Sparton Technology, Inc.
Former Coors Road Plant
Remedial Program

2002 Annual Report

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

May 16, 2003

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ENVIRONMENTAL & WATER-RESOURCE CONSULTANTS

MAY 2003

May 16, 2003

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New Mexico Environment Department – District 1
4131 Montgomery Boulevard, NE
Albuquerque, NM 87109

Subject: Sparton Technology, Inc. Former Coors Road Plant Remedial Program
2002 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 2002, and evaluations of these data to assess the performance of the systems. This document was prepared by SSP&A in cooperation 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., w/ 1 copy
Ms. Susan Widener, w/1 copy
Mr. James B. Harris, w/1 copy
Mr. Tony Hurst, w/2 copies
Mr. Gary L. Richardson, w/1 copy

Sparton Technology, Inc.
Coors Road Plant
Remedial Program

2002 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 16, 2003

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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 cubic feet per minute soil vapor extraction 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 2002 was the fourth 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 2002 was essentially the first full year of operation of this well. The 400 cubic feet per minute soil vapor extraction 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 2002, 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 221 gallons per minute, 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 began operating on January 3, 2002 and continued to operate throughout the remainder of the year at an average rate of 49 gallons per minute;

- 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 volatile organic compounds 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 volatile organic compounds, 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 trichloroethylene concentrations in the aquifer from start-up of the off-site containment well in December 1998 through November 2002 and to predict concentrations in November 2003.

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 flow patterns that captured most of the contaminated water migrating from the site, and thus controlled any potential sources that may be contributing to groundwater contamination.

The extent of groundwater contamination, as defined by the extent of the trichloroethylene plume, did not change significantly during 2002. The leading edge of the 1,1-dichloroethylene plume advanced beyond its position during the previous year, but the plume remains well within the capture zone of the containment wells. The 1,1,1-trichloroethane plume essentially disappeared during 2002; there is only one well with 1,1,1-trichloroethane concentrations slightly above the maximum allowable concentration in groundwater set by the New Mexico Water Quality Control Commission.

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, the relatively high concentrations that have been observed during 2002 in the water pumped from CW-2, and the concentrations history of well MW-60 indicate the presence of high concentration areas upgradient from the containment wells. This conclusion continues to be confirmed by the results of model recalibration efforts during the last several years.

The off-site and source containment wells operated at a combined average rate of 270 gallons per minute during 2002. A total of about 142 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 485 million gallons and represents 43 percent of the initial pore volume.

Approximately 650 kilograms (1,430 pounds) of contaminants consisting of 605 kilograms (1,330 pounds) of trichloroethylene, 41 kilograms (90 pounds) of 1,1-dichloroethylene, and about 4 kilograms (8 pounds) of 1,1,1-trichloroethane 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 2,060 kilograms (4,550 pounds) consisting of 1,950 kilograms (4,300 pounds) of trichloroethylene, 110 kilograms (240 pounds) of 1,1-dichloroethylene, and about 4 kilograms (8 pounds) of 1,1,1-trichloroethane. This represents about 41 percent of the total dissolved contaminant mass (42 percent of the trichloroethylene, 39 percent of the 1,1-dichloroethylene, and 3 percent of the 1,1,1-trichloroethane mass) currently estimated to have been present in the aquifer prior to operation of the containment well.

The remedial systems were operated with only minor difficulties during 2002. Both containment systems operated essentially continuously, with total down time of less than a day. The wellhead of five monitoring wells at an off-site well-cluster location was modified to accommodate the regrading of the land for a residential development. Three on-site and two off-site water table monitoring wells that were dry for the last several years were plugged in May. A new Deep Flow Zone monitoring well, MW-71R, was installed in February to replace well MW-71 which was plugged in 2001after a long history of leakage and contamination problems. Samples collected from the replacement well during 2002 indicated the continuing presence of contaminants in the Deep Flow Zone.

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 2003 and improvement of the model will continue next year. To assess the severity of the problem associated with the detection of contaminants in the Deep Flow Zone monitoring well MW-71R, the well will be pumped for about a year, and the pumped water will be returned to the water table after treatment by injection into the vadose zone above the existing plume. 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 2002 constitutes the fourth 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 2002 constitutes the first 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 2002 Annual Report is to:

- provide a brief history of the Sparton plant and affected areas downgradient from the plant,
- summarize remedial and other actions taken by the end of 2002,
- present the data collected during 2002 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 2001 is included in this section. Issues related to the year-2002 operation of the off-site and source containment systems, and the dismantling of the SVE system 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 2002, 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 87 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, 15 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 was treated as a ULFZ well, and MW-49 and MW-70 were 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 0.3 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/m³*), 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 past 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. In the 2001 Annual Report, however, this relationship was taken into consideration, and water level conditions at the site and its vicinity were 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 same approach is used in this 2002 Annual Report.

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 2002 water-quality data, the initial dissolved TCE mass is currently estimated to be (see Table 6.1) about 4,650 kg (10,250 lbs). Using this estimate, and the ratios of TCE mass to DCE and TCA mass determined from plume-map based estimates (see 1999 and 2000 Annual Reports [SSP&A, 2001a; 2001b]), the initial masses of dissolved DCE and TCA are estimated to be approximately

[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.

280 kg (620 lbs) and 130 kg (280 lbs), respectively. Thus, the total mass of dissolved contaminants is currently estimated to be about 5,060 kg (11,150 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 2001 Operations

During 1999 through 2001, 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 2001 included the following:

- Between December 31, 1998 and April 14, 1999, and from May 6, 1999 through December 31, 2001, 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.

- 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 was scheduled for January 3, 2002.

- 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 2001 and to predict TCE concentrations in November 2002. Plans were made to continue the calibration and improvement of the model during 2002.

A total of 344 million gallons of water, corresponding to an average rate of about 218 gpm, were pumped from the off-site containment well between the start of operations and the end of 2001. The pumped water represented 31 percent of the initial volume of contaminated groundwater (pore volume) estimated to be present in the aquifer prior to the operation of the well. Evaluation of quarterly water-level data indicated that containment of the contaminant plume was maintained throughout each year.

Approximately 1,410 kg (3,100 lbs) of contaminants consisting of 1,340 kg (2,950 lbs) of TCE and 70 kg (150 lbs) of DCE were removed from the aquifer during these years. This represents about 28 percent of the dissolved contaminant mass (29 percent of the TCE and 25 percent of the DCE mass) currently estimated to have been present in the aquifer prior to operation of the 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 (MW-18) of the monitored locations; however, the soil-gas TCE at this location was attributed to volatilization from the water table at this location which had a TCE concentration of 980 µg/L in November 1999. Soil-gas was not monitored during the 2000 and 2001 operation of the 400-cfm system, however, the performance monitoring conducted near the end of 2001, three months after the shut-down of the system, indicated that soil gas concentrations at all monitoring locations were considerably below the 10 ppmv termination criterion for the system.

The remedial systems were operated with only minor difficulties during 1999 through 2001. 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 proposed, approved, and scheduled for installation in early 2002. Other minor problems 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 - 2002

3.1 Monitoring Well System

The wellhead of off-site monitoring wells MW-47, MW-48, MW-55, MW-56 and MW-67 was modified during 2002 to accommodate the regrading of the land in their vicinity for the development of a residential subdivision.

Five UFZ monitoring wells, MW-14, MW-15, MW-28, MW-37 and MW-50, which had been dry for the last several years, were plugged in May 2002. During January and February 2002 monitoring well MW-71-R was completed as a replacement for well MW-71 that was plugged in 2001.

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 2002. Power outages and maintenance activities caused short-duration shutdowns of the system. The net operating period for the system during 2002 constituted 99.9 percent of the available time.

3.2.2 Source Containment System

The source containment system was a placed into continuous operation on January 3, 2002. Except for minor interruptions, the source containment well CW-2 operated continuously during 2002. Six short-duration shutdowns of the system occurred during 2002; two were caused by misadjusted valves, two by debris in the discharge water meters, and two resulted from routine maintenance activities. The net operating period for the system during 2002 constituted 99.8 percent of the available time.

The rapid infiltration ponds performed better than was anticipated. Only two ponds at a time were used in accordance with the following schedule (see Figure 2.10 for pond identification):

January through March, 2002: Ponds 5 and 6

April through June 2002 : Ponds 2 and 3

July through December 2002 : Ponds 1 and 4

The amount of water evaporating from the ponds was calculated to be about 1 percent of the discharged water, that is about 0.5 gpm. The performance of the ponds during this first year of their operation indicates that only two of the six ponds are needed to achieve infiltration of the treated water.

3.3 Soil Vapor Extraction System

During May 2002 the 400-cfm SVE system was dismantled by removing the two 200-cfm Roots blowers and associated piping from the site, and by plugging the remaining vapor recovery wells and vapor probes. These included recovery wells VR-1, VR-2, VR-4 and VR-5, the VP-1 to VP-6 probe cluster, and probes VP-8 through VP-11 and VP-14. Recovery well VR-3 and probes VP-7, VP-12 and VP-13 had been plugged previously, in February 2001, to allow for the construction of the rapid infiltration ponds. (See Figure 2.18 for vapor probe and recovery well locations.)

3.4 Problems and Responses

Minimal problems were experienced with the operation of the off-site and source containment systems during 2002. Both systems operated at or above 99.8% of the available time.

Section 4
Monitoring Results - 2002

The following data were collected in 2002 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 2002 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 2002, 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 2002 (November 2002), 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 2002 (November 2002) 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 2002 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 one day to fifteen 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 2002, as calculated from the totalizer data, are summarized on Table 4.3 (a). As indicated on this table, approximately 116 million gallons of water, corresponding to an average rate of 221 gpm, were pumped in 2002.

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. The meter was read at irregular frequencies. The intervals between meter readings ranged from one day to fourteen days, and averaged about four 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 2002, as calculated from the totalizer data, are summarized on Table 4.3 (b). As indicated on this table, approximately 25 million gallons of water, corresponding to an average rate of 49 gpm, were pumped in 2002.

4.2.2 Influent and Effluent Quality

4.2.2.1 Off-Site Containment System

During 2002, 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 2002 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 2002, 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 2002 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.

4.3 Soil Vapor Extraction System

The operation of the 400-cfm SVE system was terminated on June 15, 2001. Based on the results of performance monitoring conducted in 2001, the operation of the system was permanently discontinued in May 2002 by dismantling the two 200-cfm Root blowers and plugging the vapor recovery well and vapor probes. There were no data collection activities associated with the SVE system during 2002.

Section 5
Evaluation of Operations - 2002

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, which began operating on January 3, 2002, 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. The goal of the SVE system was 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; the system met this goal in 2001, did not operate during 2002, and was permanently discontinued in May 2002. This section presents the results of evaluations based on data collected during 2002 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 2002 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 2001) water-quality data from monitoring wells. (The November 2001 extent of the plume is used as representative of the area that must be contained during 2002.)

As shown in Figures 5.1, 5.4, 5.7, and 5.10, the pumping from the source containment well CW-2 does not have a significant 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 direct contribution of water from the aquifer above the silt/clay unit into the well is relatively small and occurs by leakage through the sand pack; however, as the water table rose during the year in response to the water infiltrating from the infiltration ponds, the direct contribution from this portion of the aquifer into the well also increased. It is estimated that this direct contribution from the aquifer above the silt/clay unit is less than 10 percent (less than 5 gpm) of the water pumped from this well; however, the total percentage of water derived from the aquifer above the silt/clay unit is larger because additional groundwater that leaks through the silt/clay unit, or discharges beyond the limits of this unit, into the capture zone of the source containment well CW-2, is also captured by this well.

The figures showing the elevation of the on-site water table (Figures 5.1, 5.4, 5.7, and 5.10) also indicate that by the end of 2002 the treated groundwater infiltrating from the infiltration ponds had created a significant water-table mound in the pond area. Comparison of the November 2001water levels in monitoring wells closer to the pond area with the November 2002 water levels in the same wells indicates that the rise in the water table ranged from about 0.3 foot in well MW-07 to more that 8 feet in well MW-27. Monitoring wells along the limits of the silt/clay unit (MW-9, MW-12, MW-13, and MW-33), however, continued to decline in response to regional 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 will 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 is capturing most of the portion of the plume underlying the Sparton property. The capture zone of the source containment well in both the UFZ/ULFZ and the LLFZ is wider than that predicted earlier[3]. As also shown in these figures, the limits of the off-site containment well capture zone during 2002 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; this increase, although not significant, is probably due to the higher water levels and the flushing caused by the water infiltrating from the infiltration ponds.

A plot for well MW-72 is also included in Figure 5.13. Well MW-72 (see Figure 2.3 for well location) was installed in late February 1999 to provide a means for assessing whether source areas exist outside the capture zone of the source containment well. The first two samples from this well, in March and May 1999, had TCE concentrations of 1,800 μg/L; in November 1999, the TCE concentration had declined to 1,200 μg/L. During 2000 and early 2001, the TCE

[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.

concentration in this 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. The two samples collected in May and November 2002 remained at about the same level, 2,700 μg/L and 2,800 μg/L, respectively. Semi-annual sampling of this well will continue for another year before an evaluation is made of these data, and of other data from the operation of the source containment well, to determine whether they indicate the presence of a source area outside the capture zone of the source containment well.

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 three 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. 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 two years (November 2001 and 2002) TCE concentrations increased again to 3,700 and 7,100 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 2002 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 to continue sampling the well for a year (until February 2003) before making a decision on further action. (The February 2003 sample from the well also had 180 μg/L of TCE; 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 [see Section 7.2 for further details].)

The Fourth Quarter (November) 2002 water-quality data presented in Table 4.2 were used to prepare concentration distribution maps showing conditions near the end of 2002. The horizontal extent of the TCE plume and the concentration distribution within the plume in November 2002, 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 four years and from the source containment well during 2002. [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 2002 are shown in Figures 5.16 and 5.17, respectively. The extent of the TCE plume (Figure 5.15) is similar to that in November 2001, except that concentrations on the Sparton property are generally lower. An isolated TCE plume is shown around infiltration pond monitoring well MW-77 which had a TCE concentration of 35 μg/L in November 2002.

The leading edge of the DCE plume (Figure 5.16) extends to monitoring well MW-65 which during 2002 had DCE concentrations above the MCL for this compound; DCE concentrations in this well had been below detection limits or below its MCL since its installation. 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. Also, the plume around on-site UFZ well MW-23 is shown as separate from the off-site plume due to the low concentrations in UFZ wells MW-16, MW-17, MW-21, and MW-25; the two plumes are most likely connected through the silt/clay unit or the ULFZ. These issues, however, are irrelevant as the entire area of DCE contamination is within the capture zones of either the off-site or the source containment wells.

The TCA plume (Figure 5.17) has essentially disappeared; the only well that has a TCA concentration above the 60 μg/L maximum allowable concentration in groundwater set by the NMWQCC is well MW-46 with a TCA concentration of 63 μg/L.

Changes that occurred between November 1998 (prior to the implementation of the current remedial activities) and November 2002 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 2002. (Changes in monitoring wells MW-72 and MW-77, 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 2002.) The largest increase in all three constituents occurred in off-site well MW-46; the largest decreases occurred in on-site wells MW-26 (TCE and DCE) and MW-23 (TCA). Note that significant decreases in the concentration of all three constituents occurred in the on-site area. The only on-site wells where an increase occurred in one or more constituents are MW-19 (TCE and DCE), MW-72 (DCE) and MW-77 (TCE and DCE). 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, the relatively high concentrations that have been observed during 2002 in the water pumped from CW-2, and concentrations at well MW-60, however, indicate the presence of high concentration areas upgradient from the containment wells. This conclusion is confirmed by the model calibration results discussed in Section 6.

5.3 Containment Systems

5.3.1 Flow Rates

A total of about 142 million gallons of water, corresponding to an average pumping rate of about 270 gpm, were pumped during 2002 from the off-site and source containment wells (see Table 4.3). The total volume pumped from both wells since the beginning of remedial pumping in December 1998 is 485 million gallons, and represents approximately 43 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 2002 is shown on Table 4.3 (a); a plot of the monthly production is presented in Figure 5.21. Based on the total volume of water pumped during the year (approximately 116 million gallons), the average discharge rate for the year was 221 gpm. The well was operated 99.9 percent of the time available during the year, thus the average operating discharge rate was also about 221 gpm.

Since the beginning of its operation in December 1998, the off-site containment well pumped a total of about 460 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 41 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 source containment well began operating on January 3, 2002. The volume of water pumped from the well during each month of 2002 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 25 million gallons), the average discharge rate for the year was 49 gpm. The well was operated 99.8 percent of the time available during the year, thus the average operating discharge rate was also about 49 gpm.

The 25 million gallons of water that were pumped by the source containment well during this first year of its operation represent approximately 2.2 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, total chromium, iron, and manganese in the influent to and effluent from the off-site air stripper during 2002, 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 2002 fluctuated between 1,000 and 1,400 μg/L. The average TCE concentration for the year was about 1,200 μg/L. The concentrations of DCE fluctuated within a relatively narrow range and averaged about 70 μg/L. The concentrations of TCA also fluctuated within a relatively narrow range and averaged less than 5 μg/L. 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, except for the detection of TCE in the January and February samples at very low levels (0.8 and 0.6 μg/L, respectively). Total chromium concentrations in the effluent were also below the 50 μg/L maximum allowable concentration in groundwater set by NMWQCC. (The February and October effluent concentrations of chromium were reported by the laboratory as 52 and 130 μg/L, respectively; this clearly was a laboratory error as the corresponding concentrations in the influent were 40 and 30 μg/L, respectively.)

5.3.2.2 Source Containment System

The 2002 concentrations of TCE, DCE, TCA, total chromium, iron, and manganese 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 2002 declined from an initial value of 1,100 μg/L to 450 μg/L by the end of the year. The average TCE concentration for the year was about 600 μg/L. Similarly, the concentrations of DCE and TCA declined from initial values of 200 and 34 μg/L to 66 and 11 μg/L, respectively, by the end of the year. The average DCE and TCA concentrations for the year were about 100 and 20 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 four years are shown in Figure 5.15. Note that, until the end of 2001, essentially all the water pumped from the off-site containment well came from within the contaminated groundwater plume. Some of the water pumped during 2002, however, originated from areas that are outside the current, or the original (see Figure 2.15), plume boundary. The approximately 460 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 630 feet and a height equal to the saturated thickness of the aquifer above the 4800-foot clay[4]. Because of the regional gradient, the well is not at the center of the cylinder, but it is off-centered toward the downgradient side of the cylinder. 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 is not totally cylindrical; it has a smaller radius near the water table than in the deeper horizons of the aquifer. The areas shown in Figure 5.15 represent the horizon where the "cylinder" has the greatest radius.

5.3.3.2 Source Containment Well

The approximate area of origin of the water pumped from the source containment well during 2002 is also shown in Figure 5.15. As this figure indicates, most of the water pumped from the source containment well during 2002 came from within the plume. 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 25 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 300 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 has a radius that is about 250 feet; this indicates that the well is capturing water over a larger thickness than its screened interval.

5.3.4 Contaminant Mass Removal

A total of about 650 kg (1,430 lbs) of contaminants, consisting of about 605 kg of TCE (1,330 lbs), 41 kg of DCE (90 lbs), and about 4 kg of TCA (8 lbs), were removed by the two containment wells during 2002 (see Table 5.1). The total mass removed by the containment wells since the beginning of operations in December 1998 is about 2,060 kg (4,550 lbs), consisting of about 1,950 kg (4,300 lbs) of TCE, 110 kg (240 lbs) of DCE, and about 4 kg (8 lbs) of TCA. This represents about 41 percent of the total dissolved contaminant mass, 42 percent of the TCE, 39 percent of the DCE, and 3 percent of the TCA mass, currently estimated to have

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[4] A porosity of 0.3 and an average saturated thickness of 165 ft were used in estimating the radius of the cylinder.

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.

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 2002 were estimated using the monthly discharge volumes presented on Table 4.3 (a) and the concentration of these compounds shown on Table 4.4 (a). These monthly removal rates are summarized on Table 5.1 (a) and plotted in Figure 5.24. As shown on Table 5.1 (a), about 580 kg (1,270 lbs) of contaminants, consisting of about 545 kg (1,200 lbs) of TCE, 30 kg (70 lbs) of DCE, and 2 kg (4.5 lbs) of TCA were removed by the off-site containment well during 2002.

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. As shown in this figure, by the end of 2002 the off-site containment well had removed a total of approximately 1,990 kg (4,390 lbs) of contaminants, consisting of approximately 1,890 kg (4,160 lbs) of TCE, 100 kg (220 lbs) of DCE, and 2 kg (4.5 lbs) of TCA. This represents about 39 percent of the total dissolved contaminant mass, 41 percent of the TCE, 36 percent of the DCE, and 1.5 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 2002 were estimated using the monthly discharge volumes presented on Table 4.3 (b) and the concentration of these compounds shown on Table 4.4 (b). 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 70 kg (160 lbs) of contaminants, consisting of about 60 kg (130 lbs) of TCE, 10 kg (20 lbs) of DCE, and 1.6 kg (3.6 lbs) of TCA were removed by the source containment well during 2002. This represents about 1.4 percent of the total dissolved contaminant mass, about 1.3 percent of the TCE, about 3.6 percent of the DCE, and about 1.2 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). A plot showing the cumulative mass removal by the source containment well is presented in Figure 5.25.

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.

Chromium concentrations in the effluent on February 1, 2002 and October 1, 2002 exceeded the maximum allowable concentrations. However, since the chromium concentrations in the influent on those two dates were below the maximum allowable concentrations and the chromium concentrations in the effluent for the previous and subsequent samples were also below the maximum allowable concentrations, these two elevated values were judged to be laboratory errors. Thus, all sample analysis results during 2002 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 2002 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 2002.

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 2002. No violation notices were received during 2002 for activities associated with operation of the source containment system.

5.5 Contacts

During 2002 Baird Swanson (NMED Groundwater Bureau) made four routine visits to the site to obtain split samples from monitoring well MW-71R.

On July 1, 2002, a Fact Sheet (An Update on Sparton Technology's Coors Road Facility, Albuquerque, New Mexico) was mailed to property owners located above the plume and adjacent to the treated water discharge pipeline. A copy of the Fact Sheet and the list of the property owners to which it was mailed are presented in Appendix D.

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 component of the model is based on the MODFLOW96 simulation code developed by the U.S. Geological Survey (Harbaugh and McDonald, 1996). 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 containment well in December 1998 through November 2003.

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 8,050 ft by 7,300 ft. The model consists of 88 rows and 114 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 unconfined surficial aquifer. Layers 1 and 2 are 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 northwest and southeast model domain boundaries are constant head boundaries (Figure 6.1). The procedure used to estimate heads on the constant head boundaries is described in the 2002 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;
- the seasonal variation of the water levels is best represented by a sinusoidal function; 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)	25.8*	0.000047*	0.2	2 x 10^{-6}	1,2
4970-foot silt/clay unit	0.245*	0.000037*		2 x 10^{-6}	2,3
Recent Rio Grande deposits	25	0.133	0.2	2 x 10^{-6}	3-6
Sand unit	25	0.133	0.2	2 x 10^{-6}	3-11,13
4800-foot clay unit	0.017	0.000017		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 pumping rate between January and November 1999 was about 219 gpm, the average pump rate in 2000 was 216 gpm, the average pump rate in 2001 was 216 gpm, and the average pump rate in 2002 was 221 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. 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. Use of the ponds is rotated, with only two ponds used for infiltration at any given time.

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, and irrigated fields. 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 10 ft/yr. Recharge from the irrigated fields east of the Corrales Main Canal was simulated at a rate of 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.

6.1.2 Model Calibration

The calibrated groundwater flow model described in 2002 Annual Report was used to simulate water levels from the start of pumping at well CW-1 in November 1998 through November 2002. The simulated water levels in the sand unit above the 4970-foot silt/clay unit poorly matched observed water levels in 2002, the first year of operation of CW-2 and the on-site infiltration ponds. As a result, the groundwater model was recalibrated to obtain better estimates of the hydraulic properties of the 4970-foot silt/clay unit, and the sand unit above the 4970-foot silt clay unit. Five sets of water level data were used as calibration targets in the model recalibration: water levels in November 1998 (refer to Table 2.4), water levels in October 1999 (refer to Table 4.1 of 1999 Annual Report), water levels in November 2000 (refer to Table 4.1 of 2000 Annual Report), water levels in November 2001 (refer to Table 4-1 of 2001 Annual Report) and water levels in November 2002 (refer to Table 4-1).

The minor 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 were changed to 25.8 and 0.000047 ft/d, respectively.
- The horizontal and vertical hydraulic conductivity of the 4970-foot silt/clay unit was changed to 0.245 and 0.000037 ft/d, respectively.

6.1.3 Transient Simulation – January 1998 to December 2002

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 2002. Monthly 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 2002, 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 2002 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 2002. 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 1246 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 0.80 ft, the mean of the absolute value of the residuals is 1.3 feet, and the sum of squared residuals is 3,911 ft^2. The absolute mean residual of 1.3 feet is considered acceptable since the observed water-level measurements applied as calibration targets have a total range of 28 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 E.

6.1.4 Capture Zone Analysis

The capture zones of containment wells CW-1 and CW-2 in November 2002 were calculated using particle tracking. The particle tracking was applied to the calculated November 2002 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 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 2001. 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 10 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, and 2002 originated. The area of origin of the water pumped from the aquifer in 1999, 2000, 2001, and 2002 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-1was 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 well are operating continuously at their current pumping rates and that water levels remain at their 2002 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 2002.

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 until a reasonable match was obtained between the calculated and measured TCE concentrations and TCE mass removal at both the off-site and source containment wells, CW-1 and CW-2, between December 1998 and December 2002. Once the model was calibrated, the model was used to predict TCE concentrations in the aquifer between January 2003 and December 2003. 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 2002, DCE was about 5 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, only in monitoring wells at the facility. In the latest sampling round conducted in November 2002, TCA concentrations exceeded 60 µg/L in only one well (63 µg/L in well MW-46). 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 in All Units
Porosity	0.3
Longitudinal dispersivity	25 ft
Transverse horizontal dispersivity	0.25 ft
Transverse vertical dispersitvity	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 x 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, that 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 (2000 Annual Report), in 2002 (2001 Annual Report), 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. A trial and error calibration procedure was used to estimate the concentrations at the control points in the initial calibration and in the recalibration in 2000. Last year, the control point concentrations were estimated using the parameter estimation code PEST (Doherty, 2000). The

PEST code was again used this year with control points near both the off-site and the source containment wells CW-1 and CW-2.

The calibration process has resulted in an excellent 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	1.4	190	218		
January 3, 2000	359	378	860	1,056		
January 2, 2001	822	870	1,200	1,176		
January 3, 2002	1,340	1,367	1,100	1,119	1,100	1,100
January 3, 2003	1,944	1,965	1,300	1,221	450	331

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 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), and to the current estimate of about 4650 kg (12,250 lbs) shown on Table 6.1.

A comparison of calculated to observed concentrations of TCE at all monitoring wells for all samples analyzed between for November 1998 and November 2002 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 2002. 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 2003

The groundwater transport model was applied to predict TCE concentrations through December 2003 after 60 months of pumping at well CW-1, and after 24 months of pumping at CW-2. The off-site containment well CW-1 was assumed to pump at an average rate of 221 gpm, and the source containment well CW-2 was assumed to pump at an average rate of 49 gpm in 2003. The TCE concentrations calculated for December 2002 are specified as the initial conditions for the predictive groundwater transport model.

The predicted TCE concentrations in November 2003 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 494 kg (1,090 lbs) of TCE by containment well CW-1 and 23 kg (51 lbs) from containment well CW-2 is predicted for the period of January 2003 to December 2003. The calculated TCE concentration at well CW-1 in December 2003 is 1,133 µg/L, and the calculated TCE concentration at CW-2 in December 2003 is 190 µg/L. The initial TCE concentration used in the transport model, and the calculated TCE concentrations in November 2000, November 2001, November 2002, and November 2003 are compared 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. An attempt will be made to understand why the estimate of the mass of TCE in the aquifer has more than doubled since the first model was developed in 2000 for the 1999 Annual Report, and the implications of the changing estimates of mass in the aquifer for predicting future water-quality conditions and assessing aquifer restoration.

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 2002 was the fourth 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 2002 was essentially the first full 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 2002, 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 221 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 began operating on January 3, 2002 and continued to operate throughout the remainder of the year at an average rate of 49 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 2002 and to predict concentrations in November 2003.

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 flow patterns that captured most of the contaminated water migrating from the site, and thus controlled any potential sources that may be contributing to groundwater contamination.

The extent of groundwater contamination, as defined by the extent of the TCE plume, did not change significantly during 2002. The leading edge of the DCE plume advanced beyond its position during the previous year, but the plume remains well within the capture zone of the containment wells.. The TCA plume essentially disappeared during 2002; there is only one well with TCA concentrations slightly 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, the relatively high concentrations that have been observed during 2002 in the water pumped from CW-2, and the concentrations history of well MW-60 indicate the presence of high concentration areas upgradient from the containment wells. This conclusion continues to be confirmed by the results of model recalibration efforts during the last several years.

The off-site and source containment wells operated at a combined average rate of 270 gpm during 2002. A total of about 142 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 485 million gallons and represents 43 percent of the initial pore volume.

Approximately 650 kg (1,430 lbs) of contaminants consisting of 605 kg (1,330 lbs) of TCE, 41 kg (90 lbs) of DCE, and about 4 kg (8 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 2,060 kg (4,550 lbs) consisting of 1,950 kg (4,300 lbs) of TCE, 110 kg (240 lbs) of DCE, and about 4 kg (8 lbs) of TCA. This represents about 41 percent of the total dissolved contaminant mass (42 percent of the TCE, 39 percent of the DCE, and 3 percent of the TCA mass) currently estimated to have been present in the aquifer prior to operation of the containment well.

The remedial systems were operated with only minor difficulties during 2002. Both containment systems operated essentially continuously, with total down time of less than a day. The wellhead of five monitoring wells at an off-site well-cluster location was modified to accommodate the regrading of the land for a residential development. Three on-site and two off-site water table monitoring wells that were dry for the last several years were plugged in May. A new DFZ monitoring well, MW-71R, was installed in February to replace well MW-71 which was plugged in 2001after a long history of leakage and contamination problems. Samples collected from the replacement well during 2002 indicated the continuing presence of contaminants in the DFZ.

7.2 Future Plans

The off-site containment system 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 2002. Based on the performance of the rapid infiltration ponds during 2002, 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.

Dry monitoring wells MW-35, MW-36, MW-52, and PW-1 will be plugged and abandoned. Monitoring well MW-52 will be replaced with a new well within a few hundred feet of the original well. Monitor well MW-33 will be observed for an additional year prior to deciding whether to plug or replace it.

To assess the severity of the problem associated with the detection of contaminants in the DFZ monitoring well MW-71R, which was installed as a replacement for MW-71, the well will be pumped at a rate of about 40 gpm. Sparton is in the process of negotiating the purchase, or lease, of a vacant lot about 150 feet south of MW-71R. The pumped water will be conveyed to this lot for treatment by activated carbon. A dry well will be installed on the lot for returning the treated water into the vadose zone above the existing contaminant plume. The well will be drilled with an auger to depth of 100 to 150 feet and will be equipped with 50 feet or more of screen. Samples of the influent to and effluent from the treatment unit will be obtained weekly during the first month of operation and monthly thereafter. Data from these samples will be evaluated to determine whether to continue or terminate the pumping or whether additional measures are necessary. The system will be operated for a year unless the data lead to an earlier conclusion on appropriate action. (If Sparton is not successful in acquiring access to the vacant lot, another alternative will be developed and proposed to the regulatory agencies.)

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

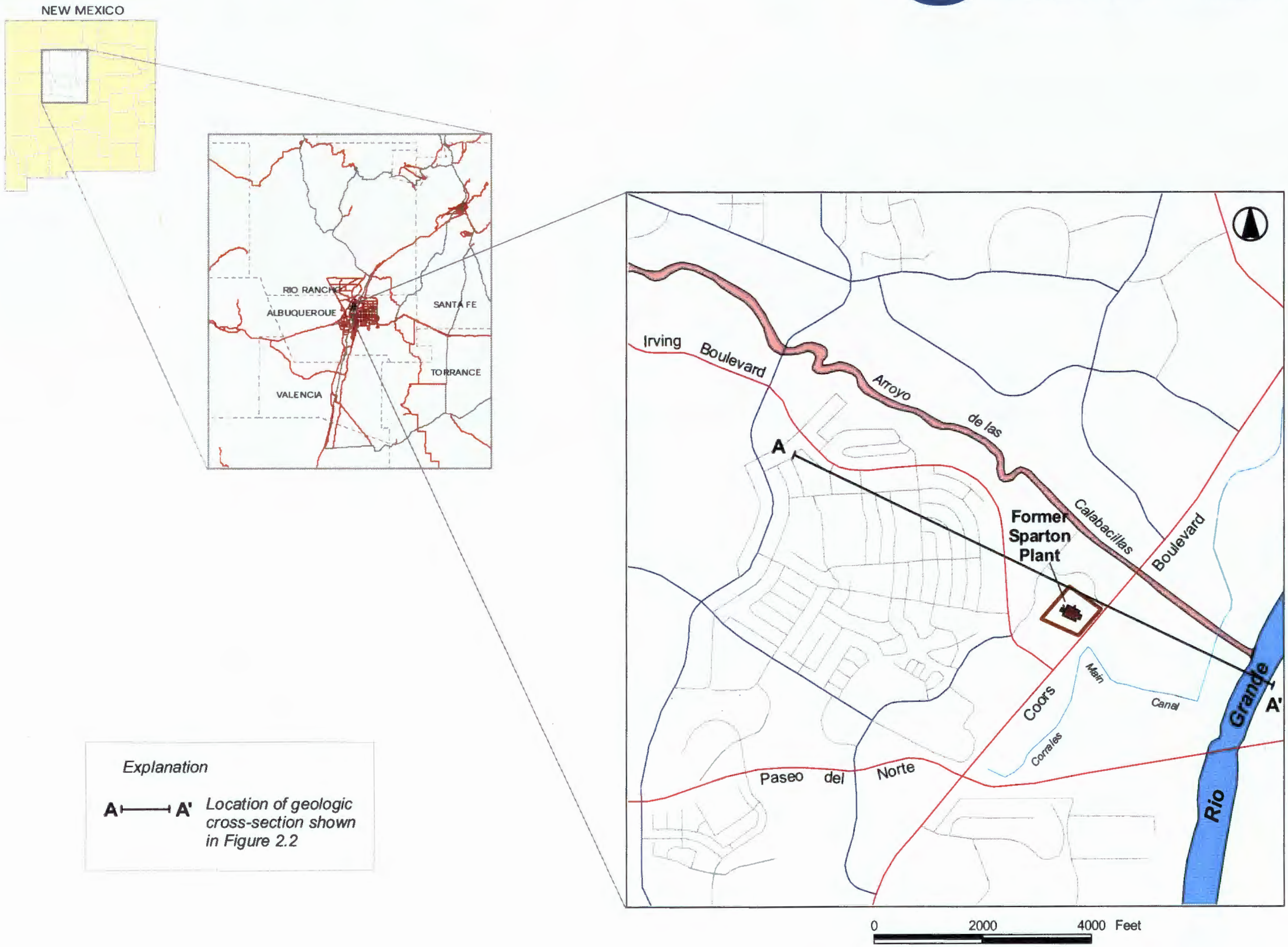


Figure 1.1 Location of the Former Sparton Coors Road Plant

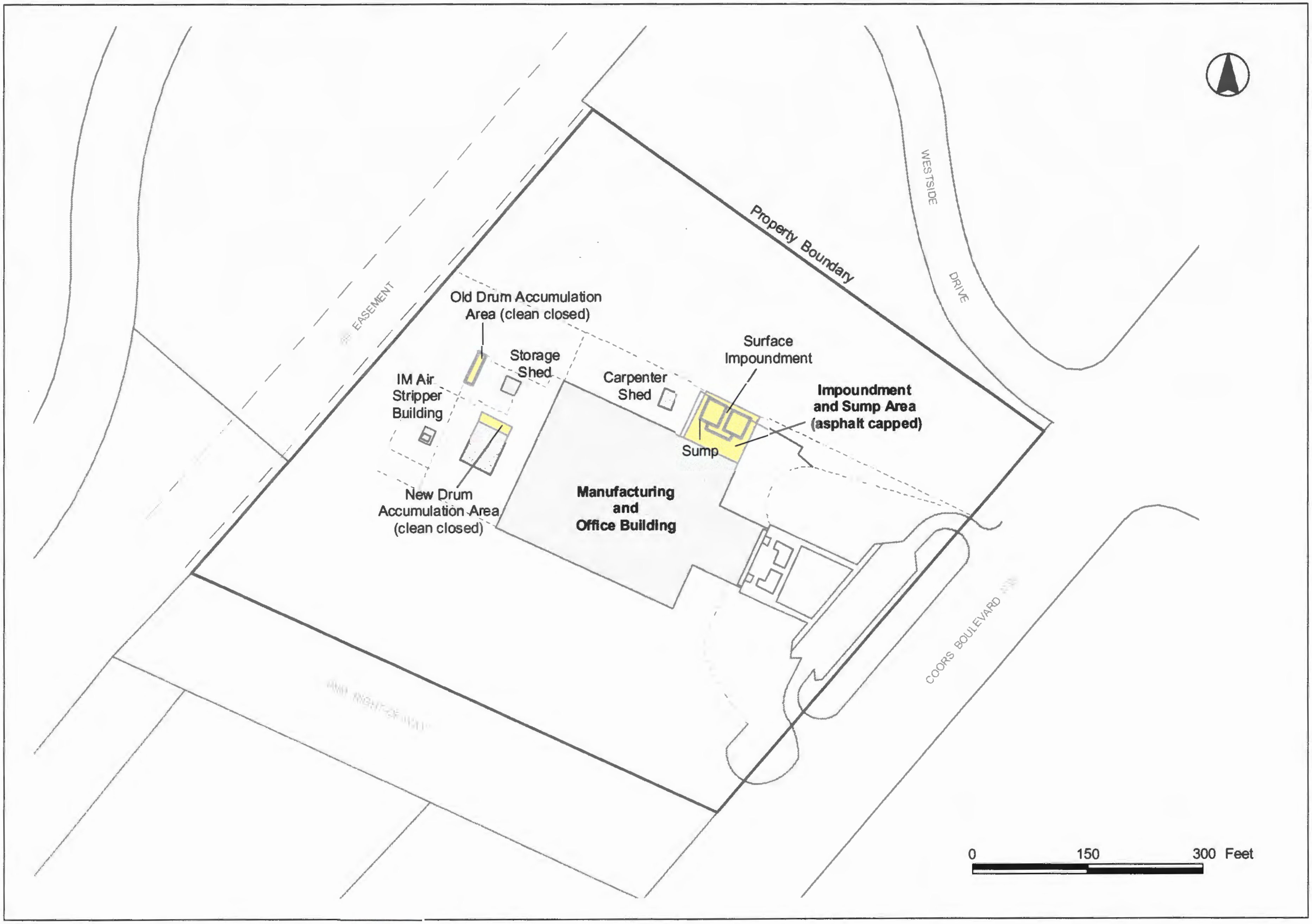
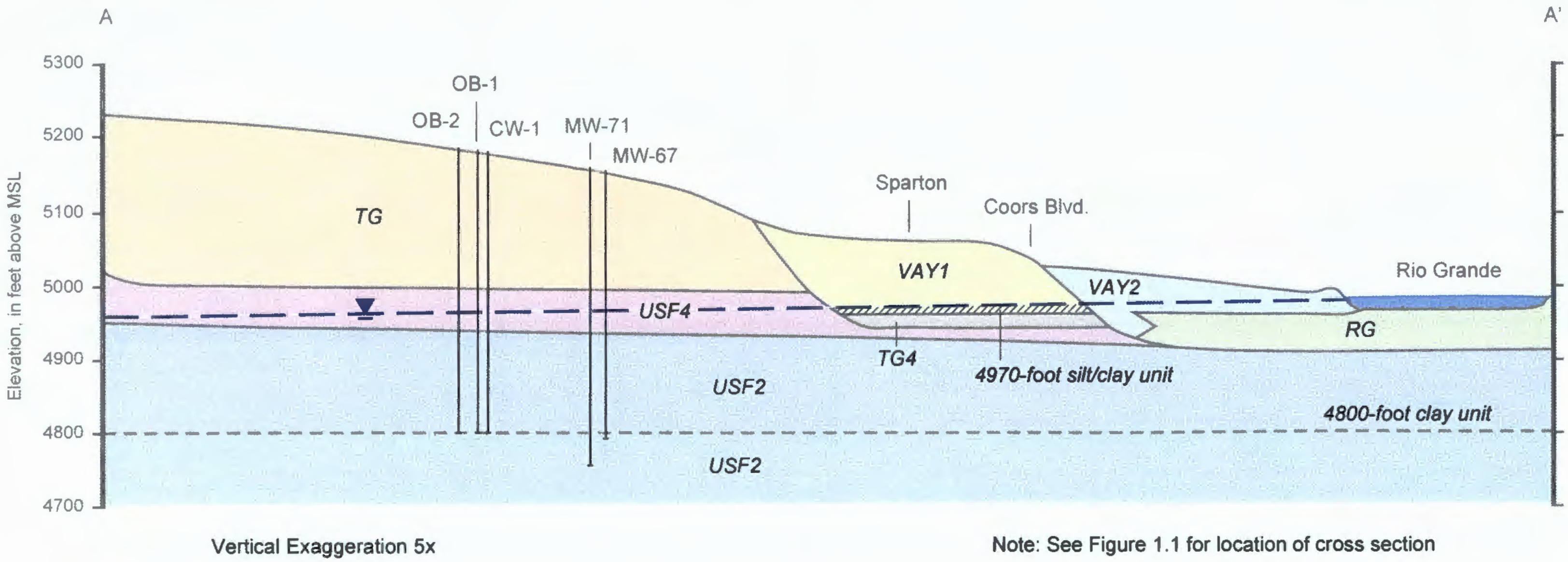


Figure 2.1 The Former Sparton Coors Road Plant



Explanation

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

Figure 2.2 Geologic Cross Section Showing Shallow Deposits

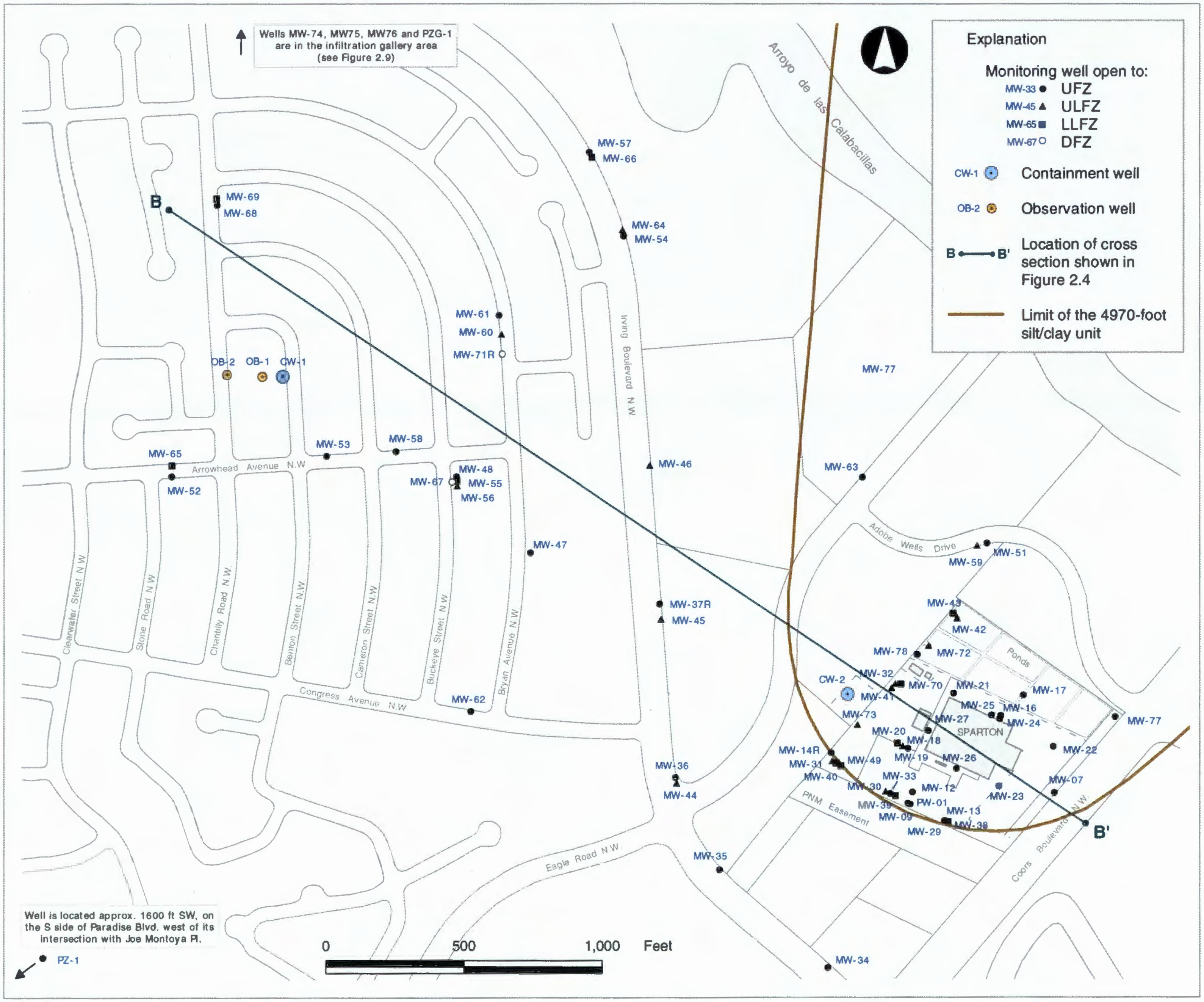


Figure 2.3 Location of Wells

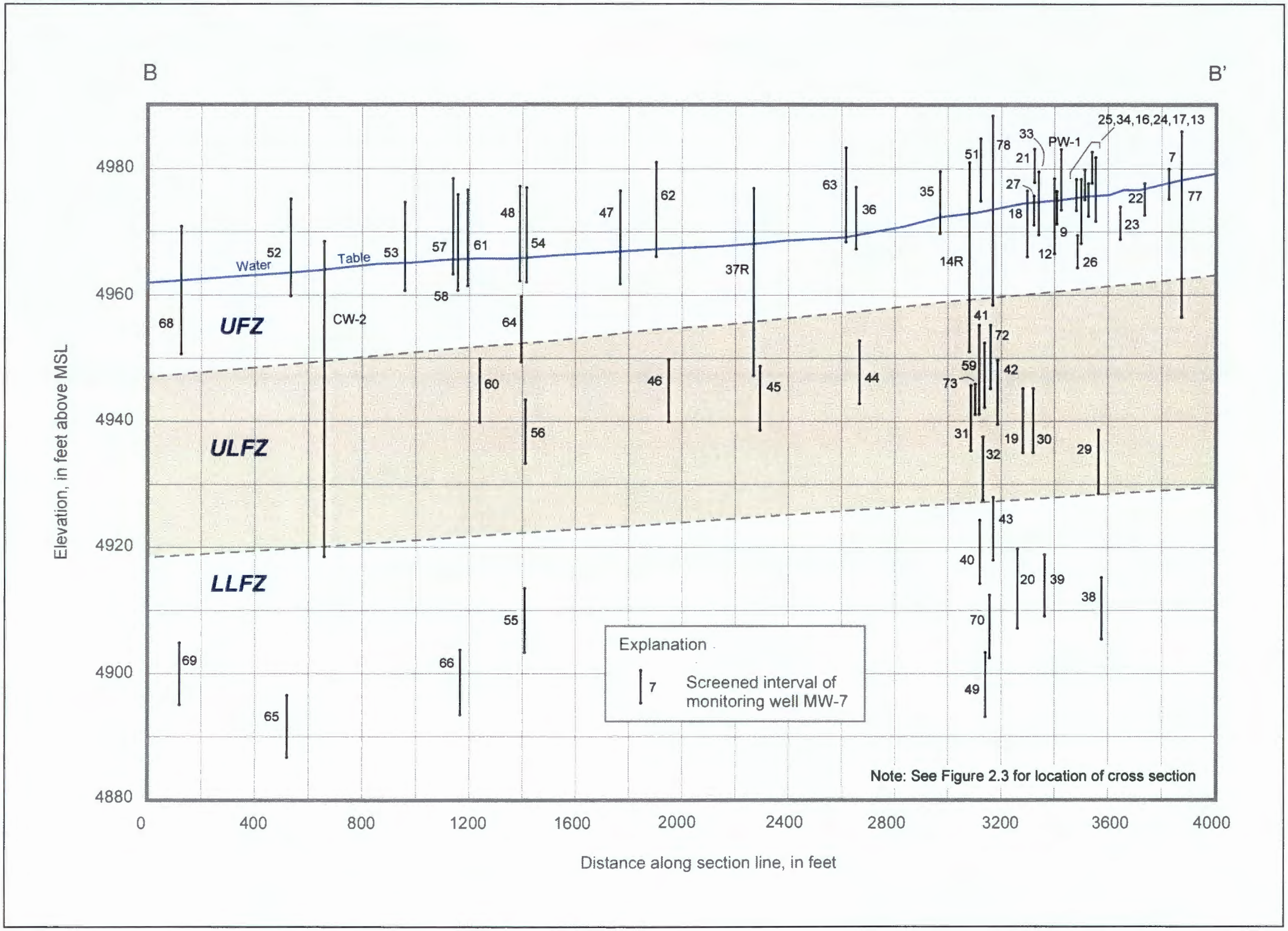


Figure 2.4 Screened Interval of Monitoring Wells and Relation to Flow Zones

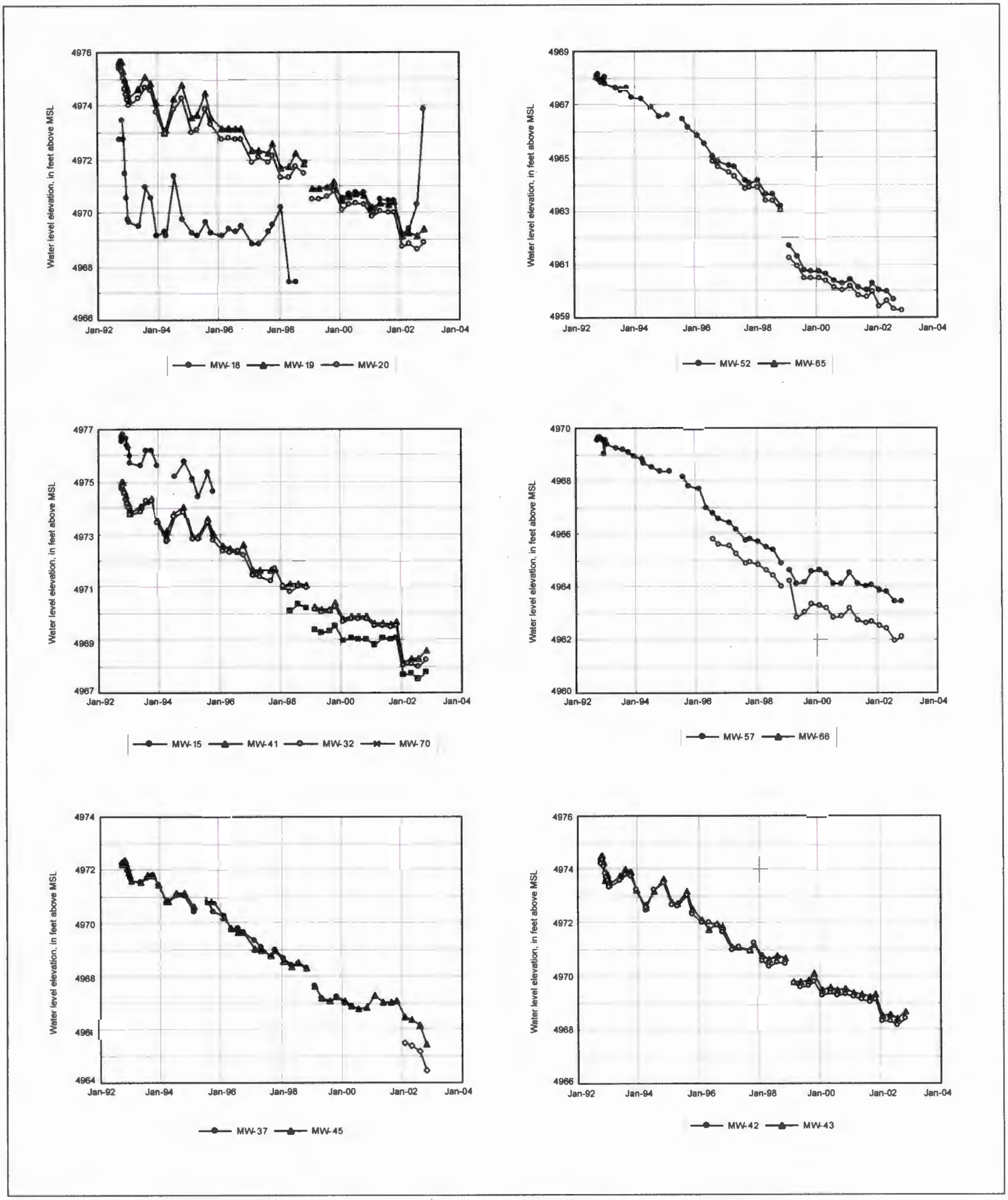


Figure 2.5 Monitoring Well Hydrographs

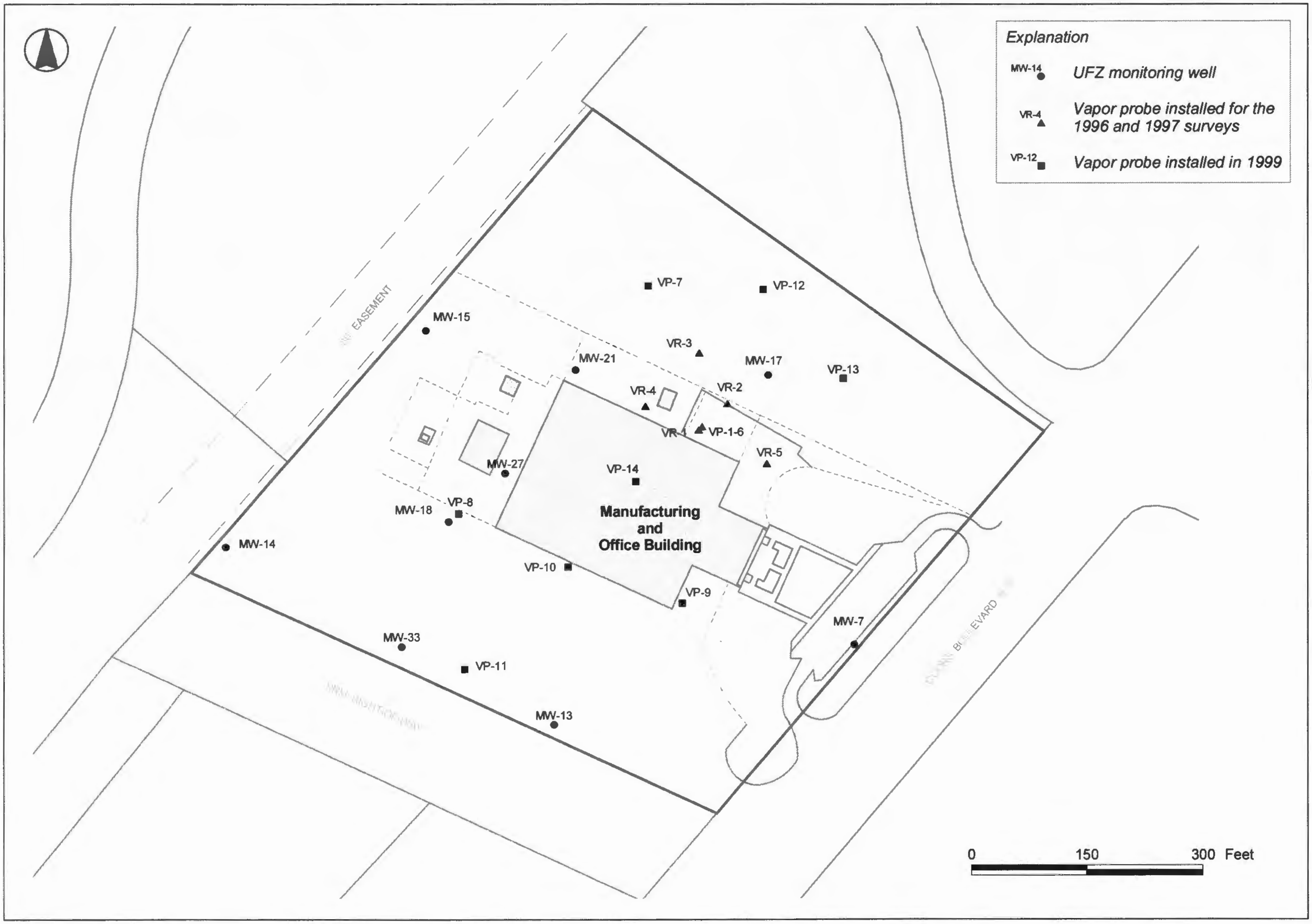


Figure 2.6 Location of Vapor Probes and On-Site Monitoring Wells Used in Vadose Zone Characterizations

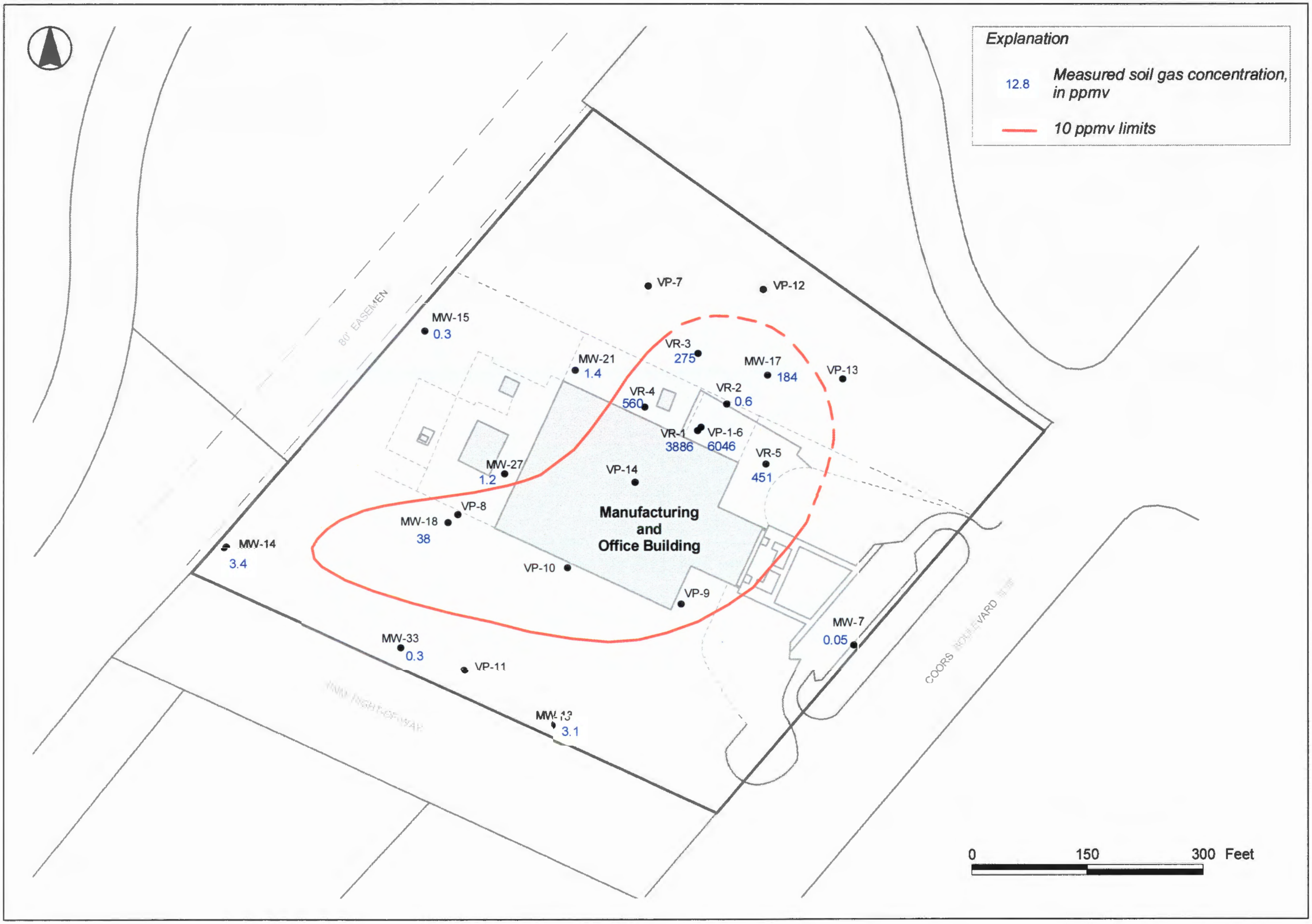


Figure 2.7 TCE Concentrations in Soil Gas - April 1996 - February 1997 Survey

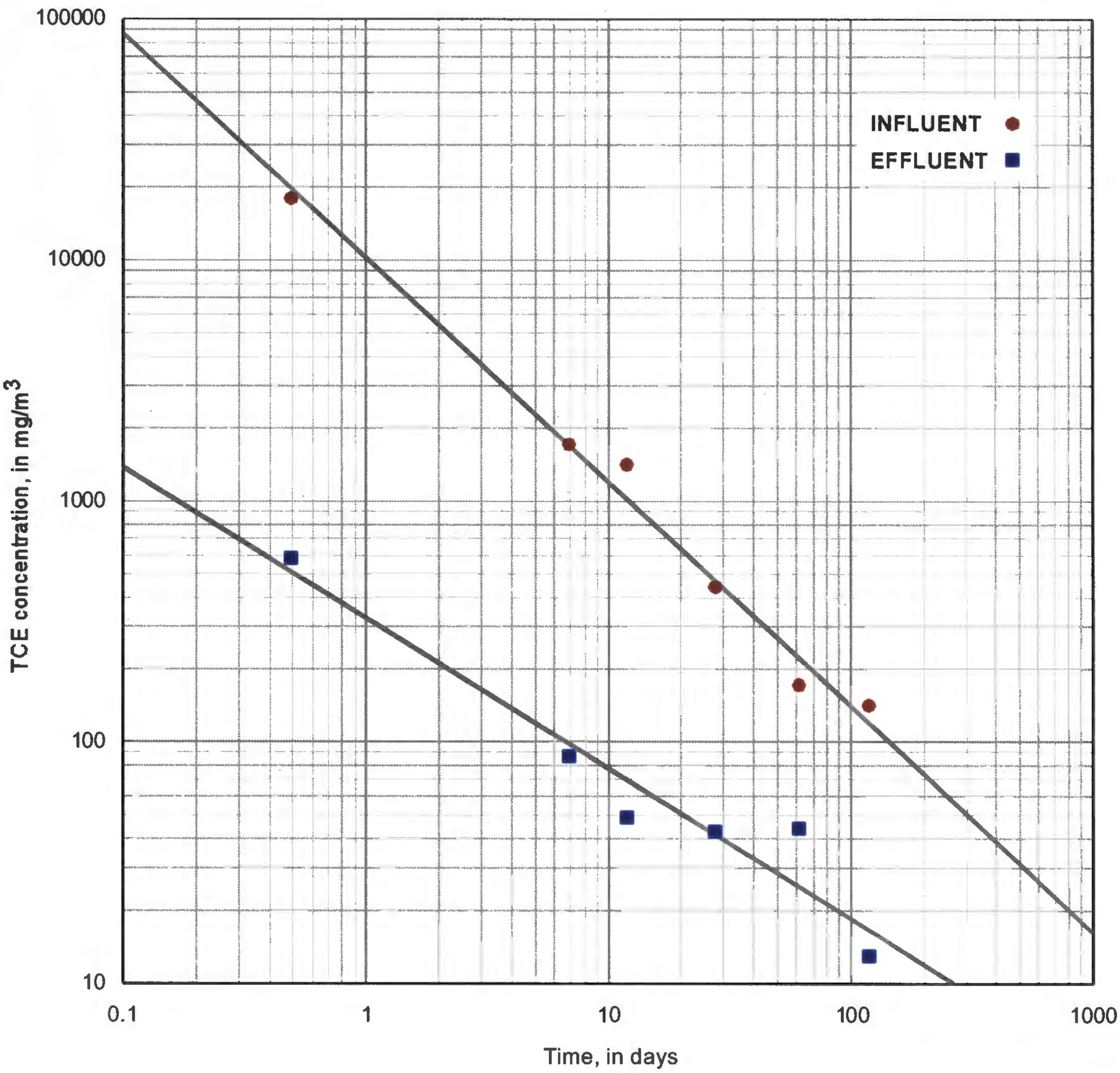


Figure 2.8 Influent and Effluent Concentrations - SVE Operation
April 8 - October 20, 1998

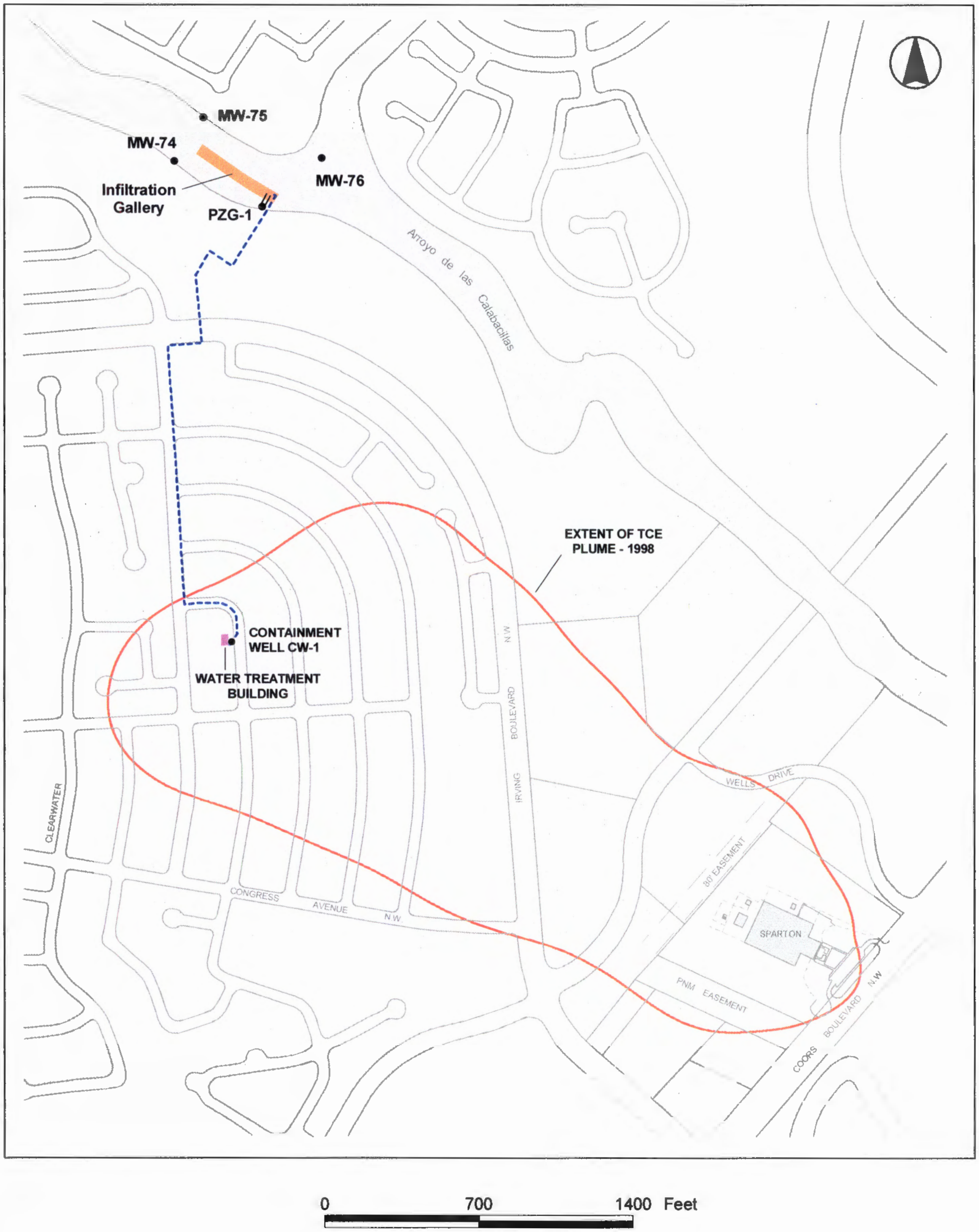


Figure 2.9 Layout of the Off-Site Containment System Components

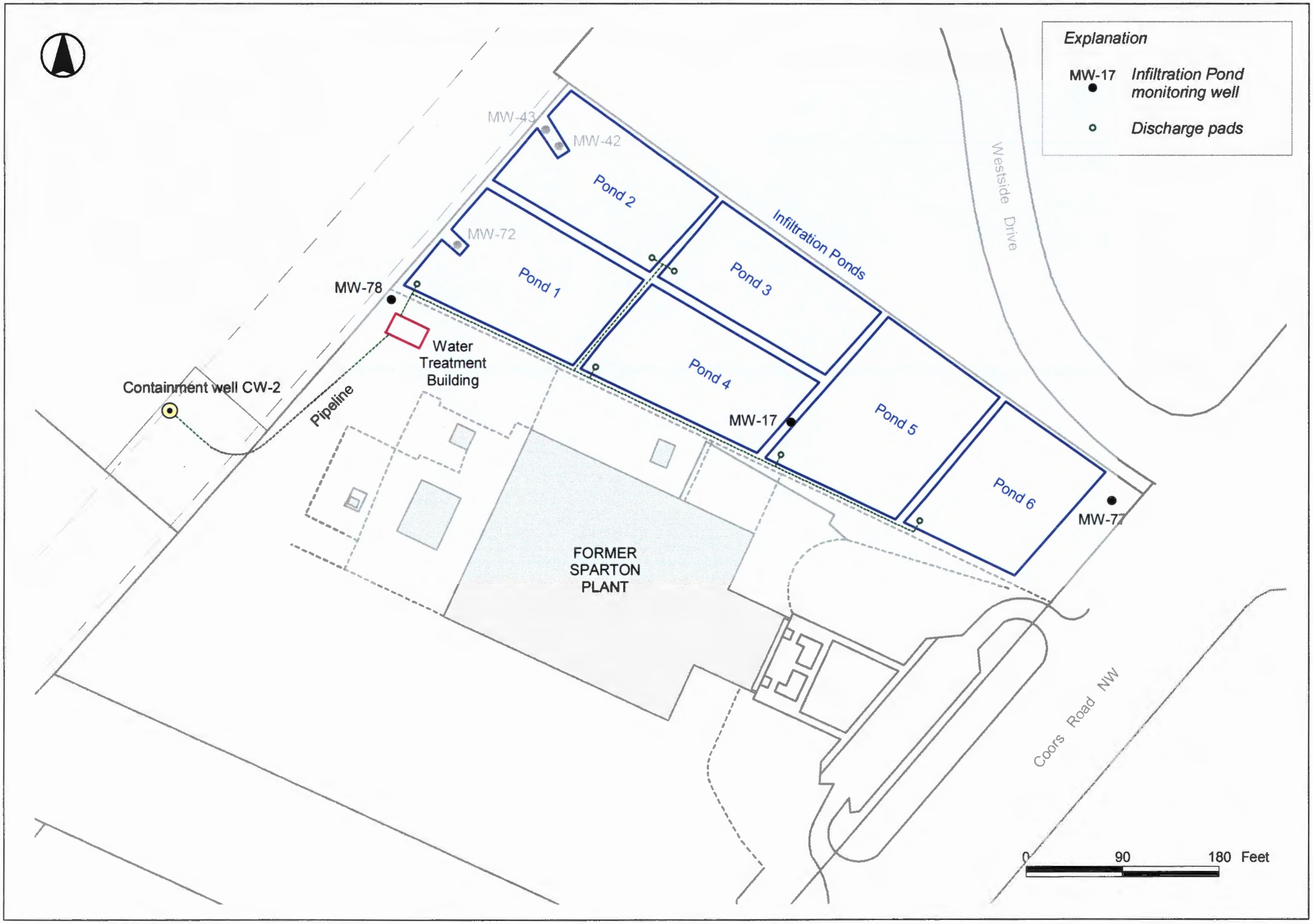


Figure 2.10 Layout of the Source Containment System Components

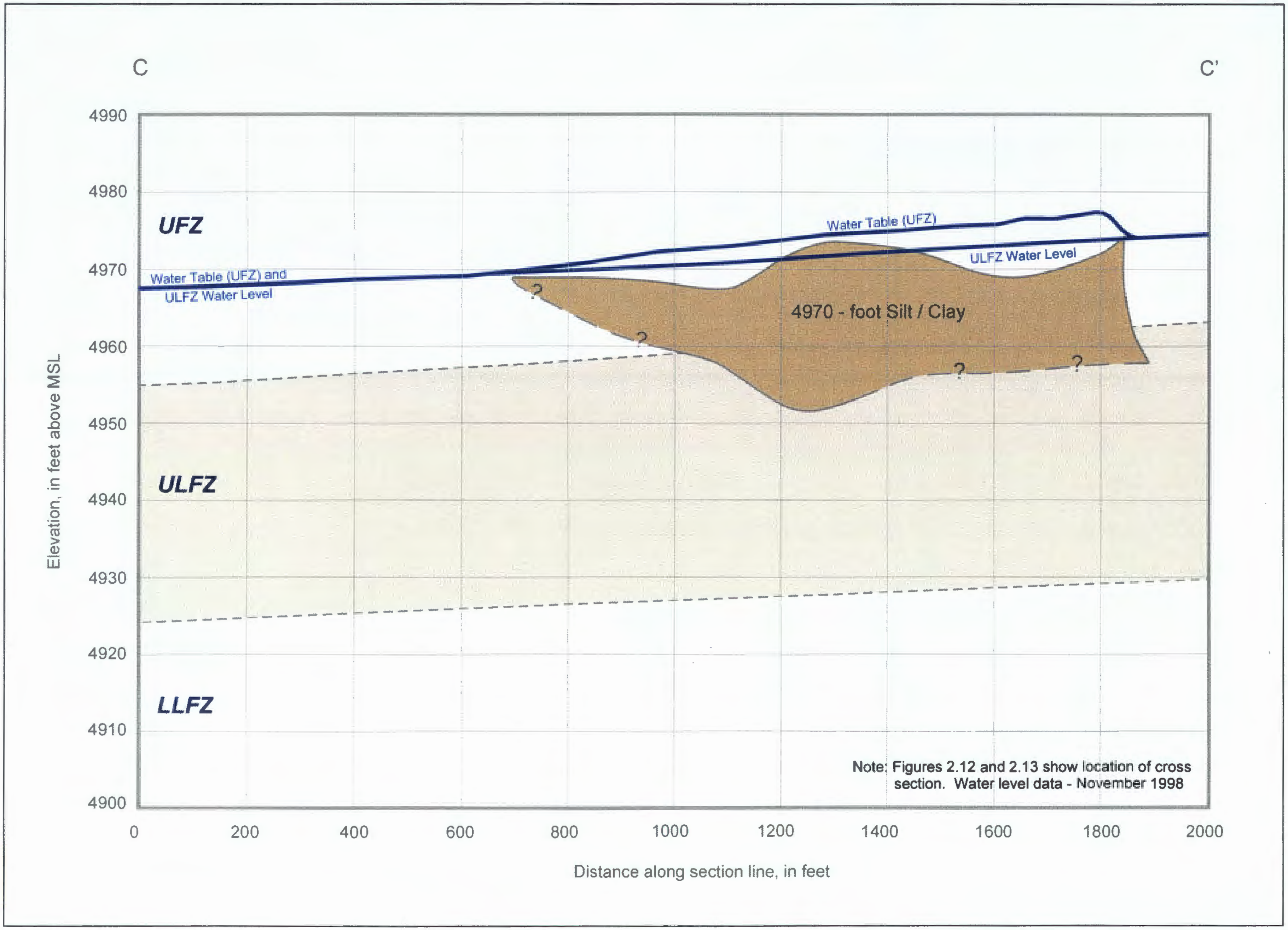


Figure 2.11 Schematic Cross-Section of the UFZ and ULFZ Water Levels

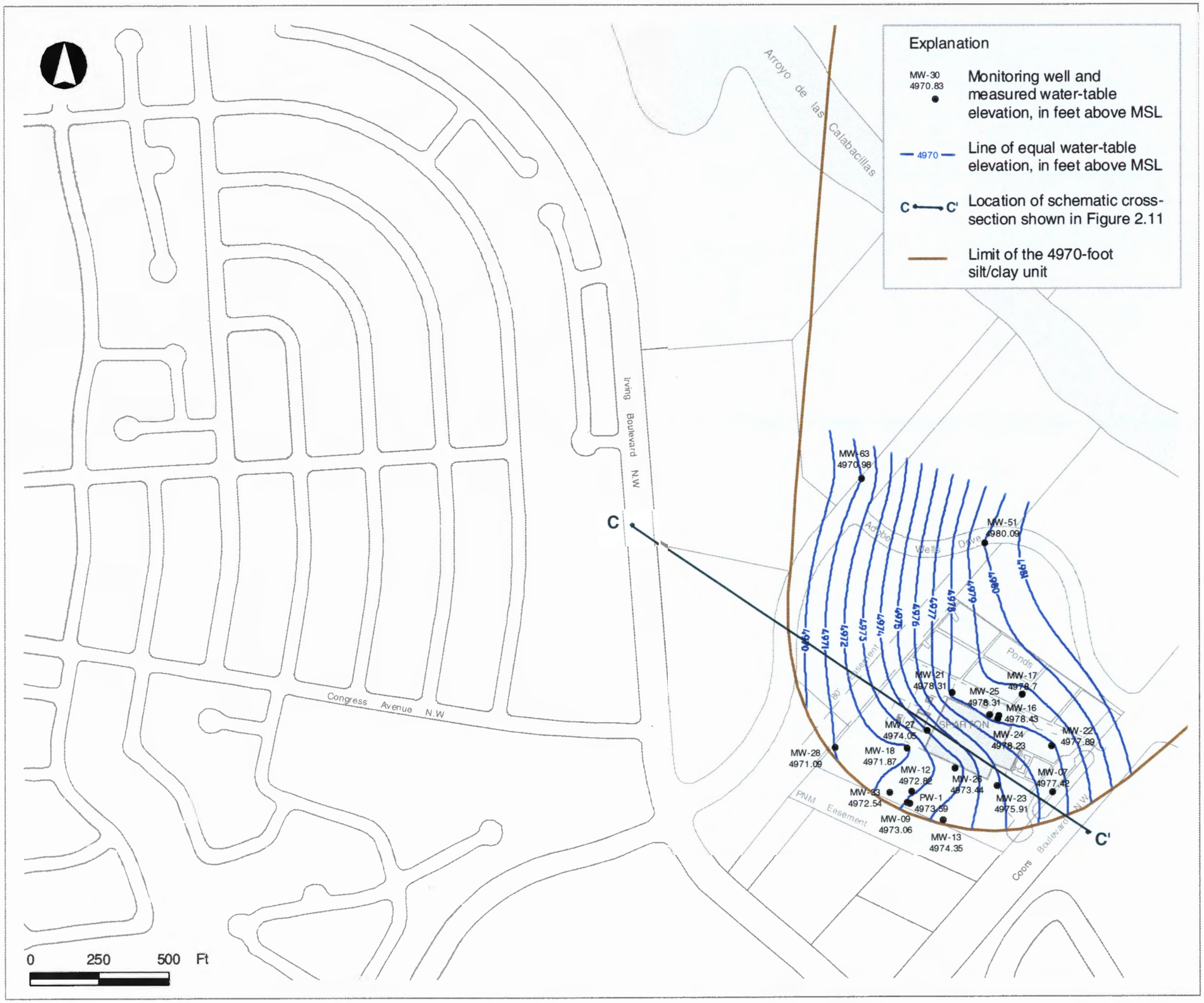


Figure 2.12 Elevation of the On-Site Water Table - November 1998

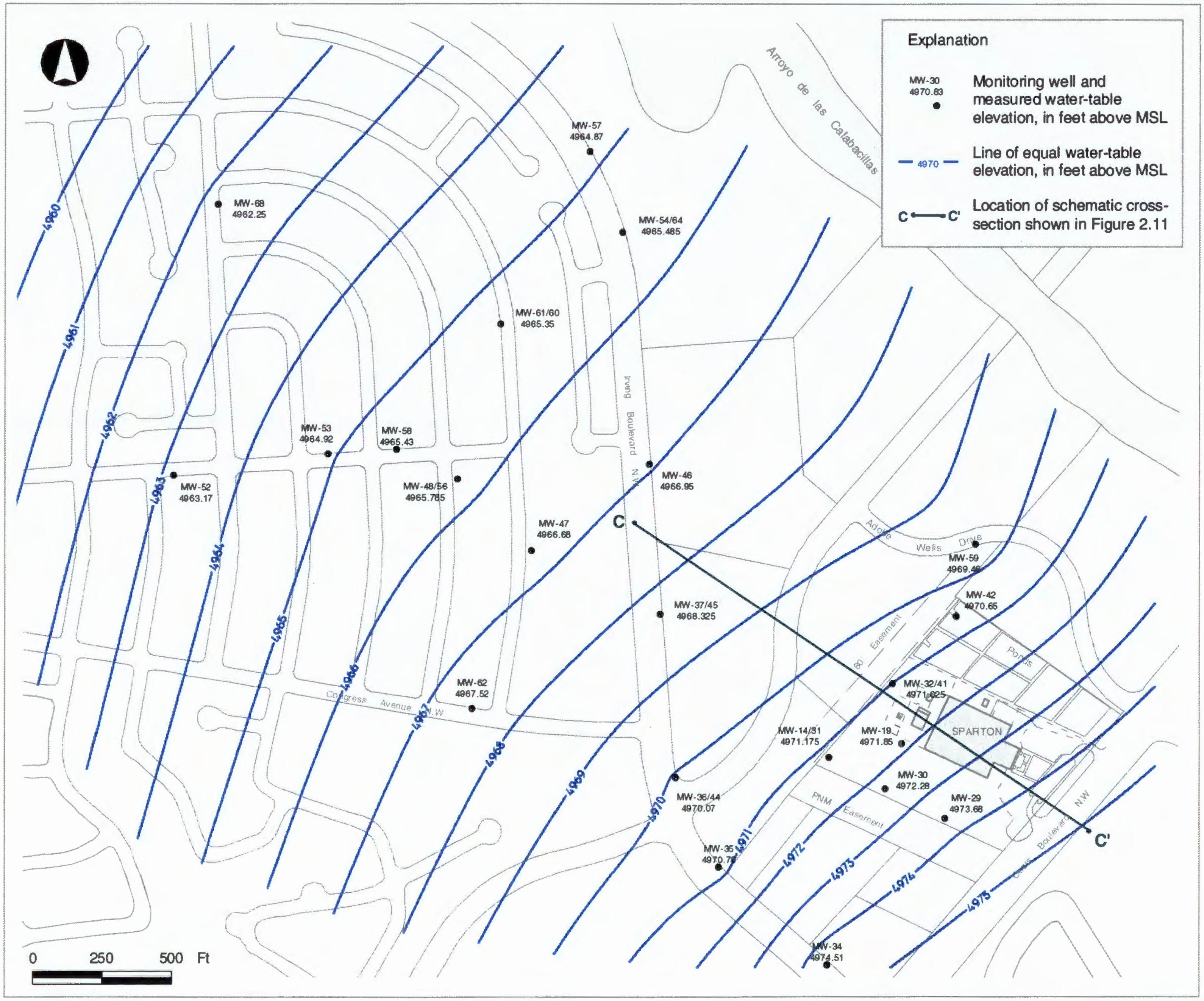


Figure 2.13 Elevation of the Water Levels in the UFZ/ULFZ - November 1998

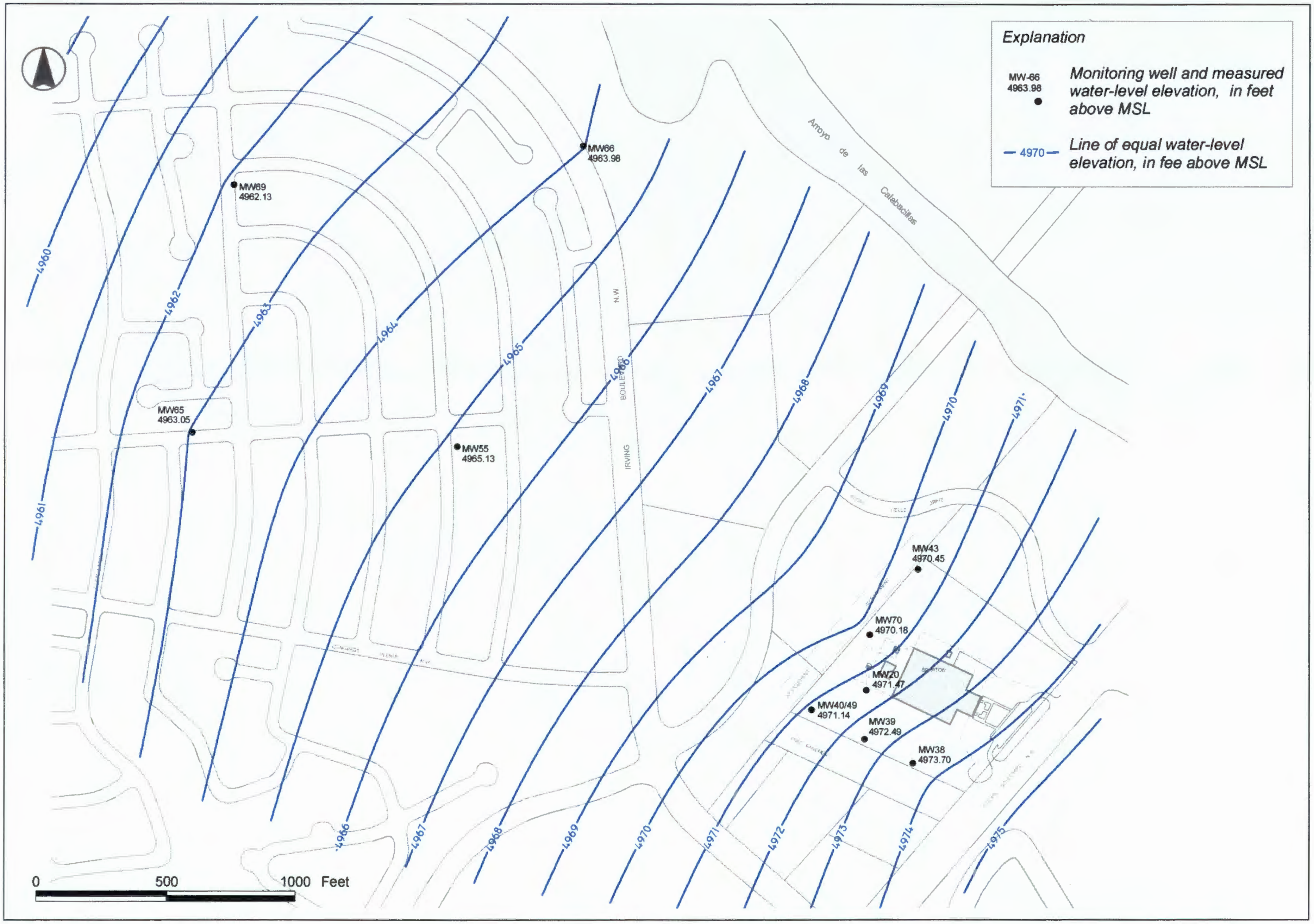


Figure 2.14 Elevation of the Water Levels in the LLFZ - November 1998

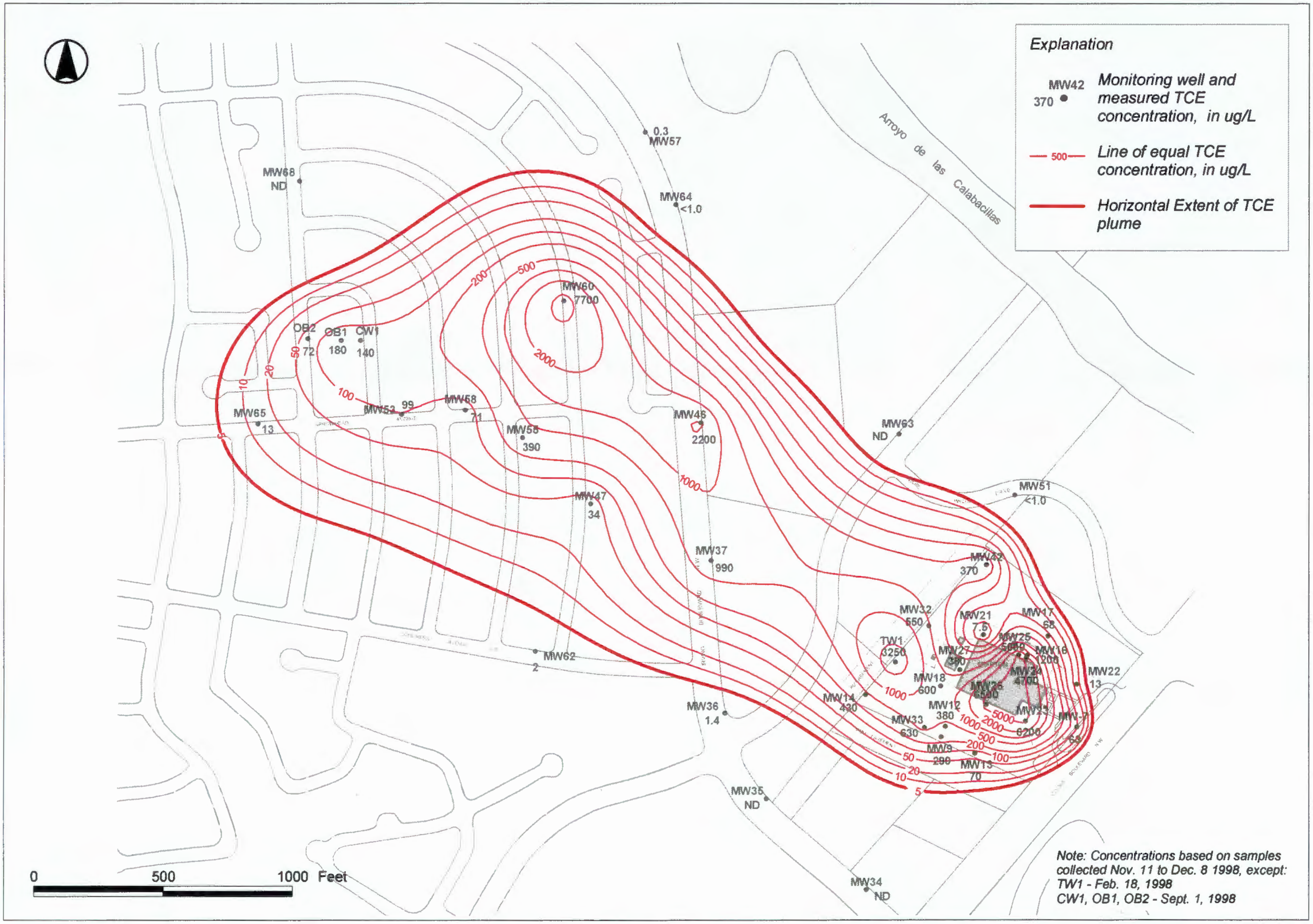


Figure 2.15 Horizontal Extent of TCE Plume - November 1998

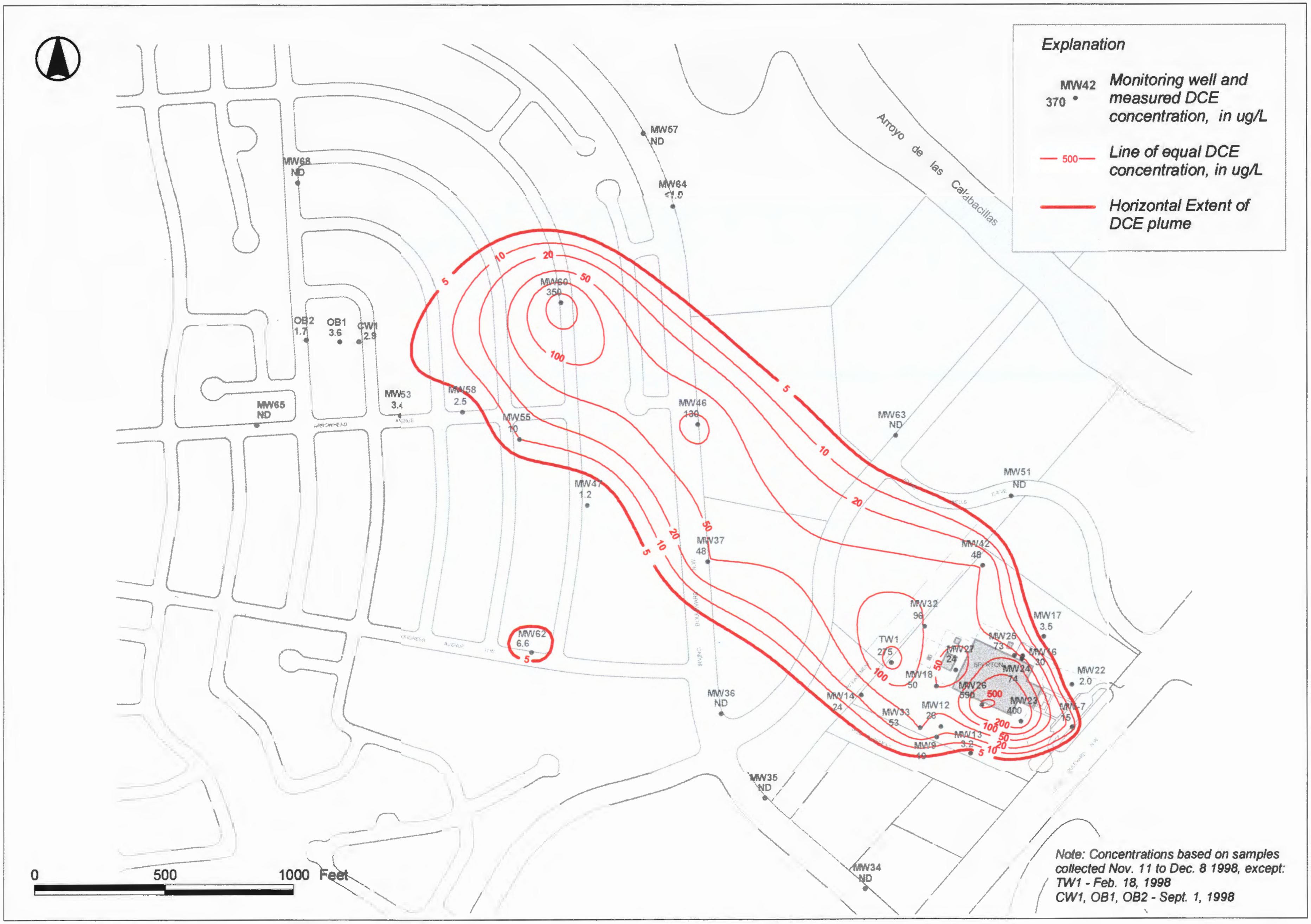


Figure 2.16 Horizontal Extent of DCE Plume - November 1998

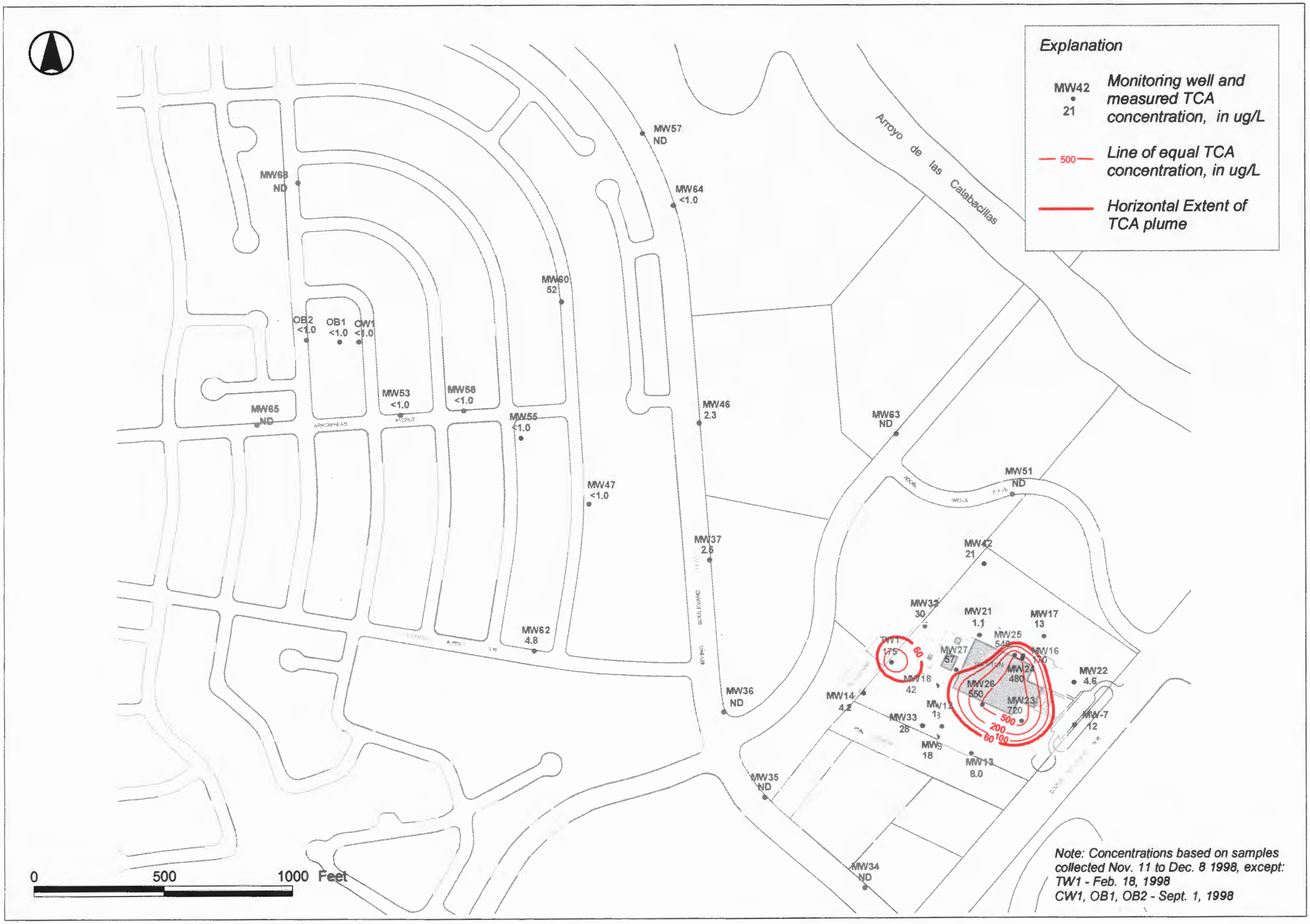


Figure 2.17 Horizontal Extent of TCA Plume - November 1998

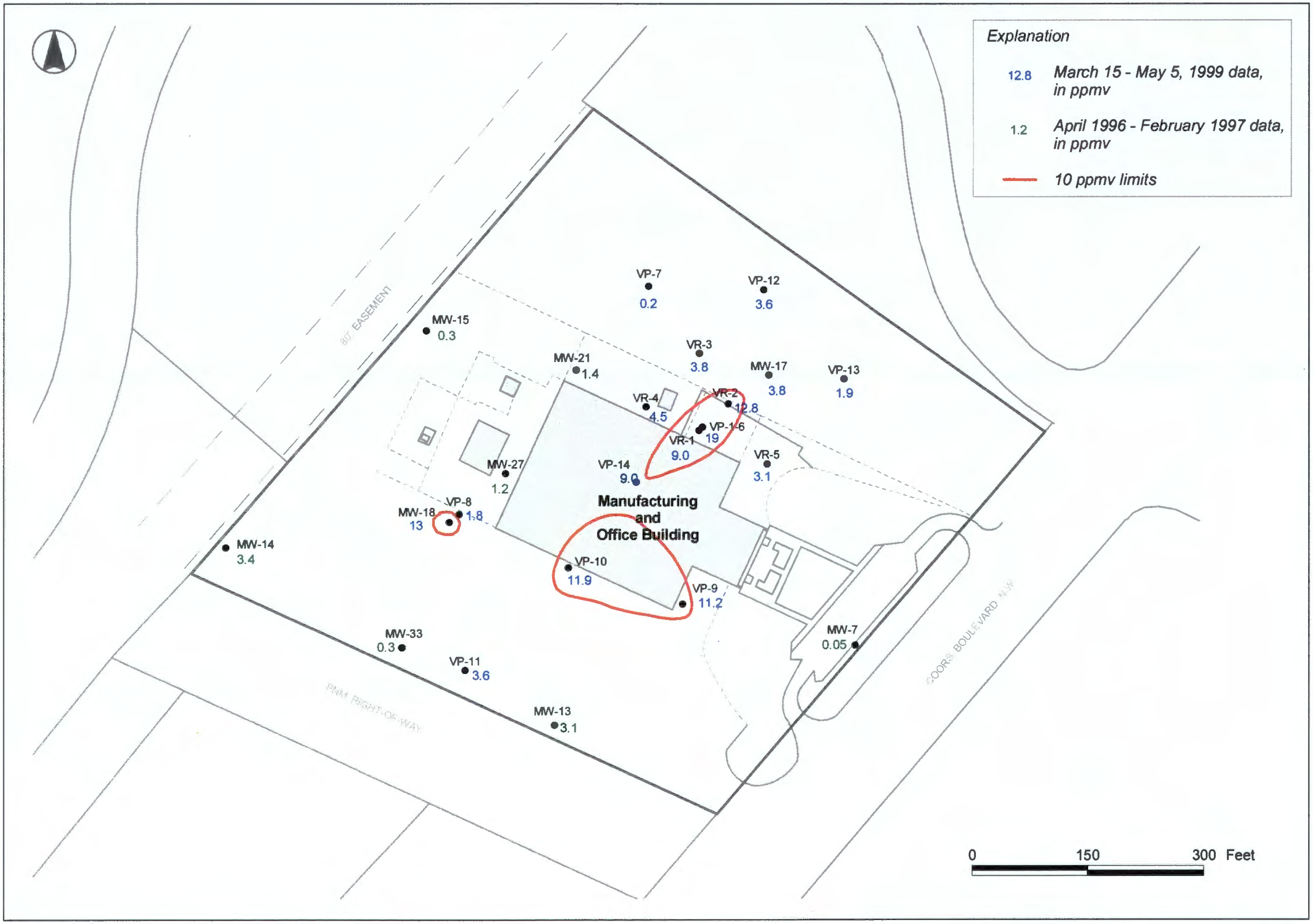


Figure 2.18 TCE Soil Gas Concentrations Prior to the 1999 Resumption of SVE System Operations

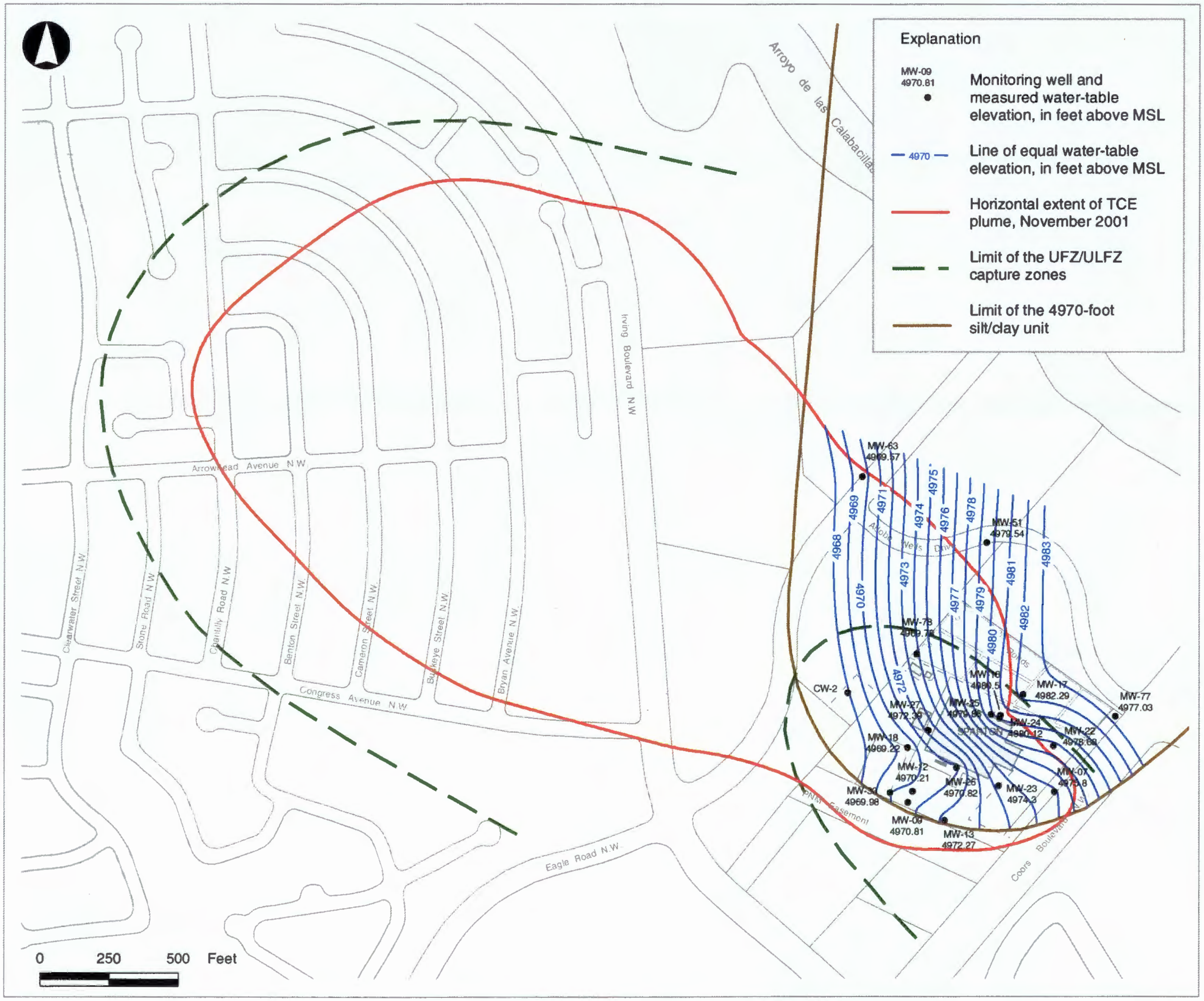


Figure 5.1 Elevation of the On-Site Water Table - February 1, 2002

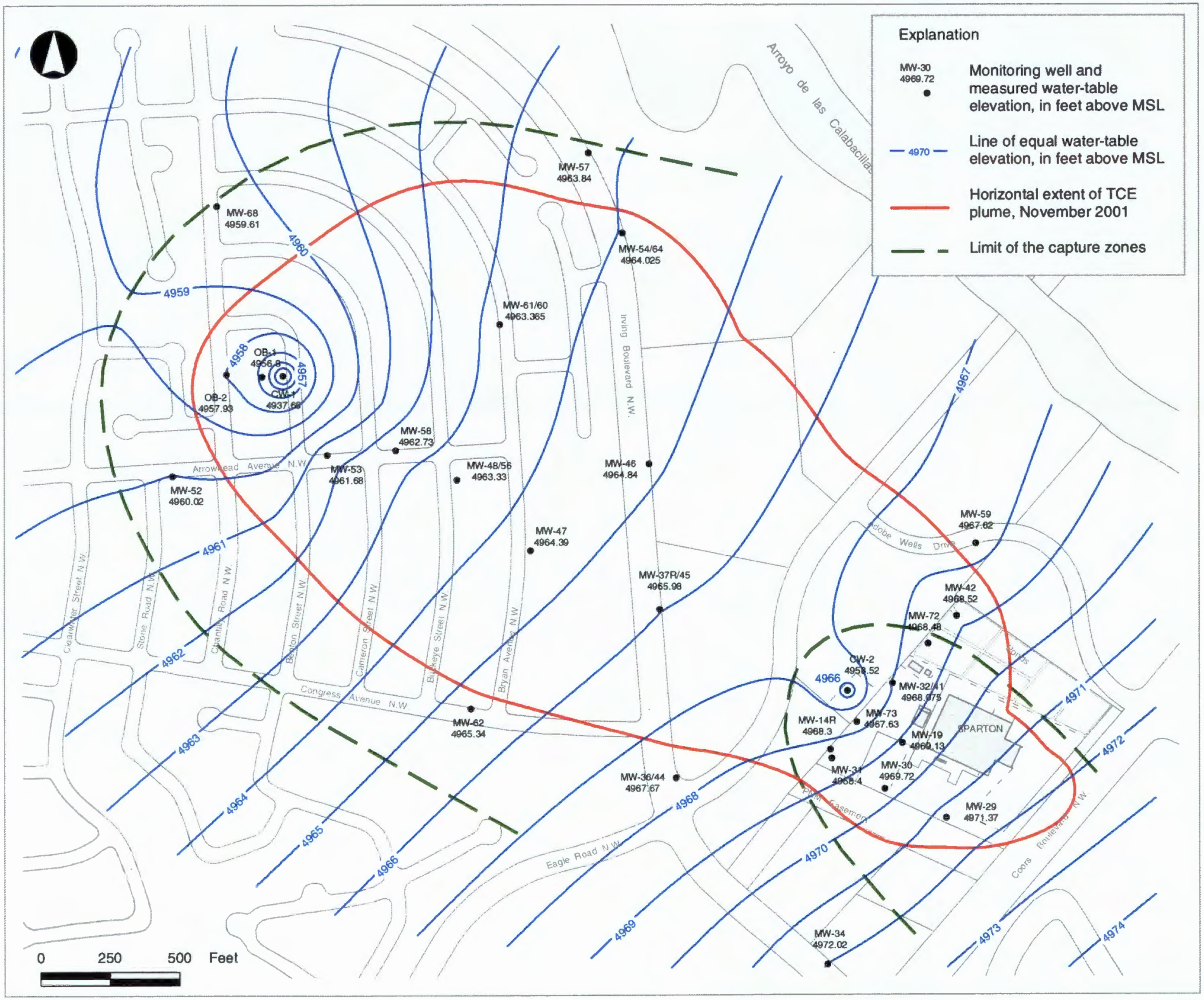


Figure 5.2 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - February 1, 2002

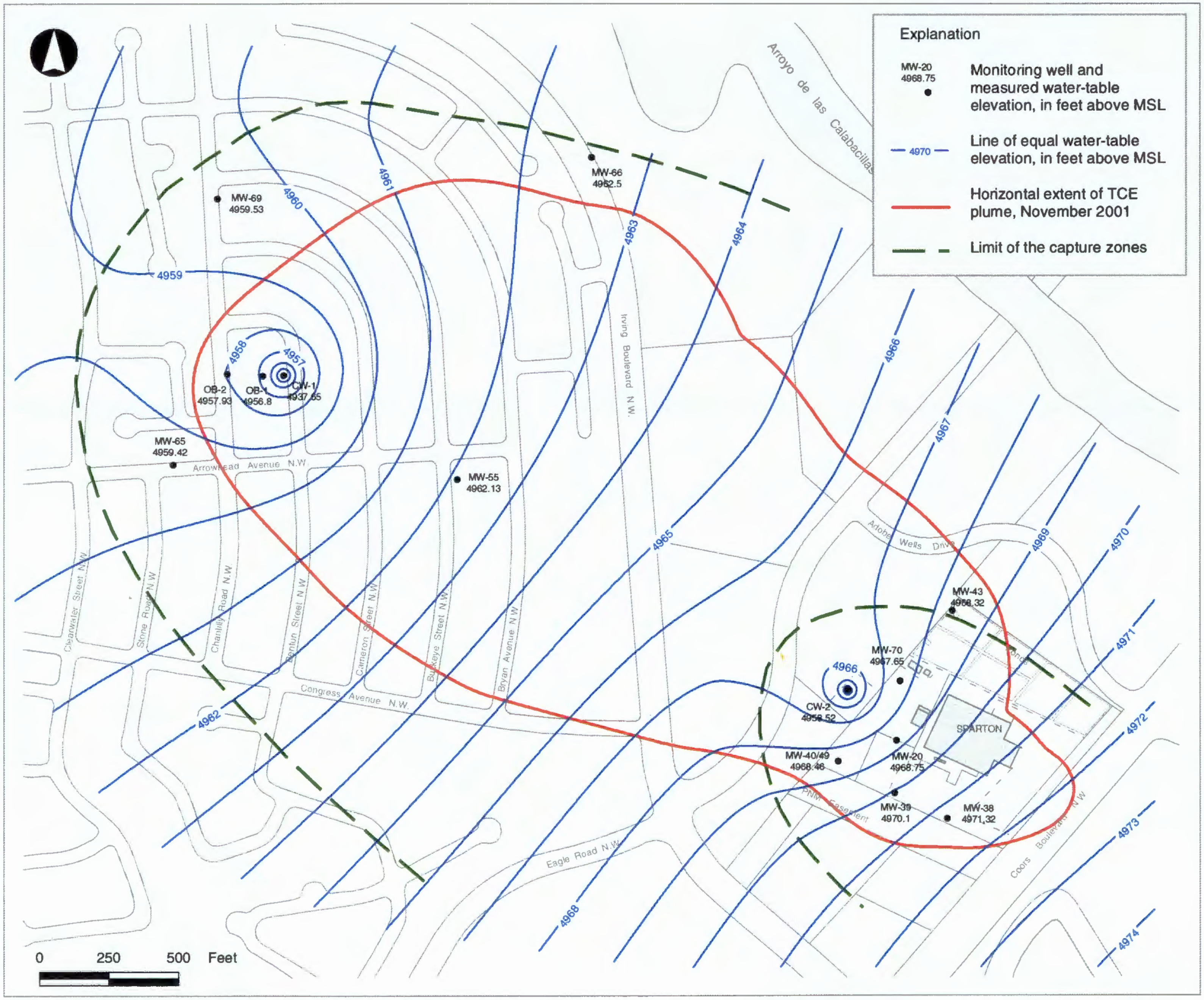


Figure 5.3 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - February 1, 2002

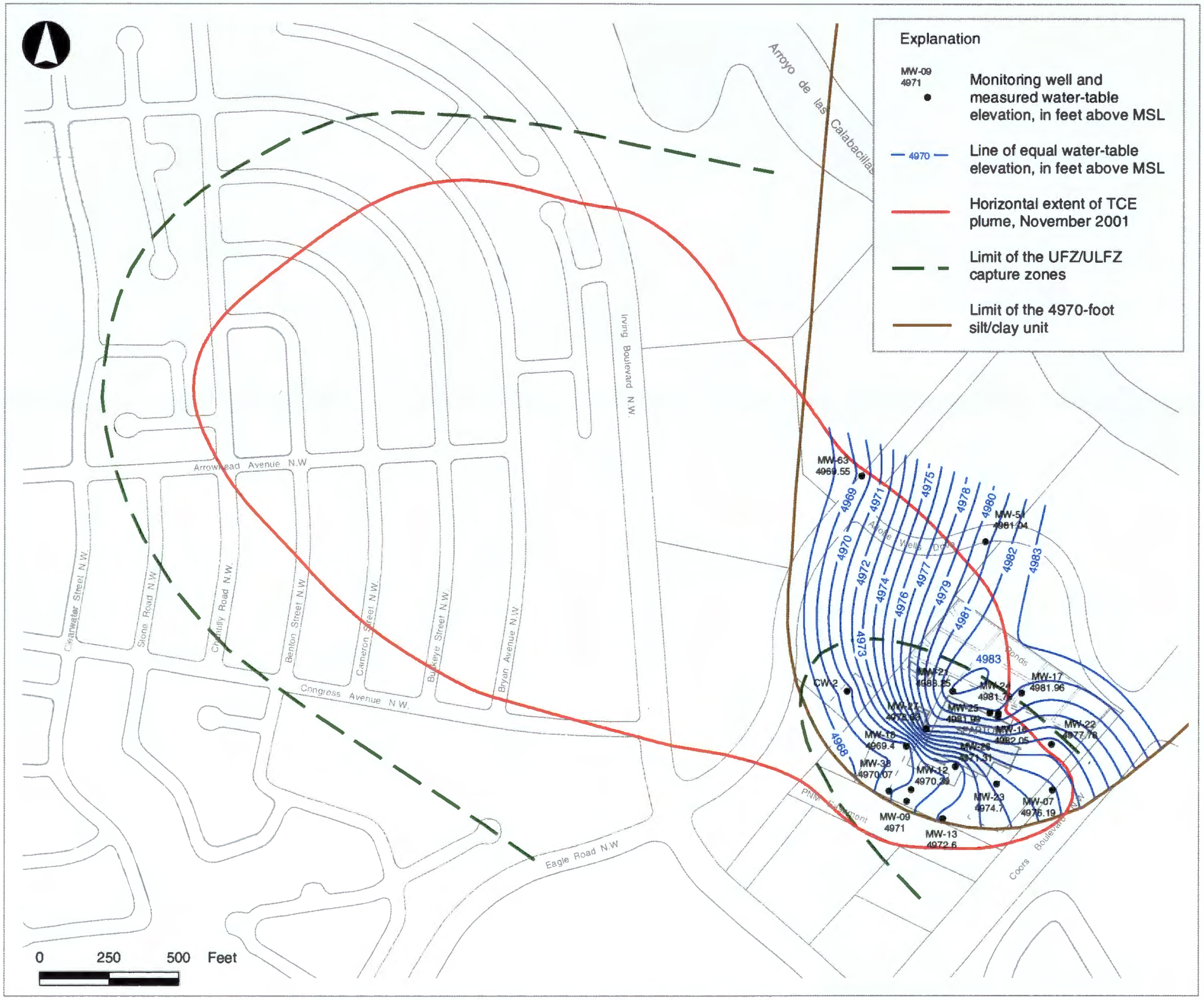


Figure 5.4 Elevation of the On-Site Water Table - May 7, 2002

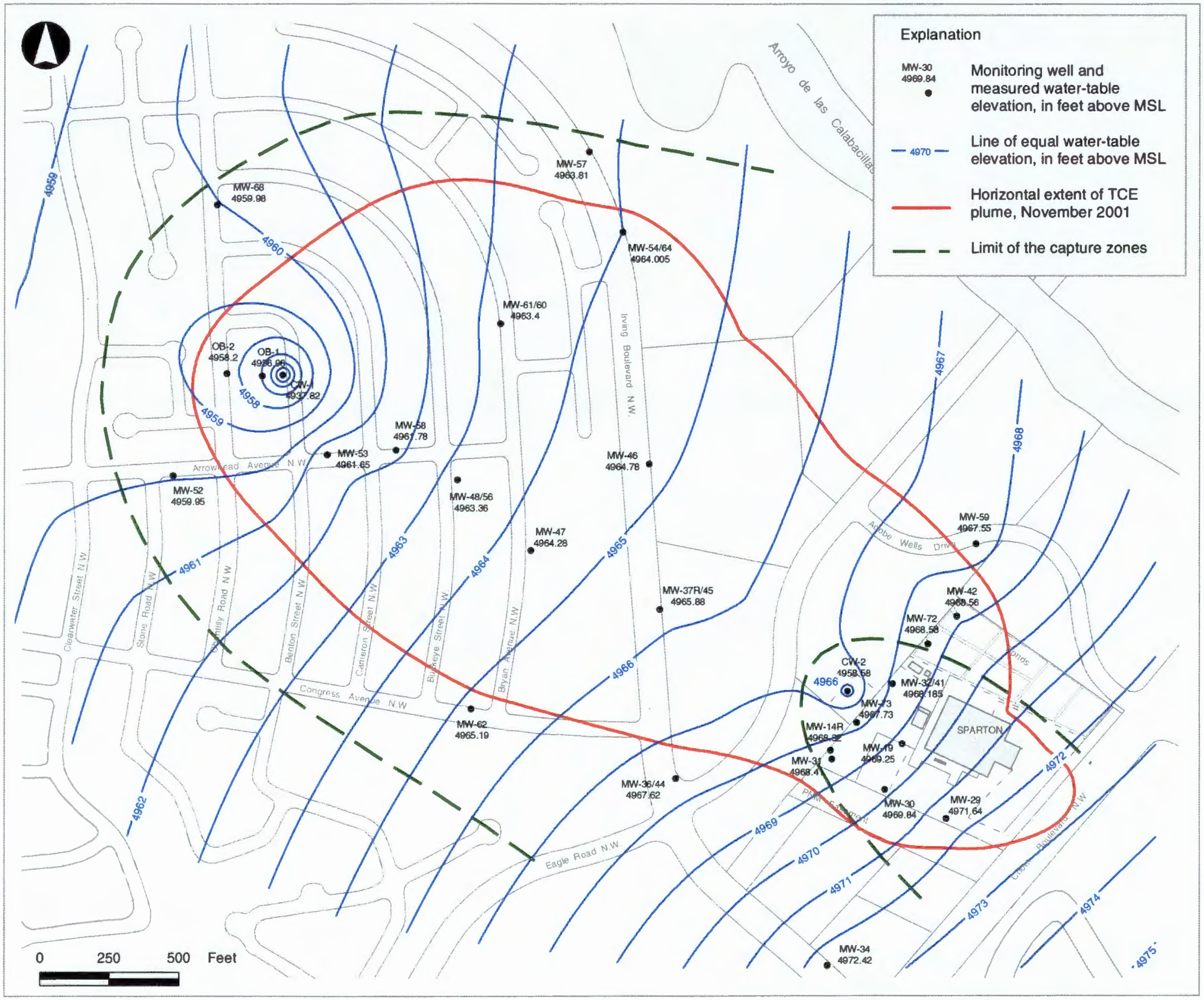


Figure 5.5 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - May 7, 2002

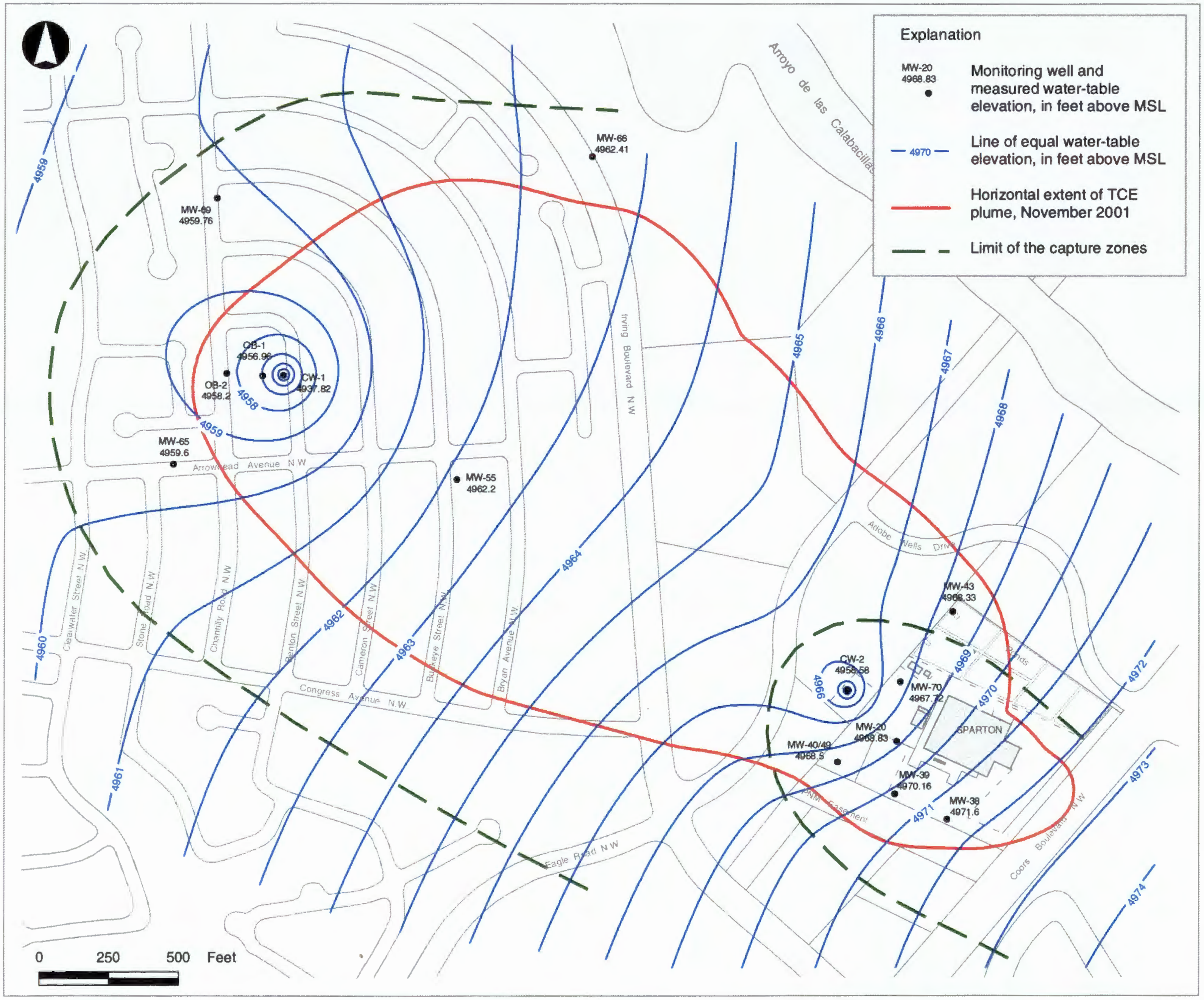


Figure 5.6 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - May 7, 2002

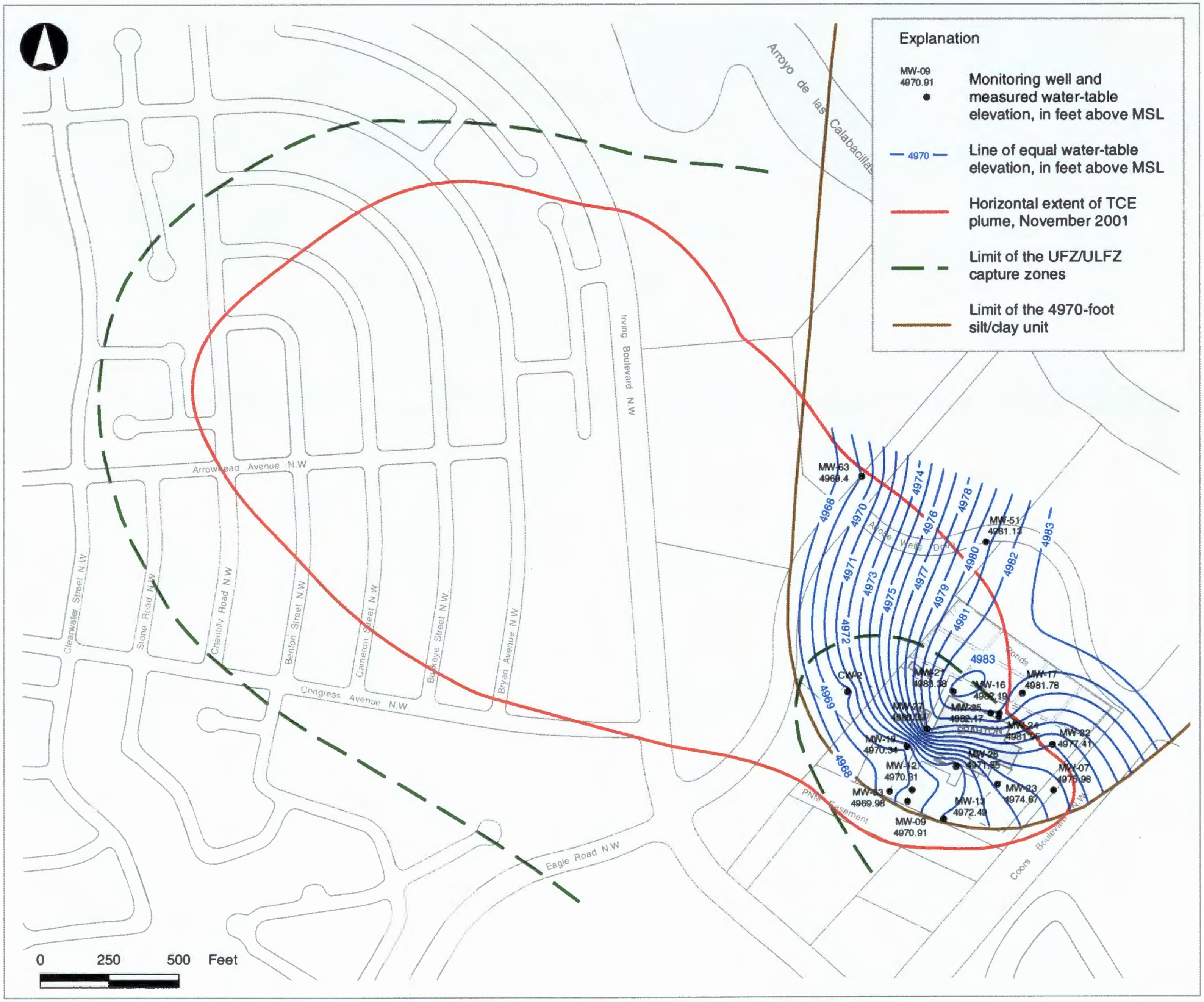


Figure 5.7 Elevation of the On-Site Water Table - August 1, 2002

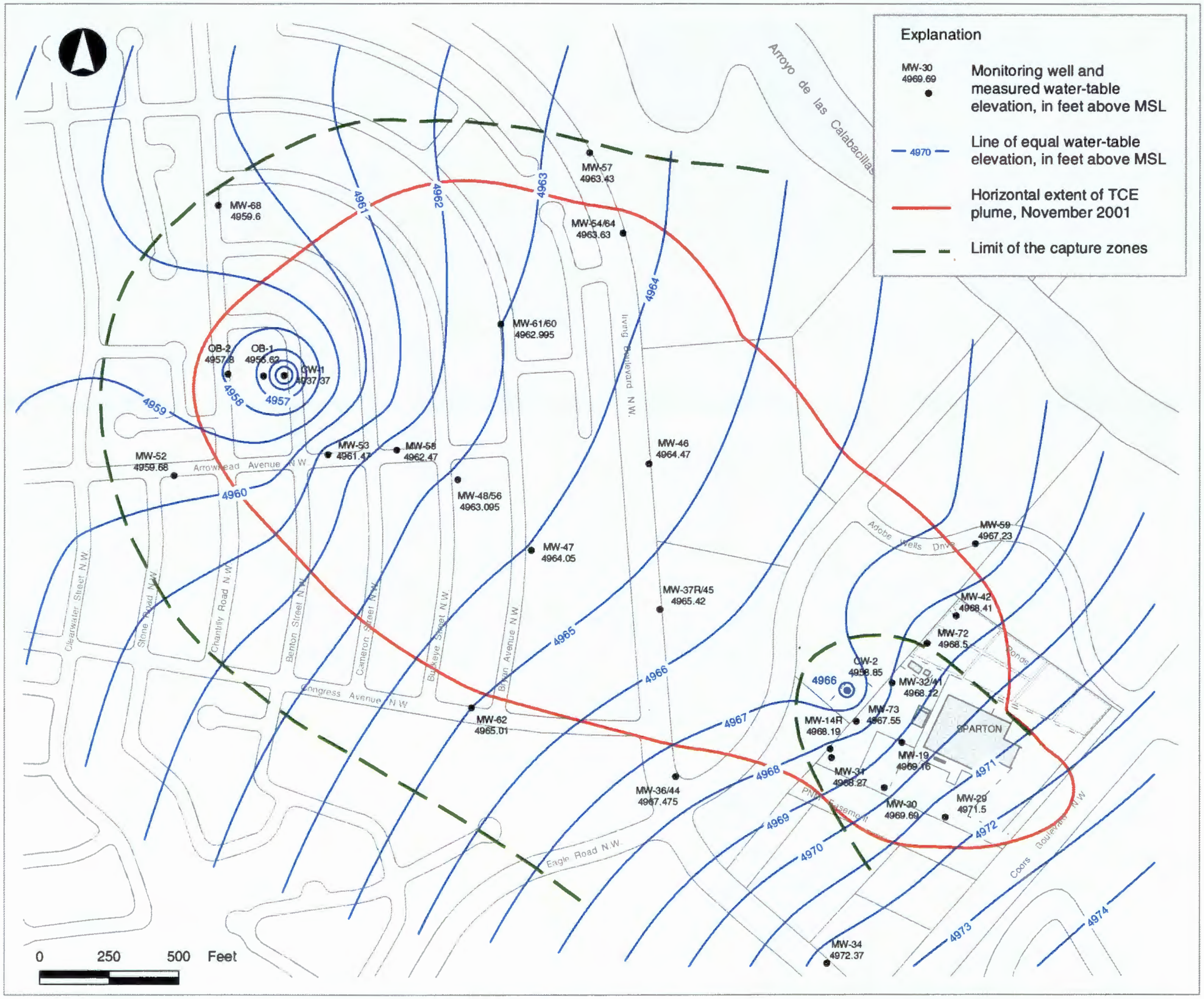


Figure 5.8 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - August 1, 2002

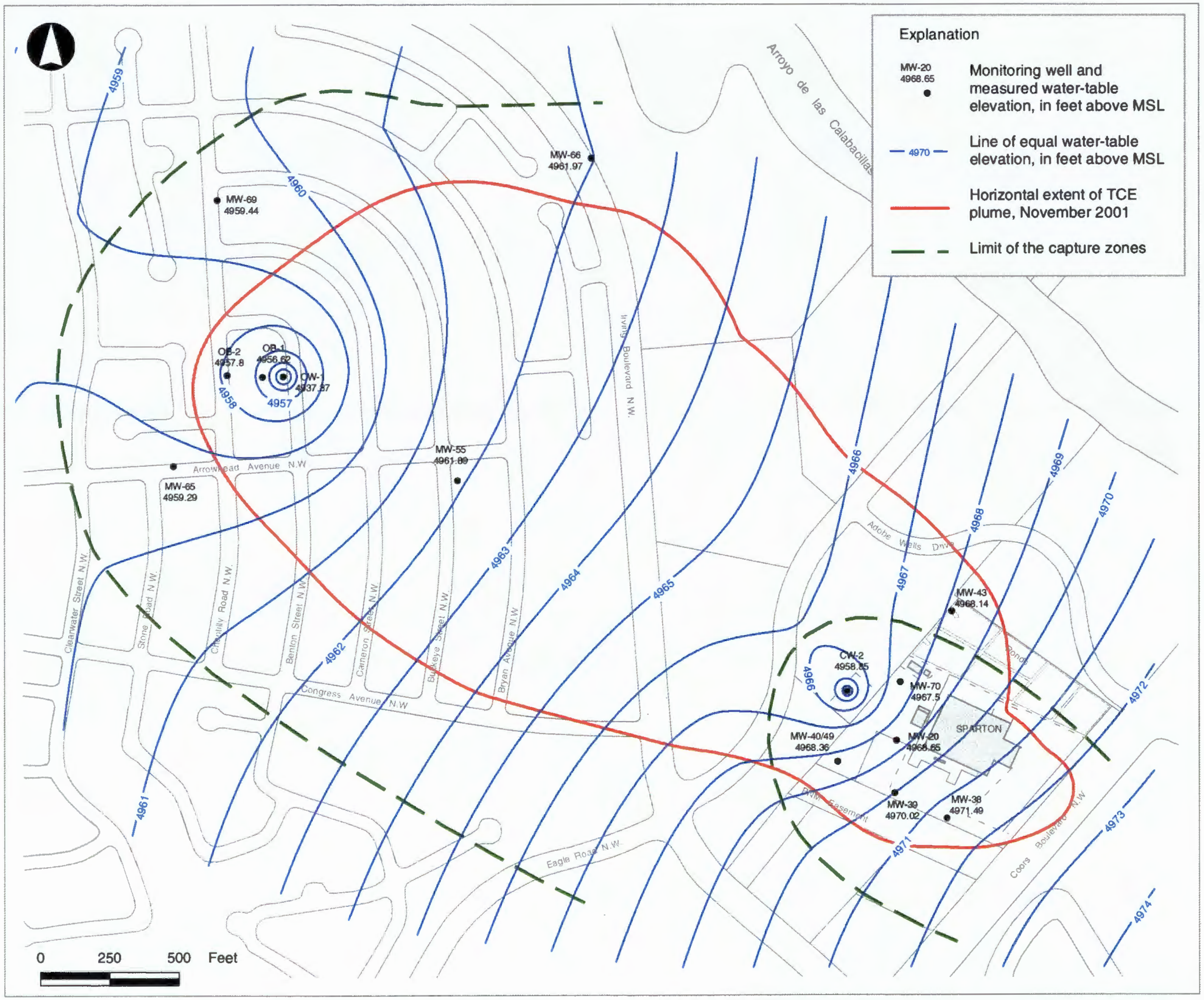


Figure 5.9 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - August 1, 2002

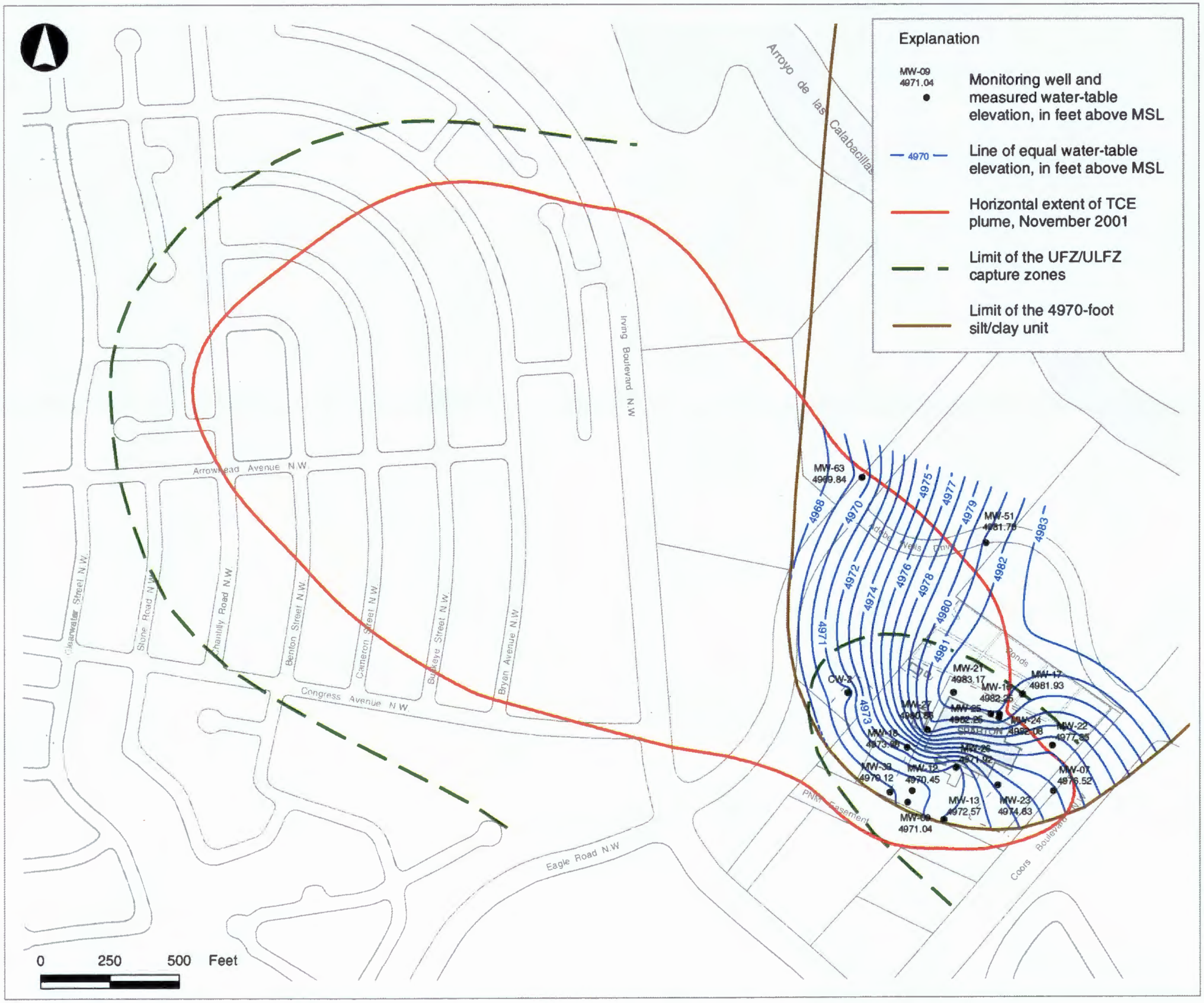


Figure 5.10 Elevation of the On-Site Water Table - November 4, 2002

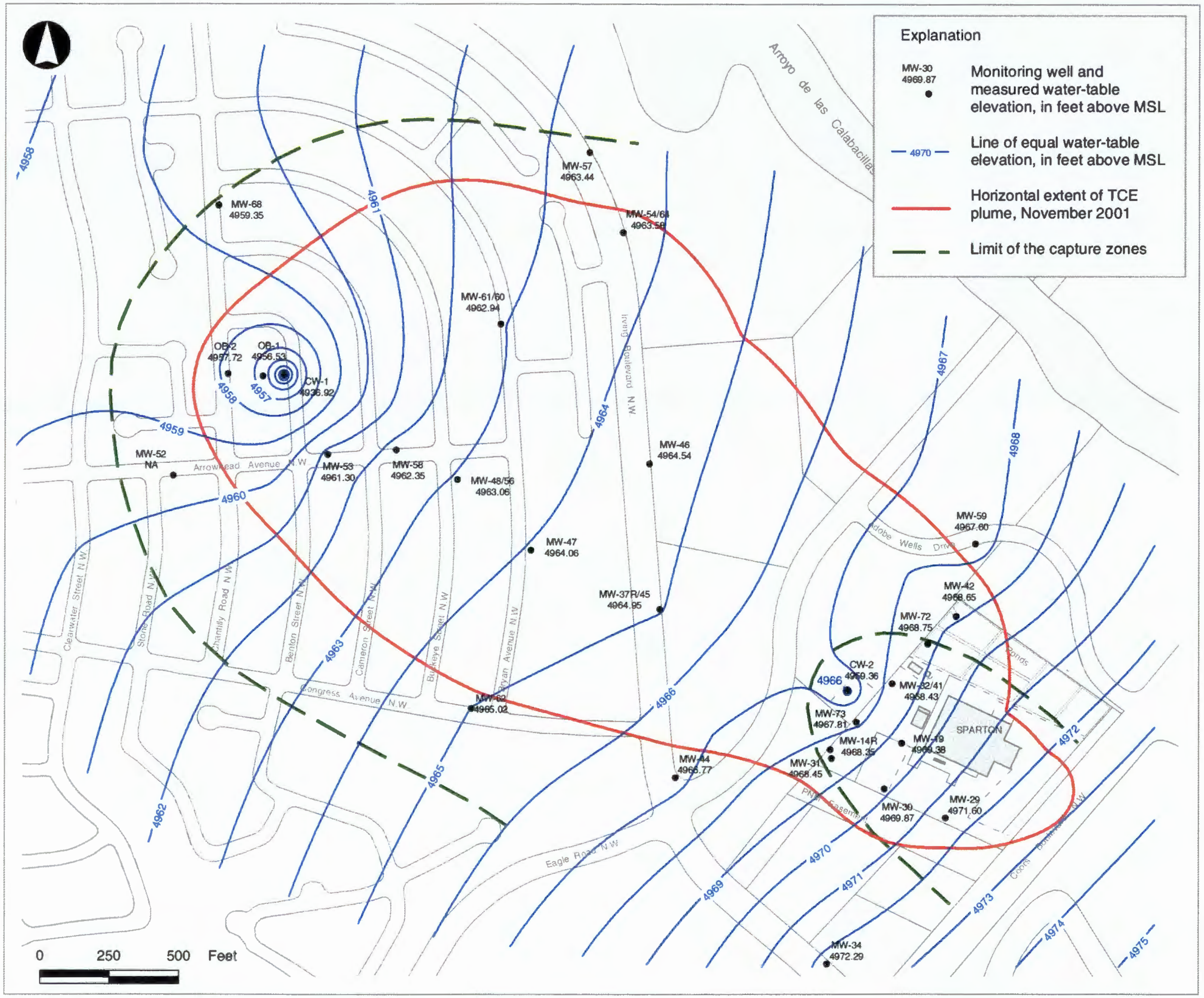


Figure 5.11 Elevation of Water Levels and Limits of Containment Well Capture Zones in the UFZ/ULFZ - November 4, 2002

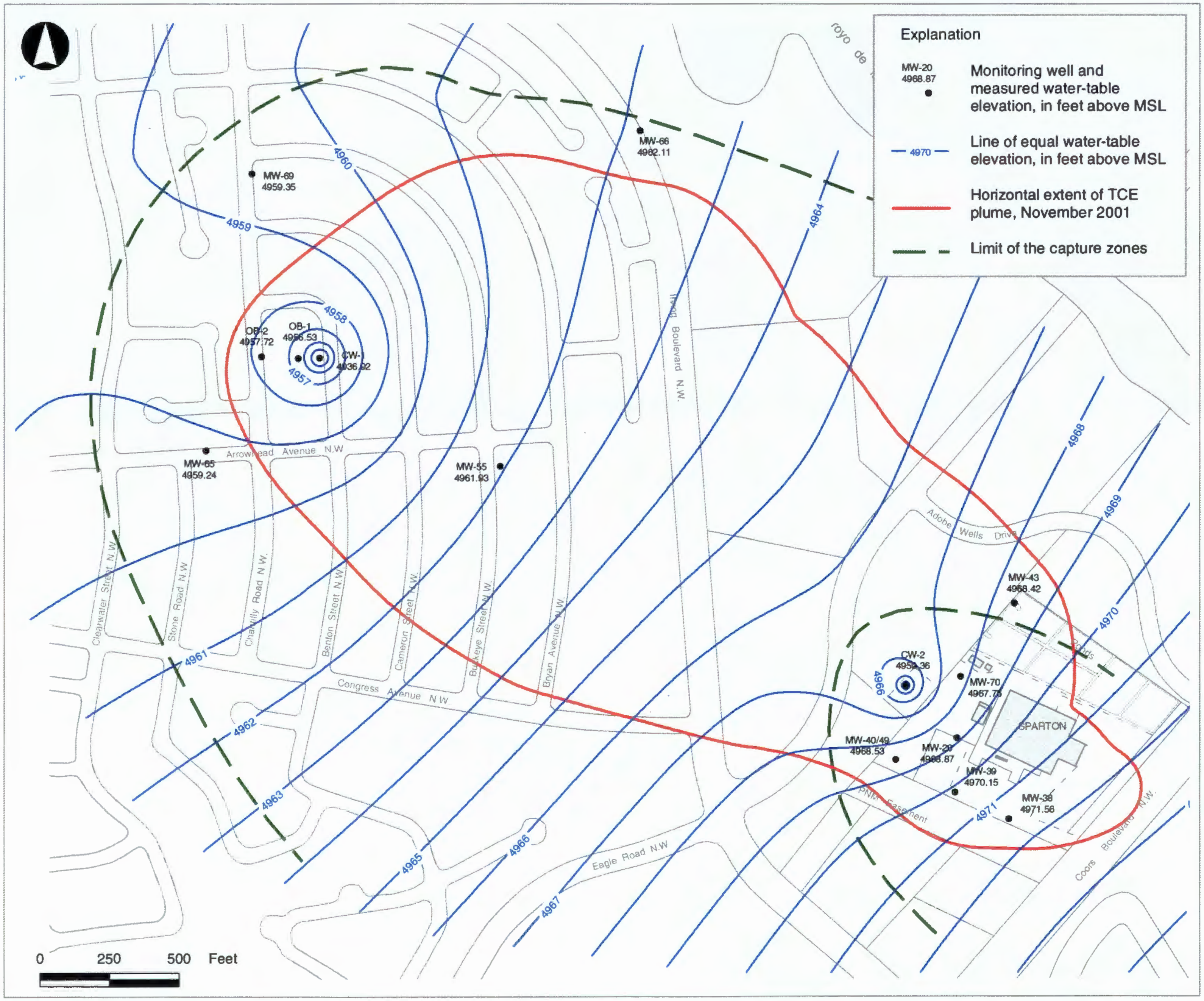


Figure 5.12 Elevation of Water Levels and Limits of Containment Well Capture Zones in the LLFZ - November 4, 2002

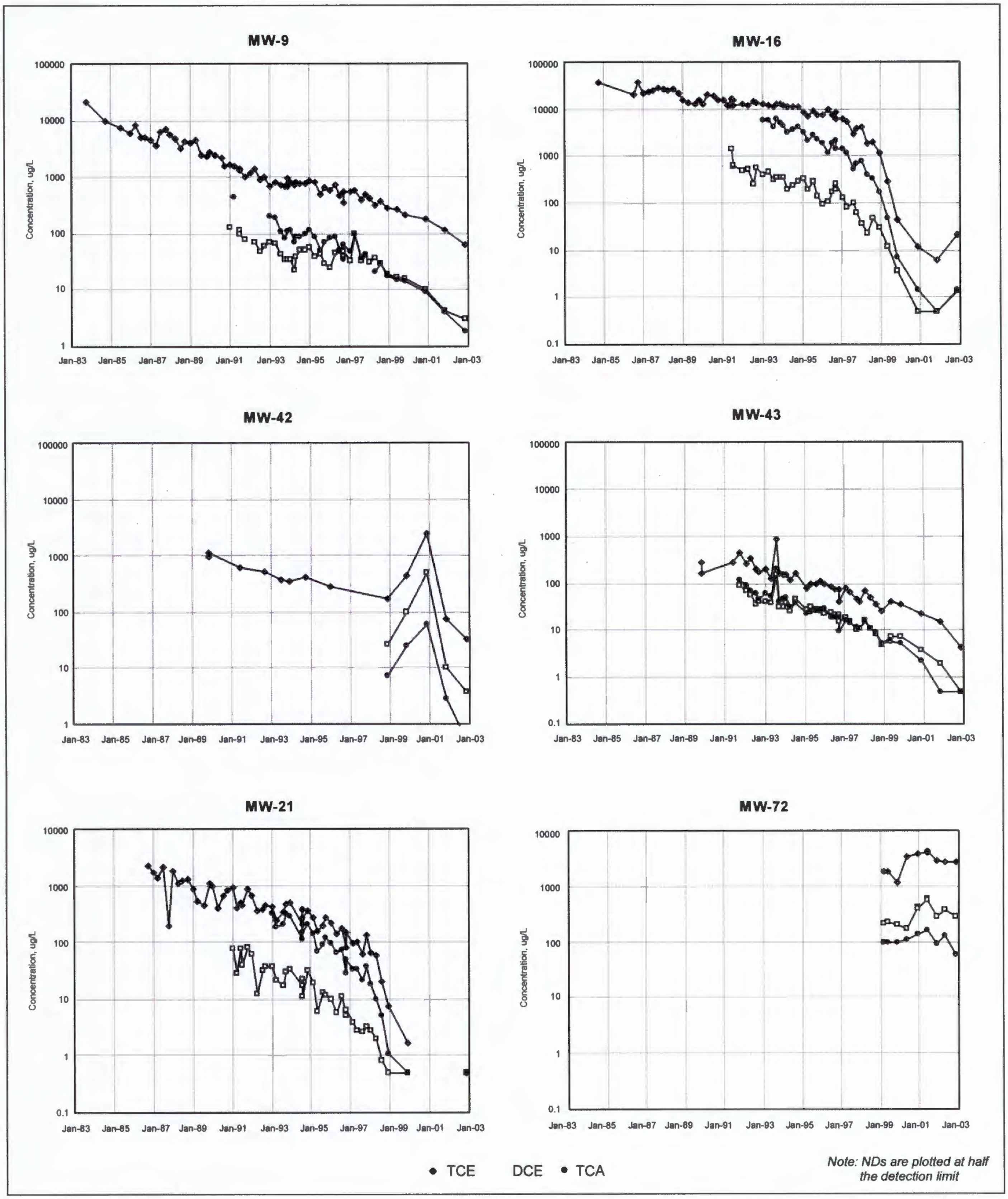


Figure 5.13 Contaminant Concentration Trends in On-Site Monitoring Wells

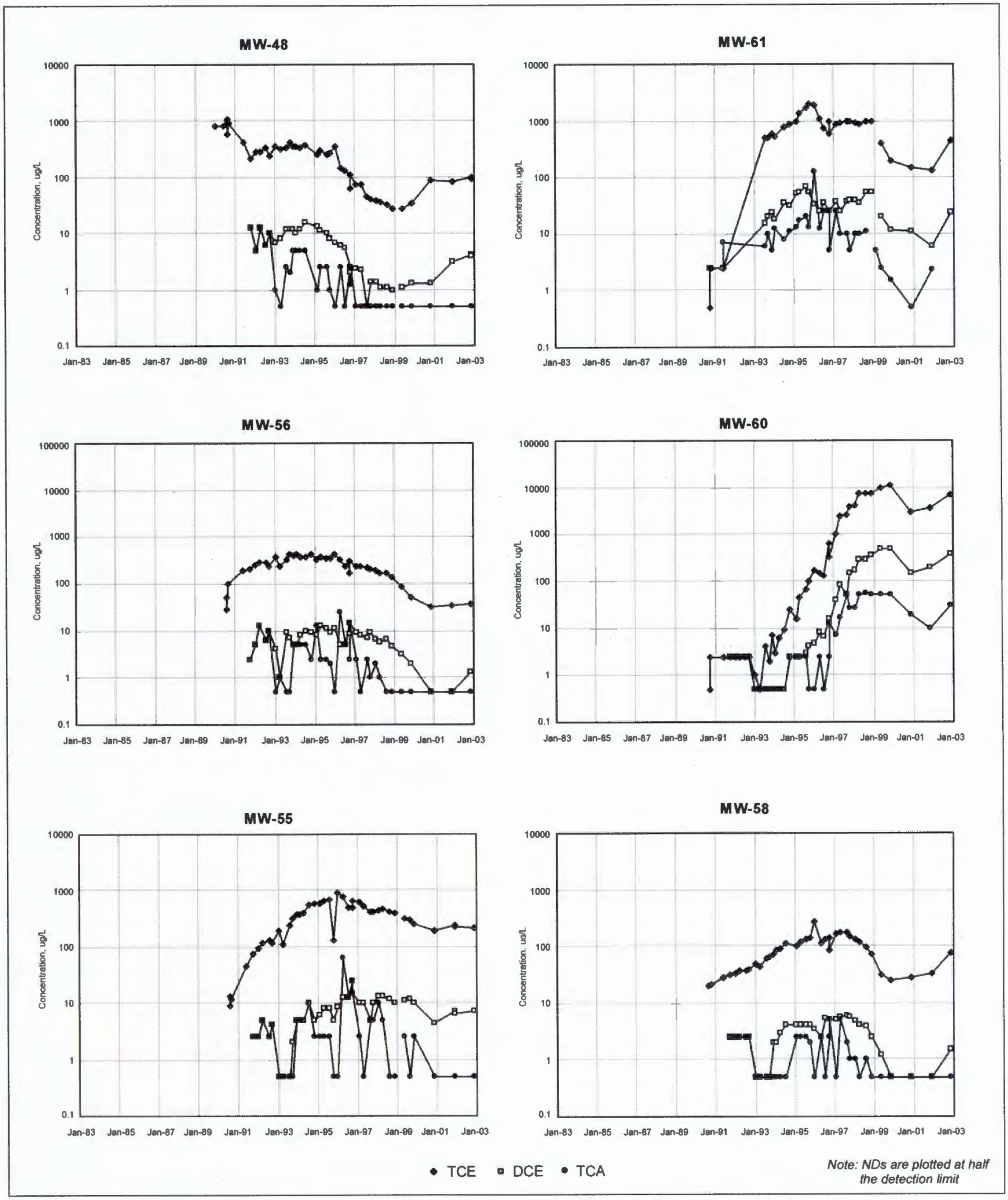


Figure 5.14 Contaminant Concentration Trends in Off-Site Monitoring Wells

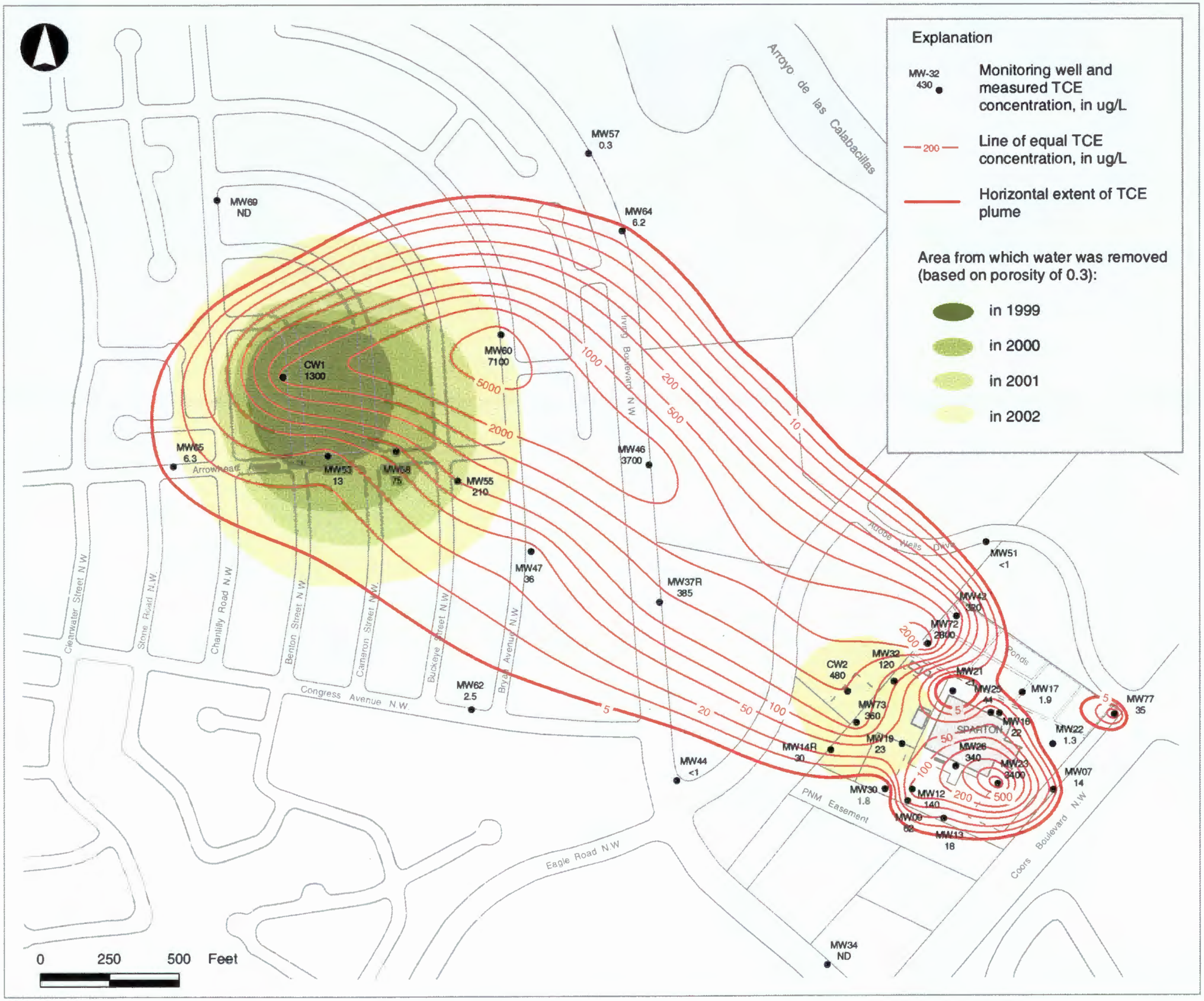


Figure 5.15 Horizontal Extent of TCE Plume - November 2002

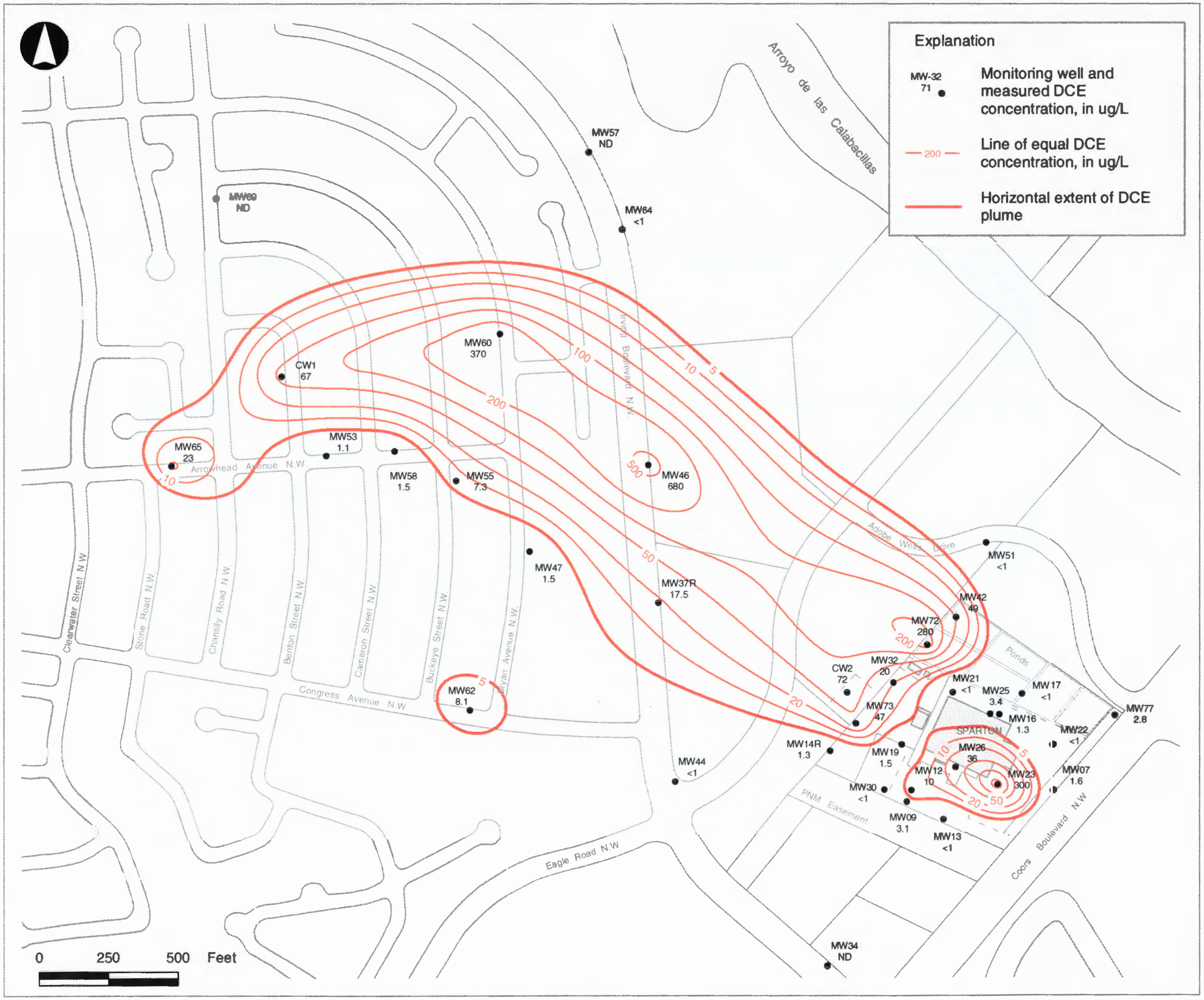


Figure 5.16 Horizontal Extent of DCE Plume - November 2002

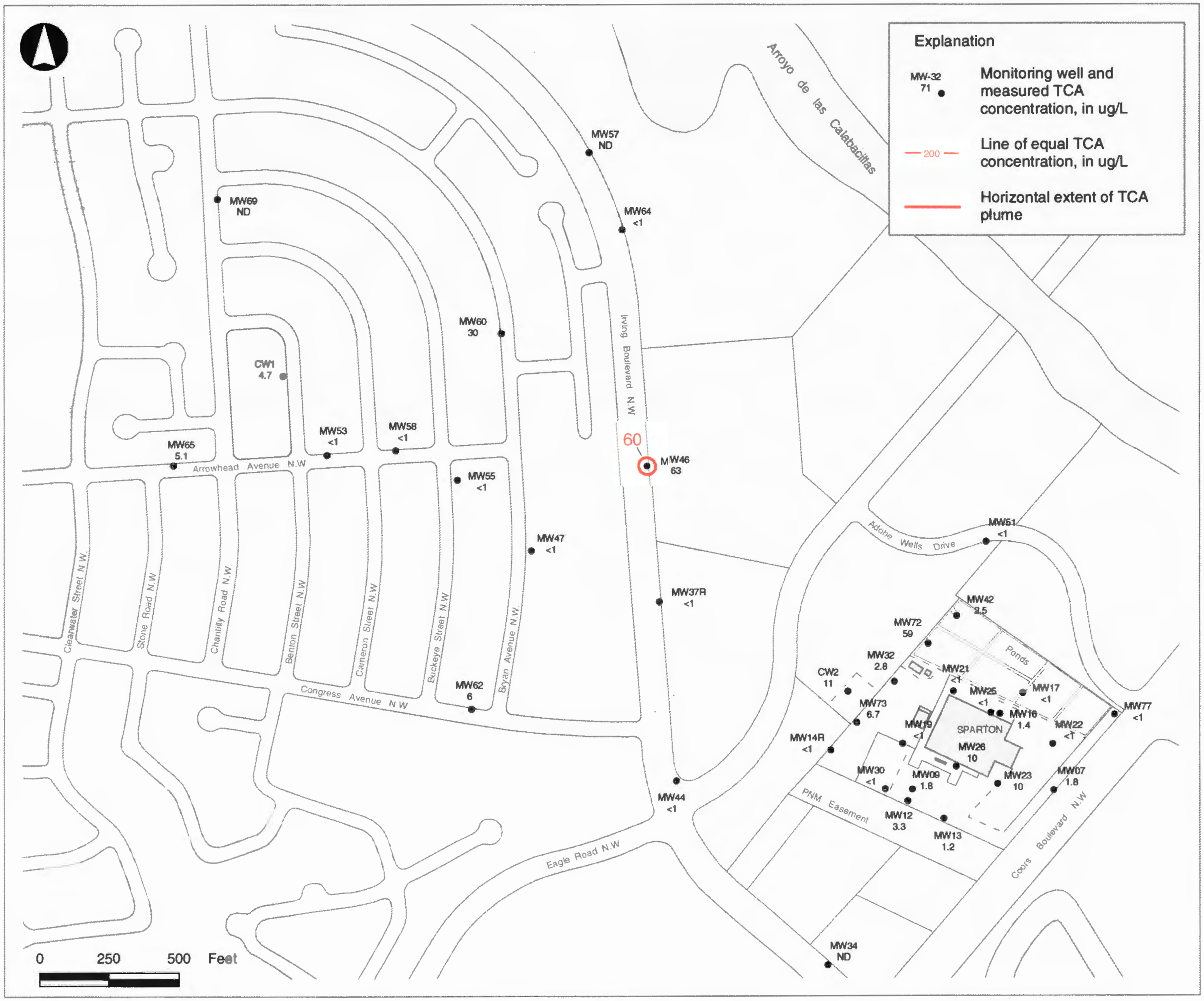


Figure 5.17 Horizontal Extent of TCA Plume - November 2002

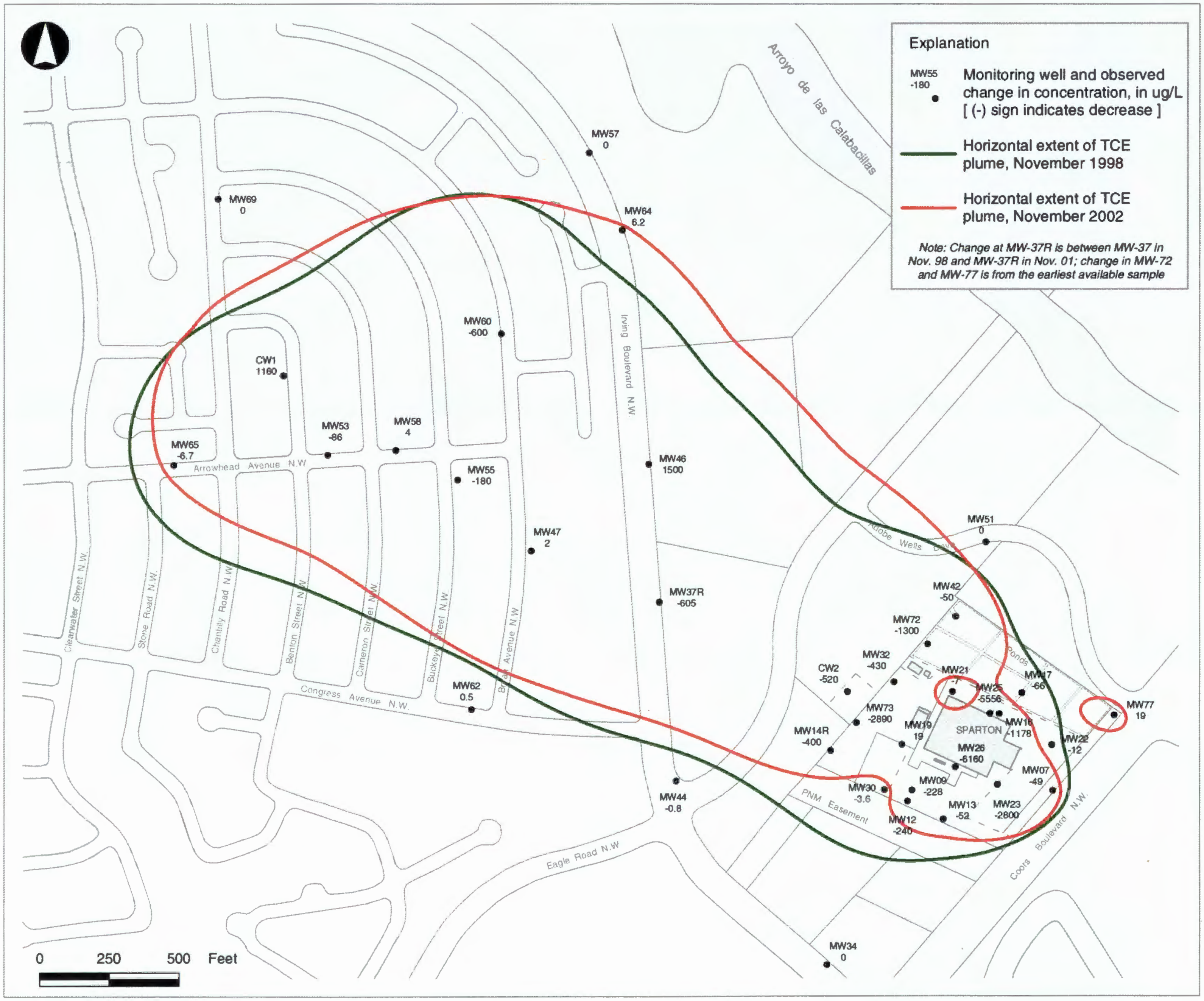


Figure 5.18 Changes in TCE Concentrations at Wells Used for Plume Definition - November 1998 to November 2002

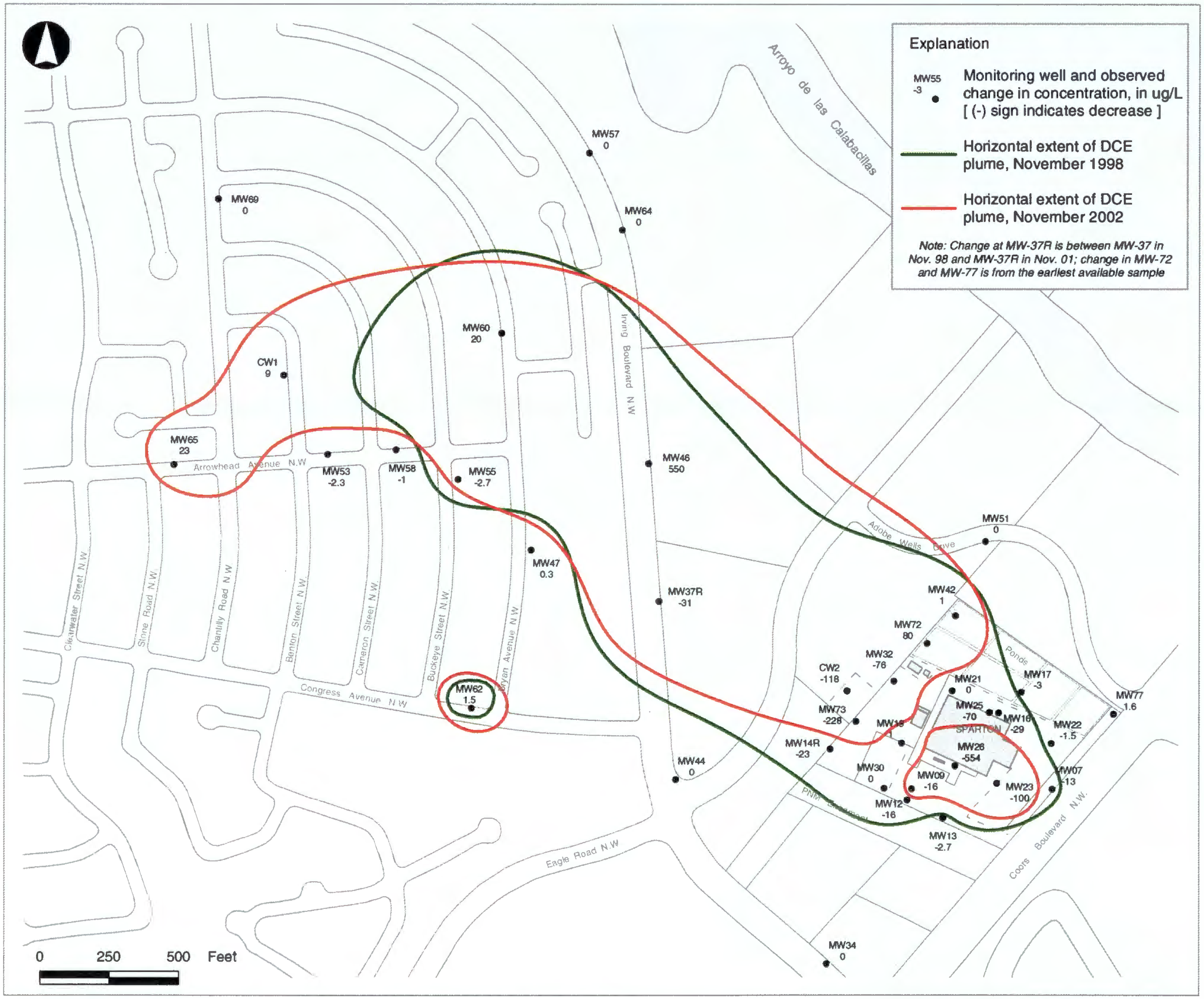


Figure 5.19 Changes in DCE Concentrations at Wells Used for Plume Definition - November 1998 to November 2002

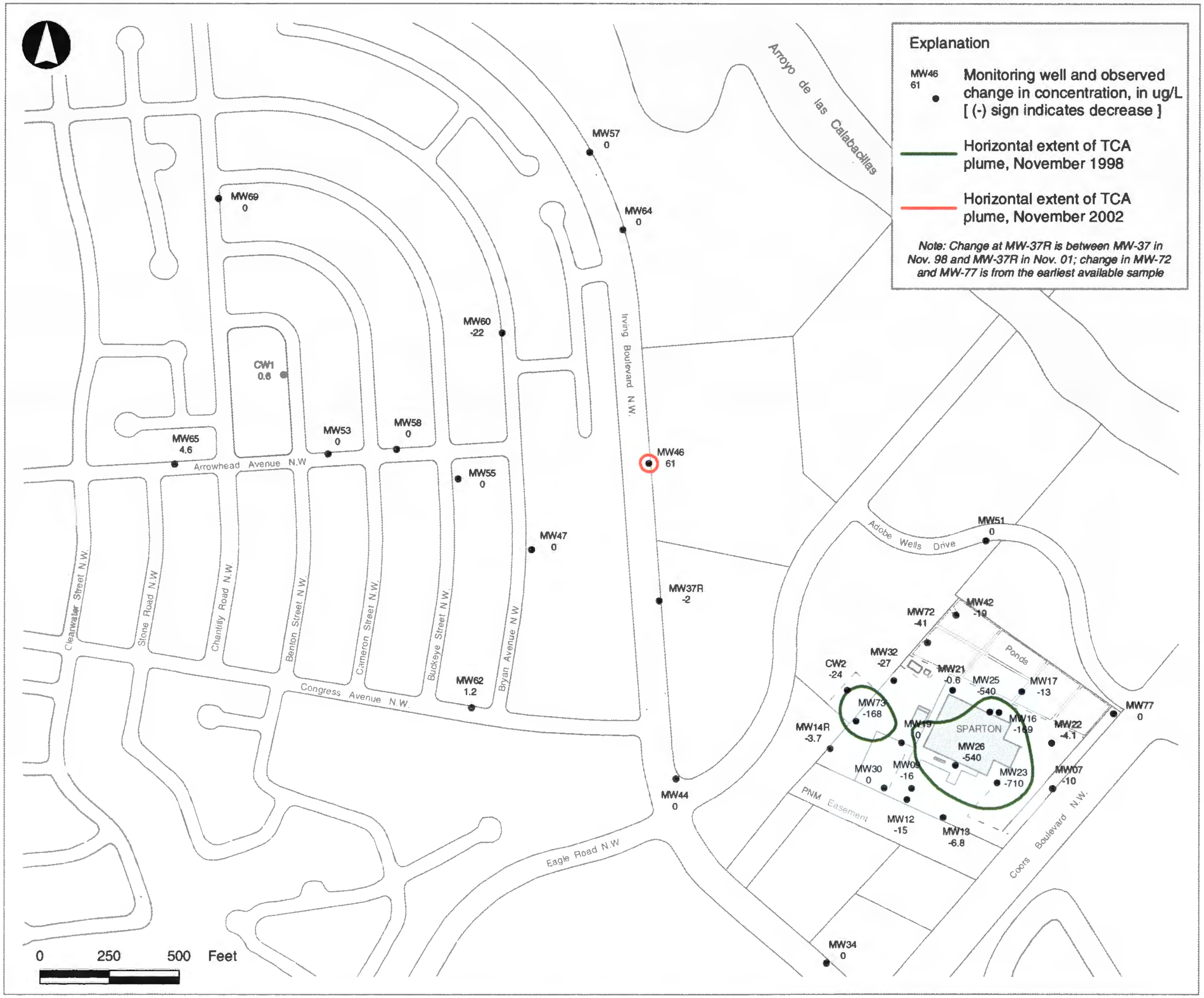


Figure 5.20 Changes in TCA Concentrations at Wells Used for Plume Definition - November 1998 to November 2002

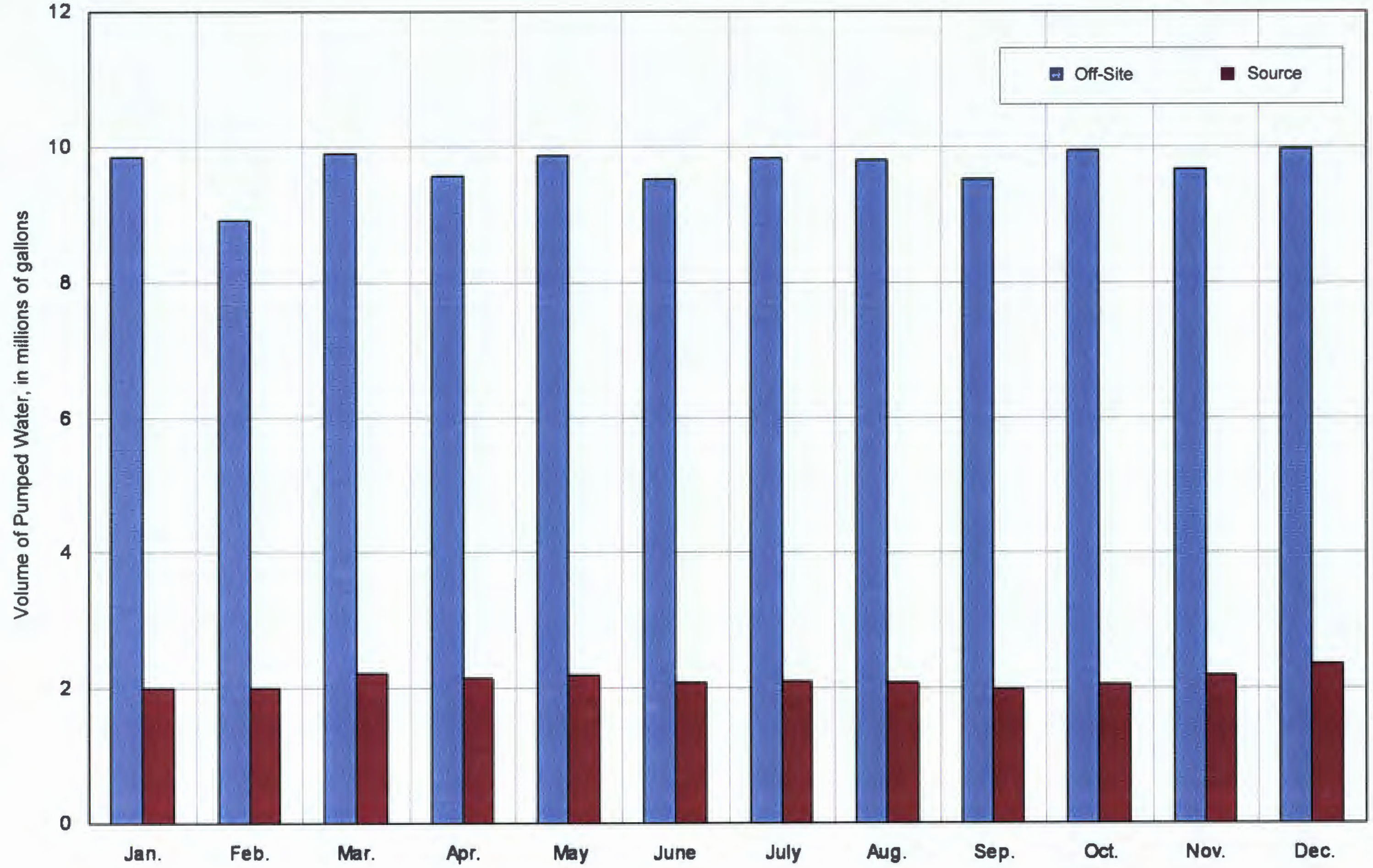


Figure 5.21 Monthly Volume of Water Pumped by the Off-Site and Source Containment Wells - 2002

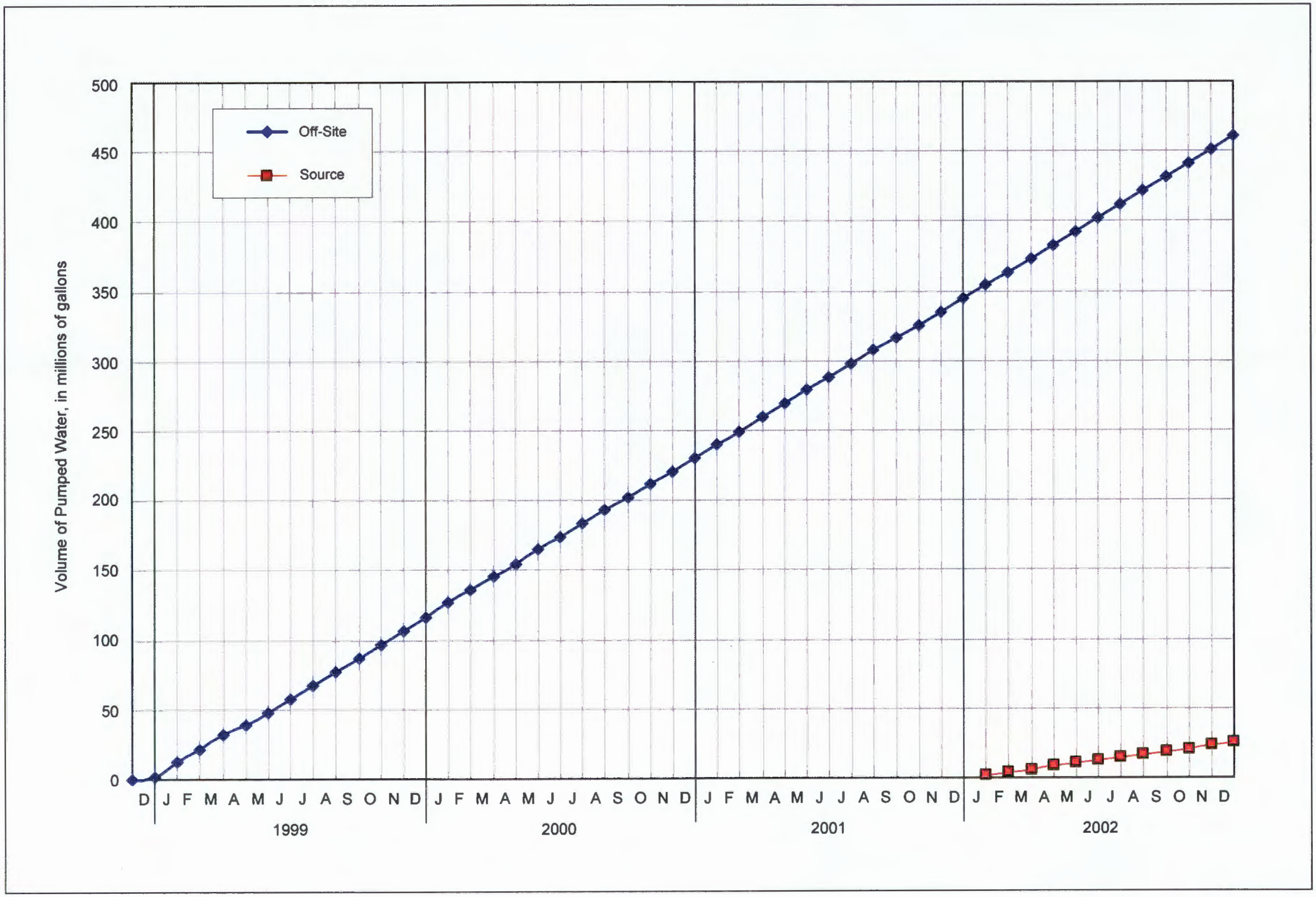


Figure 5.22 Cumulative Volume of Water Pumped by the Off-Site and Source Containment Wells

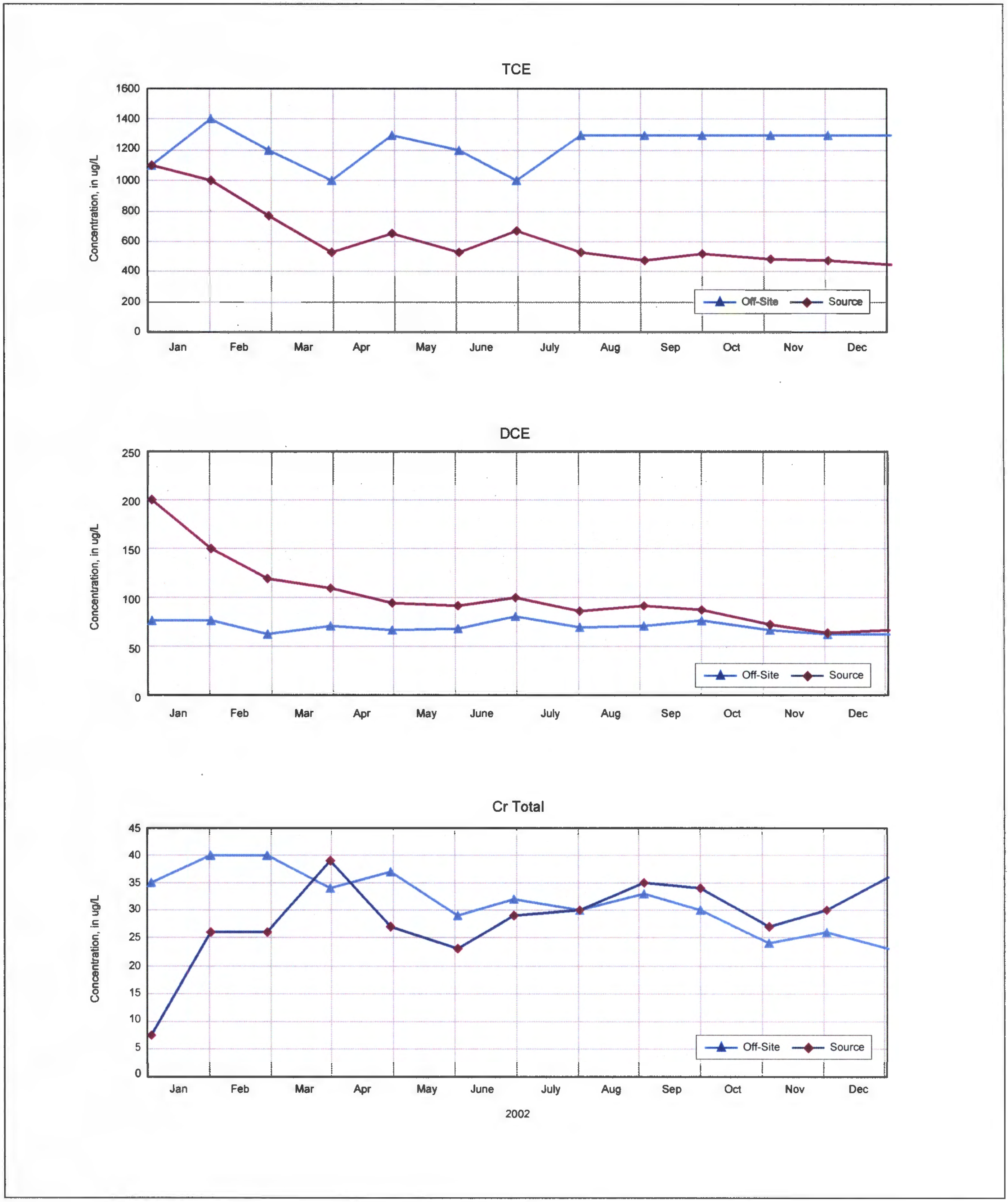
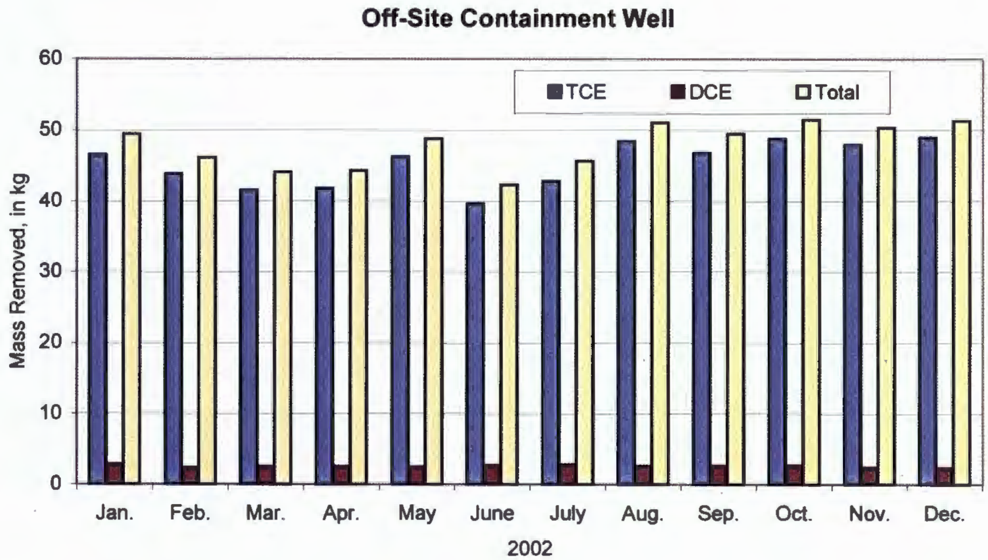


Figure 5.23 Source and Off-Site Containment Systems - TCE, DCE and Total Chromium Concentrations in the Influent - 2002



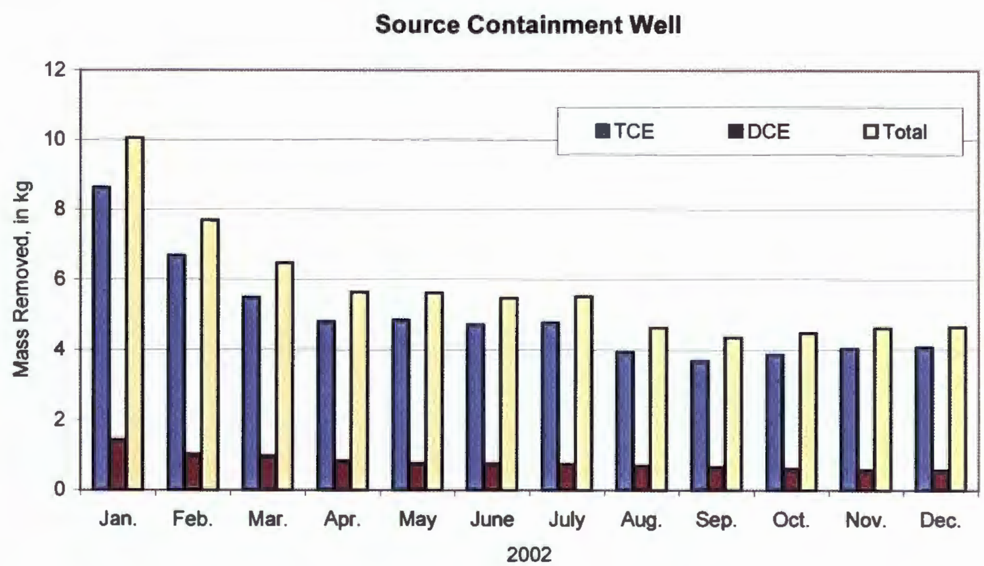
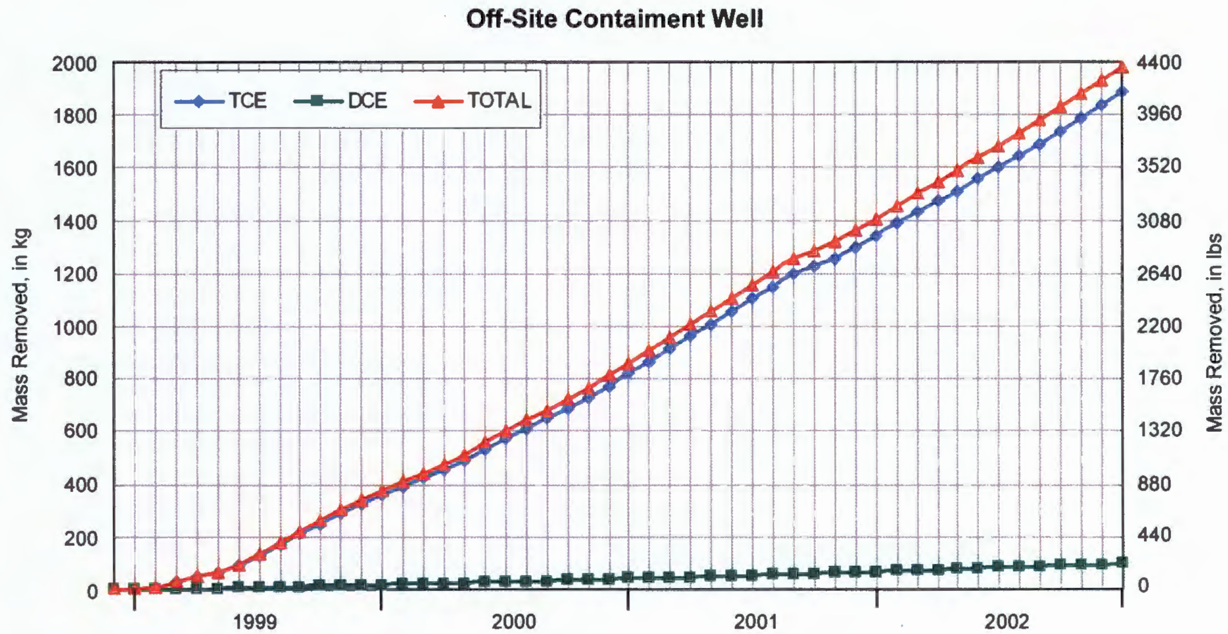


Figure 5.24 Monthly Contaminant Mass Removal by the Containment Wells - 2002



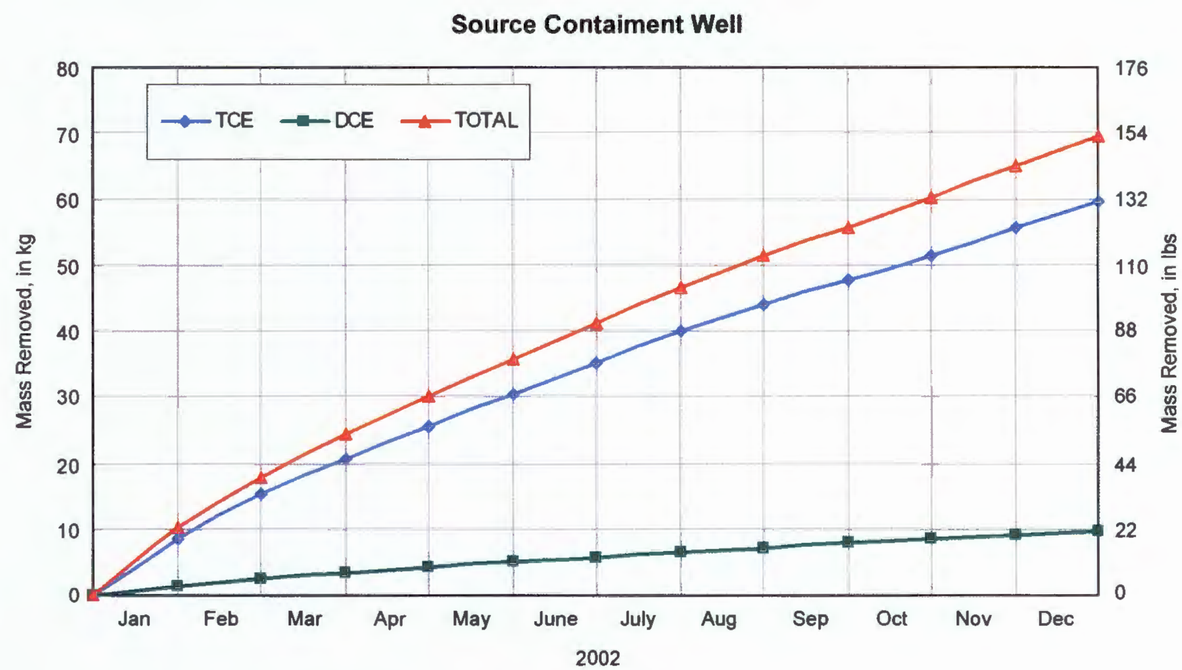


Figure 5.25 Cumulative Containment Mass Removal by the Source and Off-Site Containment Wells

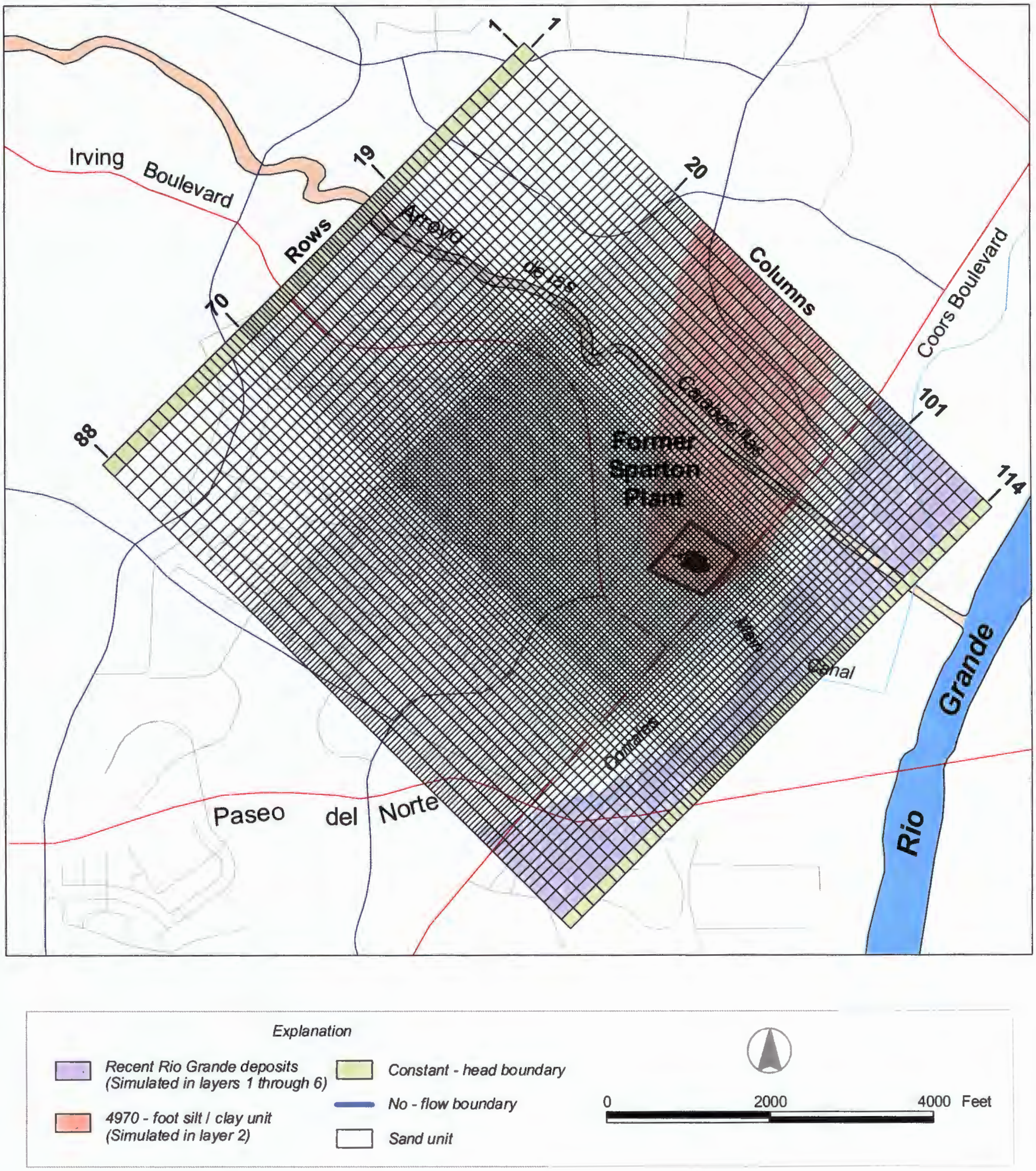


Figure 6.1 Model Grid, Hydraulic Property Zones and Boundary Conditions

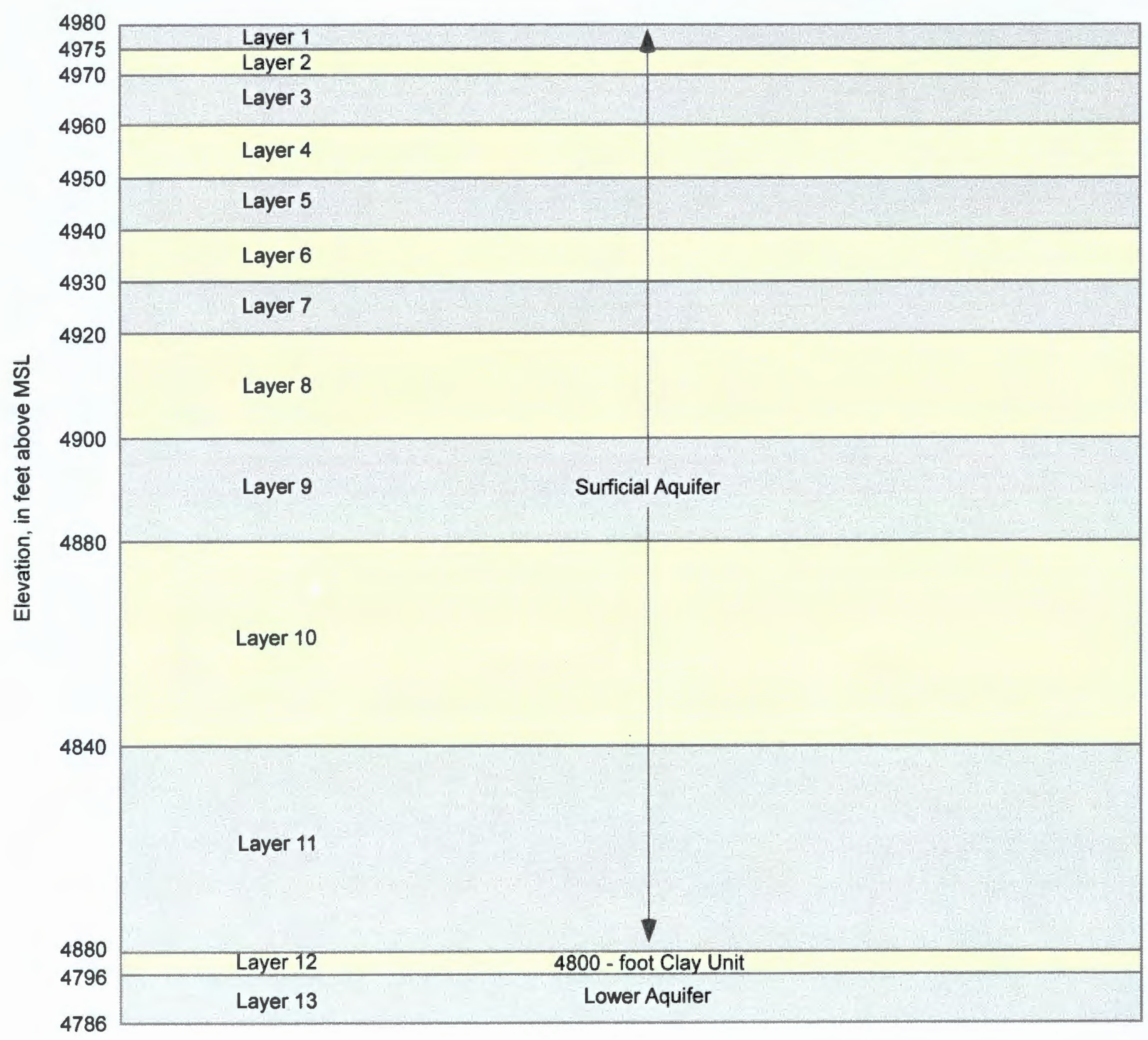


Figure 6.2 Model Layers

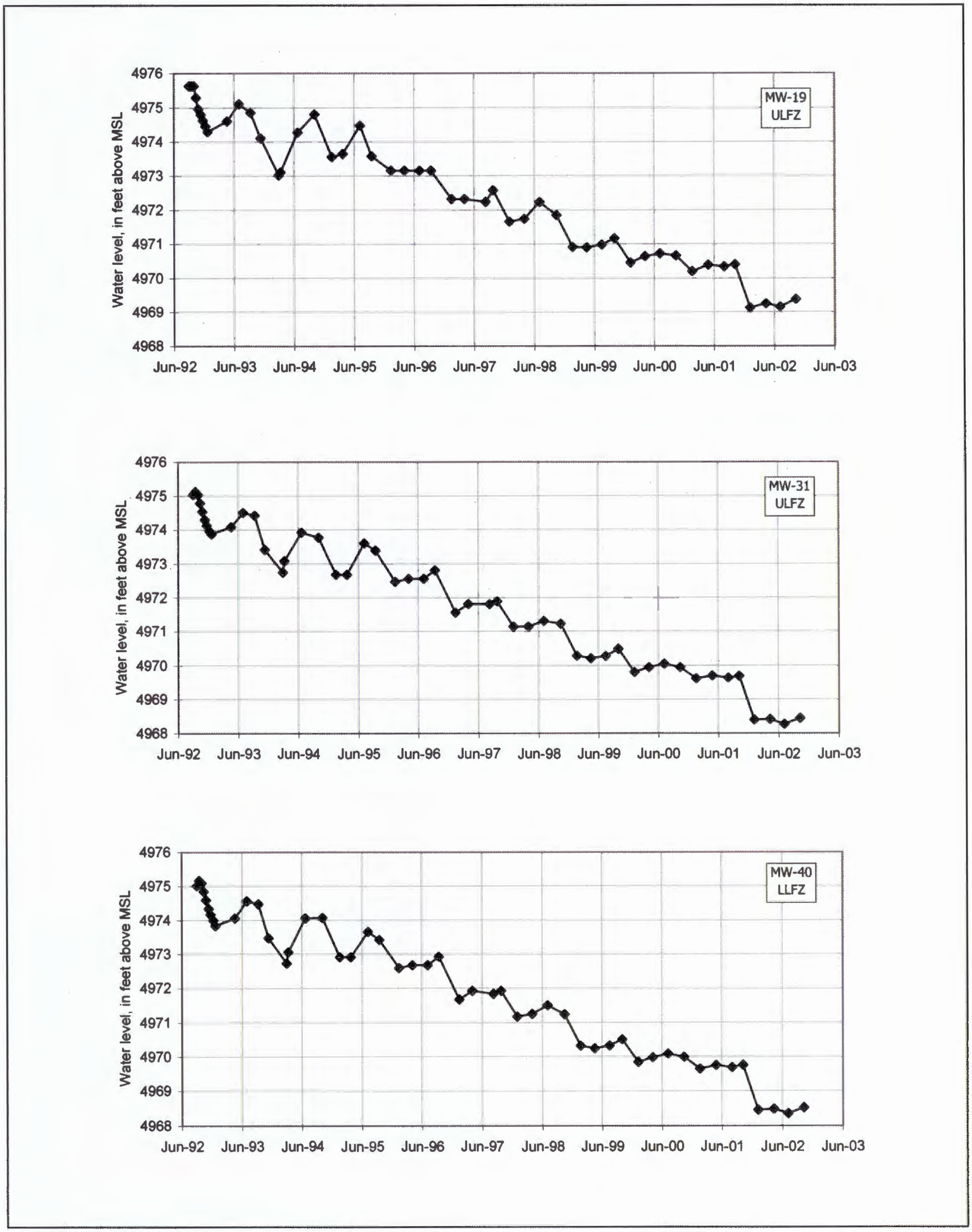


Figure 6.3 Regional Water Level Trends

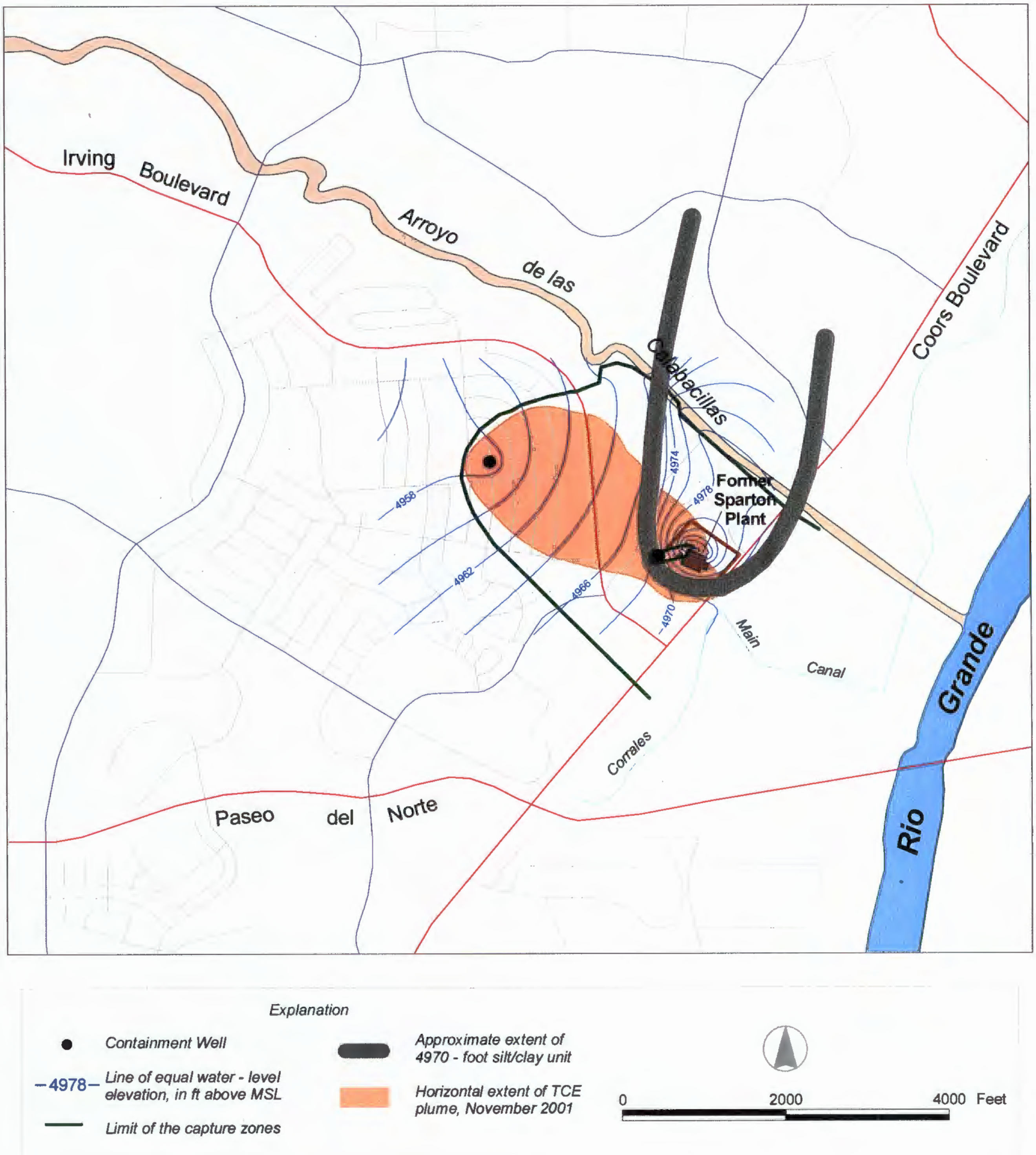


Figure 6.4 Calculated Water Levels in the UFZ and Comparison of the Calculated Capture Zone to the TCE Plume Extent

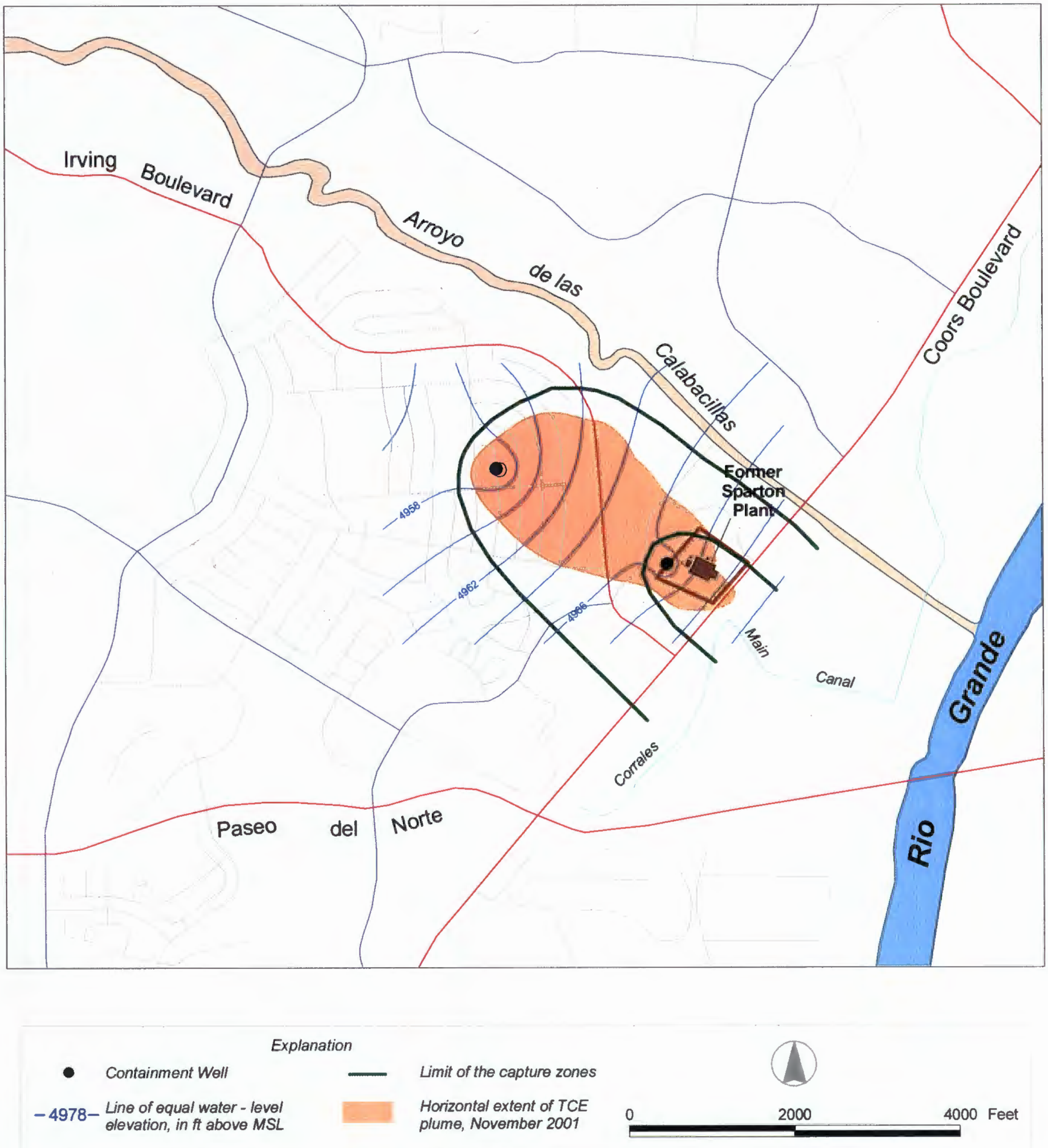


Figure 6.5 Calculated Water Levels in the ULFZ and Comparison of the Calculated Capture Zone to the TCE Plume Extent

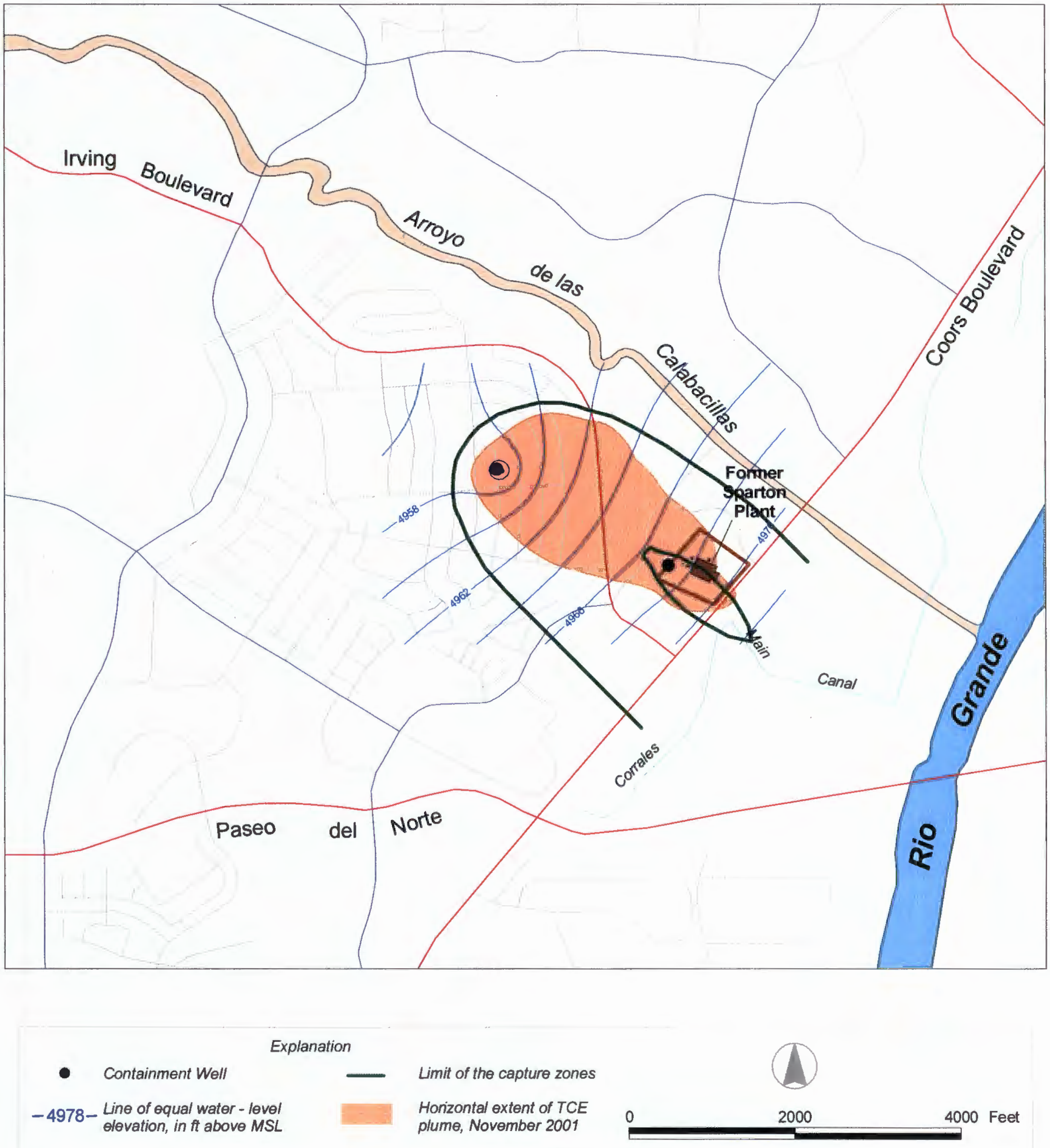


Figure 6.6 Calculated Water Levels in the LLFZ and Comparison of the Calculated Capture Zone to the TCE Plume Extent

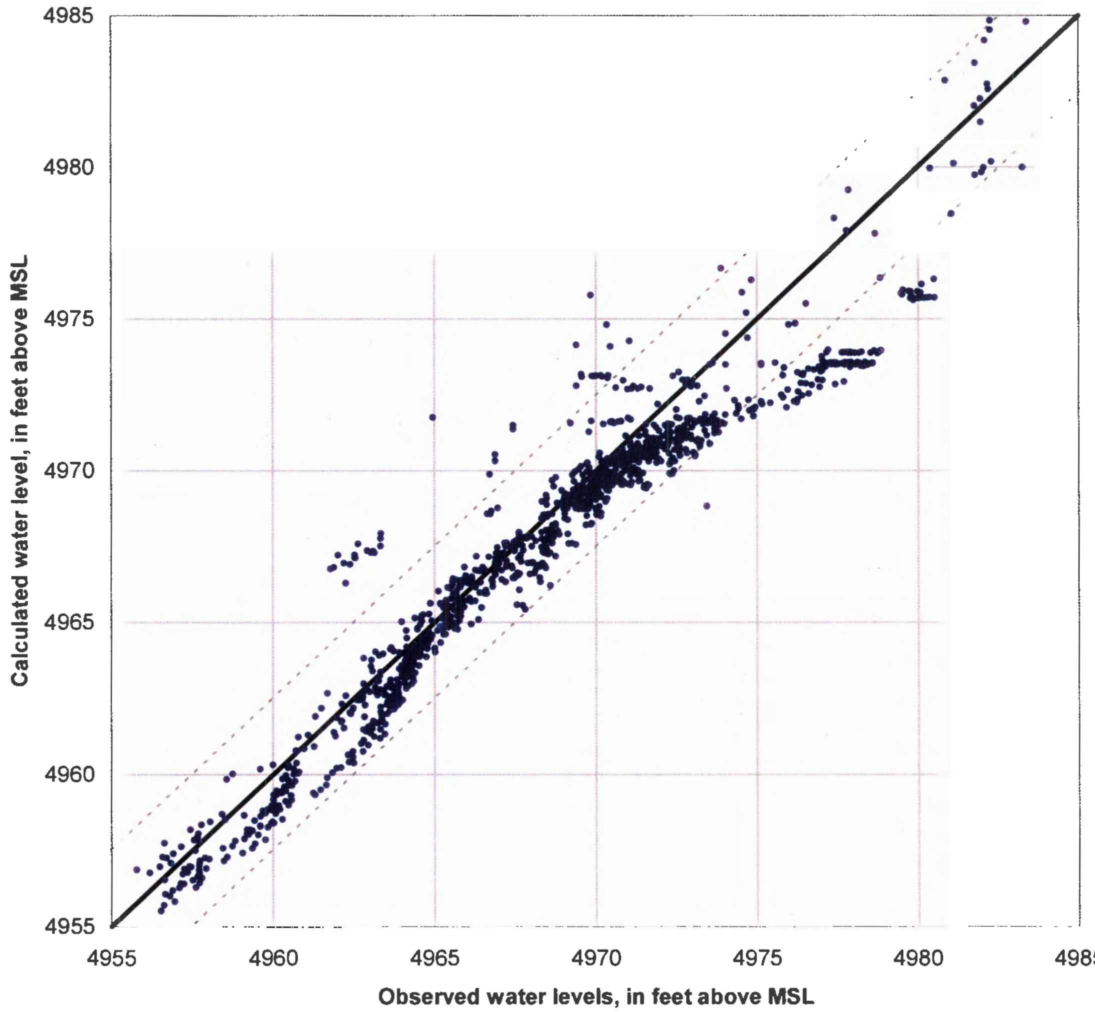


Figure 6.7 Comparison of Calculated to Observed Water Levels - November 1998 to November 2002

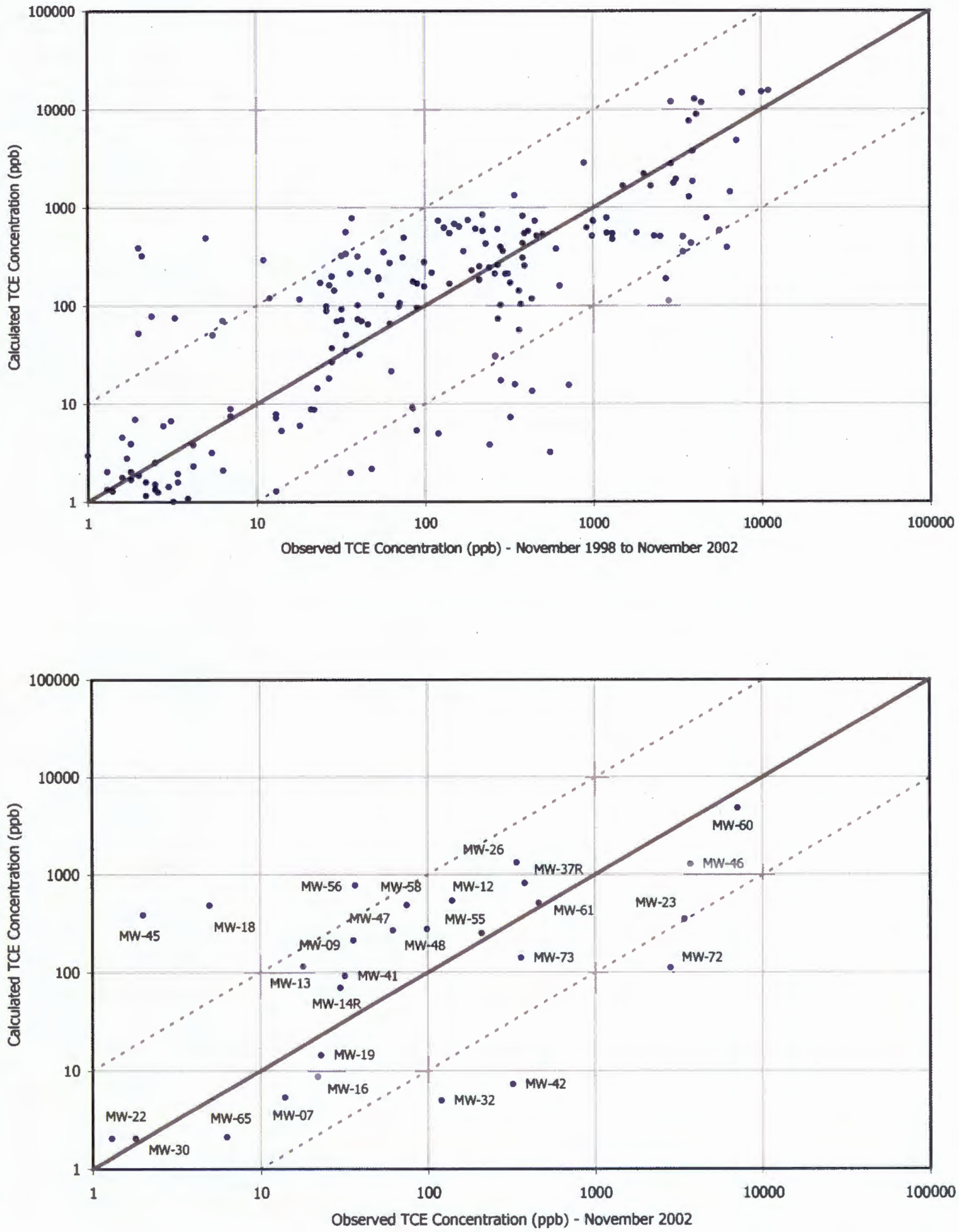


Figure 6.9 Comparisons of Calculated to Observed Concentrations TCE

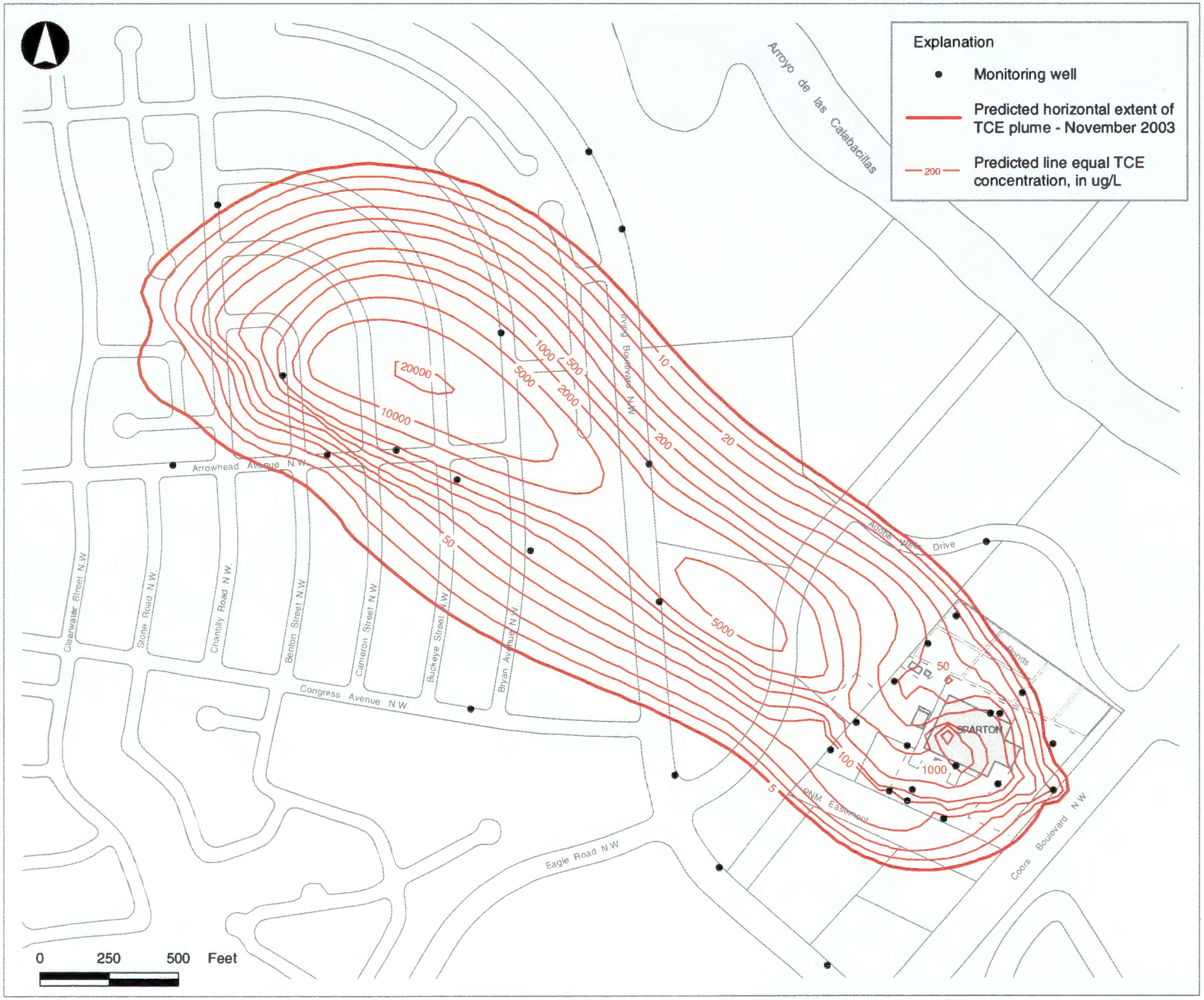


Figure 6.10 Predicted Extent of TCE Plume - November 2003

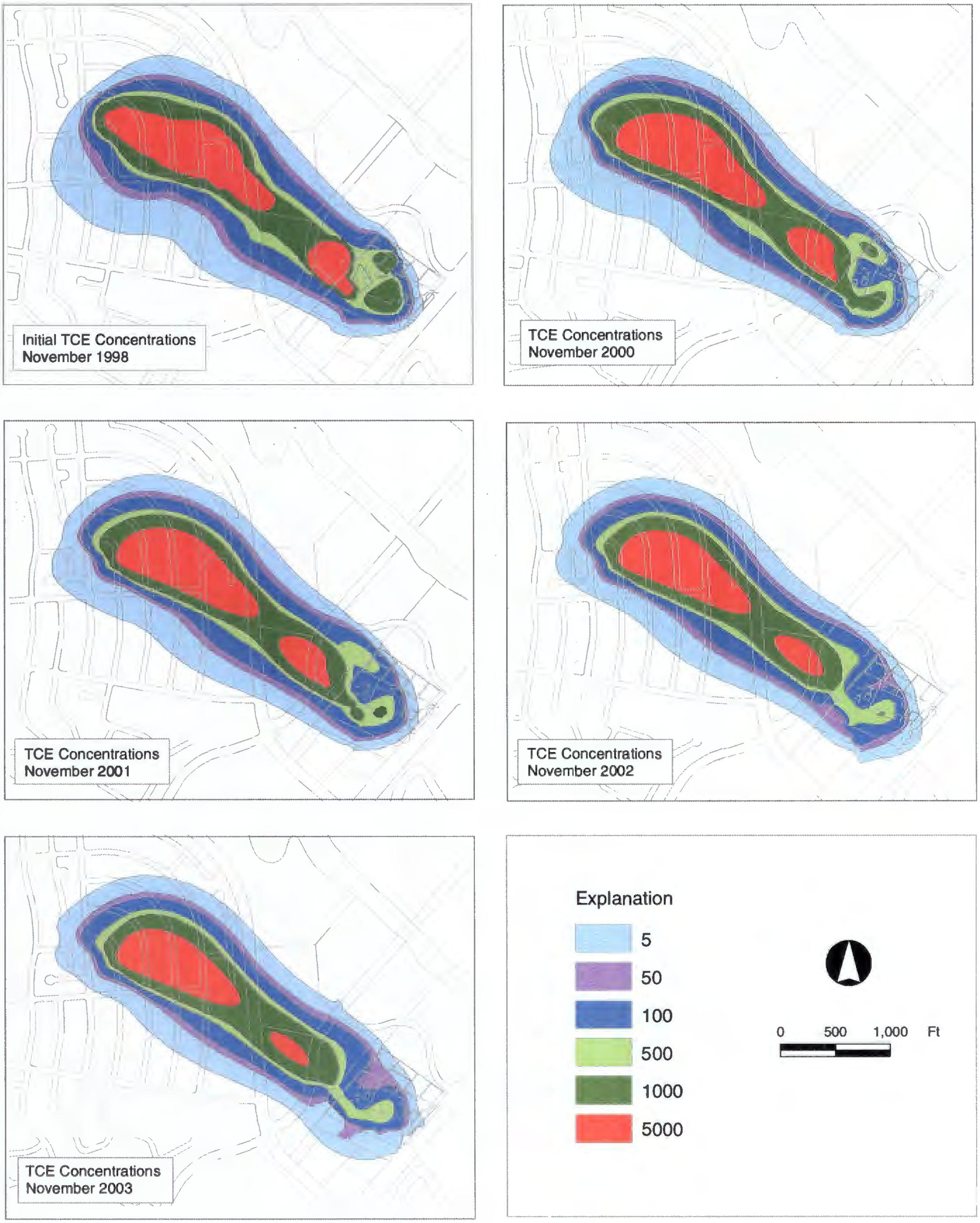


Figure 6.11 TCE Concentrations Calculated with the Recalibrated Model

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 [d]
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

Well ID	Flow Zone[a]	Easting[b]	Northing[b]	Elevation[c]
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 [d]
MW-48	UFZ	375369.75	1525239.86	5143.44 [d]
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-52	UFZ	374343.43	1525239.45	5156.35 [d]
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 [d]
MW-56	ULFZ	375371.31	1525207.68	5141.45 [d]
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	5134.87
MW-61	UFZ	375523.16	1525821.65	5135.23
MW-62	UFZ	375421.24	1524395.94	5073.69 [d]
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 [d]
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	5046.75
MW-71R	DFZ	375534.49	1525681.93	5134.19
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

[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 February 1, 2002

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-52	UFZ	5156.4	4974.8	4959.6	181.6	196.8	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**

[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
PW-1	UFZ	4973.59
PZ-1	UFZ	4956.59
MW-7	UFZ O/S *	4977.42
MW-9	UFZ O/S	4973.06
MW-12	UFZ O/S	4972.82
MW-13	UFZ O/S	4974.35
MW-14	UFZ	4971.12
MW-15	UFZ	Dry
MW-16	UFZ O/S	4978.43
MW-17	UFZ O/S	4978.7
MW-18	UFZ O/S	4971.87
MW-19	ULFZ	4971.85
MW-20	LLFZ	4971.47
MW-21	UFZ O/S	4978.31
MW-22	UFZ O/S	4977.89
MW-23	UFZ O/S	4975.91
MW-24	UFZ O/S	4978.23
MW-25	UFZ O/S	4978.31
MW-26	UFZ O/S	4973.44
MW-27	UFZ O/S	4974.05
MW-28	UFZ O/S	4971.09
MW-29	ULFZ	4973.68
MW-30	ULFZ	4972.28
MW-31	ULFZ	4971.23
MW-32	ULFZ **	4970.96
MW-33	UFZ O/S	4972.54
MW-34	UFZ	4974.51
MW-35	UFZ	4970.78
MW-36	UFZ	4970.03
MW-37	UFZ	4968.32
MW-38	LLFZ	4973.7
MW-39	LLFZ	4972.49

Well	Flow Zone	Elevation, in ft above MSL
MW-40	LLFZ	4971.25
MW-41	ULFZ	4971.09
MW-42	ULFZ	4970.65
MW-43	LLFZ	4970.45
MW-44	ULFZ	4970.11
MW-45	ULFZ	4968.33
MW-46	ULFZ	4966.95
MW-47	UFZ	4966.68
MW-48	UFZ	4965.81
MW-49	LLFZ **	4971.03
MW-50	UFZ	Dry
MW-51	UFZ O/S	4980.09
MW-52	UFZ	4963.17
MW-53	UFZ	4964.92
MW-54	UFZ	4965.56
MW-55	LLFZ	4965.13
MW-56	ULFZ	4965.76
MW-57	UFZ	4964.87
MW-58	UFZ	4965.43
MW-59	ULFZ	4969.46
MW-60	ULFZ	4965.33
MW-61	UFZ	4965.37
MW-62	UFZ	4967.52
MW-63	UFZ O/S	4970.98
MW-64	ULFZ	4965.41
MW-65	LLFZ	4963.05
MW-66	LLFZ	4963.98
MW-67	DFZ	4958.56
MW-68	UFZ	4962.25
MW-69	LLFZ	4962.13
MW-70	LLFZ ***	4970.18
MW-71	DFZ	4958.51

[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	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
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	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	<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	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

[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.

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 µg/L for TCE and DCE, and 60 µg/L for TCA).

Table 4.1

Quarterly Water-Level Elevations - 2002

Well ID	Flow Zone	Elevation, in feet above MSL			
		Feb. 1	May 7	Aug. 1	Nov. 4
CW-1	UFZ&LFZ	4937.65	4937.82	4937.37	4936.92
CW-2	UFZ&LFZ	4958.52	4958.58	4958.85	4959.36
OB-1	UFZ&LFZ	4956.80	4956.96	4956.62	4956.53
OB-2	UFZ&LFZ	4957.93	4958.20	4957.80	4957.72
PW-1	UFZ	DRY	DRY	DRY	DRY
PZ-1	UFZ	4954.52	4954.96	4954.39	4954.27
MW-7	UFZ O/S	4975.80[1]	4976.19[1]	4975.98	4976.52
MW-9	UFZ O/S	4970.81[1]	4971.00[1]	4970.91	4971.04
MW-12	UFZ O/S	4970.21	4970.39	4970.31	4970.45
MW-13	UFZ O/S	4972.27	4972.60	4972.49	4972.57
MW-14R	UFZ/ULFZ	4968.30	4968.32	4968.19	4968.35
MW-16	UFZ O/S	4980.50	4982.05	4982.19	4982.25
MW-17	UFZ O/S	4982.29	4981.96	4981.78	4981.93
MW-18	UFZ O/S	4969.22	4969.40	4970.34	4973.88
MW-19	ULFZ	4969.13	4969.25	4969.16	4969.38
MW-20	LLFZ	4968.75	4968.83	4968.65	4968.87
MW-21	UFZ O/S	MP NA	4983.25	4983.38	4983.17
MW-22	UFZ O/S	4978.68	4977.78	4977.41	4977.85
MW-23	UFZ O/S	4974.30	4974.70	4974.67	4974.83
MW-24	UFZ O/S	4980.12	4981.78	4981.95	4982.08
MW-25	UFZ O/S	4979.86	4981.99	4982.17	4982.25
MW-26	UFZ O/S	4970.82	4971.31	4971.55	4971.92
MW-27	UFZ O/S	4972.39	4978.83	4980.39	4980.86
MW-29	ULFZ	4971.37	4971.64	4971.50	4971.60
MW-30	ULFZ	4969.72	4969.84	4969.69	4969.87
MW-31	ULFZ	4968.40	4968.41	4968.27	4968.45
MW-32	ULFZ	4968.01	4968.09	4967.96	4968.26
MW-33	UFZ O/S	4969.98	4970.07	4969.98	4970.12
MW-34	UFZ	4972.02	4972.42	4972.37	4972.29
MW-36	UFZ	4967.65	4967.57	4967.43	DRY
MW-37R	UFZ/ULFZ	4965.50	4965.40	4965.16	4964.47
MW-38	LLFZ	4971.32	4971.60	4971.49	4971.56
MW-39	LLFZ	4970.10	4970.16	4970.02	4970.15
MW-40	LLFZ	4968.46	4968.49	4968.36	4968.53
MW-41	ULFZ	4968.14	4968.28	4968.28	4968.59
MW-42	ULFZ	4968.52	4968.56	4968.41	4968.65
MW-43	LLFZ	4968.32	4968.33	4968.14	4968.42

Well ID	Flow Zone	Elevation, in feet above MSL			
		Feb. 1	May 7	Aug. 1	Nov. 4
MW-44	ULFZ	4967.69	4967.64	4967.49	4966.77
MW-45	ULFZ	4966.46	4966.36	4966.14	4965.43
MW-46	ULFZ	4964.84	4964.78	4964.47	4964.54
MW-47	UFZ	4964.39	4964.28	4964.05	4964.06
MW-48	UFZ	4963.33	4963.36	4963.10	4963.04
MW-49	LLFZ	4968.46	4968.51	4968.35	4968.53
MW-51	UFZ O/S	4979.54	4981.04	4981.13	4981.76
MW-52	UFZ	4960.02	4959.95	4959.68	DRY
MW-53	UFZ	4961.68	4961.65	4961.47	4961.30
MW-54	UFZ	4964.07	4963.99	4963.64	4963.63
MW-55	LLFZ	4962.13	4962.20	4961.89	4961.93
MW-56	ULFZ	4963.33	4963.36	4963.09	4963.08
MW-57	UFZ	4963.84	4963.81	4963.43	4963.44
MW-58	UFZ	4962.73	4962.78	4962.47	4962.35
MW-59	ULFZ	4967.62	4967.55	4967.23	4967.60
MW-60	ULFZ	4963.37	4963.47	4963.05	4963.01
MW-61	UFZ	4963.36	4963.33	4962.94	4962.88
MW-62	UFZ	4965.34	4965.19	4965.01	4965.02
MW-63	UFZ O/S	4969.57	4969.55	4969.40	4969.84
MW-64	ULFZ	4963.98	4964.02	4963.62	4963.52
MW-65	LLFZ	4959.42	4959.60	4959.29	4959.24
MW-66	LLFZ	4962.50	4962.41	4961.97	4962.11
MW-67	DFZ	4956.83	4956.49	4955.77	4956.18
MW-68	UFZ	4959.61	4959.98	4959.60	4959.35
MW-69	LLFZ	4959.53	4959.76	4959.44	4959.35
MW-70	LLFZ	4967.65	4967.72	4967.50	4967.75
MW-71R	DFZ	NI	4956.60	4955.77	4956.21
MW-72	ULFZ	4968.48	4968.58	4968.50	4968.75
MW-73	ULFZ	4967.63	4967.73	4967.55	4967.81
MW-74	UFZ/ULFZ	4962.20	4962.39	4961.89	4961.78
MW-75	UFZ/ULFZ	4965.97	4966.16	4965.68	4965.56
MW-76	UFZ/ULFZ	4967.60	4967.50	4967.09	4967.20
MW-77	UFZ/ULFZ	4977.03	4977.16	4977.01	4977.21
MW-78	UFZ/ULFZ	4969.78	4972.91	4974.02	4974.53
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.

MP NA: Measuring point elevation not available

NI: Well not yet installed

Table 4.2

Water-Quality Data - Fourth Quarter 2002

Well ID	Sampling Date	Concentration, in µg/L TCE	DCE	TCA
MW-7	11/19/02	14	1.6	1.8
MW-9	11/21/02	62	3.1	1.8
MW-12	11/21/02	140	10	3.3
MW-13	11/19/02	18	<1.0	1.2
MW-14R	11/18/02	30	1.3	<1.0
MW-16	11/19/02	22	1.3	1.4
MW-17	11/19/02	1.9	<1.0	<1.0
MW-18	11/21/02	5	<1.0	<1.0
MW-19	11/25/02	23	1.5	<1.0
MW-20	11/12/01	2	<1.0	<1.0
MW-21	11/12/01	<1.0	<1.0	<1.0
MW-22	11/14/02	1.3	<1.0	<1.0
MW-23	11/21/02	3400	300	<20
MW-25		NA	NA	NA
MW-26	11/21/02	340	36	10
MW-29	11/15/02	<1.0	<1.0	<1.0
MW-30	11/15/02	1.8	<1.0	<1.0
MW-31	11/18/02	<1.0	<1.0	<1.0
MW-32	11/18/02	120	20	2.8
MW-33	11/04/02	Dry	Dry	Dry
MW-34	11/19/02	<1.0	<1.0	<1.0
MW-35	11/04/02	Dry	Dry	Dry
MW-36	11/04/02	Dry	Dry	Dry
MW-37R*	11/07/02	385	17.5	<1.0
MW-38	11/15/02	<1.0	<1.0	<1.0
MW-39	11/15/02	<1.0	<1.0	<1.0
MW-40	11/15/02	<1.0	<1.0	<1.0
MW-41	11/18/02	32	3.7	<1.0
MW-42	11/25/02	320	49	<5.0
MW-43	11/25/02	4.3	<1.0	<1.0
MW-44	11/11/02	<1.0	<1.0	<1.0
MW-45	11/11/02	2	<1.0	<1.0
MW-46	11/11/02	3700	680	63
MW-47	11/22/02	36	1.5	<1.0
MW-48*	11/22/02	97	4.1	<1.0
MW-49	11/15/02	<1.0	<1.0	<1.0
MW-51	11/11/02	<1.0	<1.0	<1.0
MW-52	11/04/02	Dry	Dry	Dry
MW-53	11/22/02	13	1.1	<1.0
MW-55	11/14/02	210	7.3	<1.0
MW-56	11/14/02	37	1.3	<1.0
MW-57	11/22/02	<1.0	<1.0	<1.0
MW-58	11/22/02	75	1.5	<1.0
MW-59	11/11/02	<1.0	<1.0	<1.0
MW-60	11/11/02	7100	370	30
MW-61	11/07/02	460	24	2.4
MW-62	11/19/02	2.5	8.1	6
MW-64	11/07/02	6.2	<1.0	<1.0
MW-65	11/06/02	6.3	23	5.1
MW-66	11/07/02	<1.0	<1.0	<1.0
MW-67	11/06/02	<1.0	<1.0	<1.0
MW-68	11/06/02	<1.0	<1.0	<1.0
MW-69	11/06/02	<1.0	<1.0	<1.0
MW-70	11/18/02	<1.0	<1.0	<1.0
MW-71R	11/07/02	180	4.9	<1.0
MW-72	11/15/02	2800	280	59
MW-73	11/18/02	360	47	6.7
MW-74	11/18/02	<1.0	<1.0	<1.0
MW-75	11/19/02	<1.0	<1.0	<1.0
MW-76	11/18/02	<1.0	<1.0	<1.0
MW-77	11/18/02	35	2.8	<1.0
MW-78	11/18/02	8.4	<1.0	<1.0
CW-1	11/04/02	1300	67	4.7
CW-2	11/04/02	480	72	11

* Results for well are the average of duplicate samples

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 µg/L for TCE and DCE, and 60 µg/L for TCA).

Table 4.3

Flow Rates - 2002

(a) Off-Site Containment Well

Month	Volume of Pumped Water, in gal.		Average Discharge Rate, in gpm	
	Monthly	Annual	Monthly	Annual
Jan.	9,859,061		221	
Feb.	8,912,253		221	
Mar.	9,901,211		222	
Apr.	9,561,517		221	
May	9,874,468		221	
June	9,524,359		220	
July	9,820,664		220	
Aug.	9,810,977		220	
Sep.	9,528,673		221	
Oct.	9,939,120		223	
Nov.	9,657,723		224	
Dec.	9,969,363	**116,359,389**	223	**221**

(b) Source Containment Well

Month	Volume of Pumped Water, in gal.		Average Discharge Rate, in gpm	
	Monthly	Annual	Monthly	Annual
Jan.	2,009,455		49	
Feb.	1,995,354		49	
Mar.	2,222,035		50	
Apr.	2,144,320		50	
May	2,191,130		49	
June	2,082,350		48	
July	2,103,414		47	
Aug.	2,075,651		46	
Sep.	1,976,153		46	
Oct.	2,051,884		46	
Nov.	2,202,882		51	
Dec.	2,348,861	**25,403,490**	53	**49**

Containment Well Summary

2002	**Total Volume of Water Pumped, in gal.**	141,762,879
	Total Average Discharge Rate, in gpm	270

Table 4.4

Influent and Effluent Quality - 2002[a]

(a) Off-Site Containment System

Sampling Date	Concentration, in μg/L							
	Influent				Effluent			
	TCE	DCE	TCA	Cr Total	TCE	DCE	TCA	Cr Total
01/03/02	1100	77	4.3	35.0	0.8	<0.2	<1.0	39
02/01/02	1400	76	4.2	40.0	0.6	<0.2	<1.0	52[b]
03/01/02	1200	63	4.4	40.0	<1.0	<1.0	<1.00	35
04/01/02	1000	71	4.2	34.0	<1.0	<1.0	<1.00	34
05/01/02	1300	67	4.8	37.0	<1.0	<1.0	<1.0	35
06/03/02	1200	68	4	29.0	<1.0	<1.0	<1.0	29
07/01/02	1000	81	4.9	32.0	<0.3	<0.2	<1.0	34
08/02/02	1300	70	8.1	30.0	<1.0	<1.0	<1.0	30
09/03/02	1300	71	4.9	33.0	<1.0	<1.0	<1.0	30
10/01/02	1300	76	5.7	30.0	<1.0	<1.0	<1.0	130[b]
11/04/02	1300	67	4.7	24.0	<1.0	<1.0	<1.0	23
12/02/02	1300	62	<5.0	26.0	<1.0	<1.0	<1.0	26
01/02/03	1300	63	<5.0	23.0	<1.0	<1.0	<1.0	24

(b) Source Containment System

Sampling Date	Concentration, in μg/L							
	Influent				Effluent			
	TCE	DCE	TCA	Cr Total	TCE	DCE	TCA	Cr Total
01/03/02	1100	200	34	7.5[c]	<0.3	<0.2	<1.0	7[c]
02/01/02	1000	150	27	26	<0.3	<0.2	<1.0	27
03/01/02	770	120	20	26	<1.0	<1.0	<1.0	24
04/01/02	530	110	18	39	<1.0	<1.0	<1.0	24
05/01/02	650	95	16	27	<1.0	<1.0	<1.0	27
06/03/02	530	92	15	23	<1.0	<1.0	<1.0	24
07/01/02	670	100	15	29	<0.3	<0.2	<1.0	30
8/2/02	530	86	15	30	<1.0	<1.0	<1.0	30
09/03/02	470	91	15	35	<1.0	<1.0	<1.0	35
10/01/02	520	87	15	34	<1.0	<1.0	<1.0	33
11/04/02	480	72	11	27	<1.0	<1.0	<1.0	29
12/02/02	470	64	11	30	<1.0	<1.0	<1.0	33
01/02/03	450	66	11	36	<1.0	<1.0	<1.0	31

[a] Data from 01/02/03 has been included to show conditions at the end of the year.

[b] Given the corresponding influent concentrations, these values reflect laboratory error. They were not, therefore, highlighted as exceeding chromium standards

[c] Total chromium value represents average of duplicate samples

Note: 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 - 2002

(a) 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	102.7	2.8	6.3	0.2	0.3	49.6	109.3
Feb.	43.8	96.6	2.3	5.2	0.1	0.3	46.3	102.0
Mar.	41.5	91.5	2.5	5.6	0.2	0.4	44.2	97.5
Apr.	41.8	92.1	2.5	5.5	0.2	0.4	44.5	98.0
May	46.3	102.0	2.5	5.5	0.2	0.4	48.9	107.9
June	39.6	87.4	2.7	5.9	0.2	0.4	42.5	93.7
July	42.8	94.4	2.8	6.2	0.2	0.5	45.9	101.2
Aug.	48.4	106.8	2.6	5.8	0.2	0.5	51.3	113.1
Sep.	46.8	103.2	2.6	5.8	0.2	0.4	49.6	109.4
Oct.	48.8	107.5	2.7	5.9	0.2	0.4	51.7	113.9
Nov.	48.0	105.8	2.4	5.2	0.1	0.3	50.5	111.3
Dec.	49.0	108.0	2.4	5.2	0.1	0.2	51.4	113.4
Total	**543.4**	**1,198.0**	**30.9**	**68.2**	**2.0**	**4.5**	**576.4**	**1,270.7**

(b) 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.	8.6	19.0	1.4	3.2	0.3	0.6	10.3	22.7
Feb.	6.7	14.7	1.0	2.2	0.2	0.4	7.9	17.4
Mar.	5.5	12.1	1.0	2.1	0.2	0.4	6.6	14.6
Apr.	4.8	10.6	0.8	1.8	0.1	0.3	5.8	12.7
May	4.9	10.7	0.8	1.7	0.1	0.3	5.8	12.7
June	4.7	10.4	0.8	1.7	0.1	0.3	5.6	12.3
July	4.8	10.5	0.7	1.6	0.1	0.3	5.6	12.4
Aug.	3.9	8.7	0.7	1.5	0.1	0.3	4.8	10.5
Sep.	3.7	8.1	0.7	1.5	0.1	0.2	4.5	9.8
Oct.	3.9	8.5	0.6	1.4	0.1	0.2	4.6	10.1
Nov.	4.0	8.9	0.6	1.3	0.1	0.2	4.7	10.4
Dec.	4.1	9.0	0.6	1.3	0.1	0.2	4.8	10.5
Total	**59.6**	**131.4**	**9.7**	**21.3**	**1.6**	**3.6**	**70.9**	**156.3**

Containment Well Summary

		in kg	in lbs
2002	**Total Mass of Removed TCE**	603.0	1329.4
	Total Mass of Removed DCE	40.6	89.5
	Total Mass of Removed TCA	3.6	8.1
	Total Mass Removed	647.3	1427.0

Table 6.1

Inital Mass and Maximum Concentration of TCE in Model Layers

Model Layer	Approximate Mass		Maximum Concentration
	in kg	in lbs	in µg/L
1	0.0	0.0	6,540
2	9.6	21.2	5,298
3	28.6	63.1	1,361
4	577.0	1272.0	13,510
5	1432.1	3157.2	46,950
6	1319.0	2907.8	46,950
7	555.2	1224.0	15,000
8	364.1	802.7	4,033
9	178.7	394.0	1,987
10	137.8	303.8	1,005
11	45.3	99.9	411
Total	**4,647.4**	**10,245.7**	-

Appendix A

2002 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
2002 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	05/09/02	48	3.8	2.4	0.034	0.0110	
	11/19/02	14	1.6	1.8	0.035	<0.0056	
MW-9	11/21/02	62	3.1	1.8	0.085	<0.0056	
MW-12	11/21/02	140	10	3.3	0.038	0.026	MeCl:1.5
MW-13	11/19/02	18	<1.0	1.2	0.0098	0.0078	
MW-14R	11/18/02	30	1.3	<1.0	0.4	NA	
MW-16	11/19/02	22	1.3	1.4	1.3	0.9	MeCl:2.3
MW-17	11/19/02	1.9	<1.0	<1.0	0.076	0.066	
MW-18	11/21/02	5.0	<1.0	<1.0	0.029	0.036	
MW-19	11/25/02	23	1.5	<1.0	<0.005	NA	
MW-20	11/25/02	2	<1.0	<1.0	<0.005	NA	
MW-21	11/19/02	<1.0	<1.0	<1.0	0.4	0.028	
MW-22	11/14/02	1.3	<1.0	<1.0	0.044	0.037	
MW-23	11/21/02	3400	300	<20	11	0.26	PCE:34
MW-26	11/21/02	340	36	10	0.56	0.12	PCE:2.6
MW-29	11/15/02	<1.0	<1.0	<1.0	<0.005	NA	
MW-30	11/15/02	1.8	<1.0	<1.0	0.024	NA	
MW-31	11/18/02	<1.0	<1.0	<1.0	0.0056	0.01	
MW-32	11/18/02	120	20	2.8	<0.005	NA	PCE:1.1
MW-34	11/19/02	<1.0	<1.0	<1.0	0.071	<0.0056	
MW-37R	11/07/02	380	18	<1.0	0.078	0.07700	cis-1,2-DCE:1.9; PCE:1.4
	11/07/02	390	17	<1.0	0.077	0.07400	cis-1,2-DCE:1.9; PCE:1.3
MW-38	11/15/02	<1.0	<1.0	<1.0	<0.005	NA	

Appendix A-1

Groundwater Monitoring Program Wells
2002 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-39	11/15/02	<1.0	<1.0	<1.0	<0.005	<0.0056	
MW-40	11/15/02	<1.0	<1.0	<1.0	<0.005	NA	
MW-41	11/18/02	32	3.7	<1.0	0.014	NA	
MW-42	11/25/02	320	49	<5.0	<0.0050	NA	
MW-43	11/25/02	4.3	<1.0	<1.0	<0.0050	NA	
MW-44	11/11/02	<1.0	<1.0	<1.0	<0.005	NA	
MW-45	11/11/02	2	<1.0	<1.0	0.075	NA	
MW-46	11/11/02	3700	680	63	0.0083	NA	1,1,2-TCTFA:36; 1,1-DCA:17; Chlor:6.4; Benz:3.3; 1,1,2-TCA:6.0
MW-47	11/22/02	36	1.5	<1.0	0.017	0.031	
MW-48	11/22/02	99	4.1	<1.0	1.2	0.047	
	11/22/02	95	4.0	<1.0	1.1	0.048	
MW-49	11/15/02	<1.0	<1.0	<1.0	<0.005	NA	
MW-51	11/11/02	<1.0	<1.0	<1.0	0.071	NA	
MW-52	02/05/02	<1.0	<1.0	<1.0	0.018	0.020	
	05/09/02	<1.0	<1.0	<1.0	0.023	0.0199	
MW-53	11/22/02	13	1.1	<1.0	0.034	0.030	
MW-55	11/14/02	210	7.3	<1.0	0.12	NA	
MW-56	11/14/02	37	1.3	<1.0	0.067	NA	
MW-57	02/06/02	<1.0	<1.0	<1.0	0.009	0.009	
	02/06/02	<1.0	<1.0	<1.0	0.011	0.007	
	05/09/02	<1.0	<1.0	<1.0	0.008	0.0064	
	08/06/02	<1.0	<1.0	<1.0	0.02	<0.00555	
	11/22/02	<1.0	<1.0	<1.0	0.015	<0.0056	
MW-58	11/22/02	75	1.5	<1.0	0.52	0.059	

Appendix A-1

Groundwater Monitoring Program Wells
2002 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-59	11/11/02	<1.0	<1.0	<1.0	0.0064	NA	
MW-60	11/11/02	7100	370	30	0.077	0.073	cis-1,2-dce:5.2; 1,1,2-TCTFA:52; 1,1-DCE:1.8Chlor:5.6
MW-61	11/07/02	460	24	2.4	0.023	0.024	1,1,2-TCTFA:6.0; PCE:4.9
MW-62	02/06/02	3.4	9	5.4	0.010	0.013	
	05/09/02	1.9	5.7	3.7	0.029	0.0099	
	08/07/02	2.7	8	6.3	0.020	<0.00555	
	11/19/02	2.5	8.1	6	0.0065	0.0079	
MW-64	11/07/02	6.2	<1.0	<1.0	<0.005	NA	
MW-65	02/05/02	1.7	5.4	1.0	0.003	NA	
	05/08/02	2.5	8.4	1.6	0.001	NA	
	08/06/02	4.2	15	3.3	<0.00500	NA	
	11/06/02	6.3	23	5.1	0.0088	NA	
MW-66	02/05/02	<1.0	<1.0	<1.0	0.002	NA	
	05/08/02	<1.0	<1.0	<1.0	0.002	NA	
	08/06/02	<1.0	<1.0	<1.0	<0.00500	NA	
	11/07/02	<1.0	<1.0	<1.0	<0.0050	NA	
MW-67	05/08/02	<1.0	<1.0	<1.0	<0.001	NA	
	11/06/02	<1.0	<1.0	<1.0	<0.0050	NA	
MW-68	02/05/02	<1.0	<1.0	<1.0	<0.001	NA	
	05/08/02	<1.0	<1.0	<1.0	0.002	NA	
	08/06/02	<1.0	<1.0	<1.0	<0.00500	NA	
	11/06/02	<1.0	<1.0	<1.0	0.021	NA	
MW-69	02/05/02	<1.0	<1.0	<1.0	0.007	NA	
	05/08/02	<1.0	<1.0	<1.0	0.001	NA	
	08/07/02	<1.0	<1.0	<1.0	<0.00500	NA	
	11/06/02	<1.0	<1.0	<1.0	<0.0050	NA	

Appendix A-1

Groundwater Monitoring Program Wells
2002 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-70	11/18/02	<1.0	<1.0	<1.0	0.0057	NA	
MW-71R	02/28/02	130	3	<1.0	0.02	0.0162	MeCl:1.5
	04/09/02	150	5.3	<1.0	0.004	NA	
	05/08/02	160	4.2	<1.0	0.003	NA	MeCl:2.1
	08/07/02	190	5.6	<1.0	<0.00500	NA	MeCl:2.0
	11/07/02	180	4.9	<1.0	<0.0050	NA	MeCl:1.7
MW-72	05/08/02	2700	380	130	0.119	NA	1,1,2-TCTFA:21; 1,1-DCA:2.5; Chlor:8.9; Benz:2.6; 1,1,2-TCA:2.5
	11/15/02	2800	280	59	0.15	NA	PCE:12
MW-73	11/18/02	360	47	6.7	0.063	NA	1,1,2-TCTFA:5.5; 1,1-DCA:1.0; PCE:1.1

*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
2002 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	02/06/02	1.2	<1.0	<1.0	0.0430	4.1800	0.1210	0.0280	0.3200	0.0160
	05/09/02	1.3	<1.0	<1.0	0.0520	11.2000	0.3040	0.0238	0.2400	0.0047
	08/16/02	2.7	<1.0	<1.0	0.1300	5.2000	0.1400	0.1200	0.0320	<0.0056
	11/19/02	1.9	<1.0	<1.0	0.0760	3.6000	0.1000	0.0660	0.0180	<0.0056
MW-74	02/05/02	<1.0	<1.0	<1.0	0.0360	0.2500	0.0060			
	05/08/02	<1.0	<1.0	<1.0	0.0350	0.1700	0.0022	0.0366	0.1900	0.0027
	08/06/02	<1.0	<1.0	<1.0	0.0340	0.0580	0.0077			
	11/18/02	<1.0	<1.0	<1.0	0.0300	0.0190	<0.005			
MW-75	02/05/02	<1.0	<1.0	<1.0	0.0620	0.8300	<0.004			
	05/08/02	<1.0	<1.0	<1.0	0.0340	0.1700	0.0029	0.0368	0.1800	0.0045
	08/16/02	<1.0	<1.0	<1.0	0.0320	0.0330	<0.0050			
	11/18/02	<1.0	<1.0	<1.0	0.0290	<0.005	<0.005			
MW-76	02/05/02	<1.0	<1.0	<1.0	0.0340	0.0800	<0.004			
	05/08/02	<1.0	<1.0	<1.0	0.0330	0.1700	0.0021	0.0352	0.1800	0.0048
	08/16/02	<1.0	<1.0	<1.0	0.0320	0.0340	<0.0050			
	11/18/02	<1.0	<1.0	<1.0	0.0270	<0.0050	<0.0050			
MW-77	02/06/02	37	1.4	<1.0	0.0020	0.1900	1.9900	0.0090	0.2600	0.7590
	05/09/02	43	2.6	<1.0	0.0010	0.1200	2.5800	0.0030	0.2700	0.8030
	08/16/02	40	3.7	<1.0	<0.0050	0.1400	4.5000	<0.0056	0.0170	0.6700
	11/18/02	35	2.8	<1.0	<0.0050	0.0670	3.8000	<0.0056	<0.011	0.7700
MW-78	02/07/02	7.0	<1.0	<1.0	0.0040	1.0500	0.0889	0.0080	0.2400	<0.004
	05/09/02	3.6	<1.0	<1.0	0.0030	0.5700	0.0717	0.0259	0.6300	0.0101
	08/16/02	5.9	<1.0	<1.0	0.0088	0.4900	0.0410	0.0090	0.0270	<0.0056
	11/18/02	8.4	<1.0	<1.0	0.0220	0.3200	0.0400	0.0220	<0.011	<0.0056

*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

Appendix B

2002 Containment Well Flow Rate Data

B-1: Off-Site Containment Well

B-2: Source Containment Well

B-1: Off-Site Source Containment Well

Appendix B-1

Off-Site Containment Well
2002 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons*
12/21/01	12:12	---	303781300		339463800
				222	
01/02/02	8:45	---	307568900		343251400
				223	
01/03/02	11:30	---	307927400		343609900
				222	
01/08/02	13:06	---	309545500		345228000
				222	
01/10/02	7:30	222	310111400		345793900
				221	
01/11/02	7:07	---	310424700		346107200
				220	
01/14/02	11:45	222	311437700		347120200
				222	
01/16/02	6:45	223	312009900		347692400
				222	
01/18/02	14:38	---	312754300		348436800
				222	
01/21/02	14:55	---	313717900		349400400
				222	
01/24/02	12:55	223	314649700		350332200
				222	
01/25/02	7:20	---	314894900		350577400
				222	
01/30/02	8:00	---	316501300		352183800
				207	
02/01/02	7:35	222	317092500		352775000
				222	
02/06/02	7:30	223	318692800		354375300
				219	
02/08/02	12:45	---	319392100		355074600
				222	
02/11/02	15:05	222	320382100		356064600
				220	
02/14/02	10:35	---	321274610		356957110
				218	
02/18/02	7:00	223	322480900		358163400
				222	
02/22/02	6:30	223	323751800		359434300
				222	
03/01/02	6:40	222	325992700		361675200
				222	
03/07/02	12:50	222	327991500		363674000
				222	

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Off-Site Containment Well
2002 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons*
03/14/02	15:30	223	330262800		365945300
				222	
03/22/02	14:35	222	332806100		368488600
				222	
03/26/02	7:40	222	333991700		369674200
				222	
03/28/02	11:15	222	334677600		370360100
				222	
04/01/02	7:05	221	335901000		371583500
				221	
04/08/02	7:30	222	338130100		373812600
				221	
04/12/02	8:15	222	339415700		375098200
				222	
04/17/02	6:45	223	340992700		376675200
				221	
04/22/02	14:10	221	342685700		378368200
				221	
04/29/02	6:50	222	344819800		380502300
				222	
05/01/02	14:20	222	345557400		381239900
				224	
05/02/02	6:20	---	345772300		381454800
				221	
05/09/02	9:30	223	348042000		383724500
				221	
05/15/02	6:45	222	349917000		385599500
				221	
05/22/02	13:40	222	352238300		387920800
				221	
05/29/02	6:45	222	354375000		390057500
				221	
06/03/02	6:30	222	355964800		391647300
				221	
06/06/02	6:45	---	356921100		392603600
				221	
06/11/02	20:30	221	358690900		394373400
				221	
06/19/02	6:55	221	361052000		396734500
				220	
06/28/02	6:40	221	363902800		399585300
				220	
07/01/02	6:30	222	364851800		400534300
				220	

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Off-Site Containment Well
2002 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons*
07/05/02	7:00	---	366125600		401808100
				219	
07/10/02	6:30	222	367695300		403377800
				221	
07/16/02	6:40	221	369608500		405291000
				220	
07/18/02	6:50	---	370243200		405925700
				220	
07/29/02	10:30	---	373773700		409456200
				220	
08/01/02	8:00	---	374692100		410374600
				220	
08/02/02	7:00	221	374995700		410678200
				220	
08/06/02	13:50	---	376353100		412035600
				219	
08/12/02	12:05	219	378220200		413902700
				220	
08/16/02	6:50	---	379416900		415099400
				220	
08/21/02	6:15	221	380991200		416673700
				220	
08/27/02	6:20	221	382889300		418571800
				220	
08/29/02	11:15	---	383588800		419271300
				221	
09/03/02	10:30	---	385168900		420851400
				220	
09/13/02	12:30	222	388370100		424052600
				221	
09/19/02	14:45	222	390305300		425987800
				221	
09/26/02	6:40	223	392422900		428105400
				221	
10/01/02	9:00	223	394045300		429727800
				221	
10/08/02	11:50	222	396306300		431988800
				221	
10/15/02	7:25	220	398472600		434155100
				223	
10/25/02	6:50	221	401675700		437358200
				225	
11/04/02	6:40	222	404916300		440598800
				224	

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Off-Site Containment Well
2002 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons*
11/07/02	15:45	---	406006600		441689100
				224	
11/22/02	12:30	221	410796600		446479100
				224	
11/27/02	11:20	222	412392500		448075000
				223	
12/02/02	12:50	224	414017300		449699800
				223	
12/06/02	15:25	---	415337700		451020200
				223	
12/11/02	11:45	---	416897000		452579500
				223	
12/19/02	9:50	225	419443400		455125900
				223	
12/23/02	12:10	223	420760200		456442700
				223	
12/28/02	16:37	218	422426300		458108800
				224	
01/02/03	11:51	---	423972700		459655200

*Total pumpage since 12/31/98

B-2: Source Containment Well

Appendix B-2

Source Containment Well
2002 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons
01/03/02	13:37	50	10732		10732
				49	
01/04/02	9:57	50	70890		70890
				49	
01/05/02	12:33	50	149170		149170
				49	
01/06/02	12:30	50	219490		219490
				49	
01/07/02	7:43	50	275870		275870
				49	
01/08/02	13:12	50	362230		362230
				49	
01/09/02	13:23	50	432970		432970
				49	
01/10/02	10:10	50	493740		493740
				50	
01/12/02	10:35	50	639280		639280
				50	
01/13/02	9:42	50	709040		709040
				50	
01/14/02	12:18	50	789180		789180
				50	
01/16/02	7:00	50	917730		917730
				50	
01/17/02	15:49	---	1016490		1016490
				50	
01/18/02	14:27	50	1084520		1084520
				50	
01/21/02	15:05	---	1302930		1302930
				50	
01/23/02	7:16	---	1423780		1423780
				50	
01/24/02	13:11	50	1513550		1513550
				50	
01/25/02	13:21	---	1586160		1586160
				40	
01/27/02	10:30	---	1693447		1693447
				49	
01/28/02	8:24	50	1758180		1758180
				49	
01/29/02	10:10	50	1834640		1834640
				50	
01/30/02	7:13	50	1897780		1897780
				50	

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Source Containment Well
2002 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons
02/01/02	7:00	50	2040800		2040800
				50	
02/05/02	8:10	50	2331600		2331600
				50	
02/08/02	12:00	---	2558020		2558020
				50	
02/11/02	14:26	50	2780250		2780250
				49	
02/15/02	10:18	---	3052720		3052720
				49	
02/18/02	8:25	50	3259930		3259930
				50	
02/22/02	7:00	50	3541100		3541100
				49	
03/01/02	7:15	50	4037070		4037070
				49	
03/05/02	11:34	---	4334070		4334070
				50	
03/07/02	12:05	50	4478700		4478700
				50	
03/15/02	14:55	50	5060320		5060320
				47	
03/16/02	9:50	50	5113780		5113780
				50	
03/18/02	12:20	50	5265760		5265760
				50	
03/22/02	14:22	50	5561000		5561000
				50	
03/26/02	6:47	50	5826940		5826940
				50	
03/28/02	11:00	50	5983700		5983700
				50	
04/01/02	7:39	50	6261650		6261650
				50	
04/08/02	7:45	50	6762300		6762300
				50	
04/12/02	8:35	50	7051020		7051020
				50	
04/17/02	7:00	50	7404090		7404090
				50	
04/22/02	12:15	50	7777100		7777100
				50	
04/29/02	7:00	50	8260570		8260570
				49	

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Source Containment Well
2002 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons
05/01/02	13:40	50	8422610		8422610
				49	
05/09/02	9:15	50	8978420		8978420
				49	
05/15/02	7:30	50	9398820		9398820
				49	
05/23/02	7:00	50	9962000		9962000
				49	
05/29/02	7:10	50	10385160		10385160
				49	
06/03/02	7:20	50	10735950		10735950
				48	
06/06/02	7:00	---	10944230		10944230
				48	
06/13/02	6:45	50	11430970		11430970
				48	
06/19/02	7:15	50	11848700		11848700
				48	
06/28/02	7:00	50	12469700		12469700
				48	
07/01/02	7:00	48	12675590		12675590
				47	
07/05/02	7:25	----	12949570		12949570
				47	
07/10/02	7:30	47	13290050		13290050
				47	
07/16/02	7:00	47.6	13696200		13696200
				47	
07/18/02	6:30	----	13830440		13830440
				47	
07/23/02	7:30	----	14171320		14171320
				47	
07/24/02	17:00	---	14265500		14265500
				47	
07/27/02	7:10	----	14440560		14440560
				47	
07/29/02	11:30	----	14587870		14587870
				47	
08/01/02	7:40	----	14780460		14780460
				47	
08/02/02	7:30	44.2	14847480		14847480
				46	
08/12/02	11:40	49.2	15524490		15524490
				47	

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Source Containment Well
2002 Flow Rate Data

Date	Time	Instantaneous Discharge	Totalizer	Average Discharge	Total Gallons
08/16/02	6:30	48.4	15778790		15778790
				47	
08/21/02	6:30	47.7	16114990		16114990
				47	
08/29/02	10:10	---	16662620		16662620
				46	
09/03/02	10:00	----	16996230		16996230
				46	
09/13/02	12:10	---	17665620		17665620
				46	
09/19/02	7:00	----	18048400		18048400
				45	
09/25/02	12:30	---	18448090		18448090
				46	
10/01/02	8:30	47	18833890		18833890
				46	
10/08/02	12:05	47	19307240		19307240
				46	
10/15/02	7:00	47	19759460		19759460
				46	
10/22/02	7:45	48	20226208		20226208
				46	
10/25/02	7:15	47	20423040		20423040
				46	
11/04/02	6:10	47	21078070		21078070
				51	
11/22/02	14:00	52.6	22425700		22425700
				53	
11/27/02	12:00	51.7	22797800		22797800
				53	
12/02/02	12:15	52.63	23177600		23177600
				53	
12/06/02	15:15	---	23490190		23490190
				53	
12/11/02	12:00	---	23858880		23858880
				53	
12/19/02	9:20	51.72	24457240		24457240
				53	
12/23/02	12:00	52.63	24768740		24768740
				53	
12/28/02	16:58	51	25163240		25163240
				53	
01/02/03	10:57	52.81	25524670		25524670

Appendix C

2002 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
2002 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)
01/03/02	1100	77	4.3	0.035	0.190	0.0007	0.8	<0.2	<1.0	0.039	0.210	0.0015
02/01/02	1400	76	4.2	0.040	0.230	0.0022	0.6	<0.2	<1.0	0.052	0.310	0.0015
03/01/02	1200	63	4.4	0.040	0.220	0.0008	<1.0	<1.0	<1.00	0.035	0.160	<0.0004
04/01/02	1000	71	4.2	0.034	0.180	<0.0004	<1.0	<1.0	<1.00	0.034	0.210	0.0004
05/01/02	1300	67	4.8	0.037	0.030	0.0011	<1.0	<1.0	<1.0	0.035	0.030	0.0008
06/03/02	1200	68	4.0	0.029	0.032	0.0007	<1.0	<1.0	<1.0	0.029	0.320	0.0006
07/01/02	1000	81	4.9	0.032	0.280	0.0009	<0.3	<0.2	<1.0	0.034	0.260	0.0005
08/02/02	1300	70	8.1	0.030	0.060	<0.0050	<1.0	<1.0	<1.0	0.030	0.010	<0.0050
09/03/02	1300	71	4.9	0.033	0.160	<0.0050	<1.0	<1.0	<1.0	0.030	0.100	<0.0050
10/01/02	1300	76	5.7	0.030	<0.010	<0.0050	<1.0	<1.0	<1.0	0.130	<0.010	<0.0050
11/04/02	1300	67	4.7	0.024	0.061	<0.0050	<1.0	<1.0	<1.0	0.023	0.029	<0.0050
12/02/02	1300	62	<5.0	0.026	<0.010	<0.0005	<1.0	<1.0	<1.0	0.026	<0.010	<0.0050
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

[a] Data from 01/02/03 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
2002 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)
01/03/02	1100	200	34	0.0075*	0.255	0.03395	<0.3	<0.2	<1.0	0.007*	0.189	0.0279
02/01/02	1000	150	27	0.026	0.300	0.0998	<0.3	<0.2	<1.0	0.027	0.320	0.0976
03/01/02	770	120	20	0.026	0.300	0.0895	<1.0	<1.0	<1.0	0.024	6.810	0.1090
04/01/02	530	110	18	0.039	0.530	0.0874	<1.0	<1.0	<1.0	0.024	0.760	0.0904
05/01/02	650	95	16	0.027	0.060	0.1030	<1.0	<1.0	<1.0	0.027	0.110	0.1030
06/03/02	530	92	15	0.023	0.410	0.0847	<1.0	<1.0	<1.0	0.024	0.440	0.0900
07/01/02	670	100	15	0.029	0.340	0.0939	<0.3	<0.2	<1.0	0.030	0.360	0.0932
08/02/02	530	86	15	0.030	0.020	0.0800	<1.0	<1.0	<1.0	0.030	0.020	0.0800
09/03/02	470	91	15	0.035	<0.0050	0.0910	<1.0	<1.0	<1.0	0.035	<0.0050	0.0910
10/01/02	520	87	15	0.034	0.140	0.0880	<1.0	<1.0	<1.0	0.033	0.470	0.0920
11/04/02	480	72	11	0.027	0.062	0.0790	<1.0	<1.0	<1.0	0.029	2.300	0.0840
12/02/02	470	64	11	0.030	0.037	0.0830	<1.0	<1.0	<1.0	0.033	3.500	0.0930
01/02/03	450	66	11	0.036	0.210	0.0870	<1.0	<1.0	<1.0	0.031	0.023	0.0860

[a] Data from 01/02/03 has been included to show conditions at the end of the year.

* Total chromium value represents average of duplicate samples

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

Copy of Notification for Public Meeting and Mailing List

FACT SHEET

An Update on Sparton Technology's Coors Road Facility, Albuquerque, New Mexico.

July 01, 2002

Sparton Technology, Inc., a New Mexico corporation (Sparton Technology) wishes to provide you with information concerning the progress of the current and planned environmental remediation activities at their former plant at 9621 Coors Road. Sparton Technology operated a defense electronics component manufacturing plant at this location from 1961 through 1994. In the late 1980's it was determined that several industrial solvents had impacted soil and groundwater. A series of investigations over the ensuing years detailed the nature and extent of the solvent contamination. Trichloroethylene (TCE), 1,1,1-trichloroethane (TCA) and lesser amounts of methylene chloride (MeCL), acetone, and 1,1-dichlorethylene (DCE) were the primary constituents impacting soil, soil gas, and groundwater. Groundwater sampling further indicated that these constituents had migrated off site up to one-half mile to the northwest of the plant. Various studies have indicated that the contaminant plume has not impacted any existing supply wells.

Sparton Technology began environmental remediation activities at the plant in 1983. In late 1988 Sparton installed a groundwater recovery and treatment system on site. During the next 10 years extensive investigation, installation of monitoring wells, and negotiations among various interested parties to establish appropriate remediation measures were undertaken. In 1998, additional remediation activities were implemented. All cleanup activities are now being implemented pursuant to the requirements reached between Sparton Technology, EPA, the City of Albuquerque, the Bernalillo County Commissioners, the New Mexico Environment Department, the New Mexico Attorney General's Office, and the New Mexico Office of the Natural Resources Trustee, as documented in a Consent Decree [CIV 97 0206 LH/JHG (D.N.M.)] dated March 3, 2000, which is filed with the U.S. District Court for the District of New Mexico. These remedial measures consist of:

(a) The installation and operation of an off-site containment system;
(b) The operation of an on-site, 400-cfm Soil Vapor Extraction (SVE) system[1] for an aggregate period of one year.
(c) The installation and operation of a source containment system.

The goals of these remedial measures are:

(a) To control hydraulically the migration of the off-site plume;
(b) To reduce contaminant concentrations in Vadose-zone[2] soils in the on-site area and thereby reduce the likelihood that these soils would contribute to any groundwater contamination;
(c) To control hydraulically any potential source areas that may be continuing to contribute to groundwater contamination at the on-site area;
(d) In the long-term, to achieve the performance standards described in the Consent Decree

The installation of the off-site containment system, consisting of a containment well, a treatment system, an infiltration gallery, 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 a brief interruption in late April and early May 1999 to

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[1] The Soil Vapor Extraction system uses a vacuum pump to remove vapors of contaminant from the soil pores above the zone of saturation.

[2] The Vadose zone is that portion of the soil below the ground surface and above the zone of saturation.

connect it to the treatment system and infiltration gallery, the well has been in operation since that date.
The 400-cfm SVE system began operation on April 10, 2000, and completed operation on June 15, 2001.

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Construction of the source (on-site) containment system construction was completed in December 2001. It began operating on January 3, 2002.

Current Activities: During 2001, considerable progress was made towards achieving the goal of the remedial measures:

- The off-site containment well was operated at 97.3 percent of the time available in 2001 which is at a rate sufficient to contain the plume. The pumped water was treated and discharged to the infiltration gallery.

- 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. During 2001, the chromium concentrations in the pumped water decreased well below the New Mexico groundwater standard. As a result, chromium treatment was discontinued on November 1, 2001.

- The 400-cfm SVE system operated for 165 days between January 1, 2001 and June 15, 2001. Soil gas sampling was conducted at the plant site in September and October 2001 to evaluate the performance of the soil vapor extractor system.

- Construction of the source containment system was completed in December 2001. The system was placed into operation on January 3, 2002.

- 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 and from the influent and effluent of the air stripper at the frequency specified in the Consent Order and applicable permits. Water samples were analyzed for TCE, DCE, TCA and total chromium.

- A 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 2001. Calibration and improvement of the model will continue next year.

The off-site containment well operated at an average rate of about 216 gpm during 2001, preventing expansion of the contaminant plume throughout the year. A total of 114 million gallons were pumped from the well. This pumped water represents about 10 percent of the initial volume of contaminated groundwater (pore volume). The total volume of water pumped since the start of the well operation on December 1998 is 344 million gallons and represents 31 percent of the initial pore volume.

Approximately 550 kg (1200 lbs) of contaminants consisting of 520 kg (1140 lbs) of TCE and 27 kg (60 lbs) of DCE were removed from the aquifer by the off-site containment well during 2001.

The total mass that was removed since the beginning of the off-site containment well is 1410 kg (3100 lbs) consisting of 1340 kg (2950 lbs) of TCE and 70 kg (150 lbs) of DCE. This represents about 39 percent of the contaminant mass (41 percent of the TCE and 35 percent of the DCE mass) estimated to be dissolved in the aquifer prior to operation of the containment well.

While the contaminant mass has been substantially reduced, exemplified by concentration reductions, the aerial extent of the TCE plume, and hence the volume of contaminated groundwater, did not change significantly during 2001.

The 400 cfm soil vapor extraction system operated for a total of 372 days from April 10, 2000 to June 15, 2001. The duration of operation of the system and the results of the September and October soil gas sampling indicated the system had met the requirements of the Consent Decree and operation of the system was no longer required.

Future Plans: 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 remediation will continue.

The off-site containment system will continue to operate at the current average operating rate of 215 to 225 gpm.

Sparton submitted the Construction Work Plan for the source containment system on January 31, 2001. Construction was completed in December 2001, and the system was placed into operation on January 3, 2002, 108 days ahead of schedule.

Sparton, through its off-site containment system, has prevented further expansion of the ground water contaminant plume. The SVE system was closed down on June 15, 2002, having met its clean-up objectives. The source containment system became fully operational as of January 3, 2002.

Copies of the Consent Decree and its associated remediation work plans as well as historical investigation/remedial work plans and reports submitted to the City, County, NMED, and EPA are available for review at the:

Taylor Ranch Public Library, (Telephone # 505 897-8816) located at:
5700 Bogart NW, Albuquerque, NM 87120.

City of Albuquerque Department of Public Works, (Telephone # 505 768-2561) located at:
One Civic Plaza NW, Albuquerque, NM 87103

New Mexico Environment Department
(Telephone # 505 428-2500) located at:
2905 Rodeo Park Drive East, Building 1, Santa Fe, NM 87505-6303

Alternatively, you may contact Mr. Tony Hurst, Sparton Technology's representative, at (505) 220-1943 or Ms. Susan Widener of Sparton Technology at (517) 787-3256.

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5528 EUBANK NE
ALBUQUERQUE NM 87111

NOONAN, LOU
TRUSTEE OF THE LOU NOONAN TRUST
9748 COLONIAL CIR. NE
ALBUQUERQUE, NM 87111

NVIBBR LTD CO
5528 EUBANK NE
ALBUQUERQUE NM 87111

ORTIZ, MELVIN & CATALINA L
518 EL DORADO DR NW
ALBUQUERQUE NM 87114

O'NEILL, JOHN J & ANNE M
136 MONEE RD
PARK FOREST IL 60466

PARKES, MARY L
4301 BRYAN AVE NW
ALBUQUERQUE NM 87120

PODNAR, KRISTOPHER A &
RILEY AMY L
4360 BRYAN AVE NW
ALBUQUERQUE NM 87114

POLMAN, LOIS B
14489 JANICE DR
MAPLE HEIGHTS OH 44137

POWELL, BOBBY L & LAUREL W ETAL
PO BOX 1467
CORRALES NM 87048

PUBLIC SERVICE COMPANY OF NEW
MEXICO
ALVARADO SQUARE
ALBUQUERQUE NM 87158

REED, DENNIS N & LYDIA R
4305 BRYAN AVE NW
ALBUQUERQUE NM 87114

RICH, CORY & POLLY F FITTER
4119 NEW VISTAS CT NW
ALBUQUERQUE NM 87120

RICH, RALPH L & DIONNE P
4235 NEW VISTAS CT NW
ALBUQUERQUE NM 87120

RIDENOUR, ROB K & TAMI L
4304 PRAIRIE HILL PL NW
ALBUQUERQUE NM 87114

RIVERA, JOSE & MARGARITA
2400 STEVENS DR NE
ALBUQUERQUE NM 87112

ROHRSCHEIB, LUKE C ETUX
3411 11TH AVE W
SEATTLE WA 98119

ROLLA, ANGELINA
P.O. BOX 0340
ALBUQUERQUE, NM 87181-0340

ROMERO, JEFFREY A.
10012 CHANTILLY RD. NW
ALBUQUERQUE, NM 87114

ROMERO, RANDY M
13220 MARQUETTE NE
ALBUQUERQUE NM 87123

ROWLAND, MICHAEL PATRICK
5500 KIM RD
RIO RANCHO NM 87124

ROYBAL, TOBY LOUIS
1872 ALEXANDER NW
ALBUQUERQUE NM 87107

RUIZ, BEN
P.O. BOX
ALBUQUERQUE NM 87193

RUIZ, BEN J & MARGARET J
TRUSTEES RUIZ REV TRUST
P.O. BOX
ALBUQUERQUE NM 87193

SALAZ, JOSE & GRACIELA
5404 CABRILLO CT. NW
ALBUQUERQUE, NM 87120

SANCHEZ, PHILIP A & KASSANDRA C
7509 STARWOOD NW
ALBUQUERQUE NM 87120

SANCHEZ, MICHAEL A & KATHLEEN E
3250 RIO BRAVO SW
ALBUQUERQUE, NM 87105

SANCHEZ, MICHAEL A & KATHLEEN E
3016 DONA TERESA SW
ALBUQUERQUE NM 87121

SCHLUETER, GLEN A & JOAN E
4211 BRYAN AVE NW
ALBUQUERQUE NM 87114

SCOTT, ROBERT A
4106 NEW VISTAS CT NW
ALBUQUERQUE NM 87114

SILVER SUN INC
4216 BRYAN AVE NW
ALBUQUERQUE NM 87114

SINGER, JO ANNE H TRUSTEE
PO BOX 1621
SANTA FE NM 87504

SINGLETON, CAROL J & JOSEPH W
SAWYER
TRUSTEES SINGLETON/SAWYE
4209 BRYAN AVE NW
ALBUQUERQUE NM 87114

SKY CREST INC
1208 SAN PEDRO NE
ALBUQUERQUE NM 87110

SOLOMON, JOSEPH M. JR. &
SANDRA DEBBAN-SOLOMON
6729 LAMAR AVE. NW
ALBUQUERQUE, NM 87120

SOMMERS, MARVIN F & SUSAN M GASS
348 ENCHANTED VALLEY RD NW
RIO RANCHO NM 87107

SORIANO, ABEL A & SANDRA S & ANNETTE
10005 CACTUS POINTE DR NW
ALBUQUERQUE NM 87114

SOTELO, ENRIQUE & MARTHA
549 58TH ST NW
ALBUQUERQUE NM 87105

SOULE, PAT L & MARGARET L
PO BOX 92602
ALBUQUERQUE NM 87199-2602

SPARTON TECHNOLOGY INC
ATTN ACCOUNTS PAYABLE
5612 JOHNSON LAKE RD
DE LEON SPRINGS FL 32130

SPARTON SOUTHWEST INC
4901 ROCKAWAY BLVD
RIO RANCHO NM 87124

SPENCE. DOUGLAS H & MAVIS JEAN
TRUSTEE SPENCE REVOCABLE TRUST
10809 CORONADO NE
ALBUQUERQUE NM 87122

STAEDEN, CARY C & LOU E
1679 PACE RD NW
ALBUQUERQUE NM 87114

STANLEY, HERBERT & LEVATER B
1517 ALAMO AVE SE
ALBUQUERQUE NM 87106

STONE, PHILIP B
11410 NW PERMIAN DR
PORTLAND OR 97229

SUAREZ, MARSHALL & KATHY Q
6305 KACINA NW
ALBUQUERQUE NM 87120

TAYLOR, GANARLD
615 LA VETA NE
ALBUQUERQUE NM 87108

TAYLOR, DEREK A
615 LA VETA NE
ALBUQUERQUE NM 87108

THOMSON, CHRISTOPHER K & STEPHANIE D
4219 BRYAN AVE NW
ALBUQUERQUE NM 87114

TORRES, VALENTINO OR DEEDEE
1611 TORRIBIO NE
ALBUQUERQUE NM 87112

TORRES, LUCILLE D
2134 COAL PL SE
ALBUQUERQUE NM 87106

TRUJILLO, JOHN P & CATHERINE L
10100 SIERRA HILL DR NW
ALBUQUERQUE NM 87114

TUCKER, MARK D
9375 SAN DIEGO AVE NE
ALBUQUERQUE NM 87122

UNITED PROPERTIES LTD CO
7201 LOMAS BLV NE
ALBUQUERQUE NM 87110

VAROZ, EDWARD & MARGARET
1900 11TH AVE SE
RIO RANCHO NM 87124

VAU, GARY N & MARYANN K VAU
9733 ACADEMY RD NW
ALBUQUERQUE NM 87114

WARREN, MARK A & DAWNE D
3600 32ND CIR SE
RIO RANCHO NM 87124

WEISENBURGER, VIRTUE V S
6048 GOLDEN VALLEY RD
MINNEAPOLIS MN 55422

WEITHMAN, JOHN A
1243 NORTH GENOA CLAY CTR RD
GENOA OH 43430

WILLCOCKSON, LARRY
10108 SIERRA HILL DR NW
ALBUQUERQUE NM 87114

WINE, MARIE
15222 N CAVE CREEK RD
PHOENIX AZ 85032

WOJCICKI, RAYMOND J WOJCICKI
RAYMOND J DECLARATION OF TRUST
7701 CATALPA AVE
CHICAGO IL 60656

YOVANOVICH, MILAN ETUX
5212 D ROYAL AVE
PORTAGE IN 46368

ZABALZA, DAVID R & KATHLEEN
1487 BERONA WAY
SAN JOSE CA 95122

ZAMORA, PAUL & PADILLA, PATRICIA
4212 BRYAN AVE NW
ALBUQUERQUE NM 87114

ZEIGLER, YAEKO
9717 CAMINO DEL SOL NE
ALBUQUERQUE NM 87111

Appendix E

Water Level Residuals – January 1998 to November 2002 Simulation

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-07	01/28/98	4976.89	4973.00	3.89
MW-09	01/28/98	4972.91	4971.72	1.19
MW-12	01/28/98	4972.50	4971.74	0.76
MW-13	01/28/98	4974.42	4972.05	2.37
MW-14	01/28/98	4971.22	4970.68	0.54
MW-16	01/28/98	4978.36	4973.59	4.77
MW-17	01/28/98	4978.86	4973.96	4.90
MW-18	01/28/98	4970.24	4971.53	-1.28
MW-19	01/28/98	4971.66	4970.96	0.70
MW-20	01/28/98	4971.32	4970.82	0.50
MW-21	01/28/98	4978.59	4973.56	5.03
MW-22	01/28/98	4977.47	4973.53	3.94
MW-23	01/28/98	4975.75	4972.49	3.26
MW-24	01/28/98	4975.56	4973.56	2.01
MW-25	01/28/98	4977.06	4973.54	3.52
MW-26	01/28/98	4966.88	4970.53	-3.65
MW-27	01/28/98	4973.15	4972.79	0.36
MW-28	01/28/98	4971.70	4970.81	0.89
MW-29	01/28/98	4973.24	4971.69	1.55
MW-30	01/28/98	4972.06	4971.13	0.93
MW-31	01/28/98	4971.14	4970.58	0.56
MW-32	01/28/98	4971.02	4970.50	0.52
MW-33	01/28/98	4972.24	4971.53	0.71
MW-34	01/28/98	4973.68	4971.86	1.82
MW-35	01/28/98	4971.24	4970.52	0.72
MW-36	01/28/98	4970.02	4969.64	0.38
MW-37	01/28/98	4968.65	4968.57	0.08
MW-38	01/28/98	4973.14	4971.61	1.53
MW-39	01/28/98	4972.22	4971.12	1.10
MW-40	01/28/98	4971.18	4970.55	0.63
MW-41	01/28/98	4971.04	4970.53	0.51
MW-42	01/28/98	4970.79	4970.55	0.24
MW-43	01/28/98	4970.58	4970.44	0.14
MW-44	01/28/98	4970.07	4969.65	0.42
MW-45	01/28/98	4968.54	4968.57	-0.02
MW-46	01/28/98	4967.46	4967.64	-0.18
MW-47	01/28/98	4967.15	4967.29	-0.14
MW-48	01/28/98	4966.41	4966.31	0.10
MW-49	01/28/98	4970.99	4970.55	0.44
MW-51	01/28/98	4980.52	4975.69	4.83
MW-52	01/28/98	4964.13	4964.20	-0.07

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference
		Observed	Computed	(ft)
MW-53	01/28/98	4965.70	4965.21	0.49
MW-54	01/28/98	4966.16	4966.40	-0.24
MW-55	01/28/98	4965.83	4966.23	-0.40
MW-56	01/28/98	4966.43	4966.32	0.12
MW-57	01/28/98	4965.68	4965.80	-0.12
MW-58	01/28/98	4966.26	4965.70	0.56
MW-59	01/28/98	4969.74	4970.26	-0.52
MW-60	01/28/98	4966.09	4965.79	0.30
MW-61	01/28/98	4966.03	4965.72	0.31
MW-62	01/28/98	4968.02	4967.82	0.20
MW-63	01/28/98	4971.67	4972.70	-1.03
MW-64	01/28/98	4966.14	4966.32	-0.18
MW-65	01/28/98	4963.91	4964.01	-0.10
MW-66	01/28/98	4964.83	4965.27	-0.44
MW-67	01/28/98	4960.00	4960.32	-0.32
MW-68	01/28/98	4963.33	4962.79	0.54
MW-69	01/28/98	4963.24	4962.60	0.64
PW-1	01/28/98	4964.96	4971.75	-6.79
MW-07	04/28/98	4977.03	4972.98	4.05
MW-09	04/28/98	4972.83	4971.70	1.13
MW-12	04/28/98	4972.59	4971.72	0.87
MW-13	04/28/98	4974.42	4972.03	2.39
MW-14	04/28/98	4971.22	4970.66	0.57
MW-16	04/28/98	4978.11	4973.58	4.53
MW-17	04/28/98	4978.64	4973.96	4.68
MW-18	04/28/98	4967.44	4971.48	-4.04
MW-19	04/28/98	4971.74	4970.91	0.83
MW-20	04/28/98	4971.32	4970.77	0.55
MW-21	04/28/98	4978.18	4973.56	4.63
MW-22	04/28/98	4977.47	4973.52	3.95
MW-23	04/28/98	4973.37	4972.45	0.92
MW-24	04/28/98	4973.62	4973.55	0.08
MW-25	04/28/98	4975.13	4973.54	1.59
MW-26	04/28/98	4966.88	4970.31	-3.43
MW-27	04/28/98	4971.16	4972.79	-1.62
MW-28	04/28/98	4971.62	4970.78	0.84
MW-29	04/28/98	4973.49	4971.65	1.85
MW-30	04/28/98	4972.22	4971.09	1.14
MW-31	04/28/98	4971.14	4970.54	0.60
MW-32	04/28/98	4970.79	4970.46	0.33
MW-33	04/28/98	4972.35	4971.51	0.84

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-34	04/28/98	4974.01	4971.83	2.18
MW-35	04/28/98	4971.24	4970.49	0.75
MW-36	04/28/98	4969.86	4969.62	0.24
MW-37	04/28/98	4968.40	4968.55	-0.15
MW-38	04/28/98	4973.47	4971.56	1.91
MW-39	04/28/98	4972.30	4971.07	1.23
MW-40	04/28/98	4971.26	4970.50	0.76
MW-41	04/28/98	4971.13	4970.49	0.64
MW-42	04/28/98	4970.63	4970.50	0.13
MW-43	04/28/98	4970.37	4970.40	-0.02
MW-44	04/28/98	4969.95	4969.62	0.33
MW-45	04/28/98	4968.38	4968.54	-0.16
MW-46	04/28/98	4967.22	4967.61	-0.39
MW-47	04/28/98	4966.91	4967.27	-0.36
MW-48	04/28/98	4966.18	4966.29	-0.10
MW-49	04/28/98	4971.08	4970.50	0.58
MW-51	04/28/98	4980.29	4975.69	4.60
MW-52	04/28/98	4963.66	4964.18	-0.51
MW-53	04/28/98	4965.41	4965.19	0.22
MW-54	04/28/98	4965.99	4966.37	-0.38
MW-55	04/28/98	4965.54	4966.19	-0.65
MW-56	04/28/98	4966.16	4966.29	-0.12
MW-57	04/28/98	4965.51	4965.77	-0.26
MW-58	04/28/98	4965.84	4965.68	0.16
MW-59	04/28/98	4969.71	4970.21	-0.50
MW-60	04/28/98	4965.83	4965.76	0.07
MW-61	04/28/98	4965.89	4965.70	0.20
MW-62	04/28/98	4967.77	4967.80	-0.03
MW-63	04/28/98	4971.30	4972.70	-1.40
MW-64	04/28/98	4966.03	4966.29	-0.26
MW-65	04/28/98	4963.41	4963.96	-0.55
MW-66	04/28/98	4964.61	4965.22	-0.61
MW-67	04/28/98	4959.60	4960.18	-0.58
MW-68	04/28/98	4962.87	4962.76	0.11
MW-69	04/28/98	4962.78	4962.54	0.24
MW-70	04/28/98	4970.09	4970.44	-0.35
PW-1	04/28/98	4971.00	4971.72	-0.72
MW-07	07/30/98	4977.70	4972.93	4.77
MW-09	07/30/98	4973.33	4971.65	1.68
MW-12	07/30/98	4972.84	4971.66	1.18
MW-13	07/30/98	4974.76	4971.97	2.79

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-14	07/30/98	4971.64	4970.59	1.05
MW-16	07/30/98	4978.59	4973.54	5.05
MW-17	07/30/98	4978.81	4973.94	4.87
MW-18	07/30/98	4967.44	4971.35	-3.91
MW-19	07/30/98	4972.24	4970.85	1.39
MW-20	07/30/98	4971.74	4970.70	1.04
MW-21	07/30/98	4978.51	4973.54	4.97
MW-22	07/30/98	4977.89	4973.49	4.40
MW-23	07/30/98	4973.20	4972.27	0.93
MW-24	07/30/98	4973.53	4973.50	0.03
MW-25	07/30/98	4975.13	4973.49	1.64
MW-26	07/30/98	4966.71	4969.87	-3.16
MW-27	07/30/98	4971.41	4972.75	-1.34
MW-28	07/30/98	4971.62	4970.70	0.92
MW-29	07/30/98	4973.91	4971.58	2.34
MW-30	07/30/98	4972.47	4971.02	1.45
MW-31	07/30/98	4971.31	4970.48	0.83
MW-32	07/30/98	4971.04	4970.39	0.65
MW-33	07/30/98	4972.73	4971.46	1.27
MW-34	07/30/98	4974.88	4971.78	3.10
MW-35	07/30/98	4971.83	4970.45	1.38
MW-36	07/30/98	4970.27	4969.57	0.70
MW-37	07/30/98	4968.44	4968.50	-0.06
MW-38	07/30/98	4973.81	4971.48	2.33
MW-39	07/30/98	4972.64	4971.00	1.64
MW-40	07/30/98	4971.51	4970.43	1.08
MW-41	07/30/98	4971.13	4970.42	0.71
MW-42	07/30/98	4970.77	4970.43	0.34
MW-43	07/30/98	4970.51	4970.32	0.19
MW-44	07/30/98	4970.27	4969.57	0.70
MW-45	07/30/98	4968.50	4968.48	0.02
MW-46	07/30/98	4967.23	4967.55	-0.32
MW-47	07/30/98	4966.98	4967.23	-0.25
MW-48	07/30/98	4966.20	4966.24	-0.04
MW-49	07/30/98	4971.16	4970.43	0.74
MW-51	07/30/98	4980.19	4975.69	4.50
MW-52	07/30/98	4963.63	4964.12	-0.49
MW-53	07/30/98	4965.22	4965.14	0.08
MW-54	07/30/98	4965.80	4966.32	-0.52
MW-55	07/30/98	4965.48	4966.12	-0.64
MW-56	07/30/98	4966.14	4966.23	-0.09

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-57	07/30/98	4965.36	4965.72	-0.36
MW-58	07/30/98	4965.78	4965.63	0.15
MW-59	07/30/98	4969.54	4970.14	-0.60
MW-60	07/30/98	4965.76	4965.70	0.06
MW-61	07/30/98	4965.71	4965.65	0.06
MW-62	07/30/98	4967.86	4967.76	0.10
MW-63	07/30/98	4971.11	4972.70	-1.59
MW-64	07/30/98	4965.80	4966.23	-0.43
MW-66	07/30/98	4964.39	4965.14	-0.75
MW-67	07/30/98	4958.75	4960.02	-1.27
MW-68	07/30/98	4962.80	4962.69	0.11
MW-69	07/30/98	4962.67	4962.45	0.22
MW-70	07/30/98	4970.34	4970.37	-0.03
PW-1	07/30/98	4971.08	4971.67	-0.59
MW-07	11/10/98	4977.42	4972.84	4.58
MW-09	11/10/98	4973.06	4971.55	1.51
MW-12	11/10/98	4972.82	4971.55	1.27
MW-13	11/10/98	4974.35	4971.87	2.48
MW-14	11/10/98	4971.12	4970.49	0.63
MW-16	11/10/98	4978.43	4973.49	4.95
MW-17	11/10/98	4978.75	4973.88	4.87
MW-19	11/10/98	4971.85	4970.75	1.10
MW-20	11/10/98	4971.47	4970.60	0.88
MW-21	11/10/98	4978.31	4973.49	4.83
MW-22	11/10/98	4977.89	4973.42	4.47
MW-29	11/10/98	4973.68	4971.48	2.21
MW-30	11/10/98	4972.28	4970.92	1.36
MW-31	11/10/98	4971.23	4970.38	0.85
MW-32	11/10/98	4970.96	4970.29	0.67
MW-33	11/10/98	4972.54	4971.37	1.18
MW-34	11/10/98	4974.51	4971.70	2.81
MW-35	11/10/98	4970.78	4970.37	0.41
MW-36	11/10/98	4969.43	4969.49	-0.06
MW-37	11/10/98	4968.32	4968.42	-0.10
MW-38	11/10/98	4973.70	4971.38	2.32
MW-39	11/10/98	4972.49	4970.90	1.59
MW-40	11/10/98	4971.25	4970.34	0.91
MW-41	11/10/98	4971.09	4970.33	0.76
MW-42	11/10/98	4970.65	4970.33	0.32
MW-43	11/10/98	4970.45	4970.22	0.23
MW-44	11/10/98	4970.11	4969.49	0.62

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-45	11/10/98	4968.33	4968.39	-0.06
MW-46	11/10/98	4966.95	4967.46	-0.51
MW-47	11/10/98	4966.68	4967.15	-0.47
MW-48	11/10/98	4965.81	4966.16	-0.35
MW-49	11/10/98	4971.03	4970.32	0.71
MW-51	11/10/98	4980.09	4975.68	4.41
MW-52	11/10/98	4963.17	4964.03	-0.86
MW-53	11/10/98	4964.92	4965.06	-0.14
MW-54	11/10/98	4965.56	4966.23	-0.67
MW-55	11/10/98	4965.13	4966.02	-0.89
MW-56	11/10/98	4965.76	4966.14	-0.38
MW-57	11/10/98	4964.87	4965.62	-0.75
MW-58	11/10/98	4965.43	4965.55	-0.12
MW-59	11/10/98	4969.46	4970.03	-0.57
MW-60	11/10/98	4965.18	4965.61	-0.42
MW-61	11/10/98	4965.37	4965.56	-0.19
MW-62	11/10/98	4967.52	4967.68	-0.16
MW-63	11/10/98	4970.98	4972.69	-1.71
MW-64	11/10/98	4965.41	4966.14	-0.73
MW-65	11/10/98	4963.05	4963.77	-0.72
MW-66	11/10/98	4963.98	4965.02	-1.04
MW-67	11/10/98	4958.56	4959.84	-1.28
MW-68	11/10/98	4962.25	4962.58	-0.33
MW-69	11/10/98	4962.13	4962.32	-0.19
MW-70	11/10/98	4970.18	4970.27	-0.09
MW-71	11/10/98	4958.51	4958.51	0.00
MW-18	11/25/98	4971.87	4971.01	0.86
MW-23	11/25/98	4975.91	4972.07	3.84
MW-24	11/25/98	4978.23	4973.46	4.77
MW-25	11/25/98	4978.31	4973.45	4.86
MW-26	11/25/98	4973.44	4968.83	4.61
MW-27	11/25/98	4974.05	4972.70	1.35
MW-28	11/25/98	4971.09	4970.64	0.45
PW-1	11/25/98	4973.59	4971.56	2.03
MW-07	02/16/99	4976.36	4972.88	3.48
MW-09	02/16/99	4972.14	4971.48	0.66
MW-12	02/16/99	4971.80	4971.50	0.30
MW-13	02/16/99	4973.39	4971.84	1.55
MW-14	02/16/99	4970.20	4970.31	-0.11
MW-16	02/16/99	4977.89	4973.51	4.38
MW-17	02/16/99	4978.16	4973.89	4.27

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-19	02/16/99	4970.91	4970.55	0.36
MW-20	02/16/99	4970.54	4970.35	0.19
MW-21	02/16/99	4974.02	4973.50	0.52
MW-22	02/16/99	4976.91	4973.43	3.48
MW-29	02/16/99	4972.59	4971.39	1.20
MW-30	02/16/99	4971.26	4970.75	0.51
MW-31	02/16/99	4970.29	4970.12	0.17
MW-33	02/16/99	4971.53	4971.28	0.25
MW-34	02/16/99	4973.03	4971.63	1.40
MW-35	02/16/99	4970.63	4970.17	0.46
MW-36	02/16/99	4969.20	4969.19	0.01
MW-37	02/16/99	4967.62	4967.97	-0.35
MW-38	02/16/99	4972.61	4971.28	1.33
MW-39	02/16/99	4971.46	4970.70	0.76
MW-40	02/16/99	4970.32	4970.03	0.29
MW-41	02/16/99	4970.24	4970.07	0.17
MW-42	02/16/99	4969.79	4970.09	-0.30
MW-43	02/16/99	4969.72	4969.96	-0.24
MW-44	02/16/99	4969.27	4969.10	0.17
MW-45	02/16/99	4967.62	4967.79	-0.16
MW-46	02/16/99	4966.35	4966.69	-0.34
MW-47	02/16/99	4965.58	4966.43	-0.85
MW-48	02/16/99	4965.31	4965.10	0.21
MW-49	02/16/99	4970.07	4969.99	0.08
MW-51	02/16/99	4979.99	4975.67	4.32
MW-52	02/16/99	4961.69	4962.66	-0.97
MW-53	02/16/99	4964.40	4963.34	1.06
MW-54	02/16/99	4965.18	4965.62	-0.44
MW-55	02/16/99	4963.74	4964.06	-0.32
MW-56	02/16/99	4965.29	4964.61	0.68
MW-57	02/16/99	4964.61	4965.04	-0.43
MW-58	02/16/99	4965.00	4964.15	0.85
MW-59	02/16/99	4968.76	4969.78	-1.02
MW-60	02/16/99	4964.78	4964.28	0.50
MW-61	02/16/99	4964.93	4964.58	0.35
MW-62	02/16/99	4967.04	4967.12	-0.08
MW-63	02/16/99	4970.62	4972.73	-2.11
MW-64	02/16/99	4965.72	4965.43	0.29
MW-65	02/16/99	4961.27	4960.92	0.35
MW-66	02/16/99	4964.21	4963.88	0.33
MW-67	02/16/99	4958.05	4958.43	-0.38

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Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-68	02/16/99	4961.08	4961.30	-0.22
MW-69	02/16/99	4960.80	4960.08	0.72
MW-70	02/16/99	4969.36	4969.97	-0.61
MW-71	02/16/99	4958.02	4957.20	0.82
MW-07	05/13/99	4976.51	4972.87	3.64
MW-09	05/13/99	4972.22	4971.39	0.83
MW-12	05/13/99	4971.87	4971.42	0.45
MW-13	05/13/99	4973.61	4971.76	1.85
MW-16	05/13/99	4977.52	4973.51	4.01
MW-17	05/13/99	4977.92	4973.89	4.03
MW-19	05/13/99	4970.90	4970.44	0.46
MW-20	05/13/99	4970.54	4970.24	0.30
MW-22	05/13/99	4976.98	4973.44	3.54
MW-29	05/13/99	4972.80	4971.31	1.49
MW-30	05/13/99	4971.31	4970.63	0.68
MW-31	05/13/99	4970.21	4969.97	0.24
MW-32	05/13/99	4970.02	4969.89	0.13
MW-33	05/13/99	4971.53	4971.17	0.36
MW-34	05/13/99	4973.32	4971.52	1.80
MW-35	05/13/99	4970.44	4969.95	0.49
MW-36	05/13/99	4968.86	4968.92	-0.06
MW-37	05/13/99	4967.18	4967.61	-0.43
MW-38	05/13/99	4972.82	4971.20	1.62
MW-39	05/13/99	4971.53	4970.59	0.94
MW-40	05/13/99	4970.25	4969.90	0.35
MW-41	05/13/99	4970.13	4969.94	0.19
MW-42	05/13/99	4969.80	4969.99	-0.19
MW-43	05/13/99	4969.59	4969.86	-0.27
MW-44	05/13/99	4968.97	4968.86	0.11
MW-45	05/13/99	4967.20	4967.50	-0.30
MW-46	05/13/99	4965.85	4966.38	-0.53
MW-47	05/13/99	4965.58	4965.93	-0.35
MW-48	05/13/99	4964.63	4964.50	0.13
MW-49	05/13/99	4970.05	4969.87	0.18
MW-51	05/13/99	4979.77	4975.67	4.10
MW-52	05/13/99	4961.31	4961.91	-0.60
MW-53	05/13/99	4963.49	4962.61	0.88
MW-54	05/13/99	4964.65	4965.25	-0.60
MW-55	05/13/99	4963.28	4963.91	-0.63
MW-56	05/13/99	4964.59	4964.27	0.32
MW-57	05/13/99	4964.12	4964.74	-0.62

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Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference
		Observed	Computed	(ft)
MW-58	05/13/99	4964.18	4963.47	0.71
MW-59	05/13/99	4968.65	4969.67	-1.02
MW-60	05/13/99	4964.22	4963.93	0.29
MW-61	05/13/99	4964.30	4964.05	0.25
MW-62	05/13/99	4966.44	4966.68	-0.24
MW-64	05/13/99	4964.57	4965.12	-0.55
MW-65	05/13/99	4960.96	4960.85	0.11
MW-66	05/13/99	4962.80	4963.82	-1.02
MW-67	05/13/99	4957.78	4958.34	-0.56
MW-68	05/13/99	4960.71	4960.79	-0.08
MW-69	05/13/99	4960.77	4960.04	0.73
MW-70	05/13/99	4969.27	4969.86	-0.59
MW-71	05/13/99	4957.72	4957.08	0.64
MW-73	05/13/99	4970.03	4969.92	0.11
OB-1	05/13/99	4958.42	4958.69	-0.27
OB-2	05/13/99	4961.24	4959.38	1.86
MW-07	08/12/99	4976.70	4972.82	3.88
MW-09	08/12/99	4972.33	4971.25	1.08
MW-12	08/12/99	4971.96	4971.30	0.66
MW-13	08/12/99	4973.77	4971.65	2.13
MW-16	08/12/99	4977.72	4973.50	4.22
MW-17	08/12/99	4978.03	4973.89	4.14
MW-19	08/12/99	4970.98	4970.24	0.74
MW-20	08/12/99	4970.61	4970.04	0.57
MW-22	08/12/99	4977.12	4973.42	3.70
MW-29	08/12/99	4972.94	4971.15	1.79
MW-30	08/12/99	4971.41	4970.45	0.97
MW-31	08/12/99	4970.28	4969.75	0.53
MW-32	08/12/99	4970.07	4969.68	0.39
MW-33	08/12/99	4971.66	4971.03	0.63
MW-34	08/12/99	4973.67	4971.38	2.29
MW-37	08/12/99	4967.04	4967.26	-0.22
MW-38	08/12/99	4972.97	4971.03	1.94
MW-39	08/12/99	4971.66	4970.40	1.26
MW-40	08/12/99	4970.33	4969.68	0.65
MW-41	08/12/99	4970.17	4969.73	0.44
MW-42	08/12/99	4969.84	4969.79	0.05
MW-43	08/12/99	4969.63	4969.66	-0.03
MW-44	08/12/99	4969.04	4968.58	0.46
MW-45	08/12/99	4967.07	4967.16	-0.09
MW-46	08/12/99	4965.68	4966.01	-0.33

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Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-47	08/12/99	4965.28	4965.48	-0.20
MW-48	08/12/99	4964.17	4963.95	0.22
MW-49	08/12/99	4970.12	4969.65	0.47
MW-51	08/12/99	4979.81	4975.69	4.12
MW-52	08/12/99	4960.78	4961.23	-0.45
MW-53	08/12/99	4962.83	4961.90	0.93
MW-54	08/12/99	4964.56	4964.93	-0.37
MW-55	08/12/99	4963.08	4963.40	-0.31
MW-56	08/12/99	4964.18	4963.74	0.44
MW-57	08/12/99	4964.14	4964.48	-0.34
MW-58	08/12/99	4963.66	4962.85	0.81
MW-59	08/12/99	4968.70	4969.48	-0.78
MW-60	08/12/99	4963.91	4963.48	0.43
MW-61	08/12/99	4963.98	4963.59	0.39
MW-62	08/12/99	4966.15	4966.26	-0.11
MW-64	08/12/99	4964.47	4964.81	-0.34
MW-65	08/12/99	4960.46	4960.22	0.24
MW-66	08/12/99	4963.03	4963.56	-0.53
MW-67	08/12/99	4957.44	4958.17	-0.73
MW-68	08/12/99	4960.47	4960.31	0.16
MW-69	08/12/99	4960.35	4959.60	0.75
MW-70	08/12/99	4969.32	4969.65	-0.33
MW-71	08/12/99	4957.46	4956.95	0.51
MW-72	08/12/99	4970.02	4969.75	0.27
MW-73	08/12/99	4970.07	4969.71	0.36
MW-74	08/12/99	4962.63	4967.58	-4.95
MW-75	08/12/99	4966.30	4967.17	-0.87
MW-76	08/12/99	4966.89	4967.11	-0.22
OB-1	08/12/99	4957.70	4957.79	-0.09
OB-2	08/12/99	4959.10	4958.64	0.46
MW-07	10/28/99	4976.94	4972.75	4.19
MW-09	10/28/99	4972.56	4971.14	1.42
MW-12	10/28/99	4972.19	4971.20	0.99
MW-13	10/28/99	4973.98	4971.54	2.44
MW-14	10/28/99	4970.37	4969.68	0.69
MW-16	10/28/99	4978.07	4973.50	4.57
MW-17	10/28/99	4978.53	4973.89	4.64
MW-18	10/28/99	4970.93	4971.14	-0.21
MW-19	10/28/99	4971.17	4970.09	1.08
MW-20	10/28/99	4970.80	4969.89	0.91
MW-21	10/28/99	4978.34	4973.51	4.83

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Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-22	10/28/99	4975.84	4973.40	2.44
MW-23	10/28/99	4975.14	4972.21	2.93
MW-25	10/28/99	4977.01	4973.46	3.55
MW-26	10/28/99	4971.28	4969.87	1.41
MW-29	10/28/99	4973.16	4971.02	2.14
MW-30	10/28/99	4971.63	4970.30	1.33
MW-31	10/28/99	4970.49	4969.58	0.91
MW-32	10/28/99	4970.27	4969.52	0.75
MW-33	10/28/99	4971.86	4970.92	0.94
MW-34	10/28/99	4973.81	4971.25	2.56
MW-35	10/28/99	4970.79	4969.54	1.25
MW-36	10/28/99	4969.04	4968.43	0.61
MW-37	10/28/99	4967.23	4967.02	0.21
MW-38	10/28/99	4973.18	4970.90	2.28
MW-39	10/28/99	4971.88	4970.26	1.62
MW-40	10/28/99	4970.51	4969.51	1.00
MW-41	10/28/99	4970.39	4969.57	0.82
MW-42	10/28/99	4970.11	4969.64	0.47
MW-43	10/28/99	4969.82	4969.51	0.31
MW-44	10/28/99	4969.13	4968.38	0.75
MW-45	10/28/99	4967.24	4966.92	0.32
MW-46	10/28/99	4965.84	4965.76	0.08
MW-47	10/28/99	4965.50	4965.18	0.32
MW-48	10/28/99	4964.39	4963.61	0.78
MW-49	10/28/99	4970.37	4969.49	0.88
MW-51	10/28/99	4980.36	4975.71	4.65
MW-52	10/28/99	4960.75	4960.79	-0.03
MW-53	10/28/99	4962.79	4961.48	1.31
MW-54	10/28/99	4964.81	4964.72	0.09
MW-55	10/28/99	4963.27	4963.06	0.21
MW-56	10/28/99	4964.30	4963.41	0.89
MW-57	10/28/99	4964.57	4964.31	0.26
MW-58	10/28/99	4963.75	4962.47	1.28
MW-59	10/28/99	4968.95	4969.33	-0.38
MW-60	10/28/99	4964.17	4963.19	0.98
MW-61	10/28/99	4964.20	4963.31	0.90
MW-62	10/28/99	4966.40	4965.97	0.43
MW-63	10/28/99	4970.85	4972.97	-2.12
MW-64	10/28/99	4964.83	4964.61	0.22
MW-65	10/28/99	4960.47	4959.82	0.65
MW-66	10/28/99	4963.33	4963.37	-0.04

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-67	10/28/99	4957.68	4958.05	-0.37
MW-68	10/28/99	4960.64	4960.02	0.62
MW-69	10/28/99	4960.55	4959.31	1.24
MW-70	10/28/99	4969.52	4969.49	0.03
MW-71	10/28/99	4957.70	4956.85	0.85
MW-72	10/28/99	4970.22	4969.59	0.63
MW-73	10/28/99	4970.27	4969.54	0.73
MW-74	10/28/99	4963.34	4967.93	-4.59
MW-75	10/28/99	4967.32	4967.49	-0.17
MW-76	10/28/99	4968.02	4967.50	0.52
OB-1	10/28/99	4957.89	4957.24	0.65
OB-2	10/28/99	4959.19	4958.18	1.01
MW-07	02/03/00	4975.95	4972.67	3.29
MW-09	02/03/00	4971.69	4971.02	0.67
MW-12	02/03/00	4971.34	4971.13	0.21
MW-13	02/03/00	4972.98	4971.41	1.57
MW-16	02/03/00	4977.48	4973.55	3.93
MW-17	02/03/00	4977.85	4973.90	3.95
MW-18	02/03/00	4970.57	4971.55	-0.98
MW-19	02/03/00	4970.46	4969.94	0.52
MW-20	02/03/00	4970.11	4969.75	0.36
MW-22	02/03/00	4976.59	4973.36	3.23
MW-23	02/03/00	4974.73	4972.33	2.40
MW-24	02/03/00	4977.34	4973.51	3.83
MW-25	02/03/00	4977.45	4973.50	3.95
MW-26	02/03/00	4972.27	4971.32	0.95
MW-27	02/03/00	4972.95	4972.78	0.18
MW-29	02/03/00	4972.18	4970.89	1.29
MW-30	02/03/00	4970.82	4970.15	0.67
MW-31	02/03/00	4969.81	4969.41	0.40
MW-32	02/03/00	4969.68	4969.37	0.31
MW-33	02/03/00	4971.07	4970.80	0.27
MW-34	02/03/00	4972.61	4971.09	1.52
MW-35	02/03/00	4970.07	4969.34	0.73
MW-36	02/03/00	4968.66	4968.20	0.46
MW-37	02/03/00	4966.98	4966.77	0.21
MW-38	02/03/00	4972.20	4970.77	1.43
MW-39	02/03/00	4971.03	4970.12	0.91
MW-40	02/03/00	4969.85	4969.36	0.49
MW-41	02/03/00	4969.79	4969.41	0.38
MW-42	02/03/00	4969.49	4969.50	-0.01

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-43	02/03/00	4969.30	4969.37	-0.07
MW-44	02/03/00	4968.75	4968.17	0.59
MW-45	02/03/00	4967.08	4966.70	0.38
MW-46	02/03/00	4965.84	4965.54	0.30
MW-47	02/03/00	4965.31	4964.90	0.41
MW-48	02/03/00	4964.28	4963.31	0.97
MW-49	02/03/00	4969.66	4969.34	0.32
MW-51	02/03/00	4979.80	4975.75	4.05
MW-52	02/03/00	4960.72	4960.38	0.34
MW-53	02/03/00	4962.80	4961.13	1.67
MW-54	02/03/00	4964.81	4964.52	0.29
MW-55	02/03/00	4963.16	4962.87	0.29
MW-56	02/03/00	4964.33	4963.17	1.16
MW-57	02/03/00	4964.60	4964.14	0.46
MW-58	02/03/00	4963.75	4962.15	1.60
MW-59	02/03/00	4968.46	4969.19	-0.73
MW-60	02/03/00	4964.29	4962.97	1.32
MW-61	02/03/00	4964.35	4963.05	1.30
MW-62	02/03/00	4966.15	4965.68	0.47
MW-63	02/03/00	4970.37	4973.05	-2.68
MW-64	02/03/00	4964.81	4964.42	0.39
MW-65	02/03/00	4960.47	4959.63	0.84
MW-66	02/03/00	4963.30	4963.23	0.07
MW-67	02/03/00	4957.65	4957.94	-0.29
MW-68	02/03/00	4960.68	4959.78	0.90
MW-69	02/03/00	4960.57	4959.15	1.42
MW-70	02/03/00	4968.94	4969.35	-0.41
MW-71	02/03/00	4957.72	4956.74	0.98
MW-72	02/03/00	4969.65	4969.44	0.21
MW-73	02/03/00	4969.67	4969.38	0.29
MW-74	02/03/00	4963.33	4967.76	-4.43
MW-75	02/03/00	4967.48	4967.35	0.13
MW-76	02/03/00	4968.32	4967.47	0.85
OB-1	02/03/00	4957.73	4957.16	0.57
OB-2	02/03/00	4959.18	4958.04	1.14
PW-1	02/03/00	4971.89	4971.04	0.85
MW-07	05/02/00	4976.27	4972.60	3.67
MW-09	05/02/00	4971.98	4970.94	1.04
MW-12	05/02/00	4971.62	4971.07	0.55
MW-13	05/02/00	4973.37	4971.32	2.05
MW-16	05/02/00	4977.39	4973.57	3.83

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-17	05/02/00	4977.72	4973.91	3.81
MW-18	05/02/00	4970.70	4971.60	-0.90
MW-19	05/02/00	4970.64	4969.83	0.81
MW-20	05/02/00	4970.29	4969.64	0.65
MW-22	05/02/00	4976.76	4973.33	3.43
MW-23	05/02/00	4975.13	4972.27	2.86
MW-24	05/02/00	4977.12	4973.52	3.60
MW-25	05/02/00	4977.16	4973.52	3.64
MW-26	05/02/00	4972.52	4971.27	1.25
MW-27	05/02/00	4972.79	4972.83	-0.04
MW-29	05/02/00	4972.59	4970.79	1.80
MW-30	05/02/00	4971.06	4970.04	1.02
MW-31	05/02/00	4969.95	4969.30	0.65
MW-32	05/02/00	4969.78	4969.26	0.52
MW-33	05/02/00	4971.28	4970.73	0.55
MW-34	05/02/00	4973.12	4970.98	2.14
MW-35	05/02/00	4970.15	4969.20	0.95
MW-36	05/02/00	4968.54	4968.05	0.49
MW-37	05/02/00	4966.86	4966.61	0.25
MW-38	05/02/00	4972.60	4970.67	1.93
MW-39	05/02/00	4971.30	4970.01	1.29
MW-40	05/02/00	4969.98	4969.24	0.74
MW-41	05/02/00	4969.89	4969.30	0.59
MW-42	05/02/00	4969.58	4969.39	0.19
MW-43	05/02/00	4969.37	4969.26	0.11
MW-44	05/02/00	4968.65	4968.02	0.63
MW-45	05/02/00	4966.89	4966.56	0.33
MW-46	05/02/00	4965.61	4965.40	0.21
MW-47	05/02/00	4965.10	4964.73	0.37
MW-48	05/02/00	4964.09	4963.15	0.94
MW-49	05/02/00	4969.82	4969.23	0.59
MW-51	05/02/00	4979.51	4975.80	3.71
MW-52	05/02/00	4960.63	4960.19	0.44
MW-53	05/02/00	4962.94	4960.97	1.97
MW-54	05/02/00	4964.68	4964.38	0.30
MW-55	05/02/00	4962.99	4962.71	0.28
MW-56	05/02/00	4964.07	4963.01	1.06
MW-57	05/02/00	4964.47	4964.01	0.46
MW-58	05/02/00	4963.54	4962.00	1.54
MW-59	05/02/00	4968.48	4969.08	-0.60
MW-60	05/02/00	4964.12	4962.83	1.29

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-61	05/02/00	4964.18	4962.91	1.27
MW-62	05/02/00	4965.92	4965.50	0.42
MW-63	05/02/00	4970.20	4973.10	-2.90
MW-64	05/02/00	4964.69	4964.29	0.40
MW-65	05/02/00	4960.39	4959.45	0.94
MW-66	05/02/00	4963.16	4963.10	0.06
MW-67	05/02/00	4957.55	4957.84	-0.29
MW-68	05/02/00	4960.58	4959.64	0.95
MW-69	05/02/00	4960.48	4958.99	1.49
MW-70	05/02/00	4969.05	4969.24	-0.19
MW-71	05/02/00	4957.66	4956.64	1.02
MW-72	05/02/00	4969.75	4969.33	0.42
MW-73	05/02/00	4969.79	4969.26	0.53
MW-74	05/02/00	4963.33	4967.51	-4.18
MW-75	05/02/00	4967.11	4967.10	0.01
MW-76	05/02/00	4967.67	4967.21	0.46
OB-1	05/02/00	4957.71	4956.99	0.72
OB-2	05/02/00	4959.11	4957.88	1.23
PW-1	05/02/00	4971.96	4970.96	1.00
MW-07	08/02/00	4976.60	4972.53	4.07
MW-09	08/02/00	4972.18	4970.86	1.32
MW-12	08/02/00	4971.80	4971.02	0.78
MW-13	08/02/00	4973.67	4971.23	2.44
MW-16	08/02/00	4977.84	4973.58	4.26
MW-17	08/02/00	4977.90	4973.91	3.99
MW-18	08/02/00	4970.78	4971.62	-0.84
MW-19	08/02/00	4970.72	4969.73	0.99
MW-20	08/02/00	4970.35	4969.54	0.81
MW-22	08/02/00	4977.02	4973.30	3.72
MW-23	08/02/00	4975.41	4972.22	3.19
MW-24	08/02/00	4977.30	4973.53	3.77
MW-25	08/02/00	4977.32	4973.54	3.78
MW-26	08/02/00	4972.67	4971.19	1.48
MW-27	08/02/00	4972.85	4972.89	-0.04
MW-29	08/02/00	4972.79	4970.69	2.10
MW-30	08/02/00	4971.20	4969.93	1.27
MW-31	08/02/00	4970.05	4969.19	0.86
MW-32	08/02/00	4969.80	4969.15	0.65
MW-33	08/02/00	4971.44	4970.69	0.75
MW-34	08/02/00	4973.53	4970.87	2.66
MW-35	08/02/00	4970.35	4969.08	1.27

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-36	08/02/00	4968.57	4967.92	0.65
MW-38	08/02/00	4972.82	4970.58	2.24
MW-39	08/02/00	4971.45	4969.91	1.54
MW-40	08/02/00	4970.09	4969.14	0.95
MW-41	08/02/00	4969.90	4969.19	0.71
MW-42	08/02/00	4969.51	4969.29	0.22
MW-43	08/02/00	4969.29	4969.16	0.13
MW-44	08/02/00	4968.68	4967.90	0.79
MW-45	08/02/00	4966.79	4966.42	0.37
MW-46	08/02/00	4965.42	4965.27	0.15
MW-47	08/02/00	4964.93	4964.57	0.36
MW-48	08/02/00	4963.89	4962.98	0.91
MW-49	08/02/00	4970.17	4969.13	1.04
MW-51	08/02/00	4979.48	4975.84	3.64
MW-52	08/02/00	4960.39	4959.98	0.41
MW-53	08/02/00	4962.47	4960.76	1.71
MW-54	08/02/00	4964.39	4964.24	0.15
MW-55	08/02/00	4962.74	4962.60	0.14
MW-56	08/02/00	4963.88	4962.87	1.01
MW-57	08/02/00	4964.12	4963.86	0.26
MW-58	08/02/00	4963.38	4961.81	1.57
MW-59	08/02/00	4968.33	4968.98	-0.65
MW-60	08/02/00	4963.77	4962.68	1.09
MW-61	08/02/00	4963.87	4962.74	1.13
MW-62	08/02/00	4965.82	4965.33	0.49
MW-63	08/02/00	4970.02	4973.13	-3.11
MW-64	08/02/00	4964.37	4964.15	0.22
MW-65	08/02/00	4960.11	4959.35	0.76
MW-66	08/02/00	4962.80	4962.98	-0.18
MW-67	08/02/00	4956.63	4957.74	-1.11
MW-68	08/02/00	4960.28	4959.45	0.83
MW-69	08/02/00	4960.13	4958.87	1.26
MW-70	08/02/00	4969.03	4969.14	-0.11
MW-71	08/02/00	4956.64	4956.53	0.11
MW-72	08/02/00	4969.75	4969.23	0.52
MW-73	08/02/00	4969.83	4969.15	0.68
MW-74	08/02/00	4962.92	4967.36	-4.44
MW-75	08/02/00	4966.88	4966.97	-0.09
MW-76	08/02/00	4967.60	4967.11	0.49
OB-1	08/02/00	4957.41	4956.97	0.45
OB-2	08/02/00	4958.83	4957.81	1.02

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Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
PW-1	08/02/00	4972.22	4970.89	1.33
MW-07	11/07/00	4976.39	4972.47	3.92
MW-09	11/07/00	4972.03	4970.81	1.22
MW-12	11/07/00	4971.68	4970.98	0.70
MW-13	11/07/00	4973.44	4971.15	2.29
MW-16	11/07/00	4977.80	4973.58	4.22
MW-17	11/07/00	4978.25	4973.92	4.33
MW-18	11/07/00	4970.77	4971.63	-0.85
MW-19	11/07/00	4970.66	4969.64	1.02
MW-20	11/07/00	4970.29	4969.44	0.85
MW-22	11/07/00	4976.97	4973.27	3.70
MW-23	11/07/00	4975.16	4972.18	2.98
MW-24	11/07/00	4977.62	4973.53	4.09
MW-25	11/07/00	4977.66	4973.55	4.11
MW-26	11/07/00	4972.58	4971.13	1.45
MW-27	11/07/00	4972.98	4972.93	0.05
MW-29	11/07/00	4972.58	4970.60	1.98
MW-30	11/07/00	4971.07	4969.84	1.23
MW-31	11/07/00	4969.95	4969.09	0.86
MW-32	11/07/00	4969.76	4969.05	0.71
MW-33	11/07/00	4971.33	4970.27	1.06
MW-34	11/07/00	4973.22	4970.78	2.44
MW-35	11/07/00	4970.30	4968.97	1.33
MW-36	11/07/00	4968.56	4967.80	0.76
MW-38	11/07/00	4972.61	4970.49	2.12
MW-39	11/07/00	4971.34	4969.82	1.52
MW-40	11/07/00	4970.00	4969.04	0.96
MW-41	11/07/00	4969.87	4969.09	0.78
MW-42	11/07/00	4969.56	4969.19	0.37
MW-43	11/07/00	4969.35	4969.06	0.29
MW-44	11/07/00	4968.68	4967.78	0.90
MW-45	11/07/00	4966.80	4966.31	0.49
MW-46	11/07/00	4965.41	4965.15	0.26
MW-47	11/07/00	4964.88	4964.45	0.43
MW-48	11/07/00	4963.81	4962.86	0.95
MW-49	11/07/00	4969.87	4969.03	0.84
MW-51	11/07/00	4980.08	4975.87	4.21
MW-52	11/07/00	4960.29	4959.85	0.44
MW-53	11/07/00	4962.32	4960.65	1.67
MW-54	11/07/00	4964.43	4964.11	0.32
MW-55	11/07/00	4962.76	4962.46	0.30

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-56	11/07/00	4963.82	4962.74	1.08
MW-57	11/07/00	4964.09	4963.74	0.35
MW-58	11/07/00	4963.24	4961.70	1.54
MW-59	11/07/00	4968.48	4968.88	-0.40
MW-60	11/07/00	4963.65	4962.56	1.09
MW-61	11/07/00	4963.75	4962.63	1.13
MW-62	11/07/00	4965.82	4965.20	0.62
MW-63	11/07/00	4970.16	4973.14	-2.98
MW-64	11/07/00	4964.35	4964.02	0.33
MW-65	11/07/00	4960.01	4959.18	0.83
MW-66	11/07/00	4962.89	4962.84	0.05
MW-67	11/07/00	4957.15	4957.61	-0.46
MW-68	11/07/00	4960.11	4959.32	0.79
MW-69	11/07/00	4960.08	4958.70	1.38
MW-70	11/07/00	4969.01	4969.04	-0.03
MW-71	11/07/00	4957.14	4956.41	0.73
MW-72	11/07/00	4969.75	4969.13	0.62
MW-73	11/07/00	4969.77	4969.05	0.72
MW-74	11/07/00	4962.55	4967.11	-4.56
MW-75	11/07/00	4966.27	4966.71	-0.44
MW-76	11/07/00	4967.22	4966.82	0.40
OB-1	11/07/00	4957.35	4956.77	0.58
OB-2	11/07/00	4958.74	4957.63	1.11
PW-1	11/07/00	4972.21	4970.83	1.38
MW-74	01/15/01	4963.03	4967.30	-4.27
MW-75	01/15/01	4966.90	4966.89	0.01
MW-76	01/15/01	4967.89	4966.94	0.95
MW-07	02/13/01	4975.81	4972.40	3.41
MW-09	02/13/01	4971.46	4970.74	0.72
MW-12	02/13/01	4971.06	4970.93	0.13
MW-13	02/13/01	4972.80	4971.06	1.74
MW-16	02/13/01	4977.92	4973.59	4.33
MW-17	02/13/01	4977.88	4973.92	3.96
MW-18	02/13/01	4969.86	4971.63	-1.77
MW-19	02/13/01	4970.20	4969.53	0.67
MW-20	02/13/01	4969.85	4969.34	0.52
MW-22	02/13/01	4976.25	4973.24	3.01
MW-23	02/13/01	4974.41	4972.13	2.28
MW-24	02/13/01	4977.25	4973.54	3.72
MW-25	02/13/01	4977.35	4973.55	3.80
MW-26	02/13/01	4971.77	4971.07	0.70

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference
		Observed	Computed	(ft)
MW-27	02/13/01	4972.78	4972.97	-0.19
MW-29	02/13/01	4971.86	4970.51	1.35
MW-30	02/13/01	4970.54	4969.74	0.80
MW-31	02/13/01	4969.62	4968.98	0.64
MW-32	02/13/01	4969.52	4968.94	0.58
MW-33	02/13/01	4970.77	4970.18	0.59
MW-34	02/13/01	4972.44	4970.69	1.75
MW-35	02/13/01	4969.82	4968.86	0.96
MW-38	02/13/01	4971.96	4970.39	1.57
MW-39	02/13/01	4970.78	4969.72	1.06
MW-40	02/13/01	4969.65	4968.93	0.72
MW-41	02/13/01	4969.61	4968.98	0.63
MW-42	02/13/01	4969.41	4969.08	0.33
MW-43	02/13/01	4969.22	4968.95	0.27
MW-44	02/13/01	4968.47	4967.66	0.81
MW-45	02/13/01	4966.81	4966.17	0.64
MW-46	02/13/01	4965.58	4965.00	0.58
MW-47	02/13/01	4964.80	4964.29	0.51
MW-48	02/13/01	4963.89	4962.67	1.22
MW-49	02/13/01	4969.51	4968.92	0.59
MW-51	02/13/01	4979.98	4975.89	4.09
MW-52	02/13/01	4960.44	4959.62	0.82
MW-53	02/13/01	4962.50	4960.39	2.11
MW-54	02/13/01	4964.57	4963.96	0.61
MW-55	02/13/01	4962.85	4962.28	0.58
MW-56	02/13/01	4963.91	4962.55	1.36
MW-57	02/13/01	4964.52	4963.58	0.94
MW-58	02/13/01	4963.32	4961.49	1.83
MW-59	02/13/01	4966.97	4968.77	-1.80
MW-60	02/13/01	4963.94	4962.38	1.56
MW-61	02/13/01	4964.01	4962.44	1.57
MW-62	02/13/01	4965.77	4965.05	0.72
MW-63	02/13/01	4970.39	4973.14	-2.75
MW-64	02/13/01	4964.75	4963.87	0.88
MW-65	02/13/01	4960.18	4958.97	1.21
MW-66	02/13/01	4963.19	4962.69	0.50
MW-67	02/13/01	4957.59	4957.49	0.10
MW-68	02/13/01	4960.38	4959.11	1.27
MW-69	02/13/01	4960.29	4958.52	1.78
MW-70	02/13/01	4968.80	4968.93	-0.13
MW-71	02/13/01	4957.61	4956.28	1.33

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference
		Observed	Computed	(ft)
MW-72	02/13/01	4969.54	4969.02	0.52
MW-73	02/13/01	4969.46	4968.94	0.52
MW-74	02/13/01	4963.14	4967.29	-4.15
MW-75	02/13/01	4966.95	4966.89	0.07
MW-76	02/13/01	4968.03	4966.94	1.09
OB-1	02/13/01	4957.51	4956.52	0.99
OB-2	02/13/01	4959.05	4957.40	1.65
PW-1	02/13/01	4971.57	4970.76	0.81
MW-74	03/16/01	4963.10	4967.32	-4.22
MW-75	03/16/01	4966.92	4966.92	0.00
MW-76	03/16/01	4968.05	4966.96	1.09
MW-74	04/16/01	4963.10	4967.34	-4.24
MW-75	04/16/01	4967.01	4966.93	0.08
MW-76	04/16/01	4968.04	4966.97	1.07
MW-07	05/22/01	4976.25	4972.34	3.91
MW-09	05/22/01	4971.86	4970.68	1.18
MW-12	05/22/01	4971.29	4970.89	0.40
MW-13	05/22/01	4973.27	4970.98	2.29
MW-16	05/22/01	4977.73	4973.58	4.15
MW-17	05/22/01	4977.78	4973.91	3.87
MW-18	05/22/01	4970.50	4971.61	-1.11
MW-19	05/22/01	4970.39	4969.44	0.95
MW-20	05/22/01	4970.04	4969.24	0.80
MW-22	05/22/01	4976.43	4973.21	3.22
MW-23	05/22/01	4974.94	4972.08	2.86
MW-24	05/22/01	4977.21	4973.53	3.68
MW-25	05/22/01	4977.21	4973.55	3.66
MW-26	05/22/01	4971.63	4970.99	0.64
MW-27	05/22/01	4972.71	4972.99	-0.28
MW-29	05/22/01	4972.38	4970.42	1.96
MW-30	05/22/01	4970.86	4969.64	1.22
MW-31	05/22/01	4969.70	4968.88	0.82
MW-32	05/22/01	4969.53	4968.85	0.68
MW-33	05/22/01	4971.10	4970.09	1.01
MW-34	05/22/01	4973.02	4970.60	2.42
MW-35	05/22/01	4969.99	4968.76	1.23
MW-38	05/22/01	4972.45	4970.30	2.15
MW-39	05/22/01	4971.11	4969.62	1.49
MW-40	05/22/01	4969.75	4968.83	0.92
MW-41	05/22/01	4969.65	4968.89	0.76
MW-42	05/22/01	4969.35	4968.99	0.36

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-43	05/22/01	4969.12	4968.85	0.27
MW-44	05/22/01	4968.42	4967.55	0.87
MW-45	05/22/01	4966.59	4966.05	0.54
MW-46	05/22/01	4965.25	4964.88	0.37
MW-47	05/22/01	4964.42	4964.15	0.27
MW-48	05/22/01	4963.60	4962.53	1.07
MW-49	05/22/01	4969.54	4968.82	0.72
MW-51	05/22/01	4979.72	4975.90	3.82
MW-52	05/22/01	4960.11	4959.46	0.65
MW-53	05/22/01	4961.97	4960.21	1.76
MW-54	05/22/01	4964.38	4963.83	0.55
MW-55	05/22/01	4962.47	4962.15	0.32
MW-56	05/22/01	4963.66	4962.42	1.24
MW-57	05/22/01	4964.10	4963.45	0.66
MW-58	05/22/01	4963.46	4961.33	2.13
MW-59	05/22/01	4966.76	4968.67	-1.91
MW-60	05/22/01	4963.80	4962.24	1.56
MW-61	05/22/01	4963.88	4962.30	1.58
MW-62	05/22/01	4965.66	4964.92	0.74
MW-63	05/22/01	4969.98	4973.13	-3.15
MW-64	05/22/01	4964.30	4963.74	0.56
MW-65	05/22/01	4959.83	4958.84	0.99
MW-66	05/22/01	4962.72	4962.57	0.15
MW-67	05/22/01	4956.91	4957.39	-0.47
MW-68	05/22/01	4960.10	4958.96	1.14
MW-69	05/22/01	4959.94	4958.39	1.55
MW-70	05/22/01	4969.07	4968.83	0.24
MW-71	05/22/01	4956.89	4956.18	0.71
MW-72	05/22/01	4969.55	4968.93	0.62
MW-73	05/22/01	4969.45	4968.85	0.61
MW-74	05/22/01	4962.02	4967.21	-5.19
MW-75	05/22/01	4965.93	4966.81	-0.88
MW-76	05/22/01	4966.87	4966.88	0.00
OB-1	05/22/01	4957.24	4956.40	0.85
OB-2	05/22/01	4958.58	4957.27	1.31
PW-1	05/22/01	4972.14	4970.70	1.44
MW-74	07/16/01	4962.53	4967.22	-4.69
MW-75	07/16/01	4966.50	4966.81	-0.31
MW-76	07/16/01	4967.39	4966.85	0.54
MW-17	07/31/01	4977.63	4973.90	3.73
MW-07	08/27/01	4976.15	4972.28	3.87

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-09	08/27/01	4971.81	4970.61	1.20
MW-12	08/27/01	4971.26	4970.84	0.42
MW-13	08/27/01	4973.21	4970.90	2.31
MW-16	08/27/01	4977.28	4973.57	3.71
MW-17	08/27/01	4977.68	4973.90	3.78
MW-18	08/27/01	4970.45	4971.59	-1.14
MW-19	08/27/01	4970.34	4969.35	0.99
MW-20	08/27/01	4969.99	4969.15	0.84
MW-22	08/27/01	4976.37	4973.18	3.19
MW-23	08/27/01	4974.87	4972.03	2.84
MW-24	08/27/01	4977.13	4973.52	3.61
MW-25	08/27/01	4977.13	4973.55	3.58
MW-26	08/27/01	4971.56	4970.93	0.63
MW-27	08/27/01	4972.68	4973.00	-0.31
MW-29	08/27/01	4972.33	4970.34	1.99
MW-30	08/27/01	4970.82	4969.56	1.26
MW-31	08/27/01	4969.64	4968.79	0.85
MW-32	08/27/01	4969.46	4968.76	0.70
MW-33	08/27/01	4971.05	4970.01	1.04
MW-34	08/27/01	4973.08	4970.52	2.57
MW-35	08/27/01	4970.02	4968.66	1.36
MW-38	08/27/01	4972.29	4970.22	2.07
MW-39	08/27/01	4971.06	4969.54	1.52
MW-40	08/27/01	4969.69	4968.74	0.95
MW-41	08/27/01	4969.57	4968.79	0.78
MW-42	08/27/01	4969.25	4968.90	0.35
MW-43	08/27/01	4969.04	4968.76	0.28
MW-44	08/27/01	4968.42	4967.45	0.97
MW-45	08/27/01	4966.55	4965.95	0.60
MW-46	08/27/01	4965.19	4964.76	0.43
MW-47	08/27/01	4964.34	4964.03	0.31
MW-48	08/27/01	4963.55	4962.40	1.15
MW-49	08/27/01	4969.49	4968.74	0.76
MW-51	08/27/01	4979.77	4975.91	3.86
MW-52	08/27/01	4960.02	4959.32	0.70
MW-53	08/27/01	4961.84	4960.07	1.77
MW-54	08/27/01	4964.16	4963.70	0.46
MW-55	08/27/01	4962.38	4962.03	0.35
MW-56	08/27/01	4963.52	4962.29	1.23
MW-57	08/27/01	4963.99	4963.32	0.67
MW-58	08/27/01	4963.31	4961.19	2.12

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Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-59	08/27/01	4966.64	4968.58	-1.94
MW-60	08/27/01	4963.62	4962.11	1.51
MW-61	08/27/01	4963.65	4962.17	1.48
MW-62	08/27/01	4965.63	4964.80	0.83
MW-63	08/27/01	4969.88	4973.12	-3.24
MW-64	08/27/01	4964.20	4963.62	0.58
MW-65	08/27/01	4959.76	4958.71	1.05
MW-66	08/27/01	4962.60	4962.45	0.15
MW-67	08/27/01	4956.58	4957.27	-0.69
MW-68	08/27/01	4959.93	4958.82	1.11
MW-69	08/27/01	4959.84	4958.25	1.59
MW-70	08/27/01	4969.01	4968.74	0.27
MW-71	08/27/01	4956.66	4956.06	0.60
MW-72	08/27/01	4969.47	4968.83	0.64
MW-73	08/27/01	4969.38	4968.75	0.63
MW-74	08/27/01	4962.53	4967.12	-4.59
MW-75	08/27/01	4966.56	4966.72	-0.16
MW-76	08/27/01	4967.41	4966.78	0.63
OB-1	08/27/01	4957.10	4956.26	0.84
OB-2	08/27/01	4958.48	4957.14	1.34
PW-1	08/27/01	4971.67	4970.63	1.04
MW-07	11/01/01	4976.23	4972.24	3.99
MW-09	11/01/01	4971.88	4970.58	1.30
MW-12	11/01/01	4971.29	4970.82	0.48
MW-13	11/01/01	4973.23	4970.87	2.36
MW-16	11/01/01	4977.43	4973.57	3.87
MW-17	11/01/01	4977.84	4973.89	3.95
MW-18	11/01/01	4970.48	4971.58	-1.10
MW-19	11/01/01	4970.40	4969.33	1.07
MW-20	11/01/01	4970.03	4969.15	0.88
MW-22	11/01/01	4976.42	4973.15	3.27
MW-23	11/01/01	4974.90	4972.01	2.89
MW-24	11/01/01	4977.29	4973.51	3.78
MW-25	11/01/01	4977.27	4973.54	3.73
MW-26	11/01/01	4971.62	4970.90	0.72
MW-27	11/01/01	4972.84	4973.00	-0.16
MW-29	11/01/01	4972.33	4970.32	2.01
MW-30	11/01/01	4970.83	4969.54	1.29
MW-31	11/01/01	4969.69	4968.77	0.92
MW-32	11/01/01	4969.54	4968.74	0.80
MW-33	11/01/01	4971.12	4969.98	1.14

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Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-34	11/01/01	4973.07	4970.47	2.60
MW-35	11/01/01	4970.08	4968.63	1.46
MW-38	11/01/01	4972.29	4970.20	2.09
MW-39	11/01/01	4971.08	4969.53	1.55
MW-40	11/01/01	4969.76	4968.73	1.03
MW-41	11/01/01	4969.66	4968.78	0.88
MW-42	11/01/01	4969.33	4968.88	0.45
MW-43	11/01/01	4969.11	4968.75	0.36
MW-44	11/01/01	4968.47	4967.43	1.04
MW-45	11/01/01	4966.62	4965.94	0.68
MW-46	11/01/01	4965.26	4964.77	0.49
MW-47	11/01/01	4964.44	4964.02	0.42
MW-48	11/01/01	4963.67	4962.41	1.26
MW-49	11/01/01	4969.60	4968.73	0.87
MW-51	11/01/01	4979.73	4975.91	3.82
MW-52	11/01/01	4960.27	4959.38	0.89
MW-53	11/01/01	4962.10	4960.23	1.87
MW-54	11/01/01	4964.27	4963.67	0.60
MW-55	11/01/01	4962.48	4962.19	0.29
MW-56	11/01/01	4963.65	4962.39	1.26
MW-57	11/01/01	4964.04	4963.28	0.76
MW-58	11/01/01	4963.12	4961.25	1.87
MW-59	11/01/01	4966.73	4968.56	-1.83
MW-60	11/01/01	4963.68	4962.17	1.51
MW-61	11/01/01	4963.74	4962.17	1.57
MW-62	11/01/01	4965.72	4964.78	0.94
MW-63	11/01/01	4969.92	4973.11	-3.19
MW-64	11/01/01	4964.28	4963.60	0.68
MW-65	11/01/01	4959.95	4958.97	0.98
MW-66	11/01/01	4962.68	4962.48	0.20
MW-67	11/01/01	4956.70	4957.24	-0.54
MW-68	11/01/01	4960.21	4958.84	1.37
MW-69	11/01/01	4960.03	4958.39	1.64
MW-70	11/01/01	4969.05	4968.73	0.32
MW-72	11/01/01	4969.55	4968.82	0.73
MW-73	11/01/01	4969.45	4968.74	0.71
MW-74	11/01/01	4962.25	4966.28	-4.03
MW-75	11/01/01	4965.67	4965.93	-0.26
MW-76	11/01/01	4966.27	4966.15	0.12
OB-1	11/01/01	4957.25	4956.88	0.37
OB-2	11/01/01	4958.45	4957.56	0.89

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Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference
		Observed	Computed	(ft)
PW-1	11/01/01	4971.74	4970.60	1.14
MW-07	02/01/02	4975.80	4973.14	2.66
MW-09	02/01/02	4970.81	4969.68	1.13
MW-12	02/01/02	4970.21	4969.88	0.33
MW-13	02/01/02	4972.27	4970.56	1.71
MW-16	02/01/02	4980.50	4976.31	4.19
MW-17	02/01/02	4982.29	4980.18	2.12
MW-18	02/01/02	4969.22	4971.55	-2.33
MW-19	02/01/02	4969.13	4967.91	1.22
MW-20	02/01/02	4968.75	4968.25	0.50
MW-22	02/01/02	4978.68	4977.81	0.87
MW-23	02/01/02	4974.30	4972.31	1.99
MW-24	02/01/02	4980.12	4976.14	3.98
MW-25	02/01/02	4979.86	4975.61	4.25
MW-26	02/01/02	4970.82	4970.70	0.12
MW-27	02/01/02	4972.39	4973.12	-0.73
MW-29	02/01/02	4971.37	4969.68	1.69
MW-30	02/01/02	4969.72	4968.51	1.21
MW-31	02/01/02	4968.40	4967.28	1.12
MW-32	02/01/02	4968.01	4966.96	1.05
MW-33	02/01/02	4969.98	4969.44	0.54
MW-34	02/01/02	4972.02	4970.30	1.72
MW-36	02/01/02	4967.65	4967.13	0.52
MW-37R	02/01/02	4965.50	4965.50	0.00
MW-38	02/01/02	4971.32	4969.66	1.66
MW-39	02/01/02	4970.10	4968.82	1.29
MW-40	02/01/02	4968.46	4967.67	0.79
MW-41	02/01/02	4968.14	4966.73	1.41
MW-42	02/01/02	4968.52	4967.96	0.56
MW-43	02/01/02	4968.32	4967.97	0.35
MW-44	02/01/02	4967.69	4966.99	0.70
MW-45	02/01/02	4966.46	4965.48	0.98
MW-46	02/01/02	4964.84	4964.45	0.39
MW-47	02/01/02	4964.39	4963.83	0.57
MW-48	02/01/02	4963.33	4962.21	1.12
MW-49	02/01/02	4968.46	4968.04	0.42
MW-51	02/01/02	4979.54	4975.94	3.60
MW-52	02/01/02	4960.02	4959.14	0.88
MW-53	02/01/02	4961.68	4959.90	1.79
MW-54	02/01/02	4964.07	4963.50	0.57
MW-55	02/01/02	4962.13	4961.76	0.37

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-56	02/01/02	4963.33	4962.06	1.27
MW-57	02/01/02	4963.84	4963.11	0.73
MW-58	02/01/02	4962.73	4961.02	1.71
MW-59	02/01/02	4967.62	4967.91	-0.29
MW-60	02/01/02	4963.37	4961.89	1.48
MW-61	02/01/02	4963.36	4961.98	1.38
MW-62	02/01/02	4965.34	4964.61	0.73
MW-63	02/01/02	4969.57	4973.09	-3.52
MW-64	02/01/02	4963.98	4963.40	0.58
MW-65	02/01/02	4959.42	4958.48	0.94
MW-66	02/01/02	4961.50	4962.18	-0.68
MW-67	02/01/02	4956.83	4957.07	-0.24
MW-68	02/01/02	4959.61	4958.62	0.99
MW-69	02/01/02	4959.53	4958.01	1.52
MW-70	02/01/02	4967.65	4967.77	-0.12
MW-72	02/01/02	4968.48	4967.58	0.90
MW-73	02/01/02	4967.63	4966.06	1.57
MW-74	02/01/02	4962.20	4966.94	-4.74
MW-75	02/01/02	4965.97	4966.53	-0.56
MW-76	02/01/02	4967.60	4966.54	1.06
MW-77	02/01/02	4977.03	4973.64	3.39
MW-78	02/01/02	4969.78	4971.26	-1.48
OB-1	02/01/02	4956.80	4956.00	0.80
OB-2	02/01/02	4957.93	4956.89	1.04
MW-07	05/07/02	4976.19	4974.85	1.34
MW-09	05/07/02	4971.00	4969.55	1.45
MW-12	05/07/02	4970.39	4969.78	0.61
MW-13	05/07/02	4972.60	4971.17	1.43
MW-14R	05/07/02	4968.32	4966.92	1.40
MW-16	05/07/02	4982.05	4979.98	2.07
MW-17	05/07/02	4981.96	4981.48	0.48
MW-18	05/07/02	4969.40	4972.79	-3.39
MW-19	05/07/02	4969.25	4967.60	1.65
MW-20	05/07/02	4968.83	4968.01	0.82
MW-21	05/07/02	4983.25	4979.99	3.26
MW-22	05/07/02	4977.78	4977.92	-0.14
MW-23	05/07/02	4974.70	4974.38	0.33
MW-24	05/07/02	4981.78	4979.74	2.04
MW-25	05/07/02	4981.99	4979.83	2.16
MW-26	05/07/02	4971.31	4971.15	0.16
MW-27	05/07/02	4978.83	4976.35	2.48

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-29	05/07/02	4971.64	4969.53	2.11
MW-30	05/07/02	4969.84	4968.23	1.61
MW-31	05/07/02	4968.41	4966.86	1.55
MW-32	05/07/02	4968.09	4966.61	1.48
MW-33	05/07/02	4970.07	4969.22	0.85
MW-34	05/07/02	4972.42	4970.00	2.42
MW-36	05/07/02	4967.57	4966.62	0.95
MW-37R	05/07/02	4965.40	4965.05	0.35
MW-38	05/07/02	4971.60	4969.50	2.10
MW-39	05/07/02	4970.16	4968.61	1.55
MW-40	05/07/02	4968.49	4967.38	1.11
MW-41	05/07/02	4968.28	4966.33	1.95
MW-42	05/07/02	4968.56	4967.73	0.83
MW-43	05/07/02	4968.33	4967.75	0.58
MW-44	05/07/02	4967.64	4966.59	1.05
MW-45	05/07/02	4966.36	4965.09	1.27
MW-46	05/07/02	4964.78	4964.13	0.65
MW-47	05/07/02	4964.28	4963.50	0.78
MW-48	05/07/02	4963.36	4961.95	1.41
MW-49	05/07/02	4968.51	4967.81	0.70
MW-51	05/07/02	4981.04	4978.48	2.56
MW-52	05/07/02	4959.95	4958.94	1.01
MW-53	05/07/02	4961.65	4959.65	2.00
MW-54	05/07/02	4963.99	4963.27	0.72
MW-55	05/07/02	4962.20	4961.53	0.67
MW-56	05/07/02	4963.36	4961.81	1.55
MW-57	05/07/02	4963.81	4962.91	0.90
MW-58	05/07/02	4962.78	4960.76	2.02
MW-59	05/07/02	4967.55	4967.70	-0.15
MW-60	05/07/02	4963.47	4961.66	1.82
MW-61	05/07/02	4963.33	4961.74	1.59
MW-62	05/07/02	4965.19	4964.33	0.86
MW-63	05/07/02	4969.55	4973.18	-3.63
MW-64	05/07/02	4964.02	4963.17	0.85
MW-65	05/07/02	4959.60	4958.30	1.30
MW-66	05/07/02	4962.41	4962.00	0.41
MW-67	05/07/02	4956.49	4956.96	-0.47
MW-68	05/07/02	4959.98	4958.43	1.55
MW-69	05/07/02	4959.76	4957.84	1.92
MW-70	05/07/02	4967.72	4967.52	0.20
MW-72	05/07/02	4968.58	4967.29	1.29

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-73	05/07/02	4967.73	4965.55	2.18
MW-74	05/07/02	4962.39	4966.90	-4.51
MW-75	05/07/02	4966.16	4966.49	-0.33
MW-76	05/07/02	4967.50	4966.51	0.99
MW-77	05/07/02	4977.16	4973.91	3.25
MW-78	05/07/02	4972.91	4972.92	-0.01
OB-1	05/07/02	4956.96	4955.82	1.14
OB-2	05/07/02	4957.20	4956.71	0.49
MW-07	08/01/02	4975.98	4974.81	1.17
MW-09	08/01/02	4970.91	4970.00	0.91
MW-12	08/01/02	4970.31	4970.24	0.07
MW-13	08/01/02	4972.49	4972.00	0.49
MW-14R	08/01/02	4968.19	4966.87	1.32
MW-16	08/01/02	4982.19	4982.57	-0.38
MW-17	08/01/02	4981.78	4983.42	-1.64
MW-18	08/01/02	4970.34	4974.81	-4.47
MW-19	08/01/02	4969.16	4967.59	1.57
MW-20	08/01/02	4968.65	4967.95	0.70
MW-21	08/01/02	4983.38	4984.79	-1.41
MW-22	08/01/02	4977.41	4978.32	-0.91
MW-23	08/01/02	4974.67	4975.19	-0.52
MW-24	08/01/02	4981.95	4982.25	-0.30
MW-25	08/01/02	4982.17	4982.73	-0.56
MW-26	08/01/02	4971.55	4971.51	0.04
MW-27	08/01/02	4980.39	4979.96	0.43
MW-29	08/01/02	4971.50	4969.50	2.00
MW-30	08/01/02	4969.69	4968.21	1.48
MW-31	08/01/02	4968.27	4966.83	1.44
MW-32	08/01/02	4967.96	4966.58	1.38
MW-33	08/01/02	4969.98	4969.59	0.39
MW-34	08/01/02	4972.37	4969.90	2.47
MW-36	08/01/02	4967.43	4966.45	0.98
MW-37R	08/01/02	4965.16	4964.87	0.29
MW-38	08/01/02	4971.49	4969.44	2.05
MW-39	08/01/02	4970.02	4968.55	1.48
MW-40	08/01/02	4968.36	4967.32	1.04
MW-41	08/01/02	4968.28	4966.32	1.96
MW-42	08/01/02	4968.41	4967.67	0.74
MW-43	08/01/02	4968.14	4967.68	0.46
MW-44	08/01/02	4967.49	4966.45	1.04
MW-45	08/01/02	4966.14	4964.94	1.20

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-46	08/01/02	4964.47	4963.98	0.49
MW-47	08/01/02	4964.05	4963.31	0.74
MW-48	08/01/02	4963.10	4961.76	1.34
MW-49	08/01/02	4968.35	4967.74	0.61
MW-51	08/01/02	4981.13	4980.12	1.01
MW-52	08/01/02	4959.68	4958.79	0.89
MW-53	08/01/02	4961.47	4959.49	1.98
MW-54	08/01/02	4963.64	4963.11	0.54
MW-55	08/01/02	4961.89	4961.39	0.50
MW-56	08/01/02	4963.09	4961.65	1.44
MW-57	08/01/02	4963.43	4962.76	0.68
MW-58	08/01/02	4962.47	4960.57	1.90
MW-59	08/01/02	4967.23	4967.62	-0.39
MW-60	08/01/02	4963.05	4961.50	1.55
MW-61	08/01/02	4962.94	4961.57	1.37
MW-62	08/01/02	4965.01	4964.15	0.86
MW-63	08/01/02	4969.40	4974.15	-4.75
MW-64	08/01/02	4963.62	4963.02	0.60
MW-65	08/01/02	4959.29	4958.17	1.12
MW-66	08/01/02	4961.97	4961.87	0.10
MW-67	08/01/02	4955.77	4956.86	-1.09
MW-68	08/01/02	4959.60	4958.29	1.31
MW-69	08/01/02	4959.44	4957.72	1.72
MW-70	08/01/02	4967.50	4967.46	0.04
MW-72	08/01/02	4968.50	4967.25	1.25
MW-73	08/01/02	4967.55	4965.57	1.98
MW-74	08/01/02	4961.89	4966.80	-4.91
MW-75	08/01/02	4965.68	4966.39	-0.71
MW-76	08/01/02	4967.09	4966.40	0.69
MW-77	08/01/02	4977.01	4973.76	3.25
MW-78	08/01/02	4974.02	4974.52	-0.49
OB-1	08/01/02	4956.62	4955.70	0.92
OB-2	08/01/02	4957.80	4956.59	1.21
MW-07	11/04/02	4976.52	4975.49	1.03
MW-09	11/04/02	4971.04	4974.27	-3.23
MW-12	11/04/02	4970.45	4974.09	-3.64
MW-13	11/04/02	4972.57	4973.25	-0.68
MW-14R	11/04/02	4968.35	4966.94	1.41
MW-16	11/04/02	4982.25	4984.52	-2.27
MW-17	11/04/02	4981.93	4985.22	-3.29
MW-18	11/04/02	4973.88	4976.66	-2.78

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-19	11/04/02	4969.38	4967.56	1.82
MW-20	11/04/02	4968.87	4967.89	0.98
MW-21	11/04/02	4983.17	4987.83	-4.66
MW-22	11/04/02	4977.85	4979.25	-1.40
MW-23	11/04/02	4974.83	4976.28	-1.45
MW-24	11/04/02	4982.08	4984.17	-2.09
MW-25	11/04/02	4982.25	4984.83	-2.58
MW-26	11/04/02	4971.92	4972.18	-0.26
MW-27	11/04/02	4980.86	4982.85	-1.99
MW-29	11/04/02	4971.60	4969.55	2.05
MW-30	11/04/02	4969.87	4968.26	1.61
MW-31	11/04/02	4968.45	4966.78	1.67
MW-32	11/04/02	4968.26	4966.46	1.80
MW-33	11/04/02	4970.12	4970.57	-0.45
MW-34	11/04/02	4972.29	4969.90	2.39
MW-37R	11/04/02	4964.47	4964.77	-0.30
MW-38	11/04/02	4971.56	4969.41	2.15
MW-39	11/04/02	4970.15	4968.50	1.65
MW-40	11/04/02	4968.53	4967.24	1.29
MW-41	11/04/02	4968.59	4966.20	2.39
MW-42	11/04/02	4968.65	4967.60	1.05
MW-43	11/04/02	4968.42	4967.61	0.81
MW-44	11/04/02	4966.77	4966.39	0.39
MW-45	11/04/02	4965.43	4964.84	0.59
MW-46	11/04/02	4964.54	4963.87	0.67
MW-47	11/04/02	4964.06	4963.18	0.88
MW-48	11/04/02	4963.04	4961.62	1.42
MW-49	11/04/02	4968.53	4967.67	0.86
MW-51	11/04/02	4981.76	4982.02	-0.26
MW-53	11/04/02	4961.30	4959.32	1.98
MW-54	11/04/02	4963.63	4962.97	0.66
MW-55	11/04/02	4961.93	4961.26	0.67
MW-56	11/04/02	4963.08	4961.51	1.57
MW-57	11/04/02	4963.44	4962.61	0.83
MW-58	11/04/02	4962.35	4960.41	1.94
MW-59	11/04/02	4967.60	4967.56	0.04
MW-60	11/04/02	4963.01	4961.36	1.65
MW-61	11/04/02	4962.88	4961.42	1.46
MW-62	11/04/02	4965.02	4964.02	1.00
MW-63	11/04/02	4969.84	4975.78	-5.94
MW-64	11/04/02	4963.52	4962.89	0.63

Appendix E

Water Level Residuals
January 1998 to November 2002 Simulation

Monitoring Well	Date	Water-level Elevation, in feet above MSL		Residual Difference (ft)
		Observed	Computed	
MW-65	11/04/02	4959.24	4958.02	1.22
MW-66	11/04/02	4962.11	4961.74	0.37
MW-67	11/04/02	4956.18	4956.75	-0.57
MW-68	11/04/02	4959.35	4958.14	1.21
MW-69	11/04/02	4959.35	4957.57	1.78
MW-70	11/04/02	4967.75	4967.37	0.38
MW-72	11/04/02	4968.75	4967.17	1.58
MW-73	11/04/02	4967.81	4965.43	2.39
MW-74	11/04/02	4961.78	4966.75	-4.97
MW-75	11/04/02	4965.56	4966.33	-0.77
MW-76	11/04/02	4967.20	4966.32	0.88
MW-77	11/04/02	4977.21	4973.99	3.22
MW-78	11/04/02	4974.53	4975.86	-1.33
OB-1	11/04/02	4956.53	4955.51	1.02
OB-2	11/04/02	4957.72	4956.42	1.30

Number of active observation points =	1245	
Number of inactive observation points =	0	
Mean of residuals =	0.80	ft
Standard Deviation of residuals =	1.58	ft
Sum of squared residuals =	3911	ft^2
Mean of absolute residuals =	1.28	ft
Maximum residual =	-6.79	ft
Minimum residual =	5.05	ft
Range in observed heads =	27.61	ft
dard Deviation/Range in observed heads =	0.20	ft/ft