Remedial Investigation Report
16th Street & Camelback WQARF Site
Phoenix, Arizona

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List of Acronyms

A.A.C.	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
amsl	above mean sea level
AS	air sparge
AWQS	aquifer water quality standard
BC	Brown and Caldwell
bgs	below ground surface
COC	contaminant of concern
1,2-DCA	1,2-dichloroethane
1,2-DCP	1,2-dichloropropane
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
EA	environmental assessment
ERA	Early Response Action
EA	environmental assessment
ft/ft	feet per foot
GZA	GZA GeoEnvironmental, Inc.
HBGL	Health-Based Guidance Level
HGC	HydroGeoChem, Inc.
KH	Henry's Law constant
Koc	organic carbon partition coefficient
Kow	octanol water partition coefficient
LAU	Lower Alluvial Unit
lb/day	pounds per day
LRL	laboratory reporting limit
MAU	Middle Alluvial Unit
MCL	Maximum Contaminant Level
MER	mass extraction rate
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MW	monitoring well
OW	observation well
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
PCS	petroleum-contaminated soil
PDBs	passive diffusion bags
PID	photoionization detector
psig	pounds per square inch gauge
ppmv	parts per million of vapor volume
PVC	polyvinyl chlorinated

REC	recognized environmental condition
RI	Remedial Investigation
ROI	radius of influence
scfm	standard cubic feet per minute
Site	16th Street and Camelback Road Water Quality Assurance Revolving Fund Site
SRP	Salt River Project
SRV	Salt River Valley
SRVB	Salt River Valley Basin
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
TCE	trichloroethylene
TDS	total dissolved solids
THM	trihalomethane
TPH	total petroleum hydrocarbons
UAU	Upper Alluvial Unit
µg/L	micrograms per liter
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound
WQARF	Water Quality Assurance Revolving Fund
WSRV	West Salt River Valley
ZOI	zone of influence

Executive Summary/Conceptual Site Model

Brown and Caldwell (BC) and the Arizona Department of Environmental Quality (ADEQ) have prepared this Remedial Investigation (RI) report for the 16th Street and Camelback Road Water Quality Assurance Revolving Fund (WQARF) site (Site) under ADEQ Contract EV09-0100 ASRAC and Task Assignment ADEQ13-040760 to meet the requirements of the Arizona Revised Statues §49-287.03 and Arizona Administrative Code (A.A.C.) R18-16-406.

This RI:

- Establishes the nature and extent of the contamination and the sources thereof;
- Identifies current and potential impacts to public health, welfare, and the environment;
- Identifies current and reasonably foreseeable uses of land and waters of the state, and;
- Evaluates any other information necessary for identification and comparison of alternative remedial actions.

This RI includes field investigations to assess physical characteristics of the Site; the extent and general characteristics of the hazardous substances released; the extent, general characteristics, and degree of the source of the release; current and reasonably foreseeable exposure routes for the hazardous substances released; other factors that pertain to the characterization of the Site or support the analysis of potential remedies; and finally, current and reasonable foreseeable impacts to aquatic and terrestrial biota. This report also includes information regarding current and reasonably foreseeable uses of land or waters of the state that have been or are threatened to be impacted by the release, and projected time-frames for future changes in those uses.

This report summarizes the findings of the RI activities that have been conducted from 1989 to present at the Site. This includes activities related to environmental assessments (EAs), Site remedial investigations, the Early Response Action (ERA) completed to date, and assembly and review of pertinent information related to the Site. These activities have included drilling, soil and soil vapor sampling, well installation, measurements of groundwater elevation, remediation pilot testing, and water quality monitoring performed at the Site.

The contaminant release area is located in Phoenix, Arizona on property south of Camelback Road and east of 16th Street in Phoenix, Arizona (Figures 1 and 2). To date, several areas, including a former dry cleaner (North Plume) and former service station (South Plume), have been investigated as potential sources of the groundwater and/or soil contamination. Dissolved tetrachloroethene (PCE) is the contaminant of concern (COC) in the North Plume and dissolved 1,2-dichloroethane (1,2-DCA) is the COC in the South Plume. Site boundaries are defined by the extent of the historical/current groundwater contaminant plumes, which generally include a 35-acre area bounded by Camelback Road to the north, Highland Avenue to the south, 15th Street to the west, and 17th Street to the east.

The Site is located within the Salt River Valley Basin (SRVB) in the Phoenix Active Management Area. Basin-fill deposits in the SRVB are subdivided into three water-bearing, hydrogeologic units: the Lower Alluvial Unit (LAU), Middle Alluvial Unit (MAU), and Upper Alluvial Unit (UAU). These basin-fill deposits are estimated to range in thickness from 100 feet near the basin margins to 10,000 feet near the center of the basin. The LAU lies unconformably on top of bedrock and can be extensively faulted. The MAU, which is less extensively faulted, overlies the LAU. Both of these units were deposited in a closed basin and lithology consists of interbedded sequences of unconsolidated to well-consolidated, fine- to coarse-grained sediments. The UAU was deposited after the development of integrated drainage. Lithology consists of unconsolidated to well-consolidated, interbedded sequences of gravel, sand, silt, clay, and evaporite deposits, yielding substantial quantities of water. Groundwater at the Site occurs within the UAU beginning at a depth of approximately 75 feet. Groundwater flow in the uppermost aquifer is generally westerly and has been observed to range from southwesterly to northwesterly.

On December 4, 1989, Bank One acquired a property at the southeast corner of 16th Street and Camelback Road through foreclosure (ADEQ, 2012). On December 6, 1989, Western Technologies, Inc. published an Environmental Property Evaluation for Valley National Bank at the southeast corner of 16th Street and Camelback Road. A copy of this report could not be located in Arizona Department of Water Resources (ADWR) records. In September 1992, a Phase I EA was performed on the subject property by Law Engineering which identified several recognized environmental conditions (RECs) associated with previous land uses on the property:

- Landscape and nursery previously located in the central portion of the property;
- Dry cleaner and an exterminator previously located in the northern portion of the property;
- Service station previously located on the southwestern portion of the property, and;
- F.F. Baugh Plumbing Shop previously located on the west-central portion of the property.

In addition to the above RECs, two off-site land uses were identified as potential environmental concerns; the Cushman golf cart repair shop previously located near the western boundary of the property, and a potentially upgradient leaky underground storage tank site located near the intersection of 24th Street and Camelback Road.

In December 1992, Law Engineering Inc. (Law) performed a Phase II EA (Law, 1993a) of the subject property which included a soil vapor survey, 43 soil borings, soil sampling, and groundwater well installation and sampling. Groundwater samples collected during the Phase II EA contained PCE in the northern portion of the Site (North Plume) and gasoline products: benzene and 1,2-DCA in the southern portion of the Site (South Plume). The source and extent of benzene and 1,2-DCA concentrations in groundwater beneath the Site could not be identified at the time. Following the soil vapor survey, it was determined that concentrations of contaminants in the soil vapor were not high enough to indicate that ongoing source(s) of contamination were present at the Site. Soil samples collected during the Phase II EA indicated that soils impacted with total petroleum hydrocarbon (TPH) compounds appear to be limited to the shallow subsurface (maximum depth of approximately

5 feet). Three monitor wells were installed in November 1992 during Phase II work, two in the northern half of the Site (MW-1 & MW-2) and one in the southern half of the Site (MW-3). Groundwater samples were collected from each of the three monitor wells. Groundwater levels from the three monitor wells indicated westerly groundwater flow. Monitor wells, MW-1 and MW-2 contained groundwater with concentrations of PCE above the Maximum Contaminant Level (MCL) of 5 micrograms per liter (μg/L). The lateral extent of impacted soil and the source and extent of PCE, benzene, and 1,2-DCA concentrations in groundwater beneath the Site were not determined during the Phase II EA.

Law conducted Phase III EA activities to further define the extent and source of contaminants encountered during Phase II EA. In April 1993, Law published findings from the Phase III EA (Law, 1993b). Phase III EA activities defined the limited extent of two small areas with TPH, one near the former service station and the second near the former nursery, to 5 feet and 10 feet deep, respectively, and identified a few locations with ‘minor TPH concentrations. Soil samples were collected to identify concentrations of PCE, benzene, and 1,2-DCA from the suspected source areas; however, none of these COCs were detected above laboratory reporting limits (LRLs). Three monitor wells were constructed from soil borings in December 1992 (MW-4 [later abandoned], MW-5 and MW-6). Three deep exploratory soil borings were drilled and sampled in December 1992 (B-49, B-52 and B-53). At the time of the Phase II EA, groundwater was determined to be flowing towards the northwest at a gradient of 0.005. PCE was not detected in the two monitor wells, MW-5, and MW-6, located upgradient from the former dry cleaner, but PCE was detected above the MCL in groundwater samples that were collected to the north (B-53) and south (B-49) of the former dry cleaner, in addition to MW-1 and MW-2. The western and northern extent of PCE contamination was not delineated beyond property boundaries at that time. The extent of benzene and 1,2-DCA contamination could not be determined without additional off-site investigations.

Following completion of the Phase III EA, GZA Geo Environmental Inc. (GZA) performed remediation of TPH-impacted soils (GZA, 1993). GZA excavated 405 tons of petroleum-contaminated soils (PCS) from the areas identified by the Phase II and Phase III EAs and thermally treated the soil on site. GZA also removed an underground storage tank (UST) discovered during the excavation of soils. Characterization of the tank indicated it was not likely a contributor to the groundwater contamination at the Site and was closed.

In 1993, ADEQ was approached by Bank One to “consider reaching a settlement agreement regarding a property located at 16th Street and Camelback Road in Phoenix.” The Consent Decree was signed in January 1994 between Bank One and ADEQ. ADEQ continued monitoring groundwater conditions in 1994 (ADEQ, 1995). ADEQ sampled existing monitor wells in August and November 1994. PCE concentrations in MW-1 and MW-2 exceeded the MCL by nearly 100 times and 10 times, respectively. In the South Plume, MW-3 exceeded the MCL for 1,2-DCA during both sampling events. Benzene and 1,2-dichloropropane (1,2-DCP) were also detected at MW-3.

In January 1995, Hydro Geo Chem (HGC, 1995) performed a follow-up soil vapor survey (under contract with ADEQ) in the area of the former dry cleaner to verify previous findings and attempt to identify the source. ADEQ’s report (ADEQ, 1995) on the vapor survey stated that the locations and concentrations at which volatile organic compounds (VOCs) were detected in soil vapor did not indicate an ongoing PCE source exists in shallow soils near the former dry cleaner and validated previous soil vapor investigations.

Four additional groundwater monitor wells, two at the North Plume (MW-9 and MW-10) and two at the South Plume (MW-7 and MW-8), and four HydroPunch® borings were installed by ADEQ in 1996 to further delineate the extend of the PCE and 1,2-DCA plumes in groundwater.

ADEQ continued to monitor groundwater at the Site periodically between 1996 and 1999. There is limited groundwater data available for this time period. Concentrations of PCE in wells MW-1, MW-2, and MW-10 exceeded the MCL at the North Plume, and well MW-3 in the South Plume exceeded the MCL for 1,2-DCA and 1,2-DCP, during a July 1998 groundwater monitoring event. It is important to note that 1,2-DCP was not detected in groundwater samples collected at the Site until the late 1990's and has only been detected above LRLs in monitor well MW-3 though June 2001. The downgradient well, MW-8 (South Plume), also had detectable concentrations of 1,2-DCA. On April 21, 1999 the Site was added to the WQARF Registry with an Eligibility and Evaluation score of 23 out of 120.

In 1999/2000, Kleinfelder began groundwater monitoring at the Site under ADEQ direction, publishing regular quarterly monitoring reports. Groundwater monitoring continued between 2000 and 2004. Kleinfelder installed monitor well MW-11, downgradient of the "source area" wells at the North Plume (Kleinfelder, 2000). Groundwater conditions at the Site monitor wells were monitored on an approximately quarterly basis until 2007.

Flow directions and gradient in the shallow aquifer have varied over time, but are generally west-northwest at a hydraulic gradient ranging from 0.015 to 0.004. Groundwater elevations have also varied over time since the first monitor wells were installed in 1992, and have declined between 11 and 13.5 feet during the past 22 years. Dedicated low-flow groundwater sampling pumps had to be lowered in December 2003 and subsequently removed the following December due to declining groundwater levels. During the first quarter sampling event in 2004, passive diffusion bags (PDBs) were used for the first time to collect groundwater samples because of declining water levels in the monitor wells. Since that time, PDBs have been used to collect groundwater samples for VOC analysis at the Site.

In May 2002, ADEQ began an ERA evaluation of the North Plume area. ADEQ states that "the ERA was designed to determine if soil vapor extraction and air sparge remediation was feasible to provide source control and remediate the PCE groundwater contamination." Kleinfelder developed a work plan in October 2002, and in January 2003, Kleinfelder installed a nested soil vapor extraction (SVE) well with air sparging (AS) and a nested observation well (OW). Kleinfelder conducted a pilot study in February 2003 to determine the feasibility of an SVE/AS remediation system. The plan was to design and construct a remediation system based on findings from the pilot test. The intent, as reported in the ERA report, was to protect the public health and environment by installing the SVE/AS remediation system which would provide containment of PCE contamination by soil source removal and by control and remediation of PCE-contaminated groundwater. In April 2003, ADEQ received the results of the pilot study and requested that Kleinfelder provide an ERA Completion Report. The mass extraction rate (MER) of PCE was lower than expected and MER did not significantly increase as the test progressed, suggesting the source to the groundwater is no longer on-going. In addition, MER did not increase once AS began; in fact, it was lower. ADEQ believed the results of the pilot test indicated an SVE/AS remediation system is not feasible or cost effective at this Site (North Plume).

Following issuance of the ERA report, additional monitor wells were installed and/or replaced, while Kleinfelder continued groundwater monitoring activities until 2007. South Plume monitor well MW-12 was installed in June 2004 at the southwest corner of 16th Street and Camelback Road to monitor the downgradient extent of PCE-contaminated groundwater. Monitor well MW-3A was drilled and constructed in April 2006 to replace MW-3 due to declining groundwater levels.

Between 2008 and 2012, groundwater monitoring activities were temporarily discontinued at the Site. In May 2013, BC resumed groundwater monitoring and sampling at the Site on behalf of ADEQ. BC used PDBs and collected groundwater samples from seven North Plume wells and four South Plume wells. Concentrations of PCE exceeded the MCL (5 μg/L) in groundwater samples collected from MW-1, MW-10 and MW-12, at 5.9 μg/L, 25.1 μg/L, and 8.94 μg/L, respectively. 1,2-DCA and 1,2-DCP were not detected above the laboratory reporting limit (LRL) of 0.5 μg/L in the South Plume monitor wells that were sampled in May 2013. The groundwater flow direction was estimated to be west-northwest in May 2013.

In January 2014, BC installed two additional downgradient monitor wells, MW-13 and MW-14, at the North Plume in order to further delineate the distal end of the PCE plume in groundwater. Two additional groundwater monitoring events were conducted during the first and second quarters 2014. Groundwater samples collected from the new monitor wells MW-13 and MW-14 during February and April 2014 were below the 5 μg/L MCL for PCE while the detected concentrations of PCE in monitor well MW-12 were 4.73 μg/L and 5.65 μg/L, respectively. In February and April 2014, PCE concentrations detected in groundwater samples collected from monitor well MW-10 remained above the MCL at 12.5 μg/L and 13.3 μg/L, respectively, and in monitor well MW-1 were 3.3 μg/L and 11.4 μg/L, respectively. The PCE concentrations in the other monitor wells sampled in February and April 2014 were below the MCL or the LRL. The results of the February 2014, April 2014 and previous groundwater monitoring events (1992-2007, 2013) demonstrate that the plume of PCE in groundwater is relatively small, decreasing in size and attenuating over time.

Groundwater samples collected in February and April 2014 from the North and South Plume monitor wells were below the LRLs for 1,2-DCA, with the exception of monitor well MW-3 which had a detection of 0.62 μg/L for 1,2-DCA. The concentrations of 1,2-DCA in groundwater at the South Plume have been below or slightly above the LRL at the South Plume monitor wells for consecutive sample events over approximately one year. The plume of 1,2-DCA in groundwater appears to have attenuated naturally over time.

Groundwater samples collected in February and April 2014 from the North and South Plume monitor wells were below the LRLs for 1,2-DCP. The relatively small plume of 1,2-DCP in groundwater observed at MW-3, in the late 1990's through June 2001 appears to have attenuated over time based on the results of the 2013/2014 groundwater monitoring events.

Based on the observed declining trends of PCE in groundwater samples collected from the North Plume monitor wells, the limited extent of the PCE contamination that is above the MCL and the location of water supply wells relative to PCE plume, concentrations of PCE in groundwater within the

North Plume do not appear to pose a threat to current groundwater use but may pose a threat to future groundwater use at the Site.

Section 1
Introduction

1.1 Remedial Investigation Objectives and Scope

The Arizona Department of Environmental Quality (ADEQ) and Brown and Caldwell (BC) prepared this Remedial Investigation (RI) report to meet the requirements of the Arizona Revised Statutes §49-287.03 and Arizona Administrative Code (A.A.C.) R18-16-406 for the 16th Street and Camelback Water Quality Assurance Revolving Fund (WQARF) site (Site).

This RI Report will:

- Establish the nature and extent of the contamination and the sources thereof;
- Identify current and potential impacts to public health, welfare, and the environment;
- Identify current and reasonably foreseeable uses of land and waters of the state, and;
- Obtain and evaluate any other information necessary for identification and comparison of alternative remedial actions.

This RI Report includes summaries of field investigations to assess physical characteristics of the Site; the extent and general characteristics of the hazardous substances released; the extent, general characteristics, and degree of the source of the release; current and reasonably foreseeable exposure routes for the hazardous substances released; other factors that pertain to the characterization of the Site or support the analysis of potential remedies; and finally, current and reasonable foreseeable impacts to aquatic and terrestrial biota. This report also includes information regarding current and reasonably foreseeable uses of land or waters of the state that have been or are threatened to be impacted by the release, and projected time-frames for future changes in those uses.

This is accomplished by summarizing the activities related to environmental assessments (EAs), Site remedial investigations, and the Early Response Action (ERA) completed to date and assembly and review of pertinent information related to the Site. These activities have included drilling, soil and soil vapor sampling, well installation, measurements of groundwater elevation, and water quality monitoring performed at the Site.

1.2 Study Area Boundaries

The location of the Site is shown on Figure 1. The extent of the RI generally covers an area between Camelback Road to the north, Highland Avenue to the south, 15th Street to the west, and 17th Street to the east. This is the area where all of the Site investigative activities have taken place. Data collected during the RI indicate that contaminant releases occurred at the properties located in the southeastern corner of 16th Street and Camelback Road.

1.3 Site Background

The property was acquired by Bank One through foreclosure on December 4, 1989. Bank One retained several environmental consultants to conduct Phase I, II, and III EAs and investigations. Law Engineering Inc. (Law) was retained by Valley National Bank and prepared the Phase I Environmental Assessment report in September 1992 and the Phase II and III reports in April 1993 for the Camelback Arboleda property. The general location of the Site is shown on Figure 1.

Three groundwater monitor wells were installed in November 1992. Monitoring wells (MW)-1 and MW-2 were placed downgradient from the former dry-cleaning facility, and one monitor well, MW-3, was placed downgradient of the former service station (Figure 2). Three additional monitor wells (MW-4, MW-5, MW-6) were installed in December 1992 (MW-4 was abandoned shortly after installation because it was not on the Site property). These investigations disclosed total petroleum hydrocarbon (TPH) contaminated soil and groundwater contaminated with tetrachloroethene (PCE), 1,2-dichloroethane (1,2-DCA), benzene, and list environmental concerns/potential sources. The suspected source of PCE was a former dry cleaner that was located on the northern portion of the property. The groundwater contamination was partially delineated in the Phase III report. In 1993, GZA GeoEnvironmental, Inc. (GZA) excavated and thermally remediated 405 tons of petroleum contaminated soil (PCS) and removed one 1,000 gallon underground storage tank (UST) from the Site (GZA, 1993). Characterization of this UST site indicated that this UST was not likely a contributor to known groundwater contamination at the Site.

In April 1993, Bank One approached the ADEQ to consider reaching a “settlement agreement” regarding the property located at the southeast corner of 16th Street and Camelback Road. ADEQ and Bank One entered into a Consent Decree in January 1994. ADEQ received all the previous investigation and remediation reports from Bank One in addition to a sum of $399,000.00 towards future costs for investigations and remediation at the Site. Bank One entered into the Consent Decree alleging it was not liable as a responsible party based on “secured lendor liability exemptions.”

In 1995, ADEQ lead a soil vapor survey performed by HydroGeoChem, Inc. (HGC). ADEQ referenced previous EA work in this report and distinguished between the PCE groundwater contamination in the “Northern Facility” associated with the former dry cleaner, and 1,2-DCA and 1,2-dichloropropane (1,2-DCP) groundwater contamination in the “Southern Facility” associated with the former UST. Trace concentrations of volatile organic compounds (VOCs), notably PCE, were detected in soil vapor samples; however, these did not indicate an ongoing PCE source at or near the suspected former dry cleaner in the North Plume.

In 1996, ADEQ expanded the groundwater monitoring network by installing four monitoring wells (MW-7, MW-8, MW-9 and MW-10). Information gathered from the expansion of the monitoring well network did not identify ongoing sources or conclusively identify the extent of groundwater contamination.

In 1999, the Site was added to the WQARF Registry with an eligibility and evaluation score of 23 out of 120. In a work plan dated December 1999, Kleinfelder references two contaminant plumes in groundwater at the Site, PCE in the northern portion, and 1,2-DCA and 1,2-DCP plumes in the southern portion. In May 2000 monitoring well MW-11 was constructed under the direction of ADEQ to further characterize the extent of groundwater contamination at the Site.

In May 2002, ADEQ commenced an ERA evaluation at the Site designed to determine if soil vapor extraction (SVE) with air-sparge (AS) remediation was feasible to provide source control and remediate PCE contaminated groundwater. A pilot study was conducted on the northern PCE plume near monitoring well MW-1 (Figure 2). In January 2003, two SVE wells and one AS well were constructed along with observation well (OW) OW-1D. According to ADEQ, pilot test results indicated that a remediation system at the Site would not be feasible or cost effective, and in May 2004 an ERA completion report was completed by Kleinfelder.

In June 2004, groundwater monitor well MW-12 was installed to help define the downgradient extent of contamination in the North Plume. Declining water levels necessitated the use of passive diffusion bags (PDBs) in 2004, and in April 2006 monitor well MW-3 was replaced by monitor well MW-3A due to continued declining groundwater levels. Groundwater monitoring continued until 2007 when RI activities were suspended due to ADEQ budget constraints. The last groundwater monitoring report for the Site prior to the hiatus in RI activities was issued following the fourth quarter 2007 monitoring event. Groundwater monitoring and characterization activities were resumed in May 2013.

1.4 Site Description

The contaminant release area consists of property south of Camelback Road and east of 16th Street in Phoenix, Arizona (Figures 1 and 2). This area is located in Section 22, Township 2 North, Range 3 East, Gila and Salt Base and Meridian, Maricopa County. It is currently the location of a number of retail, restaurant, and public storage businesses. The suspected sources of contamination, a former dry cleaner and former service station, are no longer present.

1.5 Site Operational History

The property in the southeast corner of 16th Street and Camelback Road is the location of a number of historical land uses that resulted in soil and groundwater contamination over an area greater than three acres (Kleinfelder, 2004). Historically, a landscape and nursery operation was located on the eastern half of the property which used fertilizers, pesticides, and herbicides, had a UST and a vehicle service pit. A medical building was located in the north-central portion of the property, used in the past by a pest exterminator and a dry cleaner (approximately 1957 to 1961); an automobile service station was located in the southwestern corner of the property; and FF Baugh Plumbing Shop was located in the west-central portion of the property (Figure 2). The structures and businesses associated with the release(s) of contaminants at the property discontinued operation well over 20 years ago (Kleinfelder, 2004). In April 1997 (Google Earth imagery), a structure existed in the northwest corner of the property. Between 1997 and 2002, the property was developed into a shopping center with stores, restaurants, a public storage facility, and parking lots.

The property was acquired by Bank One through foreclosure on December 4, 1989. Bank One retained several environmental consultants to conduct Phase I, II, and III EAs and investigations. Law was retained by Valley National Bank and prepared the Phase I EA report in September 1992 and the Phase II and III reports in April 1993 for the Site.

Section 2
Site Physical Characteristics

2.1 Climate

The Site is located within the Sonoran Desert Climate Region characterized by hot summers and cool winters. The average annual temperature ranges from 59.9 to 85.9 degrees Fahrenheit (www.WRCC.gov, accessed 2013). The average maximum temperatures reach a high of 106.1°F in July and 66°F in December. Average low temperatures range from 83.5°F in July to 44.8°F in December (Wikipedia, accessed 2013). The Phoenix area averages just over 8 inches of precipitation annually. The wettest months on average are July and August, and December through March. Spring and early summer, from April through June, tends to be very dry. Average annual potential evaporation is approximately 72 inches, with the greatest evaporation occurring during the summer months (Law, 1993a).

2.2 Topography

Based on surveyed elevations of monitor wells at the Site and United States Geological Survey topographic maps, the topography of the Site is relatively flat, with elevations ranging from approximately 1,147 feet above mean sea level (amsl) to 1,142 feet amsl, with the highest elevations to the east-northeast and the lowest elevations to the west-southwest. Locally, surface run-off is routed from parking lots and streets to storm water dry wells or City of Phoenix storm drains.

2.3 Geology

2.3.1 Regional and Site Geology

The Site is located in the Salt River Valley Basin, which is part of the Basin and Range physiographic province. The Basin and Range physiographic province is characterized by broad sloping valleys bounded by elongated northwest-southwest trending mountain ranges. These landforms are thought to have formed from high-angle normal faulting which began no later than 16 million years ago. The Site is located in the east-central portion of the West Salt River Valley (WSRV) and is bounded on the west by the White Tank Mountains, on the north and east by the Phoenix Mountains, Camelback Mountain and Papago Buttes, and on the south by South Mountain.

The oldest rocks in the vicinity of the Site are located in the nearby mountains and are of early Proterozoic age. These include granitic rocks, metavolcanic rocks, metasedimentary rocks, and gneissic rocks. The metamorphic rocks are intruded by plutons of early to middle Proterozoic granitic rocks. Unconformably overlying the Proterozoic rocks are middle Tertiary sedimentary and volcanic rocks exposed in Camelback Mountain and parts of Papago Park. These rocks consist of the Camels Head Formation of debris-flow coarse sedimentary rock, the Tempe Formation fine-grained siltstone and sandstone, and finally, the mafic to intermediate volcanic rocks. Juxtaposed next to much older rocks is a granitic pluton in the eastern portion of South Mountain thought to be the source of overlying and nearby Tertiary volcanic rocks. Reynolds and Bartlett (2002) described periods of structural deformation including episodes of crustal extension, faulting and erosion during the emplacement of mid-Tertiary rocks. Quaternary deposits overlie the mid-Tertiary rocks and are composed of material derived from the surrounding mountains. In the WSRV, these basin-fill deposits can be hundreds to thousands of feet thick and are primarily composed of unconsolidated to semi-consolidated layers of fine- to coarse-grained sediments. The basin-fill deposits are categorized by Corkhill, et al. (1993) into three main hydrogeologic water-bearing units described in more detail below. Overlying the basin-fill are river alluvium deposits which occur south of the Site along the Salt River.

2.3.2 Soils

The soil type which covers the entire Site is Gilman Loam, 0 to 1 percent slope (National Resources Conservation Service interactive map, accessed 2013). The landform setting is alluvial fans and (flood) plains to stream terraces. The parent material for these soil types is mixed alluvium or recent mixed alluvium. This is a well-drained soil with slope of 0 to 1 percent. The soil tends to be nonsaline to very slightly saline. The hydrologic soil group is B.

2.3.3 Hydrogeology

The Site is located in the WSRV Sub-basin of the Phoenix Active Management Area. The WSRV is drained by the Salt and Agua Fria Rivers and their tributaries which flow to the Gila River.

Bedrock units (Tertiary and older) formed of crystalline rock are considered non-water bearing, although groundwater may be present in fractures, yield is typically very poor. Regionally, the bedrock units are considered nearly impermeable boundaries to groundwater flow (Corkhill, et al., 1993). Depth to these bedrock units varies from about 100 feet near the basin margins to over 10,000 feet near the basin center.

The principal aquifers (middle Tertiary to Quaternary) at the Site consist of three discrete water-bearing zones within the basin-fill deposits. These are, from oldest to youngest, the Lower Alluvial Unit (LAU), Middle Alluvial Unit (MAU), and Upper Alluvial Unit (UAU). The LAU lies unconformably on top of the metamorphic and granitic rocks and can be extensively faulted. The MAU, which is less extensively faulted, overlies the LAU. Both of these units were deposited in a closed basin. The UAU was deposited after the development of integrated drainage. Lithology consists of unconsolidated to well-consolidated, interbedded sequences of gravel, sand, silt, clay, and evaporite deposits, yielding substantial quantities of water. Generally, unconfined conditions are found throughout the basin-fill units; however, confined conditions exist locally due to inter-fingering of fine-grained deposits. Estimated values of hydraulic conductivity range from 3 to 24 feet/day in the LAU, 4 to 60 feet/day in the MAU, and 180 to 1,700 feet/day in the UAU (Brown and Pool, 1989). Although these units are considered to be heterogeneous with aquifer characteristics that vary significantly both laterally and vertically, as a whole it is thought to function as one aquifer system (Kleinfelder, 2004).

Groundwater recharge in the basin-fill aquifers occurs through infiltration of precipitation; infiltration of runoff from adjacent mountains; infiltration of controlled released from reservoirs along the Salt River (with imported water from the Colorado River); return flow from canal seepage; agricultural irrigation; both urban and artificial recharge; and finally, subsurface groundwater inflow from adjacent areas (Corkhill, et al., 1993). The groundwater elevation near the Site has risen regionally since the 1980's with declines in groundwater use. Historically, groundwater flow direction in the shallow aquifer (UAU) beneath the Site is generally west. According to Salt River Project, groundwater flow directions have fluctuated with time, ranging from southwest to north. The Arizona Department of Water Resources (ADWR) groundwater elevation contour maps suggest regional groundwater flow is generally to the west and northwest, but may vary locally around local pumping centers. In the area of the Site, groundwater gradients and flow directions may vary from northwest to southwest throughout the year due to seasonal pumping of irrigation and water supply wells.

2.3.3.1 Groundwater Occurrence

The uppermost water-bearing unit occurs at approximately 73 to 80 feet below ground surface (bgs) based on water levels measured in the Site groundwater monitor wells in 2013 and 2014. Boring logs from Site investigations indicate that the uppermost water-bearing unit is composed of interbedded silty fine-grained to medium-grained sands and silts with varying clay content and calcareous cement.

2.3.3.2 Groundwater Use

Groundwater use within a one mile radius of the Site is mainly used for observation/monitoring, remediation purposes, and water production. The locations and use of ADWR registered wells located within one mile of the Site are shown on Figure 3. A summary of the ADWR registered wells and uses is provided in Appendix A. Two irrigation wells operated by Salt River Project (SRP) are near the Site, one approximately ¼ mile to the north and the other ½ mile to the south, but neither appears to be directly downgradient of the area of contaminated groundwater at the Site. The City of Phoenix has a well at Madison Park south and cross-gradient to the Site. There are also some wells that are identified as "water production" wells which are privately owned that are located at least ½ mile or more upgradient or cross-gradient, relative to the observed groundwater flow direction at the Site.

2.3.3.3 Groundwater Quality

Regional groundwater quality in the WSRV is generally determined by the geologic formation(s), the hydrogeologic unit, and relative proximity to, and source of recharge to the aquifer(s). The total dissolved solids (TDS) concentrations can range from 200 milligrams per liter (mg/L) near recharge areas (i.e. mountain ranges) to well over 100,000 mg/L near the Luke Salt Body to the west. The dominant cations in groundwater of the WSRV are sodium and calcium, while dominant anions are chloride and bicarbonate (Brown and Pool, 1989). Estimates of TDS from groundwater samples collected at the Site generally exceed 1,200 mg/L (BC, 2013).

2.4 Vegetation/Ecology

The Site is located in the Sonoran Basin and Range level III ecoregion as defined by the United States Environmental Protection Agency (USEPA). In undeveloped areas, this ecoregion consists of large areas of palo verde, cactus shrub, and saguaro cactus. Other types of Sonoran plants include white bursage, ocotillo, brittlebush, creosote bush, catclaw acacia, cholla, desert saltbush, pricklypear, ironwood, and mesquite. Much of the Sonoran vegetative communities have been replaced by development and agriculture. The Site is located in a highly developed area, and original native vegetation has been replaced by structures and landscaped vegetation.

Section 3
Remedial Investigation Activities

3.1 Preliminary Site Investigations – Contamination Assessment (1992-2003)

Preliminary Site investigations included work performed to better understand the nature and extent of contaminant(s), their sources, and the hydrogeology effecting their movement between the initial discovery in 1992 and 2002, prior to ADEQ contracting Kleinfelder to complete RI and the ERA activities. Law performed the initial EAs at the Site on behalf of Bank One (Valley National Bank), The Phase I EA was performed in September 1992 and the Phase II/III EA work was performed from September to December 1992. Law installed six groundwater monitor wells (MW-1 through MW-6) in addition to numerous soil borings, and a soil vapor survey in 1992 to assess the extent of soil and groundwater contamination at the Site, as part of the Phase II/III EA activities. ADEQ contracted GZA to treat and remove 405 tons of PCS at the South Plume in 1993. ADEQ subsequently performed (nearly) monthly groundwater elevation monitoring from August 1994 to June 2001 and collected groundwater samples in 1994. In 1995, HGC, on behalf of ADEQ, performed a follow up soil vapor survey at the North Plume, in the vicinity of the former dry cleaner. In 1996, ADEQ installed four additional groundwater monitor wells (MW-7 through MW-10), collected four HydroPunch® samples, and collected groundwater samples. In 2000, ADEQ contracted with Kleinfelder and expanded the groundwater monitoring network, installing MW-11. Kleinfelder continued monitoring the groundwater network (approximately) quarterly for ADEQ and installed MW-12 in 2003.

3.1.1 Phase I Environmental Assessment (1992)

The Phase I EA performed by Law (1992) identified several areas of potential environmental concern (recognized environmental conditions [RECs]) associated with previous activities, including: a former nursery, service station, plumbing facility, and dry cleaner/exterminator located on site, the previous Cushman facility, and a UST leak located off site (Figure 2). Law documented the findings from the Phase I EA work in their "Report of Phase I Environmental Assessment Services, The Proposed Cityscape Apartments, Southeastern Corner of 16th Street and Camelback Road, Phoenix, Arizona" (Law, 1992).

3.1.2 Phase II Environmental Assessment (1992)

The Phase II EA investigation validated the environmental concerns/RECs identified in the Phase I EA and verified the presence of several contaminants (Law, 1993). Phase II investigative work included background research and utility locating, a soil vapor survey, a backhoe investigation, sampling of 43 soil borings at various depths, and the drilling and sampling of three groundwater monitor wells, MW-1, MW-2, and MW-3. The locations of the borings, soil vapor survey locations and monitor wells are shown on Figure 4. Law documented the findings of the Phase II work in "Report of Phase II Environmental Assessment, Proposed City Scape Apartments, 16th Street and Camelback Road" (Law, 1993a).

3.1.2.1 Initial Soil Vapor Survey

In October 1992, Law conducted a soil vapor survey that extended across the properties southeast of 16th Street and Camelback Road. The vapor survey sampling locations are shown on Figure 4. Soil vapor sampling boreholes were drilled to 10 feet bgs on approximately 100-foot spacing. Grid density was increased in areas identified in the Phase I EA as potential environmental concerns and in areas where VOCs were detected in the initial soil vapor sampling activities (soil borings B-1 to B-4 drilled in Sept 1992). A total of 50 soil vapor samples were analyzed by an on-site mobile laboratory for aromatic hydrocarbons by USEPA Method 8020 modified for vapor. Several sample points with detectable hydrocarbons were clustered in the southern portion near the former service station (soil borings SV-1, 2, 4, 6). Toluene, total xylenes, and ethylbenzene were detected above the laboratory reporting limit (LRL) in soil vapor samples, but at minor concentrations (Law, 1993). The highest concentration of any analyte was toluene, measured at 19.1 μg/L in soil boring SV-6, which was located near the former service station on the south side. Two soil vapor samples, SV-18 and SV-21, with detected concentrations of toluene, were located near the general growing area (nursery) and near the former dry well near the former monitoring well MW-4. The last soil vapor sample with toluene detections (SV-22) was located at the approximate southern boundary of the former FF Baugh plumbing site. Vapor samples were also analyzed for volatile halogenated hydrocarbons by USEPA Method 8010 modified for vapor and TPH by USEPA Method 8015 modified for vapor, but none of the target analytes exceeded the LRL.

3.1.2.2 Backhoe Investigation

The backhoe investigation confirmed the location of utilities such as buried conduit, piping, concrete with rebar, and other miscellaneous items. A 55-gallon drum buried in pea gravel was unearthed near the former F.F. Baugh plumbing site where a soil boring (B-39) was located to investigate potential releases in this area. No soil staining, free liquids, or sludge was referenced in the field notes.

3.1.2.3 Soil Boring Drilling and Sample Results

Soil borings were drilled to depths ranging from 5 feet to 85 feet bgs during three separate events. The locations of the borings are shown on Figure 4. Soil borings B-5, B-36, B-37, and B-38 were drilled to the water table to measure groundwater levels. Soil borings B-1 to B-4 were drilled and sampled on September 14, 1992 at the drain swale, nursery store area, and former service station area. Soil borings B-6 to B-26 were drilled and sampled from October 29 to 30, 1992. The remaining soil borings (B-27 to B-43) were drilled and sampled (if applicable) from November 2 to 5, 1992.

Soil borings were drilled with hollow-stem augers and soil samples were collected using a split-spoon sampler (Law, 1993a). Subsurface lithology encountered during drilling activities was described by Law (1993a) as brownish, silty, fine-grained sand with gravel from the surface to approximately 20 feet bgs and pale brown, fine-grained sandy-silt with a trace of gravel and clay from approximately 20 feet bgs to 85 feet bgs. Groundwater was encountered in soil borings B-5, B-36, B-37, and B-38 on November 5, 1992 at depths of 70.77, 65.53, 66.13, and 71.25 feet bgs, respectively. This information was used (along with measurements from three monitor wells) to triangulate groundwater flow direction. The water level data indicated that groundwater flow was westerly to northwesterly in November 1992.

Soil samples were collected in glass sample jars and analyzed by either an on-site mobile laboratory or off-site at a fixed laboratory. On-site laboratory analyses included TPH and VOCs. Off-site laboratory analyses performed on select soil samples included: polychlorinated biphenyls (PCBs), semi-volatile organic compounds (SVOCs) extended for pesticides, chlorinated herbicides, TPH, benzene, toluene, ethylbenzene and total xylenes, phenols, total metals, lead, sulfate and nitrogen, and VOCs.

A total of 56 soil samples were collected and analyzed for TPH and 12 results were above the LRL, with four samples above the ADEQ suggested soil cleanup level of 100 milligrams per kilogram (mg/kg) (at the time of publication). These samples include B-11 (5 to 6 feet) located north of the tool shed area with 109 mg/kg TPH, and three 5-foot samples near the former service station (B-29, B-32, and B-43) with 127, 450, 160 mg/kg TPH, respectively. The 46 soil samples analyzed for volatile hydrocarbons and the 39 soil samples for volatile halogenated hydrocarbons had no detections above the LRL for target analytes.

Di-n-butyl-phthalate was detected in each of the 20 soil samples analyzed for SVOCs. The maximum concentration of di-n-butyl-phthalate detected was 1.8 mg/kg at B-27 (10-11 feet) and B-30 (5-6 feet). This compound was not detected in the laboratory method blank suggesting laboratory contamination was not the source. The laboratory reported concentrations above the LRL for fluoranthene, pyrene, chrysene, and benzo (k) fluoranthene in soil sample B-1 (5 feet) located in the drainage swale. The results for chrysene and benzo (k) fluoranthene were above the Arizona Health-Based Guidance Levels (HBGLs) at the time of the Law report.

Of the 16 soil samples submitted for chlorinated herbicides and 12 for phenols, none of the target analytes exceeded the LRL.

The laboratory reported concentrations of priority pollutant metals plus barium above the LRL in eight samples; however, none of the analytes exceeded Arizona's HBGLs. The laboratory reported concentrations above the LRL in all eight soil samples for lead, but none exceeded Arizona's HBGL. Organochlorine pesticides and PCBs were not detected above the LRL in any soil samples. Ammonia-nitrogen and sulfate were detected in soil samples from B-25 and B-26 drilled in the "white stained area." Ammonia-nitrogen is not regulated by Arizona, and the sulfate concentration was below the HBGL.

3.1.2.4 Groundwater Monitor Well Installations

Groundwater monitor wells MW-1 and MW-2 were installed in November 1992 to delineate groundwater contamination at the North Plume, believed to be associated with the former dry cleaner identified in the Phase I EA. Groundwater monitor well MW-3 was also installed in November 1992 at the South Plume to investigate groundwater contamination believed to be associated with the former service station identified in the Phase I EA. The location of monitor wells MW-1, MW-2, and MW-3 are shown on Figure 2.

For each well, an 8-inch diameter borehole was drilled using hollow-stem augers to approximately 10 feet below the observed water table. According to the lithologic logs prepared by Law (1993a), silty-fine sand was encountered down to 20 feet bgs at MW-1 with fine-grained sandy-silt from 20 to 80 feet bgs. At MW-2 and MW-3, silty-sand was encountered with increasing gravel down to 80 and 75 feet bgs, respectively. Lithologic logs are provided in Appendix B. Monitor wells were constructed inside the 8-inch diameter borehole using 2-inch diameter schedule 40 polyvinyl chlorinate (PVC) casing with 0.010-inch well screen. Well construction details and survey data are provided in Table 1.

On November 12, 1992, after each well was developed, groundwater samples were collected from MW-1, MW-2, and MW-3 and analyzed for VOCs, SVOCs, dissolved and total priority pollutant metals, and inorganic Safe Drinking Water Act parameters. The laboratory reported concentrations of PCE at 210 μg/L and 32 μg/L in MW-1 and MW-2, respectively. Both results were above the Maximum Contaminant Level (MCL) of 5 μg/L for PCE. The laboratory reported a concentration of 120 μg/L for 1,2-DCA and 160 μg/L for benzene at MW-3, both above their respective MCL of 5 μg/L. The laboratory reported dissolved priority pollutant metals above the LRL in each of the three monitor wells. None of the metals exceeded regulatory limits established at the time. The concentrations detected in the groundwater sample from MW-1 exceeded the USEPA MCLs for total lead and nitrate, the HBGL for manganese, and the USEPA MCL for nickel. The concentrations in the sample from MW-2 exceeded the USEPA MCLs for nitrate, and the concentrations in the sample from MW-3 exceeded the USEPA MCLs for nitrate and the HBGLs for sulfate and manganese. The SVOC bis (2-ethylhexyl) phthalate was detected in groundwater samples collected from MW-1, MW-2 and MW-3. Law (1993a) noted this is a common laboratory contaminant and is typically found in PVC piping. The laboratory did not report any organochlorine pesticides/PCBs above the LRL.

Groundwater was measured in monitoring wells MW-1, MW-2, and MW-3 on November 13, 1992 at 71.83, 68.80, and 65.10 feet bgs, respectively. This information was used (along with water level measurements at the four deep soil borings) to triangulate groundwater flow direction. The water level data indicate that groundwater flow is in a westerly to northwesterly direction in November 1992 (Law, 1993a).

3.1.3 Phase III Environmental Assessment (1992)

Law performed a third Site investigation (Phase III EA) to evaluate the extent of TPH-contaminated soil identified during Phase II EA work, and to evaluate potential sources that may have contributed to PCE, 1,2-DCA, and benzene groundwater contamination detected in downgradient monitoring wells MW-1, MW-2, and MW-3. Phase III EA investigations included the installation of three additional groundwater monitoring wells (MW-4, MW-5 and MW-6) and drilling of 17 additional soil borings to various depths. Law (1993b) documented the findings from Phase III EA work in its report titled "Report of Phase III Environmental Assessment Services, the Proposed Camelback Arboleda, 16th Street and Camelback Road," April 16, 1993.

3.1.3.1 Soil Boring Drilling and Sample Results

A total of 17 soil borings (B-44 through B-60) were drilled to depths ranging from 10 feet to 85 feet bgs during two separate field events. The locations of soil borings is shown on Figure 4. Four soil borings, B-44 to B-48, were drilled and sampled on December 14, 1992 in and around the drainage swale area. Five soil borings, B-49 to B-53, were drilled and sampled on December 18 to 23, 1992 near the former dry-cleaning facility. Five soil borings, B-55 to B-59, were drilled and sampled on December 19, 1992 in the area north of the former nursery tool shed adjacent to B-11. Soil borings B-54 and B-60 were drilled and sampled on December 15, 1992 and December 21, 1992, respectively, near the former service station(s), upgradient from MW-3 where the laboratory detected 1,2-DCA in groundwater above the LRL and MCL.

Soil borings were drilled with hollow-stem augers and soil samples were collected using a split-spoon sampler (Law, 1993b). Law (1993b) described the lithology as a series of silty-sands, gravels, and clay that are intermittently cemented in thin layers (except near the intersection of 16th Street and Camelback Road). Law (1993b) described fine-grained material near the intersection of 16th Street and Camelback Road consisting of interbedded clayey silts, silty sands, and coarser gravels to depths between 35 and 45 feet bgs. Beneath the finer-grained material, soil borings B-49, B-50, B-51, MW-1, and B-53 encountered a very hard, cemented zone approximately 10 to 15 feet thick. Law (1993b) described as slightly coarser material beneath the cemented zone consisting of silty-sand and gravel to the total depth of the borings (approximately 85 feet bgs).

A total of 62 soil samples were collected by Law and submitted to either an on-site mobile laboratory or off site at a fixed based laboratory (Figure 4). On-site laboratory analyses included: 12 soil samples for volatile aromatic hydrocarbons, 21 soil samples for volatile halogenated hydrocarbons, and 18 soil samples for total recoverable petroleum hydrocarbons. Off-site laboratory analyses were performed on 11 soil samples for SVOCs, Resources Conservation and Recovery Act metals, and pesticides and PCBs.

SVOC analyses of 11 soil samples collected from soil borings (at 5 or 10 feet bgs) in the drainage swale, only detected two analytes above the LRL. The sample collected from boring B-44 (5 to 6 feet bgs) contained 0.430 mg/kg di-n-butyl phthalate and the sample from B-46 (5 to 6 feet bgs) contained 0.78 mg/kg bis (2-ethylhexyl) phthalate. Both results are below the HBGL. Law (1993b) noted that di-n-butyl phthalate was detected in previous borings throughout the Site. The agro-chemicals, chrysene and benzo (k) fluoranthene, detected previously in the drainage swale (Phase II), were not detected in soil samples collected during this investigation, and the extent of the detectable concentrations was believed to be limited to a small area near the drainage swale.

Analyses of volatile halogenated hydrocarbons (including PCE) of 21 soil samples collected from soil borings near the former dry cleaner and six soil samples collected for aromatic hydrocarbons did not contain concentrations above the LRL.

Of the 12 soil samples analyzed for TPH, none contained concentrations of target analytes above the LRL. This information was used to further define the extent of TPH-contaminated soil near the former service station and the previous nursery (Law, 1993b).

Six soil samples were submitted to the laboratory for analysis of volatile aromatic hydrocarbons from the former service station borings and none contained concentrations above the LRL. Six soil samples from the same area were submitted to the laboratory for analysis of TPH and none exceeded the LRL. Based on the above results, Law established that PCE, benzene, and 1,2-DCA were not present at concentrations above the LRL in the soil boring locations near the former dry cleaner or service station.

Three North Plume soil borings B-49, B-52, and B-53 were drilled to groundwater to measure water levels and collect grab samples of groundwater. The depth to groundwater was estimated in these soil borings on December 18, 1992 and December 23, 1992, ranging from 67 to 70 feet bgs.

Groundwater grab samples were collected from exploratory borings B-49, B-52, and B-53 using a decontaminated bailer. The samples were analyzed by the on-site laboratory for VOCs. Two of the three samples contained concentrations of PCE above the LRL. The groundwater sample from B-49 contained 83 µg/L PCE and B-53 contained 165 µg/L PCE.

3.1.3.2 Monitor Well Installation, Drilling and Sample Results

Monitor wells, MW-4 and MW-5, were installed on December 14, 1992 and December 15, 1992, respectively. These two monitor wells were located to investigate the potential for upgradient groundwater contamination. Monitor well MW-6 was installed on December 17, 1992. MW-6 was located to investigate potential groundwater contamination upgradient of the former service station(s) in the South Plume. The locations of these three monitor wells are shown on Figure 2.

The boreholes for monitoring wells MW-4, MW-5, and MW-6 were drilled using hollow-stem augers to approximately 10 feet below the water table, or approximately 81 feet bgs at each location. All three monitor wells are constructed from 2-inch diameter, schedule 40, PVC casing with 0.010-inch slot well screen in the uppermost aquifer.

During drilling, soil samples were collected at approximately 5-foot intervals using a split-spoon sampler. Law (1993b) described fine-grained soils in borehole logs from MW-4 and MW-5 located along the eastern boundary of the Site. The upper 35 feet at MW-4 was described as light brown, sandy, silty-clay atop light brown silty-clay with some gravel to 81 feet bgs. The log from MW-5 is very similar with light-brown sandy silty clay with various amounts of gravel throughout the borehole (0 to 81 feet bgs). At MW-6, located at the southern boundary of the Site, Law (1993b) described the soil in the uppermost portion of the borehole as yellowish-brown silty fine-grained sand. The fine-grained sandy material alternated with light yellowish-brown fine sandy silt to 81 feet bgs. The soil beneath the southern portion of the Site appears to be coarser than the eastern portion, with alternating layers of silt and sand. The lithologic logs, including all pertinent information, for the monitor wells are provided in Appendix B.

Following the installation of the three new monitor wells, each well was developed and groundwater samples were collected. A groundwater sample collected from MW-1 was submitted to the on-site laboratory for VOC analyses to compare the Phase II results for this well. The groundwater sample from MW-1 had a concentration of 252 µg/L PCE. Groundwater samples collected from newly installed upgradient monitoring wells MW-4, MW-5, and MW-6 did not have VOCs above the LRL. Concentrations in the groundwater sample collected from MW-4 exceeded the USEPA MCL for fluoride and the HBGLs for cadmium, lead, and manganese. Concentrations in the groundwater sample collected from MW-5 exceeded the HBGLs for lead, manganese, and fluoride. Concentrations in the groundwater sample collected from MW-6 also exceeded HBGLs for lead, manganese, and fluoride (Law, 1993b).

Groundwater levels measured on December 14, 1992 in monitor wells MW-1, MW-2, MW-3, MW-5, and MW-6, indicated that groundwater flow is in a northwesterly direction at a gradient of 0.005 (Law, 1993b).

3.1.3.3 Monitor Well MW-4 Abandonment

Monitor wells MW-4, MW-5, and MW-6 were installed in December 1992 to assist in determining groundwater flow directions and upgradient groundwater chemistry information. MW-4 was strategically placed downgradient (due west) of a dry well located adjacent to the eastern property boundary. The dry well was located upgradient from the former dry cleaner, but Law suspected that surface water runoff may have flowed into the dry well or chemical dumping may have potentially impacted the groundwater in this area (Law, 1993b). Following construction, a groundwater sample was collected from each of these three monitor wells. Soon after it was determined that MW-4 was not in an appropriate location (off site) and it was abandoned. On December 14, 1992, MW-4 was backfilled with cement grout from the bottom of the casing to ground surface in accordance with ADWR regulations.

3.1.4 Contaminated Soil Remediation (1993)

In the first half of 1993, soon after LAW completed the Phase III work, ADEQ contracted GZA to perform remediation of PCS, as reported in "Report of Phase III Environmental Assessment Services, the Proposed Camelback Arboleda, 16th Street and Camelback Road," dated June 17, 1993 (GZA, 1993). Arboleda is a reference to the Site, which was used by Law in its environmental reports and possibly a name used for property development purposes. Reports by ADEQ confirm that GZA excavated and thermally treated (on site) 405 tons of PCS in the areas defined by the Phase II and Phase III EA documents by Law (presumably the southern plume area).

GZA removed a single 1,000-gallon UST discovered in the area of the southern plume during the excavation of soils. According to the report by GZA, the tank appeared sound and contained water. Laboratory results suggested a release had occurred and subsequent sampling defined the vertical and lateral extent of contamination. Contaminant characterization indicated it was not likely a contributor to the groundwater contamination (ADEQ, 1996).

3.1.5 Groundwater Monitoring by ADEQ (1994)

In August and November 1994, ADEQ sampled monitor wells at the Site and reported the results in the Soil Vapor Remedial Investigations Report (ADEQ, 1995). Groundwater samples were analyzed for VOCs. ADEQ collected groundwater samples from MW-1, MW-2, MW-3, MW-5, and MW-6. The specific groundwater sampling method was not described in ADEQ's report.

The laboratory detected PCE in groundwater samples collected from monitor well MW-1 at concentrations of 420 µg/L and 460 µg/L in August 1994 and November 1994, respectively. PCE was detected in groundwater samples at MW-2 at concentrations of 41 and 34 µg/L in August 1994 and November 1994, respectively.

The laboratory detected 1,2-DCA in groundwater samples collected from monitor well MW-3 at concentrations of 140 µg/L and 610 µg/L in August 1994 and November 1994, respectively. The laboratory also detected benzene in groundwater samples collected from monitor well MW-3 at 13 µg/L and 39 µg/L in August 1994 and November 1994, respectively. 1,2-DCP was detected in the groundwater sample collected from monitor well MW-3 at 8.5 µg/L and 22 µg/L in August 1994 and November 1994, respectively. Chloroform was measured above the LRL in groundwater samples collected from MW-1, MW-2, and MW-5 during the August and November 1994 monitoring events.

3.1.6 Second Soil Vapor Survey (1995)

ADEQ conducted a soil vapor survey in 1995 to attempt to identify any ongoing source(s) of the observed concentrations of PCE, benzene, 1,2-DCA, and 1,2-DCP in groundwater at the Site which exceed their respective MCLs (ADEQ, 1995). Previous soil vapor investigations, performed by Law in 1992, were unable to identify ongoing source area(s) contributing to the groundwater contamination. The Soil Vapor Remedial Investigation Report was prepared by ADEQ's Remedial Investigations Hydrology Unit as part of ongoing remedial action (at the time) to: evaluate all laboratory data generated during the 1995 soil vapor survey, identify potential on-site sources of VOCs which may be contributing to the contamination of groundwater in the vicinity of the former dry cleaner, and finally, to recommend further Site assessment/remediation activities at the Site.

In January 1995, ADEQ's Remedial Projects Section contracted HGC to perform a follow up soil vapor survey in the area of the former dry cleaner. HGC collected a total of 15 soil vapor samples; 14 (including one duplicate) from 10 feet bgs at 13 locations around the North Plume, focusing primarily on the footprint of the former dry cleaner. Soil vapor samples were collected at 10 feet bgs, with the exception of one that was collected at 5 feet bgs. The locations of the soil vapor sampling locations are shown on Figure 4.

The vapor samples were analyzed on site for VOCs (HGC, 1995; ADEQ, 1995). PCE was detected above the detection limit (1 μg/L) in four different samples (SG-1, SG-2, SG-11, and SG-13 at 5 feet bgs), cis-1,2-dichloroetheylene (DCE) in SG-13, and ethylbenzene, m/p-xylene, and o-xylene in SG-11. The concentration of PCE in soil vapor ranged from 1.3 to 2.3 μg/L. ADEQ stated that the observed concentrations were relatively low and did not indicate an ongoing source of PCE was present in shallow soils of the North Plume (ADEQ, 1996). The results of the 2005 investigation were consistent with the previous soil vapor investigation performed during the Phase II site assessment (Law, 1993a) and provided a basis for expanding the groundwater monitoring network (ADEQ, 1995).

3.1.7 Groundwater Monitoring Network Expansion (1996-2002)

In February 1996 ADEQ issued the Final Groundwater Remedial Investigation Work Plan for the Site (ADEQ, 1996). ADEQ expanded the groundwater monitoring network in February and March 1996 to assist in identifying source area(s) of groundwater contamination. ADEQ installed four groundwater monitor wells (MW-7, MW-8, MW-9, and MW-10) and four temporary groundwater borings/well points (HP-1, HP-2, HP-3, and HP-4). Upgradient monitor well MW-9 and downgradient monitor well MW-10 were located at the North Plume, while upgradient monitor well MW-7 and downgradient monitor well MW-8 were located at the South Plume (ADEQ, 1996). Kleinfelder, under the direction of ADEQ, installed MW-11 downgradient from the former service station(s) in 2000. The locations of the monitor wells are shown on Figure 2.

3.1.7.1 Exploratory/Temporary Well Points

The locations of temporary well points HP-1 through HP-4 were not available. Based on a letter from ADEQ, a request to the drilling firm, three of the temporary well points were drilled at the North Plume and one at the South Plume. ADWR imaged record files exist for each of the temporary borings\well points and are some of the only records available, documenting the installation of these monitoring points. The first boring was drilled in February 1996, and the three temporary well points were drilled in April 1996. The exploratory boreholes were drilled to 85 feet bgs, a temporary well was constructed using PVC casing and screen, and a groundwater sample was collected. Each temporary borehole was abandoned, following groundwater sampling using cement grout. Analytical results for groundwater samples collected from HP-1 through HP-4 could not be located for this document.

3.1.7.2 MW-7 and MW-8

Monitor wells MW-7 and MW-8 were installed at the South Plume during the first quarter of 1996 by ADEQ to expand the groundwater monitoring network in this area. Monitor wells MW-7 and MW-8 were drilled using a hollow-stem auger rig in February and March1996, respectively. The total depth of both boreholes is 80 feet bgs. The monitor wells are constructed with 4-inch diameter PVC with 0.020-inch well screen extending from 40 to 80 feet bgs.

3.1.7.3 MW-9 and MW-10

Monitor wells MW-9 and MW-10 were installed in February and April 1996, respectively, by ADEQ to expand the groundwater monitoring network in the North Plume area and identify source(s) of PCE-contaminated groundwater. Wells MW-9 and MW-10 were drilled using a hollow-stem auger to a total depth of 80 feet bgs. The monitor wells are constructed with 4-inch diameter PVC with 0.020-inch well screen extending from 40 to 80 feet bgs.

3.1.7.4 Groundwater Monitoring Results

ADEQ performed groundwater sampling of the monitor well network in July 1998. Groundwater samples were collected from monitoring wells MW-1, MW-2, MW-3, MW-5, MW-6, MW-7, MW-8, MW-9, and MW-10. PCE concentrations exceeded the LRL at MW-1, MW-2, and MW-10. The highest concentration of PCE was 140 μg/L at MW-1. PCE was detected at concentrations of 24 and 35 μg/L at MW-2 and MW-10, respectively. Both 1,2-DCP and 1,2-DCA were detected at MW-3 at 20 μg/L and 420 μg/L, respectively. At MW-8, 1,2-DCA was detected at 4.2 μg/L.

3.1.7.5 MW-11

Monitor well MW-11 was installed by Kleinfelder in May 2000 to expand the groundwater monitoring network at the South Plume. According to ADEQ, MW-11 would help "determine if potential off-site source is co-mingling with 16th Street and Camelback WQARF Plume," and delineate the downgradient extent of groundwater contamination at the South Plume. Well MW-11, (ADWR No. 55-579821), was drilled using a hollow-stem auger rig to a total depth of 81 feet bgs. The monitor well is constructed with 4-inch diameter PVC with 0.020-inch well screen extending from approximately 40 to 80 feet bgs.

3.1.7.6 Groundwater Monitoring

Groundwater monitoring of the Site's network of monitor wells by Kleinfelder continued from 2000 through 2002, at which time the ERA investigation commenced. The Site monitor wells appear to have been sampled quarterly in 2000, semi-annually in 2001, and once in 2002. Groundwater quality and water level trends are described in detail in Section 5.0.

Concentrations of PCE detected in groundwater samples collected from monitor well MW-1 ranged from 56 μg/L to 270 μg/L between 2000 and 2002, and appeared to be on a decreasing trend. Concentrations of PCE detected in groundwater samples collected from monitor well MW-2 ranged from 4.1 μg/L to 55 μg/L between 2000 and 2002, and appeared to be on a decreasing trend. Concentrations of PCE detected in groundwater samples collected from monitor well MW-8 ranged from 0.70 μg/L to 1.1 μg/L between 2000 and 2002, and appeared to be on a decreasing trend.

Concentrations of PCE detected in groundwater samples collected from monitor well MW-10 ranged from 34 µg/L to 120 µg/L between 2000 and 2002, and appeared to be on an increasing trend during this time. PCE was not detected above the LRLs in the other Site monitor wells between 2000 and 2002.

1,2-DCA was only detected above the LRL in groundwater samples collected from two of the Site monitor wells, MW-3 and MW-8, between 2000 and 2002. 1,2-DCA was detected at concentrations ranging from 230 µg/L to 350 µg/L in MW-3 and 0.79 µg/L to 0.9 µg/L in MW-8.

1,2-DCP was only detected in groundwater samples collected from monitor well MW-3 between 2000 and 2001, at concentrations ranging from 11 µg/L to 14 µg/L. Monitoring at MW-3 was discontinued after 2001 due to declining water levels. 1,2-DCP was not detected above the LRL in the other monitor wells that were sampled at the Site between 2000 and 2002.

3.2 ERA Investigation (2002-2004)

In May 2002, ADEQ initiated an ERA at the Site. Kleinfelder contracted with ADEQ to perform the ERA. The ERA was intended to contain and prevent further PCE migration by remediation of soil and groundwater near the suspected release area at the former dry cleaner. The ERA was developed in response to increasing PCE concentrations in groundwater at monitor well MW-10, indicating contamination was migrating downgradient from the suspected source area at the former dry cleaner. The objectives for the ERA included the installation of a pilot remediation system consisting of a nested SVE/AS well and a nested OW to assess the feasibility of implementing an SVE/AS remediation system at the Site. The borings for the wells were logged and multi-media samples were collected and analyzed for contaminants of concern (COCs) associated with the former dry cleaner.

A detailed summary of the ERA activities and sample results were provided in a report to ADEQ prepared by Kleinfelder, dated May 2004.

3.2.1 Boring Locations, Drilling, Sampling, and Installation Methods

The SVE/AS and OW wells were installed in January 2003. Both were located near the suspected source area (former dry cleaner), adjacent to monitor well MW-1 (Figure 2).

The borings for the two wells were drilled using a hollow-stem auger drilling rig. Soil samples were collected from well borings using a Simulprobe® in-situ sampler (if soil vapor was collected) or a modified California split-spoon sampler (where no soil vapor was collected). Kleinfelder collected soil samples for laboratory analyses, headspace screening using a flame ionization detector, and lithological descriptions in accordance with the Unified Soil Classification System (USCS). Soil and soil vapor samples were submitted to an on-site mobile laboratory for analysis of VOCs.

The nested SVE/AS well boring was drilled to a total depth of 122 feet bgs. Well construction consisted of a shallow 2-inch diameter PVC SVE well screened (0.020-inch) from 25 to 45 feet bgs, a deep 2-inch diameter PVC SVE well screened (0.020-inch) from 55 to 80 feet bgs, and a 1-inch diameter AS well screened (0.010-inch) from 98 to 100 feet bgs. The OW well was drilled to 102.5 feet bgs and was constructed with a shallow 2-inch diameter well screened (0.020-inch) from 40 to 60 feet bgs, and a separate deep 2-inch diameter well screened (0.020-inch) from 70 to

100 feet bgs. Following construction, the wells with water-saturated screens were developed by the drilling company.

3.2.1.1 Depth-Specific Soil Sampling

Soil samples were collected from the SVE/AS boring at 15, 20, 30, 40, 50, 60, 70, 80, 85, 90, 95, 105, 115, and 120 feet bgs. Soil samples were collected from the OW boring at 15, 25, 35, 45, 55, 65, 70, 85, 90, and 101 feet bgs. The soil samples from 15 to 70 feet bgs were collected with a Mini Simulprobe® sampler, with the remaining samples collected using a California split-spoon sampler. Soil samples were analyzed for VOCs. The laboratory reported no concentrations of target analytes exceeded the LRL.

3.2.1.2 Depth-Specific Soil Gas Sampling

Soil vapor samples were collected using the Simulprobe® sampler and a low-flow rate air pump operated at the surface. Soil vapor samples were collected from the Simulprobe® sampler in Tedlar® bags. Soil vapor samples were submitted to an on-site mobile lab for VOC analysis. The laboratory reported concentrations of PCE above the LRL from depth-specific soil gas samples collected from the SVE/AS and OW borings. The concentrations of PCE ranged from 0.40 to 1.16 parts per million of vapor volume (ppmv) from the SVE/AS boring and ranged from the LRL to 1.10 ppmv from the OW boring, with little to no correlation with depth or lithology. Other target analytes were not detected above the LRL.

3.2.1.3 Depth-Specific Groundwater Sampling

In-situ, or depth-specific, groundwater samples were collected at the water table and select depths below the water table using a HydroPunch® sampler. The groundwater samples were collected by Kleinfelder and submitted to an on-site mobile laboratory for analysis of VOCs. Depth-specific groundwater samples were collected from the SVE/AS well boring at 75, 85, 95, 105, 115, and 120 feet bgs. The laboratory reported PCE concentrations above the LRL at four of the six depths, with the highest values of 29 mg/L and 46 mg/L at 75 and 105 feet bgs, respectively. Depth-specific groundwater samples were collected from the OW well boring at 80, 92, and 101 feet bgs and each sample contained PCE concentrations above the LRL, with the highest values of 21 mg/L and 31 mg/L at 80 and 101 feet bgs, respectively. Other target analytes were not detected above the LRL in any groundwater samples.

3.3 ERA - Remediation System Pilot Test (2003)

The ERA was initiated by ADEQ to contain and prevent further PCE migration by remediation of soil and groundwater near the suspected release area (former dry cleaner) at the North Plume. Kleinfelder (2004) states in the ERA completion report that the “installation of the SVE-AS remediation system would provide for containment of the PCE contamination by soil source removal, if any, and by control and remediation of the PCE contaminated groundwater.” In addition, Kleinfelder planned to use results from this study to design the optimal remediation system, if/when necessary, at the Site.

3.3.1 Description of Pilot Testing

Prior to initiating the pilot test, Kleinfelder collected and recorded baseline data from the extraction, observation, and monitor wells. The information collected included depth to water, dissolved oxygen

(DO), pressure/vacuum, and VOC concentrations from the air sparge well (AS-1) and monitor wells (MW-1 and MW-2). Kleinfelder collected pressure/vacuum and VOC concentration baseline data from nested vapor extraction well VW-1 and nested observation well OW-1.

Kleinfelder performed step-down tests on vapor extraction wells VW-1S (shallow well) and VW-1D (deep well which intersects water table). The purpose of the step-down tests was to identify the optimal blower selection if a full-scale remediation system was designed. The blower was connected to each vapor extraction well and pumped or extracted over a range of vacuum levels. The applied vacuum was controlled manually by adjusting blower revolutions per minute or manual dilution valve.

3.3.1.1 Vapor Extraction Tests

The SVE wells were operated for a total of eight hours. Vapor extraction testing was performed on VW-1S for five total hours and on VW-1D for three total hours. During the first hour of extraction, parameters were measured at 15-minute intervals and then 30-minute intervals for the remainder of the test. Monitoring parameters included extraction flow rate, extraction wellhead vacuum, extracted VOC concentration (photoionization detector [PID]), and OW vacuum. Air samples were collected from the wellhead port into Tedlar bags for laboratory analysis. Air samples were analyzed on site by a mobile laboratory for VOCs. Air samples were also collected in Summa canisters for fixed-laboratory analyses of VOCs.

3.3.1.2 Air Sparge Tests

The sparge breakthrough test was performed to establish the sparge breakthrough pressure. The minimum breakthrough pressure (pressure required to overcome static water level) was applied for 15 minutes then pressure was increased until air flow was achieved. Once air flow was established, the pressure regulator was adjusted to maintain a constant sparge flow rate of 10 standard cubic feet per minute (scfm) for the remainder of the sparge test.

The vapor extraction system, both VW-1S and VW-1D, was initiated once the breakthrough test was complete. The combined vapor extraction/air sparge test (combined test) duration was approximately seven hours. During the first hour of the combined test, vapor extraction parameters, previously described, and sparge parameters including injection pressure, injection flow rate, observation well depth to water, observation well DO, observation well pressure/vacuum, and observation well VOC concentrations were monitored at 15-minute intervals. After the first hour, parameters were measured on an hourly basis. The radius of influence (ROI) was monitored through the combined test.

Air samples were collected in Tedlar® bags using a hand vacuum pump. Air samples were collected from the wellhead port and screened for VOCs on site at a mobile laboratory. Select vapor extraction vapor samples were collected in Summa canisters and submitted to a fixed-based laboratory for analysis of VOCs.

3.3.2 Results of Pilot Testing

3.3.2.1 Vapor Extraction Test Results

Using the data curves, a maximum flow rate of 65 scfm was established with a vacuum of 11 inches mercury to achieve that flow at VW-1S. At VW-1D, Kleinfelder reported a maximum flow rate of 60 scfm, with a vacuum of 10 inches mercury.

Kleinfelder (2004) estimated the zone of influence (ZOI) by determining the distance from the test well at which the vacuum is 0.1 inches water column. The ZOI for VW-1S was estimated to be 95 feet at 11.8 inches mercury. The ZOI for VW-1D was estimated to be 110 feet at an applied vacuum of 13.5 inches mercury.

Kleinfelder calculated and reported mass extraction rates using measured flow rates and vapor sample results (Kleinfelder, 2004). Mass flow rates were calculated for PCE only, as this was the only target analyte detected in laboratory results. Calculated mass flow rates ranged from 0.25 pounds per day (lb/day) in VW-1S to 0.32 lb/day in VW-1D to 0.19 lb/day and 0.07 lb/day, respectively, by the end of the combined test. Based on these results, Kleinfelder recommended carbon adsorption for vapor abatement.

3.3.2.2 Sparge Test Results

Kleinfelder calculated a minimum breakthrough pressure of 12 pounds per square inch gauge (psig). Actual breakthrough was achieved at 40 psig at an injection flow rate of 3.5 scfm. Steady-state operations with an applied pressure of 32 psig and injection flow rate of 10 scfm.

Typically, injected air around the sparge well displaced water and creates a mound. The displacement is monitored in OWs. Kleinfelder made an indirect approximation of the ROI by observing the distance from the sparge well where an increase in groundwater level of 0.1 feet occurred. The ROI, based on groundwater monitoring, was estimated to be 70 feet. An approximation of the ROI was also determined using groundwater DO levels by quantifying the distance from the sparge well where an increase in DO by 1 mg/L was observed. Kleinfelder states that DO monitoring is a more direct measurement of the ROI. Kleinfelder estimated the ROI at 18 feet using DO measurements.

VOC's were not detected above the LRL in air samples collected from observation wells during the combined test (sparge and vapor extraction). Kleinfelder proposed that this was the result of the extraction wells capturing the VOCs before making it to the OW.

Pressure/vacuum measurements made during the combined test indicated the effectiveness of sparging or vapor extraction. Pressure increased in OW-1D, 16 feet away, indicating effective sparging. Vacuum was observed at the other OW locations, further indicating the effectiveness of the SVE system.

Mass flow rates for PCE during sparging, were calculated by Kleinfelder (2004) who stated in its final report that sparging did not appear to increase the rate of PCE recovery at the Site.

3.3.3 Current Status of SVE/AS System

The pilot test wells were capped, but not abandoned, upon completion of the study. Some of the wells are used today as part of the groundwater monitoring network for measuring groundwater levels and groundwater sample collection.

3.4 Additional Monitor Wells and Groundwater Monitoring (2002-2007)

Kleinfelder continued to monitor groundwater conditions at the Site from 2002 through 2007. Data collected is documented in quarterly groundwater monitoring reports prepared by Kleinfelder.

In December 2002, Kleinfelder lowered pump intakes at monitor wells MW-1, MW-2, MW-5, MW-6, MW-8, MW-9, and MW-10 to approximately 1.5 feet above bottom of the wells; however, continued water level declines across the Site ultimately required bailing of the wells to retrieve groundwater samples. Then, during the first quarter 2004, ADEQ directed Kleinfelder to change from the purge and sample method to the use of PDBs for groundwater sampling. Kleinfelder set PDBs in ten wells on April 20, 2004 and measured groundwater levels and retrieved the PDBs on May 13, 2004. Two PDBs were set inside OW-1D, one less than 5 feet below water and the second at 10 feet below water.

Groundwater level measurements from May 13, 2004 indicated an approximate groundwater flow direction of S88ºW, with a gradient of 0.002 feet per foot (ft/ft) at the South Plume. The estimated groundwater direction at the North Plume in May 2004 was N86°W with a gradient of 0.003 ft/ft. Groundwater flow directions were calculated separately for the North Plume and South Plume since 2002. The groundwater flow directions in the North Plume range from N50°W to N89°W and gradient ranges from 0.003 to 0.005 ft/ft between 2002 and 2004. In the South Plume, groundwater flow direction ranges from S71°W to N80°W, with a gradient of 0.002 to 0.003 ft/ft.

Groundwater samples collected from the PDBs retrieved on May 13, 2004 were analyzed by Del Mar Laboratory for VOCs. The concentration of PCE exceeded the LRL at OW-1D, MW-10, MW-2, and MW-1. The concentration of PCE at OW-1D (8.0 μg/L), W-10 (45 μg/L), and MW-1 (39 μg/L) exceeded the MCL of 5 μg/L. At MW-8, 1,2-DCA was detected above the MCL at 7.6 μg/L. Well MW-3 had not been sampled since June 2001 due to declining groundwater levels. 1,2-DCP was not detected above the LRL in groundwater samples collected during May 13, 2004 monitoring event.

3.4.1 MW-12 Drilling Installation and Sampling

The second quarter report for 2004 contains a summary of the well installation activities for monitoring well MW-12, which was drilled and constructed in June 2004. Monitor well MW-12 was installed by Kleinfelder to provide further delineation of the PCE-contaminated groundwater downgradient from the Site. The location of monitoring well MW-12 is shown on Figure 2.

The borehole for monitoring well MW-12 was drilled using hollow-stem augers to a total depth of 121.5 feet bgs (Kleinfelder, 2005). Soil samples were collected every 5 feet from 10 to 35 feet bgs and every 10 feet from 35 to 115 feet bgs with a final sample at 121.5 feet bgs using a modified California split-spoon sampler.

Kleinfelder described the soil material encountered in the MW-12 borehole from the surface down to about 85 feet bgs, as fine sandy clay\clayey sand, and sand. The interval from 85 to 105 feet bgs was described as being sand with silt and clay. Fine-grained sandy clay was observed from 105 feet bgs to the bottom of the borehole at 121.5 feet bgs.

Four soils samples (10, 45, 55, and 75 feet) were preserved for laboratory analysis of VOCs in soil. Laboratory results indicated that target analytes were not detected above the LRL in the soil samples that were submitted for analysis.

Monitor well MW-12 was constructed with 4-inch diameter PVC to 120 feet bgs with 0.020-inch slotted well screen extending from approximately 80 to 120 feet bgs. The depth to water at MW-12 on June 15, 2004 following installation was approximately 80 feet bgs, as recorded in the well driller report on ADEQ imaged record files.

A representative sample of the development water (profile sample) was collected by Kleinfelder after MW-12 was developed on June 21, 2004. The sample was analyzed at a fixed-based lab for VOCs. The laboratory reported concentrations above the LDL for 1,2-DCA (11 μg/L), PCE (5.1 μg/L), and trichloroethylene (TCE) (1.7 μg/L). The reported concentrations of 1,2-DCA and PCE exceeded the USEPA MCL of 5 μg/L.

3.4.2 Groundwater Monitoring 2004-2006

Groundwater monitoring continued on an approximate quarterly basis between 2004 and 2006.

3.4.3 MW-3A Drilling, Installation, and Sampling

Monitoring well MW-3A was drilled as a replacement well for MW-3 which had been dry since December 2002 due to locally declining water levels. The borehole for monitoring well MW-3A was drilled using a hollow-stem auger to 122 feet bgs on April 6, 2006 (Kleinfelder, 2006). The locations of the original MW-3 and replacement well MW-3A are shown on Figure 2.

Soil samples were collected at 5-foot intervals beginning at 10 feet bgs and ending at the water table at 75 feet bgs. The driller used a modified California split-spoon sampler to collect soil samples. Kleinfelder describes the soil material encountered in the MW-3A borehole as a series of fine-grained silty sands and silts with varying clay content (Kleinfelder, 2006). Five soil samples (20, 30, 55, 65 and 75 feet) were preserved for laboratory analysis of VOCs. Laboratory results indicated that none of target analytes were detected above the practical quantification limit in the five soil samples. Monitor well MW-3A was constructed with 4-inch diameter PVC to 120 feet bgs with 0.020-inch slotted well screen extending from approximately 60 to 120 feet bgs. The depth to groundwater was measured at 74 feet bgs on April 6, 2006 as recorded in the well driller report from ADEQ's imaged record files.

Monitor well MW-3A was first sampled during the second quarter 2006 groundwater sampling event using PDBs set at 3 feet and 10 feet below the water table. Laboratory results for VOCs in both samples were less than 2 μg/L for each of the target analytes.

3.4.4 Groundwater Monitoring Results Third Quarter 2007

Groundwater monitoring at the Site continued through at least the third quarter 2007, at which time groundwater monitoring was temporarily suspended due to budgetary constraints. A summary of the third quarter 2007 groundwater monitoring data is provided below.

Groundwater levels were measured at eight wells in the North Plume area and PDBs in those same eight wells on August 1, 2007. The PDBs were retrieved from the North Plume monitoring wells on August 15, 2007. Prior to the August sampling event, monitor wells MW-3 and MW-3A were re-developed in June 2007 due to sediment production issues. Kleinfelder measured groundwater levels at six wells associated with the South Plume and purged and collected groundwater samples using a bailer from five wells on July 25, 2007 and August 30, 2007.

Kleinfelder reported that groundwater flow direction was southwest at a gradient of 0.003 ft/ft in the South Plume using July 25, 2007 data but, using August 30, 2007 data, was west at a gradient of

0.003 ft/ft. Kleinfelder reported the North Plume groundwater flow direction as west at a gradient of 0.004 ft/ft using August 1, 2007 data.

Kleinfelder collected purge-and-bail samples from monitoring wells MW-3A, MW-6, MW-7, MW-8, and MW-11 associated with the South Plume on July 25, 2007. 1,2-DCA was detected above the LRL in groundwater samples collected from wells MW-3A and MW-8 at 2.9 μg/L and 9.7 μg/L, respectively. The laboratory reported concentrations of 1,2-DCA in depth discrete samples collected from MW-12 at 3 feet and 10 feet below the water table at 2.4 μg/L and 4.9 μg/L, respectively. The South Plume wells were sampled again on August 30, 2007 using the purge-and-bail method. The laboratory reported a concentration of 1,2-DCA in the groundwater sample collected from monitor well MW-8 of 7.6 μg/L. Neither PCE nor 1,2-DCP were detected above the LRL in groundwater samples collected from the South Plume wells during this monitoring event.

Kleinfelder retrieved PDBs from MW-1, MW-2, MW-5, MW-9, MW-10, MW-12, and OW-1D on August 15, 2007. The laboratory reported PCE concentrations in groundwater samples collected from MW-1 (3.1 μg/L), MW-2 (6.3 μg/L), MW-10 (20 μg/L), MW-12-3 (2.9 μg/L), MW-12-10 (2.1 μg/L), and OW-1D (2.8 μg/L). 1, 2-DCP and 1,2-DCA were not detected above the LRL of <0.5 μg/L in the groundwater samples that were collected for this monitoring event.

3.5 Temporary Break from Groundwater Monitoring/Investigation Activities

From 2008 through the end of 2012, groundwater monitoring was not conducted due to budgetary constraints.

3.6 Additional Groundwater Monitoring and Monitor Well Installations (2013-2014)

3.6.1 Groundwater Monitoring (Second Quarter 2013)

A groundwater monitoring event was conducted during the second quarter of 2013 following a nearly seven-year break in groundwater monitoring activities at the Site. PDBs were deployed on May 6, 2013 in each of the 12 monitor wells at the Site, with the exception of MW-6. On May 20, 2013 the PDBs were retrieved and groundwater samples were collected for laboratory analysis of VOCs. Laboratory analytical results are presented in Table 2.

In groundwater samples collected at the North Plume, the laboratory reported PCE concentrations ranged from non-detect (<0.500 μg/L) in MW-2, MW-5, and MW-9 to 31.9 μg/L in the duplicate sample from MW-10. The laboratory reported PCE concentrations of 5.90 and 2.58 μg/L in groundwater samples collected from the two monitor wells nearest the former dry cleaner, MW-1 and OW-1D respectively. The laboratory reported 25.1 μg/L for PCE in the groundwater sample collected from downgradient monitor well MW-10 and 8.94 μg/L in the furthest downgradient monitor well MW-12. MW-12 did not contain 1,2-DCA above the LRL. This is the only well in the North Plume area to contain reportable amounts of 1,2-DCA in the past.

In groundwater samples collected at the South Plume, the laboratory did not detect 1,2-DCA above the LRL (<0.500 μg/L) in any of the monitor wells sampled. The aquifer water quality standard

(AWQS) for 1,2-DCA is 5.0 µg/L. Historically, MW-8 has exceeded the AWQS for 1,2-DCA, but the primary sample and duplicate collected from MW-8 were non-detect for this monitoring event. Historically, benzene has been detected in some South Plume monitor wells. Benzene was not detected in any of the monitor wells during this event. 1, 2-DCP was not detected above the LRL (<0.500 µg/L) in the groundwater samples that were collected for this monitoring event.

A few other VOCs were detected in monitor wells sampled during this event, primarily trihalomethanes (THMs). Of the THMs, chloroform was detected most often and at the highest concentrations. The laboratory detected chloroform in groundwater samples collected from nine wells (MW-1, MW-5, MW-7, MW-8, MW-9, MW-10, MW-11, MW-12, and OW-1D). The highest chloroform concentrations were detected in groundwater samples from MW-9 and OW-1D at 7.97 µg/L and 4.99 µg/L, respectively. Bromodichloromethane, also a THM, was detected in groundwater samples collected from one well, OW-1D, at 0.520 µg/L. The AWQS for total THMs is 100 µg/L. 1,1-dichloroethene was also detected in a groundwater sample collected from one monitor well, MW-11, at 0.780 µg/L.

Groundwater elevations were measured during the sampling event and those data are presented in Table 3.

3.6.2 MW-13 and MW-14 Installation (First Quarter 2014)

Monitor wells MW-13 and MW-14 were installed during the first quarter 2014 to help further define the downgradient edge of PCE in the North Plume. The locations of monitor wells MW-13 and MW-14 are shown on Figure 2.

The boreholes for monitor wells MW-13 and MW-14 were drilled using hollow-stem augers to 110 feet bgs. Soil samples were collected every 10 feet from 10 to 70 feet bgs and every 5 feet from 70 to 110 feet bgs using a split-spoon sampler. The lithology of each soil sample was described using the USCS. Lithologic logs are provided in Appendix B. The type of soil encountered in each borehole for MW-13 and MW-14 was predominantly silty sand with some clayey sand. Sandy lean clay was encountered at a depth of 110 feet bgs in the borehole for MW-13. The saturated interval of MW-14 was predominantly clayey sand, while the saturated interval of MW-13 was predominantly silty sand.

Groundwater monitor wells MW-13 and MW-14 were each constructed inside a 10-inch borehole drilled to approximately 110 feet bgs (BC, 2014). Both monitor wells are constructed from 4 1/2-inch outside diameter schedule 40 PVC casing set down to 110 feet bgs with 0.020-inch slotted well screen from 70 to feet bgs to 110 feet bgs. Initial groundwater monitoring of these wells is discussed below.

3.6.3 Groundwater Monitoring (First and Second Quarter 2014)

Two groundwater monitoring events were conducted at the Site during the first and second quarters of 2014, following installation of monitoring wells MW-13 and MW-14. Groundwater sampling at each well was accomplished using PDBs. Groundwater samples retrieved from the PDBs were analyzed for VOCs. The analytical results for PCE and 1,2-DCA were consistent with the results from the May 2013 groundwater monitoring event. The laboratory detected PCE in groundwater samples collected from both new monitor wells MW-13 and MW-14 at concentrations exceeding the laboratory reporting limit of <0.500 µg/L but below the MCL of 5 µg/L. Laboratory analytical results for these two events are presented in Table 2. PCE and 1,2-DCA trends are discussed in Section 5.0.

Section 4
Hydrogeology

4.1 Site Stratigraphy

As discussed in Section 2.0, stratigraphy in the vicinity of the Site is composed of thick basin-fill sediments of unconsolidated to semi-consolidated clastic sediments deposited from the Late Tertiary to Quaternary. Stratigraphy beneath the Site was determined from soil borings drilled during various Site investigations. Lithologic descriptions from these borings indicate that the Site is predominantly underlain by fine-grained sediments composed of very fine-grained sand, silts, silty sands and clays with a few sand and gravel lenses that are generally less than 10 feet in thickness. The uppermost sand and gravel lenses are typically encountered at approximately 30 to 50 feet bgs and ranged from fine to coarse in size distribution. The gravels consist largely of sub-angular to sub-round granite rock with weathered and un-weathered quartz, feldspar and mica crystals. The total depths of most of the on-site borings seldom exceed 120 feet; therefore, most borings only encounter the UAU at the Site. The UAU is reported to be approximately 200 feet thick in the surrounding area (Corkhill, et al., 1993).

Boring logs for groundwater monitoring wells with detailed lithologic descriptions and drilling observations are included in this report as Appendix B. Boring logs for monitoring wells MW-7, MW-8, MW-9, MW-10 and MW-11 could not be located. A cross-section line map is provided on Figure 5 and three generalized geologic cross-sections are presented as Figures 6, 7 and 8, respectively. The cross-sections depict the extent of coarse-grained and fine-grained sediment below the Site.

4.2 Aquifer Hydraulic Properties

RI activities at the Site have not included testing of hydraulic properties of the uppermost contaminated aquifer layers, so there is limited data available for local aquifer properties. ADWR uses an average hydraulic conductivity of 69 feet/day for the UAU at this location in the most recent Salt River Valley (SRV) groundwater flow model (Freihoefer, et al., 2009). The hydraulic conductivity of individual sand and gravel layers will likely be higher than this value. ADWR uses a specific yield of 0.10 at this location in the SRV groundwater flow model.

4.3 Depth to Groundwater

Groundwater levels were monitored regularly (monthly or quarterly) at the Site from August 1994 through August 2007. There was a break in groundwater monitoring activities between 2007 and 2013. More recently, groundwater levels were collected in May 2013, January 2014 and April 2014. Depth to groundwater and calculated groundwater elevations from August 1994 through April 2014 are provided in Appendix C, and the measurements for 2013 and 2014 are provided in Table 3. Groundwater levels have declined between 11 and 13.5 feet in the oldest monitoring wells, MW-1, MW-2, MW-3 and MW-5, which have the most extensive data set at the Site. Depth to groundwater measured at the Site monitoring wells during 2013 and 2014 ranged from 73.26 to 80.08 feet bgs.

4.4 Groundwater Flow and Gradients

Calculated groundwater elevation measurements for April 3, 2014 indicate the groundwater flow direction beneath the Site is to the northwest at a gradient of 0.0033 ft/ft (Figure 9). This is consistent with the groundwater flow directions that were observed at the North Plume area of the Site between 1999 and 2007 (Kleinfelder, 2008). Historically, groundwater flow directions at the South Plume area of the Site have been to the northwest, with occasional observations of flow to the west-southwest (Kleinfelder, 2008).

Section 5

Contaminant Transport and Data Evaluation

5.1 Potential Routes of Migration

5.1.1 Migration Pathways

An exposure pathway is the route over which a chemical or physical agent migrates from a source to an exposed population or individual (receptor) and also describes a unique mechanism by which the receptor may be potentially exposed to chemicals or physical agents at or originating from the Site. For an exposure pathway to be complete, the following four elements must be present:

- A source or release from a source (e.g., vapor emissions released from soils to air);
- A likely environmental migration route (e.g., volatilization of a site-related chemical or physical agent);
- An exposure point where receptors may come in contact with site-related chemical or physical agents (e.g., local soils); and
- A route by which potential receptors may be exposed to a site-related chemical or physical agent (e.g., inhalation of vapors)

If any one of these components is not present, the exposure pathway is considered incomplete and is not expected to contribute to the total exposure from the Site.

5.1.1.1 Groundwater Pathway

Domestic consumption of groundwater is a pathway of concern when private wells that produce water from the underlying aquifer are used to provide a source of drinking water. Exposure will occur as a result of ingestion, inhalation, and direct dermal contact with chemicals during domestic activities. This pathway is considered to be incomplete at the Site since there are no ADWR registered water supply wells located within approximately one mile downgradient of the Site.

Municipal water wells may also produce water from the aquifer in or near the Site. This pathway is considered to be incomplete for the Site since there are no known municipal wells within one mile downgradient of the Site.

Irrigation wells may also produce water from the aquifer near the Site. SRP has one active irrigation well 15R-8.5N (55-608421), located approximately 1/2 mile south of the Site, near the intersection of North 16th Street and East Campbell Avenue. This pathway is considered to be incomplete for the Site since this SRP irrigation well is located ½ mile to the south of the Site and is locate in a cross-gradient direction.

SRP also has one inactive well, 15E-9.3N (55-607749) located approximately ¼ mile north of the Site near the intersection of 16th Street and East Colter Street. This pathway is considered to be incomplete for the Site since this SRP irrigation well is located ¼ mile to the north of the Site and is located in a cross- gradient direction.

5.1.1.2 Surface Water Pathway

SRP indicates that it serves water from well 15R-8.5N (55-608421) for irrigation to customers south of the intersection of North 16th Street and East Campbell Road. Appendix B of A.A.C. R18-11-1, List of Surface Waters and Designated Uses, indicates the designated uses of canals below water treatment plants are agricultural irrigation and agricultural livestock. There are no numeric standards for PCE for these designated uses. Assuming partial or full body contact is a possibility with irrigation waters, the numeric water quality standard would be 9,333 µg/L. Concentrations of PCE in the groundwater at the Site are well below this concentration and not likely to impact SRP's wells in this area. Therefore, this pathway is considered to be incomplete for the Site.

5.1.1.3 Air Pathway

The air pathway is a pathway of concern when inhalation can occur from exposure to contaminated air due to volatilization of the COCs from surficial soils, the underlying unsaturated soils, or the aquifer.

Exposure by the inhalation pathway would be negligible outdoors, but can be significant indoors where vapors cannot readily disperse (e.g., in on-site residences and buildings.) On-site human receptors are children and adults living in the residential properties at the Site. On-site human receptors would also include adults working in commercial properties at the Site.

Health concerns have been raised about the potential for subsurface contamination in either soil or groundwater adversely impacting indoor air quality. The exposure pathway for air is considered to be incomplete at the Site because of the low concentrations of VOCs that have been detected in the upper 10 feet of soil and the relatively low concentrations and limited extent of VOCs remaining in groundwater.

5.1.1.4 Soil Contact Pathway

Direct soil contact is a pathway of concern in areas where humans may come in contact with contaminated soils. Much of the soil at the Site occurs under asphalt parking lots, asphalt-surface storage areas, or under the concrete floors of buildings at the property. Soil at the Site does not contain contaminant concentrations above soil remediation standards. Therefore, this pathway is considered to be incomplete for the Site.

5.1.2 Receptors

Potential receptors include downgradient users of groundwater; however, there are no wells located within one mile downgradient of the Site that are identified as water supply wells in ADWR's well registry.

5.1.3 Limits of Study Area

The Study Area in groundwater is limited to the extent of the network of groundwater monitor wells shown on Figure 2 and to a depth of approximately 120 feet. The extent of the Study Area in soil is limited to the area investigated using the soil and soil vapor borings shown on Figure 3 ranging in depth from 5 to approximately 75 feet.

5.2 Fate and Transport

This section describes the mechanisms involved in the fate and transport of soil and groundwater contaminants at the Site. The COCs at the Site are halogenated VOCs or more specifically, dense, chlorinated solvents. Transport of dense, chlorinated solvents is controlled by several different mechanisms, including the type of subsurface medium and geochemical conditions in the material through which the compounds are migrating. Physical and chemical transformations of the contaminants can also affect their fate and transport.

The exact nature of a dense, chlorinated solvent release is not always known. Dense, chlorinated solvents can be released to the environment as a free-phase immiscible liquid or dense non-aqueous phase liquid (DNAPL), as a dissolved-phase component of a liquid waste stream, or as vapor phase. The nature of the release will have broad implications with respect to the type and duration of remedial activities. Where a DNAPL release has occurred, migration in the subsurface is density-driven and occurs within zones of interconnected DNAPL within the soil pore spaces. In such zones, the DNAPL in different pore openings forms an immiscible-phase continuum through the intervening pore throats. Experiments have shown that even relatively small differences in hydraulic conductivity can inhibit downward migration and cause lateral spreading of DNAPLs. Once the release ceases, the forces driving DNAPL movement dissipate and the DNAPL in the pore openings become disconnected to form a zone of residual DNAPL (Pankow and Cherry, 1996).

Within the overall zone of DNAPL contamination, it is often impractical to define specific locations of residual zones. As such, remedial technologies must be directed over a larger area of interest. Residual DNAPL in the vadose zone can produce a vapor plume that, after many years, can move downward or can come in contact with infiltrating water and reach the water table. In field experiments, such vapor plumes have been shown to migrate vertically over large distances and result in groundwater contamination with maximum concentrations in the thousands of µg/L (Pankow and Cherry, 1996).

VOCs released to the subsurface as a dissolved-phase component of a liquid waste stream can occur as either a point source release (such as a wastewater infiltration pond) or non-point source release (such as leaking sewer pipes). In those cases, the distribution of VOCs in subsurface soils will generally be broader and occur at lower concentrations than is typically observed with a DNAPL release. This is likely the type of release that occurred at the Site due to the relatively low to levels of VOCs detected in soil, soil gas and groundwater that have been detected during the various RI activities.

VOCs will pass through unsaturated soils at different rates depending on physical properties of the soils. Soil physical properties such as permeability, moisture content, and organic carbon content affect the rate of migration of VOCs in soil. Physical properties of the compound itself such as specific gravity, Henry's Law constant (KH), water solubility, octanol-water partition coefficient (Kow), and organic carbon partition coefficient (Koc) also affect its fate and transport.

Organic carbon is present in all soils and causes certain chemicals to adsorb to soil. The adsorptive properties of soil depend largely on the total amount of organic carbon available and the nature of the contaminant contacting it. The Koc value is a measure of the capacity for an organic chemical to adsorb to soil. The higher the Koc value, the more readily the compound adsorbs to the soils. Based on its Koc value, PCE is expected to have moderate mobility in soil.

Another physical property that affects the mobility of liquids is the porosity of the soil. The size and interconnectedness of the pore spaces in the soil affects the retention of liquids in soil. Small pore spaces retain liquids by capillary forces. Larger pore spaces, such as those found with coarse gravels and cobbles, allow liquids to move through them more freely. 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 PCE from moist soil surfaces is an important fate process and is related to their respective KH. 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 soils with low moisture content (Cohen and Mercer, 1993).

The moisture content of a soil is also a significant factor in migration and retention of VOCs both in liquid and vapor phases. Penetration of DNAPL through the vadose zone is enhanced by dry soil conditions (Cohen and Mercer, 1993), whereas moisture filling the pores of a soil can act as a barrier to migration of DNAPL and result in lateral spreading. Similarly, the downward migration of a VOC vapor plume will be hindered by elevated moisture content in soils. Conversely, increased moisture content (as pore water) will generally increase the vertical conductivity of soil, thus enhancing infiltration and migration of dissolved-phase VOCs through the vadose zone.

Applying these VOC soil migration principles to the Site-specific conditions at the properties at the Site provides a framework for analysis of the Site soil data discussed later in this section.

5.2.1 Fate and Transport in Groundwater

Beneath source areas, contaminants may also enter the saturated zone as DNAPL, dissolved phase infiltration/leachate, or through mass transfer from vapor-phase contamination in the vadose zone. If present as DNAPL, the contaminants of concern in the Site are denser than water and are capable of moving vertically in the saturated zone. The extent of vertical migration is dependent on several factors, including chemical properties of the contaminant (e.g., specific gravity, viscosity, interfacial tension), and the degree of heterogeneity within the vadose zone and underlying aquifer. Vertical migration is expected to be greater in coarser sediments than in fine-grained sediments. Fine-grained sediments characteristically have smaller pores and pore-throat dimensions, resulting in greater capillary resistance to infiltrating DNAPL in saturated sediments. If the DNAPL encounters a finer-grained unit, differences in hydraulic conductivity can inhibit downward migration and cause lateral spreading of DNAPLs.

Contaminant plumes in groundwater generally originate through mass transfer at the water table interface beneath the immediate vicinity of the source and usually consist of dissolved-phase mass in groundwater that migrates advectively in the direction of groundwater flow. In addition to advection, other natural processes can affect the transport of contaminant mass in groundwater. These processes include hydrodynamic dispersion (defined as the combined effects of mechanical dispersion and chemical diffusion), retardation, and attenuation.

5.2.1.1 Advection

Advective transport is the process that results in the movement of contaminants in the same direction and at the same rate as the average linear velocity of groundwater. The average groundwater velocity may be estimated according to the following equation derived from Darcy's law:

$$V = \frac{K\,i}{n_e}$$

where:

V = Average Groundwater Velocity (feet per day [ft/day])

K = Hydraulic Conductivity (ft/d)

i = Gradient (foot per foot [ft/ft])

n_e = Effective Porosity

5.2.1.2 Hydrodynamic Dispersion

Hydrodynamic dispersion causes dilution of contaminants both longitudinally and laterally to groundwater flow lines. Dispersion and diffusion have the same impact on chemical transport, but through very different methods. Mechanical dispersion is the process by which contaminants are spread laterally due to heterogeneities in the porous media and variations in groundwater velocity. As groundwater moves through porous media, it encounters obstacles to flow (such as dead-end pore spaces or reduced pore throat size), forcing the water to change velocity and alter its course. Alternatively, chemical diffusion is controlled by the laws of thermodynamics and results in mass moving from areas of high concentration to areas of low concentration. As such, chemical diffusion may cause mass to travel both faster (ahead of the plume) and slower (behind the center of mass) than predicted by simple advection, and will add to laterally spreading.

In general, contaminant transport in coarse-grained media is dominated by advection and, to a lesser degree, mechanical dispersion. Chemical diffusion plays a more important role in finer-grained media where groundwater velocities are much slower. In addition, the nature of the flow field within the aquifer will affect impacts of hydrodynamic dispersion on contaminant transport. In natural flow fields with the aquifer at equilibrium, hydrodynamic dispersion may play a more significant role than in areas of aquifer discharge, such as remedial pumping centers, where flow lines are converging.

Away from the source, contaminant transport usually occurs within the more porous coarse-grained materials where impacts of hydrodynamic dispersion are less significant. Where diffusion into adjacent fine-grained materials occurs, the rate at which mass can be captured or attenuated by remedial actions may be substantially decreased.

5.2.1.3 Retardation

Another primary process affecting contaminant transport in groundwater is retardation, which deals with the process of adsorption. Adsorption is the process by which chemicals are sorbed onto the surface of sediments. This process results because the surfaces of solids, especially clays and organic soil material, have an electrical charge due to isomorphous replacement, broken bonds, or lattice imperfections. The electrical charge is imbalanced and may be satisfied by adsorbing a charged ion. Halogenated VOCs have a high affinity to organic material and can be adsorbed to the surface of organic material in an effort to achieve ionic balance.

The affinity of a VOC for soil is defined by the solid-water partition coefficient (also known as distribution coefficient), Kd. 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:

$$Kd = Koc * foc$$

where:

Kd = Distribution Coefficient (milliliters water per grams soil [ml water/g soil])

Koc = Organic Carbon Partition Coefficient (milliliters water per grams organic carbon [ml water/gm oc])

foc = Fraction of Organic Carbon (grams organic carbon per grams soil [goc/g soil])

The retardation factor of a VOC can then be calculated using the following equation:

$$R = 1 + \frac{\rho b \, Kd}{n_e}$$

where:

R = Retardation Factor (no units)

ρb = Bulk Density (grams per cubic centimeter [g/cm^3])

n_e = Effective porosity

Kd = Distribution Coefficient (ml water/g soil)

PCE is in a class of compounds with moderate mobility and will moderately adsorb to suspended solids or sediment in saturated sediments (Fetter, 1988).

5.2.1.4 Attenuation

Attenuation accounts for the multitude of chemical and biochemical reactions that can alter contaminant concentrations in groundwater flow systems. The rate of attenuation is highly variable and complex, and depends on many factors, which include: groundwater geochemistry, type and density of micro-biological agents in the soil, availability of oxygen (aerobic or anaerobic conditions), and chemical stability within those environments.

Most alluvial aquifers in the SRV occur naturally in an aerobic (oxidized) state. PCE is very stable under aerobic conditions and, therefore, would be expected to attenuate very slowly. Other compounds, such as petroleum hydrocarbons, degrade more easily in aerobic environments and are, therefore, not as persistent as PCE. In an anaerobic (reducing) environment, dechlorination of PCE occurs more readily, and results in the formation of several daughter products, including TCE, cis-

1,2-dichloroethylene(cis-1,2-DCE), and vinyl chloride. The remaining PCE in groundwater at North Plume area is likely attenuating under advection and hydrodynamic dispersion.

5.3 Distribution of Contaminants at the North Plume Area

5.3.1 Vadose Zone Contamination

The former dry cleaner located at the North Plume is considered to be the source of PCE groundwater contamination (Kleinfelder, 2004). The area around the former dry cleaner has been the primary focus of various RI activities since the discovery of PCE in monitoring well MW-1 in 1992. Two initial soil gas surveys were conducted in 1992-93 and 1995 by Law and HGC, respectively. Both surveys identified relatively low vapor concentrations of PCE at sampling points located in the general area of the former dry cleaner. Subsequent soil and soil gas sampling was conducted in 2003 by Kleinfelder as part of the ERA during drilling of pilot test wells in the vicinity of the former dry cleaner. Soil vapor samples collected during the 2003 event also revealed relatively low concentrations of PCE, and soil samples collected at the same time were below LRL for PCE. The observed distribution of PCE in the vadose zone is described in more detail below.

5.3.1.1 Distribution of PCE

The distribution of PCE in the vadose zone has been defined by soil and soil gas samples collected from numerous soil borings drilled across the southeast corner of the 16th Street and Camelback Road properties between 1992 and 2003, as described in Section 3.0. Relatively minor concentrations of PCE have been detected in the vicinity of the former dry cleaner. The only known detections of PCE were found during a shallow soil gas investigation conducted by HGC in 1995 and Kleinfelder in 2003.

PCE in soil gas was detected in four soil borings, SG-1, SG-2, SG-11 and SG-13, at depths of 10 feet, ranging from 1.3 to 2.3 μg/L, during the 1995 soil gas survey (HGC, 1995). The locations of these borings are shown on Figure 4.

PCE was detected in soil gas in two soil borings, SVE-AS1 and OW-1, from depth-specific samples collected between 15 feet bgs to 70 feet bgs. PCE concentrations ranged from 0.18 to 1.16 ppmv in these soil borings. There were no distinct trends in PCE distribution relative to lithology type or depth, although there appeared to be a slight increase in the soil gas samples collected just above the water table. Depth-discrete soil samples collected in borings SVE-AS1 and OW-1 were below the LRL of 0.10 mg/kg for PCE.

5.3.1.2 Distribution of Other Analytes in the Vadose Zone

The horizontal and vertical extent of other analytes in the vadose zone was investigated through two media: air by soil vapor survey and solid/soil through shallow soil boring sample collection.

The initial soil vapor survey was conducted by Law during the Phase II work from October 19 to 22, 1992. Law installed 50 soil vapor points and the locations are plotted on the Site Map in Figure 4-1 from the Phase II report. The soil vapor points were installed to depths of 5 to 10 feet bgs. Vapor samples were analyzed on site by a mobile lab by gas chromatography for aromatic hydrocarbons, TPH, and volatile halogenated hydrocarbons. The aromatic hydrocarbons, toluene, total xylenes, and ethylbenzene were the only three analytes detected above the LRL. For these analytes, the mobile laboratory reported concentrations that were near or less than 1 μg/l with the exception of a concentration of 19.1 μg/l of toluene reported for the sample collected from the boring for SV-06. Analyses of TPH and volatile halogenated hydrocarbons resulted in no detections in the soil vapor samples collected. Results are summarized in Table 5-1 from the Phase II report.

The initial soil sample investigation on site was conducted by Law in September, October, and November 1992 as part of the Phase II work. A total of 43 soil borings were completed to depths ranging between 6 and 85 feet bgs. Soil samples were collected using a split-spoon sampler and headspace was screened using a PID. A total of 213 analyses of soil samples were requested as part of this work. A total of 56 soil samples were submitted to mobile or off-site laboratories for analysis of TPH; 46 soil samples for volatile aromatic hydrocarbons; 39 soil samples for volatile halogenated hydrocarbons; 20 soil samples for SVOCs; 16 soil samples for chlorinated herbicides; 12 soil samples for phenols; 8 soil samples for toxicity characteristic leaching procedure including barium; 8 soil samples for lead; 4 soil samples for organochlorine pesticides and PCBs; and 2 soil samples for nitrogen and sulfate analysis. Results are tabulated in Tables 5-3 through 5-6 in the Phase II report. Di-n-butyl phthalate was detected at concentrations less than 2.0 mg/kg in borings at 5 to 20 feet bgs throughout the southeast corner of 16th Street and Camelback Road. Soil sample B-1 (5 feet bgs) in the drainage swale contained concentrations of fluoranthene, pyrene, chrysene, and benzo(k)fluoranthene. Chrysene and benzo(k)fluranthene were detected above the HBGL. Twelve soil samples contained TPH detections above the LRL. Four of the soil samples contained TPH concentrations above the ADEQ suggested soil clean-up level of 100 mg/kg: B-11 (5 to 6 feet bgs), B-29 (5 to 6 feet bgs), B-32 (5 to 6 feet bgs), and B-43 (5 to 6 feet bgs) at concentrations ranging from 109 mg/kg at B-11 to 450 mg/kg at B-32 (Figure 4). The other eight samples with TPH detections ranged from 22 to 96 mg/kg and were typically from the 5 to 6 feet bgs samples. There were no detections above the LRL for volatile aromatic or halogenated compounds, chlorinated herbicides, phenols, or organochlorine pesticides and PCBs during this soil sample investigation. Priority pollutant metals and lead were detected in the soil samples, but results did not exceed the HBGLs. Ammonia nitrogen was detected in two samples, but is not regulated, and sulfate was detected in one sample and was well below the regulatory limit.

The second soil sample investigation was conducted by Law in December 1992 as part of the Phase III work. A total of 17 soil borings (B-44 to B-60) were completed and sampled to depths ranging from 10 to 85 feet bgs (Figure 4-1 from Phase II report). Soil borings B-44 to B-48 focused on the drainage swale area, B-54 and B-60 focused on the former service station, and the remaining soil borings were drilled near the former dry cleaner. A total of 62 soil samples were analyzed during this investigation. A total of 18 soil samples were submitted to the laboratory for analyses of TPH; 12 soil samples were analyzed for volatile aromatic hydrocarbons; 21 soil samples were analyzed for volatile halogenated hydrocarbons; and 11 soil samples were analyzed for SVOCs. Analysis for SVOCs in soil samples collected from the drainage swale detected di-n-butyl phthalate above the LRL in one soil sample and bis (2-ethylhexyl) phthalate above the LRL in another soil sample, but neither exceeded the HBGL. Soil samples collected from borings in the southwestern service station area analyzed for volatile aromatic hydrocarbons and TPH did not contain concentrations above the LRL. Soil samples collected from the area of the former dry cleaner and nursery tool shed in the northern part of the

Site analyzed for volatile halogenated hydrocarbons and TPH did not contain concentrations above the LRL.

5.3.2 Groundwater Contamination

5.3.2.1 Distribution of PCE

The horizontal extent of PCE contamination in groundwater is defined by the network of Site groundwater monitoring wells. PCE occurs below the northern portion of the Site near the former dry cleaner, and extends from the area around monitoring well OW-1D to the northwest past 16th Street as far as monitoring well MW-13 and as far west as 15th Street at monitoring well MW-14. The downgradient edge of the PCE plume in groundwater is defined by monitoring wells MW-13 and MW-14, where concentrations of PCE were below the MCL of 5 µg/L during the February and April 2014 groundwater monitoring events. The southern extent of PCE is defined by monitoring well MW-2, and the northern extent is generally defined by MW-13. The concentrations of PCE in groundwater samples collected from the Site monitor wells in April 2014 are presented on Figure 10. PCE concentration-trend graphs over time are presented with each monitoring well on Figure 11.

5.3.2.2 Distribution of Other Analytes in Groundwater

Benzene has not been detected in groundwater in the northern portion of the Site since 2000, with the exception of a detection of 6.6 µg/L in OW-1D in June 2007 and 24 µg/L at MW-1 in January 2004. 1,2-DCA has not been detect above the LRL in groundwater samples collected from monitor wells in the northern portion of the Site with the exception of monitor MW-12 where 1,2-DCA was detected above the LRL between December 2005 and August 2007 at concentrations ranging from 1.3 to 6.13 µg/L. 1,2-DCA has not been detected in groundwater samples collected from monitor wells in the North Plume area during the May 2013, February 2014 and April 2014 monitoring events. 1,2-DCP has not been detected above the LRL in groundwater samples collected from monitor wells in the north plume portion of the Site.

A summary of the analytical data for groundwater is provided in Appendix D.

5.3.2.3 Concentration Trends

The concentrations of PCE in groundwater have decreased steadily since the original wells were installed in 1992. Concentration-trend graphs are shown with each monitoring well on Figure 11. PCE has been decreasing steadily across most of the Site since the early 1990's.

Over time, PCE has decreased in the following monitor wells:

- MW-1 from 270 µg/L in 2000 to 11.4 µg/L in February 2014;
- MW-2 from over 55 µg/L in 2000 to 0.65 µg/L in February 2014;
- MW-12 from 19 µg/L in 2005 to 5.65 µg/L in February 2014; and
- MW-10 from 120 µg/L in 2002 to 10.6 µg/L in February 2014.

5.3.3 Potential of Off-site Transport Mechanism

The primary off-site transport mechanism for PCE is most likely advection occurring in the aquifer, as described in Section 5.2. Dissolved-phase PCE in groundwater has flowed away from the Site's suspected source area (former dry cleaner) in a west-to-northwesterly direction under the natural groundwater gradient.

5.4 Distribution of Contaminants at the South Plume Area

The former service station in the southern end of the Site is presumed to be the source of 1,2-DCA groundwater contamination and other petroleum hydrocarbons that have been detected periodically in downgradient monitor wells (Kleinfelder, 2004).

5.4.1 Vadose Zone Contamination

The extent of contamination in the vadose zone on the south side of the Site is defined by soil and soil vapor samples collected during Phase II and Phase III environmental assessment activities performed by Law (1993a and 1993b). Overall, only minor levels of contaminants associated with petroleum hydrocarbons were detected during these investigation activities. The extent of TPH appears to be limited to the upper 5 feet based on analytical results from the Phase II and Phase III environmental assessment.

Analytical results from the deepest soil borings, B-54 and B-60, drilled in the area of the former service station, indicate there were no detectable concentrations of 1,2-DCA or other associated compounds, including benzene, toluene, ethylbenzene, or total xylene which exceeded LRLs.

5.4.2 Groundwater Contamination

5.4.2.1 Distribution of 1,2-DCA

The horizontal extent of 1,2-DCA contamination in groundwater is defined by the network of Site groundwater monitoring wells. The plume of 1,2-DCA in groundwater is generally defined using data collected from the following monitoring wells in the southern portion of the Site: MW-6, MW-7, MW-3, MW-3A, MW-8, MW-11, and MW-12 in the northern portion of the Site. MW-12 appears to be the only well in the northern portion of the Site that has had detections of 1,2-DCA in groundwater samples. PCE concentration-trend graphs over time are presented with monitor wells on Figure 11. The highest concentrations of 1,2-DCA have occurred in groundwater samples collected from monitoring well MW-3, with periodic detections in MW-3A, MW-8 and as far north as MW-12. Some of the detections of 1,2-DCA at MW-12 exceeded the MCL of 5 µg/L in 2006 and 2007. 1,2-DCA has not been detected in groundwater samples collected from downgradient monitoring well MW-11 between 2000 and 2014.

The plume of 1,2-DCA appears to have reduced in size with concentrations below 0.5 µg/L at the Site monitoring wells based on recent groundwater monitoring in 2013 and 2014. 1,2-DCA was not detected above the LRL of 0.5 µg/L in groundwater samples collected in May 2013, February 2014 and April 2014, with the exception of a minor detection of 0.62 µg/L in the groundwater sample collected from well MW-3 in April. It is important to note that upgradient monitoring well MW-6 could not be sampled during these events, and MW-8 could not be sampled in February 2014 due to access issues. MW-6 is upgradient from the suspected source area and has not had historical detections of 1,2-DCA.

5.4.2.2 Distribution of 1,2-DCP

1,2-DCP has only been detected in groundwater samples collected from one monitor well in the South Plume area. 1,2-DCP was detected in monitor well MW-3 from the 1990s through June 2001, about the time this well went dry. 1,2-DCP was not detected above the LRL in groundwater samples collected from the replacement well MW-3A between June 2006 and October 2007. 1,2-DCP has not been detected above the LRL in groundwater samples collected from MW-3 in May 2013, February 2014 and April 2014. Monitor well MW-3A could not be located for sampling during the 2013 and 2014 groundwater monitoring events but water levels had risen high enough to allow sampling of MW-3.

5.4.2.3 Distribution of Other Analytes

Some of the groundwater samples collected from monitoring wells in the southern portion of the Site have had minor detections of THM compounds, including chloroform, bromo-dichloromethane and dibromo-chloromethane. These monitoring wells include MW-7 and MW-11. The most common THM appears to be chloroform.

Benzene has not been detected in groundwater in the southern portion of the Site since the 1990s, with the exception of a 18 µg/L detection in MW-8 in June 2007.

A summary of the analytical data for groundwater is provided on compact digital format disk in Appendix D.

5.4.3 Potential Off-site Transport Mechanism

The primary off-site transport mechanism for 1,2-DCA and 1, 2 DCP is most likely advection occurring in the aquifer, as described in Section 5.2. Residual dissolved-phase 1,2-DCA and 1,2-DCP in groundwater has flowed away from the Site's suspected source area (former service station) in a west-to-northwesterly direction under the natural groundwater gradient.

Section 6
Land and Water Use Evaluation

6.1 Reasonably Foreseeable Land Use

6.1.1 Land Use Planning and Zoning

The Site and general vicinity is zoned for Commercial use. The City of Phoenix indicated that there are no future zoning plans; however, the southwest corner of 16th Street and Camelback Road could be redeveloped in the future. An apartment complex is currently under construction at the northwest corner of Highland Avenue and 16th Street.

6.1.2 Current and Projected Land Use

The City of Phoenix indicated that current land uses within the Site are restaurant and retail businesses and that the area is currently zoned for commercial development, and possible redevelopment to multifamily residential. This is consistent with the businesses that are currently observed in the area around the intersection of 16th Street and Camelback Road. An apartment complex is currently under construction at the northwest corner of Highland Avenue and 16th Street.

6.2 Reasonably Foreseeable Water Use

6.2.1 Available Water Resources

Land and water use study questionnaires (Survey) were sent to Salt River Project Agricultural Improvement and Power District (SRP) and the City of Phoenix in March 2014, the primary water providers in the area. Both surveys were returned and are provided in Appendix E. The primary water resources in the vicinity of the Site are groundwater and surface water. Surface water is transported in the SRP Grand Canal, located approximately 0.8 miles southeast of the Site.

A review of ADWR registered wells within a one-mile radius of the Site indicate that the uppermost water-bearing unit occurs between 75 and 100 feet bgs. The general locations of these wells are shown on Figure 3, and a listing of information for each of these wells is provided in Appendix A.

SRP has two wells in the vicinity of the Site which are, or have been used to pump groundwater for use by their customers in the area, but neither of the wells are located within the Site boundary. One active SRP well (15E-8.5N), is located at the southwest corner of Campbell Avenue and 16th Street and one inactive SRP well (15E-9.3N) is located on the southwest corner of Coulter and 16th Street. SRP indicated that groundwater pumped from SRP well 15E-8.5N is pumped to their customers south of 16th Street and Campbell.

The City of Phoenix has a production well registered with the ADWR at Madison Park. This well is south and cross-gradient of the Site, not threatened by the Site contaminant plume, and also is not in use.

As discussed in Section 2.3.3.2, there are some other ADWR registered wells located within one mile of the Site that are listed as "water supply wells." These are privately owned wells upgradient or cross-gradient of the Site and are not threatened by the Site contaminant plume.

6.2.2 Current and Projected Water Use

The groundwater use by wells within a one-mile radius of the Site is shown on Figure 3. With the exception of the two SRP wells mentioned in previous sections, the predominant well use is for monitoring and remediation purposes. Regarding current and projected water use, SRP states, "Currently, the wells provide water for irrigation but SRP anticipates that the wells will transition to drinking water supply wells as the area develops. SRP is in discussions with the City of Phoenix about providing additional groundwater to the City when surface water supplies are unavailable or insufficient and to give the City more operational flexibility."

The land and water use study questionnaire response provided by the City of Phoenix indicates the City does not have production wells at the Site and does not have plans to develop any for the next 100 years. However, as indicated above, the City of Phoenix is in discussions with SRP to possibly attain water from SRP wells located in the area.

In their survey responses, SRP indicates because of their reliance on groundwater to supplement its surface water supplies during periods of drought, SRP is very concerned with any water quality problems in the aquifer or with a threat of groundwater contamination. It is important to SRP to safeguard the ability to utilize their wells, and SRP indicates it is conceivable that during periods of severe drought, SRP wells in the area may be utilized at their full annual registered volumes.

Also in its land and water use questionnaire response, SRP anticipates all of its properties in the vicinity of the Site will remain in use in the future. Therefore, SRP believes any plan to remediate groundwater needs to recognize the highly variable pumping scenarios that may occur in and around the Site. Appendix E contains the land and water use study questionnaires completed by SRP and the City of Phoenix.

The annual use of groundwater by SRP will fluctuate depending upon the availability of surface water. Based on specific well information, the most reliable method of projecting future aquifer use by SRP may be through evaluation of their past aquifer use as reported in ADWR's databases. Well 15E-8.5N has pumped an average of 333 acre-feet per year between 1990 and 2012, with annual pumping of less than 10 acre-feet per year for eight of those years (1992-93, 1996, 1998 and 2005-06, and 2008-2011). The maximum pumping year for well 15E-8.5N was 1161 acre-feet in 1990. Well 15E-9.3N has been inactive and does not have reported annual pumping volumes in ADWRs' database. This may represent the future average annual pumpage by SRP near the Site.

SRP collects groundwater samples periodically from their active pumping wells. SRP well 15E-8.5N has been sampled for PCE and TCE annually between 1990 and 2013, with the exception of 1997, 2006, 2008, and 2011. During this time period, PCE and TCE were not detected above the reporting limit of 0.5 µg/L, with the exception of one detection of PCE at a concentration of 0.6 µg/L in December 2003.

As discussed in Section 2.3.3.2, there are some other ADWR registered wells located with in one mile of the Site that are listed as "water supply wells." The City of Phoenix owns a well at Madison

Park and the other wells are privately owned. However, these wells are located at least ½ mile or more upgradient or cross-gradient, relative to the observed groundwater flow direction at the Site, and are not likely to be impacted by the plume of PCE in groundwater at the Site.

Section 7
Summary and Conclusions

BC and the ADEQ have prepared this RI report for the 16^{th} Street and Camelback WQARF Site under ADEQ Contract EV09-0100 ASRAC and Task Assignment ADEQ13-040760 to meet the requirements of Arizona Revised Statute §49-287.03 and A.A.C. R18-16-406.

This RI:

- Establishes the nature and extent of the contamination and the sources thereof;
- Identifies current and potential impacts to public health, welfare, and the environment;
- Identifies current and reasonably foreseeable uses of land and waters of the state, and;
- Evaluates any other information necessary for identification and comparison of alternative remedial actions.

This RI includes field investigations to assess physical characteristics of the Site; the extent and general characteristics of the hazardous substances released; the extent, general characteristics, and degree of the source of the release; current and reasonably foreseeable exposure routes for the hazardous substances released; other factors that pertain to the characterization of the Site or support the analysis of potential remedies; and finally, current and reasonable foreseeable impacts to aquatic and terrestrial biota. This report also includes information regarding current and reasonably foreseeable uses of land or waters of the state that have been or are threatened to be impacted by the release, and projected time-frames for future changes in those uses.

This report summarizes the findings of the RI activities that have been conducted from 1989 to present at the Site. This includes activities related to EAs, Site remedial investigations, and the ERA completed to date and assembly and review of pertinent information related to the Site. These activities have included drilling, soil and soil vapor sampling, well installation, measurements of groundwater elevation, remediation pilot testing, and water quality monitoring performed at the Site.

The contaminant release area is located in Phoenix, Arizona on property south of Camelback Road and east of 16^{th} Street in Phoenix, Arizona (Figures 1 and 2). To date, several contaminant release areas, including a former dry cleaner (North Plume) and former service station (South Plume), have been investigated as potential sources of the groundwater and/or soil contamination. Dissolved PCE is the COC in the North Plume and dissolved 1,2-DCA is the COC in the South Plume. Site boundaries are defined by the extent of the historical/current groundwater contaminant plumes, which generally include a 35-acre area bounded by Camelback Road to the north and Highland Avenue to the south, 15^{th} Street to the west, and 17^{th} Street to the east.

The Site is located within the Salt River Valley Basin (SRVB) in the Phoenix Active Management Area. Basin-fill deposits in the SRVB are subdivided into three water-bearing, hydrogeologic units: the LAU, MAU, and UAU. These basin-fill deposits are estimated to range from 100 feet near the basin margins to 10,000 feet near the center of the basin. The LAU lies unconformably on top of bedrock and can be extensively faulted. The MAU, which is less extensively faulted, overlies the LAU. Both of these units were deposited in a closed basin and lithology consists of interbedded sequences of unconsolidated to well-consolidated, fine- to coarse-grained sediments. The UAU was deposited after the development of integrated drainage. Lithology consists of unconsolidated to well-consolidated, interbedded sequences of gravel, sand, silt, clay, and evaporite deposits, yielding substantial quantities of water. The uppermost aquifer at the Site occurs within the UAU beginning at a depth of approximately 75 feet. Groundwater flow in the uppermost aquifer is generally westerly and has been observed to range from southwesterly to northwesterly.

GZA excavated 405 tons of PCS from the areas identified by the Phase II and Phase III EAs and thermally treated the soil on site (GZA, 1993). GZA also removed a UST discovered during the excavation of soils. Characterization of the tank indicated it was not likely a contributor to the groundwater contamination at the Site and was closed.

ADEQ continued to monitor groundwater at the Site periodically between 1996 and 1999. On April 21, 1999, the Site was added to the WQARF Registry with an Eligibility and Evaluation score of 23 out of 120.

In 1999-2000, Kleinfelder began groundwater monitoring at the Site under ADEQ direction, publishing regular quarterly monitoring reports. Groundwater monitoring continued between 2000 and 2004. Kleinfelder installed monitor well MW-11, downgradient of the “source area” wells at the North Plume (Kleinfelder, 2000). Groundwater conditions at the Site monitor wells were monitored on an approximately quarterly basis until 2007.

Flow directions and gradient in the shallow aquifer have varied over time, but are generally west-northwest at a hydraulic gradient ranging from 0.015 to 0.004. Groundwater elevations have also varied over time since the first monitor wells were installed in 1992, and have declined between 11 and 13.5 feet during the past 22 years. Dedicated low-flow groundwater sampling pumps had to be lowered in December 2003 and subsequently removed the following December due to declining groundwater levels. During the first quarter sample event in 2004, PDBs were used for the first time to collect groundwater samples because of declining water levels in the monitor wells. Since that time, PDBs have been used to collect groundwater samples for VOC analysis at the Site.

In May 2002, ADEQ began an ERA evaluation of the North Plume area. ADEQ states that “the ERA was designed to determine if SVE and AS remediation was feasible to provide source control and remediate the PCE groundwater contamination.” Kleinfelder developed a work plan in October 2002 and in January 2003, Kleinfelder installed a nested SVE well with AS and a nested OW. Kleinfelder conducted a pilot study in February 2003. The plan was to design and construct a remediation system based on findings from the pilot test. In April 2003, ADEQ received the results of the pilot study and requested that Kleinfelder provide an ERA Completion Report. The MER of PCE was lower than expected.

Following issuance of the ERA report, additional monitor wells were installed and/or replaced, while Kleinfelder continued groundwater monitoring activities until 2007.

Between 2008 and 2012, groundwater monitoring activities were temporarily discontinued at the Site. In May 2013, BC resumed groundwater monitoring and sampling at the Site on behalf of ADEQ. BC used PDBs and collected groundwater samples from seven North Plume wells and four South Plume wells. Concentrations of PCE exceeded the MCL (5 μg/L) in groundwater samples collected from MW-1, MW-10 and MW-12, at 5.9 μg/L, 25.1 μg/L, and 8.94 μg/L, respectively. 1,2-DCA was not detected above the LRL of 0.5 μg/L in the South Plume monitor wells that were sampled in May 2013. The groundwater flow direction was estimated to be west-northwest in May 2013.

In January 2014, BC installed two additional downgradient monitor wells, MW-13 and MW-14, at the North Plume in order to further delineate the distal end of the PCE plume in groundwater. Two additional groundwater monitoring events were conducted during the first and second quarters 2014. Groundwater samples collected from the new monitor wells MW-13 and MW-14 during February and April 2014 were below the 5 µg/L MCL for PCE, while the detected concentrations of PCE in monitor well MW-12 were 4.73 μg/L and 5.65 μg/L, respectively. In February and April 2014, PCE concentrations detected in groundwater samples collected from monitor well MW-10 remained above the MCL at 12.5 μg/L and 13.3 μg/L, respectively, and in monitor well MW-1 were 3.3 μg/L and 11.4 μg/L, respectively. The PCE concentrations in the other monitor wells sampled in February and April 2014 were below the MCL or the LRL. The results of the February 2014, April 2014 and previous groundwater monitoring events (1992-2007, 2013) demonstrate that the plume of PCE in groundwater is relatively small, decreasing in size and attenuating over time.

Groundwater samples collected in February and April 2014 from the North and South Plume monitor wells were below the LRLs for 1,2-DCA, with the exception of monitor well MW-3 which had a detection of 0.62 μg/L for 1,2-DCA. The concentrations of 1,2-DCA in groundwater at the South Plume have been below or slightly above the LRL at the South Plume monitor wells for consecutive sample events over approximately one year. The plume of 1,2-DCA in groundwater appears to have attenuated naturally over time.

The plume of PCE in groundwater at the North Plume does not appear to be a significant threat to current and future groundwater use at the Site, based on the observed declining trends of PCE in groundwater samples collected from the North Plume monitor wells, the limited extent of the PCE contamination that is above the MCL, and the location of water supply wells relative to PCE plume.

Section 8

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Figures

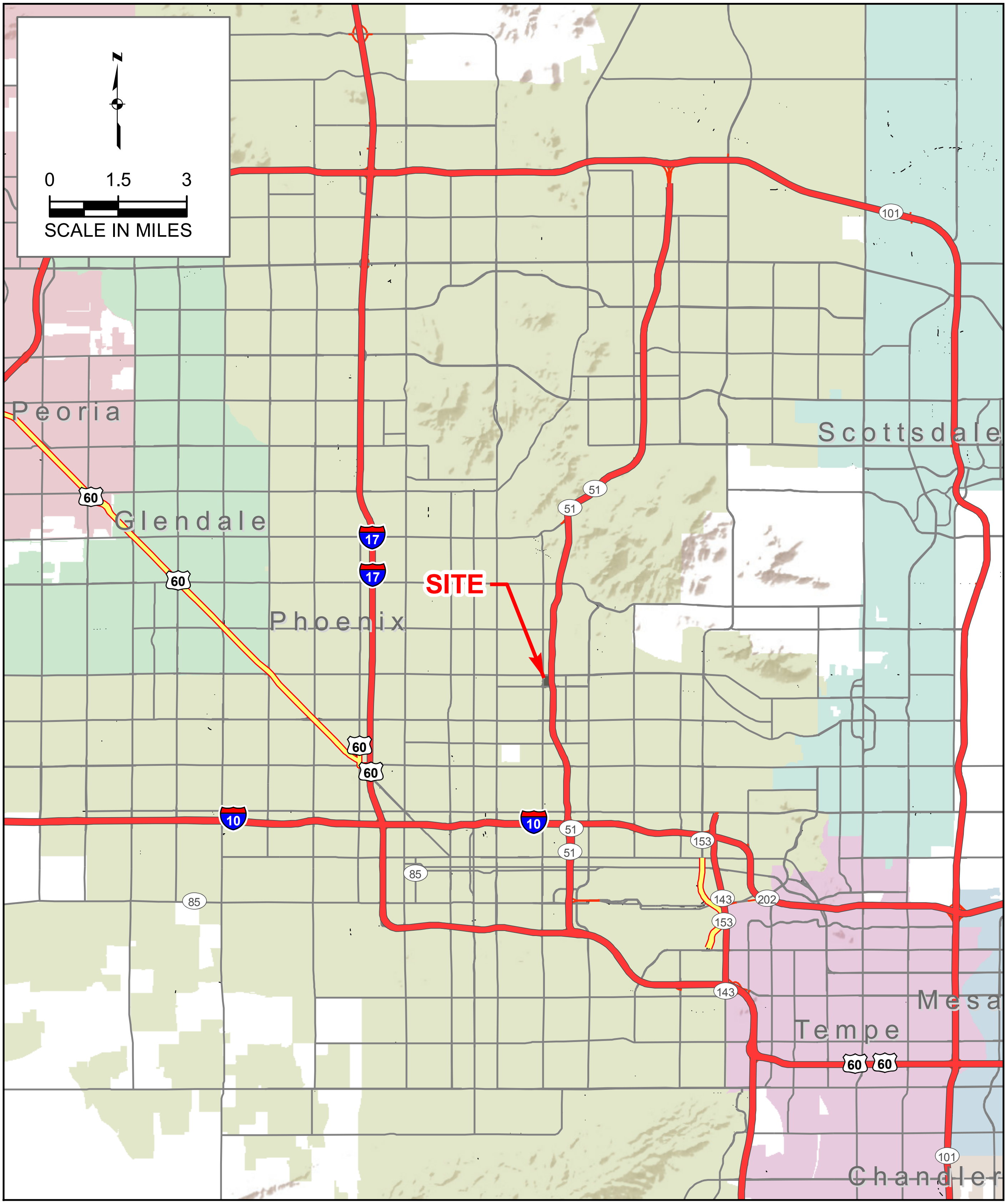

Figure 1

SITE LOCATION MAP

REMEDIAL INVESTIGATION
SUMMARY REPORT
16TH STREET AND CAMELBACK WQARF SITE
PHOENIX, ARIZONA

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

0 75 150
SCALE IN FEET

EXPLANATION

- MONITOR WELL
- OBSERVATION WELL
- REPLACEMENT MONITOR WELL
- FORMER BUILDING LOCATION

Figure 2

MONITOR WELL LOCATIONS WITH AREAS OF CONCERN

REMEDIAL INVESTIGATION SUMMARY REPORT
16TH STREET AND CAMELBACK WQARF SITE
PHOENIX, ARIZONA

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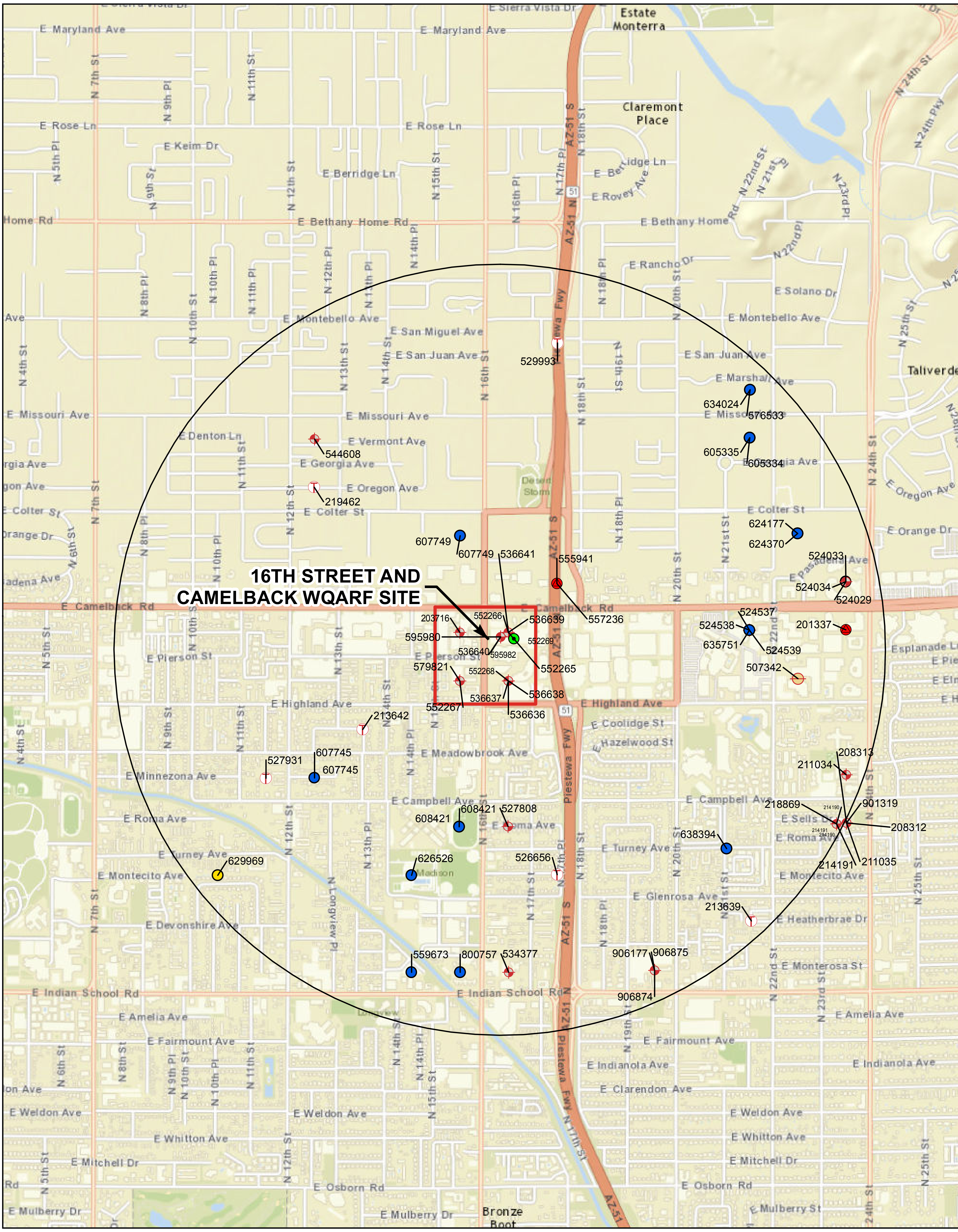

Base MaprSource: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013
Data Source: ADWR 55 Well Registration Database, 2013

0 0.25 0.5
Miles

EXPLANATION

WELL (BY USE)

- CAPPED
- CATHODIC
- GEOTECHNICAL
- MINERAL EXPLORATION
- MONITOR
- PIEZOMETER
- WATER PRODUCTION
- ONE MILE BUFFER
- SITE BOUNDARY

Note: Well descriptions contained in Appendix A

Brown AND Caldwell

Figure 3

ADWR REGISTERED WELLS WITHIN ONE MILE

REMEDIAL INVESTIGATION SUMMARY REPORT
16TH STREET AND CAMELBACK WQARF SITE
PHOENIX, ARIZONA

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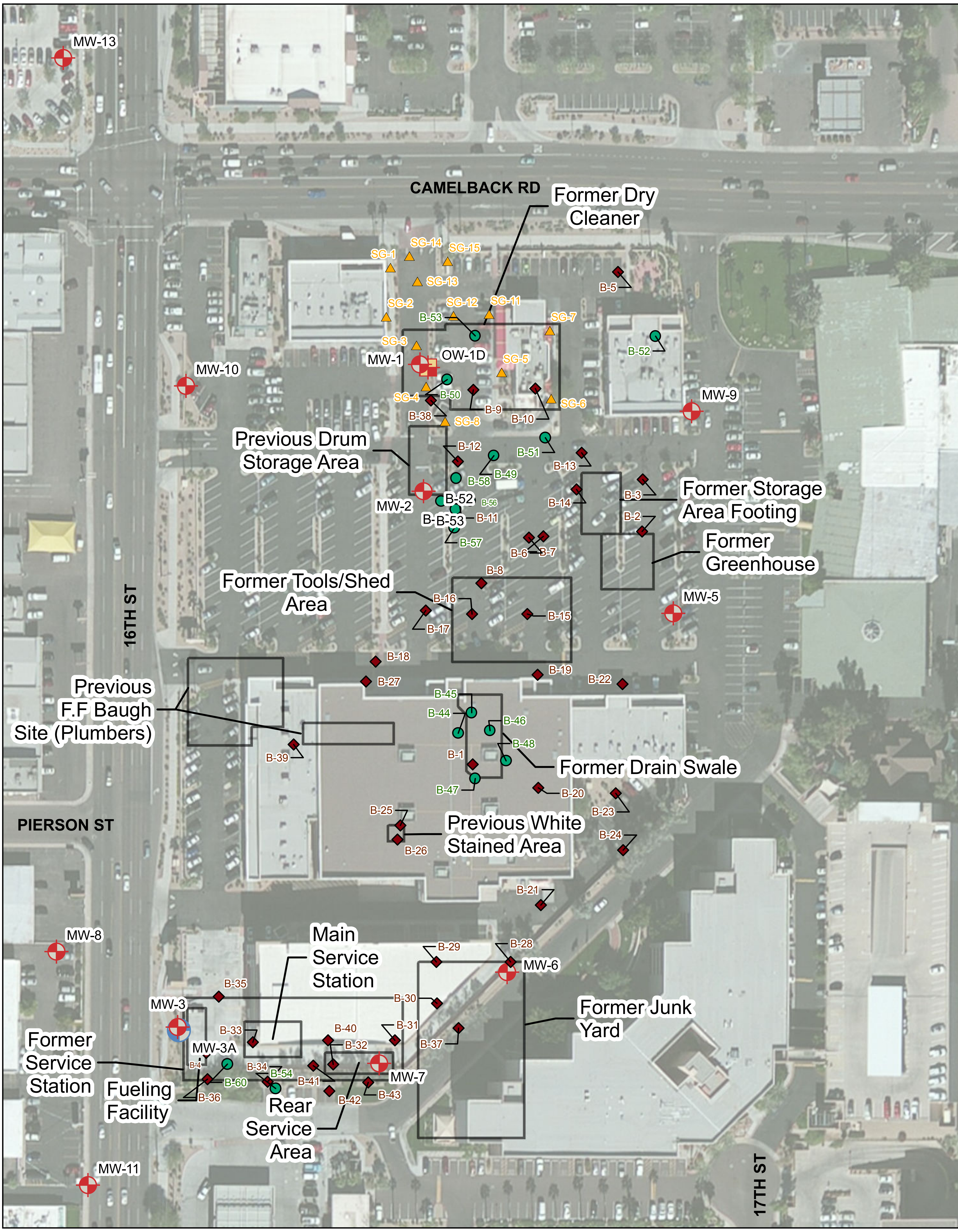

EXPLANATION

- SOIL VAPOR SAMPLE (LAW, 1993a)
- SOIL VAPOR SAMPLE (LAW, 1993a)
- SOIL VAPOR SAMPLE (LAW, 1993b)
- SOIL VAPOR SAMPLE (ADEQ, 2005)
- MONITOR WELL
- OBSERVATION WELL
- REPLACEMENT MONITOR WELL
- FORMER BUILDING OR AREA OF CONCERN

N

0 50 100

SCALE IN FEET

Figure 4
RI SAMPLING LOCATION MAP
REMEDIAL INVESTIGATION SUMMARY REPORT
16TH STREET AND CAMELBACK WQARF SITE
PHOENIX, ARIZONA

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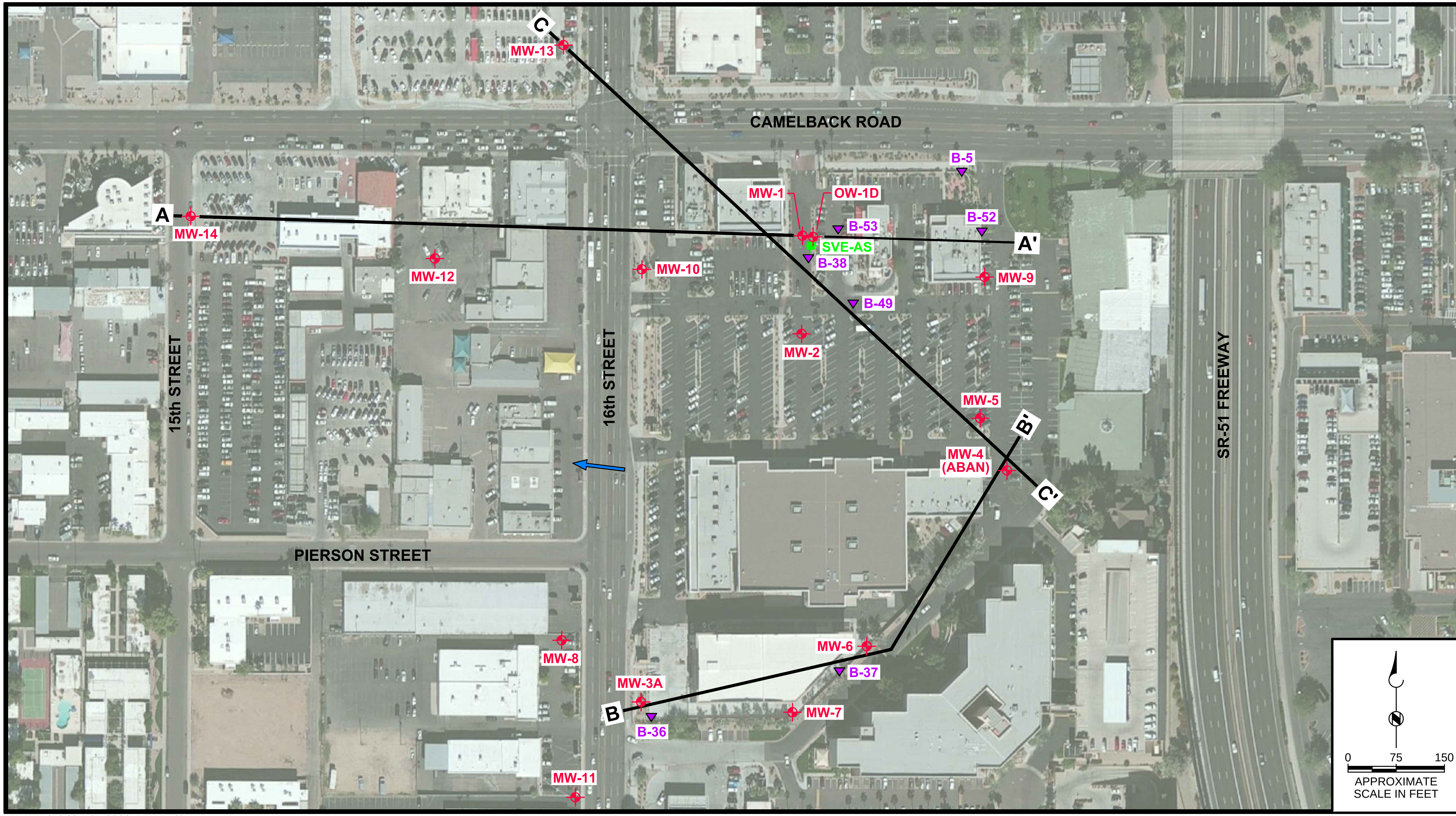

AERIAL PHOTO SOURCE: GOOGLE EARTH, 2014

EXPLANATION

A —— A' CROSS-SECTION LOCATION LINE

MW-8 MONITORING WELL LOCATION

B-5 BORING LOCATION (LOCATIONS APPROXIMATE)

SVE-AS FORMER AIR SPARGE WELL

APPROXIMATE GROUNDWATER FLOW DIRECTION

Brown AND Caldwell

Figure 5

CROSS-SECTION LOCATION MAP
REMEDIAL INVESTIGATION REPORT
16th STREET AND CAMELBACK WQARF SITE
PHOENIX, ARIZONA

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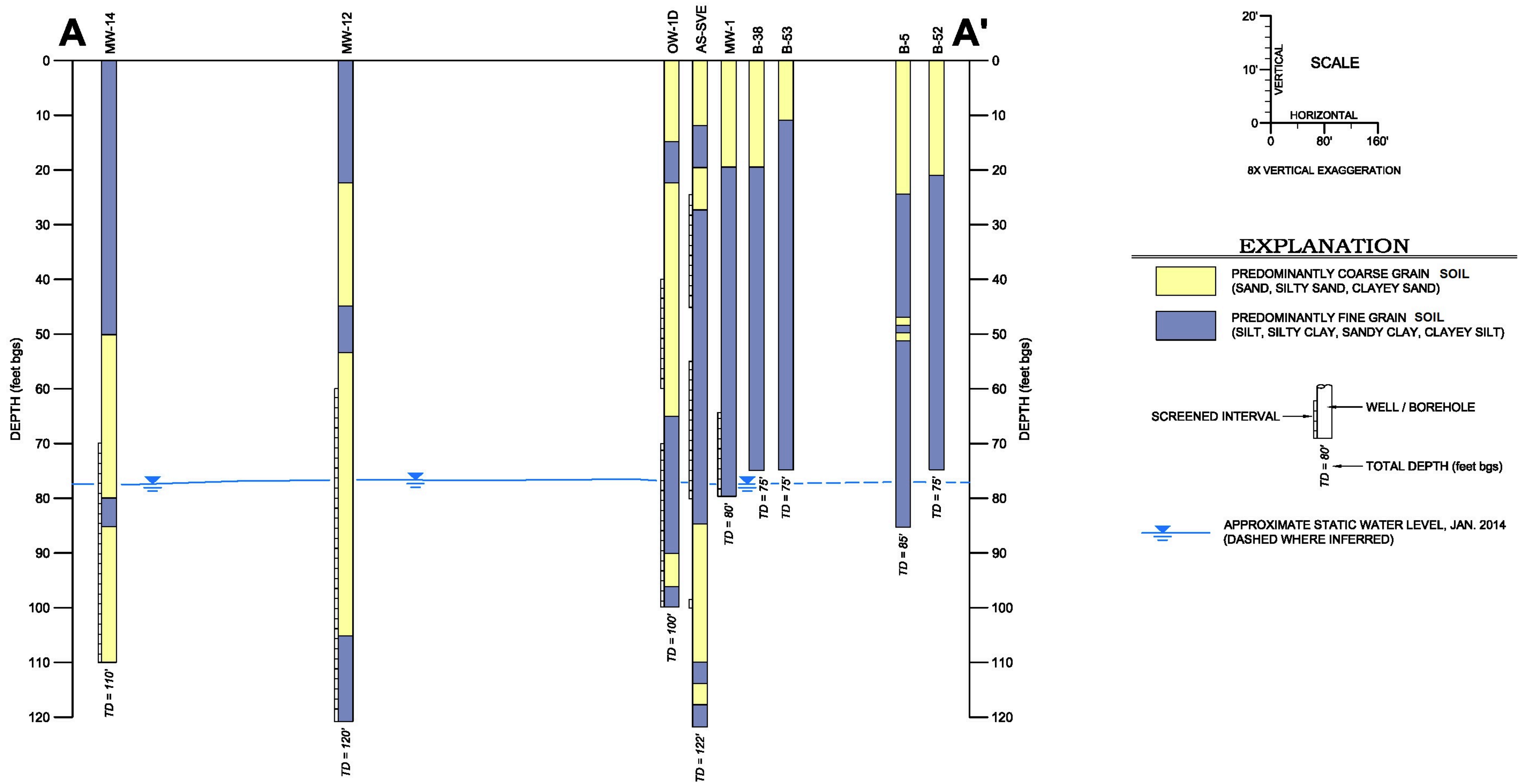

Figure 6

CROSS-SECTION A-A'
REMEDIAL INVESTIGATION REPORT
16th STREET AND CAMELBACK WQARF SITE
PHOENIX, ARIZONA

Brown AND Caldwell

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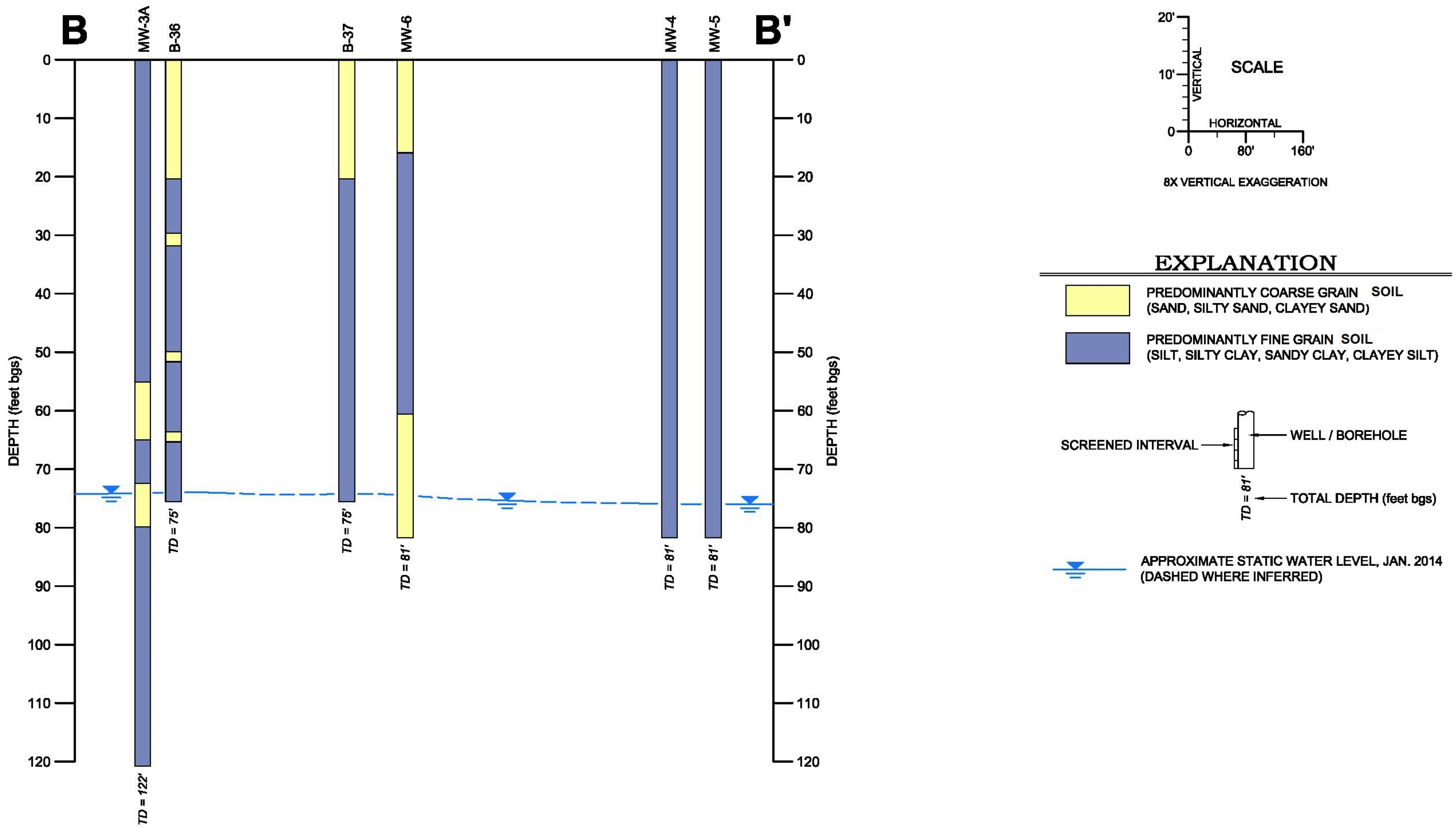

Brown AND Caldwell

Figure 7

CROSS-SECTION B-B'

REMEDIAL INVESTIGATION REPORT

16th STREET AND CAMELBACK WQARF SITE
PHOENIX, ARIZONA

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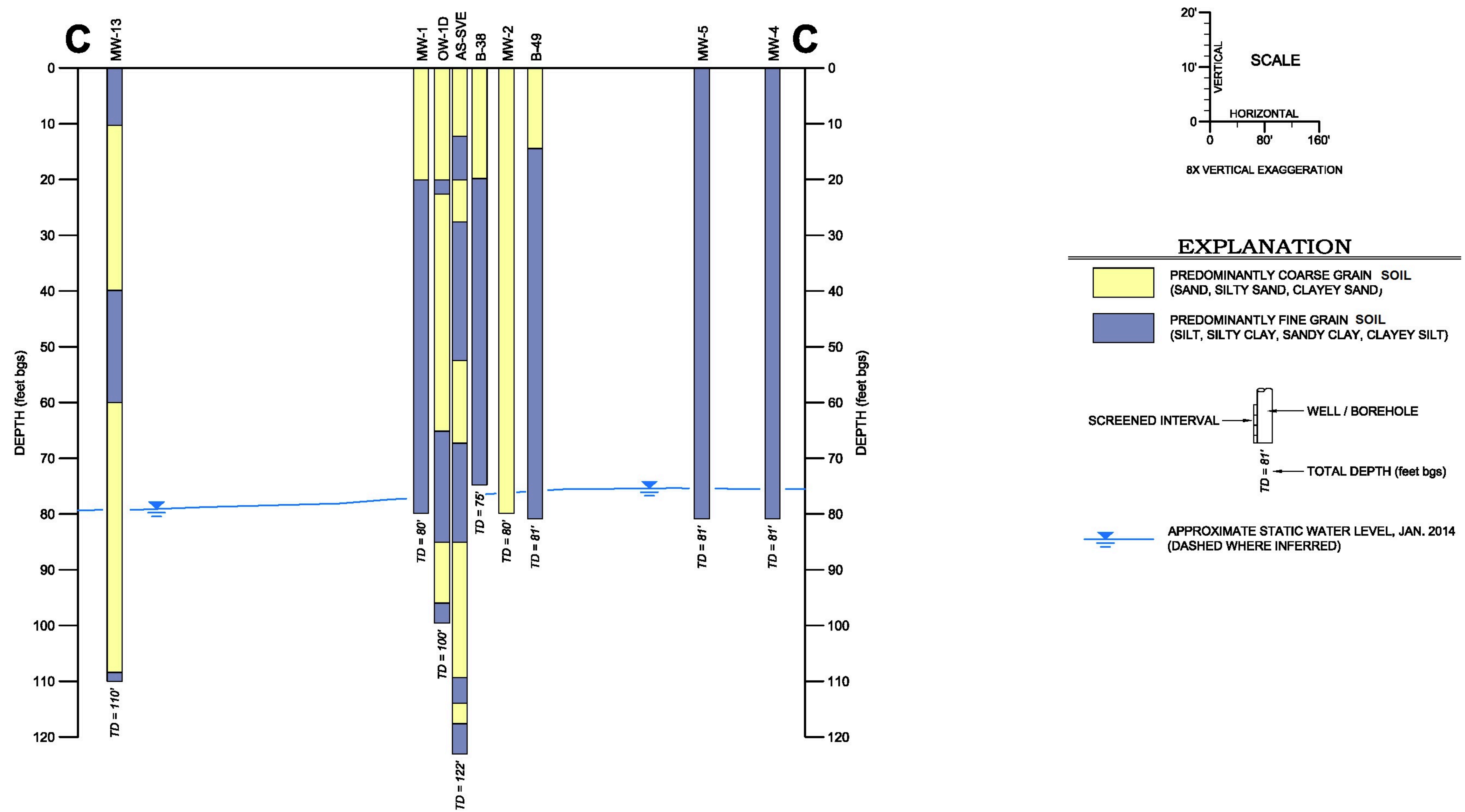

Brown AND Caldwell

Figure 8

CROSS-SECTION C-C'

REMEDIAL INVESTIGATION REPORT

16th STREET AND CAMELBACK WQARF SITE
PHOENIX, ARIZONA

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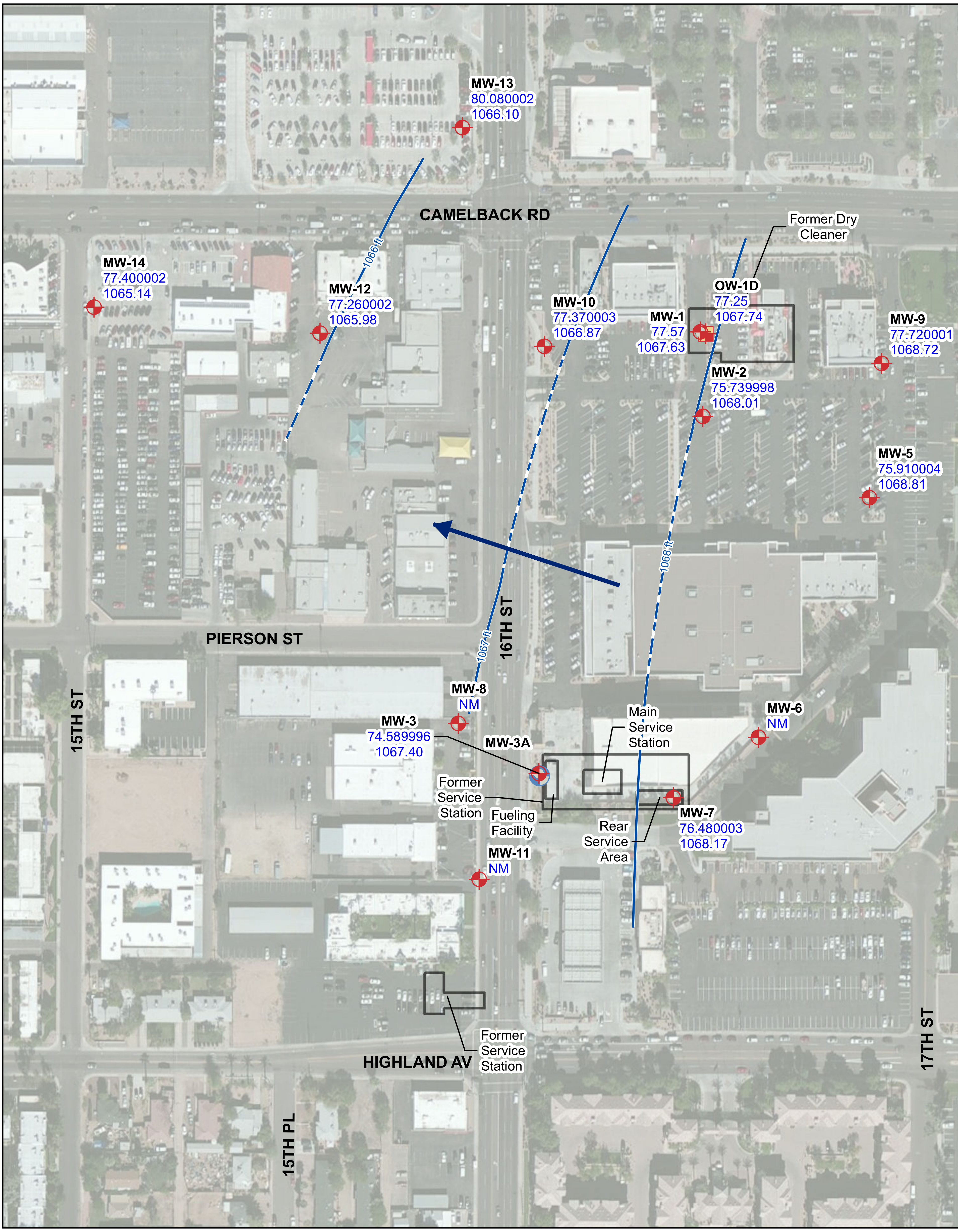

EXPLANATION

MONITOR WELL

MW-1
76.17 (DTW in ft below MP)
1069.03 (Groundwater Elevation in ft amsl)

OBSERVATION WELL

REPLACEMENT MONITOR WELL

GROUNDWATER ELEVATION CONTOUR (Dashed where inferred)

DIRECTION OF GROUNDWATER FLOW

DTW = DEPTH TO WATER
AMSL = ABOVE MEAN SEA LEVEL
MP = MEASURING POINT
NM = NOT MEASURED

N

0 75 150
SCALE IN FEET

Note: Measuring Point = North side top of casing, DTW measured April 3, 2014.

Figure 9
GROUNDWATER ELEVATION MAP
APRIL 2014

REMEDIAL INVESTIGATION SUMMARY REPORT
16TH STREET AND CAMELBACK WQARF SITE
PHOENIX, ARIZONA

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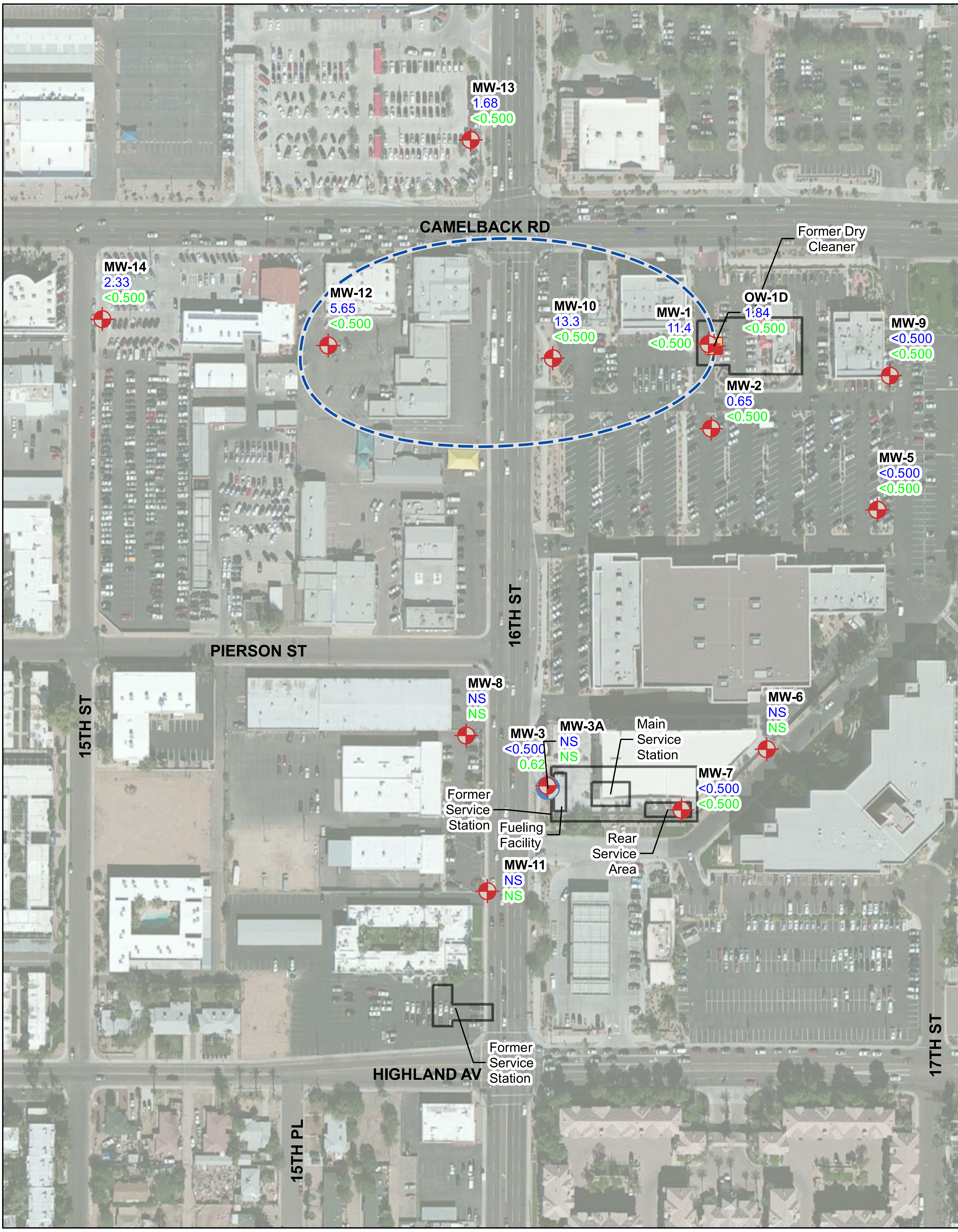

EXPLANATION

MONITOR WELL

MW-1
5.90 (PCE, µg/L)
<0.500 (1,2-DCA, µg/L)
NS = Not Sampled

APPROXIMATE LOCATION OF 5 UG/L PCE ISOCONCENTRATION CONTOUR

N

0 75 150
SCALE IN FEET

Figure 10
APRIL 2014 PCE CONCENTRATIONS IN GROUNDWATER
REMEDIAL INVESTIGATION SUMMARY REPORT
16TH STREET AND CAMELBACK WQARF SITE
PHOENIX, ARIZONA

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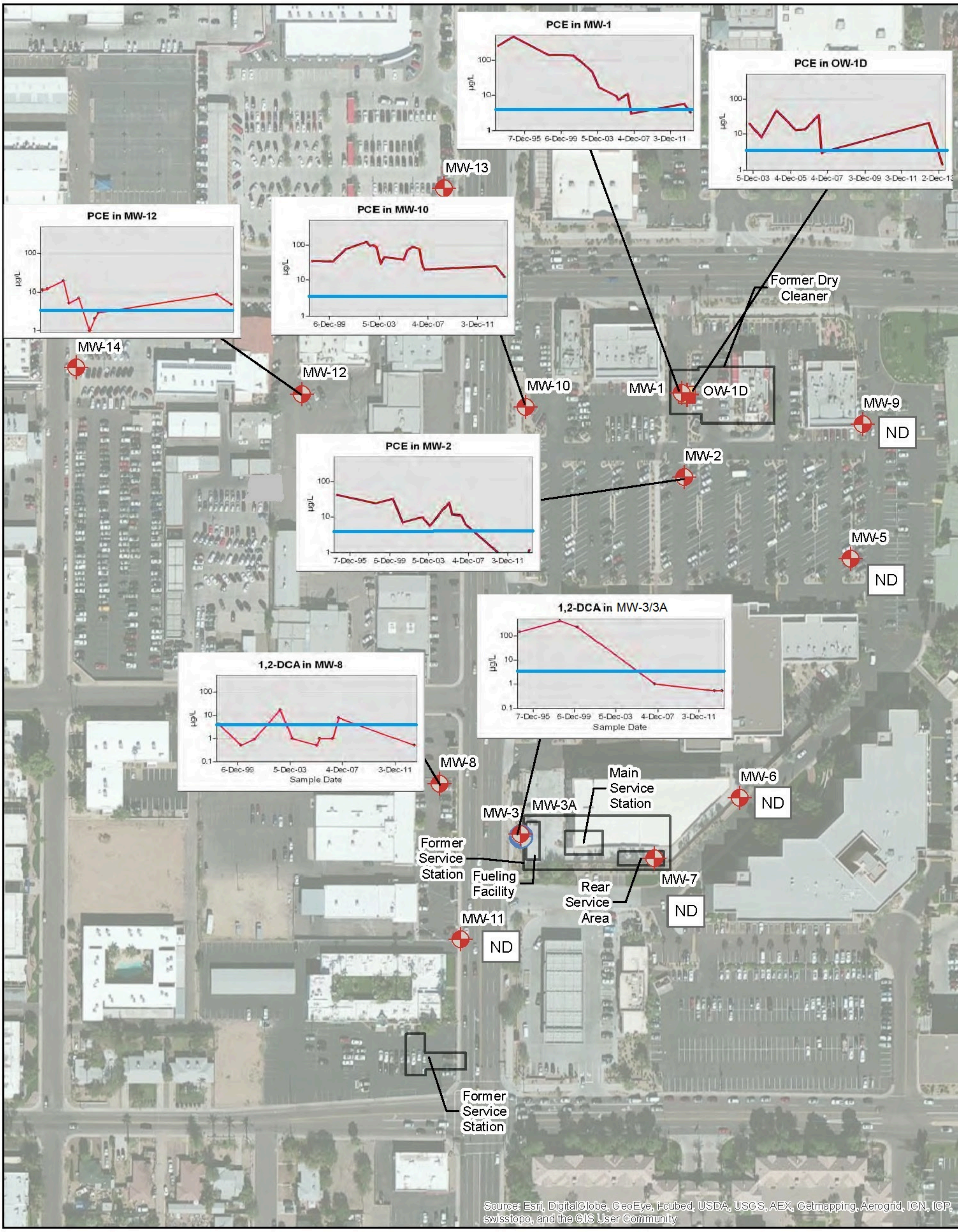

0 75 150

SCALE IN FEET

Brown AND Caldwell

EXPLANATION

- MONITOR WELL
- OBSERVATION WELL
- REPLACEMENT MONITOR WELL
- FORMER BUILDING LOCATION

ND - WELL WITH ALL OR MOSTLY NON-DETECTIONS

5 µg/L is the MCL for PCE and 1,2-DCA

Figure 11

PCE AND 1,2-DCA TRENDS IN GROUNDWATER

REMEDIAL INVESTIGATION SUMMARY REPORT

16TH STREET AND CAMELBACK WQARF SITE

PHOENIX, ARIZONA

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Tables

Table 1. Monitor Well Information

Well Name	ADWR REG ID	Latitude	Longitude	Well Vault Completion	Casing Diameter (inches)	Blank Interval (ft btoc)	Screen Interval (ft btoc)	MP Elevation TOC N Side
MW-1	55-536636	33° 30' 31.393" N	112° 02' 47.529" W	At Grade	2" PVC	0-63.23	63.23-78.5	1145.20
MW-2	55-536637	33° 30' 30.091" N	112° 02' 47.482" W	At Grade	2" PVC	0-63.12	64.12-79.5	1143.75
MW-3	55-536638	33° 30' 24.585" N	112° 02' 50.486" W	At Grade	2" PVC	0-58.09	59.09-74.50	1141.99
MW-3A	55-904586	33° 30' 24.551" N	112° 02' 50.472" W	At Grade	4" PVC	0-60	60-120	1141.84
MW-5	55-536640	33° 30' 28.841" N	112° 02' 44.422" W	At Grade	2" PVC	0-59.07	60.07-80.50	1144.72
MW-6	55-536641	33° 30' 25.153" N	112° 02' 46.453" W	At Grade	2" PVC	0-59.07	60.07-80.50	1145.27
MW-7	55-552268	33° 30' 24.217" N	112° 02' 48.017" W	At Grade	4" PVC	0-40	40-80	1144.65
MW-8	55-552267	33° 30' 025.36" N	112° 02' 251.97" W	At Grade	4" PVC	0-40	40-80	1141.98
MW-9	55-552266	33° 30' 30.913" N	112° 02' 44.199" W	At Grade	4" PVC	0-40	40-80	1146.44
MW-10	55-552265	33° 30' 31.169" N	112° 02' 50.394" W	At Grade	4" PVC	0-40	40-80	1144.24
MW-11	55-579821	33° 30' 22.961" N	112° 02' 51.581" W	At Grade	4" PVC	0-40	40-80	1140.76
MW-12	55-203716	33° 30' 31.366" N	112° 02' 54.516" W	At Grade	4.5" PVC	0-60	60-120	1143.24
OW-1D	55-595980	33° 30' 31.361" N	112° 02' 247.43" W	At Grade	2" PVC	0-70	70-100	1144.99
MW-13	55-916238	33° 30' 34.515" N	112° 02' 51.918" W	At Grade	4" PVC	0-70	70-110	1146.18
MW-14	55-916239	33° 30' 31.746" N	112° 02' 58.681" W	At Grade	4" PVC	0-70	70-110	1142.54

Notes:
MW-4 was abandoned
ft btoc = Feet below top of casing
MP = Measuring point
TOC = Top of casing
ADWR Reg ID = Arizona Department of Water Resources Registry Identification
PVC = Polyvinyl chloride

Table 2. Recent Groundwater Quality Data

Well Name	Sample Date	Tetrachloroethylene (ug/L)	Trichloroethene (ug/L)	1,2-Dichloroethane (ug/L)	Chloroform (ug/L)	Bromodichloromethane (ug/L)	1,1-Dichloroethene (ug/L)	TTHM (ug/L)
MW-1	8/15/2007	3.1	<2.0	<2.0	<2.0	<2.0	<5.0	NR
	5/20/2013	5.9	<0.5	<0.5	3.93	<0.5	<0.5	3.93
	2/5/2014	3.3	<0.5	<0.5	1.62	<0.5	<0.5	1.62
	4/17/2014	11.4	<0.5	<0.5	1.97	<0.5	<0.5	1.97
MW-2	8/15/2007	6.3	<2.0	<2.0	<2.0	<2.0	<5.0	NR
	5/20/2013	<0.5	0.57	<0.5	<0.5	<0.5	<0.5	<0.5
	2/5/2014	1.17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	4/17/2014	0.65	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
MW-3	5/20/2013	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	2/5/2014	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	4/17/2014	<0.5	<0.5	0.62	<0.5	<0.5	<0.5	<0.5
MW-3A	8/30/2007	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0	NR
MW-5	8/15/2007	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0	NR
	5/20/2013	<0.5	<0.5	<0.5	3.18	<0.5	<0.5	3.18
	2/5/2014	<0.5	<0.5	<0.5	2.24	<0.5	<0.5	2.24
	4/17/2014	<0.5	<0.5	<0.5	2.69	<0.5	<0.5	2.69
MW-6	8/30/2007	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0	NR
MW-7	8/30/2007	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0	NR
	5/20/2013	<0.5	<0.5	<0.5	1.3	<0.5	<0.5	1.3
	2/5/2014	<0.5	<0.5	<0.5	0.95	<0.5	<0.5	0.95
	4/17/2014	<0.5	<0.5	<0.5	1.13	<0.5	<0.5	1.13
MW-8	8/30/2007	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0	NR
	5/20/2013	<0.5	<0.5	<0.5	1.03	<0.5	<0.5	1.03

Table 2. Recent Groundwater Quality Data

Well Name	Sample Date	Tetrachloroethylene (ug/L)	Trichloroethene (ug/L)	1,2-Dichloroethane (ug/L)	Chloroform (ug/L)	Bromodichloromethane (ug/L)	1,1-Dichloroethene (ug/L)	TTHM (ug/L)
MW-8	5/20/2013[1]	<0.5	<0.5	<0.5	1.09	<0.5	<0.5	1.09
MW-9	8/30/2007	<2.0	<2.0	7.6	<2.0	<5.0	<5.0	NR
	5/20/2013	<0.5	<0.5	<0.5	7.97	<0.5	<0.5	7.97
	2/5/2014	<0.5	<0.5	<0.5	5.04	<0.5	<0.5	5.04
	4/17/2014	<0.5	<0.5	<0.5	5.7	<0.5	<0.5	5.7
MW-10	8/15/2007	20	<5	<2.0	<2.0	<2.0	<5	NR
	5/20/2013	25.1	<0.5	<0.5	3.02	<0.5	<0.5	3.02
	5/20/2013[1]	31.9	<0.5	<0.5	3.43	<0.5	<0.5	3.43
	2/5/2014	12.5	<0.5	<0.5	1.82	<0.5	<0.5	1.82
	2/5/2014[1]	13.8	<0.5	<0.5	1.9	<0.5	<0.5	1.9
	4/17/2014	13.3	<0.5	<0.5	2.27	<0.5	<0.5	2.27
	4/17/2014[1]	10.6	<0.5	<0.5	2.05	<0.5	<0.5	2.05
MW-11	8/30/2007	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0	NR
	5/20/2013	<0.5	<0.5	<0.5	2.08	<0.5	0.78	2.08
	2/5/2014	<0.5	<0.5	<0.5	1.15	<0.5	<0.5	1.15
MW-12	8/15/2007	2.9	<2.0	2.4	<2.0	<2.0	<5.0	NR
	5/20/2013	8.94	0.59	<0.5	2.98	<0.5	<0.5	2.98
	2/5/2014	4.73	<0.5	<0.5	1.81	<0.5	<0.5	1.81
	4/17/2014	5.65	0.61	<0.5	2.23	<0.5	<0.5	2.23
OW-1D	8/15/2007	3.1	<2.0	<2.0	2.3	<2.0	<5.0	NR
	5/20/2013	20.58	<0.5	<0.5	4.99	0.52	<0.5	50.51
	2/5/2014	1.45	<0.5	<0.5	3.45	<0.5	<0.5	3.45
	4/17/2014	1.84	<0.5	<0.5	4.67	0.53	<0.5	5.2

Table 2. Recent Groundwater Quality Data

Well Name	Sample Date	Tetrachloroethylene (ug/L)	Trichloroethene (ug/L)	1,2-Dichloroethane (ug/L)	Chloroform (ug/L)	Bromodichloromethane (ug/L)	1,1-Dichloroethene (ug/L)	TTHM (ug/L)
MW-13	2/5/2014	1.88	<0.5	<0.5	1.41	<0.5	<0.5	1.41
	4/17/2014	1.68	<0.5	<0.5	1.54	<0.5	<0.5	1.54
MW-14	2/5/2014	1.42	0.95	<0.5	<0.5	<0.5	<0.5	<0.5
	4/17/2014	2.33	1.34	<0.5	<0.5	<0.5	<0.5	<0.5

Notes:
[1] = Duplicate sample
ug/L = Micrograms per liter
TTHM = Total Trihalomethanes
NR = Not reported by laboratory

Table 3. Recent Groundwater Level Data

Well Name	Measuring Point Elevation TOC N Side (ft amsl)	Measure Date	Measured Depth to Water (ft bmp)	Groundwater Elevation (ft amsl)
MW-1	1145.20	7/1/2007	77.91	1067.29
		4/26/2013	76.12	1069.08
		5/6/2013	76.17	1069.03
		1/22/2014	77.21	1067.99
		4/3/2014	77.57	1067.63
MW-2	1143.75	7/1/2007	76.37	1067.38
		4/26/2013	74.46	1069.29
		5/6/2013	74.49	1069.26
		1/22/2014	75.54	1068.21
		4/3/2014	75.74	1068.01
MW-3	1141.99	5/6/2013	73.28	1068.71
		1/22/2014	74.23	1067.76
		4/3/2014	74.59	1067.40
MW-3A	1141.84	7/1/2007	75.91	1065.93
MW-5	1144.72	7/1/2007	76.31	1068.41
		4/26/2013	74.52	1070.20
		5/6/2013	74.55	1070.17
		1/22/2014	75.57	1069.15
		4/3/2014	75.91	1068.81
MW-6	1145.27	7/1/2007	77.24	1068.03
MW-7	1144.65	7/1/2007	77.00	1067.65
		4/26/2013	75.01	1069.64
		5/6/2013	75.01	1069.64
		1/22/2014	76.09	1068.56
		4/3/2014	76.48	1068.17
MW-8	1141.98	7/1/2007	75.46	1066.52
		5/6/2013	73.63	1068.35
MW-9	1146.44	7/1/2007	77.92	1068.52
		4/26/2013	76.29	1070.15
		5/6/2013	76.35	1070.09
		1/22/2014	77.34	1069.10
		4/3/2014	77.72	1068.72

Table 3. Recent Groundwater Level Data

Well Name	Measuring Point Elevation TOC N Side (ft amsl)	Measure Date	Measured Depth to Water (ft bmp)	Groundwater Elevation (ft amsl)
MW-10	1144.24	7/1/2007	77.77	1066.47
		4/26/2013	75.91	1068.33
		5/6/2013	75.95	1068.29
		1/22/2014	76.98	1067.26
		4/3/2014	77.37	1066.87
MW-11	1140.76	7/1/2007	74.13	1066.63
		4/26/2013	72.33	1068.43
		5/6/2013	72.29	1068.47
		1/22/2014	73.26	1067.50
MW-12	1143.24	6/14/2004	78.50	1064.74
		7/1/2007	77.66	1065.58
		4/26/2013	75.88	1067.36
		5/6/2013	75.91	1067.33
		1/22/2014	76.86	1066.38
		4/3/2014	77.26	1065.98
OW-1D	1144.99	7/1/2007	77.60	1067.39
		4/26/2013	75.81	1069.18
		5/6/2013	75.85	1069.14
		1/22/2014	76.90	1068.09
		4/3/2014	77.25	1067.74
MW-13	1146.18	1/22/2014	79.69	1066.49
		4/3/2014	80.08	1066.10
MW-14	1142.54	1/22/2014	76.95	1065.59
		4/3/2014	77.40	1065.14

Notes:
TOC = Top of casing
ft amsl = Feet above mean sea level
ft bmp = Feet below measuring point
MW-3A could not be located for this monitoring event

Appendix A: ADWR Registered Wells

ADWR Registered Well Located with in One Mile of 16th Street and Camelback Road WQARF Site

ADWR Registry 55-	CADASTRAL	UTM_X_METER	UTM_Y_METER	OWNER NAME	Pump Installed	WELL TYPE	Description	INSTALLED	Well Depth (feet)	WATER Level (feet)	CASING Depth (feet)	CASING DIA (inches)	CASING Type
201337	A02003022AAA	404216.3	3708129	SPEEDIE & ASSOCIATES INC	NO	GEOTECHNICAL	GEOTECHNICAL	12/8/2003	0	73	0	0	NO CASING CODE LISTED
203716	A02003021AAA	402606.6	3708132	ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY	NO	MONITOR	MONITOR	6/15/2004	120	80	120	5	PLASTIC OR PVC
208312	A02003022DAA	404211.4	3707322	EXXON MOBIL CORPORATION	NO	MONITOR	MONITOR	7/20/2005	86	72	86	5	PLASTIC OR PVC
208313	A02003022DAA	404211.4	3707322	EXXON MOBIL CORPORATION	NO	MONITOR	MONITOR	7/20/2005	86	72	86	5	PLASTIC OR PVC
211034	A02003022ADD	404212.2	3707524	EXXON MOBIL OIL CORPORATION	NO	MONITOR	MONITOR	2/27/2006	89	75	89	4	PLASTIC OR PVC
211035	A02003022DAA	404211.4	3707322	EXXON MOBIL OIL CORPORATION	NO	MONITOR	MONITOR	2/22/2006	90	75	90	4	PLASTIC OR PVC
214190	A02003022DAA	404211.4	3707322	EXXON MOBIL OIL CORPORATION	NO	AIR SPARGING	NO SITE USE CODE LISTED	1/12/2007	84	72	82	1	PLASTIC OR PVC
214191	A02003022DAA	404211.4	3707322	EXXON MOBIL OIL CORPORATION	NO	AIR SPARGING	NO SITE USE CODE LISTED	1/10/2007	84	72	82	1	PLASTIC OR PVC
213639	A02003022DCA	403811.6	3706917	SOUTHWEST GAS CORPORATION	NO	CATHODIC	CATHODIC		0	0	0	0	
213642	A02003021ACA	402197.9	3707730	SOUTHWEST GAS CORPORATION	NO	CATHODIC	CATHODIC		0	0	0	0	
219462	A02003016DBC	402004.3	3708743	SOUTHWEST GAS CORPORATION	NO	CATHODIC	CATHODIC		0	0	0	0	
218869	A02003022DAA	404211.4	3707322	EXXON MOBIL OIL ENVIRONMENTAL SERVICES COMPANY	NO	AIR SPARGING	NO SITE USE CODE LISTED	5/13/2009	83	73	82	1	PLASTIC OR PVC
507342	A02003022AAC	404015.4	3707927	WESTERN TECHNOLOGIES,	NO	EXPLORATION	PIEZOMETER		80	69	80	1	PLASTIC OR PVC
524537	A02003022ABA	403814.7	3708130	ANCHOR CENTRE MASTER,	NO	MONITOR OR PIEZOMETER	MONITOR	5/12/1989	101	63	100	4	PLASTIC OR PVC
524538	A02003022ABA	403814.7	3708130	ANCHOR CENTRE MASTER,	NO	MONITOR OR PIEZOMETER	MONITOR	5/12/1989	101	67	100	4	PLASTIC OR PVC
524539	A02003022ABA	403814.7	3708130	ANCHOR CENTRE MASTER,	NO	MONITOR OR PIEZOMETER	MONITOR	5/15/1989	103	65	97	4	PLASTIC OR PVC
524029	A02003015DDD	404217.9	3708330	ATLANTIC RICHFIELD CO	YES	MONITOR	WATER PRODUCTION	4/2/1989	68	68	55	2	PLASTIC OR PVC
524033	A02003015DDD	404217.9	3708330	ARCO PETROLEUM PROD,	NO	MONITOR OR PIEZOMETER	MONITOR	4/2/1989	67	62	55	0	PLASTIC OR PVC
524034	A02003015DDD	404217.9	3708330	ARCO PETROLEUM PROD,	NO	MONITOR OR PIEZOMETER	MONITOR	4/6/1989	98	69	97	5	PLASTIC OR PVC
527808	A02003022CBB	402799.6	3707320	MOBIL OIL CORP,	NO	MONITOR OR PIEZOMETER	MONITOR	5/11/1990	111	70	100	4	PLASTIC OR PVC
527931	A02003021BDD	401791.5	3707531	SOUTHWEST GAS CORP,	NO	EXPLORATION	CATHODIC	4/30/1990	260	0	20	6	PLASTIC OR PVC
526656	A02003022CBD	403003.8	3707118	SW GAS CORP,	NO	EXPLORATION	CATHODIC	1/26/1990	260	0	20	6	PLASTIC OR PVC
529993	A02003015BCA	403024.3	3709337	SOUTHWEST GAS CORP,	NO	EXPLORATION	CATHODIC	11/21/1990	160	0	160	6	PLASTIC OR PVC
534377	A02003022CCC	402798	3706712	METRIC REALTY SERV,	NO	MONITOR OR PIEZOMETER	MONITOR	2/10/1992	60	54	0	0	NO CASING CODE LISTED
536636	A02003022BBC	402806.5	3707928	VALLEY NATIONAL BANK	NO	MONITOR OR PIEZOMETER	MONITOR	11/11/1992	80	65	65	2	PLASTIC OR PVC
536637	A02003022BBC	402806.5	3707928	VALLEY NATIONAL BANK	NO	MONITOR OR PIEZOMETER	MONITOR	11/11/1993	80	65	65	2	PLASTIC OR PVC
536638	A02003022BBC	402806.5	3707928	VALLEY NATIONAL BANK	NO	MONITOR OR PIEZOMETER	MONITOR	11/12/1992	80	65	65	2	PLASTIC OR PVC
536639	A02003022BBB	402808.8	3708130	VALLEY NATIONAL BANK	NO	MONITOR OR PIEZOMETER	MONITOR	12/14/1993	80	70	80	2	PLASTIC OR PVC
536640	A02003022BBB	402808.8	3708130	VALLEY NATIONAL BANK	NO	MONITOR OR PIEZOMETER	MONITOR	12/15/1992	80	65	80	2	PLASTIC OR PVC
536641	A02003022BBB	402808.8	3708130	VALLEY NATIONAL BANK	NO	MONITOR OR PIEZOMETER	MONITOR	12/18/1993	80	65	80	2	PLASTIC OR PVC
544608	A02003016DBB	402006.8	3708944	ARCO PRODUCTS CO,	NO	MONITOR OR PIEZOMETER	MONITOR	10/3/1994	125	90	80	4	PLASTIC OR PVC
552265	A02003022BBB	402808.8	3708130	ADEQ,	NO	MONITOR OR PIEZOMETER	MONITOR	4/30/1996	80	63	80	4	PLASTIC OR PVC
552266	A02003022BBB	402808.8	3708130	ADEQ,	NO	MONITOR OR PIEZOMETER	MONITOR	3/28/1996	80	60	80	4	PLASTIC OR PVC
552267	A02003021AAD	402604.1	3707929	ADEQ,	NO	MONITOR OR PIEZOMETER	MONITOR	3/1/1996	80	60	80	4	PLASTIC OR PVC
552268	A02003022BBC	402806.5	3707928	ADEQ,	NO	MONITOR OR PIEZOMETER	MONITOR	2/28/1996	80	58	80	4	PLASTIC OR PVC
552269	A02003022BBB	402808.8	3708130	ADEQ,	NO	EXPLORATION	MINERAL EXPLORATION	2/27/1996	85	64	0	0	NO CASING CODE LISTED
555941	A02003015CCD	403012.5	3708332	UNOCAL,	NO	EXPLORATION	GEOTECHNICAL	4/24/1996	0	0	0	0	NO CASING CODE LISTED
557236	A02003015CCD	403012.5	3708332	CONOCO PHILLIPS COMPANY	NO	EXPLORATION	GEOTECHNICAL	4/24/1996	0	0	0	0	NO CASING CODE LISTED
559673	A02003021DDC	402392.1	3706715	PHOENIX ART GROUP,	YES	WITHDRAWAL PERMIT	WATER PRODUCTION	9/12/1996	120	14	120	10	PLASTIC OR PVC
576533	A02003015ACD	403825.1	3709134	ROBERT D HURT	NO	EXEMPT	WATER PRODUCTION	1/26/2001	125	68	125	6	STEEL - PERFORATED OR SLOTTED CASING
579821	A02003021AAD	402604.1	3707929	ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY	NO	MONITOR	MONITOR	5/9/2000	81	65	80	4	PLASTIC OR PVC
605334	A02003015DBA	403822.9	3708934	MOORE,A G	NO	NON-EXEMPT	WATER PRODUCTION	4/16/1948	240	42	131	12	OTHER - BLACK STEEL - IRON - SEAMLESS
605335	A02003015DBA	403822.9	3708934	MOORE,A G	NO	EXEMPT	WATER PRODUCTION	1/1/1951	180	0	0	4	NO CASING CODE LISTED
595980	A02003022BBB	402808.8	3708130	ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY	NO	MONITOR	MONITOR	1/22/2003	100	74	100	2	PLASTIC OR PVC
595982	A02003022BBB	402808.8	3708130	ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY	NO	MONITOR	MONITOR	1/15/2003	100	74	100	2	PLASTIC OR PVC
608421	A02003021DAA	402596.7	3707321	SALT RIVER PROJECT,	YES	NON-EXEMPT	WATER PRODUCTION	3/11/1968	403	82	403	18	STEEL - PERFORATED OR SLOTTED CASING
607745	A02003021ACC	401994	3707530	SALT RIVER PROJECT,	YES	NON-EXEMPT	WATER PRODUCTION	9/1/1923	201	50	201	12	OTHER - BLACK STEEL - IRON - SEAMLESS
607749	A02003016DDA	402610.9	3708535	SALT RIVER PROJECT,	NO	NON-EXEMPT	WATER PRODUCTION	6/16/1951	348	107	348	20	NO CASING CODE LISTED
624177	A02003015DDB	404019.5	3708532	VANDERWEY, JOHN,A	NO	EXEMPT	WATER PRODUCTION		0	0	0	8	STEEL - PERFORATED OR SLOTTED CASING
626526	A02003021DAC	402395.4	3707120	PHOENIX, CITY OF,	YES	NON-EXEMPT	WATER PRODUCTION		0	0	0	0	NO CASING CODE LISTED
624370	A02003015DDB	404019.5	3708532	RAY,W E	NO	NON-EXEMPT	WATER PRODUCTION		0	0	0	0	NO CASING CODE LISTED
635751	A02003022ABA	403814.7	3708130	CAMELBACK PROPERTIES,	NO	EXEMPT	WATER PRODUCTION	1/1/1940	300	75	250	12	STEEL - PERFORATED OR SLOTTED CASING
629969	A02003021CAC	401587.3	3707127	STEELE,B V	NO	EXEMPT	CAPPED		0	0	0	0	NO CASING CODE LISTED
634024	A02003015ACD	403825.1	3709134	ROBERT D HURT	NO	EXEMPT	WATER PRODUCTION		0	0	0	0	NO CASING CODE LISTED
638394	A02003022DB0	403711.3	3707220	P F P DEVEL,	NO	EXEMPT	WATER PRODUCTION		0	0	0	0	NO CASING CODE LISTED
800757	A02003021DDD	402594.5	3706713	PHX INDIAN MED CNTR,	YES	NON-EXEMPT	WATER PRODUCTION		0	0	0	0	NO CASING CODE LISTED
906874	A02003022CDD	403406.1	3706714	7-ELEVEN INC.	NO	MONITOR	MONITOR	5/2/2007	89	68	88	5	PLASTIC OR PVC
906875	A02003022CDD	403406.1	3706714	7-ELEVEN INC.	NO	MONITOR	MONITOR	5/4/2007	89	68	88	5	PLASTIC OR PVC
906177	A02003022CDD	403406.1	3706714	SEVEN ELEVEN, ATTN: KEN HILLIARD	NO	MONITOR	MONITOR	1/4/2007	88	68	88	4	PLASTIC OR PVC
901319	A02003022DAA	404211.4	3707322	EXXON MOBIL CORPORATION	NO	MONITOR	MONITOR	11/23/2004	95	77	95	4	PLASTIC OR PVC

Appendix B: Soil Boring Logs

BORING NUMBER B-5

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: City Scape Apartments

PROJECT NO: 92599.504

DATE STARTED: 10-29-92 DATE COMPLETED: 10-29-92

LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND SURFACE ELEVATION (FT.):

CASING REF. POINT ELEVATION (FT.):

DRILLING/COMPANY: Geomechanics SW

LOGGED BY: W. Miller CHECKED BY: E.V. James

DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	Depth	LITHOLOGIC DESCRIPTION	REMARKS
B-5	0.0-1.0	12			SM; Silty Fine Sand, brown (7.5YR 5/4), little gravel, firm, dry	BZ = 0 ppm
					; slight decrease in gravel	
B-5	5.0-6.0	12		5		HS = 0 ppm
B-5	10.0-11.0	12		10		HS = 0 ppm
B-5	15.0-16.0	12		15		HS = 0 ppm
B-5	20.0-21.0	12		20		HS = 0 ppm
B-5	25.0-26.0	12		25	ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel, firm, damp	HS = 0 ppm
B-5	30.0-31.0	12		30		HS = 0 ppm

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-5

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: City Scape Apartments | PROJECT NO: 92599.504

DATE STARTED: 10-29-92 | DATE COMPLETED: 10-29-92 | LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND SURFACE ELEVATION (FT.): | CASING REF. POINT ELEVATION (FT.): | DRILLING/COMPANY: Geomechanics SW

LOGGED BY: W. Miller | CHECKED BY: E.V. James | DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
B-5	35.0-36.0	12			ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel, firm, damp	HS = 0 ppm
B-5	40.0-41.0	12		40		HS = 0 ppm
B-5	45.0-46.0	12		45		HS = 0 ppm
					SM; Silty Fine Sand, light brown (7.5YR 6/4), little gravel	
					ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel	
B-5	50.0-51.0	12		50	SM; Silty Fine Sand, light brown (7.5YR 6/4), little gravel	HS = 0 ppm
					ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel	
B-5	55.0-56.0	12		55		HS = 0 ppm
B-5	60.0-61.0	12		60		HS = 0 ppm
B-5	65.0-66.0	12		65		HS = 0 ppm

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-5

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: City Scape Apartments PROJECT NO: 92599.504

DATE STARTED: 10-29-92 DATE COMPLETED: 10-29-92 LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND SURFACE ELEVATION (FT.): CASING REF. POINT ELEVATION (FT.): DRILLING/COMPANY: Geomechanics SW

LOGGED BY: W. Miller CHECKED BY: E.V. James DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
B-5	70.0-71.0	12			ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel	HS = 0 ppm
					; many thin lenses of firm soil	
B-5	75.0-76.0	12		75	; little gravel, moist	HS = 0 ppm
						Difficult Drilling
B-5	80.0-81.0	12		80		HS = 0 ppm
B-5	84.0-85.0	12		85		HS = 0 ppm
					TD = 85 feet below ground surface	
					Water level = 70.96 feet below ground surface	
					Boring backfilled to ground surface with cement/bentonite grout	
				90		
				95		
				100		

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-36

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: City Scape Apartments

PROJECT NO: 92599.504

DATE STARTED: 11-3-92

DATE COMPLETED: 11-3-92

LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND SURFACE ELEVATION (FT.):

CASING REF. POINT ELEVATION (FT.):

DRILLING/COMPANY: Geomechanics SW

LOGGED BY: W. Miller

CHECKED BY: E.V. James

DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
				0	SM; Silty Fine Sand, brown (7.5YR 5/4), little gravel, firm, damp	BZ = 0 ppm
B-36	5.0-6.0	12	11	5		HS = 0 ppm
B-36	10.0-11.0	12	23	10		HS = 0 ppm
B-36	15.0-16.0	12	18	15		HS = 0 ppm
				20	ML; Fine Sandy Silt, brown (7.5YR 5/4), trace gravel, loose, damp	HS = 0 ppm
				25		HS = 0 ppm
				29-30	SM; Silty Fine Sand, brown (7.5YR 5/4), little gravel, damp	HS = 0 ppm
				31	ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel	

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-36

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: City Scape Apartments | PROJECT NO: 92599.504

DATE STARTED: 11-3-92 | DATE COMPLETED: 11-3-92 | LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND SURFACE ELEVATION (FT.): | CASING REF. POINT ELEVATION (FT.): | DRILLING/COMPANY: Geomechanics SW

LOGGED BY: W. Miller | CHECKED BY: E.V. James | DRILLING METHOD: HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	SAMPLE RECOVERY (IN.)	SAMPLE BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
					ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel	HS = 0 ppm
				40		HS = 0 ppm
				45		HS = 0 ppm
				50	SM; Silty Fine Sand, little gravel	HS = 0 ppm
					ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel, damp	
				55		HS = 0 ppm
				60		
					SM; Silty Fine Sand, little gravel	
				65	ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel, damp	HS = 0 ppm

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-36

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: City Scape Apartments

PROJECT NO: 92599.504

DATE STARTED: 11-3-92 DATE COMPLETED: 11-3-92

LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND SURFACE ELEVATION (FT.):

CASING REF. POINT ELEVATION (FT.):

DRILLING/COMPANY: Geomechanics SW

LOGGED BY: W. Miller CHECKED BY: E.V. James

DRILLING METHOD: HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
					ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel, damp	HS = 0 ppm
				75	TD = 75 feet below ground surface Groundwater level = 66.38 feet below ground surface Boring backfilled to ground surface with cement/bentonite grout	HS = 0 ppm
				80		
				85		
				90		
				95		
				100		

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-37

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: City Scape Apartments | PROJECT NO: 92599.504

DATE STARTED: 11-4-92 | DATE COMPLETED: 11-4-92 | LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND SURFACE ELEVATION (FT.): | CASING REF. POINT ELEVATION (FT.): | DRILLING/COMPANY: Geomechanics SW

LOGGED BY: W. Miller | CHECKED BY: E.V. James | DRILLING METHOD: HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
				0	SM; Silty Fine Sand, brown (7.5YR 5/6), little gravel, firm, damp	BZ = 0 ppm
B-37	5.0-6.0	12	14	5		HS = 0 ppm
B-37	10.0-11.0	12	21	10		HS = 0 ppm
B-37	15.0-16.0	12	25	15		HS = 0 ppm
				20	ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel, damp	HS = 0 ppm
				25		HS = 0 ppm
				30		HS = 0 ppm

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-37

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: City Scape Apartments

PROJECT NO: 92599.504

DATE STARTED: 11-4-92 DATE COMPLETED: 11-4-92

LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND SURFACE ELEVATION (FT.):

CASING REF. POINT ELEVATION (FT.):

DRILLING/COMPANY: Geomechanics SW

LOGGED BY: W. Miller

CHECKED BY: E.V. James

DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH SCALE	LITHOLOGIC DESCRIPTION	REMARKS
					ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel, damp	HS = 0 ppm
				40		HS = 0 ppm
				45		HS = 0 ppm
				50		HS = 0 ppm
				55		HS = 0 ppm
				60		
				65		HS = 0 ppm

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-37

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: City Scape Apartments | PROJECT NO: 92599.504

DATE STARTED: 11-4-92 | DATE COMPLETED: 11-4-92 | LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND SURFACE ELEVATION (FT.): | CASING REF. POINT ELEVATION (FT.): | DRILLING/COMPANY: Geomechanics SW

LOGGED BY: W. Miller | CHECKED BY: E.V. James | DRILLING METHOD: HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	SAMPLE RECOVERY (IN.)	SAMPLE BLOWS 12"	DEPTH		LITHOLOGIC DESCRIPTION	REMARKS
						ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel, damp	HS = 0 ppm
				75			HS = 0 ppm
						TD = 75 feet below ground surface	
						Groundwater level = 66.13 feet below ground surface	
						Boring backfilled to ground surface with cement/bentonite grout	
				80			
				85			
				90			
				95			
				100			

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-38

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: City Scape Apartments

PROJECT NO: 92599.504

DATE STARTED: 11-5-92 **DATE COMPLETED:** 11-5-92

LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND SURFACE ELEVATION (FT.):

CASING REF. POINT ELEVATION (FT.):

DRILLING/COMPANY: Geomechanics SW

LOGGED BY: W. Miller **CHECKED BY:** E.V. James **DRILLING METHOD:** HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	SAMPLE RECOVERY (IN.)	SAMPLE BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
				0	SM; Silty Fine Sand, brown (7.5YR 5/6), little gravel, firm, damp	BZ = 0 ppm
				5		HS = 0 ppm
				10		HS = 0 ppm
				15		HS = 0 ppm
				20	ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel, firm, damp	HS = 0 ppm
				25		HS = 0 ppm
				30		HS = 0 ppm

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-38

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: City Scape Apartments

PROJECT NO: 92599.504

DATE STARTED: 11-5-92

DATE COMPLETED: 11-5-92

LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND SURFACE ELEVATION (FT.):

CASING REF. POINT ELEVATION (FT.):

DRILLING/COMPANY: Geomechanics SW

LOGGED BY: W. Miller

CHECKED BY: E.V. James

DRILLING METHOD: HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	SAMPLE RECOVERY (IN.)	SAMPLE BLOWS 12"	DEPTH		LITHOLOGIC DESCRIPTION	REMARKS
						ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel, firm, damp	HS = 0 ppm
				40			HS = 0 ppm
				45			HS = 0 ppm
				50			HS = 0 ppm
				55			HS = 0 ppm
				60			
				65			HS = 0 ppm

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-38

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: City Scape Apartments   PROJECT NO: 92599.504

DATE STARTED: 11-5-92   DATE COMPLETED: 11-5-92   LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND SURFACE ELEVATION (FT.):   CASING REF. POINT ELEVATION (FT.):   DRILLING/COMPANY: Geomechanics SW

LOGGED BY: W. Miller   CHECKED BY: E.V. James   DRILLING METHOD: HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	SAMPLE RECOVERY (IN.)	SAMPLE BLOWS 12"	DEPTH		LITHOLOGIC DESCRIPTION	REMARKS
						ML; Fine Sandy Silt, pale brown (10YR 7/4), trace gravel, firm, damp	HS = 0 ppm
				75		TD = 75 feet below ground surface Groundwater level = 71.24 feet below ground surface Boring backfilled to ground surface with cement/bentonite grout	HS = 0 ppm
				80			
				85			
				90			
				95			
				100			

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-49

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: Camelback Arboleda

PROJECT NO: 92676.504

DATE STARTED: 12-18-92 DATE COMPLETED: 12-18-92

LOCATION: 16th St. & Camelback Rd.

GROUND SURFACE ELEVATION (FT.):

CASING REF. POINT ELEVATION (FT.):

DRILLING/COMPANY: GMS

LOGGED BY: W. Miller CHECKED BY: G. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
				0	SM; Silty Fine Sand, yellowish brown (10YR 5/4), little clay, gravel	BZ = 0 ppm
B-49	5.0-6.0		27	5		HS = 0 ppm
				8	; increase in gravel (8'-9')	
B-49	10.0-10.9		80	10		HS = 0 ppm
B-49	15.0-16.0		82	15	ML; Fine Sandy Silt, light yellowish brown (10YR 6/4), little clay, damp, light cementation	HS = 0 ppm
B-49	20.0-21.0		62	20		HS = 0 ppm
B-49	25.0-26.0		57	25		HS = 0 ppm
B-49	30.0-30.8		100	30		HS = 0 ppm

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-49

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: Camelback Arboleda

PROJECT NO: 92676.504

DATE STARTED: 12-18-92 DATE COMPLETED: 12-18-92

LOCATION: 16th St. & Camelback Rd.

GROUND SURFACE ELEVATION (FT.):

CASING REF. POINT ELEVATION (FT.):

DRILLING/COMPANY: GMS

LOGGED BY: W. Miller CHECKED BY: G. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
B-49	35.0-36.0				ML; Fine Sandy Silt, light yellowish brown (10YR 6/4), little clay, damp, light cementation	HS = 0 ppm
B-49	40.0-41.0			40		HS = 0 ppm
B-49	45.0-46.0			45	; extremely hard layer	HS = 0 ppm
B-49	50.0-51.0	3	50	50		HS = 0 ppm
B-49	55.0-56.0	6	50	55		HS = 0 ppm
B-49	60.0-61.0	6	50	60		HS = 0 ppm
B-49	65.0-65.4		50	65	; yellowish brown (10YR 5/4), clayey silt, little sand, moist, low to medium plasticity, medium cementation	HS = 0 ppm

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-49

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: Camelback Arboleda **PROJECT NO:** 92676.504

DATE STARTED: 12-18-92 **DATE COMPLETED:** 12-18-92 **LOCATION:** 16th St. & Camelback Rd.

GROUND SURFACE ELEVATION (FT.): **CASING REF. POINT ELEVATION (FT.):** **DRILLING/COMPANY:** GMS

LOGGED BY: W. Miller **CHECKED BY:** G. Dozer **DRILLING METHOD:** HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
B-49	70.0-70.5		61		ML; Clayey Silt, yellowish brown (10YR 5/4), little sand, moist, low to medium plasticity, medium cementation ∇	HS = 0 ppm
B-49	75.0-75.5		60	75	; Fine Sandy Silt, little clay, moist	HS = 0 ppm
B-49	80.0-80.9		89	80	;very moist	HS = 0 ppm
					TD = 81 feet below ground surface	
					Groundwater level = 72 feet below ground surface	
				85	Boring backfilled to ground surface with cement grout	
				90		
				95		
				100		

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-52

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: Camelback Arboleda **PROJECT NO:** 92676.504

DATE STARTED: 12-23-92 **DATE COMPLETED:** 12-23-92 **LOCATION:** 16th St. & Camelback Rd.

GROUND SURFACE ELEVATION (FT.): **CASING REF. POINT ELEVATION (FT.):** **DRILLING/COMPANY:** GMS

LOGGED BY: W. Miller **CHECKED BY:** G. Dozer **DRILLING METHOD:** HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	Depth (ft)	LITHOLOGIC DESCRIPTION	REMARKS
				0	SM; Silty Fine Sand, yellowish brown (10YR 5/4), little gravel, trace clay, moist	BZ = 0 ppm
				5		HS = 0 ppm
				10		HS = 0 ppm
				15		HS = 0 ppm
				20		HS = 0 ppm
				21	ML; Fine Sandy Silt, light yellowish brown (10YR 6/4), little clay, damp	
				25		HS = 0 ppm
				30		HS = 0 ppm

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-52

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: Camelback Arboleda **PROJECT NO:** 92676.504

DATE STARTED: 12-23-92 **DATE COMPLETED:** 12-23-92 **LOCATION:** 16th St. & Camelback Rd.

GROUND SURFACE ELEVATION (FT.): **CASING REF. POINT ELEVATION (FT.):** **DRILLING/COMPANY:** GMS

LOGGED BY: W. Miller **CHECKED BY:** G. Dozer **DRILLING METHOD:** HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	Depth	LITHOLOGIC DESCRIPTION	REMARKS
					ML; Fine Sandy Silt, light yellowish brown (10YR 6/4), little clay, damp	HS = 0 ppm
				40		HS = 0 ppm
				45		HS = 0 ppm
				50		HS = 0 ppm
				55		HS = 0 ppm
				60		HS = 0 ppm
				65		HS = 0 ppm

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-52

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: Camelback Arboleda

PROJECT NO: 92676.504

DATE STARTED: 12-23-92 DATE COMPLETED: 12-23-92

LOCATION: 16th St. & Camelback Rd.

GROUND SURFACE ELEVATION (FT.):

CASING REF. POINT ELEVATION (FT.):

DRILLING/COMPANY: GMS

LOGGED BY: W. Miller CHECKED BY: G. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
					ML; Fine Sandy Silt, light yellowish brown (10YR 6/4), little clay, damp ∇	HS = 0 ppm
				75	TD = 75 feet below ground surface Groundwater level = 72 feet below ground surface Boring backfilled to ground surface with cement grout	HS = 0 ppm
				80		
				85		
				90		
				95		
				100		

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-53

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: Camelback Arboleda

PROJECT NO: 92676.504

DATE STARTED: 12-23-92 DATE COMPLETED: 12-23-92

LOCATION: 16th St. & Camelback Rd.

GROUND SURFACE ELEVATION (FT.):

CASING REF. POINT ELEVATION (FT.):

DRILLING/COMPANY: GMS

LOGGED BY: W. Miller CHECKED BY: G. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	Depth	LITHOLOGIC DESCRIPTION	REMARKS
				0	SM; Silty Fine Sand, yellowish brown (10YR 5/4), little gravel and clay, moist	BZ = 0 ppm
				5		HS = 0 ppm
				10		HS = 0 ppm
				11	ML; Fine Sandy Silt, light yellowish brown (10YR 6/4), little clay, damp, light cementation	
				15		HS = 0 ppm
				20		HS = 0 ppm
				25		HS = 0 ppm
				30		HS = 0 ppm

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-53

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: Camelback Arboleda		**PROJECT NO:** 92676.504	
DATE STARTED: 12-23-92	**DATE COMPLETED:** 12-23-92	**LOCATION:** 16th St. & Camelback Rd.	
GROUND SURFACE ELEVATION (FT.):	**CASING REF. POINT ELEVATION (FT.):**	**DRILLING/COMPANY:** GMS	
LOGGED BY: W. Miller	**CHECKED BY:** G. Dozer	**DRILLING METHOD:** HSA	

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	Depth	LITHOLOGIC DESCRIPTION	REMARKS
					ML; Fine Sandy Silt, light yellowish brown (10YR 6/4), little clay, damp, light cementation	HS = 0 ppm
				40		HS = 0 ppm
				45		HS = 0 ppm
				50		HS = 0 ppm
				55		HS = 0 ppm
				60		HS = 0 ppm
				65		HS = 0 ppm

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

BORING NUMBER B-53

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

BORING LOG

PROJECT NAME: Camelback Arboleda **PROJECT NO:** 92676.504

DATE STARTED: 12-23-92 **DATE COMPLETED:** 12-23-92 **LOCATION:** 16th St. & Camelback Rd.

GROUND SURFACE ELEVATION (FT.): **CASING REF. POINT ELEVATION (FT.):** **DRILLING/COMPANY:** GMS

LOGGED BY: W. Miller **CHECKED BY:** G. Dozer **DRILLING METHOD:** HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	SAMPLE RECOVERY (IN.)	SAMPLE BLOWS 12"	Depth	LITHOLOGIC DESCRIPTION	REMARKS
					ML; Fine Sandy Silt, light yellowish brown (10YR 6/4), little clay, damp, light cementation ∇	HS = 0 ppm
				75	TD = 75 feet below ground surface Groundwater level = 71 feet below ground surface Boring backfilled to ground surface with cement grout	HS = 0 ppm
				80		
				85		
				90		
				95		
				100		

NOTES: Headspace measured using photoionization detector with 10.2eV lamp; BH = Borehole; BZ = Breathing Zone; HS = Sample Headspace; Borehole = 8" dia.; TD = Total Depth of Borehole

WELL NUMBER MW-1

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: City Scape Apartments

PROJECT NO: 92599.504

DATE STARTED: 11-5-92

DATE COMPLETED: 11-5-92

LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND WATER ELEVATION (FT.): 1070.44

CASING REF. POINT ELEVATION (FT.): 1142.27

DRILLING/COMPANY: Geomechanics SW

LOGGED BY: E.V. James

CHECKED BY: G.J. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	WELL CONST.	REMARKS
				0	SM; Silty Fine Sand, light brown (7.5YR 6/4), little gravel, low plasticity, loose, dry		Steel flush-mounted vault and 4'x4' cement pad
							2" dia. Sch. 40 PVC casing set in Portland cement and bentonite grout seal
				5			
				10			
				15			
				20	ML; Fine Sandy Silt, light brown (7.5YR 6/4), trace gravel, low plasticity, firm, dry		
				25	; brown (7.5YR 5/4), some gravel		
				30			

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-1

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: City Scape Apartments

PROJECT NO: 92599.504

DATE STARTED: 11-5-92

DATE COMPLETED: 11-5-92

LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND WATER ELEVATION (FT.): 1070.44

CASING REF. POINT ELEVATION (FT.): 1142.27

DRILLING/COMPANY: Geomechanics SW

LOGGED BY: E.V. James

CHECKED BY: G.J. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	SAMPLE RECOVERY (IN.)	SAMPLE BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	WELL CONST.	REMARKS
					ML; Fine Sandy Silt, brown (7.5YR 5/4), some gravel, low plasticity, firm, dry		2" dia. Sch. 40 PVC casing set in Portland cement and bentonite grout seal
				40			
				45			
				50			
							52 ft. BGS
							Bentonite seal
				55			
							57 ft. BGS
							Sand pack (10/20 grade sand)
				60			
							64.23 ft. BGS, Top of Screen, 2" dia. Sch. 40 PVC screen (.010 slot) set in sand pack (10/20 grade sand)
				65			

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-1

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: City Scape Apartments | PROJECT NO: 92599.504

DATE STARTED: 11-5-92 | DATE COMPLETED: 11-5-92 | LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND WATER ELEVATION (FT.): 1070.44 | CASING REF. POINT ELEVATION (FT.): 1142.27 | DRILLING/COMPANY: Geomechanics SW

LOGGED BY: E.V. James | CHECKED BY: G.J. Dozer | DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	WELL CONST.	REMARKS
					ML; Fine Sandy Silt, brown (7.5YR 5/4), some gravel, low plasticity, firm, dry		2" dia. Sch. 40 PVC screen (.010 slot) set in sand pack (10/20 grade sand)
				75			
							79.5 ft. BGS, Base of well
				80	TD = 80 feet below ground surface Groundwater level = 71.83 feet below reference point		
				85			
				90			
				95			
				100			

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-2

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: City Scape Apartments

PROJECT NO: 92599.504

DATE STARTED: 11-5-92

DATE COMPLETED: 11-5-92

LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND WATER ELEVATION (FT.): 1070.88

CASING REF. POINT ELEVATION (FT.): 1139.68

DRILLING/COMPANY: Geomechanics SW

LOGGED BY: E.V. James

CHECKED BY: G. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	SAMPLE RECOVERY (IN.)	SAMPLE BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	WELL CONST.	REMARKS
				0	SM; Silty Sand, light brown (7.5YR 6/4), loose, dry		Steel traffic cover and cement pad at surface
							2" dia. Sch. 40 PVC casing set in Portland cement and bentonite grout seal
				5			
				10			
				15			
				20			
				25			
				30			

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-2

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: City Scape Apartments

PROJECT NO: 92599.504

DATE STARTED: 11-5-92 DATE COMPLETED: 11-5-92

LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND WATER ELEVATION (FT.): 1070.88

CASING REF. POINT ELEVATION (FT.): 1139.68

DRILLING/COMPANY: Geomechanics SW

LOGGED BY: E.V. James

CHECKED BY: G. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	SAMPLE RECOVERY (IN.)	SAMPLE BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	WELL CONST	REMARKS
					SM; Silty Sand, light brown (7.5YR 6/4), loose, dry		2" dia. Sch. 40 PVC casing set in Portland cement and bentonite grout seal
				40			
				45	; with gravel		
				50			
							52 ft. BGS
							Bentonite seal
				55	; brown (7.5YR 5/4), damp, gravel		
							57 ft. BGS
							Sand pack (10/20 grade sand)
				60			
				65			64.12 ft. BGS, Top of Screen, 2" dia. Sch. 40 PVC screen (.010 slot) set in sand pack (10/20 grade sand)
					; moist		

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-2

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: City Scape Apartments

PROJECT NO: 92599.504

DATE STARTED: 11-5-92

DATE COMPLETED: 11-5-92

LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND WATER ELEVATION (FT.): 1070.88

CASING REF. POINT ELEVATION (FT.): 1139.68

DRILLING/COMPANY: Geomechanics SW

LOGGED BY: E.V. James

CHECKED BY: G. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	Depth	LITHOLOGIC DESCRIPTION	WELL CONST.	REMARKS
				75–80	SM; Silty Sand, brown (7.5YR 5/4), gravel, damp		2" dia. Sch. 40 PVC screen (.010 slot) set in sand pack (10/20 grade sand)
				80			79.5 ft. BGS, Base of well
				80–100	TD = 80 feet below ground surface Groundwater level = 68.80 feet below reference point		

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-3

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: City Scape Apartments

PROJECT NO: 92599.504

DATE STARTED: 11-5-92 DATE COMPLETED: 11-5-92

LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND WATER ELEVATION (FT.): 1072.30

CASING REF. POINT ELEVATION (FT.): 1137.40

DRILLING/COMPANY: Geomechanics SW

LOGGED BY: E.V. James CHECKED BY: G. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	Depth	LITHOLOGIC DESCRIPTION	WELL CONST	REMARKS
				0	SM; Silty Sand, light brown (7.5YR 6/4), loose, dry		Steel flush-mounted vault and 4'x4' cement pad
							2" dia. Sch. 40 PVC casing set in Portland cement and bentonite grout seal
				5			
				10			
				15			
				20			
				25			
				30			

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-3

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: City Scape Apartments

PROJECT NO: 92599.504

DATE STARTED: 11-5-92

DATE COMPLETED: 11-5-92

LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND WATER ELEVATION (FT.) 1072.30

CASING REF. POINT ELEVATION (FT.): 1137.40

DRILLING/COMPANY: Geomechanics SW

LOGGED BY: E.V. James

CHECKED BY: G. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	Depth	LITHOLOGIC DESCRIPTION	WELL CONST.	REMARKS
					SM; Silty Sand, light brown (7.5YR 6/4), loose, dry		2" dia. Sch. 40 PVC casing set in Portland cement and bentonite grout seal
				40			
				45	; with gravel		
				50	; firm, damp		
							53 ft. BGS Bentonite seal
				55			
							57.5 ft. BGS Sand pack (10/20 grade sand)
							59.09 ft. BGS, Top of Screen, 2" dia. Sch. 40 PVC screen (.010 slot) set in sand pack (10/20 grade sand)
				60			
				65			

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-3

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: City Scape Apartments | PROJECT NO: 92599.504

DATE STARTED: 11-5-92 | DATE COMPLETED: 11-5-92 | LOCATION: 16th St. & Camelback, Phoenix, AZ

GROUND WATER ELEVATION (FT.): 1072.30 | CASING REF. POINT ELEVATION (FT.): 1137.40 | DRILLING/COMPANY: Geomechanics SW

LOGGED BY: E.V. James | CHECKED BY: G. Dozer | DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	WELL CONST.	REMARKS
					SM; Silty Sand, light brown (7.5YR 6/4), gravel, firm, damp		2" dia. Sch. 40 PVC screen (.010 slot) set in sand pack (10/20 grade sand)
				75			74.5 ft. BGS, Base of well
					TD = 75 feet below ground surface		
					Groundwater level = 65.10 feet below reference point		
				80			
				85			
				90			
				95			
				100			

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

DEPTH (feet)	WELL CONSTRUCTION	PCE (mg/kg)	1,2 DCA (mg/kg)	1,2 DCP (mg/kg)	Benzene (mg/kg)	Chloroform (mg/kg)	FLD vapor PID (ppm)	BLOWS/6"	SAMPLE NUMBER	U.S.C.S. DESIGNATION	SOIL DESCRIPTION
0										ML	Silt, Strong Brown (7.5YR 5/6) Dry
5											
10	4" DIA. Schedule 40 PVC Casing Packed In Bentonite-Cement Grout						0.0	15 30 50/5		ML	Silt, Strong brown (7.5YR 5/6), Dry, Silt Some sand, Fine gravel, Reddish brown (5YR 5/4) Dry, Hard.
										ML	Silt, Light brown (7.5 YR 5/6), Dry, Hard.
15							0.0	25 50/5			
										ML	Silt, Light brown (7.5 YR 5/6), Dry, Hard.
20		<0.050	<0.050	<0.050	<0.050	<0.050	1.7	30 50/5	S-MW3A-20		
										ML	Silt, Trace fine gravel, Light brown (10YR 6/4), Dry Hard.
25							0.0	30 50/5			
										ML	Silt, Trace fine gravel, Light brown (10YR 6/4), Dry Hard.
30		<0.050	<0.050	<0.050	<0.050	<0.050	0.0	25 38 50/4	S-MW3A-30		
										ML	No sample recovery; described from soil cuttings
35	4" DIA. Schedule 40 PVC Casing Packed In Bentonite-Cement Grout							50/5			
40								50/4			
45								65/6			
										ML	Silt, Trace fine gravel, Light brown, (10YR 6/4), Dry, Hard.
50							0.0	75/6			
	4" DIA. Schedule 40 PVC Casing Packed In Bentonite Pellets									SM	Fine sand with silt, Light brown, (7.5YR 6/4), Dry, Very dense.
55		<0.050	<0.050	<0.050	<0.050	<0.050	0.0	75/4	S-MW3A-55		
	4" DIA. Schedule 40 PVC Casing									SM	Fine sand with silt, Light brown, (7.5YR 6/4),
60											

Logged by: David Neidigh
Date started: 4/5/2006
Date completed: 4/6/2006

Ground surface elevation (feet): 1142.0
Total depth (feet): 122.0
Drilling method: Hollow Stem Auger

Diameter of boring (inches): 10 1/4
Screen slot size (inches): 0.020
Casing diameter (inches): 4.0

ENV_KAZ_8260 61781.GPJ 6/1/06 RG

KLEINFELDER

Project Number 61781 June 2006

Arizona Department of Environmental Quality WQARF site
16th Street and Camelback Road
Phoenix, Arizona

LOG OF BORING MW3A

PLATE C-3

DEPTH (feet)	WELL CONSTRUCTION	PCE (mg/kg)	1,2 DCA (mg/kg)	1,2 DCP (mg/kg)	Benzene (mg/kg)	Chloroform (mg/kg)	FLD vapor PID (ppm)	BLOWS/6"	SAMPLE NUMBER	U.S.C.S. DESIGNATION	SOIL DESCRIPTION
60	Packed In 8-12 Colo. Silica Sand						0.0	75/6		SM	Dry, Very dense.
										ML	Silt, Some very fine sand, Trace fine Gravel, Brown, (7.5YR 5/3), Moist, Hard.
65		<0.050	<0.050	<0.050	<0.050	<0.050	0.0	25 50/4	S-MW3A-65		
										SM	Fine sand with silt, Light brown, (7.5YR 6/4), Dry, Very dense.
70	Measured Depth of Water for 4/6/06						0.0	75/6			
										SM	Fine sand with silt, Light brown, (7.5YR 6/4), Dry, Very dense.
75	Estimated depth of saturated drill cuttings	<0.050	<0.050	<0.050	<0.050	<0.050	3.8	30 50/4	S-MW3A-75		
80											**No samples collected below the water table.**
85–120	4" DIA. 0.020 inch Slotted Schedule 40 PVC Screen Casing Packed In 8-12 Colo. Silica										
125											

ENV_KAZ_8260 61781.GPJ 6/1/06 RG

KLEINFELDER

Project Number 61781 June 2006

Arizona Department of Environmental Quality WQARF site
16th Street and Camelback Road
Phoenix, Arizona

LOG OF BORING MW3A

PLATE C-3

WELL NUMBER MW-4

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: Camelback Arboleda **PROJECT NO:** 92676.504

DATE STARTED: 12-14-92 **DATE COMPLETED:** 12-14-92 **LOCATION:** 16th St. & Camelback Rd.

GROUND WATER ELEVATION (FT.): 1073.17 **CASING REF. POINT ELEVATION (FT.):** 1140.17 **DRILLING/COMPANY:** GMS

LOGGED BY: E. James **CHECKED BY:** G. Dozer **DRILLING METHOD:** HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	Depth	LITHOLOGIC DESCRIPTION	REMARKS
					Asphalt 4"	2" dia. Sch. 40 PVC casing set in Portland cement and bentonite grout seal
					ML; Sandy Silty Clay, light brown (7.5YR 6/4), low plasticity, hard, some caliche nodules (1/4"-3/4"), dry	MW-4 abandoned 12-14-92. MW-4 backfilled with cement grout from bottom of casing to ground surface in accordance with ADWR regulations.
MW-4	5.0-6.0	5	37	5	; caliche clasts and sand decrease with depth, firm	
MW-4	10.0-11.0	6	50	10		
MW-4	15.0-16.0	6	50	15		
MW-4	20.0-21.0	4	50	20		
MW-4	25.0-26.0	2	50	25		
MW-4	30.0-31.0	5	50	30		

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-4

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: Camelback Arboleda **PROJECT NO:** 92676.504

DATE STARTED: 12-14-92 **DATE COMPLETED:** 12-14-92 **LOCATION:** 16th St. & Camelback Rd.

GROUND WATER ELEVATION (FT.): 1073.17 **CASING REF. POINT ELEVATION (FT.):** 1140.17 **DRILLING/COMPANY:** GMS

LOGGED BY: E. James **CHECKED BY:** G. Dozer **DRILLING METHOD:** HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
MW-4	35.0-36.0	6	50		ML; Silty Clay, light brown (7.5YR 6/4), low plasticity, firm, dry	
MW-4	40.0-41.0	6	46	40		
MW-4	45.0-46.0	5	50	45	; some gravel clasts (1/4-1")	
MW-4	50.0-51.0	3	50	50		50 ft. BGS Bentonite seal
MW-4	55.0-56.0	5	50	55	;loose, damp	55 ft. BGS Sand pack (10/20 grade sand)
MW-4	60.0-61.0	6	47	60		60.14 ft. BGS, Top of screen 2" dia. Sch. 40 PVC screen (.010 slot) set in sand pack (10/20 grade sand)
MW-4	65.0-66.0	12	89	65		

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-4

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: Camelback Arboleda
PROJECT NO: 92676.504

DATE STARTED: 12-14-92
DATE COMPLETED: 12-14-92
LOCATION: 16th St. & Camelback Rd.

GROUND WATER ELEVATION (FT.): 1073.17
CASING REF. POINT ELEVATION (FT.): 1140.17
DRILLING/COMPANY: GMS

LOGGED BY: E. James
CHECKED BY: G. Dozer
DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	WELL CONST.	REMARKS
MW-4	70.0-71.0	12	42		ML; Silty Clay, light brown (7.5YR 6/4), low plasticity, some gravel clasts (1/4-1"), loose, damp		
MW-4	75.0-76.0	12	40	75	; loose, saturated		
MW-4	80.0-81.0	12	23	80			80.5 ft. BGS, Base of well (1/2 foot of sand below well)
					TD = 81 feet below ground surface		
					Groundwater level = 67 feet below ground surface (1073.17 feet above MSL)		
				85			
				90			
				95			
				100			

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-5

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: Camelback Arboleda | PROJECT NO: 92676.504

DATE STARTED: 12-15-92 | DATE COMPLETED: 12-15-92 | LOCATION: 16th St. & Camelback Rd.

GROUND WATER ELEVATION (FT.): 1077.90 | CASING REF. POINT ELEVATION (FT.): 1144.93 | DRILLING/COMPANY: GMS

LOGGED BY: SJB/EJ | CHECKED BY: G. Dozer | DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	Depth	LITHOLOGIC DESCRIPTION	REMARKS
					ML; Sandy Silty Clay, light brown (7.5YR 6/4), low plasticity, little sand, firm, dry	Steel flush-mounted vault and 4' x 4' cement pad
MW-5	5.0-6.0	12	44	5		2" dia. Sch. 40 PVC casing set in Portland cement and bentonite grout seal
MW-5	10.0-11.0	5	50	10	; some gravel clasts, loose	
MW-5	15.0-16.0	5	50	15	; some organics, loose, damp	
MW-5	20.0-21.0	6	69	20	; no organics	
MW-5	25.0-26.0	12	48	25	; some small gravel clasts	
MW-5	30.0-31.0	12	90	30	; gravel increases with depth	

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-5

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: Camelback Arboleda | PROJECT NO: 92676.504

DATE STARTED: 12-15-92 | DATE COMPLETED: 12-15-92 | LOCATION: 16th St. & Camelback Rd.

GROUND WATER ELEVATION (FT.): 1077.90 | CASING REF. POINT ELEVATION (FT.): 1144.93 | DRILLING/COMPANY: GMS

LOGGED BY: SJB/EJ | CHECKED BY: G. Dozer | DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
MW-5	35.0-35.5	6	80		ML; Sandy Silty Clay, light brown (7.5YR 6/4), low plasticity, little sand, firm, dry, some gravel (1/4"-1")	
MW-5	40.0-40.4	12	50	40	; no gravel	
MW-5	45.0-45.5	6	80	45	; large gravel (2")	
MW-5	50.0-50.3	4	50	50	; no gravel	50 ft. BGS Bentonite seal
MW-5	55.0-55.3	4	50	55	; some gravel clasts (1/4"-1/2")	Sand pack (10/20 grade sand)
MW-5	60.0-61.0	12	80	60	; some cementation, firm, damp	60.07 ft. BGS, Top of screen 2" dia. Sch. 40 PVC screen (.010 slot) set in sand pack (10/20 grade sand)
MW-5	65.0-66.0	5	50	65	; some gravel	

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-5

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: Camelback Arboleda

PROJECT NO: 92676.504

DATE STARTED: 12-15-92

DATE COMPLETED: 12-15-92

LOCATION: 16th St. & Camelback Rd.

GROUND WATER ELEVATION (FT.): 1077.90

CASING REF. POINT ELEVATION (FT.): 1144.93

DRILLING/COMPANY: GMS

LOGGED BY: SJB/EJ

CHECKED BY: G. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	WELL CONST.	REMARKS
MW-5	70.0-71.0	4	50		ML; Sandy Silty Clay, light brown (7.5YR 6/4), low plasticity, little sand, firm, saturated		
MW-5	75.0-76.0	12	57	75			
MW-5	80.0-81.0	5	65	80			80.5 ft. BGS, Base of well (1/2 foot of sand below well)
					TD = 81 feet below ground surface		
					Groundwater level = 67.03 feet below ground surface		
				85			
				90			
				95			
				100			

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-6

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: Camelback Arboleda

PROJECT NO: 92676.504

DATE STARTED: 12-17-92 DATE COMPLETED: 12-17-92

LOCATION: 16th St. & Camelback Rd.

GROUND WATER ELEVATION (FT.): 1078.51 CASING REF. POINT ELEVATION (FT.): 1143.17

DRILLING/COMPANY: GMS

LOGGED BY: W. Miller CHECKED BY: G. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	REMARKS
					SM; Silty Fine Sand, yellowish brown (10YR 5/4), little gravel and clay, moist	Steel flush-mounted vault and 4' x 4' cement pad
MW-6	5.0-6.0		21	5		2" dia. Sch. 40 PVC casing set in Portland cement and bentonite grout seal
MW-6	10.0-11.0		14	10		
MW-6	15.0-16.0		28	15	ML; Fine Sandy Silt, light yellowish brown (10YR 6/4), little clay, trace gravel, moist	
MW-6	20.0-21.0		33	20		
MW-6	25.0-26.0		18	25		
MW-6	30.0-31.0		45	30		

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-6

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: Camelback Arboleda

PROJECT NO: 92676.504

DATE STARTED: 12-17-92 DATE COMPLETED: 12-17-92

LOCATION: 16th St. & Camelback Rd.

GROUND WATER ELEVATION (FT.): 1078.51 CASING REF. POINT ELEVATION (FT.): 1143.17

DRILLING/COMPANY: GMS

LOGGED BY: W. Miller CHECKED BY: G. Dozer

DRILLING METHOD: HSA

SAMPLE NO.	DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	Depth	LITHOLOGIC DESCRIPTION	WELL CONST.	REMARKS
MW-6	35.0-36.0		35		ML; Fine Sandy Silt, light yellowish brown (10YR 6/4), little clay, trace gravel, moist, light to medium cementation		
MW-6	40.0-41.0		29	40			
MW-6	45.0-45.8		100	45			
MW-6	50.0-51.0		35	50			50 ft. BGS Bentonite seal
MW-6	55.0-55.3		50	55	; light to medium cementation		Sand pack (10/20 grade sand)
MW-6	60.0-60.9		80	60	SM; Silty Sand, yellowish brown (10YR 5/4), little clay, trace gravel, moist, light to medium cementation		60.07 ft. BGS, Top of screen 2" dia. Sch. 40 PVC screen (.010 slot) set in sand pack (10/20 grade sand)
MW-6	65.0-65.3		50	65			

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

WELL NUMBER MW-6

LAW ENGINEERING, INC., 4634 S. 36th PLACE, PHOENIX, ARIZONA 85040

WELL LOG

PROJECT NAME: Camelback Arboleda | PROJECT NO: 92676.504

DATE STARTED: 12-17-92 | DATE COMPLETED: 12-17-92 | LOCATION: 16th St. & Camelback Rd.

GROUND WATER ELEVATION (FT.): 1078.51 | CASING REF. POINT ELEVATION (FT.): 1143.17 | DRILLING/COMPANY: GMS

LOGGED BY: W. Miller | CHECKED BY: G. Dozer | DRILLING METHOD: HSA

SAMPLE NO.	SAMPLE DEPTH (FT.)	RECOVERY (IN.)	BLOWS 12"	DEPTH	LITHOLOGIC DESCRIPTION	WELL CONST.	REMARKS
MW-6	70.0-70.9		100		SM; Silty Sand, yellowish brown (10YR 5/4), little clay, trace gravel, moist, light to medium cementation		
MW-6	75.0-75.8		100	75			
MW-6	80.0-81.0		60	80			80.5 ft. BGS, Base of well (1/2 foot of sand below well)
					TD = 81 feet below ground surface		
					Groundwater level = 64.66 feet below ground surface		
				85			
				90			
				95			
				100			

NOTES: Borehole = 8" diameter, BGS = Below Ground Surface, TD = Total Depth of Borehole; MSL = Mean Sea Level

ADWR Well No.: 55-203716

DEPTH (feet)	WELL CONSTRUCTION	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylenes (mg/kg)	FLD vapor PID (ppm)	BLOWS/6"	SAMPLE INTERVAL / NUMBER	U.S.C.S. DESIGNATION	SOIL DESCRIPTION
0	12" diameter traffic-rated steel vault and cover with 12" concrete apron								AC	**Asphalt**
10		<0.050	<0.050			37.3	14 16 26		CL	**Sandy Clay,** 5YR 5/3 reddish brown, predominately fine grained sand, moist, hard, medium plasticity, non-cemented
15	4.0" DIA. Schedule 40 PVC Casing Packed In Bentonite-Cement Grout	NA	NA			2.1	16 21 32		CL	**Sandy Clay,** same as above, slightly cemented, reacts with HCl
20		NA	NA			17.3	19 19 20			
25		NA	NA			14.1	12 18 23		SC	**Clayey Sand,** 5YR 5/4 reddish brown, predominately medium to coarse grained sand, trace fine grained sand, moist, dense, low plasticity, reacts with HCl, moderately cemented
30		NA	NA			18.6	16 16 19			Note: increase in sand and gravel
35										

Logged by: Ryan Merkley
Date started: 6/14/2004
Date completed: 6/15/2004

Ground surface elevation (feet): ~1143
Total depth (feet): 121.5
Drilling method: Hollow Stem Auger

Diameter of boring (inches): 10
Screen slot size (inches): 0.020
Casing diameter (inches): 4.0

KLEINFELDER

Project Number 51252 June 2005

Arizona Department of Environmental Quality
16th Street and Camelback Road WQARF Site
Phoenix, Arizona

LOG OF BORING MW-12

PLATE 3

DEPTH (feet)	WELL CONSTRUCTION	Benzene	Toluene	Ethylbenzene	Total Xylenes	FLD vapor PID	BLOWS/6"	SAMPLE INTERVAL	SAMPLE NUMBER	U.S.C.S. DESIGNATION	SOIL DESCRIPTION
		mg/kg				ppm					
35	4.0" DIA. Schedule 40 PVC Casing Packed In Bentonite-Cement Grout	NA	NA			15.5	16 24 36			SC-SM	**Silty Clayey Sand,** 5YR 5/4 reddish brown, predominately fine grained sand, moist, very dense, low plasticity, moderate to high cementation, reacts with HCl
44										CL	**Sandy Clay,** 5YR 5/4 reddish brown, predominately fine grained sand, trace coarse sand, moist, hard, medium plasticity, moderately cemented, reacts with HCl
45		<0.050	<0.050			33.5	19 50/5				
50	Bentonite seal										
53										SC	**Clayey Sand,** 5YR 6/4 light reddish brown, predominately fine to medium grained sand, trace fine grained gravel, moist, very dense, non-plastic to low plasticity, highly cemented, reacts with HCl
55	4.0" DIA. Schedule 40 PVC Casing Packed In 8-12 Colo. Silica Sand	<0.050	<0.050			33.2	84/6				
64										SC-SM	**Clayey Sand with Silt,** 5YR 6/4 light reddish brown, predominately fine grained sand, moist, very dense, low plasticity, highly cemented, reacts with HCl
65	4.0" DIA. 0.020 inch Slotted Schedule 40 PVC Screen Casing Packed In 8-12 Colo. Silica	NA	NA			33.0	35 50/4				
74										SC	**Clayey Sand,** 5YR 6/4 light reddish brown,
75											

DEPTH (feet)	WELL CONSTRUCTION	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylenes (mg/kg)	FLD vapor PID (ppm)	BLOWS/6"	SAMPLE INTERVAL	SAMPLE NUMBER	U.S.C.S. DESIGNATION	SOIL DESCRIPTION
75		<0.050	<0.050			35.5	31 50/4			SC	some silt, predominately fine grained sand, moist, very dense, medium plasticity, moderately cemented, reacts with HCl
85		NA	NA			29.6	15 18 24			SP	Sand with Silt and Clay, 5YR 4/4 dark grey, predominately medium grained sand, some fine grained gravel, wet, dense, non-plastic, non-cemented, no reaction with HCl
95	4.0" DIA. 0.020 inch Slotted Schedule 40 PVC Screen Casing Packed In 8-12 Colo. Silica	NA	NA			31.6	84/6			SP-SC	Sand with Silt and Clay, 5YR 5/3 reddish brown, predominately medium grained sand, some fine grained gravel, wet, very dense, low plasticity, moderately cemented, reacts with HCl
105		NA	NA			3.1	15 23 31			CL	Sandy Clay, 5RY 4/4 reddish brown, predominately fine grained sand, trace fine grained gravel, wet, hard, non- to very weakly cemented, no reaction with HCl
110											Note: clay becomes very hard to drill 110-115 feet
115											

ENV_KAZ_8260 51252.GPJ 6/24/05 KWB

KLEINFELDER

Project Number 51252 June 2005

Arizona Department of Environmental Quality
16th Street and Camelback Road WQARF Site
Phoenix, Arizona

LOG OF BORING MW-12

PLATE 3

DEPTH (feet)	WELL CONSTRUCTION	Benzene	Toluene	Ethylbenzene	Total Xylenes	FLD vapor PID	BLOWS/6"	SAMPLE INTERVAL	SAMPLE NUMBER	U.S.C.S. DESIGNATION	SOIL DESCRIPTION
		mg/kg				ppm					
115	4.0" DIA. 0.020 inch Slotted Schedule 40 PVC Screen Casing Packed In 8-12 Colo. Silica	NA	NA			37.5	26 24 38			CL	**Sandy Clay with Silt,** 5YR 4/4 reddish brown, predominately fine grained sand, trace fine grained gravel, wet, very dense, medium plasticity, slight to moderately cemented, reacts with HCl
120	Bottom cap	NA	NA			26.2	15 25 38				Note: decrease in sand, 5YR 6/2 Note: less cementation
											Boring terminated at 121.5 feet Sampling stopped at 123.0 feet
125											
130											
135											
140											
145											
150											
155											

ENV_KAZ_8260 51252.GPJ 6/24/05 KWB

KLEINFELDER

Project Number 51252 June 2005

Arizona Department of Environmental Quality
16th Street and Camelback Road WQARF Site
Phoenix, Arizona

LOG OF BORING
MW-12

PLATE

3

BROWN AND CALDWELL

BORING LOG

Project Name: 16th Street and Camelback		Well Number: MW-13	
Soil Boring ☐	Monitoring Well ☒	Project Number: 144183	Sheet 1 of 4
Boring Location: Camelback Toyota		Elevation: --	East: North:
Drilling Contractor: YJD	Driller: Roger	Date Started: 1/7/14	Date Finished: 1/8/14
Drilling Equipment: BK-81	Borehole Diameter: 9.75"	Completed Depth: (feet) 110.0	Water Depth: (feet) 77.9'
Sampling Method: Split Spoon		Type and Diameter of Well Casing: 4" Sch 40 PVC	
Drilling Method: Auger	Drilling Fluid: N/A	Screened Interval & Bottom: Screen 70-110; Bottom at 110	
Backfill Material: Well		Slot Size: .020"	Filter Material: 10-20 Sand
Logged By: R. Schaefer		Development Method: Surge and Bail	

Depth (feet)	USC Soil Type	Description	Sample	Lithology	Well	PID Readings (ppm)	Remarks
0	ML	**SILT WITH SAND** Fines (F) 75%, Sand (S) 20%, Gravel (G) 5% Silt is non-plastic. Loose. Dry. Sand is Fine (F), Sub-rounded. Gravel is angular to sub-angular. Dry. Light Brown.					SOIL DESCRIPTIONS BASED ON THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS).
5							
10	SM	**SILTY SAND** S 65%, F 35%, G <5% Sand is MF grained. Sub-angular to sub-rounded. Loose. Fines are non-plastic. Gravels are angular to sub-rounded. Dry. Light Brown.				0.0	
15							
20	SM	**SILTY SAND** S 55%, F 45%, G <5% Sand is F grained. Loose and well sorted. Sub-angular to sub-rounded. Loose. Fines are non-plastic. Gravels are angular to sub-rounded. Dry. Light Brown.				0.0	

BROWN AND CALDWELL

BORING LOG

Project Name: **16th Street and Camelback** Well Number: **MW-13**

Soil Boring ☐ Monitoring Well ☒ Project Number: **144183** Sheet **2** of **4**

Depth (feet)	USC Soil Type	Description	PID Readings (ppm)	Remarks
30	SM	**SILTY SAND** S 65%, F 30%, G 5% Sand MF. Sub-angular to sub-rounded. Loose. Fines are non-plastic. Gravels are F. Angular to sub-rounded. Dry. Light Brown.	0.0	
35				
40	ML	**SANDY SILT** F 55%, S 45%, G <5% Fines are non-plastic. Dry. Sand is F. Sub-rounded. Gravels are F. Sub-rounded. Dry. Brown.	0.0	
45				
50				
55				

IMSAMET ADEQ-16TH ST_CAMELBACK.GPJ BRN&CALD.GDT 1/31/14

BROWN AND CALDWELL

BORING LOG

Project Name: **16th Street and Camelback** Well Number: **MW-13**

Soil Boring ☐ Monitoring Well ☒ Project Number: **144183** Sheet **3** of **4**

Depth (feet)	USC Soil Type	Description	PID Readings (ppm)	Remarks
60	SM	**SILTY SAND** S 50%, F 40%, G 10% Sand is CMF. Angular to sub-rounded. Fines are non-plastic to having low plasticity. Gravels are angular. Dry. Brown.	0.0	
65				
70	SM	**SILTY SAND** S 70%, F 15%, G 15% Sand is CMF. Angular to sub-rounded. Majority MF. Fines have low plasticity, minor Clay. Gravels are angular to sub-angular. Majority F gravels. Moist. Light Brown.	0.0	
75				
80	SM	**SILTY SAND** S 70%, F 30%, G <5% Sand is MF grained. Majority is F. Sub-angular to sub-rounded. Fines are non-plastic. Loose. Moist. Dark Brown.	0.0	
85	SC	**CLAYEY SAND** S 55%, F 45%, G <5% Sand is MF. Majority F grained. Sub-angular. Fines have low plasticity. Soft. Moist. Dark Brown.	0.0	
90				

BROWN AND CALDWELL

BORING LOG

Project Name: **16th Street and Camelback** Well Number: **MW-13**

Soil Boring ☐ Monitoring Well ☒ Project Number: **144183** Sheet **4** of **4**

Depth (feet)	USC Soil Type	Description	PID Readings (ppm)	Remarks
	SM	**SILTY SAND** S 70%, F 20%, G 10% Sand is CMF. Angular to sub-rounded. Fines are non-plastic to having low plasticity. Gravels are F. Angular to sub-angular. Wet. Dark Brown.	0.0	
95	SC	**CLAYEY SAND** S 55%, F 45%, G <5% Sand is MF. Majority F grained. Sub-angular. Fines have low plasticity. Soft. Moist. Dark Brown.	0.0	
100	SM	**SILTY SAND** S 70%, F 20%, G 10% Sand is CMF. Angular to sub-rounded. Fines are non-plastic to having low plasticity. Gravels are F. Angular to sub-angular. Wet. Dark Brown.	0.0	
105	SM	**SILTY SAND** S 65%, F 25%, G 10% Sand is MF. Angular to sub-rounded. Fines are non-plastic. Gravels are F. Angular. Wet. Brown.	0.0	
110	CL	**SANDY LEAN CLAY** F 50%, S 40%, G 10% Fines have low plasticity. Minor cemetation. Sand is CMF. Majority F grained. Gravels are F. Angular to Sub-Angular. Moist. Light Brown.	0.0	

BROWN AND CALDWELL

BORING LOG

Project Name: 16th Street and Camelback	Well Number: MW-14
Soil Boring ☐ Monitoring Well ☒	Project Number: 144183 Sheet 1 of 4

Boring Location: 15th Stree, south of Camelback		Elevation: --	East: North:
Drilling Contractor: YJD	Driller: Roger	Date Started: 1/9/14	Date Finished: 1/10/14
Drilling Equipment: BK-81	Borehole Diameter: 9.75"	Completed Depth: (feet) 110.0	Water Depth: (feet) 80'
Sampling Method: Split Spoon		Type and Diameter of Well Casing: 4" Sch 40 PVC	
Drilling Method: Auger	Drilling Fluid: N/A	Screened Interval & Bottom: Screen 70-110; Bottom at 110	
Backfill Material: Well		Slot Size: .020"	Filter Material: 10-20 Sand
Logged By: R. Schaefer		Development Method: Surge and Bail	

Depth (feet)	USC Soil Type	Description	Sample	Lithology	Well	PID Readings (ppm)	Remarks
	ML	**SANDY SILT** F 65%, S 30%, G 5% Sand is F grained. Fines are non-plastic. Gravels are F. Angular. Loose. Dry. Light Brown.					SOIL DESCRIPTIONS BASED ON THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS).
5							
10			X			0.0	
15							
20			X				

IMSAMET ADEQ-16TH ST_CAMELBACK.GPJ BRN&CALD.GDT 1/31/14

BROWN AND CALDWELL

BORING LOG

Project Name: **16th Street and Camelback** Well Number: **MW-14**

Soil Boring ☐ Monitoring Well ☒ Project Number: **144183** Sheet **2** of **4**

Depth (feet)	USC Soil Type	Description	PID Readings (ppm)	Remarks
30	ML	**SILT WITH SAND** F 80%, S 20%, G <5% Fines are non-plastic. Sand is F. Sub-angular to sub-rounded. Dry. Brown.	0.0	
35				
40			0.0	
45				
50	SM	**SILTY SAND** S 55%, F 40%, G 5% Sand is CMF. Majority F grained. Angular to sub-rounded. Medium density. Fines are non-plastic. Gravels are F. Angular to sub-angular. Dry. Brown.	0.0	
55				

IMSAMET ADEQ-16TH ST_CAMELBACK.GPJ BRN&CALD.GDT 1/31/14

BROWN AND CALDWELL

BORING LOG

Project Name: **16th Street and Camelback** Well Number: **MW-14**

Soil Boring ☐ Monitoring Well ☒ Project Number: **144183** Sheet **3** of **4**

Depth (feet)	USC Soil Type	Description	PID Readings (ppm)	Remarks
60	SC	**CLAYEY SAND** Sand is CMF. Majority F grained. Angular to sub-rounded. Fines have low plasticity. Moderate density. Gravels are F. Angular to sub-angular. Dry. Dark Brown.	0.0	
65				
70	SM	**SILTY SAND** S 55%, F 45%, G <5% Sand is F grained. Sub-angular to sub-round. Fines have low plasticity. Heavily cemented. Dry. Dark Brown.	0.0	
75				
80	ML	**SANDY SILTY** F 65%, S 35%, G <5% Fines are non-plastic to having low plasticity. Soft. Sand is F grained. Sub-angular to sub-round. Moist. Dark Brown.	0.0	
85	SC	**CLAYEY SAND** S 50%, F 45%, G 5% Sand is CMF. Angular to sub-rounded. Fines have medium plasticity. Moist. Dark Brown.	0.0	
90				

BORING LOG

Project Name: **16th Street and Camelback** Well Number: **MW-14**

Soil Boring ☐ Monitoring Well ☒ Project Number: **144183** Sheet **4** of **4**

Depth (feet)	USC Soil Type	Description	Sample	Lithology	Well	PID Readings (ppm)	Remarks
	SC	**CLAYEY SAND** S 70%, F 25%, G 5% Sand is CMF. Angular to sub-rounded. Fines have medium plasticity. Moist. Dark Brown.				0.1	
95						0.0	
100	SC	**CLAYEY SAND** S 65%, F 35%, G <5% Sand is CMF. Angular to sub-rounded. Fines have medium plasticity. Moist. Dark Brown.				0.0	
105	SC	**CLAYEY SAND** S 80%, F 15%, G 5% Sand is CMF. Angular to sub-rounded. Fines have medium plasticity. Moist. Heavy cementation. Brown.				0.0	
110	SC	**CLAYEY SAND** S 60%, F 40%, G <5% Sand is CMF. Angular to sub-rounded. Fines have medium plasticity. Moist. Heavy cementation. Brown.				0.0	

LOG OF BORING OW

ADWR Well No.: 55-595980

DEPTH (feet)	WELL CONSTRUCTION	1,1-DCE	trans1,2-DCE	cis 1,2-DCE	TCE	PCE	FLD vapor PID (ppm)	BLOWS/6"	SAMPLE NUMBER	U.S.C.S. DESIGNATION	SOIL DESCRIPTION
		ppm=soil vapor ug/l=groundwater					ppm				
0	18" Traffic Rated Vault with Concrete Skirt									SM	**3" Asphalt** / **3" Aggregate Base** / **Silty Sand**, predominantly fine grained sand, trace fine gravel, yellowish brown (10YR, 5/4), moist, loose, weakly cemented, moderately reactive to dilute HCl
10											Note: increase in percent silt
15	2" Sch 40 PVC Casing in Cement Grout	<0.25 ppm	<0.25 ppm	<0.25 ppm	<0.19 ppm	0.18 ppm	0	13 17 20	OW1-15S	SM-SC	As above except clayey sand, brown (7.5YR, 4/4)
20								17 22 22	OW1-20.5S	ML	**Sandy Silt**, predominantly fine grained sand, mottled, very pale brown (10YR, 7/3) and yellowish brown (10YR, 5/4), very firm, low plasticity, moderately cemented, moderately to strongly reactive to dilute HCl
23										SM-SC	**Silty Sand**, predominantly fine grained sand, some coarse sand, brown, (10YR, 5/3), moist, dense, low to moderate plasticity, weakly to moderately cemented, strongly reactive to dilute HCl
25		<0.25 ppm	<0.25 ppm	<0.25 ppm	<0.19 ppm	1.16 ppm	0	20 32 36	OW1-25S		
32–35	Sand/Bentonite Seal										

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35

Logged by: Dave Mazzanti
Date started: 1/21/2003
Date completed: 1/21/2003

Ground surface elevation (feet): ~1145
Total depth (feet): 100.0
Drilling method: Hollow Stem Auger

Diameter of boring (inches): 12
Screen slot size (inches): 0.020
Casing diameter (inches): 2.0

KLEINFELDER

Project Number 23039 (17) May, 2004

Arizona Department of Environmental Quality
16th Street & Camelback Road WQARF Site
Phoenix, Arizona

LOG OF BORING OW

PLATE A-4

DEPTH (feet)	WELL CONSTRUCTION	1,1-DCE	trans1,2-DCE	cis 1,2-DCE	TCE	PCE	FLD vapor PID (ppm)	BLOWS/6"	SAMPLE NUMBER	U.S.C.S. DESIGNATION	SOIL DESCRIPTION
		ppm=soil vapor ug/l=groundwater					ppm				
35		<0.25 ppm	<0.25 ppm	<0.25 ppm	<0.19 ppm	<0.15 ppm	0	21 47 50/1	OW1-35S	SM-SC	As above except fine to medium grained sand, trace fine gravel, dark yellowish brown (10YR, 4/4)
42										SM	**Silty Sand**, predominately fine grained sand, brown (7.5YR, 4/4), moist, very dense, moderately to strongly cemented, strongly reactive to dilute HCl
45		<0.25 ppm	<0.25 ppm	<0.25 ppm	<0.19 ppm	0.50 ppm	0	15 50/2	OW1-45S		
48	2" Sch 40 PVC Screen (0.020" Slot) in 8-12 Colorado Silica Sand										
50										SC	**Clayey Sand**, predominately fine to medium grained sand, trace fine grained gravel, light yellowish brown (10YR, 6/4), moist, very dense, low plasticity, strongly cemented, strongly reactive to dilute HCl
55		<0.25 ppm	<0.25 ppm	<0.25 ppm	<0.19 ppm	0.72 ppm	0	75/6 100/3	OW1-55S		
65	Sand/Bentonite Seal	<0.25 ppm	<0.25 ppm	<0.25 ppm	<0.19 ppm	0.27 ppm	0	36 71/6	OW1-65S	ML	**Clayey Silt**, fine grained sand, pale brown (10YR, 6/3), moist, hard, low to medium plasticity, moderately cemented, very strongly reactive to dilute HCl
70		<0.25 ppm	<0.25 ppm	<0.25 ppm	<0.19 ppm	1.00 ppm	0	27 32 81/6	OW1-70S		As above except brown (10YR, 5/3), weakly cemented, slightly reactive to dilute HCl Note: depth to water ~71' bgs (1/2003)
72	2" Sch 40 PVC Screen (0.020" Slot)										
75											

KLEINFELDER

Project Number 23039 (17) May, 2004

Arizona Department of Environmental Quality
16th Street & Camelback Road WQARF Site
Phoenix, Arizona

LOG OF BORING OW

PLATE A-4

DEPTH (feet)	WELL CONSTRUCTION	CHEMICAL ANALYSES – LABORATORY: 1,1-DCE	trans1,2-DCE	cis 1,2-DCE	TCE	PCE	FLD: vapor PID	BLOWS/6"	SAMPLE: INTERVAL / NUMBER	U.S.C.S. DESIGNATION	SOIL DESCRIPTION
		ppm=soil vapor ug/l=groundwater					ppm				
75										ML	Note: drilling rate increased at 77.5'
80											Note: hard drilling
										SC-ML	**Clayey Sand, Clayey Silt**, predominately fine grained sand, some medium grained sand, brown (10YR, 4//3), wet, hard, medium plasticity, strongly cemented, non reactive to dilute HCl, interbedded clayey sands and fines, alternating increased and decreased drilling rates
85	2" Sch 40 PVC Screen (0.020" Slot)	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	21 ug/l	0	35 41 50/4	OW1-85S		
90		<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	9.1 ug/l	0	52/6 41 45	OW1-90S	SC	**Clayey Sand**, well graded, some fine to coarse gravel, dark yellow brown (10YR. 4/4), wet, very dense, low to medium plasticity, weakly to moderately cemented, spotty slight reaction to dilute HCl Drilling rate decreases
95										ML	**Silt**, fine grained sand, pale brown (10YR, 6/4), wet, hard, low plasticity, strongly cemented, strongly reactive to dilute HCl Alternating increasing and decreasing drilling rates
100		<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	31 ug/l	0	44 39 57/6	OW1-101S		
105											
110											
115											

KLEINFELDER

Project Number 23039 (17) May, 2004

Arizona Department of Environmental Quality
16th Street & Camelback Road WQARF Site
Phoenix, Arizona

LOG OF BORING OW

PLATE A-4

DEPTH (feet)	WELL CONSTRUCTION	1,1-DCE	trans1,2-DCE	cis 1,2-DCE	TCE	PCE	FLD vapor PID	BLOWS/6"	SAMPLE INTERVAL	SAMPLE NUMBER	U.S.C.S. DESIGNATION	SOIL DESCRIPTION ADWR Well No.: 55-595982
		ppm=soil vapor ug/l=groundwater					ppm					
0	24" Traffic Rated Vault with Concrete Skirt											**4" Asphalt**
											SM	**~ 3" Aggregate Base**
												Silty Sand, predominantly fine grained sand, trace fine gravel, yellowish brown (10YR, 5/4), moist, loose, weakly cemented, moderately reactive to dilute HCl
5												
10	Two 2" Sch 40 PVC Casing One 1" Sch 80 Tubing in Cement Grout											
											ML	**Clayey Silt**, fine grained sand, trace fine gravel, dark yellowish brown (10YR, 4/4), moist, hard, low to moderate plasticity, slightly to moderately cemented, moderately to strongly reactive with to HCl
15		<0.25 ppm	<0.25 ppm	<0.25 ppm	<0.19 ppm	0.68 ppm	0	25 29 50/5		SVE-AS1-15S		
	Bentonite Seal											Decreasing fines
20		<0.25ppm	<0.25ppm	<0.25 ppm	<0.19 ppm	0.72 ppm	0	11 9 21		SVE-AS1-20S	SM-SC	**Silty Sand**, predominately fine to medium grained sand, trace fine gravel, dark yellowish brown (10YR, 4/4), moist, low to medium plasticity, slightly cemented, moderately to strongly reactive to dilute HCl Sieve analysis performed
25								12 15 16		SVE-AS1-25S		As above
	2" Sch 40 PVC Screen (0.020" Slot) in 8-12 Colorado Silica Sand										ML	**Sandy Silt**, fine grained sand, yellowish brown (10YR, 5/4), dry, hard, low plasticity, weakly cemented, moderately to strongly reactive to dilute HCl
30		<0.25 ppm	<0.25 ppm	<0.25 ppm	<0.19 ppm	0.50 ppm	0	13 18 27		SVE-AS1-30S		
35												

Logged by: Dave Mazzanti
Date started: 1/13/2003
Date completed: 1/14/2003

Ground surface elevation (feet): ~1145
Total depth (feet): 122.0
Drilling method: Hollow Stem Auger

Diameter of boring (inches): 14
Screen slot size (inches): 0.020,0.010
Casing diameter (inches): 2 & 1

KLEINFELDER

Project Number 23039 (17) May, 2004

Arizona Department of Environmental Quality
16th Street & Camelback Road WQARF Site
Phoenix, Arizona

LOG OF BORING SVE-AS

PLATE **A-3**

DEPTH (feet)	WELL CONSTRUCTION	1,1-DCE	trans1,2-DCE	cis 1,2-DCE	TCE	PCE	FLD vapor PID	BLOWS/6"	SAMPLE NUMBER	U.S.C.S. DESIGNATION	SOIL DESCRIPTION
		ppm=soil vapor ug/l=groundwater					ppm				
35								17 20 25	SVE-AS1-35S	ML	As above, except moist Sieve analysis performed
40	2" Sch 40 PVC Screen (0.020" Slot) in 8-12 Colorado Silica Sand	<0.25 ppm	<0.25 ppm	<0.25 ppm	<0.19 ppm	0.40 ppm	0	142/6	SVE-AS1-40S		**Clayey Silt**, fine grained sand. yellowish brown (10YR, 5/4), moist, hard. low to medium plasticity. strongly cemented, moderately to strongly reactive to dilute HCl
45								106/6	SVE-AS1-45S		As above, except mottled yellowish brown (10YR, 5/4), and very pale yellowish brown (10YR, 7/3)
50	Sand/Bentonite Seal	<0.25 ppm	<0.25 ppm	<0.25 ppm	<0.19 ppm	0.68 ppm	0	183/6	SVE-AS1-50S		As above, except strongly reactive to dilute HCl
										SC	**Clayey Sand**, predominately fine to medium grained sand, trace coarse sand, brown (10YR, 5/3), very dense, strongly cemented, moderately to strongly reactive to dilute HCl
55								127/6	SVE-AS1-55S		
60		<0.25 ppm	<0.25 ppm	<0.25 ppm	<0.19 ppm	0.63 ppm	0	59/6 75/4	SVE-AS1-60S		As above, except very strongly reactive to dilute HCl
65	2" Sch 40 PVC Screen (0.020" Slot) in 8-12 Colorado Silica Sand							56/6 50/3	SVE-AS1-65S		As above
										ML	**Clayey Silt**, fine grained sand, yellowish brown (10YR, 5/3), moist, hard, low to medium plasticity, moderately cemented, moderately to strongly reactive to HCl
70		<0.25 ppm	<0.25 ppm	<0.25 ppm	<0.19 ppm	1.10 ppm	0	41 50/6	SVE-AS1-70S		Note: depth to water ~71' bgs
75											

16TH ST AND CAMELBACK 23039.GPJ cnewman@kleinfelder.com 5/14/04 sm

KLEINFELDER

Project Number 23039 (17) May, 2004

Arizona Department of Environmental Quality
16th Street & Camelback Road WQARF Site
Phoenix, Arizona

LOG OF BORING SVE-AS

PLATE A-3

DEPTH (feet)	WELL CONSTRUCTION	1,1-DCE	trans1,2-DCE	cis 1,2-DCE	TCE	PCE	FLD vapor PID	BLOWS/6"	SAMPLE NUMBER	U.S.C.S. DESIGNATION	SOIL DESCRIPTION
		ppm=soil vapor ug/l=groundwater					ppm				
75	2" Sch 40 PVC Screen (0.020" Slot) in 8-12 Colorado Silica Sand	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	29 ug/l	0	39 50/3	SVE-AS1-75S	ML	As above, except non to weakly reactive to dilute HCl
80								42 50/6	SVE-AS1-80S	CL	**Silty Clay**, some fine grained sand, dark yellow brown (10YR, 4/4), hard, moderately cemented, moderately reactive to dilute HCl
85	Bentonite Seal	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	5.6 ug/l	0	19 22 37	SVE-AS1-85S	SM	**Silty Sand**, fine grained sand, brown (10YR, 5/3), very dense, low plasticity, moderately cemented, slightly to moderately reactive to dilute HCl Sieve analysis performed Note: gravelly at approximately 89' to 90'
90		<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	<0.10 ug/l	0	22 35 50/5	SVE-AS1-90S		As above except fine to coarse grained trace gravel, non reactive to dilute HCl Note: alternating increasing and decreasing drilling rates
										SC	**Clayey Sand**, fine to medium grained sand, some fine gravel, dark yellowish brown (10YR, 4/4), medium plasticity, moderately cemented, moderately reactive to dilute HCl
95	1" Sch 40 PVC Screen (0.010" Slot) in 10-20 Colorado Silica Sand	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	0	74/6 100/5	SVE-AS1-95S		
100	Bentonite Seal							20 26 47	SVE-AS1-100		As above, except weakly cemented, weakly to moderately reactive to dilute HCl Sieve analysis performed
105	Gravel	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	46 ug/l	0	24 27 37	SVE-AS1-105		As above, except non to weakly reactive to dilute HCl
110								44 50/4	SVE-AS1-110	ML	**Clayey Silt**, fine grained sand, yellowish brown (10YR, 4,4), wet, hard, low to medium plasticity, moderately cemented, moderate to strongly reactive to dilute HCl
										SC	**Clayey Sand**, fine to medium grained sand, trace coarse grained sand, brown (10YR, 4/3), hard, medium plasticity, moderately
115											

KLEINFELDER

Project Number 23039 (17) May, 2004

Arizona Department of Environmental Quality
16th Street & Camelback Road WQARF Site
Phoenix, Arizona

LOG OF BORING SVE-AS

PLATE A-3

DEPTH (feet)	WELL CONSTRUCTION	CHEMICAL ANALYSES — LABORATORY: 1,1-DCE	trans1,2-DCE	cis 1,2-DCE	TCE	PCE	FLD: vapor PID	BLOWS/6"	SAMPLE: INTERVAL	SAMPLE: NUMBER	U.S.C.S. DESIGNATION	SOIL DESCRIPTION
		ppm=soil vapor ug/l=groundwater					ppm					
115	Gravel	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	2.1 ug/l	0	46 75/5		SVE-AS1-115	SC	cemented, weakly reactive to dilute HCl
											CL	**Silty Clay**, fine grained sand, yellowish brown, (10YR, 5,4), hard, medium plasticity, moderately cemented, weakly reactive to dilute HCl
120		<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	<2.0 ug/l	0	22 31 44		SVE-AS1-120		
125												
130												
135												
140												
145												
150												
155												

Appendix C: Groundwater Level Database (on CD)

Appendix D: Groundwater Quality Database (on CD)

Appendix E: Land and Water Use Surveys

LAND AND WATER USE STUDY QUESTIONNAIRE
FOR MUNICIPALITIES WITHIN THE
16TH STREET AND CAMELBACK ROAD WQARF REGISTRY SITE

Please answer all questions. Mark "NA" for questions that are not applicable. Mark "UNK" if the answer is unknown to you at the time of completion. Please attach any additional pages as needed.

Municipality Name: City of Phoenix

Date Questionnaire was completed: March 14, 2014

Name of person completing Questionnaire: Philip McNeely/ Gary Gin

Contact Name: Philip McNeely

Title: Manager, Office of Environmental Programs

Division: Office of Environmental Programs/ Water Services Department

Address: 20 West Washington/ 14th Floor

Phoenix, 85003

Phone Number: 602-256-5654

A. Property Information

1. What is the current use of your municipality's the property within the 16th Street and Camelback Road WQARF site? (Boundaries are Medlock Drive to the north, 17th Street to the east, Highland Avenue to the south, and 15th Street to the west).

   Restaurant and retail.

2. Please list the municipality's properties of concern/boundaries (neighborhood planning committees, zoning, canals, wells, etc.) with in the 16th Street and Camelback Road WQARF site boundary.

   Camelback East Village Planning Committee.

3. What are the foreseeable plans for the municipality property with in the 16th Street and Camelback Road WQARF site boundary as far into the future as they are known and up to 100 years, if possible?

   Currently, entitled for commercial development, however, in the future it could be redeveloped to multifamily residential.

4. Does the municipality have a published general plan for the property within the 16th Street and Camelback Road WQARF site boundary?

   Yes.

5. Are parcel, zoning, or land maps available through the municipality? Where are they located?

   Yes, phoenix.gov/planning.

6. Please list any specific concerns the municipality is aware of with in the 16th Street and Camelback Road WQARF site boundaries? Please list future concerns (e.g. freeway expansion, water use, water availability, etc.)

   N/A

7. Please list any future zoning plans or area plans for the municipality with in the 16th Street and Camelback Road WQARF site boundary?

   None planned, possible redevelopment of SW corner of 16th St and Camelback.

8. Please list any "special projects" projected or anticipated within the 16th Street and Camelback Road WQARF boundary.

   Non planned, projected or anticipated.

9. If any property is leased (the municipality is the lessor), how long is the lease term?

   N/A

10. If the property is leased, are there plans to renew the lease and if so, for how long?
    N/A

B. Environmental Information

1. Are there any groundwater wells on the property? If so, what is the current use (up to 100 years) of water in those wells? (e.g.- drinking water, water supply, monitoring, irrigation, remediation)

   There are no wells on the property.

2. Are there any proposed changes to the current use of water in the wells from item #1 anticipated for the next 100 years?

   None planned.

3. Please list your municipality's waste streams within the 16th Street and Camelback Road WQARF site, if any?

   N/A

4. Please list any environmental spill of material or waste products that has occurred within municipality within the 16th Street and Camelback Road WQARF site boundary in the past 5 years?

   Aware of none.

5. Is your municipality currently sampling any groundwater wells with in the 16th Street and Camelback Road WQARF site? If so, how often is the sampling conducted? Are analytical results being submitted to ADEQ for the groundwater database?

   No.

6. If there are any groundwater wells with in the 16th Street and Camelback Road WQARF site that supply drinking water, how in any people are served and what is the Public Water Supply (PWS) number?

   No.

7. Do you anticipate that any groundwater wells will be drilled in the next 100 years within the 16th Street and Camelback Road WQARF site? If yes, what will the water be used for?

   None planned.

8. Does your municipality have an environmental manager or is environmental management outsourced to an environmental consulting firm? If so, please list the person's information:

   Name: Philip McNeely

   Address: 200 West Washington Street, 14th Floor, Phoenix, 85003

   Phone Number: 602-256-5654

Thank you for your time. The Project Manager, Rebecca Kearny or a representative from ADEQ's consultant, Chris Legg at Brown and Caldwell, may follow-up on answers provided.

LAND AND WATER USE STUDY QUESTIONNAIRE
FOR UTILITIES WITHIN THE
16TH STREET AND CAMELBACK ROAD WQARF REGISTRY SITE

Please answer all questions. Mark "NA" for questions that are not applicable. Mark "UNK" if the answer is unknown to you at the time of completion. Please attach any additional pages as needed.

Utility Name: ____Salt River Project__________________________________

Date Questionnaire was completed: __March 26, 2014___________________

Name of person completing Questionnaire: _____Andrea Martinez_______

Contact Name: ____Andrea Martinez_________________________

Title: ___Senior Environmental Engineer______________________

Division: ___Environmental Compliance___________________

Address: ___PAB 352, P. O. Box 52025____________________

___Phoenix AZ 85233__________________________

Phone Number: ___602-236-2618___________________________

A. Property Information

1. What is the current use of your utility's the property within the 16th Street and Camelback Road WQARF site? (Boundaries are Medlock Drive to the north, 17th Street to the east, Highland Avenue to the south, and 15th Street to the west).

   SRP owns and operates water conveyance structures and water supply wells (both wells within in one quarter mile) that produce and convey water for its shareholders.

2. Please list the utility's properties of concern/boundaries (neighborhood planning committees, zoning, canals, wells, etc.) with in the 16th Street and Camelback Road WQARF site boundary.

   SRP owns two water supply wells in the area, one active located at the southwest corner of Campbell Avenue and 16th Street (SRP Wellsite 15E-8.5N) the second inactive well located on the southwest corner of Coulter and 16th Streets (SRP Wellsite 15E-9.3N). Though not technically in the WQARF site, these two wells are located within one quarter (1/4) mile of the site.

Because of our reliance on groundwater during drought, SRP is very concerned with any water quality problems in the aquifer or with the threat of groundwater contamination. This is important to safeguard the ability to utilize these wells.

3. What are the foreseeable plans for the utility's property with in the 16th Street and Camelback Road WQARF site boundary as far into the future as they are known and up to 100 years, if possible?

   Future plans are dictated by water service expansions in the area. Since this area is built out, service expansions should be limited in the vicinity of the 16th Street and Camelback WQARF site.

4. Does the utility have a published general plan for the property within the 16th Street and Camelback Road WQARF site boundary?

   No, all major utilities are in place.

5. Are parcel, zoning, or land maps available through the utility? Where are they located?

   Not available.

6. Please list any specific concerns the utility is aware of with in the 16th Street and Camelback Road WQARF site boundaries? Please list future concerns (e.g. freeway expansion, water use, water availability, etc.)

   No concerns within the boundaries, except water quality.

7. Please list any future zoning plans or area plans for the utility with in the 16th Street and Camelback Road WQARF site boundary?

   None, SRP does not do zoning.

8. Please list any "special projects" projected or anticipated within the 16th Street and Camelback Road WQARF boundary.

   No "special projects", routine maintenance and operation of existing facilities.

9. If any property is leased (the utility is the lessor), how long is the lease term?

   There is no property in the area where SRP is the lessor.

10. If the property is leased, are there plans to renew the lease and if so, for how long?

    N/A

B. Environmental Information

1. Are there any groundwater wells on or near the property? If so, what is the current use (up to 100 years) of water in those wells? (e.g.- drinking water, water supply, monitoring, irrigation, remediation)

   Yes SRP owns one active well located at the southwest corner of Campbell Avenue and 16th Street, Wellsite 15E-8.5N is approximately one eighth (1/8) mile north the WQARF site. The second well is currently inactive, located on the southwest corner of Coulter and 16th Streets, SRP Wellsite 15E-9.3N is approximately one quarter (1/4) mile south of the WQARF site. Current water use is agricultural and urban irrigation.

2. Are there any proposed changes to the current use of water in the wells from item #1 anticipated for the next 100 years?

   SRP expects to retain and operate the above-listed wells to provide water supply for its shareholders. Currently, the wells provide water for irrigation, but SRP anticipates that the wells will transition to drinking water supply as the area develops. SRP is in discussions with the City of Phoenix about providing additional groundwater to the City when surface water supplies are unavailable or insufficient and to give the City more operational flexibility. To achieve such a result, SRP would either direct connect wells to the City's municipal water distribution system or deliver groundwater to a canal that serves a City water treatment plant.

3. Please list your utility's waste streams within the 16th Street and Camelback Road WQARF site, if any?

   Waste streams generated within the WQARF site, if any, would be maintenance and operations related. Any waste material generated is removed from the property and properly disposed of offsite.

4. Please list any environmental spill of material or waste products that has occurred within utility within the 16th Street and Camelback Road WQARF site boundary in the past 5 years?

   None

5. Is your utility currently sampling any groundwater wells with in the 16th Street and Camelback Road WQARF site? If so, how often is the sampling conducted? Are analytical results being submitted to ADEQ for the groundwater database?

   Yes, Wellsite 15.0E-8.5N is currently sampled periodically, sampled annually most years. Analytical results are being submitted to ADEQ for the groundwater database.

6. If there are any groundwater wells with in the 16th Street and Camelback Road WQARF site that supply drinking water, how in any people are served and what is the Public Water Supply (PWS) number?

   SRP does not have wells within this WQARF site that supply during water.

7. Do you anticipate that any groundwater wells will be drilled in the next 100 years within the 16th Street and Camelback Road WQARF site? If yes, what will the water be used for?

   None planned at this time. SRP considers all land within the Salt River Reservoir District boundaries potentially available for future well locations. Please see response #2 above regarding potential future use of wells.

8. Does your utility have an environmental manager or is environmental management outsourced to an environmental consulting firm? If so, please list the person's information:

   Name: David Sultana

   Address: SRP Manager Water Quality, Waste Management, Field Services

   PAB 352, P. O. Box 52025

   Phoenix AZ 85233

   Phone Number: 602-236-8118

Thank you for your time. The Project Manager, Rebecca Kearny or a representative from ADEQ's consultant, Chris Legg at Brown and Caldwell, may follow-up on answers provided.

Appendix F: Responsiveness Summary

RESPONSIVENESS SUMMARY

REMEDIAL INVESTIGATION REPORT
16TH STREET AND CAMELBACK WQARF REGISTRY SITE
PHOENIX, ARIZONA

Arizona Department of Environmental Quality
Remedial Projects Unit
1110 West Washington
Phoenix, Arizona 85007

Prepared By:

Arizona Department of Environmental Quality
Remedial Projects Unit

March 31, 2015

RESPONSIVENESS SUMMARY

REMEDIAL INVESTIGATION REPORT

16TH STREET AND CAMELBACK WQARF REGISTRY SITE
PHOENIX, ARIZONA

INTRODUCTION

Pursuant to the requirements of the Arizona Administrative Code (ACC) R-18-16406(H) the Arizona Department of Environmental Quality (ADEQ) has prepared this comprehensive responsiveness summary for comments received on the *Draft Remedial Investigation Report, 16th Street and Camelback Road WQARF Site, Phoenix, Arizona* dated January 6, 2015. The 16th Street and Camelback Water Quality Assurance Revolving Fund (WQARF) site (Site) Draft Remedial Investigation (RI) Report was made available for public review and comment on January 6, 2015 for 60 days. A community advisory board (CAB) meeting was held at A.L. Moore-Grimshaw Mortuaries Bethany Chapel on March 11, 2015 during the 60-day public comment period. The purpose of the meeting was to receive oral and/or written comments on the Draft RI Report and to solicit and consider proposed remedial objectives. ADEQ received two oral comments from CAB member Stan Watts during the CAB meeting and an oral comment from CAB member Maureen Rooney via telephone on March 23 regarding the Draft RI Report. Subsequent to the CAB meeting, Mr. Watts clarified one of his comments in an email to ADEQ and CAB member Mr. Paul Thomas Cox submitted an email with a written comment on the Draft RI Report. The following sections include the text of the comments along with responses from ADEQ to address the comments. The written comments received are included in Attachment A.

Oral Comments

Stan Watts

1. Mr. Watts mentioned on one of the drawings, areas were identified on the Site from which water would be used but isn't used now or hasn't been for a while. Mr. Watts stated they weren't called production wells, and asked for clarification in the document, talking more about what that water source is, stating the difference between production wells and other water sources or wells.

- ADEQ Response: There are several wells within one mile of the Site that are designated as water production wells that are owned by Salt River Project (SRP), the City of Phoenix and private owners. However, there are no wells within the Site boundaries that are used for water production. The report mentions the presence of the wells within one mile of the Site in Section 2.3.3.2 and Section 6.2.2. The report mentions that these are water supply wells that are in locations that are not at a risk by the contamination. There is a table in Appendix A that identifies the wells. A foot note has been added to Figure 3 indicating the presence of the Appendix A table.

Stan Watts

2. Mr. Watts had another comment on the maps, stating that they were strong showing background and analysis, but they were not consistent with showing updated aerials and/or graphics to show consistency. He stated one of the maps was a current map on a historic aerial photo and that they should all be the same aerial for consistency.

- ADEQ Response: There are three figures (Figures 1, 3, and 5) that are not consistent with the majority of the figures regarding the aerials and/or graphics. Because of the scale used for figures 1 and 3 to show the surrounding area of the Site, ADEQ believes that aerial photographs should not be used as background. Figure 5 has been updated to use an aerial photograph that is the same as the photograph used in the other figures.

Maureen Rooney

3. Ms. Rooney called to identify a typo on page 1-3 regarding the address description of the site. She also indicated that the Land and Water Use Evaluation Section of the report does not mention residential use even though there is current construction of a new apartment complex at the northwest corner of 16th Street and Highland Avenue.

- ADEQ Response: The sentence with the typo has been removed as it was misleading. The zoning description has been edited to identify the apartment construction.

Written Comments

Stan Watts

1. My confusing question last night related to Figure 3 of the RI. There are blue dots upgradient from our site that are labeled "water production." The report mentions them, but does not explain what they are. I assume they must be closed private wells, but there is no way to tell. This lack of clarity leav**e**s room for folks to be worried about the unknown. I would like to have this clarified so there is no confusion. Thanks.

- ADEQ Response: Section 2.3.3.2 and Section 6.2.2 of the RI report state that two of the wells are SRP wells used for irrigation but did not elaborate on the other water production wells. These are a City of Phoenix well located at Madison Park and privately owned wells and the two sections have been edited to state this. Also, as mentioned above, Figure 3 has a footnote added stating that Appendix A contains a table identifying the wells.

Paul Thomas Cox

2. The Draft adequately discusses what is currently included in the Report. However, it slights discussion on the actual and potential impacts of contaminants on the site to public health, *welfare* and the environment in **Section 6.**

Since ADEQ's stated goal is to protect and enhance the environment *and improve the quality of life*, it provides balance between the natural world and people, who depend on it for sustenance, *prosperity and fulfilling quality of life.*

Perhaps why **Section 6** is so weak in this Draft is that the Director of ADEQ admits, in its FY2014 Annual Report, based on its current liability scheme and funding challenges, that its program is not sustainable.

This goes full circle, that is, the current Purpose and Function of the CAB is limited by inadequacy of **Section 6** to provide information to the public on impacts affecting *prosperity and fulfilling quality of life.* Why investigate and present such detailed information in Sections 2 thru 5, when resources available are very questionable to assure *prosperity and fulfilling quality of life* can be achieved or most probably face diminishment. These are concepts that the public can grasp not so much presentation on technical details of remediation.

With more weight given to **Section 6**, the Purpose and Function of CAB can be strengthened and expanded. The following Feasibility Study will be more balanced, our Community Involvement more effective, and our public can be made aware of alternatives affecting *prosperity and fulfilling quality of life.* The public become aroused when prosperity and quality of life are threatened.

ADDENDUM

The 16th Street & Camelback WQARF Site Draft Report is but one example of how technical aspects of a problem area become disassociated with social and welfare of the public affected. Add to this the general problem that departments and agencies fall to the 'silo' affect. That is, in following their own mandate, too often narrowly defined, the overriding social and welfare concerns of the body public become minimal.

This results in under appreciation of an individual department or agency contributions to the general welfare by the public. This, in turn, allows legislators to under fund their efforts.

In reading ADEQ's Mission and Vision, I see why the problem surfaced in the above review exists. My recommendation to rewrite and adopt changes as the following:

Assembles, interprets and communicates credible, science-based information to legislators, regulators, policymakers, the media, the private sector, and the public. ADEQ will be recognized as a credible and objective source of science-based information on environmental remedial issues across the urban–rural continuum—especially those issues regarding landscape environments, related natural resource, societal, and environmental concerns necessary to sustain quality of life.

In short, more of a mandate sought to emphasize prescriptive as well as description to the public.

Assembles, interprets and communicates credible, science-based information to legislators, regulators, policymakers, the media, the private sector, and the public. ADEQ will be recognized as a credible and objective source of science-based information on environmental remedial issues across the urban–rural continuum—especially those issues regarding landscape environments, related natural resource, societal, and environmental concerns necessary to sustain quality of life. (sic)

- ADEQ Response: The purpose of Section 6 is to identify current and future land and water uses within the site. Section 6 has been edited to better identify groundwater wells that are located within one mile of the Site.

ATTACHMENT A

RESPONSIVENESS SUMMARY – WRITTEN COMMENTS

REMEDIAL INVESTIGATION REPORT

16TH STREET AND CAMELBACK WQARF REGISTRY SITE
PHOENIX, ARIZONA

The written comments are attached.

Kevin C. Snyder

From: Stan Watts <watts@dwlaw.net>
Sent: Thursday, March 12, 2015 10:55 AM
To: Kevin C. Snyder
Subject: 16th and Camelback RI

Kevin –
My confusing question last night related to Figure 3 of the RI. There are blue dots upgradient from our site that are labeled "water production." The report mentions them, but does not explain what they are. I assume they must be closed private wells, but there is no way to tell. This lack of clarity leaves room for folks to be worried about the unknown. I would like to have this clarified so there is no confusion. Thanks.
Regards,
Stan Watts

Dohrer & Watts, P.L.C.
One E. Camelback Rd., Ste. 550
Phoenix, AZ 85012

Tel. 602/279-7488
Fax 602/279-5563

Caroline Oppleman

From: Tom Cox <tom.cox.ceo@gmail.com>
Sent: Tuesday, March 17, 2015 9:40 PM
To: Alicia Hawley; Anthony Ricci; Caroline Oppleman; Chad Johnson; Daniel Kingston; Lynn Morrow; Maureen Rooney; Pam Perry; Paul Barquinero; Stan Watts
Subject: COMMENTS
Attachments: ADEQ.docx

SEE ATTACHED

COMMENTS

By

Paul Thomas Cox, CAB Member

On

Draft Remedial Report, 16th Street & Camelback WQARF Site

The Draft adequately discusses what is currently included in the Report. However, it slights discussion on the actual and potential impacts of contaminants on the site to public health, *welfare* and the environment in **Section 6.**

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This results in under appreciation of an individual department or agency contributions to the general welfare by the public. This, in turn, allows legislators to under fund their efforts.

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In short, more of a mandate sought to emphasize prescriptive as well as description to the public.

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Appendix G: Remedial Objectives

REMEDIAL OBJECTIVES REPORT
16^{th} STREET AND CAMELBACK
WATER QUALITY ASSURANCE REVOLVING FUND
REGISTRY SITE
PHOENIX, ARIZONA

May 6, 2015

Arizona Department of Environmental Quality
Remedial Projects Unit
1110 West Washington
Phoenix, Arizona 85007

TABLE OF CONTENTS

APPENDICES

LIST OF ABBREVIATIONS & ACRONYMS

A.A.C.	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
AMA	Active Management Area
A.R.S.	Arizona Revised Statutes
CAB	Community Advisory Board
COC	Contaminant of Concern
FS	Feasibility Study
LWUS	Land and Water Use Study
PCE	Tetrachloroethene
RO	Remedial Objective
RI	Remedial Investigation
SRL	Soil Remediation Level
SRP	Salt River Project Agricultural Improvement and Power District
WQARF	Water Quality Assurance Revolving Fund

1.0 INTRODUCTION

The Arizona Department of Environmental Quality (ADEQ) has prepared this Remedial Objectives (ROs) Report for the 16th Street and Camelback Water Quality Assurance Revolving Fund (WQARF) Registry Site (the Site) to meet requirements established under Arizona Administrative Code (A.A.C.) R18-16-406. This RO Report relies upon the Land and Water Use Study (LWUS) and questionnaires contained in the 16th Street and Camelback Remedial Investigation (RI) Report prepared by ADEQ and others.

ROs are established for the current and reasonably foreseeable uses of land and waters of the state that have been or are threatened to be affected by a release of a hazardous substance. Pursuant to A.A.C. R18-16-406(D), it is specified that reasonably foreseeable uses of land are those likely to occur at the site and the reasonably foreseeable uses of water are those likely to occur within one hundred years unless site-specific information suggests a longer time period is more appropriate.

Reasonably foreseeable uses are those likely to occur, based on information provided by water providers, well owners, land owners, government agencies, and others. Not every use identified in the LWUS will have a corresponding RO. Uses identified in the LWUS may or may not be addressed based on information gathered during the public involvement process, limitations of WQARF, and whether the use is reasonably foreseeable.

The ROs must be stated in the following terms: (1) protecting against the loss or impairment of each use; (2) restoring, replacing, or otherwise providing for each use; (3) when action is needed to protect or provide for the use; and (4) how long action is needed to protect or provide for the use.

The ROs chosen for the site will be evaluated in the feasibility study (FS) phase of the WQARF process. The FS will evaluate specific remedial measures and strategies required to meet ROs. A remedial strategy is one or a combination of six general strategies identified in Paragraph B.4 of Arizona Revised Statutes (A.R.S.) 49-282-06 (plume remediation, physical containment, controlled migration, source control, monitoring, and no action.). A remedial measure is a specific action taken in conjunction with remedial strategies to achieve one or more ROs (for example, well replacement, well modification, water treatment, water supply replacement, and engineering controls.).

The FS will propose at least three remedies, a reference remedy and generally two alternative remedies, capable of meeting ROs. A reference remedy is a remedial strategy or combination of remedial strategies and measures capable of achieving ROs, and is compared with alternative remedies for purposes of selecting a proposed remedy. An alternative remedy is a remedial strategy or combination of remedial strategies and measures different from the reference remedy; alternative remedies are compared with the reference remedy for purposes of selecting a proposed remedy. Proposed remedies will also be generally compatible with future land and water use specified by land owners and water providers.

Written comments on this Proposed RO Report will be accepted for a period of 30 days following its release.

2.0 REMEDIAL OBJECTIVES FOR LAND USE

The Site is located in the City of Phoenix and is bounded approximately by Camelback Road to the north, 17th Street to the east, Highland Avenue to the south and 15th Street to the west. Contaminant of concern (COC) for the Site is tetrachloroethene (PCE). After several years of investigations, the source area of the COC was determined to be at the former drycleaner facility at the southeast corner of 16th Street and Camelback Road.

Typically, ROs for land use are established for those properties known to be contaminated with hazardous substances above a Soil Remediation Level (SRL) or a risk-based level. However; all soil investigations conducted in the southeast corner of 16th Street and Camelback Road indicate that the COC is no longer present in soils at the Site.

2.1 Summary of Current and Reasonably Foreseeable Land Use

Generally, the Site is located in a commercial area. Based on the current zoning maps provided by the City of Phoenix, the Site is zoned as commercial with possible redevelopment to multifamily residential. Currently the northwest corner of Highland Avenue and 16th Street is under construction for an apartment complex.

2.2 Soil Remedial Objective

Based on the information presented above, the COC is not present in soil at concentrations greater than Arizona remediation standards. Therefore, no remedial objectives are needed for land use or soil remediation.

3.0 REMEDIAL OBJECTIVES FOR GROUNDWATER USE

The groundwater use portion of the Use Report is an inclusive summary of information gathered from the Arizona Department of Water Resources (ADWR), water providers, municipalities, and land owners. Currently there are no groundwater supply wells within the Site boundaries.

3.1 Summary of Current and Reasonably Foreseeable Groundwater Use

The Site lies within the Phoenix Active Management Area (AMA). The Phoenix AMA was created by the Arizona Groundwater Management Code passed in 1980 and covers approximately 5,646 square miles in central Arizona. All groundwater withdrawn from any AMA must occur under a groundwater right or permit, unless groundwater is being withdrawn from an exempt well.

According to ADWR records, there are no non-exempt withdrawal wells or exempt withdrawal wells in the Site. The City of Phoenix and Salt River Project Agricultural Improvement and Power District (SRP) have service area rights in the Site, however, of the two, only SRP is currently pumping groundwater in the vicinity of the Site.

Land and water use questionnaires were mailed to the City of Phoenix and SRP to obtain information regarding current and future uses of groundwater within the Site. The following paragraphs identify current and foreseeable groundwater uses within the Site and ROs.

The Site is in the City of Phoenix and the Phoenix AMA, an area where groundwater use is controlled and regulated. The City of Phoenix does not have groundwater wells within the Site but has indicated that it may install wells here in the future. Currently a portion of the groundwater within the Site is contaminated with COCs that would restrict use of the groundwater by the City of Phoenix if the city wanted to use the groundwater for municipal purposes.

With the exception of two SRP wells, the predominant well use is for monitoring purposes. Regarding current and projected water use, SRP states, "Currently, the wells provide water for irrigation but SRP anticipates that the wells will transition to drinking water supply wells as the area develops. SRP is in discussions with the City of Phoenix about providing additional groundwater to the City when surface water supplies are unavailable or insufficient and to give the City more operational flexibility."

In its survey responses, SRP indicates because of its reliance on groundwater to supplement its surface water supplies during periods of drought, SRP is very concerned with any water quality problems in the aquifer or with a threat of groundwater contamination. It is important to SRP to safeguard the ability to utilize their wells, and SRP indicates it is conceivable that during periods of severe drought, SRP wells in the area may be utilized at their full annual registered volumes.

Also in its land and water use questionnaire response, SRP anticipates all of its properties in the vicinity of the Site will remain in use in the future. Therefore, SRP believes any plan to remediate groundwater needs to recognize the highly variable pumping scenarios that may occur in and around the Site.

3.2 Groundwater Remedial Objective

There is no current groundwater use in the Site, however, the regional aquifer is considered to be a drinking water source for the City of Phoenix and SRP. Therefore, the current and future use of the regional aquifer must be protected.

> **The remedial objective for regional groundwater at the site is to protect for the use as a groundwater supply by the City of Phoenix and SRP. This action is currently not needed but may be needed if/when groundwater use changes to municipal/drinking water. This action will be needed for as long as the level of contamination in the groundwater threatens the use of the regional groundwater for municipal/drinking water uses.**

4.0 REMEDIAL OBJECTIVES FOR SURFACE WATER USE

The surface water use portion of the Use Report indicates that surface water usage within the Site is for agricultural and urban irrigation. The surface water source is outside the Site.

4.1 Summary of Current and Reasonably Foreseeable Surface Water Use

SRP does not extract groundwater from the Site. However, surface water is conveyed across the Site via lateral canals which can be used for irrigation within the site and discharges into the SRP Grand Canal south of the site which is subsequently used for irrigation outside of the site. Future SRP plans for the Grand Canal include a possible drinking water treatment plant that may be constructed at the end of the Grand Canal.

4.2 Surface Water Remedial Objective

Current surface water use in the Site is for irrigation and comes from groundwater sources outside the site; SRP's reasonably foreseeable plans are to use the surface water for drinking water purposes. However the source of this surface water is from groundwater outside the site and is discharged to concrete lined canals. Contaminated groundwater within the site does not discharge to these canals and therefore no RO is necessary. When SRP opts to construct their drinking water treatment plant, the water will be adequately protected for drinking water use.

APPENDIX A

A ORAL RECOMMENDATIONS RECEIVED DURING SOLICITATION FOR PROPOSED REMEDIAL OBJECTIVES

As per Arizona Administrative Code (A.A.C.) R18-16-406(I), a community advisory board (CAB) meeting was held at A.L. Moore-Grimshaw Mortuaries Bethany Chapel on March 11, 2015 during the 45-day to 90-day public solicitation period for the Remedial Objectives (ROs). The purpose of the meeting was to solicit and consider proposed ROs for the 16th Street and Camelback Water Quality Assurance Revolving Fund (WQARF) Site. The meeting gave a public forum for oral and written comments to be submitted. Arizona Department of Environmental Quality (ADEQ) received an oral proposed RO from the CAB members present during the meeting. The oral proposed RO received is as follows:

CAB Members

The CAB requested that the sample RO presented during the CAB meeting which designated that the regional groundwater at the site be protected for the use as a groundwater supply by the City of Phoenix, and Salt River Project (SRP).

APPENDIX B

B WRITTEN RECOMMENDATIONS RECEIVED DURING SOLICITATION FOR PROPOSED REMEDIAL OBJECTIVES

As mentioned in Appendix A, per Arizona Administrative Code (A.A.C.) R18-16-406(I), a community advisory board meeting was held at A.L. Moore-Grimshaw Mortuaries Bethany Chapel on March 11, 2015 during the 45-day to 90-day public solicitation period for the Remedial Objectives (ROs). The purpose of the meeting was to solicit and consider proposed ROs for the 16th Street and Camelback Water Quality Assurance Revolving Fund (WQARF) Site. The meeting gave a public forum for written comments to be submitted. The Arizona Department of Environmental Quality (ADEQ) did not receive any written proposed remedial objectives during the meeting or during the solicitation period.

APPENDIX C

C WRITTEN COMMENTS RECEIVED FOR PROPOSED REMEDIAL OBJECTIVES

As per A.A.C. R18-16-406(I)(5), "The Department shall provide notice and accept and consider public comment on the proposed remedial objectives in the remedial objectives report and shall hold at least 1 additional public meeting if significant public interest exists or if significant issues or information have been brought to the attention of the Department which have not been considered previously." A public notice for the 16th Street and Camelback Water Quality Assurance Revolving Fund (WQARF) Site (Site) Draft Remedial Objectives Report was issued on April 2, 2015 and the comment period extended from April 2 through May 1, 2015. No public meeting was held during the extended 30 day comment period. The Arizona Department of Environmental Quality (ADEQ) received one written comment during the 30 day comment period. The written comment received is as follows:

Tom Cox

The Introduction states The ROs must be stated in the following terms: (1) protecting against the loss or impairment of each use; (2) restoring, replacing, or otherwise providing for each use; (3) when action is needed to protect or provide for the use; and (4) how long action is needed to protect or provide for the use.

3.2 Groundwater Remedial Objective indicates that action is currently not needed but may be needed if/when groundwater use changes to municipal/drinking water. This action will be needed for as long as the level of contamination in the groundwater threatens the use of the regional groundwater for municipal/drinking water uses. Again however, as stated in my earlier comments on the Draft Remedial Report, impacts affecting *prosperity and fulfilling quality of life* are ignored.

The public and subsequent public policy cannot easily grasp *if/when* concepts. Remedial actions first require public awareness then generation of public support for action. Then hopefully follows citizen push for legislative action that will provide the financial resources along with private sector support.

Therefore the *if/when* should be stated in probabilities within specific time periods the public can relate to actions needed. Example below:

0 -10 years – 0.0% – 10%
11 – 20 years – 10% - 30%
21 – 50 years – 30% - 70%
51 – 100 years – 70% - ?

It must be noted Pursuant to A.A.C. R18-16-406(D), it is specified that reasonably foreseeable uses of land are those likely to occur at the site and the reasonably foreseeable uses of water are those likely to occur within *one hundred years* unless site-specific information suggests a longer time period is more appropriate.

In short, it is evident there is little short term risk to this site. However, the intensity of increasing risk over time must be stressed in order to start the public awareness referred to above if we expect to gain benefit from our efforts expended to date.

ADEQ Response: The Remedial Objective (RO) for groundwater is protective of human health and the environment; currently and for the future. If a water provider choses to install a groundwater production well within the Site the RO for groundwater will be met at that time. Because of extenuating factors such as the current drought and changes in water usage, ADEQ can not put a date or percentage on the day or likelihood that water providers may install a groundwater production well within the Site. Therefore, the RO is written to not be restrictive of the time frame for groundwater usage. However, based on data obtained during the remedial investigation of the Site, ADEQ expects that natural attenuation of the Site COC will be complete within approximately five to ten years.

The written comment is attached.

Kevin C. Snyder

From: Tom Cox <tom.cox.ceo@gmail.com>
Sent: Sunday, April 12, 2015 10:52 PM
To: Kevin C. Snyder; Alicia Hawley; Anthony Ricci; Caroline Oppleman; Chad Johnson; Daniel Kingston; Lynn Morrow; Maureen Rooney; Pam Perry; Paul Barquinero; Stan Watts
Subject: RO COMMENTS
Attachments: ADEQ-1.docx

SEE ATTACHED

COMMENTS

By

Paul Thomas Cox, CAB Member

On

Draft Remedial Objectives Report

16th Street & Camelback WQARF Site

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04-12-2015