FINAL REMEDIAL INVESTIGATION REPORT

WESTERN AVENUE PLUME

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May 2009

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TABLE OF CONTENTS

ACRONYMS v

EXECUTIVE SUMMARY vii

1.1 INTRODUCTION 1
1.2 SITE BACKGROUND 1
1.3 OPERATIONAL HISTORY 2

2.1 FIELD INVESTIGATIONS 3
2.2 1994 SITE INVESTIGATION 3
2.3 1995 EPA/ADEQ PA/SI INVESTIGATION 3
2.4 1995 INSTALLATION OF MW-1 AND MW-2 3
2.5 1996 - 1999 GROUNDWATER SAMPLING 4
2.6 2000 INSTALLATION AND SAMPLING OF MONITORING WELLS 4
2.5.1 Hydropunch Investigation 5
2.7 2001 SITE INDUSTRIAL SURVEY AND EPA PA/SI INVESTIGATIONS 6
2.6.l Former Western Avenue Dry Cleaning 6
2.6.2 Former Aladdin Dry Cleaners 7

3.1 SITE CHARACTERISTICS 9
3.2 REGIONAL GEOLOGY AND HYDROGEOLOGY 9
3.3 SITE GEOLOGY AND HYDROGEOLOGY 10
3.4 HISTORICAL WATER LEVEL DATA 11
3.3.1 Site-Related Water Level Monitoring 11

4.1 RESULTS OF DATA QUALITY ASSESSMENT 13
4.2 INTRODUCTION 13
4.1.2 Previously Evaluated Data 13
4.3 JANUARY 2004 GROUNDWATER SAMPLING 13
4.3.1 Analytical Results of Duplicate Samples 14
4.3.2 Analytical Results of QA/QC Samples 14
4.3.3 Data Usability 15
4.4 JANUARY 2005 GROUNDWATER SAMPLING 15
4.3.l Analytical Data Evaluation 16
4.3.2 Analytical Results of Duplicate Samples 16
4.3.3 Analytical Results of Quality Assurance/Quality Control Samples 16
4.3.4 Data Usability 17

5.1 NATURE AND EXTENT OF CONTAMINATION 18
5.2 CONTAMINANTS OF CONCERN 18
5.3 OTHER DETECTED CONTAMINANTS 18
5.4 PHYSICAL AND CHEMICAL PROPERTIES OF THE CONTAMINANTS OF CONCERN 18
5.5 CONTAMINANT SOURCES 18
5.6 SOURCE AREA(S) 19

5.7 DISTRIBUTION AND TRENDS OF SOIL CONTAMINATION 19
5.8 DISTRIBUTION AND TRENDS OF GROUNDWATER CONTAMINATION 19

6.1 FATE AND TRANSPORT 21
6.2 FATE AND TRANSPORT OF PCE IN SOILS 21
6.3 FATE AND TRANSPORT OF PCE IN GROUNDWATER 22
6.3.1 Groundwater Movement 22
6.3.2 Extent of Groundwater Contamination 22
6.3.3 Flow and Transport of Contaminants 22
6.4 NATURAL ATTENUATION EVALUATION 23
6.5 AREAS OF UNCERTAINTY 24

7.0 LAND AND WATER USE 25
7.1 LAND USE 25
7.2 GROUNDWATER USES 25
7.3 SURFACE WATER USES 25

8.0 SUMMARY AND CONCLUSIONS 26

9.0 REFERENCES 27

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LIST OF TABLES

Table 2-1 Summary of Groundwater Sampling
Table 2-2 Well Location and Construction Information
Table 2-3 Water Level Data
Table 2-4 Original and Duplicate Groundwater Samples, Volatile Organic Compounds
Table 2-5 Original and Duplicate Groundwater Samples, Inorganic Sample Results
Table 2-6 Original and Duplicate Groundwater Samples, Pesticide, SVOC and PCB Sample Results
Table 2-7 Summary of Soil vapor Analytical Results, Western Avenue Dry Cleaners
Table 2-8 Summary of Soil Sample Analytical Results, Western Avenue Dry Cleaners
Table 5-1 Summary of PCE Concentrations
Table 5-2 Potential Users of PCE
Table 5-3 Potential Source Areas

LIST OF FIGURES

Figure 1-1 Western Avenue Plume WQARF Site Area
Figure 1-2 Initial Groundwater Investigation
Figure 2-1 March 1995 PCE Soil Vapor Samples, City of Goodyear Public Works Site
Figure 2-2 Locations of Monitor Wells - Western Avenue Plume WQARF Site
Figure 2-3 Location of PASI Investigations and Historical Dry Cleaner Locations
Figure 2-4 March 1995 PCE Soil Vapor Samples, Western Dry Cleaners

Figure 2-5 August 2001 PCE Soil Vapor Samples, Aladdin Dry Cleaners
Figure 3-1 MW-1 Water Level Elevations and PCE Concentrations
Figure 3-2 MW-2 Water Level Elevations and PCE Concentrations
Figure 3-3 GMW-4 Water Level Elevations and PCE Concentrations
Figure 3-4 GMW-5 Water Level Elevations and PCE Concentrations
Figure 3-5 COG-MW3 Water Level Elevations and PCE Concentrations
Figure 3-6 MW-3 Water Level Elevations and PCE Concentrations
Figure 3-7 MW-4 Water Level Elevations and PCE Concentrations
Figure 3-8 MW-5 Water Level Elevations and PCE Concentrations
Figure 3-9 MW-6 Water Level Elevations and PCE Concentrations
Figure 3-10 MW-7 Water Level Elevations and PCE Concentrations
Figure 3-11 Groundwater Elevations - November 2000
Figure 3-12 Groundwater Elevations -January 2001
Figure 3-13 Groundwater Elevations -April 2001
Figure 3-14 Groundwater Elevations - July 2001
Figure 3-15 Groundwater Elevations - May 2002
Figure 3-16 Groundwater Elevations - July 2002
Figure 3-17 Groundwater Elevations - October 2002
Figure 3-18 Groundwater Elevations - March 2003
Figure 3-19 Groundwater Elevations - January 2004
Figure 3-20 Ground Water Elevations - January 2005
Figure 5-1 November 2004 PGA Water Levels - Potentiometric Surface - Subunit A
Figure 5-2 November 2004 PGA Water Levels - Potentiometric Surface - Subunit C
Figure 5-3 PCE Concentrations - November 2000
Figure 5-4 PCE Concentrations - January 2001
Figure 5-5 PCE Concentrations - April 2001
Figure 5-6 PCE Concentrations - July 2001
Figure 5-7 PCE Concentrations - May 2002
Figure 5-8 PCE Concentrations - August 2002
Figure 5-9 PCE Concentrations - October 2002
Figure 5-10 PCE Concentrations - March 2003
Figure 5-11 PCE Concentrations - January 2004
Figure 5-12 PCE Concentrations - January 2005

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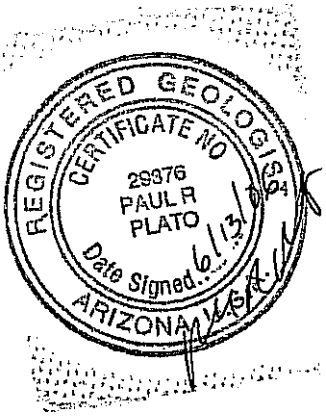
LIST OF APPENDICES

Appendix A Soil Boring Logs
Appendix B Geologic Cross Sections
Appendix C Western Avenue Dry Cleaning Soil Vapor Sampling Analytical Results
Appendix D Western Avenue Dry Cleaning Soil Sample Analytical Results
Appendix E Aladdin Dry Cleaning Soil Vapor Sample Analytical Results
Appendix F Groundwater Sample Results for January 2004
Appendix G Arizona Data Qualifiers
Appendix H Groundwater Sample Results for January/February 2005
Appendix I Current and Future Beneficial Land and Water Use

LIST OF ATTACHMENTS

CD containing Analytical Laboratory Reports 2000-2005



ACRONYMS

A.A.C.	Arizona Administrative Code
ACC	Avondale City Cleaners
ADC	Aladdin Dry Cleaning
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
A.R.S.	Arizona Revised Statute
AWQS	Aquifer Water Quality Standards
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CAS	Columbia Analytical Services, Inc.
COA	City of Avondale
COC	Contaminant of Concern
COG	City of Goodyear
COGPW	City of Goodyear Public Works
DLCS	Duplicate Laboratory Control Sample
DMS	Duplicate Matrix Spike
DNAPL	Dense Non-Aqueous Phase Liquid
EB	Equipment Blank
ft/ft	Feet per Foot
GeoTrans	GeoTrans, Inc.
gpd	Gallons per Day
gpm	Gallons per Minute
LAU	Lower Alluvial Unit
LCS	Laboratory Control Sample
MAU	Middle Alluvial Unit
MDL	Method Detection Limit
MRL	Method Reporting Limit
MS	Matrix Spike
µg/Kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
mg/L	Milligrams per Liter
PA Report	Preliminary Assessment Report
PCE	Tetrachloroethene
PA/SI	Preliminary Assessment / Site Inspections
PCB	Polychlorinated Biphenyls
PGA-S	Phoenix Goodyear Airport - South
QA/QC	Quality Assurance / Quality Control
QCMS	Quality Control Matrix Spike
QCDMS	Quality Control Duplicate Matrix Spike
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
SVOCs	Semi-Volatile Organic Compound
TASOW	Task Assignment Scope of Work
TB	Trip Blank

ACRONYMS - CONTINUED

TCE	Trichloroethene
THF	THF Drilling, Inc.
UAU	Upper Alluvial Unit
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USTs	Underground Storage Tanks
VOCs	Volatile Organic Compounds
WDC	Western Avenue Dry Cleaning
WQARF	Water Quality Assurance Revolving Fund
WSRV	Western Salt River Valley

EXECUTIVE SUMMARY

This report su=arizes the findings of the remedial investigation (Rl) activities that have been conducted by the Arizona Department of Environmental Quality (ADEQ) from 1993 through the present at the Western Avenue Plume Water Quality Assuraoce Revolving Fund (WQARF) Site (the Site) located in Avondale aod Goodyear, Arizona. GeoTraos, Inc. (GeoTraos) has prepared this Draft *Rl* Report for the Western Avenue WQARF Site to meet the requirements established under Arizona Revised Statues (A.R.S.) to determine appropriate cleanup actions at the Site.

The Site occupies approximately 200 acres along Western Avenue, aod is located within the boundaries of the cities of Avondale and Goodyear, Arizona. The Site boundaries are defined by the extent of the groundwater contaminaot plume, which generally extends to Hill Drive to the north; 3rd Street to the east; approximately 1000 feet north of State Route 85 to the south; and Litchfield Road to the west. Dissolved tetrachloroethene (PCE) is the contarninaot of concern (COC) in the groundwater at the Site.

The alluvial sediments are subdivided into three hydrologic units: the Upper, Middle, aod Lower Alluvial units (UAU, MAU and LAU, respectively). The total thickness of alluvial sediments is estimated to exceed 1,200 feet in the vicinity of the Site. The UAU cao be subdivided into: Subunit A, Subunit B, aod Subunit C. Contamination at the Site is confined to Subunit A, which is the uppermost subunit of the UAU, extending to a depth of approximately 130 feet below ground surface (bgs). It consists of interbedded deposits of alluvial sediments ranging from silt aod clay to varying amounts of saod aod gravel. Subunit B consists primarily of a thick clay layer, aod Subunit C is the lowermost subunit of the UAU, extending to the top of the MAU.

Due to increasing concentrations of PCE in groundwater at the Phoenix Goodyear Airport-South (PGA-S) Superfund Site, the ADEQ collected groundwater samples in June 1994 from three monitoring wells to be aoalyzed for PCE. Concentrations of PCE reported in all three monitoring wells exceeded the ADEQ Aquifer Water Quality Staodard (AWQS) of 5 micrograms per liter (µg/L).

ADEQ has conducted Preliminary Assessment/Site Inspections (PA/SI) investigations at three facilities near the Site, which included soil and soil vapor sampling. Based on aoalytical data collected during these investigations, the potential source of PCE in soils could not be conclusively identified.

Between April 1996 aod April 1999, a total of 11rounds of groundwater samples were collected by the ADEQ from monitoring wells at the Site. Nine additional rounds of groundwater samples have been collected through Jaouary 2004. Analytical data indicates that PCE concentrations have steadily declined since 1995.

In October 2000, GeoTraos installed five additional monitoring wells (designated as MW-3 through MW-7) at the Site on behalf of the ADEQ. These wells were added to the existing monitoring well network, aod have been included in the groundwater sampling program since their installation.

In 2001, the ADEQ contracted GeoTraos to conduct a site industrial survey in the vicinity of the

Western Avenue Plume WQARF Site to identify potential sources of PCE. Based on data collected by GeoTrans, six former dry cleaning facilities were identified in the area: the Western Dry Cleaner, Aladdin Cleaners, Avondale City Cleaners, Quinn Cleaners, Goodyear Dry Cleaners, and a dry cleaning facility of unknown name that historically operated at 1072 South Litchfield Road.

PCE concentrations in groundwater samples collected in January 2004 were reported below the AWQS of 5 µg/L. However, the PCE concentration at monitoring well MW-1 was 5.1 in January 2005.

Based on the fact that the PCE plume is defined and stable, in addition to aquifer hydraulics determining the advective movement of the plume, sufficient information is available to proceed with the feasibility study.

1.0 INTRODUCTION

This report summarizes the findings of remedial investigation (RI) activities that have been conducted by the Arizona Department of Environmental Quality (ADEQ) from 1993 through the present at the Western Avenue Plume Water Quality Assurance Revolving Fund (WQARF) Site (the Site) located in Avondale and Goodyear, Arizona (Figure 1-1). GeoTrans, Inc. (GeoTrans), under contract with the ADEQ, has prepared this Draft RI Report for the Western Avenue WQARF Site to meet the requirements established under Arizona Revised Statues (A.R.S.) §49-287.03 and Arizona Administrative Code (A.A.C.) Rl 8-16-406. The purpose of the RI is to collect sufficient information to determine appropriate cleanup actions at the Site. Information collected during the RI includes: the nature, extent and sources of contamination; and the impact of contaminants present on the Site to public health, welfare and the environment. The RI also identifies present and reasonably foreseeable uses ofland and water of the State that have been, or are threatened to be, impacted by identified contaminants.

GeoTrans has prepared this report for the ADEQ in accordance with Task Assignment Scope of Work (TASOW) No. 04-0045, including subsequent amendments and agreements.

1.1 SITE BACKGROUND

The Site occupies approximately 200 acres, and is located along Western Avenue, within the boundaries of the cities of Avondale and Goodyear, Arizona (Figure 1-1). The Site boundaries are defined by the extent of the groundwater contaminant plume, which generally extends to Hill Drive to the north, 3rd Street to the east, approximately 1000 feet north of State Route 85 to the south, and Litchfield Road to the west. Dissolved tetrachloroethene (PCE) is the contaminant of concern (COC) inthe groundwater at the Site.

In November 1991, the ADEQ conducted a Preliminary Assessment/Site Inspection (PA/SI) at the City of Goodyear Public Works (COGPW). Two monitoring wells, designated as COG-MWl and COG-MW2, were installed at the COGPW site to investigate a potential release from a 500-gallon and a 1ODO-gallon capacity underground storage tanks. A third monitoring well (designated as COG-MW3) was installed in February 1993 (Figure 1-2).

In 1994, PCE was detected at concentrations which exceeded the AWQS of 5 µg/L inmonitoring wells GMW-3 (7.1 µg/L), GMW-4 (29 µg/L), and GMW-7 (27 µg/L), which are located at the Phoenix Goodyear Airport-South (PGA-S) Superfund Site. GMW-3 is located in the Lockheed facility, just west of Litchfield Road and south of Yuma Road; GMW-4 is located in the Lockheed parking area, south of Calle de Oro; GMW-5 is located east of Litchfield Road, approximately at the center of the Lockheed parking area. In addition, PCE was detected in five groundwater extraction wells, which are operated as part of the PGA-S Superfund Site groundwater pump-and-treat system. COCs identified at the PGA-S Superfund Site include trichloroethene (TCE) and chromium. In response to detections of PCE at and upgradient, of the PGA-S Superfund Site, the ADEQ placed the Western Avenue Site on the WQARF Site Registry in December 1998.

1.2 OPERATIONAL IDSTORY

Former and existing dry cleaning facilities located within the area of the Site have been identified as potential sources of PCE contamination in groundwater. Because no specific source area has been identified to date, this section does not present a discussion on the operational history of the contaminant source. Section 2.6 provides a detailed discussion on the most likely areas where PCE contamination could have originated.

Information related to the source of groundwater samples collected, orgaoization conducting the field investigation, analytical methods, and analytical laboratory performing the analysis is presented in Table 2-1. Table 2-2 presents well construction information for wells sampled during the RI, from 1995 through January/February 2005. Table 2-3 presents water level data collected during the RI. Tables 2-4, 2-5 and 2-6 present groundwater quality data collected during this investigation, including volatile organic compounds (VOCs), semi-volatile orgaoic compounds (SVOCs), pesticides, poly-chlorinated biphenyls (PCBs) and inorgaoic sample results.

2.1 1994 SITE INVESTIGATION

Due to a trend of increasing PCE concentrations in groundwater at the PGA-S Superfund Site, the ADEQ sampled three monitoring wells in June 1994. Concentrations of PCE were reported at 43 micrograms per liter (µg/L) in COG-MW!, 38 µg/L in COG-MW2, and 54 µg/L in COG-MW3 (Figure 1-2). PCE concentrations reported in all three monitoring wells exceeded the *5* µg/L AWQS. The COCs identified at the PGA-S Superfund Site include PCE and chromium.

2.2 1995 EPA/ADEQ PA/SI INVESTIGATION

During a follow-up investigation conducted by the ADEQ at the COGPW site in June 1995, soil samples were collected at seven locations at a depth of 8.5 feet below ground surface (bgs) and 17 feet bgs. Samples were analyzed for VOCs following US EPA Method 801OA/8020A. Analytical data indicated that PCE and/or other target compounds were not present in soil above the method detection limit (MDL) of 4 micrograms per kilogram (µg/Kg).

Eleven soil vapor samples were collected at the COGPW site, and PCE was not detected in samples collected [1]. Concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) were detected. Figure 2-1 presents the PCE concentrations in soil vapor samples collected. Based on data obtained from the investigation, the ADEQ concluded that no release of PCE had occurred in the vadose zone. Detailed information regarding the ADEQ investigation at the COGPW site can be found in the report titled *Preliminmy Assessment/Site Inspection Report, City of Goodyear Public Works,* dated June 30, 1995.

2.3 1995 INSTALLATION OF IVIW-1 AND IVIW-2

In 1995, Growth Environmental (on behalf of the ADEQ) installed monitoring wells MW-1 (located directly downgradient from the former Western Dry Cleaners facility) and MW-2 (directly downgradient from the former Aladdin Dry Cleaners facility) along Western Avenue. Both MW-1

[1] The detection limit for all samples was 2.0 µg/L, with the exception of sample COG-02, which was 20 µg/L.

and MW-2 are located hydraulically upgradient from the COGPW monitoring wells. In addition, a soil boring was completed to the northeast of MW-1 (designated as SB-3B) and northeast of MW-2 (designated as SB-3A) (Figure 1-2). Prior to abandoning the soil borings, groundwater samples were collected from the open borehole to assess the extent of the PCE plume to the north of Western Avenue. PCE was not detected in groundwater samples collected from soil borings SB-3A and SB-3B, or monitoring well MW-1. PCE concentrations were reported at 51 µg/L in monitoring well MW-2.

2.4 1996 - 1999 GROUNDWATER SAMPLING

Between April 1996 and April 1999, a total of 11rounds of groundwater samples were collected by the ADEQ from monitoring wells MW-1 and MW-2; monitoring well COG-MW3 was sampled during eight of the sampling events; monitoring wells GMW-4 and GMW-5 (both installed as part of the PGA-S Superfund Site) were sampled during one and 10 sampling events, respectively.

Analytical data indicated that PCE was present in all wells sampled, as follows:

- MW-1: from 87 µg/L (April 1996) to 24 µg/L (April 1999);
- MW-2: from 73 µg/L (April 1996) to 13 µg/L (December 1998);
- COG-MW3: from 82 µg/L (December 1996) to 19 µg/L (December 1998);
- GMW-4: reported at 34 µg/L (sampled on December 1996); and
- GMW-5: from 9.5 µg/L (December 1996) to 5.6 µg/L (December 1997).

2.5 2000 INSTALLATION AND SAMPLING OF MONITORING WELLS

In October 2000, GeoTrans oversaw installation of five monitoring wells (designated as MW-3 through MW-7) at the Site on behalf of the ADEQ. The objective of the monitoring wells installed by GeoTrans was to assess the extent of contamination near the edge of the PCE plume to the east, north, and south, as well as to evaluate PCE concentrations near the suspected center of the plume. Figure 2-2 illustrates locations for these wells, and monitoring well construction details are presented in Table 2-2. A copy of the soil boring logs is included in Appendix A.

The monitoring wells installed by GeoTrans were located as follows:

- Monitoring well MW-3 was installed near the comer of north 5•h Street and east Western Avenue (Figure 2-2) to assess the potential upgradient extent of the plume. Monitoring well MW-3 is also located upgradient of MW-2, where PCE concentrations have historically exceeded the ADEQ AWQS of 5 µg/L. The former Aladdin Dry Cleaners was located between MW-2 and MW-3.

- Monitoring well MW-4 was installed near the comer of north 3'd Street and West Madden (Figure 2-2) to assess the northern extent of the PCE plume.

- Monitoring well MW-5 was installed along South 3ro Street (approximately 500 feet south of Western Avenue) to assess the degree of groundwater contamination near the center of

the PCE plume, as well as evaluate natural attenuation processes that may be occurring within this area. Additionally, Hydropunch™ groundwater sampling was performed in an attempt to assess the vertical extent of groundwater contamination in the area.

Monitoring well MW-6 was installed near the comer of south 3rd Street and west Ely Lane to assess the southern extent of the PCE plume.

- Monitoring well MW-7 was installed approximately 400 feet east of north Litchfield Road and 1000 feet south of Western Avenue, near the upgradient boundary of the PGA-S Superfund Site. This location was anticipated to be in the middle of the horizontal extent of the PCE plume. The objective ofthis well was to assess the degree of contamination at this location, as well as evaluate natural attenuation processes that may be occurring in the area. Additionally, Hydropunch™ groundwater sampling was performed in an attempt to assess the vertical extent of groundwater contamination within the area.

Drilling was performed by THF Drilling, Inc. (THF) using a Becker Dual Wall Air Percussion drill rig. At each of the five drilling locations, a 9-inch diameter exploration borehole was drilled to a depth of approximately 130 feet bgs. Schedule 40 PVC, 0.020-inch slotted well screen, and blank casing was used in well installation. Colorado Silica Sand (8-12) was added as filter pack. Following well installation, each well was developed through a combination of bailing and pumping. After well development was completed, THF equipped each monitoring well with a dedicated submersible pump. Table 2-2 documents well construction information for wells at the Site. Appendix B contains copies of the geologic cross sections.

2.5.1 Hydropunch Investigation

During completion of soil borings MW-5 and MW-7, depth-specific HydropunchTM groundwater samples were collected in an attempt to delineate the vertical extent of contaminants within the aquifer. Hydropunch™ groundwater samples were collected as follows:

- MW-5: 65 feet, 95 feet, and 125 feet bgs;
- MW-7: 75 feet, 95 feet, and 115 feet bgs.

Samples were analyzed for VOCs (including PCE) following US EPA Method 802 IB. Analytical results for the PCE (detection limit was 0.5 µg/L) are as follows:

- MW-5: 4.1 µg/L at 65 feet bgs; 0.54 µg/L at 95 feet bgs; <0.5 µg/L at 125 feet bgs.
- MW-7: <0.5 µg/L in all three samples collected.

Based on analytical data, the vertical extent of contaminant migration within the Subunit A of the Upper Alluvial Unit (UAU) appears to extend to a depth ofless than 95 feet bgs. Because the UAU extends to a depth of approximately 130 feet bgs, further groundwater investigations of Subunits B and/or C of the UAU were not performed.

2.6 2001 SITE INDUSTRIAL SURVEY AND EPA PA/SI INVESTIGATIONS

In 2001, the ADEQ contracted GeoTrans to conduct a site industrial survey in the vicinity of the Western Avenue Plume WQARF Site to identify potential sources of the PCE plume. Based on data collected by GeoTrans, the former location of six dry cleaning facilities were identified in the area: the Western Dry Cleaner, Aladdin Cleaners, Avondale City Cleaners, Quinn Cleaners, Goodyear Dry Cleaners, and a dry cleaning facility of unknown name that historically operated at 1072 South Litchfield Road (Figure 2-3).

Based on the location of the above noted potential sources of PCE relative to the location of existing monitoring wells MW-1 and MW-2, additional field investigation was conducted at the former site of the Western Avenue Dry Cleaning (WDC) and the Aladdin Dry Cleaning (ADC) facilities.

2.6.1 Former Western Avenue Dry Cleaning

The former WDC facility was located at 216/218 West Western Avenue. The WDC facility operated approximately 600 feet east (upgradient) of monitoring well MW-1, where the highest concentrations of PCE (up to 87 µg/L in April 1996) have been reported.

According to the Cole Directories, a Chevron gas and service station operated at that location between 1963 and 1985. The Cole Directory indicates that the WDC operated at 218 W. Western Avenue, Avondale, between 1963 and 1985. However, based on the *Preliminary Assessment/Site Inspection Repo11; Western Dry Cleaners* (PA Report) prepared by the ADEQ in June 1995 (ADEQ 1995), the WDC was located at 216 West Western Avenue in 1978, at the time when Mr. Hong *Kim* (owner/operator of the WDC) purchased it from Mr. David Waltman. The reason for the discrepancy on the street number for the WDC is currently unlmown. On January 21, 1985, Mr. *Kim* moved the WDC location to the current address of 300 West Western Avenue to expand the customer parking area.

During a site visit conducted by the ADEQ on November 24, 1994, a former gas pump island was observed at the south side of the building, at approximately 25 feet to the east of the eastern end of the building. The gas pumps were not present at the time of the ADEQ field reconnaissance. The PA Report also documents the potential presence of two to three underground storage tanks (USTs) buried on the southeast comer of the lot.

InMarch 1995, a total of 15 soil vapor samples (including system blanks, ambient air samples, and duplicate samples) were collected by the ADEQ at a depth of 8.5 feet bgs, except for the two soil vapor samples near the buried USTs, which were collected at a depth of 13.5 feet bgs. Samples collected were analyzed for VOCs following US EPA Modified Method 8010/8020. Soil vapor sample results indicated the presence of PCE above the method detection limit in samples WDC-6SV, WDC-7SV, WDC-9SV, and WDC-lOSV. The highest concentration was detected in sample WDC-lOSV at 5.4 µg/L. Figure 2-4 illustrates the location of the soil vapor samples collected, as well as PCE concentrations reported at each location. A summary of soil vapor analytical data is presented in Table 2-7; a copy of the laboratory analytical data is included in Appendix C.

In March 1995, the ADEQ collected 13 soil samples (including duplicate samples) using a Geoprobe® Large Bore Sampler. Samples were collected at WDC-1, WDC-2, WDC-3, WDC-4,

WDC-5, WDC-6, WDC-7, WDC-8, WDC-9, and WDC-10. Samples were collected at a depth of 10 to 12 feet bgs; in the vicinity of the USTs, soil samples (WDC-4 and WDC-5) were collected at a depth of 15 to 17 feet bgs. Locations of samples collected are shown in Figure 2-4. Soil sample analytical results indicate that all concentrations were below the method detection limit of 4 µg/L. A copy of the analytical report is included in Appendix D.

2.6.2 Former Aladdin Dry Cleaners

The former ADC was located at 322 East Western Avenue. The former ADC is upgradient from monitoring well MW-2, where PCE concentrations were reported up to 76 µg/L in June 2001. The facility operated under the name of Aladdin Cleaners from February 5, 1992, to January 1998. In 1998, the name of the business changed to Estrella Equestrian Laundry. Prior to 1991, a dry cleaning facility by the name of Briteway Cleaners operated at that location (ADEQ, 2001). A fitness spa currently operates at this location.

According to the Aladdin Dry Cleaner's owner, all-dry-cleaning operations were conducted at this address, even though a Cole Directory search indicates that the business was also located at 310 East Western Avenue. The 310 East Western Avenue was apparently the address of the former Aladdin Dry Cleaner's business office.

In March 2001, the ADEQ conducted a PA/SI at the ADC facility. This investigation included collection of 11 soil and 17 soil vapor samples from 10 sampling locations. Samples were collected at depths of 8.5 to 14.5 feet bgs and analyzed for VOCs following Field Analytical Service Program Procedure #902. PCE was not detected in any of the soil samples collected. PCE concentrations in soil vapor samples (collected at a depth of approximately 8.5 feet) ranged from non-detect (sample collected northwest of the parking lot) to 70 µg/L, as displayed in Figure 2-5. The highest concentrations were detected in two soil vapor samples collected approximately 30 feet west of the Aladdin Cleaners building. A summary of soil vapor analytical data collected during this investigation is presented in Table 2-8. A copy of the laboratory analytical report is included in Appendix E.

The ADEQ concluded that the WDC and the ADC did not present a potential source of PCE in groundwater. Although the geometry and behavior of the groundwater plume implies a source in the vicinity of monitoring well MW-1, the location of this source is still undetermined. Detailed information regarding the PA/SI investigations conducted by the ADEQ can be found in the reports *titled Preliminmy Assessment /Site Inspection Report, Western D1y Cleaners,* dated June 30, 1995 and *Preliminmy Assessment/Site Inspection Report, Aladdin Cleaners,* dated June 15, 2001.

In addition to the two facilities listed above, the following facilities (shown in Figure 2-3) were identified during the industrial survey conducted by GeoTrans:

3. Avondale City Cleaners (ACC) operated at 207 East Western Avenue between 1959 and 1972. The ACC facility was located approximately 50 to 100 feet east (upgradient) of monitoring well MW-2. The ACC operated prior to the promulgation of the Resource Conservation and Recovery Act (RCRA); therefore, records related to chemicals used onsite may not be available.

4. Quinn Cleaners operated at 404 East Western Avenue between 1957 and 1961. The facility was located approximately 700 feet east (upgradient) of groundwater monitoring well MW-2. Quinn Cleaners operated prior to the promulgation of RCRA; therefore, records related to chemicals used onsite may not be available.

5. Two dry cleaners operated in adjacent suites of a shopping plaza between 1995 and 2002: Goodyear Dry Cleaners operated at 1084 South Litchfield Road between 1995 and 2000, and a dry cleaning facility of unknown name operated at 1072 South Litchfield Road between 2001 and 2002. Both locations are hydraulically downgradient from the Western Avenue WQARF Site's monitoring wells, but hydraulically upgradient from the PGA-S Superfund Site monitoring wells.

In summary, the PA/SI investigations conducted by ADEQ indicate that none of the facilities investigated represent a significant source of PCE contamination in soil or groundwater. Although the geometry and behavior of the groundwater plume appears to imply a source(s) in the vicinity of monitoring well MW-1, the specific location(s)/source(s) has not been identified.

3.1 REGIONAL GEOLOGY AND HYDROGEOLOGY

The Site is located on the western portion of the Salt River Valley (WSRV), a broad, relatively level alluvial valley in the Basin and Range physiographic province of Central Arizona. This alluvium represents a combination of deposits from the surrounding mountains and fluvial deposits from the Salt River. A detailed description of the general alluvial basin geology is documented in the United States Geological Survey (USGS) Open-File Report 89-378, *Geohydrology and Water Resources of Alluvial Basins in South-Central Arizona and Parts of Adjacent States* (Anderson et al., 1990).

The USGS divides the stratigraphy of the WSRV into the Mountain Bedrock, Pre-Basin and Range Sediments, Lower Basin-Fill, Upper Basin-Fill, and Stream Alluvium. Inupward sequence, the Mountain Bedrock consists of igneous, metamorphic and consolidated sedimentary rocks ranging from Precambrian to Cenozoic in age. The Pre-Basin and Range Sediments consist of moderately to highly consolidated continental deposits of silt, clay gravel and conglomerate, primarily Tertiary in age. Examples of these sediments would be Camelshead Formation and the Tempe Beds, exposed in the Papago Park area of east Phoenix. These sediments generally exceed several thousand feet in thickness. Above the Pre-Basin and Range Sediments lie the Lower Basin-Fill Sediments. The thickness, areal extent, and grain size of the Lower Basin-Fill Sediments are variable, but generally consist of weakly to highly consolidated gravel, sand, silt and clay and may include interbedded evaporate deposits and volcanic rocks at selected locations. The Lower Basin-Fill Sediments typically include 2,000 to 7,000 feet of :fine-grained facies of silt and clay at the base, in the center of the basins in which these deposits are found.

The Upper Basin fill is generally composed of unconsolidated to moderately consolidated fanglomerates and alluvial deposits laid down during the last stages of the Basin and Range disturbance. This unit also grades into finer grained facies towards the interiors of the basins, but is generally coarser than the lower unit and with less evaporates. This unit is generally a very good producer of groundwater. Some :fine-grained deposits in this unit impede the vertical migration of groundwater, such that perched or semi-perched conditions exist in much of the area near the Site. The upper basin fill is composed mainly of silt, sand, and gravel; locally, relatively thin clay layers can be present. Within the WSRV, the unit is predominantly gravel and sand with some thick zones of cobbles near the present channels of the Salt River. Gravel and sand is also found in areas north and south of the present-day channel, where the ancestral channel was located.

The upper-most geologic unit in the WSRV is the Stream Alluvium, which represents stream channel and related sediments typically up to 1,200 feet thick. This sedimentary unit was deposited after the basins were filled, and during the establishment of the present drainage system. Sediments consist of flood-plain, channel-fill, alluvial-fan, and playa deposits. The stream alluvium is generally unconsolidated, except where cemented by caliche. Grain size ranges from boulder- and cobble-size gravel in the alluvial fans to clays in local playa deposits. Ingeneral, sand and gravel are found along the stream channels.

The Arizona Department of Water Resources (ADWR) documented the Site area hydrogeology in a document titled *A Regional Groundwater Flow lvfodel of the Salt River Valley - Phase I Phoenix Active Management Area Hydrogeologic Framework and Basic Data Report* (Corkhill et al., 1993). Although the hydrogeologic stratigraphy generally corresponds to the geologic units devised by the USGS, the correlation is not exact and different unit names are used.

The alluvial sediments (Lower and Upper Basin Fill) are subdivided into three hydro logic units: the Upper, Middle, and Lower Alluvial units (UAU, MAU and LAU, respectively). The total thickness of alluvial sediments is estimated to exceed 1,200 feet in the vicinity of the Site.

The LAU is composed of consolidated sands and gravels. The MAU is also consolidated, but it contains a higher proportion of fine-grain material. Both the MAU and LAU represent depositional environment within closed basin (lake bed) conditions. Although the hydraulic properties of the MAU are less favorable for water production, the MAU is the most productive unit basin-wide. The UAU consists of unconsolidated sands and gravels deposited by flowing drainages, and is the most permeable unit. According to the ADWR, the UAU is typically 300 to 400 feet thick in the WSRV. Where thick saturated sections of the UAU are present, the groundwater production rates are generally very high.

Inaddition to the UAU, MAU and LAU, several noted geologic units have been classified, including the pre-Basin and Range sedimentary units (Tempe Beds and Camelshead Formation) and the crystalline bedrock. Hydrologically, these units are not significant for groundwater use or production except in a few limited areas of the WSRV.

3.2 SITE GEOLOGY AND HYDROGEOLOGY

The alluvial sediments (which corresponds to the Lower and Upper Basin Fill following the USGS nomenclature) are subdivided into three hydrologic units: the UAU, MAU and LAU, respectively. The total thickness of alluvial sediments is estimated to exceed 1,200 feet in the vicinity of the Site.

The UAU beneath the site extends from ground surface to its contact with the MAU at approximately 360 feet bgs. The UAU consists of poorly to well-sorted deposits of clay, silt, sand, and gravel. Based on particle size distribution and data from geophysical logs, the UAU can be subdivided into: Subunit A, Subunit B, and Subunit C. Coarse-grained sediments (greater than silt size) represent approximately 60 to 70 percent of Subunits A and C, and approximately 20 to 30 percent in Subunit B.

Subunit A is the uppermost subunit of the UAU extending to a depth of approximately 130 feet bgs. It consists of interbedded deposits of alluvial sediments ranging from silt and clay to varying amounts of sand and gravel. Subunit A is considered an unconfined aquifer; the saturated portion, if found, is located within the lower one-half to one-third of the subunit. Water from Subunit A is used for irrigation purposes. Based on aquifer testing conducted as part of the investigation at the PGA-S Superfund Site, the transmissivity of Subunit A is estimated to range from 100 to 80,000 gallons per day per foot (gpd/ft), with an average of 20,000 gpd/ft. The average hydraulic conductivity was determined to be about 400 gallons per day per square foot (gpd/ff); the specific yield likely range between 0.05 and 0.15 (CH2M-Hill 1989).

Subunit B consists primarily of a thick clay layer between approximately 130 feet and 240 feet bgs. Current site-specific subsurface data is not sufficient to determine if this subunit is continuous and/or confining below the Site. Subunit B is interpreted to be an aquitard between Subunits A and C. The thickness of the subunit and grain size are the main factors in retarding the vertical groundwater flow between Subunits A and C. Based on aquifer testing conducted at the PGA-S Superfund Site, the average transmissivity of Subunit B is estimated at approximately 2,000 gpd/ft; the average horizontal hydraulic conductivity was estimated at 40 gpd/ft'. The vertical hydraulic conductivity ranged from 0.04 and 4 gpd/ft' (CH2M-Hill 1989).

Subunit C is the lowermost subunit of the UAU and extends from the base of Subunit B (approximately 240 feet bgs) to the top of the MAU, at a depth of approximately 360 feet bgs. Within the UAU, Subunit C is the primary source of groundwater for municipal and agricultural purposes. Subunit C consists of interbedded alluvial sediments ranging from clay to poorly-sorted gravel. The upper half of the subunit generally consists of sandy gravel; the lower half of the subunit (generally finer grained than the upper half of the subunit) consists mainly of interbedded deposits of sand, clay and gravel. Based on studies conducted at the PGA-S Superfund Site, Subunit C is interpreted to be a highly transmissive, leaky confined aquifer. Some aquifer interconnection may take place between Subunit C and thin transmissive sand lenses (where present) within the upper portion of the MAU. Based on aquifer testing conducted at the PGA-S Superfund Site, the estimated transmissivity of Subunit C is estimated to be 120,000 gpd/ft; the average hydraulic conductivity is estimated at 1,000 gpd/ft' and 600 gpd/ft' for the upper and lower halves of Subunit C, respectively.

3.3 IDSTORICAL WATER LEVEL DATA

GeoTrans has completed groundwater monitoring and sampling at the Site since November 2000, including water level measurements, to characterize the nature of contamination at the Site. Results from previous monitoring and groundwater sampling conducted by GeoTrans between November 2000 and March 2003 are documented in several reports, which are referenced in Section 9.0 of this report.

Current water levels are approximately 4 to 14feet lower than the highest levels noted in early 2001. Table 2-3 presents a summary of water level data for the Site monitoring wells. Water level data from monitoring wells GMW-4, GMW-5, COG-MW3, MW-1 and MW-2 are also available for the period 1995to 2000. Since the groundwater sampling event conducted in March 2003, groundwater levels have declined approximately 1to 2 feet. The data also indicate that groundwater flow is and has been generally in a westward direction. Figures 3-1 through 3-10 illustrate water level versus PCE concentrations data collected between 1995 and January 2005 for monitoring wells MW-1, MW-2, GMW-4, GMW-5, COG-MW3, MW-3, MW-4, MW-5, MW-6, and MW-7.

3.3.l Site-Related Water Level Monitoring

GeoTrans has conducted water level monitoring at the Site since November 2000. Currently, water levels are approximately 4 to 14 feet lower than the highest levels noted in early 2001. Water level data from monitoring wells GMW-4, GMW-5, COG-MW3, MW-1 and MW-2 is also available for the period 1995 to 2000.

Figure 3-11 illustrates water levels for November 2000, which included seven monitoring wells. Water levels were highest at well MW-1, with groundwater flow oriented generally westward. The high water level at MW-1 is questionable, and is not evident in subsequent monitoring rounds. For this reason, contouring of the data were not completed, since this data point appears to be questionable.

Figures 3-12 through 3-20 illustrate water levels for monitoring events between January 2001 through January 2005.

Based on the most recent depth-to-water measurements collected by GeoTrans on January 27, 28, 2005, as well as February 3, 2005, the general groundwater flow direction in Subunit A appears to be toward the west. Figure 3-20 illustrates groundwater levels and flow direction at the Site for January/February 2005. A review of these data indicates that the groundwater gradient in the eastern portion of the Site along Western Avenue was calculated to be approximately 0.002 feet per foot (ft/ft). The groundwater gradient in the western portion of the Site, near Litchfield Road, was calculated to be approximately 0.002 ft/ft.

Based on water level elevations, it appears that north of Western Avenue groundwater flow may have shifted from north-westward to a westward flow. Water level elevations in the southwest portion of the Site, near MW-7, indicate the flow regime changes in this area. A groundwater divide in this area appears to be present, causing the groundwater to flow slightly north of west (north of MW-7), and south of west (south of MW-7). The effects of the groundwater divide were less evident during the January 2004 water level data collection period. The reason for this flow regime is not known at this time. The lack of monitoring wells north and south of Western Avenue, between Central Avenue and 5•h Street, precludes a better understanding of the groundwater flow in this particular area. Table 2-3 shows the water levels collected historically through January 2005.

4.0 RESULTS OF DATA QUALITY ASSESSMENT

4.1 INTRODUCTION

This section presents a data quality assessment for laboratory analytical results collected during 2004 and 2005. Based on that review, analytical results provided by Columbia Analytical Services Inc. (CAS) are valid within the limitations of a Tier II evaluation. The goal of a Tier II data evaluation is to identify data quality issues, deficiencies, and indicate whether the quality of the data is consistent with its intended use. Tier II data can be used for site assessment investigations.

4.1.1 Analytical Data Evaluation

Analytical data may be qualified for any of the following reasons:

1. Laboratory deviation from the designated method;
2. The data did not meet the designated method criteria; and/or,
3. The professional judgement of the data reviewer.

Data qualifiers are used by the laboratory to describe the analytical results of individual samples. A list of Arizona Data Qualifiers is included with the analytical data report, and is presented in Appendix G. One, none, or a combination of these data qualifiers may appear in the analytical reports to flag the analytical results of an individual sample, based on the reasons given above.

4.1.2 Previously Evaluated Data

As noted, this section presents an evaluation oflaboratory analytical results collected during 2004 and 2005. Historically, samples have been collected (and evaluated) by ADEQ (prior to November 2000) and GeoTrans (since November 2000). Copies of analytical reports for samples collected by ADEQ prior to 2000 were provided to GeoTrans during the initial phases of the project. These data have been reviewed and incorporated into this report where relevant, but GeoTrans has not conducted a data validation process for these data. Data collected by GeoTrans since November 2000 have been evaluated as part of each previous report where documented. Copies oflaboratory analytical reports for samples collected by GeoTrans are included in a CD attached to this report.

4.2 JANUARY 2004 GROUNDWATER SAMPLING

Groundwater samples collected from seven monitoriog wells were submitted to CAS on January 30, 2004, under service request No. X2400084. The seven samples (designated MW-1 through MW-7) were submitted for VOC analysis following US EPA Method 8260B. In addition, a trip blank (TB) and an equipment blank (EB) sample were submitted for quality assurance/quality control (QA/QC) purposes. Laboratory QA/QC samples included a Method Blank, Matrix/Duplicate Matrix Spike (MS/DMS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS). All samples submitted were analyzed within the holding time requirements recommended by the US EPA. A copy of the laboratory analytical report is included in Appendix F. A review of the analytical report provided by CAS indicates that none of the data were qualified.

4.2.1 Analytical Results of Duplicate Samples

A groundwater duplicate sample was collected at monitoring well COG-MW3, and was labeled ADEQ-MW3. The sample was collected for QA/QC purposes of field analytical data. The analytical report showed no discrepancies in the analytical results between the original sample and its duplicate. The only analyte reported in both samples is tetrachloroethene at a concentration of 4.4 µg/L in sample COG-MW3 and 5 µg/L in its duplicate sample ADEQ-MW3. Based on the good correlation in hath samples, and the fact that no other discrepancies were found between the analytical results, it is concluded that the data is representative of site conditions and can be used for their intended purposes.

4.2.2 Analytical Results of QA/QC Samples

Analytical results for the trip blank sample TB (submitted to the laboratory for QA/QC purposes) showed that all VOC concentrations were below the laboratory method reporting limit (MRL) for each of the analytes. However, analytical data for the equipment blank sample EB-1 (submitted as a QA/QC sample) showed the presence of the following analytes:

- 9.9 µg/L bromodichloromethane;
- 5.8 µg/L bromoform;
- 4.7 µg/L chloroform;
- 14 µg/L dibromochloromethane;
- 0.97 µg/L ethylbenzene;
- 2.0 µg/L PCE;
- 1.2 µg/L toluene;
  2.3 µg/L xylenes (m,p); and,
- 1.5 µg/L xylenes (o).

None of the analytes detected in the equipment blank sample EB-1 (with the exception of PCE) were detected in the groundwater samples collected from the Site monitoring wells or the laboratory QA/QC samples. Therefore, it appears that this issue is specifically related to the decontamination of the field equipment from where the sample was collected, rather than being indicative of additional contaminants present in groundwater. The concentrations of trihalomethane compounds (THMs) suggest that chlorinated water (such as tap water) may not have been removed from the equipment prior to sample collection, or may have been used to collect the sample in place of deionized water. Detectable concentrations of BTEX compounds could have a number of sources, including airborne gasoline vapors, or contact with the gasoline in the generator. The detection of PCE is indicative of inadequate equipment decontamination.

Analytical data for the laboratory Method Blank QA/QC sample were not qualified, and did not show detected concentrations of any of the analytes. The percent recovery for all surrogates were within the acceptable range established for each surrogate. The surrogate percent recovery for the sample batches was also within the established acceptable limits. Surrogate recovery analysis was performed in the following samples: GMW-5, COG-MW3, ADEQ-MW3, Trip Blank, Method Blank, Batch QC, Batch QCMS, Batch QCDMS, LCS, and DLCS. Laboratory QA/QC analytical results are included within the analytical data presented in Appendix F.

4.2.3 Data Usability

As stated in Section 4.2.2, analytes (other than PCE) which were detected in the equipment blank sample (EB-1) were not detected in any other sample collected, or in any of the QA/QC samples analyzed. GeoTrans has undertaken additional field training to address concerns regarding equipment decontamination procedures. Because THM and BTEX compounds were not noted in samples, the issue appears to be confined primarily to PCE detection. From a statistical, quantitative approach, the detection of PCE in the equipment blank would tend to indicate the potential for a positive bias for this round of data.

The EPA webpage guidance on environmental data verification and validation (http://www.eoa.gov/OUALITY/gs-docs/g8-final.pdf) suggests on page 61, Step 3:

> *Any QC deficiency may bring particular sample results into question. The data validator should consider the deficiency and make a determination as to whether a particular analytical batch is adversely affected, whether the nonconformance indicates a widespread bias in the analysis that affects all samples, or whether the deficiency has no significant impact on data quality and the sample results can be used as reported. As noted earlier, the purpose of the sampling and analysis effort should be taken into account during the data validation process in order to understand the end-use of the data.*

Ifa statistical investigation of the data for bias to a normal distribution were completed, it would be significantly complicated by the presence of a declining trend in PCE concentrations. This might tend to invalidate a direct bias determination without accounting for the trend. Additionally the number of data points available for such a statistical analysis is low (8 data points prior to January 2004) thereby weakening the utility for such an evaluation. Additionally, the use of the data for this project is more qualitative, and trend-oriented.

An examination of the historical PCE detections indicates that the sample results from the January 2004 sampliog round do not appear to deviate significantly from previous values. Therefore, it appears that the reliability of the samples collected has not been adversely impacted. The fact that the data were not qualified, and that all surrogate recoveries were within the acceptable range established are also indicators that the data collected are reliable. Therefore, the data collected may be used for all purposes within the limitations of a Tier IIdata deliverable.

4.3 JANUARY 2005 GROUNDWATER SAMPLING

A total of nine groundwater samples were collected by GeoTrans in January 2005. Samples were designated as MW-1 through MW-7, GMW-5, and COG-MW3. Field QA/QC samples were collected as follows: ADEQ MW-1 (sample duplicate of MW-1), ADEQ MW-6 (sample duplicate of MW-6), ADEQG MW-3 (sample duplicate of COG MW-3), and a Trip Blank. The laboratory QA/QC samples included a Method Blank, MS, DMS, LCS, and DLCS. No discrepancies with the accompanying chain of custody were reported by the laboratory. All samples submitted were analyzed within the holding time requirements reco=ended by the US EPA. A copy of the laboratory analytical report is included in Appendix H.

4.3.1 Analytical Data Evaluation

A review of the analytical report provided by CAS indicates that 1,3-dichloropropane; 1,2-dibromoethane; chlorobenzene; bromobenzene; and 1,3-dichlorobenzene were qualified with one or more of the following qualifiers:

- Ll: indicates that the associated blank spike recovery was above the laboratory acceptance limits;

- Ml : indicates that the matrix spike recovery was high, however, the method control sample recovery was acceptable; and,

  V8: indicates that the calibration verification recovery was below the method control limit for this analyte; however, the average percent difference or percent drift for all the analytes met method criteria.

These analytes are not COCs at the Site.

4.3.2 Analytical Resnits of Duplicate Samples

Duplicate groundwater samples were collected at monitoring wells MW-1 (sample duplicate labeled ADEQ-MWl), MW-6 (sample duplicate labeled ADEQ-MW6), and COG-MW3 (sample duplicate labeled ADEQ-MW3). Based on the laboratory analytical report, no discrepancies were reported in the results between samples MW-1 and its duplicate ADEQ-MWl. PCE was the only analyte reported in both samples at concentrations of 5.1 µg/L (MW-1) and 3.9 µg/L (ADEQ-MWl). These concentrations are within an acceptable range between each other, and do not present a concern regarding the validity and representativeness of the data.

Neither sample MW-6 nor its duplicate sample ADEQ-MW6 indicated measureable concentrations of analytes. Analytical results of sample COG-MW3 and its duplicate ADEQ-MW3 indicated PCE at concentrations of 2.1 µg/L in both samples.

4.3.3 Analytical Results of Quality Assurance/Quality Control Samples

QAJQC samples collected in the field included a field equipment blank (EB-1) and a trip blank (TB). Laboratory QA/QC samples included a method blank, matrix spike (QCMS), a duplicate matrix spike (QCDMS), a lab control spike, and a duplicate lab control spike. The laboratory surrogate recovery was within the method control limits. Concentrations of analytes were not detected in the trip blank sample, indicating that no outside contamination was introduced in the samples collected during transportation to the analytical laboratory. None of the analytes were detected in the laboratory QA/QC samples, indicating that no laboratory contamination was introduced in the samples collected during analysis. All the recovery percentages were reported within the method control limits. All concentrations of analytes were reported as none detected; however, several of the analytes were flagged with one or more of the qualifiers discussed in Section 4.3.1. As noted, these analytes are not COCs at the Site.

4.3.4 Data Usability

The reported concentrations of PCE were not qualified by the laboratory; therefore, the analytical data is still considered valid and representative for the Site.

The percent recovery for analytes qualified with either a Ll or Ml was higher than the laboratory acceptance limits, indicating that concentrations reported were higher than actual concentrations present. Based on the fact that these analytes are not COCs at the Site, and that they were not detected in any of the QA/QC samples analyzed, the validity and representativeness of the data is not believed to be compromised.

The calibration verification recovery for analytes qualified with a "V" were below the method control limit; however, as stated in the analytical report, the average percent difference for all analytes met the method criteria. The reason for qualifying the data relates to laboratory instrumentation calibration, and not to the sample collection methodology. None of these analytes were present in groundwater samples collected or are COCs at the Site.

Concentrations for PCE reported for samples analyzed were not qualified and do not appear to be impacted by laboratory instrumentation issues; therefore, the concentrations reported are considered to be valid when used within the limitations of a Tier II data review.

5.0 NATURE AND EXTENT OF CONTAMINATION

5.1 CONTAMINANTS OF CONCERN

PCE is the COC identified at the Site. Table 5-1 presents a SUIIllilary of PCE concentrations detected at each monitoring well. Since 1990, concentrations of PCE have been detected in groundwater samples collected from several monitoring wells located at the PGA-S Superfund Site, which is located hydraulically downgradient from the Site's western boundary. In 1993, PCE was detected in groundwater samples collected from monitoring wells upgradient from the PGA-S Superfund Site. Since 1993, PCE concentrations in groundwater samples collected from monitoring wells at the PGA-S Superfund Site have consistently exceeded the aquifer water quality standards (AWQS). PCE has also been detected in four groundwater extraction wells operated as part of the PGA-S Superfund Site groundwater pump-and-treat system. No other COCs have been identified in groundwater beneath the Site.

5.2 OTHER DETECTED CONTAMINANTS

Based on the current plume configuration, impacted groundwater at the PGA-S Superfund Site is in general being captured by the pumping wells. Figures 5-1 and 5-2 illustrate water levels for November 2004 in Subunits A and C. To date, TCE and chromium have not been detected at concentrations which exceed their respective AWQS in groundwater samples from the Site. BTEX constituents have been detected at the COGPW facility. Nitrate has been detected at concentrations which exceed AWQS, but nitrate is not a COC. Arsenic has also been detected at concentratiosn which exceed the AWQS, but arsenic is also not considered a COC.

5.3 PHYSICAL AND CHEMICAL PROPERTIES OF THE CONTAMINANTS OF CONCERN

Approximately 60 percent of the PCE used in the US (in 1991), was in the dry cleaning and textile industries. Among other applications, PCE is also used in vapor degreasing and metal cleaning operations, and the production of solvent soaps, adhesives, sealants, and as a solvent in various consumer products. PCE is a colorless, non-flammable liquid that does not occur naturally in the environment. Its solubility is less than 1 milligram per liter (mg/L), and a density of 1.63 grams/milliliter. The density of water is 1 gram/milliliter.

5.4 CONTAMINANT SOURCES

The highest concentrations of PCE in groundwater have been identified in the shallow saturated zone. Based on results of the shallow soil borings and soil vapor investigations conducted by the ADEQ to date, it appears that there is/are no continuing on-site source(s) of VOCs impacting the groundwater. Due to the lack of definitive results from the soil vapor investigations conducted within likely source areas, the source(s) is/are undetermined at this time. It should be emphasized that results of subsurface soil and soil vapor investigations conducted to date have been inconclusive

as far as identifying a source area(s). Based on data obtained from long-term monitoring of groundwater flow, the source(s) is/are suspected to be along Western Avenue.

Dissolved-phase PCE within the shallow aquifer (Subunit A) has migrated off-site; however, the aerial extent of contaminant migration is anticipated to continue to attenuate as concentrations of PCE mix and dilute with uncontaminated groundwater. The anticipated effects of mixing and dilution on the geometry and extent of the plume migration can be verified using groundwater modeling.

5.5 SOURCE AREA(S)

Based on information collected while performing the Site Industrial Survey, GeoTrans identified more than 50 potential locations within the boundaries of the survey area that historically had and/or currently have the potential for using PCE (Table 5-2). Based on the distribution of PCE concentrations in groundwater, the investigation focused along Western Avenue, where the City of Goodyear Public Works Facility is located, and six former dry cleaners operated (Table 5-3) (Figure 2-3). Although PCE has been detected in groundwater at the Site, a source(s) has/have not yet been identified. The exact nature of the operation and/or physical structure where the release originated from is/are currently unknown. Analytical data collected to date indicate that dense non-aqueous phase liquids (DNAPLs) are not present in groundwater.

Based on the distribution of PCE in groundwater, the most probable source areas are former dry cleaning facilities along Western Avenue, possibly the locations of Western Dry Cleaners and Aladdin Dry Cleaners. PCE was detected in soil vapor at each site, although at concentrations which did not indicate a higbly contaminated source area. The City of Goodyear Public Works Facility did not have detectable concentrations of PCE in soil vapor, and may not be a source area for PCE contamination.

5.6 DISTRIBUTION AND TRENDS OF SOIL CONTAMINATION

Analytical data collected from previous investigations at the Site show that there are no elevated concentrations of PCE remaining in subsurface soil. Figures 2-1, 2-4 and 2-5 show the locations where previous subsurface soil and soil vapor samples were collected, as well as the PCE concentrations reported. No clear source area for soil contamination has been identified.

5.7 DISTRIBUTION AND TRENDS OF GROUNDWATER CONTAMINATION

Figures 3-1 through 3-10 illustrate PCE concentrations at each monitoring well sampled between 1995 and January 2005. In general, the higbest PCE concentrations were detected during the first years of the sampling period. The highest PCE concentration was detected in monitoring well MW-1during the March 1996 sampling event, of 87 µg/L. PCE was also detected at relatively high concentrations in monitoring well MW-2 (73 µg/L) and GMW-4 (34 µg/L). The highest concentration of PCE in monitoring well COG-MW3 (82 µg/L) was detected during the December 1996 sampling event.

Figures 5-3 through 5-12 illustrate PCE concentrations from groundwater sampling conducted from November 2000 through January 2005. Concentrations of PCE in monitoring wells MW-4, MW-5, and MW-7 (constructed in 2000) have generally declined between 2001 and 2004. As of January 2004, no wells exceeded the AWQS for PCE of 5 µg/L. However, results of groundwater samples collected during January 2005 indicate that PCE concentrations in monitoring well MW-1 (5.1 µg/L) exceeded the AWQS of 5 µg/L.

In accordance with the approved scope of work, during the January 2004 sampling event, groundwater samples were collected using both low-flow techniques and standard three well-volume purging. Groundwater samples were collected using low flow sampling techniques from monitoring wells MW-3, MW-4 and MW-5 (January 29, 2004), MW-7 (January 30, 2004), and COG-MW3 (February 1, 2004). PCE was detected in groundwater samples collected from monitoring wells MW-4, MW-5 and COG-MW3 at concentrations of 2.6 µg/L, 2.7 µg/L, and 4.4 µg/L, respectively (Figure 5-11). None of the samples collected contained PCE at concentrations which exceeded the ADEQ AWQS of 5 µg/L.

From January 29 to February 1, 2004 groundwater samples were collected from monitoring wells MW-1, MW-2, MW-6 and GMW-5 after purging three well-volumes and field parameters stabilized. GeoTrans was unable to collect a groundwater sample from monitoring well GMW-4, because its dedicated pump was not operational. PCE was detected in the groundwater sample collected from monitoring well MW-1 at a concentration of 2.9 µg/L (Figure 5-11). A summary of analytical data is presented in Table 2-4. Copies of the laboratory analytical report and the field sampling reports for January/February 2004 are included in Appendix F.

Between January 27 and February 3, 2005, GeoTrans collected groundwater samples from monitoring wells MW-1 through MW-7, COG-3, and GMW-5. PCE concentrations were detected in monitoring well MW-1 at 5.1 µg/L (3.9 µg/L in the duplicate sample); monitoring well MW-2 at 2.1 µg/L; monitoring well MW-4 at 1.9 µg/L; monitoring well MW-5 at 1.4 µg/L; monitoring well MW-7 at 0.81 µg/L; monitoring well COG-3 and its duplicate sample at 2.1 µg/L; and GMW-5 at 0.86 µg/L. A summary of analytical data is presented in Table 2-4. Copies of the laboratory analytical report and the field sampling reports for January/February 2005 are included in Appendix H.

6.0 FATE AND TRANSPORT

6.1 FATE AND TRANSPORT OF PCE IN SOILS

Vertical migration of PCE into the shallow aquifer (Subunit A) is the primary mechanism for groundwater contamination at the Site. The rate of migration is influenced by the physical and chemical properties of PCE and the type of subsurface sediments. Sorption and release from soils is dependent upon organic matter content, temperature, saturation, and salinity. Approximately 97 percent sorption of PCE will take place in unsaturated top soil; however, it is estimated that in saturated deep soils, 26 percent of PCE leaches into the groundwater. Approximately 2 percent of the PCE present in unsaturated top soil will volatilize into soil air. Small amounts of anaerobic microbial degradation may also take place. (htto://www.epa.1mv/chemfact/s perchl.txt)

Impacts to the groundwater is likely to be the result of one (or more) of the following mechanisms:

- The amount of PCE released is sufficient to saturate the shallow subsurface sediments and migrate into the groundwater as a DNAPL. As a result, the release point will be a continuous source of PCE into the subsurface soil and shallow aquifer. High concentrations of PCE would be expected in subsurface soils at and/or near the source area;

  PCE is released into the subsurface soil, and migrates into the shallow aquifer by the interaction of percolating surface water and/or infiltration of wastewater leaking from underground sewers; and/or,

- Dissolution of PCE from the gaseous state to a liquid state as it interacts with groundwater or percolating surface water or wastewater.

Based on Site data presented, the first mechanism listed (DNAPL migration) is not supported by the available data. Sufficiently high concentrations of PCE in soils and soil vapor were not identified which would suggest the presence of DNAPL conditions. Additionally, decreasing concentrations of PCE in groundwater suggest that a continuous source (such as a PCE DNAPL) is not present. However, this mechanism may have been operative in the past, prior to the sampling events conducted by ADEQ, and therefore it cannot be ruled out.

The second mechanism presented is supported by the available soil and soil vapor data. PCE was detected in soil vapor at the Western Dry Cleaners and Aladdin Dry Cleaners locations. Concentrations detected at these locations indicated PCE is present in the soils, but not at sufficiently high levels to indicate DNAPL transport. Conceptually, PCE in the vadose zone would be transported by dissolution into percolating waters to groundwater. This mechanism does not contradict soil, soil vapor and groundwater data for the Site.

The third mechanism presented assumes vapor transport of PCE to groundwater. This mechanism is also practical, and because groundwater is fairly shallow at the Site, it is a reasonable transport mechanism.

The actual transport mechanism is likely a combination of the above suggested processes, likely the second and third items presented.

6.2 FATE AND TRANSPORT OF PCE IN GROUNDWATER

Volatilization of PCE into the atmosphere is the main route of removal from water. Hydrolysis occurs very slowly or only under high temperature conditions. The hydrogeology of the aquifer beneath the Site consists of three Subunits. Subunit A consists of alluvial sediments located between the ground surface and approximately 130 feet bgs. Subunit B underlays Subunit A and consists of a thick clay layer, which is generally regarded as an semi-confining layer (CH2MHill, 1989). Subunit C consists of alluvial sediments and is believed to exist between approximately 240 and 360 feet bgs. Water from Subunit A is used for irrigation purposes and groundwater from Subunit C is used for drinking water supply. Based on data collected in January 2005, the depth to groundwater is approximately 65 feet bgs.

6.2.1 Groundwater Movement

The predominant transport mechanism for PCE and other VOCs at the Site is advection. Groundwater is estimated to flow west at a rate of approximately 0.02 to 0.03 ft/day, with PCE transported via advective processes.

6.2.2 Extent of Groundwater Contamination

The Site boundaries are defined by the PCE groundwater contamination plume, which generally extends from Hill Drive to the north, 3rd Street to the east, approximately 1000 feet north of State Route 85 to the south, and Litchfield Road to the west.

6.2.3 Flow and Transport of Contaminants

No well-defined source of PCE in groundwater was been specifically identified at the Site. The highest PCE concentrations have been measured in the shallow saturated zone, in monitoring wells downgradient from Western Dry Cleaning and Aladdin Dry Cleaning locations. Based on the results of the groundwater investigation, it appears that there is not a continuing on-Site source of VOCs to the groundwater (such as a DNAPL), or the source has become isolated within subsurface soils due to declines in groundwater levels.

TCE, PCE, and 1,1-DCE are all hydrophobic chemicals that readily sorb to the organic fraction of the soil matrix. Because of their low solubility, they also sorb to any solid surface to a moderate extent. Sorption retards the rate of transport by advection and serves to disperse a plume that has a discontinuous or variable source by temporarily storing contaminants in the solid phase and subsequently releasing them to cleaner groundwater. Based on the relatively low organic carbon content of the aquifer materials at the Site, sorption onto organic material is expected to play a relatively minor role in the retardation of contaminant transport. Within the shallow aquifer, the decline of the water table into low permeability silts and clay may result in an increased sorption onto mineral faces. This sorption onto aquitard materials may result in low concentrations of PCE in groundwater for an extended period.

COCs identified in the groundwater beneath the PGA-S Super:fund Site include TCE and chromium. Currently, two ongoing remedial actions at the PGA-S Super:fund Site are actively pumping and treating groundwater from Subunit A and Subunit C using three remediation systems. These systems include:

- The Subunit A system is currently pumping groundwater from 12 extraction wells; the extracted groundwater is treated and subsequently re-injected at 16injection wells, resulting in no net use of groundwater, with the exception oflosses that occur during treatment. The system currently pumps 450 to 550 gallons per minute (gpm) from the shallow (Subunit A) aquifer.

- Two remediation systems are in operation in the Subunit C aquifer, a North System and a South System. The Subunit C – South system currently includes three extraction and three injection wells, operating at a rate of 400 gpm. One of the extraction wells was shutdown in 1999, and one more will probably be shut down in the near future. The system started operation in 1995 and is projected to operate through 2008.

Currently, groundwater transport processes carry PCE westward, where the groundwater enters the PGA-S Superfund Site. A review of the groundwater contours for the PGA-S (Figure 5-1) suggests that PCE contamination is likely captured by the Subunit A groundwater treatment system.

6.3 NATURAL ATTENUATION EVALUATION

Natural attenuation refers to the processes that can reduce the mass, toxicity, mobility, volume and/or contaminant concentration in the groundwater system as a result of biodegradation, dispersion, dilution, sorption, volatilization, chemical or biological stabilization, and/or transformation. Natural attenuation processes affect the fate and transport of chlorinated solvents in all hydrologic systems. When these processes are shown to be capable of attaining site-specific remediation objectives within a reasonable time period when compared to other alternatives, they may be selected as the preferred remedial alternative, or in combination with other remedial technologies.

Natural attenuation mechanisms can be classified as either destructive or nondestructive. Biodegradation is the most important destructive attenuation mechanism. Nondestructive attenuation mechanisms include sorption, dispersion, dilution from recharge, and volatilization.

The decrease in contaminant concentrations observed within Subunit A and the current plume configuration are most likely the result of attenuation mechanisms such as sorption, dilution, volatilization, dispersion, and/or abiotic degradation, as well as a decline in water levels. As a result of the decline in water levels within the shallow saturated system, much of the residual PCE within the shallow plume sorbed on the fine-grained soil and/or volatilized within the vadose zone.

Although chlorinated hydrocarbon concentrations are generally decreasing, preliminary natural attenuation screening for the Site suggests that anaerobic (reductive dechlorination) biodegradation is not the primary cause for the decline observed in PCE concentrations. Based on this information, and in conjunction with the aquifer hydraulics determining the advective movement of the plume,

the fact that the extent of the plume has been defined, and the decreasing concentrations of PCE in groundwater, sufficient information is available to proceed with the feasibility study.

6.4 AREAS OF UNCERTAINTY

The source area(s) for the VOCs detected in groundwater remains in question. Although several PA/SI investigations and an industrial survey have been conducted, specific locations containing sufficient VOC concentrations in soil or soil vapor samples which would define a source area have not been identified. It is likely that implementing further field investigation(s) may fail to conclusively identify a source of PCE contamination.

7.0 LAND AND WATER USE

7.1 LAND USE

Land use in the vicinity of the Site is primarily residential and co=ercial. In order to evaluate reasonably foreseeable land use within the Western Avenue Plume WQARF Site, documents and maps were obtained from the Cities of Avondale and Goodyear, Arizona. These maps and information outline land use planning and zoning for the Site area, which allows a general discussion ofland use as it relates to potential site remediation. Based on this information, in 2003 GeoTrans conducted a complete assessment of the reasonably foreseeable land use. In general, this report focuses on defining existing or future land use which may impede or restrict options for Site remediation or investigation. A copy of the *CwTent Beneficial Land and Water Use* report is included as Appendix I.

A key land use concern in the vicinity of the Site is the presence of the Lockheed Martin facility, which is located adjacent the Site. This facility may present concerns regarding potential remediation activities, due to its large size and location i=ediately downgradient of the Site.

7.2 GROUNDWATER USES

GeoTrans obtained and reviewed a copy of the Water Resource Element from the *City of Avondale General Plan, June 17, 2002* and the *Goodyear General Plan Update 2003-2013.* This report outlines the current and projected future sources of water and demands for the cities of Avondale and Goodyear. Using this information, in 2003, GeoTrans conducted a complete assessment of the reasonably foreseeable water use, which is included as part of the *CwTent Beneficial Land and Water Use* report (Appendix I). Ingeneral, this report focuses on defining existing or future water uses which may impede or restrict options for Site remediation or investigation.

7.3 SURFACE WATER USES

There are no permanent sources of surface water located at the Site, other than storm-water runoff. During occasional precipitation events, rainfall drainage is determined by local flood control and storm-water sewers. The nearest natural river channels are the Agua Fria River, located approximately 0.5 miles east of the Site, and the Gila River, which is located south of the Site. Surface water drainage at the Site is likely to the south and east, toward the Gila and Agua Fria rivers.

8.0 SUMMARY AND CONCLUSIONS

The groundwater investigation at the Site has included drilling and installation of five monitoring wells and sampling and monitoring of 11monitoring wells. Results from these activities have been used to characterize subsurface soils and identify the vertical and horizontal distribution of voes in groundwater.

ADEQ has identified PCE as the COC at the Site. In January 2005, PCE was detected in groundwater samples collected from monitoring wells MW-2, MW-4, MW-5, MW-7, GMW-5 and COG-MW3 at concentrations of 2.l µg/L, 1.9 µg/L, 1.4 µg/L,0.81 µg/L, 0.86 µg/L and 2.1 µg/L, respectively. PCE was detected at a concentration of 5.1 µg/L in a groundwater sample collected from monitoring well MW-1, which exceeds the AWQS of 5 µg/L. All other concentrations of PCE in groundwater samples collected in January 2005 were reported below the AWQS of 5 µg/L.

Since the wells are completed above the base of Subunit-A, the depth of which is estimated at 120 to 150 feet bgs (Bushner, 1992), it is possible that the plume is dropping below the screened interval of the wells; however, it is likely that the plume is attenuating. The bottom of the screened interval for the deepest monitoring wells, MW-1 and MW-2, is at 97 and 95 feet bgs, respectively. The remaining monitoring wells completed in Subunit A are screened to 80 feet bgs. PCE concentrations in the deep wells do not vary significantly from the shallow wells, suggesting that vertical changes in the plume are not significant.

The decrease in contaminant concentrations observed within Subunit A, as well as the current plume definition, are the result of attenuation mechanisms such as sorption, dilution, volatilization, dispersion, and/or abiotic degradation. The current plume definition and general lack of further plume migration in Subunit A has been attained through the decline in water levels, which has resulted in much of the residual PCE being sorbed on the fine-grained soil, and/or being volatilized within the vadose zone.

Based on the fact that the PCE plume is defined and stable, in addition to aquifer hydraulics determining the advective movement of the plume, sufficient information is available to proceed with the feasibility study.

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