Final Remedial Investigation Report

West Central Phoenix East Grand Avenue WQARF Site

Volume I of III: Text, Figures, and Tables

June 2006

Final Remedial Investigation Report
WCP East Grand Avenue WQARF Site
Phoenix, Arizona

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ACRONYMS

ac-ft	acre-feet
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ADWR	Arizona Department of Water Resources
amsl	above mean sea level
ARS	Arizona Revised Statutes
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
AWQS	Aquifer Water Quality Standard
BBL	Blasland, Blouck, & Lee, Inc.
bgs	below ground surface
BKH	Braun-Knecht-Heimann Company
Blue Stake	Arizona Blue Stake Center
BS/BSD	blank spike/blank spike duplicate
BTEX	benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CEC	Coronado Engineering and Consulting
CLP	contract laboratory program
COC	chain-of-custody
Columbia	Columbia Analytical Services, Inc.
COP	City of Phoenix
Danone	Danone Waters of North America
DO	dissolved oxygen
DOT	Department of Transportation
ºF	degrees Fahrenheit
1,1-DCA	1,1-dichloroethane
1,2-DCA	1,2-dichloroethane
1,1-DCE	1,1-dichloroethene or 1,1-dichloroethylene
cis-1,2-DCE	*cis*-1,2-dichloroethene or *cis*-1,2-dichloroethylene
4,4-DDE	dichlorodiphenyldichloroethene
4,4-DDT	dichlorodiphenyltrichloroethane
Earth Tech	Earth Technology Corporation
EnecoTech	EnecoTech Southwest, Inc.
EDD	electronic data deliverables
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
Fluor Daniel	Fluor Daniel GTI, Inc.
f_{oc}	fraction of organic carbon
FS	Feasibility Study
FSP	Field Sampling Plan

ACRONYMS (continued)

ft/day	feet per day
ft^2/day	square feet per day
ft/ft	feet per foot
gal/day/ft	gallons per day per feet
gal/day/ft^2	gallons per day per square feet
GC/MS	gas chromatogram/mass spectrometer
GPL	Groundwater Protection Level
gpm	gallons per minute
HBGL	Health Based Guidance Level
HLA	Harding Lawson Associates, Inc.
HSA	hollow stem auger
IDW	investigation-derived waste
K_{oc}	soil adsorption constant
LAU	Lower Alluvial Unit
Levitz	Levitz Furniture
LUST	leaking underground storage tank
MAU	Middle Alluvial Unit
MCL	Maximum Contaminant Level
MDL	method detection limit
MEK	methylethyl ketone
MTBE	methyl tertiary-butyl ether
µg/L	micrograms per liter
µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
NTU	nephelometric turbidity unit
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbons
PCE	tetrachloroethene or tetrachloroethylene
PDB	passive diffusion bag
PE	performance evaluation
PID	photoionization detector
PNL	Phoenix National Laboratories, Inc.
PPE	personal protection equipment
PSC	Philip Services Corp.
PVC	polyvinyl chloride

ACRONYMS (continued)

QA	quality assurance
QAPP	Quality Assurance Project Plan
QBD	Quality By Design
QC	quality control
RBCA	Risk-Based Corrective Action
RCRA	Resource Conservation Recovery Act
Redox	Oxidation-reduction potential
RI	Remedial Investigation
RPD	relative percent difference
RRTA	Resource Recovery Techniques of Arizona, Inc.
SCS	SCS Engineers
SDG	sample delivery group
SI	Site Inspection
SRL	Soil Remediation Level
SRP	Salt River Project
SRV	Salt River Valley
STL	Severn Trent Laboratories-Chicago
SVE	Soil vapor extraction
SVOC	semivolatile organic compound
SWL	static water level
1,1,1-TCA	1,1,1-trichloroethane
TCE	trichloroethene or trichloroethylene
TPH	Total petroleum hydrocarbons
TD	total depth
Transwest	Transwest Geochem, Inc.
UAU	Upper Alluvial Unit
Univar	Univar Corporation
UPS	United Parcel Service
USBR	U.S. Bureau of Reclamation
USCS	Unified Soil Classification System
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound
VW&R	Van Waters & Rogers
WCP	West Central Phoenix
WESTON	Weston Solutions, Inc.
WQARF	Water Quality Assurance Revolving Fund

EXECUTIVE SUMMARY

Weston Solutions, Inc. (WESTON®) has prepared this Final Remedial Investigation (RI) Report as part of the requirements of Contract Number 99-0017-AN with the Arizona Department of Environmental Quality (ADEQ), Task Assignment 99-0148. The purpose of the Work Assignment is to complete the RI of the West Central Phoenix (WCP) East Grand Avenue Water Quality Assurance Revolving Fund (WQARF) Site. The RI report summarizes previous environmental investigations as well as the current RI activities conducted at the Site and more specifically at the former Van Waters & Rogers (VW&R) facility. Although there are other sources of contamination within the WCP East Grand Avenue WQARF Site, the VW&R facility is the primary source of contamination at the Site. As part of the RI, a Land and Water Use Report and an Aquifer Test Report, were also prepared. These reports are presented as appendices to the RI.

VW&R operated at West Osborn Road from 1957 to 1970. Operations included warehousing and distribution of industrial and agricultural chemical products, upholstery supplies, and laundry and dry cleaning supplies. Repackaging of the following compounds has been documented to have occurred at the facility: ferric chloride, hydrochloric acid, sulfuric acid, caustic soda, antifreeze, acetone, methylethyl ketone, aqueous ammonia, chlorothene (1,1,1-TCA), and trichloroethene (TCE). An additional five compounds of unknown identity were also repackaged at the facility. Vopak, the owner of VW&R, has stated that tetrachloroethene (PCE) might have been one of these unidentified compounds (Vopak, 2000).

Previous investigations of the VW&R facility included soil-gas surveys, surficial and sub-surface soil sampling, and the installation of six groundwater monitor wells. The current RI generated additional data on the nature and extent of soil and groundwater contamination beneath the VW&R facility and in the WCP East Grand Avenue WQARF Site. WESTON conducted the current RI activities in four Phases: Phase III, Phase IV, Phase V and Phase VI.

- Phase III activities included a vadose zone investigation (10 soil borings) on the VW&R facility, the installation of eight wells, and sampling of upgradient and downgradient monitor wells (Groundwater Sampling Rounds 1 through 6). Phase III activities were conducted from September 1999 through December 2000.

- Phase IV of the investigation included installation of nine additional groundwater monitor wells upgradient and downgradient of the VW&R facility. The new wells were added to the monitor well network and all were sampled during four separate events (Rounds 7 through 10). In May 2001, WESTON conducted step drawdown tests on monitor wells WCP-28 and WCP-29 and a constant rate pumping test on monitor well WCP-29. This phase of the investigation was conducted from January 2001 through June 2001.
- Phase V activities included the installation of seven groundwater monitor wells. These wells were added to the monitoring network and sampled during Rounds 11 and 13. Groundwater samples were collected from select wells during Round 12 using both the passive diffusion bag (PDB) sample collection method and the pump discharge sample collection method. This phase of the investigation was conducted from July 2 through July 27, 2001.
- Phase VI activities included the installation of seven additional groundwater monitor wells. These wells were added to the monitoring network and sampled during Round 15. A limited number of the newly installed wells were sampled during Round 14. Phase VI activities occurred in November 2001 through February 2002.

Based on data collected during previous investigations and the current RI, the contaminants of concern for the WCP East Grand Avenue WQARF Site are PCE, TCE, and 1,1-dichloroethene (1,1-DCE). The distribution of contaminant concentrations in soil-gas, soil, and groundwater indicates an apparent source area near and under the former building foundation on the VW&R facility. Information obtained from VW&R indicated that areas to the west and east of the former building foundation were used for bulk product repackaging and that rinsate generated during the cleaning of the transfer hoses used in the repackaging process was routinely poured onto asphalt in these areas.

Soil sampling analytical results confirmed the presence of PCE, TCE, and 1,1-DCE beneath the facility; however, analytical results for soil samples collected from off-site borings were below the method detection limit. The highest concentrations of VOCs detected in on-site soil borings were found in fine-grained zones underlying sandy units occurring at approximately 56 feet below ground surface (bgs) to 71 feet bgs and in the unsaturated zone directly above the water table. Due to declining groundwater elevations in the area, it appears that contaminants in the groundwater are being retained in sediments in the unsaturated zone directly above the water table. Detectable concentrations of the contaminants of concern in soil did not exceed their respective Arizona Soil Remediation Levels (SRLs) or minimum Groundwater Protection Levels (GPLs).

TCE has been detected at concentrations above the Arizona Water Quality Standard/Maximum Contaminant Level (AWQS/MCL) in monitor well WCP-94, which is approximately 2,800 feet downgradient from the VW&R facility and in WCP-88, which is approximately 1,125 feet downgradient from the VW&R facility. It is unclear from the data whether the concentration of TCE in WCP-94 is related to the main contaminant plume or from an additional nearby source.

PCE and 1,1-DCE have been detected at concentrations exceeding the AWQS/MCLs in monitor wells located up to 1,200 feet downgradient from the facility. Observed concentrations of the contaminants of concern in groundwater are highest in monitor wells located on the VW&R facility (WCP-16, WCP-17, and WCP-93) and downgradient (WCP-30, WCP-87, and WCP-88) from the facility. TCE has been detected in minor concentrations in groundwater samples collected from monitor wells located upgradient from the VW&R facility. At this time, there is insufficient data to determine the source for the upgradient occurrences of TCE, although an additional contaminant source may be present.

Based on Hydropunch® data and data from the deep well installed as part of the RI, the vertical extent of groundwater contamination appears to be within the range of 152 feet bgs and 235 feet bgs. Analytical results from groundwater samples collected from WCP-48 at an approximate depth of 235 feet bgs indicate that only 1,1-DCE is present at that depth. Concentrations of 1,1-DCE in WCP-48 were below the MCL of 7 μg/L. Further characterization of the vertical extent of groundwater contamination will be addressed during the Feasibility Study (FS), if needed, based on the remedy selection.

Vertical stratification of contaminants within the screened interval of shallow wells was indicated based on analytical results obtained from the PDB samplers. Analytical results of samples collected closer to the source area indicated concentrations were higher near the groundwater-vadose zone interface than in the deeper portion of the screened interval. Contaminant concentrations in PDB samples increased with depth in wells farther from the center of the VW&R facility.

1.0 INTRODUCTION

Weston Solutions, Inc. (WESTON®) prepared this Final Remedial Investigation (RI) Report as part of the requirements of Contract Number 99-0017-AN with the Arizona Department of Environmental Quality (ADEQ), Task Assignment 99-0148. The purpose of the Work Assignment is to complete the RI of West Central Phoenix (WCP) East Grand Avenue Water Quality Assurance Revolving Fund (WQARF) Site, with a focus on the former Van Waters & Rogers (VW&R) facility as the primary source of the groundwater contamination (Figure 1-1). Additional sources of contamination are discussed in Section 7.6.2. The RI is being conducted for ADEQ and funded by the Arizona WQARF.

1.1 SITE BACKGROUND

In 1982, a volatile organic compound (VOC), trichloroethene (TCE), was detected in several City of Phoenix (COP) municipal wells located in WCP (Figure 1-1). Subsequent groundwater sampling confirmed the presence of TCE at concentrations above the U.S. Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCLs). ADEQ subsequently designated the area of groundwater contamination as the WCP WQARF area and recommended further study under the State Superfund WQARF program. The WCP WQARF area was placed on the WQARF Priority List in 1987.

In 1998, the following five WQARF Registry Sites were established within the WCP WQARF area pursuant to Arizona Revised Statutes (ARS) §49-287.01:

- West Osborn Complex Site
- West Grand Avenue Site
- East Grand Avenue Site
- North Canal Site
- North Plume Site

The VW&R facility is located within the WCP East Grand Avenue WQARF Site. Contaminants known to be present in the groundwater at levels above regulatory limits include the chlorinated solvents TCE, tetrachloroethene (PCE), and 1,1-dichloroethene (1,1-DCE).

1.2 FACILITY HISTORY

The VW&R facility is located in the southeast ¼ of the southwest ¼ of the northeast ¼ of Section 26, Township 2 North, Range 2 East of the Gila and Salt River Base Line and Meridian in Maricopa County, Arizona. VW&R was a chemical distribution firm that operated at 2930 West Osborn Road in Phoenix, Arizona (Figures 1-1 and 1-2) from 1957 to 1970. Van Waters & Rogers, Inc. was incorporated in the state of Washington in 1924 and dissolved in 1966 when it merged with United Pacific Corporation and was incorporated in the state of Delaware as "VWR United Corporation". "VWR United Corporation" changed its name to Univar Corporation (Univar) in 1974 (HLA, 1995). Univar had changed their name to Vopak USA but is currently known as Univar once again.

From approximately 1957 until the mid-1960s, site operations consisted primarily of warehousing and distribution of inventory maintained by Braun-Knecht-Heimann Company (BKH), a subsidiary company (HLA, 1995). BKH was a distributor of scientific and laboratory apparatus and equipment. In the mid-1960s, facility operations expanded to include warehousing and distribution of industrial and agricultural chemical products, upholstery supplies, and laundry and dry cleaning supplies.

VW&R operated at West Osborn Road from 1957 until Motor Rim & Wheel Service of California, now known as Century Wheel & Rim, purchased the property in 1970. At that time, VW&R moved the operation to its current location at South 45th Avenue in Phoenix and discontinued activities at the West Osborn Road facility. Century Wheel & Rim continues to occupy the property, but the current owner is Bakala Investment Properties, L.L.C.

1.2.1 Chemical Handling and Storage

In 1969, VW&R installed two aboveground, 7,500-gallon fiberglass storage tanks (Figure 1-2). These tanks were used for storage and repackaging of ferric chloride and hydrochloric acid. The tanks were installed on a concrete slab surrounded by a soil containment berm in the northeastern portion of the property (Vopak, 2000). VW&R continued to use the storage tanks under a rental agreement after Motor Wheel & Rim purchased the property. The tanks were in use until approximately 1971 when VW&R arranged for their removal. VW&R also reported that two small tanks for methylethyl ketone (MEK) and acetone might have been present in a covered shed area. The location of the covered shed was not given but is assumed to be the former building foundation (Figure 1-2).

Chemical products were mainly received into inventory and distributed to customers in containers pre-packaged by the product manufacturers; however, repackaging of 15 different compounds did occur at the facility (Vopak, 2000). The identity of 10 of these compounds is known and includes ferric chloride, hydrochloric acid, sulfuric acid, caustic soda, antifreeze, acetone, MEK, aqueous ammonia, chlorothene (also known as 1,1,1-TCA), and TCE. VW&R was not sure of the identity of the five remaining repack products; however, they believed PCE might also have been repacked at the facility (Vopak, 2000).

Repackaging occurred at three locations on the facility (Figure 1-2). The main tanker truck and rail tank car repackaging area was located east of the former building foundation. Repackaging occurred on the west side of the former building foundation when the main repackaging area was busy. Repackaging of the aboveground storage tank (AST) products occurred south of the tanks. The following steps were followed in the repackaging process (Vopak, 2000):

- Empty drums were lined up in a row and then the first empty drum would be placed on a portable scale.
- The bungs were removed from the top of each drum and the drum would be labeled to reflect the chemical that was to be repacked.
- One end of an approximate 1½ - to 2-inch chemical transfer hose was attached to the tanker truck, rail car, or storage tank. The other end of the hose had a valve handle and spigot.

- The spigot was placed in the hole on the top of the first drum located on the scale and the drum was filled to the desired weight.
- The repack person checked the level of liquid in the drum and then walked down the line of drums and filled each of them to the same level in a process known as “squirt filling”.
- At the end of drumming, the repack person attempted to drain the chemical remaining in the hose into one of the drums being repacked and the hose was then disconnected from the tank truck.
- The bungs were tightened on the drums.
- The chemical transfer hose was washed out with water and the rinsate would be allowed to flow onto the asphalt in the repack area.

Once repackaged, drums available for resale were stored primarily inside the warehouse, as well as under and near the shed. Full drums were also stored along the east and west fence lines between the warehouse and the shed (Vopak, 2000).

Empty drums were stored on the northwest corner of the facility prior to being shipped to the drum recycler (Figure 1-2) (Vopak, 2000). Although the drums were not routinely washed at the facility, some of the empty drums were rinsed if additional cleaning was needed prior to recycling. The rinsate was typically poured on the soil east of the empty drum storage area (Figure 1-2). Although not a common practice, VW&R believes that occasionally non-saleable product may have been released in the same general location as the empty drum rinsate (Vopak, 2000).

1.2.2 Chemical Releases

VW&R has reported some minor accidental releases (Vopak, 2000). The following incidents reportedly occurred at the facility. Dates of each incident were not given:

- Ammonium hydroxide—one weekend during the summer, ammonium hydroxide drums were stacked three pallets high (four drums per pallet). The drums on the bottom pallet ruptured due to the heat and all the pallets collapsed, resulting in a release.
- Caustic soda leak—approximately 100 gallons of caustic soda was spilled by a third-party driver during the off loading process.
- Ferric acid—the repack person was accidentally sprayed with ferric acid during the repackaging process.

- Punctured drums—occasionally, drums would be punctured by forklifts and limited amounts of various products would be released.
- Repackaging spills—incidental spills would occur when repackaging bulk products.

1.3 PREVIOUS INVESTIGATIONS

Previous investigations at the VW&R facility have included soil-gas surveys, subsurface soil sampling, and groundwater sampling. These investigations are summarized in the following sections.

1.3.1 CERCLA Site Inspection (ADEQ, 1993)

In 1993, ADEQ conducted a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Preliminary Assessment (PA) and Site Inspection (SI) on behalf of the EPA (ADEQ, 1993a). Historical records and information obtained by ADEQ indicated that VW&R stored and distributed various chemicals at the 2930 West Osborn Road facility. Site reconnaissance at the facility revealed a dry well behind the northeast corner of the existing building (Figure 1-2). The SI report indicated the dry well was thought to be approximately 3 to 4 feet deep but there has been no subsequent information that confirms the depth of the dry well. Vopak indicated the dry well was believed to have been installed to control water runoff (Vopak, 2000). Also noted during the site reconnaissance were two areas of discolored soil, which included the area between the main building and east fence line and the area south of the drum storage area.

ADEQ also reviewed historical aerial photographs showing the two ASTs, numerous drums, and several areas of stained soil on the subject property. Aerial photographs from 1964 indicated drums were present on the northeast corner of the main building and along the west fence line. Numerous drums appeared to be scattered approximately 200 to 300 feet north of the main building and along the east fence line in a 1971 aerial photograph. The surrounding ground surface also appeared to be stained or discolored.

As part of the CERCLA SI, ADEQ collected samples of surficial and sub-surface soil and soil-gas samples from 15 locations at the facility (Figure 1-3). The locations were chosen by the

ADEQ based upon their review of the aerial photographs and a site reconnaissance. Soil-gas samples were collected at an approximate depth of 5 feet below ground surface (bgs), surficial soil samples were collected from 6 to 12 inches bgs, and subsurface soil samples were collected at depths ranging from 6 to 8 feet bgs.

Semivolatile organic compounds (SVOCs), including polycyclic aromatic hydrocarbons (PAHs), phthalates, metals, and pesticides, were detected in the surficial soil samples. Phthalates are common laboratory contaminants and were not considered contaminants of concern at the facility. Various PAHs were detected at concentrations exceeding the existing Health Based Guidance Levels (HBGLs) at the time of the investigation. Dichlorodiphenyldichloroethene (4,4-DDE) and dichlorodiphenyltrichloroethane (4,4-DDT) were the pesticides with the highest detected concentrations. The concentrations, however, were below the existing HBGLs at the time. Metals were present in all of the surficial soil samples, but were detected at concentrations below or near the background concentrations for the facility.

TCE, PCE, 1,1-DCE, 1,1,1-trichloroethane (1,1,1-TCA), ethylbenzene, and toluene were detected in the soil-gas samples. Soil-gas samples collected beneath the former AST, storage drum, and stained soil areas identified in the aerial photographs indicated detections of TCE, PCE and 1,1-DCE at concentrations up to three times the background level. Background levels were determined by analytical results from soil-gas samples collected from two locations on the south side of the building. These locations were selected as background because no apparent historical facility activities were conducted there (ADEQ, 1993a).

TCE, PCE and 1,1,1-TCA were detected in approximately half of the subsurface soil samples. The concentrations of these VOCs, however, were below the existing HBGLs at the time. No groundwater samples were collected as part of the ADEQ SI.

1.3.2 Soil-Gas Survey (HLA, 1994)

At the request of the ADEQ, Univar, the parent company of VW&R in 1994, agreed to perform a preliminary site characterization of their former property. The first phase of site characterization was a soil-gas survey conducted by Harding Lawson Associates, Inc. (HLA) in July 1994 (HLA, 1994). The survey included collection of 51 soil-gas samples (Figure 1-4). The locations of the samples were determined based on an approximate 50-foot grid that covered the entire property. Additional samples were collected from locations adjacent to the dry well located on the property. All soil-gas samples were collected at an approximate depth of 5 feet bgs. The survey identified elevated concentrations of PCE, TCE, and 1,1-DCE in almost all of the soil-gas samples collected from locations near the central portion of the facility (Figures 1-4, 1-5, and 1-6). HLA concluded that analysis of soil-gas collected from locations adjacent to the dry well indicated that the area around the dry well did not appear to be impacted by previous site activities.

At the end of the survey, HLA proposed a second phase of site characterization that included additional subsurface soil investigation in areas that exhibited high VOC concentrations in the soil-gas.

1.3.3 Subsurface Soil Investigation and Risk Assessment (HLA, 1995)

On behalf of Univar, HLA performed a subsurface soil investigation and risk assessment at the VW&R facility in December 1994 (HLA, 1995). The investigation was performed to evaluate site lithology, nature and extent of VOC contamination in soil, and to evaluate the potential human health and environmental risks related to the presence of VOCs in subsurface soils at the facility. The subsurface investigation involved advancing seven soil borings to depths ranging from 87.5 to 100 feet bgs (Figure 1-7). The locations of the borings were determined by elevated VOC concentrations in the soil-gas detected during the soil-gas survey performed by HLA earlier in 1994.

Soil samples were collected from the borings at 5-foot intervals. Samples were submitted to an off-site laboratory for VOC analysis based upon photoionization detector (PID) screening results, sample depth, and lithologic type. Of the 122 soil samples collected during the subsurface investigation, HLA submitted 38 soil samples collected from the unsaturated zone for laboratory analysis. In addition, one sample collected from the capillary fringe in SB-2 was also submitted for laboratory analysis. Groundwater was encountered only in SB-2 at approximately 97 feet bgs.

Earth Technology Corporation (Earth Tech) was contracted by the ADEQ to oversee the subsurface investigation. Thirteen split samples were collected by Earth Tech during the investigation and were submitted to a separate off-site laboratory for VOC analysis. Twelve of these samples were collected from unsaturated soil and one sample (VWR-SB2-95.5) was collected from the capillary fringe.

The following table summarizes the results of the soil investigation. Only those samples that had detections are listed below. No other contaminants were detected above the method detection limit (MDL) in any of the other samples.

Soil Boring	Sample Depth (feet bgs)	Sample Date	Collected by	PCE (µg/kg)	TCE (µg/kg)	1,1,1-TCA (µg/kg)	Freon 11 (µg/kg)
ADEQ GPL				1,300	610	1,000	NE
ADEQ R SRL				53,000	27,000	1,200,000	380,000
ADEQ NR SRL				170,000	70,000	4,800,000	1,300,000
SB-2	65	12/14/94	HLA	<5.0	<5.0	<5.0	<5.0
SB-2	61	12/14/94	Earth Tech	***95***	<50	<50	<50
SB-2	95 *	12/14/94	HLA	***140***	***80***	<5.0	<5.0
SB-2	95.5 *	12/14/94	Earth Tech	***140***	<50	<50	<50
SB-3	56	12/20/94	HLA	<5.0	<5.0	<5.0	***12***
SB-3	70.5	12/20/94	HLA	<5.0	<5.0	<5.0	***13***
SB-4	60.5	12/19/94	HLA	***9.8***	***18***	<5.0	<5.0
SB-4	86	12/19/94	Earth Tech	<50	<50	***130***	<50
SB-6	21	12/12/94	HLA	***6.6***	<5.0	<5.0	<5.0
SB-6	56	12/12/94	HLA	***11***	***17***	<5.0	<5.0
SB-6	70.5	12/12/94	HLA	***44***	***44***	<5.0	<5.0
SB-7	91	12/19/94	Earth Tech	<50	<50	***86***	<50

* Indicates samples collected at the capillary fringe.
Bold values are detections above MDLs
Freon 11 = Trichlorofluoromethane

μg/kg = micrograms per kilogram
NE = none established
ADEQ NR SRL = ADEQ Non-residential Soil Remediation Level
ADEQ R SRL = ADEQ Residential Soil Remediation Level
ADEQ GPL = ADEQ Groundwater Protection Levels (default values)

After reviewing the analytical results, HLA concluded that the VOC concentrations detected in the unsaturated soil were attributable to soil-gas migration from an off-site source. HLA attributed the VOCs detected in the capillary fringe to impacts from contaminated groundwater from off-site sources (HLA, 1995).

As part of the soil investigation, HLA performed a risk assessment to assess the potential for human health effects and groundwater impacts associated with VOCs detected in soils at the VW&R facility. The risk assessment used a conservative vadose zone transport model (VLEACH) developed for the EPA by CH2M Hill in 1990 to evaluate impacts to groundwater. The conclusion of the risk assessment was that "…the level of VOCs present in site soils does not pose a human health risk and would not impact groundwater quality" (HLA, 1995).

At the conclusion of the subsurface investigation and risk assessment, HLA stated that no further action was necessary at the facility and recommended that case closure be given from the ADEQ. ADEQ reviewed the report and prepared a comment letter dated May 25, 1995, which stated that the investigation was considered incomplete without analytical results from upgradient and downgradient monitor wells to provide information concerning groundwater conditions beneath the VW&R facility.

1.3.4 Phase I Remedial Investigation (Fluor Daniel, 1997)

In 1997, ADEQ contracted Fluor Daniel GTI, Inc. (Fluor Daniel) to install and sample three groundwater monitor wells, WCP-15, WCP-16, and WCP-17, at the VW&R facility as part of a Phase I RI (Fluor Daniel, 1997). Soil samples were collected during the drilling of the monitor wells from three depth intervals in each boring. Soil samples were collected from the vadose zone (approximately 20 feet bgs), from a confining layer (70 to 80 feet bgs), and from the capillary zone (90 to 100 feet bgs). Figure 1-8 shows the locations of the Phase I monitor wells.

The following table summarizes the results of the PCE and TCE analyses conducted on soil samples during drilling of the wells.

Well ID	Sample Date	Sample Depth (feet bgs)	PCE (µg/kg)	TCE (µg/kg)
ADEQ GPL			1,300	610
ADEQ R SRL			53,000	27,000
ADEQ NR SRL			170,000	70,000
WCP-15	3/18/1997	20-21.5	***65***	<50
WCP-15	3/18/1997	80-81.5	<50	<50
WCP-15	3/18/1997	100-101.5 *	<50	<50
WCP-16	3/17/1997	20-21.5	<50	<50
WCP-16	3/17/1997	70-71.5	***65***	***98***
WCP-16	3/17/1997	100-101.5 *	***88***	***120***
WCP-17	3/19/1997	20-21.5	<50	<50
WCP-17	3/19/1997	80-81.5	<50	<50
WCP-17	3/19/1997	100-101.5 *	<50	<50

bgs = below ground surface
Bold values are detections above MDLs
* = Samples collected at 100-101.5 feet bgs were collected in the capillary zone
ADEQ NR SRL = ADEQ Non-residential Soil Remediation Level
ADEQ R SRL = ADEQ Residential Soil Remediation Level
ADEQ GPL = ADEQ Groundwater Protection Levels (default values)

On March 28 and April 29, 1997, monitor wells WCP-15, WCP-16, and WCP-17 were sampled. Samples were collected after a minimum of three well casing volumes were purged, unless the well was purged dry. The following table summarizes the results for PCE, TCE, and 1,1-DCE.

Well ID	Sample Date	PCE (µg/L)	TCE (µg/L)	1,1-DCE (µg/L)
EPA MCL		5	5	7
Arizona AWQS		5	5	7
WCP-15	3/28/1997	***380***	***210***	***65***
WCP-15	4/29/1997	***430***	***270***	***80***
WCP-16	3/28/1997	***1,700***	***2,700***	***290***
WCP-16	4/29/1997	***1,500***	***2,600***	***270***
WCP-17	3/28/1997	***470***	***1,100***	***180***
WCP-17	4/29/1997	***470***	***1,100***	***170***

EPA MCL = EPA Maximum Contaminant Level
Arizona AWQS = Arizona Aquifer Water Quality Standard
µg/L = Micrograms per liter
Bold values exceed AWQS and/or MCL

In June 1997, Fluor Daniel prepared a field report that documented the well drilling and sampling activities and presented the analytical results. However, per contract requirements with ADEQ, interpretation of the data was not provided. Subsequent to the completion of the field report by Fluor Daniel, WESTON prepared a letter report that presented an interpretation of the groundwater quality data obtained by Fluor Daniel (WESTON, 1997). The following conclusions were summarized in the report:

- PCE, TCE, and 1,1-DCE were present at concentrations significantly exceeding the EPA MCLs in the groundwater collected from all three monitor wells. Groundwater collected from monitor well WCP-16 had the highest contaminant concentrations, with PCE at 1,500 to 1,700 micrograms per liter (µg/L), TCE at 2,600 to 2,700 µg/L, and 1,1-DCE at 270 to 290 µg/L.
- Monitor well WCP-16 contained groundwater with the highest detected concentrations of contaminants and is located immediately east of a building foundation on the property. The building foundation area was found to have elevated VOC concentrations in soil-gas samples, as reported by Univar (HLA, 1994). However, information on operations that may have been conducted at the building was not available.
- VOCs were detected in soil samples collected from the property, but the detections were sporadic and did not show a consistent pattern.
- Groundwater flow directions at the VW&R facility varied in response to pumping of Salt River Project (SRP) Well 10.5E-7.5N, located less than 2,000 feet west of the VW&R facility. When the SRP well was being pumped, the general groundwater flow direction was to the northwest. When the SRP well was not being pumped, the general flow direction was to the southwest. Based on the variability of groundwater flow directions obtained at the facility, it was not possible to evaluate the potential source area of the contaminants without additional data. There appeared to be a source in the vicinity of monitor well WCP-16; however, additional upgradient wells were required to determine if the source area was on the VW&R facility or originated from an off-site, upgradient source.

1.3.5 Phase II Remedial Investigation Report (WESTON, 1998)

In 1998, ADEQ contracted WESTON to initiate a Phase II RI at the VW&R facility to evaluate the lateral extent of groundwater contamination beneath the facility and in the WCP East Grand

Avenue WQARF Site, based on groundwater flow at the time, and to identify the potential source areas of the release (WESTON, 1998). Two monitor wells, WCP-28 and WCP-29, were installed upgradient and one monitor well, WCP-30, was installed downgradient from the VW&R facility (Figure 1-8).

Soil samples were collected in 10-foot intervals during the well installations. The soil headspace for each sample was analyzed with a flame ionization detector (FID). No soil samples were submitted for laboratory VOC analysis. A composite sample collected from the soil cuttings from the well installations was submitted to an off-site laboratory for VOC analysis to characterize the material for disposal purposes. There were no VOCs detected in the soil during the soil headspace screening or the disposal characterization analysis.

Groundwater was sampled from WCP-15, WCP-16, WCP-17, WCP-28, WCP-29, and WCP-30 during two groundwater sampling events. Groundwater samples were submitted for VOC analyses by EPA Methods 601/602. Static water levels were also collected from the six monitor wells to evaluate the direction and gradient of groundwater flow near the facility.

Concentrations of PCE, TCE, and 1,1-DCE were detected in samples collected from all six wells during both sampling events at concentrations exceeding their respective EPA MCLs. Groundwater elevation data collected during the Phase II RI indicated that the groundwater flow direction in the vicinity of the VW&R facility was to the southwest when the SRP well was not pumping.

WESTON prepared a report summarizing the Phase II RI activities and describing the nature and extent of VOC contamination in the soil and groundwater based on interpretation of the Phase II RI data and previous investigations (WESTON, 1998). The following sections summarize the findings presented in the Phase II RI Report.

1.3.5.1 Soil Contamination

Although no soil samples were submitted for laboratory VOC analyses during the Phase II RI, previous subsurface investigations showed that observed detections of VOCs occurred at the top of fine-grained units, suggesting that lateral migration of VOCs may have occurred at the facility. The VOC concentrations were not elevated in soil samples collected along any of the property boundaries, and the soil samples with the most numerous VOC detections were collected from the center of the property. In the Phase II report, WESTON disagreed with HLA's hypothesis that the VOC contamination observed in subsurface soil was attributable to impact from soil-gas migration from an off-site source. WESTON proposed additional drilling and subsurface soil sampling to further delineate the VOC contamination and trace it back to the source(s).

1.3.5.2 Groundwater Contamination

Detected concentrations of PCE, TCE and 1,1-DCE were above the MCLs for groundwater samples analyzed prior to 1998 from monitor wells near the VW&R facility. The observed VOC concentrations were highest in the groundwater collected from the on-site and downgradient monitor wells, indicating that the VW&R facility was a source of the contamination present in the groundwater. The presence of VOCs in upgradient wells, however, indicated that the upgradient extent had not been defined. WESTON proposed that further groundwater investigation was needed to define the lateral extent and evaluate the vertical extent of VOC contamination.

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2.0 SITE CHARACTERISTICS

Geological and hydrogeological characteristics were investigated to understand their influence on distribution and migration of contaminants at the WCP East Grand Avenue WQARF Site. Subsurface site characteristics were evaluated by reviewing the geologic literature for the area and examining lithologic samples recovered from the borings. The composition of alluvial sediments beneath the site, especially near the top of the saturated zone, is significant in assessing groundwater movement and contaminant migration at the facility. Static water levels (SWLs) measured during the investigation were used to evaluate the direction and approximate rate of groundwater movement beneath the facility. The results and evaluation of SWLs and groundwater elevation measurements obtained during the RI are presented in Section 2.7.

2.1 CLIMATE

Phoenix lies at approximately 33 degrees north latitude along an arid and semi-arid zone, characterized by hot summers and mild winters. The maximum mean monthly temperature for the year is 93 degrees Fahrenheit (°F), occurring in July. Maximum and minimum temperatures in July average 106 and 81°F, respectively. The minimum mean monthly temperatures during the year occur in January at 54°F. Maximum and minimum temperatures during this month average 66 and 41°F, respectively. The yearly average temperature is approximately 73°F.

Average annual precipitation in the Phoenix area ranges from 7 to 8 inches and occurs in two distinct precipitation periods. The winter period spans December through March, with December having the highest average precipitation. These winter storms are distinguishable from summer storms by characteristically being widespread, of low intensity, and of long duration. The summer rain period usually begins in July and lasts through September, during what is classified as monsoon season. A monsoon day for the Phoenix area is any day during which the average of the hourly dew point temperatures equals or exceeds 55°F. Storms during the monsoon period are typically scattered, of short duration, of high intensity, and flash flooding may occur. Average annual evaporation is approximately 72 inches, with the greatest evaporation occurring during the summer months (Corkhill, et al, 1993).

2.2 TOPOGRAPHY

Topography in the WCP area is generally flat lying with a gentle slope to the southwest. The elevation at the northeast portion of the area is approximately 1,120 feet above mean sea level (amsl) with a gradual decline in elevation to the southwest to approximately 1,090 feet amsl. Surface elevations in the WCP East Grand Avenue WQARF Site range from approximately 1,113 feet amsl to 1,110 feet amsl.

2.3 SOIL

The WCP area lies within the West Salt River Valley (SRV) of the Basin and Range physiographic province. The area is located within a larger area of Quaternary sedimentary deposits composed mainly of alluvial gravel, sand, silt, and clay in flood plains, terraces, fans and former lakebeds. The area is characterized by deep, well-drained soils formed in recent alluvium. The soils are derived from a mixture of rock, including schist, granite, andesite, and rhyolite. The majority of surface soils consist of brown clay loams and loamy fine sand having moderate to moderately low permeability.

2.4 REGIONAL GEOLOGY

The SRV is an alluvial basin consisting of a thick sequence of basin-fill deposits of unconsolidated to semi-consolidated clastic sediments of Late Tertiary to Quaternary age (Corkhill et al., 1993). The basin-fill deposits range in thickness from less than 100 feet near the margins of the basin to over 10,000 feet in the central areas of the basin (Corkhill et al., 1993). The basin-fill deposits consist of interbedded sequences of conglomerate, gravel, sand, silt, clay, and evaporites. These deposits comprise the regional aquifer in the SRV and have been divided into hydrogeologic units, as discussed in later sections.

The SRV is surrounded by generally northwest-southeast trending, fault-blocked mountain ranges characteristic of the Basin & Range physiographic province. The rocks that comprise the floor of the SRV and surrounding mountain ranges predominantly consist of Precambrian to middle Tertiary crystalline and middle Tertiary to Quaternary extrusive rocks (Brown and Pool, 1989). The crystalline rocks are composed of metamorphic and granitic rocks including schist, gneiss, metavolcanics, quartzite, and granite. The extrusive rocks include rhyolites and basalts. These crystalline units may transmit small quantities of water where they are fractured, but are not considered a regional scale aquifer (Corkhill et al., 1993).

The red unit, also known as the Tempe beds and the Camel's Head Formation, is a sedimentary rock of Late Tertiary age. This unit consists of reddish-colored, well-cemented breccia, conglomerate, sandstone, and siltstone and locally forms the bedrock in the valley (Laney and Hahn, 1986). The breccia and conglomerate are poorly sorted and particle size ranges from clay to boulders. The upper portion of the red unit contains interbedded volcanic flows and pyroclastic rocks. The red unit is not a significant source of groundwater on a regional scale due to its limited areal extent and cementation (Corkhill et al., 1993).

2.5 SITE GEOLOGY

Subsurface lithology was determined by analyzing lithologic samples collected from soil borings and monitor wells drilled at the facility and surrounding area during current and previous investigations. Soil borings were completed to varying depths ranging from 121 to 182 feet bgs on the VW&R facility property. The groundwater monitor wells were completed to varying depths ranging from 125 to 245 feet bgs. None of the borings or monitor wells drilled during the investigation encountered bedrock.

Based on lithologic samples, subsurface sediments beneath the facility are predominantly fine sandy silts to silty sands with varying amounts of clays and gravels inter-bedded throughout. Highly dense calcified zones were also encountered during the investigation at varying depths ranging from approximately 60 to 90 feet bgs. Up to three zones of gravelly sand (up to 40 percent gravel) have been documented in borings at the facility. Lithologic descriptions of sediments encountered during the investigation are presented in the lithologic logs found in Appendix A.

Stratigraphic units encountered during the subsurface investigations at the VW&R facility and in the WCP East Grand Avenue WQARF Site have been identified, correlated, and illustrated on cross sections and maps (Figures 2-1 through 2-8). The cross sections have been prepared to include stratigraphic units with Unified Soil Classification System (USCS) symbols, interpretation/correlation of these units, approximate groundwater elevations as of January 2002, significant stratigraphic features, and borings/monitor wells used to construct the cross sections.

2.6 REGIONAL HYDROGEOLOGY

The SRV consists of two distinct but interconnected alluvial groundwater basins, the West SRV and the East SRV. The WCP East Grand Avenue WQARF Site lies within the West SRV. A lower unit consisting of mostly conglomerate and gravel, a middle unit of predominantly silt and clay, and an upper unit of mostly sand and gravel generally characterize the basin-fill deposits of the valleys. Corkhill et al. (1993) present a correlation of the units as defined by the U.S. Bureau of Reclamation (USBR), Arizona Department of Water Resources (ADWR), and the U.S. Geological Survey (USGS). This RI report uses the hydrogeologic units as defined by ADWR, which are based on particle size, lithologic data, and the unique hydraulic properties of the units (Corkhill et al., 1993). The three hydrogeologic units are, in descending stratigraphic order:

- Upper Alluvial Unit (UAU)
- Middle Alluvial Unit (MAU)
- Lower Alluvial Unit (LAU)

The UAU consists of gravels, sands, and silts deposited during the final stages of development of the alluvial basin. Near the riverbeds of the Salt and Gila Rivers and along the margins of the basins, the UAU is predominantly gravel and sand, whereas in other areas the unit is typically sand and silt. The relatively uniform thickness of the unit and association of coarser-grained sediments with the locations of major drainage suggest that the unit was deposited by the ancestral Salt River after the establishment of through-flowing drainages and from alluvial fans along the mountain fronts. The UAU is reported to be between 300 and 400 feet thick in the West SRV (Corkhill et al., 1993). The UAU was once the primary source of groundwater for the

West SRV; however, the unit has been dewatered in many areas due to groundwater withdrawal. Groundwater is typically unconfined; however, semi-confined conditions exist locally where there is an increase in finer-grained materials (USBR, 1977). Hydraulic conductivity values for the UAU reported by Corkhill et al. (1993) are 20 to 250 feet per day (ft/day) and are highest near the Salt and Gila Rivers. Additionally, potential yield to wells completed in this unit were reported to range from 1,500 to 5,500 gallons per minute (gpm).

The MAU is generally considered an aquitard, but does yield water from interbedded, coarser deposits and sandy horizons (USBR, 1977). The MAU consists of clay, silt, mudstone, and gypsiferous mudstone with some interbedded sand and gravel. The unit is estimated to be approximately 650 feet thick in the West SRV with the top of the unit at 300 to 400 feet bgs. Corkhill et al. (1993) state that the MAU is the primary source of groundwater in the SRV and speculated that the recoverable groundwater in the unit originated from interbedded coarse layers. Hydraulic conductivity values reported for the MAU range from 5 to 50 ft/day and potential yield for wells screened in the unit range from 350 to 2,200 gpm.

The LAU overlies, or is in fault contact with, the crystalline rock unit and the red unit. The LAU is composed predominantly of conglomerate and gravel deposits near the basin margins, grading to mudstone, gypsiferous and anhydritic mudstone and anhydrite beds in the central portions of the basins. The thickness of the LAU near the basin margins is less than 100 feet, but the thickness of the unit is unknown in the central portions of the basin due to the lack of deep drilling data. Wells tapping the LAU are typically located around the periphery of the valley. Hydraulic conductivity values for the LAU range from 5 to 60 ft/day and potential well yields range from 50 to 3,500 gpm. Corkhill et al. (1993) state that most of the recoverable groundwater from this unit is from the upper 500 feet. The LAU is estimated to be encountered around 1,000 feet bgs in the West SRV and may be up to 1,600 feet thick.

The regional groundwater flow in the West SRV is greatly influenced by groundwater pumping. Historical water level elevation contour maps developed from data from 1913 show a west to southwest flow direction having a gradient of approximately 0.002 feet/foot (ft/ft) (USBR, 1977).

Major sources of recharge in the SRV are from infiltration in the Salt River, seepage losses from irrigation canals, and excess irrigation. Within the WCP area, the Grand Canal, an irrigation canal that transports water across the SRV, was a major source of artificial recharge to the UAU. In recent years, many areas of the Grand Canal have been lined reducing its influence on recharge of the UAU. The source of water in the canal is from surface water from the Salt and Verde Rivers and from groundwater pumped by the SRP.

2.7 SITE HYDROGEOLOGY

The stratigraphy beneath the WCP East Grand Avenue WQARF Site is consistent with its regional geologic setting generally consisting of heterogeneous alluvial/fluvial valley-fill deposits. The primary aquifer of concern beneath the VW&R facility and the WCP East Grand Avenue WQARF Site is the UAU. Lithologies in the upper portion of the saturated zone beneath the facility are typically fine-grained, consisting predominantly of sandy silts with silty sands. A coarser-grained zone of varying thickness was encountered in WCP-30, WCP-40, WCP-41, WCP-43, WCP-45, WCP-46, WCP-47, and WCP-48 at a depth ranging from approximately 134 to 145 feet bgs. In general, however, the formation is dominated by fine sediments at this depth, with variable clay and sand content.

Geophysical logs obtained during the installation of WCP-48 indicated sand layers from approximately 110 to 115 feet bgs, 132 to 148 feet bgs, 155 to 165 feet bgs, and 220 to 240 feet bgs. The results of geophysical logging at WCP-48 are presented in Appendix B.

Inflow to the UAU in the WCP East Grand Avenue WQARF Site is primarily from infiltration from the Grand Canal and from groundwater flow into the area. According to Figure 2-5 in Appendix D provided by the Salt River Valley Water User's Association, which shows lined and unlined portions of the canal as of the year 2000, there are three reaches of the canal in the immediate vicinity of the WCP East Grand Avenue WQARF Site that are lined, unlined, or lined on one side of the canal only. The dates when the canal was lined are not documented. A 1995 Water Transmission System report from SRP shows the entire reach of the canal within the WCP

East Grand Avenue WQARF Site as being lined on the south bank. Information from SRP in 2000 indicated that some reaches are lined on the bottom as well.

A visual inspection of the Grand Canal between 19th and 39th Avenues was conducted on January 24, 2002. This inspection was conducted during the annual canal dry-up that occurred January 4, through February 3, 2002. Based on observations made during the inspection, the canal is primarily unlined between 19th Avenue and Interstate 17 except for lined portions near Indian School Road, 23rd Avenue, and Interstate 17. The canal is lined on the south bank and on the southern half of the bottom from Interstate 17 to 27th Avenue and on the bottom and both banks from 27th Avenue to 39th Avenue. Data from the SRP showed that lined portions of the canal still contribute water to the groundwater system. There is minimal recharge from irrigation of landscaping or infiltration of precipitation.

2.7.1 Groundwater Gradients and Flow Directions

WESTON has been collecting depth-to-groundwater measurements from approximately 40 monitor wells located throughout the WCP East Grand Avenue WQARF Site and its vicinity. Depth-to-groundwater data collected during the monitoring events were used to calculate groundwater elevations in feet amsl (COP datum) and estimate groundwater flow directions and gradient in the WCP East Grand Avenue WQARF Site. WESTON also conducted an aquifer test at groundwater monitoring wells WCP-28 and WCP-29 and constructed a groundwater flow model for the WCP East Grand Avenue WQARF Site vicinity.

Groundwater elevations were entered into a database and then plotted and contoured using SURFER®, a commercial contouring software package. Groundwater elevation contour maps for April 1999 and May 1999 (Figures 2-9 and 2-10) and the quarterly groundwater elevation contour maps for September 1999 through January 2002 (Figure 2-11 through 2-20) are included. The quarterly groundwater elevation data were collected to correspond with groundwater sampling event dates. The groundwater elevation contour maps include depth-to-groundwater measurements and groundwater elevations.[1]

Groundwater elevations measured during January 2002 ranged from 1,004 feet amsl near the intersection of Weldon Avenue and 27th Avenue to 978 feet amsl near the intersection of 33rd Avenue and Earll Drive (Figure 2-20). Water levels appear to fluctuate approximately 5 feet per year, due to regional changes in groundwater elevations. Hydraulic gradients vary from 0.025 ft/ft northeast of the site north of the Grand Canal to approximately 0.002 ft/ft at the southwestern portion of the site due to changes in hydraulic conductivity.

WESTON contacted municipal facilities, ADWR, and private consulting companies to obtain pumping data for irrigation and/or remediation wells operated in the WCP East Grand Avenue WQARF Site. The pumping data were evaluated with the groundwater elevations to determine the effect pumping has on the groundwater flow directions and gradient beneath the WCP East Grand Avenue WQARF Site.

WESTON contacted the SRP to obtain pumping data for the irrigation wells 10.5E-7.5N and 11.2E-7.7N located to the west and east of the VW&R facility, respectively (Figure 2-1). SRP operated these irrigation wells during the month of April 1999, removing approximately 161 ac-ft of groundwater from irrigation well 10.5E-7.5N and 96 ac-ft of groundwater from irrigation well 11.2E-7.7N. ADEQ finalized an agreement with SRP in April 1999 to temporarily discontinue operation of both irrigation wells.

Depth-to-groundwater data collected in April 1999 indicated that groundwater flow and gradient are influenced by the operation of the SRP Well 10.5E-7.5N. Groundwater flow directions during the April 1999 monitoring event, when SRP was pumping from 10.5E-7.5N, were toward the west-northwest beneath the WCP East Grand Avenue WQARF Site. Groundwater elevation

[1] Groundwater elevation data for MGL-3, located on the Mogul facility, is anomalous and is not used for contouring. Depth-to-water groundwater measurements taken at MGL-3 are consistently two feet deeper than nearby wells. The limited data available to WESTON provide no explanation for the anomaly. Two possible causes are construction problems with the well or an error in the surveyed top-of-casing elevation.

data for the remaining monthly monitoring events indicate that groundwater generally flows toward the west-southwest beneath the WCP East Grand Avenue WQARF Site.

2.7.2 Groundwater Elevation Hydrographs

WESTON prepared hydrographs summarizing changes in groundwater elevations over time for all wells included in the monitor well network (Figures 2-21 through 2-24). Groundwater data collection for this project began in April 1999 and continued monthly through the January 2002 monitoring period. Data from earlier studies are included on the hydrographs.

WESTON evaluated changes in groundwater elevations over time beneath the WCP East Grand Avenue WQARF Site by grouping wells that have similar geographic locations and similar hydrogeologic settings together. The hydrographs all show a seasonal fluctuation in water levels that is caused by seasonal variations in groundwater extraction and potentially by the reduction in recharge during the annual dry up of the Grand Canal during December or January. Groundwater elevations are highest during early spring and decline to their lowest elevations during November and December.

The hydrographs also show a downward trend in elevations for water levels collected during the same month each year. Groundwater elevations in WCP-15 and WCP-16 have declined approximately 17 feet since 1997 and approximately 4 to 6 feet throughout the remaining WCP East Grand Avenue WQARF Site area since 1999. These declines are the result of regional declines in water levels, as groundwater pumping in other areas of the SRV has increased to meet irrigation needs due to decreases in surface water supplies because of drought conditions in the watershed.

The direction of groundwater flow is generally towards the southwest across the site and appears to be strongly influenced by the episodic pumping of SRP well 10.5E-7.5N, located less than 2,000 feet west of the VW&R facility (WESTON, 1997). This well, drilled in 1949, is screened from 210 feet bgs to 685 feet bgs. Pumping records obtained from SRP indicate that this well was last pumped in April 1999, removing 161 acre-feet (ac-ft) of groundwater. Between 1972 and 1999, annual pumping rates for the well ranged from 0 to 3,581 ac-ft, averaging 965 ac-ft per year. Available data indicate that groundwater flow directions beneath the WCP East Grand Avenue WQARF Site shift from a southwesterly flow direction to a westerly or northwesterly direction when the SRP well is pumping (Figure 2-9) (WESTON, 1997). Fluctuations in the groundwater flow direction caused by pumping of the SRP well may have caused broadening of the downgradient contaminant plume and accelerated contaminant migration.

A second SRP well (11.2E-7.7N), is located along the south side of the Grand Canal, east of the VW&R facility near the southbound frontage road of Interstate 17. This well was drilled in 1950 and was screened from 200 to 485 feet bgs. The impact of pumping in 11.2E-7.7N on groundwater and the contaminant plume is less clear than the impact of 10.5E-7.5N. The well pumped an average of 386 ac-ft per year between 1972 and 1999, with a range in annual pumping of 0 to 1,334 ac-ft per year. In April 1999, 96 ac-ft of groundwater were removed from the well. ADEQ finalized an agreement with SRP in April 1999 to temporarily discontinue operation of both 11.2E-7.7N and 10.5E-7.5N.

Other pumping wells near the VW&R facility include the Michigan Trailer Park well, owned by Michigan Mobile Home Park LLC, and a well owned by Danone Waters of North American (Danone). The Michigan Trailer Park well, located approximately 2,000 feet west of the facility, is approximately 400 to 600 feet deep. This well was constructed prior to 1946 and there are no records available indicating the screened interval of the well. The pumping capacity of the well is approximately 80 gpm (Pederson, 2001). The Danone well, located approximately 3,000 feet to the southwest of the facility, is 952 feet deep with a screened interval of 850 to 950 feet bgs and a pumping capacity of 225 gpm (Jackson, 2001). Pumping from either well does not appear to impact the groundwater elevation in the WCP East Grand Avenue WQARF Site.

2.7.3 Aquifer Testing

WESTON conducted an aquifer test at groundwater monitoring wells WCP-28 and WCP-29 (Figure 2-1). The results of the May 22 through 23, 2001 test are summarized below. The complete Aquifer Test Report is presented as Appendix C.

2.7.3.1 Step Drawdown Test

Step drawdown testing was conducted on the selected wells to identify a sustainable pumping rate that would stress the aquifer. Wells WCP-28 and WCP-29 selected for aquifer testing were redeveloped via bailing, surging, and pumping prior to testing to ensure that development effects would not significantly impair interpretation of testing results.

WESTON conducted step drawdown tests at WCP-28 and WCP-29 on May 10, 2001. A Hermit™ 3000 data logger with an In Situ PXD-261™ pressure transducer was installed in the pumping well to monitor changes in groundwater levels. A flowmeter accurate to ± 0.1 percent gpm was used to monitor and record discharge rates and total flow. A water-level indicator accurate to 0.01 feet was used to manually confirm transducer data in the pumped well and to monitor water levels in the observation well. The step tests consisted of three steps for WCP-28 and four steps for WCP-29 of approximately one-hour duration each (Table 2-1 of Appendix C). Each well was pumped at a constant discharge rate until drawdown stabilized. Data were plotted as they were collected.

2.7.3.2 Aquifer Test and Recovery

Groundwater monitor well WCP-29 was pumped at 34.7 gpm for approximately 21.5 hours (approximately 45,000 gallons) using a Flint and Walling® 2-horsepower submersible pump. The pump was suspended approximately 1 foot from the bottom of the well. Drawdown was monitored using a Hermit™ 3000 datalogger attached to pressure transducers in groundwater monitor wells WCP-29, WCP-28, and WCP-16. Solinst® PXD-261 Leveloggers® were installed in observation wells WCP-15 and WCP-84, and background wells WCP-17 and WCP-42. Additionally, a Barologger™ was suspended in WCP-84 to monitor changes in barometric pressure. Once the pumping phase of the aquifer test was completed, recovery data were collected in the pumping, observation, and background wells for the next 300 minutes (Figure 1-3 of Appendix C). A water-level indicator was also used to manually measure depth-to-water during the pumping and recovery stages of the test in addition to the pressure transducers. This provided independent confirmation of data obtained from the pressure transducers. Data were plotted as they were collected. The aquifer test was suspended after 21.5 hours because IDW storage tanks neared capacity and the data were sufficient to analyze for aquifer parameters.

The total drawdown for each well at the end of the pumping portion of the test was WCP-29 at 2.95 feet, WCP-28 at 1.24 feet, WCP-16 at 1.21 feet, WCP-15 at 0.51 feet, and WCP-84 at 0.63 feet. Background wells WCP-17 and WCP-42 did not respond to the pumping event. The drawdown data are presented in the Aquifer Test Report (Appendix C). The time-drawdown data collected during the pumping and recovery portions of the aquifer test are illustrated in Figures 4-1 through 4-5 of Appendix C.

Analysis of data was accomplished using the Theis Unconfined Method (Theis, 1935), Theis Recovery Method (Theis, 1935), and the Cooper Jacob Approximation to the Theis Equation (Cooper and Jacob, 1946). Prior to data analysis, groundwater levels were corrected for outside influences such as barometric pressure changes and regional groundwater level changes. The corrected aquifer test data were imported into AquiferWin32™ (Environmental Solutions, Inc., 1999) for analysis and analyzed using the late time data, believed to be more representative of aquifer conditions (Kruseman & de Ridder, 1990). However, the early data from the recovery portion of the aquifer test were used during the Theis Recovery analysis. The analytical results are summarized in the following table.

Transmissivity (gallons/day/foot)			
WELL ID	**Theis Unconfined**	**Theis Recovery**	**Cooper and Jacob**
WCP-15	31,532	29,906	26,141
WCP-16	28,987	29,331	27,952
WCP-28	29,219	27,906	28,060
WCP-29	na	28,764	na
WCP-84	35,702	30,466	26,550

na = not analyzed

Hydraulic Conductivity (gallons/day/foot squared)			
WELL ID	**Theis Unconfined**	**Theis Recovery**	**Cooper and Jacob**
WCP-15	1,704	1,617	1,413
WCP-16	1,567	1,585	1,511
WCP-28	1,579	1,508	1,517
WCP-29	na	1,555	na
WCP-84	1,930	1,647	1,435

na = not analyzed

Note: Hydraulic conductivity was calculated using an approximate aquifer thickness of 18.5 feet in the aquifer test area.

An analysis of data collected from the four observation wells suggests that transmissivity ranges from 26,141 to 35,702 gallons per day per foot (gal/day/ft) [3,495 to 4,773 square feet per day (ft^2/day)] (Figures 4-6 to 4-15 of the Aquifer Test Report in Appendix C). Data collected from WCP-29 during the aquifer test indicated a transmissivity of 28,764 gal/day/ft (3845 ft^2/day) (Figure 4-10 of Aquifer Test Report in Appendix C). Hydraulic conductivity in the pumping and observation wells ranged from 1,413 to 1,930 gallons per day per square feet (gal/day/ft^2) [189 to 258 feet per day (ft/day)]. The short duration of the aquifer test resulted in low storage coefficients ranging from 8.3 E-04 to 3.3 E-03.

2.7.3.3 Velocity Calculation

The average linear velocity of groundwater can be estimated using the following equation (Bear, 1979):

$$V = K/n_e \quad (dh/dl)$$

V = average linear velocity (ft/day)

K = hydraulic conductivity (ft/day)

n_e = effective porosity

dh/dl = hydraulic gradient

The following ranges of hydraulic parameters were used:

Hydraulic Conductivity, K (ft/day)	189 – 258
Effective Porosity, n_e	0.20 – 0.30
Hydraulic Gradient, dh/dl	0.00381 – 0.00667

The equation was used in combination with the range of hydraulic parameters given above to calculate a range of average linear groundwater velocities. Based upon the hydraulic parameters at the WCP East Grand Avenue WQARF Site aquifer test, the average linear velocity of groundwater is 2.4 to 8.6 ft/day.

2.8 WATER QUALITY

The WCP East Grand Avenue WQARF Site is located in the western portion of the SRV. Groundwater quality throughout the area is the result of naturally occurring geochemical processes and human activities (Brown and Pool, 1989). Groundwater in alluvial basins undergo geochemical changes due to natural factors such as mineralogy, the presence of evaporite deposits, and the order in which various mineral assemblages are encountered during groundwater movement (Freeze and Cherry, 1979). Human influences such as sewage effluent, stormwater runoff, and recharge of excess irrigation have affected groundwater quality in portions of the western SRV. Generally, groundwater within the western portion of the SRV is acceptable for domestic, agricultural, and industrial uses. However, concentrations of fluoride, nitrate, or dissolved solids exceed drinking water standards at certain locations within the SRV (Reeter and Remick, 1986). The principal ions present within local groundwater include sodium, calcium, chloride, and bicarbonate (Reeter and Remick, 1986).

2.9 POTENTIAL IMPACTS TO WATER QUALITY

WESTON evaluated other facilities that may have contributed to the degraded groundwater quality within the WCP East Grand Avenue WQARF Site. A review of the ADEQ leaking underground storage tank (LUST) database was conducted to identify sites within an approximate 0.5-mile radius of the VW&R facility. LUST facilities were reviewed because of the potential for petroleum hydrocarbon contamination to facilitate natural biodegradation of VOCs.

The ADEQ database indicated several facilities near the WCP East Grand Avenue WQARF Site boundary that had a release from an underground storage tank (UST) system (Table 2-1). Figure 2-25 shows the locations and approximate property boundaries of those facilities. Facility names in both Table 2-1 and Figure 2-25 are as they appear in the ADEQ LUST database and do not necessarily reflect facilities currently located on the property. The following facilities have been identified as having the greatest potential impact to water quality in the WCP East Grand Avenue WQARF Site.

2.9.1 Southwest Roofing and United Parcel Services Facilities

The Southwest Roofing/United Parcel Services (UPS) property is located approximately 1,700 feet southwest of the VW&R facility at 3151 West Osborn Road (Figure 2-25). Both facilities are listed in the ADEQ LUST database as having releases from USTs. The Southwest Roofing facility was located in the northwestern portion of the property that is now owned by UPS.

LUST File Numbers 1034.01 through 1034.03 are assigned to releases at the UPS facility. The current LUST site status for all three LUST file numbers associated with the UPS facility is "5R1", which indicates the files are closed and soils meet the Risk-Based Corrective Action (RBCA) Tier 1 requirements (ADEQ, 2001). Eight USTs have been closed and removed from the property, which included four gasoline USTs, two bulk-oil USTs, and two used-oil USTs (Blasland, Bouck, and Lee [BBL], 1997). Assessment of the impacted soils related to the releases was completed and a soil vapor extraction (SVE) system was operated on the property from April 1991 through April 1992. The LUST file numbers were closed in July 1998.

PCE was detected in a soil sample collected during a 1996 site characterization of the property. The sample, collected at a depth of 9 to 11 feet bgs near a new/used oil UST, had a PCE concentration of 220 micrograms per kilogram (μg/kg). Total petroleum hydrocarbons (TPH) were also detected at that depth at a concentration of 500 milligrams per kilogram (mg/kg). The concentration of PCE detected in soil at the UPS facility was below the minimum Groundwater Protection Level (GPL) of 1,300 μg/kg and no other detections were noted in additional samples.

A groundwater sample was collected from a monitoring well located south of the new/used oil UST area. PCE at a concentration of 6 μg/L, 1,1-DCE at a concentration of 0.3 μg/L, and styrene at a concentration of 0.3 μg/L were detected. No other contaminants were detected. Because PCE in soil was detected close to the ground surface, with no detections of VOCs deeper within the soil profile, BBL (1997) concluded that the presence of PCE in groundwater was due to the WCP East Grand Avenue WQARF Site groundwater plume.

LUST File No. 2593.01 is assigned to the Southwest Roofing facility. A release was reported following the removal of one 1,000-gallon gasoline UST in December 1992. The current LUST site status of the Southwest Roofing facility is "1D", which indicates that the extent of contamination in soil and groundwater has been defined and remediation is required. An SVE/air sparging remediation system was installed by AMEC and became operational in January 2001.

Southwest Roofing monitor wells MWB-4, MWB-5, and MWB-6 were included in the WCP East Grand Avenue WQARF Site groundwater-sampling network. MWB-14 was added to the sampling network during Round 13. Groundwater elevation data indicate the presence of a groundwater mound at the Southwest Roofing and UPS properties that may result in changes to groundwater flow beneath the property. The mound appeared concurrently with the start of air sparging activities in January 2001 and is believed to be a result of those activities. The potential effects of the remediation system to groundwater flow in the area should be evaluated further during remedy selection for the WCP East Grand Avenue WQARF Site. The remediation system treats groundwater *in situ* and does not require pumping of groundwater.

2.9.2 Former Fedmart/Sunbelt Facility

The former Fedmart/Sunbelt property is currently part of the Shamrock Towing property, located near the intersection of Osborn Road and Grand Avenue, approximately 950 feet to the southwest of the VW&R facility (Figure 2-25). Fedmart/Sunbelt operated a retail gasoline distribution facility from 1967 to 1990. In 1990, the facility was closed and the property was sold. Three 10,000-gallon gasoline USTs were excavated and removed from the property at that time.

Two historical releases were identified on the former Fedmart/Sunbelt property. LUST File No. 1618.01 was assigned to a release within the UST basin, and LUST File No. 1618.02 was assigned to a release in the former dispenser island area. One groundwater/SVE well was installed in November 1991 within the UST basin area. Approximately 1.2 feet thick of free product accumulated in this well shortly after installation (EnecoTech, 1999).

EnecoTech Southwest, Inc. (EnecoTech) conducted a site characterization of the property in 1999. Five soil borings were drilled and sampled and four groundwater monitor wells were installed on the property. To date, a total of eight groundwater wells have been installed on the property (EnecoTech, 2002). Free product was again observed in two of the groundwater monitor wells at a thickness of 0.30 and 0.70 feet.

Approximately 80 gallons of product were bailed from wells on the site in 2002 (EnecoTech, 2002). The LUST files associated with the Fedmart/Sunbelt property remain open; however, no remediation systems are currently in place at the property.

The groundwater monitor well MW-2 (ENT-MW-2) was added to the WCP East Grand Avenue WQARF Site groundwater sampling network in March 2000. Concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) detected in ENT-MW-2 since March 2000 are as follows:

- Benzene, 3,500 to 7,000 μg/L
- Toluene, 1,500 to 6,100 μg/L
- Ethylbenzene, 850 to 1,400 μg/L
- Total xylenes, 1,600 to 7,600 μg/L

Detection limits for PCE, TCE, and 1,1-DCE in samples collected from ENT-MW-2 were typically elevated to 25 μg/L or 50 μg/L because the high BTEX concentrations required dilution of the samples prior to laboratory analyses. When detection limits for these chlorinated VOCs were lower (0.05 μg/L), the detected concentration of PCE, TCE, and 1,1-DCE was 2 μg/L or less.

2.9.3 Levitz Furniture Store

Levitz Furniture (Levitz) is located north of the VW&R facility at 2801 W. Indian School Road (Figure 2-25). From 1967 through 1987, a UST located on the southeast corner of the property was used to store gasoline. The UST was abandoned in-place in 1987 by pouring slurry into the tank and then covering the area with asphalt (Earth Tech, 1995).

In March 1994, Coronado Engineering and Consulting (CEC) conducted a Phase I Site Assessment for Levitz. Contaminant concentrations above the suggested soil clean up levels were detected in samples retrieved from boreholes drilled near the UST area. The release was reported to ADEQ and assigned LUST File Number 3490.01.

Earth Tech installed groundwater monitoring wells and an SVE system on the property in 1995. Free product has been consistently noted in two on-site wells, and as of September 24, 2001, 279.75 quarts of free product have been recovered at the facility (AMEC, 2001). The most recent analytical data available, July 2001, indicate BTEX concentrations in groundwater remain in exceedance of their respective AWQS/MCLs. Additional compounds have been detected in groundwater including 1,2-dichloroethane (1,2-DCA), methyl tert-butyl ether (MTBE), and 1,2-dibromoethane. All three of these compounds have been used as gasoline additives. These contaminants do not appear in upgradient wells on the WCP East Grand Avenue WQARF Site and are present only in wells associated with other LUST sites downgradient from the VW&R facility.

2.9.4 ARCO Service Station

The former ARCO Service Station facility #5275 is located south of the VW&R facility at 2926 NW Grand Avenue (Figure 2-25). This facility was evaluated to investigate potential contribution to the high benzene concentrations detected in WCP-202. A UST release of unknown volume was reported to ADEQ in November 1993 and LUST number 3198.01 was assigned to the release.

A Final Site Characterization Report for the facility was prepared in 1996, which reported that concentrations of BTEX in soil samples recovered from borings drilled on the facility were not above laboratory reporting limits (EMCON, 1996). The current status of the LUST number is "5R1", which indicates the file is closed and soil levels meet RBCA Tier 1 requirements.

2.9.5 Former Mogul Facility

The former Mogul property is located at 3030 North 30th Avenue, approximately 1,900 feet south-southwest of the VW&R facility (Figure 2-25). A water treatment business was operated under different owners at the site from 1962 to 1995. Willmore Manufacturing, which produces accessories for cars and trucks, purchased the property in 1997 (SCS Engineers [SCS], 1998).

WESTON completed a review of ADEQ's internal files on previous investigations at the property. Site investigation activities began with a Resource Conservation Recovery Act (RCRA) SI by ADEQ in 1988. This led to several additional investigations that included soil and groundwater sampling and a 1992 ADEQ CERCLA SI. Analyses of soil and groundwater samples indicated that a release of metals and VOCs occurred at the facility (ADEQ, 1993b).

Historical groundwater sampling indicated the presence of TCE, PCE, 1,1-DCE, dibromochloromethane, 1,2-DCA, benzene, and chromium above laboratory MDLs. WESTON added groundwater monitor wells MGL-1, MGL-2, and MGL-3, located on the Mogul property, to the WCP East Grand Avenue WQARF Site groundwater-sampling network during Round 8. VOC concentrations detected in the Mogul wells since sampling for the WCP East Grand Avenue WQARF Site RI began are as follows:

- PCE, 0.3 to 0.7 μg/L
- TCE, 4 to 9 μg/L
- 1,2-DCA, 1 to 26 μg/L
- 1,1-DCE, 0.6 to 1 μg/L
- Benzene, 0.5 to 170 μg/L

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3.0 LAND AND WATER USE

As required by the WQARF Remedy Selection Rules, R18-16-406(D), a Land and Water Use Report was prepared as part of this RI (WESTON, 2002). The Land and Water Use Report presents information regarding current and "foreseeable" uses of land or waters that have been, or are threatened to be, impacted by a contaminant release. Information gathered from discussions with property owners, water providers, municipalities, and well owners is included in the report. The written report is presented in its entirety in Appendix D.

3.1 SUMMARY OF USES

The land and water uses most likely relevant to discussion of remedial objectives are presented below.

3.1.1 Land Uses

The zoning pattern in the area has been long established and there are no foreseeable changes for the future. Land uses for the WCP East Grand Avenue WQARF Site area are expected to remain predominantly industrial or light industrial.

3.1.2 Groundwater Uses

Current and future groundwater uses within the WCP East Grand Avenue WQARF Site area include the following:

- The COP anticipates the possible need for additional drinking water wells to augment production in the WCP area sometime in the future.
- SRP owns several irrigation wells in the area and will continue to need operational wells to supplement surface water supplies. A water treatment plant may be built on the Grand Canal sometime in the future, which would change the use of the groundwater from irrigation to drinking water.
- The Michigan Trailer Park is expected to continue to use the on-site well, MTP-1, to provide drinking water to park residents.
- Danone is expected to continue to use the well located on their property in their bottling operations.

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4.0 REMEDIAL INVESTIGATION ACTIVITIES

The WCP East Grand Avenue WQARF Site RI included the advancement of soil borings, installation of monitor wells, groundwater monitoring, and aquifer testing. The objectives of the RI and field activities used to accomplish these objectives are discussed in the following sections.

4.1 OBJECTIVES OF THE RI

The objectives of the RI were to:

1. Evaluate the lateral extent of VOCs in groundwater upgradient and downgradient from the VW&R facility and in the WCP East Grand Avenue WQARF Site.
2. Evaluate the concentration and distribution of VOCs in subsurface soils identified in previous investigations of the facility.
3. Characterize the physical properties of soils in the vadose zone and aquifer to evaluate their impact on contaminant migration.
4. Evaluate the vertical extent of VOC concentration in groundwater beneath and downgradient from the VW&R facility and in the WCP East Grand Avenue WQARF Site.
5. Evaluate the impact of groundwater extraction from the two SRP wells in the area on groundwater flow direction and contaminant distribution.
6. Provide data to construct a numerical groundwater flow and transport model to evaluate fate and transport of identified VOCs in the groundwater and the potential remedial alternatives to address that contamination.

Objectives 1 through 5 were accomplished during the RI. A numerical transport model was not constructed.

4.2 CURRENT FIELD ACTIVITIES

Current RI activities were conducted in four phases: Phase III, Phase IV, Phase V, and Phase VI. Each phase is described in the following sections and a chronological summary of activities is presented in Table 4-1, which also includes a summary of activities from previous investigations. Evaluation and discussion of the analytical data collected during the current field activities can be found in Section 7.0.

Groundwater sampling activities were initiated after the Phase III monitor wells were installed in December 1999. Groundwater sampling was performed on a monthly basis for the first three months and then performed quarterly for the months thereafter. Monitor wells installed after December 1999 were also sampled monthly for the first three months and then incorporated into the quarterly sampling system. The groundwater monitor well network included monitoring wells within the VW&R facility boundaries, upgradient of the facility and downgradient of the facility. Figure 4-1 presents all wells sampled during the investigation and includes wells installed during each phase of the RI. Evaluation of the analytical results of collected groundwater samples are presented in Section 7.5.

Depth-to-groundwater data collected during the WCP East Grand Avenue WQARF Site RI have been used to calculate groundwater elevations. Groundwater elevations have been used to evaluate the direction of groundwater flow in the WCP East Grand Avenue WQARF Site and to determine the effects of groundwater pumping from the SRP wells. Groundwater elevation data are further discussed in Section 2.7 of this report.

4.2.1 Phase III Field Activities

Phase III activities conducted by WESTON included a vadose zone investigation on the VW&R facility and the installation and sampling of upgradient and downgradient monitor wells. Phase III activities were conducted from September 1999 through December 2000 and are summarized in Table 4-1.

4.2.1.1 Vadose Zone Investigation

A vadose zone soil investigation was performed at the VW&R facility to further assess the extent of VOC contamination detected during previous investigations at the facility. Ten soil borings, SB-8 through SB-17, were drilled within the boundaries of the VW&R facility (Figure 4-2).

4.2.1.1.1 Soil Boring Location Rationale

Soil boring locations were selected based on elevated concentrations of VOCs detected in soil and soil-gas samples collected during previous investigations. Borings SB-8 through SB-14 were advanced to depths ranging from 121 feet bgs to 127 feet bgs. Borings SB-15, SB-16 and SB-17 were advanced to depths ranging from 166 to 182 feet bgs to assess the vertical extent of VOC contamination.

4.2.1.1.2 Lithologic Sample Rationale

Lithologic samples were collected from each of the borings at 5-foot intervals with a split-spoon sampler driven ahead of a hollow stem auger (HSA). Lithologic information was recorded for each sample interval and headspace analyses were performed with an FID.

A maximum of ten lithologic samples were collected from each borehole for laboratory analyses of VOCs. Soil samples were collected from the split-spoon sampler using an Encore™ sampling device in accordance with the procedures detailed in Section 5.1 of the Field Sampling Plan (FSP) (WESTON, 2001a). The rationale for soil sample collection and analysis was to:

- Characterize near-surface soils, up to 10 feet bgs, in areas with suspected contamination to identify potential surface source(s) and to obtain near-surface soil data for risk assessment purposes.
- Evaluate zones where lateral migration potentially occurred from downward-migrating fluids (i.e., immediately beneath areas of coarse-to-fine lithologic transitions).
- Provide coverage of the entire lithologic column from the surface to the groundwater table.
- Assess zones immediately above the water table to evaluate the potential migration of VOCs from the water table into overlying sediments.

Eight soil samples were submitted for physical properties testing including grain size, moisture content, density, specific gravity, permeability, and total organic carbon.

4.2.1.1.3 Hydropunch® Groundwater Sampling

As part of the vadose zone investigation, a Hydropunch® sampler was advanced to groundwater and samples were collected. Borings SB-15 through SB-17 included the collection of additional groundwater samples from depth specific intervals below the water table. The groundwater samples were collected using the Hydropunch® method as described in Section 5.3 of the FSP

(WESTON, 2001a). These samples were collected to define the distribution of contaminants in shallow groundwater beneath the facility and in the WCP East Grand Avenue WQARF Site.

4.2.1.2 Phase III Monitor Well Installation

During Phase III of the RI, additional groundwater monitor wells were installed upgradient and downgradient of the VW&R facility to:

- Evaluate the limits of groundwater contamination identified in previous investigations.
- Assess the groundwater flow direction and gradient near the facility and in the WCP East Grand Avenue WQARF Site.
- Evaluate the vertical extent of VOC contamination downgradient from the facility.
- Provide wells with which to monitor changes in extent and concentration of VOCs with respect to time.

Field activities associated with the installation of Phase III wells included utility location, drilling, well development, depth-to-groundwater measurements and wellhead elevation surveying.

4.2.1.2.1 Phase III Monitor Well Location Rationale

Monitor wells were installed on the east, south, southwest, west, and north sides of the VW&R facility to evaluate the lateral extent of contamination and to evaluate groundwater flow (Figure 4-1). Prior to initiating Phase III activities, groundwater elevation data suggested the groundwater flow direction varied from southwest to northwest. The variation in directional flow was attributed to seasonal pumping in SRP Well 10.5E-7.5N (WESTON, 1998). In 1999, ADEQ and SRP reached an agreement to discontinue pumping from 10.5E-7.5N, 11.2E-7.7N, and other SRP wells in the WCP area. The hydraulic gradient described in each rationale below is based on the assumption that the SRP wells would not be pumped and groundwater flow direction is to the southwest.

Monitor Well WCP-40 was installed on the COP right-of-way along 29th Avenue to the northeast of existing wells WCP-28 and WCP-29. The well is positioned hydraulically upgradient from the center of the VW&R facility to evaluate the upgradient extent of VOC contamination in groundwater. The well also provides information to evaluate groundwater flow direction.

Monitor Well WCP-41 was installed on the COP right-of-way along 29th Avenue, southeast of existing wells WCP-28 and WCP-29 and south of monitor well WCP-40. This well is positioned hydraulically crossgradient from the center of the VW&R facility. The purpose of this well is to provide information concerning static water levels to evaluate groundwater flow southeast of the VW&R facility.

Monitor Well WCP-42 was installed on the Western Plastics Corporation property, approximately 110 feet south of Whitton Avenue. This well is positioned hydraulically crossgradient and northwest of the center of the facility. The purpose of the well is to provide information concerning groundwater flow direction data near the north portion of the facility and evaluate the northern limits of shallow groundwater contamination associated with the VW&R facility.

Monitor Well WCP-43 was installed on the COP right-of-way near the corner of 28th Avenue and Whitton Avenue, east of well WCP-40. The purpose of this well is to provide groundwater level and flow direction information and to evaluate the upgradient water quality data.

Monitor Well WCP-44 was installed on the COP right-of-way of Osborn Road near its intersection with Grand Avenue. The purpose of the well is to evaluate the lateral extent of VOC contamination in shallow groundwater southwest of the VW&R facility. The well also provides information concerning the groundwater flow direction in this area.

Monitor Well WCP-45 was installed on the Shamrock Towing property west-southwest of well WCP-30. This well was positioned approximately downgradient of the VW&R facility, based on static water elevations calculated prior to its installation. This well was installed to evaluate the downgradient extent of VOC contamination associated with the VW&R facility.

Monitor Well WCP-46 was installed on the Shamrock Towing property west-northwest of well WCP-30. The purpose of this well is to evaluate the northwestern extent of VOC contamination associated with the VW&R facility and provide groundwater elevation data.

Deep Monitor Well WCP-48 was installed on the Shamrock Towing property approximately 20 feet north of WCP-45. The purpose of this well is to evaluate the vertical extent of VOC contamination associated with the VW&R facility. It is positioned approximately downgradient from the center of the facility.

4.2.1.2.2 Phase III Hydropunch® Samples

Hydropunch® samples were collected in each Phase III monitor well boring at or just below the water table prior to well installation.

During the installation of WCP-48, groundwater samples were collected at 30-foot depth increments to the total depth of the borehole using a Hydropunch® sampling device. Five groundwater samples were collected during drilling. The recovered groundwater samples were analyzed by Transwest Geochem, Inc. (Transwest) for specific VOCs using EPA Method 8260B.

4.2.1.3 Phase III Lithologic Samples

A lithologic log was created for each borehole drilled during Phase III RI activities from lithologic samples collected during the vadose zone investigation and groundwater monitor well installations. Soil samples were classified using the USCS in accordance with the American Society for Testing and Materials (ASTM) Standard Practice D2488. Lithologic descriptions were based on visual inspection of the soil for texture, color, moisture content, grain size distribution, and density. Soil descriptions were documented on lithologic logs for each borehole drilled during Phase III RI activities. Stratigraphic cross sections of the subsurface conditions beneath the VW&R facility and the WCP East Grand Avenue WQARF Site were developed from the boring logs to identify potential contaminant migration pathways. The results of the lithologic investigation were discussed in Section 2.5. Soil boring lithologic logs are provided in Appendix A.

4.2.1.4 Phase III Groundwater Monitoring

Phase III of the RI included six rounds of groundwater sampling beginning in December 1999 and ending in December 2000. The monitor well sampling network included monitor wells

WCP-15, WCP-16, WCP -17, WCP -28, WCP -29, and WCP -30 (all located within or directly adjacent to the VW&R facility), monitor wells WCP-40 through WCP-46, and monitor wells MWB-4, MWB-5, and MWB-6 located north of the UPS property (southwest of the VW&R facility) (Figure 4-1). Drinking water well MTP-1, located in the Michigan Trailer Park west of the VW&R facility, was added to the list of monitored wells during the second round of sampling. The EnecoTech monitor well, ENT-MW-2, located on the southern boundary of the Shamrock Towing property southwest of the VW&R facility, was added during the third round of monitoring. Deep monitor well WCP-48 was added to the list during the fifth round of groundwater sampling.

4.2.2 Phase IV Field Activities

The August 2000 technical memorandum documented the Phase III investigation results and concluded that additional upgradient and downgradient monitor wells were necessary to complete the delineation of VOC contamination in groundwater (WESTON, 2000). An aquifer pumping test was also recommended to evaluate aquifer characteristics. Phase IV activities included all recommendations contained in the August 2000 technical memorandum and were conducted from January 2001 through June 2001 (Table 4-1).

4.2.2.1 Phase IV Monitor Well Installation

Phase IV activities included the installation and sampling of nine additional groundwater monitor wells to further delineate the extent of VOC contamination. Other field activities included utility location prior to well placement, well development, depth-to-groundwater measurements, and wellhead elevation surveying.

4.2.2.1.1 Phase IV Monitor Well Location Rationale

Specific rationales for the placement of each Phase IV well are described below.

Monitor Well WCP-47 was installed on the COP right-of-way along 31st Avenue. The purpose of this well is to evaluate groundwater quality and flow directions in the area. WCP-47 also acts as a sentinel well to evaluate the westward migration of VOC contamination associated with the

VW&R facility toward the SRP well and MTP-1, the drinking water well at Michigan Trailer Park.

Monitor Well WCP-83 was installed in the COP right-of-way of 28th Avenue near the intersection of Osborn Road. This well is hydraulically crossgradient from the VW&R facility and is designed to monitor groundwater elevations and groundwater quality in the WCP East Grand Avenue WQARF Site.

Monitor Well WCP-84 was installed in the COP right-of-way of 29th Avenue between Whitton Avenue and Osborn Road. This well is hydraulically crossgradient from the VW&R facility and is designed to monitor groundwater elevations and groundwater quality within the WCP East Grand Avenue WQARF Site.

Monitor Well WCP-85 was installed on the northeast portion of the Hanson Pipe property near the Grand Canal and 27th Avenue. This well is hydraulically upgradient from the VW&R facility and is designed to monitor the groundwater elevations and groundwater quality within the eastern extent of the WCP East Grand Avenue WQARF Site.

Monitor Well WCP-86 was installed on commercial property to the south of the VW&R facility and is designed to monitor groundwater elevations and groundwater quality within the southern extent of the WCP East Grand Avenue WQARF Site.

Monitor Well WCP-87 was installed on the southern half of the Shamrock Towing property. This well is approximately downgradient from the VW&R facility and is designed to monitor groundwater elevations and groundwater quality within the WCP East Grand Avenue WQARF Site.

Monitor Well WCP-88 was installed on a commercial property along 30th Avenue, south of Grand Avenue. This well is hydraulically downgradient from the VW&R facility and is designed to monitor groundwater elevations and groundwater quality within the southwestern extent of the WCP East Grand Avenue WQARF Site.

Monitor Well WCP-89 was installed on a commercial property to the west of the UPS/Southwest Roofing property. This well is approximately downgradient from the VW&R facility and is designed to monitor groundwater elevations and groundwater quality within the western extent of the WCP East Grand Avenue WQARF Site.

Monitor Well WCP-90 was installed on a commercial property on Weldon Avenue north of the Grand Canal. This well is designed to monitor groundwater elevations and groundwater quality within the northern extent of the WCP East Grand Avenue WQARF Site.

4.2.2.1.2 Phase IV Lithologic Samples

A lithologic log was recorded for each borehole drilled during Phase IV RI activities from lithologic samples collected during monitor well installations. Samples were classified using the USCS protocol in accordance with the ASTM Standard Practice D2488. Soil descriptions were documented on lithologic logs for each borehole drilled during Phase IV of the RI. Stratigraphic cross sections of the subsurface conditions beneath the VW&R facility and the WCP East Grand Avenue WQARF Site were developed from the boring logs to identify potential contaminant migration pathways. The results of the lithologic investigation were discussed in Section 2.5.

Nine soil samples were also submitted for physical properties testing. Analysis included grain size analysis, porosity, moisture content, density, specific gravity, total organic carbon, and permeability.

4.2.2.2 Phase IV Groundwater Monitoring

Phase IV of the RI included Rounds 7 through 10 of groundwater sampling beginning in February 2001 and ending in June 2002. The groundwater monitor well sampling network included the wells monitored during Phase III and monitor wells WCP-47 and WCP-83 through WCP-90 (Figure 4-1). Monitor wells MGL-1, MGL-2, and MGL-3, located on the southern portion of the Mogul property southwest of the VW&R facility, were added in the eighth round of monitoring.

4.2.2.3 Aquifer Pumping Tests

The August 30, 2000 technical memorandum to the ADEQ that summarized the Phase III RI results recommended performing aquifer tests to further evaluate aquifer characteristics at the WCP East Grand Avenue WQARF Site.

In preparation for the aquifer testing, WESTON redeveloped monitor wells WCP-28 and WCP-29. Step-drawdown tests were conducted on May 10, 2001 on each of these wells. The tests involved recording the drawdown at each well while operating a submersible pump at several steady-state pumping rates. The data collected during the step drawdown test were used to design the aquifer pumping test.

The aquifer pumping test was conducted at monitor well WCP-29 on May 23, 2001. Monitor wells WCP-15, WCP-16, WCP-28, and WCP-84 were used as observation wells and monitor wells WCP-17 and WCP-42 were used as background wells. The details and results of the aquifer test are discussed in Section 2.7.3.

4.2.3 Phase V Field Activities

Phase V field activities included the drilling and installation of seven shallow monitor wells to further assess groundwater quality within the WCP East Grand Avenue WQARF Site. Field activities associated with the installation of these monitor wells were initiated in June 2001 and included, but were not limited to, utility location for well placement, drilling, well development, depth-to-groundwater measurements, sampling, and well head elevation surveying (Table 4-1). Hydropunch® samples were collected from each borehole prior to well installation.

4.2.3.1 Phase V Monitor Well Installation

Phase V of the RI included the installation of monitor wells WCP-92 through WCP-98. Field drilling activities were conducted on July 2 through July 27, 2001.

4.2.3.1.1 Phase V Monitor Well Location Rationale

Specific rationales for the locations of the monitor wells are provided below.

Monitor Well WCP-92 was installed in the COP right-of-way on Catalina Drive east of 31st Avenue. This monitor well is located hydraulically downgradient from the VW&R facility and Mogul facility. The placement of this monitor well was based on groundwater analytical results obtained from Mogul facility wells MGL-1 through MGL-3 (Figure 4-1). WCP-92 was installed to further assess the downgradient extent of VOCs detected in groundwater.

Monitor Well WCP-93 was installed in the COP right-of-way on Osborn Road west of 29th Avenue. This monitor well is located near the southeastern portion of the property. Historical data indicated that the eastern property boundary was accessible by railcar and used for chemical distribution and offloading. This monitor well was installed to assess the dispersion of VOCs detected in groundwater beneath the VW&R facility and to monitor groundwater elevations.

Monitor Well WCP-94 was installed in the COP right-of-way on 33rd Avenue north of Earll Drive. This monitor well is located hydraulically downgradient from the VW&R facility and was installed to further assess the downgradient extent of VOCs detected in groundwater.

Monitor Well WCP-95 was installed in the COP right-of-way on Weldon Avenue west of 27th Avenue. This well is located hydraulically upgradient from the VW&R facility. Groundwater sample analytical results obtained from groundwater monitor wells WCP-43 and WCP-85 indicated concentrations of VOCs above the laboratory MDLs. Monitor well WCP-95 is positioned hydraulically upgradient from these monitor wells to assess the upgradient extent of VOCs detected in groundwater and to evaluate variations in groundwater elevations north of the canal.

Monitor Well WCP-96 was installed in the COP right-of-way on 31st Avenue near the UPS facility. This well is located hydraulically downgradient from the VW&R facility and was designed to monitor groundwater elevations and assess the downgradient extent of VOCs detected in groundwater.

Monitor Well WCP-97 was installed in the COP right-of-way on 28th Avenue south of Osborn Road. This well is located hydraulically crossgradient from the VW&R facility. This well was designed to monitor groundwater elevations and to further assess the lateral extent of VOCs detected in the groundwater.

Monitor Well WCP-98 was installed in the COP right-of-way on 26th Drive south of Osborn Road. This well is located crossgradient from the VW&R facility. This well was designed to monitor groundwater elevations and to further assess the lateral extent of VOCs detected in groundwater.

4.2.3.1.2 Phase V Lithologic Samples

Lithologic samples were collected at 5-foot intervals during the installation of the Phase V monitor wells. Samples were classified using the USCS protocol in accordance with the ASTM Standard Practice D2488. Stratigraphic cross sections of the subsurface conditions beneath the VW&R facility and the WCP East Grand Avenue WQARF Site were developed from the logs and analytical data to identify potential contaminant migration pathways. The results of the lithologic investigation were discussed in Section 2.5.

Fourteen soil samples were also submitted for physical property testing. Analysis included grain size, moisture content, density, permeability, porosity, and total organic carbon.

4.2.3.2 Phase V Groundwater Monitoring

Phase V of the RI included Rounds 11 through 13 of groundwater sampling beginning in July 2001 and ending in November 2001 (Table 4-1). The monitor wells sampled during Round 11 included all of the wells sampled in previous rounds with the addition of monitor wells WCP-92 through WCP-98 (Figure 4-1).

Passive diffusion bag (PDB) samplers were installed in nine wells prior to Round 12 groundwater sampling to test the feasibility of using PDB samplers in future studies and monitoring in the WCP East Grand Avenue WQARF Site. PDB samplers were installed in WCP-16, WCP-17, WCP-28, WCP-29, WCP-85, WCP-87, WCP-88, WCP-93, and WCP-94. Groundwater samples were collected during Round 12 from each of these wells using both the PDB sampling methodology and pump discharge sample methodology. Groundwater samples were also collected from WCP-92, WCP-95, WCP-96, WCP-97, and WCP-98 during Round 12 using the pump only.

Due to high concentrations of benzene in ENT-MW-2, groundwater sampling of this well was discontinued during Round 13. All other monitor wells previously sampled were included in Round 13; however, a sample was not collected from WCP-15 during this round due to insufficient water in the well. The only additional monitor well added during this round was MWB-14, located north of the UPS property.

A second sampling port at MTP-1, designated MTP-2, was also added during Round 12. Both MTP-1 and MTP-2 designate groundwater samples collected from the one drinking water well located at the Michigan Trailer Park. MTP-2 was sampled from a spigot located on a building north of the MTP-1 wellhead. As in previous sampling rounds, the sample designated MTP-1 was collected from the spigot located at the wellhead. The Michigan Trailer Park sampling frequency was changed to monthly for both of these sampling ports.

4.2.4 Phase VI Field Activities

Phase VI field activities included the drilling and installation of seven shallow monitor wells. Field activities associated with the installation of these monitor wells were initiated in November 2001 and concluded in December 2001. Field activities included, but were not limited to, utility location for well placement, drilling, well development, depth-to-groundwater measurements, sampling, and wellhead elevation surveying (Table 4-1). Hydropunch® samples were collected from WCP-100 and WCP-200 prior to well installation.

4.2.4.1 Phase VI Monitor Well Installation

Phase VI of the RI included the installation of monitor wells WCP-99, WCP-100, and WCP-200 through WCP-204 (Figure 4-1). Field drilling activities were conducted on November 14 through December 17, 2001.

4.2.4.1.1 Phase VI Monitor Well Location Rationale

Specific rationales for the locations of the monitor wells are provided below.

Monitor Well WCP-99 was installed on private property east of 27th Avenue and south of the Grand Canal. This well is located between SRP well 11.2E-7.7N and the VW&R facility and was installed to investigate possible additional sources of VOC contamination in groundwater.

Monitor Wells WCP-100, WCP-200, and WCP-201 were installed on the VW&R facility property to replace existing monitor wells WCP-16, WCP-15, and WCP-17, respectively, due to declining groundwater elevations. WCP-15 was subsequently abandoned by Vopak. The remaining wells (WCP-16 and WCP-17) will be maintained for possible use as remedial SVE wells.

Monitor Well WCP-202 was installed in the COP right-of-way south of the Grand Avenue frontage road on 30th Avenue. This well is located hydraulically downgradient from the VW&R facility and will assist in evaluating groundwater analytical data for the determination of a possible separation of contaminant plumes.

Monitor Well WCP-203 was installed near the intersection of Weldon Avenue and Grand Avenue. This monitor well is located hydraulically upgradient from the Michigan Trailer Park drinking water well. This well investigates the potential upgradient sources that could impact the Michigan Trailer Park well.

Monitor Well WCP-204 was installed in the COP right-of-way on 33rd Avenue. The placement of this monitor well was based on groundwater analytical data obtained from WCP-94 and is located hydraulically downgradient from the VW&R facility and monitor well WCP-94. WCP-204 further assesses the downgradient extent of VOCs detected in groundwater.

4.2.4.1.2 Phase VI Lithologic Samples

Lithologic samples were collected at 5-foot intervals during the installation of the Phase VI monitor wells. Samples were classified using the USCS protocol in accordance with the ASTM Standard Practice D2488. The results of the lithologic investigation were discussed in Section 2.5. No soil samples were submitted for physical properties testing during this portion of the investigation.

4.2.4.2 Phase VI Groundwater Monitoring

Phase VI groundwater sampling included Rounds 14 and 15 in addition to the monthly sampling of MTP-1 and MTP-2 (Table 4-1). Due to pump equipment failure, completion of Round 14 groundwater sampling was not possible. Monitor wells WCP-90, WCP-100, WCP-202, and WCP-204 were sampled. No other monitor wells were sampled during Round 14. Phase VI groundwater sampling activities began in December 2001 and ended in January 2002.

Monitor wells not included in Round 15 groundwater sampling were MGL-1, MGL-2, MGL-3, MWB-4, MWB-5, WCP-15, WCP-16, and WCP-17. As described in Section 4.2.4.1.1, WCP-100, WCP-200, and WCP-201 replaced WCP-15, WCP-16, and WCP-17. Previously sampled wells and the newly installed Phase VI monitor wells were sampled during Round 15.

In addition to groundwater sampling, pressure transducers were installed in monitor wells WCP-43, WCP-85, WCP-95, WCP-99, WCP-83, and WCP-97 to monitor groundwater levels and to assess the effects of infiltration water from the Grand Canal. Solinst® 3001 Mini LT Levelogger® pressure transducers were installed in December 2001. These pressure transducers provided information needed to evaluate the effect of the Grand Canal on flow and contaminant movement in the WCP East Grand Avenue WQARF Site area.

4.3 PERMITS AND UNDERGROUND UTILITY CLEARANCES

WESTON obtained the necessary property access agreements, permits, and utility clearances as described in Section 4.1 of the FSP, prior to initiating field investigation activities (WESTON, 2001a). WESTON also reviewed COP maps for the location of storm sewers not included in the Blue Stake utility locate. COP right-of-way permits were issued to the ADEQ under the revocable permit #RP-91011.

4.4 GROUNDWATER ELEVATION AND WELL SURVEY DATA

WESTON contracted private surveying companies to provide latitude and longitude, land surface elevation, and top of well casing elevation survey data for monitor wells installed during Phase III through Phase VI of the WCP East Grand Avenue WQARF Site RI. An Arizona registered land surveyor conducted the surveying activities. The surveyors provided the horizontal data based on the Arizona Central Zone's North America Datum of 1927 (NAD27) State Plan Coordinate Grid and vertical elevations based on the National Geodetic Vertical Datum of 1929 (NGVD29) as currently used by the COP. All wells were surveyed in accordance with the requirements of the most recent *ADEQ Locational Data Policy (LDP) #0034.001, Level One.*

4.5 LABORATORY ANALYSES

Laboratory analyses were performed on soil, Hydropunch® groundwater, and groundwater monitor well samples collected during the WCP East Grand Avenue WQARF Site RI. Soil and water samples of IDW were also collected and submitted for analysis. The following sections discuss the laboratories performing the analyses, analyses performed, the laboratory quality assurance/quality control (QA/QC) program, and the data validation methods employed during the investigation.

4.5.1 Analytical Laboratories

All analytical laboratories subcontracted during the WCP East Grand Avenue WQARF Site RI were licensed by the Arizona Department of Health Services (ADHS) to perform each analysis requested. Laboratories subcontracted during the course of the investigation are listed below.

4.5.1.1 Severn Trent Laboratories

Hydropunch® (except for those collected during the deep well installation), groundwater, and soil samples collected during this RI were submitted to Severn Trent Laboratories–Chicago (STL) for analysis. The laboratory prepared a Level IV CLP equivalent data package for each sample delivery group (SDG), submitted to the laboratory. Results were also supplied in electronic format.

The data packages included a complete set of CLP forms or CLP equivalent forms for the sample results and the QC data package, plus copies of the completed chain-of-custody (COC) forms. The analytical data package included analytical results, blank sample results, both laboratory and client sample identifications, appropriate dates, method reporting limits, method references, surrogate recoveries as appropriate, and the laboratory's name and address. The custody forms included the receipt of the sample and the laboratory's internal tracking. The QC data package included a tabular list of the laboratory's sample identification, spiking concentrations, recoveries, percentage calculations, and acceptance windows. Raw data provided included chromatograms, instrument print outs, injection logs, digestion/preparation logs, and standard logs.

4.5.1.2 Transwest Geochem

Hydropunch® samples collected during the installation of WCP-48 were analyzed by Transwest. The laboratory prepared Level III data packages, plus copies of the completed COC forms. The analytical package included analytical results, blank sample results, both laboratory and client sample identifications, appropriate dates, method reporting limits, method references, and matrix spike and blank spike results. Analytical results were also supplied in electronic format.

4.5.1.3 ATL, Inc.

Physical analyses of soils collected during the vadose zone investigation and Phase IV well installation were conducted by ATL, Inc. (ATL) of Phoenix, Arizona. Analyses included soil density (specific gravity), soil porosity, permeability, moisture content, total organic carbon, and grain-size analysis.

4.5.1.4 Columbia Analytical Services, Inc.

PDB samples collected during Round 12 groundwater sampling were submitted to Columbia Analytical Services, Inc. (Columbia) for analysis. The laboratory prepared Level IV data packages for each SDG submitted and results were also supplied in electronic format. The Columbia Level IV data packages included the same information as data packages received from STL as described in Section 4.5.1.1.

4.5.1.5 Phoenix National Laboratories, Inc.

Physical analyses of soil samples collected during the Phase V well installation were conducted by Phoenix National Laboratories, Inc. (PNL). Analyses included soil density (specific gravity), soil porosity, permeability, moisture content, total organic carbon, and grain-size analysis.

4.5.2 Analytical Methods

Methods selected to analyze samples collected during the WCP East Grand Avenue WQARF Site RI are specified in the Quality Assurance Project Plan (QAPP) (WESTON, 1999). Table 4-2 presents a summary of requested analyses by SDG for all samples submitted for chemical laboratory analysis.

4.5.2.1 Groundwater Analyses

Both monitor well and Hydropunch® groundwater samples were analyzed for VOCs using EPA Method 8260B. Round 6 groundwater samples from WCP-28 and WCP-29 were also analyzed for SVOCs using EPA Method 8270, as requested by ADEQ.

4.5.2.2 Soil Analyses

Soil samples were analyzed for VOCs using EPA Method 8260B. Soil samples were preserved and/or extracted according to the ADEQ requirements for the implementation of EPA Method 5035. Selected lithologic samples collected from borings during the vadose zone investigation and Phase IV well installation were also tested for physical properties including:

- Soil density (specific gravity)—ASTM D-2937.
- Soil porosity—EPA Method 9100.
- Moisture content—ASTM D-2216.
- Total organic carbon—Walkley-Black method.
- Grain-size analysis—ASTM D-422.
- Permeability—ASTM D-2434.

4.5.2.3 IDW Analyses

All composite soil samples were analyzed for VOCs in accordance with EPA Method 8260B and 13 priority pollutant metals in accordance with EPA Methods 6010B and 7471A. Select soil composite samples were also analyzed for ignitability in accordance with EPA Method 1010 and paint filter in accordance with EPA Method 9095 to further characterize soil IDW. Paint filter and flashpoint were added to the list of requested analyses for soil IDW following the deep well installation. Composite IDW groundwater samples were analyzed for VOCs in accordance with EPA Method 8260B, 13 priority pollutant metals in accordance with EPA Method 200.7/245.1 or EPA Method 6010B/7470, and pH in accordance with EPA Method 9041.

4.5.3 Data Quality Assessment

The quality of analytical data was assessed through validation. Quality by Design (QBD), a third party data validation company, completed data validation on groundwater and soil analytical packages completed by STL. Analytical results for IDW samples, WCP-48 Hydropunch® samples submitted to Transwest, and PDB samples submitted to Columbia were not validated by QBD. Results of physical testing analysis done on soil samples collected during the vadose zone investigation, Phase IV, and Phase V well installations were also not validated by QBD. Results of the data quality assessments are presented in Section 6.0.

4.5.3.1 Data Validation Methods

Data validation was performed according to the guidelines found in the following documents:

- *Functional Guidelines for Evaluating Organics Analyses,* EPA, revised 1994.
- *Remedial Investigation/Feasibility Study Quality Assurance Project Plan, Van Waters and Rogers Facility,* WESTON, September 1999.
- Criteria listed in the referenced method.

Data validation performed by QBD also included the following steps:

- Comparison of electronic data deliverables (EDDs) with the laboratory’s hard copy report for consistency and accuracy.

- Review of the COC associated with each SDG to ensure all samples listed on the COC form were reported in the laboratory deliverables, that a date and time of sampling were provided, and that the sample custody trail was complete. Sample condition upon receipt was also reviewed to determine that the samples were not compromised during shipping.
- Review of appropriate documentation to ensure all samples were properly preserved and analyzed within technical holding times and that no deviations from proper handling and identification occurred.

5.0 FIELD METHODS AND PROCEDURES

Specific methods and procedures followed during field activities at the WCP East Grand Avenue WQARF Site were detailed in the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) prepared for this project (WESTON, 2001a and 1999) including the following.

- Hollow-stem auger/mud rotary drilling procedures.
- Lithologic logging procedures.
- Geophysical logging procedures.
- Monitor well installation, development, surveying, and low-flow purging procedures.
- Water level measurement procedures.
- Sample collection procedures and equipment, including borehole soil sample collection, non-discrete soil sample collection, Hydropunch® groundwater sample collection, and groundwater monitor well sample collection.
- Field quality control samples (field blanks, trip blanks, and field duplicates) including sample frequency.
- Sample handling and shipping procedures.
- Field documentation procedures including field logbook and field form requirements.
- Equipment decontamination procedures.
- Investigation derived waste handling and disposal procedures.

The following sections describe deviations from or additions to the written project plans.

5.1 MONITOR WELL COMPLETION

Completion of the monitor wells involved the installation of blank and slotted casing, filter pack materials, and annular well sealing materials. Monitor wells were constructed in accordance with ADWR's Well Construction and Driller’s Rules, Arizona Administrative Code, Article 8 as specified in the FSP. The specifications for the monitor well completions are presented in Table 5-1. Well completion diagrams for each well installed by WESTON are presented in Appendix E.

Boreholes converted into shallow monitor wells were drilled with a nominal 11-inch diameter to approximately 30 feet below the estimated SWL. The total depth (TD) of the monitor well borings ranged from approximately 139.5 to 155 feet bgs.

The deep monitor well borehole was drilled in a nominal 10-inch borehole to a depth of 300 feet bgs and completed to a depth of 246 feet bgs. Groundwater samples were collected using a Hydropunch® sampler upon encountering the groundwater zone, at approximately 30-foot depth increments to the total depth of the borehole. Groundwater samples collected during drilling were analyzed for VOCs using EPA Method 8260B. The screened interval and the total depth of the deep well were based on the Hydropunch® laboratory analytical results and the geophysical data.

5.2 AQUIFER TEST PROCEDURES

An Aquifer Test Proposal was submitted to ADEQ after completion of the Phase IV well installations (WESTON, 2001b). The proposal recommended performing step drawdown and aquifer pumping tests at monitor wells WCP-28 and WCP-29 and detailed the proposed test methodology. The aquifer tests included two step tests and one 21.5-hour constant rate pumping test.

Data derived from the aquifer test were evaluated following completion of the test. The data were analyzed in accordance with accepted analytical methods to evaluate aquifer parameters such as hydraulic conductivity, transmissivity, and storage coefficient. Results of the aquifer test data analyses are discussed in Section 2.7.3. The complete aquifer test procedures and analysis techniques are documented in Appendix C of this report.

5.3 MONITOR WELL SAMPLING

Groundwater samples were collected during 15 sampling events during the course of the RI. Groundwater samples were collected beginning with the least contaminated wells and progressing to wells with higher concentrations of suspected contamination.

The first sampling event was conducted in December 1999. The samples were collected using a bailer after low-flow purging was completed using a submersible pump. During the following two sampling rounds, groundwater samples were collected directly from the pump discharge in addition to using the bailer method.

Round 2 sampling was conducted in January and February 2000. Each well was sampled directly from the pump and six monitor wells on or near the VW&R facility (WCP-15, WCP-16, WCP-17, WCP-28, WCP-29, and WCP-30) were also sampled using the bailer method upon removal of the submersible pump. Groundwater sampling during Round 3, conducted in March 2000, used both sampling methods for each monitor well sampled. Groundwater samples were collected directly from the pump in subsequent groundwater sampling events.

The purge method was changed during Round 10 so three casing volumes were removed at higher flow rates compared with the low-flow techniques typically used. This round was conducted immediately following Round 9 in order to compare analytical results from samples collected using different purge methods. The three casing volume method was also used during Rounds 13 through 15. A discussion of different sample and purge methods is presented in Section 7.5.2.1 and 7.5.2.2.

The depth of the intake of the submersible pump used to purge and collect samples changed over the course of the project. Initially, the pump intakes were placed in a permeable zone based on lithologic logs, or at 5 to 10 feet above the bottom of the well. The pump intake for WCP-15, WCP-16, and WCP-17 was placed approximately 2 to 3 feet above the bottom of the well.

Beginning with groundwater sampling Round 7, the first round after installing the Phase IV monitor wells, the pump intake was set at 5 feet below the measured water level for the new wells (WCP-47, WCP-83, WCP-84, WCP-85, WCP-86, WCP-87, WCP-88, WCP-89, and WCP-90). The pump placements for the remaining wells in the sampling network were set at the depths mentioned above.

The pump intake setting depths were standardized at 5 feet below the measured water level beginning with Round 8. In wells where the water column is less than 5 feet, the pump intake was placed approximately 1 foot off the bottom of the well. The only time the pump settings have been different for subsequent rounds occurred during Rounds 10, 13, 14, and 15. The pump intake settings for these sampling rounds was 10 feet below the water table in order to allow for greater drawdowns associated with the higher flow rates used during the three well purge prior to sampling.

The following sections describe the procedures followed for each purge and sample method.

5.3.1 Monitor Well Purging Methods

Prior to groundwater sample collection, depth-to-water measurements were taken and then all monitor wells were purged either by the low-flow purge method or by removing three casing volumes of purge water. The low-flow purge method was described in the FSP. The three casing volume purge method is described below.

5.3.1.1 Three Casing Volume Purge Method

The following procedures were followed during the three casing volume purge process.

- Same as Step 1 of the low-flow method.
- Same as Step 2 of the low-flow method.
- Same as Step 3 of the low-flow method.
- A stainless steel submersible pump was placed 10 feet below the initial SWL, unless the well had a water column less than 10 feet deep. If the water column in the well was less than 10 feet, the pump was set approximately 1 inch off the bottom of the well.
- The pumping rate was set at the lowest sustainable rate possible.
- Groundwater quality parameters were monitored as described in Step 6 of the low-flow method.
- The sample was collected after a minimum of three well casing volumes had been removed from the well, or after the groundwater parameters from Step 6 stabilized within the specified ranges over three consecutive readings.

If a monitor well was pumped dry prior to removing three well casing volumes, the well was allowed to recover for approximately 20 minutes before pumping resumed. If the well was pumped dry a second time, before the three well casing volumes had been removed and/or before the groundwater parameters had stabilized, the pump was pulled from the well. The well was allowed to recover to approximately 80 percent of the original SWL and a groundwater sample was then collected using a disposable bailer.

5.3.2 Passive Diffusion Bag Sample Collection Method

During Round 12 of groundwater sampling, samples from nine wells (WCP-16, WCP-17, WCP-28, WCP-29, WCP-85, WCP-87, WCP-88, WCP-93, and WCP-94) were collected using PDB samplers. Samples from these wells were also collected following the low-flow purge method and pump discharge collection methods described in the FSP.

Each well was outfitted with two PDB samplers, excluding WCP-16 and WCP-17, which did not have a sufficient water column for two samplers. PDB samplers were installed 2 feet beneath the groundwater surface in each of the nine wells. The second PDB sampler in the remaining wells was installed opposite a permeable zone near the bottom of the well. Protective mesh covers for the sampler bags were not used because the sampler was installed in a cased monitor well. The installation of the samplers and sample collection are described below.

Installation

- The line was unwrapped until the first sampler location was reached. Wing nut clamps were attached to ¼-inch diameter holes in the tabs at the top of the PDB sampler, using the stainless steel snap ring or plastic cable ties.
- The line was further unwrapped to the desired location of the second sampler and the bag was attached as described above. When only one PDB sampler was placed in the monitoring well, the bottom of the sampler was attached to the line using a cable tie.
- After the final sampler bag was attached to the line, the top end of the line was attached to the well cap so the sampler bags were located at the desired depth. A plastic disk with a diameter greater than the inside diameter of the monitoring well was added to the top of each line as a safety device to ensure the sampler bags and hardware could not accidentally be lost down the well.

Recovery

- The samplers remained in the wells for 14 days after installation to allow for full equilibration prior to recovery.

- The sampler was removed using a plastic reel and then dried using a clean paper towel.
- Within one hour of removing the sampler from the monitoring well, the water sample was transferred into 40-mL glass vials. The top tab of the sampler was partially cut below the heat seal and the contents were carefully poured into the glass vials.
- The sample vials were labeled and prepared for shipment to Columbia following standard chain-of-custody protocol.

5.4 INVESTIGATION-DERIVED WASTE HANDLING AND DISPOSAL

IDW generated during the WCP East Grand Avenue WQARF Site RI included: lithologic cuttings/drilling mud from the drilling of soil boring/monitor wells; rinse water from equipment decontamination; purged groundwater from monitor well development, sampling, and aquifer testing; personal protection equipment (PPE); and miscellaneous trash. IDW generated during the investigation was either temporarily stored within the boundaries of the WCP East Grand Avenue WQARF Site or transported to Philip Services Corp (PSC) in Department of Transportation (DOT) approved 55-gallon drums, waste roll-off bins, water wagons, and/or Baker tanks pending receipt of waste characterization analytical results. Waste characterization sampling of IDW was conducted in accordance with the RI FSP prepared by WESTON for the project (WESTON, 2001). IDW generated during this investigation was managed as non-hazardous solid waste. The waste handling procedures followed by WESTON for lithologic cuttings/drilling mud and purged groundwater are discussed in the following sections.

5.4.1 Lithologic Cuttings/Drilling Mud

Lithologic cuttings/drilling mud generated during the RI was contained in DOT approved roll-off bins with inserted plastic liners. WESTON collected composite samples from five locations within the roll-off bins to characterize soil IDW generated during the investigation. All composite samples were collected within the appropriate laboratory supplied sample containers, placed in a cooler with ice, and transported with signed COC documentation to STL.

Composite sample analytical results for waste characterization indicated that cuttings generated during the WCP East Grand Avenue WQARF Site RI were non-hazardous. Upon receipt of the analytical results, PSC completed the necessary waste profile forms for subsequent disposal.

Cuttings generated during the investigation were transported by PSC to Butterfield Solid Waste Landfill for disposal. The liquid associated with the drilling mud was transported to Resource Recovery Techniques of Arizona, Inc. (RRTA) then to Rainbow Valley West of Phoenix, Arizona for land farm application. The signed waste profile forms and transportation manifest prepared by PSC are presented in Appendix F. Analytical results of the IDW samples are included in Appendix G.

5.4.2 Rinse Water/Purged Groundwater

Liquid IDW generated during the WCP East Grand Avenue WQARF Site RI included rinse water from equipment decontamination and purged groundwater from monitor well development, sampling, and aquifer testing. Rinse water generated from the decontamination of drill rig augers was contained in a temporary decontamination pit lined with plastic. The decontamination water that did not evaporate and the plastic liner were transported to a roll-off bin with the residual soil to be disposed of as solid waste with soil cuttings, as discussed in Section 5.4.1. Purged groundwater generated during the investigation was either stored in Baker tanks or transported in a 500-gallon water wagon to be discharged directly to the COP sewer in accordance with the COP discharge permit. WESTON collected a composite sample from each Baker tank and/or water wagon using a disposable bailer. Liquid samples were decanted from the bailer into the appropriate laboratory supplied sample containers, labeled, and placed in a cooler with ice to be transported with COC documentation to STL in Chicago. The analytical results were used along with historical monitor well sample analytical results to obtain sewer discharge permits and manhole entry permits from the COP Water Services Department/Pollution Control Division. WESTON discharged purged groundwater generated during the investigation to City sewer manhole #403, located south of Whitton Avenue on 28th Avenue (Figure 4-1).

Groundwater sample analytical results indicated that purged groundwater generated from monitor wells WCP-44 and ENT-MW-2 contained concentrations of benzene above the Instantaneous Effluent Limitations as outlined in the COP Code, Chapter 28, Section 28-8 of

Article II. Subsequently, purged groundwater generated during the sampling of these monitor wells was contained separately in 55-gallon or 30-gallon drums. The drums were transported to an appropriate facility for disposal.

6.0 RESULTS OF DATA QUALITY ASSESSMENTS

The data quality level for the laboratory analyses was EPA Level IV. Appropriate uses for data at this level include:

- Site characterization and source identification
- Nature and extent of contamination
- Evaluation of remedial alternatives
- Engineering design
- Human health and ecological risk assessment
- Hydrogeologic modeling

6.1 QUALIFIED DATA

As described in Section 4.5.3.1, data quality was evaluated through the data validation process by QBD, a third party data validator. Data were qualified for any of the following reasons:

1. Because of laboratory deviation from the designated method.
2. Because the data did not meet the criteria listed in the references above.
3. By the professional judgment of the reviewer.

A list of potential data qualifiers used by the laboratory is presented at the beginning of Appendix H. One, none, or a combination of these data qualifiers may appear in the analytical reports to describe the analytical results of individual samples.

The following data validation flags were applied by QBD to qualified sample results to indicate either analytes that are not detectable or limitations in data usability because of deficiencies in field or laboratory QC parameters.

U The analyte was analyzed for but not detected above the numerical quantitation limit.

J The analyte was analyzed for and was positively identified, but the associated numerical value is an estimated quantity.

UJ The analyte was analyzed for but was not detected above the reporting level, but the reporting level is an estimated level.

R The data are unusable for all purposes. The analyte was analyzed for, but the target analyte might not be present.

N The analysis indicates presumptive evidence of the presence of the analyte.

NJ The analysis indicates presumptive evidence of the presence of the analyte, but the numerical value is an estimated quantity.

6.2 DATA USABILITY

Qualified data were evaluated for limitations in data usability. The assessment considered the data quality objectives and the EPA data quality level of generated data. Both the laboratory's flags and the data validation flags were considered. Qualified data may not be of adequate quality for all intended uses. The following general guidelines for data usability were considered:

- All data qualified with a **J** flag can be used for their intended purposes as listed in Section 6.0; however, the value is estimated and should be used with caution.
- Any result that has been qualified **UJ** is considered undetected with an estimated detection limit.
- All data qualified with an **R** flag are invalid and are not considered usable for any purpose.
- All data qualified with an **NJ** flag can be used for site characterization, evaluation of alternatives, and engineering design, but should not be used for human health or ecological risk assessment. Data that have been flagged **NJ** are tentatively identified and the associated numerical value represents an approximate concentration.

The following discusses the implications of data qualifiers on data usability and is summarized according to the qualifier used and reason for the qualifier flag.

- For analytical data flagged **U or UJ** due to blank contamination, the absence of the analyte was not definitely established at the reported level and the potential exists for false negatives. Such qualified results should be used with caution as estimated values for all intended purposes.
- For analytical results flagged **J** or **UJ** due to outlying surrogate or matrix spike/matrix spike duplicate (MS/MSD) recoveries, the reported values are subject to bias attributed to matrix interferences. False positive and false negative results may be reported depending on the direction and degree of bias. Such qualified results are appropriate for all interpretive uses, but should be used with caution.

- For analytical results flagged **J** due to holding time violations, positive results may exhibit low bias due to sample degradation. Such qualified results may be used as estimated values for all intended uses.
- For analytical results flagged **JN** or **NJ,** the qualitative identification of the compound was not definitely established. Therefore, the reported concentration could not be determined accurately. Such qualified results may be used with caution as estimated values for all purposes except risk assessment.
- For analytical results flagged **R,** the data should not be used for interpretation or decision-making for any purpose due to serious QC deficiencies in the collection or analysis of the sample. The data were rejected as unacceptable because the validity of the quantitative and qualitative results could not be determined.

During the VW&R RI, approximately 7 percent of the sample results undergoing data validation were qualified with **R** data qualifier flags. Approximately 90 percent of those sample results were common laboratory contaminants that were flagged **R** due to calibration deficiencies. The remaining results given **R** flags were due to a subsequent sample dilution. These samples were reanalyzed providing a more technically sound result for that analyte. Because the **R** flagged results were either on common laboratory contaminants or replaced with subsequent valid data, the affect on overall data quality for this project is minimal and the completeness of the data set is considered acceptable.

6.3 DATA VALIDATION RESULTS

The results of data validation were documented in reports prepared by QBD, and laboratory data summary sheets were amended with the QBD data qualifiers. Appendix H summarizes QC deficiencies and corresponding data qualifiers regarding any of the following issues:

- Holding times or preservation errors
- Gas chromatogram/mass spectrometer (GC/MS) tuning criteria
- Laboratory control standards
- MS/MSD and blank spike/blank spike duplicate (BS/BSD)
- Surrogate recoveries
- Internal standard performance
- Compound quantitation and reported detection limits

Deficiencies not mentioned in the above list are discussed by sampling event below. Assessment of performance evaluation (PE) sample results, blank contamination, and field duplicates are in Sections 6.4, 6.5, and 6.6 respectively.

6.3.1 Vadose Zone Investigation

Sample delivery groups (SDGs) applicable to the vadose zone investigation were summarized in Table 4-2. A total of 108 soil samples, 15 Hydropunch® samples, 12 trip blanks, 10 equipment blanks, 10 field duplicates, and one IDW sample were submitted to STL for analysis under 13 separate SDGs. (Note: Hydropunch® samples are included in this discussion because they were collected during the vadose zone investigation field mobilization.) Although not required, the IDW sample was validated along with the other samples submitted under the same SDG. The following item was noted during data validation:

- SDGs 9908G763, 9909G798, and 9909G957 were received at temperatures lower than the acceptance criteria of 4±2°C. No data qualifier flags were recommended since the laboratory did not note specific damage to the samples, such as evidence of freezing, and because a lower temperature would not adversely affect the analytical results.

6.3.2 Phase III Well Installation

During the Phase III well installation, 21 soil samples, seven Hydropunch®, eight trip blanks, six equipment blanks, and five field duplicates were collected and submitted under eight SDGs. Groundwater from ENT-MW-2 and IDW water samples were also submitted under an additional SDG. The following items were noted during data validation:

- SDGs 9909G086, 9909G138, and 9909G328 were received at temperatures lower than the acceptance criteria of 4±2°C. No data qualifier flags were recommended since the laboratory did not note specific damage to the samples, such as evidence of freezing, and because a lower temperature would not adversely affect the analytical results.
- Benzene was detected in the method blank associated with the samples from SDG 9909G167 and the laboratory flagged all results with a **B**. Because the concentration of benzene was less than the reporting limit, no additional data qualifier flags were recommended.

6.3.3 Round 1 Groundwater Sampling

Round 1 groundwater sampling included three SDGs with 16 groundwater samples, three trip blanks, two equipment blanks, two field duplicates, and one performance evaluation sample. The results of the performance evaluation sample are discussed in Section 6.4. The following items were noted during data validation:

- The COCs for Round 1 were not signed by the laboratory upon receipt of the samples; however, the Federal Express airbills were appended to the data packages. The airbills were signed and dated by the laboratory upon receipt of the samples, indicating that custody had been maintained.
- The laboratory failed to obtain the reporting limit of 1 μg/L listed in the QAPP for carbon disulfide. Undiluted samples with no matrix interference were reported at 2 μg/L. No follow-up was recommended because an Arizona AWQS has not been established for this analyte and carbon disulfide is not considered a contaminant of concern for the WCP East Grand Avenue WQARF Site.

6.3.4 Round 2 Groundwater Sampling

Round 2 groundwater sampling included three SDGs with 22 groundwater samples, two trip blanks, two equipment blanks, one field blank, three field duplicates and one IDW water sample. The following item was noted during data validation:

- The laboratory failed to obtain the reporting limit of 1 μg/L listed in the QAPP for carbon disulfide. Undiluted samples with no matrix interference were reported at 2 μg/L. No follow-up was recommended because there is no Arizona AWQS established for this analyte and carbon disulfide is not considered a contaminant of concern for the WCP East Grand Avenue WQARF Site.

6.3.5 Round 3 Groundwater Sampling

Round 3 included three SDGs with 34 groundwater samples, two trip blanks, five equipment blanks, one field blank, and four field duplicates. An IDW water sample was also submitted for analysis. The following items were noted during data validation:

- The “Sample Date” on the analytical report for Samples MWB-MW-005 and MWB-MW-B05 was incorrectly listed. The date was corrected in both the hard copy and electronic copy of the analytical results.

- The laboratory failed to obtain the reporting limit of 1 µg/L listed in the QAPP for carbon disulfide. Undiluted samples with no matrix interference were reported at 2 µg/L. No follow-up was recommended because an Arizona AWQS has not been established for this analyte and carbon disulfide is not considered a contaminant of concern for the WCP East Grand Avenue WQARF Site.
- The laboratory did not sign the COC for the IDW sample; however, the COC lists the same airbill number as the other samples that have a complete signature trail, and the laboratory has an internal COC record of the sample. Based on this, custody was maintained.

6.3.6 Round 4 Groundwater Sampling

Round 4 groundwater samples were submitted under four SDGs and included 18 groundwater samples, four trip blanks, two equipment blanks, one field blank, and two field duplicates. The following items were noted in the data validation report:

- The laboratory did not sign the COC for the IDW sample; however, the COC lists the same airbill number as the other samples that have a complete signature trail, and the laboratory has an internal COC record of the sample. Based on this, custody was maintained.
- Sample WCP-EB-030-060900 was incorrectly identified in the analytical report. The hard copy laboratory report and the electronic data report were corrected.

6.3.7 Deep Well Installation

During the deep well installation of WCP-48, six SDGs were submitted for analysis with seven soil samples, one groundwater sample, six trip blanks, one equipment blank, one field duplicate, one IDW soil sample and one IDW water sample. Additionally, five Hydropunch® samples and two trip blanks were collected and analyzed but these results were not validated. The following items were noted during validation of the applicable samples:

- The laboratory did not provide pH verification for the trip blank in SDG 9A06G792. Since this sample was a trip blank, no data qualifiers were recommended.
- Samples in SDG 9A06G811 were received at a temperature of 18°C, which exceeded the acceptance criteria of 4±2°C. All positive results were flagged with a **J** to indicate an estimated value and all results below the detection limit were flagged with **UJ** to indicate an estimated reporting limit.

- The laboratory internal COC for SDG 9A06G810 did not show a signature trail from the laboratory sample control to the volatile organics group. No data qualifiers were recommended since the laboratory was able to show documentation that the COC was not broken from the field to the laboratory and because the laboratory is a secured facility.

6.3.8 Round 5 Groundwater Sampling

Round 5 groundwater sampling included four SDGs with 19 groundwater samples, four trip blanks, three equipment blanks, one field blank, two field duplicates, and one IDW water sample. The following items were noted during data validation:

- Good laboratory practice violations on the COC occurred for SDG 9A09G614. Two errors that were corrected by obliteration or write-overs were noted. In addition, the pH sample was received and relinquished by the wet chemistry laboratory without signatures. This deviation was noted by sample receiving, and no further action was required.
- The laboratory incorrectly identified sample ENT-MW-002-091900 on the laboratory report. The report was corrected.
- The sample result for TCE at MTP-1 was given a **J** flag by the laboratory. The detected concentration of 0.3 μg/L was below the laboratory reporting limit but above the MDL. This value is considered an approximate value.

6.3.9 Round 6 Groundwater Sampling

Round 6 groundwater samples were submitted under five SDGs. Nineteen groundwater samples, three trip blanks, two equipment blanks, two field duplicates, and one IDW water sample were collected. The following items were noted during data validation:

- The internal laboratory COC for SDG 9A12G073 showed documentation of the date, time, and who placed the samples in the storage location; however, there was no documentation of the date, time, and who removed and replaced the samples for analyses. Since security was maintained within the laboratory, no data qualifier flags were recommended.
- The IDW sample listed in SDG 9A12G073 was not checked out on the internal custody form for the pH analysis. The laboratory noted this error. No flags were recommended.

6.3.10 Phase IV Well Installation

Phase IV well installation samples were submitted for analysis under 16 SDGs. Twenty-four soil samples, 11 Hydropunch® samples, 14 trip blanks, two equipment blanks, one field blank, two field duplicates, seven IDW samples and one IDW water sample were submitted for analysis. The following items were noted during data validation:

- The spectra for PCE result in sample WCP-HP-086-126 (SDG 201558) were missing from the data package. The laboratory supplied the missing page.
- The sample condition upon receipt was not recorded on the COC (SDG 201658). The laboratory provided additional documentation to show that the temperature was recorded and sample condition was checked. No further action was recommended. The date and time the laboratory received the samples was not recorded on the COC. Since the airbill that accompanied the data package showed a date and time of receipt, no additional action was required. The internal COC did not show the transfer of the trip blank from department to department.
- The internal COC did not show all samples transfer record (SDG 201695). Only the soil samples from this SDG were shown. No data qualifier flags were recommended. The laboratory was advised to show transfer of all samples.
- The laboratory report incorrectly identified WCP-HP-083-121 (SDG 201695). The data validator manually corrected the laboratory report and contacted the laboratory.
- The laboratory showed the sampling date of SDG 201774 incorrectly. A new laboratory report was issued with the correct sampling date listed. No data qualifier flags were issued because the samples were analyzed within the holding times.

6.3.11 Round 7 Groundwater Sampling

Round 7 groundwater sampling included samples submitted under 10 SDGs. Thirty groundwater samples, eight trip blanks, two equipment blanks, one field blank, three field duplicates, and three IDW water samples were submitted for analysis. The following items were noted during data validation:

- The pH for all samples in SDG 202227 was not documented on the run log that was originally provided from the laboratory. A revised run log that indicated the pH for all samples was provided by the laboratory.
- An incorrect sample identification was listed in the laboratory report for SDG 202274. The laboratory issued a corrected report.
- Analytical results for PCE and TCE at MTP-1 indicated concentrations of 0.8 μg/L and 0.6 μg/L, respectively. These results were given a **J** qualifier due to possible contaminant carryover in the laboratory instrumentation. The results should be considered as estimated values.

6.3.12 Round 8 Groundwater Sampling

Nine SDGs were submitted during Round 9 groundwater sampling covering 32 groundwater samples, seven trip blanks, three equipment blanks, one field blank, one PE sample, two field duplicates, and five IDW water samples. Results of the PE sample are discussed in Section 6.4. The following item was noted during data validation:

- The sample result for TCE at MTP-1 was given a **J** flag by the laboratory. The detected concentration of 0.3 µg/L was below the laboratory reporting limit but above the MDL. This value is considered an approximate value.

6.3.13 Aquifer Test

Samples collected during the aquifer test included three groundwater samples, two trip blanks, and three IDW water samples. These samples were submitted under two SDGs. The following item was noted during data validation:

- The data package for SDG 203546 did not contain raw data for the 2 µg/L standard of the initial calibration, and several copies of pages were missing. The laboratory was contacted and provided the missing information.

6.3.14 Round 9 Groundwater Sampling

Round 9 groundwater sampling included 11 SDGs with 31 groundwater samples, nine trip blanks, three equipment blanks, one field blank, three field duplicates, and two IDW water samples were submitted for analysis. The following item was noted during data validation:

- The sample identification for WCP-EB-084-061201 and WCP-MW-084-061201 were switched. Historical data were reviewed to confirm the switch. The correct sample identifications were manually marked in red by QBD and the EDD was corrected.

6.3.15 Round 10 Groundwater Sampling

Round 10 groundwater sampling included 11 SDGs. Thirty groundwater samples, 10 trip blanks, three equipment blanks, one field blank, three field duplicates, and three IDW water samples were submitted for analysis. The following items were noted during data validation:

- The laboratory data package was missing three pages of supporting documentation (pages 248, 249, and 250). The laboratory was contacted and the missing pages were provided.

- The analysis of the dilutions of Samples WCP-MW-030-062701 and WCP-MW-087-062701 (SDG 204166) exceeded the holding time of 14 days by two days. The positive results were flagged **J**.
- The analysis of benzene in Samples MGL-MW-002-062801 and MGL-MW-001-062801 (SDG 204200) exceeded the holding time of 14 days by one day. The positive results have been flagged **J**.

6.3.16 Phase V Well Installation

Phase V well installation included 23 soil samples, seven Hydropunch® samples, nine trip blanks, two equipment blanks, one field blank, three field duplicates, and four soil IDW samples under 11 SDGs. The following items were noted during data validation:

- Samples WCP-MW-097-016 and WCP-MW-097-086 from SDG 204235 contained target analytes that were reported at concentrations less than the reporting limits. The associated results were flagged **J** to indicate an estimated value.
- The data package for SDG 204328 did not contain the raw data for the determination of percent moisture. The laboratory was contacted and provided this documentation.
- Three soil samples collected from the boring for WCP-96 and listed on the COC associated with the SDG 204521 were not analyzed by the laboratory. The samples were collected using the Encore™ sampling device on a Friday and shipped for overnight delivery to the laboratory by Federal Express. The samples did not arrive at the laboratory until Monday, which exceeded the 48-hour preservation holding time. WESTON was contacted and decided to not analyze those soil samples.
- Percent moisture analysis was requested on the COC for Sample WCP-MW-093-126D in SDG 204565; however, additional sample volume was not provided and the laboratory could not perform the requested analysis.

6.3.17 Round 11 Groundwater Sampling

Round 11 groundwater sampling samples were included under 15 SDGs. Thirty-eight groundwater samples, four field duplicates, two field blanks, four equipment blanks, 13 trip blanks, and four IDW water samples were submitted for analyses. The following items were noted during data validation:

- The laboratory failed to obtain the reporting limit of 1 μg/L listed in the QAPP for carbon disulfide. Undiluted samples with no matrix interference were reported at 2 μg/L. No follow-up was recommended because there is no Arizona AWQS established for this analyte and carbon disulfide is not considered a contaminant of concern for the WCP East Grand Avenue WQARF Site.

- The identification of sample ENT-MW-002-081501 in SDG 204996 was incorrectly reported as WCP-MW-002-081501. The laboratory report was corrected and the electronic data deliverable was updated.
- The laboratory failed to obtain the reporting limits listed in the QAPP for all compounds in sample ENT-MW-002-081501 due to the dilution required for analysis of benzene. In the reviewer's professional opinion, the laboratory achieved the lowest possible reporting limits; therefore, no follow-up was recommended.

6.3.18 Round 12 Groundwater Sampling

Round 12 groundwater sampling included 14 groundwater samples, 2 field duplicates, one field blank, two equipment blanks, five trip blanks, and two IDW water samples submitted to the laboratory under seven SDGs. An additional 16 groundwater samples and four trip blanks collected with PDB samplers were submitted to Columbia under four additional SDGs. The PDB analytical results were not validated by QBD. No data validation issues were noted regarding the analyses undergoing data validation other than the data qualifiers presented in Appendix H.

6.3.19 Round 13 Groundwater Sampling

Round 13 included 37 groundwater samples, four field duplicates, one field blank, four equipment blanks, 10 trip blanks, and one IDW water sample submitted to the laboratory under 11 SDGs. No data validation issues were noted other than the data qualifiers presented in Appendix H.

6.3.20 Phase VI Well Installation

Phase VI Well Installation included 12 SDGs. Thirty soil samples, three field duplicates, two groundwater, one field blank, three equipment blanks, nine trip blanks, and four IDW soil samples were collected and submitted for analysis. The following item was noted during validation:

- The data package for SDG 206900 did not contain the raw data for the percent solids determinations for samples collected under this SDG. The laboratory was contacted and the data was supplied.

6.3.21 Round 14 Groundwater Sampling

Round 14 groundwater sampling included six groundwater samples, one equipment blank, and three trip blanks under three SDGs. The following item was noted during validation:

- The original laboratory report did not contain the results for methyl tert-butyl ether for SDGs 207292 and 207313. The laboratory was contacted and issued revised reports.

6.3.22 Round 15 Groundwater Sampling

Round 15 groundwater sampling included 39 groundwater samples, four field duplicates, two field blanks, three equipment blanks, nine trip blanks, and two IDW water samples collected under nine SDGs. The following item was noted during validation:

- Several pages were missing in the laboratory report for SDG 207673. The laboratory was contacted and provided the missing pages.

6.4 PERFORMANCE EVALUATION SAMPLE RESULTS

Three PE samples were submitted to the analytical laboratory, STL. The first PE sample was submitted in December 1999 during Round 1 groundwater sampling. Sample results were compared with the true values as certified by Environmental Resource Associates of Arvada, Colorado, as shown in Table 6-1. Of the 23 compounds present in the PE sample, the laboratory detected and reported 20 analytes. The three analytes that were not reported were not part of this project’s target compound list. The average percent recovery of the true value for those analytes reported was 88.4 percent. The laboratory reported 17 out of 20, or 85 percent, of the results within the control limits. The recommended percent of reported results falling within the control limits for an acceptable PE sample is 90 to 100 percent. The three analytes not within the control limits were benzene, methylene chloride, and styrene. These compounds are not considered contaminants of concern for this project; therefore the results of this PE sample are considered acceptable.

The second PE sample was submitted to STL on May 2, 2001. Out of 23 possible acceptable results, the laboratory reported 20 results (Table 6-2). As in the previous PE sample, the analytes not reported were not part of the target compound list. Of the 20 results reported by the laboratory, six results were determined to be unacceptable, which resulted in a score of 70 percent acceptable. The unacceptable results were carbon tetrachloride, chlorobenzene, PCE, 1,1,1-TCA, m/p-xylenes, and total xylenes. The average percent recovery was 84.7 percent.

Due to the low overall score, the poor average percent recovery, and the unacceptable result for PCE, which is a primary compound of concern for this project, the laboratory was asked to perform a corrective action. The laboratory reviewed the analytical data and supporting QC data including initial and continuing calibrations, surrogate recoveries, internal standards, second source laboratory control standards and duplicates, and method blank results. All laboratory QC results were within acceptance criteria. The laboratory also checked for transcription errors and reviewed integration and ion ratios, which were confirmed correct. There were no QC deficiencies detected in relationship to the questioned sample results.

A third PE sample was submitted to STL one week later on May 7, 2001. The results of this PE sample were acceptable (Table 6-3). As in the previous two PE samples submitted, 20 out of 23 possible analytes were reported. The three non-reported analytes were not on the target analyte list. The average percent recovery was 98.6 percent and all 20 of the reported analyte results were within acceptable control limits. Based on the results of this PE sample and the 1999 PE sample, the overall performance of the laboratory is considered acceptable.

6.5 ASSESSMENT OF FIELD BLANK CONTAMINATION

A summary of field QC validation results of trip blank, equipment blank, and field blanks is presented in Table 6-4. The majority of detectable contaminants that were found in field blanks were common laboratory contaminants (acetone, methylene chloride, and 2-butanone). Appropriate data qualifier flags were applied as shown in Table 6-4. Detected contaminants that are not common laboratory contaminants included chloromethane, toluene, m,p-xylenes, benzene, and MTBE. Additionally, TCE, PCE, and 1,1-DCE were detected in some blank samples; however, the associated samples did not have detectable concentrations of these analytes and therefore data qualifier flags were not applied to the associated sample results.

As described above, data qualified due to blank contamination is useable, however the possibility of false negative results exists. Analytical results for TCE were affected by contamination in the field blank samples in only two samples: ENT-MW-2 in Round 6 and WCP-46 in Round 10. The reporting limits of TCE for those samples were raised to 4 μg/L and 1 μg/L, respectively. No other analytical results for any of the primary contaminants of concern, PCE, TCE, or 1,1-DCE, were affected by contamination in field blanks.

6.6 ASSESSMENT OF FIELD DUPLICATE SAMPLES

There are no standard procedures for evaluating field duplicates. Typically, assessment criteria of field duplicates defaults to the criteria listed in EPA's *Functional Guidelines for Inorganic and Organic Data Review*, which is a relative percent difference (RPD) of ≤20 percent for water and ≤50 percent for soil. These values were listed as the acceptance criteria in the project QAPP.

Some field duplicate results were not within the above acceptance criteria. Results near the MDL often result in a high RPD and the absolute criteria listed in the project QAPP should not be applied. When the results were near the MDL, a five times rule, as described in the EPA guidelines, was used. In the five times rule, results that were greater than five times the MDL were evaluated against the criteria stated above. RPDs for analyte concentrations that are less than five times the MDL were evaluated on a case-by-case basis. Field duplicate results not within acceptance criteria are presented in Table 6-4.

Although some field duplicate sample results were out of acceptance criteria as written in the project QAPP, the effect on overall data usability is minimal. The implications to data usability for each duplicate result listed in Table 6-4 are as follows:

- The calculated RPD of 28.6 percent for *cis*-1,2-dichloroethene (*cis*-1,2-DCE) in WCP-15 during Round 1 is only slightly above the acceptance criteria. The analytical results of both the sample and field duplicate of 3 μg/L and 4 μg/L, respectively, are below the AWQS/MCL of 70 μg/L. Presence of this compound is generally used as an indicator species of the degradation of PCE and TCE. Due to the low concentrations of *cis*-1,2-DCE detected throughout this project, it is not a contaminant of concern and the field duplicate results do not affect project decision making.

- Due to serial dilution, the detection limit for 1,1-DCE in WCP-30 during Round 2 was 12 μg/L. Sample and field duplicate results were 69 μg/L and 54 μg/L, respectively. Because of the increased detection limit, the five times rule would be applicable in this instance and the RPD of 24.4 percent is considered acceptable.
- The analytical result of PCE in WCP-15 during Round 6 sampling and the associated field duplicate, 47 μg/L and 61 μg/L, respectively, are both above the AWQS/MCL of 5 μg/L. Both the duplicate and sample results are within the concentration range of PCE in previous samples collected from WCP-15.
- Analytical results for both the sample and duplicates for WCP-87 for 1,1-DCE, TCE, and PCE during Round 9 sampling are significantly greater than their corresponding AWQS/MCL (7 μg/L, 5 μg/L, and 5 μg/L, respectively). Round 9 analytical results indicate an increase in 1,1-DCE, TCE, and PCE results over previous samples collected from WCP-87; however, the duplicate sample results for Round 9 more closely reflect previous sample results of these contaminants. Due to the high RPD for these sample results, the concentrations should be considered estimated values.
- The calculated RPD for chloroform in WCP-90 during Round 15 was 28.6 percent, based on the sample result of 3 μg/L and the field duplicate of 4 μg/L. Because chloroform is a common laboratory contaminant, the differences in sample and duplicate results likely are a result of laboratory contamination and do not affect overall data quality.
- The analytical result of TCE in WCP-202 of 2 μg/L and the associated field duplicate result of 3 μg/L during Round 15 are both below the AWQS/MCL for TCE. Because of the low concentrations, the effects to data usability are minimal.

6.7 ANALYTICAL PROBLEMS/CORRECTIVE ACTION

The following discussion presents the problems encountered and the corrective actions taken during the laboratory analysis of samples for this investigation.

- During the early portion of the RI (vadose zone investigation and Phase III well installation), STL did not report *trans*-1,2-dichloroethene. This compound was listed as a target compound in Table 2-3C of the project QAPP; however, the original analysis request was for EPA Methods 601/602, which did not include this analyte. The target list was not updated when the change order was made to analyze by EPA Method 8260B. It was decided not to reissue the affected reports and a corrective action was implemented so that analyses beginning with Round 1 groundwater sampling would include this analyte.

- Analysis of equipment blanks collected during the vadose zone investigation and Phase III well installation showed consistent positive results for several contaminants. In order to identify the source of the contamination, samples of the ultra pure water, deionized water, and the hexane rinse used for equipment decontamination were submitted to the analytical laboratory. Results of the analysis indicated positive results for acetone and 4-methyl-2-pentanone in the ultra pure water, 4-methyl-2-pentanone in the deionized water, and 4-methyl-2-pentanone, benzene, toluene, and total xylenes in the hexane rinse.

  Contamination detected in equipment blanks was attributed to a combination of laboratory contamination and field practices. The hexane rinse sample contained the greatest number of contaminants and also contained contaminants that are not common laboratory contaminants. Hexane, for use as an equipment decontamination rinse, had been kept on hand in a locked storage area. The hexane was potentially used over the course of several projects and kept on hand for varying amounts of time, creating the possibility for contamination. Corrective actions included purchasing new hexane for each drilling project and not storing excess hexane in the storage area for extended periods of time. Corrective actions for laboratory contamination included changing to factory sealed ultra pure water rather than laboratory supplied ultra pure water.

- As discussed in Section 6.3, the performance by the laboratory in the analysis of the May 2, 2001 PE sample was not within the recommended acceptance criteria. Because the laboratory did not find any deficiencies in their QC results a corrective action was not developed. A subsequent PE sample submitted to STL resulted in 100 percent of sample results falling within the acceptable criteria. No further corrective action was requested.

7.0 NATURE AND EXTENT OF CONTAMINATION

The present understanding of the nature and extent of soil contamination beneath the VW&R facility and groundwater contamination in the WCP East Grand Avenue WQARF Site has been developed from data generated during previous investigations (HLA, 1994 and 1995; Fluor Daniel, 1997; and WESTON, 1998) and the current RI activities. The description of the VOC contaminants and their distribution in soil and groundwater are discussed in the following sections.

7.1 CONTAMINANTS OF CONCERN

Several contaminants have been detected in soil and groundwater samples collected during previous and current investigations of the WCP East Grand Avenue WQARF Site. The primary contaminants of concern include PCE, TCE, and 1,1-DCE. These compounds have been detected in soil-gas and soil samples collected on the VW&R facility and in groundwater samples collected from wells in the WCP East Grand Avenue WQARF Site.

The State of Arizona has established relevant standards against which these contaminants are compared. Soil contaminant concentrations are compared to the Arizona Soil Remediation Levels (SRLs) and to the minimum GPLs. The SRLs are established in Arizona Administrative Code (AAC) R18-7-205 and consist of residential and non-residential standards. Contaminant concentrations in groundwater are compared with Aquifer Water Quality Standards (AWQS) for Arizona, which are established in AAC R18-11-406. The AWQSs include the EPA MCLs and are referenced in this document as AWQS/MCLs. The following table lists the relevant standards for the contaminants of concern at the WCP East Grand Avenue WQARF Site.

Contaminant of Concern	AWQS/MCL (µg/L)[1]	GPL (mg/kg)[2]	Residential SRL (mg/kg)[2]	Nonresidential SRL (mg/kg)[2]
PCE	5	1.3	53	170
TCE	5	0.61	27	70
1,1-DCE	7	0.81	0.36	0.8

[1]µg/L = micrograms per liter
[2]mg/kg = milligrams per kilogram

The concentrations in groundwater of the three primary contaminants of concern have exceeded the AWQS/MCL in several locations. Maximum concentrations of PCE, TCE, and 1,1-DCE detected in groundwater samples collected from around the Site during the current RI sampling activities are 920 µg/L, 1,100 µg/L, and 210 µg/L, respectively. Historical concentrations of PCE and TCE detected in samples from monitor wells located on the VW&R facility have been as high as 1,800 µg/L and 2,700 µg/L, respectively.

7.2 OTHER DETECTED CONTAMINANTS

Other contaminants detected in groundwater during the WCP East Grand Avenue RI that exceeded the AWQS/MCLs include benzene, toluene, ethylbenzene, and xylenes (BTEX). Relevant standards for these contaminants are listed below.

Detected Contaminant	AWQS/MCL (µg/L)[1]	GPL (mg/kg)[2]	Residential SRL (mg/kg)[2]	Nonresidential SRL (mg/kg)[2]
Benzene	5	0.71	0.62	1.4
Ethylbenzene	700	120	1,500	2,700
Toluene	1,000	400	790	2,700
1,2-DCA	5	0.21	2.5	5.5
Carbon Tetrachloride	5	1.6	1.6	5.0

[1]µg/L = micrograms per liter
[2]mg/kg = milligrams per kilogram

BTEX constituents were typically detected in wells located on or near documented LUST sites downgradient from the VW&R facility and were generally highest in ENT-MW-2, WCP-44, and WCP-202. Concentrations of these compounds in monitor wells located on the VW&R facility were either below the MDL or were considered estimated values because the compound was detected above the MDL but below the laboratory reporting limit indicating that the VW&R facility is not the source of BTEX constituents in groundwater.

Although WCP-44 and WCP-202 are located near documented LUST sites, the high concentrations of benzene detected at these locations, up to 6,300 μg/L in WCP-202, appear to be the result of an unrelated benzene release. STL chemists evaluated the chromatograms and spectra for results from ENT-MW-2, WCP-44, and WCP-202. The spectra from ENT-MW-2 had a definite fuel hydrocarbon pattern and appeared to be attributable to a gasoline release (Wright and Kaczinski, 2002). The spectra from WCP-44, located southeast of ENT-MW-2, contained some hexane and pentane peaks but no large hydrocarbon peaks. The chemist determined that the results from WCP-44 appeared to have characteristics of both a possible fuel hydrocarbon release and a possible benzene release. Analytical results were also evaluated for WCP-202, located southwest of ENT-MW-2 and WCP-44. Based on a review of the chromatograms and spectra for this well, there were no hydrocarbon peaks present and the high benzene detections were attributed to a benzene release.

Concentrations of 1,2-DCA were detected above the AWQS/MCL in samples collected from MGL-1 and MGL-2 located on the Mogul facility. A bailed sample collected from ENT-MW-2 during Round 3 also had a 1,2-DCA concentration of 380 μg/L, which also exceeded the AWQS/MCL. There were no additional occurrences of 1,2-DCA in this well either before this sampling event or after this event, indicating this result was anomalous. This compound was also detected in samples collected from monitor wells located on the VW&R facility but at concentrations that did not exceed the AWQS/MCL. The exceedances of the AWQS/MCL observed in the Mogul wells appear to be localized in that area and unrelated to the main contaminant plume, therefore, 1,2-DCA is not considered to be a contaminant of concern.

Carbon tetrachloride was detected in Hydropunch® groundwater samples collected from soil borings drilled on the VW&R facility during the vadose zone investigation. Concentrations of carbon tetrachloride met or exceeded the AWQS/MCL of 5 μg/L in Hydropunch® samples collected from SB-10, SB-16, and SB-17. Carbon tetrachloride was also detected in

Hydropunch® groundwater samples collected during the installation of WCP-87 and WCP-93; however, concentrations were below the AWQS/MCL. Concentrations of carbon tetrachloride in groundwater samples collected during groundwater monitoring events were also below the AWQS/MCL and therefore, carbon tetrachloride is not considered a contaminant of concern.

Concentrations of 1,1,1-TCA were observed in soil samples from earlier investigations of the facility (HLA, 1995). This compound was not identified in soil samples collected during this RI or in groundwater samples collected during the groundwater monitoring activities. Because it has not appeared in detectable concentrations during this investigation, 1,1,1-TCA is not considered a contaminant of concern and will not be discussed further.

7.3 CHARACTERISTICS OF THE CONTAMINANTS OF CONCERN

The following sections describe the general characteristics of the three primary contaminants of concern. Table 7-1 lists the physico-chemical properties of PCE, TCE, and 1,1-DCE. Fate and transport mechanisms for these contaminants are discussed in Section 7.8 and the distributions of the contaminants are discussed in Sections 7.4 and 7.5.

7.3.1 PCE

PCE is a colorless liquid that has been historically used as a dry cleaning agent and as a chemical intermediate in the production of fluorocarbons. It is classified as a probable carcinogen to humans based on sufficient animal research evidence and limited human research evidence (Toxnet, 2001). It has moderate mobility in soil based on a soil adsorption constant (K_{oc}) of approximately 303 milliliters per gram (mL/g) and may volatilize from dry soil surfaces (Fetter, 1994). With a specific gravity of 1.62, PCE is denser than water and as a free-phase liquid will sink when in contact with groundwater. It has a solubility in water of 150 mg/L (Cohen and Mercer, 1993).

7.3.2 TCE

TCE is a colorless liquid that has historically been used in degreasing operations as well as in the plastics, appliances, jewelry, automobile, textile, paper, glass and printing industries. TCE is also a byproduct of the anaerobic biodegradation of PCE. It is classified as a probable carcinogen to humans based on sufficient animal research evidence and limited human research evidence (Toxnet, 2001). TCE has a moderate mobility in soils based upon an average K_{oc} of 152 mL/g and has the potential to volatilize from dry soil surfaces (Fetter, 1994). Sorption of TCE from the vapor phase onto soil is also possible. TCE is denser than water, with a specific gravity of 1.46. It has a solubility in water of 1,100 mg/L (Cohen and Mercer, 1993).

7.3.3 1,1-DCE

1,1-DCE is a colorless liquid often used in the manufacturing of plastics, adhesives, and synthetic fibers. 1,1-DCE is also formed during the anaerobic biodegradation of TCE, by way of a minor pathway, and by the hydrolysis of 1,1,1-TCA (Toxnet, 2001). It is categorized as a possible human carcinogen, but a definitive classification cannot be established due to inadequate evidence from animal and human research (Toxnet, 2001). An estimated K_{oc} of 217 mL/g suggests that 1,1-DCE would have moderate mobility through soil (Fetter, 1994). 1,1-DCE is denser than water having a specific gravity of 1.21. The solubility of 1,1-DCE in water is 400 mg/L (Cohen and Mercer, 1993).

7.4 DISTRIBUTION AND TRENDS OF SOIL CONTAMINATION

The results of the vadose zone investigation and previous investigations provide most of the available information concerning the distribution of contaminants in soils at the VW&R facility. Physical testing results of soil samples are presented in Appendix I and are tabulated in Table 7-2. Tables 7-3 through 7-5, presented by sampling event, summarize analytical results for VOCs detected in soil samples collected as part of this RI. All analytical results for current RI activities are presented in electronic format and are attached as Appendix G. Previous investigation results are presented in Section 1.3.

Analytical results from previous investigations and from Phase III samples of the RI confirmed the presence of TCE and PCE in subsurface soils in the areas of the VW&R facility where elevated VOC concentrations were detected in soil-gas samples collected in 1994. The detections of these compounds, however, did not exceed the minimum GPLs or the Arizona SRLs established for TCE and PCE. Contaminant and lithologic cross sections of the soil borings drilled during the vadose zone investigation were prepared to evaluate the distribution of contaminants in soils on the VW&R facility (Figures 7-1 through 7-5).

The time elapsed since VOC products were documented to have been present on the site is approximately 31 years, suggesting that near-surface soils are unlikely to exhibit detectable concentrations of VOCs, even if surface releases occurred during the time that these chemicals were present on the facility. However, as discussed in Section 7.8.1, VOCs do not migrate readily through fine-grained materials and movement is impeded in moister soils; therefore, low concentrations of VOCs are more likely to be detected in near-surface fine-grained soils.

Soil-gas samples were collected at the VW&R facility in 1994 by HLA as described in Section 1.3.2. Elevated concentrations of PCE, TCE, and 1,1-DCE were located primarily in two areas (Figures 1-4, 1-5 and 1-6) (HLA, 1994). One area encompassed the former building foundation and extended southwest of it. The other area was located approximately 120 feet northwest of the former building foundation.

Near-surface soil contamination was detected in borings SB-11, SB-14, and SB-17. Results indicated the presence of PCE at 1 foot bgs with concentrations ranging from 0.062 to 0.093 mg/kg. TCE and PCE were also detected in a near-surface fine-grained unit at 21 feet bgs in borings SB-14 and SB-17 at concentrations ranging from 0.062 to 0.074 mg/kg and 0.069 to 0.072 mg/kg, respectively (Figures 7-3 and 7-4). PCE was detected in soil samples from SB-6 and WCP-15 at 20 to 21 feet bgs at concentrations of 0.0066 mg/kg and 0.065 mg/kg, respectively (Figures 1-7 and 1-8).

A zone of elevated PCE and TCE concentrations in the vadose zone occurred at the 56 to 71 feet bgs (elevation 1048 to 1087 feet amsl) depth interval beneath the facility. This zone is located at a lithological transition from coarse to fine-grained materials as illustrated in Figures 7-2 through 7-5. The transition from coarse to fine-grained material represents a location where lateral spreading would be expected to occur from reduction in vertical conductivity on a downward-migrating liquid. Soil samples collected from this zone contained concentrations of PCE ranging from 0.044 to 0.220 mg/kg and TCE ranging from 0.060 to 0.250 mg/kg. The highest concentration of TCE was at approximately 61 feet bgs in SB-12 and SB-14. Soil samples collected at 61 feet bgs in SB-12 had the highest concentration of PCE at 0.220 mg/kg. Soil borings SB-12 and SB-14 are located approximately 75 feet northwest of the former VW&R building foundation. Soil samples collected from Phase VI well WCP-100 at this depth horizon contained PCE concentrations ranging from 0.077 mg/kg to 0.190 mg/kg and TCE concentrations from 0.087 mg/kg to 0.210 mg/kg.

Detectable concentrations of PCE and TCE were found in samples collected from several borings in the unsaturated zone above the water table. The depth-to-water at WCP-16 at the time of installation was approximately 106 feet bgs. Soil samples collected from the boring at 100 to 101.5 feet bgs indicated PCE and TCE concentrations of 0.088 mg/kg and 0.120 mg/kg, respectively. By 1999, when the Phase III vadose zone investigation was conducted, depth-to-water measurements under the facility varied from approximately 116 feet bgs to 121 feet bgs. Samples collected from SB-8, SB-10, SB-12, SB-16, and SB-17 contained PCE concentrations ranging from 0.081 mg/kg to 0.340 mg/kg and TCE concentrations ranging from 0.058 mg/kg to 0.480 mg/kg at approximately 120 feet bgs (Figures 7-2 and 7-4). Soil samples collected from the borings of the Phase VI wells, WCP-100 and WCP-200, also had detectable concentrations of PCE and TCE at 116 feet to 126 feet bgs. Concentrations of PCE in the unsaturated zone above the water table from WCP-100 ranged from 0.170 mg/kg to 0.190 mg/kg and TCE was detected at 116 and 121 feet bgs at a concentration of 0.160 mg/kg. Samples collected from WCP-200 at depths from 116 feet bgs to 126 feet bgs indicated PCE at a concentration of 0.390 mg/kg to 0.550 mg/kg and TCE at a concentration of 0.270 mg/kg to 0.410 mg/kg. Concentrations of 1,1-DCE were also detected in WCP-200 in samples from depths ranging from 116 feet bgs to 126 feet bgs at concentrations ranging from 0.057 mg/kg to 0.140 mg/kg (Figure 7-5). As stated previously, the unsaturated zone directly above the water table (i.e., approximately 116 feet bgs to 126 feet bgs) is also located at a lithologic transition from coarse to fine-grained materials.

7.4.1 Saturated Soil Samples

Soil samples were also recovered from the saturated zone and analyzed for VOC concentrations, as identified in Tables 7-3 through 7-5. Many of these samples were collected at the same approximate depth as Hydropunch® samples to provide data from which to compare concentrations in groundwater samples with those in the aquifer materials that contain them. These samples should not, however, be considered "soil sample" nor should they be compared with the SRLs and/or GPLs for vadose zone soils.

7.5 DISTRIBUTION AND TRENDS OF GROUNDWATER CONTAMINATION

Evaluation of groundwater contaminant distribution was based on analytical results obtained from samples collected during each round of groundwater monitoring and from Hydropunch® samples collected during the vadose zone investigation. Hydropunch® contaminant distribution is discussed in Section 7.5.1 and the lateral distribution of contaminants based on groundwater monitoring data is discussed in Section 7.5.2. The vertical extent of groundwater contamination is discussed in Section 7.5.3.

Groundwater elevations have shown a general decline since the first groundwater monitor well was installed on the VW&R facility in 1997 (Figures 2-21 through 2-24). WESTON compared 1,1-DCE, PCE, and TCE concentrations and groundwater elevations over time in seven monitoring wells where concentrations were consistently above the AWQS/MCL. The monitor wells evaluated included WCP-15, WCP-16, WCP-17, WCP-28, WCP-30, WCP-45, and WCP-87 (Figures 7-6 through 7-12).

Groundwater levels declined approximately 17 feet in WCP-15, WCP-16, and WCP-17 since 1997, approximately 14 feet in WCP-28 and WCP-30 since 1998, approximately 6.5 feet in WCP-45 since 1999, and approximately 4 feet in WCP-87 since 2001. Contaminant concentrations obtained from groundwater samples collected from these wells have also shown a general decrease over time. The groundwater-vadose zone interface is typically located in a zone of fine-grained sediments. These fine-grained sediments have a tendency to retain contaminantrich pore water through capillary forces during declines in the water table, which appears to result in a reduction of VOC concentrations in the groundwater.

7.5.1 Hydropunch® Samples

Hydropunch® samples collected from 10 boreholes drilled on the VW&R facility (as described in Section 4.2.1) and from selected monitor well boreholes drilled during Phases III through VI of the WCP East Grand Avenue WQARF Site RI were described in Section 4.0. A summary of detected concentrations of VOCs in Hydropunch® samples is presented in Tables 7-6 through 7-9. All analytical results are presented in electronic format and are attached as Appendix G.

WESTON evaluated the Hydropunch® sample results from the boreholes drilled during the Phase III vadose zone investigation. Concentration contours were developed to evaluate the lateral distribution of the contaminants of concern beneath the VW&R facility (Figures 7-13 through 7-15). These concentration contour results generally correspond to earlier soil-gas results from the HLA soil-gas survey conducted in 1994 and to soil sample results from the corresponding wells. As illustrated on the figures, the highest concentrations of PCE and 1,1-DCE were found in samples collected from boring SB-10, located southwest of the former building foundation. The highest concentration of TCE was from SB-8, located underneath the former building foundation.

The results for Hydropunch® samples collected prior to well installations are presented on Figure 7-16. Generally, the Hydropunch® sample results mirror the distribution of the contaminant plume as defined by the groundwater monitoring data. An exception to this correlation occurs for the first groundwater sample collected after the Hydropunch® sample collection. Hydropunch® sample results tended to be greater than the groundwater monitor well result in samples collected closer to the VW&R facility. Sample locations at the perimeter of the plume area typically had Hydropunch® sample results with lower concentrations than the groundwater monitor well sample.

The concentration differences can be generally attributed to two factors. First, samples collected using the Hydropunch® method were generally collected close to the groundwater-unsaturated zone interface. During groundwater monitoring, the pump intake was typically set 5 to 10 feet below the groundwater interface. Groundwater contaminant concentrations tend to decrease with depth near the source area, where contaminants have adsorbed to fine-grained materials at the groundwater-unsaturated zone interface as groundwater elevations have decreased. Therefore, samples collected closer to the source and to the groundwater-unsaturated zone interface are expected to yield greater contaminant concentrations than samples collected 5 to 10 feet below this zone. As contaminated groundwater moves away from the source area, the effects of diffusion and dispersion tend to reduce this concentration stratification.

The second contributing factor in the concentration variances between Hydropunch® samples and groundwater monitoring well samples is the monitor well purging process. As the monitor wells are purged, water with either lower or higher concentrations of contaminants can be mixed with groundwater at the well location. Additional discussion of the effects of purging methods on sample results can be found in Section 7.5.2.2.

7.5.2 Groundwater Monitoring Data

Groundwater monitoring activities associated with this RI began in December 1999 and were conducted monthly for the first three rounds of sampling. During those sampling events, groundwater samples were collected using both a disposable bailer and directly from the pump, as discussed in Section 5.0. Samples were collected using both methods in order to compare sample results.

Detected concentrations of VOCs are presented in Tables 7-10 through 7-24. All groundwater monitoring analytical results are presented in electronic format and are attached as Appendix G. Table 7-25 presents field data collected during each round of groundwater sampling. Analytical data for PCE, TCE, and 1,1-DCE were used to develop concentration contour maps for most of the groundwater sampling rounds. Concentration contour maps were not developed for Round 12 because this sampling event tested the use of PDB sample collection methods and a limited number of monitor wells were sampled. An evaluation of PDB sample data is presented in Section 7.5.2.3. Concentration contour maps were also not developed for Round 14 due to the incomplete data set resulting from the sampling problems discussed in Section in 4.2.4.2.

Figures 7-17 through 7-52 present PCE, TCE, and 1,1-DCE concentration contour maps for groundwater samples collected using the pump discharge sample collection method for Rounds 2 through 15, excluding Rounds 12 and 14. To maintain comparability of data, the following discussion is limited to the distribution of groundwater contamination based on the results of the pump discharge samples only. A discussion of the effects of the bailer sample collection method on sample results and distribution of contamination is presented in Section 7.5.2.1.

The orientation of the long axis of the 1,1-DCE, PCE, and TCE concentration plumes for Rounds 2 through 6 vary from those of subsequent rounds. The plume appears to trend in a more west-southwesterly direction in the early rounds compared with a southwesterly direction beginning with sampling Round 7, conducted in February and March 2001. This apparent change in plume direction is a function of the distribution of wells available for sampling during the initial rounds, rather than any change in actual contaminant distribution. Round 7 groundwater sampling followed the installation of nine additional monitor wells. The additional monitor well data and the monitor well distribution provided a more clear definition of contaminant distribution and plume orientation. The SRP well, 10.5E-7.5N, has not been pumped since May 1999 and therefore, had no effect on plume orientation.

Based on the concentration contours, the lateral distribution of groundwater contamination varies slightly by contaminant, but the center of the plume is generally located around WCP-16 and WCP-30. The center of the plume is more clearly defined in Round 7 with the addition of WCP-87, and extends southwest from the center of the VW&R facility. WCP-93 was installed on the southeast corner of the facility and sampled during July 2001 as Round 11. This well provides additional definition of the plume southeast of the VW&R facility.

Concentrations of PCE, and to a lesser extent TCE, in samples from WCP-28 collected in Rounds 2 (Figures 7-17 and 7-29) and 4 (Figures 7-18 and 7-31) appear to be anomalously high when compared to the entire data set. Minor local variations in groundwater flow may have contributed to the anomalous readings. The PCE result was flagged as possibly having a high bias due to unacceptable surrogate recoveries in Round 2, contributing to the high reading for this compound. Subsequent sampling demonstrates that these high readings are not representative of the typical concentration of VOCs in groundwater at this location.

The reasons for the increased VOC concentrations in WCP-16 and decreased VOC concentrations in WCP-87 during Rounds 11 through 13 are likely related to a combination of two factors: the overall groundwater elevation decline in the area and a change in monitor well purge methods. Samples for each of these sampling rounds were collected using the pump discharge method; however, the purge method varied. Samples from WCP-87 were collected following low-flow purge methods in Rounds 7, 8, 9, and 11. Three well-casing volumes were removed prior to sample collection during Rounds 10, 13, and 15.

The only deep well drilled during the investigation, WCP-48, is located west of the VW&R facility. Results of the deep well samples collected from WCP-48 are not posted on the contour maps because it is completed in a different hydrogeologic zone than other wells in the WCP East Grand Avenue WQARF Site monitoring network. The pump depth was consistently set at approximately 235 feet bgs during sampling of this well. Analytical results indicate that only 1,1-DCE is present at that depth. The concentrations of 1,1-DCE ranged from 0.6 μg/L to 0.8 μg/L. The AWQS/MCL for 1,1-DCE is 7 μg/L.

7.5.2.1 Comparison of Bailer and Pump Discharge Sample Collection Methods

Groundwater concentration contours for PCE, TCE, and 1,1-DCE in samples collected using the bailer method during the first three groundwater sampling events are presented in Figures 7-53 through 7-61. Consistent with sample results using the pump discharge sample collection method, groundwater analytical results obtained during the first three sampling events using the bailer sample collection method indicated that concentrations of PCE, TCE, and 1,1-DCE were typically highest in the samples from monitor wells near or on the VW&R facility. These wells, WCP-15, WCP-16, WCP-17, WCP-28, and WCP-30, also had the greatest variability in contaminant concentration results when comparing the bailer sample collection and pump discharge sample collection methods. At greater distances from the VW&R facility, contaminant concentrations were similar for samples collected with the bailer and those collected directly from the pump discharge.

In general, samples collected using the bailer sample collection method had higher VOC concentrations than comparative samples collected using the pump discharge method. As discussed previously, VOC contaminants are retained in the soils near the groundwater interface because of the decline in groundwater elevation. The variation in contaminant concentrations between the bailer and pump discharge sampling methods appears to be related to the retention of VOCs in the soils. When using the bailer collection method, the groundwater sample is collected closer to the groundwater-vadose zone interface than the pump discharge sample, resulting in higher groundwater sample concentrations. When moving toward the outer limits of the contaminant plume, concentrations of contaminants retained in capillary fringe soils are lower, resulting in less variation between the sampling methods.

When comparing the two sampling methods, the apparent center of the plume also differs. As shown in Figures 7-53 through 7-61, the center of the plume for the bailed samples is located east of the center of the plume for the pump discharge samples and is predominantly positioned below the VW&R facility. The highest concentration contour line, as defined by the bailed sample results, most likely also defines the lateral extent of contamination retained in the fine-grained soil material at the groundwater-vadose zone interface.

7.5.2.2 Comparison of Purging Methods

During Rounds 9 and 10, groundwater samples were collected following two different purge methods as described in the project FSP and in Section 5.3 of this report. The sampling events were conducted approximately within two weeks of each other to minimize the effects of time and declining groundwater elevations on sample results and to obtain a more valid comparison of results based on purge method differences alone.

Evaluation of the June 2001 low-flow purge round (Round 9) and the June 2001 three-casing volume purge indicated that the sample results from Round 10, in which the three-well purge method was used, are generally lower than Round 9, where the low-flow purge method was used. The differences in concentrations illustrated by the PCE contour maps were most significant closer to the center of the contaminant plume, particularly in monitor well WCP-16 on the VW&R facility and WCP-30 just west of the VW&R facility (Figures 7-24 and 7-25). Concentrations obtained from samples collected from the same well using each of the two methods were compared by calculating the relative percent difference (RPD). RPDs for WCP-16 and WCPO-30 are presented in the following table.

	Concentration (µg/L)		
WCP-16	**Round 9**	**Round 10**	**RPD**
1,1-DCE	43	17	87%
PCE	130	44	99%
TCE	210	55	117%
WCP-30			
1,1-DCE	72	27	91%
PCE	230	91	87%
TCE	150	42	113%

The greater differences between the two purging methods at sampling locations closer to the source area can be explained by the following reasons. The three-casing volume purge method results in the removal of greater volumes of groundwater, which results in a greater potential for dilution as groundwater outside the contaminated zone is drawn into the sampling zone (Vroblesky, 2001). Additionally, the three-casing volume purge method increases the potential for groundwater aeration and the likelihood of stripping VOCs from the water. In areas of higher concentration, volatilization of the contaminants is greater.

7.5.2.3 Evaluation of Passive Diffusion Bag Samplers

Samples were collected with PDB samplers in nine monitor wells as described in Section 5.3.2. Groundwater samples were also collected using the pump discharge and low-flow purge method concurrently with the PDB samplers for comparison. Table 7-26 shows the analytical results for each sampling method and the sample collection depth. Analytical results are also presented on

Figures 7-62 through 7-64. The overall objective of the investigation was to test the feasibility of using PDB samplers for future studies and monitoring in the WCP East Grand Avenue WQARF Site. The following is a general discussion of PDB samplers compared to traditional purge and sample methods.

The feasibility of using PDB samplers is mainly dependent on the objectives of the project (Vroblesky, 2001). PDB sampling may be appropriate if the goal of the investigation is to monitor higher concentrations or to evaluate stratification of contaminants within the well screen. In areas where vertical stratification is anticipated, using multiple PDB samplers may more fully characterize the contaminated horizon than using a single PDB sampler. The use of PDB samplers eliminates the need for purging the well; therefore, the area of the screened interval that contributes water to the sample is not as great as that for a purged sample, and the potential for mixing stratified layers and dilution of the sample is reduced.

Samples collected using traditional purge-and-sample methods may be more appropriate if the objective of the investigation is to determine the average concentrations for the entire screened area. As discussed previously, pumping results in a mixing of vertical layers within the screen interval and potentially mixes water from outside the contaminant plume with contaminated water, depending on the flow rate at which water is pumped and on the quantity of water pumped.

PDB sample results compared to purge-and-sample results will generally be greater due to the above reasons. Although low-flow purging methods still can integrate water within the radius of pumping influence, samples collected using low-flow purge methods will typically be more similar to samples collected with PDB samplers than multiple casing volume purge samples (Vroblesky, 2001).

As expected, based on the above discussion, the contaminant concentrations in PDB samples collected during Round 12 were greater than concentrations from samples collected using the pump discharge method. It is unclear how much of the variance in sample concentration between the two sample collection methods is a result of the method and how much is a result of chemical stratification because the pump sample was not collected at the same depth as a PDB sample. Although a difference in sample concentration was expected, chemical stratification in the screen interval was indicated based on results from each of the wells where two PDB samplers were installed.

PDB sample results from WCP-16, WCP-17, WCP-28, and WCP-29 indicate that the highest concentrations of contaminants are close to the groundwater-vadose zone interface and decrease with depth. The contaminant concentrations increase with depth as you move farther from the center of the VW&R facility.

The lithologic logs for WCP-87 indicate coarse-grained sediments are dominant from approximately 117 feet bgs to approximately 138 feet bgs. A narrow band of fine-grained sediments is present from 130 feet bgs to 133 feet bgs. Fine-grained sediments become dominant from approximately 138 feet bgs to 153 feet bgs. Based on the lithology, groundwater contaminants would be expected to migrate more readily both horizontally and vertically through the coarse-grained sediment with migration becoming more retarded as the contaminants enter the finer-grained materials. The PDB sample concentrations for WCP-87 are lower in the sample collected at approximately 124 feet bgs when compared with the sample collected at approximately 149 feet bgs.

PDB sample results from WCP-93 also increase with depth, although the reasons are less clear based on the lithology. Lithologic logs prepared for WCP-93, located on the southeast corner of the VW&R facility, indicate fine-grained materials are present from approximately 93 feet bgs to 147 feet bgs. WCP-93 is located closer to the source areas, and therefore additional lateral migration throughout the fine-grained zones may be occurring in the WCP-93 vicinity.

7.5.3 Vertical Extent of Groundwater Contamination

The overall vertical extent of groundwater contamination was evaluated using the Hydropunch® data and groundwater monitoring data collected from WCP-48. In 1999, Hydropunch® samples were collected from borings SB-16 and SB-17 at approximately 122 feet bgs, 142 feet bgs, and 182 feet bgs. Concentrations of VOCs in these samples were greatest at the groundwater interface at 122 feet bgs and decreased with depth. VOCs were not detected above the MDL at 182 feet bgs. Analytical results from Hydropunch® samples collected prior to the installation of wells WCP-87, WCP-100, and WCP-200 in 2001 indicated VOCs were present at concentrations significantly above AWQS/MCLs at 153 feet bgs.

Data collected from the deep monitor well, WCP-48, which is downgradient from the above mentioned Hydropunch® samples, indicate that only 1,1-DCE is present in groundwater at sample depths of 235 feet bgs. As stated previously, concentrations of 1,1-DCE in WCP-48 are well below the AWQS/MCL.

Based on these data, the vertical extent of groundwater contamination appears to be within the range of 153 feet bgs and 235 feet bgs. Further definitive characterization of the vertical extent of groundwater contamination will be addressed during the FS, if needed, based on the selected remedial alternative.

7.6 CONTAMINANT SOURCES

7.6.1 VW&R Facility

Historical records and information obtained from VW&R indicated various chemicals were stored and distributed at the facility, including acids, bases, solvents, chlorinated solvents, pesticides, and herbicides. TCE use at the facility has been confirmed and PCE is believed to have been one of five unidentified repack products (Section 1.2.1).

The distribution of contaminant concentrations in soil-gas, soil, and groundwater during this investigation and previous investigations indicates a primary source area of the contaminants of concern near and under the former building foundation. Although not a contaminant of concern, the distribution of carbon tetrachloride in groundwater also appears to be confined to wells located on the VW&R facility.

Information obtained from VW&R indicated that areas to the west and east of the former building foundation were used for bulk product repackaging. The rinsate generated during the cleaning of the transfer hoses used in the repackaging process was routinely poured on the asphalt in the repackaging areas and incidental spills were known to have occurred in these areas. The occasional disposal of unsalable product to the ground surface north of the former building foundation has also been reported (Vopak, 2000). Stained soil has been observed in historical aerial photographs of the facility.

7.6.2 Additional Contaminant Sources

An additional potential TCE source upgradient and separate from the VW&R facility may be indicated by groundwater contaminant contours. Data are insufficient to evaluate the possibility that upgradient occurrences of TCE in groundwater near WCP-41 are caused by an additional potential source or from transport mechanisms.

7.6.2.1 Mogul Facility

WESTON completed a review of ADEQ's files on previous investigations at the former Mogul Property, located approximately 1,900 feet south-southwest of the VW&R facility (Figure 2-25). Results of this review are outlined in Section 2.9.5. Three monitor wells installed as part of a previous investigation conducted at Mogul were added to the VW&R groundwater-sampling network during Round 8. VOC concentrations detected in groundwater samples collected from the Mogul wells since sampling for the VW&R RI began include PCE, TCE, 1,2-DCA, and 1,1-DCE. Benzene has also been detected. Of the contaminants that have been detected in the Mogul wells, TCE appears to be the most significant, ranging in concentration from 4 μg/L to 9 μg/L (Figures 7-35 through 7-39). The contaminants in this plume appear to be from an additional source located at or near the Mogul facility and are not attributable to releases from the VW&R facility. Additionally, concentrations of VOCs detected in WCP-92, installed southeast of the Mogul facility, can be attributed to the contaminant source at Mogul.

7.6.2.2 Benzene Contamination

WESTON evaluated other facilities that may have contributed to groundwater contamination within the WCP East Grand Avenue WQARF Site, including several facilities that had a release from a UST. Details of this evaluation are presented in Section 2.9.

Chromatograms and spectra from groundwater samples collected from three monitor wells, ENT-MW-2, WCP-44, and WCP-202, were evaluated to determine if high benzene concentrations could be attributed to documented fuel hydrocarbon releases known to be present at nearby LUST sites.

Based on chromatogram and spectra evaluations (Section 7.2), high benzene concentrations in WCP-202 (5,900 μg/L to 6,300 μg/L) appeared to be the result of a pure benzene release. The closest downgradient monitor well to WCP-202 is WCP-96, which is approximately 675 feet southwest. Concentrations of benzene in samples from that well have been below the detection limit. The source of the benzene release is unknown at this time.

Results from WCP-44 appeared to be influenced by both fuel hydrocarbon releases and a benzene release (Wright and Kaczinski, 2002). Fuel hydrocarbon contamination in WCP-44 and in ENT-MW-2 is most likely attributable to releases from the former Fedmart/Sunbelt property. The unknown benzene source that is affecting WCP-202 may also be contributing to benzene concentrations in WCP-44. Benzene concentrations in WCP-44 were detected at a maximum concentration of 2,800 μg/L.

7.7 POTENTIAL FOR NATURAL BIODEGRADATION

The most important process for the natural biodegradation of PCE, TCE, and 1,1-DCE is reductive dechlorination under anaerobic conditions (EPA, 1998). All three compounds are resistant to aerobic degradation; however, TCE may be degraded cometabolically (Toxnet, 2001).

In general, reductive dechlorination occurs by the sequential loss of chlorine atoms. PCE will degrade to TCE, to DCE, to vinyl chloride, and then to ethene. The rate of reductive dechlorination varies for each of the compounds. PCE is the most oxidized and therefore, is most susceptible to reductive dechlorination. Vinyl chloride is the least susceptible to reductive dechlorination because it is the least oxidized (EPA, 1998). Reductive dechlorination has been demonstrated under nitrate-and iron-reducing conditions but the most rapid biodegradation rates occur under sulfate-reducing and methanogenic conditions (EPA, 1998). In order for reductive dechlorination to occur, there must be a sufficient source of carbon for microbial growth. Potential carbon sources include natural organic matter and fuel hydrocarbons.

Sufficient data have not been collected to determine the exact potential for natural biodegradation at the WCP East Grand Avenue WQARF Site. Based on DO and redox data collected in the field during groundwater sample collection (Table 7-24), the conditions within the screened portion of the aquifer appear to be generally aerobic, which is not conducive to reductive dechlorination, with the exception of the leading edge of the plume. Analytical results of groundwater samples are also not indicative of natural biodegradation. Concentrations of vinyl chloride above the MDL have not been indicated in any groundwater sample collected to date. Additionally, the presence of *cis*-1,2-DCE, the most prevalent of the DCE isomer daughter products, has been indicated at low concentrations in only a few monitor well locations. This isomer could also have been present as part of a mixture in a solvent packaged at the facility; therefore, its presence is not a clear indication of natural biodegradation.

As stated above, anaerobic conditions are indicated near the leading edge of the plume, specifically near ENT-MW-2, WCP-44, WCP-88, and WCP-202. These wells also correspond with elevated BTEX concentrations detected in groundwater samples. Due to the anaerobic conditions and the presence of a potential carbon source (BTEX constituents), this area would have a greater potential for natural biodegradation. However, additional data are needed to further evaluate the potential for natural biodegradation. Data regarding specific natural biodegradation indicator parameters have not been collected to date. Future analyses of the following parameters are needed to more completely evaluate the conditions in the area.

- Nitrate
- Sulfate
- Sulfide
- Iron (II)
- Methane, ethane, and ethene
- Chloride
- Dissolved organic carbon
- Alkalinity

7.8 FATE AND TRANSPORT

The environmental fate and transport of a contaminant is controlled by the compound's physico-chemical properties and by the nature of the subsurface medium, as well as the geochemical conditions of the material through which the contaminant is migrating.

Each phase of the RI was designed to provide additional information to assess fate and transport of the identified contaminants of concern. This information included the definition of lateral and vertical extents of groundwater contamination in the WCP East Grand Avenue WQARF Site, aquifer properties, and physical characteristics of the aquifer materials. Aquifer properties and characteristics were discussed in Section 2.0. General fate and transport processes of and their application to site-specific conditions are discussed below.

7.8.1 Transport in Soils

Based on the specific gravity and K_{oc} values for PCE, TCE, and 1,1-DCE, these VOC liquids will pass more quickly than water through an unsaturated soil horizon, leaving less residual liquid in the soil and dissipating more rapidly from the soil. TCE and 1,1-DCE are expected to have high mobility in soil, while PCE is expected to have moderate mobility in soil (Table 7-1)

The size and interconnectedness of the pore space in the soil, measured by permeability, also affects retention of liquids in soil. Small pore spaces retain water by capillary forces. Coarse gravels and cobbles do not retain liquids passing through them because of their large, interconnected pore spaces. Extremely fine particles, such as silt and clay, retain liquids by the capillary forces produced by their small pore sizes and reduced interconnectedness of the pores. Thus, VOC contamination would be expected to dissipate (i.e., drain and volatilize) most rapidly in coarse-grained soils, such as gravel and sand, and least rapidly in silts and clays.

Volatilization of TCE, PCE, and 1,1-DCE from moist soil surfaces is an important fate process given their Henry's Law constants (Table 7-1). The moisture content of a soil is a significant factor in migration and retention of VOCs both in liquid and vapor phases. Moisture filling the pores of a soil can act as a barrier to migration of VOC liquids. Conversely, penetration of VOC liquids through the vadose zone is enhanced by dry soil conditions (Cohen and Mercer, 1993). Moist soils inhibit downward migration and can result in lateral migration of VOC liquids.

Contact of VOCs in liquid or vapor phases with moisture in soils results in VOC contamination of the soil moisture, which is also known as pore water. Release of VOCs dissolved in pore water is typically much slower than volatilization from a free-phase VOC liquid. Therefore, moist soils retain evidence of VOCs that have passed through the soil column longer than equivalent soils with low moisture content (Cohen and Mercer, 1993).

Applying these VOC soil migration principles to the site-specific conditions at the former VW&R facility provides the framework for analysis of the soil site data. Boring logs for monitor wells WCP-15 and WCP-16 describe the soil beneath the facility as being dry to moist (Appendix A). Actual moisture content of soil samples was not analyzed until the Vadose Zone Investigation and during later well installations (Table 7-27). Most of the soil samples recovered from borings at the facility were characterized as being dry (less than 10 percent) to moist (greater than 18 percent), thereby enhancing the speed of vertical migration in the soils and limiting the amount of residual contamination in the dry soils.

Soils beneath the facility vary from sands and gravels to silts and clays (Figures 7-2 through 7-5). Transitions from coarse sediments to fine sediments result in reduced permeability, which may cause ponding and lateral migration of VOCs. VOC migration in the coarse sediments is likely to be nearly vertical, presenting a relatively small target for a vertical soil drilling and sampling program. Coarse sediments with low moisture content are unlikely to have residual VOC contamination even in areas where VOC liquids may have passed through from a potential surface release.

Most of the soil samples with detectable concentrations of TCE and PCE recovered from beneath the VW&R facility were from fine-grained sediments consisting of silts and clays (Figures 7-1 through 7-5). Several of the samples with TCE and PCE contamination were recovered from the top of a fine-grained unit, immediately beneath coarser, sand-dominated units. The observed detections of contaminants at the top of fine-grained units is consistent with downward migration of VOCs that would tend to spread laterally at the transition from coarse sediments to fine sediments due to reduction in permeability.

7.8.2 Transport in Groundwater

VOCs in groundwater are transported in the direction of groundwater flow through advection and in all directions through the processes of diffusion and dispersion. Advection is movement parallel to groundwater flow paths either under the influence of gravity (unconfined conditions) or pressure (confined conditions). However, contaminants can disperse perpendicular to groundwater flow lines, dependent on the concentration of the contaminant, the quantity of the contaminant released, the hydraulic gradient and the tortuosity of the groundwater flow system. In groundwater, chemicals gradually spread and occupy an increasing aquifer volume beyond what would be expected from advective transport solely due to groundwater movement. The spreading of a chemical mass is called dispersion. Dispersion has both advective and diffusive components. Diffusion is the process of contaminant movement from areas of high concentration to areas of lower concentration by random molecular action. Diffusion takes place in all directions from a source of high concentration. Rates of diffusion, however, are typically much lower than rates of advective (flow) transport and therefore are typically a minor component of dispersion of contaminants in groundwater systems. Dispersion is affected by local groundwater velocity, in both direction and magnitude, and by how tortuous the flow paths are. Flow velocity variations occur as a result of changes in porosity, variations in hydraulic conductivity, and the presence of retarding layers. Dispersion takes place both longitudinally (in the direction of groundwater flow) and transversely (perpendicular to groundwater flow). Longitudinal dispersion is greater than transverse dispersion. Thus, a VOC dispersion plume is typically elongated in the direction of flow, emanating from the source area.

The general direction of contaminant migration across the site is consistent with the groundwater flow pattern. The groundwater contaminant plume appears to extend to the southwest from beneath the VW&R facility (Figures 7-28, 7-40, and 7-52), following the southwesterly groundwater flow typical of the WCP East Grand Avenue WQARF Site (Figure 2-20). The downgradient extent of PCE and 1,1-DCE concentrations appears to be defined by recent samples from WCP-88. TCE, however, is present in recent samples from WCP-88 and from WCP-94 at concentrations well above the AWQS/MCLs (Figure 7-40). WCP-94 appears to be on the flow path of the known contaminant plume. It is unclear whether these TCE concentrations are related to the main body of the WCP East Grand Avenue WQARF Site plume or are associated with an undefined source.

Because PCE, TCE, and 1,1-DCE are denser than water, vertical migration in the saturated zone may occur. The extent of the vertical migration of the contaminant plume is dependent upon the aquifer materials and the presence of a free-phase VOC liquid in the saturated zone. As in soil migration, VOC movement would be greater in coarse-grained areas and more retarded in finer-grained aquifer materials. Based on analytical results from soil borings and groundwater monitoring activities at the WCP East Grand Avenue WQARF Site, there has been no indication of the existence of free-phase VOCs beneath the site.

Dissolved PCE, TCE, and 1,1-DCE migrate readily with groundwater, but their movement is retarded by adsorptive and absorptive processes. The K_{oc} values for TCE and 1,1-DCE indicate that these VOCs are not expected to adsorb to suspended solids and sediment in the groundwater. However, adsorption of TCE and 1,1-DCE onto suspended solids or sediment in groundwater depends upon the fraction of organic carbon (f_{oc}) of the sediments in the aquifer. For aquifer materials low in organic carbon, direct sorption onto mineral phases of the soil can become important. The adsorption of a contaminant onto an aquifer material results in a reduction of concentration in the aqueous phase and a “retardation” of the velocity of contaminant migration. Retardation of TCE and 1,1-DCE occurs because these chemicals are nonpolar and this causes them to partition to the organic matter in the soil. Partitioning is a reversible process; molecules that have partitioned to the organic matter will move back into the groundwater as relative concentrations change. Retardation and, therefore, retardation factors are a function of the f_{oc} of the aquifer.

In order to determine the f_{oc} of the soil at any given site, an analysis for Total Organic Carbon (TOC) must be conducted on the soil. TOC analysis was done on selected soil samples collected during the WCP East Grand Avenue WQARF Site RI. Results indicate that TOC is less than 0.12 percent (Table 7-2). Based on these results, retardation due to organic content of the aquifer material is expected to be negligible.

Saturated soils, especially at the top of the groundwater zone, can form a barrier to migration resulting in ponding or lateral migration of free-phase VOC liquids in addition to direct groundwater contamination. The lateral migration of VOCs in soils at the groundwater interface, or capillary fringe area, contributes to the lateral migration of contaminated groundwater. As groundwater levels decline, VOCs may be retained in the soils or sorbed to soil particles at the capillary fringe, thereby decreasing the contaminant concentrations in the groundwater. The contaminated capillary fringe area can act as an episodic source for groundwater contamination, particularly if groundwater elevations fluctuate periodically.

7.8.3 Groundwater Transport Calculations

The transport of VOCs in groundwater is first dependent upon the properties of the soil matrix supporting the advective and diffusional flow system. Other considerations include physico-chemical interactions between the VOCs and the soil matrix. The affinity of a VOC for soil is defined by the solid-water partition coefficient (also known as the distribution coefficient), K_d. The distribution coefficient relates to the mass of contaminant dissolved in groundwater to the mass sorbed to the soil and is calculated using the following equation:

$$K_d = K_{oc}\, f_{oc}$$

where: K_d = Distribution coefficient, in milliliters per grams soil (mL_{water}/g_{soil})

K_{oc} = Organic Carbon Partition Coefficient, in milliliters water per grams organic carbon

f_{oc} = Fraction of organic carbon, in grams organic carbon per grams soil

The retardation factor of a VOC in the soil present at a site can be calculated using the following equation:

$$R_d = 1 + \frac{\Delta_b(K_d)}{n_e}$$

where: R_d = Retardation factor, no units
Δ_b = Bulk density, grams per cubic centimeter (g/cm^3)
K_d = Distribution coefficient, mL_{water}/g_{soil}
n_e = Effective porosity, milliliters water per cubic centimeter soil (mL_{water}/cm^3_{soil})

Total organic carbon was analyzed in soil samples collected from the VW&R facility and results were below the detection limit. TOC analysis was performed on selected soil samples collected during the WCP East Grand Avenue WQARF Site RI. Results indicate that TOC is below the detection limit of 0.07 to 0.12 percent (Table 7-2). The average (arithmetic mean) bulk density is 1.944 g/cm^3. The effective porosity used during the aquifer test was 20 to 30 percent. The following table summarizes the results of the calculations obtained from the above equations for the UAU beneath the WCP East Grand Avenue Site:

Chemical	**K_{oc}**	**f_{oc} (1)**	**K_d**	**R_d (2)**
PCE	303	0.0006	0.18	2.4
TCE	152	0.0006	0.09	1.7
1,1-DCE	217	0.0006	0.13	2.0

(1) One-half of the detection limit for TOC was used for the f_{oc} value.
(2) R_d calculations based on average n_e of 0.25.

The rate of contaminant movement can be estimated based on the average groundwater velocity and the retardation factor using the following equation:

$$V_c = V/R_d$$

where: V_c = Contaminant Velocity, ft/day
V = Average Groundwater Velocity, ft/day
R_d = Retardation factor, no units

An aquifer test was completed on the WCP East Grand Avenue WQARF Site and was described in Section 2.7.3. Average groundwater velocity for the WCP East Grand Avenue was calculated to be 2.4 to 8.6 feet/day (Section 2.7.3.3). Contaminant velocity was calculated for each of the contaminants of concern and is shown in the following table:

Chemical	V (ft/year)	V_c (ft/year)
PCE	876 to 3139	370 to 1300
TCE	876 to 3139	520 to 1800
1,1-DCE	876 to 3139	440 to 1600

The estimated contaminant migration distance downgradient from the source at the WCP East Grand Avenue WQARF Site can be calculated based on the contaminant velocity and the age of the release. The source of contamination has been identified as being on the VW&R facility and occurring over the length of operation of the facility. VW&R operated at this location from 1956 to 1970. Assuming the age of release is 31 years, the estimated length of the contaminant plume (L_c) can be calculated by the following equation:

$$L_c = V_c \text{ (Age of release)}$$

The estimated contaminant migration distance downgradient from the source at the VW&R facility for PCE, TCE, and 1,1-DCE in the UAU are 11,000 feet, 16,000 feet, and 14,000 feet, respectively. In January 2002, monitoring well WCP-96, located approximately 2,025 feet downgradient from the source area at the VW&R facility, contained PCE and TCE at concentrations of 0.4 mg/L.

Contaminant velocities and estimated length of the contaminant plume should be viewed as qualitative indicators only. As indicated in the data presented above, actual migration rates can vary greatly from these estimates. The above calculations use simplified assumptions and neglect the following potential site-specific effects:

- Vertical and horizontal heterogeneities in hydraulic conductivity, porosity, and TOC in the aquifer material throughout the site.
- Contaminant degradation due to the benzene release at the leading edge of the plume.

- Contaminant degradation due to the SVE system installed at the Southwest Roofing/UPS facility.

- Changes in historical groundwater flow direction and therefore, contaminant migration, due to historical pumping of the SRP wells 10.5E-7.5N and 11.2E-7.5N.

- Changes in groundwater flow direction due to lining of the Grand Canal.

- Changes in groundwater gradient due to removal of recharge resulting from lining the Grand Canal (i.e., the groundwater gradient was more flat prior to lining the Grand Canal than the current gradient).

- Changes in groundwater gradient due to regional reductions in groundwater levels resulting from protracted drought conditions.

- Declining groundwater elevation and subsequent sorption of contaminants to the capillary fringe area and/or to the mineral phase of the aquifer material.

8.0 SUMMARY AND CONCLUSIONS

The purpose of the RI conducted at the WCP East Grand Avenue WQARF Site was to determine the nature and extent of contamination at the site. The RI also identified present and reasonably foreseeable uses of land and waters of the state that have been or are threatened to be, impacted by the contamination. Based upon the data collected, the following conclusions are drawn.

Soil

- The main source of contamination in soil at the WCP East Grand Avenue WQARF Site is near the former building foundation on the VW&R facility where bulk repackaging historically occurred.
- PCE and TCE contamination beneath the VW&R facility extends from approximately 1 foot bgs to 120 feet bgs. A zone of elevated PCE and TCE concentrations occurs between 56 to 71 feet bgs, where a lithologic transition from coarse to fine-grained materials occurs. 1,1-DCE contamination occurs from approximately 116 to 126 feet bgs in the area west and southwest of the former building foundation. Concentrations of PCE, TCE, and 1,1-DCE in soil did not exceed SRLs or GPLs.

Groundwater

- The source of groundwater contamination in the WCP East Grand Avenue WQARF site is near the former building foundation on the VW&R facility where bulk repackaging historically occurred.
- The lateral extent of groundwater contamination in the WCP East Grand Avenue WQARF site has been adequately defined to determine the appropriate cleanup actions needed at the site. The lateral extent of groundwater contamination is represented by the dissolved TCE plume as defined by monitor wells WCP-42, WCP-86, WCP-83, and WCP-96.
- The contaminant plume migration is predominantly controlled by groundwater gradient and flow direction. Adsorption of contaminants to fine-grained materials at the groundwater-vadose zone interface and/or mineral phase of the aquifer material is indicated. The adsorbed contaminants can serve as an episodic source of contamination should elevations rise in the future.
- An additional source of TCE may be present downgradient of the contaminant plume near WCP-94.

- The vertical extent of contamination has been defined by Hydropunch® data and groundwater monitoring data as being between 153 feet bgs and 235 feet bgs. Further definitive characterization of the vertical extent of groundwater contamination will be addressed during the FS, if needed, based on the selected remedial alternative.

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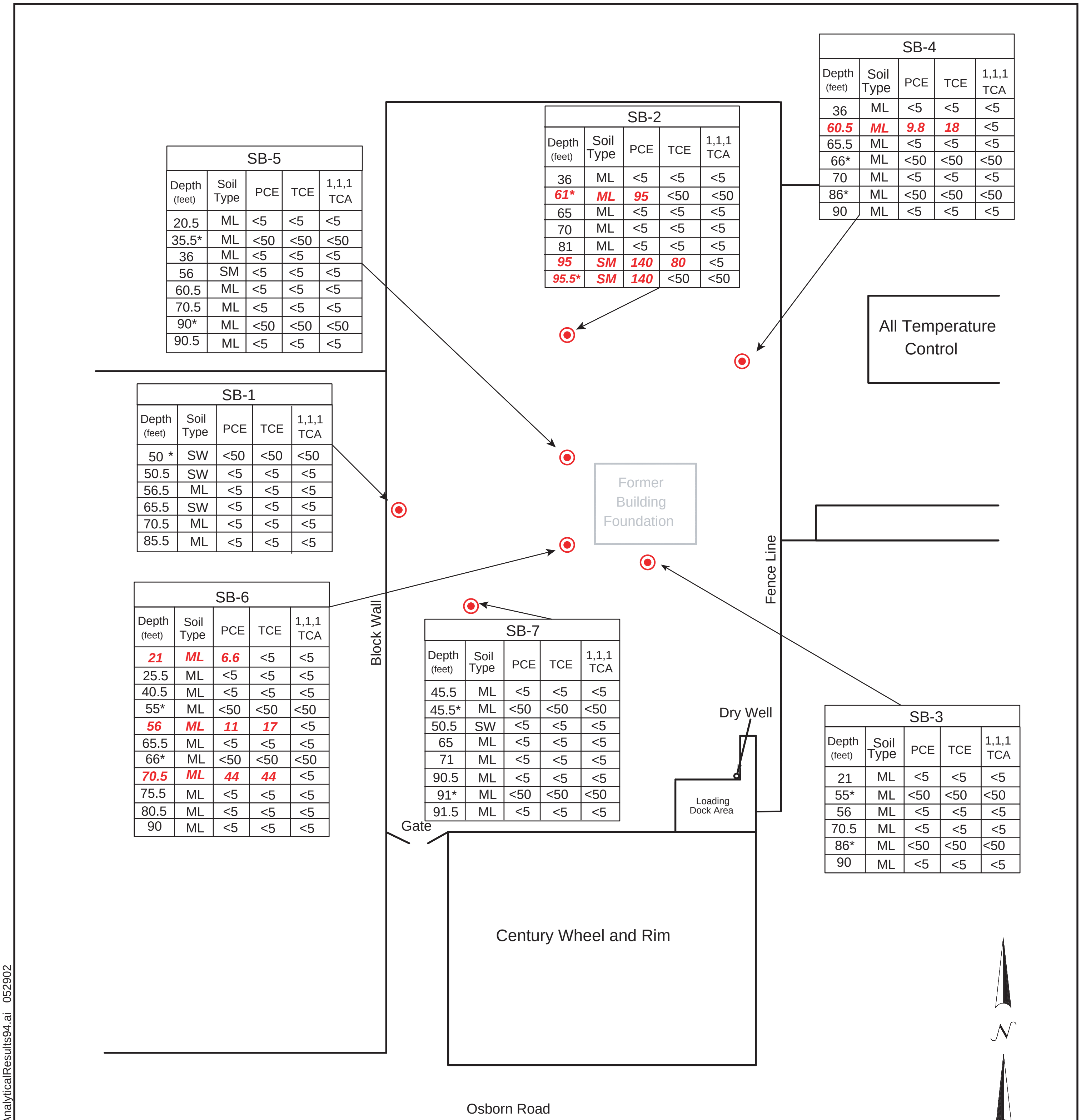

SB-5

Depth (feet)	Soil Type	PCE	TCE	1,1,1 TCA
20.5	ML	<5	<5	<5
35.5*	ML	<50	<50	<50
36	ML	<5	<5	<5
56	SM	<5	<5	<5
60.5	ML	<5	<5	<5
70.5	ML	<5	<5	<5
90*	ML	<50	<50	<50
90.5	ML	<5	<5	<5

SB-2

Depth (feet)	Soil Type	PCE	TCE	1,1,1 TCA
36	ML	<5	<5	<5
61*	***ML***	***95***	<50	<50
65	ML	<5	<5	<5
70	ML	<5	<5	<5
81	ML	<5	<5	<5
95	***SM***	***140***	***80***	<5
95.5*	***SM***	***140***	<50	<50

SB-4

Depth (feet)	Soil Type	PCE	TCE	1,1,1 TCA
36	ML	<5	<5	<5
60.5	***ML***	***9.8***	***18***	<5
65.5	ML	<5	<5	<5
66*	ML	<50	<50	<50
70	ML	<5	<5	<5
86*	ML	<50	<50	<50
90	ML	<5	<5	<5

SB-1

Depth (feet)	Soil Type	PCE	TCE	1,1,1 TCA
50 *	SW	<50	<50	<50
50.5	SW	<5	<5	<5
56.5	ML	<5	<5	<5
65.5	SW	<5	<5	<5
70.5	ML	<5	<5	<5
85.5	ML	<5	<5	<5

SB-6

Depth (feet)	Soil Type	PCE	TCE	1,1,1 TCA
21	***ML***	***6.6***	<5	<5
25.5	ML	<5	<5	<5
40.5	ML	<5	<5	<5
55*	ML	<50	<50	<50
56	***ML***	***11***	***17***	<5
65.5	ML	<5	<5	<5
66*	ML	<50	<50	<50
70.5	***ML***	***44***	***44***	<5
75.5	ML	<5	<5	<5
80.5	ML	<5	<5	<5
90	ML	<5	<5	<5

SB-7

Depth (feet)	Soil Type	PCE	TCE	1,1,1 TCA
45.5	ML	<5	<5	<5
45.5*	ML	<50	<50	<50
50.5	SW	<5	<5	<5
65	ML	<5	<5	<5
71	ML	<5	<5	<5
90.5	ML	<5	<5	<5
91*	ML	<50	<50	<50
91.5	ML	<5	<5	<5

SB-3

Depth (feet)	Soil Type	PCE	TCE	1,1,1 TCA
21	ML	<5	<5	<5
55*	ML	<50	<50	<50
56	ML	<5	<5	<5
70.5	ML	<5	<5	<5
86*	ML	<50	<50	<50
90	ML	<5	<5	<5

Legend

◉ Soil Boring (HLA, 1995)

21 Bold/Italic font indicates result above detection limit

* Earth Tech Sample

Approximate Scale
1 inch = 80 feet
0 40 80 160

Source: Harding Lawson Associates (1995)

NOTE: All concentrations in (μg/kg) micrograms per kilogram

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Figure 1-7
Soil Analytical Results
Subsurface Soil Investigation - HLA
(December 1994)

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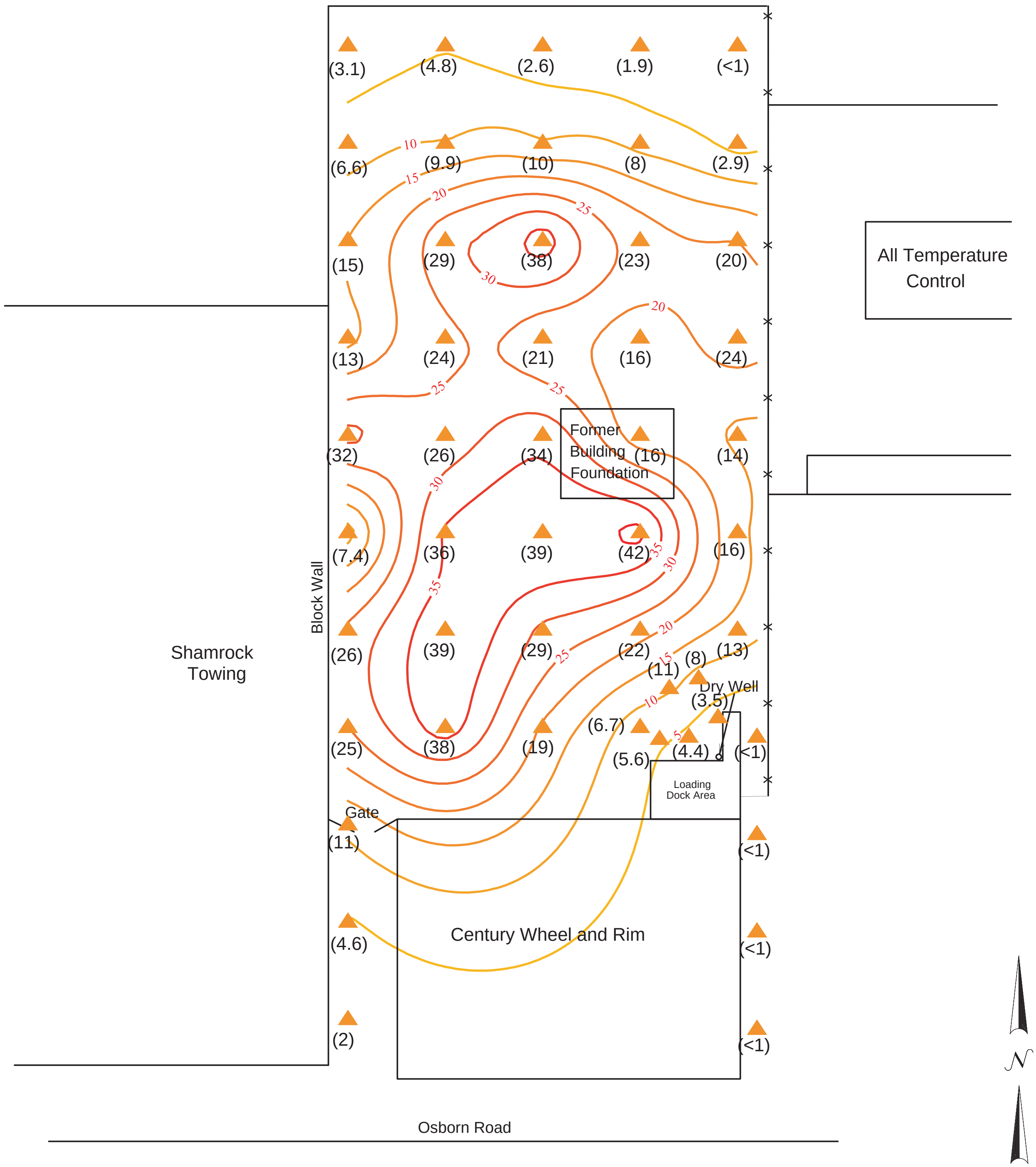

Legend

Soil-Gas Sampling Location

(21) 1,1-DCE Concentration in micrograms per liter

Fence

Soil-Gas Contour Line
Contour Interval = 5 µg/L

µg/L micrograms per liter

Soil-gas samples collected at approximately 5 feet bgs.

Approximate Scale
1 inch = 80 feet
0 40 80 160

Figure 1-6
1,1-DCE Concentrations in Soil-Gas Samples
Soil-Gas Survey - HLA
(July 12-14, 1994)

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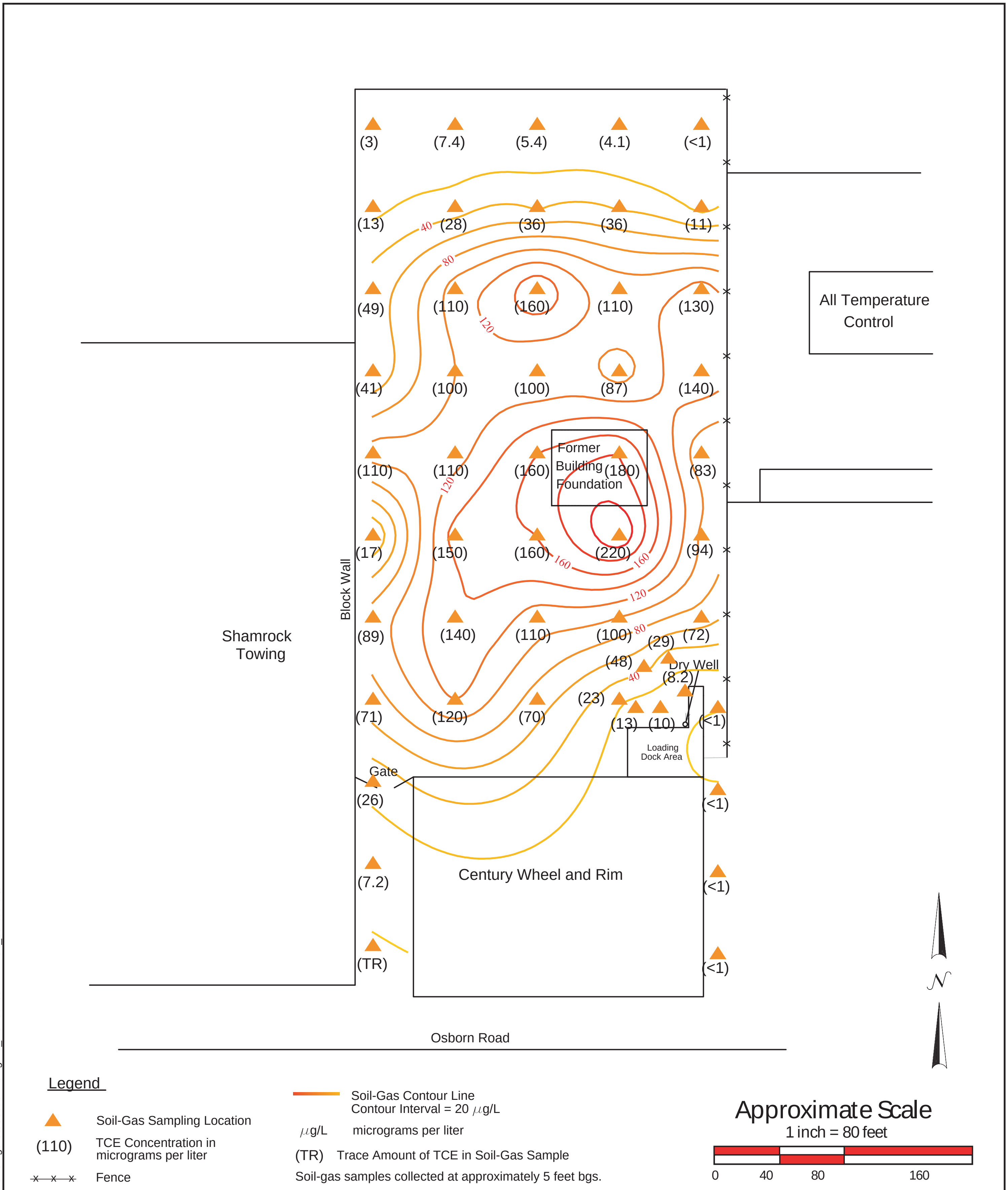

Figure 1-5
TCE Concentrations in Soil-Gas Samples
Soil-Gas Survey - HLA
(July 12-14, 1994)

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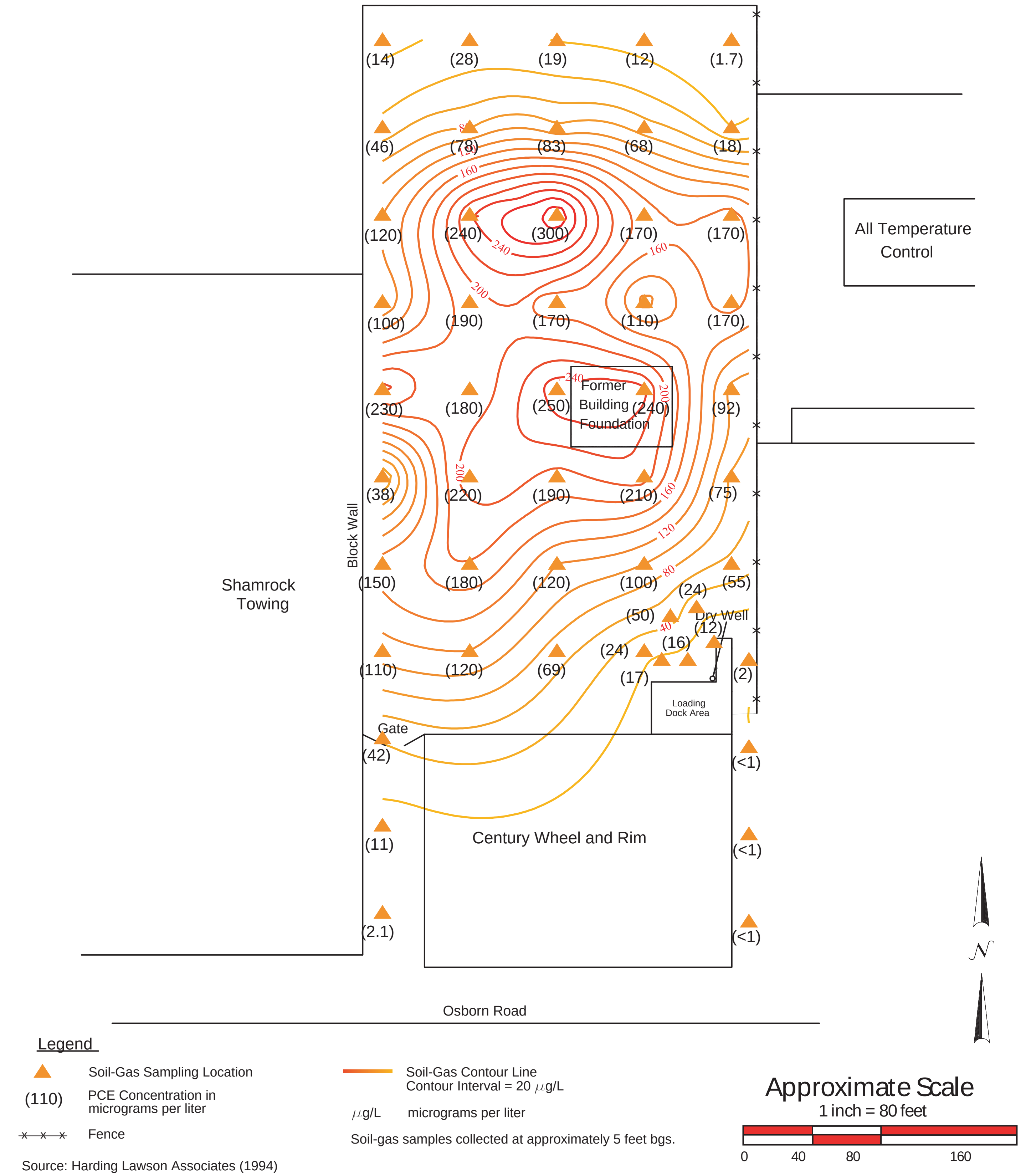

Figure 1-4
PCE Concentrations in Soil-Gas Samples
Soil-Gas Survey - HLA
(July 12-14, 1994)

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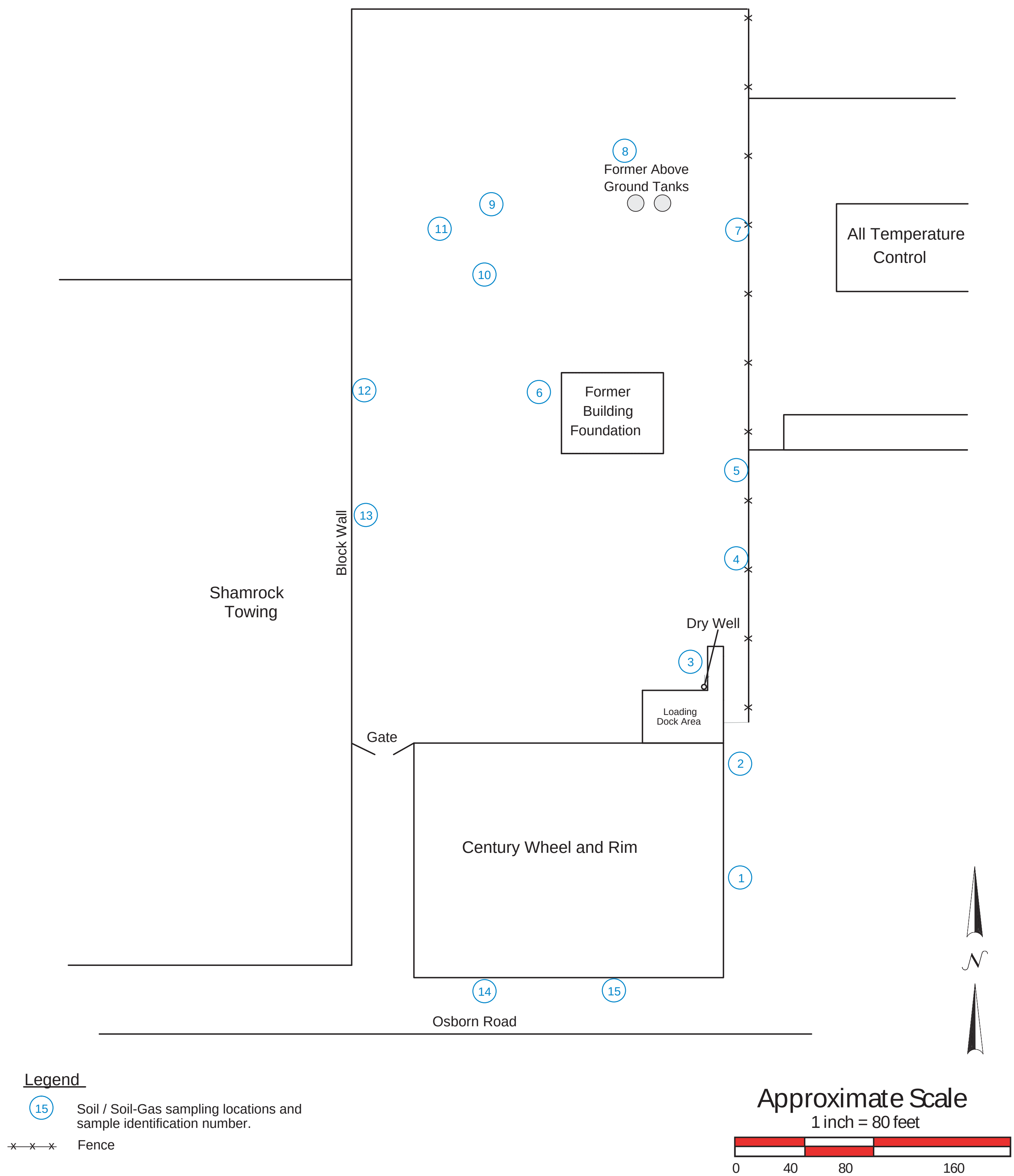

Figure 1-3
VW&R Site Inspection - ADEQ (1993)
Soil and Soil-Gas Sampling Locations

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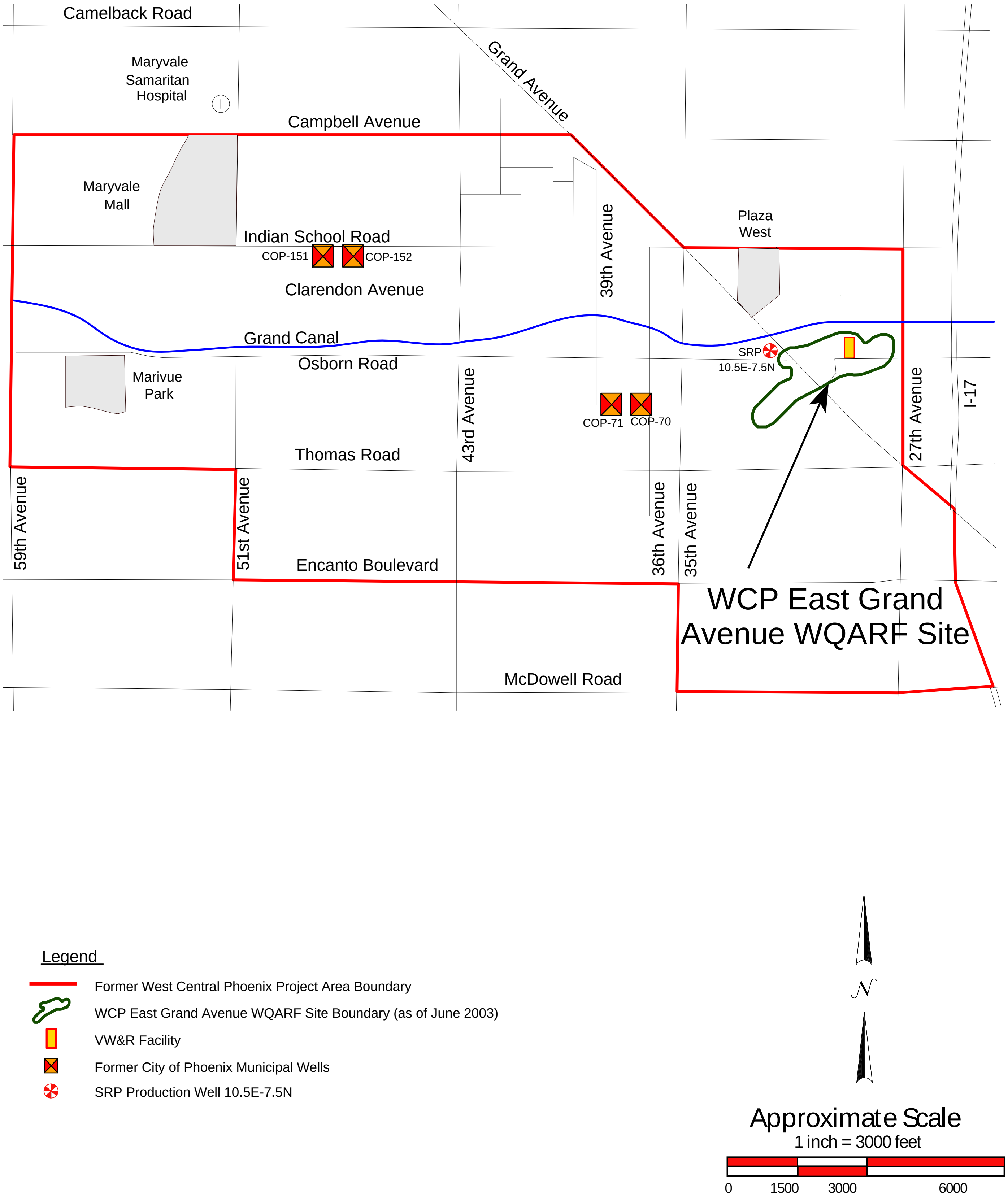

Figure 1-1
WCP East Grand Avenue WQARF Site

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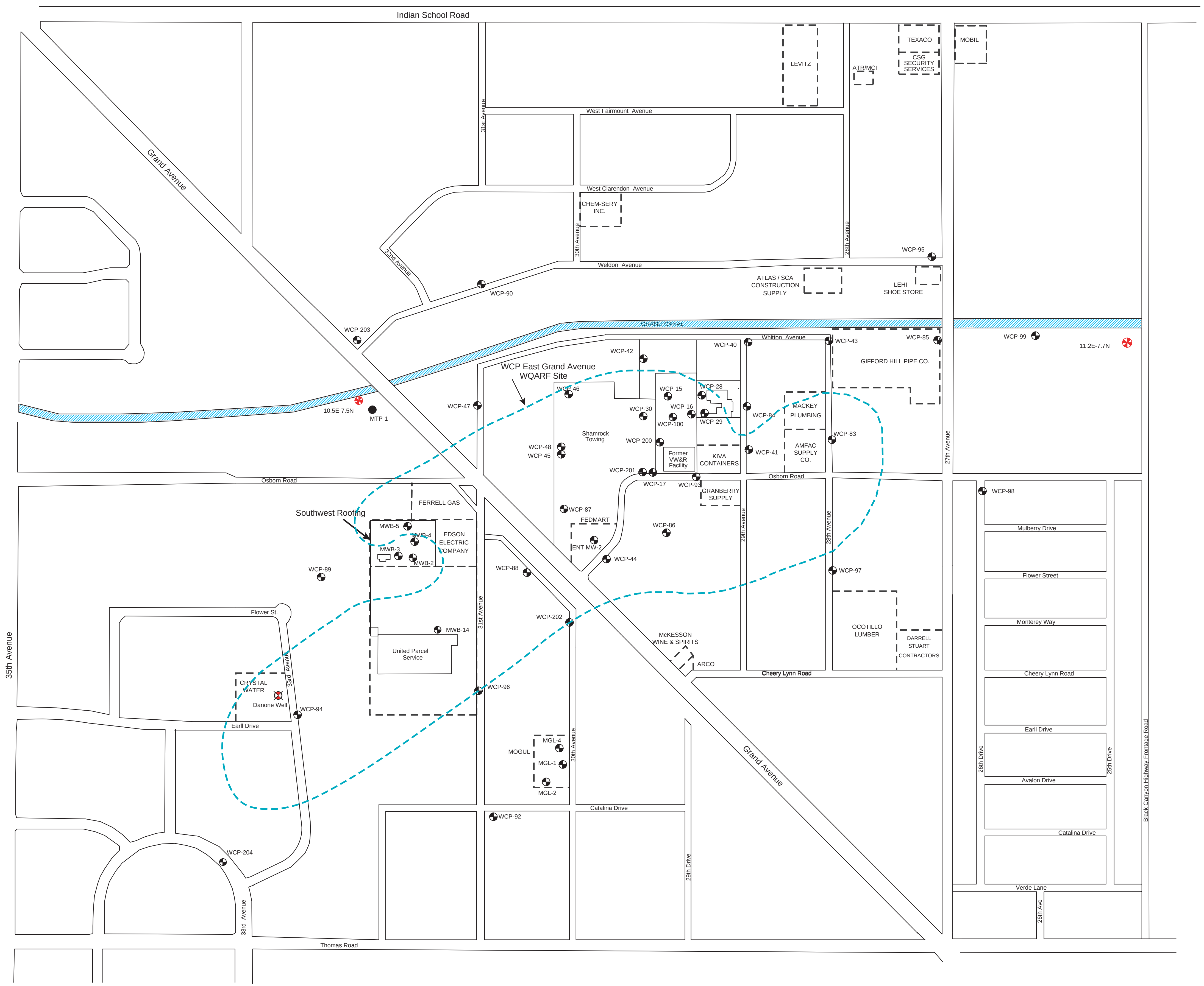

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Figure 2-25
LUST Sites near the WCP East Grand Avenue WQARF Site

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- WQARF Registry Site Boundary
- Approximate Property Boundary

NOTES: All well locations are approximate.

N

Approximate Scale
1 inch = 600 feet
0 300 600 1200

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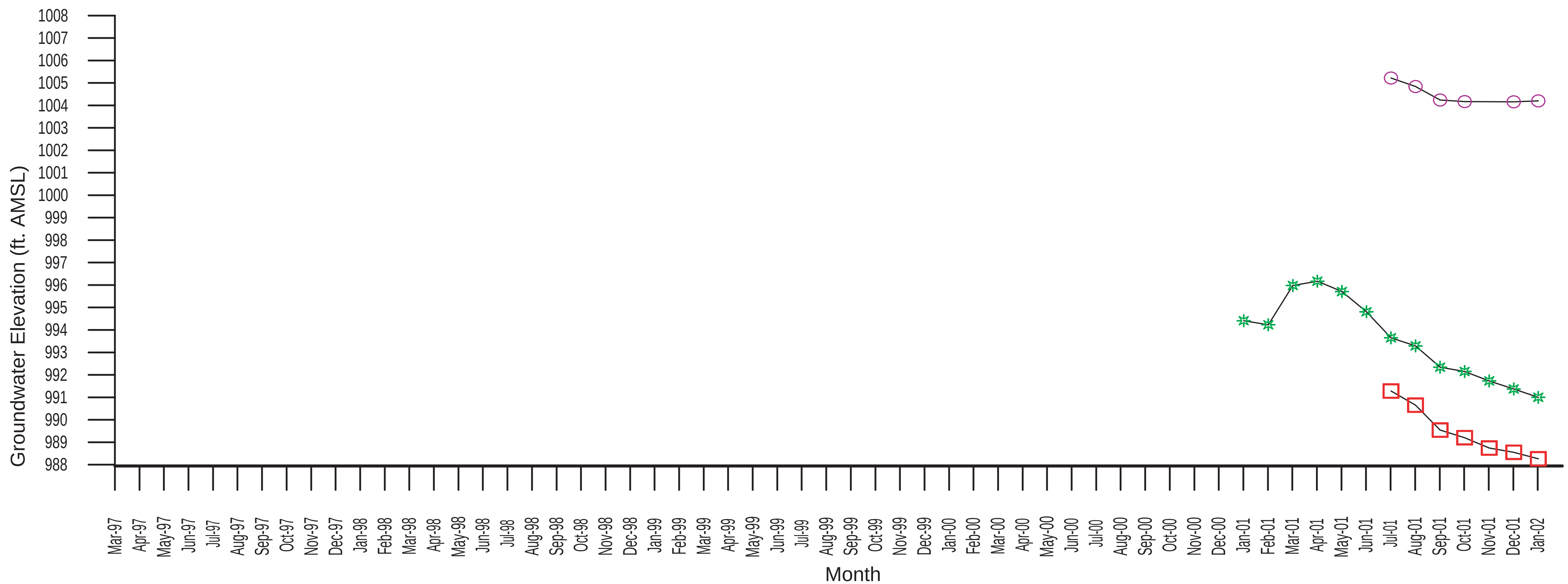

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Figure 2-24
Hydrographs
WCP East Grand Avenue
WQARF Site

(January 2001 - January 2002)

Legend

WCP-98
WCP-95
WCP-85

ft. amsl Feet Above Mean Sea Level

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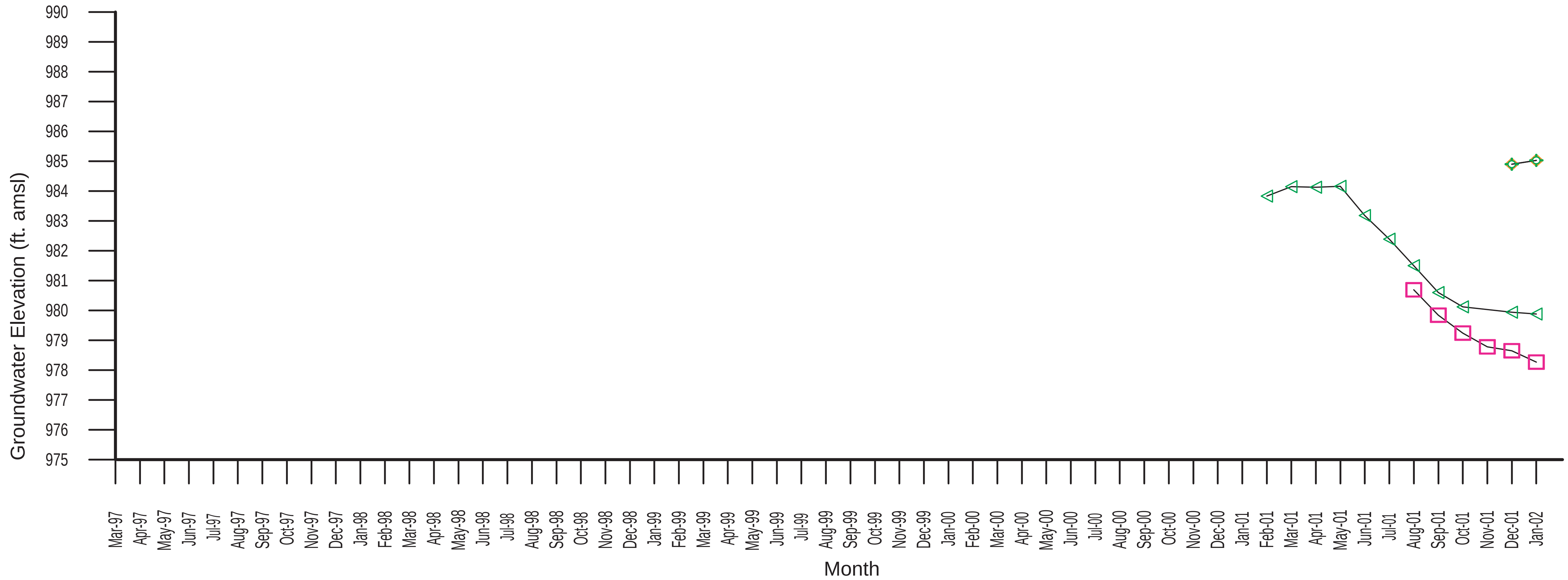
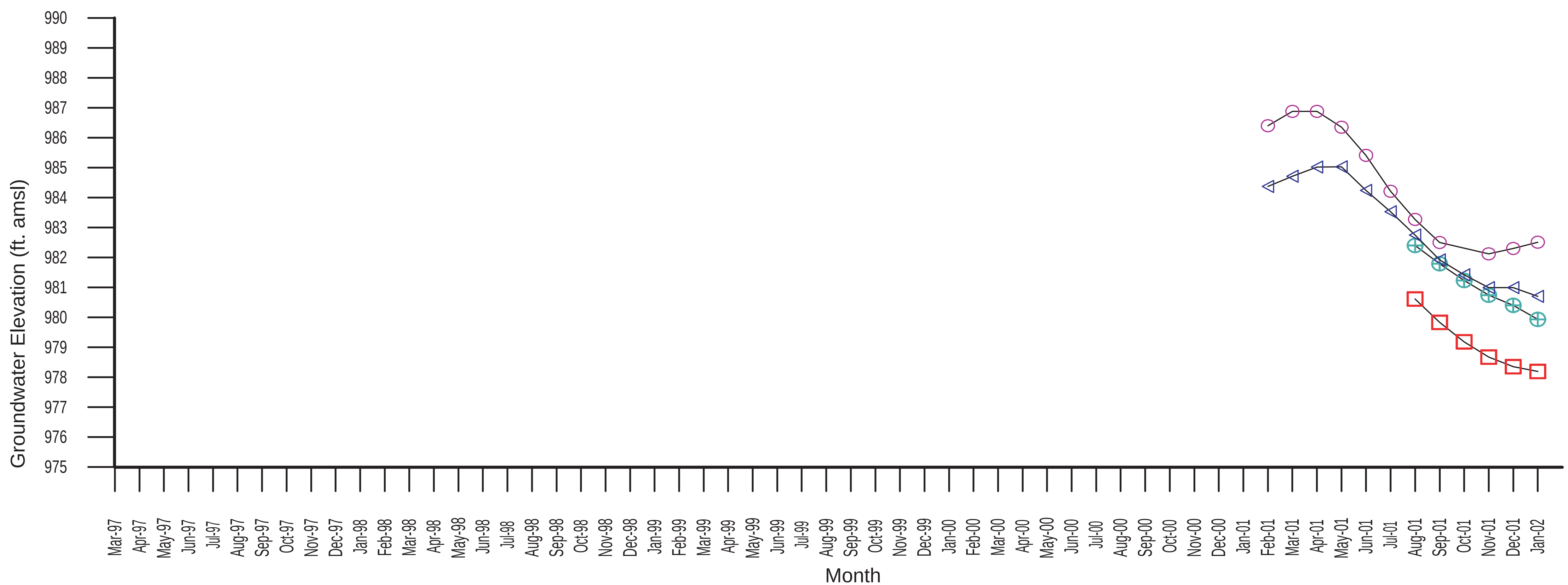
Figure 2-23
Hydrographs
WCP East Grand Avenue
WQARF Site

(April 1999 - January 2002)





Legend

- WCP-89
- WCP-94
- MWB-5
- MWB-4
- WCP-92
- WCP-96
- WCP-88
- WCP-47

ft. amsl — Feet Above Mean Sea Level

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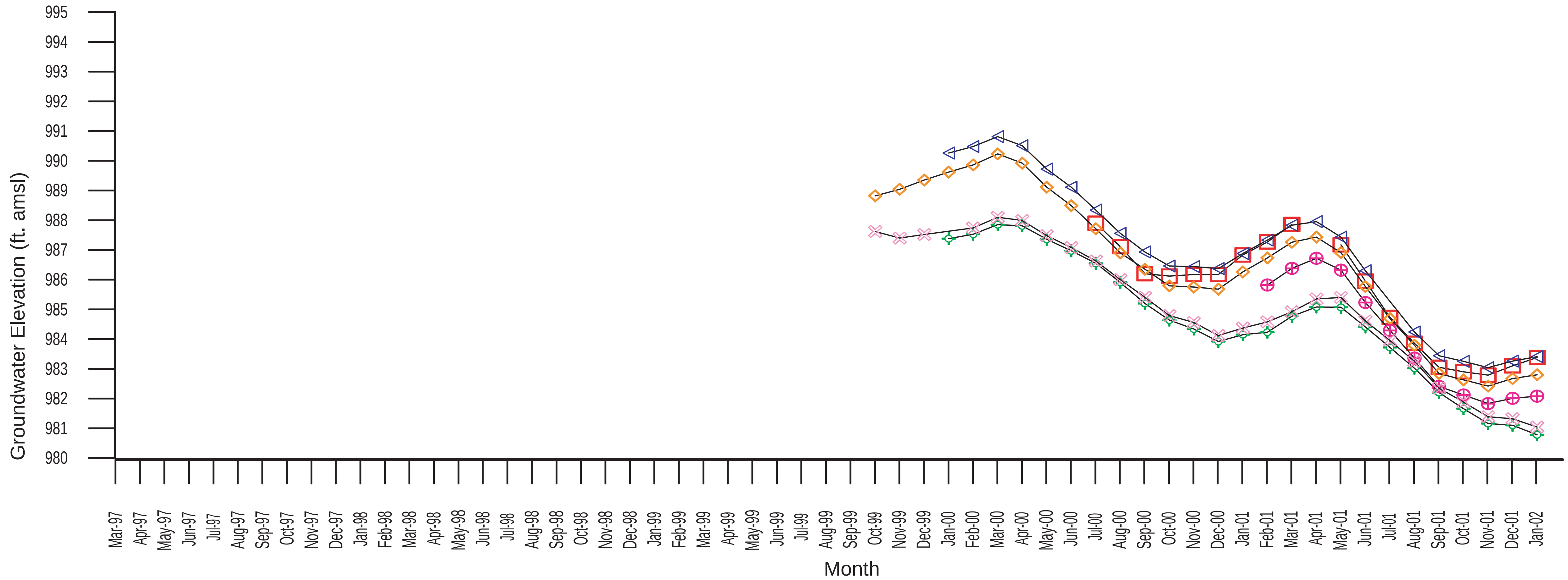

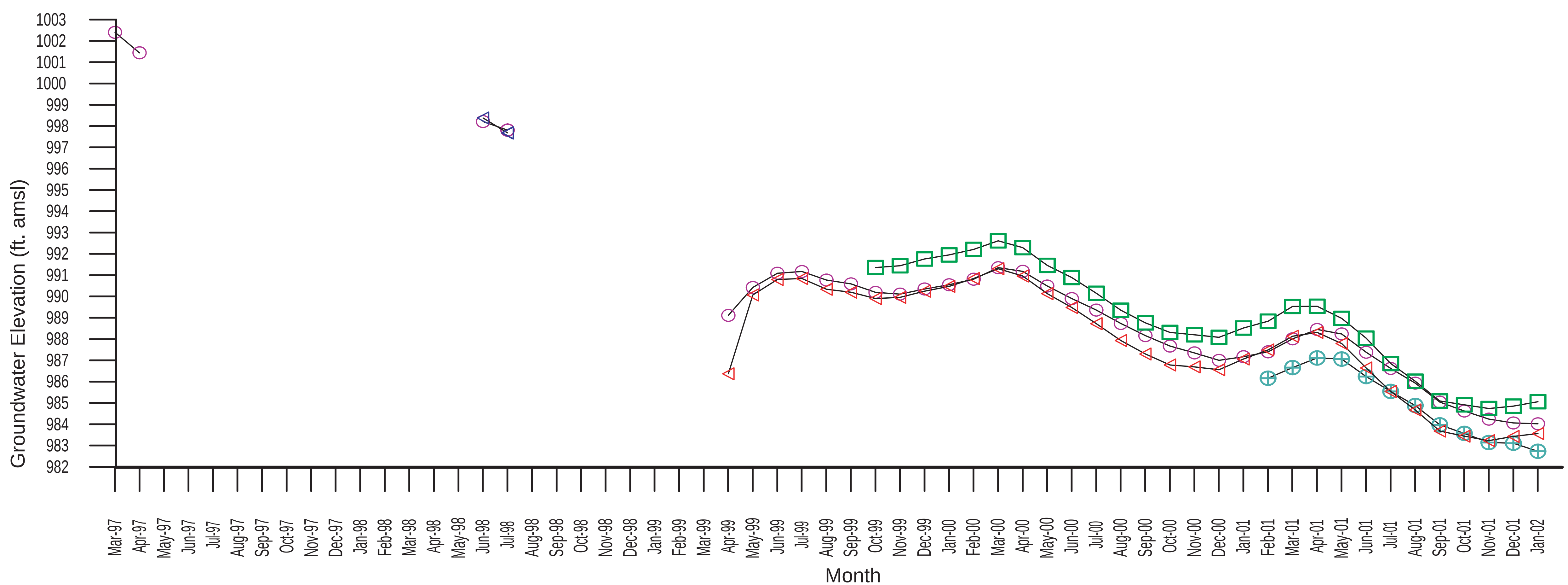

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Figure 2-22
Hydrographs
WCP East Grand Avenue
WQARF Site

(April 1999 - January 2002)

Legend

- WCP-46
- WCP-48
- WCP-45
- WCP-44
- WCP-87
- ENT-MW-2
- WCP-42
- WCP-86
- WCP-30
- WCP-17

ft. amsl Feet Above Mean Sea Level

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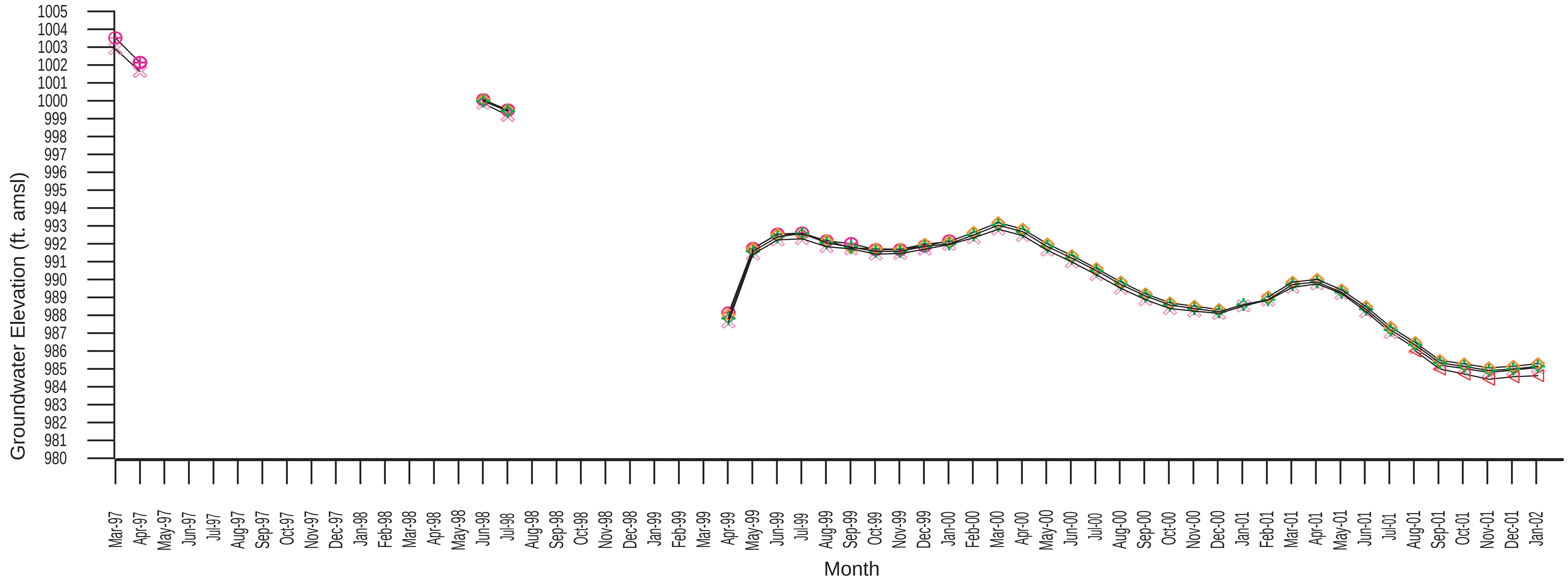

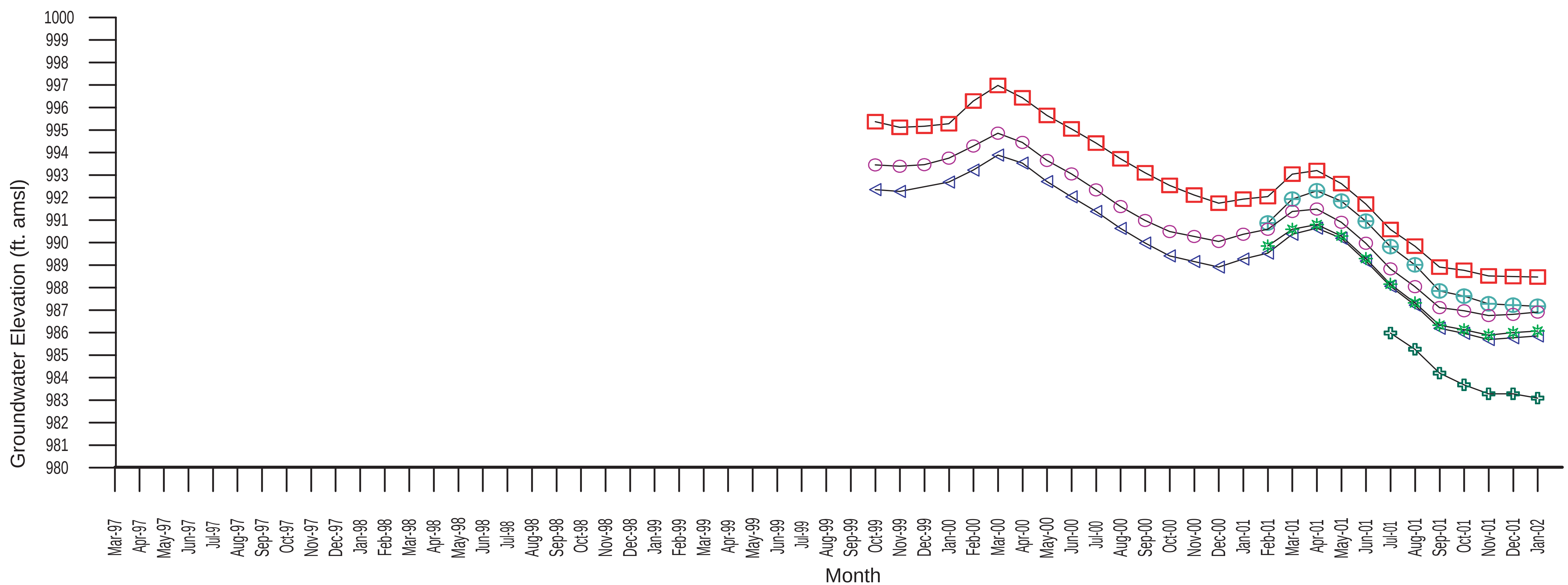

Figure 2-21
Hydrographs
WCP East Grand Avenue
WQARF Site

(April 1999 - January 2002)

Legend

WCP-93
WCP-29
WCP-28
WCP-16
WCP-15
WCP-43
WCP-83
WCP-41
WCP-40
WCP-84
WCP-97

ft. amsl Feet Above Mean Sea Level

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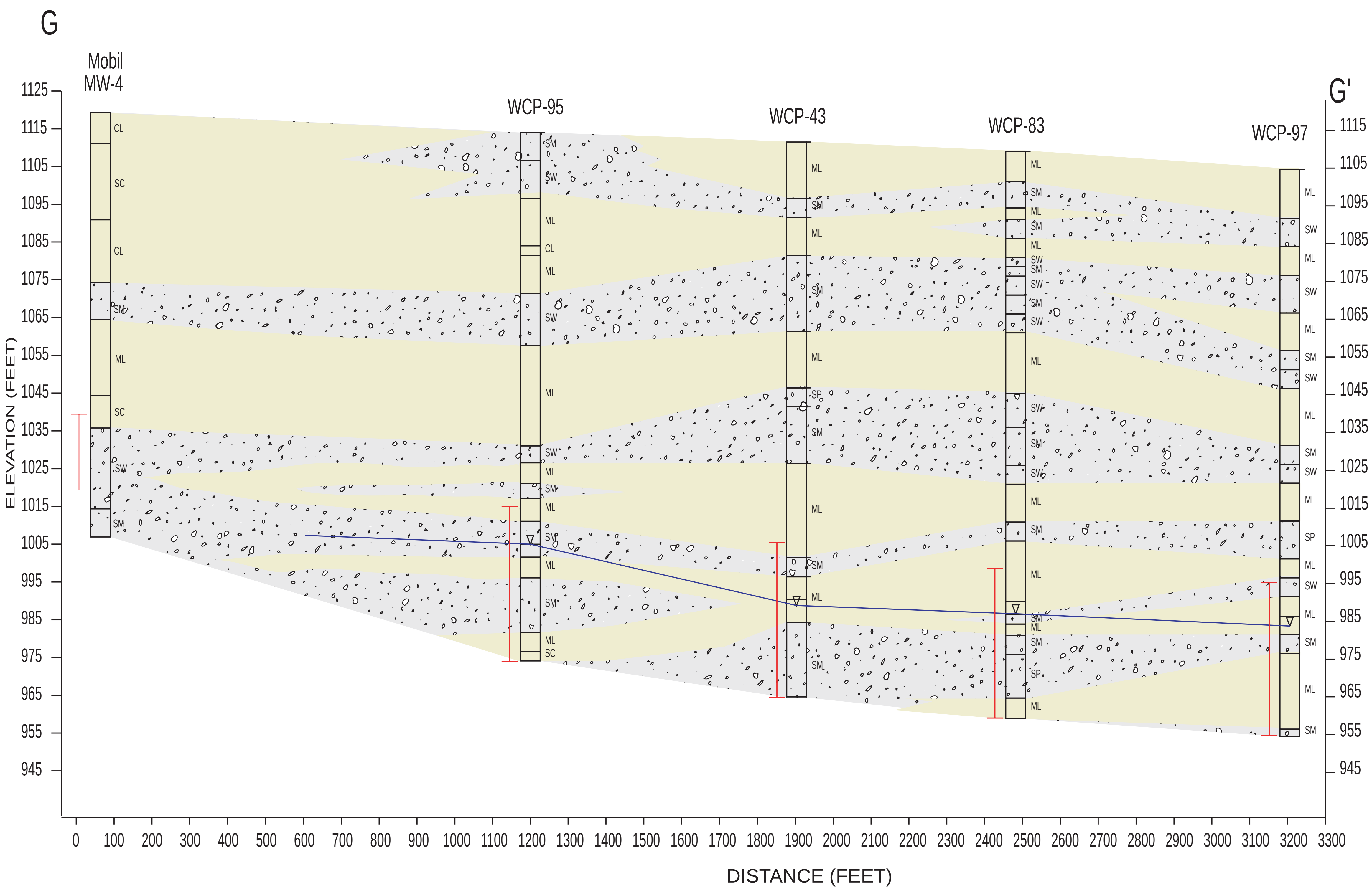

Figure 2-8
Geologic Cross Section G - G'
WCP East Grand Avenue WQARF Site

Legend

- Fine-Grained Units (ML, CL, SC)
- Coarse-Grained Units (SM, SP, SW)
- Water Table - January 2002
- Monitor Well Screen Interval

NOTE: All well locations and data points are approximate.

MOBIL MW-4 January 2002 GW elevation unavailable.

Approximate Vertical Scale
1 inch = 30 feet
0 15 30 60

Approximate Horizontal Scale
1 inch = 300 feet
0 150 300 600

Vertical Exaggeration = 10x

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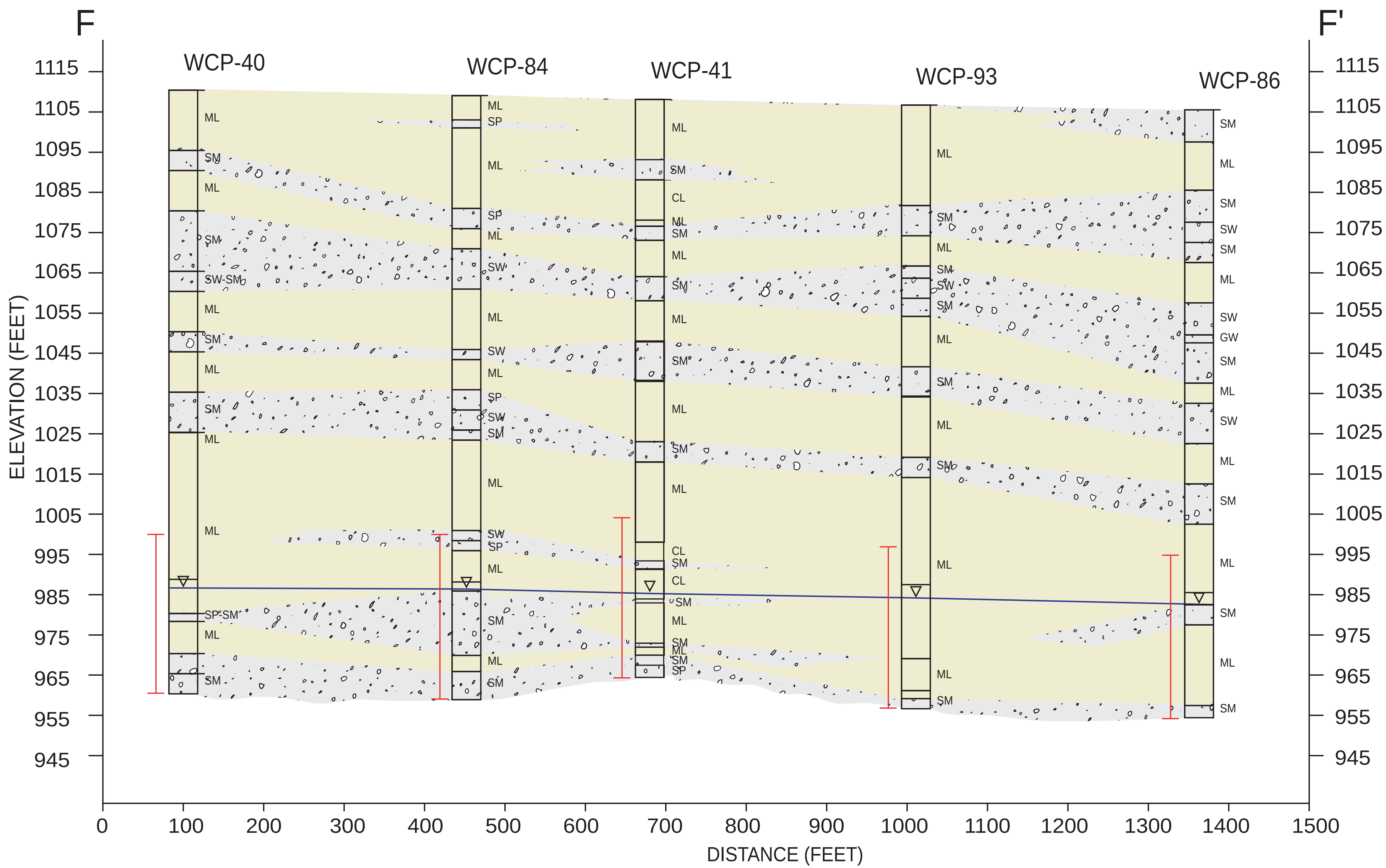

Figure 2-7
Geologic Cross Section
F - F'
WCP East Grand Avenue
WQARF Site

Legend

Fine-Grained Units (ML, CL, SC)

Coarse-Grained Units (SM, SP, SW)

Water Table - January 2002

Monitor Well Screen Interval

NOTE: All well locations and data points are approximate.

Approximate Vertical Scale
1 inch = 30 feet
0 15 30 60

Approximate Horizontal Scale
1 inch = 150 feet
0 75 150 300

Vertical Exaggeration = 5x

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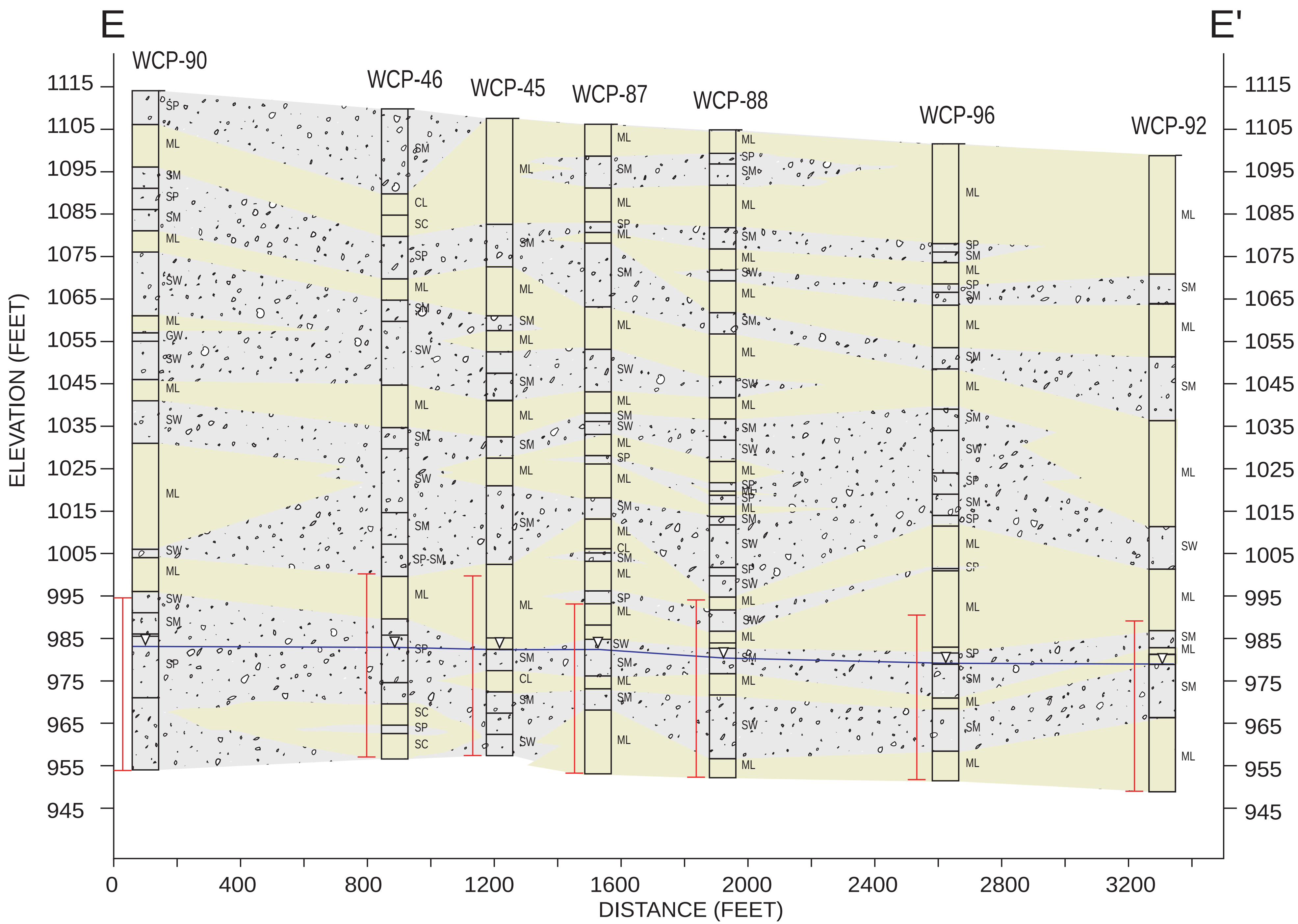

Figure 2-6
Geologic Cross Section E - E'
WCP East Grand Avenue WQARF Site

Legend

- Fine-Grained Units (ML, CL, SC)
- Coarse-Grained Units (SM, SP, SW)
- Water Table - January 2002
- Monitor Well Screen Interval

NOTE: All well locations and data points are approximate.

Approximate Vertical Scale
1 inch = 30 feet
0 15 30 60

Approximate Horizontal Scale
1 inch = 400 feet
0 200 400 800

Vertical Exaggeration = 13.3x

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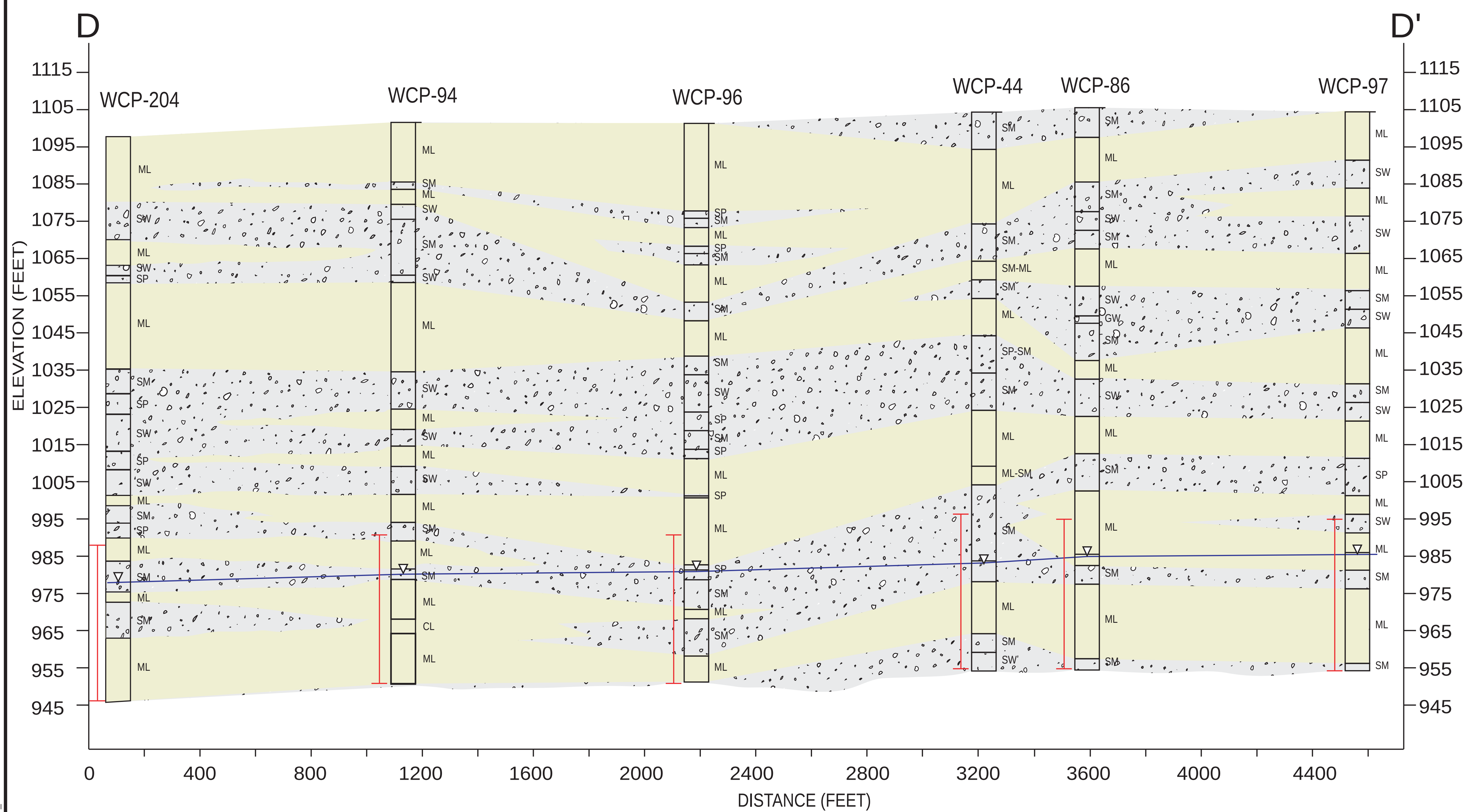

Figure 2-5
Geologic Cross Section D - D'
WCP East Grand Avenue WQARF Site

Legend

- Fine-Grained Units (ML, CL, SC)
- Coarse-Grained Units (SM, SP, SW)
- Water Table - January 2002
- Monitor Well Screen Interval

NOTE: All well locations and data points are approximate.

Approximate Vertical Scale
1 inch = 30 feet
0 15 30 60

Approximate Horizontal Scale
1 inch = 400 feet
0 200 400 800

Vertical Exaggeration = 13.3x

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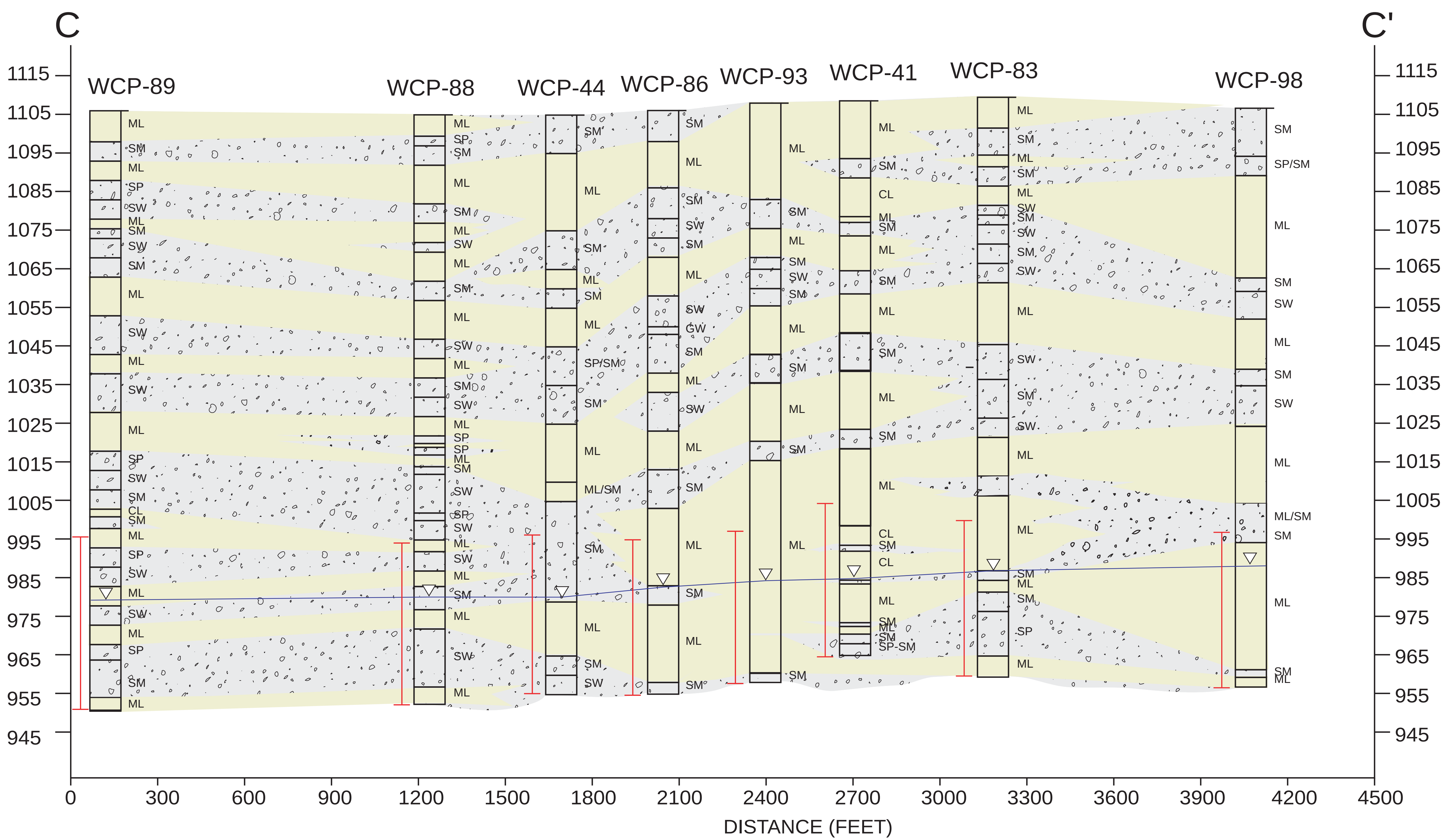

Figure 2-4
Geologic Cross Section
C - C'
WCP East Grand Avenue
WQARF Site

Legend

- Fine-Grained Units (ML, CL, SC)
- Coarse-Grained Units (SM, SP, SW)
- Water Table - January 2002
- Monitor Well Screen Interval

NOTE: All well locations and data points are approximate.

Approximate
Vertical Scale
1 inch = 30 feet
0 15 30 60

Approximate
Horizontal Scale
1 inch = 400 feet
0 200 400 800

Vertical Exaggeration = 13.3x

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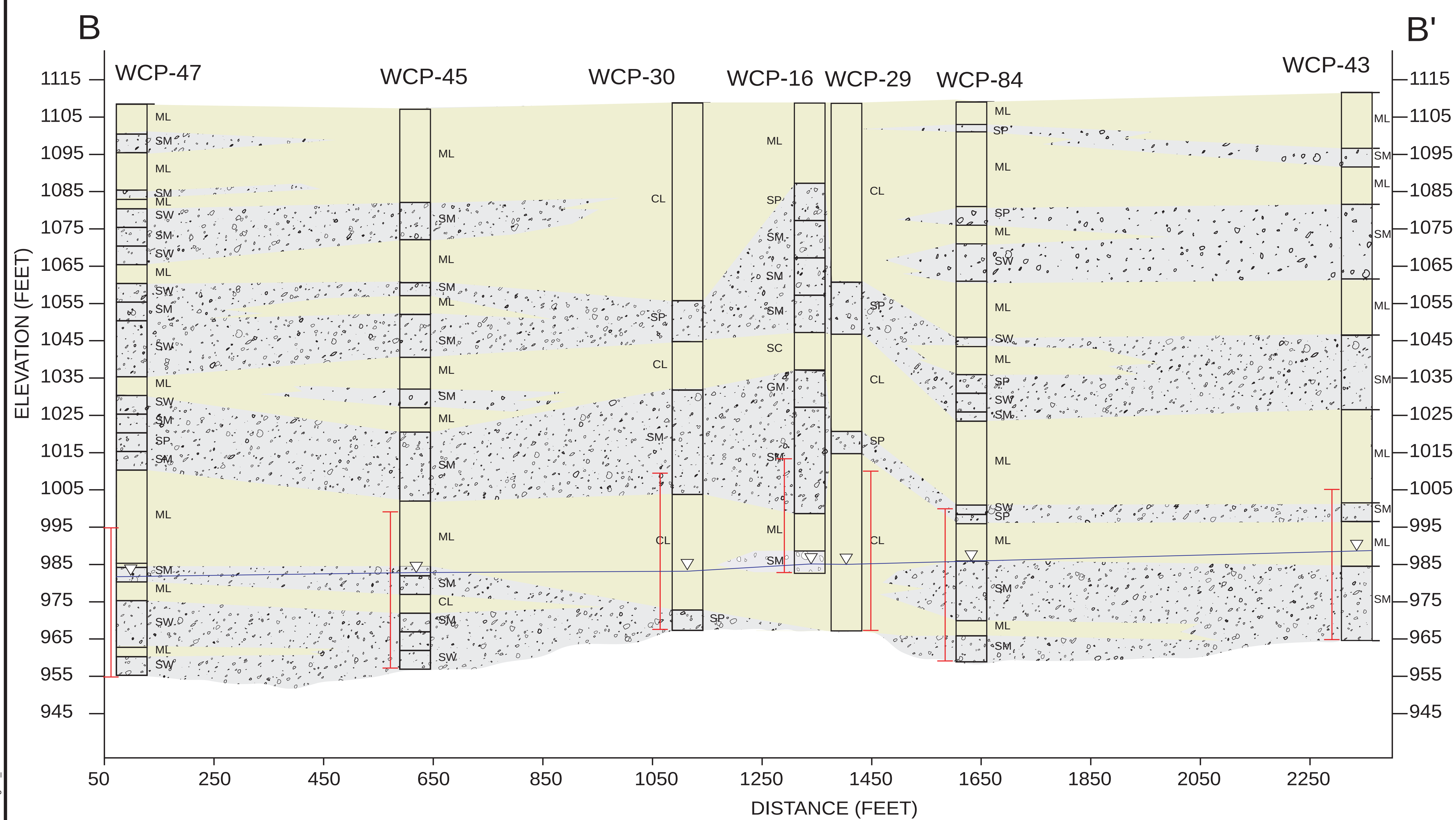

Figure 2-3
Geologic Cross Section
B - B'
WCP East Grand Avenue
WQARF Site

Legend

Fine-Grained Units (ML, CL, SC)

Coarse-Grained Units (SM, SP, SW)

Water Table - January 2002

Monitor Well Screen Interval

NOTE: All well locations and data points are approximate.

Approximate
Vertical Scale
1 inch = 30 feet
0 15 30 60

Approximate
Horizontal Scale
1 inch = 200 feet
0 100 200 400

Vertical Exaggeration = 6.7x

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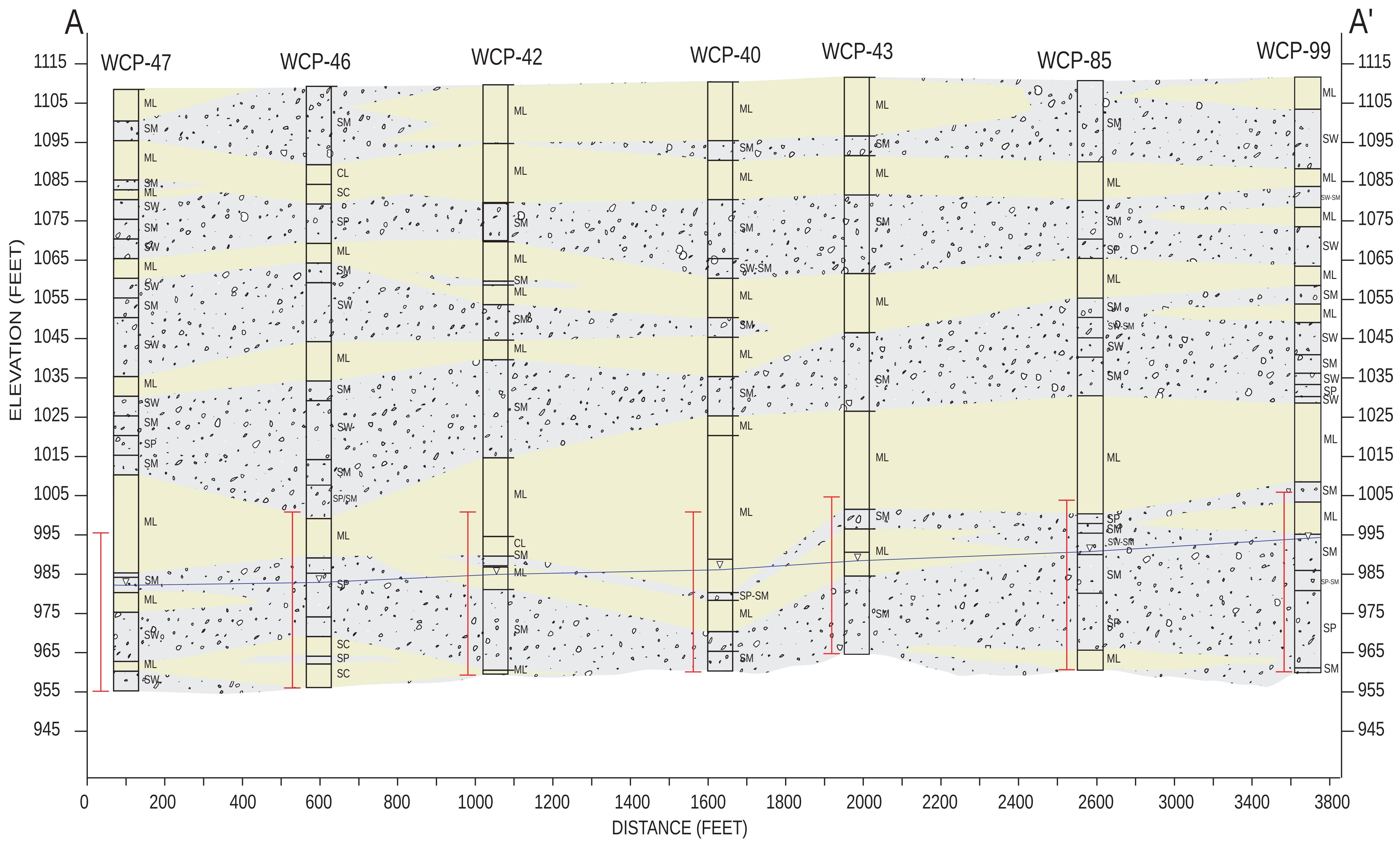

Figure 2-2
Geologic Cross Section
A - A'
WCP East Grand Avenue
WQARF Site

Legend

- Fine-Grained Units (ML, CL, SC)
- Coarse-Grained Units (SM, SP, SW)
- Water Table - January 2002
- Monitor Well Screen Interval

NOTE: All well locations and data points are approximate.

Approximate
Vertical Scale
1 inch = 30 feet
0 15 30 60

Approximate
Horizontal Scale
1 inch = 300 feet
0 150 300 600

Vertical Exaggeration = 10x

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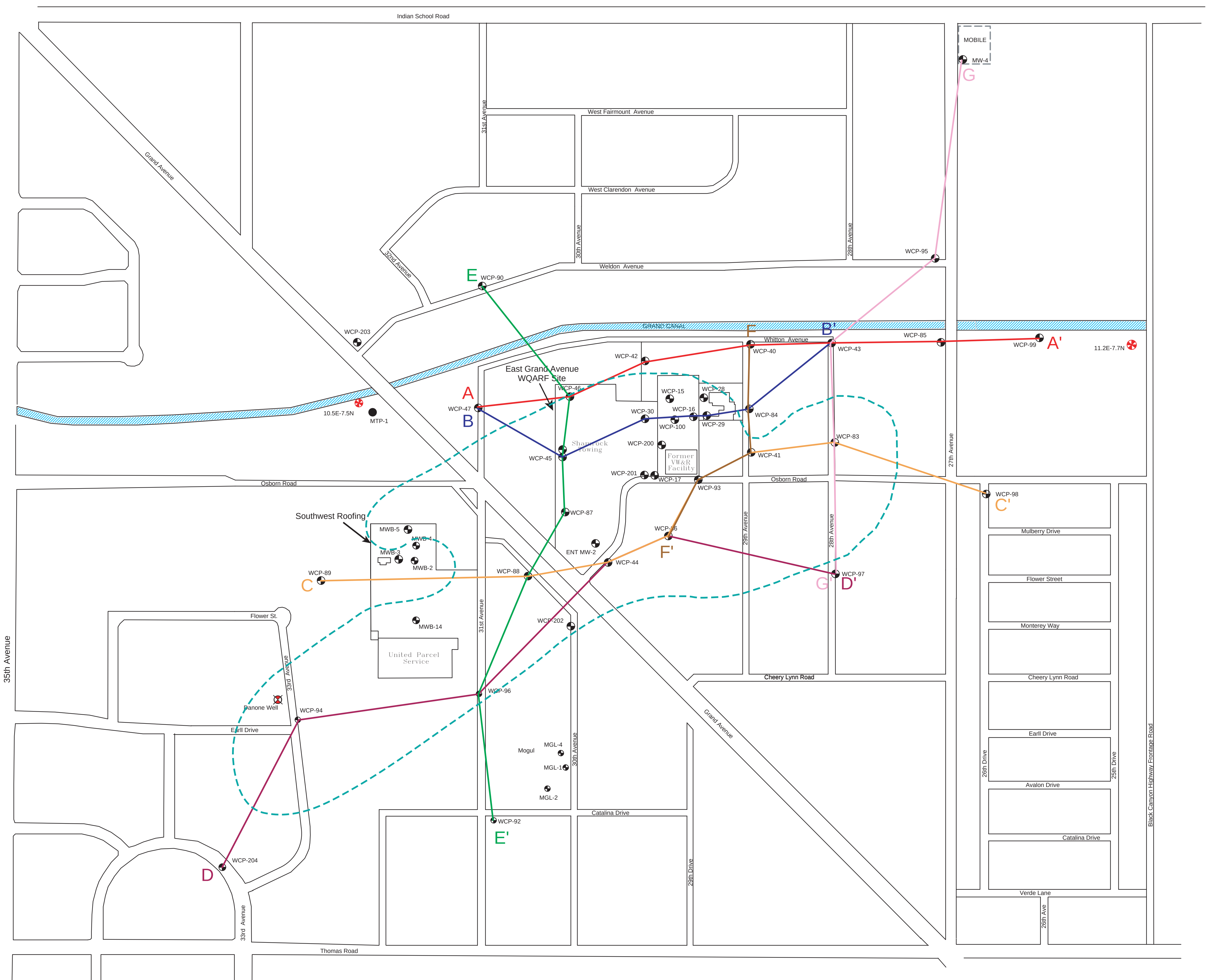

Figure 2-1
Trace of Geologic Cross Sections

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- X—X' Cross Section Locations
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- WQARF Registry Site Boundary

NOTES: All well locations are approximate.

N

Approximate Scale
1 inch = 600 feet
0 300 600 1200

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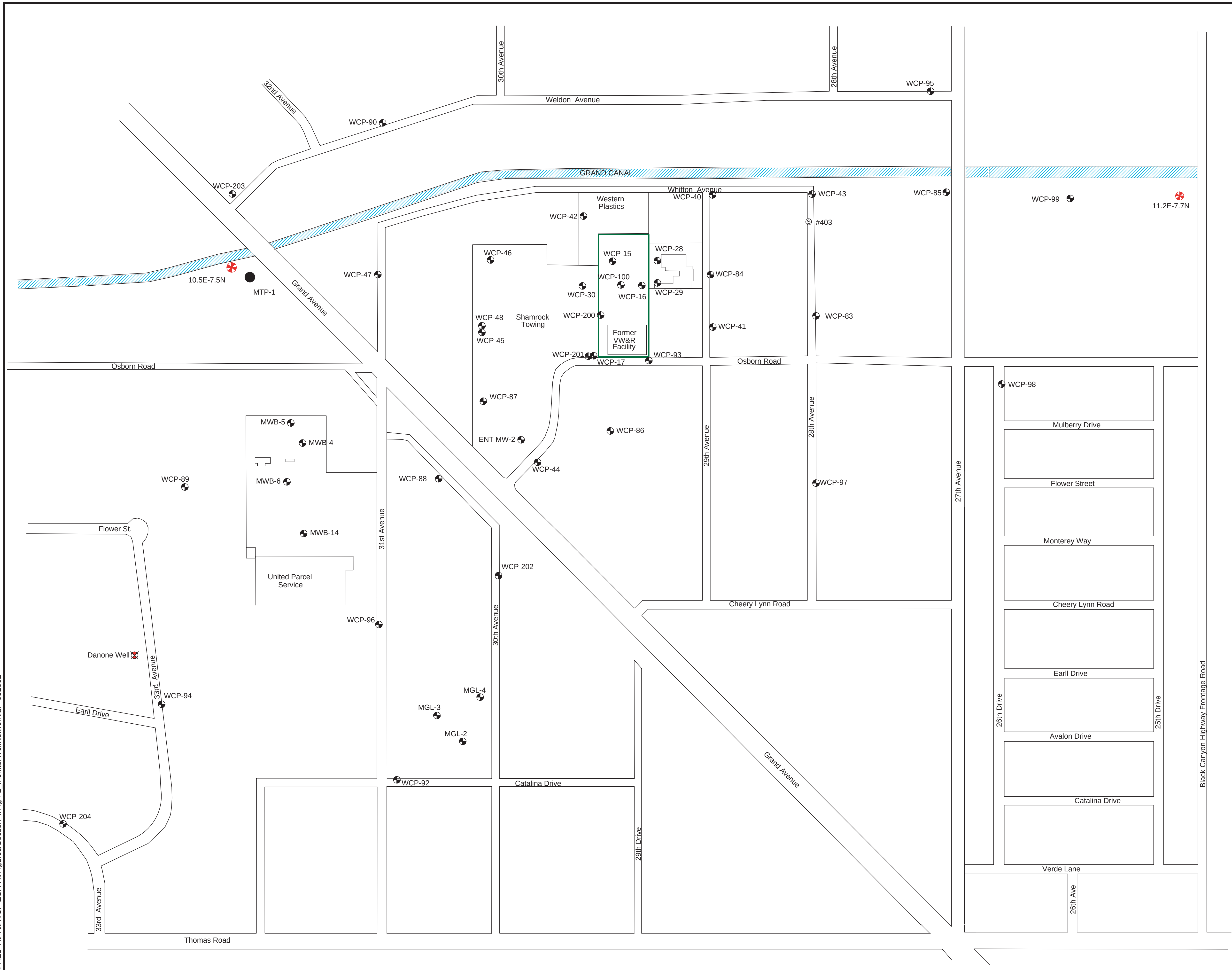

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Figure 4-1
Groundwater Monitor Well Network
WCP East Grand Avenue WQARF Site

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- Sewer Manhole

NOTES: All well locations are approximate.

N

Approximate Scale
1 inch = 450 feet

0 225 450 900

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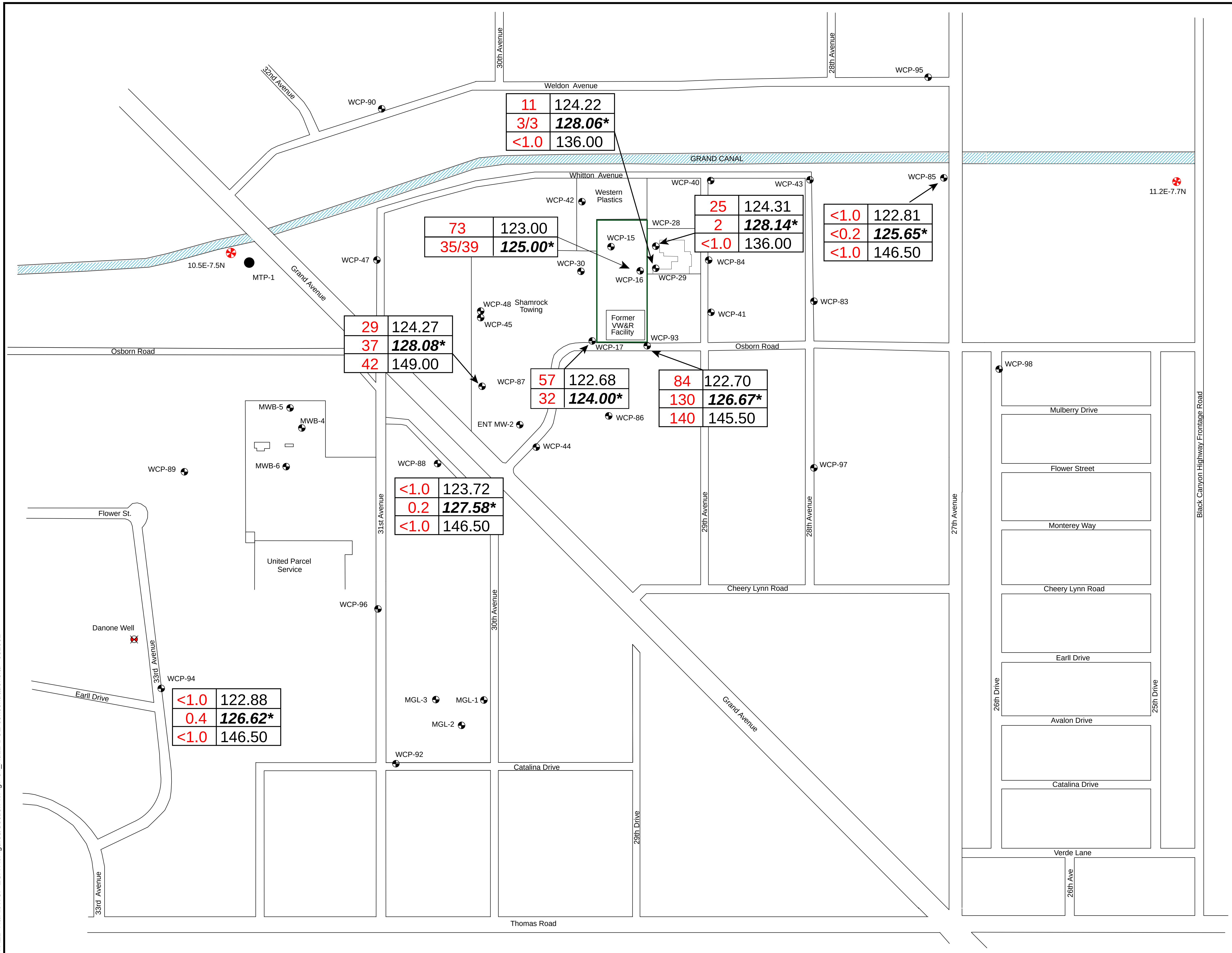

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Figure 7-64
1,1-DCE Concentrations Groundwater Sampling Round 12 - PDB vs. Pump
October 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- 230 — 1,1-DCE Concentration in (μg/L)
- 122.81 — Sample Depth Below Ground Surface Using Passive Diffusion Bag Method
- ***125.65**** — Sample Depth Below Ground Surface Using Pump Method

NOTES: All well locations are approximate. Sample depth measured in feet below ground surface.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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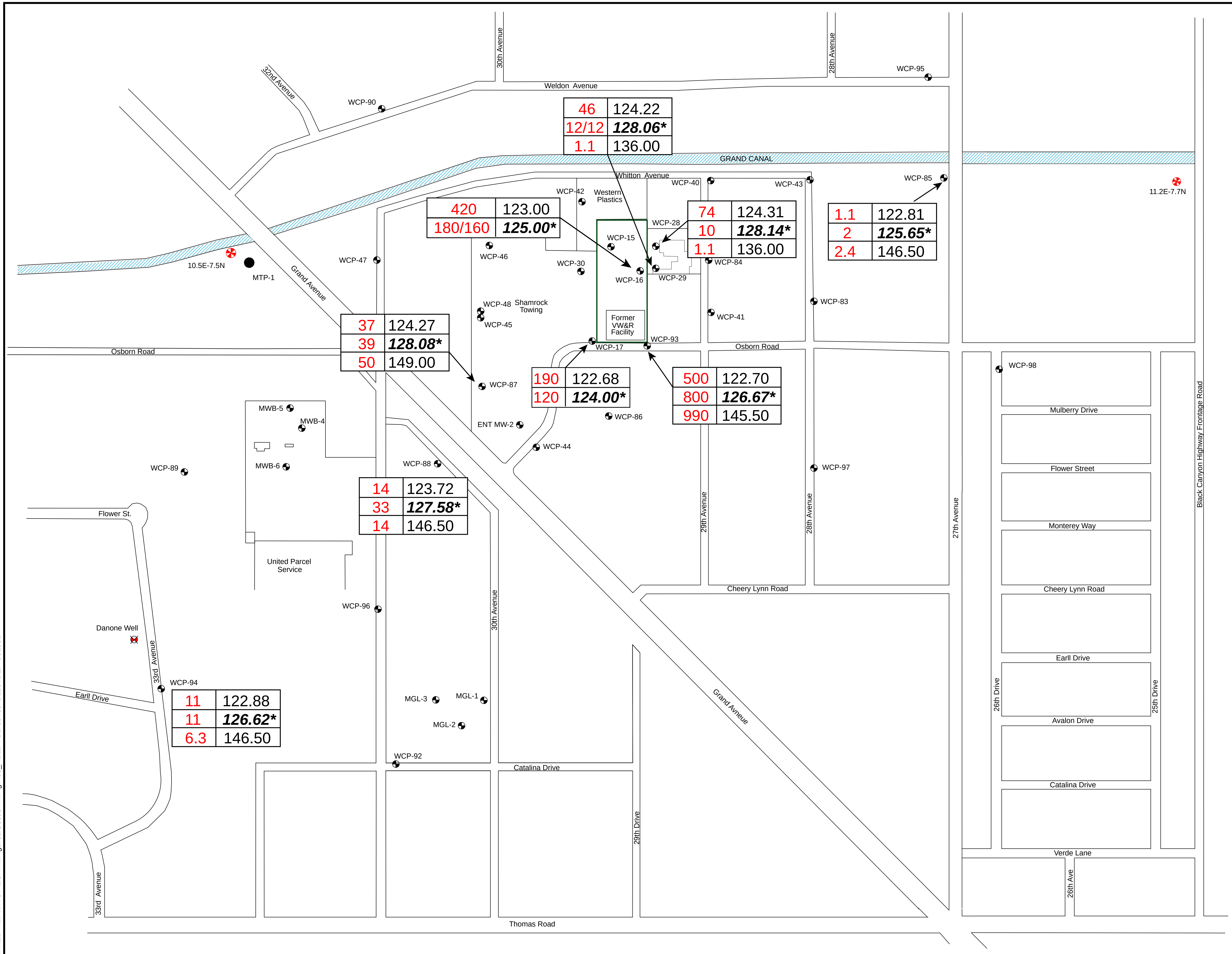

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Figure 7-63
TCE Concentrations Groundwater Sampling Round 12 - PDB vs. Pump October 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- 230 — TCE Concentration in $\mu g/L$
- 122.81 — Sample Depth Below Ground Surface Using Passive Diffusion Bag Method
- ***125.65**** — Sample Depth Below Ground Surface Using Pump Method

NOTES: All well locations are approximate. Sample depth measured in feet below ground surface.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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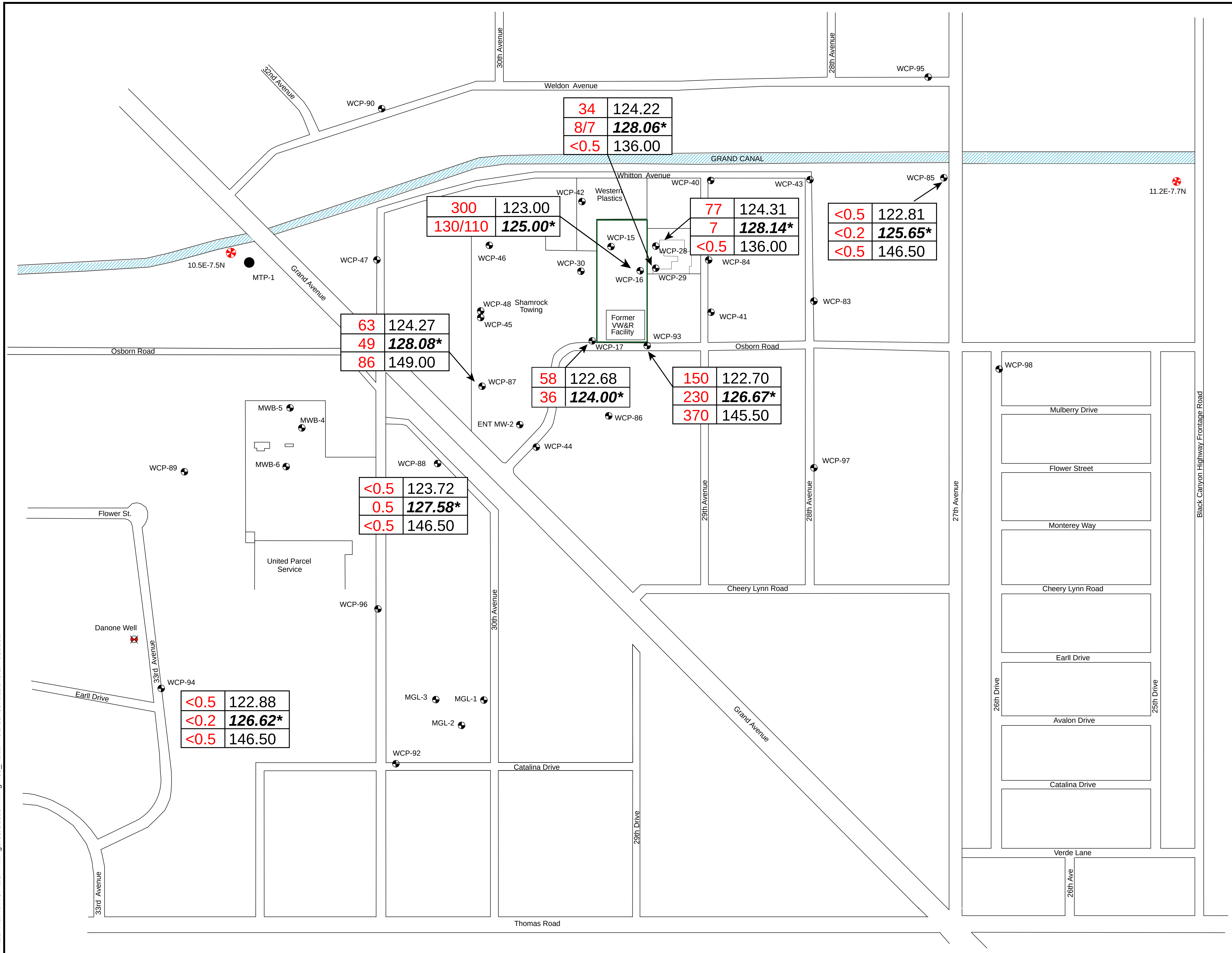

Figure 7-62
PCE Concentrations
Groundwater Sampling
Round 12 - PDB vs. Pump
October 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- 230 PCE Concentration in $\mu g/L$
- 122.81 Sample Depth Below Ground Surface Using Passive Diffusion Bag Method
- ***125.65**** Sample Depth Below Ground Surface Using Pump Method

NOTES: All well locations are approximate. Sample depth measured in feet below ground surface.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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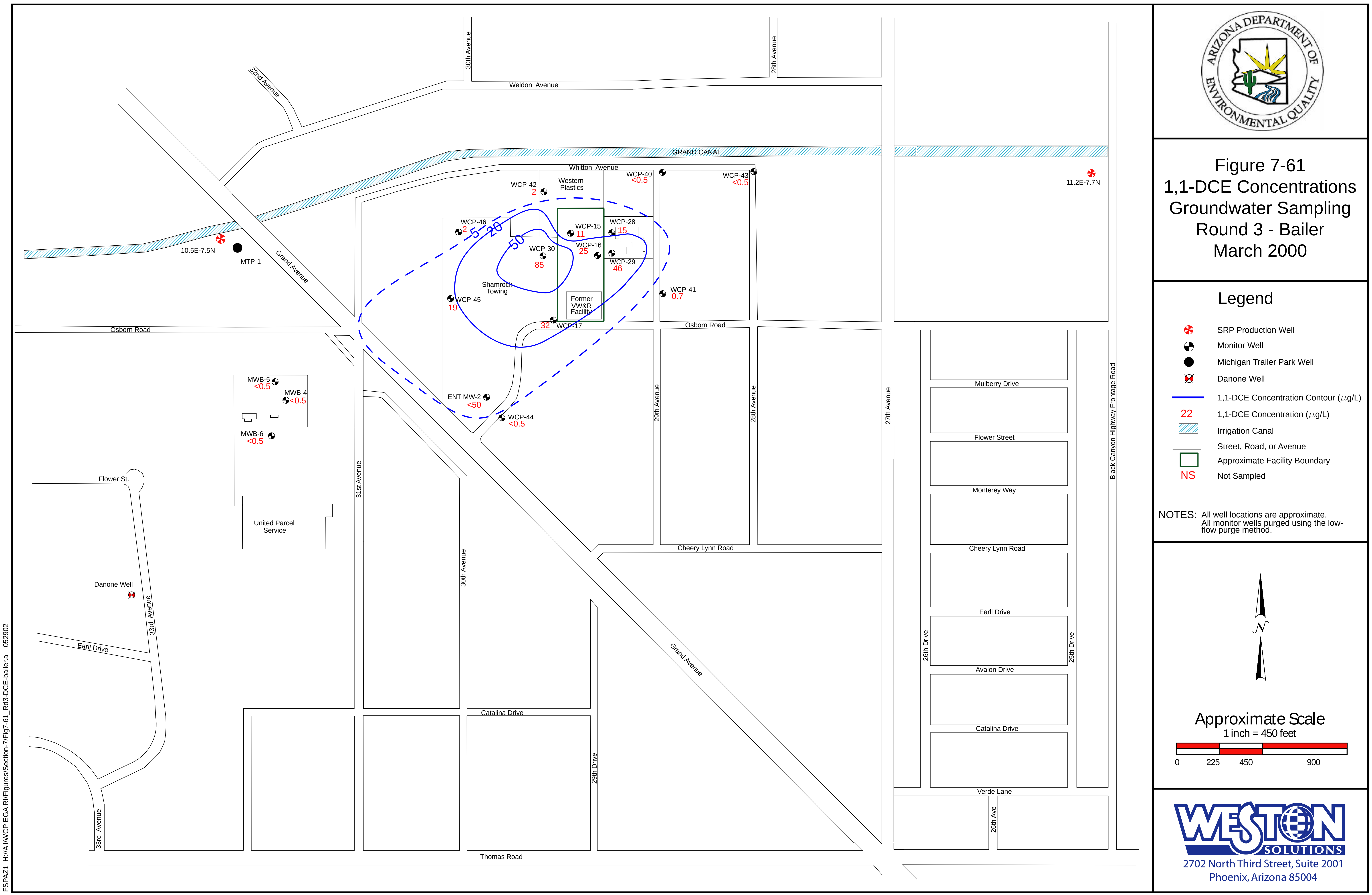

Figure 7-61
1,1-DCE Concentrations
Groundwater Sampling
Round 3 - Bailer
March 2000
Legend
SRP Production Well
Monitor Well
Michigan Trailer Park Well
Danone Well
1,1-DCE Concentration Contour (µg/L)
22
1,1-DCE Concentration (µg/L)
Irrigation Canal
Street, Road, or Avenue
Approximate Facility Boundary
NS
Not Sampled
NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.
N
Approximate Scale
1 inch = 450 feet
0
225
450
900
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GRAND CANAL
Weldon Avenue
Whitton Avenue
Osborn Road
Cheery Lynn Road
Catalina Drive
Thomas Road
Grand Avenue
30th Avenue
28th Avenue
32nd Avenue
31st Avenue
29th Avenue
27th Avenue
29th Drive
33rd Avenue
26th Drive
25th Drive
26th Ave
Black Canyon Highway Frontage Road
Mulberry Drive
Flower Street
Monterey Way
Earll Drive
Avalon Drive
Verde Lane
Flower St.
Earll Drive
Western Plastics
Shamrock Towing
Former VW&R Facility
United Parcel Service
Danone Well
10.5E-7.5N
MTP-1
11.2E-7.7N
WCP-42 2
WCP-40 <0.5
WCP-43 <0.5
WCP-46 2
WCP-15 11
WCP-28 15
WCP-30 85
WCP-16 25
WCP-29 46
WCP-45 19
WCP-41 0.7
32 WCP-17
ENT MW-2 <50
WCP-44 <0.5
MWB-5 <0.5
MWB-4 <0.5
MWB-6 <0.5
5
20
50
FSPAZ1 H://All/WCP EGA RI/Figures/Section-7/Fig7-61_Rd3-DCE-bailer.ai 052902

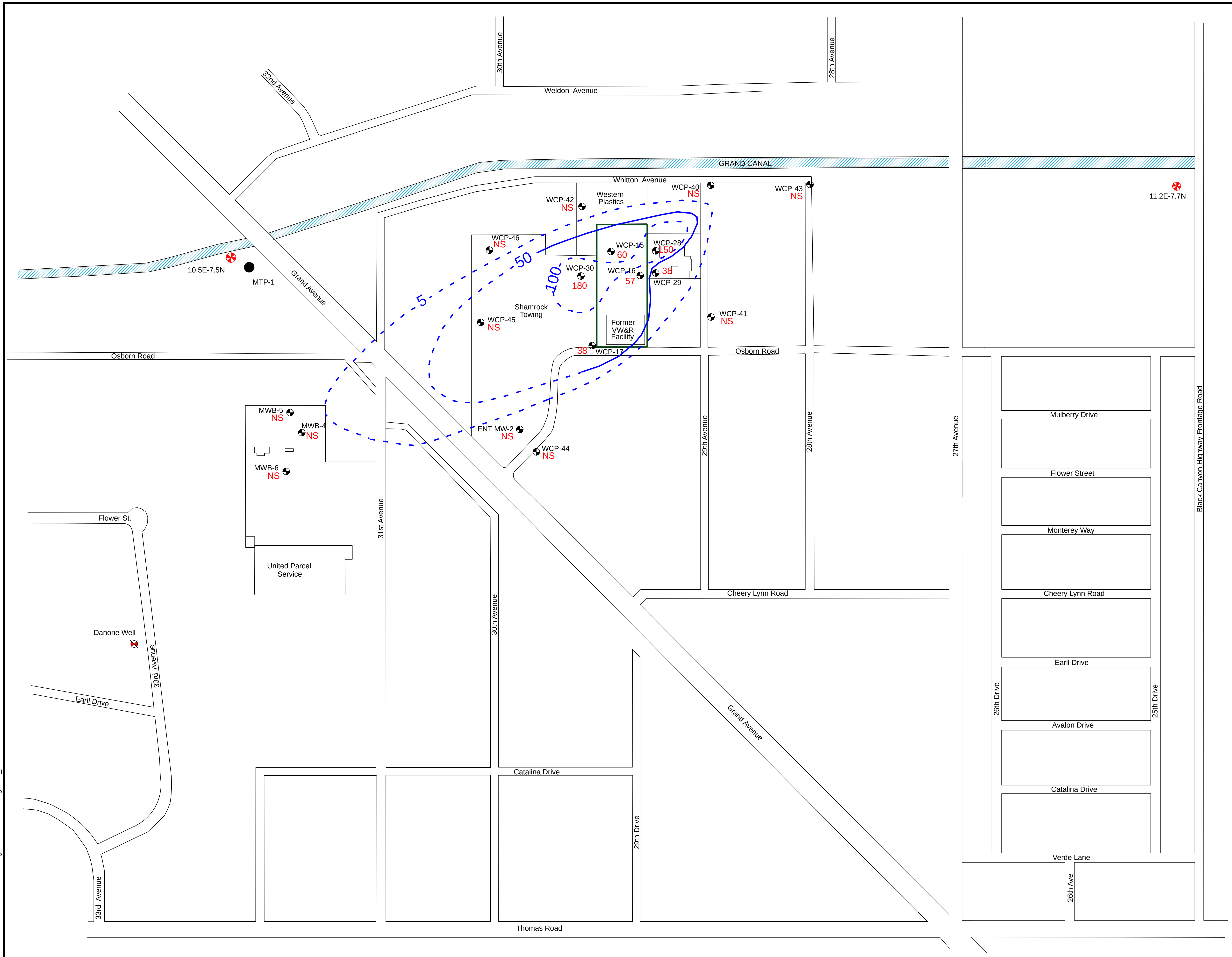

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Figure 7-60
1,1-DCE Concentrations
Groundwater Sampling
Round 2 - Bailer
January-February 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- 1,1-DCE Concentration Contour (μg/L)
- 22 1,1-DCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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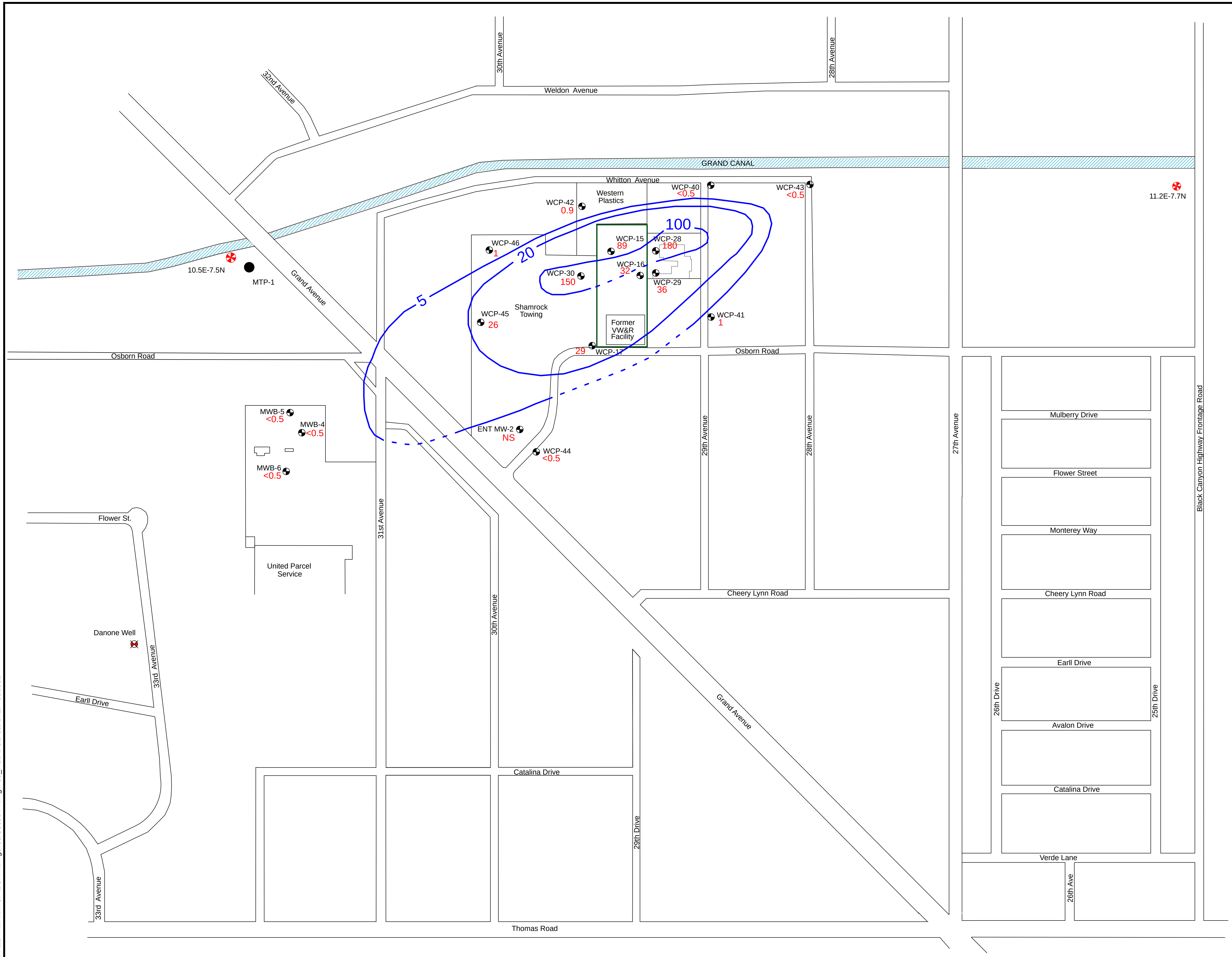

Figure 7-59
1,1-DCE Concentrations
Groundwater Sampling
Round 1 - Bailer
December 1999

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- 1,1-DCE Concentration Contour (μg/L)
- 22 — 1,1- DCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS — Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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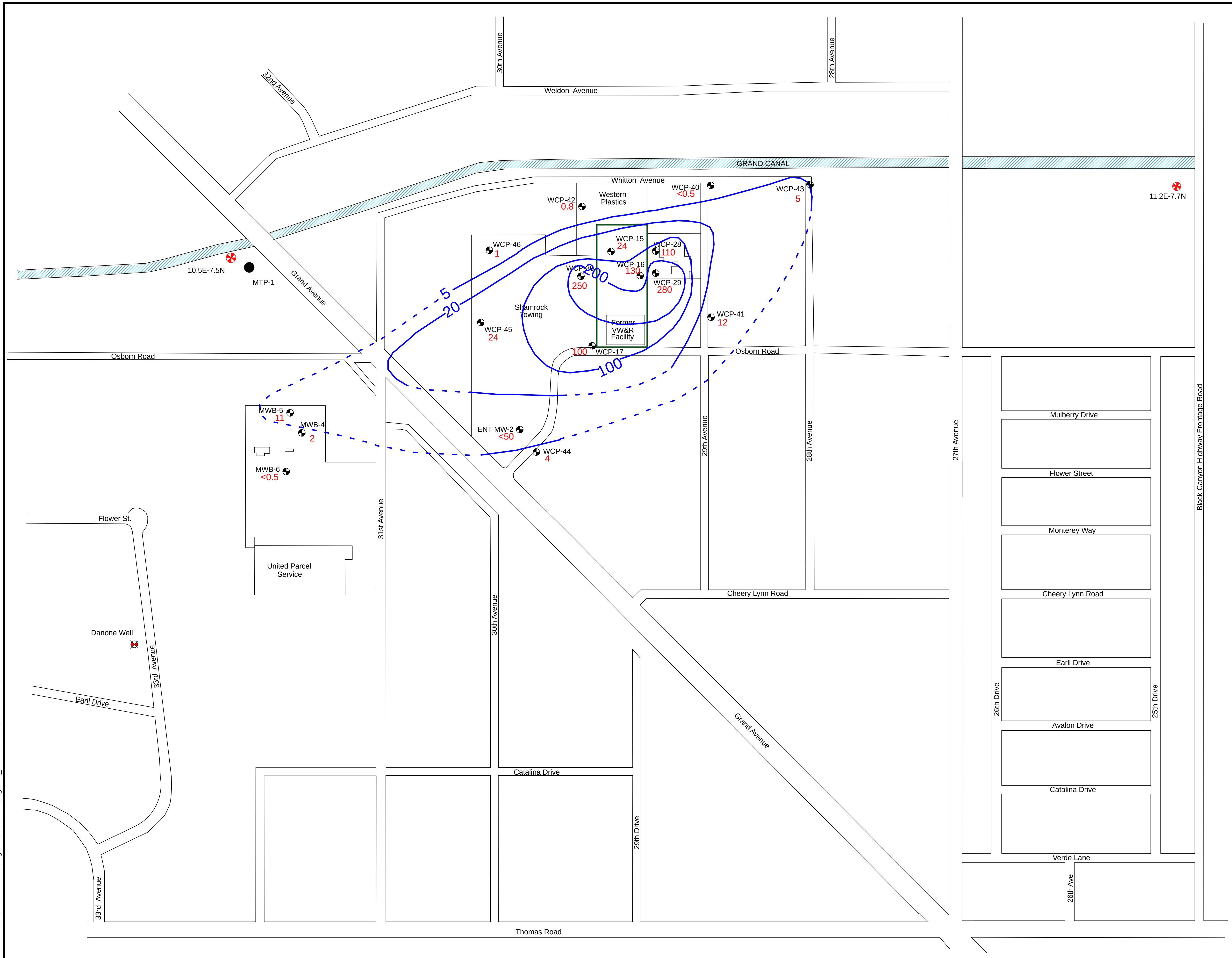

Figure 7-58
TCE Concentrations
Groundwater Sampling
Round 3 - Bailer
March 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- TCE Concentration Contour (μg/L)
- 22 — TCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS — Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet

0 225 450 900

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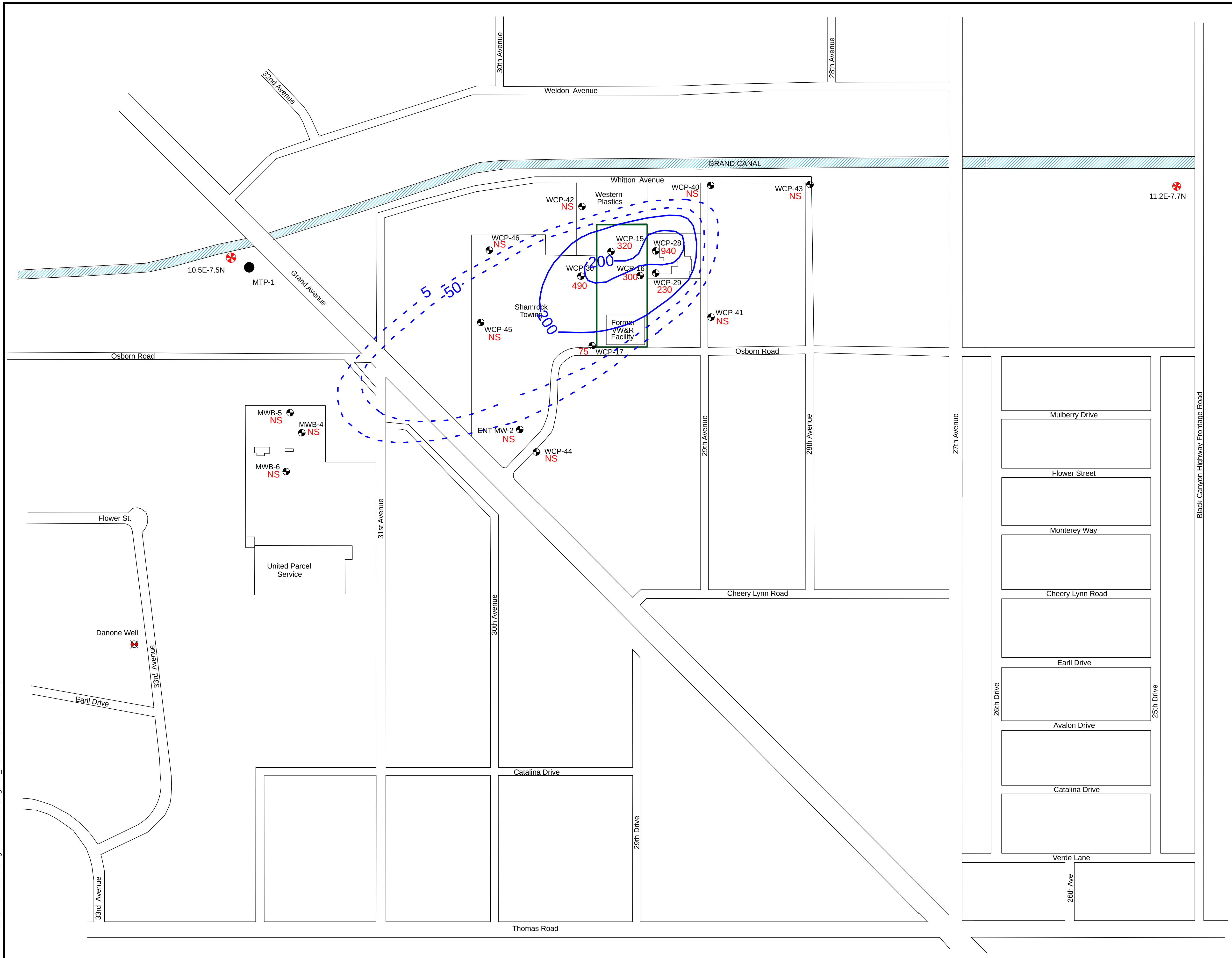

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Figure 7-57
TCE Concentrations Groundwater Sampling Round 2 - Bailer January-February 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- TCE Concentration Contour (μg/L)
- 22 TCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS Not Sampled

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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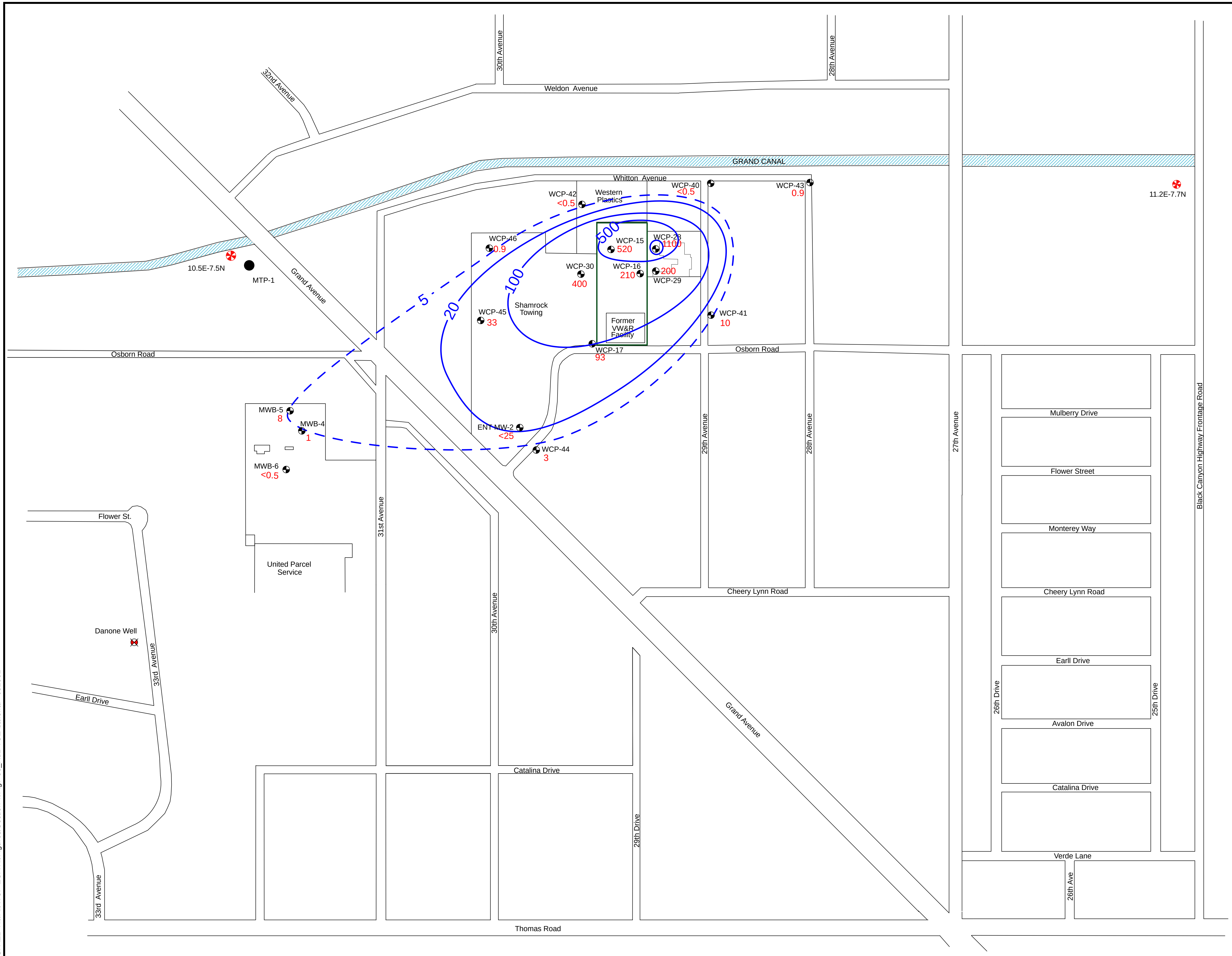

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Figure 7-56
TCE Concentrations Groundwater Sampling Round 1 - Bailer December 1999

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- TCE Concentration Contour (μg/L)
- 22 TCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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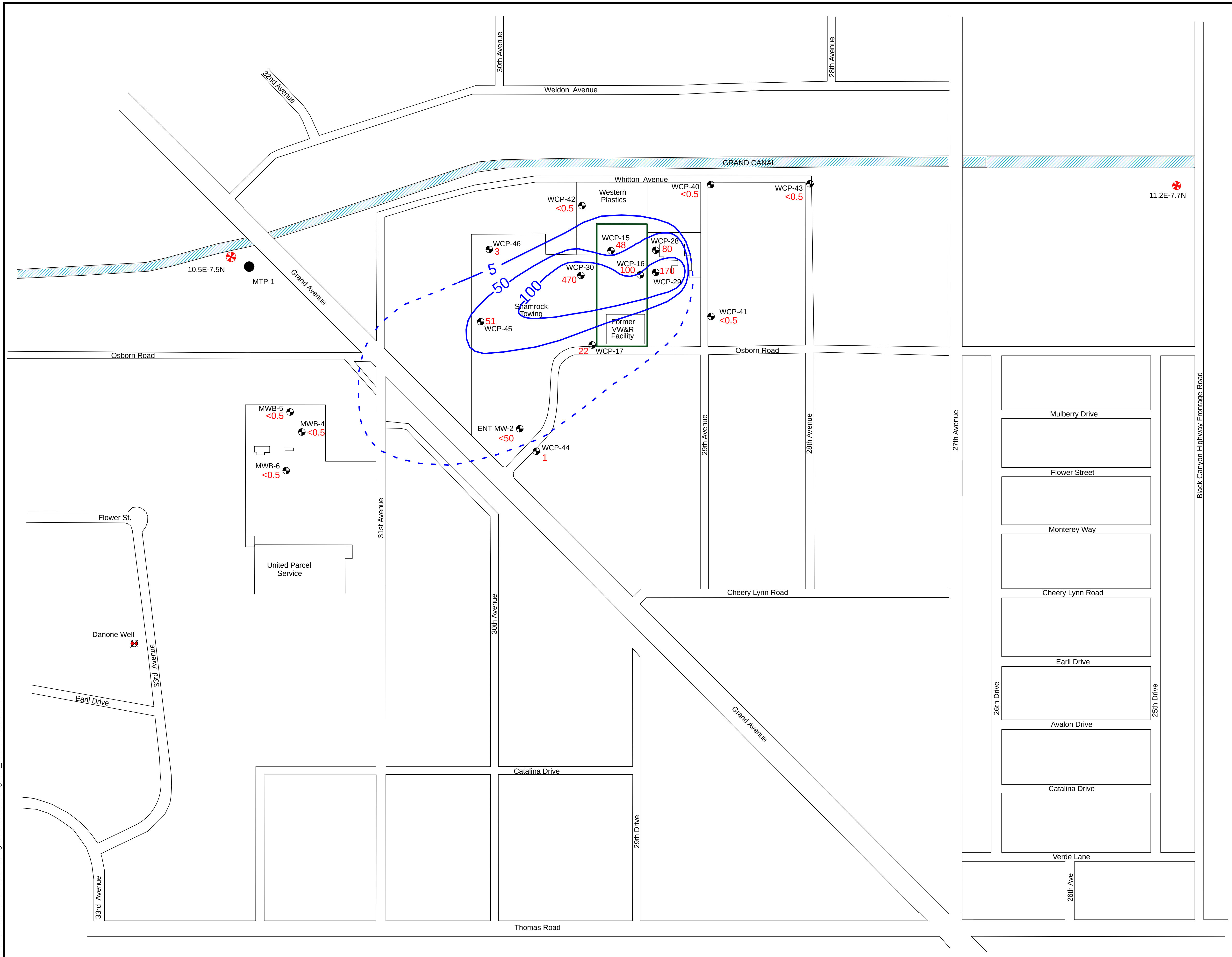

Figure 7-55
PCE Concentrations
Groundwater Sampling
Round 3 - Bailer
March 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- PCE Concentration Contour (μg/L)
- 22 PCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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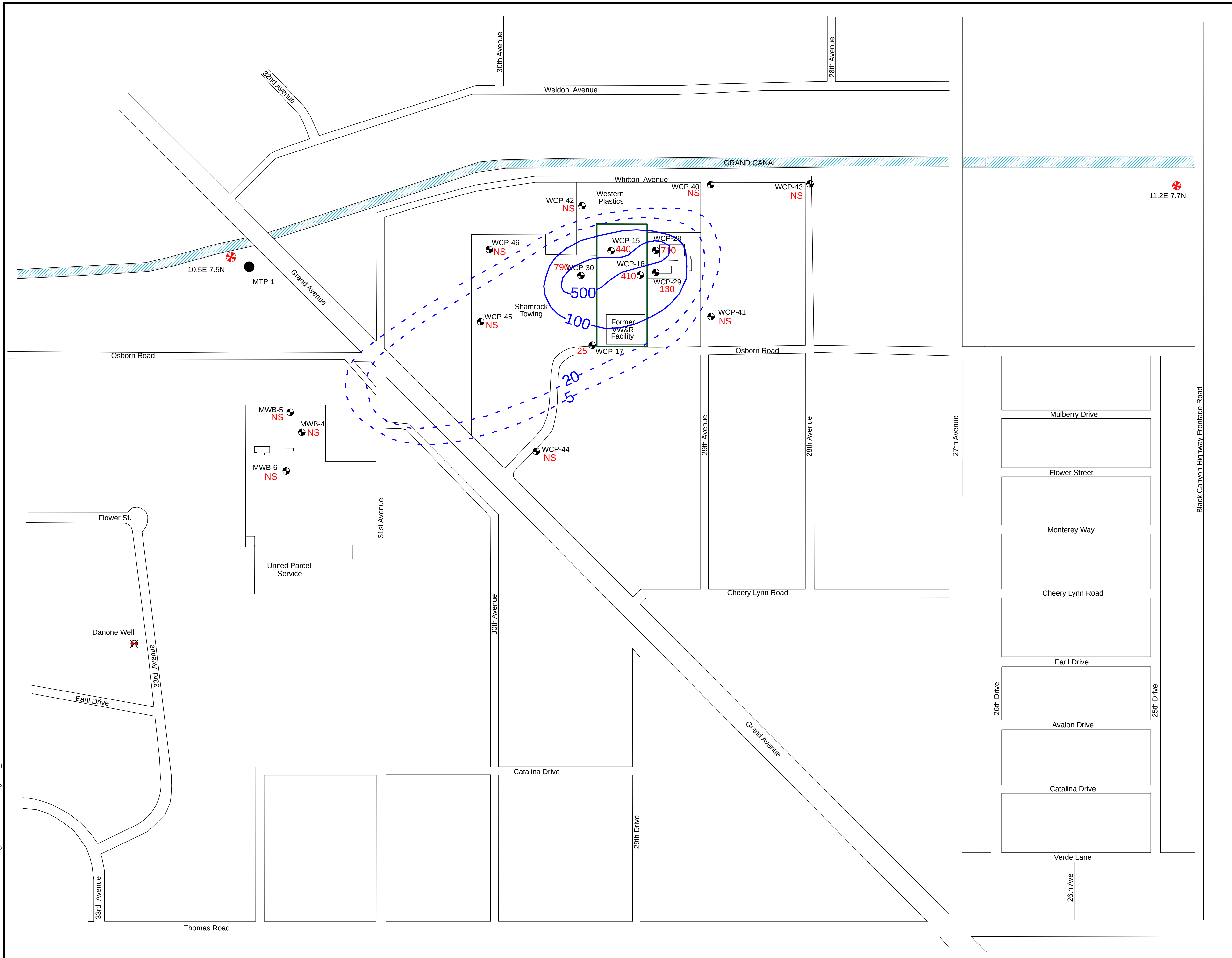

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Figure 7-54
PCE Concentrations
Groundwater Sampling
Round 2 - Bailer
January-February 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- PCE Concentration Contour (μg/L)
- 22 PCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

Approximate Scale
1 inch = 450 feet
0 225 450 900

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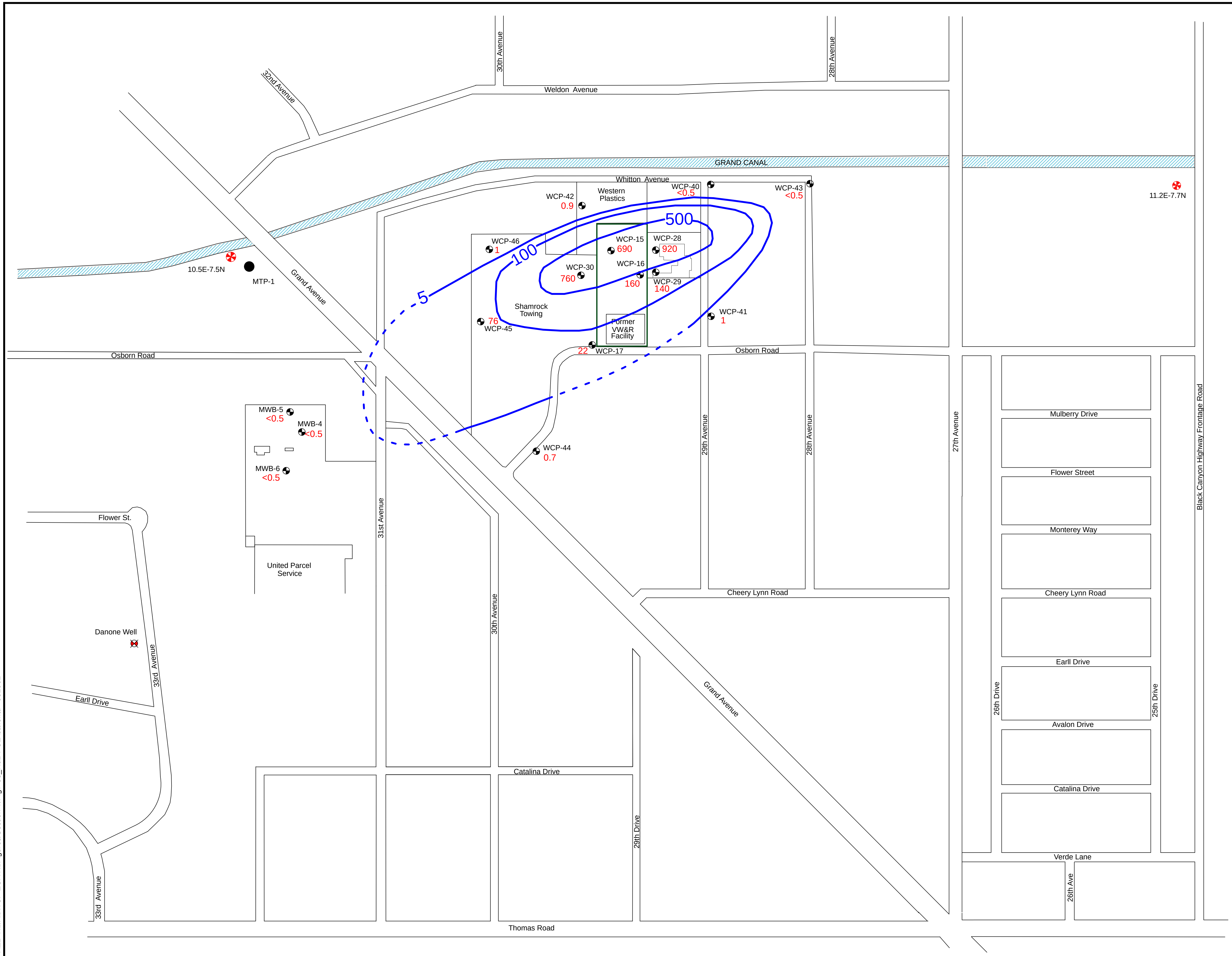
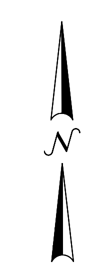


Figure 7-53
PCE Concentrations
Groundwater Sampling
Round 1 - Bailer
December 1999

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- PCE Concentration Contour (μg/L)
- 22 PCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary

NOTES: All well locations are approximate.
All monitor wells purged by using the low-flow purging method.



Approximate Scale
1 inch = 450 feet

0 225 450 900

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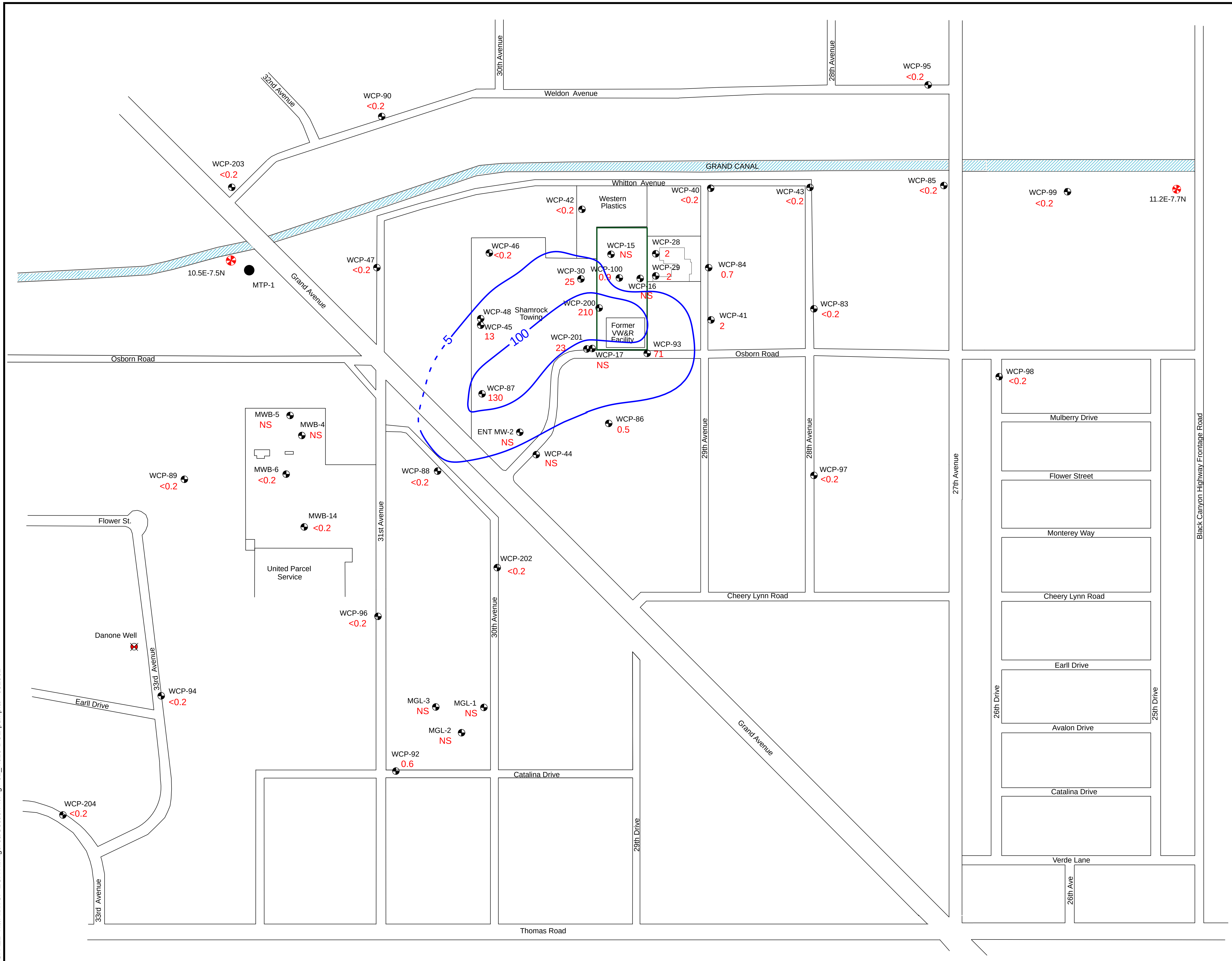

Figure 7-52
1,1-DCE Concentrations
Groundwater Sampling
Round 15 - Pump
January 2002

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- 230 1,1-DCE Concentration in (μg/L)
- NS Not Sampled
- 1,1-DCE Concentration Contours (μg/L)

NOTES: All well locations are approximate. Monitor wells were purged by removing three well-casing volumes.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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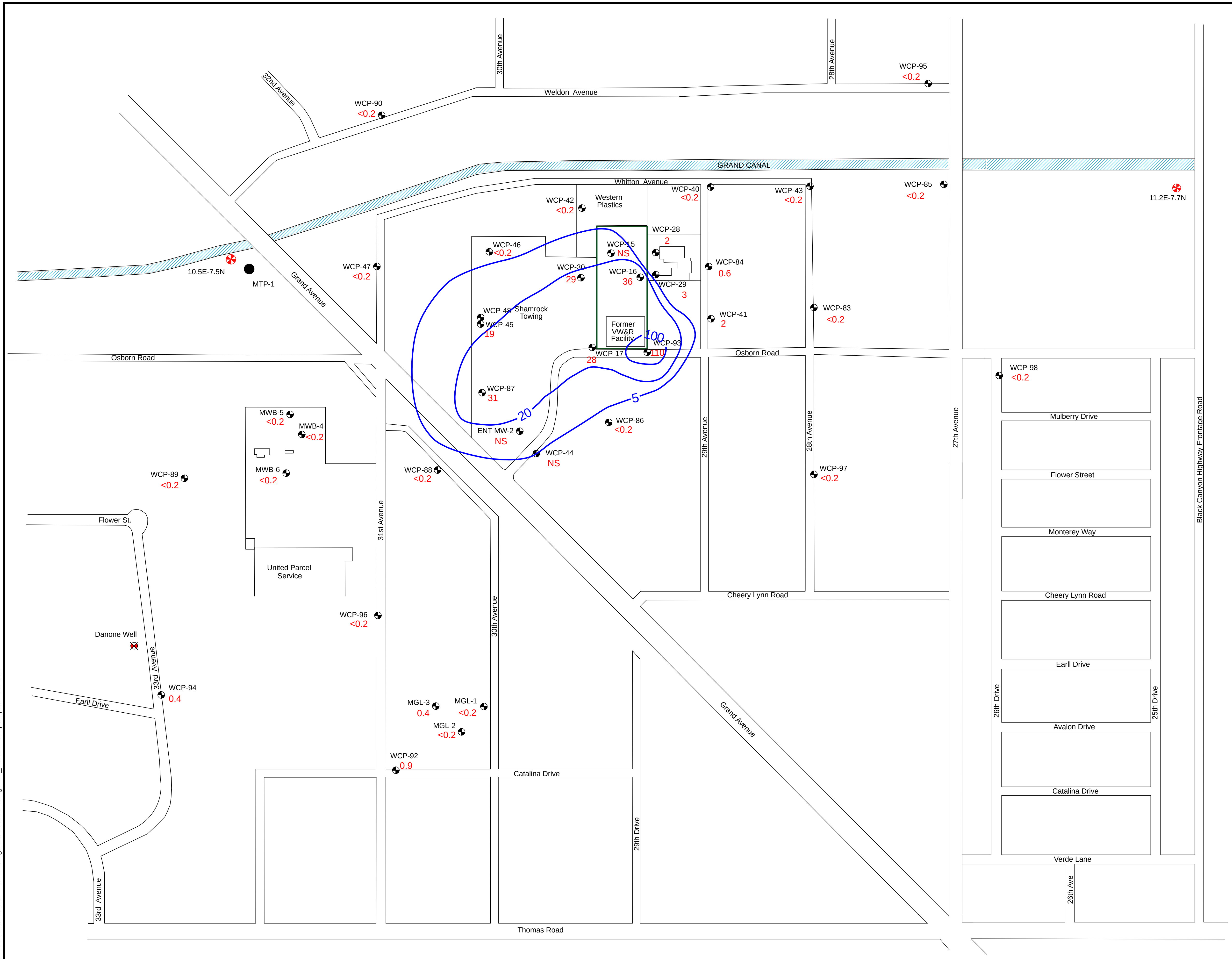

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Figure 7-51
1,1-DCE Concentrations Groundwater Sampling Round 13 - Pump October-November 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- 230 1,1-DCE Concentration in (μg/L)
- NS Not Sampled
- 1,1-DCE Concentration Contours (μg/L)

NOTES: All well locations are approximate. Wells were purged by removing three well-casing volumes.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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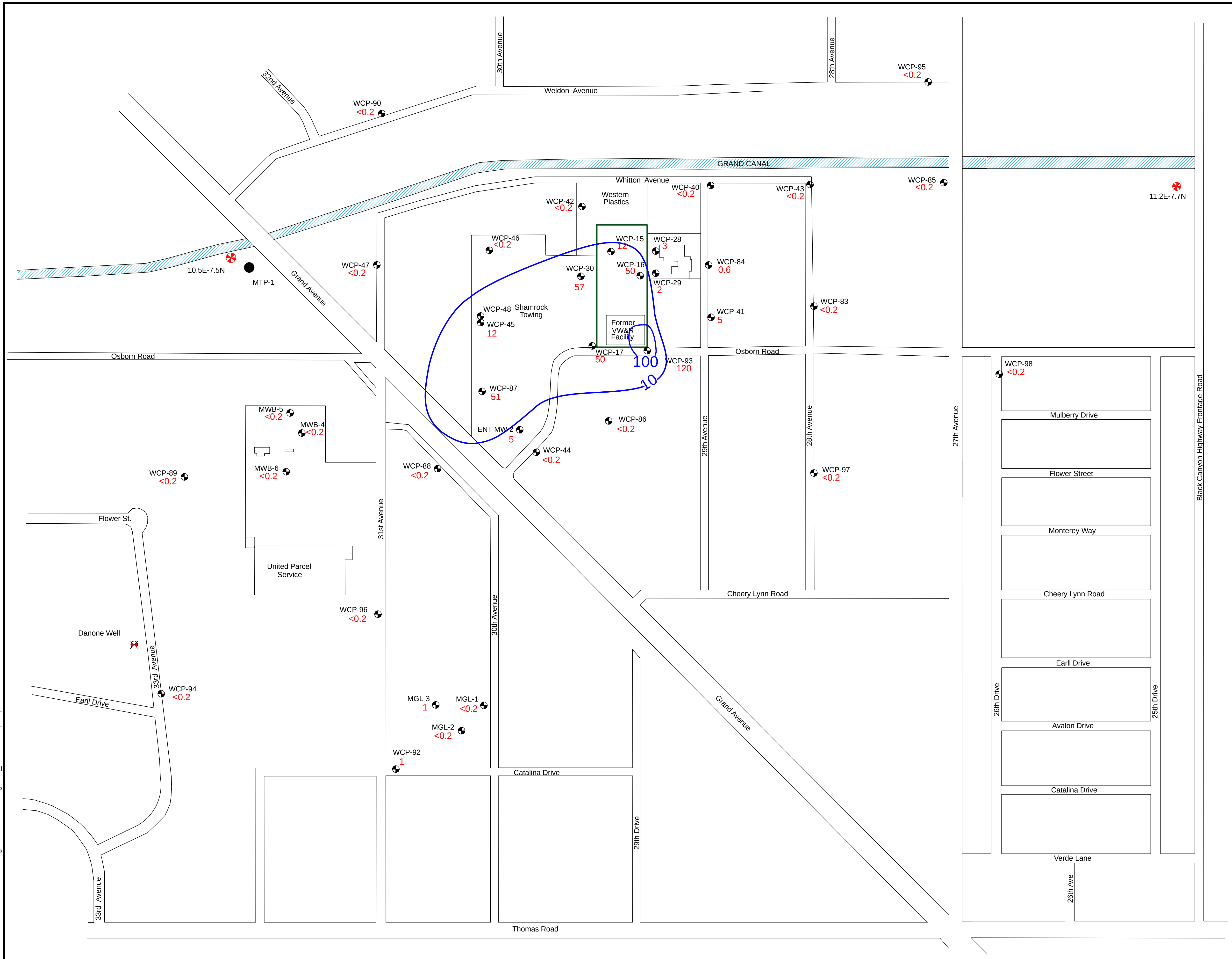

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Figure 7-50
1,1-DCE Concentrations Groundwater Sampling Round 11 - Pump July-August 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- 1,1-DCE Concentration Contour (μg/L)
- 22 — 1,1-DCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS — Not Sampled

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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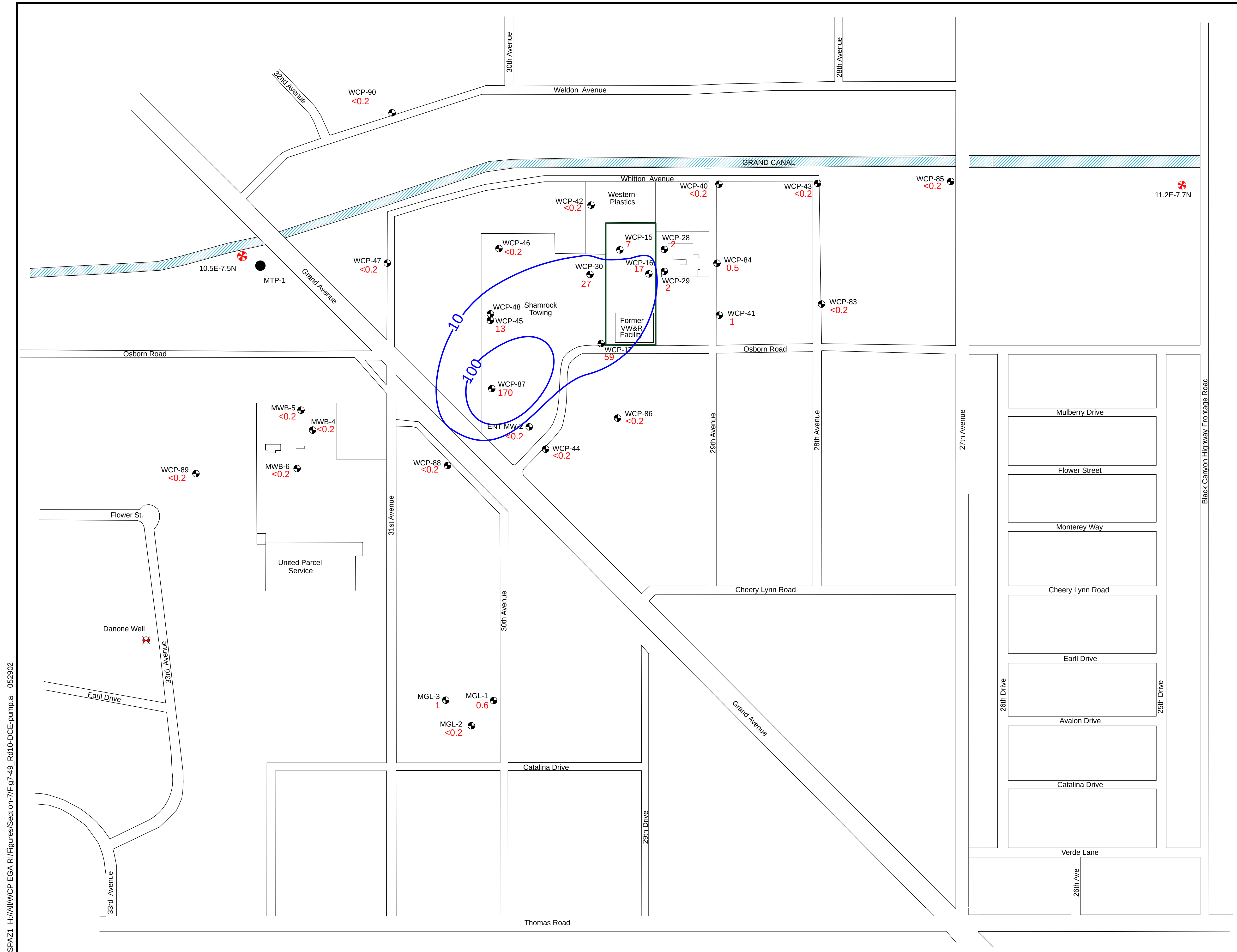

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Figure 7-49
1,1-DCE Concentrations
Groundwater Sampling
Round 10 - Pump
June 18-29 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- 1,1-DCE Concentration Contour (μg/L)
- 22 — 1,1-DCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS — Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged by removing three well-casing volumes.

Approximate Scale
1 inch = 450 feet
0 225 450 900

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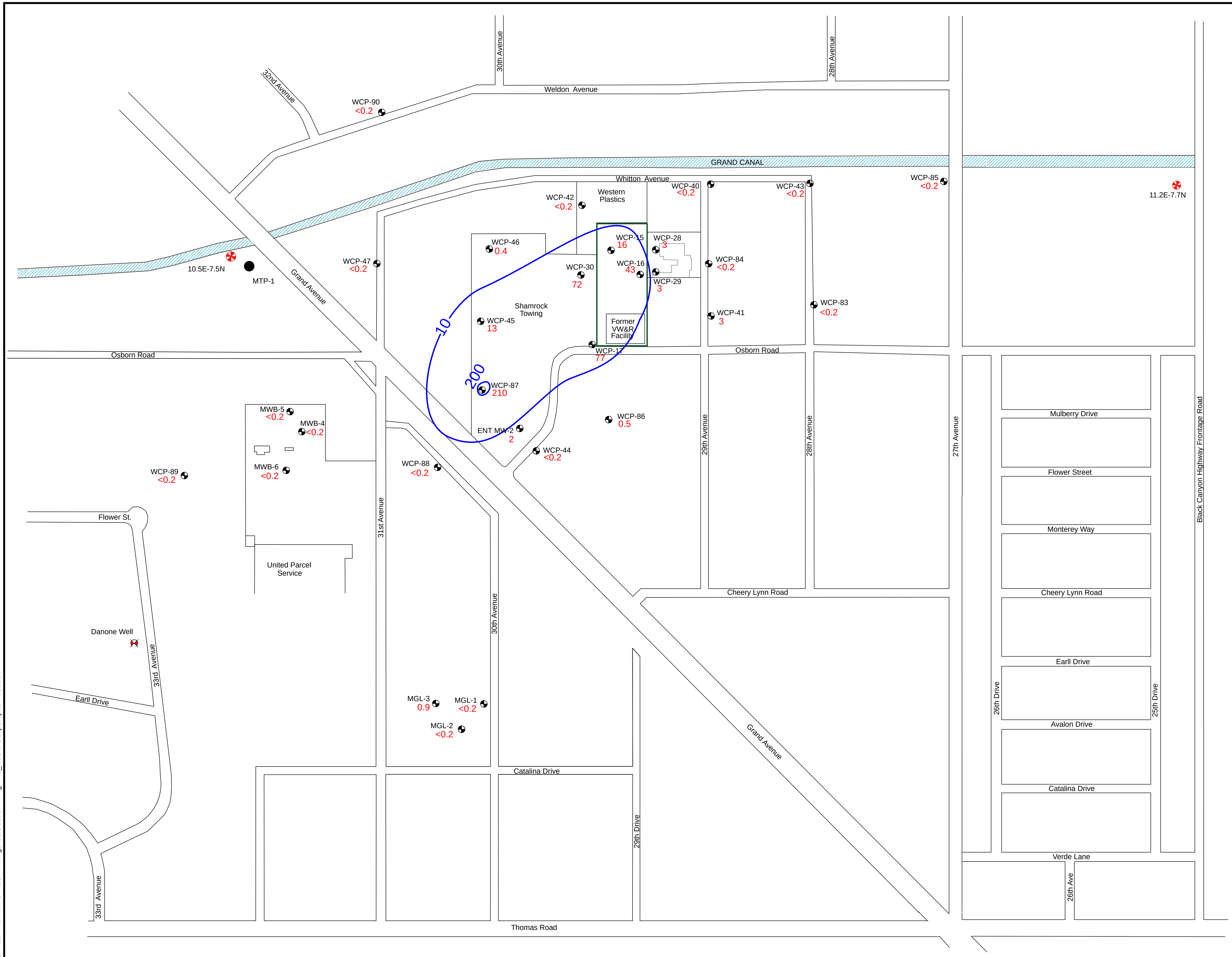

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Figure 7-48
1,1-DCE Concentrations Groundwater Sampling Round 9 - Pump June 5-15 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- 1,1-DCE Concentration Contour (μg/L)
- 22 — 1,1-DCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS — Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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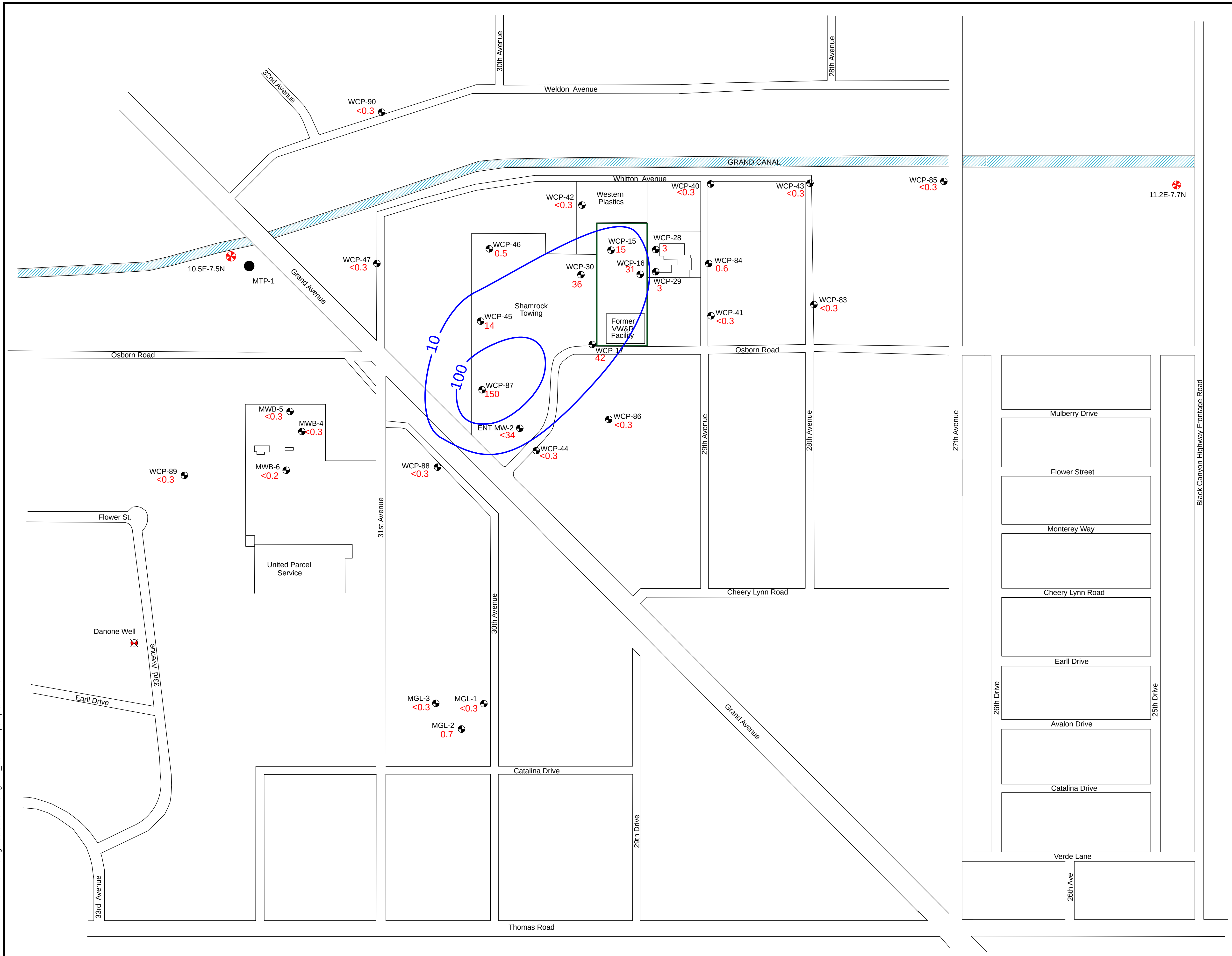

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Figure 7-47
1,1-DCE Concentrations
Groundwater Sampling
Round 8 - Pump
April-May 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- 1,1-DCE Concentration Contour (μg/L)
- 22 — 1,1-DCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS — Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet

0 225 450 900

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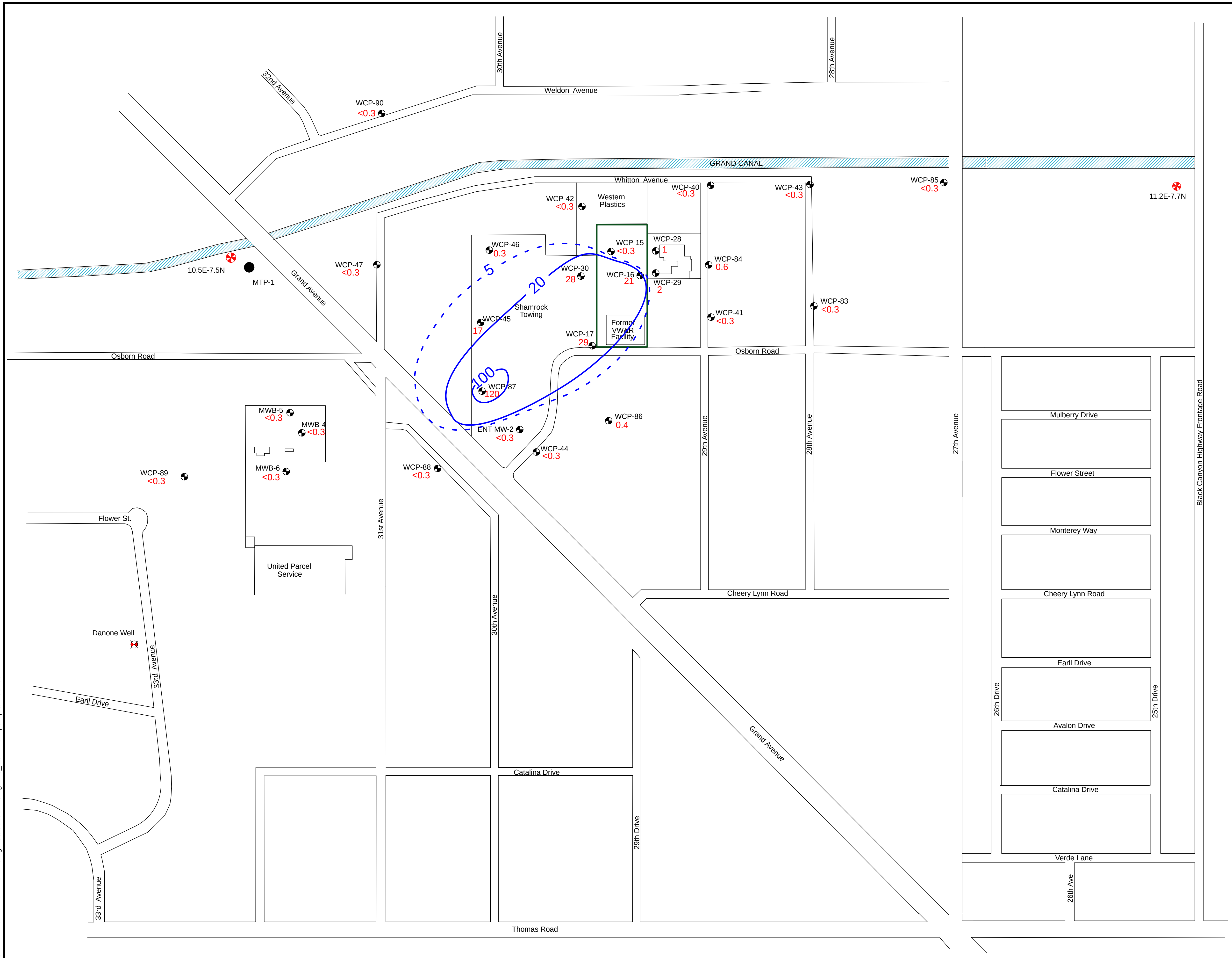

Figure 7-46
1,1-DCE Concentrations Groundwater Sampling Round 7 - Pump February-March 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- 1,1-DCE Concentration Contour (μg/L)
- 22 — 1,1-DCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS — Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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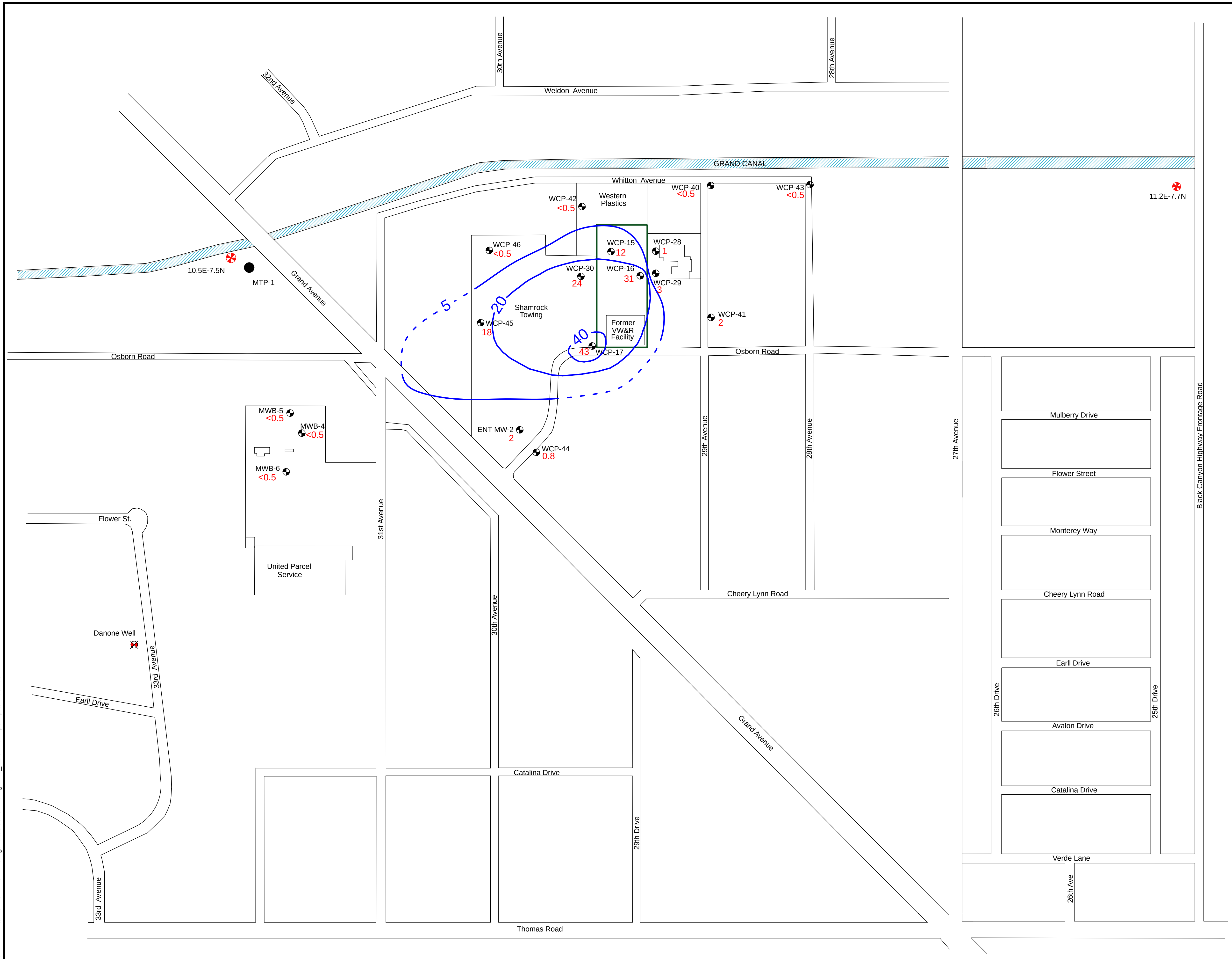

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Figure 7-45
1,1-DCE Concentrations Groundwater Sampling Round 6 - Pump December 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- 1,1-DCE Concentration Contour (μg/L)
- 22 — 1,1-DCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS — Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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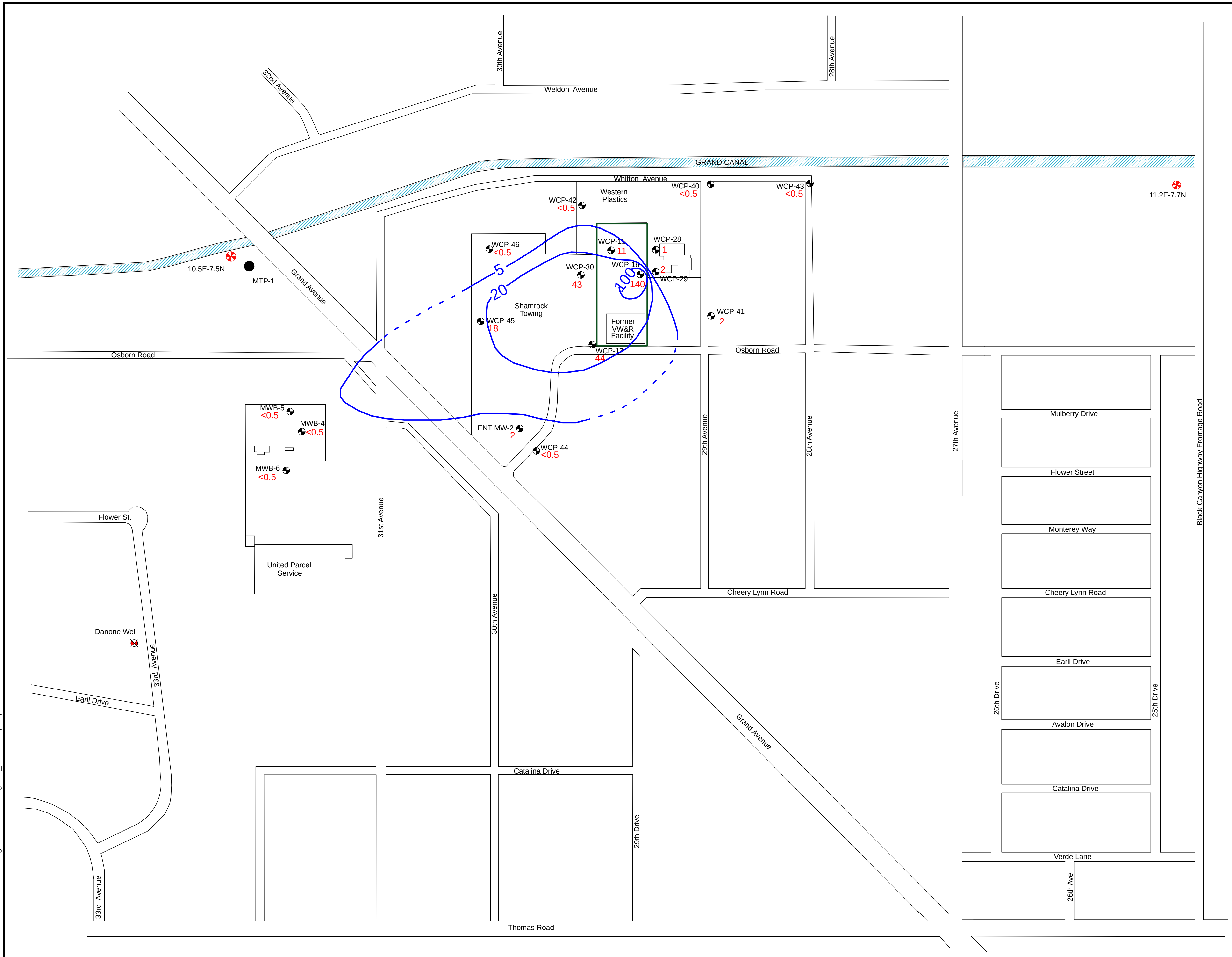

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Figure 7-44
1,1-DCE Concentrations Groundwater Sampling Round 5 - Pump September 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- 1,1-DCE Concentration Contour (μg/L)
- 22 — 1,1-DCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS — Not Sampled

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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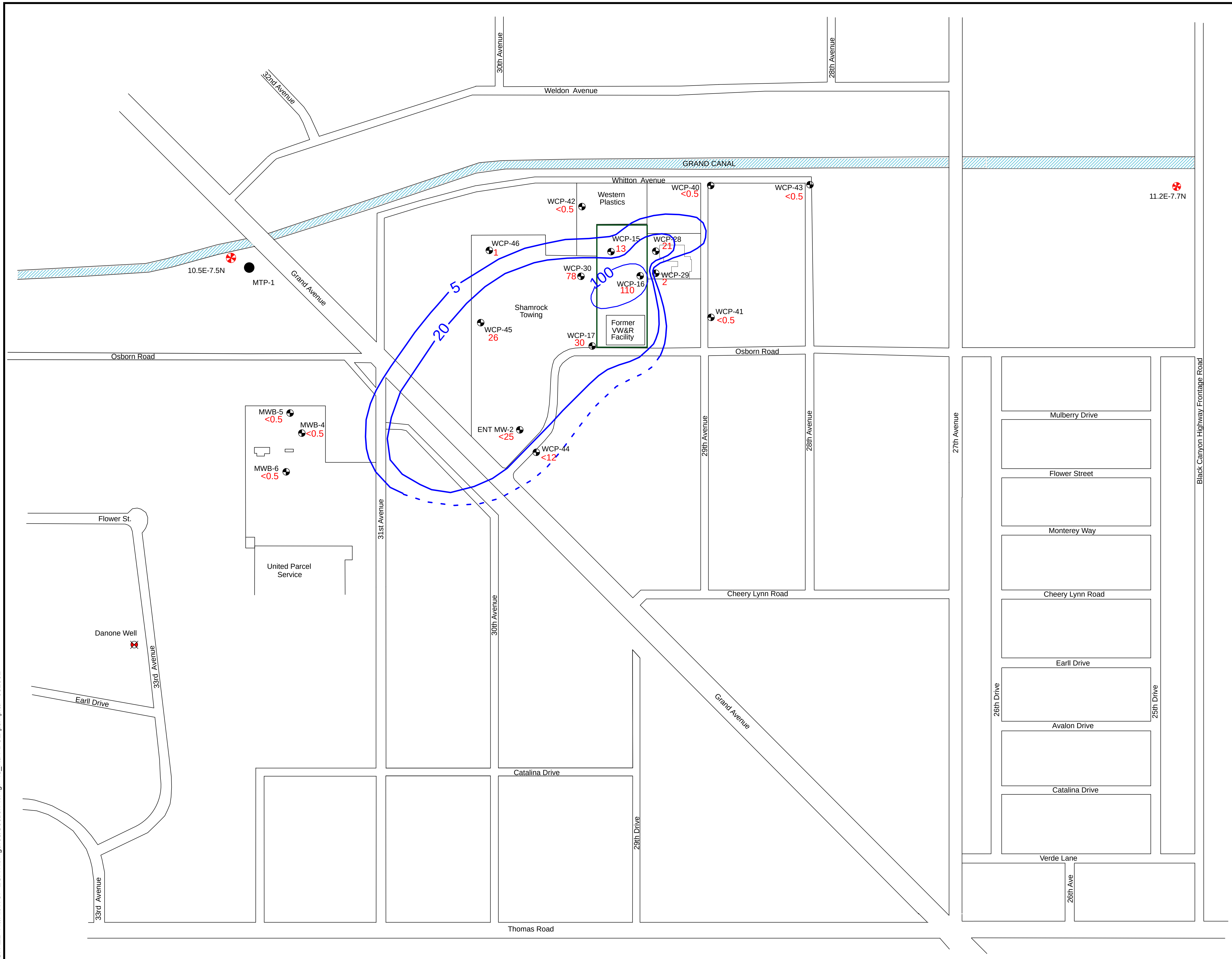

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Figure 7-43
1,1-DCE Concentrations
Groundwater Sampling
Round 4 - Pump
June 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- 1,1-DCE Concentration Contour (μg/L)
- 22 — 1,1-DCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS — Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet

0 225 450 900

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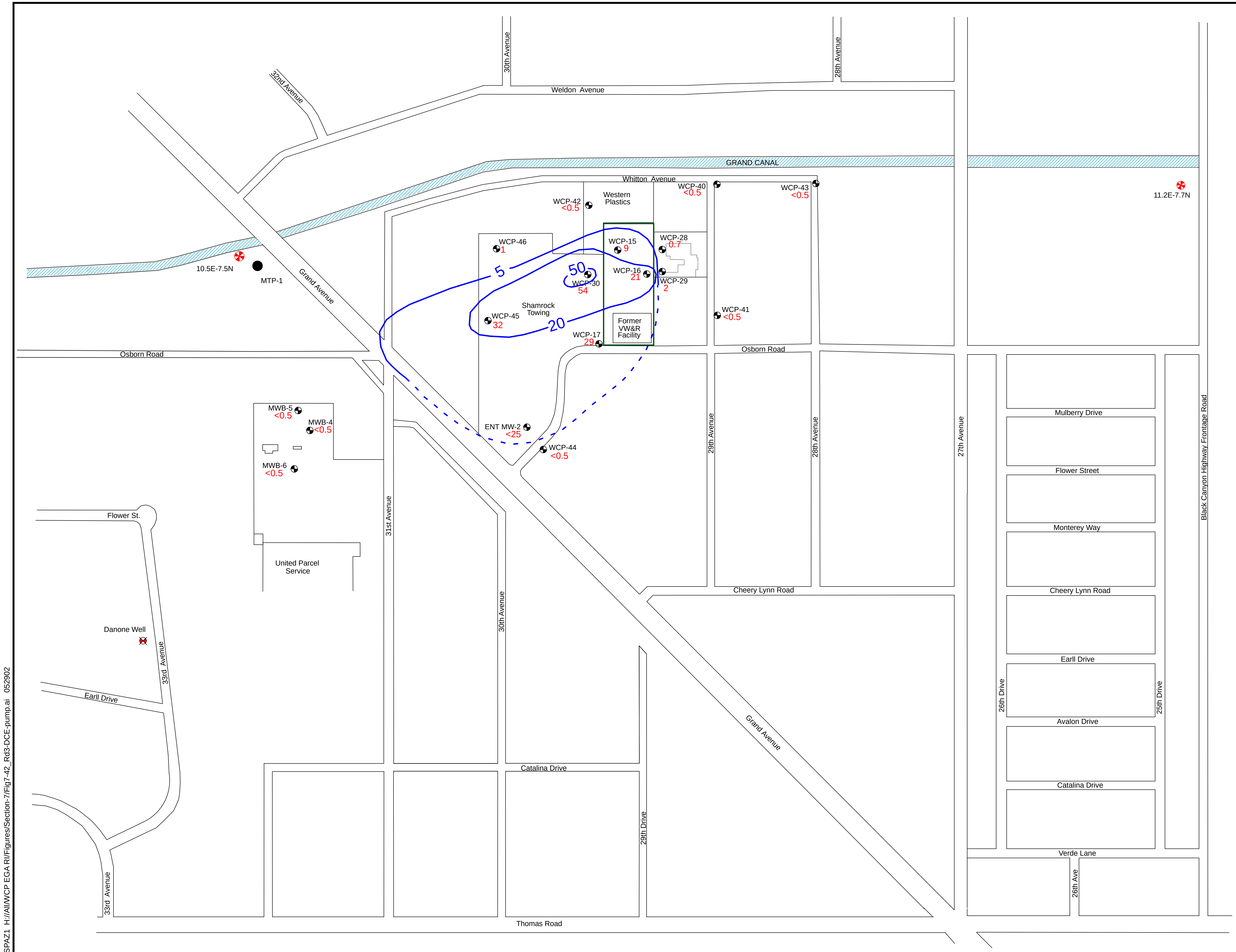

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Figure 7-42
1,1-DCE Concentrations Groundwater Sampling Round 3 - Pump March 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- 1,1-DCE Concentration Contour (μg/L)
- 22 — 1,1-DCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS — Not Sampled

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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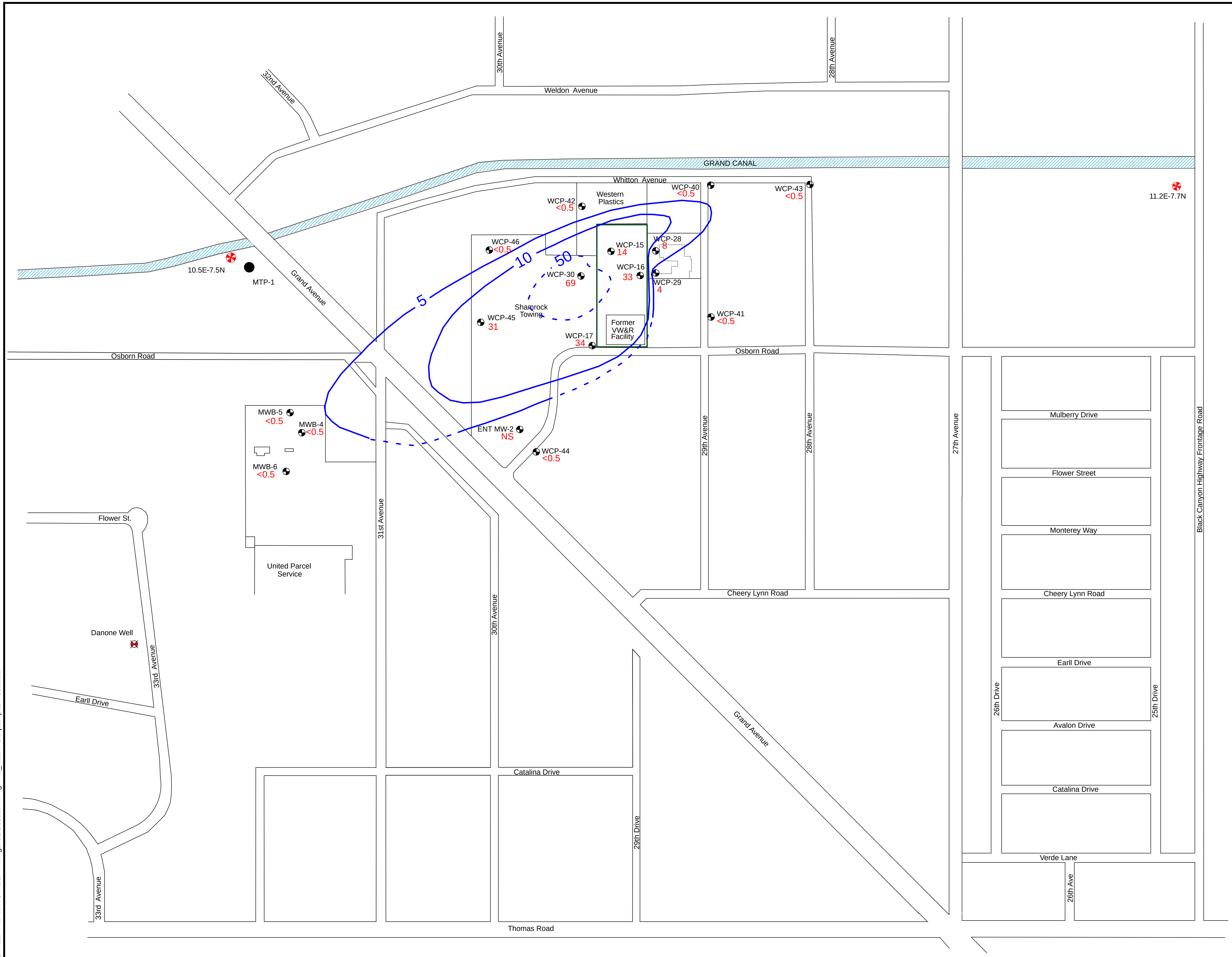

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Figure 7-41
1,1-DCE Concentrations Groundwater Sampling Round 2 - Pump January-February 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- 1,1-DCE Concentration Contour (μg/L)
- 22 — 1,1-DCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS — Not Sampled

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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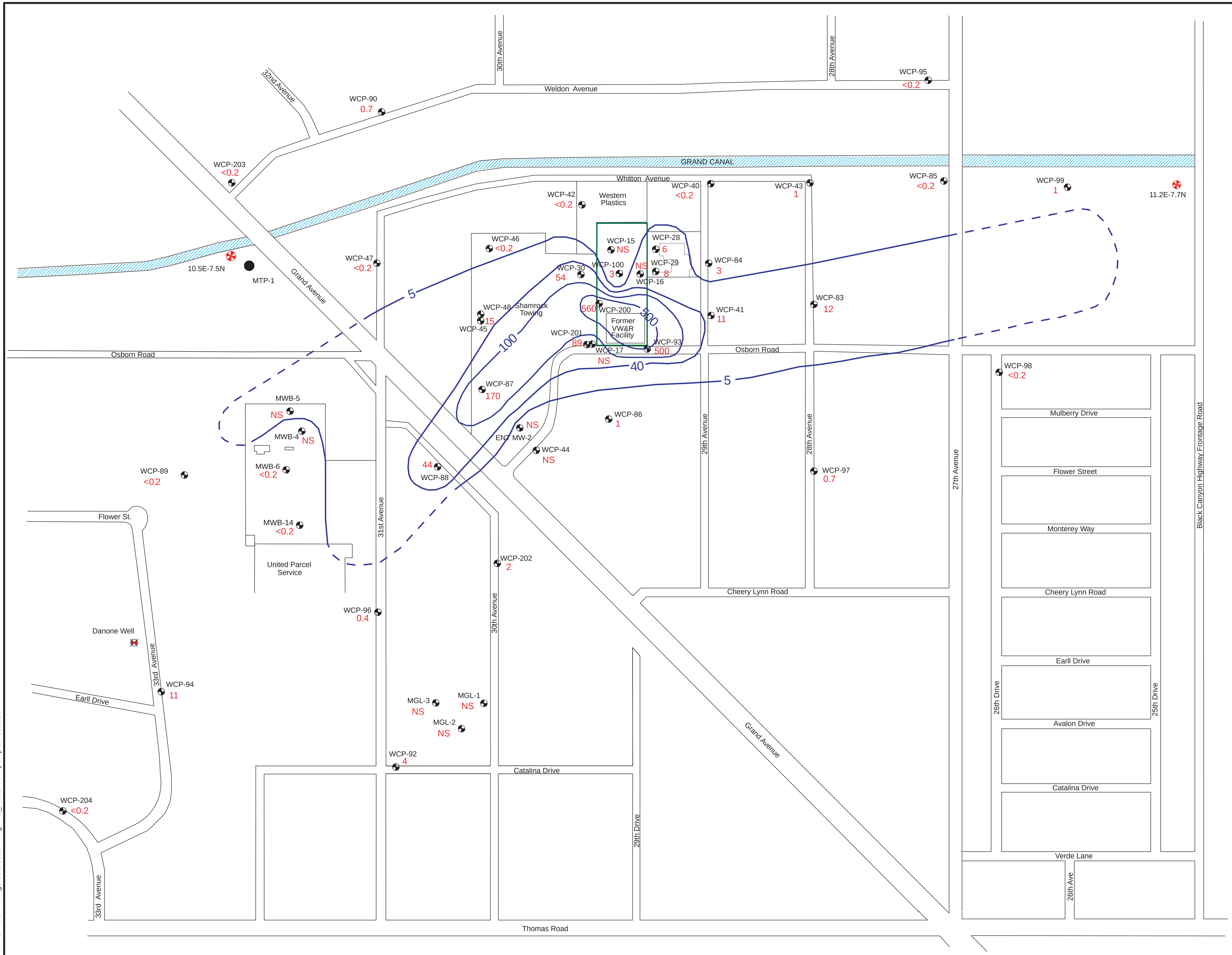

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Figure 7-40
TCE Concentrations Groundwater Sampling Round 15 - Pump
January 2002

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- 230 TCE Concentration in (μg/L)
- NS Not Sampled
- TCE Concentration Contours (μg/L)

NOTES: All well locations are approximate. Monitor wells were purged by removing three well-casing volumes.

Approximate Scale
1 inch = 450 feet
0 225 450 900

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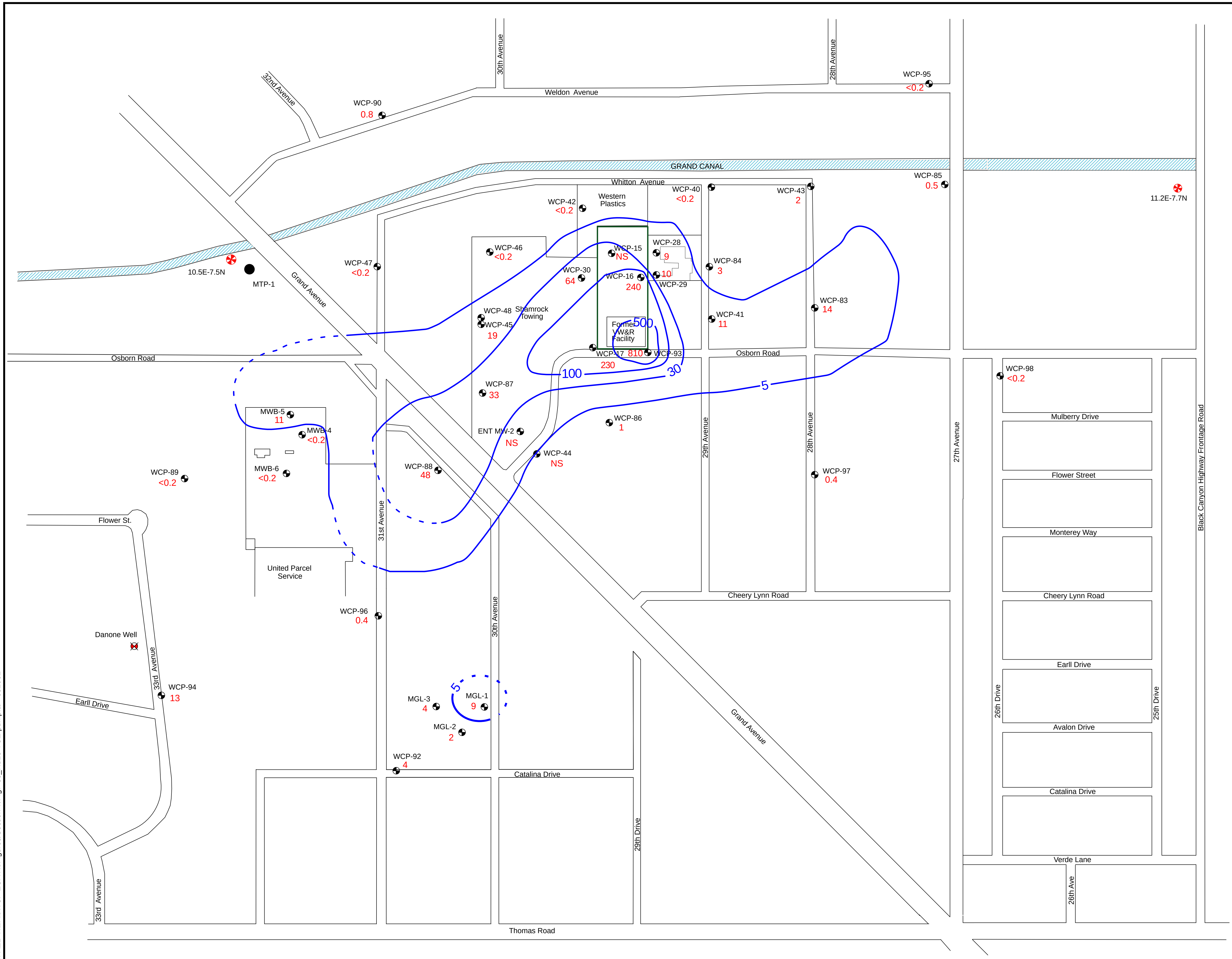

Figure 7-39
TCE Concentrations
Groundwater Sampling
Round 13 - Pump
November 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- 230 TCE Concentration in (μg/L)
- NS Not Sampled
- TCE Concentration Contours (μg/L)

NOTES: All well locations are approximate. Monitor wells were purged by removing three well-casing volumes.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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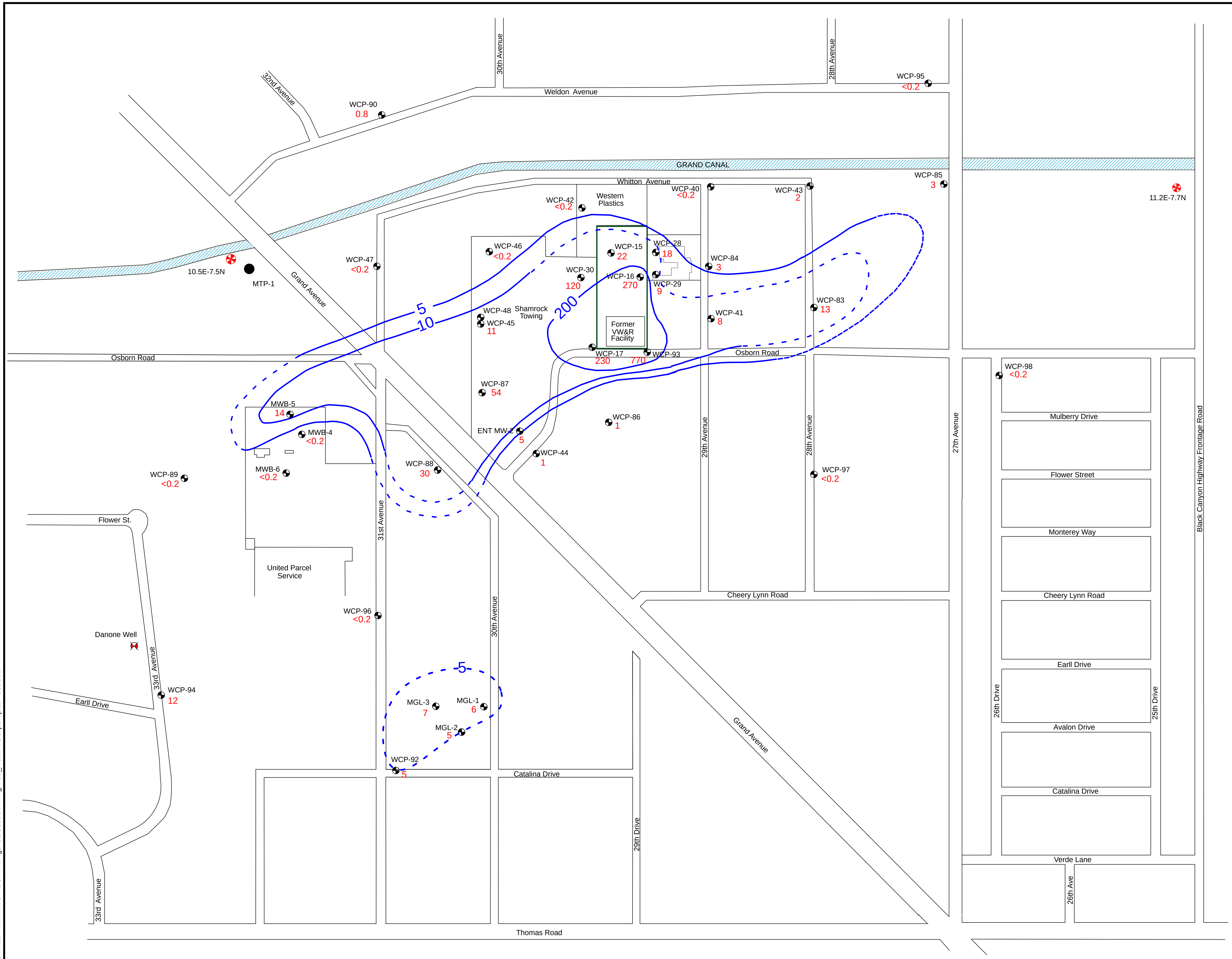

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Figure 7-38
TCE Concentrations Groundwater Sampling Round 11 - Pump July-August 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- TCE Concentration Contour (μg/L)
- 22 TCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS Not Sampled

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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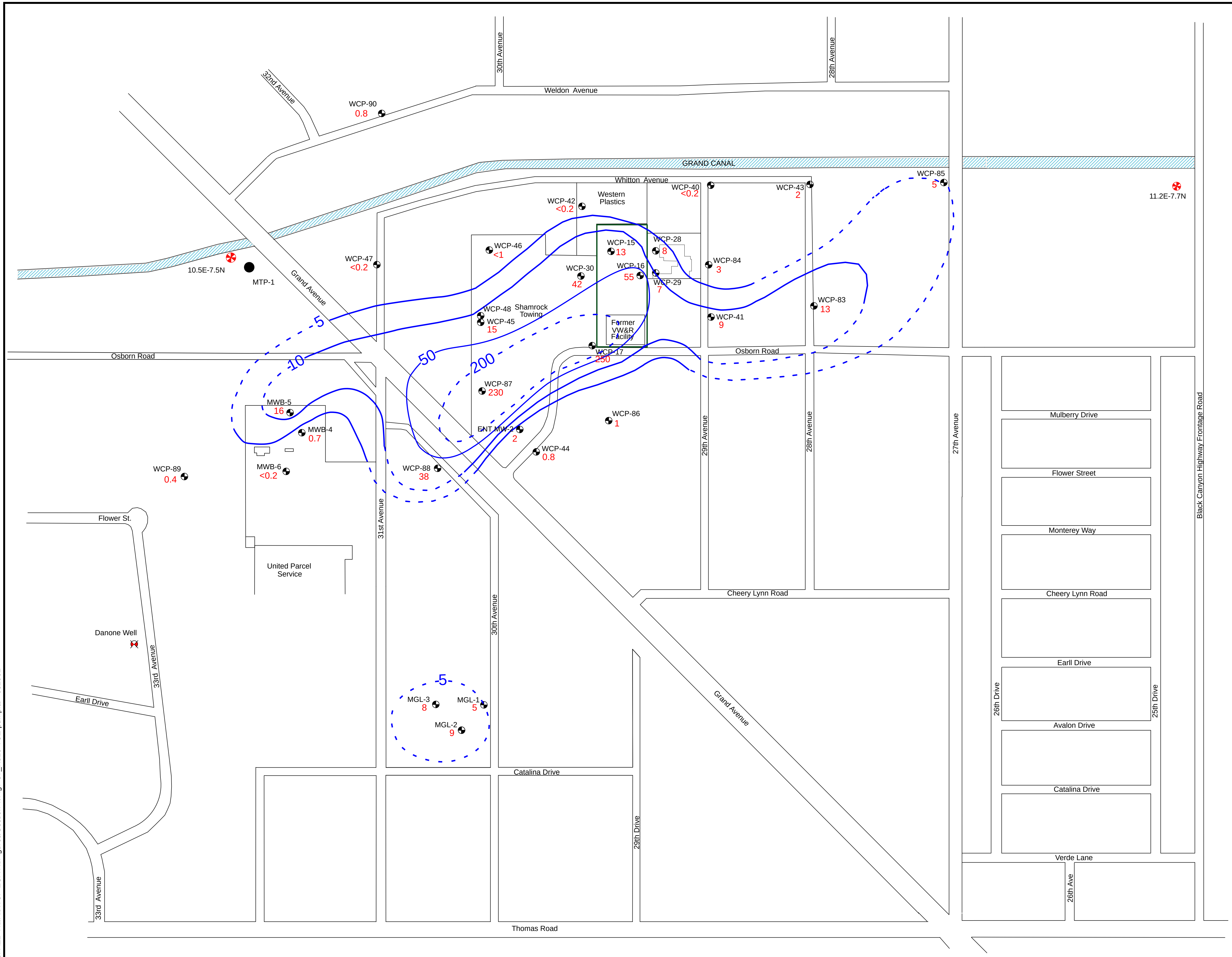

Figure 7-37
TCE Concentrations Groundwater Sampling Round 10 - Pump June 18-29 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- TCE Concentration Contour (μg/L)
- 22 TCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS Not Sampled

NOTES: All well locations are approximate. All monitor wells purged by removing three well-casing volumes.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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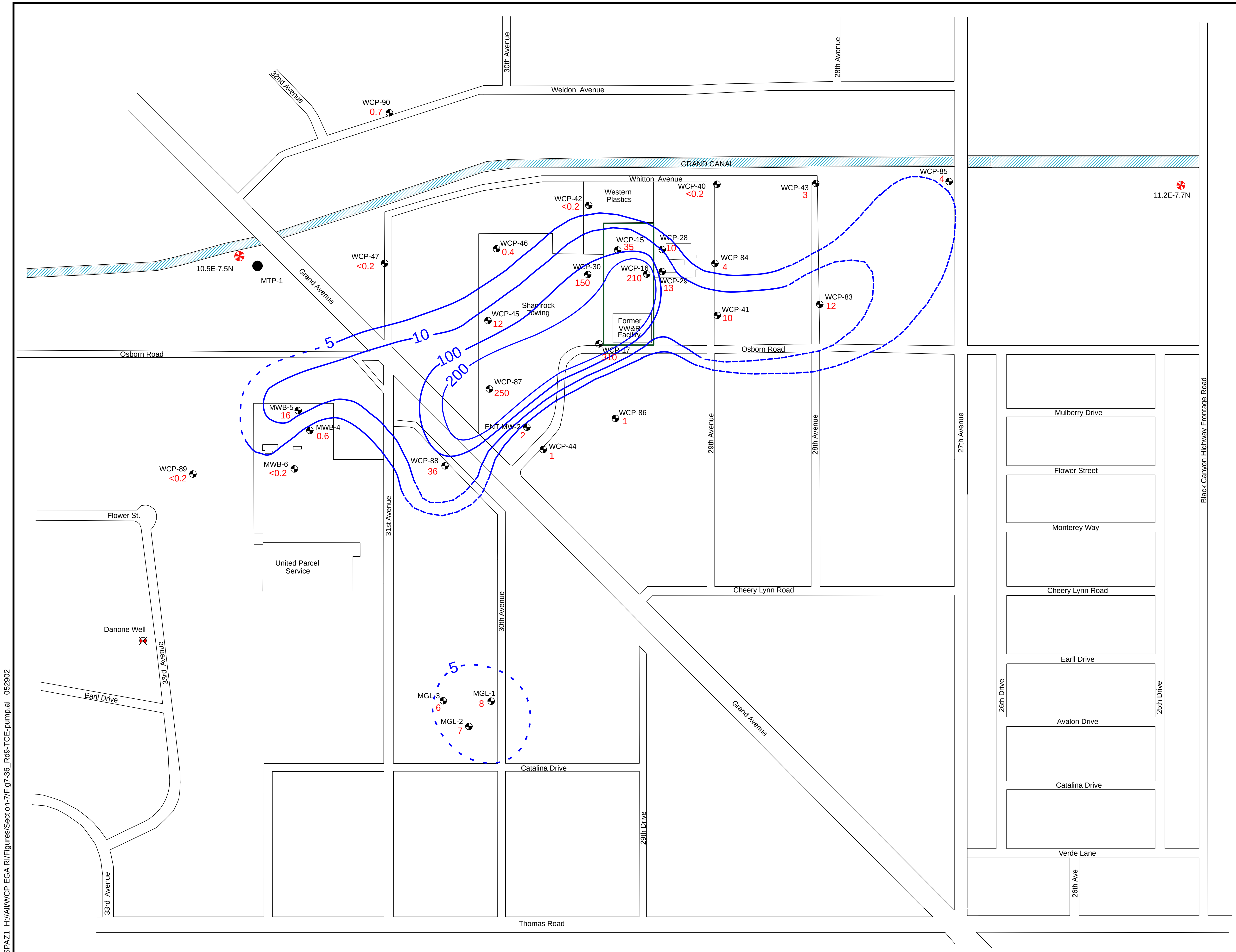

Figure 7-36
TCE Concentrations
Groundwater Sampling
Round 9 - Pump
June 5-15 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- TCE Concentration Contour (μg/L)
- 22 TCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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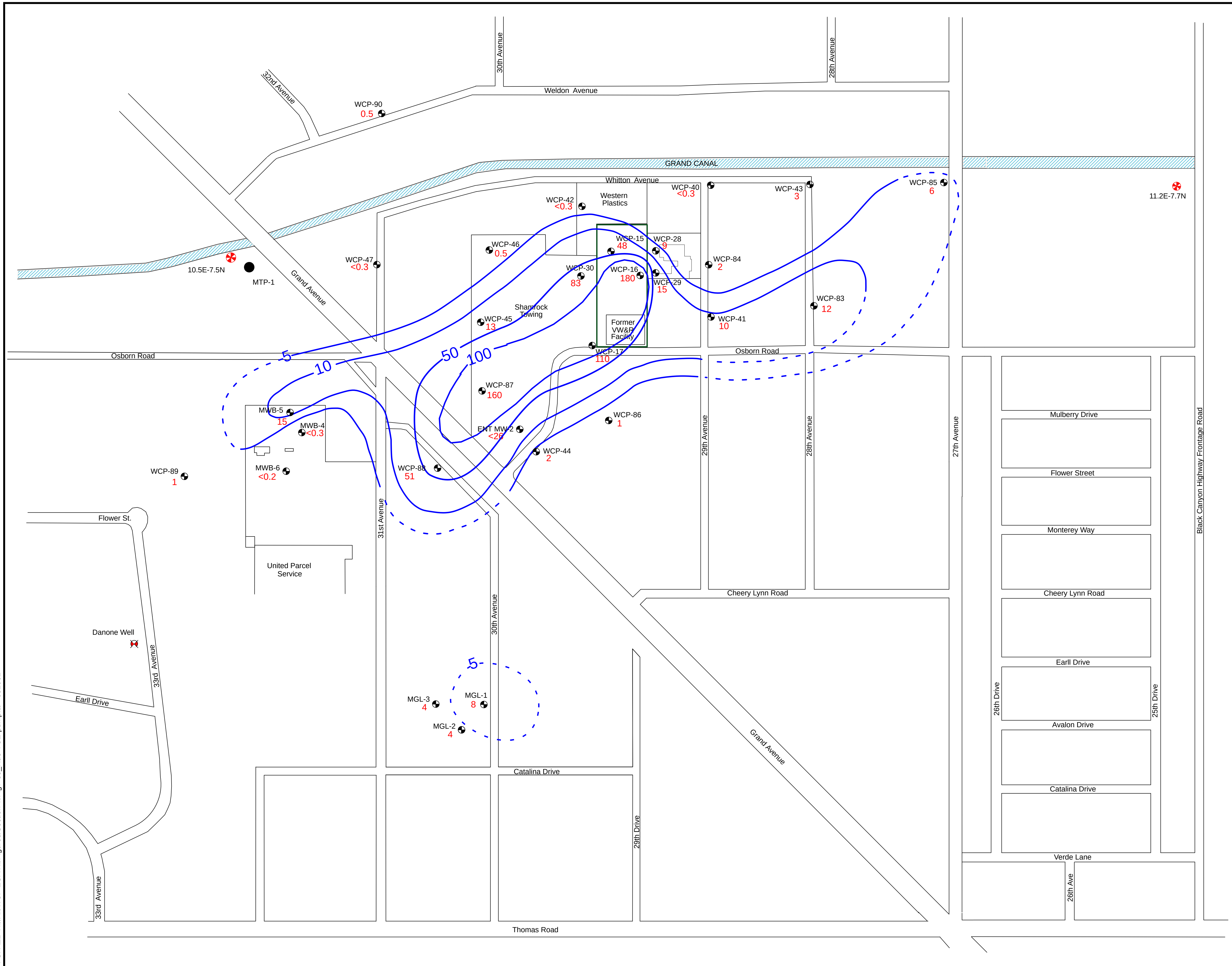

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Figure 7-35
TCE Concentrations
Groundwater Sampling
Round 8 - Pump
April-May 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- TCE Concentration Contour (μg/L)
- 22 TCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet

0 225 450 900

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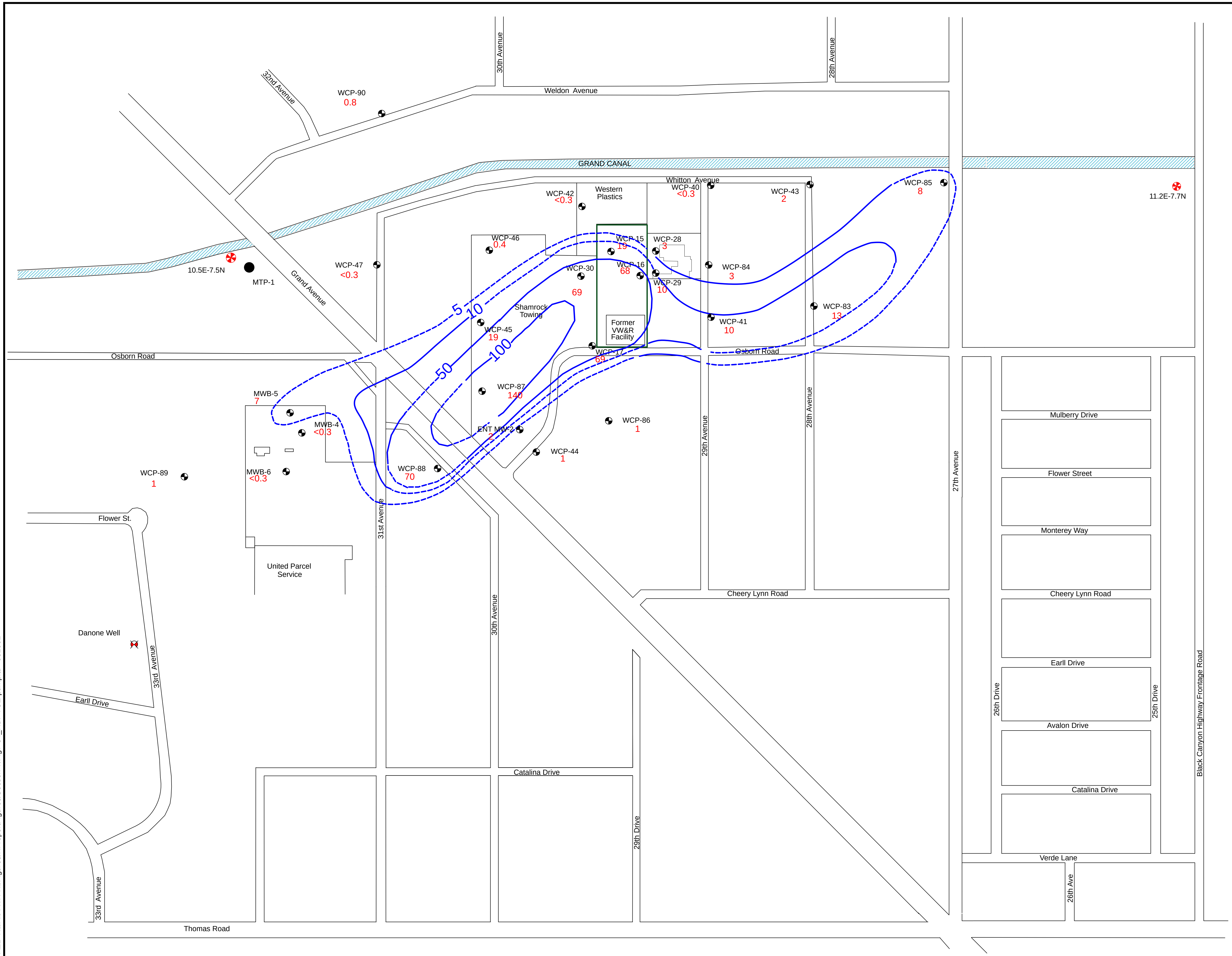

Figure 7-34
TCE Concentrations
Groundwater Sampling
Round 7 - Pump
February-March 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- TCE Concentration Contour (μg/L)
- 22 TCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

Approximate Scale
1 inch = 450 feet
0 225 450 900

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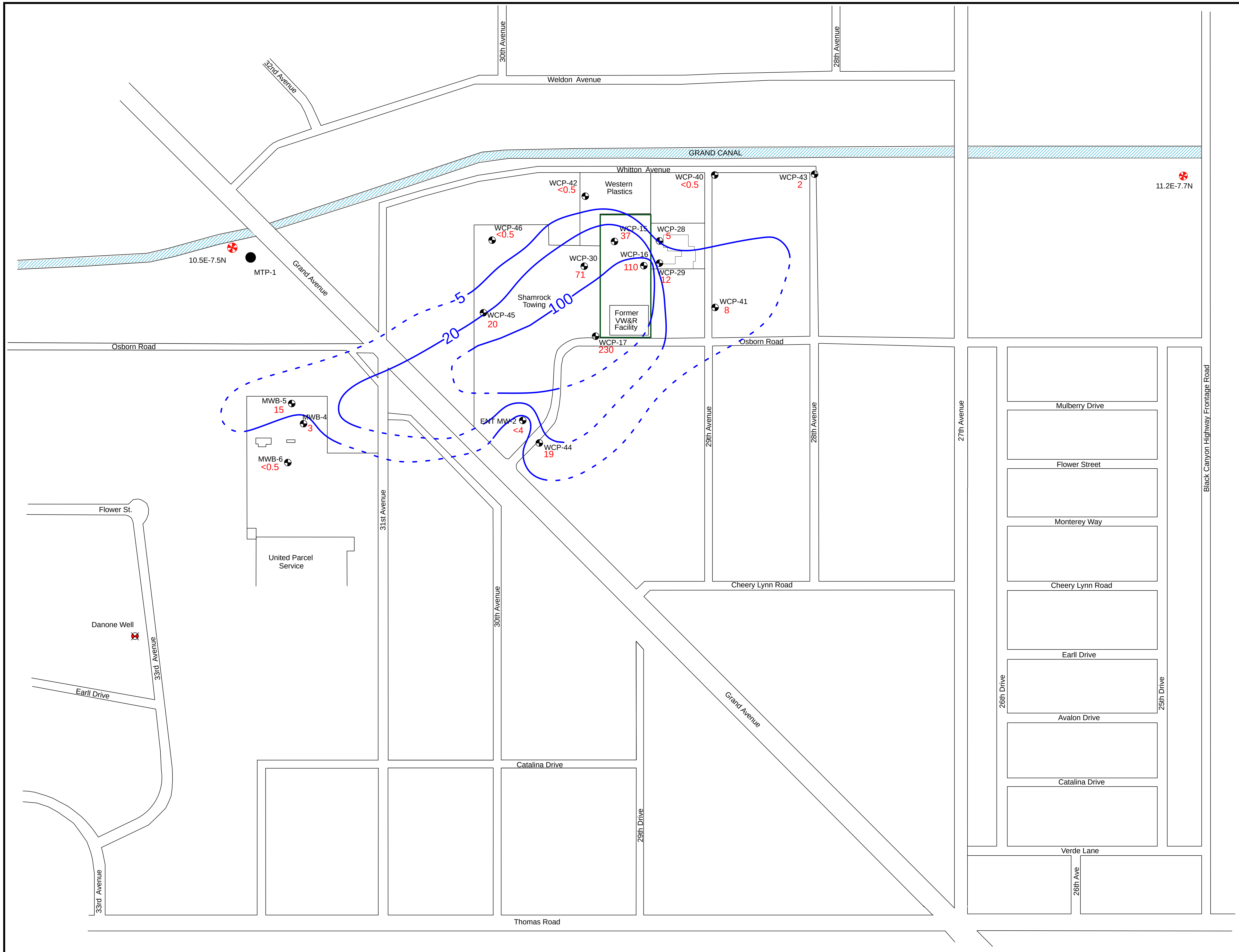

Figure 7-33
TCE Concentrations Groundwater Sampling Round 6 - Pump December 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- TCE Concentration Contour (μg/L)
- 22 TCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

Approximate Scale
1 inch = 450 feet
0 225 450 900

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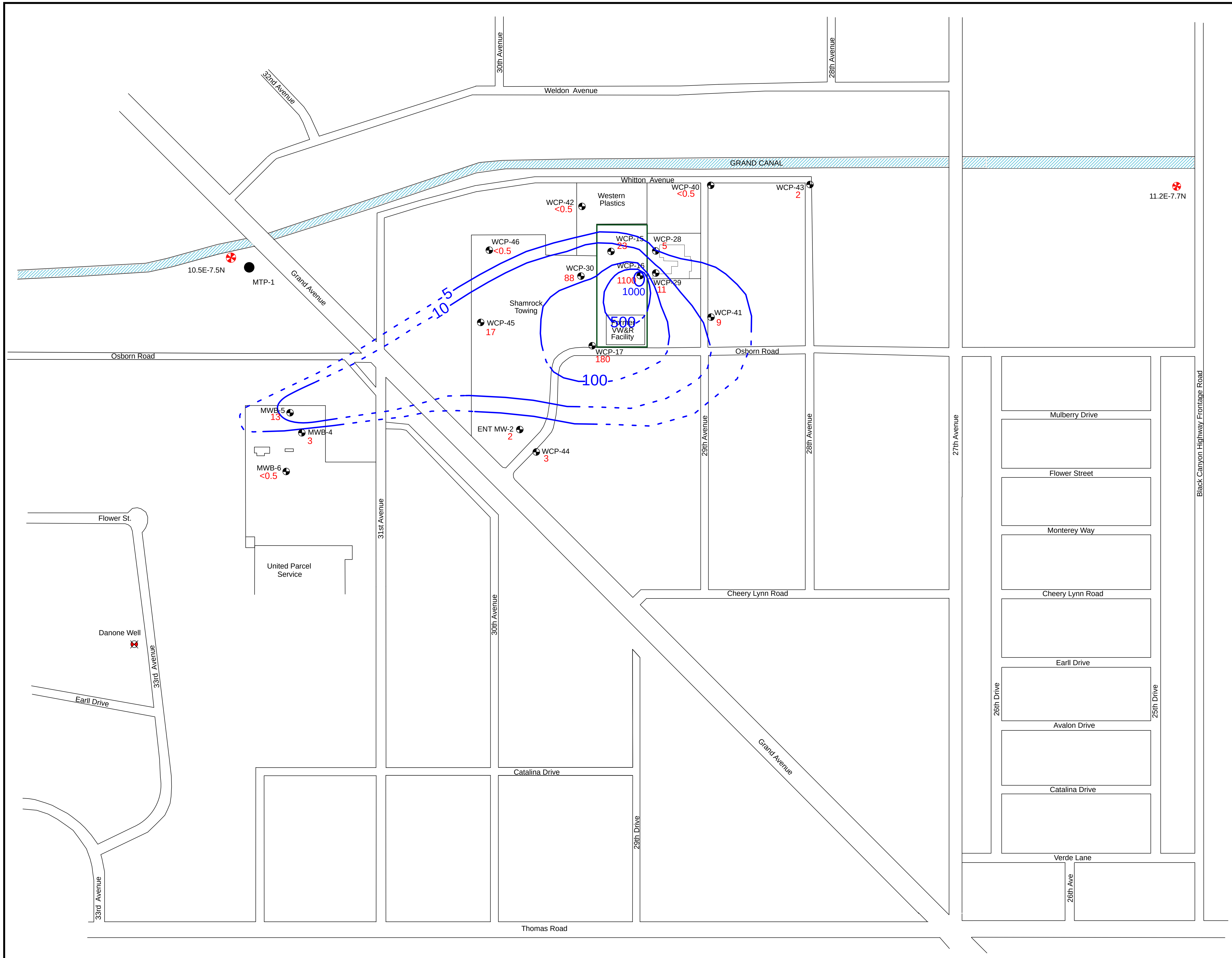

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Figure 7-32
TCE Concentrations
Groundwater Sampling
Round 5 - Pump
September 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- TCE Concentration Contour (μg/L)
- 22 TCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS Not Sampled

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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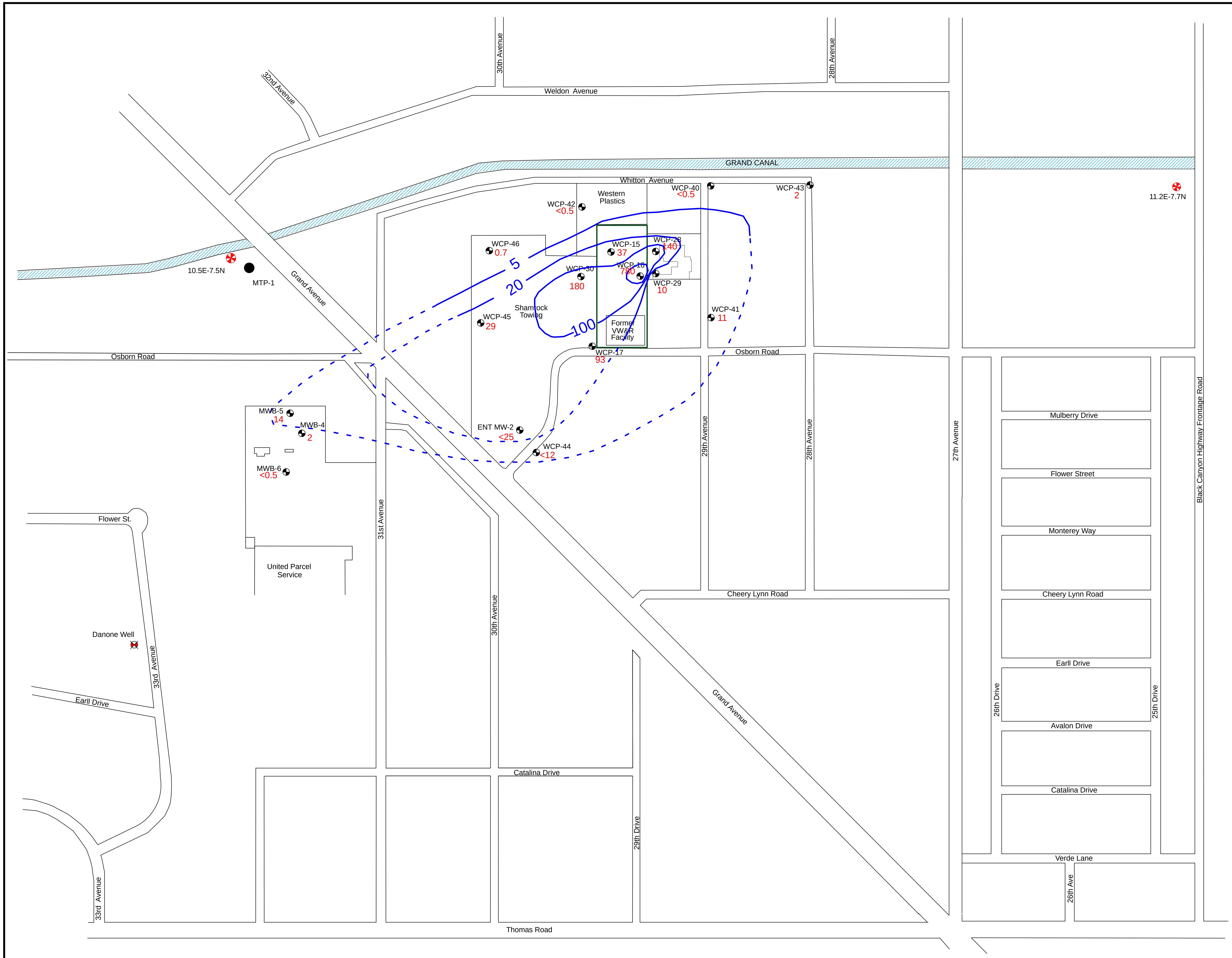

Figure 7-31
TCE Concentrations
Groundwater Sampling
Round 4 - Pump
June 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- TCE Concentration Contour (μg/L)
- 22 — TCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS — Not Sampled

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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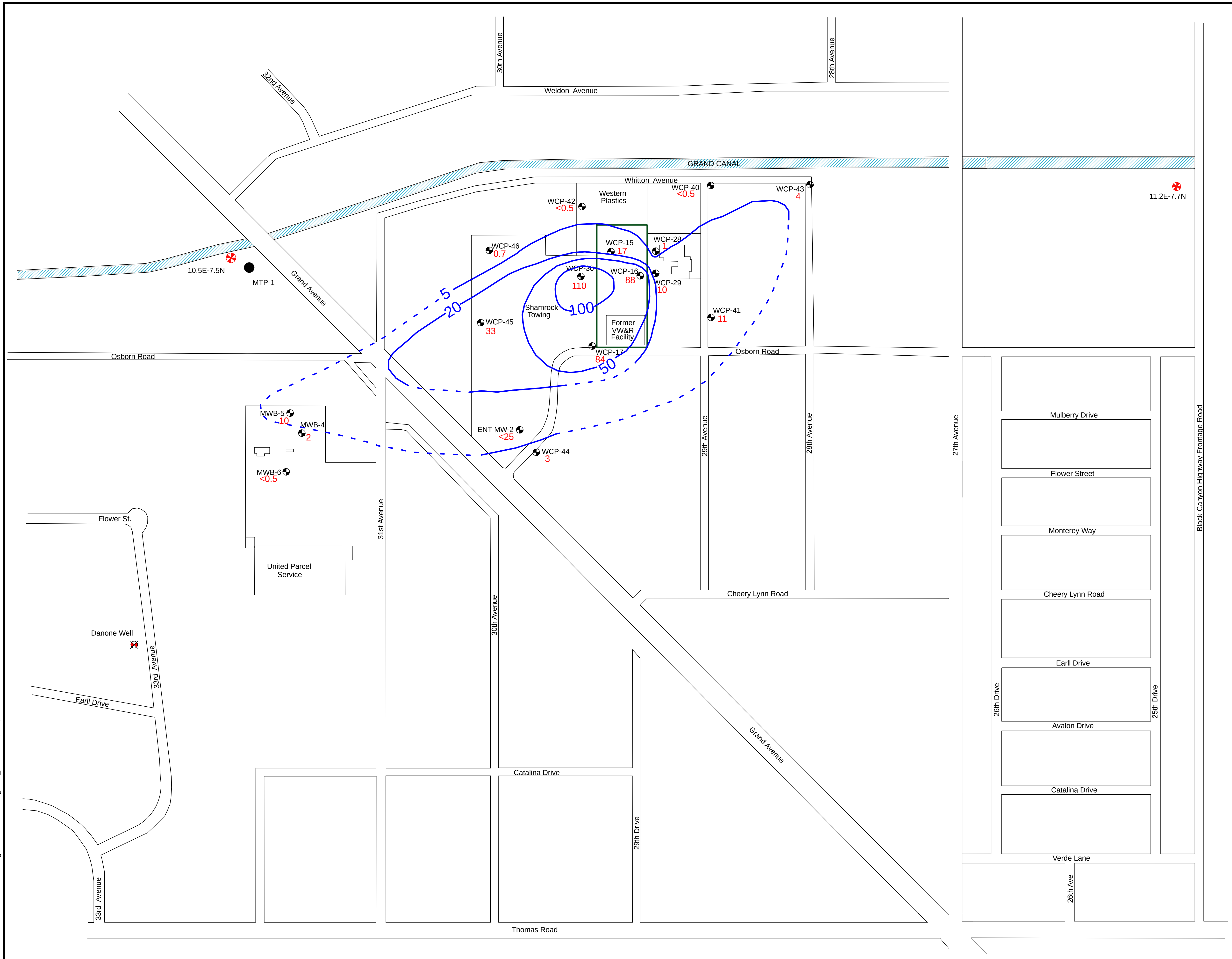

Figure 7-30
TCE Concentrations Groundwater Sampling Round 3 - Pump
March 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- TCE Concentration Contour (μg/L)
- 22 TCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS Not Sampled

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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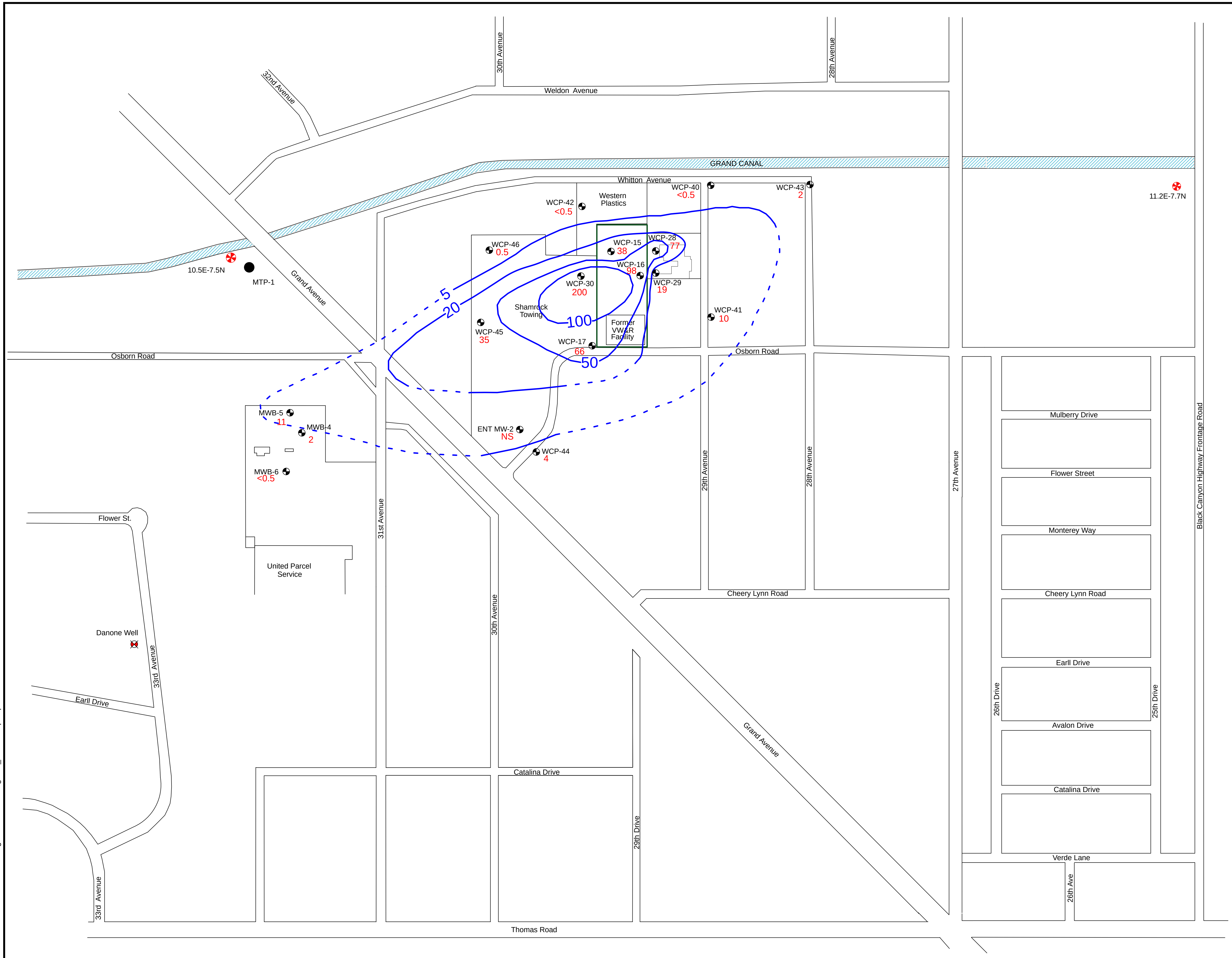

Figure 7-29
TCE Concentrations Groundwater Sampling Round 2 - Pump January-February 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- TCE Concentration Contour (μg/L)
- 22 TCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- NS Not Sampled

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

Approximate Scale
1 inch = 450 feet
0 225 450 900

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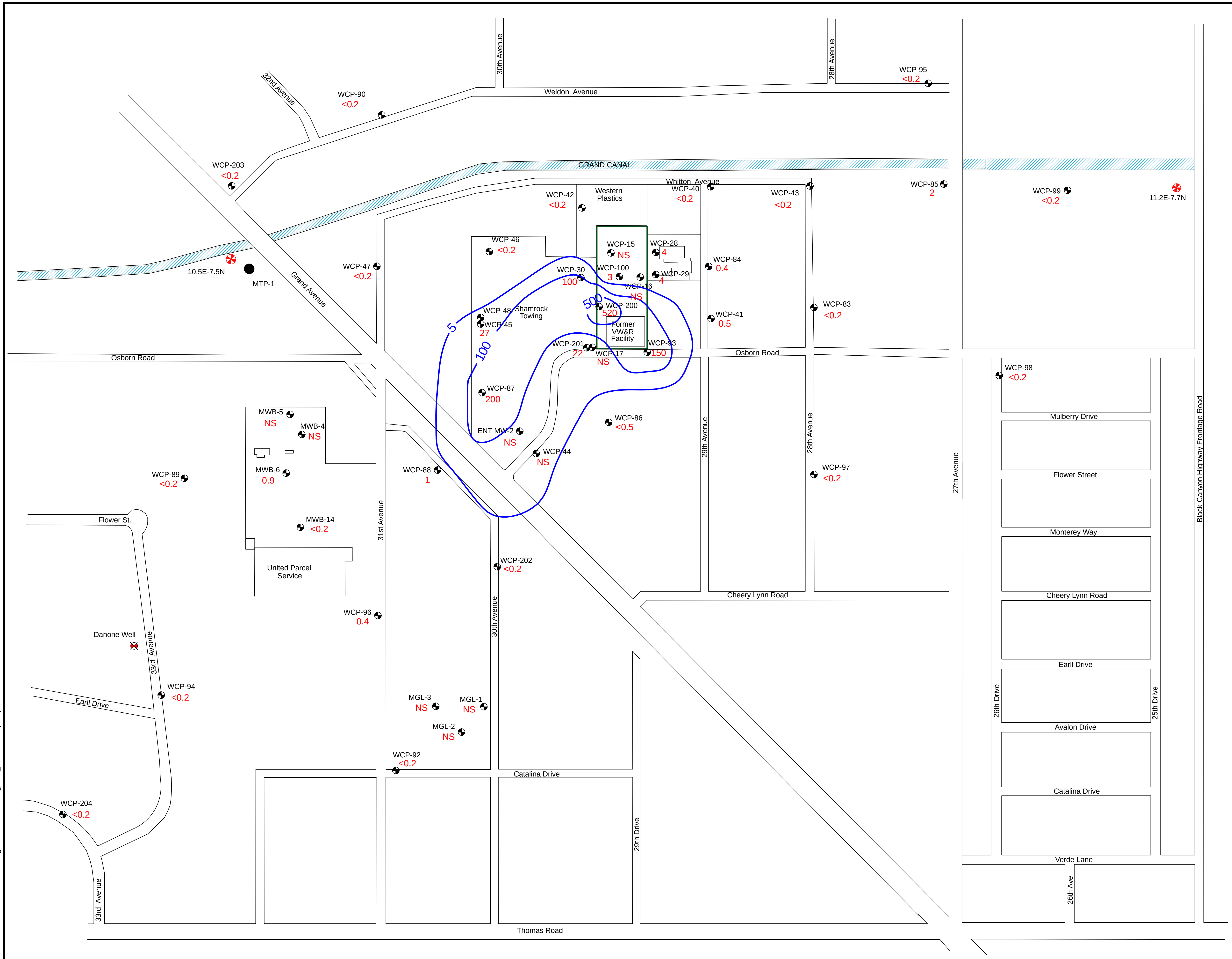

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Figure 7-28
PCE Concentrations Groundwater Sampling Round 15 - Pump January 2002

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- 230 PCE Concentration (μg/L)
- NS Not Sampled
- PCE Concentration Contours (μg/L)

NOTES: All well locations are approximate. Monitor wells were purged by removing three well-casing volumes.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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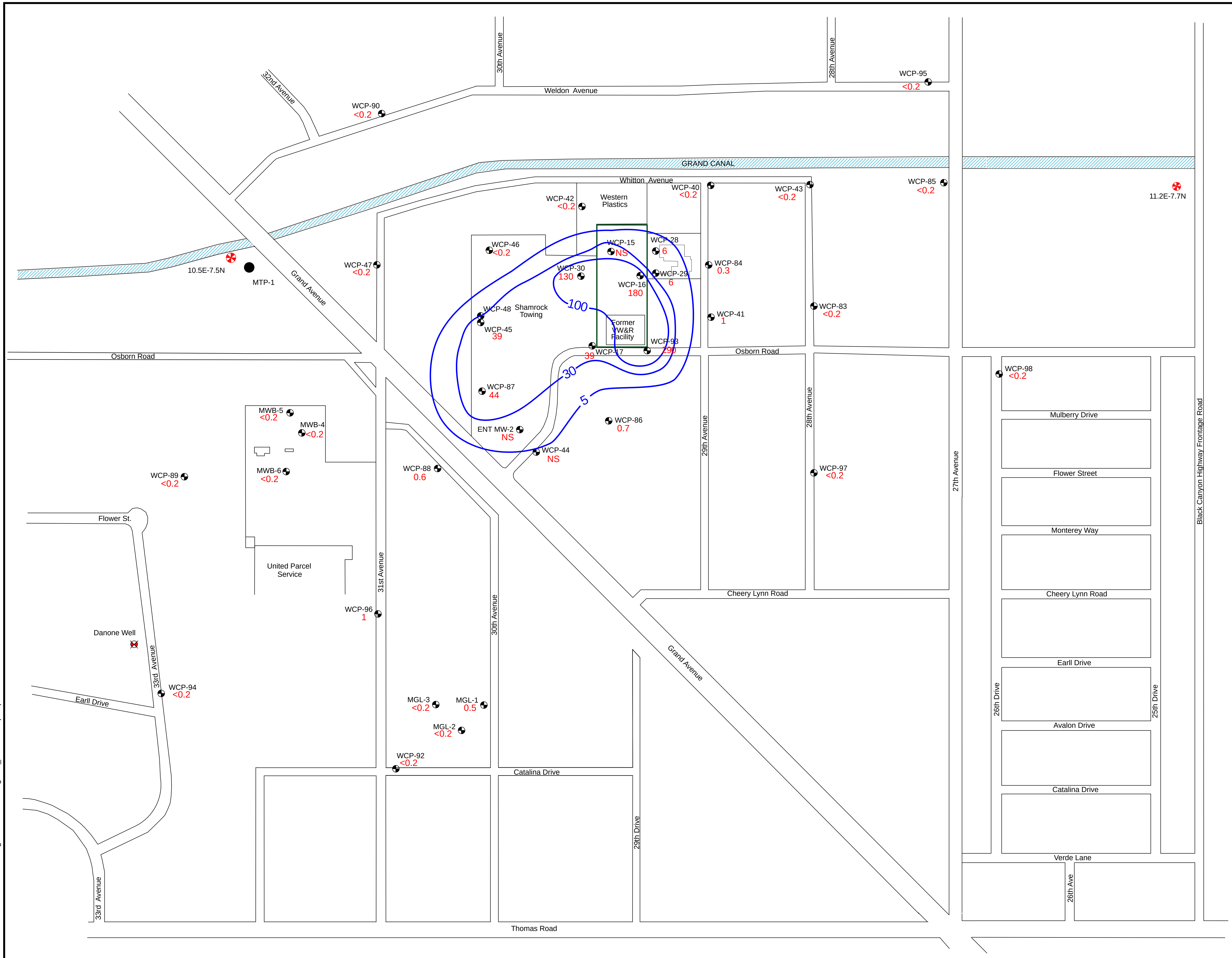

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Figure 7-27
PCE Concentrations
Groundwater Sampling
Round 13 - Pump
November 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- 230 PCE Concentration (μg/L)
- NS Not Sampled
- PCE Concentration Contours (μg/L)

NOTES: All well locations are approximate. Monitor wells were purged by removing three well-casing volumes.

N

Approximate Scale
1 inch = 450 feet

0 225 450 900

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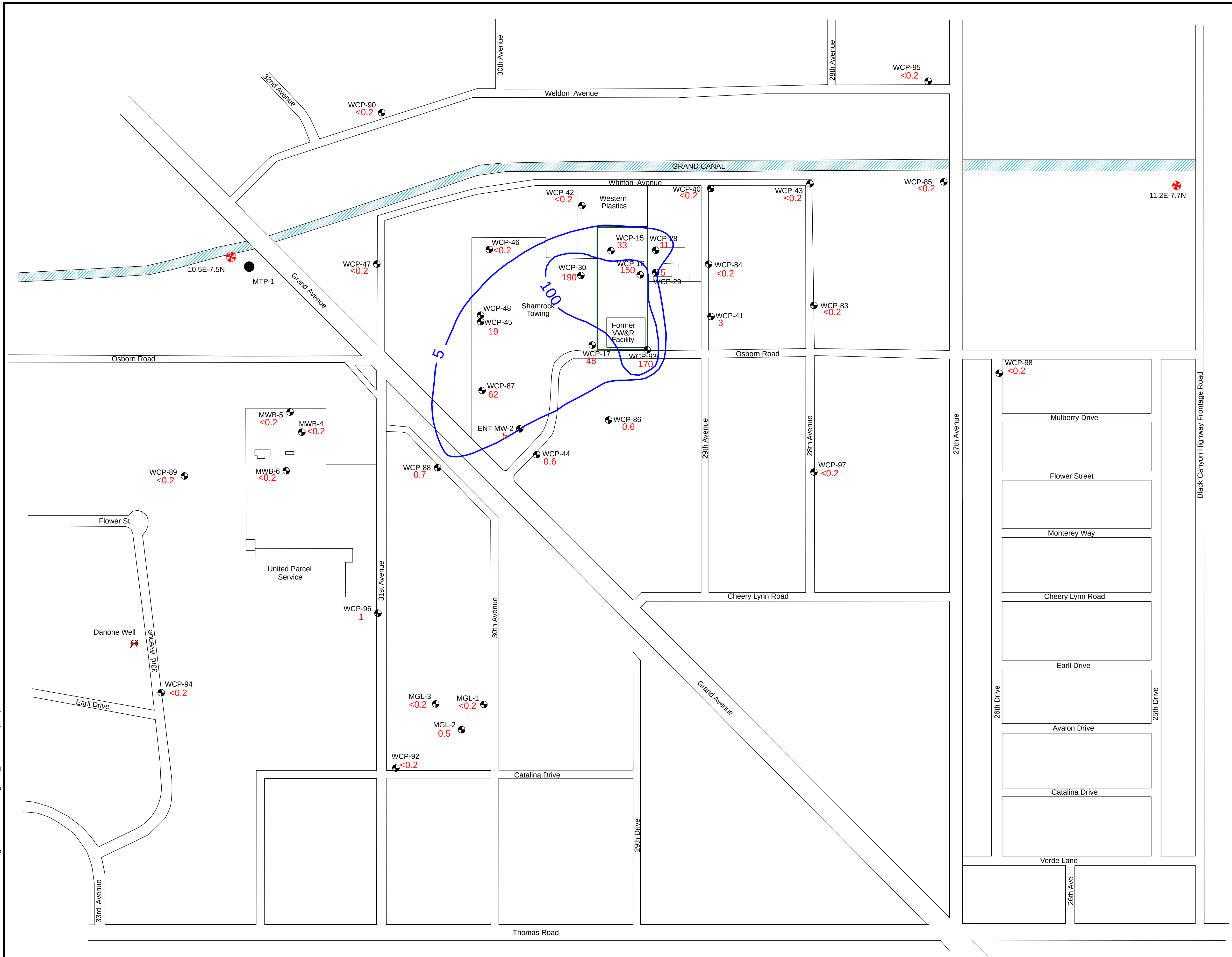

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Figure 7-26
PCE Concentrations Groundwater Sampling Round 11 - Pump July-August, 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- PCE Concentration Contour (μg/L)
- 22 PCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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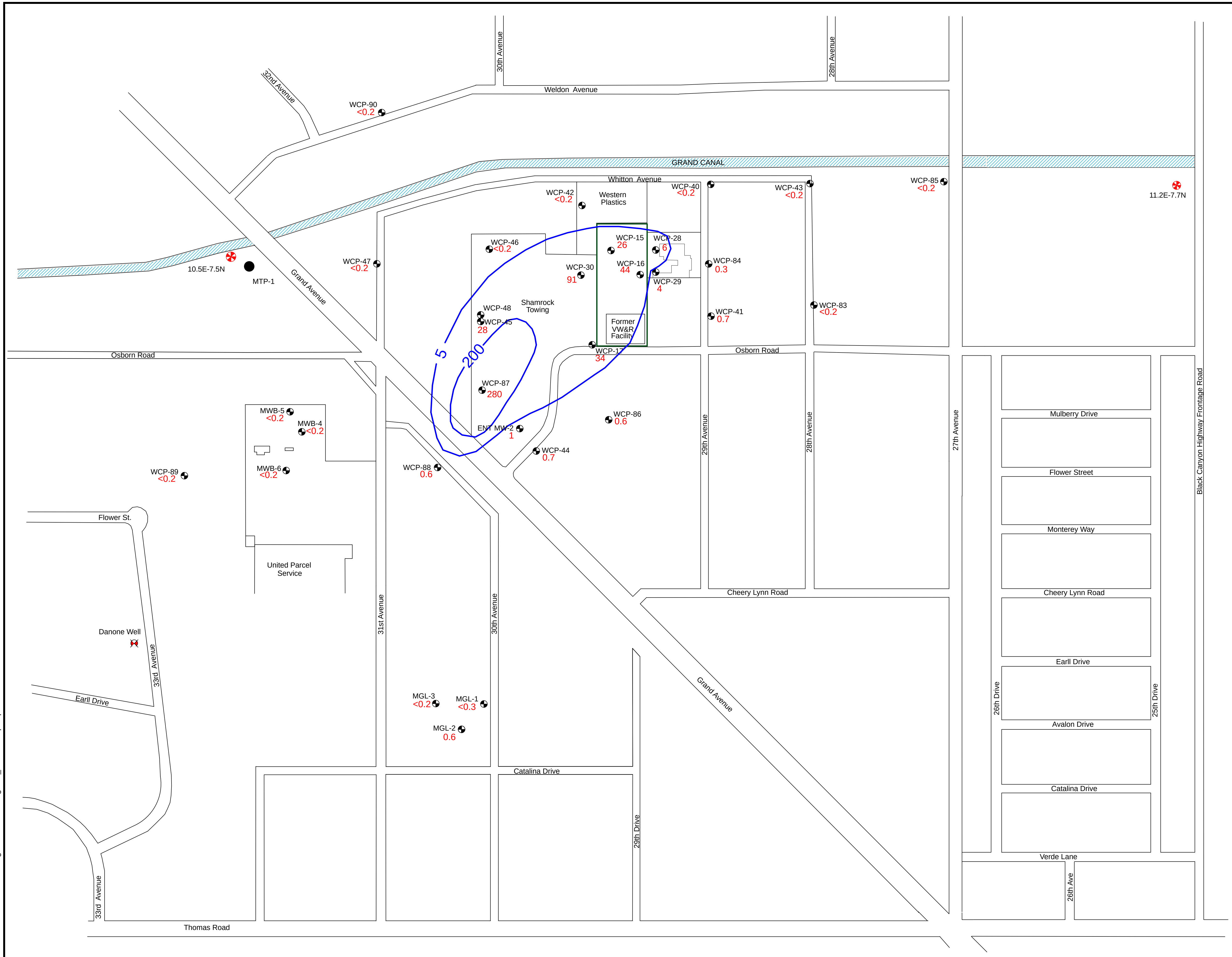

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Figure 7-25
PCE Concentrations Groundwater Sampling Round 10 - Pump
June 18-29, 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- PCE Concentration Contour (μg/L)
- 22 PCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary

NOTES: All well locations are approximate.
All monitor wells purged by removing three well-casing volumes.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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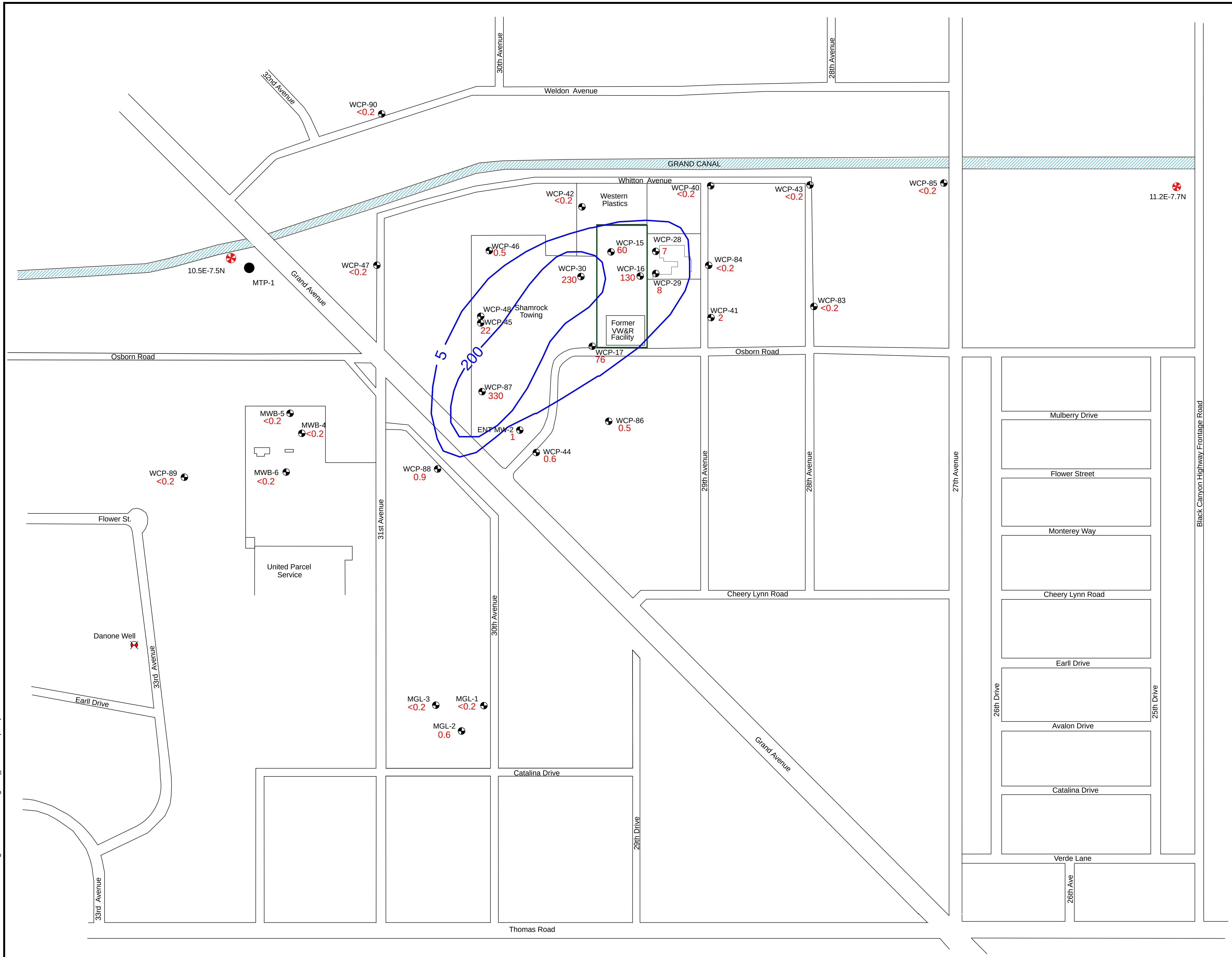

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Figure 7-24
PCE Concentrations
Groundwater Sampling
Round 9 - Pump
June 5-15, 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- PCE Concentration Contour (μg/L)
- 22 PCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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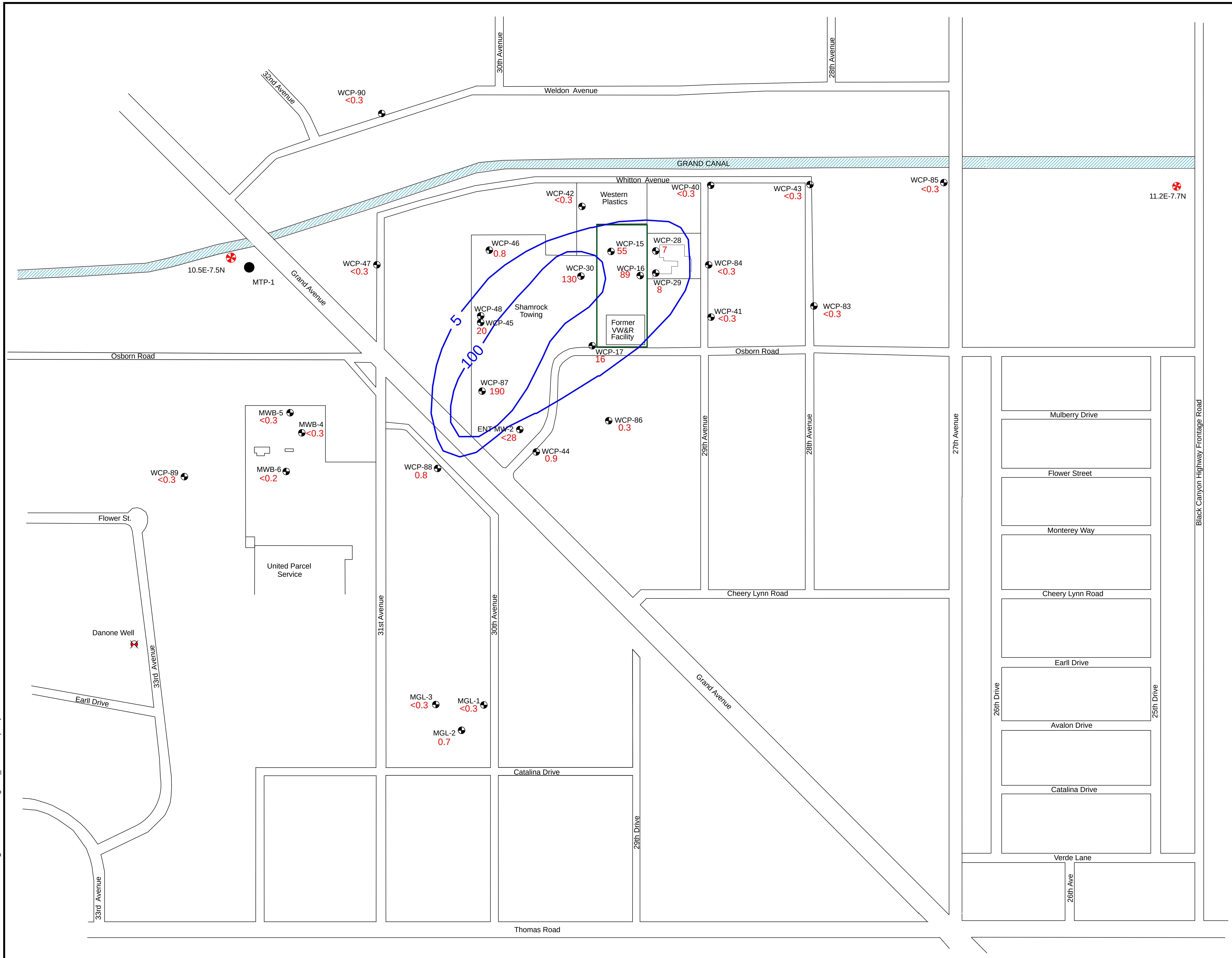

Figure 7-23
PCE Concentrations
Groundwater Sampling
Round 8 - Pump
April-May 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- PCE Concentration Contour (μg/L)
- 22 PCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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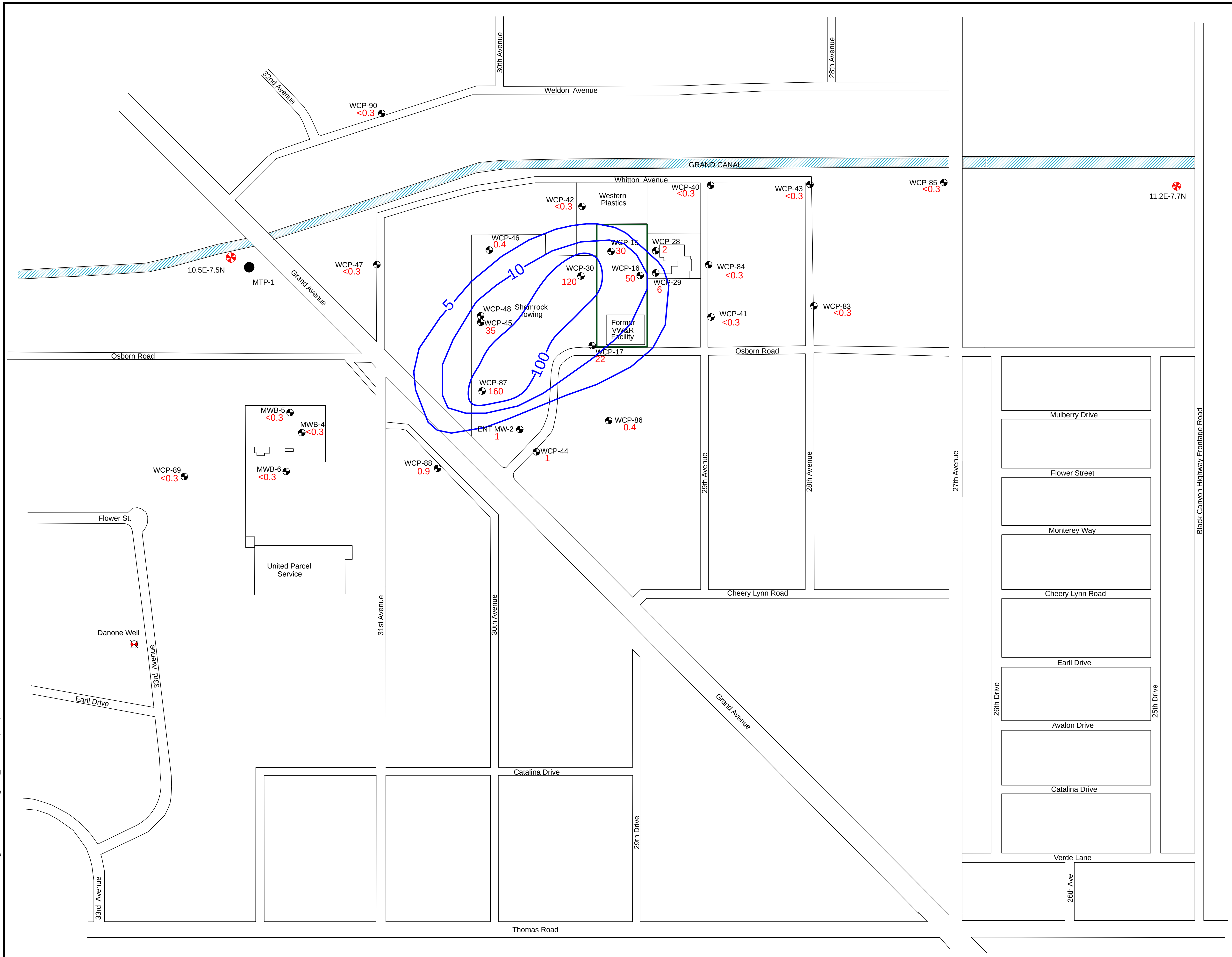

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Figure 7-22
PCE Concentrations Groundwater Sampling Round 7 - Pump February-March 2001

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- PCE Concentration Contour (μg/L)
- 22 PCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet

0 225 450 900

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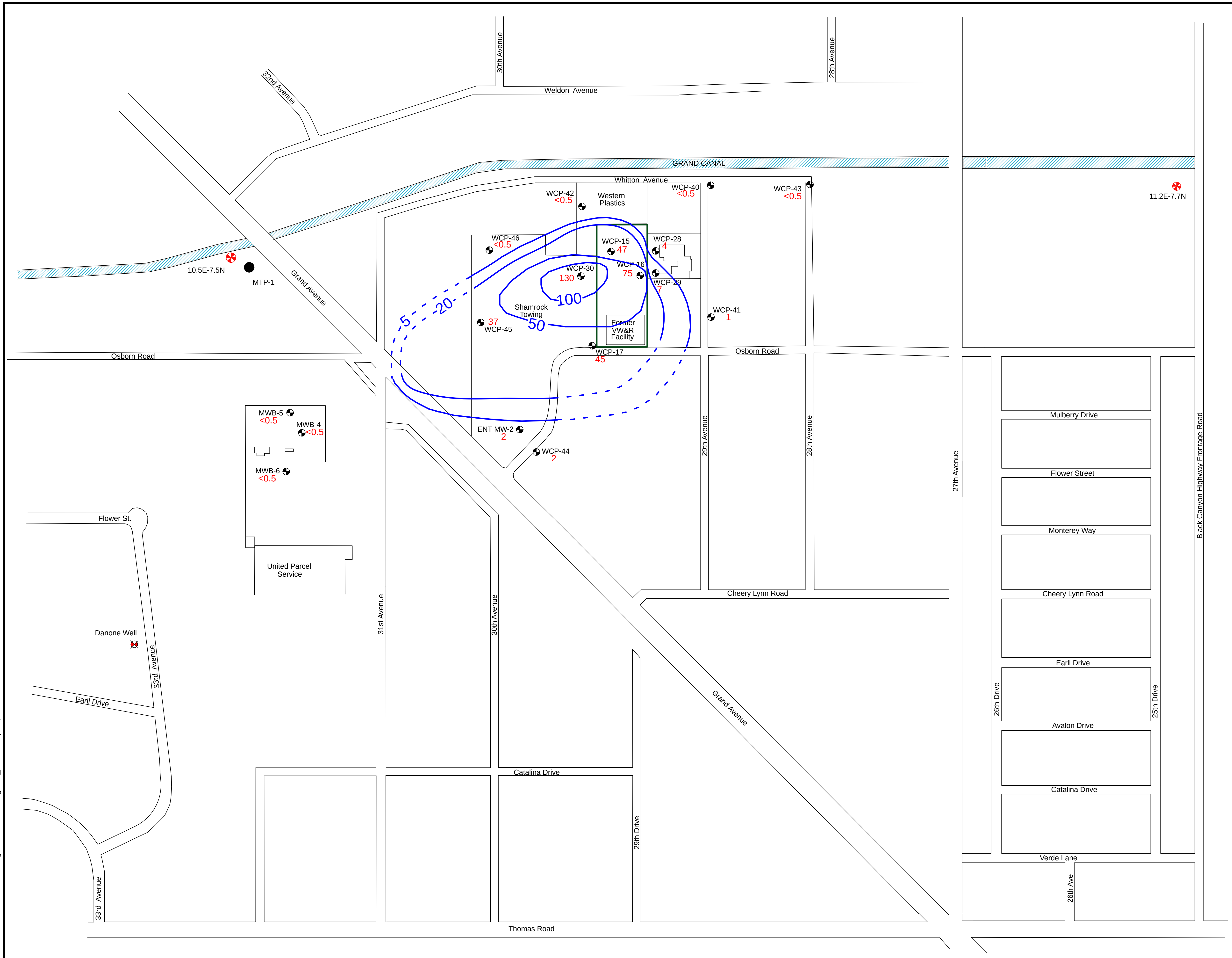

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Figure 7-21
PCE Concentrations
Groundwater Sampling
Round 6 - Pump
December 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- PCE Concentration Contour (μg/L)
- 22 PCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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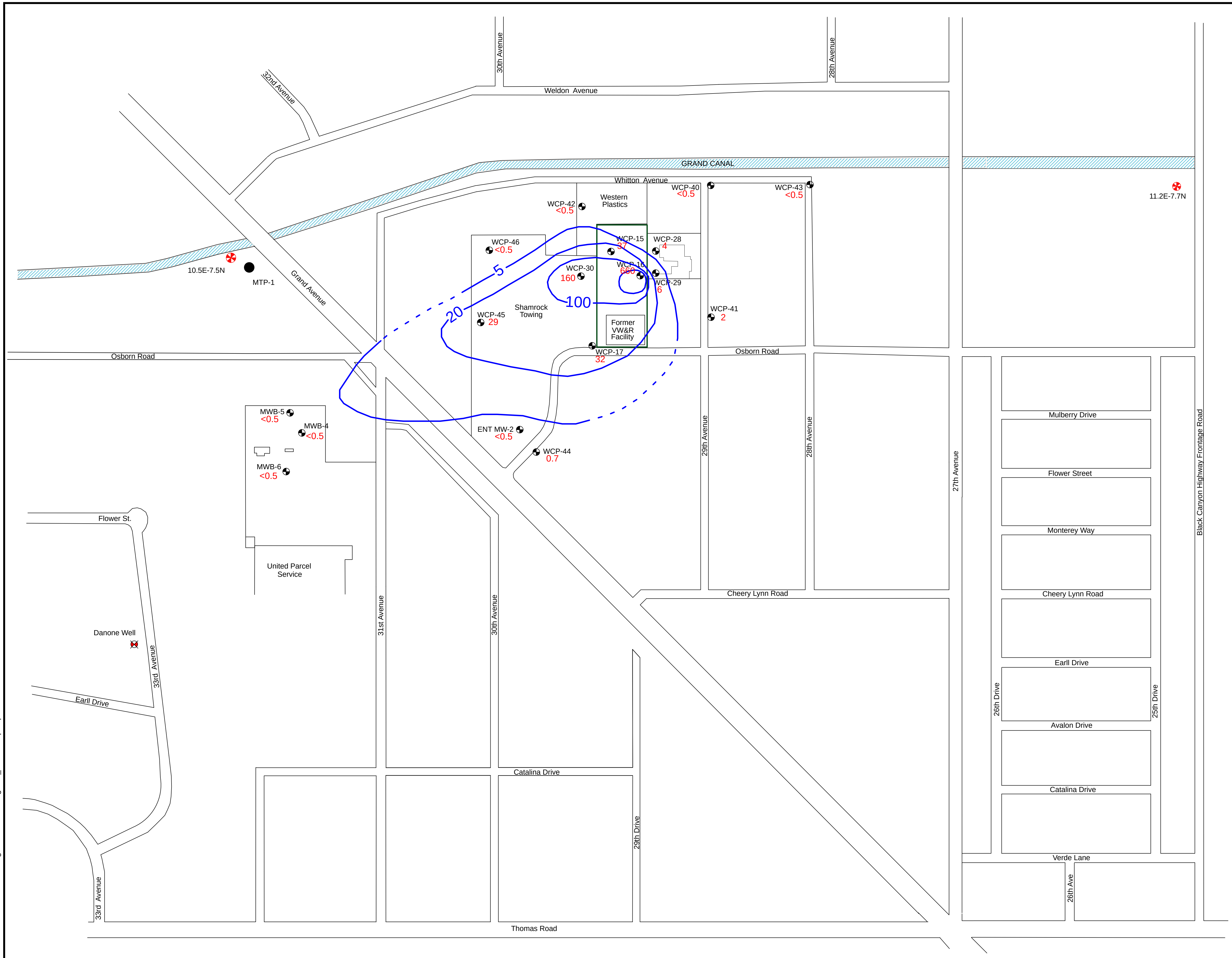

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Figure 7-20
PCE Concentrations Groundwater Sampling Round 5 - Pump September 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- PCE Concentration Contour (μg/L)
- 22 PCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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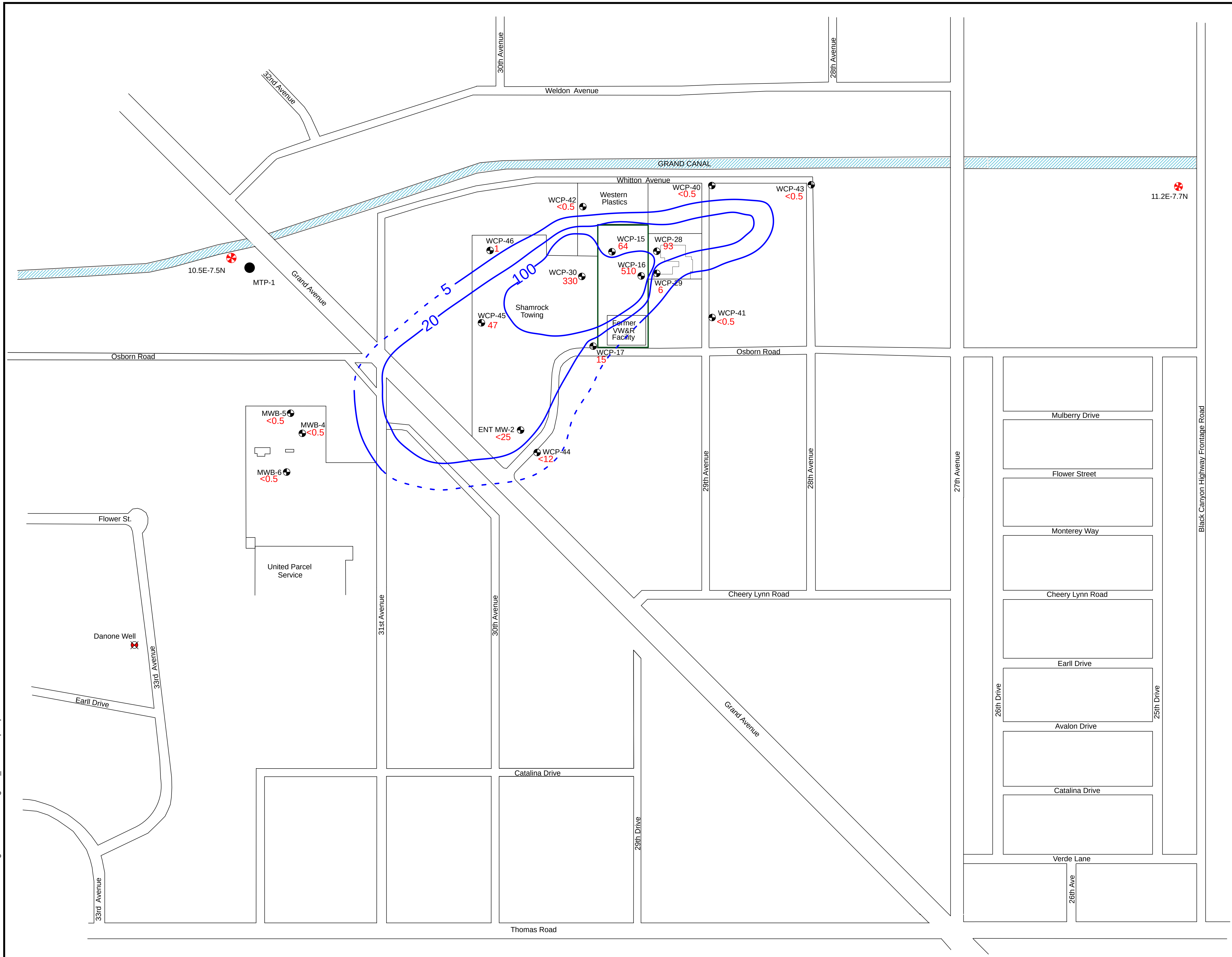

Figure 7-19
PCE Concentrations
Groundwater Sampling
Round 4 - Pump
June 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- PCE Concentration Contour (μg/L)
- 22 PCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary

NOTES: All well locations are approximate.
All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet

0 225 450 900

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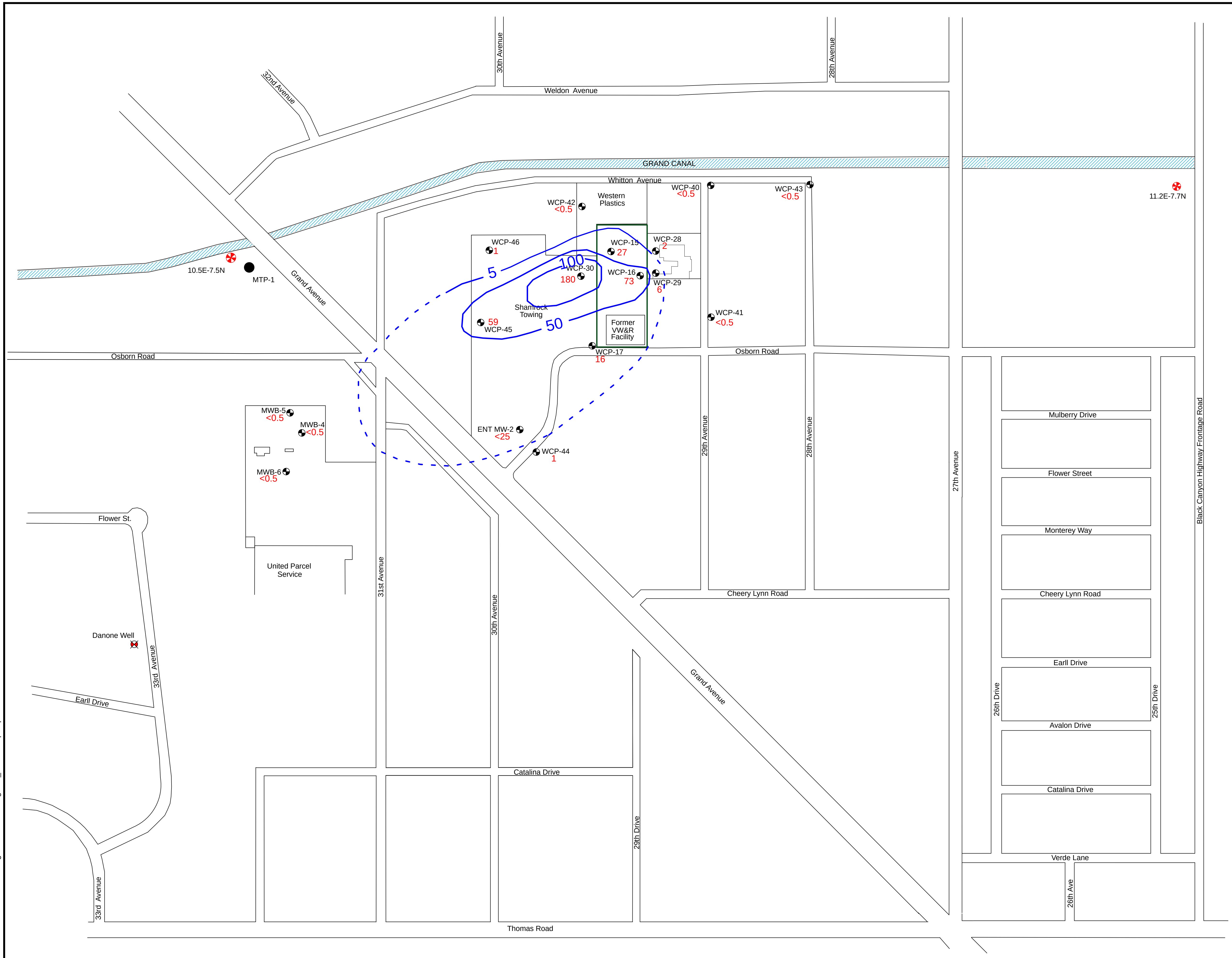

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Figure 7-18
PCE Concentrations Groundwater Sampling Round 3 - Pump March 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- PCE Concentration Contour (μg/L)
- 22 PCE Concentration (μg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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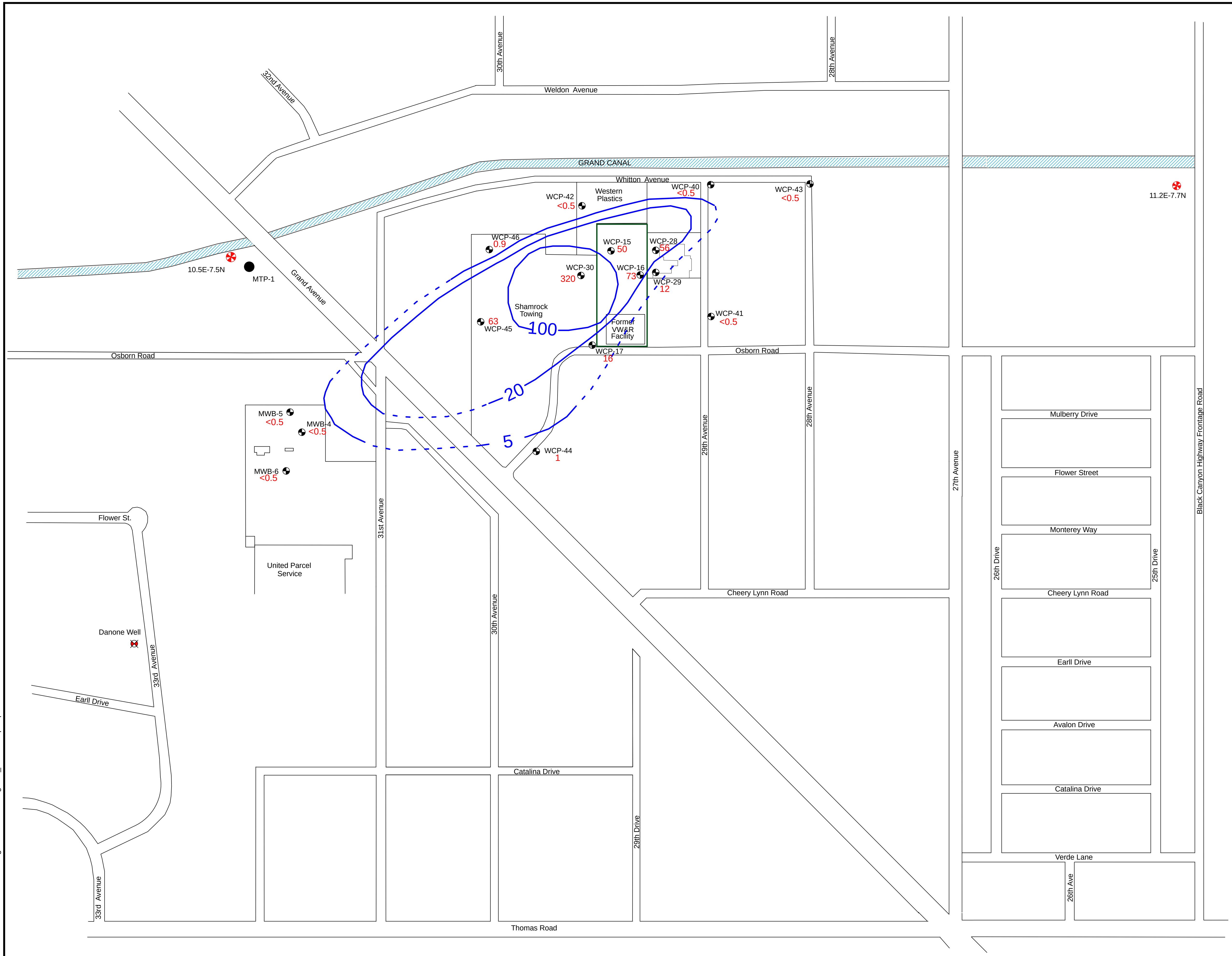

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Figure 7-17
PCE Concentrations Groundwater Sampling Round 2 - Pump January-February 2000

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- PCE Concentration Contour (µg/L)
- 22 PCE Concentration (µg/L)
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary

NOTES: All well locations are approximate. All monitor wells purged using the low-flow purge method.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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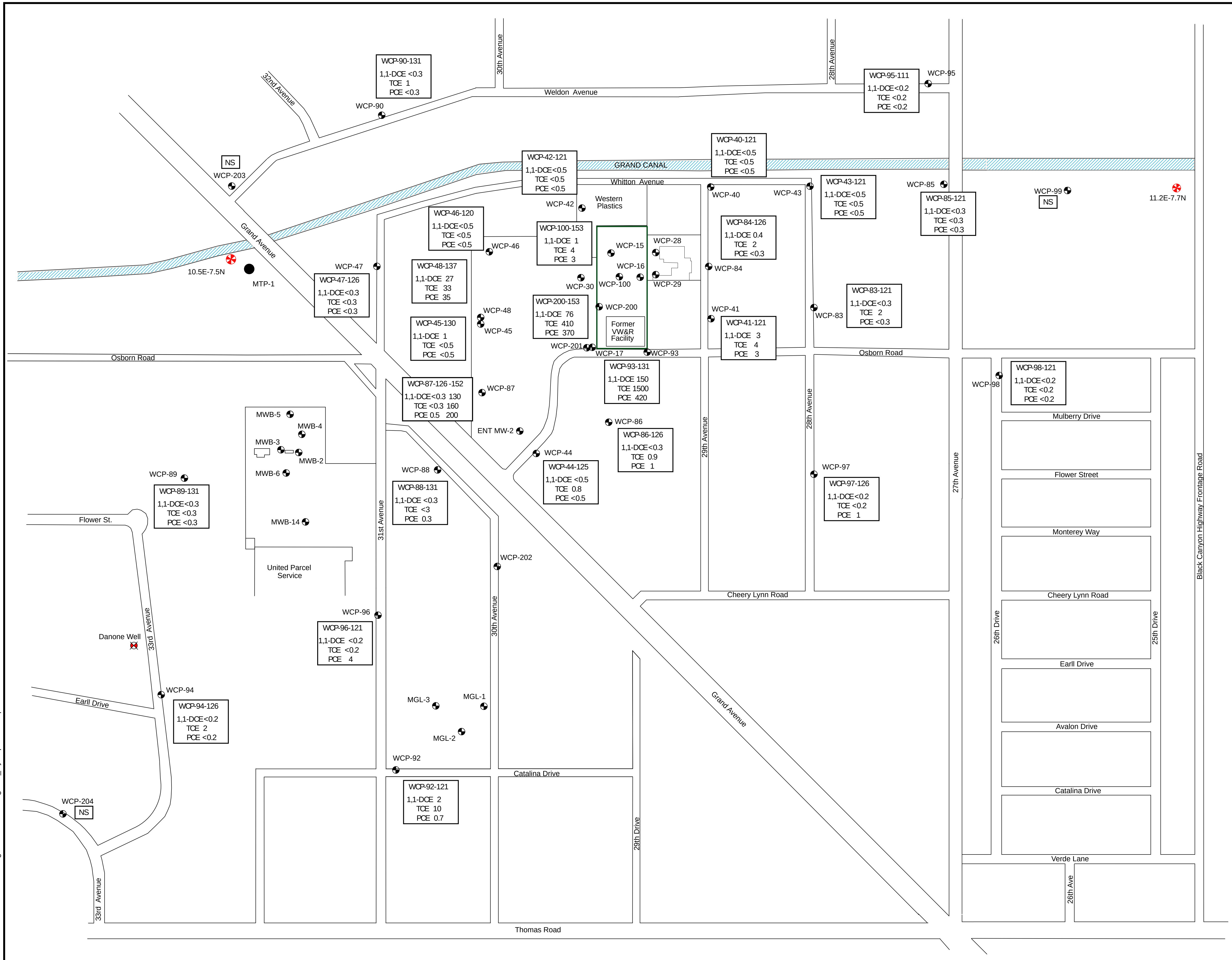

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Figure 7-16
Hydropunch®
Sample Results
WCP East Grand Avenue
WQARF Site

Legend

- SRP Production Well
- Monitor Well
- Michigan Trailer Park Well
- Danone Well
- Irrigation Canal
- Street, Road, or Avenue
- Approximate Facility Boundary
- WCP-92-121 Well identification number and depth of Hydropunch sample.
- NS Not Sampled.

NOTES: All well locations are approximate. Concentrations in micrograms per liter.

N

Approximate Scale
1 inch = 450 feet
0 225 450 900

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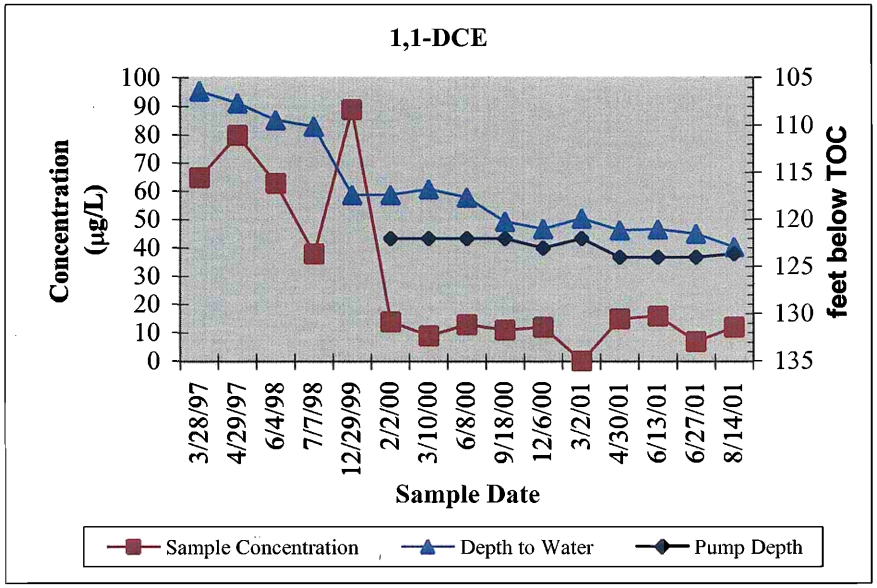

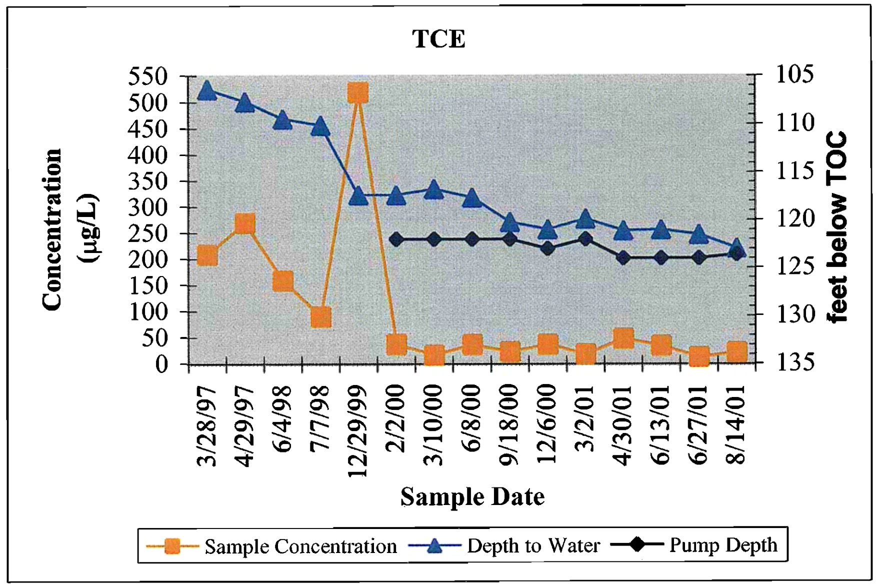

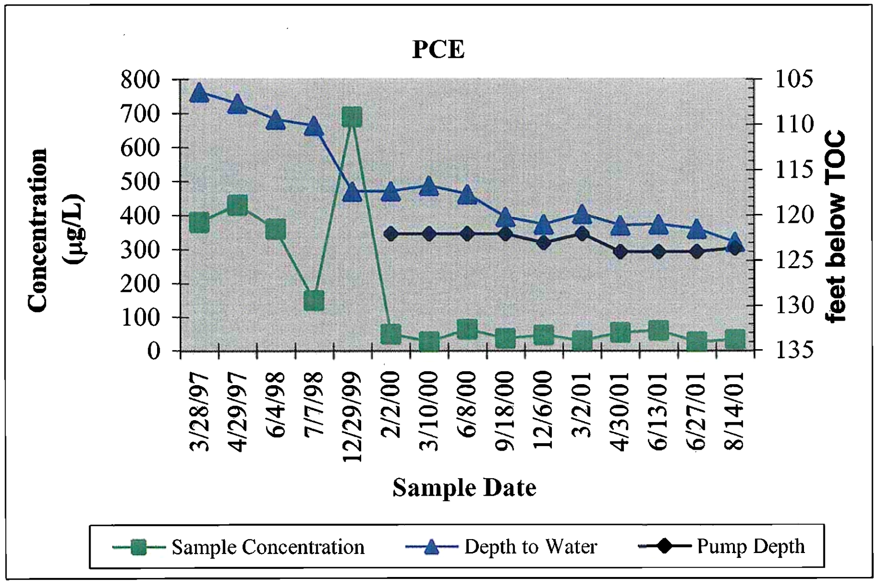

Notes:

1) 1997 data from Fluor Daniel Groundwater Investigation. 1998 data from the Weston Phase II Remedial Investigation.
2) Analytical results less than the detection limit are plotted at one-half the detection limit.
3) Total Depth of Well: 125 ft below ground surface
4) Samples collected prior to 2/2/00 were collected with a bailer. Remaining samples collected using the pump discharge collection method. Well was purged by removing three casing volumes through 1998 and on 6/27/01. The low-flow purge method used during the remaining sample events.
5) feet below TOC = feet below top of casing
   µg/L = micrograms per liter

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Figure 7-6
Depth to Water, Pump Depth and Contaminant Concentrations
Monitor Well WCP-15
WCP East Grand Avenue WQARF Site Remedial Investigation

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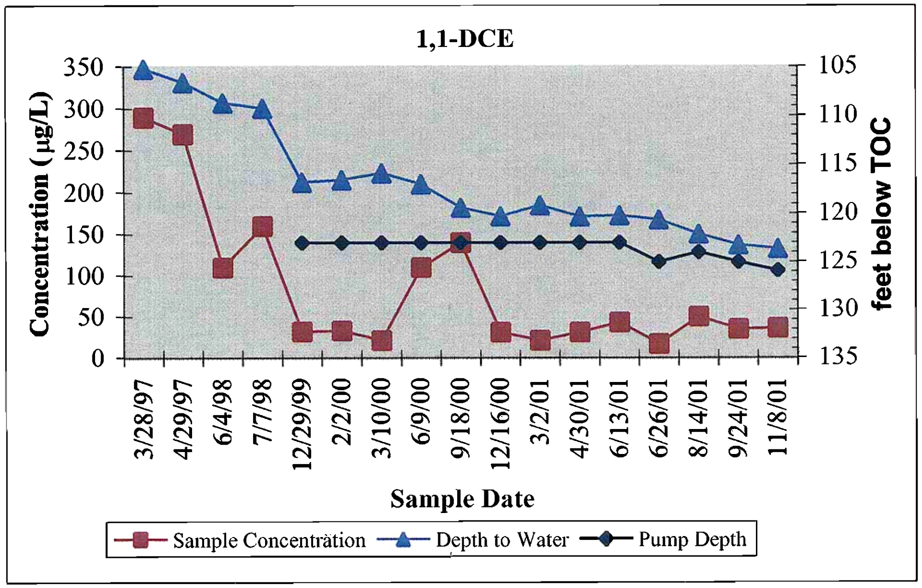

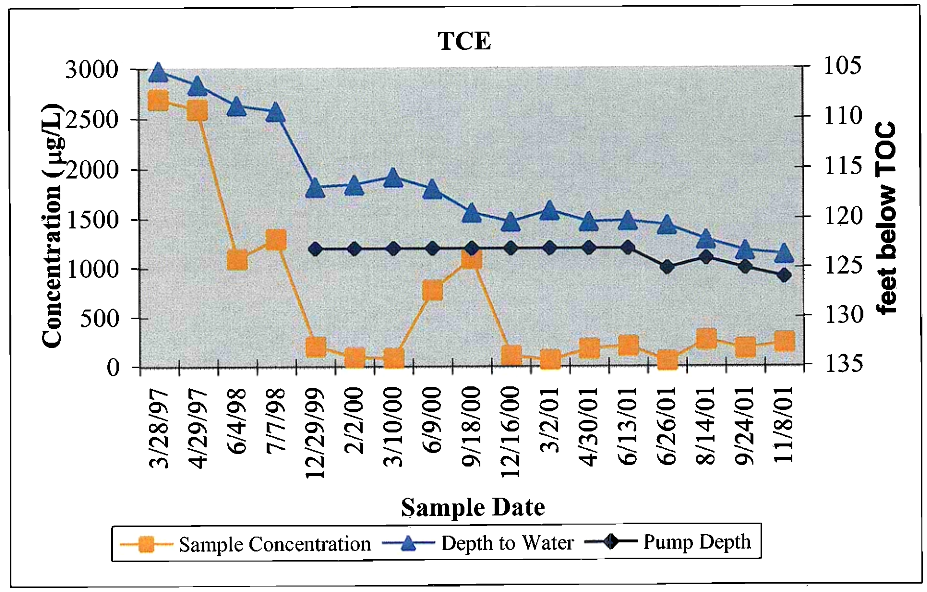

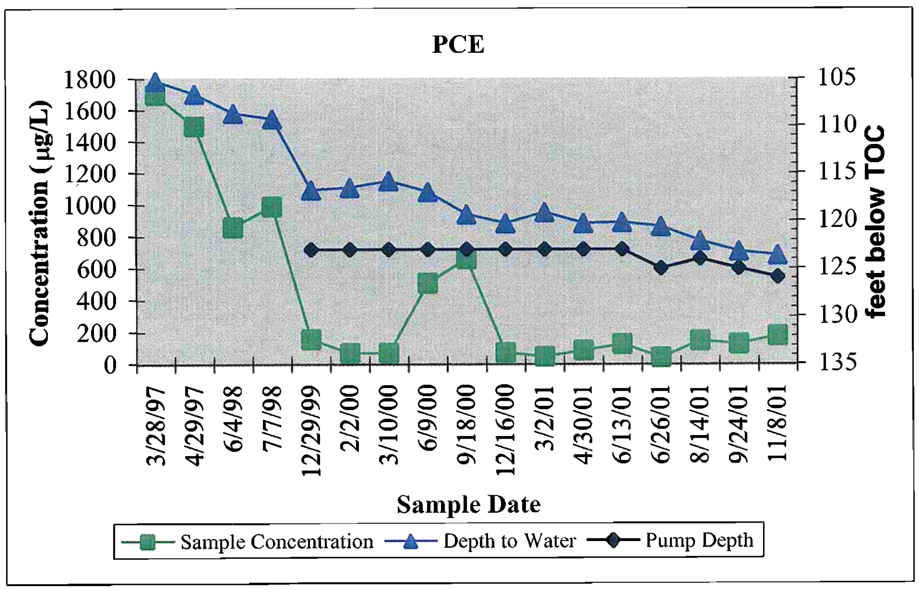

Notes:

1) 1997 data from Fluor Daniel Groundwater Investigation.
   1998 data from the Weston Phase II Remedial Investigation.
2) Analytical results less than the detection limit are plotted at one-half the detection limit.
3) Total Depth of Well: 126 ft below ground surface
4) Samples collected prior to 2/2/00 were collected with a bailer. Remaining samples collected using the pump discharge collection method. Well was purged by removing three casing volumes through 1998 and on 6/26/01 and 11/8/01. The low-flow purge method used during the remaining sample events.
5) feet below TOC = feet below top of casing
   µg/L = micrograms per liter

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Figure 7-7
Depth to Water, Pump Depth and Contaminant Concentrations
Monitor Well WCP-16
WCP East Grand Avenue WQARF Site Remedial Investigation

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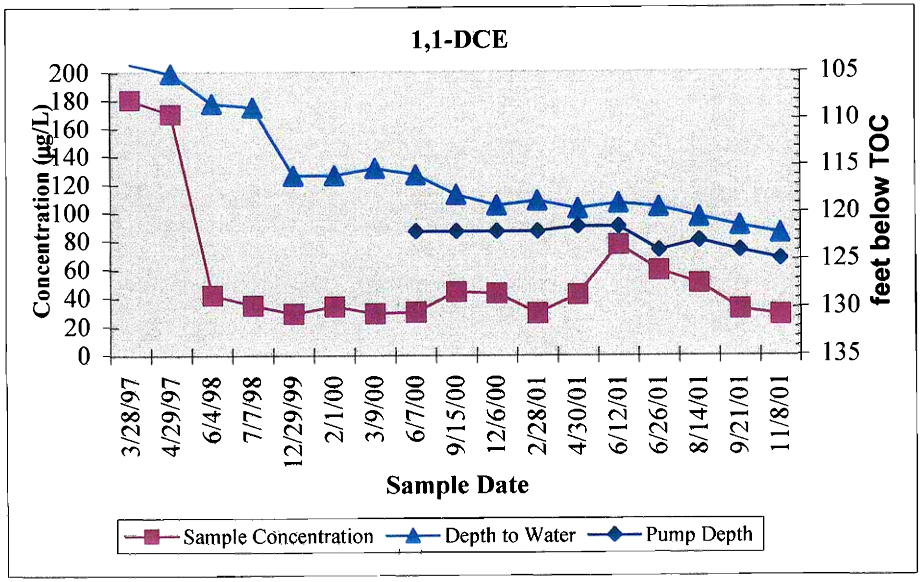

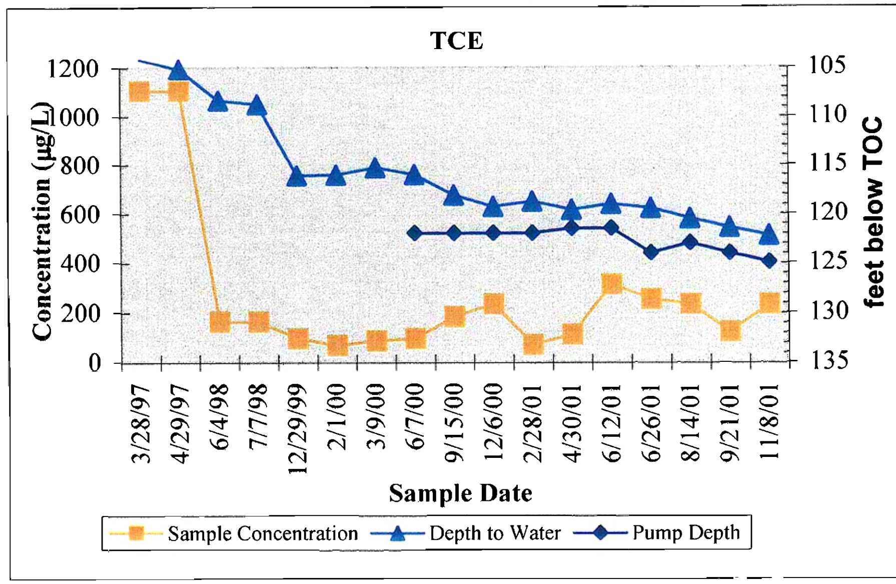

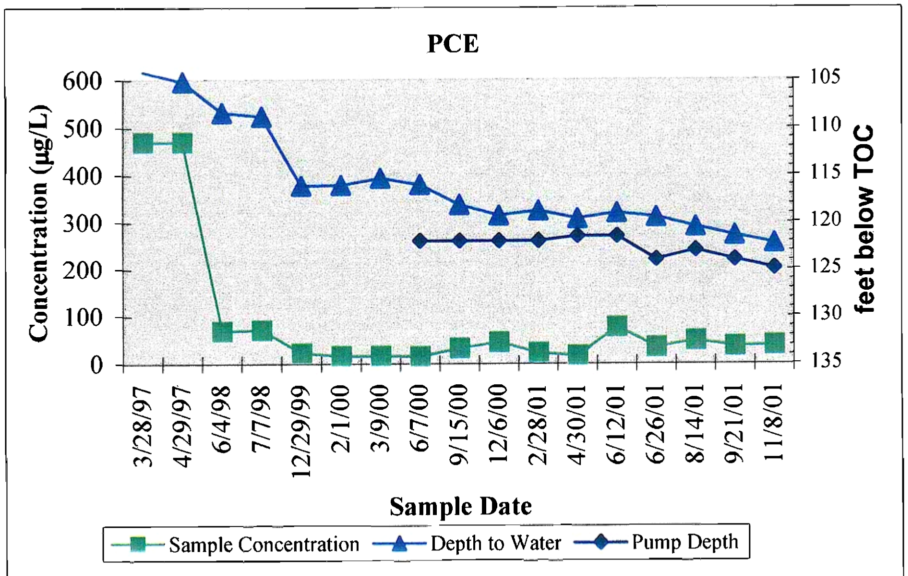

Notes:

1) 1997 data from Fluor Daniel Groundwater Investigation.
   1998 data from the Weston Phase II Remedial Investigation.
2) Analytical results less than the detection limit are plotted at one-half the detection limit.
3) Total Depth of Well: 125 ft below ground surface
4) Samples collected prior to 2/1/00 were collected with a bailer. Remaining samples collected using the pump discharge collection method. Well was purged by removing three casing volumes through 1998 and on 6/26/01 and 11/8/01. The low-flow purge method used during the remaining sample events.
5) feet below TOC = feet below top of casing
   µg/L = micrograms per liter

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Figure 7-8
Depth to Water, Pump Depth and Contaminant Concentrations
Monitor Well WCP-17
WCP East Grand Avenue WQARF Site Remedial Investigation

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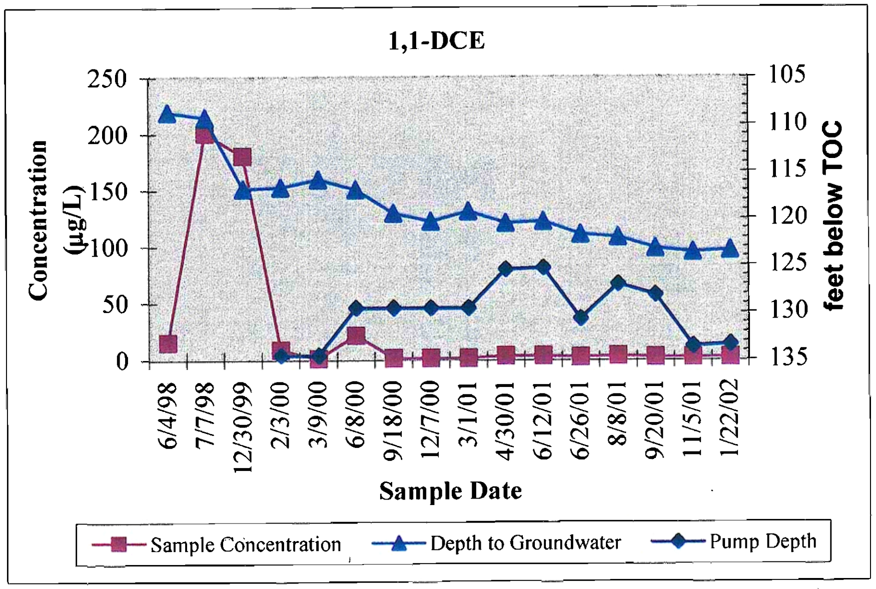

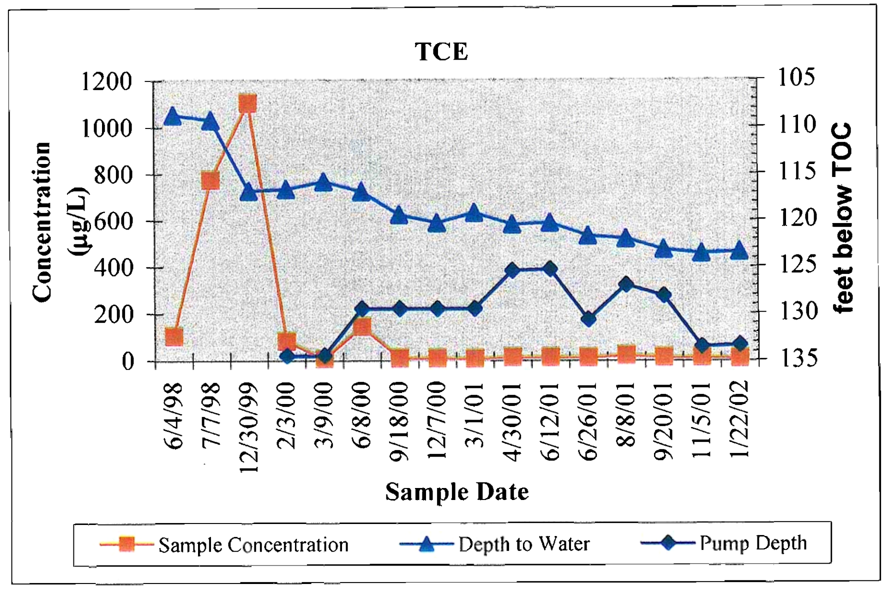

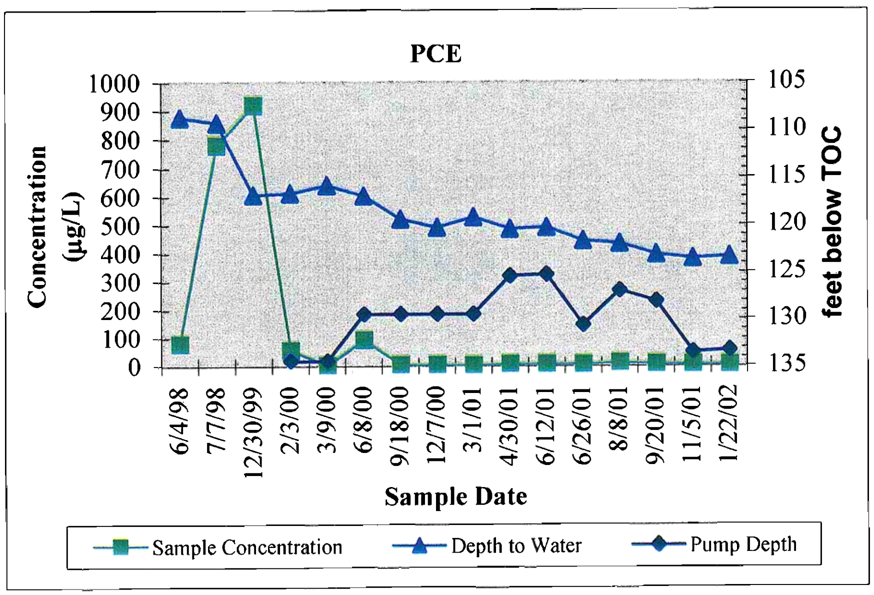

Notes:

1) 1998 data from the Weston Phase II Remedial Investigation.
2) Analytical results less than the detection limit are plotted at one-half the detection limit.
3) Total Depth of Well: 139.5 ft below ground surface
4) Samples collected prior to 2/3/00 were collected with a bailer. Remaining samples collected using the pump discharge collection method. Well was purged by removing three casing volumes through 1998 and on 6/26/01, 11/5/01, and 1/22/02. The low-flow purge method used during the remaining sample events.
5) feet below TOC = feet below top of casing
   µg/L = micrograms per liter

Figure 7-9
Depth to Water, Pump Depth and Contaminant Concentrations
Monitor Well WCP-28
WCP East Grand Avenue WQARF Site Remedial Investigation

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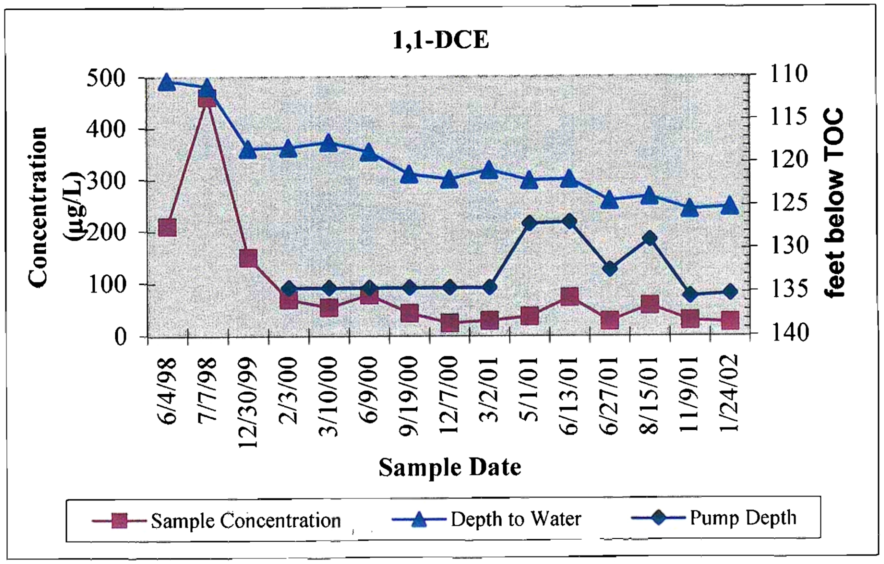

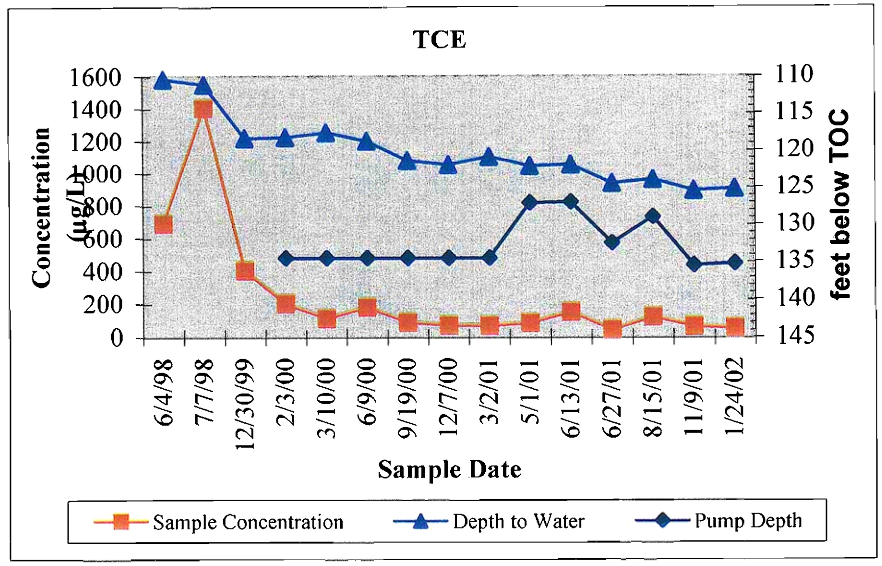

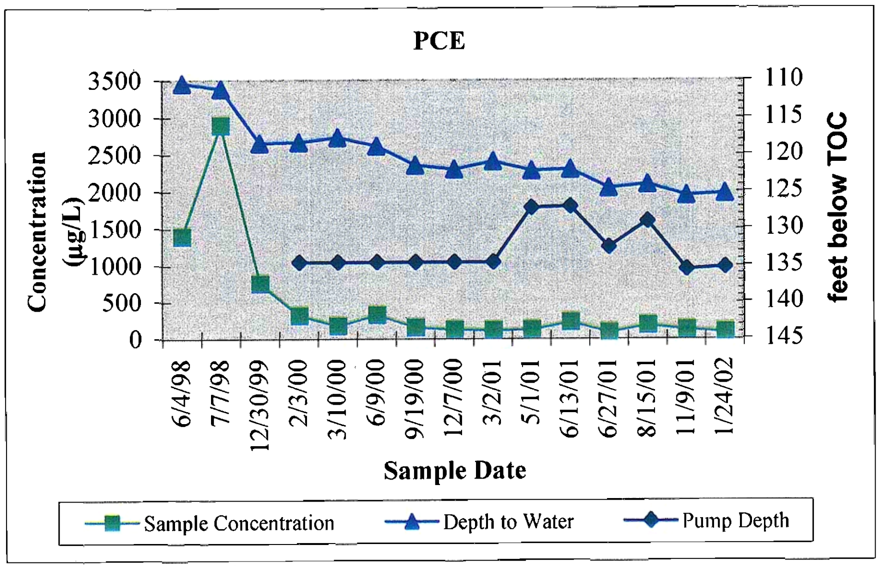

Notes:

1) 1998 data from the Weston Phase II Remedial Investigation.
2) Analytical results less than the detection limit are plotted at one-half the detection limit.
3) Total Depth of Well: 139.5 ft below ground surface
4) Samples collected prior to 2/3/00 were collected with a bailer. Remaining samples collected using the pump discharge collection method. Well was purged by removing three casing volumes through 1998 and on 6/27/01, 11/9/01, and 1/24/02. The low-flow purge method used during the remaining sample events.
5) feet below TOC = feet below top of casing
   µg/L = micrograms per liter

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Figure 7-10
Depth to Water, Pump Depth and Contaminant Concentrations
Monitor Well WCP-30
WCP East Grand Avenue WQARF Site Remedial Investigation

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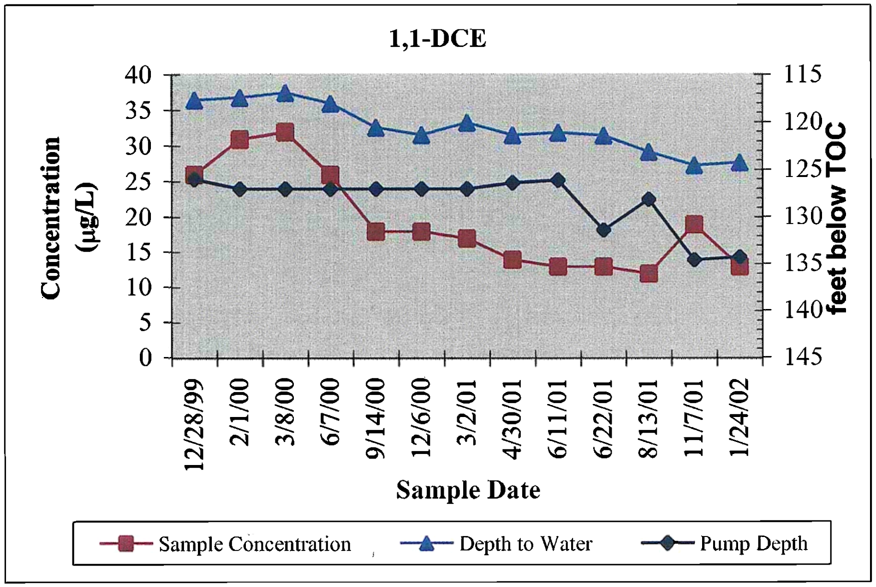

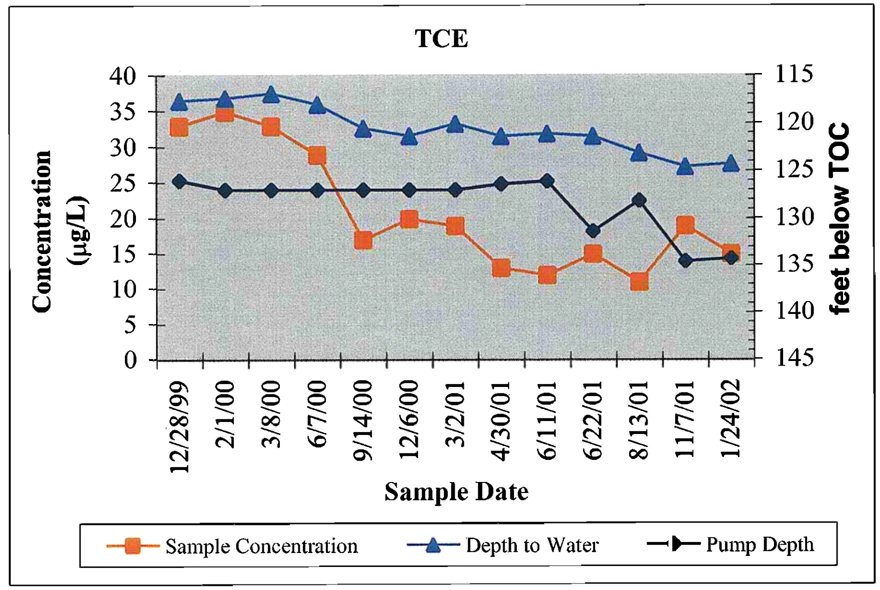

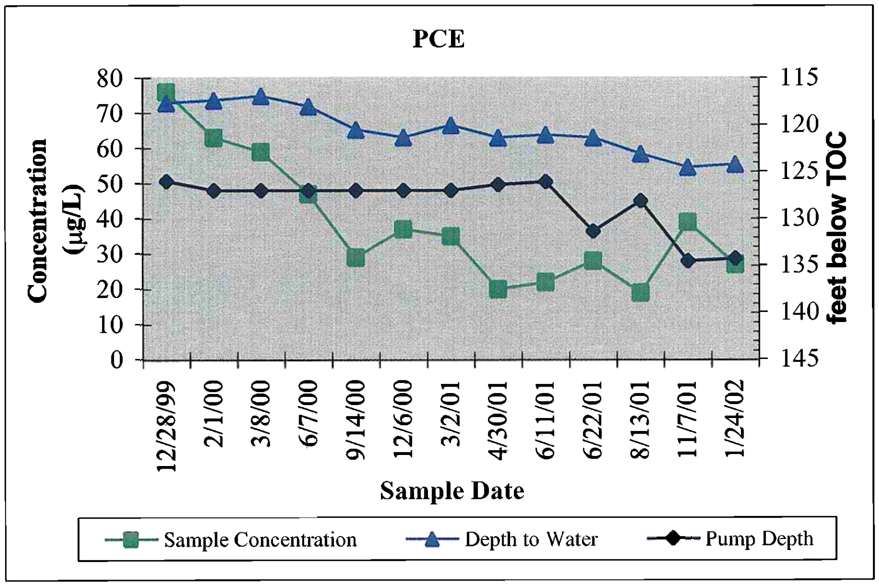

Notes:

1) Analytical results less than the detection limit are plotted at one-half the detection limit.
2) Total Depth of Well: 148 ft below ground surface
3) Samples collected prior to 2/1/00 were collected with a bailer. Remaining samples collected using the pump discharge collection method. Well was purged by removing three casing volumes on 6/22/01, 11/7/01, and 1/24/02. The low-flow purge method was used during remaining sample events.
4) feet below TOC = feet below top of casing
   µg/L = micrograms per liter

Figure 7-11
Depth to Water, Pump Depth and Contaminant Concentrations
Monitor Well WCP-45
WCP East Grand Avenue WQARF Site Remedial Investigation

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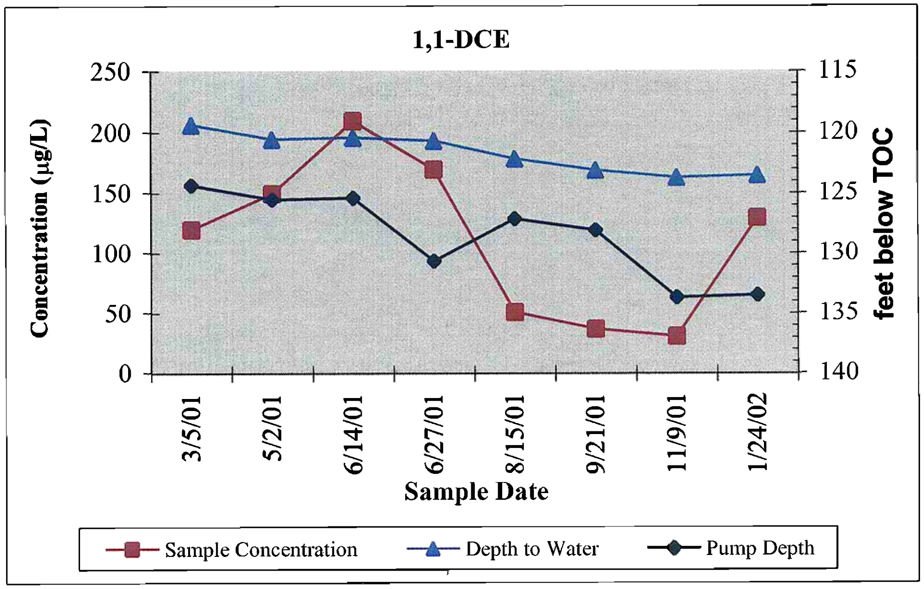

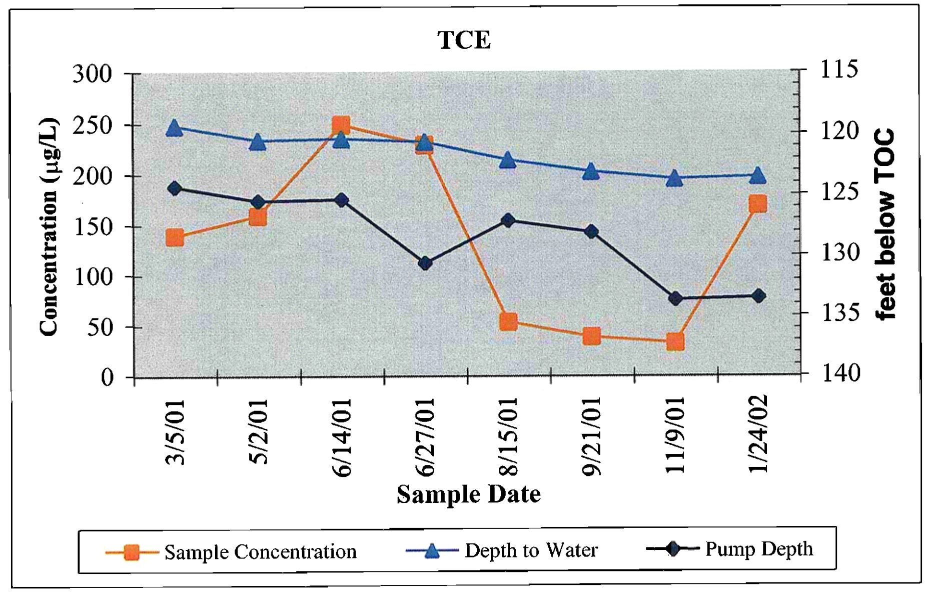

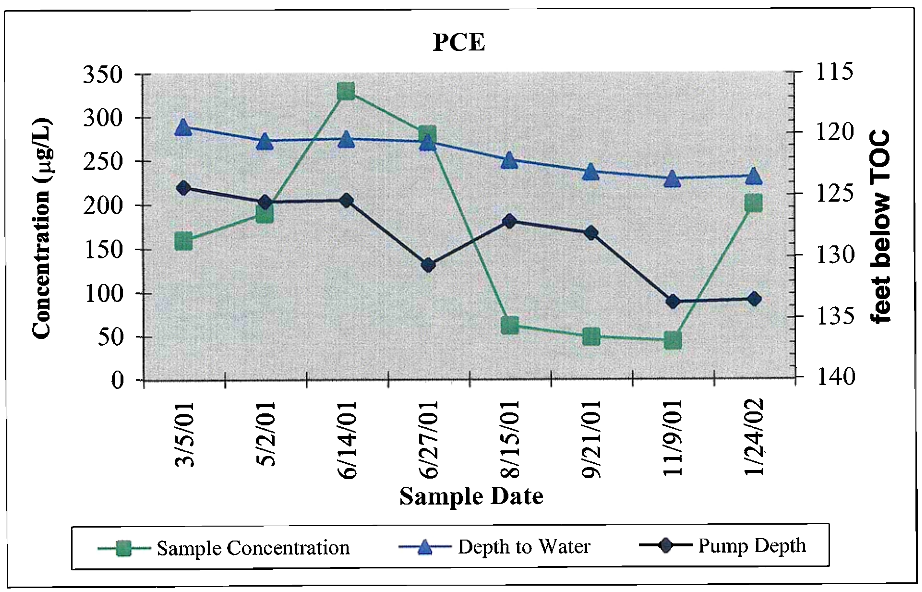

Notes:

1) Analytical results less than the detection limit are plotted at one-half the detection limit.
2) Total Depth of Well: 152.5 ft below ground surface
3) Samples collected using the pump discharge method. Well was purged by removing three casing volumes on 6/27/01, 11/9/01, and 1/24/02. The low-flow purge method was used during the remaining sample events.
4) feet below TOC = feet below top of casing
μg/L = micrograms per liter

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Figure 7-12
Depth to Water, Pump Depth and Contaminant Concentrations
Monitor Well WCP-87
WCP East Grand Avenue WQARF Site Remedial Investigation

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000151

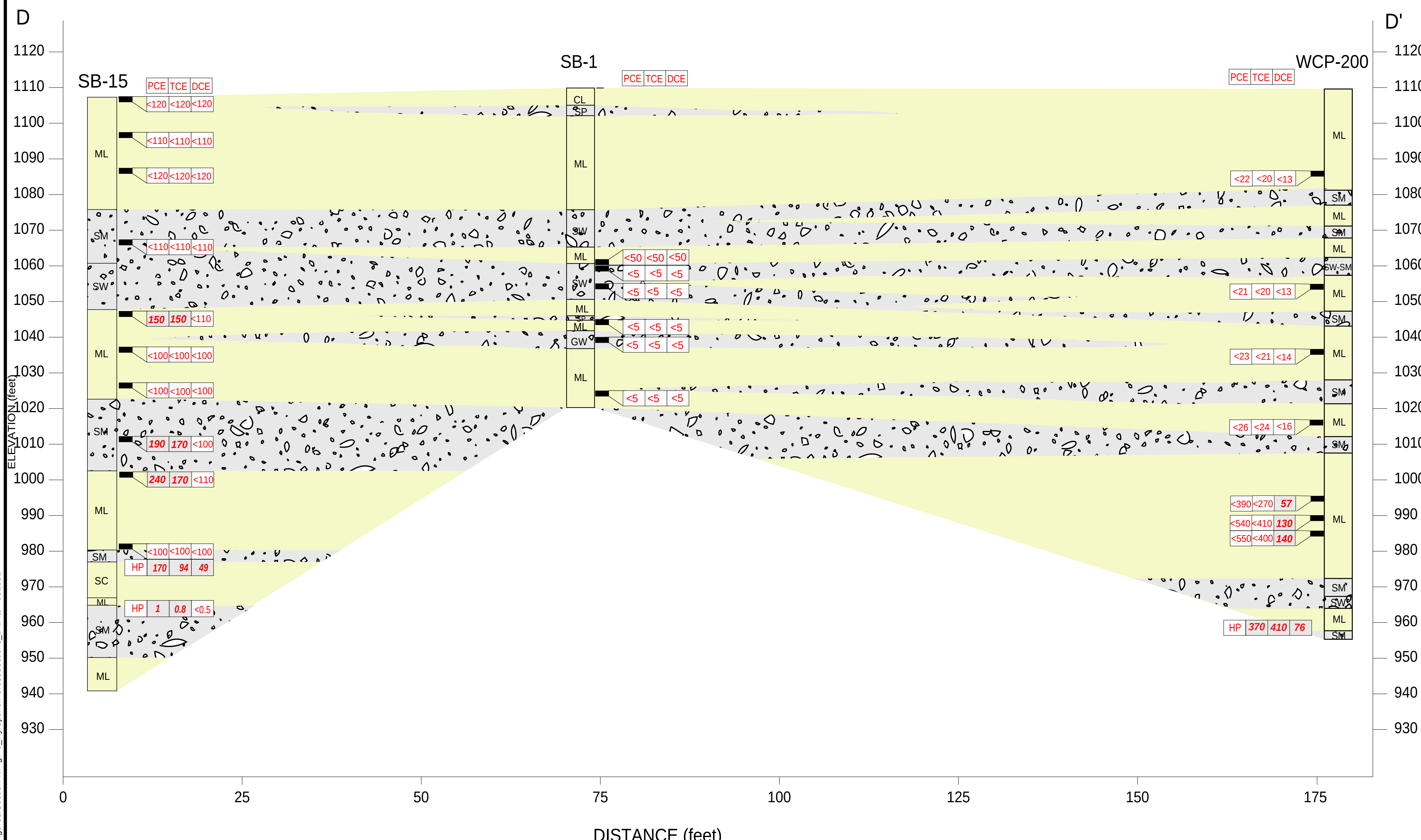

Figure 7-5
Cross Section D-D'
Showing PCE, TCE, and
1,1-DCE Concentrations
in Soil
WCP East Grand Avenue
Remedial Investigation

Legend

Fine-Grained Units (ML, CL, SC)

Coarse-Grained Units (SM, SP, SW)

Soil Sample Depth and Analytical Result (μg/kg)

HP Hydropunch® Sample and Analytical Result (μg/L)

350 Result above analytical method detection limit

NOTE: All well locations and data points are approximate.

Approximate
Vertical Scale
1 inch = 30 feet
0 15 30 60

Approximate
Horizontal Scale
1 inch = 15 feet
0 7.5 15 30

Vertical Exaggeration = 0.5x

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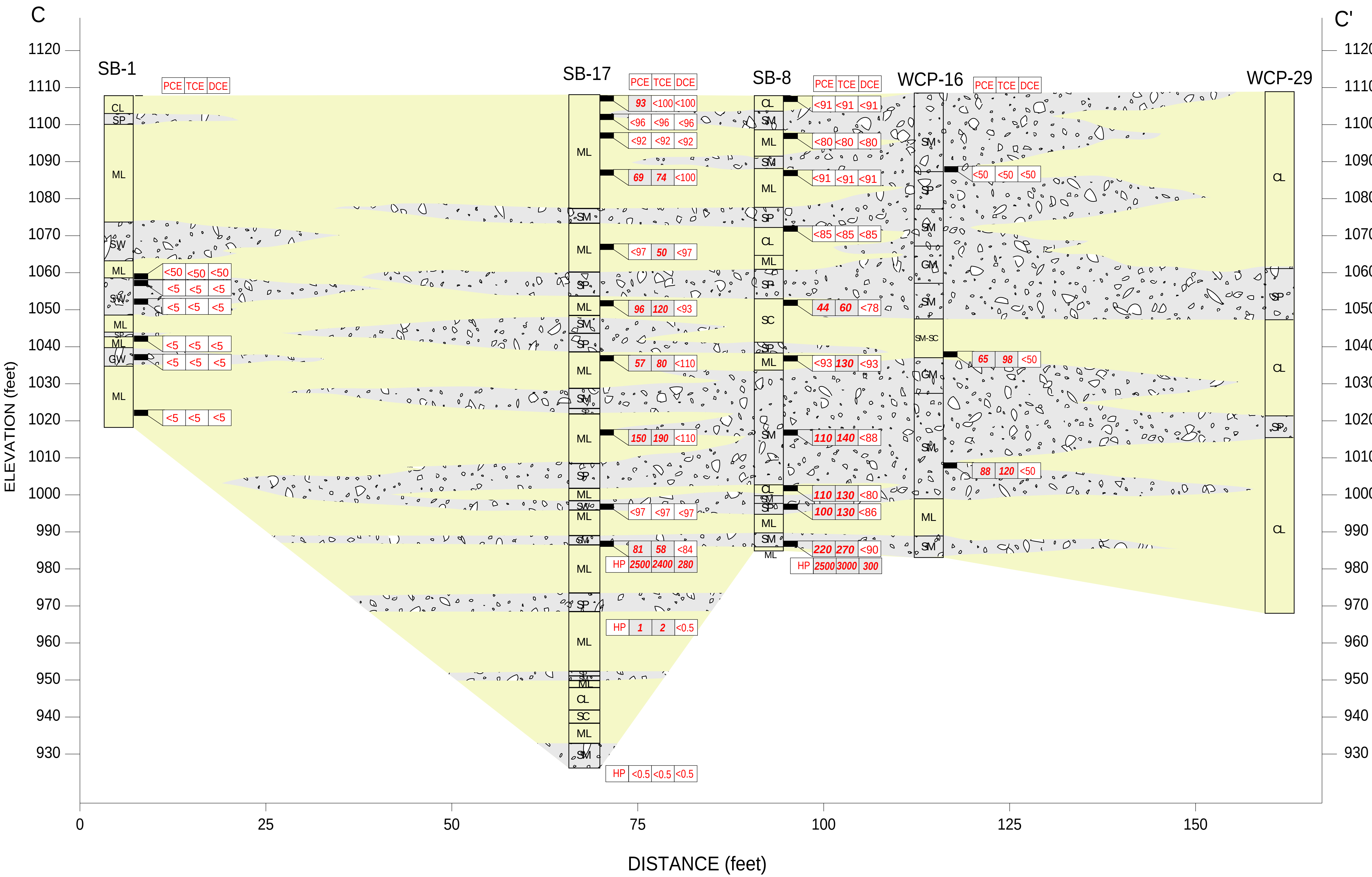
FSPAZ1 H://All/WCP EGA RI/Figures/Section-7/Fig7-5_Hydropunch-CrossSections_D-D'.ai 052902



FSPAZ1 H://All/WCP EGA RI/Figures/Section-7/Fig7-4_Hydropunch-CrossSections_C-C'.ai 052902

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Figure 7-4
Cross Section C-C'
Showing PCE, TCE, and
1,1-DCE Concentrations
in Soil
WCP East Grand Avenue
Remedial Investigation

Legend

Fine-Grained Units (ML, CL, SC)

Coarse-Grained Units (SM, SP, SW)

Soil Sample Depth and Analytical Result (μg/kg)

Hydropunch® Sample and Analytical Result (μg/L)

Result above analytical method detection limit

NOTE: All well locations and data points are approximate.

Approximate
Vertical Scale
1 inch = 30 feet

0 15 30 60

Approximate
Horizontal Scale
1 inch = 15 feet

0 7.5 15 30

Vertical Exaggeration = 0.5x

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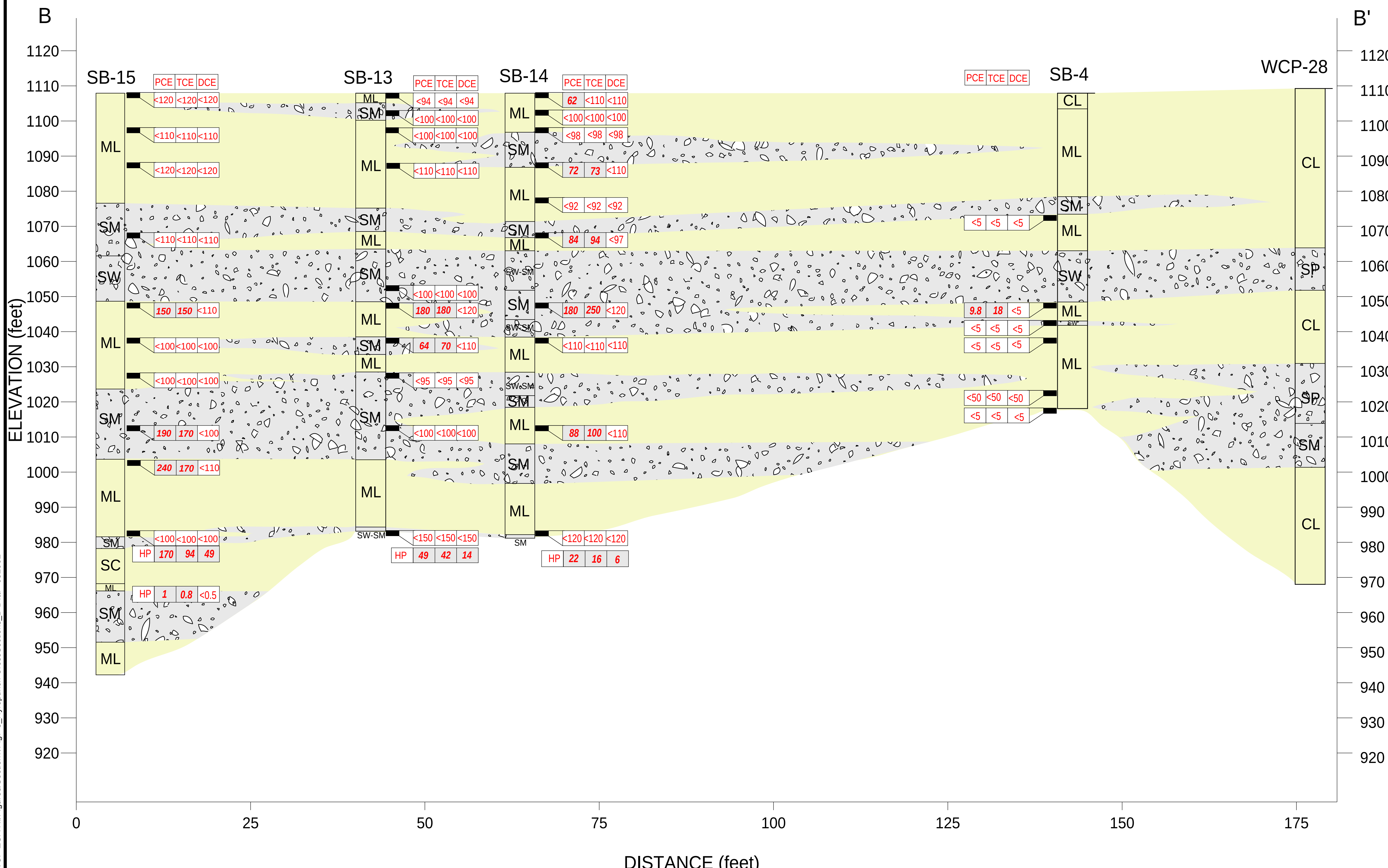

Figure 7-3
Cross Section B-B'
Showing PCE, TCE, and
1,1-DCE Concentrations
in Soil
WCP East Grand Avenue
Remedial Investigation

Legend

- Fine-Grained Units (ML, CL, SC)
- Coarse-Grained Units (SM, SP, SW)
- Soil Sample Depth and Analytical Result (μg/kg)
- Hydropunch® Sample and Analytical Result (μg/L)
- Result above analytical method detection limit

NOTE: All well locations and data points are approximate.

Approximate Vertical Scale
1 inch = 30 feet
0 15 30 60

Approximate Horizontal Scale
1 inch = 15 feet
0 7.5 15 30

Vertical Exaggeration = 0.5x

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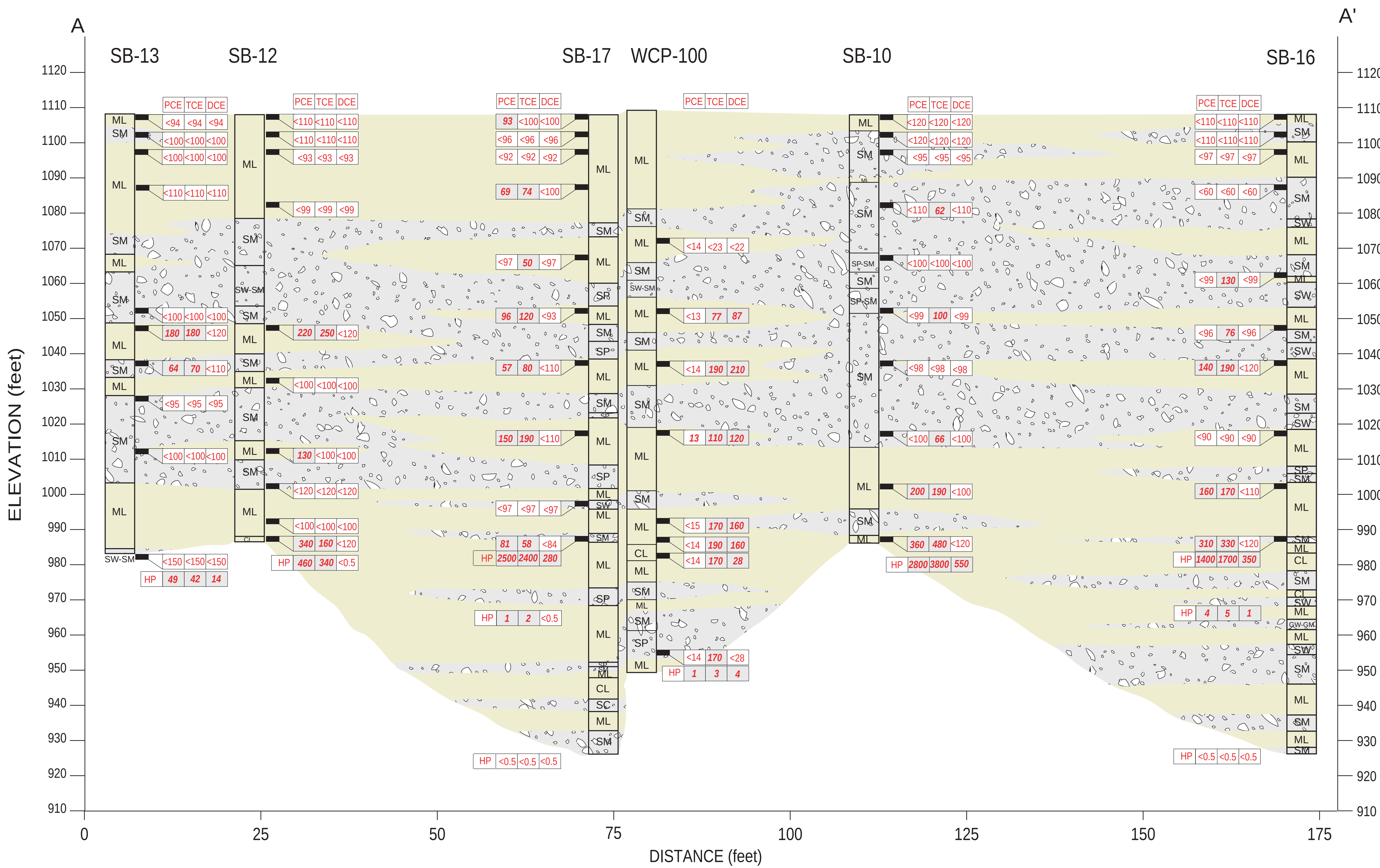

Figure 7-2
Cross Section A-A'
Showing PCE, TCE, and
1,1-DCE Concentrations
in Soil
WCP East Grand Avenue
Remedial Investigation

Legend

Fine-Grained Units (ML, CL, SC)

Coarse-Grained Units (SM, SP, SW)

Soil Sample Depth and Analytical Result (μg/kg)

Hydropunch® Sample and Analytical Result (μg/L)

Result above analytical method detection limit

NOTE: All well locations and data points are approximate.

Approximate Vertical Scale
1 inch = 30 feet

Approximate Horizontal Scale
1 inch = 15 feet

Vertical Exaggeration = 0.5x

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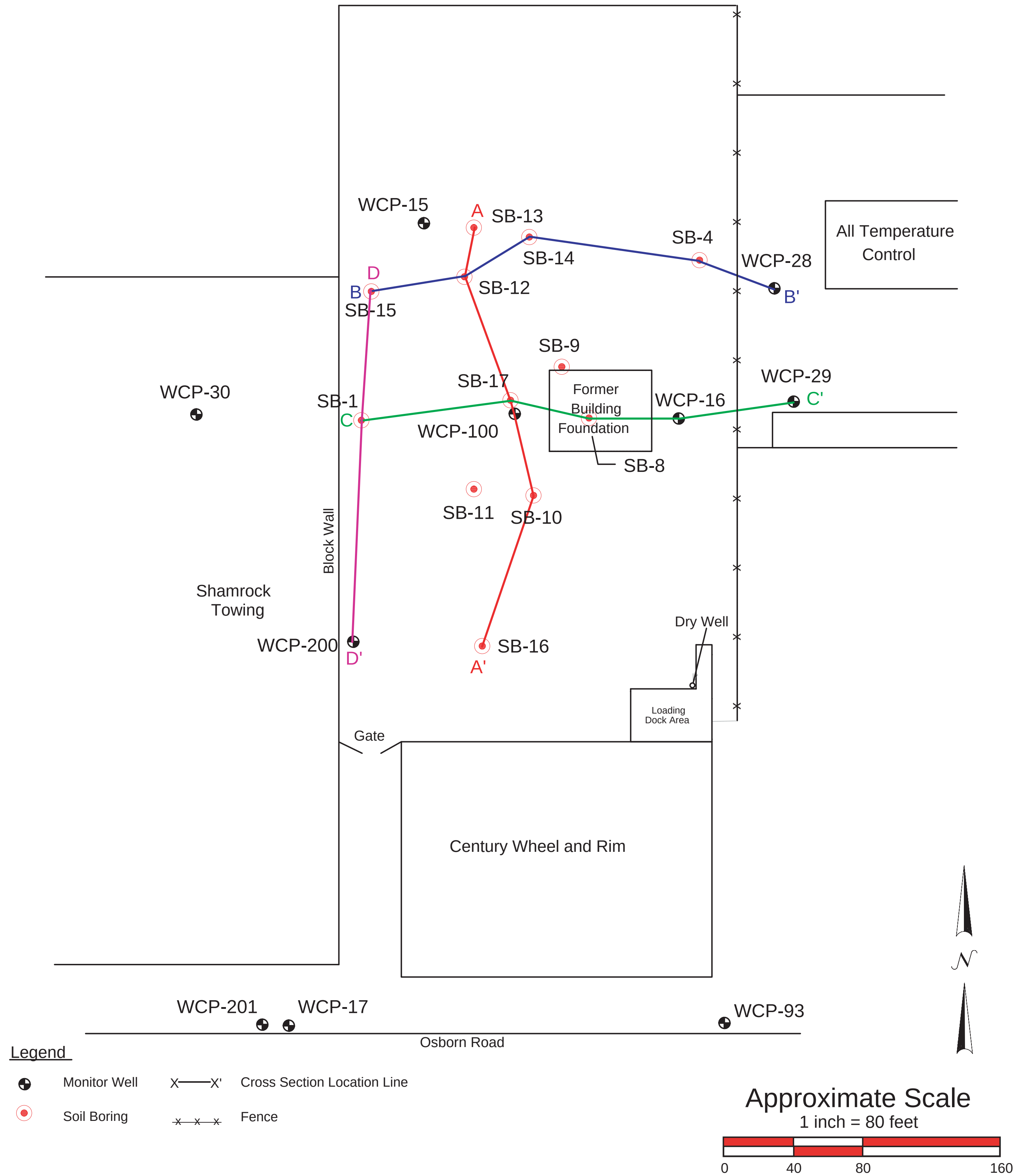

Figure 7-1
Trace of Soil Contaminant Cross Sections
WCP East Grand Avenue WQARF Site

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Table 7-27
Percent Moisture in Soils
WCP East Grand Avenue WQARF Site

Sample ID	Sample Date	Percent Moisture
SB-10-001	9/1/1999	16.0
SB-10-006	9/1/1999	11.8
SB-10-011	9/1/1999	11.8/11.8
SB-10-021	9/1/1999	22.8
SB-10-031	9/1/1999	7.3
SB-10-055	9/1/1999	13.5
SB-10-071	9/1/1999	10.8
SB-10-096	9/1/1999	12.4
SB-10-111	9/1/1999	16.1
SB-10-121	9/1/1999	21.5
SB-11-001	9/2/1999	16.3
SB-11-006	9/2/1999	9.2
SB-11-011	9/2/1999	11.7
SB-11-026	9/2/1999	12.5
SB-11-041	9/2/1999	9.4
SB-11-056	9/2/1999	11.2
SB-11-071	9/2/1999	6.5
SB-11-091	9/2/1999	7.6
SB-11-106	9/2/1999	16.5
SB-11-121	9/2/1999	19.1/19.1
SB-12-001	9/3/1999	14.6
SB-12-006	9/3/1999	16.6
SB-12-011	9/3/1999	10.1
SB-12-026	9/3/1999	11.1
SB-12-061	9/3/1999	23.5
SB-12-076	9/3/1999	12.7
SB-12-096	9/3/1999	13.3
SB-12-106	9/3/1999	22.1
SB-12-116	9/3/1999	16.8
SB-12-121	9/3/1999	22.9/22.9
SB-13-001	9/7/1999	18.5
SB-13-006	9/7/1999	9.6
SB-13-011	9/7/1999	11.3
SB-13-021	9/7/1999	11.9
SB-13-056	9/7/1999	3.1
SB-13-061	9/7/1999	22.7
SB-13-071	9/7/1999	12.8
SB-13-081	9/7/1999	4.3
SB-13-096	9/7/1999	9.7
SB-13-126	9/7/1999	16.3
SB-14-001	9/8/1999	15.8
SB-14-006	9/8/1999	9.4
SB-14-011	9/8/1999	10.3
SB-14-021	9/8/1999	16.3
SB-14-031	9/8/1999	6.3
SB-14-036	9/8/1999	8.6
SB-14-041	9/8/1999	16.4
SB-14-056	9/8/1999	6.1/6.1
SB-14-061	9/8/1999	22.7
SB-14-071	9/8/1999	9.9

Sample ID	Sample Date	Percent Moisture
SB-14-096	9/8/1999	15.7
SB-14-111	9/8/1999	8.2
SB-14-126	9/8/1999	22.4
SB-15-001	9/9/1999	27.0
SB-15-011	9/9/1999	20.2
SB-15-021	9/9/1999	24.0
SB-15-041	9/9/1999	22.9
SB-15-061	9/9/1999	16.8
SB-15-071	9/9/1999	11.2
SB-15-081	9/9/1999	8.0
SB-15-096	9/9/1999	12.8
SB-15-106	9/9/1999	21.4
SB-15-126	9/9/1999	19.1
SB-15-167	9/10/1999	25.7
SB-16-001	9/13/1999	18.3
SB-16-006	9/13/1999	12.8
SB-16-011	9/13/1999	15.9
SB-16-021	9/13/1999	12.3
SB-16-046	9/13/1999	15.8
SB-16-061	9/13/1999	11.5
SB-16-071	9/13/1999	22.8
SB-16-091	9/13/1999	8.9
SB-16-106	9/13/1999	21.1
SB-16-121	9/13/1999	24.8
SB-17-001	9/15/1999	13.6
SB-17-006	9/15/1999	13.1/9.2
SB-17-011	9/15/1999	11.0
SB-17-021	9/15/1999	15.7
SB-17-041	9/15/1999	12.0
SB-17-056	9/15/1999	13.3
SB-17-071	9/15/1999	9.8/14.3
SB-17-091	9/15/1999	14.0
SB-17-106	9/15/1999	15.0
SB-17-111	9/15/1999	13.9
SB-17-120	9/15/1999	11.0
SB-17-136	9/16/1999	22.7
WCP-MW-100-036	11/20/2001	10.0
WCP-MW-100-056	11/20/2001	12.4
WCP-MW-100-071	11/20/2001	13.3
WCP-MW-100-091	11/20/2001	11.6
WCP-MW-100-116	11/20/2001	18.5
WCP-MW-100-121	11/20/2001	14.5/15.3
WCP-MW-100-126	11/20/2001	28.3
WCP-MW-200-026	11/16/2001	13.5
WCP-MW-200-056	11/16/2001	12.0
WCP-MW-200-076	11/16/2001	7.8
WCP-MW-200-096	11/16/2001	9.5
WCP-MW-200-116	11/16/2001	9.4
WCP-MW-200-121	11/16/2001	22.8
WCP-MW-200-126	11/16/2001	24.9

Table 7-27
Percent Moisture in Soils
WCP East Grand Avenue WQARF Site

Sample ID	Sample Date	Percent Moisture
WCP-40-016	9/27/1999	6.0
WCP-40-086	9/27/1999	9.1
WCP-40-121	9/27/1999	24.2
WCP-41-016	9/29/1999	7.2
WCP-41-091	9/29/1999	16.5
WCP-41-116	9/29/1999	17.5
WCP-42-016	10/1/1999	11.9
WCP-42-096	10/1/1999	15.9
WCP-42-111	10/1/1999	25.3
WCP-43-016	10/11/1999	4.9
WCP-43-086	10/11/1999	14.0
WCP-43-116	10/11/1999	20.9
WCP-44-021	11/30/1999	21.6
WCP-44-086	11/30/1999	22.4
WCP-44-121	11/30/1999	18.1
WCP-45-016	10/5/1999	11.2
WCP-45-081	10/5/1999	16.4
WCP-45-121	10/5/1999	21.3
WCP-MW-046-021	12/2/1999	26.0
WCP-MW-046-091	12/2/1999	9.4
WCP-MW-046-116	12/2/1999	20.7
WCP-MW-047-016	1/15/2001	10.7
WCP-MW-047-076	1/15/2001	16.1/11.3
WCP-MW-047-126	1/15/2001	18.3
WCP-MW-083-016	1/22/2001	12.7
WCP-MW-083-091	1/22/2001	12.3
WCP-MW-083-111	1/22/2001	16.5
WCP-MW-084-016	1/24/2001	10.6
WCP-MW-084-086	1/24/2001	19.6
WCP-MW-084-116	1/24/2001	20.7
WCP-MW-085-021	1/8/2001	2.9
WCP-MW-085-086	1/8/2001	17.8
WCP-MW-085-121	1/8/2001	10.4
WCP-MW-086-016	1/10/2001	13.7
WCP-MW-086-071	1/10/2001	22.2
WCP-MW-086-086	1/10/2001	11.3
WCP-MW-086-126	1/10/2001	19.1
WCP-MW-087-016	1/26/2001	9.5/17.5
WCP-MW-087-081	1/26/2001	8.1
WCP-MW-088-016	1/30/2001	25.6
WCP-MW-088-081	1/30/2001	16.1/15.3
WCP-MW-088-121	1/30/2001	22.6
WCP-MW-089-016	2/1/2001	22.2
WCP-MW-089-081	2/1/2001	19.1
WCP-MW-089-116	2/1/2001	15.9
WCP-MW-089-126	2/1/2001	23.0
WCP-MW-090-016	1/17/2001	16.3
WCP-MW-090-086	1/18/2001	15.2
WCP-MW-092-016	7/16/2001	13.0

Sample ID	Sample Date	Percent Moisture
WCP-MW-092-081	7/16/2001	19.4
WCP-MW-092-121	7/16/2001	17.4/17.1
WCP-MW-093-016	7/24/2001	9.5
WCP-MW-093-076	7/24/2001	17.4
WCP-MW-093-121	7/24/2001	23.8
WCP-MW-093-126	7/24/2001	21.4/21.4
WCP-MW-094-021	7/18/2001	13.5
WCP-MW-094-081	7/18/2001	12.2
WCP-MW-094-126	7/18/2001	17.9
WCP-MW-095-016	7/5/2001	1.6/2.5
WCP-MW-095-091	7/5/2001	16.4
WCP-MW-095-111	7/5/2001	21.0
WCP-MW-095-56	7/5/2001	3.1
WCP-MW-097-016	7/2/2001	7.8
WCP-MW-097-086	7/2/2001	15.4/18.3
WCP-MW-098-021	7/10/2001	18.4
WCP-MW-098-056	7/10/2001	15.0
WCP-MW-098-086	7/10/2001	13.9
WCP-MW-098-121	7/10/2001	21.0
WCP-MW-099-026	11/14/2001	18.7
WCP-MW-099-071	11/14/2001	12.4
WCP-MW-099-116	11/14/2001	12.1
WCP-MW-202-021	12/4/2001	16.1
WCP-MW-202-081	12/4/2001	16.5/16.0
WCP-MW-203-021	12/17/2001	5.3
WCP-MW-203-056	12/17/2001	6.1/9.1
WCP-MW-203-111	12/17/2001	18.6
WCP-MW-204-016	11/28/2001	10.4
WCP-MW-204-056	11/28/2001	12.1
WCP-MW-204-096	11/28/2001	15.6
WCP-MW-204-116	11/28/2001	12.2
WCP-SB-048-121	6/14/2000	29.6
WCP-SB-048-161	6/14/2000	14.3
WCP-SB-048-196	6/15/2000	26.0
WCP-SB-048-221	6/15/2000	16.4
WCP-SB-048-241	6/16/2000	18.7
WCP-SB-048-276	6/16/2000	28.8
WCP-SB-048-301	6/17/2000	18.7/18.7
WCP-MW-201-016	11/30/2001	11.9
WCP-MW-201-076	11/30/2001	16
WCP-MW-201-121	11/30/2001	25
WCP-MW-201-126	11/30/2001	21.1

Notes:

All borings listed on Page 1 were drilled on the VW&R facility.

Two results indicate duplicate sample results.

Samples analyzed by Severn Trent Laboratories.

Table 7-26
Passive Diffusion Bag Samples Vs. Pump Discharge Samples
Round 12 - September 2001
WCP East Grand Avenue WQARF Site Groundwater Sampling

Well	Depth to Water [1] (ft bgs)	Sample Type	Sample Depth[2] (ft bgs)	PCE (μg/L)	TCE (μg/L)	1,1-DCE (μg/L)	Acetone (μg/L)
WCP-16	123.22	PDB	123.00	300	420	73	32
		Pump Sample	125.00	130	180	35	<2
		Pump Duplicate	125.00	110	160	39	<2
WCP-17	121.40	PDB	122.68	58	190	57	26
		Pump Sample	124.00	36	120	32	<2
WCP-28	123.14	PDB-shallow	124.31	77	74	25	28
		Pump Sample	128.14	7	10	2	<2
		PDB-deep	136.00	<0.5	1.1	<1.0	25
WCP-29	123.06	PDB-shallow	124.22	34	46	11	29
		Pump Sample	128.06	8	12	3	<2
		Pump Duplicate	128.06	7	12	3	<2
		PDB-deep	136.00	<0.5	1.1	<1.0	24
WCP-85	120.65	PDB-shallow	122.81	<0.5	1.1	<1.0	32
		Pump Sample	125.65	<0.2	2	<0.2	<2
		PDB-deep	146.50	<0.5	2.4	<1.0	32
WCP-87	123.08	PDB-shallow	124.27	63	37	29	57
		Pump Sample	128.08	49	39	37	<2
		PDB-deep	149.00	86	50	42	45
WCP-88	122.48	PDB-shallow	123.72	<0.5	14	<1.0	25
		Pump Sample	127.58	0.5	33	0.2	<2
		PDB-deep	146.50	<0.5	14	<1.0	22
WCP-93	121.67	PDB-shallow	122.70	150	500	84	45
		Pump Sample	126.67	230	800	130	<2
		PDB-deep	145.50	370	990	140	43
WCP-94	121.62	PDB-shallow	122.88	<0.5	11	<1.0	46
		Pump Sample	126.62	<0.2	11	0.4	<2
		PDB-deep	146.50	<0.5	6.3	<1.0	52

Notes:
(1) Depth-to-water measurements indicate level on day of sampling.
ft bgs = feet below ground surface
(2) Sample depth indicates the pump depth or depth at which PDB was installed.
μg/L = micrograms per liter

Table 7-25
Groundwater Sampling Field Data
WCP East Grand Avenue WQARF Site Remedial Investigation

Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (μS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)
ENT-MW-2	NA	10/14/1999	3 CV	Bailer	NA	117.41	31.8	2636	Clear	5.29	NA	NA
	3	3/10/2000	Low Flow	Bailer and Pump	126	117.4	30.37	2172	6	6.97	30.7	-101
	4	6/12/2000	Low Flow	Pump	NA	117.91	30.54	1809	5.1	6.9	27.02	-239.9
	5	9/19/2000	Low Flow	Pump	126	119.64	29.6	3100	11	6.99	0.36	-278
	6	12/8/2000	Low Flow	Pump	126	122.74	28.34	2780	14.9	6.88	1.6	281
	7	3/6/2001	Low Flow	Pump	126	120.33	30.39	2830	0	7.02	2.58	-282
	8	5/2/2001	Low Flow	Pump	126.25	121.25	34.5	2800	0	7.03	1.52	-259
	9	6/15/2001	Low Flow	Pump	125.55	120.55	33.8	2700	0	6.82	1.69	-264
	10	6/29/2001	3 CV	Pump	130.65	120.65	29.57	2950	NA	6.64	1.9	-266
	11	8/15/2001	Low Flow	Pump	126.87	121.87	38.35	2780	0	7.03	1.49	-239
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MGL-1	8	5/2/2001	Low Flow	Pump	122.17	117.17	30.9	2100	0	7.19	3.01	66
	9	6/14/2001	Low Flow	Pump	120.95	115.95	33.34	2000	0	7.12	3.32	76
	10	6/28/2001	3 CV	Pump	124	116.18	25.7	2420	85	6.77	2.76	172
	11	8/7/2001	Low Flow	Pump	122.23	117.23	32.92	2040	0	7.34	3.03	89
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	11/5/2001	3 CV	Pump	124	119.23	34.57	1790	3	7.42	1.46	133.8
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MGL-2	8	5/3/2001	Low Flow	Pump	122.69	117.69	29	2200	32	7.19	2.63	69
	9	6/14/2001	Low Flow	Pump	121.4	116.4	31.07	2000	0	7.11	2.78	55
	10	6/28/2001	3 CV	Pump	124	116.68	24.76	2240	0	6.81	0.97	373
	11	8/7/2001	Low Flow	Pump	122.73	117.73	28.3	1930	0	7.35	2.98	98
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13*	11/6/2001	3 CV	Pump	124	119.75	30.47	1900	1687	7.14	6.97	18.7
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MGL-3	8	5/2/2001	Low Flow	Pump	123.03	118.03	29.9	2200	12	7.15	3.39	47
	9	6/14/2001	Low Flow	Pump	123	116.84	30.34	2100	0	7.15	4.65	117
	10	6/28/2001	3 CV	Pump	124.5	117.11	24.66	2460	200	6.87	4.21	250
	11	8/8/2001	Low Flow	Pump	123.2	118.2	29.55	2230	0	7.31	3.88	69

Table 7-25
Groundwater Sampling Field Data
WCP East Grand Avenue WQARF Site Remedial Investigation

Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (μS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)
MGL-3	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	11/6/2001	3 CV	Pump	124.5	120.2	28.35	1940	14.5	7.36	3.73	230.1
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MWB-4	1	12/29/1999	Low Flow	Bailer	124	118.33	30.2	1396	36	7.22	12.66	26
	2	2/2/2000	Low Flow	Pump	124	118.25	29.83	1884	32.8	7.3	4.44	126.6
	3	3/8/2000	Low Flow	Bailer and Pump	126	117.98	28.58	1449	21	7.3	38	96.4
	4	6/6/2000	Low Flow	Pump	124	118.57	33.5	1498	12	7.2	5.88	483.2
	5	9/14/2000	Low Flow	Pump	124	120.89	31.2	2020	56	7.3	6.11	99
	6	12/5/2000	Low Flow	Pump	124	121.72	27.52	1850	-10	7.15	4.92	45
	7	2/28/2001	Low Flow	Pump	127	120.95	29.84	2010	>999	7.89	6.08	209
	8	4/25/2001	Low Flow	Pump	124.82	121.82	32.9	1800	1000	7.86	7.97	202
	9	6/7/2001	Low Flow	Pump	126.37	121.37	32.6	1700	64.2	7.38	6.96	287
	10	6/20/2001	3 CV	Pump	129	121.7	32.69	1800	0	7.2	5.95	227
	11	7/30/2001	Low Flow	Pump	125.45	122.45	32.4	1680	>1000	8.13	5.95	151
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13*	10/30/2001	3 CV	Pump	124.67	126.3	34.47	1640	335	8.13	6.22	108
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MWB-5	1	12/28/1999	Low Flow	Bailer	125	118.67	27.1	1232	8.8	7.28	10.32	-22.2
	2	2/2/2000	Low Flow	Pump	125	118.58	26.1	1479	4	7.25	3.52	108.6
	3	3/8/2000	Low Flow	Bailer and Pump	NA	118.33	27.1	1244	9	7.3	4.57	46.3
	4	6/6/2000	Low Flow	Pump	125	118.86	27.3	1256	9	7.09	6.02	455.8
	5	9/13/2000	Low Flow	Pump	125	121.15	29.8	1700	51	7.41	5.9	112
	6	12/5/2000	Low Flow	Pump	125	122.04	25.43	1790	-10	7.14	5.19	57
	7	3/1/2001	Low Flow	Pump	125	121.23	28.04	1900	0	7.28	6.38	246
	8	4/24/2001	Low Flow	Pump	127.23	122.23	29.3	1900	0	7.11	6.2	103
	9	6/7/2001	Low Flow	Pump	126.65	121.65	29.52	1800	0	7.06	5.62	150
	10	6/20/2001	3 CV	Pump	129	121.95	27.81	1900	0	6.93	4.93	116
	11	8/6/2001	Low Flow	Pump	128.2	123.2	35.36	1680	38	7.28	6.3	186
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	11/2/2001	3 CV	Pump	129	125	29.27	1870	0	7.28	5.24	253.7
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 7-25
Groundwater Sampling Field Data
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Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (μS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)
MWB-5	15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MWB-6	1	12/28/1999	Low Flow	Bailer	124	119.3	30	3157	5.9	6.93	4.64	46.2
	2	2/2/2000	Low Flow	Pump	125	119.04	28.82	2224	2.1	6.93	3.19	143.9
	3	3/8/2000	Low Flow	Bailer and Pump	NA	118.94	30.1	1540	3	6.89	3.28	47.6
	4	6/8/2000	Low Flow	Pump	125	119.24	30.7	1817	2	6.85	9.46	492.7
	5	9/13/2000	Low Flow	Pump	125	121.44	33.2	2490	9	7.06	2.81	114
	6	12/5/2000	Low Flow	Pump	125	122.52	28.3	2270	-10	6.82	4.14	93
	7	3/1/2001	Low Flow	Pump	125	121.31	25.88	2280	132	7.9	7.51	233
	8	4/25/2001	Low Flow	Pump	127.11	122.11	31	2100	122	7.94	7.23	311
	9	6/8/2001	Low Flow	Pump	127.25	122.25	31.44	2200	0	7.32	6.87	319
	10	6/20/2001	3 CV	Pump	129	122.4	35.05	2100	0	7.27	5.34	192
	11	7/31/2001	Low Flow	Pump	127.8	122.79	34.35	1990	107	8	5.5	104
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	10/30/2001	3 CV	Pump	128	125.01	32.34	1800	587.8	8.1	5.81	-53.2
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15*	1/24/2002	3 CV	Pump	128.5	125.92	27.89	1800	54.4	7.8	6.47	145.7
MWB-14	13	11/8/2001	3 CV	Pump	131.86	121.86	26.6	1940	86	7.24	7.63	230
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/21/2002	3 CV	Pump	132.18	122.18	25.32	1910	44.4	7.35	7.26	191
WCP-15	1	12/29/1999	Low Flow	Bailer	123	117.38	25.2	1128	4	7.51	12.8	-58.9
	2	2/2/2000	Low Flow	Bailer and Pump	122	117.36	25.2	1490	4	7.45	4.25	144.7
	3	3/10/2000	Low Flow	Bailer and Pump	122	116.74	26.4	1220	4	7.56	5.75	28.4
	4	6/8/2000	Low Flow	Pump	122	117.65	27.3	1366	3	7.31	6.09	488.1
	5	9/18/2000	Low Flow	Pump	122	120.19	26.2	1690	25	7.55	7.7	38
	6	12/6/2000	Low Flow	Pump	123	120.98	25.8	1860	-10	7.29	5.79	26
	7	3/2/2001	Low Flow	Pump	122	119.87	27.48	2100	0	7.4	5.74	110
	8	4/30/2001	Low Flow	Pump	124	121.11	30.07	2000	0	7.17	9.44	150
	9	6/13/2001	Low Flow	Pump	124	121.00	31.1	1900	0	7.1	5.59	247
	10	6/27/2001	3 CV	Pump	124	121.49	23.92	2300	0	6.9	NA	192
	11	8/14/2001	Low Flow	Pump	123.6	122.92	29.38	2020	27	7.36	5.61	98
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

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Groundwater Sampling Field Data
WCP East Grand Avenue WQARF Site Remedial Investigation

Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (μS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)
WCP-15	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
WCP-16	1	12/29/1999	Low Flow	Bailer	123	116.77	25	1970	5	7.59	2.11	143
	2	2/2/2000	Low Flow	Bailer and Pump	123	116.54	26.71	1529	8.2	7.59	3.85	143.6
	3	3/10/2000	Low Flow	Bailer and Pump	123	115.83	27.61	1311	30	7.55	36.5	103
	4	6/9/2000	Low Flow	Pump	123	116.97	26.3	1359	4	7.64	10.38	350.9
	5	9/18/2000	Low Flow	Pump	123	119.36	25.3	1700	79	7.55	7.77	39
	6	12/16/2000	Low Flow	Pump	123	120.28	24.73	1780	15.9	7.46	5.64	76
	7	3/2/2001	Low Flow	Pump	123	119.15	25.99	1940	0	7.53	6.18	140
	8	4/30/2001	Low Flow	Pump	123	120.3	29.01	1900	0	7.23	9.37	177
	9	6/13/2001	Low Flow	Pump	123	120.19	28.9	1800	0	7.15	5.8	282
	10	6/26/2001	3 CV	Pump	125	120.63	23.63	2220	0	7.01	NA	155
	11	8/14/2001	Low Flow	Pump	124	122.1	26.8	1920	18	7.45	5.88	113
	12	9/24/2001	Low Flow	Pump	125	123.22	26.86	4970	74.5	7.43	10.43	226
	13	11/8/2001	3 CV	Pump	125.9	123.61	27.2	1730	2.5	7.48	76	226
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
WCP-17	1	12/29/1999	Low Flow	Bailer	122	116.12	27.2	1423	9	7.32	12.23	-70.2
	2	2/1/2000	Low Flow	Bailer and Pump	122	116.08	29	1764	28	7.64	4.83	155.7
	3	3/9/2000	Low Flow	Bailer and Pump	NA	115.32	28.6	1439	20	7.39	6.31	43.9
	4	6/7/2000	Low Flow	Pump	122	116.05	35.3	1830	18	7.39	12.66	454.4
	5	9/15/2000	Low Flow	Pump	122	118.15	33.8	3230	113	7.26	8.72	120
	6	12/6/2000	Low Flow	Pump	122	119.31	28.81	2900	-10	7.17	6.26	50
	7	2/28/2001	Low Flow	Pump	122	118.8	24.66	2430	48	7.35	7.16	203
	8	4/30/2001	Low Flow	Pump	121.5	119.64	32.22	2400	56	7.18	11.29	179
	9	6/12/2001	Low Flow	Pump	121.5	119.05	33.3	2900	0	7.08	6.01	119
	10	6/26/2001	3 CV	Pump	124	119.45	29.92	3110	9.1	6.87	NA	99
	11	8/14/2001	Low Flow	Pump	123	120.5	32.86	2880	86	7.27	5.93	144
	12	9/21/2001	Low Flow	Pump	124	121.4	33.24	7350	40.5	7.24	10.83	232
	13*	11/8/2001	3 CV	Pump	124.9	122.23	31.87	2500	92	7.24	6.62	175
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
WCP-17	15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

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WCP East Grand Avenue WQARF Site Remedial Investigation

Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (μS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)
WCP-28	1	12/30/1999	Low Flow	Bailer	129.5	116.81	24.5	1289	8	7.48	6.65	-46.4
	2	2/3/2000	Low Flow	Bailer and Pump	134.5	116.64	24.3	1543	5	7.35	4.48	114.9
	3	3/9/2000	Low Flow	Bailer and Pump	134.5	115.81	24.6	1375	7.5	7.49	5.32	-4.9
	4	6/8/2000	Low Flow	Pump	129.5	116.9	24.8	1525	8	7.57	5.18	361.3
	5	9/18/2000	Low Flow	Pump	129.5	119.4	25	1790	61	7.6	8.25	58
	6	12/7/2000	Low Flow	Pump	129.5	120.27	24.7	2070	3	7.41	5.35	37
	7	3/1/2001	Low Flow	Pump	129.5	119.2	24.73	2300	0	7.42	7.06	189
	8	4/30/2001	Low Flow	Pump	125.44	120.44	28.74	2100	0	7.36	10.62	136
	9	6/12/2001	Low Flow	Pump	125.27	120.27	26.83	2000	0	7.13	6.49	217
	10	6/26/2001	3 CV	Pump	130.67	121.67	23.65	2330	0	7.02	NA	184
	11	8/8/2001	Low Flow	Pump	126.98	121.98	25.91	2070	0	7.47	6.84	131
	12	9/20/2001	Low Flow	Pump	128.14	123.14	25.35	5410	32.6	7.46	15.3	188
	13	11/5/2001	3 CV	Pump	133.55	123.55	25.36	1870	0	7.53	7.05	259
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/22/2002	3 CV	Pump	133.36	123.36	23.49	1850	0	7.48	6.88	170.2
WCP-29	1	12/30/1999	Low Flow	Bailer	129.5	116.85	23.84	2510	3.7	7.63	2.35	132.8
	2	2/3/2000	Low Flow	Bailer and Pump	129	116.48	25.34	1468	13	7.69	3.45	145.5
	3	3/9/2000	Low Flow	Bailer and Pump	129	115.65	25.19	1615	3	7.56	16.13	126.2
	4	6/8/2000	Low Flow	Pump	129.5	116.81	25.1	1394	1.6	7.47	3.52	444.7
	5	9/18/2000	Low Flow	Pump	129.5	119.36	26.2	1660	91	7.48	7.87	105
	6	12/7/2000	Low Flow	Pump	129.5	120.21	24.6	1930	2	7.41	5.55	43
	7	3/1/2001	Low Flow	Pump	129.5	119.15	24.51	2140	0	7.53	7.28	185
	8	4/30/2001	Low Flow	Pump	125.35	120.35	28.58	2000	0	7.31	10.7	157
	9	6/12/2001	Low Flow	Pump	125.18	120.18	27.23	1900	0	7.16	6.61	249
	10	6/26/2001	3 CV	Pump	130.58	120.58	23.5	2150	0	6.96	NA	194
	11	8/8/2001	Low Flow	Pump	126.91	121.91	26.08	1890	0	7.48	6.53	151
	12	9/20/2001	Low Flow	Pump	128.06	123.06	25.64	4930	25.6	7.47	14.98	218
	13	11/5/2001	3 CV	Pump	133.48	123.48	25.03	1720	0	7.54	7.44	275.9
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/22/2002	3 CV	Pump	133.27	123.27	23.47	1700	0	7.49	6.96	171.8

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Groundwater Sampling Field Data
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Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (µS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)
WCP-30	1	12/30/1999	Low Flow	Bailer	129	118.39	25.1	2110	10	7.71	1.96	138.8
	2	2/3/2000	Low Flow	Bailer and Pump	134.5	118.25	26.3	1210	18	7.78	3.46	160
	3	3/10/2000	Low Flow	Bailer and Pump	134.5	117.64	27.4	1126	13	7.66	5.59	-16.8
	4	6/9/2000	Low Flow	Pump	134.5	118.77	25.6	1216	2	7.66	7.75	464.8
	5	9/19/2000	Low Flow	Pump	134.5	121.39	26.1	1580	54	7.53	6.88	55
	6	12/7/2000	Low Flow	Pump	134.5	121.96	25.1	1840	0	7.47	5.27	38
	7	3/2/2001	Low Flow	Pump	134.5	120.89	24.85	1940	0	7.67	6.18	98
	8	5/1/2001	Low Flow	Pump	127.13	122.13	28.9	1900	0	7.45	6.86	232
	9	6/13/2001	Low Flow	Pump	126.97	121.97	28.61	1700	0	7.33	5.86	222
	10	6/27/2001	3 CV	Pump	132.47	124.47	23.78	2180	0	7.05	4.51	147
	11	8/15/2001	Low Flow	Pump	128.98	123.98	26.32	1800	0	7.4	5.72	152
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	11/9/2001	3 CV	Pump	135.47	125.47	24.84	1800	0	7.53	6.66	232
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/24/2002	3 CV	Pump	135.2	125.2	23.61	1770	0	7.52	6.29	161.6
WCP-40	1	12/27/1999	Low Flow	Bailer	128	116.94	24.95	1529	5	7.47	7.54	-25.7
	2	1/31/2000	Low Flow	Pump	128	116.77	25.9	1470	21	7.22	6.84	127.6
	3	3/7/2000	Low Flow	Bailer and Pump	130	115.94	25.5	1401	56	7.49	5.82	74.7
	4	6/5/2000	Low Flow	Pump	128	116.8	26.6	1636	28	7.19	8.24	461.7
	5	9/12/2000	Low Flow	Pump	128	119.18	26	1920	>990	7.37	7.92	67
	6	12/4/2000	Low Flow	Pump	128	120.39	25.83	2100	-10	7.22	7.49	51
	7	2/22/2001	Low Flow	Pump	128	119.5	25.03	2240	0	7.38	6.14	84
	8	4/23/2001	Low Flow	Pump	124	119.01	29.6	2200	26.2	7.37	7.51	139
	9	6/5/2001	Low Flow	Pump	125.15	120.15	29.1	2100	0	7.43	5.38	159
	10	6/18/2001	3 CV	Pump	130.49	120.49	26.95	2200	0	6.9	6.25	112
	11	7/31/2001	Low Flow	Pump	126.84	121.84	26.48	1930	116	7.52	7.12	103
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	10/29/2001	3 CV	Pump	133.47	123.47	27.3	1630	7.3	7.57	6.93	170
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/10/2002	3 CV	Pump	133.46	123.46	24.02	1870	6.5	7.37	6.67	91.7
WCP-41	1	12/29/1999	Low Flow	Bailer	134.5	115.62	25.51	1874	3.1	7.74	2.73	139.4
	2	1/31/2000	Low Flow	Pump	134	115.47	25.1	1052	5	7.56	5.95	131.2

Table 7-25
Groundwater Sampling Field Data
WCP East Grand Avenue WQARF Site Remedial Investigation

Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (µS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)
WCP-41	3	3/8/2000	Low Flow	Bailer and Pump	134.5	114.48	25.93	1117	1.5	7.71	35.9	93.1
	4	6/6/2000	Low Flow	Pump	134	115.37	27.4	1205	30	7.07	8.05	517.9
	5	9/13/2000	Low Flow	Pump	134	117.85	25.8	1660	260	7.67	6.19	74
	6	12/5/2000	Low Flow	Pump	134	118.96	24.64	1740	-10	7.45	5.48	52
	7	2/27/2001	Low Flow	Pump	134	118.04	24.37	1700	0	7.66	6.25	204
	8	4/27/2001	Low Flow	Pump	123.99	118.99	29.05	1700	49	7.37	10.73	283
	9	6/12/2001	Low Flow	Pump	123.81	118.81	28.11	1800	0	7.37	5.53	196
	10	6/21/2001	3 CV	Pump	129.12	119.12	23.73	1920	18.7	7.3	12.77	92
	11	8/2/2001	Low Flow	Pump	125.38	120.38	27.8	1970	12	7.5	7.03	108
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	11/1/2001	3 CV	Pump	132.18	122.18	25.39	1670	0	7.65	6	219.7
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/22/2002	3 CV	Pump	132.07	122.07	23.42	1550	0	7.67	5.76	159.5
WCP-42	1	12/27/1999	Low Flow	Bailer	135	117.93	23.52	1817	16.8	7.53	6.78	99
	2	1/31/2000	Low Flow	Pump	134	117.68	24.15	3189	42.8	7.46	2.57	84.7
	3	3/7/2000	Low Flow	Bailer and Pump	133	117.38	25.6	1324	23	7.57	6.23	44.3
	4	6/5/2000	Low Flow	Pump	134	118.18	25.3	1586	27	6.74	11.71	523.3
	5	9/12/2000	Low Flow	Pump	134	120.62	25.9	2010	310	7.52	7.74	36
	6	12/4/2000	Low Flow	Pump	134	121.39	24.14	2150	13	7.33	7.02	23
	7	2/22/2001	Low Flow	Pump	134	120.51	24.75	2280	0	7.38	5.31	71
	8	4/23/2001	Low Flow	Pump	126.55	121.55	26.9	2000	18.7	7.53	8.52	90
	9	6/5/2001	Low Flow	Pump	126.37	121.37	27.66	2100	0	7.67	5.43	112
	10	6/18/2001	3 CV	Pump	131.69	121.69	25.06	2200	0	7.09	5.91	101
	11	7/30/2001	Low Flow	Pump	128.15	123.13	24	2050	720	7.64	6.97	102
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	10/29/2001	3 CV	Pump	134.17	124.17	26.01	1840	0	7.65	6.65	178.2
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/10/2002	3 CV	Pump	134.62	124.62	23.05	1970	2.3	7.43	7.21	87.2
WCP-43	1	12/27/1999	Low Flow	Bailer	130	116.42	25.69	1668	15.2	7.51	6.2	71.8
	2	1/31/2000	Low Flow	Pump	134	116.36	25.77	2590	19.9	7.46	3.02	177.1
	3	3/7/2000	Low Flow	Bailer and Pump	134	114.97	24.58	1460	21	7.49	39	125.6
	4	6/5/2000	Low Flow	Pump	134	115.94	25.4	1188	19	7.16	7.9	480.5

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Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (µS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)
WCP-43	5	9/12/2000	Low Flow	Pump	134	118.22	25.1	1500	300	7.49	7.48	37
	6	12/4/2000	Low Flow	Pump	134	119.59	26.08	1830	-2	7.36	7.16	24
	7	2/22/2001	Low Flow	Pump	134	119.18	25.14	2040	0	7.3	6.65	86
	8	4/24/2001	Low Flow	Pump	124.86	119.86	28	2000	0	7.24	6.84	118
	9	6/6/2001	Low Flow	Pump	124.64	119.64	29.81	2000	0	7.21	6.3	177
	10	6/19/2001	3 CV	Pump	129.97	119.97	25.9	1700	0	6.91	5.57	116
	11	8/1/2001	Low Flow	Pump	126.27	121.27	26.98	1650	32	7.38	7.74	124
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	10/31/2001	3 CV	Pump	132.84	122.82	25.71	1590	0	7.33	6.65	205
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/22/2002	3 CV	Pump	133.04	123.04	23.63	1530	2.1	7.32	6.29	136.1
WCP-44	1	12/29/1999	Low Flow	Bailer	137	117.00	27.31	4650	10	6.95	0.62	50.1
	2	2/1/2000	Low Flow	Pump	138	116.95	27.4	2697	29	6.92	0.26	47.1
	3	3/9/2000	Low Flow	Bailer and Pump	136	116.67	29.3	3200	6	6.92	36.7	23.6
	4	6/12/2000	Low Flow	Bailer	NA	117.09	29.17	2506	6	6.81	3.54	-187.6
	5	9/19/2000	Low Flow	Pump	138	118.88	30.4	4060	26	6.9	0.48	-196
	6	12/8/2000	Low Flow	Pump	138	120.11	29.68	3510	35.1	6.8	1.7	251
	7	3/6/2001	Low Flow	Pump	138	119.69	29.87	3790	0	6.87	2.4	-227
	8	5/2/2001	Low Flow	Pump	125.6	120.6	31.5	3700	0	6.91	1.95	-201
	9	6/15/2001	Low Flow	Pump	124.86	119.86	31.95	3600	0	6.66	1.74	-216
	10	6/29/2001	3 CV	Pump	130.01	120.01	28.19	3830	29	6.6	3	-225
	11	8/15/2001	Low Flow	Pump	126.07	121.07	35.65	3620	0	6.9	1.63	-206
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
WCP-45	1	12/28/1999	Low Flow	Bailer	NA	117.67	25.17	1589	40.6	7.88	3.16	148.7
	2	2/1/2000	Low Flow	Pump	127	117.4	26.03	936	4.6	7.85	3.31	190
	3	3/8/2000	Low Flow	Bailer and Pump	127	116.9	25.86	959	30	7.88	35.9	104
	4	6/7/2000	Low Flow	Pump	127	118.02	27.1	1171	11	7.42	6.63	523.7
	5	9/14/2000	Low Flow	Pump	127	120.53	28.6	1740	109	7.51	7.4	112
	6	12/6/2000	Low Flow	Pump	127	121.34	25.1	1670	-10	7.48	6.11	17
	7	3/2/2001	Low Flow	Pump	127	120.04	25.24	1660	17	7.8	6.28	144

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Groundwater Sampling Field Data
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Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (μS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)
WCP-45	8	4/30/2001	Low Flow	Pump	126.37	121.37	29.64	1700	15	7.5	9.97	192
	9	6/11/2001	Low Flow	Pump	126.08	121.08	29.3	1800	0	7.23	6.22	209
	10	6/22/2001	3 CV	Pump	131.38	121.38	24.51	1790	0	7.25	16.47	78
	11	8/13/2001	Low Flow	Pump	128.13	123.13	26.53	1820	50	7.5	6.44	79
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	11/7/2001	3 CV	Pump	134.55	124.55	24.48	1580	0.3	7.68	6.83	256
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/24/2002	3 CV	Pump	134.25	124.25	24.24	1610	0	7.69	6.37	147.7
WCP-46	1	12/28/1999	Low Flow	Bailer	NA	119.12	25.4	1123	33	7.93	6.8	-103.1
	2	2/1/2000	Low Flow	Pump	128	119.06	24.85	1130	37.9	7.92	3.99	123.6
	3	3/8/2000	Low Flow	Bailer and Pump	128	118.58	25.3	1155	16	7.87	5.42	-7.1
	4	6/7/2000	Low Flow	Pump	128	119.65	25.4	1247	4	7.61	7.5	469.3
	5	9/14/2000	Low Flow	Pump	128	122.1	25.2	1510	218	7.85	7.46	73
	6	12/6/2000	Low Flow	Pump	128	122.85	24.3	1720	-10	7.73	5.99	46
	7	2/23/2001	Low Flow	Pump	NA	121.75	25.73	1840	0	7.96	6.28	187
	8	4/25/2001	Low Flow	Pump	127.81	122.81	28	1800	20	7.6	8.59	182
	9	6/7/2001	Low Flow	Pump	127.66	122.66	27.02	1800	0	7.57	6.44	160
	10	6/22/2001	3 CV	Pump	133.1	123.1	23.27	1940	0	7.51	17.92	100
	11	8/2/2001	Low Flow	Pump	129.46	124.46	26.51	1810	13	7.78	8.02	150
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	11/1/2001	3 CV	Pump	136.06	126.06	24.97	1720	0	7.88	6.69	208.9
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/10/2002	3 CV	Pump	135.8	125.8	23.51	1690	3	7.84	6.87	104.1
WCP-47	7	2/22/2001	Low Flow	Pump	126.78	121.78	23.89	1780	0	7.49	5.24	71
	8	4/23/2001	Low Flow	Pump	128.01	123.01	27.4	1600	0	7.5	7.83	111
	9	6/6/2001	Low Flow	Pump	127.83	122.83	26.2	1700	0	7.17	6.15	227
	10	6/18/2001	3 CV	Pump	133.1	124.1	24.95	1700	0	7.01	6.36	116
	11	7/31/2001	Low Flow	Pump	129.56	124.56	25.66	1670	48	7.62	5.81	100
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	10/29/2001	3 CV	Pump	136.1	126.1	25.05	1460	0	7.79	6.28	191.4
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/18/2002	3 CV	Pump	135.84	125.84	22.6	1610	17.8	7.53	6.94	118.8
WCP-48		8/17/2000	Low Flow	Pump	235	119.7	28.4	1350	200	7.56	6.6	144
	5	9/29/2000	Low Flow	Pump	235	120.59	28.2	1120	990	6.14	3.12	114

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Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (µS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)
WCP-48	6	12/11/2000	Low Flow	Pump	235	121.76	26.64	1320	0	7.29	5.57	14
	7	3/6/2001	Low Flow	Pump	235	119.33	26.13	1370	37	7.52	6.84	27
	8	4/25/2001	Low Flow	Pump	235	121.72	29.3	1300	0	7.52	8.06	75
	9	6/11/2001	Low Flow	Pump	235	120.92	28.55	1300	0	7.23	6.04	71
	10	6/25/2001	3 CV	Pump	235	121.36	25.02	1330	0	7.16	NA	32
	11	8/3/2001	Low Flow	Pump	235	122.67	28.28	1270	0	7.59	5.7	122
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	11/1/2001	3 CV	Pump	235	124.2	26.56	1180	0	7.58	6.25	233.7
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/17/2002	3 CV	Pump	235	123.66	24.25	1190	5.1	7.54	5.6	62.3
WCP-83	7	2/26/2001	Low Flow	Pump	122.55	117.55	23.83	1750	0	7.41	4.15	156
	8	4/27/2001	Low Flow	Pump	123.11	118.11	30.11	1800	17	7.19	8.78	174
	9	6/8/2001	Low Flow	Pump	122.8	117.8	27.49	1800	0	7.12	5.04	124
	10	6/21/2001	3 CV	Pump	128.15	118.15	25.26	1800	0	6.89	5	236
	11	8/3/2001	Low Flow	Pump	124.42	119.42	27.56	1830	0	7.44	5.07	76
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	11/2/2001	3 CV	Pump	131.4	121.4	24.86	1790	0	7.46	4.96	220.2
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/23/2002	3 CV	Pump	131.66	121.66	23.2	1810	0	7.4	5.22	145.1
WCP-84	7	2/26/2001	Low Flow	Pump	123.83	118.83	23.72	1790	0	7.55	4.37	168
	8	4/26/2001	Low Flow	Pump	124.8	119.8	27.3	1800	9	7.33	6.34	200
	9	6/12/2001	Low Flow	Pump	124.68	119.68	27.11	1700	0	7.22	5.73	181
	10	6/21/2001	3 CV	Pump	129.95	119.95	25.3	1700	0	7.09	5.7	199
	11	8/3/2001	Low Flow	Pump	126.22	121.22	27.16	1710	0	7.57	5.67	108
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	11/2/2001	3 CV	Pump	132.96	122.96	24.51	1610	0	7.61	6.45	240.7
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/10/2002	3 CV	Pump	132.89	122.89	23.44	1530	0	7.56	6.12	94.7
WCP-85	7	2/27/2001	Low Flow	Pump	122.96	117.96	25.07	1610	43	7.39	5.64	205
	8	4/26/2001	Low Flow	Pump	123.46	118.46	28.5	1600	0	7.07	5.77	152
	9	6/8/2001	Low Flow	Pump	124.06	118.06	28.46	1400	0	7.15	5.38	130
	10	6/20/2001	3 CV	Pump	128.35	118.35	26.92	1400	0	7	4.61	125
	11	8/1/2001	Low Flow	Pump	124.46	119.46	28.8	1400	9	7.41	6.8	123
	12	9/19/2001	Low Flow	Pump	125.65	120.65	25.52	4020	53.2	7.4	15.39	174
	13	11/2/2001	3 CV	Pump	131.17	121.17	25.42	1490	0	7.47	5	196.1

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Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (μS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)
WCP-85	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/14/2002	3 CV	Pump	131.97	121.97	29.46	1410	116.8	7.59	5.31	12.5
WCP-86	7	2/26/2001	Low Flow	Pump	124.08	119.08	27.86	2370	0	7.21	3.91	193
	8	4/24/2001	Low Flow	Pump	124.84	119.84	31.5	2300	0	7.24	4.87	85
	9	6/7/2001	Low Flow	Pump	124.02	119.02	32.55	2700	0	7.06	4.12	116
	10	6/19/2001	3 CV	Pump	129.3	119.3	27.29	2800	0	6.86	3.98	110
	11	8/2/2001	Low Flow	Pump	125.35	120.35	31.81	2870	3	7.18	5.12	93
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	10/31/2001	3 CV	Pump	132	122	26.76	2700	32.3	7.11	4.4	172.8
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/11/2002	3 CV	Pump	132.83	122.83	24.88	2450	74.2	7.17	4.78	98
WCP-S87	7	3/5/2001	Low Flow	Pump	124.3	119.3	26.71	1440	0	7.53	5.79	133
WCP-D87	7	3/5/2001	Low Flow	Pump	150	119.3	25.98	1430	0	7.55	5.95	126
WCP-87	8	5/2/2001	Low Flow	Pump	125.49	120.49	31	1500	0	7.4	5.98	261
	9	6/14/2001	Low Flow	Pump	125.36	120.36	33.47	1500	0	7.33	6.7	230
	10	6/27/2001	3 CV	Pump	130.63	120.63	25.09	1690	0	7.03	4.44	105
	11	8/15/2001	Low Flow	Pump	127.11	122.11	30	1850	0	7.34	1.92	-21
	12	9/21/2001	Low Flow	Pump	128.08	123.08	31.41	4890	0	7.41	8.84	11
	13	11/9/2001	3 CV	Pump	133.68	123.68	25.92	1740	0	7.41	0.58	125.86
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/24/2002	3 CV	Pump	133.5	123.5	24.98	1340	0	7.54	5.66	164.5
WCP-88	7	2/28/2001	Low Flow	Pump	124.95	119.95	25.16	1870	0	7.33	4.58	124
	8	5/1/2001	Low Flow	Pump	125.34	120.34	29.4	1700	25	7.26	4.2	79
	9	6/13/2001	Low Flow	Pump	125.03	120.03	30.68	1600	0	7.12	4.7	91
	10	6/27/2001	3 CV	Pump	130.48	120.48	25.1	1860	0	6.84	2.93	136
	11	8/13/2001	Low Flow	Pump	126.51	121.51	28.33	1630	20	7.3	3.98	74
	12	9/21/2001	Low Flow	Pump	127.58	122.48	27.18	4420	3.7	7.3	12.99	97
	13	11/7/2001	3 CV	Pump	133.32	123.32	25.04	1540	0	7.33	3.74	256.2
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/24/2002	3 CV	Pump	133.73	123.73	24.69	1520	0	7.3	3.94	132.4
WCP-89	7	2/23/2001	Low Flow	Pump	126.49	121.49	26.5	1740	0	7.36	5.83	114
	8	4/24/2001	Low Flow	Pump	127.59	122.59	28.9	1600	61	7.26	7.2	105
	9	6/6/2001	Low Flow	Pump	127.05	122.05	29.82	2100	0	7.11	6.13	162
	10	6/18/2001	3 CV	Pump	132.37	122.37	27.7	2100	0	6.72	6.08	117

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Groundwater Sampling Field Data
WCP East Grand Avenue WQARF Site Remedial Investigation

Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (μS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)
WCP-89	11	8/1/2001	Low Flow	Pump	128.58	123.58	30	2190	5	7.23	7.4	116
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	10/31/2001	3 CV	Pump	135.47	125.47	26.94	1920	0	7.2	6.64	212
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/11/2002	3 CV	Pump	135.74	125.74	25.48	1890	32.8	7.25	6.45	113.9
WCP-90	7	2/23/2001	Low Flow	Pump	130.78	125.78	26.75	2280	0	7.4	4.69	69
	8	4/24/2001	Low Flow	Pump	132.22	127.22	29.5	2300	7	7.23	5.71	88
	9	6/6/2001	Low Flow	Pump	132.12	127.12	29.13	2400	0	7.08	5.7	155
	10	6/19/2001	3 CV	Pump	137.49	127.49	28.23	2300	0	6.92	5.47	114
	11	7/31/2001	Low Flow	Pump	133.85	128.85	29.2	2340	16	7.35	5.41	103
	12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	13	10/30/2001	3 CV	Pump	140.18	130.18	27.67	2090	0	7.38	6.41	259.9
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/16/2002	3 CV	Pump	139.83	129.83	25.74	2020	0	7.41	7.1	109.5
WCP-92	11	8/8/2001	Low Flow	Pump	122.65	117.65	26.29	2350	22	7.31	4.85	106
	12	9/19/2001	Low Flow	Pump	123.59	118.59	26.07	6060	61.7	7.34	14.92	118.72
	13	11/6/2001	3 CV	Pump	129.33	119.67	24.64	2060	0	7.31	5.36	309.6
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/23/2002	3 CV	Pump	130.27	120.27	24.28	2160	0	7.34	5.04	140.5
WCP-93	11	8/13/2001	Low Flow	Pump	125.5	120.5	30.13	3080	66	7.21	6.41	112
	12	9/24/2001	Low Flow	Pump	126.67	121.67	28.02	7920	49.8	7.23	10.2	183
	13	11/9/2001	3 CV	Pump	132.11	122.11	24.54	2430	4	7.26	7.4	266
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/25/2002	3 CV	Pump	132.02	122.02	23.94	2010	2.4	7.36	6.55	150.1
WCP-94	11	8/9/2001	Low Flow	Pump	125.63	120.65	27.59	1770	17	7.31	5.78	89
	12	9/20/2001	Low Flow	Pump	126.62	121.62	28.43	4610	26.4	7.44	14.18	235
	13	11/7/2001	3 CV	Pump	132.65	122.65	24.71	1570	9.5	7.54	6.81	256.4
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/23/2002	3 CV	Pump	133.2	123.2	24.47	1530	9.3	7.56	6.75	145.5
WCP-95	11	8/6/2001	Low Flow	Pump	114.22	109.22	34.78	1330	3	7.39	6.71	224
	12	9/18/2001	Low Flow	Pump	114.88	109.88	30.43	3400	23	7.24	11.73	285
	13	11/5/2001	3 CV	Pump	120.07	110.07	26.87	1530	25.2	7.37	7.11	215.6
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/16/2002	3 CV	Pump	119.89	109.89	25.73	1390	17.2	7.5	6.68	91.2

Table 7-25
Groundwater Sampling Field Data
WCP East Grand Avenue WQARF Site Remedial Investigation

Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (μS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)
WCP-96	11	8/9/2001	Low Flow	Pump	123.71	118.71	28.59	1720	33	7.23	5.16	160
	12	9/19/2001	Low Flow	Pump	124.37	119.37	27.01	4490	25.4	7.33	15.38	258
	13	10/31/2001	3 CV	Pump	130.2	120.2	25.89	1520	0	7.36	7.21	208.2
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/16/2002	3 CV	Pump	131.26	121.26	24.19	1530	16.2	7.46	7.01	100.3
WCP-97	11	8/6/2001	Low Flow	Pump	123.82	118.82	32.07	1510	44	7.36	7.01	93
	12	9/19/2001	Low Flow	Pump	125.06	120.06	31.65	4010	10.2	7.4	13.52	270
	13	11/2/2001	3 CV	Pump	130.82	120.82	25.7	1300	0	7.55	5.53	262.4
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/17/2002	3 CV	Pump	131.22	121.22	24.09	1230	2.3	7.57	5.79	96.4
WCP-98	11	8/7/2001	Low Flow	Pump	120.47	115.47	29.61	1550	6	7.43	7.55	183
	12	9/18/2001	Low Flow	Pump	121.66	116.66	28.85	4080	30.5	7.36	15.35	269
	13	11/5/2001	3 CV	Pump	127.47	117.47	24.59	1340	0	7.51	8.07	236.4
	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/17/2002	3 CV	Pump	127.99	117.99	22.88	1140	0	7.7	7.81	109.1
WCP-99	14	12/18/2001	3 CV	Pump	126.7	116.7	24.83	1350	18.8	7.37	7.57	75.6
	15	1/17/2002	3 CV	Pump	127.22	117.22	22.51	1480	5.8	7.45	7.24	95.2
WCP-100	14	12/19/2001	3 CV	Pump	134.08	124.08	23.5	1680	0	7.33	6.23	172.2
	15	1/23/2002	3 CV	Pump	133.84	123.84	23.23	1760	0	7.42	6.83	152.9
WCP-200		1/7/2002	3 CV	Pump	133.86	123.86	24.12	1650	34.2	7.49	6.34	85.8
	15	1/25/2002	3 CV	Pump	133.7	123.7	24.11	1710	0	7.48	6.55	157.6
WCP-201		1/8/2002	3 CV	Pump	132.69	122.69	24.27	1580	9.3	7.6	5.88	81.4
	15	1/25/2002	3 CV	Pump	132.53	122.53	24.35	1550	0	7.57	5.55	149.9
WCP-202	14	12/18/2001	3 CV	Pump	130.15	120.15	26.06	2030	9.6	7.16	0.2	-110.1
	15	1/24/2002	3 CV	Pump	130.43	120.43	25.78	2170	0	7.23	0.34	14.4
WCP-203	14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	15	1/22/2002	3 CV	Pump	139.85	129.85	25.45	2210	0	7.31	6.56	164.6
WCP-204	14	12/18/2001	3 CV	Pump	129.37	119.37	24.54	2620	2.5	7.07	8.04	150
	15	1/21/2002	3 CV	Pump	129.61	119.61	24.28	2760	0	7.2	7.2	156.4

Table 7-25
Groundwater Sampling Field Data
WCP East Grand Avenue WQARF Site Remedial Investigation

Monitor Well	Round	Sample Date	Purge Method (1)	Sample Method (2)	Pump Depth (3) (ft bgs)	Depth to Water (4) (ft)	Temperature (°C)	Conductance (µS/cm)	Turbidity (NTU)	pH	DO (mg/L)	Redox (mV)

1) 3 CV = Three-casing volumes were removed prior to sampling; Low Flow = Drawdown during purging was≤4 inches; pump rates were approximately 0.5-4 liters per minute.
NS = Not sampled
2) Bailer = Sample collected with a disposable bailer; Pump = Sample collected with a 2-inch Grundfos™ pump.
3) Pump depth in feet below ground surface (ft bgs).
4) Depth to water measurement is prior to purging activities.
* Well purged dry. Parameter measurements were not stabilized.
°C = Degrees Centigrade
S/cm = Siemens per centimeter
NTU = Nephelometric turbidity units
mg/L = milligrams per liter
mV = millivolts

Table 7-18
Detected Organic Compounds in Groundwater
Round 9 - June 2001
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AQWS/MCL	ENT-MW-2	MGL-1	MGL-2	MGL-3	MTP-1	MWB-4	MWB-5	MWB-6	WCP-15	WCP-16	WCP-17	WCP-28	WCP-29	WCP-30	WCP-40	WCP-41	WCP-42	WCP-43	WCP-44	WCP-45	WCP-145	WCP-46	WCP-47	WCP-48	WCP-83	WCP-183	WCP-84	WCP-85	WCP-86	WCP-87	WCP-187	WCP-88	WCP-89	WCP-90
1,1,2-Trichloroethane	**5**																																	0.4	
1,1-Dichloroethane	**NE**									0.5	0.6	1			2																2	2			
1,1-Dichloroethene	**7**	2			0.9					**16**	**43**	**77**	3	3	**72**		3				**13**	**13**	0.4		0.7			0.8		0.5	**210**	**140**			
1,2-Dichloroethane	**5**		**26**	**19**	1					0.6	1		1		0.7	2																			
Acetone	**NE**		63		2																2		2										28		
Benzene	**5**	**3700**	**59**	**85**																**200**													3		
Bromodichloromethane	**100**																																	28	0.8
Carbon disulfide	**NE**	5																																	
Carbon tetrachloride	**5**											3			0.7																1	1			
Chloroform	**100**		0.7	0.9			0.4	0.4		0.5	0.9	1	0.9	0.9	0.8	0.7	0.9	1	1				0.8	0.4		1	1	1	0.6	1			0.9	1	4
cis-1,2-Dichloroethene	**70**							0.4							0.9											0.6	0.6				0.6	0.6	0.8		
Dibromochloromethane	**100**							0.4																			0.4								
Ethylbenzene	**700**	**860**																		3															
m&p-Xylenes	**NE**	730																		1															
Methylene chloride	**5**																																	0.6	
Methyl-tert-butyl-ether	**NE**															0.3																			
o-Xylene	**10,000**	770		2																															
Tetrachloroethene	**5**	1		0.6						**60**	**130**	**76**	**7**	**8**	**230**		2			0.6	**22**	**22**	0.5					0.5		0.5	**330**	**180**	0.9		
Toluene	**1,000**	**1800**								0.7										0.4												0.6			
Trichloroethene	**5**	2	**8**	**7**	**6**		0.6	**16**		**35**	**210**	**310**	**10**	**13**	**150**		**10**		3	1	**12**	**12**	0.4			**12**	**12**	4	4	1	**250**	**150**	**36**		0.7
Xylenes (total)	**10,000**	1600		2																1															

Notes: µg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
WCP-145, WCP-183, and WCP-187 are duplicates of WCP-45, WCP-83, and WCP-87, respectively.
All samples collected using the low-flow purge method and the pump discharge sample collection method.
Blank fields indicate analyte not detected above the method detection limit.
Highlighted result indicates exceedance of the AWQS/MCL.

Table 7-19
Detected Organic Compounds in Groundwater
Round 10 - June 2001
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AWQS/MCL	ENT-MW-2	MGL-1	MGL-2	MGL-3	MWB-4	MWB-5	MWB-6	WCP-15	WCP-16	WCP-17	WCP-28	WCP-29	WCP-129	WCP-30	WCP-40	WCP-41	WCP-141	WCP-42	WCP-43	WCP-44	WCP-45	WCP-46	WCP-47	WCP-48	WCP-83	WCP-84	WCP-85	WCP-86	WCP-87	WCP-88	WCP-188	WCP-89	WCP-90
1,1-Dichloroethane	**NE**										0.6				1							0.3								2				
1,1-Dichloroethene	**7**		0.6		1				**7**	**17**	**59**	2	2	2	**27**		1	1				**13**			0.7		0.5			**170**				
1,2-Dichloroethane	**5**		**17**	**25**	1										1	2																		
Acetone	**NE**				3																						3							
Benzene	**5**	**3500**	**59**	**170**	0.5																**200**										1	1		
e	**100**																										0.3						31	0.7
Carbon disulfide	**NE**	5																																
Carbon tetrachloride	**5**										2				0.4															1				
Chloroform	**100**		0.6	0.8		0.4			0.5	0.9	0.7	0.8	1	1	0.9	0.7	1	1	1	1		0.4	0.8	0.4		1	0.9	0.5	1	0.4	0.8	0.7	1	3
Chloromethane	**NE**		0.9	1																	1													
cis-1,2-Dichloroethene	**70**														0.5		0.4	0.4								0.5				0.8	0.7	0.7		
Ethylbenzene	**700**	**870**																			3													
m&p-Xylenes	**NE**	680																			4													
Methylene chloride	**5**																																0.6	
o-Xylene	**10,000**	890	4	4																	0.6													
Tetrachloroethene	**5**	1	0.3	0.6					**26**	**44**	**34**	**6**	4	4	**91**		0.7	0.7			0.7	**28**					0.3		0.6	**280**	0.6	0.5		
Toluene	**1,000**	**1500**																			0.9													
Trichloroethene	**5**	2	**5**	**9**	**8**	0.7	**16**		**13**	**55**	**250**	**8**	**7**	**7**	**42**		**9**	**9**		2	0.8	**15**				**13**	3	**5**	1	**230**	**38**	**35**	0.4	0.8
Xylenes (total)	**10,000**	1600	4	4																	5													

Notes: µg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
WCP-129, WCP-141, and WCP-188 are duplicate samples of WCP-29, WCP-41, and WCP-88, respectively.
All samples collected using the three casing volume purge method and the pump discharge sample collection method.
Blank fields indicate analyte not detected above method detection limit.
Highlighted result indicates exceedance of the AWQS/MCL.

Table 7-20
Detected Organic Compounds in Groundwater
Round 11 - August 2001
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AWQS/ MCL	ENT-MW-2	MGL-1	MGL-2	MGL-3	MTP-1	MWB-4	MWB-5	MWB-6	WCP-15	WCP-16	WCP-17	WCP-28	WCP-128	WCP-29	WCP-30	WCP-40	WCP-41	WCP-42	WCP-43	WCP-143	WCP-44	WCP-45	WCP-46	WCP-47	WCP-48	WCP-83	WCP-84	WCP-85	WCP-86	WCP-87	WCP-88	WCP-89	WCP-90	WCP-92	WCP-93	WCP-94	WCP-194	WCP-95	WCP-195	WCP-96	WCP-97	WCP-98
1,1,2-Trichloroethane	**5**																																0.5										
Dichloroethane	**NE**										0.7	0.6				2															1					2							
Dichloroethene	**7**				1					**12**	**50**	**50**	3	3	2	**57**		5					**12**			0.8		0.6			**51**				1	**120**							
1,2-Dichloroethane	**5**			**8**	1					0.7	1		1			0.6	1																		1								
Acetone	**NE**	330																														37											
Benzene	**5**	**3100**	**53**																			**170**									1	5											
Bromodichloromethane	**100**																																39	0.8			0.6	0.6	9	10			
Bromomethane	**NE**																																0.6										
Carbon tetrachloride	**5**											2				0.7																				0.6							
Chloroform	**100**		0.6	0.6						0.6	1	0.8	0.8	0.8	0.9	0.8	0.6	0.7	1	1	1			0.8			2	0.9		1		0.9	1	3		1	2	2	18	18			
Chloromethane	**NE**																																								0.6		
cis-1,2-Dichloroethene	**70**															1											0.8					0.6				1							
Dibromochloromethane	**100**																																						1	1			
Ethylbenzene	**700**	630																				0.7																					
m&p-Xylenes	**NE**	430																																									
chloride	**5**																																0.7			1							
o-Xylene	**10,000**	540	1																																								
Tetrachloroethene	**5**			0.5						**33**	**150**	**48**	**11**	**11**	**5**	**190**		3				0.6	**19**							0.6	**62**	0.7				**170**					1		
Toluene	**1,000**	**1400**																																									
Trichloroethene	**5**		**6**	**5**	**7**	0.5		**14**		**22**	**270**	**230**	**18**	**18**	**9**	**120**		**8**		2	2	1	**11**				**13**	3	3	1	**54**	**30**		0.8	**5**	**770**	**12**	**12**					
Xylenes (total)	**10,000**	1000	1																																								

Notes: µg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
WCP-128, WCP-143, WCP-194, and WCP-195 are field duplicates of WCP-28, WCP-43, WCP-94, and WCP-95, respectively
Blank fields indicate analyte not detected above the method detection limit.
All samples collected using the low-flow purge method and the pump discharge sample collection method.
Highlighted results indicate an exceedance of the AWQS/MCL.

Table 7-21
Detected Organic Compounds in Groundwater
Round 12 - September 2001
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AWQS/MCL	WCP-16	WCP-116	PDB-16	WCP-17	PDB-17	WCP-28	PDB-28D	PDB-28S	WCP-29	WCP-129	PDB-29D	PDB-29S	WCP-85	PDB-85D	PDB-85S	WCP-87	PDB-87D	PDB-87S	WCP-88	PDB-88D	PDB-88S	WCP-92	WCP-93	PDB-93D	PDB-93S	WCP-94	PDB-94D	PDB-94S	WCP-95	WCP-96	WCP-97	WCP-98
1,1-Dichloroethane	**NE**			0.94	0.5	0.57											0.6	0.6						2	2.6	1.2							
1,1-Dichloroethene	**7**	**35**	**39**	**73**	**32**	**57**	2		**25**	3	3		**11**				**37**	**42**	**29**				0.9	**130**	**140**	**84**	0.4						
1,2-Dichloroethane	**5**	1	1	0.96			1	1.4	1												1.1	1.1	0.6										
1,1,2-Trichlorotrifluoroethane	**NE**			7.1					4				2																				
1,2,4-Trimethylbenzene	**NE**																				2	1											
1,3,5-Trimethylbenzene	**NE**																					3											
Acetone	**NE**			32		26	2	25	28		2	24	29		32	32		45	57		22	25			43	45		52	46				
Benzene	**5**																2	1.5	3	4	**28**	**28**											
Bromodichloromethane	**100**																										0.8	3.7	1.3	13			
Carbon tetrachloride	**5**			0.55	2	2.7																		0.8	1.2	0.63							
Chloroform	**100**	0.9	0.9		0.8		0.8			0.9	0.9	1.1								0.8	1.8	1.8		2	1.7		3	12	4.4	27			
cis-1,2-Dichloroethene	**70**																			0.8				1	0.98								
Dibromochloromethane	**100**																													1			
m,p-Xylenes	**10,000**																				2.9	3.3											
Methylene chloride	**5**	0.6	1				0.9			0.8	0.8													2	1.1		1			0.5			
o-Xylene	**10,000**																				3	7											
Tetrachloroethene	**5**	**130**	**110**	**300**	**36**	**58**	**7**		**77**	**8**	**7**		**34**				**49**	**86**	**63**	0.5				**230**	**370**	**150**					0.9	0.3	
Trichloroethene	**5**	**180**	**160**	**420**	**120**	**190**	**10**	1.1	**74**	**12**	**12**	1.1	**46**	2	2.4	1.1	**39**	**50**	**37**	**33**	**14**	**14**	4	**800**	**1100**	**500**	**11**	**6.3**	**11**		0.4	0.7	0.3

Notes: μg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
PDB = Samples collected using passive diffusion samplers. "S" indicates sample collected at shallow depth and "D" indicates sample collected at a deeper depth.
All non-PDB samples collected using the low flow purge method and the pump discharge sample collection method.
WCP-116 and WCP-129 are field duplicates of WCP-16 and WCP-29, respectively.
Blank fields indicate analyte not detected above the method detection limit.
Highlighted results indicate an exceedance of the AWQS/MCL.
PDB analytical results did not undergo third party validation.

Table 7-22
Detected Organic Compounds in Groundwater
Round 13 - October and November 2001
WCP East Grand Avenue WQARF Site
Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AWQS/ MCL	MGL-1	MGL-2	MGL-3	MTP-1	MTP-2	MWB-4	MWB-5	MWB-6	MWB-14	WCP-16	WCP-17	WCP-28	WCP-128	WCP-29	WCP-30	WCP-40	WCP-41	WCP-42	WCP-43	WCP-45	WCP-46	WCP-47	WCP-48	WCP-148	WCP-83	WCP-84	WCP-85	WCP-86	WCP-87	WCP-88	WCP-89	WCP-90	WCP-190	WCP-92	WCP-93	WCP-193	WCP-94	WCP-95	WCP-96	WCP-97	WCP-98
1,1-Dichloroethane	**NE**										0.4	0.5				0.9					0.4									2						2	2					
1,1-Dichloroethene	**7**			0.4							**36**	**28**	2	2	3	**29**		2			**19**			0.7	0.9		0.6			**31**					0.9	**110**	**120**	0.4				
1,2-Dichloroethane	**5**	**51**	3								0.8		2	2		0.8	0.7																						0.5			
Acetone	**NE**								3																																	3
Benzene	**5**	**180**	**5**				2		0.6																					2	1											
Bromodichloromethane	**100**														0.4					0.5												22	0.8	0.9				0.4	10			
Carbon tetrachloride	**5**																																			0.6	0.6					
Chloroform	**100**	0.8	0.4					0.6			0.7	0.7	0.8	0.8	1	0.7	0.6	1	1	1	0.4	0.9				2	0.9		1	0.4	0.8	0.9	3	3		2	1	1	21			
cis-1,2-Dichloroethene	**70**															0.4										0.8				3	1					2	0.9					
Dibromochloromethane	**NE**																																						0.7			
Ethylbenzene	**700**						3																																			
m&p-Xylenes	**NE**						0.5		0.5																																	
Methylene chloride	**5**																															0.6				1	0.8					
Methyl-tert-butyl-ether (MTBE)	**NE**								0.4																																	
o-Xylene	**NE**	6																																								
Tetrachloroethene	**5**	0.5			0.4						**180**	**39**	**6**	**6**	**6**	**130**		1			**39**						0.3		0.7	**44**	0.6					**290**	**290**			1		
Toluene	**1,000**								2																																	
Trichloroethene	**5**	**9**	2	4	0.5			**11**			**240**	**230**	**9**	**9**	**10**	**64**		**11**		2	**19**					**14**	3	0.5	1	**33**	**48**		0.8	0.9	4	**810**	**840**	**13**		0.4	0.4	
Xylenes (total)	**10,000**	6					0.6		0.6																																	

Notes: µg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
WCP-128, WCP-148, WCP-190, and WCP-193 are field duplicates for WCP-28, WCP-48, WCP-90, and WCP-93, respectively.
All samples collected using the three casing volume purge method and the pump discharge sample collection method.
Blank fields indicate analyte not detected above the method detection limit.
Highlighted results indicate an exceedance of the AWQS/MCL.

Table 7-23
Detected Organic Compounds in Groundwater
Round 14 - December 2001
VW&R Remedial Investigation

ANALYTE	ACTION LEVEL AWQS/MCL	MTP-1	MTP-2	WCP-99	WCP-100	WCP-202	WCP-204
1,1-Dichloroethene	**7**				2		
1,2-Dichloroethane	**5**				0.6		
Acetone	**NE**		5				
Benzene	**5**				0.5	**6000**	
Bromoform	**NE**	1	2		0.7		
Chloroform	**100**						
Dibromochloromethane	**NE**		0.5				
Tetrachloroethene	**5**			0.3	**6**		0.3
Trichloroethene	**5**			0.5	**7**		

Notes: µg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
All samples collected using the three casing volume purge method and the pump discharge sample collection method.
Blank fields indicate analyte not detected above the method detection limit.
Highlighted results indicate an exceedance of the AWQS/MCL.

Detected Organic Compounds in Groundwater
Round 15 - January 2002
WCP East Grand Avenue WQARF Site
Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AWQS/MCL	MTP-1	MTP-2	MWB-6	MWB-14	MWB-14D	WCP-28	WCP-29	WCP-30	WCP-40	WCP-41	WCP-42	WCP-43	WCP-45	WCP-46	WCP-47	WCP-48	WCP-83	WCP-84	WCP-85	WCP-86	WCP-87	WCP-88	WCP-89	WCP-90	WCP-90D	WCP-92	WCP-93	WCP-94	WCP-94D	WCP-95	WCP-96	WCP-97	WCP-98	WCP-99	WCP-100	WCP-MW-200-0107	WCP-MW-200-0125	WCP-MW-201-0108	WCP-MW-201-0125	WCP-202	WCP-202D	WCP-203	WCP-204
1,1,2-Trichloroethane	**5**																							0.4																				
1,1-Dichloroethane	**NE**								0.9					0.3								2						1									3	3						
1,1-Dichloroethene	**7**						2	2	**25**					**13**			0.7		0.7		0.5	**130**					0.6	**71**		0.4						0.9	**190**	**210**	**26**	**23**				
1,2-Dichloroethane	**5**						2		0.8	1																	0.8									0.9	0.9	1						
1,2-Dichloropropane	**NE**																							0.3																				
Acetone	**NE**																								3						3													
Benzene	**5**																						0.6					0.3										0.3	0.4		**6300**	**5900**		
Bromodichloromethane	**100**												0.7					0.3	0.3					26	0.8	0.9			0.6	0.6	12													
Carbon tetrachloride	**5**																					1						0.3									2	2	0.5					
Chloroform	**100**						0.7	1	0.7	0.7	1	1	2	0.5	0.9			1	1		1	0.5	1	1	3	4		1	2	2	25					0.8	1	1	0.6	0.7		0.3	1	
cis-1,2-Dichloroethene	**70**								0.4		0.6							0.8				0.8	2					0.6									2	2		0.3				
Dibromochloromethane	**100**																														0.4													
Ethylbenzene	**700**																																								0.6	0.5		
m&p-Xylenes	**NE**																																								1	1		
Tetrachloroethene	**5**			**0.9**			4	4	**100**		0.5			**27**					0.4	2	0.5	**200**	1					**150**				0.4				3	**550**	**520**	**27**	**22**		0.7		
Toluene	**1,000**																																						0.3		0.9	0.9		
Trichloroethene	**5**						**6**	**8**	**54**		**11**		1	**15**				**12**	3		1	**170**	**44**		0.7	0.8	4	**500**	**11**	**13**		0.4	0.7		1	3	**550**	**560**	**96**	**89**	2	3		
Xylenes (total)	**10,000**																																								2	1		

Notes: µg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established
MWB-14D, WCP-90D, WCP-94D, and WCP-202D are field duplicates of MWB-14, WCP-90, WCP-94, and WCP-202, respectively.
All samples collected using the three casing volume purge method and the pump discharge sample collection method.
Blank fields indicate analyte not detected above the method detection limit.
Highlighted results indicate an exceedance of the AWQS/MCL.

Table 7-10
Detected Organic Compounds in Groundwater
Round 1- December 1999
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AWQS/MCL	MWB-4	MWB-5	MWB-6	WCP-15	WCP-115	WCP-16	WCP-17	WCP-28	WCP-29	WCP-30	WCP-40	WCP-41	WCP-42	WCP-43	WCP-44	WCP-45	WCP-145	WCP-46
1,1-Dichloroethane	**NE**				5	5			2		6							0.5	
1,1-Dichloroethene	**7**				**89**	**93**	**32**	**29**	**180**	**36**	**150**		1	0.9			**26**	**28**	1
Benzene	**5**						0.7						2			**1900**			
Carbon Tetrachloride	**5**				1	1		2	1		2								
Chloroform	**100**	1	0.6		2	2	0.7		1	0.9	1	0.7	0.6	0.6	0.5				
cis-1,2-Dichloroethene	**70**				3	4			0.6		2								
m/p-Xylene	**NE**															11			
Methylene Chloride	**5**				2	2			0.7		0.8								
Methyl-tert-butyl ether	**NE**			16															
Tetrachloroethene	**5**				**690**	**670**	**160**	**22**	**920**	**140**	**760**		1	0.9		0.7	**76**	**76**	1
Toluene	**1,000**															1			
Trichloroethene	**5**	1	**8**		**520**	**540**	**210**	**93**	**1100**	**200**	**400**		**10**		0.9	3	**33**	**35**	0.9
Xylene (total)	**10,000**															12			

Notes: μg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
WCP-115 and WCP-145 are duplicate samples of WCP-15 and WCP-45, respectively.
All samples collected using the low-flow purge method and the bailer sample collection method.
Blank fields indicate the analyte was not detected above method detection limit.
Highlighted result indicates exceedance of the AWQS/MCL.

Table 7-11
Detected Organic Compounds in Groundwater
Round 2 - January and February 2000
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AQWS/MCL	MTP-1	MWB-4	MWB-5	MWB-6	WCP-15	WCP-B15	WCP-16	WCP-B16	WCP-17	WCP-B17	WCP-28	WCP-B28	WCP-29	WCP-129	WCP-B29	WCP-30	WCP-130	WCP-B30	WCP-40	WCP-41	WCP-141	WCP-42	WCP-43	WCP-44	WCP-45	WCP-46
1,1-Dichloroethane	NE					0.4	4		0.7				2				3	3	7							0.8	
1,1-Dichloroethene	7					14	60	33	57	34	38	8	150	4	4	38	69	54	180							31	
Benzene	5																								2600		
Bromodichloromethane	100		0.5									0.2			0.3												
Carbon Tetrachloride	5						1		0.5	2	2		1				1	1	2								
Chloroform	100		2			0.6	2	0.8	0.9			1	1	0.9	0.9	0.8	0.8	0.9		0.9	0.9	0.8	0.9	1			
cis-1,2-Dichloroethene	70						2						0.7				1	1	3								
m/p-Xylene	NE																								9		
Methylene Chloride	5						2						0.8														
Methyl-tert-butyl ether	NE				21																						
Tetrachloroethene	5					50	440	73	410	16	25	56	710	12	12	130	320	300	790						1	63	0.9
Toluene	1,000																								0.6		
Trichloroethene	5		2	11		38	320	98	300	66	75	77	940	19	18	230	200	200	490		10	10		2	4	35	0.5
Xylene (total)	10,000																								10		

Notes: μg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
Sample identifications with a "B", such as WCP-B15, indicate the sample was collected using the bailer sample collection method. All other samples were collected using the pump discharge sample collection method. The low-flow purge method was used for all Round 2 samples.
WCP-129, WCP-130, and WCP-141 are duplicate samples of WCP-29, WCP-30, and WCP-41, respectively.
Blank fields indicate the analyte was not detected above method detection limit.
Highlighted result indicates exceedance of the AWQS/MCL.

Table 7-12
Detected Organic Compounds in Groundwater
Round 3 - March 2000
WCP East Grand Avenue WQARF Site
Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AWQS/MCL	ENT-MW-2	ENT-MW-B02	MTP-1	MWB-4	MWB-B04	MWB-5	MWB-B05	MWB-6	MWB-B06	WCP-15	WCP-B15	WCP-I15	WCP-16	WCP-B16	WCP-I16	WCP-17	WCP-B17	WCP-28	WCP-128	WCP-B28	WCP-29	WCP-B29	WCP-30	WCP-B30	WCP-40	WCP-B40	WCP-41	WCP-141	WCP-B41	WCP-42	WCP-B42	WCP-43	WCP-B43	WCP-44	WCP-B44	WCP-45	WCP-B45	WCP-46	WCP-B46
1,1-Dichloroethane	**NE**																						0.5	2	5												0.6			
1,1-Dichloroethene	**7**										9	11	12	21	25	28	29	32	0.7	0.6	15	2	46	54	85					0.7		2					32	19	1	2
1,2-Dichloroethane	**5**		380												1				2	2	2						1													
Benzene	**5**	6700	7000																																2100	2800				
Bromodichloro-methane	**100**					0.6																											0.5							
Carbon Tetrachloride	**5**																1	2						0.8	2															
Chloroform	**100**				2	2		0.5	0.6	0.6	0.6	0.6	0.7	0.9	0.9	0.9			0.9	0.9	1	0.9	0.9	0.7	0.9	0.8	0.6	0.8	0.9	0.9	0.7	0.6	2	2						
cis-1,2-Dichloroethene	**70**																							0.7	2															
Ethylbenzene	**700**	1200	1400																																					
m/p-Xylene	**NE**	5000	6100																																8	14				
Methylene Chloride	**5**																								0.7															
Methyl-tert-butyl ether	**NE**								36	32																														
o-Xylene	**10,000**	1200	1600																																					
Tetrachloroethene	**5**										27	48	46	73	100	120	16	22	2	2	80	6	170	180	470							3			1	1	59	51	1	3
Toluene	**1,000**	5200	6100																																					
Trichloroethene	**5**				2	2	10	11			17	24	27	88	130	160	84	100	1	1	110	10	280	110	250			11	11	12		0.8	4	5	3	4	33	24	0.7	1
Xylene (total)	**10,000**	6200	7600																																9	14				

Notes: μg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
Blank fields indicate analyte was not detected above the method detection limit.
Sample identifications with a "B", such as WCP-B15, indicate the sample was collected using the bailer sample collection method. All other samples were collected using the pump discharge sample collection method. The low-flow purge method was used for all Round 3 samples.
WCP-128 and WCP-141 are duplicate samples of WCP-28 and WCP-41, respectively.
WCP-I15 and WCP-I16 are duplicate samples of WCP-B15 and WCP-B16, respectively.
Highlighted result indicates exceedance of the AWQS/MCL.

Table 7-13
Detected Organic Compounds in Groundwater
Round 4 - June 2000
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AWQS/MCL	ENT-MW-2	MTP-1	MWB-4	MWB-5	MWB-6	WCP-15	WCP-16	WCP-17	WCP-28	WCP-29	WCP-30	WCP-130	WCP-40	WCP-41	WCP-42	WCP-43	WCP-44	WCP-45	WCP-145	WCP-46
1,1-Dichloroethane	**NE**						0.5	1		0.4		2	2						0.6	0.6	
1,1-Dichloroethene	**7**						**13**	**110**	**30**	**21**	2	**78**	**84**						**26**	**25**	1
1,2-Dichloroethane	**NE**						0.6	0.6				0.6	0.6	1							
Acetone	**NE**	960						5													
Benzene	**5**	**5100**																**2000**			
Carbon Disulfide	**NE**								2												
Carbon Tetrachloride	**5**							0.8	2			0.9	0.9								
Chloroform	**100**						0.6	1	0.4	1	1	0.8	0.8						0.4	0.4	0.5
cis-1,2-Dichloroethene	**70**							0.6				1	1						0.3		
Ethylbenzene	**700**	**980**																			
m/p-Xylene	**NE**	2800																14			
o-Xylene	**10,000**	1000																			
Tetrachloroethene	**5**						**64**	**510**	**15**	**93**	**6**	**330**	**360**						**47**	**47**	1
Toluene	**1,000**	**4100**							5												
Trichloroethene	**5**			2	**14**		**37**	**780**	**93**	**140**	10	**180**	**200**		**11**		2		**29**	**27**	0.7
Xylene (total)	**10,000**	3900																15			

Notes:
μg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
WCP-130 and WCP-145 are duplicate samples of WCP-30 and WCP-45, respectively.
All samples collected using the low-flow purge method and the pump discharge sample collection method.
Blank fields indicate analyte not detected above the method detection limit.
Highlighted result indicates exceedance of the AWQS/MCL.

Table 7-14
Detected Organic Compounds in Groundwater
Round 5 - September 2000
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AWQS/MCL	ENT-MW-2	MTP-1	MWB-4	MWB-5	MWB-6	WCP-15	WCP-16	WCP-116	WCP-17	WCP-28	WCP-29	WCP-30	WCP40	WCP-41	WCP-42	WCP-43	WCP-44	WCP-45	WCP-145	WCP-46	WCP-48
1,1-Dichloroethane	**NE**							2	2				2									
1,1-Dichloroethene	**7**	2					**11**	**140**	**140**	**44**	1	2	**43**		2				**18**	**16**	0.5	0.9
Benzene	**5**	**3600**																**1400**				
Carbon Disulfide	**NE**	0.6																3				
Carbon Tetrachloride	**5**							1	1	3			0.7									
Chloroform	**100**			2	0.4	0.4	0.7	1	2	0.7	0.8	0.9	0.8	0.7	0.7	1	1				0.6	
cis-1,2-Dichloroethene	**70**							0.7	0.7				0.7									
Ethylbenzene	**700**	**820**																				
m/p-Xylene	**NE**	1700																8				
o-Xylene	**10,000**	800																				
Tetrachloroethene	**5**						**37**	**660**	**630**	**32**	4	**6**	**160**		2			0.7	29	**26**		
Toluene	**1,000**	**2300**																				
Trichloroethene	**5**	2	0.3	3	**13**		**23**	**1100**	**1000**	**180**	**5**	**11**	**88**		**9**		2	**3**	**17**	**16**		
Xylene (total)	**10,000**	2500																8				

Notes:
µg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
WCP-116 and WCP-145 are duplicate samples of WCP-16 and WCP-45, respectively.
All samples collected using the low-flow purge method and the pump discharge sample collection method.
Blank fields indicate analyte not detected above the method detection limit.
Highlighted result indicates exceedance of the AWQS/MCL.

Table 7-15
Detected Organic Compounds in Groundwater
Round 6 - December 2000
VW&R Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AWQS/MCL	ENT-MW-2	MTP-1	MWB-4	MWB-5	MWB-6	WCP-15	WCP-115	WCP-16	WCP-116	WCP-17	WCP-28	WCP-29	WCP-30	WCP-40	WCP-41	WCP-42	WCP-43	WCP-44	WCP-45	WCP-46	WCP-48
1,1-Dichloroethane	**NE**						0.5	0.4			0.6			0.9						0.4		
1,1-Dichloroethene	**7**	2					**12**	**12**	**31**	**32**	**43**	1	3	**24**		2			0.8	**18**		0.6
1,2-Dichloroethane	**NE**								1	2												
Benzene	**5**	**3900**																	**1000**			
Bromodichloromethane	**100**												0.3									
Carbon Disulfide	**NE**	1																	6			
Carbon Tetrachloride	**5**									1	3			0.4								
Chloroform	**100**			1	0.3		0.6	0.6	1	1	0.9	0.8	1	0.6	0.6	0.7	0.8	0.9	1		0.5	
Chloromethane	**NE**	11																				
cis-1,2-Dichloroethene	**70**									3				0.4								
Ethylbenzene	**700**	**930**																				
m/p-Xylene	**NE**	1500																	5			
o-Xylene	**10,000**	890																				
Tetrachloroethene	**5**	2					**47**	**61**	**75**	**71**	**45**	4	**7**	**130**		1			**2**	**37**		
Toluene	**1,000**	2200																	0.5			
Trichloroethene	**5**			**3**	**15**		**37**	**32**	**110**	**100**	**230**	**5**	**12**	**71**		**8**		2	**19**	**20**		
Xylene (total)	**10,000**	2400																	6			

Notes: µg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
WCP-115 and WCP-116 are duplicate samples of WCP-15 and WCP-16, respectively.
All samples collected using the low-flow purge method and the pump discharge sample collection method.
Blank fields indicate analyte not detected above the method detection limit.
Highlighted result indicates exceedance of the AWQS/MCL.

Table 7-16
Detected Organic Compounds in Groundwater
Round 7 - March 2001
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AWQS/MCL	ENT-MW-2	MTP-1	MWB-4	MWB-5	MWB-6	WCP-15	WCP-16	WCP-17	WCP-28	WCP-29	WCP-30	WCP-40	WCP-41	WCP-42	WCP-43	WCP-44	WCP-144	WCP-45	WCP-46	WCP-47	WCP-48	WCP-83	WCP-84	WCP-184	WCP-85	WCP-185	WCP-86	WCP-88	WCP-89	WCP-90	WCP-S87	WCP-D87
1,1-Dichloroethane	**NE**											0.9							0.4													2	2
1,1-Dichloroethene	**7**							**21**	**29**	1	2	**28**							**17**	0.3		0.7		0.6	0.7			0.4				**120**	**130**
1,2-Dichloroethane	**5**							1		2		0.7	2				12												0.4				
2-Butanone (MEK)	**NE**													3												3							
Acetone	**NE**																												8				
Benzene	**5**	**4000**		0.3												1	**250**	**260**											1				
Bromodichloromethane	**100**															0.4														2	0.7		
Carbon tetrachloride	**5**								3			0.3																				2	1
Chloroform	**100**			0.5				0.9	0.5	0.9	0.9	0.7	0.7	1	0.9	1			0.4	0.7	0.3		1	1	1	0.9	0.9	0.9	1		3	0.4	
cis-1,2-Dichloroethene	**70**											0.5		0.5									0.7			0.5	0.5		1			0.6	0.6
Ethylbenzene	**700**	**850**															3	3															
m&p-Xylenes	**NE**	900														0.5	2	2															
Methyl-tert-butyl-ether	**NE**			3		2									4	3				18													
o-Xylene	**10,000**	800															3	3															
Tetrachloroethene	**5**	1	0.8				**30**	**50**	**22**	2	**6**	**120**					1	0.9	35	0.4								0.4	0.9			**160**	**180**
Toluene	**1,000**	2100															9	9															
Trichloroethene	**5**	2	0.6	0.3	**7**		**19**	**68**	**69**	3	**10**	**69**		**10**		2	1	1	**19**	0.4			**13**	3	3	**8**	**7**	1	**70**	1	0.8	**140**	**150**
Xylenes (total)	**10,000**	1800														0.5	6	6															

Notes: µg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
WCP-144, WCP-184, and WCP-185 are duplicate samples of WCP-44, WCP-84, and WCP-85, respectively.
WCP-S87 collected at shallow depth from WCP-87 (pump depth at 124.3 ft bgs).
WCP-D87 was collected at deep depth from WCP-87 (pump depth at 150 ft bgs).
All samples collected using the low-flow purge method and the pump discharge sample collection method.
Blank fields indicate analyte not detected above the method detection limit.
Highlighted result indicates exceedance of the AWQS/MCL.

Table 7-17
Detected Organic Compounds in Groundwater
Round 8 - April and May 2001
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/L)

ANALYTE	ACTION LEVEL AWQS/MCL	ENT-MW-2	MGL-1	MGL-2	MGL-3	MTP-1	MWB-4	MWB-5	MWB-6	WCP-15	WCP-16	WCP-17	WCP-28	WCP-29	WCP-30	WCP-40	WCP-41	WCP-42	WCP-43	WCP-44	WCP-144	WCP-45	WCP-46	WCP-47	WCP-48	WCP-83	WCP-84	WCP-85	WCP-185	WCP-86	WCP-87	WCP-88	WCP-188	WCP-89	WCP-90
1,1-Dichloroethane	**NE**									0.8	0.5				1							0.4									2				
1,1-Dichloroethene	**7**			0.7						**15**	**31**	**42**	3	3	**36**							**14**	0.5		0.6		0.6				**150**				
1,2-Dichloroethane	**5**		**24**	**7**	2					0.9	1		1		0.7	2																			
Acetone	**NE**													3																					
Benzene	**5**	**4800**	**33**											0.5						**310**	**290**											0.5	0.6		
Bromodichloromethane	**100**													0.3													0.2							2	0.7
Carbon tetrachloride	**5**											2			0.5																1				
Chloroform	**100**		0.8	0.8						0.8	1	0.4	0.9	0.9	0.7	0.6	0.8	0.9	1			0.5	0.7	0.4		1	0.9	0.7	0.7	0.8		0.9	0.9		3
cis-1,2-Dichloroethene	**70**														0.6													0.4	0.4		0.6	1	1		
Ethylbenzene	**700**	**1200**												0.3						8	9														
m&p-Xylenes	**NE**	1200																		2	2														
Methyl-tert-butyl-ether	**NE**						0.8							3																					
o-Xylene	**10,000**	1300																		11	12														
Tetrachloroethene	**5**			0.7						**55**	**89**	**16**	**7**	**8**	**130**					0.9	0.9	**20**	0.8				0.3			0.3	**190**	0.8	1		
Toluene	**1,000**	3400																		11	12														
Trichloroethene	**5**		**8**	4	4	0.3		**15**		**48**	**180**	**110**	**9**	**15**	**83**		**10**		3	2	2	**13**	0.5			**12**	2	**6**	**6**	1	**160**	**51**	**51**	1	0.5
Xylenes (total)	**10,000**	2700																		13	14														

Notes:
µg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = EPA Safe Drinking Water Maximum Contaminant Level
NE = None established.
WCP-144, WCP-185, and WCP-188 are duplicate samples of WCP-44, WCP-85, and WCP-88, respectively
All samples collected using the low-flow purge method and the pump discharge sample collection method
Blank fields indicate analyte not detected above the method detection limit.
Highlighted result indicates exceedance of the AWQS/MCL.

Table 7-3
Detected Organic Compounds in Soils
Phase III Well Installation - September to December 1999
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/kg)

SAMPLE_ID	SAMPLE DATE	1,1-Dichloroethene	2-Butanone	2-Hexanone	4-Methyl-2-pentanone	Acetone	Methylene Chloride	Tetrachloroethene	Trichloroethene	Xylene (total)
Action Level - Minimum GPL		**0.81**	**NE**	**NE**	**NE**	**NE**	**NE**	**1.3**	**0.61**	**2,200**
Arizona SRL-Residential		**0.36**	**7,100**	**NE**	**770**	**2,100**	**77**	**53**	**27**	**2,800**
Arizona SRL-Non-residential		**0.8**	**27,000**	**NE**	**2,800**	**8,800**	**180**	**170**	**70**	**2,800**
SB-08-056	08/30/1999							0.044	0.060	
SB-08-071	08/30/1999								0.130	
SB-08-091	08/30/1999							0.110	0.140	
SB-08-106	08/30/1999							0.110	0.130	
SB-08-110	08/30/1999		0.140	0.098	0.087	0.130		0.100	0.130	
SB-08-121	08/30/1999		0.120					0.220	0.270	
SB-09-001	08/31/1999		0.110							
SB-09-006	08/31/1999		0.110							
SB-09-011	08/31/1999		0.094							
SB-09-061	08/31/1999							0.120	0.160	
SB-09-076	08/31/1999					0.160		0.066	0.100	
SB-09-106	08/31/1999					0.100		0.310	0.330	
SB-09-116	08/31/1999	0.046				0.110		0.300	0.260	
SB-09-116D	08/31/1999					0.099		0.260	0.210	
SB-09-121*	08/31/1999					0.140		0.160	0.150	
SB-10-021	09/01/1999								0.062	
SB-10-055	09/01/1999								0.100	
SB-10-096	09/01/1999								0.066	
SB-10-111	09/01/1999							0.200	0.190	
SB-10-121*	09/01/1999							0.360	0.480	
SB-11-001	09/02/1999			0.200	0.140			0.070		
SB-11-091RE	09/02/1999							0.093	0.099	
SB-11-106RE	09/02/1999							0.120	0.110	
SB-11-121DRE*	09/02/1999							0.150	0.130	
SB-11-121RE*	09/02/1999							0.130	0.110	
SB-12-061	09/03/1999							0.220	0.250	
SB-12-096	09/03/1999							0.130		
SB-12-121*	09/03/1999							0.340	0.160	
SB-12-121D*	09/03/1999							0.250	0.140	
SB-13-001	09/07/1999					0.160				
SB-13-006	09/07/1999					0.140				
SB-13-011	09/07/1999		0.110			0.150				
SB-13-021	09/07/1999		0.130			0.200				
SB-13-056	09/07/1999		0.130			0.150				
SB-13-061	09/07/1999					0.780		0.180	0.180	
SB-13-061D	09/07/1999		0.150					0.078	0.078	
SB-13-071	09/07/1999					0.210		0.064	0.070	

Table 7-3
Detected Organic Compounds in Soils
Phase III Well Installation - September to December 1999
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/kg)

SAMPLE_ID	SAMPLE DATE	1,1-Dichloroethene	2-Butanone	2-Hexanone	4-Methyl-2-pentanone	Acetone	Methylene Chloride	Tetrachloroethene	Trichloroethene	Xylene (total)
Action Level - Minimum GPL		**0.81**	**NE**	**NE**	**NE**	**NE**	**NE**	**1.3**	**0.61**	**2,200**
Arizona SRL-Residential		**0.36**	**7,100**	**NE**	**770**	**2,100**	**77**	**53**	**27**	**2,800**
Arizona SRL-Non-residential		**0.8**	**27,000**	**NE**	**2,800**	**8,800**	**180**	**170**	**70**	**2,800**
SB-14-001	09/08/1999							0.062		
SB-14-021	09/08/1999							0.072	0.073	
SB-14-041	09/08/1999							0.084	0.094	
SB-14-061	09/08/1999							0.180	0.250	
SB-14-096	09/08/1999							0.088	0.100	
SB-15-061	09/09/1999							0.150	0.150	
SB-15-071	09/09/1999					0.190				
SB-15-081	09/09/1999									
SB-15-096	09/09/1999			0.130	0.110	0.640		0.190	0.170	
SB-15-106	09/09/1999					0.140		0.240	0.170	
SB-16-006	09/13/1999		0.120							
SB-16-046	09/13/1999								0.130	
SB-16-061	09/13/1999								0.076	
SB-16-071	09/13/1999							0.140	0.190	
SB-16-091	09/13/1999					0.220				
SB-16-106	09/13/1999					0.500		0.160	0.170	
SB-16-121*	09/13/1999					0.270		0.310	0.330	
SB-17-001	09/15/1999					0.110		0.093		
SB-17-021	09/15/1999							0.069	0.074	
SB-17-041	09/15/1999								0.050	
SB-17-056	09/15/1999							0.096	0.120	
SB-17-071	09/15/1999							0.057	0.080	
SB-17-091	09/15/1999							0.150	0.190	
SB-17-111	09/15/1999						0.220			
SB-17-120*	09/15/1999						0.180	0.081	0.058	
WCP-40-016	09/27/1999					0.100				
WCP-40-086	09/27/1999					0.150				
WCP-40-121*	09/27/1999		0.100			0.120				
WCP-40-121D*	09/27/1999					0.180				
WCP-42-111D*	10/01/1999					0.140				0.084

Notes: mg/kg = milligrams per kilogram
GPL = Groundwater Protection Limit
SRL = Soil Remediation Level
NE = None established
D = Duplicate
RE = Replicate
DRE = Duplicate/Replicate
Blank field indicates analyte not detected above the method detection limit.
* Indicates sample collected from the saturated zone.

Table 7-4
Detected Organic Compounds in Soils
Phase IV and V Well Installation
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/kg)

Phase IV SAMPLE ID	SAMPLE DATE	Acetone	Bromo-methane	Chloromethane	m&p-Xylenes	Trichloro-ethene	Xylenes (total)
Action Level - Minimum GPL		**NE**	**NE**	**NE**	**NE**	**0.61**	**2,200**
Arizona SRL - Residential		**2,100**	**6.8**	**12**	**NE**	**27**	**2,800**
Arizona SRL - Non-residential		**8,800**	**23**	**26**	**NE**	**70**	**2,800**
WCP-MW-085-021	1/8/2001			0.065			
WCP-MW-085-086	1/8/2001	0.048		0.035			0.053
WCP-MW-090-016	1/17/2001			0.044			

Phase V SAMPLE ID	SAMPLE DATE	Acetone	Bromo-methane	Ethylbenzene	m&p-Xylenes	Trichloro-ethene	Xylenes (total)
Action Level - Minimum GPL		**NE**	**NE**	**120**	**NE**	**0.61**	**2,200**
Arizona SRL - Residential		**2,100**	**6.8**	**1,500**	**NE**	**27**	**2,800**
Arizona SRL - Non-residential		**8,800**	**23**	**2,700**	**NE**	**70**	**2,800**
WCP-MW-093-126*	07/24/01					0.180	
WCP-MW-093-126D*	07/24/01					0.200	
WCP-MW-097-016	07/02/01	0.360			0.085		0.088
WCP-MW-097-086	07/02/01			0.024	0.095		0.098
WCP-MW-097-116	07/02/01	0.380					

Notes:
mg/kg = micrograms per kilogram
GPL = Groundwater Protection Limit
SRL = Arizona Soil Remediation Level
NE = None established.
Blank fields indicate analyte not detected above method detection limit.
WCP-MW-093-126D is a field duplicates of WCP-MW-093-126.
* Indicates sample collected from the saturated zone.

Table 7-5
Detected Organic Compounds in Soils
Phase VI Well Installation - November and December 2001
WCP East Grand Avenue WQARF Site Remedial Investigation
(mg/kg)

SAMPLE ID	SAMPLE DATE	1,1,2-Trichloroethane	1,1-Dichloroethene	Bromomethane	Chlorobenzene	m/p-Xylenes	Tetrachloroethene	Trichloroethene
Action Level - Minimum GPL		**NE**	**0.81**	**NE**	**NE**	**NE**	**1.3**	**0.61**
Arizona SRL - Residential		**6.5**	**0.36**	**7**	**65**	**NE**	**53**	**27**
Arizona SRL - Non-residential		**15**	**0.8**	**23**	**220**	**NE**	**170**	**70**
WCP-MW-100-056	11/20/01						0.077	0.087
WCP-MW-100-071	11/20/01						0.190	0.210
WCP-MW-100-091	11/20/01						0.110	0.120
WCP-MW-100-116	11/20/01						0.170	0.160
WCP-MW-100-121	11/20/01						0.190	0.160
WCP-MW-100-121D	11/20/01						0.250	0.200
WCP-MW-100-126	11/20/01						0.170	
WCP-MW-200-026	11/16/01	0.030						
WCP-MW-200-116	11/16/01		0.057		0.022	0.050		
WCP-MW-200-121	11/16/01		0.130		0.029	0.066		
WCP-MW-200-126	11/16/01		0.140		0.028	0.063		

Notes: mg/kg = micrograms per kilogram
GPL = Groundwater Protection Limit
SRL = Arizona Soil Remediation Level
Blank fields indicate analyte not detected above method detection limit.
WCP-MW-100-121D is a field duplicate of WCP-MW-100-121.
* Indicates sample collected from the saturated zone.

Table 7-6
Detected Organic Compounds in HydropunchÒ Samples
Phase III Well Installation
WCP East Grand Avenue WQARF Site Remedial Investigation
(µg/L)

BORING	SAMPLE ID	SAMPLE DATE	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Acetone	Benzene	Bromodichloromethane	Carbon Tetrachloride	Chloroform	cis-1,2-Dichloroethene	m/p-Xylene	Methylene Chloride	Tetrachloroethene	Trichloroethene	Xylene (total)
Action Level - AWQS/MCL			**NE**	**7**	**5**	**NE**	**5**	**100**	**5**	**100**	**70**	**NE**	**5**	**5**	**5**	**10,000**
SB-8	HP-08-123	08/30/1999	7	**300**					3	2	2		1	**2500**	**3000**	
SB-9	HP-09-123	08/31/1999	5	**140**					4	1				**1800**	**1600**	
SB-10	HP-10-123	09/01/1999	10	**550**			0.6		**7**	4	4		1	**2800**	**3800**	
SB-11	HP-11-123	09/02/1999	6	**81**		8			2	2	2			**760**	**760**	
SB-12	HP-12-124	09/03/1999	4						1	1	2			**460**	**340**	
SB-13	HP-13-129	09/07/1999		**14**						0.5				**49**	**42**	
SB-14	HP-14-129	09/08/1999		6										**22**	**16**	
SB-15	HP-15-128	09/09/1999	1	**49**					0.8	0.7			0.7	**170**	**94**	
SB-15	HP-15-142	09/09/1999												1	0.8	
SB-16	HP-16-122	09/13/1999	8	**350**			0.5		**5**	2	4		0.7	**1400**	**1700**	
SB-16	HP-16-141	09/13/1999		1	2					1				4	5	
SB-17	HP-17-122	9/15/1999	9	**280**			0.5		**5**	3	4			**2500**	**2400**	
SB-17	HP-17-142	09/16/1999								0.7				1	2	
SB-17	HP-17-142D	09/16/1999								0.8				1	2	
WCP-40	HP-WCP-40-121	09/27/1999						0.2		0.8						
WCP-41	HP-WCP-41-121	09/29/1999		3										3	4	
WCP-42	HP-WCP-42-121	10/01/1999								0.6						
WCP-45	HP-WCP-45-130	10/06/1999		1												
WCP-44	HP-WCP-44-125	12/01/1999					**1100**					5			0.8	6

Notes: µg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = Safe Drinking Water Maximum Contaminant Level
NE = None established
D = Duplicate Sample
Blank field indicates analyte not detected above the method detection limit.
Highlighted results indicate an exceedance of the AWQS/MCL.

Table 7-7
Detected Organic Compounds in HydropunchÒ Samples
Phase IV Well Installation - Jan to Feb 2001
WCP East Grand Avenue WQARF Site
(mg/L)

BORING	SAMPLE ID	SAMPLE DATE	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloropropane	Acetone	Benzene	Bromodichloromethane	Carbon tetrachloride	Chloroform	cis-1,2-Dichloroethene	m&p-Xylenes	Tetrachloroethene	Trichloroethene	Xylenes (total)
Action Level (AWQS/MCL)			**5**	**NE**	**7**	**5**	**NE**	**5**	**100**	**5**	**100**	**70**	**NE**	**5**	**5**	**10,000**
WCP-47	WCP-HP-047-126	1/15/2001					2									
WCP-83	WCP-HP-083-121	1/22/2001									3				2	
WCP-84	WCP-HP-084-126	1/24/2001			0.4						0.5				2	
WCP-84	WCP-HP-184-126	1/24/2001			0.4						0.5				2	
WCP-85	WCP-HP-85-121	1/8/2001										0.4				
WCP-86	WCP-HP-086-126	1/10/2001									1			1	0.9	
WCP-87	WCP-HP-087-126	1/26/2001						**5**					0.5	0.5		0.6
WCP-87	WCP-HP-087-152	1/29/2001		2	**130**					1		0.6		**200**	**160**	
WCP-88	WCP-HP-088-131	1/30/2001						2			0.4			0.3	3	
WCP-89	WCP-HP-089-131	2/1/2001	0.4			0.4	9		27		1					
WCP-90	WCP-HP-090-131	1/18/2001					4		1		4				1	

Notes:
μg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = Safe Drinking Water Maximum Contaminant Level
NE = None established
Blank field indicates analyte not detected above the method detection limit.
Highlighted results indicate an exceedance of the AWQS/MCL.

Table 7-8
Detected Organic Compounds in Hydropunch® Samples
Phase V Well Installation - July 2001
WCP East Grand Avenue Remedial Investigation
(mg/L)

BORING	SAMPLE ID	SAMPLE DATE	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Acetone	Bromodichloromethane	Carbon tetrachloride	Chloroform	Chloromethane	cis-1,2-Dichloroethene	Dibromochloromethane	Methylene chloride	Tetrachloroethene	Trichloroethene
Action Level (AWQS/MCL)			**NE**	**7**	**5**	**NE**	**100**	**5**	**100**	**NE**	**70**	**100**	**5**	**5**	**5**
WCP-92	WCP-HP-092-121	07/16/01		2	2	4				0.7				0.7	**10**
WCP-93	WCP-HP-093-131	07/24/01	3	**150**				1	2	4	1		1	**420**	**1500**
WCP-96	WCP-HP-096-121	07/20/01								2				4	
WCP-97	WCP-HP-097-126	07/02/01												1	
WCP-98	WCP-HP-098-121	07/10/01								0.8					
WCP-94	WCP-HP-94-126	07/18/01					0.7		2	0.8					2
WCP-95	WCP-HP-95-111	07/05/01					10		21			1	0.5		

Notes:
µg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = Safe Drinking Water Maximum Contaminant Level
NE = None established.
Blank fields indicate analyte not detected above the method detection limit.
Highlighted results indicate an exceedance of the AWQS/MCL.
Results are unvalidated.

Table 7-9

Detected Organic Compounds in Hydropunch® Samples

Phase VI Well Installation - Nov and Dec 2001

WCP East Grand Avenue WQARF Site Remedial Investigation

(mg/L)

BORING	SAMPLE ID	SAMPLE DATE	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Carbon tetra-chlorid	Chloroform	cis-1,2-Dichloroethe	Tetrachloroethene	Trichloroethene
Action Level (AWQS/MCL)			**NE**	**7**	**5**	**5**	**100**	**70**	**5**	**5**
WCP-100	WCP-HP-100-153	11/20/01		1	0.6		0.8		3	4
WCP-200	WCP-HP-200-153	11/19/01	1	**76**	1	0.9	1	0.5	**370**	**410**

Notes:
μg/L = micrograms per liter
AWQS = Arizona Aquifer Water Quality Standard
MCL = Safe Drinking Water Maximum Contaminant Level
NE = None established.
Blank fields indicate analyte not detected above the method detection limit.
Highlighted results indicate an exceedance of the AWQS/MCL.

Table 7-2
Physical Properties of Soil
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample ID	Soil Type	Laboratory	Void Ratio	Total Porosity (%)	Moisture Content (%)	Bulk Density[1] (g/cm^3)	Specific Gravity	Total Organic Carbon [2] (%)	Permeability (cm/sec)
SB-14-036	Silty sand	ATL	0.459	31.5	10.6	1.998	2.641	<0.08 [3]	8.46×10^{-4}
SB-14-056	Silty sand	ATL	0.585	36.9	9.6	1.891	2.740	<0.07 [3]	4.23×10^{-2}
SB-14-111	Sandy silt	ATL	0.869	46.5	26.2	1.765	2.620	<0.08 [3]	1.69×10^{-3}
SB-15-167	Silt with sand	ATL	0.876	46.7	31.7	1.797	2.566	<0.12 [3]	1.05×10^{-2}
SB-17-006	Sandy silt	ATL	1.021	50.5	17.9	1.503	2.581	<0.09 [3]	--
SB-17-071	Silt	ATL	0.768	43.4	16.6	1.754	2.665	<0.08 [3]	2.12×10^{-3}
SB-17-106	Sandy silt	ATL	0.617	38.2	17.1	1.826	2.528	<0.08 [3]	6.35×10^{-3}
SB-17-136	Poorly graded sand	ATL	0.889	47.1	21.9	1.668	2.590	<0.09 [3]	4.23×10^{-3}
WCP-47-126	Silty sand	ATL	0.413	29.2	13.6	2.177	2.714	NT	1.8×10^{-5}
WCP-84-126	Silty sand	ATL	0.459	31.4	15.6	2.163	2.735	NT	9.7×10^{-5}
WCP-84-141	Silt with sand	ATL	0.917	47.8	31.5	1.849	NT	NT	2.7×10^{-6}
WCP-84-151	Silty sand	ATL	0.444	30.8	15.1	2.151	2.705	NT	8.9×10^{-4}
WCP-85-126	Silty sand	ATL	0.825	45.2	30.4	1.898	2.662	NT	2.1×10^{-6}
WCP-87-126	Silty sand	ATL	NT	NT	NT	NT	NT	NT	1.7×10^{-4}
WCP-87-131	Silty sand	ATL	0.686	40.7	22.5	1.978	2.728	NT	2.8×10^{-6}
WCP-87-151	Silt	ATL	0.365	26.8	13.3	2.236	NT	NT	1.8×10^{-6}
WCP-88-131	Sandy silt	ATL	0.713	41.6	24.9	1.986	2.729	NT	1.3×10^{-5}
WCP-92-121	Silty sand	PNL	NT	30.9	10.7	2.240	NT	ND	7.4×10^{-6}
WCP-92-135	Sandy silt	PNL	NT	50.6	22.1	1.990	NT	ND	1.8×10^{-6}

Table 7-2 (continued)
Summary of Soil Physical Properties
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample ID	Soil Type	Laboratory	Void Ratio	Total Porosity (%)	Moisture Content (%)	Bulk Density[(1)] (g/cm^3)	Specific Gravity	Total Organic Carbon [(2)] (%)	Permeability (cm/sec)
WCP-92-145	Sandy silt	PNL	NT	47	21.1	2.058	NT	ND	1.4×10^{-5}
WCP-93-121	Sandy silt	PNL	NT	49	21.1	2.020	NT	ND	2.6×10^{-6}
WCP-93-131	Sandy silt	PNL	NT	54.8	22.5	1.798	NT	ND	8.5×10^{-6}
WCP-93-146	Sandy silt	PNL	NT	44.4	15.2	1.994	NT	ND	4.3×10^{-6}
WCP-95-131	Silty sand	PNL	NT	51.6	24.4	1.986	NT	ND	1.4×10^{-5}
WCP-95-140	Clayey sand	PNL	NT	53	25.1	1.994	NT	ND	6.7×10^{-6}
WCP-96-121	Poorly graded sand	PNL	NT	36.6	12.8	2.137	NT	ND	1.3×10^{-5}
WCP-96-136	Silty sand	PNL	NT	47.9	19.2	1.998	NT	ND	4.3×10^{-6}
WCP-96-151	Silt	PNL	NT	64	37.2	1.795	NT	ND	1.4×10^{-6}
WCP-97-126	Silty sand	PNL	NT	57.3	28.5	1.870	NT	ND	2.3×10^{-6}
WCP-97-136	Silt	PNL	NT	60.2	30.2	1.824	NT	ND	2.0×10^{-7}
WCP-97-151	Silty sand	PNL	NT	51.5	22.7	1.971	NT	ND	5.9×10^{-6}

(1) Wet density results presented. Units have been converted to g/cm^3 for this table.
(2) Total Organic Carbon by the Walkley-Black Method.
(3) Walkley-Black results reported by Severn Trent Laboratories

-- = Laboratory was unable to run sample
% = percent
cm/sec = centimeters per second
ATL = ATL, Inc., Geotechnical Consultants
PNL = Phoenix National Laboratories, Inc.
NT = Not tested
ND = Not detected

Table 7-1
Physico-Chemical Properties of Contaminants of Concern
WCP East Grand Avenue WQARF Site RI

Chemical	Specific Gravity	Water Solubility [1] (mg/L)	Vapor Pressure[2] (mm Hg)	Henry's Law Constant[2] (atm-m^3/mol)	K_{oc}[3] (mL/g)
PCE	1.62	150	18.5	1.77×10^{-2}	303
TCE	1.46	1,100	69	9.85×10^{-3}	152
1,1-DCE	1.21	400	591	2.61×10^{-2}	217

(1) Cohen, R.M. and J. W. Mercer, DNAPL Site Evaluation. 1993.

Solubility at 25 °C.

(2) Toxicology Data Network, National Library of Medicine (Toxnet). Hazardous Substance Data base, http://toxnet.nlm.nih.gov (28 Aug 2001).

Vapor pressure and Henry's Law Constants at 25 °C.

(3) Fetter, C.W., Applied Hydrogeology. 1994.

Table 6-4
Summary of Field Quality Control Sample Results [1,2]
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	QC Sample	Affected SDG	Detected Contaminant	Data Validation Recommendation [3,4]
Vadose Zone Investigation (SB8 through SB17)	Trip Blanks	9909G970 9909G850	Methylene chloride	No flags were recommended for affected samples that were non-detect. The reporting limit was raised for samples with positive results.
	Equipment Blanks	9909G828	Methylene chloride	No data qualifiers were recommended because these compounds were not detected in the laboratory blanks, trip blanks, and associated samples for the affected SDGs.
		9909G838	Chloroethane, 1,1-dichloroethene, methylene chloride, and cis-1,2,-dichloroethene	
		9909G880	1,1-dichloroethene and 4-methyl-2-pentanone	
	Field Duplicates			All analytes that were not non-detect had RPDs within the acceptance criteria.
Phase III Well Installation (WCP-40 through WCP-46)	Trip Blanks	9909G328 9909G138	Chloromethane, 2-butanone, 4-methyl-2-pentanone, and 2-hexanone	No flags were recommended for affected samples that were non-detect. The reporting limit was raised for samples with positive results.
	Equipment Blanks	9910G241 9910G328 9912G006 9912G043	Acetone and 4-methyl-2-pentanone	All affected samples were non-detect for 4-methyl-2-pentanone therefore flags were not required. The reporting limit for affected samples with positive acetone results was raised to the observed sample concentration.
	Field Duplicates			All analytes that were not non-detect had RPDs within the acceptance criteria.
Groundwater Samples (Round 1)	Trip Blanks		None	Not applicable.
	Equipment Blanks	9912G405 9A01G414	Acetone	Acetone was not detected in any of the associated samples. No data qualifiers were recommended.
	Field Duplicates	9912G405	cis-1,2-dichloroethene	WCP-15 - 3 µg/L; Duplicate - 4 µg/L; RPD = 28.6
Groundwater Samples (Round 2)	Trip Blanks			No analytes were found above the detection limit.
	Equipment Blanks	9A02G872	Acetone, toluene, and m,p-xylenes	These compounds were not detected in the samples. No data qualifier flags were recommended.
	Field Blanks	9A02G872	Acetone, toluene, and m,p-xylenes	These compounds were not detected in the samples. No data qualifier flags were recommended
	Field Duplicates	9A02G872	1,1-dichloroethene	WCP-30 – 69 µg/L; Duplicate – 54 µg/L; RPD = 24.4

Table 6-4 (continued)
Summary of Field Quality Control Sample Results [1,2]
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	QC Sample	Affected SDG	Detected Contaminant	Data Validation Recommendation [3,4]
Groundwater Samples (Round 3)	Trip Blanks			No analytes were found above the detection limit
	Equipment Blanks	9A03G239	Acetone	None of these analytes were detected in the samples. No data qualifiers recommended.
		9A03G270	Acetone, benzene, toluene, m,p-xylenes, total xylenes	
		9A03G271	Acetone	
	Field Blanks	9A03G239	Acetone	Acetone was not detected in the samples. No data qualifiers recommended.
	Field Duplicates	9A03G239 9A03G270		All analytes with positive results had acceptable RPDs.
Groundwater Samples (Round 4)	Trip Blanks	9A06G630 9A06G666	Methylene chloride	Not detected in the samples. No qualifiers recommended.
		9A06G682	Methylene chloride Methyl-tert-butyl-ether	The reporting limit of affected samples was raised to the observed concentration.
	Equipment Blanks	9A06G630	Methylene chloride, acetone, carbon disulfide, chloroform	Methylene chloride, acetone, and carbon disulfide were not detected in the samples. No qualifiers were recommended. Chloroform was detected in samples. The reporting limit of affected samples was raised to the observed concentration.
	Field Blanks	9A06G630	Methylene chloride, acetone, carbon disulfide, chloroform	
	Field Duplicates	9A06G666 9A06G682		All analytes with positive results had acceptable RPDs.
Deep Well Installation (WCP-48)	Trip Blanks	9A06G746	Methyl-tert-butyl-ether	Not detected in the samples. No qualifiers recommended.
		9A06G811	Bromomethane	The reporting level in affected samples was raised to the observed concentration.
		9A06G810 9A08G428	Methylene Chloride	Not detected in the samples. No qualifiers recommended.
	Equipment Blanks			All analytes reported as non-detect.
	Field Duplicates	9A06G810		All analytes reported as non-detect.

Table 6-4 (continued)
Summary of Field Quality Control Sample Results [1,2]
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	QC Sample	Affected SDG	Detected Contaminant	Data Validation Recommendation [3,4]
Groundwater Samples (Round 5)	Trip Blanks	9A09G600	Methylene chloride	The reporting limit of affected samples was raised to the observed concentration.
	Equipment Blanks	9A09G688	Acetone, methylene chloride and trichloroethene	The reporting limit of affected samples was raised to the observed concentration.
	Field Blanks			All analytes reported as non-detect.
	Field Duplicates	9A09G614 9A09G600		All positive results had acceptable RPDs.
Groundwater Samples (Round 6)	Trip Blanks	9A12G073	Acetone and trichloroethene	Acetone not detected in the samples. No data qualifiers were recommended. The reporting limit of samples with less than 5x the blank concentration of TCE was raised to the blank concentration. No flags were recommended for samples with results greater than 5x the blank concentration.
		9A12G076	Trichloroethene and tetrachloroethene	Not detected in associated samples. No qualifier flags recommended.
	Equipment Blanks			All analytes reported as non-detect.
	Field Blanks			All analytes reported as non-detect.
	Field Duplicates	9A12G065	Tetrachloroethene	WCP-15 – 47 µg/L; Duplicate – 61 µg/L; RPD 25.9
		9A12G073		All positive results had acceptable RPDs.
Phase IV Well Installation	Trip Blanks			All analytes were reported as non-detects.
	Equipment Blanks			All analytes were reported as non-detects.
	Field Blanks			All analytes were reported as non-detects.
	Field Duplicates	201757 201850		All analytes were reported as non-detect.
Groundwater Samples (Round 7)	Trip Blanks	202148	Acetone	The reporting limit of affected samples was raised to the observed concentration if the sample concentration was less than 10x the concentration of the blank. If greater than 10x the blank concentration, no flags were recommended.
		202167	Acetone and 2-butanone	Affected samples flagged as explained above.

Table 6-4 (continued)
Summary of Field Quality Control Sample Results [1,2]
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	QC Sample	Affected SDG	Detected Contaminant	Data Validation Recommendation [3,4]
Groundwater Samples (Round 7)	Trip Blanks	202180 202691	Acetone	Affected samples flagged as explained above.
	Equipment Blanks	202148 202251	Acetone	Affected samples flagged as explained above.
	Field Blanks	202148	Acetone	Affected samples flagged as explained above.
	Field Duplicates	202167 202180 202274		All analytes with positive results had acceptable RPDs.
Groundwater Samples (Round 8)	Trip Blanks	203007	Acetone	The reporting limit of affected samples was raised to the observed concentration
		203050 203083	Acetone	Not detected in the samples; no additional flags were necessary regarding blank contamination.
	Equipment Blanks	203196	Acetone	Not detected in samples. No data qualifier flags recommended.
	Field Blanks			All analytes were reported as non-detect.
	Field Duplicates	203050 203130		All analytes with positive results had acceptable RPDs.
Aquifer Test	Trip Blanks	203546		All analytes were reported as non-detect.
	Equipment Blanks			Not collected.
	Field Blanks			Not collected.
	Field Duplicates			Not collected.
Groundwater Samples (Round 9)	Trip Blanks	203744	Dibromochloromethane	The reporting limit of affected samples was raised to the observed concentration if the sample concentration was less than 5x the concentration of the blank. If greater than 5x the blank concentration, no flags were recommended.
		203808 203820 203837 203894 203957	Acetone	The reporting limit of affected samples was raised to the observed concentration if the sample concentration was less than 10x the concentration of the blank. If greater than 10x the blank concentration, no flags were recommended.

Table 6-4 (continued)
Summary of Field Quality Control Sample Results [1,2]
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	QC Sample	Affected SDG	Detected Contaminant	Data Validation Recommendation [3,4]
	Equipment Blanks			All analytes were reported as non-detect.
	Field Blanks			All analytes were reported as non-detect.
	Field Duplicates	203820 203837		All analytes with positive results had acceptable RPDs.
		203932	1,1-dichloroethene Trichloroethene Tetrachloroethene	WCP-87 – 206 µg/L; Duplicate 145 µg/L; RPD 34.7 WCP-87 – 249 µg/L; Duplicate 153 µg/L; RPD 47.8 WCP-87 – 330 µg/L; Duplicate 175 µg/L; RPD 61.4
Groundwater Samples (Round 10)	Trip Blanks	203988 204015 204041	Acetone	The reporting limit of affected samples was raised to the observed concentration if the sample concentration was less than 10x the concentration of the blank. If greater than 10x the blank concentration, no flags were recommended.
		204093	Acetone, trichloroethene	Samples affected by acetone contamination were flagged as explained above. The reporting limit of samples affected by trichloroethene was raised to the observed concentration if the sample concentration was less than 5x the blank concentration. If greater than 5x the blank concentration, no flags were recommended.
		204143	Acetone, bromomethane, toluene, and methylene chloride	Samples affected by acetone contamination were flagged as explained above. Bromomethane, toluene, and methylene chloride were not detected in the associated samples. No flags were recommended.
		204200	Methylene chloride	Not detected in samples. No flags were recommended.
	Equipment Blanks			All analytes were reported as non-detect.
	Field Blanks			All analytes were reported as non-detect.
Groundwater Sampling (Round 10)	Field Duplicates	204066 204143 204166		All analytes with positive results had acceptable RPDs.

Table 6-4 (continued)
Summary of Field Quality Control Sample Results [1,2]
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	QC Sample	Affected SDG	Detected Contaminant	Data Validation Recommendation [3,4]
Phase V Well Installation	Trip Blanks	204235 204263 204328 204406 204448 204521 204565	Methylene Chloride	No flags were recommended for affected samples that were non-detect. The reporting limit was raised for samples with positive results.
	Equipment Blanks	204406	Chloromethane	No flags were recommended for affected samples that were non-detect. The reporting limit was raised for samples with positive results.
		204565		All analytes were reported as non-detect.
	Field Blank	204406	Methylene Chloride	Not detected in samples. No flags were recommended.
	Field Duplicates	204263		All analytes were reported as non-detect.
		204406 204565		All analytes detected had acceptable RPDs.
Groundwater Sampling (Round 11)	Trip Blanks	204680 204727 204752 204763 204788 204840 204932 204962 204996	Methylene Chloride	No flags were recommended for affected samples that were non-detect. The reporting limit was raised for samples with positive results.
	Equipment Blanks	204698 204816 204962	Acetone Methylene Chloride	All analytes were reported as non-detect.
		204870	Acetone Chloromethane Methylene Chloride	No flags were recommended for affected samples that were non-detect. The reporting limit was raised for samples with positive results.
	Field Blank	204680	Methylene Chloride	All samples were reported as non-detect.
		204763	Acetone Methylene Chloride	All samples were reported as non-detect.

Table 6-4 (continued)
Summary of Field Quality Control Sample Results [1,2]
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	QC Sample	Affected SDG	Detected Contaminant	Data Validation Recommendation [3,4]
	Field Duplicates	204727 204788 204840 204870		All analytes detected had acceptable RPDs.
Groundwater Sampling (Round 12)	Trip Blanks	205606	Trichloroethene	The reporting limit was raised to the observed concentration in the blank if the sample concentration was less than 5x the blank concentration. If greater than 5x the blank concentration, no flags were recommended.
		205632	Methylene Chloride	No flags were recommended for affected samples that were non-detect. The reporting limit was raised for samples with positive results.
	Equipment Blanks	205632		All analytes were reported as non-detect.
	Field Blank	205606	Tetrachloroethene	The reporting limit was raised to the observed concentration in the blank if the sample concentration was less than 5x the blank concentration. If greater than 5x the blank concentration, no flags were recommended.
	Field Duplicates	205632		All analytes detected had acceptable RPDs.
		205676	Methylene Chloride	WCP-16 – 0.6 µg/L; Duplicate 1.0 µg/L; RPD 50.0
Groundwater Sampling (Round 13)	Trip Blanks	206374 206491 206602	Methylene Chloride	No flags were recommended for affected samples that were non-detect. The reporting limit was raised for samples with positive results.
	Equipment Blanks	206436 206472 206538 206602		All analytes were reported as non-detect.
	Field Blank	206406		All analytes were reported as non-detect.
	Field Duplicates	206734 206436 206491		All analytes detected had acceptable RPDs.
		206602	Chloroform\ cis-1,1-dichloroethene	WCP-93 – 2 µg/L; Duplicate 1 µg/L; RPD 66.7 WCP-93 – 2 µg/L; Duplicate 0.9 µg/L; RPD 75.8

Table 6-4 (continued)
Summary of Field Quality Control Sample Results [1,2]
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	QC Sample	Affected SDG	Detected Contaminant	Data Validation Recommendation [3,4]
Phase VI Well Installation	Trip Blanks	206679 206768 206803 206945	Acetone and methylene chloride	Not detected in samples. No flags were necessary.
		206740 207017	Methylene chloride	Not detected in samples. No flags were necessary.
	Equipment Blanks	206803 207017		All analytes were reported as non-detect.
	Field Blank	206803		All analytes were reported as non-detect.
	Field Duplicates	206803 207017 207254		All analytes detected had acceptable RPDs.
Groundwater Sampling (Round 14)	Trip Blanks	207154 207292 207313		All analytes either not detected or detected below the reporting limits.
	Equipment Blanks			None collected.
	Field Blank			None collected.
	Field Duplicates			None collected.
Groundwater Sampling (Round 15)	Trip Blanks			All analytes either not detected or detected below the reporting limits.
	Equipment Blanks	207752		All analytes either not detected or detected below the reporting limits.
		207869	Tetrachloroethene and trichloroethene	The reporting limit was raised to the observed concentration in the blank if the sample concentration was less than 5x the blank concentration. If greater than 5x the blank concentration, no flags were recommended.
	Field Blank	207673 207804		All analytes either not detected or detected below the reporting limits.
	Field Duplicates	207752	Chloroform	WCP-90 – 3 µg/L; Duplicate 4 µg/L; RPD 28.6
		207804		All analytes were reported as non-detect.
		207869	Trichloroethene	WCP-202– 2 µg/L; Duplicate – 3 µg/L; RPD 40.0

Table 6-4 (continued)
Summary of Field Quality Control Sample Results [1,2]
WCP East Grand Avenue WQARF Site Remedial Investigation

Notes:

1) Analyses of blank samples were not detected above the method detection limit (MDL) unless listed otherwise.

2) Analyses of field duplicates were within the relative percent difference (RPD) acceptance criteria unless listed otherwise. Values near the MDL often result in a high RPD. When the data were near the MDL, a “five times” rule was used in evaluating the RPD of field duplicates. Results greater than five times the MDL were evaluated against the criteria listed in the QAPP (RPD ≤20% for water, ≤50% for soil). RPDs for analyte concentrations that were less than five times the MDL were evaluated on a case-by-case basis.

3) For blank samples with detected contaminants that are common laboratory contaminants (acetone, 2-butanone, methylene chloride), data qualifiers were not applied to associated sample results that were less than ten times the highest blank result. Instead, the reporting limit was raised to the observed concentration. No flags were recommended for those samples that were non-detect or greater than ten times the blank concentration.

4) For blank samples with detected contaminants that are not common laboratory contaminants, data qualifiers were not applied to associated sample results that were less than five times the highest blank result. Instead, the reporting limit was raised to the observed concentration. No flags were recommended for those samples that were non-detect or greater than five times the blank concentration.

SDG = Sample delivery group

Table 6-1
Performance Evaluation Sample Results
December 1999
WCP East Grand Avenue WQARF Site Remedial Investigation

Compound	Value Reported (µg/L)	True Value (µg/L)	Lower Control Limit (µg/L)	Upper Control Limit (µg/L)	Acceptable Result?	Percent Recovery
Benzene	14	17.8	14.2	21.4	No	78.6
Carbon Tetrachloride	17	16.7	13.4	20	Yes	101.8
Chlorobenzene	6	6.98	4.19	9.77	Yes	85.9
1,2-Dichloroethane	14	14.0	11.2	16.8	Yes	100
1,1-Dichloroethene	12	13.8	11	16.6	Yes	86.9
cis-1,2-Dichloroethene	6	8.05	4.83	11.3	Yes	74.5
trans-1,2-Dichloroethene	7	9.11	5.47	12.8	Yes	76.8
1,2-Dichloropropane	13	15.8	12.6	19	Yes	82.2
Ethylbenzene	13	14.8	11.8	17.8	Yes	87.8
Methylene chloride	8	10.8	8.64	13	No	74.1
Styrene	ND	14.7	11.8	17.6	No	NC
Tetrachloroethene	17	18.4	14.7	22.1	Yes	92.4
Toluene	11	11.6	9.28	13.9	Yes	94.8
1,1,1-Trichloroethane	7	8.33	5.00	11.7	Yes	84.0
1,1,2-Trichloroethane	10	10.4	8.32	12.5	Yes	96.2
Trichloroethene	16	15.0	12.0	18	Yes	106.0
Vinyl chloride	7	8.6	5.16	12	Yes	81.4
o-Xylene	8	8.62	5.17	12.1	Yes	92.8
m/p-Xylenes	23	25.4	20.34	30.5	Yes	90.5
Xylenes, total	32	34.0	27.2	40.8	Yes	94.0
					Average Percent Recovery	88.4

Total Number of Possible Results	20
Number of Acceptable Results	17
Number of Unacceptable Results	3
Percent of Acceptable Results	85%

NC = Not Calculable
ND = Not detected above the method detection limit
µg/L = micrograms per liter

Table 6-2
Performance Evaluation Sample Results
May 2, 2001
WCP East Grand Avenue WQARF Site Remedial Investigation

Compound	Value Reported (µg/L)	True Value (µg/L)	Lower Control Limit (µg/L)	Upper Control Limit (µg/L)	Acceptable Result?	Percent Recovery
Benzene	6.0	6.55	3.93	9.17	Yes	91.6
Carbon Tetrachloride	7.0	10.7	8.56	12.8	No	65.4
Chlorobenzene	9.0	11.4	9.12	13.7	No	78.9
1,2-Dichloroethane	11.0	13.4	10.7	16.1	Yes	82.1
1,1-Dichloroethene	4.0	4.05	2.43	5.67	Yes	98.8
cis-1,2-Dichloroethene	31.0	31.7	25.4	38.0	Yes	97.8
trans-1,2-Dichloroethene	9.0	9.17	5.5	12.8	Yes	98.1
1,2-Dichloropropane	6.0	6.34	3.8	8.88	Yes	94.6
Ethylbenzene	2.0	2.77	1.66	3.88	Yes	72.2
Methylene chloride	19.0	18.9	15.1	22.7	Yes	100.5
Styrene	8.0	9.31	5.59	13.0	Yes	85.9
Tetrachloroethene	9.0	13.1	10.5	15.7	No	68.7
Toluene	16.0	19.3	15.4	23.2	Yes	82.9
1,1,1-Trichloroethane	9.0	11.9	9.52	14.3	No	75.6
1,1,2-Trichloroethane	18.0	16.3	13.0	19.6	Yes	110.4
Trichloroethene	8.0	9.7	5.82	13.6	Yes	82.5
Vinyl chloride	20.0	25.0	15.0	35.0	Yes	80.0
o-Xylene	5.0	6.38	3.83	8.93	Yes	78.4
m/p-Xylene	18.0	25.51	18.43	32.6	No	70.6
Xylenes, total	25.0	31.9	25.5	38.8	No	78.4
Average Percent Recovery						84.7

Total Number of Possible Results	20
Number of Acceptable Results	14
Number of Unacceptable Results	6
Percent of Acceptable Results	70%

µg/L = micrograms per liter

Table 6-3
Performance Evaluation Sample Results
May 7, 2001
WCP East Grand Avenue WQARF Site Remedial Investigation

Compound	Value Reported (µg/L)	True Value (µg/L)	Lower Control Limit (µg/L)	Upper Control Limit (µg/L)	Acceptable Result?	Percent Recovery
Benzene	5	5.24	3.14	7.34	Yes	95.4
Carbon Tetrachloride	9	8.56	6.85	10.2	Yes	105.1
Chlorobenzene	8	9.12	7.3	10.9	Yes	87.7
1,2-Dichloroethane	11	10.7	8.58	12.9	Yes	102.8
1,1-Dichloroethene	4	3.24	1.94	4.54	Yes	123.5
cis-1,2-Dichloroethene	23	25.4	20.3	30.4	Yes	90.6
trans-1,2-Dichloroethene	8	7.34	4.4	10.2	Yes	109.0
1,2-Dichloropropane	5	5.07	3.04	7.10	Yes	98.6
Ethylbenzene	2	2.22	1.33	3.10	Yes	90.1
Methylene chloride	16	15.1	12.1	18.1	Yes	106.0
Styrene	7	7.45	4.47	10.4	Yes	94.0
Tetrachloroethene	9	10.5	8.38	12.6	Yes	85.7
Toluene	15	15.4	12.4	18.5	Yes	97.4
1,1,1-Trichloroethane	10	9.52	7.62	11.4	Yes	105.0
1,1,2-Trichloroethane	14	13.0	10.4	15.6	Yes	107.7
Trichloroethene	8	7.76	4.66	10.9	Yes	103.1
Vinyl chloride	19	20.0	12.0	28.0	Yes	95.0
o-Xylene	5	5.10	3.06	7.15	Yes	98.0
m/p-Xylene	17	20.4	14.8	26.1	Yes	83.5
Xylenes, total	24	25.5	20.4	30.6	Yes	94.1
Average Percent Recovery						98.6

Total Number of Possible Results	20
Number of Acceptable Results	20
Number of Unacceptable Results	0
Percent of Acceptable Results	100%

µg/L = micrograms per liter

Table 5-1
Monitor Well Construction Details
WCP East Grand Avenue WQARF Site
Remedial Investigation

Well ID	ADEQ Well No.	Property Owner Contact Information[1]	ADWR Registration No.	Install Date	Casing		Screen		Screened Interval (ft bgs)	Total Well Depth (ft bgs)	Total Boring Depth (ft bgs)	Sand Pack	TOC Elev (ft amsl)/ Survey Date	Well Abandonment	Latitude	Longitude	Datum
					Material	Length (ft)	Material	Length (ft)									
WCP-15	57140	Bakala Investment Properties, L.L.C.	55-561071	3/18/1997	4" Dia. Sch. 40 PVC	95	0.01" Slotted PVC	30	95-125	125	127	10-20 Colorado Silica Sand	1109.28 / 4/2/1997	Yes	33º29'20"	112º07'17"	NAD 27
WCP-16	57141	Bakala Investment Properties, L.L.C.	55-561072	3/17/1997	4" Dia. Sch. 40 PVC	95	0.01" Slotted PVC	31	95-126	126	136	10-20 Colorado Silica Sand	1108.71 / 4/2/1997	No	33º29'19"	112º07'15"	NAD 27
WCP-17	57142	City of Phoenix	55-561073	3/19/1997	4" Dia. Sch. 40 PVC	95	0.01" Slotted PVC	30	95-125	125	127	10-20 Colorado Silica Sand	1106.61 / 4/2/1997	No	33º29'15"	112º07'18"	NAD 27
WCP-28	58848	Leonard R. Destremps and Cheryl H. Destremps	55-568218	5/26/1998	4" Dia. Sch. 40 PVC	99.5	0.01" Slotted PVC	40	99.5-139.5	139.5	141.5	8-12 Colorado Silica Sand	1108.65	No	33º29'19.84"	112º07'15.15"	NAD 27
WCP-29	58849	Leonard R. Destremps and Cheryl H. Destremps	55-568217	5/28/1998	4" Dia. Sch. 40 PVC	99.5	0.01" Slotted PVC	40	99.5-139.5	139.5	141.5	8-12 Colorado Silica Sand	1108.7	No	33º29'19.21"	112º07'15.03"	NAD 27
WCP-30	58850	Harold W. Borhauer, II and Lynda A. Borhauer	55-568219	5/27/1998	4" Dia. Sch. 40 PVC	99.5	0.01" Slotted PVC	40	99.5-139.5	139.5	141.5	8-12 Colorado Silica Sand	1108.78	No	33º29'19.13"	112º07'19.03"	NAD 27
WCP-40	58854	City of Phoenix	55-575869	9/28/1999	4" Dia. Sch. 40 PVC	110	0.01" Slotted PVC	40	110-150	150	150	10-20 Colorado Silica Sand	1110.4	No	33º29'23"	112º07'12"	NAD 27
WCP-41	58855	City of Phoenix	55-575871	9/30/1999	4" Dia. Sch. 40 PVC	103.5	0.01" Slotted PVC	40	103.5-143.5	143.5	145	10-20 Colorado Silica Sand	1108.11	No	33º29'17"	112º07'12"	NAD 27
WCP-42	58856	Fred & Sylvia Shindell	55-575875	10/4/1999	4" Dia. Sch. 40 PVC	108.5	0.01" Slotted PVC	40	108.5-148.5	148.5	150	10-20 Colorado Silica Sand	1109.69	No	33º29'22"	112º07'19"	NAD 27
WCP-43	58857	City of Phoenix	55-575870	10/12/1999	4" Dia. Sch. 40 PVC	106	0.01" Slotted PVC	40	106-146	146	147	10-20 Colorado Silica Sand	1111.59	No	33º29'23"	112º07'07"	NAD 27
WCP-44	58858	City of Phoenix	55-575872	12/1/1999	4" Dia. Sch. 40 PVC	108	0.01" Slotted PVC	40	108-148	148	150	10-20 Colorado Silica Sand	1104.33	No	33º29'11"	112º07'21"	NAD 27
WCP-45	58859	Harold W. Borhauer, II and Lynda A. Borhauer	55-575873	10/6/1999	4" Dia. Sch. 40 PVC	108	0.01" Slotted PVC	40	108-148	148	150	10-20 Colorado Silica Sand	1107.10	No	33º29'17"	112º07'24"	NAD 27
WCP-46	58860	Harold W. Borhauer, II and Lynda A. Borhauer	55-575874	12/3/1999	4" Dia. Sch. 40 PVC	108	0.01" Slotted PVC	40	108-148	148	150	10-20 Colorado Silica Sand	1109.29	No	33º29'20"	112º07'24"	NAD 27
WCP-47	59409	City of Phoenix	55-584133	1/16/2001	4" Dia. Sch. 40 PVC	112.5	0.01" Slotted PVC	40	112.5-152.5	152.5	153	10-20 Colorado Silica Sand	1108.45	No	33º29'19.63"	112º07'30.06"	NAD 27

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TOC = Top-of-casing elevation
NA = Information not available
[1] Property owner at the time of the RI.

Table 5-1
Monitor Well Construction Details
WCP East Grand Avenue WQARF Site
Remedial Investigation

Well ID	ADEQ Well No.	Property Owner Contact Information[1]	ADWR Registration No.	Install Date	Casing		Screen		Screened Interval (ft bgs)	Total Well Depth (ft bgs)	Total Boring Depth (ft bgs)	Sand Pack	TOC Elev (ft amsl)/ Survey Date	Well Abandonment	Latitude	Longitude	Datum
					Material	Length (ft)	Material	Length (ft)									
WCP-48	58861	Harold W. Borhauer, II and Lynda A. Borhauer	55-575868	6/20/2000	4" Dia. Sch. 40 PVC	225	0.01" Slotted PVC	40	225-245	245	301	10-20 Colorado Silica Sand	1107.04	No	33º29'17"	112º07'24"	NAD 27
WCP-83	59421	City of Phoenix	55-584131	1/23/2001	4" Dia. Sch. 40 PVC	109	0.01" Slotted PVC	40	109-149	149	151	10-20 Colorado Silica Sand	1108.89	No	33º29'1789"	112º07'06.55"	NAD 27
WCP-84	59422	City of Phoenix	55-584132	1/29/2001	4" Dia. Sch. 40 PVC	108.5	0.01" Slotted PVC	40	108.5-148.5	148.5	151	10-20 Colorado Silica Sand	1109.04	No	33º29'19.70"	112º07'12.26"	NAD 27
WCP-85	59423	Hanson Pipe & Products, Inc. Sean Seelbach	55-584666	1/9/2001	4" Dia. Sch. 40 PVC	109	0.01" Slotted PVC	40	109-149	149	151.5	10-20 Colorado Silica Sand	1113.1	No	33º29'23.36"	112º06'59.42"	NAD 27
WCP-86	59424	Jay Joel Rivin	55-584903	1/16/2001	4" Dia. Sch. 40 PVC	110	0.01" Slotted PVC	40	110-150	150	151	10-20 Colorado Silica Sand	1105.54	No	33º29'12.57"	112º07'17.52"	NAD 27
WCP-87	59425	Harold W. Borhauer, II and Lynda A. Borhauer	55-585041	1/29/2001	4" Dia. Sch. 40 PVC	112.5	0.01" Slotted PVC	40	112.5-152.5	152.5	153	10-20 Colorado Silica Sand	1105.63	No	33º29'13.99"	112º07'24.32"	NAD 27
WCP-88	59426	Grand Avenue Industrial Properties Greg Hoyt	55-585117	1/31/2001	4" Dia. Sch. 40 PVC	110	0.01" Slotted PVC	40	110-150	150	152.5	10-20 Colorado Silica Sand	1/8/1903	No	33º29'10.41"	112º07'26.72"	NAD 27
WCP-89	59427	Flower Street Capital, L.L.C.	55-585116	2/2/2001	4" Dia. Sch. 40 PVC	113	0.01" Slotted PVC	40	113-153	153	155	10-20 Colorado Silica Sand	1105.53	No	33º29'10.07"	112º07'40.39"	NAD 27
WCP-90	59428	Berfam Jack Berg	55-584665	1/19/2001	4" Dia. Sch. 40 PVC	118	0.01" Slotted PVC	40	118-158	158	160	10-20 Colorado Silica Sand	1113.73	No	33º29'26.65"	112º07'32"	NAD 27
WCP-92	59429	City of Phoenix	55-586975	7/17/2001	4" Dia. Sch. 40 PVC	109	0.01" Slotted PVC	40	109-149	149	151	10-20 Colorado Silica Sand	1098.56	No	33º28'56.63"	112º07'31.39"	NAD 27
WCP-93	59430	City of Phoenix	55-587463	7/25/2001	4" Dia. Sch. 40 PVC	109	0.01" Slotted PVC	40	109-149	149	151	10-20 Colorado Silica Sand	1106.71	No	33º29'15.86"	112º07'17.94"	NAD 27
WCP-94	59431	City of Phoenix	55-586979	7/19/2001	4" Dia. Sch. 40 PVC	110	0.01" Slotted PVC	40	110-150	150	151	10-20 Colorado Silica Sand	1101.57	No	33º29'00.35"	112º07'44.31"	NAD 27
WCP-95	59432	City of Phoenix	55-586978	7/6/2001	4" Dia. Sch. 40 PVC	99	0.01" Slotted PVC	40	99-139	139	140	10-20 Colorado Silica Sand	1114.22	No	33º29'27.81"	112º07'02.84"	NAD 27
WCP-96	59433	City of Phoenix	55-587616	7/23/2001	4" Dia. Sch. 40 PVC	109.5	0.01" Slotted PVC	40	109.5-149.5	149.5	151	10-20 Colorado Silica Sand	1101.29	No	33º29'04.01"	112º07'32.61"	NAD 27

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NA = Information not available

Table 5-1
Monitor Well Construction Details
WCP East Grand Avenue WQARF Site
Remedial Investigation

Well ID	ADEQ Well No.	Property Owner Contact Information[1]	ADWR Registration No.	Install Date	Casing		Screen		Screened Interval (ft bgs)	Total Well Depth (ft bgs)	Total Boring Depth (ft bgs)	Sand Pack	TOC Elev (ft amsl)/ Survey Date	Well Abandonment	Latitude	Longitude	Datum
					Material	Length (ft)	Material	Length (ft)									
WCP-97	59434	City of Phoenix	55-586977	7/3/2001	4" Dia. Sch. 40 PVC	109	0.01" Slotted PVC	40	109-149	149	151	10-20 Colorado Silica Sand	1104.38	No	33º29'10.42"	112º07'09.02"	NAD 27
WCP-98	59435	City of Phoenix	55-586976	7/11/2001	4" Dia. Sch. 40 PVC	109	0.01" Slotted PVC	40	109-149	149	150	10-20 Colorado Silica Sand	1106.37	No	33º29'14.87"	112º06'59.07"	NAD 27
MWB-4	57189	United Parcel Service	55-538228	NA	4" Dia. Sch. 40 PVC	NA	0.01" Slotted PVC	NA	95-130	130	NA	NA	1105.81	No	33º29'12"	112º07'34"	NAD 27
MWB-5	57184	United Parcel Service	55-542155	7/12/1993	4" Dia. Sch. 40 PVC	93	0.01" Slotted PVC	35	93-128	128	NA	NA	1106.32	No	NA	NA	NA
MWB-6	57185	United Parcel Service	55-542154	2/2/1994	4" Dia. Sch. 40 PVC	90	0.01" Slotted PVC	40	90-130	130	NA	NA	1105.95	No	33º29'10.28"	112º07'34.75"	NA
MWB-14	61940	United Parcel Service	55-586221	NA	4" Dia. Sch. 40 PVC	140	0.01" Slotted PVC	50	90-140	140	141	8-12 Silica Sand	NA	No	33º29'17.68"	112º07'35.47"	NA
ENT-MW-2	58100	Sunbelt Management Company	55-576648	NA	4" Dia. Sch. 40 PVC	105	0.01" Slotted PVC	40	105-135	135	141	NA	1105.28	No	NA	NA	NA
MGL-1	57135	Willmore Manufacturing Jay Willmore	55-535620	6/9/1992	4" Dia. Sch. 40 PVC	99	0.01" Slotted PVC	30	99-129	129	NA	NA	1098.72	No	33º28'60"	112º07'24"	NAD 27
MGL-2	57136	Willmore Manufacturing Jay Willmore	55-535621	6/9/1992	4" Dia. low carbon steel	99	0.01" Slotted SS	30	99-129	129	NA	NA	1099.04	No	33º28'58"	112º07'25"	NAD 27
MGL-3	57137	Willmore Manufacturing Jay Willmore	55-535622	6/9/1992	4" Dia. low carbon steel	99	0.01" Slotted SS	30	99-129	129	NA	NA	1097.49	No	33º28'59"	112º07'26"	NAD 27
MTP-1	9800	Michigan Trailer Park L.L.C.	55-618512	NA	10" Dia. steel Casing	NA	NA	NA	NA	400	NA	NA	NA	No	NA	NA	NA
WCP-99	60377	Phoenix Union High School District	55-589557	11/15/2001	4"Dia. Sch.40 PVC	108	0.01" Slotted PVC	40	108-148	148	151	10-20 Colorado Silica Sand	1111.28	No	33º29'23.42"	112º06'55.39"	NAD 27
WCP-100	60378	Bakala Investment Properties, L.L.C.	55-589558	11/21/2001	4"Dia. Sch.40 PVC	114.8	0.01" Slotted PVC	45	114.8-159.8	159.8	161	10-20 Colorado Silica Sand	1109.01	No	33º29'19.33"	112º07'19.52"	NAD 27
WCP-200	60379	Bakala Investment Properties, L.L.C.	55-589559	11/19/2001	4"Dia. Sch.40 PVC	114	0.01" Slotted PVC	40	114-154	154	155	10-20 Colorado Silica Sand	1108.2	No	33º29'17.99"	112º07'20.66"	NAD 27

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[1] Property owner at the time of the RI.

Table 5-1
Monitor Well Construction Details
WCP East Grand Avenue WQARF Site
Remedial Investigation

Well ID	ADEQ Well No.	Property Owner Contact Information[1]	ADWR Registration No.	Install Date	Casing		Screen		Screened Interval (ft bgs)	Total Well Depth (ft bgs)	Total Boring Depth (ft bgs)	Sand Pack	TOC Elev (ft amsl)/ Survey Date	Well Abandonment	Latitude	Longitude	Datum
					Material	Length (ft)	Material	Length (ft)									
WCP-201	60380	City of Phoenix	55-589527	12/3/2001	4"Dia. Sch.40 PVC	114	0.01" Slotted PVC	40	114-154	154	156	10-20 Colorado Silica Sand	1106.65	No	33º29'15.85"	112º07'21.22"	NAD 27
WCP-202	60381	City of Phoenix	55-589529	12/5/2001	4" Dia. Sch. 40 PVC	111	0.01" Slotted PVC	40	111-151	151	152	10-20 Colorado Silica Sand	1100.90	No	33º29'06.19"	112º07'26.10"	NAD 27
WCP-203	60382	McCallister Investments Arizona L.L.P.	55-590060	12/18/2001	4" Dia. Sch. 40 PVC	121.5	0.01" Slotted PVC	40	121.5-161.5	161.5	162	10-20 Colorado Silica Sand	1111.90	No	33º29'23.42"	112º07'40.50"	NAD 27
WCP-204	60383	City of Phoenix	55-589528	11/29/2001	4" Dia. Sch. 40 PVC	110	0.01" Slotted PVC	40	110-150	150	151	10-20 Colorado Silica Sand	1097.47	No	33º28'54.78"	112º07'49.65"	NAD 27

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NA = Information not available
[1] Property owner at the time of the RI.

Table 4-2
Summary of Field Sample Submittals
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	Sampling Dates	SDG	Analysis Requested	Analytical Method	QC Samples					Field Samples		
					Trip Blanks	Equipment Blanks	Field Blanks	PE Sample	Field Duplicate	Soil Sample	Hydro-punch Samples	Ground-water Samples
Vadose Zone Investigation	Aug 30, 1999	9908G763	VOCs	EPA 8260B	1	1	0	0	0	10	1	0
Vadose Zone Investigation	Aug 31, 1999	9909G816	VOCs	EPA 8260B	1	1	0	0	2	10	1	0
Vadose Zone Investigation	Sept 1, 1999	9909G798	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	10	1	0
Vadose Zone Investigation	Sept 2, 1999	9909G828	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	10	1	0
IDW	Sept 2, 1999	9909G828	VOCs Metals/Mercury	EPA 8260B EPA 6010B/7471	0	0	0	0	0	1	0	0
Vadose Zone Investigation	Sept 3, 1999	9909G838	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	10	1	0
Vadose Zone Investigation	Sept 7, 1999	9909G850	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	10	1	0
Vadose Zone Investigation	Sept 8, 1999	9909G865	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	10	1	0
Vadose Zone Investigation	Sept 9, 1999	9909G880	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	10	2	0
Vadose Zone Investigation	Sept 13, 1999	9909G908	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	10	2	0
Vadose Zone Investigation	Sept 14, 1999	9909G957	VOCs	EPA 8260B	1	0	0	0	0	0	1	0
Vadose Zone Investigation	Sept 15, 1999	9909G970	VOCs Percent Solids	EPA 8260B SM 2540G	1	0	0	0	0	10	1	0
Vadose Zone Investigation	Sept 8-15, 1999	299141 (ATL)	Soil density Soil porosity Moisture content Total organic carbon Grain-size analysis	ASTM D-2435 EPA 9100 ASTM D-2216 Walkley-Black ASTM D-422	0	0	0	0	0	8	0	0
Vadose Zone Investigation	Sept 16, 1999	9909G984	VOCs	EPA 8260B	1	1	0	0	1	0	2	0
Vadose Zone Investigation	Sept 8, 1999	9911G718	Total Organic Carbon Percent Solids	Walkley-Black SM 2540G	0	0	0	0	0	8	0	0
Phase III Well Installation	Sept 27, 1999	9909G138	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	3	1	0
Phase III Well Installation	Sept 29, 1999	9909G167	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	3	1	0
Phase III Well Installation	Oct 1, 1999	9910G207	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	3	1	0

Table 4-2 (continued)
Summary of Field Sample Submittals
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	Sampling Dates	SDG	Analysis Requested	Analytical Method	QC Samples: Trip Blanks	QC Samples: Equipment Blanks	QC Samples: Field Blanks	QC Samples: PE Sample	QC Samples: Field Duplicate	Field Samples: Soil Sample	Field Samples: Hydro-punch Samples	Field Samples: Ground-water Samples
Phase III Well Installation	Oct 5, 1999	9910G241	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	3	0	0
	Oct 6, 1999	9910G308	VOCs	EPA 8260B	1	0	0	0	0	0	1	0
	Oct 11, 1999	9910G328	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	0	3	1	0
	Nov 29, 1999	9912G006	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	0	3	0	0
	Dec 2, 1999	9912G043	VOCs	EPA 8260B	1	0	0	0	1	3	2	0
ENT-MW-2	Oct 14, 1999	9910G396	VOCs	EPA 8260B	1	0	0	0	0	0	0	1
IDW			VOCs	EPA 8260B	0	0	0	0	0	0	0	1
DI Water	Oct 21, 1999	9910G504	VOCs	EPA 8260B	1	0	3	0	0	0	0	0
ROUND 1	Dec 28, 1999	9912G388	VOCs	EPA 8260B	1	0	0	0	1	0	0	7
	Dec 29, 1999	9912G405	VOCs	EPA 8260B	1	1	0	1	1	0	0	6
	Dec 30, 1999	9A01G414	VOCs	EPA 8260B	1	1	0	0	0	0	0	3
ROUND 2	Jan 31, 2000- Feb 1, 2000	9A02G845	VOCs	EPA 8260B	1	0	0	0	1	0	0	9
	Feb 2, 2000- Feb 3, 2000	9A02G872	VOCs	EPA 8260B	2	1	1	0	2	0	0	14
IDW	Feb 3, 2000	9A02G873	VOCs Metals/Mercury	EPA 8260B EPA 6010B/7470	0	0	0	0	0	0	0	1
ROUND 3	Mar 7, 2000- Mar 8, 2000	9A03G239	VOCs	EPA 8260B	1	2	1	0	1	0	0	18
	Mar 9, 2000- Mar 10, 2000	9A03G270	VOCs	EPA 8260B	0	2	0	0	4	0	0	14
	Mar 10, 2000	9A03G271	VOCs	EPA 8260B	1	1	0	0	0	0	0	2
IDW			VOCs Metals/Mercury pH	EPA 8260B EPA 6010/7470 EPA 9040B	0	0	0	0	0	0	0	1
ROUND 4	June 5, 2000	9A06G630	VOCs	EPA 8260B	1	1	1	0	0	0	0	6
	June 7, 2000	9A06G666	VOCs	EPA 8260B	1	0	0	0	1	0	0	6
	June 8, 2000	9A06G682	VOCs	EPA 8260B	1	1	0	0	1	0	0	3
IDW	June 9, 2000	9A06G682	VOCs Metals/Mercury pH	EPA 8260B EPA 6010/7470 EPA 9040B	0	0	0	0	0	0	0	1

Table 4-2 (continued)
Summary of Field Sample Submittals
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	Sampling Dates	SDG	Analysis Requested	Analytical Method	QC Samples					Field Samples		
					Trip Blanks	Equipment Blanks	Field Blanks	PE Sample	Field Duplicate	Soil Sample	Hydro-punch Samples	Ground-water Samples
ROUND 4	Jun 12, 2000	9A06G709	VOCs	EPA 8260B	1	0	0	0	0	0	0	3
Deep Well Installation WCP-48	Jun 14, 2000	9A06G746	VOCs Soil Moisture	EPA 8260B SM 2540G	1	0	0	0	0	2	0	0
	Jun 15, 2000	9A06G792	VOCs Soil Moisture	EPA 8260B SM 2540G	1	0	0	0	0	1	0	0
	Jun 15-16, 2000	9A06G811	VOCs Soil Moisture	EPA 8260B SM 2540G	1	0	0	0	0	3	0	0
Deep Well Installation WCP-48	Jun 17, 2000	9A06G810	VOCs	EPA 8260B	1	0	0	0	1	1	0	0
	June 16, 2000	0006107	VOCs	EPA 8260B	2	0	0	0	0	0	5	0
	Aug 17, 2000	9A08G428	VOCs	EPA 8260B	1	1	0	0	0	0	0	1
IDW	Jun 12, 2000	9A07G086	VOCs Metals pH Flashpoint Paint Filter	EPA 8260B EPA 6010B/7470 EPA 9040B EPA 1010 EPA 9095A	1	0	0	0	0	1	0	1
ROUND 5	Sep 12, 2000 Sep 13, 2000	9A09G588	VOCs	EPA 8260B	1	1	1	0	0	0	0	6
	Sep 14, 2000	9A09G600	VOCs	EPA 8260B	1	0	0	0	1	0	0	4
	Sep 18, 2000 Sep 19, 2000	9A09G614	VOCs	EPA 8260B	1	1	0	0	1	0	0	8
IDW			VOCs Metals pH	EPA 8260B EPA 6010B/7470 EPA 9040B	0	0	0	0	0	0	0	1
ROUND 5	Sep 29, 2000	9A09G688	VOCs	EPA 8260B	1	1	0	0	0	0	0	1
IDW			Metals/Mercury pH	EPA 6010B/7470 EPA 9040B	0	0	0	0	0	0	0	1
ROUND 6	Dec 4, 2000	9A12G047	VOCs	EPA 8260B	1	1	1	0	0	0	0	7
	Dec 6, 2000 Dec 7, 2000	9A12G065	VOCs (all) Semi VOCs (WCP-28 and –29 only)	EPA 8260B EPA 8270	1	0	0	0	1	0	0	7
	Dec 8, 2000	9A12G073	VOCs (all) Semi VOCs (WCP –16 only)	EPA 8260B EPA 8270	1	0	0	0	1	0	0	4
IDW	Dec 8, 2000	9A12G073	VOCs Metals pH	EPA 8260B EPA 6010B/7470 EPA 9040B	1	0	0	0	0	0	0	1

Table 4-2 (continued)
Summary of Field Sample Submittals
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	Sampling Dates	SDG	Analysis Requested	Analytical Method	QC Samples: Trip Blanks	QC Samples: Equipment Blanks	QC Samples: Field Blanks	QC Samples: PE Sample	QC Samples: Field Duplicate	Field Samples: Soil Sample	Field Samples: Hydro-punch Samples	Field Samples: Ground-water Samples
ROUND 6	Dec 11, 2000	9A12G076	VOCs	EPA 8260B	1	1	0	0	0	0	0	1
IDW	Dec 11, 2000	9A12G077	Metals/Mercury pH	EPA 6010B/7470 EPA 9040B	0	0	0	0	0	0	0	1
Phase IV Well Installation	Jan 8, 2001	201528	VOCs Percent Solids	EPA 8260B EPA 2540G	1	0	0	0	0	3	1	0
	Jan 10, 2001	201558	VOCs Percent Solids	EPA 8260B EPA 2540G	1	0	0	0	0	4	1	0
Phase IV Well Installation	Jan 15, 2001	201612	VOCs Percent Solids	EPA 8260B EPA 2540G	1	1	0	0	0	4	1	0
	Jan 17, 2001	201658	VOCs Percent Solids	EPA 8260B EPA 2540G	1	0	0	0	0	1	0	0
	Jan 18, 2001	201671	VOCs Percent Solids	EPA 8260B EPA 2540G	1	0	0	0	0	1	1	0
	Jan 22, 2001	201695	VOCs Percent Solids	EPA 8260B EPA 2540G	1	0	0	0	0	3	1	0
	Jan 24, 2001	201731	VOCs Percent Solids	EPA 8260B EPA 2540G	1	1	1	0	0	3	2	0
	Jan 26, 2001	201757	VOCs	EPA 8260B	1	0	0	0	1	2	1	0
IDW			VOCs Metals Flashpoint Paint Filter	EPA 8260B EPA 6010B/7471 EPA 1010 EPA 9095A	0	0	0	0	0	1	0	0
Phase IV Well Installation	Jan 29, 2001	201774	VOCs	EPA 8260B	1	0	0	0	0	0	1	0
	Jan 31, 2001	201850	VOCs Percent Solids	EPA 8260B EPA 2540G	1	0	0	0	1	3	1	0
	Jan 15-30, 2001	201022 (ATL)	Soil density Soil porosity Moisture content Total organic carbon Grain-size analysis Permeability	ASTM D-2435 EPA 9100 ASTM D-2216 Walkley-Black ASTM D-422 ASTM D-2434	0	0	0	0	0	9	0	0
	Feb 1, 2001	201892	VOCs Percent Solids	EPA 8260B EPA 2540G	1	1	0	0	0	4	1	0

Table 4-2 (continued)
Summary of Field Sample Submittals
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	Sampling Dates	SDG	Analysis Requested	Analytical Method	QC Samples: Trip Blanks	QC Samples: Equipment Blanks	QC Samples: Field Blanks	QC Samples: PE Sample	QC Samples: Field Duplicate	Field Samples: Soil Sample	Field Samples: Hydro-punch Samples	Field Samples: Ground-water Samples
IDW	Jan 15, 2001	201607	VOCs Metals/Mercury Flashpoint Paint Filter Percent Solids	EPA 8260B EPA 6010B/7471 EPA 1010 EPA 9095A SM 2540G	0	0	0	0	0	1	0	0
IDW	Jan 23, 2001	201716	VOCs Metals/Mercury Flashpoint Paint Filter Percent Solids	EPA 8260B EPA 6010B/7471 EPA 1010 EPA 9095A SM 2540G	1	0	0	0	0	1	0	0
IDW	Jan 30, 2001	201852	VOCs Metals/Mercury Flashpoint Paint Filter Percent Solids	EPA 8260B EPA 6010B/7471 EPA 1010 EPA 9095A SM 2540G	0	0	0	0	0	1	0	0
IDW	Feb 5, 2001	201922	VOCs Metals/Mercury Flashpoint Paint Filter Percent Solids	EPA 8260B EPA 6010B/7471 EPA 1010 EPA 9095A SM 2540G	1	0	0	0	0	1	0	0
IDW	Feb 9, 2001	201985	VOCs Metals/Mercury pH	EPA 8260B EPA 200.7/245/1 EPA 9040B	1	0	0	0	0	0	0	1
ROUND 7	Feb 22, 2001 Feb 23, 2001	202148	VOCs	EPA 8260B	1	1	1	0	0	0	0	7
ROUND 7	Feb 26, 2001	202167	VOCs	EPA 8260B	1	0	0	0	1	0	0	3
ROUND 7	Feb 27, 2001	202180	VOCs	EPA 8260B	1	0	0	0	1	0	0	2
ROUND 7	Feb 28, 2001	202205	VOCs	EPA 8260B	1	0	0	0	0	0	0	3
ROUND 7	Mar 1, 2001	202227	VOCs	EPA 8260B	1	0	0	0	0	0	0	4
ROUND 7	Mar 2, 2001	202251	VOCs	EPA 8260B	1	1	0	0	0	0	0	4
ROUND 7	Mar 5, 2001 Mar 6, 2001	202274	VOCs	EPA 8260B	1	0	0	0	1	0	0	6
ROUND 7	Apr 3, 2001	202691	VOCs	EPA 8260B	1	0	0	0	0	0	0	1
IDW	Feb 27, 2001	202182	VOCs Metals/Mercury pH	EPA 8260B EPA 200.7/245.1 EPA 9040B	0	0	0	0	0	0	0	1

Table 4-2 (continued)
Summary of Field Sample Submittals
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	Sampling Dates	SDG	Analysis Requested	Analytical Method	QC Samples					Field Samples		
					Trip Blanks	Equipment Blanks	Field Blanks	PE Sample	Field Duplicate	Soil Sample	Hydro-punch Samples	Ground-water Samples
IDW	Mar 6, 2001	202273	VOCs Metals/Mercury pH	EPA 8260B EPA 200.7/245.1 EPA 9040B	0	0	0	0	0	0	0	2
ROUND 8	Apr 23, 2001 Apr 24, 2001	203007	VOCs	EPA 8260B	1	0	0	0	0	0	0	9
	Apr 25, 2001 Apr 26, 2001	203050	VOCs	EPA 8260B	1	1	1	0	0	0	0	7
	Apr 27, 2001	203083	VOCs	EPA 8260B	1	0	0	0	0	0	0	2
	Apr 30, 2001	203109	VOCs	EPA 8260B	1	0	0	0	0	0	0	6
	May 1, 2001	203130	VOCs	EPA 8260B	1	0	0	1	1	0	0	2
	May 2, 2001	203196	VOCs	EPA 8260B	1	2	0	0	1	0	0	6
IDW	Apr 26, 2001	203053	VOC Metals/Mercury pH	EPA 8260B EPA 200.7/245.1 EPA 9040B	0	0	0	0	0	0	0	1
	May 2, 2001 May 3, 2001	203197	VOC Metals/Mercury pH	EPA 8260B EPA 200.7/245.1 EPA 9040B	0	0	0	0	0	0	0	2
AQUIFER TEST	May 22, 2001 May 23, 2001	203546	VOCs	EPA 8260B	1	0	0	0	0	0	0	3
IDW	May 16, 2001	203432	VOC Metals/Mercury pH	EPA 8260B EPA 200.7/245.1 EPA 9040B	1	0	0	0	0	0	0	2
	May 24, 2001	203572	VOC Metals/Mercury pH	EPA 8260B EPA 200.7/245.1 EPA 9040B	1	0	0	0	0	0	0	3
ROUND 9	Jun 5, 2001	203744	VOCs	EPA 8260B	1	0	0	0	0	0	0	2
	Jun 6, 2001	203779	VOCs	EPA 8260B	1	1	1	0	0	0	0	5
	Jun 7, 2001	203808	VOCs	EPA 8260B	1	0	0	0	0	0	0	4
	Jun 8, 2001	203820	VOCs	EPA 8260B	1	0	0	0	1	0	0	3
	Jun 11, 2001	203837	VOCs	EPA 8260B	1	0	0	0	1	0	0	2
	Jun 12, 2001	203876	VOCs	EPA 8260B	1	1	0	0	0	0	0	5
	Jun 13, 2001	203894	VOCs	EPA 8260B	1	0	0	0	0	0	0	4
	Jun 14, 2001	203932	VOCs	EPA 8260B	1	1	0	0	1	0	0	4
	Jun 15, 2001	203957	VOCs	EPA 8260B	1	0	0	0	0	0	0	2

Table 4-2 (continued)
Summary of Field Sample Submittals
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	Sampling Dates	SDG	Analysis Requested	Analytical Method	QC Samples					Field Samples		
					Trip Blanks	Equipment Blanks	Field Blanks	PE Sample	Field Duplicate	Soil Sample	Hydro-punch Samples	Ground-water Samples
IDW	Jun 11, 2001	203836	VOC Metals/Mercury pH	EPA 8260B EPA 200.7/245.1 EPA 9040B	0	0	0	0	0	0	0	1
IDW	Jun 15, 2001	203958	VOC Metals/Mercury pH	EPA 8260B EPA 200.7/245.1 EPA 9040B	0	0	0	0	0	0	0	1
ROUND 10	Jun 18, 2001	203988	VOCs	EPA 8260B	1	0	0	0	0	0	0	4
ROUND 10	Jun 19, 2001	204015	VOCs	EPA 8260B	1	1	1	0	0	0	0	3
ROUND 10	Jun 20, 2001	204041	VOCs	EPA 8260B	1	0	0	0	0	0	0	4
ROUND 10	Jun 21, 2001	204066	VOCs	EPA 8260B	1	1	0	0	1	0	0	3
ROUND 10	Jun 22, 2001	204093	VOCs	EPA 8260B	1	0	0	0	0	0	0	2
ROUND 10	Jun 25, 2001	204119	VOCs	EPA 8260B	1	0	0	0	0	0	0	1
ROUND 10	Jun 27, 2001	204143	VOCs	EPA 8260B	1	1	0	0	1	0	0	4
ROUND 10	Jun 27, 2001	204166	VOCs	EPA 8260B	1	0	0	0	1	0	0	4
ROUND 10	Jun 28, 2001	204200	VOCs	EPA 8260B	1	0	0	0	0	0	0	3
ROUND 10	Jun 29, 2001	204219	VOCs	EPA 8260B	1	0	0	0	0	0	0	2
IDW	Jun 29, 2001	204219	VOC Metals/Mercury pH	EPA 8260B EPA 200.7/245.1 EPA 9040B	0	0	0	0	0	0	0	1
IDW	Jun 19, 2001	204013	VOC Metals/Mercury pH	EPA 8260B EPA 200.7/245.1 EPA 9040B	0	0	0	0	0	0	0	2
Phase V Well Installation	Jul 2, 2001	204235	VOCs Percent Solids	EPA 8260B SM 2540G	1	0	0	0	0	3	1	0
Phase V Well Installation	Jul 5, 2001	204263	VOCs Percent Solids	EPA 8260B SM 2540G	1	0	0	0	1	4	1	0
Phase V Well Installation	Jul 10, 2001	204328	VOCs Percent Solids	EPA 8260B SM 2540G	1	0	0	0	0	4	1	0
Phase V Well Installation	Jul 16, 2001	204406	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	1	0	1	3	1	0
Phase V Well Installation	Jul 18, 2001	204448	VOCs Metals/Mercury Percent Solids	EPA 8260B EPA 6010B/7471 SM 2540G	1	0	0	0	0	3	1	0
Phase V Well Installation	Jul 20, 2001	204521	VOCs	EPA 8260B	1	0	0	0	0	0	1	0

Table 4-2 (continued)
Summary of Field Sample Submittals
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	Sampling Dates	SDG	Analysis Requested	Analytical Method	QC Samples					Field Samples		
					Trip Blanks	Equipment Blanks	Field Blanks	PE Sample	Field Duplicate	Soil Sample	Hydro-punch Samples	Ground-water Samples
Phase V Well Installation	Jul 25, 2001	204565	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	4	1	0
IDW	Jul 9, 2001	204308	VOCs Metals/Mercury Percent Solids	EPA 8260B EPA 6010B/7471 SM 2540G	1	0	0	0	0	1	0	0
	Jul 18, 2001	204450	VOCs Metals/Mercury Percent Solids	EPA 8260B EPA 6010B/7471 SM 2540G	0	0	0	0	0	1	0	0
	Jul 24, 2001	204567	VOCs Metals/Mercury Flashpoint Paint Filter Percent Solids	EPA 8260B EPA 6010B/7471 EPA 1010 EPA 9095A SM 2540G	0	0	0	0	0	1	0	0
IDW	Jul 26, 2001	204614	VOCs Metals/Mercury Flashpoint Paint Filter Percent Solids	EPA 8260B EPA 6010B/7471 EPA 1010 EPA 9095A SM 2540G	1	0	0	0	0	1	0	0
ROUND 11	Jul 30, 2001	204680	VOCs	EPA 8260B	1	0	1	0	0	0	0	3
	Jul 31, 2001	204698	VOCs	EPA 8260B	1	1	0	0	0	0	0	3
	Aug 1, 2001	204727	VOCs	EPA 8260B	1	0	0	0	1	0	0	3
	Aug 2, 2001	204752	VOCs	EPA 8260B	1	0	0	0	0	0	0	4
	Aug 3, 2001	204763	VOCs	EPA 8260B	1	0	1	0	0	0	0	3
	Aug 6, 2001	204788	VOCs	EPA 8260B	1	0	0	0	1	0	0	3
	Aug 7, 2001	204816	VOCs	EPA 8260B	1	1	0	0	0	0	0	3
	Aug 8, 2001	204840	VOCs	EPA 8260B	1	0	0	0	1	0	0	4
ROUND 11	Aug 9, 2001	204870	VOCs	EPA 8260B	1	1	0	0	1	0	0	2
	Aug 13, 2001	204932	VOCs	EPA 8260B	1	0	0	0	0	0	0	3
	Aug 14, 2001	204962	VOCs	EPA 8260B	1	1	0	0	0	0	0	3
	Aug 15, 2001	204996	VOCs	EPA 8260B	1	0	0	0	0	0	0	4
IDW	Aug 3, 2001	204764	VOCs Metals/Mercury PH	EPA 8260B EPA 200.7/245.1 EPA 9040B	0	0	0	0	0	0	0	1
	Aug 15, 2001	204995	VOCs Metals/Mercury PH	EPA 8260B EPA 200.7/245.1 EPA 9040B	0	0	0	0	0	0	0	1

Table 4-2 (continued)
Summary of Field Sample Submittals
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	Sampling Dates	SDG	Analysis Requested	Analytical Method	QC Samples					Field Samples		
					Trip Blanks	Equipment Blanks	Field Blanks	PE Sample	Field Duplicate	Soil Sample	Hydro-punch Samples	Ground-water Samples
	Aug 23, 2001	205146	VOCs Metals/Mercury PH	EPA 8260B EPA 200.7/245.1 EPA 9040B	1	0	0	0	0	0	0	2
ROUND 12	Sept 18, 2001	205567	VOCs	EPA 8260B	1	0	0	0	0	0	0	2
	Sept 19, 2001	205606	VOCs	EPA 8260B	1	0	1	0	0	0	0	4
	Sept 20, 2001	205632	VOCs	EPA 8260B	1	1	0	0	1	0	0	3
	Sept 21, 2001	205656	VOCs	EPA 8260B	1	0	0	0	0	0	0	3
	Sept 24, 2001	205676	VOCs	EPA 8260B	1	1	0	0	1	0	0	2
IDW	Sept 21,2001	205655	VOCs Metals/Mercury PH	EPA 8260B EPA 200.7/245.1 EPA 9040B	0	0	0	0	0	0	0	1
IDW	Sept 24, 2001	205675	VOCs Metals/Mercury PH	EPA 8260B EPA 200.7/245.1 EPA 9040B	0	0	0	0	0	0	0	1
ROUND 12 (PDB Samples)	Sept 19, 2001	X2100805	VOCs	EPA 8260B	1	0	0	0	0	0	0	2
	Sept 20, 2001	X2100814	VOCs	EPA 8260B	1	0	0	0	0	0	0	6
	Sept 21, 2001	X2100830	VOCs	EPA 8260B	1	0	0	0	0	0	0	5
	Sept 24, 2001	X2100838	VOCs	EPA 8260B	1	0	0	0	0	0	0	3
IDW	Oct 15, 2001	X2100930	VOCs Metals/Mercury Flashpoint pH	EPA 8260B EPA 6010B, 7060A, 7740, 7841/7470A EPA 1010 EPA 9040B	1	0	0	0	0	0	0	9
IDW	Oct 26,2001	X2100980	VOCs TCLP	EPA 8260B EPA 1311	1	0	0	0	0	0	0	1
ROUND 13	Oct 29, 2001	206341	VOCs	EPA 8260B	1	0	0	0	0	0	0	3
	Oct 30, 2001	206374	VOCs	EPA 8260B	1	1	0	0	1	0	0	3
	Oct 31, 2001	206406	VOCs	EPA 8260B	1	0	1	0	0	0	0	6
	Nov 1, 2001	206436	VOCs	EPA 8260B	1	0	0	0	1	0	0	3
	Nov 2, 2001	206472	VOCs	EPA 8260B	1	1	0	0	0	0	0	5
	Nov 5, 2001	206491	VOCs	EPA 8260B	1	0	0	0	1	0	0	5
	Nov 6, 2001	206518	VOCs	EPA 8260B	1	0	0	0	0	0	0	3
	Nov 7, 2001	206538	VOCs	EPA 8260B	1	1	0	0	0	0	0	3
	Nov 8, 2001	206567	VOCs	EPA 8260B	1	0	0	0	0	0	0	3
	Nov 9, 2001	206602	VOCs	EPA 8260B	1	1	0	0	1	0	0	3

Table 4-2 (continued)
Summary of Field Sample Submittals
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Sample Event	Sampling Dates	SDG	Analysis Requested	Analytical Method	QC Samples					Field Samples		
					Trip Blanks	Equipment Blanks	Field Blanks	PE Sample	Field Duplicate	Soil Sample	Hydro-punch Samples	Ground-water Samples
IDW	Nov 9, 2001	206601	VOCs Metals/Mercury pH	EPA 8260B EPA 200.7/245.1 EPA 9040B	0	0	0	0	0	0	0	1
Phase VI Well Installation	Nov 14, 2001	206679	VOCs Percent Solids	EPA 8260B SM 2540G	1	0	0	0	0	3	0	0
	Nov 16, 2001	206740	VOCs Percent Solids	EPA 8260B SM 2540G	1	0	0	0	0	7	0	0
	Nov 19, 2001	206768	VOCs	EPA 8260B	1	0	0	0	0	0	1	0
	Nov 20, 2001	206803	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	1	0	1	7	1	0
Phase VI Well Installation	Nov 28, 2001	206900	VOCs Percent Solids	EPA 8260B SM 2540G	1	0	0	0	0	4	0	0
	Nov 30, 2001	206945	VOCs Percent Solids	EPA 8260B SM 2540G	1	0	0	0	0	4	0	0
	Dec 4, 2001	207017	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	2	0	0
	Dec 17, 2001	207254	VOCs Percent Solids	EPA 8260B SM 2540G	1	1	0	0	1	3	0	0
IDW	Nov 19, 2001	206767	VOCs Metals/Mercury Flashpoint Paint Filter pH Percent Solids	EPA 8260B EPA 6010B/7471 EPA 1010 EPA 9095A EPA 9045C SM 2540G	0	0	0	0	0	1	0	0
	Nov 30, 2001	206944	VOCs Metals/Mercury Flashpoint Paint Filter pH Percent Solids	EPA 8260B EPA 6010B/7471 EPA 1010 EPA 9095A EPA 9045C SM 2540G	0	0	0	0	0	1	0	0
	Dec 6, 2001	207081	VOCs Metals/Mercury Flashpoint Paint Filter pH Percent Solids	EPA 8260B EPA 6010B/7471 EPA 1010 EPA 9095A EPA 9045C SM 2540G	1	0	0	0	0	1	0	0

Table 4-2 (continued)
Summary of Field Sample Submittals
WCP East Grand Avenue WQARF Site Remedial Investigation

Sample Event	Sampling Dates	SDG	Analysis Requested	Analytical Method	QC Samples					Field Samples		
					Trip Blanks	Equipment Blanks	Field Blanks	PE Sample	Field Duplicate	Soil Sample	Hydro-punch Samples	Ground-water Samples
IDW	Dec 19, 2001	207312	VOCs Metals/Mercury Flashpoint Paint Filter pH Percent Solids	EPA 8260B EPA 6010B/7471 EPA 1010 EPA 9095A EPA 9040B SM 2540G	0	0	0	0	0	1	0	0
ROUND 14	Dec 11, 2001	207154	VOCs	EPA 8260B	1	0	0	0	0	0	0	2
	Dec 18, 2001	207292	VOCs	EPA 8260B	1	1	0	0	0	0	0	3
	Dec 19, 2001	207313	VOCs	EPA 8260B	1	0	0	0	0	0	0	1
ROUND 15	Jan 7, 2002	207589	VOCs	EPA 8260B	1	0	0	0	0	0	0	2
	Jan 10, 2002	207673	VOCs	EPA 8260B	1	0	1	0	0	0	0	6
ROUND 15	Jan 14, 2002	207699	VOCs	EPA 8260B	1	0	0	0	0	0	0	3
	Jan 16, 2002	207752	VOCs	EPA 8260B	1	1	0	0	1	0	0	7
	Jan 18, 2002	207765	VOCs	EPA 8260B	1	0	0	0	0	0	0	1
	Jan 21, 2002	207804	VOCs	EPA 8260B	1	0	1	0	1	0	0	7
	Jan 23, 2002	207869	VOCs	EPA 8260B	1	2	0	0	2	0	0	10
	Jan 25, 2002	207898	VOCs	EPA 8260B	1	0	0	0	0	0	0	3
IDW	Jan 28, 2002	207909	VOCs Metals/Mercury pH	EPA 8260B EPA 200.7/245.1 EPA 9040B	1	0	0	0	0	0	0	2
MTP	Feb 14, 2002	208214	VOCs	EPA 8260B	1	0	0	0	0	0	0	2

Table 4-1
Chronology of Field Activities
WCP East Grand Avenue WQARF Site Remedial Investigation

RI Phase	Start Date	End Date	Activity	Comments
I	March 1997	April 1997	Monitor Well Installation/ Development/Groundwater Sampling	Work performed by Fluor Daniel for ADEQ. Installed monitor wells WCP-15, WCP-16, and WCP-17 and collected soil samples. Collected groundwater samples during two sampling events.
II	May 1998	July 1998	Monitor Well Installation/ Development/Groundwater Sampling	Installed WCP-28, WCP-29, and WCP-30. Collected groundwater samples from WCP-15, -16, -17, -28, -29, and -30 during two separate sampling events.
III	Aug 30, 1999	Sept 16, 1999	Subsurface Investigation	Advanced soil borings SB-8 through SB-17. Collected soil and groundwater samples (Hydropunch®).
III	Sept 27, 1999	Oct 14, 1999	Monitor Well Installation/ Development	Installed and developed monitor wells WCP-40, -41, -42, -43, -45.
III	Oct 14, 1999	Oct 14, 1999	Groundwater Sampling	Sampled monitor well ENT-MW-2.
III	Nov 30, 1999	Dec 3, 1999	Monitor Well Installation	Installed monitor wells WCP-44 and -46.
III	Dec 7, 1999	Dec 7, 1999	Well Development	Developed monitor wells WCP-44 and -46.
III	Dec 27, 1999	Dec 30, 1999	Groundwater Sampling	Round 1: Sampled monitor wells: WCP-15, -16, -17, -28, -29, -30, -40, -41, -42, -43, -44, -45, and -46; MWB-4, -5, and -6.
III	Jan 31, 2000	Feb 4, 2000	Groundwater Sampling	Round 2: Sampled monitor wells: WCP-15, -16, -17, -28, -29, -30, -40, -41, -42, -43, -44, -45, and -46; MWB-4, -5, and -6. Added sample from monitor well MTP-1.
III	March 7, 2000	March 10, 2000	Groundwater Sampling	Round 3: Sampled monitor wells: WCP-15, -16, -17, -28, -29, -30, -40, -41, -42, -43, -44, -45, and -46; MWB-4, -5, and -6; MTP-1; Added sample from monitor well ENT-MW-2.
III	June 5, 2000	June 12, 2000	Groundwater Sampling	Round 4: Sampled monitor wells: WCP-15, -16, -17, -28, -29, -30, -40, -41, -42, -43, -44, -45, and -46; MWB-4, -5, and -6; MTP-1; and ENT-MW-2.
III	June 13, 2000	June 20, 2000	Monitor Well Installation	Installed deep monitor well WCP-48 using the mud rotary drilling technique.
III	June 22, 2000	June 22, 2000	Well Development	Developed deep monitor well WCP-48.
III	Aug 17, 2000	Aug 17, 2000	Groundwater Sampling	Sampled groundwater from monitor well WCP-48.
III	Sept 12, 2000	Sept 29, 2000	Groundwater Sampling	Round 5: Sampled monitor wells: WCP-15, -16, -17, -28, -29, -30, -40, -41, -42, -43, -44, -45, and -46, -48; MWB-4, -5, and -6; MTP-1; and ENT-MW-2.
III	Dec 4, 2000	Dec 11, 2000	Groundwater Sampling	Round 6: Sampled monitor wells: WCP-15, -16, -17, -28, -29, -30, -40, -41, -42, -43, -44, -45, -46, and -48; MWB-4, -5, and -6; MTP-1; and ENT-MW-2.
IV	Jan 8, 2001	Jan 11, 2001	Monitor Well Installation	Installed monitor wells WCP-85 and -86.

Table 4-1 (continued)
Chronology of Field Activities
WCP East Grand Avenue WQARF Site Remedial Investigation

RI Phase	Start Date	End Date	Activity	Comments
IV	Jan 11, 2001	Jan 11, 2001	Well Development	Developed monitor well WCP-85.
IV	Jan 15, 2001	Feb 2, 2001	Monitor Well Installation	Installed monitor wells WCP-47, -83, -84, -87, -88, -89, and -90.
IV	Feb 6, 2001	Feb 9, 2001	Well Development	Developed monitor wells WCP-47, -83, -84, -86, -87, -88, -89, and -90.
IV	Feb 27, 2001	March 6, 2001	Groundwater Sampling	Round 7: Sampled monitor wells: WCP-15, -16, -17, -28, -29, -30, -40, -41, -42, -43, -44, -45, -46, -47, -48, -83, -84, -85, -86, -87, -88, -89, and -90; MWB-4, -5, and -6; MTP-1; and ENT-MW-2.
IV	April 3, 2001	April 3, 2001	Groundwater Sampling	Resampled Michigan Trailer Park well MTP-1.
IV	April 23, 2001	May 3, 2001	Groundwater Sampling	Round 8: Sampled monitor wells: WCP-15, -16, -17, -28, -29, -30, -40, -41, -42, -43, -44, -45, -46, -47, -48, -83, -84, -85, -86, -87, -88, -89, and -90; MWB-4, -5, and -6; MTP-1; and ENT-MW-2. Added samples from monitor wells MGL-1, -2, and -3.
IV	May 3, 2001	May 3, 2001	Well Development	Redeveloped monitor wells WCP-28 and -29.
IV	May 10, 2001	May 10, 2001	Step Drawdown Test	Performed step drawdown tests at monitor wells WCP-28 and -29.
IV	May 23, 2001	May 23, 2001	Aquifer Pumping Test	Performed aquifer pumping test at monitor well WCP-29. Monitor wells WCP-15, -16, -28, and -84 were used as observation wells. Monitor wells WCP-17, and -42 were used as background wells.
IV	June 5, 2001	June 15, 2001	Groundwater Sampling	Round 9: Sampled monitor wells: WCP-15, -16, -17, -28, -29, -30, -40, -41, -42, -43, -44, -45, -46, -47, -48, -83, -84, -85, -86, -87, -88, -89, and -90; MWB-4, -5, and -6; MGL-1, -2, and -3; MTP-1; and ENT-MW-2.
IV	June 18, 2001	June 29, 2001	Groundwater Sampling	Round 10: Sampled monitor wells: WCP-15, -16, -17, -28, -29, -30, -40, -41, -42, -43, -44, -45, -46, -47, -48, -83, -84, -85, -86, -87, -88, -89, and -90; MWB-4, -5, and -6; MGL-1, -2, and -3; and ENT-MW-2. Did not sample MTP-1.
V	July 2, 2001	July 27, 2001	Monitor Well Installation/ Development	Installed/developed monitor wells WCP-92, -93, -94, -95, -96, -97, and -98.
V	July 30, 2001	Aug 15, 2001	Groundwater Sampling	Round 11: Sampled monitor wells: WCP-15, -16, -17, -28, -29, -30, -40, -41, -42, -43, -44, -45, -46, -47, -48, -83, -84, -85, -86, -87, -88, -89, -90, -92, -93, -94, -95, -96, -97, and -98; MWB-4, -5, and -6; MGL-1, -2, and -3; MTP-1; and ENT-MW-2.
V	Sept 5, 2001	Sept 5, 2001	PDB Sampler Installation	Installed PDB samplers in WCP-16, -17, -28, -29, -85, -87, -88, -93, and –94.

Table 4-1 (continued)
Chronology of Field Activities
WCP East Grand Avenue WQARF Site Remedial Investigation

RI Phase	Start Date	End Date	Activity	Comments
V	Sept 18, 2001	Sept 24, 2001	Groundwater Sampling	Round 12: Sampled monitor wells: WCP-16, -17, -28, -29, -85, -87, -88, -93, -94 using both PDB samplers and the pump. Also sampled WCP-92, -95, -96, -97, -98 using the pump only.
V	Oct 29, 2001	Nov 9, 2001	Groundwater Sampling	Round 13: Sampled monitor wells: WCP-16, -17, -28, -29, -30, -40, -41, -42, -43, -45, -46, -47, -48, -83, -84, -85, -86, -87, -88, -89, -90, -92, -93, -94, -95, -96, -97, and -98, MWB-4, -5, and -6, MGL-1, -2, and -3; MTP-1, and added MTP-2 and MWB-14.
VI	Nov 14, 2001	Dec 17, 2001	Monitor Well Installation/ Development	Installed/developed monitor wells WCP-99, -100, -200, -201, -202, -203, and -204.
VI	Dec 11, 2001	Dec 11, 2001	Groundwater Sampling	Sampled MTP-1 and MTP-2
VI	Dec 18, 2001	Dec 19, 2001	Groundwater Sampling	Round 14: Sampled monitor wells: WCP-99, -100, -202, and -204.
VI	Dec 19, 2001	Dec 20, 2001	Pressure Transducer Installation	Installed Solinst® 3001 Mini LT Levelogger™ pressure transducers to WCP-43, -85, -95, -99, -83, and -97.
VI	Jan. 31, 2002	Jan 31, 2002	Pressure Transducer Installation	Installed Solinst® 3001 Mini LT Levelogger™ pressure transducers to WCP-47 and -98.
VI	Jan 7, 2002	Jan 8, 2002	Groundwater Sampling	Sampled monitor wells WCP-200 and –201.
VI	Jan 10, 2002	Jan 25, 2002	Groundwater Sampling	Round 15: Sampled monitor wells WCP-28, -29, -30, -40, -41, -42, -43, -45, -46, -47, -48, -83, -84, -85, -86, -87, -88, -89, -90, -92, -93, -94, -95, -96, -97, -98, -99, -100, -200, -201, -202, -203, -204, MWB-6, MWB-14, MTP-1, and MTP-2.
VI	Feb 13, 2002	Feb 13, 2002	Pressure Transducer Removal	Removed Solinst® 3001 Mini LT Levelogger™ pressure transducers from WCP-47 and -98.
VI	Feb 14, 2002	Feb 14, 2002	Groundwater Sampling	Sampled MTP-1 and MTP-2

Table 2-1
Leaking Underground Storage Tank Sites [1] near the WCP East Grand Avenue WQARF Site

FACILITY ID	LEAK ID	LEVEL [2]	FACILITY NAME	FACILITY ADDRESS	DATE OF INCIDENT	DATE CLOSED	OTHER LUST ID
0-006116	2593.01	1D	SOUTHWEST ROOFING SUPPLY	3151 W Osborn	12/11/1992		
0-006237	1618.01	1F	OLD FED MART FACILITY	3010 NW Grand Ave	01/25/1991		
0-006237	1618.02	1F	OLD FED MART FACILITY	3010 NW Grand Ave	01/25/1991		
0-002956	3490.01	1F	LEVITZ FURNITURE	2801 W Indian School Rd	04/22/1994		
0-004996	2510.01	1F	PHOENIX PEST CONTROL INC	2911 N 26th Ave	10/14/1992		
0-003194	0431.01	1D	MOBIL 18-574	2649 W Indian School Rd	04/06/1988		
0-003194	0431.02	5S	MOBIL 18-574	2649 W Indian School Rd	12/22/1994	08/05/1996	3838.01
0-003194	3838.01	7	MOBIL 18-574	2649 W Indian School Rd	12/22/1994	09/27/1995	0431.02
0-006657	0608.01	2	AMFAC SUPPLY COMPANY WAREHOUSE	2800 W Osborn	01/05/1989		
0-006035	2367.01	2	MACKEY PLUMBING CO	3434 N 28th Ave	06/29/1992		
0-004923	2019.01	2	TEXACO # 60-349-0024/EQUILON	2701 W Indian School Rd	10/25/1991		
0-000126	0869.01	5G1	AMERICAN TELEVISION RELAY/MCI	4025 N 28th Ave	09/11/1989	02/20/1997	
0-000515	1991.01	5R1	ARCO # 5275	2926 NW Grand Ave	10/08/1991	05/11/1998	
0-000515	1991.02	5R1	ARCO # 5275	2926 NW Grand Ave	11/22/1993	05/11/1998	3198.01
0-000515	1991.03	5R1	ARCO # 5275	2926 NW Grand Ave	11/22/1993	05/11/1998	3198.02
0-000515	1991.04	5R1	ARCO # 5275	2926 NW Grand Ave	11/22/1993	05/11/1998	3198.03
0-000515	1991.05	5R1	ARCO # 5275	2926 NW Grand Ave	11/22/1993	05/11/1998	
0-000515	3198.01	7	ARCO # 5275	2926 NW Grand Ave	11/22/1993	08/08/1997	1991.02
0-000515	3198.02	7	ARCO # 5275	2926 NW Grand Ave	11/22/1993	08/08/1997	1991.03
0-000515	3198.03	7	ARCO # 5275	2926 NW Grand Ave	11/22/1993	08/08/1997	1991.04
0-000515	3198.04	7	ARCO # 5275	2926 NW Grand Ave	11/22/1993	08/08/1997	1991.05
0-007483	2310.01	5R1	ATLAS/SCA CONSTRUCTION SUPPLY	2801 W Weldon St	05/15/1992	08/12/1993	
0-007483	2310.01	5R1	ATLAS/SCA CONSTRUCTION SUPPLY	2801 W Weldon St	05/15/1992	08/12/1993	
0-001139	1204.01	5R1	CHEM-SERV INC	2955 W Clarendon	03/27/1990	05/05/1994	
0-001695	4962.01	5R1	CRYSTAL BOTTLED WATER	3302 W Earll Dr	11/02/1998	01/20/1999	

Table 2-1 (continued)
Leaking Underground Storage Tank Sites [1] near the WCP East Grand Avenue WQARF Site Vicinity

FACILITY ID	LEAK ID	LEVEL [2]	FACILITY NAME	FACILITY ADDRESS	DATE OF INCIDENT	DATE CLOSED	OTHER LUST ID
0-007822	0746.01	5R1	CSG SECURITY SERVICES	4010 N 27th Ave	05/24/1989	12/22/1989	
0-007373	1914.01	5R1	DARRELL STUART CONTRACTORS OF AZ	3048 N 27th Ave	08/14/1991	05/11/1999	
0-006659	0923.01	5R1	EDSON ELECTRIC SUPPLY INC	3320 N 31st Ave	10/13/1989	03/22/1993	
0-000786	3504.01	5R1	FERRELLGAS	3111 NW Grand Ave	04/29/1994	09/17/1996	
0-000786	3504.02	5R1	FERRELLGAS	3111 NW Grand Ave	04/29/1994	12/09/1999	
0-003559	2377.01	5R1	GIFFORD HILL PIPE CO	3450 N 27th Ave	07/02/1992	10/29/1999	
0-005238	1303.01	5R1	GRANBERRY SUPPLY CORP	3320 N 29th Ave	06/05/1990	06/10/1998	
0-007061	1129.01	5R1	KIVA CONTAINER CORPORATION	2830 W Osborn Rd	02/22/1990	02/02/1996	
0-007919	2425.01	5R1	LEHI SHOE STORE	3614 N 27th Ave	08/12/1992	05/24/1996	
0-003546	1606.01	5R1	OCOTILLO LUMBER SALES INC	3121 N 28th Ave	01/10/1991	01/13/1994	
0-005010	1034.01	5R1	UNITED PARCEL SERVICE	3150 N 31st Ave	08/03/1990	07/13/1998	
0-005010	1034.02	5R1	UNITED PARCEL SERVICE	3150 N 31st Ave	08/03/1990	07/13/1998	
0-003105	1364.01	5S	MCKESSON WINE & SPIRITS	2929 NW Grand Ave	07/27/1990	12/17/1990	

Notes:

(1) Information obtained from the ADEQ Leaking Underground Storage Tank Semi-Annual Listing (Dated November 2001).
(2) LUST Case Status Priority Code Definitions (revised August 24, 1999):

1D = Defined soil and groundwater; requires remediation (levels exceed standards for one or more media).
1F = Free product present on groundwater and/or surface water.
2 = Undefined soil contamination (default for newly reported LUSTs).
5G1 = Closed; soil/groundwater levels meet RBCA Tier 1.
5R1 = Closed; soil levels meet RBCA Tier 1.
5S = Closed case for suspected release (false alarm).
7 = LUST case close out involving combination of other LUST number/case at the same property.