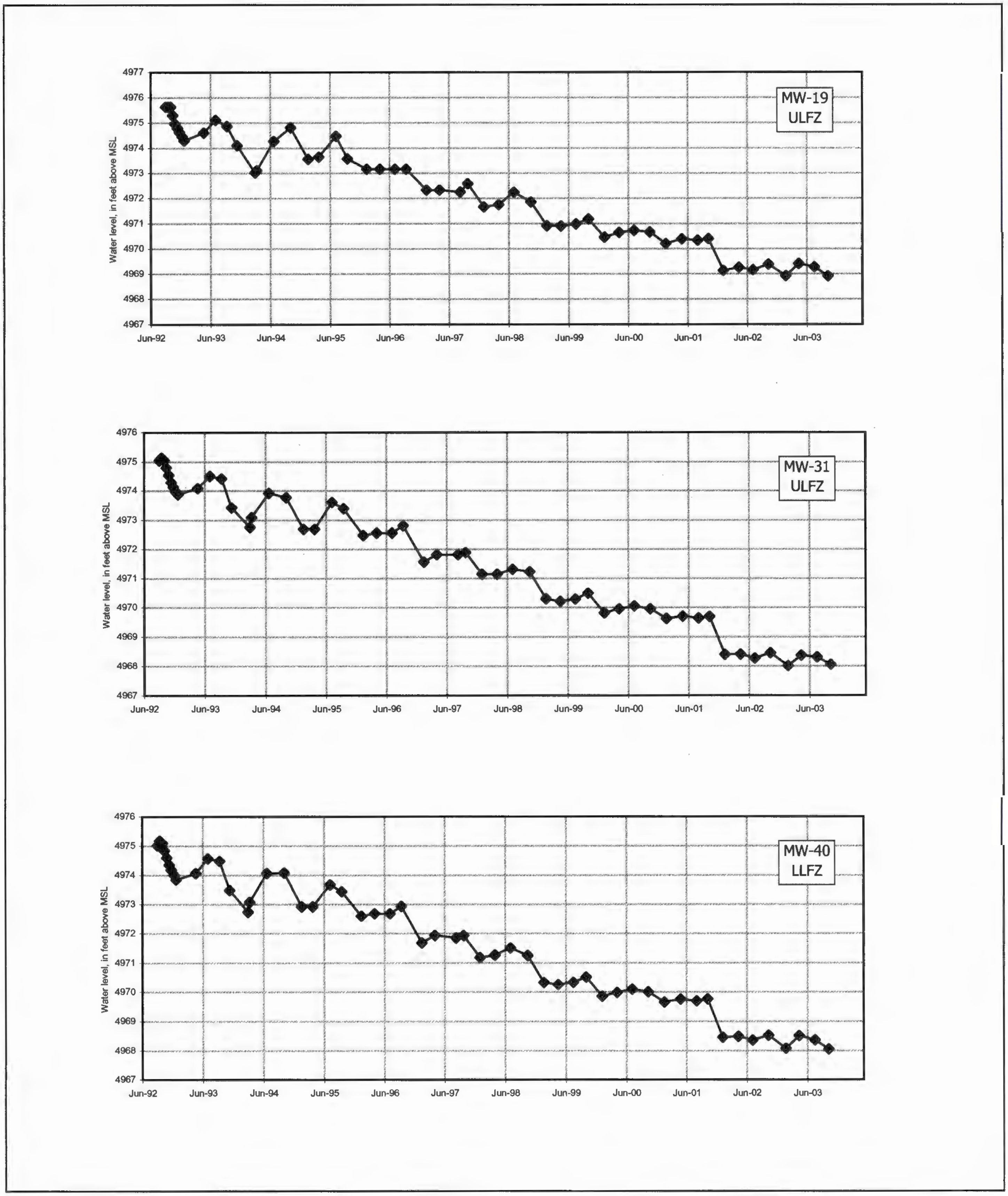

Figure 6.3 Regional Water Level Trends

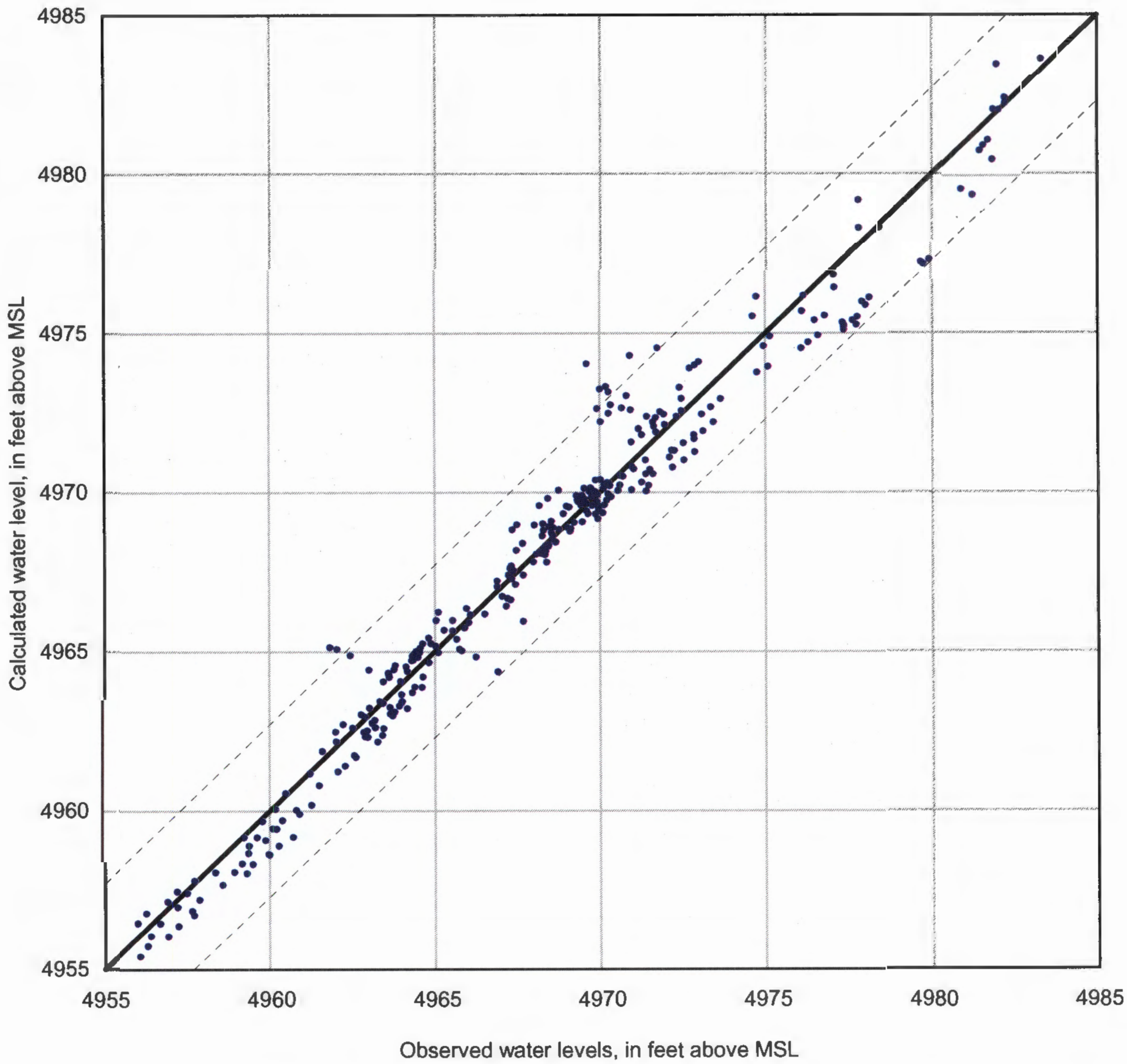

Figure 6.7 Comparison of Calculated to Observed Water Levels - November 1998 to November 2003

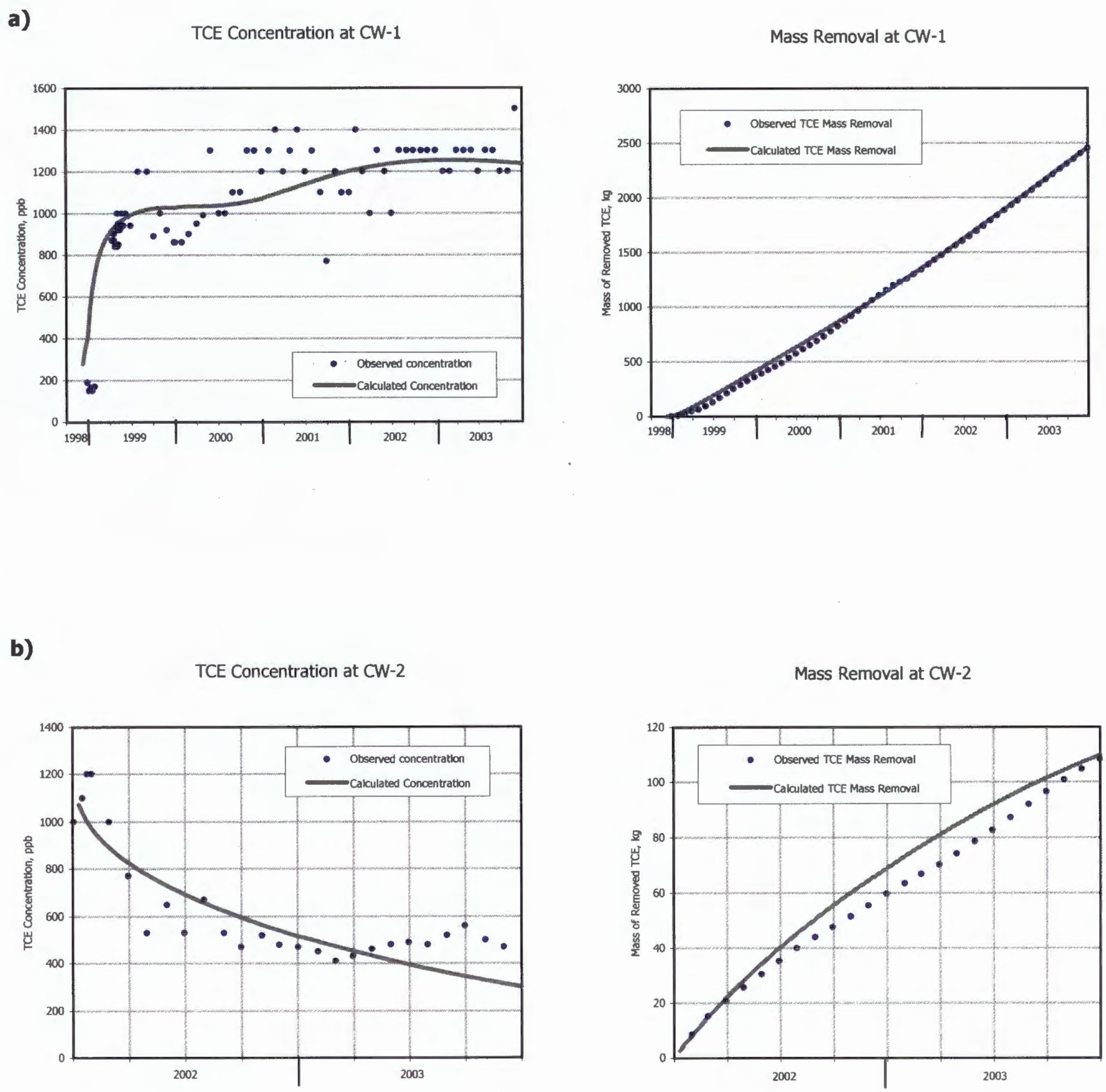

Figure 6.8 Comparison of Calculated to Observed TCE Concentrations and Mass Removal

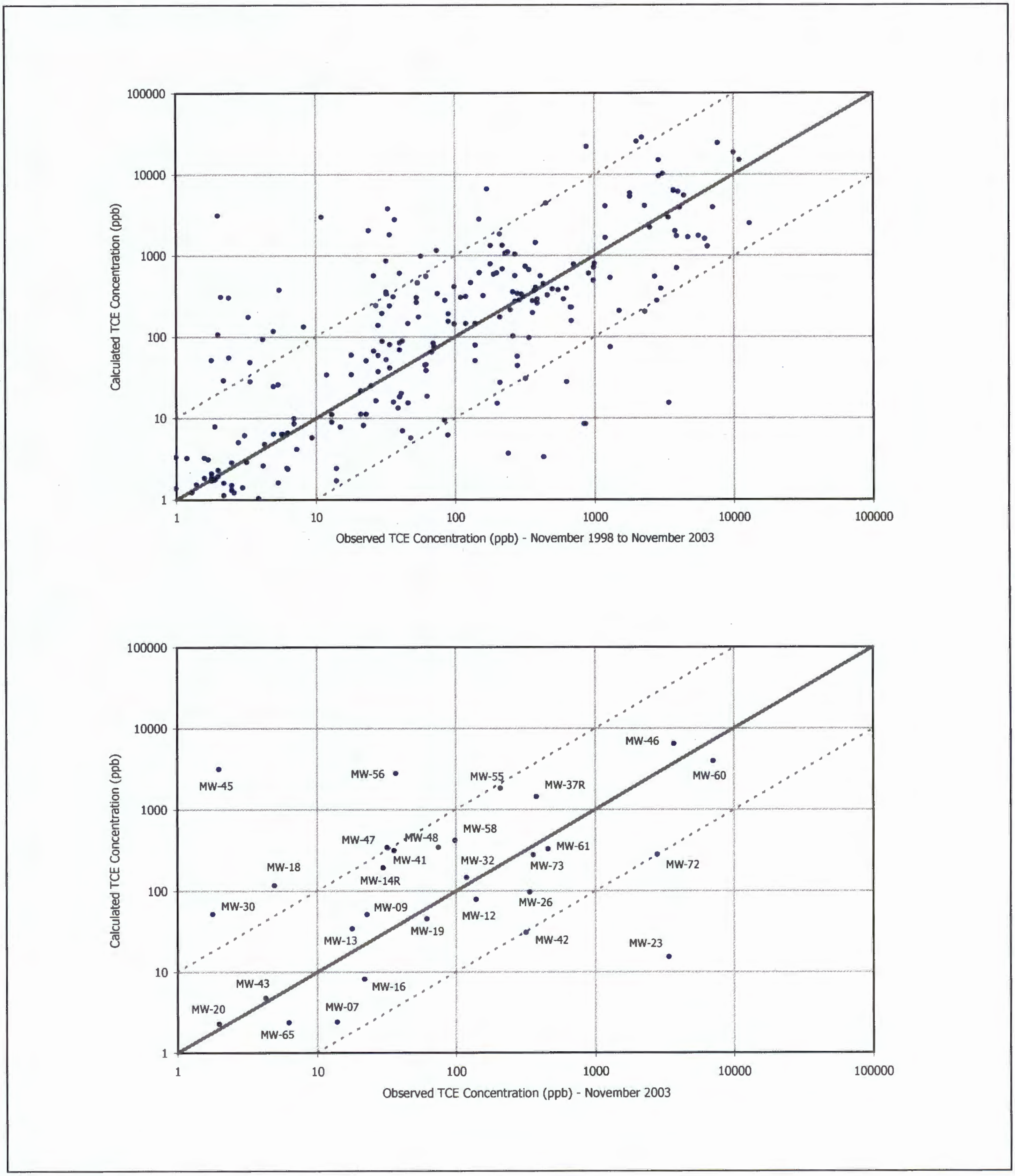

Figure 6.9 Comparisons of Calculated to Observed TCE Concentrations

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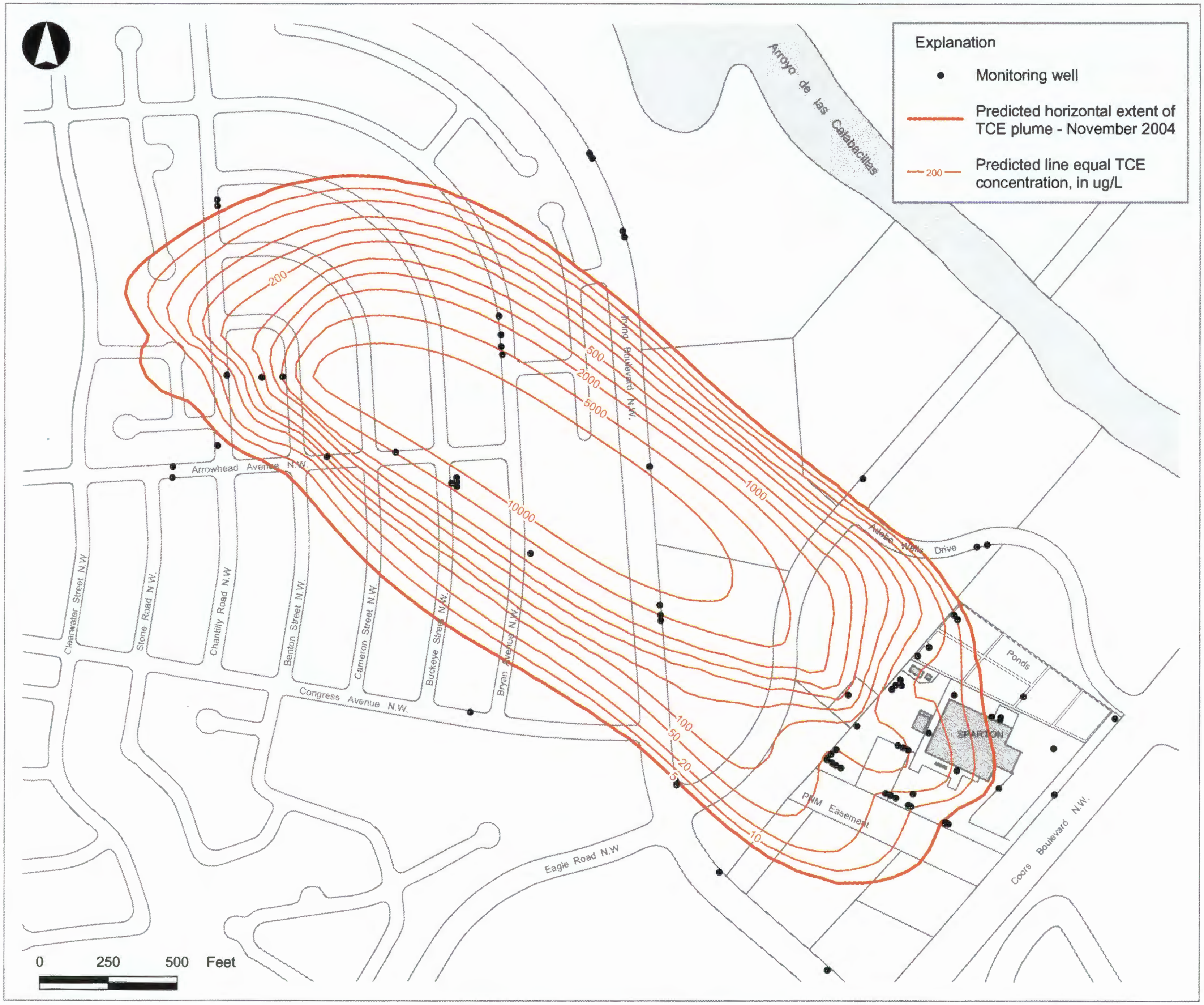

Figure 6.10 Predicted Extent of TCE Plume - November 2004

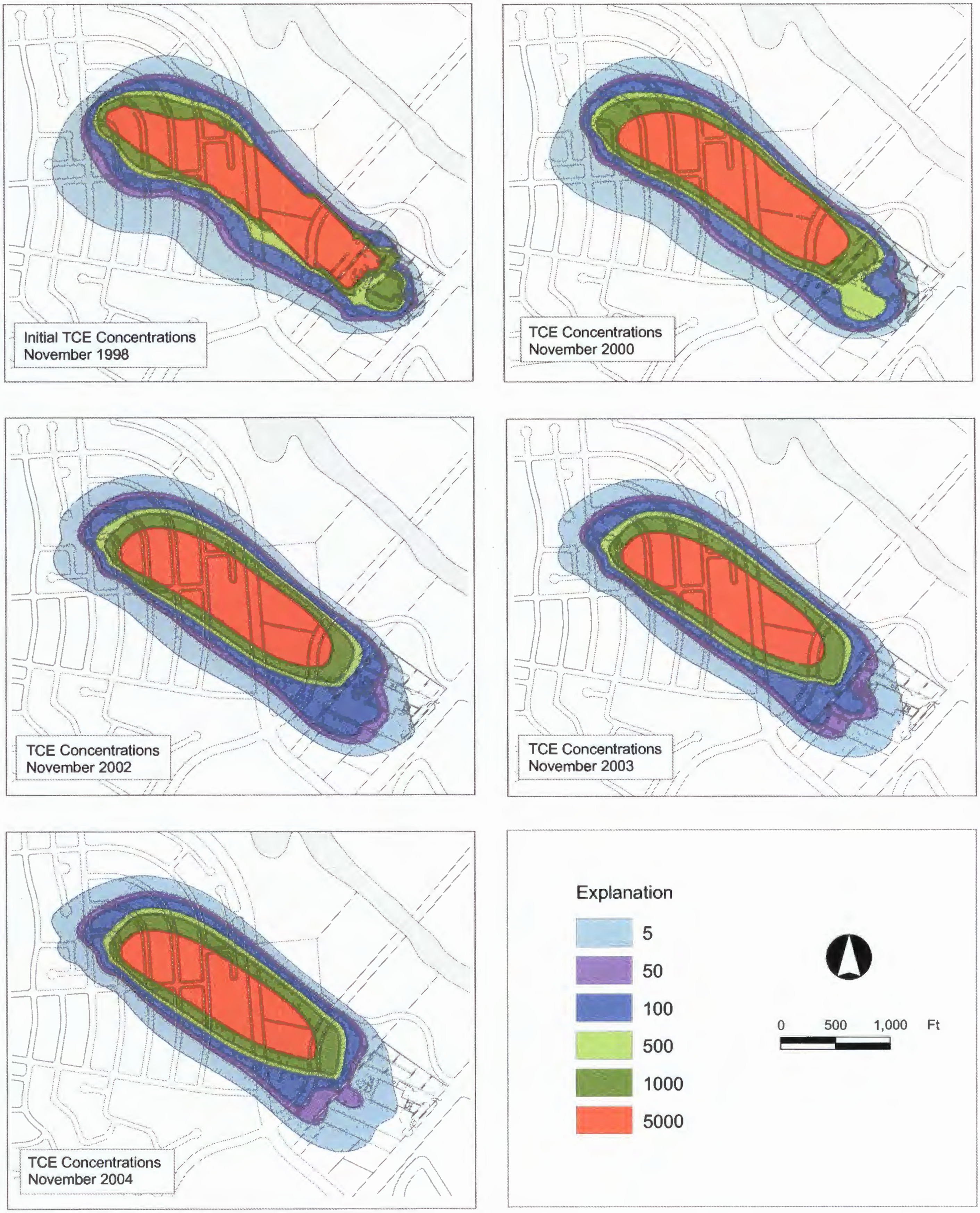

Figure 6.11 TCE Concentrations Calculated with the Recalibrated Model

TABLES

Table 2.1

Completion Flow Zone, Location Coordinates, and Measuring Point Elevation of Wells

Well ID	Flow Zone[a]	Easting[b]	Northing[b]	Elevation[c]
CW-1	UFZ&LFZ	374740.43	1525601.48	5168.02
CW-2	UFZ-LLFZ	376788.70	1524459.40	5045.61
OB-1	UFZ&LFZ	374665.16	1525599.52	5169.10
OB-2	UFZ&LFZ	374537.98	1525606.65	5165.22
PW-1	UFZ	377014.89	1524058.48	5042.30
PZ-1	UFZ	372283.60	1523143.31	5141.79
MW-7	UFZ	377535.41	1524101.14	5043.48
MW-9	UFZ	377005.75	1524062.25	5042.46
MW-12	UFZ	377023.27	1524102.56	5042.41
MW-13	UFZ	377137.23	1523998.34	5041.98
MW-14R	UFZ/ULFZ	376727.10	1524246.40	5040.92
MW-15	UFZ	376976.13	1524514.13	5047.63
MW-16	UFZ	377340.57	1524378.38	5047.50
MW-17	UFZ	377423.18	1524452.68	5049.28
MW-18	UFZ	377005.22	1524260.58	5043.38
MW-19	ULFZ	376986.52	1524269.27	5043.30
MW-20	LLFZ	376967.98	1524277.98	5043.20
MW-21	UFZ	377171.22	1524458.71	5045.78
MW-22	UFZ	377531.77	1524267.24	5044.73
MW-23	UFZ	377333.63	1524123.03	5045.74
MW-24	UFZ	377338.05	1524367.39	5048.70
MW-25	UFZ	377307.91	1524380.40	5046.17
MW-26	UFZ	377180.89	1524187.40	5045.37
MW-27	UFZ	377078.91	1524323.46	5046.04
MW-28	UFZ	376745.76	1524262.70	5041.31
MW-29	ULFZ	377144.48	1523998.74	5041.88
MW-30	ULFZ	376924.12	1524105.15	5042.12
MW-31	ULFZ	376731.49	1524215.04	5041.38
MW-32	LLFZ	376958.37	1524494.18	5045.29
MW-33	UFZ	376940.80	1524097.74	5042.20
MW-34	UFZ	376715.25	1523469.17	5034.49
MW-35	UFZ	376322.45	1523922.39	5042.50
MW-36	UFZ	376161.85	1524154.66	5059.46
MW-37R	UFZ/ULFZ	376104.50	1524782.90	5093.12
MW-38	LLFZ	377150.52	1523995.17	5041.70
MW-39	LLFZ	376961.13	1524088.17	5042.30
MW-40	LLFZ	376745.33	1524207.40	5041.44
MW-41	ULFZ	376945.67	1524479.28	5044.56
MW-42	ULFZ	377183.28	1524730.69	5057.33
MW-43	LLFZ	377169.66	1524747.27	5057.74
MW-44	ULFZ	376166.14	1524136.09	5058.75
MW-45	ULFZ	376108.80	1524726.75	5090.11
MW-46	ULFZ	376067.09	1525279.84	5118.98
MW-47	UFZ	375638.14	1524967.74	5121.16
MW-48	UFZ	375369.75	1525239.86	5143.44
MW-49	3rd FZ	376763.40	1524197.32	5041.44
MW-50	UFZ	372810.17	1527180.09	5211.51
MW-51	UFZ	377291.45	1525000.02	5060.31
MW-52R	UFZ/ULFZ	374504.50	1525353.60	5156.37
MW-53	UFZ	374899.50	1525314.41	5148.62
MW-54	UFZ	375974.55	1526106.27	5097.64
MW-55	LLFZ	375370.70	1525224.15	5143.45
MW-56	ULFZ	375371.31	1525207.68	5141.45
MW-57	UFZ	375849.02	1526406.98	5103.54
MW-58	UFZ	375148.43	1525330.73	5146.40
MW-59	ULFZ	377253.38	1524991.51	5060.61
MW-60	ULFZ	375530.19	1525753.61	5134.68[d]
MW-61	UFZ	375523.16	1525821.65	5135.23
MW-62	UFZ	375421.24	1524395.94	5073.69
MW-63	UFZ	376840.50	1525236.52	5063.10
MW-64	ULFZ	375968.81	1526127.81	5097.84
MW-65	LLFZ	374343.87	1525277.92	5156.45
MW-66	LLFZ	375859.24	1526389.09	5103.03
MW-67	DFZ	375352.47	1525220.38	5142.21
MW-68	UFZ	374503.81	1526216.71	5168.54
MW-69	LLFZ	374502.80	1526239.55	5167.79
MW-70	3rd FZ	376981.33	1524492.75	5046.74[e]
MW-71R	DFZ	375534.49	1525681.93	5134.12[f]
MW-72	ULFZ	377079.68	1524630.73	5056.25
MW-73	ULFZ	376821.45	1524346.08	5051.08
MW-74	UFZ/ULFZ	374484.30	1527810.76	5094.80
MW-75	UFZ/ULFZ	374613.33	1528009.97	5113.74
MW-76	UFZ/ULFZ	375150.41	1527826.10	5108.32
MW-77	UFZ/ULFZ	377754.90	1524374.20	5045.64
MW-78	UFZ/ULFZ	377038.50	1524599.30	5052.91
PZG-1	Infilt. Gall.	374871.44	1527608.15	5090.90
Canal				4996.07

Notes:

[a] UFZ denotes the Upper Flow Zone; ULFZ, LLFZ and 3rdFZ denote the upper, lower and deeper intervals of the Lower Flow Zone (LFZ); DFZ denotes a deeper flow zone seperated from the Lower Flow Zone by a continuous clay layer that casues significant head differences between LFZ and DFZ.

[b] New Mexico "Modified State Plane" coordinates, in feet

[c] In feet above mean sea level (MSL)

[d] Elevation effective November 1, 2003. Changed on quarterly basis

[e] Elevation effective August 1, 2003

[f] Elevation effective August 1, 2003. Also changed between first and second quarters

Table 2.2

Well Screen Data

Well ID	Flow Zone	Elevation, in ft above MSL			Depth below Ground, in ft		Screen Length, in ft
		Ground Surface	Top of Screen	Bottom of Screen	Top of Screen	Bottom of Screen	
CW-1	UFZ&LFZ	5166.4	4957.5	4797.5	208.9	368.9	160.0
CW-2	UFZ-LLFZ	5048.5	4968.5	4918.5	80.0	130.0	50.0
OB-1	UFZ&LFZ	5166.2	4960.3	4789.8	205.9	376.4	170.5
OB-2	UFZ&LFZ	5164.8	4960.3	4789.7	204.5	375.1	170.6
PW-1	UFZ	5042.2	4982.9	4972.9	59.3	69.3	10.0
PZ-1	UFZ	5141.3	4961.5	4951.3	179.8	190.0	10.2
MW-7	UFZ	5043.0	4979.7	4974.7	63.3	68.3	5.0
MW-9	UFZ	5042.4	4975.8	4970.8	66.6	71.6	5.0
MW-12	UFZ	5042.3	4978.2	4966.2	64.1	76.1	12.0
MW-13	UFZ	5041.9	4981.5	4971.6	60.4	70.3	9.9
MW-14R	UFZ/ULFZ	5040.8	4980.5	4950.5	60.3	90.3	30.0
MW-15	UFZ	5047.2	4986.1	4974.4	61.1	72.8	11.7
MW-16	UFZ	5046.2	4979.7	4974.7	66.5	71.5	5.0
MW-17	UFZ	5047.5	4982.3	4977.3	65.2	70.2	5.0
MW-18	UFZ	5042.9	4976.0	4966.0	66.9	76.9	10.0
MW-19	ULFZ	5042.9	4944.8	4934.8	98.1	108.1	10.0
MW-20	LLFZ	5042.8	4919.2	4906.8	123.6	136.0	12.4
MW-21	UFZ	5045.7	4982.8	4977.8	62.9	67.9	5.0
MW-22	UFZ	5044.6	4977.2	4972.2	67.4	72.4	5.0
MW-23	UFZ	5045.6	4973.8	4968.8	71.8	76.8	5.0
MW-24	UFZ	5046.2	4977.5	4972.5	68.7	73.7	5.0
MW-25	UFZ	5046.1	4977.9	4972.9	68.2	73.2	5.0
MW-26	UFZ	5045.4	4969.1	4964.1	76.3	81.3	5.0
MW-27	UFZ	5045.8	4975.4	4970.4	70.4	75.4	5.0
MW-28	UFZ	5040.9	4975.8	4970.8	65.1	70.1	5.0
MW-29	ULFZ	5041.9	4938.3	4928.3	103.6	113.6	10.0
MW-30	ULFZ	5041.7	4944.8	4934.8	96.9	106.9	10.0
MW-31	ULFZ	5040.9	4945.2	4935.2	95.7	105.7	10.0
MW-32	LLFZ	5044.8	4937.3	4927.3	107.5	117.5	10.0
MW-33	UFZ	5042.1	4980.1	4969.1	62.0	73.0	11.0
MW-34	UFZ	5034.4	4978.0	4968.0	56.4	66.4	10.0
MW-35	UFZ	5042.1	4979.3	4969.3	62.8	72.8	10.0
MW-36	UFZ	5059.5	4976.9	4966.9	82.6	92.6	10.0
MW-37R	UFZ/ULFZ	5093.0	4976.6	4946.6	116.4	146.4	30.0
MW-38	LLFZ	5041.6	4915.0	4905.0	126.6	136.6	10.0
MW-39	LLFZ	5042.2	4918.7	4908.7	123.5	133.5	10.0
MW-40	LLFZ	5040.0	4923.9	4913.9	116.1	126.1	10.0

Table 2.2

Well Screen Data

Well ID	Flow Zone	Elevation, in ft above MSL			Depth below Ground, in ft		Screen Length, in ft
		Ground Surface	Top of Screen	Bottom of Screen	Top of Screen	Bottom of Screen	
MW-41	ULFZ	5044.1	4952.1	4942.1	92.0	102.0	10.0
MW-42	ULFZ	5054.8	4949.3	4939.3	105.5	115.5	10.0
MW-43	LLFZ	5055.2	4927.7	4917.7	127.5	137.5	10.0
MW-44	ULFZ	5058.8	4952.4	4942.4	106.4	116.4	10.0
MW-45	ULFZ	5090.1	4948.5	4938.5	141.6	151.6	10.0
MW-46	ULFZ	5118.5	4949.4	4939.4	169.1	179.1	10.0
MW-47	UFZ	5120.7	4976.4	4961.4	144.3	159.3	15.0
MW-48	UFZ	5143.0	4976.9	4961.9	166.1	181.1	15.0
MW-49	3rd FZ	5041.0	4903.2	4893.2	137.8	147.8	10.0
MW-50	UFZ	5211.5	4976.5	4961.5	235.0	250.0	15.0
MW-51	UFZ	5059.9	4984.5	4974.5	75.4	85.4	10.0
MW-52R	UFZ/ULFZ	5156.2	4968.5	4938.5	187.7	217.7	15.2
MW-53	UFZ	5148.6	4974.4	4960.4	174.2	188.2	14.0
MW-54	UFZ	5097.2	4976.8	4961.8	120.4	135.4	15.0
MW-55	LLFZ	5143.1	4913.1	4903.1	230.0	240.0	10.0
MW-56	ULFZ	5141.0	4942.9	4932.9	198.1	208.1	10.0
MW-57	UFZ	5103.1	4978.0	4963.0	125.1	140.1	15.0
MW-58	UFZ	5146.4	4975.4	4960.4	171.0	186.0	15.0
MW-59	ULFZ	5060.2	4954.9	4944.4	105.3	115.8	10.5
MW-60	ULFZ	5134.4	4949.5	4939.5	184.9	194.9	10.0
MW-61	UFZ	5134.8	4976.2	4961.2	158.6	173.6	15.0
MW-62	UFZ	5073.7	4980.8	4965.8	92.9	107.9	15.0
MW-63	UFZ	5063.1	4983.1	4968.1	80.0	95.0	15.0
MW-64	ULFZ	5097.4	4959.3	4949.1	138.1	148.3	10.2
MW-65	LLFZ	5156.5	4896.4	4886.4	260.1	270.1	10.0
MW-66	LLFZ	5102.6	4903.3	4893.3	199.3	209.3	10.0
MW-67	DFZ	5142.2	4798.1	4788.1	344.1	354.1	10.0
MW-68	UFZ	5168.5	4970.5	4950.5	198.0	218.0	20.0
MW-69	LLFZ	5167.8	4904.7	4894.7	263.1	273.1	10.0
MW-70	3rd FZ	5046.3	4912.1	4902.1	134.2	144.2	10.0
MW-71R	DFZ	5134.2	4761.5	4756.5	372.7	377.7	5.0
MW-72	ULFZ	5053.7	4955.0	4945.0	98.7	108.7	10.0
MW-73	ULFZ	5050.6	4945.5	4940.5	105.1	110.1	5.0
MW-74	UFZ/ULFZ	5092.4	4969.2	4939.2	123.2	153.2	30.0
MW-75	UFZ/ULFZ	5111.6	4971.2	4941.2	140.4	170.4	30.0
MW-76	UFZ/ULFZ	5105.5	4972.4	4942.4	133.1	163.1	30.0
MW-77	UFZ/ULFZ	5045.5	4985.9	4955.9	59.6	89.6	30.0
MW-78	UFZ/ULFZ	5050.5	4988.1	4958.1	62.4	92.4	30.0

Table 2.3

Production History of the Former On-Site Groundwater Recovery System

Year	Volume of Recovered Water, in gal	Average Discharge Rate, in gpm
1988[a]	25,689	1.05
1989	737,142	1.40
1990	659,469	1.25
1991	556,300	1.06
1992	440,424	0.84
1993	379,519	0.72
1994	370,954	0.71
1995	399,716	0.76
1996	306,688	0.58
1997	170,900	0.33
1998	232,347	0.44
1999[b]	137,403	0.26
Total Recovered Volume, in gal	**4,416,550**	
Average Discharge Rate, in gpm		**0.77**

Notes:

[a] System began operating on December 15, 1988.

[b] System was terminated on November 16, 1999.

Table 2.4

Water-Level Elevations - Fourth Quarter 1998[a]

Well ID	Flow Zone	Elevation, in ft above MSL	Well	Flow Zone	Elevation, in ft above MSL
PW-1	UFZ	4973.59	MW-40	LLFZ	4971.25
PZ-1	UFZ	4956.59	MW-41	ULFZ	4971.09
MW-7	UFZ O/S *	4977.42	MW-42	ULFZ	4970.65
MW-9	UFZ O/S	4973.06	MW-43	LLFZ	4970.45
MW-12	UFZ O/S	4972.82	MW-44	ULFZ	4970.11
MW-13	UFZ O/S	4974.35	MW-45	ULFZ	4968.33
MW-14	UFZ	4971.12	MW-46	ULFZ	4966.95
MW-15	UFZ	Dry	MW-47	UFZ	4966.68
MW-16	UFZ O/S	4978.43	MW-48	UFZ	4965.81
MW-17	UFZ O/S	4978.7	MW-49	LLFZ **	4971.03
MW-18	UFZ O/S	4971.87	MW-50	UFZ	Dry
MW-19	ULFZ	4971.85	MW-51	UFZ O/S	4980.09
MW-20	LLFZ	4971.47	MW-52	UFZ	4963.17
MW-21	UFZ O/S	4978.31	MW-53	UFZ	4964.92
MW-22	UFZ O/S	4977.89	MW-54	UFZ	4965.56
MW-23	UFZ O/S	4975.91	MW-55	LLFZ	4965.13
MW-24	UFZ O/S	4978.23	MW-56	ULFZ	4965.76
MW-25	UFZ O/S	4978.31	MW-57	UFZ	4964.87
MW-26	UFZ O/S	4973.44	MW-58	UFZ	4965.43
MW-27	UFZ O/S	4974.05	MW-59	ULFZ	4969.46
MW-28	UFZ O/S	4971.09	MW-60	ULFZ	4965.33
MW-29	ULFZ	4973.68	MW-61	UFZ	4965.37
MW-30	ULFZ	4972.28	MW-62	UFZ	4967.52
MW-31	ULFZ	4971.23	MW-63	UFZ O/S	4970.98
MW-32	ULFZ **	4970.96	MW-64	ULFZ	4965.41
MW-33	UFZ O/S	4972.54	MW-65	LLFZ	4963.05
MW-34	UFZ	4974.51	MW-66	LLFZ	4963.98
MW-35	UFZ	4970.78	MW-67	DFZ	4958.56
MW-36	UFZ	4970.03	MW-68	UFZ	4962.25
MW-37	UFZ	4968.32	MW-69	LLFZ	4962.13
MW-38	LLFZ	4973.7	MW-70	LLFZ ***	4970.18
MW-39	LLFZ	4972.49	MW-71	DFZ	4958.51

Notes: [a] Water levels were measured on November 10, 1998, except for wells PW-1, MW-18, and MW-23 through MW-28 which were measured on November 25, 1998.

* UFZ O/S denotes UFZ wells, mostly on-site, which are screened above or within the 4970-foot silt/clay.

** Previously classified as LLFZ

*** Previously classified as 3rdFZ

Table 2.5

Water-Quality Data - Fourth Quarter 1998[a]

Well ID	Sampling Date	Concentration, in μg/L TCE	DCE	TCA
CW-1	09/01/98	140	2.9	<20
OB-1	09/01/98	180	3.6	<20
OB-2	09/01/98	72	1.7	<20
PW-1	12/04/98	48	1.0	2.2
MW-7	12/01/98	63	15	12
MW-9	12/03/98	290	19	18
MW-12	12/07/98	380	26	18
MW-13	12/01/98	70	3.2	8.0
MW-14	12/01/98	430	24	4.2
MW-16	12/08/98	1200	30	170
MW-17	12/01/98	68	3.5	13
MW-18	12/02/98	600	50	42
MW-19	11/23/98	4.2	<1.0	<1.0
MW-20	11/23/98	<1.0	<1.0	<1.0
MW-21	12/02/98	7.5	<1.0	1.1
MW-22	11/19/98	13	2.0	4.6
MW-23	12/03/98	6200	400	720
MW-24	12/08/98	4700	74	480
MW-25	12/08/98	5600	73	540
MW-26	12/03/98	6500	590	550
MW-27	12/02/98	380	24	90
MW-29	11/19/98	<1.0	<1.0	<1.0
MW-30	11/23/98	5.4	<1.0	<1.0
MW-31	11/23/98	<1.0	<1.0	<1.0
MW-32	11/30/98	550	96	30
MW-33	12/02/98	630	53	28
MW-34	11/18/98	<1.0	<1.0	<1.0
MW-35	12/08/98	<1.0	<1.0	<1.0
MW-36	12/07/98	1.4	<1.0	<1.0
MW-37	12/03/98	990	48	<5
MW-38	11/19/98	<1.0	<1.0	<1.0
MW-39	11/23/98	<1.0	<1.0	<1.0
MW-40	11/30/98	<1.0	<1.0	<1.0
MW-41	11/19/98	170	26	<15
MW-42	11/19/98	370	48	21
MW-43	11/19/98	25	5.1	5.4
MW-44	11/18/98	1.3	<1.0	<1.0
MW-45	11/18/98	40	1.7	<1.0
MW-46	11/19/98	2200	130	2.3
MW-47	11/17/98	34	1.2	<1.0
MW-48	11/17/98	28	1.0	<1.0
MW-49	11/23/98	<1.0	<1.0	<1.0
MW-51	11/18/98	<1.0	<1.0	<1.0
MW-52	11/30/98	<1.0	<1.0	<1.0
MW-53	11/16/98	99	3.4	<1.0
MW-55	11/16/98	390	10	<1.0
MW-56	11/16/98	140	4.7	<1.0
MW-57	12/08/98	<1.0	<1.0	<1.0
MW-58	11/16/98	71	2.5	<1.0
MW-59	11/18/98	<1.0	<1.0	<1.0
MW-60	11/17/98	7700	350	52
MW-61	12/07/98	1000	54	11
MW-62	12/07/98	2.0	6.6	4.8
MW-63	12/02/98	<1.0	<1.0	<1.0
MW-64	11/17/98	<1.0	<1.0	<1.0
MW-65	11/16/98	13	<1.0	<1.0
MW-66	11/17/98	<1.0	<1.0	<1.0
MW-67	11/17/98	<1.0	<1.0	<1.0
MW-68	11/12/98	<1.0	<1.0	<1.0
MW-69	11/12/98	<1.0	<1.0	<1.0
MW-70	11/23/98	<1.0	<1.0	<1.0
MW-71	11/17/98	56	1.6	<1.0
TW-1	02/18/98	3100	280	180
TW-1 Dup.		3400	270	170
TW-2	02/19/98	18	<1.0	<1.0
TW-2 Dup.		16	<1.0	<1.0

Notes: [a] Includes 2/18/98 data from temporary well TW-1/2 which was drilled at the current location of well MW-73, and 9/1/98 data from the containment well CW-1.

Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 μg/L for TCE and DCE, and 60 μg/L for TCA).

Table 4.1

Quarterly Water-Level Elevations - 2003

Well ID	Flow Zone	Elevation, in feet above MSL			
		Feb. 18	May 8	Aug. 12	Nov. 3
CW-1	UFZ&LFZ	4936.87	4937.01	4936.73	4936.37
CW-2	UFZ&LFZ	4957.40	4957.74	4957.59	4957.26
OB-1	UFZ&LFZ	4956.55	4956.71	4956.36	4956.22
OB-2	UFZ&LFZ	4957.75	4957.86	4957.60	4957.63
PW-1	DRY	DRY	DRY	DRY	DRY
PZ-1	UFZ	4954.66	4954.97	4954.14	4954.08
MW-7	UFZ O/S	4975.78	4976.27	4976.59	4976.05
MW-9	UFZ O/S	4970.58[1]	4971.04	4971.12	4970.58[1]
MW-12	UFZ O/S	4970.01	4970.53	4970.56	4970.04
MW-13	UFZ O/S	4972.07	4972.70	4972.82	4972.13
MW-14R	UFZ/ULFZ	4967.91	4968.26	4968.18	4967.75
MW-16	UFZ O/S	4982.22	4982.38	4982.35	4982.12
MW-17	UFZ O/S	4981.93	4982.07	4982.17	4981.93
MW-18	UFZ O/S	4974.62	4975.33	4975.54	4975.25
MW-19	ULFZ	4968.92	4969.40	4969.27	4968.91
MW-20	LLFZ	4968.42	4968.83	4968.75	4968.36
MW-21	UFZ O/S	4983.51	4983.58	4983.40	4983.07
MW-22	UFZ O/S	4977.52	4977.99	4978.17	4977.70
MW-23	UFZ O/S	4974.37	4975.01	4975.15	4974.50
MW-24	UFZ O/S	4982.00	4982.18	4982.20	4981.96
MW-25	UFZ O/S	4982.24	4982.36	4982.36	4982.14
MW-26	UFZ O/S	4971.61	4972.12	4972.07	4971.57
MW-27	UFZ O/S	4981.21	4981.45	4981.37	4981.18
MW-29	ULFZ	4971.09	4971.71	4971.73	4971.10
MW-30	ULFZ	4969.41	4969.88	4969.84	4969.31
MW-31	ULFZ	4968.01	4968.37	4968.31	4968.06
MW-32	ULFZ	4968.03	4968.16	4968.07	4967.77
MW-33	UFZ O/S	4969.70	4970.17	4970.19	4969.68
MW-34	UFZ	4971.65	4972.37	4972.65	4971.84
MW-36	UFZ	DRY	4967.43	4967.35	4967.21
MW-37R	UFZ/ULFZ	4965.07	4965.25	4965.03	4964.99
MW-38	LLFZ	4971.07	4971.69	4971.77	4971.13
MW-39	LLFZ	4969.70	4970.23	4970.25	4969.64
MW-40	LLFZ	4968.08	4968.51	4968.37	4968.06
MW-41	ULFZ	4968.36	4968.54	4968.51	4968.24
MW-42	ULFZ	4968.44	4968.72	4968.46	4968.29
MW-43	LLFZ	4968.21	4968.53	4968.28	4968.04

Well ID	Flow Zone	Elevation, in feet above MSL			
		Feb. 18	May 8	Aug. 12	Nov. 3
MW-44	ULFZ	4967.30	4967.60	4967.43	4967.31
MW-45	ULFZ	4966.03	4966.27	4966.04	4965.96
MW-46	ULFZ	4964.45	4964.66	4964.42	4964.28
MW-47	UFZ	4963.94	4964.16	4963.98	4963.85
MW-48	UFZ	4963.00	4963.11	4962.95	4962.83
MW-49	LLFZ	4968.11	4968.54	4968.45	4968.11
MW-51	UFZ O/S	4981.73	4981.90	4981.86	4982.07
MW-52R	UFZ/ULFZ	NI	NI	4959.12	4958.97
MW-53	UFZ	4961.23	4961.41	4961.35	4961.19
MW-54	UFZ	4963.65	4963.87	4963.56	4963.39
MW-55	LLFZ	4961.85	4962.07	4961.89	4961.64
MW-56	ULFZ	4963.00	4963.06	4962.97	4962.93
MW-57	UFZ	4963.48	4963.72	4963.40	4963.25
MW-58	UFZ	4962.29	4962.47	4962.30	4962.15
MW-59	ULFZ	4967.44	4967.67	4967.04	4967.29
MW-60	ULFZ	4962.92	4963.05	4962.91	4962.68
MW-61	UFZ	4962.84	4963.13	4962.82	4962.69
MW-62	UFZ	4964.83	4964.97	4964.82	4964.75
MW-63	UFZ O/S	4970.04	4970.17	4972.15	4974.77
MW-64	ULFZ	4963.69	4963.84	4963.52	4963.51
MW-65	LLFZ	4959.27	4959.41	4959.10	4959.01
MW-66	LLFZ	4962.15	4962.27	4961.82	4961.81
MW-67	DFZ	4956.47	4956.55	4955.57	4955.60
MW-68	UFZ	4959.54	4959.69	4959.43	4958.97
MW-69	LLFZ	4959.41	4959.58	4959.25	4959.12
MW-70	LLFZ	4967.68	4967.63	4967.50	4967.18
MW-71R	DFZ	4956.49	4956.64	4955.65	4955.71
MW-72	ULFZ	4968.46	4968.83	4968.60	4968.30
MW-73	ULFZ	4967.30	4967.69	4967.57	4967.24
MW-74	UFZ/ULFZ	4961.95	4962.17	4961.71	4961.60
MW-75	UFZ/ULFZ	4965.73	4966.10	4965.63	4965.65
MW-76	UFZ/ULFZ	4967.20	4967.62	4967.06	4967.01
MW-77	UFZ/ULFZ	4976.80	4977.31	4977.40	4976.84
MW-78	UFZ/ULFZ	4974.78	4975.17	4975.06	4974.90
PZG-1	Infilt. Gall.	DRY	DRY	DRY	DRY
Canal[a]		DRY	DRY	DRY	DRY

Notes: Wells MW-15, 28, 35, and 50 were dry all year

[1] Measurement is not representative, water level below bottom of screen.

[a] Measured near the SE corner of Sparton property.

NI: Well not yet installed

Table 4.2

Water-Quality Data - Fourth Quarter 2003

Well ID	Sampling Date	Concentration, in µg/L		
		TCE	DCE	TCA
MW-7	11/20/03	9.6	1.1	1.1
MW-9	11/20/03	39	1.5	1.1
MW-12	11/19/03	210	16	4.5
MW-13	11/20/03	NA	NA	NA
MW-14R	11/14/03	30	1.3	<1.0
MW-16	11/19/03	5.0	<1.0	<1.0
MW-17	11/20/03	1.1	<1.0	<1.0
MW-18	11/19/03	2.4	<1.0	<1.0
MW-19	11/21/03	630	67	12
MW-20	11/21/03	1.9	<1.0	<1.0
MW-21	11/19/03	<1.0	<1.0	<1.0
MW-22	11/18/03	<1.0	<1.0	<1.0
MW-23*	11/20/03	850	86	30
MW-25	11/19/03	42	3.1	<1.0
MW-26	11/19/03	61	2.7	<1.0
MW-29	11/18/03	1.2	<1.0	<1.0
MW-30	11/18/03	2.2	<1.0	<1.0
MW-31	11/14/03	<1.0	<1.0	<1.0
MW-32	11/14/03	140	21	2.6
MW-33	11/20/03	NA	NA	NA
MW-34	11/20/03	<1.0	<1.0	<1.0
MW-35	11/20/03	NA	NA	NA
MW-36	11/20/03	NA	NA	NA
MW-37R	11/12/03	180	7.4	<1.0
MW-38	11/14/03	<1.0	<1.0	<1.0
MW-39	11/18/03	<1.0	<1.0	<1.0
MW-40	11/14/03	<1.0	<1.0	<1.0
MW-41	11/14/03	8.2	<1.0	<1.0
MW-42	11/21/03	200	34	4.8
MW-43	11/21/03	3.2	<1.0	<1.0
MW-44	11/12/03	<1.0	<1.0	<1.0
MW-45	11/12/03	<1.0	<1.0	<1.0

Well ID	Sampling Date	Concentration, in µg/L		
		TCE	DCE	TCA
MW-46	11/11/03	2300	350	38
MW-47	11/20/03	32	1.2	<1.0
MW-48	11/11/03	62	2.1	<1.0
MW-49	11/14/03	<1.0	<1.0	<1.0
MW-51	11/12/03	<1.0	<1.0	<1.0
MW-52R	11/07/03	6.2	10	1.2
MW-53	11/11/03	13	<1.0	<1.0
MW-55	11/11/03	150	5.0	<1.0
MW-56	11/11/03	33	1.2	<1.0
MW-57	11/20/03	NA	NA	NA
MW-58	11/11/03	54	<1.0	<1.0
MW-59	11/12/03	<1.0	<1.0	<1.0
MW-60	11/12/03	13000	600	49
MW-61	11/20/03	250	12	1.1
MW-62	11/11/03	2.3	6.7	5.3
MW-64	11/11/03	3.6	<1.0	<1.0
MW-65	11/07/03	14	47	15
MW-66	12/11/03	<1.0	<1.0	<1.0
MW-67	11/12/03	<1.0	<1.0	<1.0
MW-68	11/07/03	<1.0	<1.0	<1.0
MW-69	11/07/03	<1.0	<1.0	<1.0
MW-70*	11/12/03	5.75	<1.0	<1.0
MW-71R	11/18/03	190	5.3	<1.0
MW-72	11/21/03	680	57	5.7
MW-73*	11/14/03	675	60	11
MW-74	11/24/03	<1.0	<1.0	<1.0
MW-75	11/24/03	<1.0	<1.0	<1.0
MW-76	11/24/03	<1.0	<1.0	<1.0
MW-77	11/24/03	26	1.8	<1.0
MW-78	11/24/03	5.0	<1.0	<1.0
CW-1	11/03/03	1200	72	4.6
CW-2	11/03/03	470	62	8.3

Notes: * Results for well are the average of duplicate samples
Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 µg/L for TCE and DCE, and 60 µg/L for TCA).

Table 4.3

Flow Rates - 2003

(a) Containment Well Summary

2003	**Total Volume of Water Pumped from both Wells, in gal.**	145323006
	Total Average Discharge Rate from both Wells, in gpm	277

(b) Off-Site Containment Well

Month	**Volume of Pumped Water, in gal.**		**Average Discharge Rate, in gpm**	
	Monthly	**Annual**	**Monthly**	**Annual**
Jan.	9850654		221	
Feb.	9130130		226	
Mar.	10103932		226	
Apr.	9772080		226	
May	10121243		227	
June	9786642		227	
July	10099273		226	
Aug.	10003437		224	
Sep.	9576168		222	
Oct.	10102417		226	
Nov.	9794312		227	
Dec.	9689749	**118030036**	224	**225**

(c) Source Containment Well

Month	**Volume of Pumped Water, in gal.**		**Average Discharge Rate, in gpm**	
	Monthly	**Annual**	**Monthly**	**Annual**
Jan.	2274639		53	
Feb.	2135673		53	
Mar.	2007180		53	
Apr.	2274619		53	
May	2376664		53	
June	2299311		53	
July	2364090		53	
Aug.	2315023		52	
Sep.	2281666		53	
Oct.	2360746		53	
Nov.	2283694		53	
Dec.	2319666	**27292970**	52	**52**

Table 4.4

Influent and Effluent Quality - 2003[a]

(a) Off-Site Containment System

Sampling Date	Concentration, in µg/L							
	Influent				Effluent			
	TCE	DCE	TCA	Cr Total	TCE	DCE	TCA	Cr Total
01/02/03	1300	63	<5.0	23	<1.0	<1.0	<1.0	24
2/3/2003	1200	60	4.4	26	<1.0	<1.0	<1.0	24
03/04/03	1200	76	4.9	25	<1.0	<1.0	<1.0	26
04/01/03	1300	75	4.8	26	<1.0	<1.0	<1.0	27
05/02/03	1300	63	4.6	27	<1.0	<1.0	<1.0	25
06/02/03	1300	73	4.9	15	<1.0	<1.0	<1.0	15
07/01/03	1200	59	4.3	24	<1.0	<1.0	<1.0	22
08/01/03	1300	71	4.5	24	<1.0	<1.0	<1.0	23
09/02/03	1300	75	4.9	31	<1.0	<1.0	<1.0	30
10/01/03	1200	70	4.4	26	<1.0	<1.0	<1.0	26
11/03/03	1200	72	4.6	24	<1.0	<1.0	<1.0	23
12/03/03	1500	88	5.6	30	<1.0	<1.0	<1.0	28
01/06/04	1200	72	4.6	23	<1.0	<1.0	<1.0	23

(b) Source Containment System

Sampling Date	Concentration, in µg/L							
	Influent				Effluent			
	TCE	DCE	TCA	Cr Total	TCE	DCE	TCA	Cr Total
01/02/03	450	66	11	36	<1.0	<1.0	<1.0	31
2/3/2003	410	58	9.8	35	<1.0	<1.0	<1.0	39
03/04/03	430	65	11	31	<1.0	<1.0	<1.0	33
04/01/03	460	58	11	34	<1.0	<1.0	<1.0	34
05/02/03	480	62	9.8	32	<1.0	<1.0	<1.0	33
06/02/03	490	73	11	27	<1.0	<1.0	<1.0	23
07/01/03	480	57	9	28	<1.0	<1.0	<1.0	30
08/01/03	520	65	10	30	<1.0	<1.0	<1.0	31
09/02/03	560	76	10	24	<1.0	<1.0	<1.0	23
10/01/03	500	68	8.8	31	<1.0	<1.0	<1.0	32
11/03/03	470	62	8.3	29	<1.0	<1.0	<1.0	29
12/03/03	430	56	7.5	32	<1.0	<1.0	<1.0	31
01/06/04	380	50	6.8	29	<1.0	<1.0	<1.0	28

Notes: [a] Data from 01/06/04 has been included to show conditions at the end of the year.
Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 ug/L for TCE and DCE, 60 ug/L for TCA and 50 ug/L for total chromium).

Table 5.1

Contaminant Mass Removal - 2003

(a) Containment Well Summary

		in kg	in lbs
2003	Total Mass of Removed TCE	616.6	1359.3
	Total Mass of Removed DCE	38.2	84.1
	Total Mass of Removed TCA	3.1	6.7
	Total Mass Removed	657.8	1450.1

(b) Off-Site Containment Well

Month	Mass of Removed TCE		Mass of Removed DCE		Mass of Removed TCA		Total Mass Removed	
	in kg	in lbs	in kg	in lbs	in kg	in lbs	in kg	in lbs
Jan.	46.6	102.8	2.3	5.1	0.1	0.3	49.0	108.1
Feb.	41.5	91.4	2.4	5.2	0.2	0.4	44.0	97.0
Mar.	47.8	105.4	2.9	6.4	0.2	0.4	50.9	112.2
Apr.	48.1	106.0	2.6	5.6	0.2	0.4	50.8	112.0
May	49.8	109.8	2.6	5.7	0.2	0.4	52.6	116.0
June	46.3	102.1	2.4	5.4	0.2	0.4	48.9	107.9
July	47.8	105.4	2.5	5.5	0.2	0.4	50.4	111.2
Aug.	49.2	108.5	2.8	6.1	0.2	0.4	52.2	115.0
Sep.	45.3	99.9	2.6	5.8	0.2	0.4	48.1	106.1
Oct.	45.9	101.2	2.7	6.0	0.2	0.4	48.8	107.5
Nov.	50.1	110.3	3.0	6.5	0.2	0.4	53.2	117.3
Dec.	49.5	109.2	2.9	6.5	0.2	0.4	52.6	116.0
Total	**567.9**	**1252.0**	**31.6**	**69.7**	**2.1**	**4.6**	**601.6**	**1326.2**

(c) Source Containment Well

Month	Mass of Removed TCE		Mass of Removed DCE		Mass of Removed TCA		Total Mass Removed	
	in kg	in lbs	in kg	in lbs	in kg	in lbs	in kg	in lbs
Jan.	3.7	8.2	0.5	1.2	0.1	0.2	4.3	9.5
Feb.	3.4	7.5	0.5	1.1	0.1	0.2	4.0	8.8
Mar.	3.4	7.5	0.5	1.0	0.1	0.2	3.9	8.7
Apr.	4.0	8.9	0.5	1.1	0.1	0.2	4.7	10.3
May	4.4	9.6	0.6	1.3	0.1	0.2	5.1	11.2
June	4.2	9.3	0.6	1.2	0.1	0.2	4.9	10.7
July	4.5	9.9	0.5	1.2	0.1	0.2	5.1	11.3
Aug.	4.7	10.4	0.6	1.4	0.1	0.2	5.4	12.0
Sep.	4.6	10.1	0.6	1.4	0.1	0.2	5.3	11.6
Oct.	4.3	9.6	0.6	1.3	0.1	0.2	5.0	11.0
Nov.	3.9	8.6	0.5	1.1	0.1	0.2	4.5	9.9
Dec.	3.6	7.8	0.5	1.0	0.1	0.1	4.1	9.0
Total	**48.7**	**107.3**	**6.5**	**14.4**	**1.0**	**2.2**	**56.2**	**123.9**

Table 6.1

Initial Mass and Maximum Concentration of TCE in Model Layers

Model Layer	Approximate Mass		Maximum Concentration in µg/L
	in kg	in lbs	
1	0.0	0.0	6,540
2	2.4	5.2	5,298
3	15.4	33.9	1,361
4	536.1	1181.9	12,000
5	2081.5	4589.0	28,666
6	2019.6	4452.5	28,666
7	1961.4	4324.2	28,666
8	364.1	802.7	4,033
9	178.7	394.1	1,987
10	137.8	303.7	1,005
11	45.3	100.0	411
Total	**7,342**	**16,187**	-

Appendix A

2003 Groundwater Quality Data

A-1: Groundwater Monitoring Program Wells

A-2: Infiltration Gallery and Pond Monitoring Wells

A-1: Groundwater Monitoring Program Wells

Appendix A-1

Groundwater Monitoring Program Wells
2003 Analytical Results*

Well ID	Sample Date	TCE ug/L	1,1-DCE ug/L	1,1,1-TCA ug/L	Cr Total, mg/L		Other
					Unfiltered	Filtered	
MW-7	11/20/03	9.6	1.1	1.1	0.0080	0.0023	
MW-9	11/20/03	39	1.5	1.1	0.0028	0.0013	
MW-12	11/19/03	210	16	4.5	0.011	0.0092	1,1-DCA:1.0
MW-13	11/20/03	NA	NA	NA	NA	NA	
MW-14R	11/14/03	30	1.3	<1.0	0.350	NA	
MW-16	11/19/03	5.0	<1.0	<1.0	0.710	0.510	MethChl:1.0
MW-17	11/20/03	1.1	<1.0	<1.0	0.035	0.029	
MW-18	11/19/03	2.4	<1.0	<1.0	0.030	0.030	
MW-19	11/21/03	630	67	12	0.0051	NA	1,1,1-TCA:12; PCE:2.2; 1,1-DCA:1.6
MW-20	11/21/03	1.9	<1.0	<1.0	<0.0010	NA	
MW-21	11/19/03	<1.0	<1.0	<1.0	0.110	0.029	
MW-22	11/18/03	<1.0	<1.0	<1.0	<0.0010	0.037	
MW-23	11/20/03	840	82	28	2.4	0.049	1,1-DCA:1.4; Chlor:1.2; 1,1,2-TCA:1.7: PCE:7.1
	11/20/03	860	90	32	2.8	0.047	1,1-DCA:1.5; Chlor:1.3; 1,1,2-TCA:1.8: PCE:7.7
MW-25	01/08/03	NA	NA	NA	0.330	0.270	
	01/08/03	NA	NA	NA	0.320	0.280	
	01/09/03	42	3.1	<1.0	NA	NA	MeCl:1.7; cis-1,2-DCE:1.6
	01/09/03	46	3.6	<1.0	NA	NA	MeCl:2.0; cis-1,2-DCE:2.0
	11/19/03	42	3.1	<1.0	0.077	0.036	MeCl:2.6; cis-1,2-DCE:2.1
MW-26	11/19/03	61	2.7	<1.0	0.600	0.140	
MW-29	11/18/03	1.2	<1.0	<1.0	<0.0010	NA	
MW-30	11/18/03	2.2	<1.0	<1.0	0.038	NA	
MW-31	11/14/03	<1.0	<1.0	<1.0	0.0045	NA	
MW-32	11/14/03	140	21	2.6	<0.0010	NA	PCE:1.5
MW-33	11/20/03	NA	NA	NA	NA	NA	
MW-34	11/20/03	<1.0	<1.0	<1.0	0.790	0.0049	
MW-35	11/20/03	NA	NA	NA	NA	NA	
MW-36	11/20/03	NA	NA	NA	NA	NA	
MW-37R	11/12/03	180	7.4	<1.0	0.04300	NA	

Appendix A-1

Groundwater Monitoring Program Wells
2003 Analytical Results*

Well ID	Sample Date	TCE ug/L	1,1-DCE ug/L	1,1,1-TCA ug/L	Cr Total, mg/L		Other
					Unfiltered	Filtered	
MW-38	11/14/03	<1.0	<1.0	<1.0	0.0059	NA	
MW-39	11/18/03	<1.0	<1.0	<1.0	0.0039	NA	
MW-40	11/14/03	<1.0	<1.0	<1.0	<0.0010	NA	
MW-41	11/14/03	8.2	<1.0	<1.0	0.032	NA	
MW-42	11/21/03	200	34	4.8	0.023	NA	PCE:2.2
MW-43	11/21/03	3.2	<1.0	<1.0	0.0025	NA	
MW-44	11/12/03	<1.0	<1.0	<1.0	<0.0010	NA	
MW-45	11/12/03	<1.0	<1.0	<1.0	0.054	NA	
MW-46	11/11/03	2300	350	38	0.0048	NA	1,1-DCA:8.9; Chlor:7.6; PCE:22
MW-47	11/20/03	32	1.2	<1.0	0.025	0.023	
MW-48	11/11/03	62	2.1	<1.0	0.330	0.044	
MW-49	11/14/03	<1.0	<1.0	<1.0	<0.0010	NA	
MW-51	11/12/03	<1.0	<1.0	<1.0	0.022	NA	
MW-52R	08/14/03	5.7	10	1.1	0.0078	0.0140	
	11/07/03	6.2	10	1.2	0.014	NA	
MW-53	11/11/03	13	<1.0	<1.0	0.032	0.027	
MW-55	11/11/03	150	5.0	<1.0	0.058	NA	
MW-56	11/11/03	33	1.2	<1.0	0.049	NA	
MW-57	02/21/03	<1.0	<1.0	<1.0	0.02	0.006	
	05/14/03	<1.0	<1.0	<1.0	0.0078	0.003	
	08/14/03	<1.0	<1.0	<1.0	0.0032	0.0028	
MW-58	11/11/03	54	<1.0	<1.0	0.540	0.040	
MW-59	11/12/03	<1.0	<1.0	<1.0	0.024	NA	
MW-60	11/12/03	13000	600	49	0.051	NA	cis-1,2-dce:12; 1,1,2-TCTFA:95; Chlor:10; PCE:120
MW-61	11/20/03	250	12	1.1	0.031	0.011	PCE:2.1

Appendix A-1

Groundwater Monitoring Program Wells
2003 Analytical Results*

Well ID	Sample Date	TCE ug/L	1,1-DCE ug/L	1,1,1-TCA ug/L	Cr Total, mg/L		Other
					Unfiltered	Filtered	
MW-62	02/21/03	3.4	9.9	7.6	0.0130	<0.0056	
	05/14/03	2.3	6.9	4.8	0.0140	0.0021	
	05/14/03	2.2	6.5	4.6	0.0110	0.0019	
	08/14/03	2.2	6.4	4.8	0.0011	<0.0011	
	11/11/03	2.3	6.7	5.3	0.0190	0.0041	
MW-64	11/11/03	3.6	<1.0	<1.0	<0.001	NA	
MW-65	02/19/03	10	38	11.0	<0.0050	NA	
	02/19/03	10	37	12.0	<0.0050	NA	
	05/14/03	12	42	11.0	<0.0010	NA	1,2,3-Trimethylbenzene:1.1
	08/13/03	12	43	13.0	<0.0010	NA	
	11/07/03	14	47	15.0	<0.0010	NA	
MW-66	02/21/03	<1.0	<1.0	<1.0	<0.0050	NA	
	05/13/03	<1.0	<1.0	<1.0	<0.0010	NA	
	08/13/03	<1.0	<1.0	<1.0	<0.0010	NA	
	12/11/03	<1.0	<1.0	<1.0	<0.0010	NA	
MW-67	05/13/03	<1.0	<1.0	<1.0	<0.0010	NA	
	11/12/03	<1.0	<1.0	<1.0	<0.0010	NA	
MW-68	02/19/03	<1.0	<1.0	<1.0	<0.0050	NA	
	05/13/03	<1.0	<1.0	<1.0	<0.0010	NA	
	08/13/03	<1.0	<1.0	<1.0	<0.0010	NA	
	11/07/03	<1.0	<1.0	<1.0	<0.0010	NA	
MW-69	02/19/03	<1.0	<1.0	<1.0	<0.0050	NA	
	05/13/03	<1.0	<1.0	<1.0	<0.0010	NA	
	08/13/03	<1.0	<1.0	<1.0	<0.0010	NA	
	11/07/03	<1.0	<1.0	<1.0	<0.0010	NA	
MW-70	11/12/03	5.8	<1.0	<1.0	<0.0010	NA	
	11/12/03	5.7	<1.0	<1.0	<0.0010	NA	

Appendix A-1

Groundwater Monitoring Program Wells
2003 Analytical Results*

Well ID	Sample Date	TCE ug/L	1,1-DCE ug/L	1,1,1-TCA ug/L	Cr Total, mg/L Unfiltered	Cr Total, mg/L Filtered	Other
MW-71R	02/19/03	180	5.9	<1.0	<0.0050	NA	MeCl:1.9
	05/13/03	190	5.4	<1.0	<0.0010	NA	MeCl:1.9
	08/13/03	210	5.8	<1.0	<0.0010	NA	MeCl:2.1
	08/13/03	210	6.2	<1.0	<0.0010	NA	MeCl:2.1
	11/18/03	190	5.3	<1.0	0.015	NA	MeCl:2.4
MW-72	05/14/03	1700	150	23	0.081	NA	Chlor:5.3; PCE:15
	11/21/03	680	57	5.7	0.025	NA	1,1,2-TCTFA:10; Chlor:1.2; PCE:6.4
MW-73	11/14/03	670	61	11	0.120	NA	1,1-DCA:1.3; Chlor:1.7; 1,1,2-TCA:1.6; PCE:3.9
	11/14/03	680	59	11	0.110	NA	1,1-DCA:1.3; Chlor:1.6; 1,1,2-TCA:1.5; PCE:3.7

*VOCs by EPA Method 8260

NA = Not analyzed

Notes: Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 ug/L for TCE and DCE, 60 ug/L for TCA and 50 ug/L for total chromium).

A-2: Infiltration Gallery and Pond Monitoring Wells

Appendix A-2

Infiltration Gallery and Pond Monitoring Wells
2003 Analytical Results*

Well	Sample Date	TCE ug/l	1,1DCE ug/l	1,1,1TCA ug/l	Cr(total) mg/l	Fe(total) mg/l	Mn(total) mg/l	Cr(diss) mg/l	Fe(diss) mg/l	Mn(diss) mg/l
MW-17	02/19/03	1.5	<1.0	<1.0	<0.050	2.2	0.058	0.044	0.027	<0.0056
	05/13/03	1.3	<1.0	<1.0	0.041	3.3	0.092	0.035	0.022	0.0034
	08/14/03	1.1	<1.0	<1.0	0.035	1.8	0.059	0.040	<0.022	0.0064
	11/03/03	1.1	<1.0	<1.0	0.035	NA	NA	NA	NA	NA
MW-74	02/21/03	<1.0	<1.0	<1.0	0.028	0.019	<0.0070			
	05/13/03	<1.0	<1.0	<1.0	0.027	0.036	<0.0070			
	08/13/03	<1.0	<1.0	<1.0	0.017	<0.020	0.0042			
	11/24/03	<1.0	<1.0	<1.0	0.025	0.032	0.0086			
MW-75	02/21/03	<1.0	<1.0	<1.0	0.027	0.015	<0.0070			
	05/13/03	<1.0	<1.0	<1.0	0.026	<0.020	<0.0070			
	08/13/03	<1.0	<1.0	<1.0	0.016	0.033	<0.0030			
	11/24/03	<1.0	<1.0	<1.0	0.024	0.029	<0.0030			
MW-76	02/21/03	<1.0	<1.0	<1.0	0.027	0.0240	<0.0070			
	05/13/03	<1.0	<1.0	<1.0	0.024	0.0200	<0.0070			
	08/13/03	<1.0	<1.0	<1.0	0.015	<0.020	<0.0030			
	11/24/03	<1.0	<1.0	<1.0	0.024	0.0450	0.0037			
MW-77	02/19/03	[illegible]	1.9	<1.0	<0.0050	0.081	8.1	<0.0056	0.030	0.7600
	05/13/03	[illegible]	1.9	<1.0	<0.0010	0.095	7.6	<0.0011	0.036	0.6700
	8/14/03	30	2.0	<1.0	<0.0010	0.140	14	<0.0011	<0.022	0.0700
	11/24/03	[illegible]	1.8	<1.0	<0.0010	0.091	8.9	<0.0010	0.074	0.8800
MW-78	02/19/03	[illegible]	<1.0	<1.0	0.0260	0.0800	0.0079			
	05/13/03	[illegible]	<1.0	<1.0	0.0280	0.3400	0.034			
	08/14/03	[illegible]	<1.0	<1.0	0.0220	0.780	0.080			
	11/24/03	5.0	<1.0	<1.0	0.0290	0.068	0.016			

*VOCs by EPA Method 8260

Notes: Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 ug/L for TCE and DCE, 60 ug/L for TCA and 50 ug/L for total chromium).

Appendix B

2003 Containment Well Flow Rate Data

B-1: Off-Site Containment Well

B-2: Source Containment Well

B-1: Off-Site Containment Well

Appendix B-1

Off-Site Containment Well
2003 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons*
12/28/02	16:37	218	422426300		458108800
				224	
01/02/03	11:51	---	423972700		459655200
01/06/03	10:35	222	423972700		459655200
				223	
01/13/03	15:40	223	427563900		463246400
				223	
01/21/03	8:20	---	430040000		465722500
				224	
01/28/03	8:25	---	432297000		467979500
				220	
02/03/03	11:00	226	434233500		469916000
				220	
02/07/03	12:45	---	435522300		471204800
				226	
02/10/03	15:00	224	436528900		472211400
				227	
02/27/03	12:30	222	442040800		477723300
				227	
03/04/03	12:10	226	443672700		479355200
				224	
03/11/03	15:00	---	445972500		481655000
				228	
03/12/03	10:25	225	446237600		481920100
				227	
03/14/03	14:30	---	446945800		482628300
				227	
03/19/03	13:00	226	448557300		484239800
				227	
03/27/03	12:40	229	451168800		486851300
				226	
04/01/03	10:50	226	452774400		488456900
				227	
04/04/03	15:10	---	453815200		489497700
				223	
04/05/03	14:35	---	454128500		489811000
				222	
04/07/03	12:45	227	454743500		490426000
				227	
04/08/03	15:05	---	455102600		490785100
				227	
04/14/03	11:50	---	457019100		492701600
				225	

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Off-Site Containment Well
2003 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons*
04/21/03	14:00	---	459316000		494998500
				228	
04/24/03	11:45	226	460268800		495951300
				226	
04/28/03	13:01	228	461590000		497272500
				227	
05/01/03	9:50	224	462528000		498210500
				227	
05/08/03	8:15	---	464790400		500472900
				227	
05/13/03	9:00	---	466435200		502117700
				227	
05/16/03	10:45	---	467440600		503123100
				227	
05/20/03	9:50	223	468735000		504417500
				227	
05/23/03	13:50	---	469769300		505451800
				227	
05/30/03	12:45	---	472039700		507722200
				227	
06/02/03	13:00	---	473022500		508705000
				225	
06/05/03	9:30	227	473946500		509629000
				219	
06/08/03	19:45	---	475025700		510708200
				220	
06/10/03	13:05	---	475570400		511252900
				227	
06/13/03	13:00	---	476548100		512230600
				227	
06/20/03	11:30	226	478816200		514498700
				226	
06/24/03	16:38	---	480187000		515869500
				227	
07/01/03	15:15	---	482460400		518142900
				227	
07/03/03	11:50	228	483067300		518749800
				228	
07/11/03	10:15	228	485669300		521351800
				228	
07/15/03	19:10	---	487102900		522785400
				228	
07/22/03	10:55	227	489287900		524970400
				228	

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Off-Site Containment Well
2003 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons*
07/25/03	10:10	---	490263100		525945600
				114	
07/25/03	16:50	---	490308500		525991000
				286	
07/29/03	15:45	227	491936600		527619100
				149	
08/01/03	12:45	---	492551800		528234300
				228	
08/06/03	8:20	227	494130600		529813100
				228	
08/08/03	8:40	---	494792100		530474600
				223	
08/11/03	15:25	---	495844700		531527200
				214	
08/19/03	7:00	---	498198200		533880700
				227	
08/22/03	8:45	229	499203600		534886100
				227	
08/29/03	12:00	228	501538200		537220700
				94	
08/29/03	22:58	---	501599800		537282300
				227	
09/02/03	10:55	225	502745000		538427500
				228	
09/04/03	9:00	---	503375200		539057700
				227	
09/08/03	9:30	223	504687000		540369500
				219	
09/10/03	12:33	---	505358500		541041000
				228	
09/12/03	20:30	---	506122300		541804800
				227	
09/15/03	7:30	229	506927500		542610000
				228	
09/23/03	9:35	226	509578900		545261400
				210	
09/24/03	12:30	---	509918700		545601200
				224	
09/26/03	9:20	----	510521000		546203500
				227	
10/01/03	9:40	225	512162700		547845200
				227	
10/09/03	15:45	228	514865900		550548400
				227	

Appendix B-1

Off-Site Containment Well
2003 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons*
10/10/03	16:10	---	515198700		550881200
				222	
10/13/03	12:55	---	516113100		551795600
				221	
10/18/03	14:30	---	517724100		553406600
				229	
10/27/03	12:20	229	520658900		556341400
				228	
10/30/03	9:30	---	521605900		557288400
				227	
11/03/03	8:30	---	522901600		558584100
				225	
11/10/03	12:15	---	525224400		560906900
				228	
11/12/03	14:45	---	525915000		561597500
				228	
11/24/03	9:30	---	529776900		565459400
				228	
11/26/03	11:00	223	530453000		566135500
				222	
12/03/03	7:25	---	532647800		568330300
				227	
12/11/03	13:00	228	535344100		571026600
				228	
12/16/03	12:40	----	536978600		572661100
				223	
12/19/03	10:47	---	537619500		573302000
				228	
01/02/04	12:55	---	542250200		577932700

*Total pumpage since 12/31/98

B-2: Source Containment Well

Appendix B-2

Source Containment Well
2003 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons
12/28/02	16:58		25163240		25163240
				53	
01/02/03	10:57	56.8	25524670		25524670
				53	
01/06/03	10:20	---	25827590		25827590
				53	
01/13/03	15:30	57.0	26376490		26376490
				52	
01/21/03	11:20	---	26965190		26965190
				54	
01/31/03	13:20	56.9	27665920		27665920
				53	
02/03/03	10:20	56.7	27885470		27885470
				53	
02/07/03	13:20	---	28200330		28200330
				53	
02/10/03	12:40	56.8	28427050		28427050
				53	
02/18/03	8:04	---	29023110		29023110
				53	
02/27/03	12:50	56.6	29725270		29725270
				53	
03/04/03	11:30	56.8	30102750		30102750
				53	
03/12/03	10:45	---	30356340		30356340
				53	
03/14/03	14:45	---	30521780		30521780
				53	
03/17/03	8:08	56.3	30729730		30729730
				53	
03/27/03	12:15	56.5	31503890		31503890
				53	
04/01/03	10:00	56.7	31877990		31877990
				53	
04/07/03	12:30	56.6	32339940		32339940
				53	
04/16/03	8:30	56.6	33015060		33015060
				52	
04/17/03	12:06	---	33101800		33101800
				53	
04/21/03	12:55	---	33410400		33410400
				53	
04/24/03	11:00	---	33632410		33632410
				53	

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Source Containment Well
2003 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons
04/28/03	8:33	---	33930360		33930360
				53	
05/01/03	8:50	56.7	34160660		34160660
				53	
05/07/03	13:38	56.6	34633910		34633910
				53	
05/19/03	7:37	56.5	35531140		35531140
				53	
05/20/03	9:40	---	35614250		35614250
				52	
05/23/03	13:30	56.5	35852403		35852403
				53	
05/28/03	12:40	---	36231220		36231220
				53	
06/02/03	14:00	---	36616960		36616960
				53	
06/05/03	8:30	---	36827700		36827700
				53	
06/10/03	12:45	---	37223060		37223060
				53	
06/13/03	12:45	57.0	37451540		37451540
				53	
06/20/03	11:50	56.9	37982900		37982900
				53	
06/24/03	16:30	---	38301247		38301247
				53	
07/01/03	15:00	---	38830960		38830960
				53	
07/03/03	12:15	54:98	38974630		38974630
				53	
07/11/03	9:50	---	39577400		39577400
				53	
07/15/03	19:30	---	39913130		39913130
				53	
07/22/03	10:25	56.7	40418340		40418340
				53	
07/25/03	10:00	---	40646000		40646000
				53	
07/30/03	16:15	56.7	41047400		41047400
				53	
08/01/03	12:15	---	41187120		41187120
				53	
08/06/03	8:02	---	41555780		41555780
				56	

Appendix B-2

Source Containment Well
2003 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons
08/08/03	9:20	---	41722080		41722080
				52	
08/14/03	13:50	---	42182450		42182450
				53	
08/19/03	7:30	---	42513730		42513730
				53	
08/22/03	9:00	56.0	42747020		42747020
				53	
08/29/03	11:00	56.3	43286660		43286660
				53	
09/02/03	10:15	56.9	43588530		43588530
				53	
09/04/03	8:30	---	43734660		43734660
				53	
09/08/03	9:00	56.8	44041100		44041100
				53	
09/15/03	7:50	56.6	44570590		44570590
				53	
09/23/03	9:50	56.8	45186780		45186780
				53	
09/26/03	10:00	---	45415890		45415890
				53	
10/01/03	9:15	56.7	45794132		45794132
				53	
10/10/03	16:20	---	46501675		46501675
				53	
10/18/03	14:50	56.9	47105460		47105460
				53	
10/27/03	12:05	56.9	47783930		47783930
				53	
10/30/03	10:00	---	48005500		48005500
				53	
11/03/03	8:00	---	48302690		48302690
				53	
11/14/03	17:00	---	49166660		49166660
				53	
11/24/03	8:30	---	49900155		49900155
				53	
11/26/03	11:05	56.9	50060690		50060690
				53	
12/03/03	7:30	---	50581700		50581700
				53	
12/12/03	7:50	56.7	51266490		51266490
				53	

Appendix B-2

Source Containment Well
2003 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons
12/16/03	12:55	---	51586500		51586500
				53	
12/19/03	10:40	---	51807120		51807120
				53	
01/02/04	13:35		52879540		52879540

Appendix C

2003 Influent / Effluent Quality Data

C-1: Off-Site Treatment System

C-2: Source Treatment System

C-1: Off-Site Treatment System

Appendix C-1

Off-Site Treatment System
2003 Analytical Results[a]

Sample Date	Influent TCE (ug/l)	Influent 1,1DCE (ug/l)	Influent 1,1,1TCA (ug/l)	Influent Cr(total) (mg/l)	Influent Fe(total) (mg/l)	Influent Mn(total) (mg/l)	Effluent TCE (ug/l)	Effluent 1,1DCE (ug/l)	Effluent 1,1,1TCA (ug/l)	Effluent Cr(total) (mg/l)	Effluent Fe(total) (mg/l)	Effluent Mn(total) (mg/l)
01/02/03	1300	63	<5.0	0.023	<0.010	<0.0050	<1.0	<1.0	<1.0	0.024	<0.010	<0.0050
2/3/2003	1200	60	4.4	0.026	0.210	<0.0050	<1.0	<1.0	<1.0	0.024	0.097	<0.0050
03/04/03	1200	76	4.9	0.025	0.027	<0.0050	<1.0	<1.0	<1.0	0.026	0.078	<0.0050
04/01/03	1300	75	4.8	0.026	<0.020	<0.0030	<1.0	<1.0	<1.0	0.027	0.11	<0.0030
05/02/03	1300	63	4.6	0.027	0.170	<0.0030	<1.0	<1.0	<1.0	0.025	0.042	<0.0030
06/02/03	1300	78	4.9	0.015	<0.020	<0.0030	<1.0	<1.0	<1.0	0.015	0.030	<0.0030
07/01/03	1200	59	4.3	0.024	0.100	<0.0030	<1.0	<1.0	<1.0	0.022	0.140	<0.0030
08/01/03	1300	71	4.5	0.024	0.130	<0.0030	<1.0	<1.0	<1.0	0.023	0.260	<0.0030
09/02/03	1300	75	4.9	0.031	0.038	0.10	<1.0	<1.0	<1.0	0.030	<0.020	0.10
10/01/03	1200	70	4.4	0.026	0.058	<0.0030	<1.0	<1.0	<1.0	0.026	0.120	<0.0030
11/03/03	1200	72	4.6	0.024	<0.020	<0.0030	<1.0	<1.0	<1.0	0.023	0.029	<0.0030
12/03/03	1500	88	5.6	0.030	0.038	<0.0030	<1.0	<1.0	<1.0	0.028	0.056	<0.0030
01/06/04	1200	72	4.6	0.023	<0.020	<0.0030	<1.0	<1.0	<1.0	0.023	0.035	<0.0030

[a] Data from 01/06/04 has been included to show conditions at the end of the year.

Notes: Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 ug/L for TCE and DCE, 60 ug/L for TCA and 50 ug/L for total chromium).

C-2: Source Treatment System

Appendix C-2

Source Treatment System
2003 Analytical Results[a]

Sample Date	Influent						Effluent					
	TCE (ug/l)	1,1DCE (ug/l)	1,1,1TCA (ug/l)	Cr(total) (mg/l)	Fe(total) (mg/l)	Mn(total) (mg/l)	TCE (ug/l)	1,1DCE (ug/l)	1,1,1TCA (ug/l)	Cr(total) (mg/l)	Fe(total) (mg/l)	Mn(total) (mg/l)
01/02/03	450	66	11	0.036	0.210	0.087	<1.0	<1.0	<1.0	0.031	0.023	0.086
02/03/03	410	58	9.8	0.035	0.150	0.087	<1.0	<1.0	<1.0	0.039	6.8	0.140
03/04/03	430	65	11	0.031	0.035	0.079	<1.0	<1.0	<1.0	0.033	0.110	0.089
04/01/03	460	58	11	0.034	0.180	0.091	<1.0	<1.0	<1.0	0.034	0.330	0.094
05/02/03	480	62	9.8	0.032	0.240	0.091	<1.0	<1.0	<1.0	0.033	0.460	0.096
06/02/03	490	73	11	0.027	0.160	0.092	<1.0	<1.0	<1.0	0.023	<0.020	0.092
07/01/03	480	57	9	0.028	0.098	0.085	<1.0	<1.0	<1.0	0.030	0.270	0.091
08/01/03	520	65	10	0.030	<0.020	0.093	<1.0	<1.0	<1.0	0.031	<0.020	0.093
09/02/03	560	76	10	0.024	<0.020	<0.0030	<1.0	<1.0	<1.0	0.023	0.095	<0.0030
10/01/03	500	68	8.8	0.031	0.067	0.100	<1.0	<1.0	<1.0	0.032	0.095	0.100
11/03/03	470	62	8.3	0.029	<0.020	0.100	<1.0	<1.0	<1.0	0.029	<0.020	0.100
12/03/03	430	56	7.5	0.032	0.150	0.110	<1.0	<1.0	<1.0	0.031	0.029	0.110
01/06/04	380	50	6.8	0.029	0.031	0.100	<1.0	<1.0	<1.0	0.028	0.023	0.100

[a] Data from 01/06/04 has been included to show conditions at the end of the year.

Notes: Shaded cells indicate concentrations that exceed MCLs based on the more stringent of the drinking water standards or the maximum allowable concentrations in groundwater set by the NMWQCC (5 ug/L for TCE and DCE, 60 ug/L for TCA and 50 ug/L for total chromium).

Appendix D

Water Level Residuals
1998 to 2003 Simulation

Appendix D

Water Level Residuals
1999 to 2003 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-07	1999	4976.62	4974.93	1.68
MW-09	1999	4972.33	4972.39	-0.06
MW-12	1999	4971.95	4972.46	-0.51
MW-13	1999	4973.67	4972.94	0.73
MW-16	1999	4977.80	4975.52	2.28
MW-17	1999	4978.16	4976.12	2.03
MW-19	1999	4970.99	4970.81	0.18
MW-20	1999	4970.62	4970.23	0.40
MW-29	1999	4972.86	4971.81	1.05
MW-30	1999	4971.40	4971.02	0.38
MW-31	1999	4970.32	4970.21	0.11
MW-32	1999	4970.12	4970.13	0.00
MW-33	1999	4971.64	4972.08	-0.44
MW-34	1999	4973.45	4972.21	1.24
MW-35	1999	4970.57	4970.06	0.51
MW-36	1999	4969.02	4968.89	0.14
MW-37	1999	4967.30	4967.61	-0.32
MW-38	1999	4972.88	4971.27	1.61
MW-39	1999	4971.63	4970.58	1.04
MW-40	1999	4970.35	4969.86	0.49
MW-41	1999	4970.24	4970.31	-0.08
MW-42	1999	4969.89	4970.39	-0.50
MW-43	1999	4969.69	4970.03	-0.34
MW-44	1999	4969.11	4968.77	0.34
MW-45	1999	4967.25	4967.40	-0.15
MW-46	1999	4965.98	4966.35	-0.37
MW-47	1999	4965.56	4965.65	-0.10
MW-48	1999	4964.66	4964.20	0.46
MW-49	1999	4970.15	4969.60	0.55
MW-51	1999	4979.97	4977.39	2.58
MW-52	1999	4961.24	4961.17	0.07
MW-53	1999	4963.42	4962.38	1.05
MW-54	1999	4964.84	4965.42	-0.58
MW-55	1999	4963.44	4963.39	0.06
MW-56	1999	4964.63	4963.88	0.75
MW-57	1999	4964.41	4964.94	-0.53
MW-58	1999	4964.19	4963.22	0.97
MW-59	1999	4968.77	4970.07	-1.30
MW-60	1999	4964.33	4963.71	0.62
MW-61	1999	4964.41	4963.89	0.52
MW-62	1999	4966.53	4966.18	0.36

Appendix D

Water Level Residuals
1999 to 2003 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-64	1999	4964.90	4965.25	-0.35
MW-65	1999	4960.92	4959.90	1.02
MW-66	1999	4963.35	4963.43	-0.08
MW-67	1999	4957.76	4957.81	-0.06
MW-68	1999	4960.83	4960.04	0.79
MW-69	1999	4960.73	4959.18	1.55
MW-70	1999	4969.37	4969.84	-0.47
MW-71	1999	4957.75	4956.72	1.03
MW-72	1999	4970.03	4970.41	-0.37
MW-73	1999	4970.15	4970.25	-0.10
OB-1	1999	4958.39	4958.07	0.32
OB-2	1999	4960.02	4958.62	1.40
MW-07	2000	4976.31	4974.72	1.60
MW-09	2000	4971.97	4972.13	-0.15
MW-12	2000	4971.61	4972.21	-0.60
MW-13	2000	4973.37	4972.68	0.69
MW-16	2000	4977.66	4975.41	2.25
MW-17	2000	4977.94	4976.00	1.94
MW-18	2000	4970.68	4972.66	-1.97
MW-19	2000	4970.62	4970.54	0.08
MW-20	2000	4970.26	4969.95	0.31
MW-22	2000	4976.81	4975.56	1.24
MW-23	2000	4975.10	4973.96	1.14
MW-24	2000	4977.35	4975.34	2.01
MW-25	2000	4977.38	4975.25	2.13
MW-26	2000	4972.49	4972.56	-0.08
MW-27	2000	4972.89	4974.01	-1.12
MW-29	2000	4972.54	4971.55	0.99
MW-30	2000	4971.04	4970.74	0.30
MW-31	2000	4969.94	4969.92	0.02
MW-32	2000	4969.76	4969.85	-0.09
MW-33	2000	4971.28	4971.82	-0.54
MW-34	2000	4973.13	4971.93	1.20
MW-35	2000	4970.22	4969.75	0.47
MW-36	2000	4968.58	4968.54	0.04
MW-37	2000	4966.90	4967.22	-0.32
MW-38	2000	4972.56	4971.02	1.55
MW-39	2000	4971.28	4970.31	0.97
MW-40	2000	4969.98	4969.58	0.41
MW-41	2000	4969.87	4970.03	-0.17
MW-42	2000	4969.54	4970.13	-0.59

Appendix D

Water Level Residuals
1999 to 2003 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-43	2000	4969.33	4969.77	-0.43
MW-44	2000	4968.68	4968.43	0.25
MW-45	2000	4966.90	4967.03	-0.13
MW-46	2000	4965.56	4965.98	-0.41
MW-47	2000	4965.04	4965.17	-0.14
MW-48	2000	4964.01	4963.65	0.36
MW-49	2000	4969.89	4969.32	0.57
MW-51	2000	4979.73	4977.30	2.43
MW-52	2000	4960.50	4960.56	-0.06
MW-53	2000	4962.62	4961.69	0.94
MW-54	2000	4964.57	4965.11	-0.54
MW-55	2000	4962.90	4962.95	-0.04
MW-56	2000	4964.01	4963.40	0.61
MW-57	2000	4964.32	4964.72	-0.40
MW-58	2000	4963.46	4962.59	0.87
MW-59	2000	4968.44	4969.81	-1.37
MW-60	2000	4963.94	4963.29	0.65
MW-61	2000	4964.02	4963.43	0.60
MW-62	2000	4965.92	4965.74	0.18
MW-63	2000	4970.20	4973.33	-3.13
MW-64	2000	4964.55	4964.97	-0.41
MW-65	2000	4960.24	4959.44	0.80
MW-66	2000	4963.03	4963.23	-0.20
MW-67	2000	4957.24	4957.48	-0.24
MW-68	2000	4960.40	4959.70	0.70
MW-69	2000	4960.31	4958.90	1.41
MW-70	2000	4969.01	4969.57	-0.55
MW-71	2000	4957.28	4956.39	0.90
MW-72	2000	4969.73	4970.14	-0.41
MW-73	2000	4969.77	4969.96	-0.19
MW-74	2000	4963.03	4964.42	-1.39
MW-75	2000	4966.92	4964.36	2.56
MW-76	2000	4967.69	4965.95	1.74
OB-1	2000	4957.55	4957.43	0.11
OB-2	2000	4958.96	4958.08	0.88
MW-07	2001	4976.10	4974.53	1.57
MW-09	2001	4971.71	4971.90	-0.19
MW-12	2001	4971.18	4972.00	-0.82
MW-13	2001	4973.09	4972.46	0.64
MW-16	2001	4977.76	4975.27	2.49
MW-17	2001	4978.05	4975.88	2.16

Appendix D

Water Level Residuals
1999 to 2003 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference
		Observed	Computed	(ft)
MW-18	2001	4970.28	4972.49	-2.21
MW-19	2001	4970.28	4970.30	-0.02
MW-20	2001	4969.92	4969.72	0.21
MW-22	2001	4976.51	4975.41	1.10
MW-23	2001	4974.77	4973.78	0.99
MW-24	2001	4977.38	4975.20	2.19
MW-25	2001	4977.39	4975.12	2.27
MW-26	2001	4971.70	4972.35	-0.64
MW-27	2001	4972.74	4973.90	-1.16
MW-29	2001	4972.19	4971.33	0.86
MW-30	2001	4970.72	4970.50	0.21
MW-31	2001	4969.60	4969.67	-0.06
MW-32	2001	4969.44	4969.61	-0.17
MW-33	2001	4970.96	4971.59	-0.63
MW-34	2001	4972.86	4971.69	1.18
MW-35	2001	4969.97	4969.48	0.49
MW-36	2001	4968.32	4968.24	0.07
MW-38	2001	4972.21	4970.79	1.42
MW-39	2001	4970.97	4970.08	0.89
MW-40	2001	4969.65	4969.33	0.33
MW-41	2001	4969.55	4969.79	-0.24
MW-42	2001	4969.30	4969.90	-0.60
MW-43	2001	4969.09	4969.54	-0.45
MW-44	2001	4968.38	4968.14	0.23
MW-45	2001	4967.06	4966.73	0.33
MW-46	2001	4965.30	4965.67	-0.38
MW-47	2001	4964.50	4964.81	-0.31
MW-48	2001	4963.66	4963.25	0.41
MW-49	2001	4969.49	4969.07	0.41
MW-51	2001	4979.79	4977.24	2.55
MW-52	2001	4960.20	4960.07	0.13
MW-53	2001	4962.08	4961.23	0.85
MW-54	2001	4964.34	4964.86	-0.52
MW-55	2001	4962.53	4962.61	-0.08
MW-56	2001	4963.67	4963.04	0.63
MW-57	2001	4964.15	4964.53	-0.38
MW-58	2001	4963.28	4962.17	1.11
MW-59	2001	4968.18	4969.59	-1.40
MW-60	2001	4963.74	4962.98	0.76
MW-61	2001	4963.80	4963.10	0.69
MW-62	2001	4965.68	4965.39	0.29

Appendix D

Water Level Residuals
1999 to 2003 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference
		Observed	Computed	(ft)
MW-63	2001	4970.02	4973.25	-3.23
MW-64	2001	4964.36	4964.73	-0.37
MW-65	2001	4959.90	4959.08	0.82
MW-66	2001	4962.79	4963.03	-0.24
MW-67	2001	4956.95	4957.16	-0.21
MW-68	2001	4960.12	4959.45	0.67
MW-69	2001	4960.00	4958.65	1.35
MW-70	2001	4968.91	4969.33	-0.42
MW-71	2001	4956.98	4956.06	0.92
MW-72	2001	4969.48	4969.90	-0.42
MW-73	2001	4969.35	4969.71	-0.36
MW-74	2001	4962.46	4964.88	-2.42
MW-75	2001	4966.26	4964.83	1.44
MW-76	2001	4967.18	4966.43	0.76
OB-1	2001	4957.25	4956.98	0.27
OB-2	2001	4958.61	4957.68	0.93
MW-07	2002	4976.12	4975.70	0.43
MW-09	2002	4970.95	4972.60	-1.65
MW-12	2002	4970.35	4972.76	-2.41
MW-13	2002	4972.49	4972.95	-0.46
MW-14R	2002	4968.29	4969.01	-0.72
MW-16	2002	4981.76	4981.13	0.63
MW-17	2002	4981.91	4982.09	-0.18
MW-18	2002	4970.93	4974.30	-3.38
MW-19	2002	4969.24	4969.05	0.19
MW-20	2002	4968.78	4968.84	-0.06
MW-22	2002	4977.86	4978.37	-0.51
MW-23	2002	4974.63	4975.54	-0.91
MW-24	2002	4981.50	4980.79	0.71
MW-25	2002	4981.61	4980.96	0.65
MW-26	2002	4971.44	4972.38	-0.95
MW-27	2002	4978.42	4978.30	0.12
MW-29	2002	4971.53	4970.73	0.80
MW-30	2002	4969.78	4969.58	0.20
MW-31	2002	4968.39	4968.33	0.06
MW-32	2002	4968.10	4968.05	0.05
MW-33	2002	4970.04	4972.22	-2.17
MW-34	2002	4972.27	4971.31	0.96
MW-36	2002	4967.34	4967.68	-0.34
MW-37R	2002	4965.13	4966.23	-1.10
MW-38	2002	4971.50	4970.22	1.28

Appendix D

Water Level Residuals
1999 to 2003 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-39	2002	4970.11	4969.36	0.75
MW-40	2002	4968.46	4968.31	0.16
MW-41	2002	4968.35	4968.04	0.31
MW-42	2002	4968.54	4969.09	-0.55
MW-43	2002	4968.31	4968.80	-0.49
MW-44	2002	4967.40	4967.54	-0.15
MW-45	2002	4966.10	4966.16	-0.06
MW-46	2002	4964.65	4965.25	-0.60
MW-47	2002	4964.18	4964.38	-0.20
MW-48	2002	4963.20	4962.84	0.36
MW-49	2002	4968.47	4968.35	0.11
MW-51	2002	4980.94	4979.58	1.36
MW-52	2002	4959.81	4959.68	0.13
MW-53	2002	4961.52	4960.81	0.71
MW-54	2002	4963.82	4964.56	-0.74
MW-55	2002	4962.03	4962.17	-0.14
MW-56	2002	4963.21	4962.62	0.59
MW-57	2002	4963.62	4964.28	-0.66
MW-58	2002	4962.57	4961.75	0.82
MW-59	2002	4967.50	4968.98	-1.48
MW-60	2002	4963.21	4962.62	0.60
MW-61	2002	4963.12	4962.76	0.36
MW-62	2002	4965.13	4964.97	0.16
MW-63	2002	4969.61	4974.04	-4.43
MW-64	2002	4963.78	4964.43	-0.65
MW-65	2002	4959.39	4958.67	0.72
MW-66	2002	4962.24	4962.72	-0.48
MW-67	2002	4956.31	4956.79	-0.48
MW-68	2002	4959.64	4959.17	0.47
MW-69	2002	4959.52	4958.32	1.20
MW-70	2002	4967.68	4968.39	-0.72
MW-71R	2002	4956.36	4955.75	0.61
MW-72	2002	4968.59	4968.89	-0.30
MW-73	2002	4967.69	4967.40	0.29
MW-74	2002	4962.06	4965.08	-3.02
MW-75	2002	4965.83	4965.03	0.80
MW-76	2002	4967.31	4966.62	0.69
MW-77	2002	4977.10	4976.44	0.66
MW-78	2002	4973.01	4974.10	-1.10
OB-1	2002	4956.73	4956.46	0.26
OB-2	2002	4957.91	4957.22	0.69

Appendix D

Water Level Residuals
1999 to 2003 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-07	2003	4976.17	4976.18	-0.01
MW-09	2003	4970.83	4973.04	-2.21
MW-12	2003	4970.28	4973.16	-2.88
MW-13	2003	4972.43	4973.30	-0.88
MW-14R	2003	4968.03	4968.97	-0.94
MW-16	2003	4982.26	4982.46	-0.20
MW-17	2003	4982.02	4983.49	-1.47
MW-18	2003	4975.16	4974.91	0.26
MW-19	2003	4969.13	4968.86	0.27
MW-20	2003	4968.59	4968.63	-0.03
MW-21	2003	4983.36	4983.69	-0.32
MW-22	2003	4977.84	4979.23	-1.39
MW-23	2003	4974.75	4976.16	-1.41
MW-24	2003	4982.08	4982.08	0.00
MW-25	2003	4982.27	4982.28	-0.02
MW-26	2003	4971.84	4972.53	-0.69
MW-27	2003	4981.28	4979.40	1.88
MW-29	2003	4971.41	4970.59	0.82
MW-30	2003	4969.61	4969.41	0.20
MW-31	2003	4968.19	4968.11	0.08
MW-32	2003	4968.01	4967.81	0.20
MW-33	2003	4969.93	4972.63	-2.70
MW-34	2003	4972.12	4971.11	1.01
MW-36	2003	4967.27	4967.39	-0.12
MW-37R	2003	4965.06	4965.97	-0.92
MW-38	2003	4971.41	4970.04	1.37
MW-39	2003	4969.96	4969.16	0.79
MW-40	2003	4968.26	4968.08	0.18
MW-41	2003	4968.41	4967.80	0.61
MW-42	2003	4968.48	4968.92	-0.44
MW-43	2003	4968.27	4968.62	-0.35
MW-44	2003	4967.35	4967.28	0.06
MW-45	2003	4966.05	4965.91	0.14
MW-46	2003	4964.45	4965.00	-0.55
MW-47	2003	4963.98	4964.07	-0.09
MW-48	2003	4962.97	4962.52	0.45
MW-49	2003	4968.30	4968.14	0.16
MW-51	2003	4981.88	4980.51	1.38
MW-52R	2003	4959.26	4959.17	0.09
MW-53	2003	4961.29	4960.19	1.10
MW-54	2003	4963.61	4964.32	-0.71

Appendix D

Water Level Residuals
1999 to 2003 Simulation

Monitoring Well	Year	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-55	2003	4961.61	4961.87	-0.27
MW-56	2003	4962.98	4962.31	0.67
MW-57	2003	4963.46	4964.05	-0.59
MW-58	2003	4962.30	4961.41	0.89
MW-59	2003	4967.36	4968.82	-1.46
MW-60	2003	4962.90	4962.33	0.56
MW-61	2003	4962.87	4962.47	0.40
MW-62	2003	4964.84	4964.65	0.19
MW-63	2003	4971.76	4974.54	-2.78
MW-64	2003	4963.64	4964.20	-0.56
MW-65	2003	4959.19	4958.35	0.84
MW-66	2003	4962.01	4962.48	-0.47
MW-67	2003	4956.05	4956.48	-0.43
MW-68	2003	4959.40	4958.91	0.50
MW-69	2003	4959.33	4958.04	1.29
MW-70	2003	4967.49	4968.18	-0.69
MW-71R	2003	4956.13	4955.43	0.70
MW-72	2003	4968.55	4968.72	-0.17
MW-73	2003	4967.46	4967.11	0.35
MW-74	2003	4961.85	4965.13	-3.28
MW-75	2003	4965.77	4965.08	0.69
MW-76	2003	4967.22	4966.67	0.55
MW-77	2003	4977.08	4976.84	0.24
MW-78	2003	4974.97	4974.60	0.37
OB-1	2003	4956.46	4956.07	0.39
OB-2	2003	4957.70	4956.86	0.84

Number of active observation points =	311	
Number of inactive observation points =	2	
Mean of residuals =	-0.12	ft
Standard Deviation of residuals =	1.04	ft
Sum of squared residuals =	342	ft^2
Mean of absolute residuals =	0.76	ft
Maximum residual =	-2.58	ft
Minimum residual =	4.43	ft
Range in observed heads =	26.22	ft