OCTOBER 7, 2014

REVISED PROPOSED REMEDIAL ACTION PLAN

WESTERN AVENUE WQARF SITE

AVONDALE AND GOODYEAR, ARIZONA

PREPARED FOR:
ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

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ACRONYMS AND ABBREVIATIONS

A.C.C.	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
ARS	Arizona Revised Statutes
AWQS	Aquifer Water Quality Standard
bgs	Below ground surface
CAG	Community Advisory Group
COG	City of Goodyear
COGPW	City of Goodyear Public Works
COG-01	City of Goodyear production well number 1
CSM	Conceptual site model
EPA	U.S. Environmental Protection Agency
ERA	Early response action
ft/ft	Feet per foot
FS	Feasibility study
GeoTrans	GeoTrans, Inc.
gpd/ft	Gallons per day per foot
gpd/ft^2	Gallons per day per square foot
H+A	Hargis + Associates, Inc.
ITSI	ITSI Gilbane Company
LAU	Lower alluvial unit
MAU	Middle alluvial unit
mg/l	Milligram per liter
MNA	Monitored natural attenuation
Nitrate-N	Nitrate as nitrogen
PCE	Perchloroethene/tetrachloroethene
PGA-North	Phoenix Goodyear Airport-North Superfund Site
PGA-South	Phoenix Goodyear Airport-South Superfund Site
PRP	Potentially responsible party
PI	Preliminary investigation
PRAP	Proposed remedial action plan
Revised PRAP	Revised Proposed remedial action plan

ACRONYMS AND ABBREVIATIONS (continued)

RI	Remedial investigation
ROs	Remedial objectives
ROD	Record of Decision
the Site	Western Avenue Water Quality Assurance Revolving Fund Site
UAU	Upper alluvial unit
USGS	U.S. Geological Survey
USTs	Underground storage tanks
VOC(s)	Volatile organic compound(s)
WQARF	Water Quality Assurance Revolving Fund
µg/l	Micrograms per liter

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1.0 SUMMARY AND PURPOSE

The Arizona Department of Environmental Quality (ADEQ) is proposing a remedy for the Western Avenue Water Quality Assurance Revolving Fund (WQARF) Site (the Site). Pursuant to Arizona Administrative Code (A.A.C.) R18-16-408 and Arizona Revised Statues (A.R.S.) 49-287.04; this document presents a Revised Proposed Remedial Action Plan (Revised PRAP) for the Site which is located in Avondale and Goodyear, Arizona (Figure 1). This Revised PRAP was prepared on behalf of the ADEQ and is based on public comments and information presented in the following Site documents:

- The Remedial Investigation (RI) report dated May 2009 (GeoTrans, Inc. [GeoTrans], 2009b),
- The Feasibility Study (FS) report dated April 23, 2014 (Hargis + Associates, Inc. [H+A], 2014b).

The proposed remedy is intended to attain the remedial action objectives identified for the Site for the protection of public health and the environment. This Revised PRAP identifies the proposed remedy, summarizes the other alternatives considered and discusses the reasons for the proposed remedy.

The purpose of the Revised PRAP is to describe the proposed (or reference) remedy selected from the alternatives evaluated during the FS. The proposed remedy was selected to address Subunit A groundwater contaminated with perchloroethene/tetrachloroethene (PCE) consistent with the Site remedial objectives (ROs) (H+A, 2014b).

2.0 COMMUNITY INVOLVEMENT

ADEQ seeks input from the community on this Revised PRAP. The Revised PRAP is part of the remedy selection process under the WQARF program where public comment and input is sought. The public is encouraged to review the Revised PRAP during the public comment period on the ADEQ website as well as at the following repositories:

Sam Garcia Western Avenue Library
495 East Western Avenue
Avondale, Arizona 85323

ADEQ Records Management Center
1110 West Washington Street
Phoenix, Arizona 85007
Call (602) 771-4380
or (800) 234-5677 ext. 771-4138 to schedule an appointment

A notice of the Revised PRAP availability and comment period will be mailed to the Site mailing list, the Community Advisory Group (CAG), and other interested parties on October 7, 2014. The notice will also be placed on the ADEQ website. The public comment period for the Revised PRAP will be 30 days from the start date provided to the public by ADEQ. Written comments from the public postmarked or emailed during the comment period can be submitted to:

Arizona Department of Environmental Quality
ATTN: Tina Le Page
Manager, Remedial Projects Section
1110 West Washington Street
Phoenix, Arizona 85007
Lepage.tina@azdeq.gov

ADEQ may modify the proposed remedy or select another of the alternatives presented in this Revised PRAP based on new information or public comments. Comments will be summarized and addressed in the responsiveness summary section of the Record of Decision (ROD). The ROD is ADEQ's final selection of the remedy for this site.

3.0 SITE BACKGROUND

The following descriptions are excerpted from selected reports prepared on behalf of ADEQ for the Site (ADEQ, 1995, 2001; GeoTrans, 2001a, 2001b, 2002a, 2002b, 2002c, 2002d, 2003a, 2003b, 2003c, 2003d, 2005, 2008, 2009a and 2009b; H+A, 2010, 2011a, 2011b, 2012a, 2012c, 2013a, 2013b, 2014a, 2014b and 2014c). These reports can be reviewed for more detailed Site information. The latest Site information, documents, and notices can be found at: http://www.azdeq.gov/environ/waste/sps/Western_Avenue_PCE.html.

3.1 SITE BOUNDARIES

The Site occupies approximately 300 acres situated along Western Avenue in portions of the cities of Avondale and Goodyear, Arizona. From Western Avenue; the Site extends north to San Xavier Boulevard, east to Third Street; south to State Route 85; and west to the Phoenix-Goodyear Airport (PGA)/Litchfield Road (Figure 2).

ADEQ has identified PCE as the chemical of concern in groundwater at the Site. Therefore the Site boundaries that are the subject of the remedial action are generally defined by the historic occurrence of PCE in groundwater. Land use across the Site is a mix of residential, commercial, and industrial properties.

3.2 WQARF REGISTRY

PCE-impacted groundwater was first discovered in the Site area as part of groundwater monitoring activities conducted at the adjacent PGA-South Superfund Site (PGA-South) in 1993. PCE, which is not a compound of concern at the PGA-South Site, was detected in monitor wells located upgradient (east) of PGA-South. Increasing concentrations of PCE over time in these monitor wells indicated a potential upgradient source within the Site area.

The ADEQ conducted a preliminary investigation (PI) in 1994 that included limited soil vapor sampling at two potential source areas: 1) the City of Goodyear Public Works (COGPW) facility leaking underground storage tank site, and 2) the Western Avenue Dry Cleaners (ADEQ, 1995). These potential source area locations are illustrated on Figure 3. Two monitor wells were installed in 1995 to assess water quality north and east of PGA-South.

PCE was detected in groundwater samples collected from the two monitor wells. The Site was subsequently placed on the WQARF Registry in December 1998 with a score of 51 out of a possible 120.

3.3 CHRONOLOGY OF SITE ACTIVITIES

The following chronology summarizes major events and investigative milestones for the Site:

1993: PCE was detected upgradient of PGA-South. Monitor wells at PGA-South showed increasing trends in PCE concentration in shallow groundwater. . Increasing concentrations of PCE over time in these monitor wells indicated a potential upgradient source within the Site area.

1994: The ADEQ Site Assessment and Hydrology Unit conducted limited soil vapor sampling at the COGPW facility and also at Western Dry Cleaners. The vapor sample results from both facilities did not detect a source for PCE contamination.

1995: Monitor wells MW-1 and MW-2 were installed by ADEQ to characterize the groundwater quality east and north of PGA-South, downgradient of suspected source areas (Figures 2 and 3). PCE was detected in groundwater samples collected from both monitor wells as high as 87 micrograms per liter (µg/l) in samples collected in 1996. No private wells were noted within the Site boundaries. City of Goodyear (COG) well COG-01 is located within the Site boundaries.

ADEQ conducted an investigation at the COGPW facility located on the south east corner of Western Avenue and Litchfield Road. Analytical data indicated that PCE and/or other target compounds were not present in soil above the method detection limit.

1998: The Site was placed on the WQARF Registry.

2000: ADEQ installed five additional monitor wells (MW-3 through MW-7) as part of an Early Response Action (ERA) evaluation (Figure 2).

2001: ADEQ conducted a soil gas survey at the former Aladdin Dry Cleaners property (ADEQ, 2001). Results of the soil gas survey indicated minor concentrations of PCE.

2003: An Industrial Survey Report was completed as part of the RI to identify properties where PCE may have been used or disposed. Six former dry cleaning facilities were identified in the area. Additional field activities were conducted at two of the dry cleaning facilities, Western Avenue Dry Cleaning and Aladdin Dry Cleaning.

The results of the investigations indicated that the facilities did not represent a significant source of PCE contamination in soil or groundwater (GeoTrans, 2003c).

2005: The current and future beneficial land and water use for the Site was evaluated in 2005. Groundwater use within the Site area was expected to remain predominately mixed residential, commercial and industrial. It was believed that mixed land use at the Site would be prevalent into the future. The zoning patterns in the area were long established and major changes were not anticipated.

2006: The highest concentration of PCE detected in groundwater during the March monitoring event was 3.2 µg/l at COGPW facility monitor well COG-MW3 (Figure 2). The Draft RI Report including the report titled "Current and Future Beneficial Land and Water Use" was submitted for public comment in August (GeoTrans, 2005). One comment was received during the 30-day comment period. This comment did not require a change in the RI.

2007: The highest concentration of PCE detected in groundwater during the August monitoring event was 12 µg/l at monitor well MW-2. Prior to the August sampling results, the last exceedance of the Arizona Aquifer Water Quality Standard (AWQS) for PCE of 5 µg/l in a groundwater sample collected from monitor well MW-2 occurred in April 1999. PCE was detected at concentrations less than the AWQS in subsequent groundwater samples collected from monitor well MW-2.

2008: Monitor well MW-8 was installed by ADEQ north of COG production well number 1 (COG-01) to provide data to define the northern boundary of PCE-impacted groundwater.

2009: Groundwater samples were collected from Site monitor wells in January. The highest concentration of PCE in groundwater was 4.5 µg/l at monitor well MW-2, less than the AWQS of 5.0 µg/l. The RI was finalized with the issuance of the Proposed ROs report (GeoTrans, 2009b; ADEQ, 2009). ADEQ began the FS phase.

2010: Groundwater samples were collected from Site monitor wells in May and November. The highest concentration of PCE in groundwater during these two events was 6.8 µg/l at monitor well MW-1, a concentration slightly greater than the AWQS.

2011: Innovative Technical Solutions, Inc. (ITSI) initiated an "Area Between the Sites" study. The objectives of the study were to collect data in an effort to further define water level and water quality conditions in the area where the PGA-North Superfund, PGA-South, and Western Avenue sites meet. The results of the study were finalized in March 2013 and indicated that there was not enough information to connect PCE in the PGA-North Site to the Western Avenue WQARF Site (ITSI, 2013).

Groundwater samples were collected from Site monitor wells in February, May, August, and November. The highest concentration of PCE in groundwater during the four 2011 events was 12.0 µg/l at monitor well MW-1 in November.

2012: Groundwater samples were collected from Site monitor wells in February, May, August, and November using PDB samplers placed at depths determined from the vertical profiling conducted at each well during May 2011. The highest concentration of PCE in groundwater during the 2012 events was 6.59 µg/l at monitor well MW-1 in May. Verification sampling was conducted in June 2012 to verify suspect volatile organic compound (VOC) concentrations at selected wells during the May event. The results of the verification sampling and August 2012 sampling indicated that PCE concentrations were within normal ranges (5.3 µg/l).

A concentration of 6.2 µg/l was reported in November 2012 at MW-1. The Draft FS Work Plan was completed October 25, 2012.

2013: Groundwater samples were collected from Site monitor wells in 2013. The highest concentration of PCE in groundwater during was 7.8 µg/l at monitor well MW-1 in May. PCE was not detected at concentrations greater than the AWQS at any of the other monitor wells.

A time-series groundwater test was conducted at well COG-01 during March and April 2013. The purpose of the test was to collect data to determine the source and nature of PCE detected in groundwater from well COG-01. The investigation determined that the low concentrations of PCE in well COG-01 groundwater are the result of well construction issues with the well. The PCE only impacts the well due to defects and/or wear in the well seal and/or casing and that the low concentrations of PCE in groundwater are reduced or removed as well COG-01 is pumped. Groundwater samples collected during the time-series investigation also detected perchlorate in COG-01 at concentrations ranging from non-detect to 3.7 µg/l. A Draft Summary Report was completed on May 15, 2013 and shared with the Cities of Avondale and Goodyear.

The Cities submitted comments; ADEQ addressed the Cities' comments in the Final report dated November 1, 2013 (H+A, 2013b).

A draft of the FS report was completed April 4, 2013. The draft FS was shared with the Cities of Avondale and Goodyear. The Cities submitted comments; ADEQ addressed the Cities' comments in a draft FS dated November 4, 2013. The draft FS report was presented at the November 7, 2013 CAG quarterly meeting.

2014: The final FS report was prepared on April 23, 2014. ADEQ prepared a PRAP and issued it for public comment in June. ADEQ received seven sets of written comments and the decision was made to incorporate additional information into a Revised PRAP. ADEQ will also issue a notice to inform the public of the availability of this Revised PRAP and to ensure that the public has an opportunity to comment on the plan. ADEQ will then complete a comprehensive responsiveness summary. Public notice will be provided on the availability of both the responsiveness summary and the ROD (A.A.C. R18-16-404).

Groundwater monitoring is continuing during 2014.

4.0 RESULTS OF REMEDIAL INVESTIGATION

4.1 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) was developed to aid in understanding the likely contaminant transport and exposure pathways associated with the Site. The CSM integrates available data and information including the operational history, geologic and hydrogeologic framework, potential source areas, and groundwater quality dynamics of the Site.

4.1.1 Operational History

The potential sources of PCE contamination in groundwater have been identified as former and existing dry cleaning facilities located within the Site area. However no specific source area has been identified to date. In 2001, an industrial survey conducted in the vicinity of the Site identified six dry cleaning facilities as potential sources of the PCE contamination:

- Western Avenue Dry Cleaning,
- Aladdin Dry Cleaning,
- Avondale City Cleaners,
- Quinn Cleaners,
- Goodyear Dry Cleaners, and
- A dry cleaning facility of unknown name that historically operated at 1072 South Litchfield Road.

These locations are illustrated in Figure 3. Additional field investigations were focused on the former site of the Western Avenue Dry Cleaning and Aladdin Dry Cleaning based on analytical data observed in monitor wells MW-1 and MW-2.

Former Western Avenue Dry Cleaning

The former Western Avenue Dry Cleaning facility was located at 216/218 West Western Avenue and operated approximately 600 feet east (upgradient) of well MW-1. Presently, Western Dry Cleaners is located at 300 West Western Avenue. The highest concentrations of PCE detected at the Site have been detected in samples obtained from well MW-1 (87 µg/l in 1996).

A Chevron gas and service station operated at that location between 1963 and 1985 and historical documents indicate two to three underground storage tanks (USTs) were at one time buried on the southeastern corner of the lot (south of the building) (GeoTrans, 2009b). In 1995, soil vapor sampling conducted in the area near the buried USTs indicated the presence of PCE above the method detection limit in four samples, with the highest concentration reported at 5.4 µg/l. Soil sampling in this area at depths ranging from 10 to 17 feet below ground surface (bgs) indicated that all VOC concentrations were below the method detection limit of 4 µg/l (GeoTrans, 2009b).

Former Aladdin Dry Cleaners

The former Aladdin Dry Cleaners was located at 322 East Western Avenue and was located upgradient from well MW-2 where PCE concentrations were reported as high as 76 µg/l in 1996. The facility operated under the name of Aladdin Cleaners from February 5, 1992 to January 1998, and in 1998, the name of the business changed to Estrella Equestrian Laundry. Prior to 1991, a dry cleaning facility by the name of Briteway Cleaners operated at that location (ADEQ, 2001). A fitness spa currently operates at this location.

ADEQ conducted an investigation of soil and soil vapor from 10 sample locations at the former Aladdin Dry Cleaners in March 2001. Samples were collected at depths ranging from 8.5 to 14.5 feet bgs and were analyzed for VOCs. PCE was not detected in any of the soil samples. PCE concentrations in soil vapor (collected at a depth of approximately 8.5 feet) ranged from non-detect to 70 µg/l. The highest concentrations were detected in two soil vapor samples collected approximately 30 feet west of the Aladdin Cleaners building (GeoTrans, 2009b).

Other Identified Dry Cleaning Facilities

In addition to the two facilities listed above, the following facilities were identified during the industrial survey as potential sources of the PCE contamination:

- Avondale City Cleaners operated at 207 East Western Avenue between 1959 and 1972. The facility was located approximately 50 to 100 feet east (upgradient) of well MW-2.
- Quinn Cleaners operated at 404 East Western Avenue between 1957 and 1961. The facility was located approximately 700 feet east (upgradient) of well MW-2.

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

All facility locations are illustrated in Figure 3. ADEQ concluded that none of the facilities investigated represented a significant source of PCE to groundwater. Additionally, the geometry and behavior of the impacted groundwater implies a contaminant source may have been present in the vicinity of well MW-1, however, the specific location(s) of which remains undetermined.

4.1.2 Enforcement Status

Potentially Responsible Parties (PRPs) are those who may be legally liable for contamination at a site. This may include past or present owners, operators, waste generators and haulers. Based upon information gathered to date, no source was identified for the PCE in groundwater associated with the Site. Therefore, no PRP was identified and ADEQ determined that cost recovery was not appropriate for the site. Remedial action costs will be funded by WQARF (A.R.S. 49-282[E]2[e]).

4.1.3 Geology

The Site is located in the western portion of the Salt River Valley (WSRV), a broad, relatively level alluvial valley in the Basin and Range physiographic province of central Arizona. The WSRV alluvium comprises an assemblage of sediments derived from the surrounding mountains and fluvial deposits derived from the Salt River. A detailed description of the general alluvial basin geology is documented in (Anderson *et al.,* 1990). The U.S. Geological Survey (USGS) divides the stratigraphy of the WSRV into Mountain Bedrock, pre-Basin and Range Sediments, Lower Basin-Fill, Upper Basin-Fill, and Stream Alluvium (Anderson, *et al.,* 1990).

4.1.4 Hydrogeology

Hydrogeology at the Site and in its vicinity has been described in an Arizona Department of Water Resources (ADWR) report (Corkhill *et al.,* 1993). Although the hydrogeologic stratigraphy generally corresponds to the geologic unit nomenclature of the USGS, the correlation is not exact and different unit names are used.

The alluvial sediments (lower and upper basin fill) are subdivided into three hydrologic units: the upper, middle, and lower alluvial units (UAU, MAU and LAU, respectively). In the vicinity of the Site, the total thickness of alluvial sediments is estimated to be in excess of 1,200 feet (Corkhill, *et al.,* 1993).

4.1.5 Regional Hydrogeologic Unit Descriptions

Regionally, the hydrogeology of the WSRV is discussed in terms of the LAU, MAU, and UAU. The LAU includes consolidated sands and gravels. The MAU is also consolidated, but with a higher proportion of fine-grained materials. Both the MAU and LAU represent depositional environment within closed basin (lake bed) conditions. Although the hydraulic properties of the MAU are less favorable for water production, the MAU is the most productive basin-wide unit due to its saturated thickness.

The UAU consists of unconsolidated sands and gravels deposited by flowing drainages, and is the most transmissive of the three units. According to the ADWR, the UAU is typically 300 to 400 feet thick in the WSRV (Corkhill, *et al.*, 1993). Where thick saturated sections of the UAU are present, the groundwater production rates are generally very high. At the Site, the UAU extends from ground surface to its contact with the MAU, at approximately 360 feet bgs.

The UAU comprises poorly to well-sorted deposits of clay, silt, sand, and gravel. Based on particle size distribution and data from geophysical logs, the UAU can be subdivided into three subunits referred to as Subunit A, B, and C, in order of increasing depth in the Site area.

Generalized cross-sections through Subunits A and B are provided in Figures 4 and 5. Sediments greater than silt size represent approximately 60 to 70 percent of Subunits A and C and approximately 20 to thirty 30 percent in Subunit B.

4.1.6 Site Hydrogeologic Unit Descriptions - Subunit A

Subunit A is the uppermost subunit of the UAU at the Site extending to a depth of approximately 130 feet bgs. It consists of interbedded deposits of alluvial sediments ranging from silt and clay to varying amounts of sand and gravel. Subunit A is considered an unconfined aquifer. The saturated portion is within the lower one-half to one-third of the subunit. Groundwater from Subunit A may be used for irrigation purposes in some areas.

The transmissivity of Subunit A was estimated to range from 100 to 80,000 gallons per day per foot (gpd/ft) with an average of 20,000 gpd/ft based on aquifer testing conducted as part of the investigation at the adjacent PGA-South. The average hydraulic conductivity was determined to be about 400 gallons per day per square foot (gpd/ft^2) and the specific yield ranges between 0.05 and 0.15 percent (CH2M Hill, 1989).

4.1.7 Subunit B

Subunit B is reported to consist primarily of clay layer situated at depths between approximately 130 feet and 240 feet bgs in the Site area (CH2M Hill, 1989). Subunit B is believed to act as an aquitard hydraulically isolating Subunit A from Subunit C. However, there are no monitor wells completed solely in Subunit B at the Site. Therefore, site-specific data are insufficient to determine the exact nature and thickness of Subunit B or whether Subunit B is continuous or confining beneath the Site; thereby raising uncertainty as to the effectiveness of interaquifer isolation.

The main factors limiting vertical groundwater flow between Subunits A and C are the thickness and grain size of Subunit B. The average transmissivity of Subunit B has been estimated to be 2,000 gpd/ft based on aquifer tests conducted at the PGA-South. The average horizontal hydraulic conductivity has been estimated at 40 gpd/ft^2, and vertical hydraulic conductivity between 0.04 and 4 gpd/ft^2 (CH2M Hill, 1989).

4.1.8 Subunit C

Subunit C is the lowermost subunit of the UAU and extends from the base of Subunit B to the top of the MAU estimated at a depth of approximately 360 feet bgs. Subunit C is the primary source of groundwater for municipal and agricultural users in the Site area.

Subunit C is reported to consist of interbedded alluvial sediments ranging from clay to poorly-sorted gravel. The upper half of the subunit generally consists of sandy gravel. The lower half of the subunit is generally finer-grained than the upper half of the subunit, and consists primarily of interbedded deposits of sand, clay and gravel. Subunit C is a highly transmissive, leaky confined aquifer based on studies conducted at the adjacent PGA-South. Some aquifer interconnection may take place between Subunit C and thin transmissive sand lenses (where present) within the underlying upper portion of the MAU.

The estimated transmissivity of Subunit C is 120,000 gpd/ft, and the average hydraulic conductivity for the upper and lower halves of the Subunit is estimated at 1,000 gpd/ft^2 and 600 gpd/ft^2, respectively based on aquifer testing conducted at PGA-South.

4.1.9 Groundwater Movement

Periodic groundwater level monitoring and sampling has been performed between 2000 and the present. The most recent groundwater monitoring event was conducted in August 2014. Review of water level contour maps prepared from 2008 to the present indicates that the direction of groundwater flow in Subunit A is to the west-northwest at gradients ranging from approximately 0.0015 to 0.0025 feet per foot (ft/ft). These conditions are consistent with those defined prior to 2008. During August 2014, the observed depth to water ranged from approximately 70 to 80 feet bgs (Figure 6). Water levels are approximately ten to 20 feet lower than the highest levels measured in early 2001. Time-series graphs of PCE concentrations and groundwater levels over the entire Site period of record are presented in Appendix A.

Groundwater gradients across the Site are relatively flat. Accordingly, they are quite sensitive to regional influences resulting from a variety of stresses including operation of extraction and recharge wells operating in nearby remedial projects, municipal pumping centers and recharge facilities, agricultural withdrawals, and intermittent flow within the Salt and Agua Fria rivers. This is evident in the historical water level measurements observed at Site wells, which trend with seasonal fluctuations and influence from withdrawals at the COG production wells.

In addition to influencing gradients and directions of flow within the individual hydrogeologic subunits, the regional influences also indicate the potential for creating vertical gradients, which may induce vertical flow of groundwater between or across subunits. The resultant effect(s) of such regional influences on contaminant migration are not fully known. Another consideration is that, if there is significant movement of contaminants within Subunit A, it would appear the plume would move towards the capture zone of adjacent remedial projects. Water level data are insufficient to determine groundwater movement in Subunits B and C in the Site area.

4.2 DELINEATION OF SOURCE AREA(S) – VADOSE ZONE

Investigations performed by ADEQ in 2001 and 2002 were directed toward the identification of potential PCE source areas in Site vadose zone soil. These investigations included soil and soil vapor sampling at selected potential source areas. The results of these investigations were inconclusive as no elevated concentrations of PCE were detected in subsurface soil or soil gas (GeoTrans, 2009b). The limited presence and decreasing concentrations of PCE in shallow groundwater at the Site suggest that there is no significant, continuing source of PCE in vadose zone soil (Section 3.3.1). Subsequently, an industrial survey report was completed as part of the RI to focus on additional potential vadose zone source areas (GeoTrans, 2003c). The data obtained from the survey indicated that additional source areas were not identified (GeoTrans, 2009b).

4.3 DELINEATION OF GROUNDWATER CONTAMINATION

4.3.1 Subunit A

Concentrations of PCE in Subunit A Site monitor wells during the last five to eight years have remained relatively stable or continued to decrease to concentrations significantly less than those observed during the 1990s and early 2000s. PCE concentrations have remained below the AWQS at most Site wells since the late 1990s and early 2000s (H+A, 2014c).

PCE is still routinely detected at monitor well MW-1 at concentrations greater than the AWQS and sporadically at monitor well MW-2 greater than the AWQS. Based on Site data and using the AWQS of 5 µg/l to define groundwater contamination, the extent of contamination in Subunit A appears to be consistently limited to a small area of approximately 500 by 500 feet in the vicinity of well MW-1. While no vadose zone source area was identified during the source investigations, the gradient and distribution of PCE in groundwater suggests a source or sources in the area of monitor wells MW-1 and perhaps to a much lesser extent well MW-2. Dry cleaner operations were formerly present in the area of these two monitor wells (GeoTrans, 2009b).

PCE concentrations during August 2014 are provided in Figure 7. PCE was detected above the limit of detection in groundwater samples collected from four monitor wells during the August 2014 monitoring event. PCE was detected at concentrations ranging from 2.4 µg/l at monitor well MW-8 to 5.6 µg/l at monitor well MW-1.

PCE was only detected at a concentration above the Arizona AWQS at monitor well MW-1. PCE was not detected in groundwater samples collected at monitor wells COG-MW3, MW-5, MW-6, and MW-7 in August 2014. This is consistent with recent monitoring events.

Time-series graphs of PCE concentrations and groundwater levels over the entire Site period of record for all wells are presented in Appendix A. These graphs indicate downward trends in PCE concentrations. A conceptual diagram illustrating the extent of PCE in Subunit A groundwater is presented as Figure 8.

4.3.2 Subunit C

Two wells are screened in Subunit C in the Site area, well COG-1 and monitor well EMW-22LC (Figure 2). Well COG-01 is reported to be screened approximately in the lowermost seven feet of Subunit B and extending into the uppermost 13 feet of Subunit C (COG, 2012). Monitor well EMW-22LC is located at the western boundary of the Site area. Well EMW-22LC is reported to be screened in the lower portion of Subunit C from approximately 280 feet to 310 feet bgs.

PCE has been detected in groundwater samples collected from well COG-01. However, no samples to date have contained PCE at concentrations greater than the AWQS. PCE was detected in the most recent groundwater samples collected from well COG-01 at a concentration of 0.86 µg/l during August 2014. Well COG-01 was operating prior to the August 2014 event. Monitor well EMW-22LC is not sampled as part to the Site groundwater monitoring program. However, a groundwater sample was collected during the well COG-01 time-series test from well EMW-22LC and analyzed for VOCs (see below). No VOCs were detected in the sample.

A time-series groundwater test was conducted at well COG-01 during March and April 2013. The purpose of the test was to collect data to determine the source and nature of the PCE detected in groundwater from well COG-01. The investigation determined that the low concentrations of PCE in well COG-01 groundwater are the result of well construction issues with COG-01. The PCE only impacts the well due to defects and/or wear in the well seal and/or casing and that the low concentrations of PCE in groundwater are reduced or removed as well COG-01 is pumped. Groundwater samples collected during the time-series investigation also detected perchlorate in COG-01 at concentrations ranging from non-detect to 3.7 µg/l.

During the time-series test, nitrate as nitrogen (nitrate-N) was also detected in well COG-01 at concentrations that exceeded the AWQS/MCL of 10 milligrams per liter (mg/l). Concentrations of nitrate-N ranged from non-detect to 13 mg/l.

This range of nitrate-N concentrations is consistent with previous samples collected from well COG-01 which makes blending necessary prior to delivery of COG-01 water. A complete summary of the methods and results of the time-series test was prepared on behalf of ADEQ on November 1, 2013 (H+A, 2013b).

4.3.3 Vertical Extent

The vertical extent of PCE has been adequately defined to concentrations below AWQS and Federal MCLs within Subunit A at the Site. Subunit A monitor wells MW-1, MW-2, MW-4 through MW-7, and COG-MW3 are screened across the water table to depths ranging from approximately 80 to 97 feet bgs (H+A, 2014c). Vertical groundwater profiling conducted at each Subunit A monitor well in May 2011 indicated that although measureable concentrations of PCE were present near some of the bottoms of the Subunit A monitor wells; the PCE concentrations in the lower portions of Subunit A were all less than the AWQS and exhibited decreasing trends with depth (Table 1; Figure 9). Monitor well locations are illustrated on Figure 2.

The data indicate that the existing Site monitor wells are screened appropriately to monitor the highest PCE-impacted zones within Subunit A groundwater. The data also suggest that the lower portions of Subunit A below the bottoms of the screened intervals do not contain PCE at concentrations greater than the AWQS. There are no Site monitor wells that are completed solely within Subunit B. However, monitor well MW-8 was screened from approximately 120 to 150 feet bgs to extend into the upper portion of Subunit B. Groundwater samples collected from monitor well MW-8 from 2009 to 2014 indicate that PCE concentrations range from non-detect to 2.6 µg/l.

Review of the May 2011 vertical profiling indicates that no sampled intervals within monitor well MW-8 contained PCE at concentrations greater than the AWQS. PCE was not detected in the deepest interval sampled at 146.8 feet bls (Table 1; Figure 9). Although monitor well MW-8 is not located directly downgradient of the suspected source area(s), these data suggest that there is not a significant amount of PCE in the upper portion of Subunit B at the Site.

Well COG-01 is reported to be screened in the lower portion of Subunit B and the upper portion of Subunit C from approximately 175 to 195 feet bgs (COG, 2012). Although PCE has been detected in groundwater samples collected from well COG-01 at concentrations near, but not exceeding the AWQS; these elevated concentrations appear to be the result of leakage through breaches in the casing and/or annulus after periods of inactivity (H+A, 2013b).

The results of the well COG-01 time-series test indicated that pumping well COG-01 removes the PCE that enters the well through leakage and is slowly replaced with unimpacted Subunit B and C groundwater the longer the well is pumped. PCE concentrations in groundwater samples collected from well COG-01 after the well has been pumped for extended periods of time are either near or at detection limits. Well COG-01 is located downgradient of the suspected source area(s) and these data indicate that PCE is not present in the lower portion of Subunit B or upper portion of Subunit C at concentrations greater than the AWQS (Figure 2).

Monitor well EMW-22LC is screened from approximately 280 to 310 feet bgs in the lower portion of Subunit C and is not sampled as part to the Site groundwater monitoring program. However, a groundwater sample was collected during the well COG-01 time-series test from well EMW-22LC and analyzed for VOCs. No VOCs were detected in the sample. Similar to well COG-01, discussed above, monitor well EMW-22LC is located downgradient of the suspected source area(s) and these data indicate that PCE is not present in the lower portion of Subunit C.

4.3.4 Remedial Objectives

The objectives for the remedial program have been established through the remedy selection process (A.A.C. R18-16-407). The reference remedy shall consist of a remedial strategy that is capable of achieving all of the remedial objectives. ADEQ discussed and proposed ROs for the Site in January 2009 (ADEQ, 2009). Pursuant to A.A.C. R18-16-406 (I)(4), the ROs were chosen with consideration for the current and reasonably foreseeable future uses of land and water of the state that have been or are threatened to be affected by a release of a hazardous substance. PCE was identified as the sole chemical of concern for the Site. Since no potential source areas or areas of significantly PCE-impacted soil or soil vapor were identified at the Site; no ROs for land use were identified (ADEQ, 2009).

The ROs for current and future use of groundwater supply for irrigation and municipal use are as follows:

"To protect the supply of groundwater for municipal and irrigation use and for the associated recharge capacity that is threatened by contamination emanating from the Western Avenue WQARF Site. To restore, replace or otherwise provide for the groundwater supply lost due to contamination associated with the Western Avenue WQARF Site. This action will be needed for as long as the need for the water exists, the resource remains available and the contamination associated with the Western Avenue WQARF Site prohibits or limits groundwater use." (ADEQ, 2009).

5.0 SUMMARY OF PROPOSED REMEDY

5.1 REMEDY SELECTION

To be selected, the remedy must be:

- Protective of public health and welfare and the environment;
- To the extent practicable provide for the control, management or cleanup of the hazardous substance in order to allow the maximum beneficial use of the waters of the state;
- Be reasonable, necessary, cost-effective and technically feasible; and
- Comply with other statutory requirements.

The remedy must also attain the remedial action objectives identified for the Site, which are presented in Section 4.3.4. Potential remedial alternatives for the Site were identified, screened and evaluated in the FS report.

Monitored natural attenuation (MNA) with contingencies was identified as the reference remedy in the FS (H+A, 2014b). Because PCE concentrations in groundwater have not exceeded the AWQS or the MCL in well COG-01, MNA with contingencies was chosen as the proposed remedy. MNA with contingencies is capable of achieving the ROs as measured by concentrations of PCE less than the AWQS. MNA with contingencies will be utilized to accomplish this requirement by restoring the groundwater supply lost due to contamination. This is based on:

- Site data indicating that there is not a significant continuing source or sources of PCE within the Site area;
- Site data indicating that concentrations of PCE in Subunit A groundwater have decreased significantly during the last 15 to 20 years;
- Site data that indicates that the present day extent of PCE contamination in groundwater is minimal, and
- Present information that indicates that since monitoring of the Site began, concentrations of PCE in well COG-01 have never been detected at concentrations greater than its AWQS or Federal MCL, both of which are 5 µg/L.

This condition has existed even during the initial years of investigation when PCE concentrations in the upper portion of the aquifer system (Subunit A) were at their highest observed levels. However, PCE concentrations have approached the AWQS in the recent past. ADEQ anticipates that the continued decrease of PCE in the area of monitor well MW-1, a possible source of PCE to well COG-01, will reduce any potential risk to well COG-01 in the future. However, ADEQ proposes to continue to monitor PCE at both wells COG-01 and MW-1 in the future (Section 5.3).

Based on the current trend of PCE concentrations at well MW-1, it is projected that PCE will decrease to concentrations less than the AWQS in less than ten years (Appendix A). No continuing PCE source or sources have been identified within the Site area. Therefore, source control was not included in the FS as part of the reference remedy.

The evaluation of groundwater data collected from Site monitor wells over the past 15 to 20 years indicates a decreasing trend of PCE concentrations in nearly all wells (Appendix A). Thus, it is reasonable to conclude that PCE concentrations will continue to decline due to the natural physical, geochemical, and/or biological processes that are present in the aquifer system.

The term MNA refers to the reliance on natural attenuation processes to achieve the applicable groundwater remediation standard which is the AWQS and MCL. Natural attenuation processes include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce mass, toxicity, mobility, volume, or concentrations of contaminants in groundwater. These processes include biodegradation, dispersion, dilution, sorption, volatilization and chemical or biological stabilization, transformation, or destruction of contaminants.

A summary of the remedial alternatives that were considered for this site is presented in Appendix B. Cost information is presented in the form of present worth, which represents the amount of money invested in the current year that would be sufficient to cover all present and future costs associated with the alternative. This enables the costs of remedial alternatives to be compared on a common basis. A summary of the remedial alternative costs is included as Appendix B, Table B-1.

5.2 PRACTICABILITY, COST, RISK AND BENEFIT

Practicability

MNA is practicable and feasible for the Site. MNA is active in the Site area and has been proven to be effective in the long-term based on the decreasing PCE concentrations from the 1990s to the present. PCE concentrations above applicable cleanup standards, are only consistently remaining at the Site near monitor well MW-1. It is anticipated that PCE concentrations will continue to decrease at their current rate. As such, MNA will be effective in the short-term as PCE is anticipated to continue to decrease in concentration in the well MW-1 area to below the AWQS in less than ten years. MNA would achieve the groundwater ROs because groundwater quality would then be restored to concentrations at or below the AWQS.

Cost

The estimated cost to implement MNA is approximately $425,000 for a period of 15 years (H+A, 2014b). Although it is anticipated that concentrations of PCE at well MW-1 will be less than the AWQS in approximately 10 years by MNA; costs are estimated for 15 years as a contingency. This timeframe is anticipated to be more than adequate for natural processes to reduce PCE concentrations to less than its AWQS and for MNA to confirm that PCE concentrations have not rebounded. Costs were estimated assuming that eight of the ten existing Subunit A monitor wells and well COG-01 would be sampled for VOCs and other selected MNA parameters on a semiannual basis for 15 years. The cost estimate also includes semi-annual reporting, a one-year review, and project administrative review every five years.

Risk

MNA will be protective of public health by confirming that PCE is reduced in all monitor wells to concentrations less than its AWQS and meeting Site groundwater ROs. The fate and transport of contaminants over the life of the remedy is not anticipated to be significant since there is only one limited area consistently above the AWQS and this condition has been present since the early 2000s.

However, reduced PCE concentrations in Subunit A will decrease the potential risk to the COG water supply in Subunit C. There are no potential exposure pathways for human or terrestrial biota since Subunit A groundwater is not used as a source of groundwater for domestic or municipal use. There are no surface water bodies present at the Site so there is no potential exposure pathway for aquatic biota.

The residual risk at the conclusion of remediation will be minimal as groundwater ROs will be met and PCE will not be present in Subunit A groundwater at concentrations greater than the AWQS.

Benefit

Natural attenuation appears to be effective in reducing PCE concentrations at the Site. MNA will therefore confirm that reduced PCE concentrations will present a lower risk to potential receptors, reduce the volume of impacted groundwater, and decrease the liability of the state. Reduced PCE concentrations in Subunit A will decrease the potential risk to the COG water supply in Subunit C. By achieving groundwater ROs, MNA will also provide benefit for existing and future uses in the community; potentially improving the local economy.

5.3 ELEMENTS OF THE REMEDY

The elements of MNA with contingencies are as follows:

1. Develop and implement a monitoring plan that will include groundwater monitoring (water level measurements and groundwater sampling) at Site monitor wells and well COG-01 that could potentially be affected by migration of the groundwater contamination. The monitoring plan will assess the performance and effectiveness of the remedy and includes, but may not be limited to:

    - Quarterly groundwater monitoring to assess the performance and effectiveness of the remedy; the entire Site monitoring network will be retained for monitoring;
    - Quarterly groundwater monitoring of well COG-01 to assess the nature of potential vertical migration from Subunit A to Subunit C;
    - Groundwater samples will be collected from well COG-01 after the well has pumped for a period of at least 24-hours. It is ADEQ's understanding that well COG-01 typically operates for periods of several days to several weeks at a time. This will ensure that representative groundwater samples are collected from well COG-01.
    - Analyzing all samples for VOCs using EPA Method 8260B; and selected samples for perchlorate using EPA Method 314.0 and nitrate as N using EPA Method 300.0;

- VOC analysis for well COG-01 will be analyzed on 24-hour expedited basis. If a quarterly sample from well COG-01 detects PCE above the applicable regulatory standard of 5 µg/l, ADEQ will notify City of Goodyear within 24-hours receipt of laboratory analyses.
- Utilizing HydraSleeve® samplers for MNA field parameters analyses (pH, temperature, dissolved oxygen, reduction-oxidation potential and electrical conductivity) on a semi-annual basis;
- Reviewing all data after a period of one year to evaluate contaminant attenuation and based on this review, modify sample frequency and reporting as appropriate, and
- Developing a schedule of monitoring and frequency of submittals.

2. Develop a response plan that would be implemented if PCE concentrations in well COG-01 exceed the AWQS. PCE concentrations in groundwater samples collected from well COG-01 have all been less than the AWQS. However, the response plan will be implemented by ADEQ following two consecutive groundwater sampling events where PCE is detected in a groundwater sample from well COG-01 at a concentration greater than the AWQS. The response plan will be developed to outline the appropriate action or actions that are necessary to ensure that water supplied by the City of Goodyear is of no lesser quality as currently distributed. Appropriate action may include, but may not be limited to collecting a "point of compliance" sample at some location within the City of Goodyear water supply system immediately prior to distribution, development of a blending plan, well modification, abandonment or replacement, provisions for a replacement water supply, or institutional controls. Any contingency actions, if necessary, will be implemented in cooperation with the City of Goodyear.

If future conditions were to indicate potential risks for Subunit C water supply wells downgradient of the Site, contingencies will also be implemented in cooperation with the City of Goodyear. The implementation of operational strategies including the installation of a Subunit C monitor well (more aggressive remedy) or institutional controls (less aggressive remedy) may be implemented.

Similarly, if for any reason, concentrations of PCE begin to increase in the future at monitor wells at the Site, further investigations will be conducted by ADEQ to determine the reasons why and a plan developed to address the issue.

6.0 REFERENCES

Anderson, T.W., Freethey, G.W., and Tucci, P., 1990. Geohydrology and Water Resources of Alluvial Basins in South-Central Arizona and Parts of Adjacent States. U.S. Geological Survey Open-File Report 89-378, 99 p.

Arizona Department of Environmental Quality (ADEQ), 1995. Preliminary Assessment/Site Inspection Report – Western Avenue Dry Cleaners, 300 West Western Ave., Avondale, Arizona. June 30, 1995.

_____, 2001. Preliminary Assessment/Site Inspection Report – Aladdin Cleaners, 322 E. Western Ave., Avondale, Arizona. August 15, 2001.

_____, 2009. Proposed Remedial Objectives Report – Western Avenue WQARF Site, Avondale/Goodyear, Arizona. January 2009.

CH2M Hill, 1989. Public Comment Draft Remedial Investigation/Feasibility Study, Phoenix Goodyear Airport. June 1989.

City of Goodyear, 2012. Draft COG-01 Well Diagram. Prepared by the City of Goodyear and Brown & Caldwell, Inc. November 19, 2012.

Corkhill, E.F., S. Corell, B.M. Hill, and D.A. Carr, 1993. A Regional Groundwater Flow Model of the Salt River Valley -Phase I Phoenix Active Management Area Hydrogeologic Framework and Basic Data Report. Arizona Department of Resources Modeling Report No. 6. 1993.

GeoTrans, Inc. (GeoTrans), 2001a. Groundwater Monitoring and Sampling Results – November 2000, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. May 31, 2001.

_____, 2001b. Groundwater Monitoring and Sampling Results – January 2001, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. June 1, 2001.

_____, 2002a. Groundwater Monitoring and Sampling Results – April 2001, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. January 25, 2002.

_____, 2002b. Groundwater Monitoring and Sampling Results – First Yearly Report (November 2000 through July 2001), Western Avenue Plume WQARF Site, Avondale and Goodyear, Arizona. August 27, 2002.

_____, 2002c. Groundwater Monitoring and Sampling Results – October 2001, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. August 27, 2002.

_____, 2002d. Groundwater Monitoring and Sampling Results – May, 2002, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. August 28, 2002.

_____, 2003a. Groundwater Monitoring and Sampling Results – August 2002, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. March 19, 2003.

_____, 2003b. Groundwater Monitoring and Sampling Results – October 2002, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. March 21, 2003.

_____, 2003c. Industrial Survey Report, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. May 6, 2003.

_____, 2003d. Groundwater Monitoring and Sampling Results – March 2003, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. June 19, 2003.

_____, 2005. Current and Future Beneficial Land and Water Use, Western Avenue WQARF Site, Cities of Avondale and Goodyear, Arizona. June 30, 2005.

_____, 2008. September 2008 Groundwater Monitoring Report Western Avenue Plume WQARF Site, Avondale and Goodyear, Arizona. October 21, 2008.

_____, 2009a. January 2009 Groundwater Monitoring and Sampling Report Western Avenue Plume WQARF Site, Avondale and Goodyear, Arizona. January 26, 2009.

_____, 2009b. Final Remedial Investigation Report, Western Avenue Plume WQARF Site, Avondale and Goodyear, Arizona. May 2009.

Hargis + Associates, Inc. (H+A), 2010. Groundwater Monitoring Report May 2010, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. October 18, 2010.

_____, 2011a. Groundwater Monitoring Report, February 2011, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. April 20, 2011.

_____, 2011b. Groundwater Monitoring Report, June 2011, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. June 14, 2011.

_____, 2012a. Semi-Annual Groundwater Monitoring Report Second Half 2011, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. February 17, 2012.

_____, 2012c. Semi-Annual Groundwater Monitoring Report First Half 2012, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. December 18, 2012.

_____, 2013a. Semi-Annual Groundwater Monitoring Report Second Half 2012, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. March 27, 2013.

_____, 2013b. Summary Report, Time-Series Groundwater Sampling, City of Goodyear well COG-01. Western Avenue WQARF Site, Avondale and Goodyear, Arizona. November 1, 2013.

_____, 2014a. Semi-Annual Groundwater Monitoring Report First Half 2013, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. February 3, 2014.

_____, 2014b. Feasibility Study, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. April 23, 2014.

_____, 2014c. Draft Semi-Annual Groundwater Monitoring Report Second Half 2013, Western Avenue WQARF Site, Avondale and Goodyear, Arizona. In production.

ITSI Gilbane, 2013. Technical Memorandum Groundwater Investigation for the Area Between Phoenix-Goodyear Airport North Superfund Site, Phoenix-Goodyear Airport South Superfund Site, and Western Avenue Plume Water Quality Assurance Revolving Fund Site, Goodyear, Arizona. March 5, 2013.

TABLE

TABLE 1

Subunit A Screened Intervals

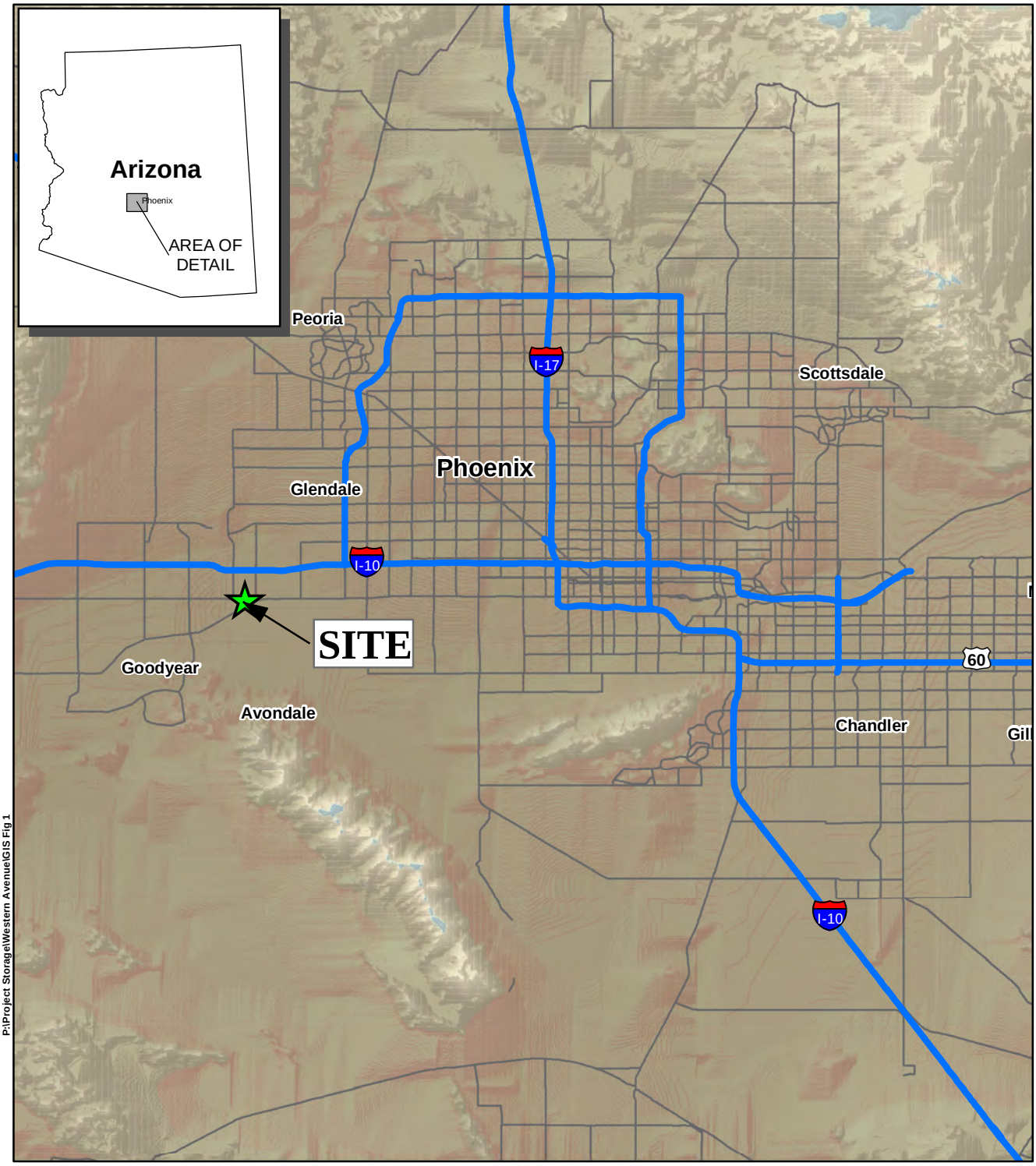
PCE Concentrations

Well Identifier	Sample Depth (feet bgs)	PCE (µg/l)
COG-MW1	73.8	<0.50
	79.0	<0.50
MW-1	70.7	8.85
	75.2	9.30
	79.7	8.59
	84.3	6.69
	88.8	4.52
MW-2	75.6	1.18
	80.7	1.03
	85.8	0.810
MW-4	73.5	2.11
	78.7	1.78
MW-5	72.6	<0.50
	78.1	<0.50
MW-6	73.4	<0.50
	78.8	<0.50
MW-7	67.4	<0.50
	72.9	<0.50
	78.3	<0.50
MW-8	122.4	0.730
	127.3	0.700
	132.2	0.740
	137.1	0.660
	142.0	0.640
	146.8	<0.50

Feet bgs = Feet below ground surface

µg/l = Microgram per liter

FIGURES



P:\Project Storage\Western Avenue\GIS Fig 1

N

0 4 8 Miles

WESTERN AVENUE WQARF SITE
AVONDALE AND GOODYEAR, ARIZONA

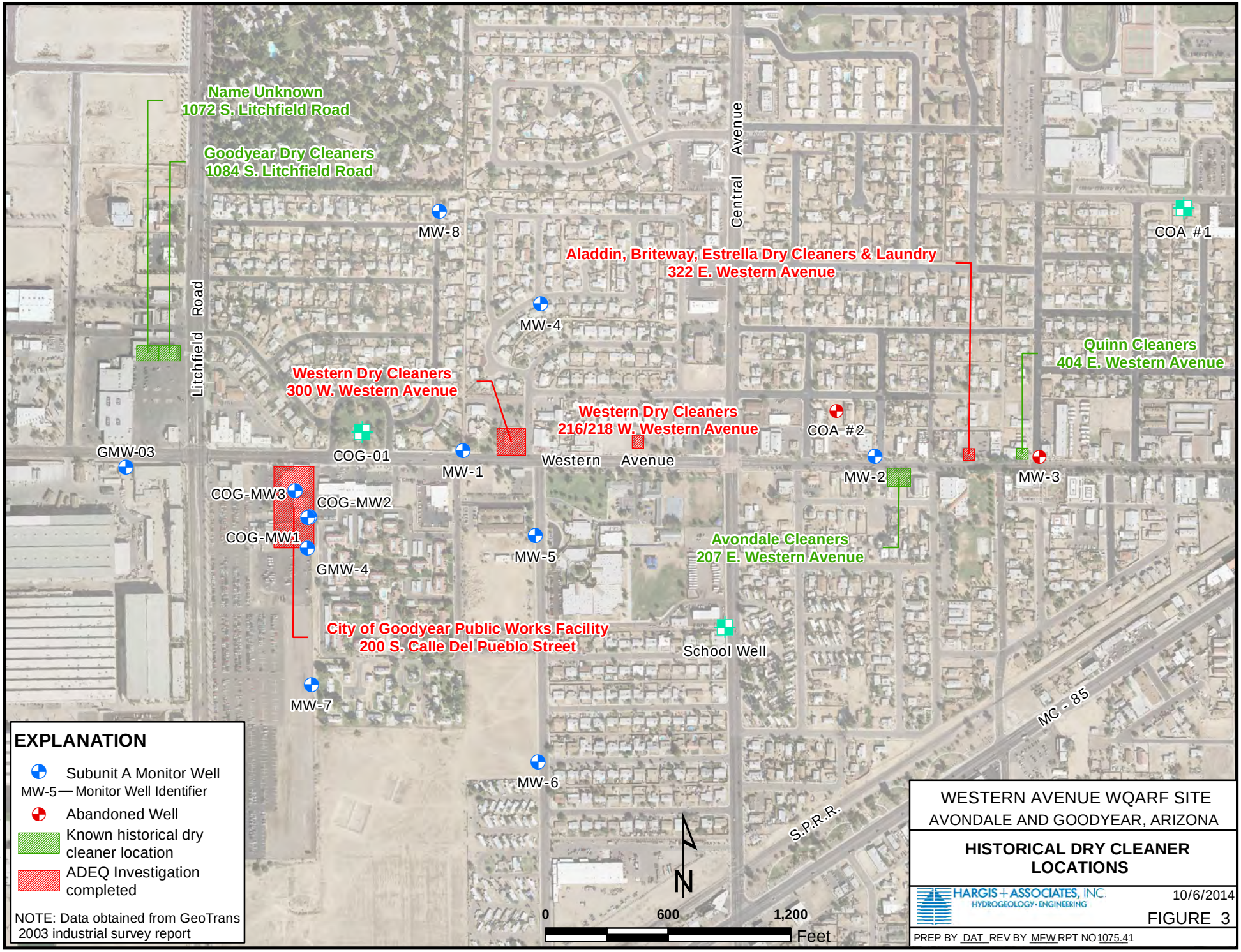
SITE LOCATION

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

FIGURE 1

PREP BY: JWM REV BY: MFW	DATE: 6/21/2010 FILE: Fig 1.mxd	PROJECT: 1075.41


B
San Xavier Boulevard
MW-8
MW-4
Litchfield Road
Central Avenue
Dysart Road
EMW-22LC
COG-01
A
MW-1
Western Avenue
A'
MW-2
COG-MW3
MW-5
GMW-4
3rd Street
MW-7
MC - 85
MW-6
B'
S.P.R.R.
EXPLANATION
Subunit C Monitor Well
Subunit A Monitor Well
Production Well
A—A' Location of Cross-section
Western Avenue WQARF Site
N
0
500
1,000
Feet
WESTERN AVENUE WQARF SITE
AVONDALE AND GOODYEAR, ARIZONA
SITE AND MONITOR WELL LOCATIONS
HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY · ENGINEERING
10/6/2014
FIGURE 2
PREP BY JWM REV BY MFW RPT NO 1075.41
Path: P:\Project Storage\1075-Western Avenue\GIS\Site and Well Locations_2014.mxd


Name Unknown
1072 S. Litchfield Road
Goodyear Dry Cleaners
1084 S. Litchfield Road
Litchfield Road
Central Avenue
MW-8
COA #1
Aladdin, Briteway, Estrella Dry Cleaners & Laundry
322 E. Western Avenue
MW-4
Quinn Cleaners
404 E. Western Avenue
Western Dry Cleaners
300 W. Western Avenue
Western Dry Cleaners
216/218 W. Western Avenue
COA #2
GMW-03
COG-01
MW-1
Western Avenue
MW-2
MW-3
COG-MW3
COG-MW2
COG-MW1
GMW-4
MW-5
Avondale Cleaners
207 E. Western Avenue
City of Goodyear Public Works Facility
200 S. Calle Del Pueblo Street
School Well
MW-7
MC - 85
MW-6
S.P.R.R.
EXPLANATION
Subunit A Monitor Well
MW-5 Monitor Well Identifier
Abandoned Well
Known historical dry cleaner location
ADEQ Investigation completed
NOTE: Data obtained from GeoTrans 2003 industrial survey report
N
0
600
1,200
Feet
WESTERN AVENUE WQARF SITE
AVONDALE AND GOODYEAR, ARIZONA
HISTORICAL DRY CLEANER LOCATIONS
HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING
10/6/2014
FIGURE 3
PREP BY DAT REV BY MFW RPT NO 1075.41
\\Phoenix02\d-drive\Project Storage\1075 - Western Avenue\GIS\Historical Source Locations.mxd

NORTH
B

SOUTH
B'

MW-8 | MW-4 | MW-5 | MW-6

APPROXIMATE LAND SURFACE

SUBUNIT A

SUBUNIT B

SUBUNIT C

MIDDLE ALLUVIAL UNIT

UPPER ALLUVIAL UNIT

TD=150

TD=80

ELEVATION, FEET MEAN SEA LEVEL

980 960 940 920 900 880 860 840 820 800 780 760 740 720 700 680 660 640 620 600 580 560 540 520 500

EXPLANATION

- SUBUNIT A (SAND/GRAVEL)
- SUBUNIT B (SILT/CLAY)
- SUBUNIT C (SILT/SAND/GRAVEL)
- MIDDLE ALLUVIAL UNIT (SILT/CLAY)
- APPROXIMATE STATIC WATER LEVEL
- SCREENED INTERVAL
- TD – TOTAL DEPTH

VERTICAL SCALE
FEET
200
100
0

HORIZONTAL SCALE
200 100 0
FEET

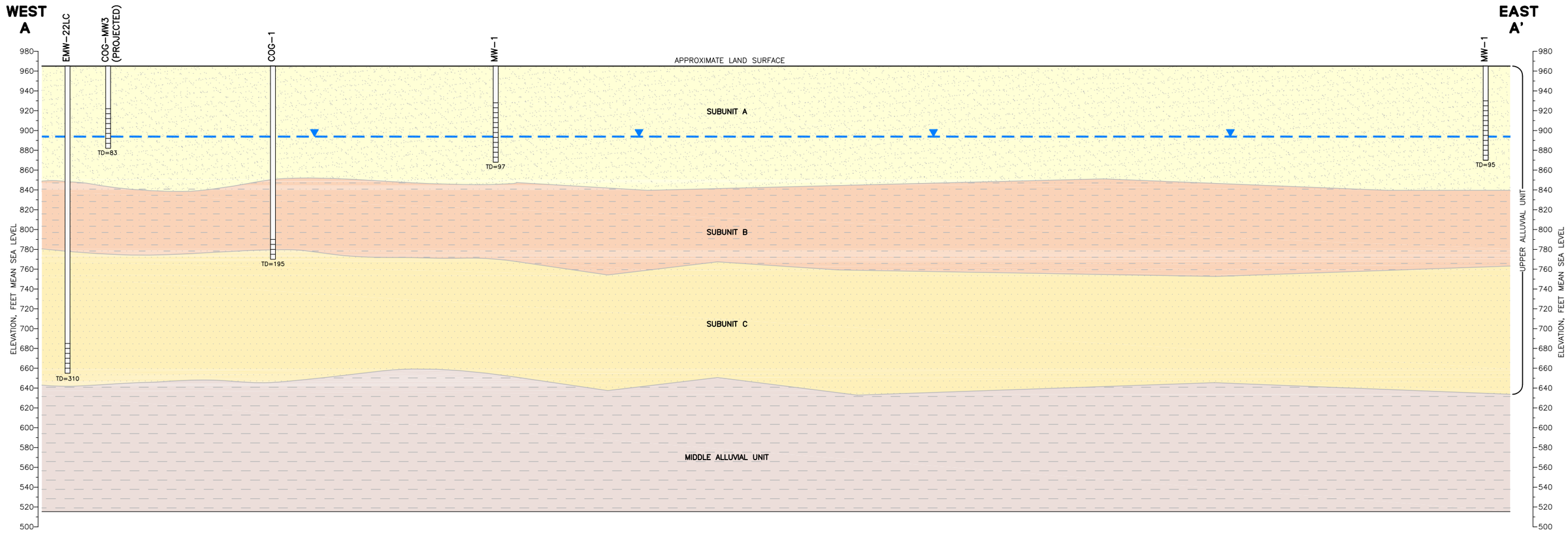
ADAPTED FROM GEOTRANS, INC., 2006.

Apr 22, 2014 - 2:17pm ADH - T:\2014\1000-1099\1075 ADEQ\Hydrogeology\X-Sections\310-1239.dwg

HARGIS + ASSOCIATES, INC
Hydrogeology/Engineering

04/14 | RPT NO. | 310-1239 | A

FIGURE 4.
NORTH – SOUTH HYDROGEOLOGIC CROSS SECTION



EXPLANATION

- SUBUNIT A (SAND/GRAVEL)
- SUBUNIT B (SILT/CLAY)
- SUBUNIT C (SILT/SAND/GRAVEL)
- MIDDLE ALLUVIAL UNIT (SILT/CLAY)
- APPROXIMATE STATIC WATER LEVEL
- SCREENED INTERVAL
- TD – TOTAL DEPTH

VERTICAL SCALE
FEET
200
100
0

HORIZONTAL SCALE
200 100
FEET

ADAPTED FROM GEOTRANS, INC., 2006.

04/14	RPT NO.	310-1232	A

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Hydrogeology/Engineering

FIGURE 5.
EAST – WEST HYDROGEOLOGIC CROSS SECTION

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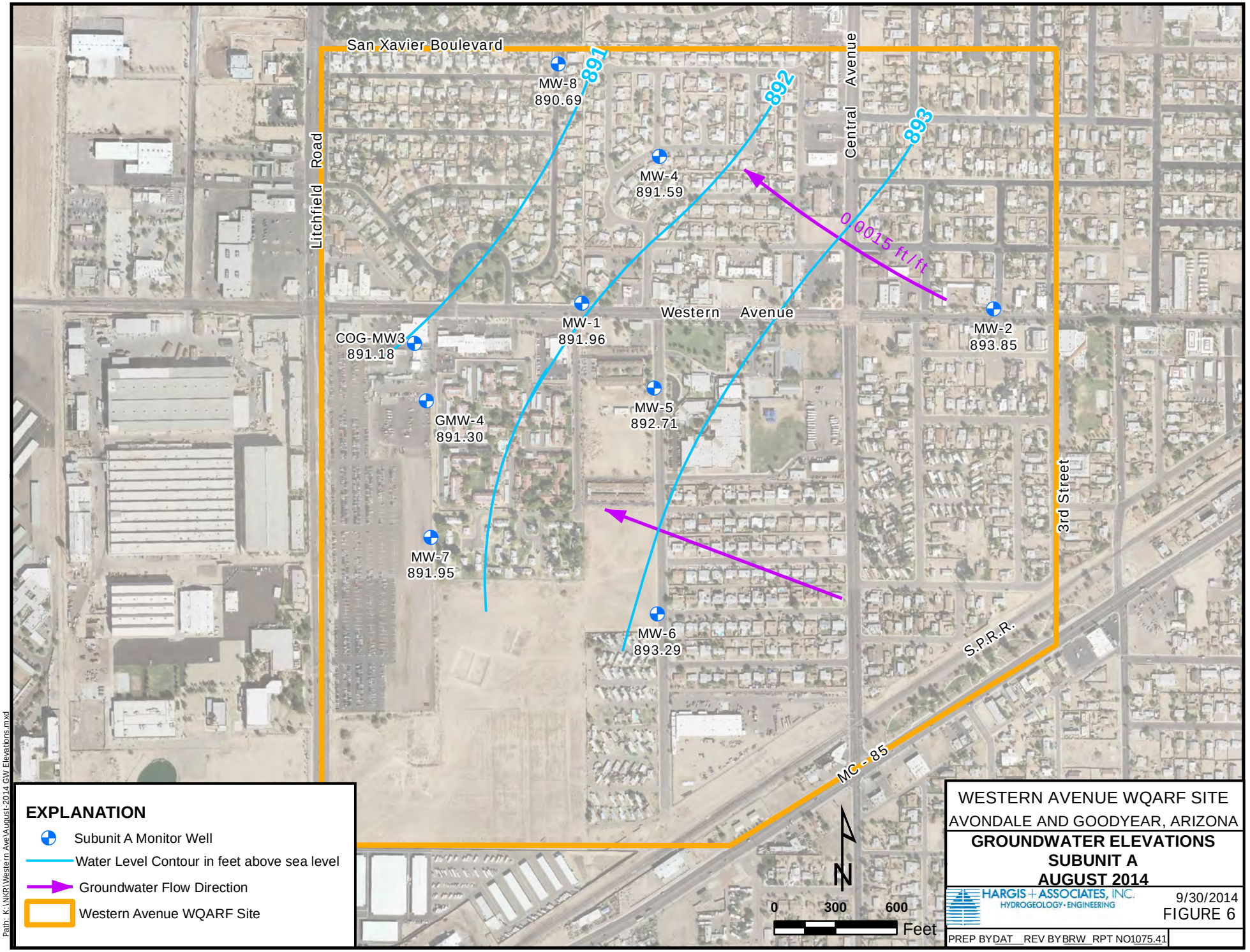
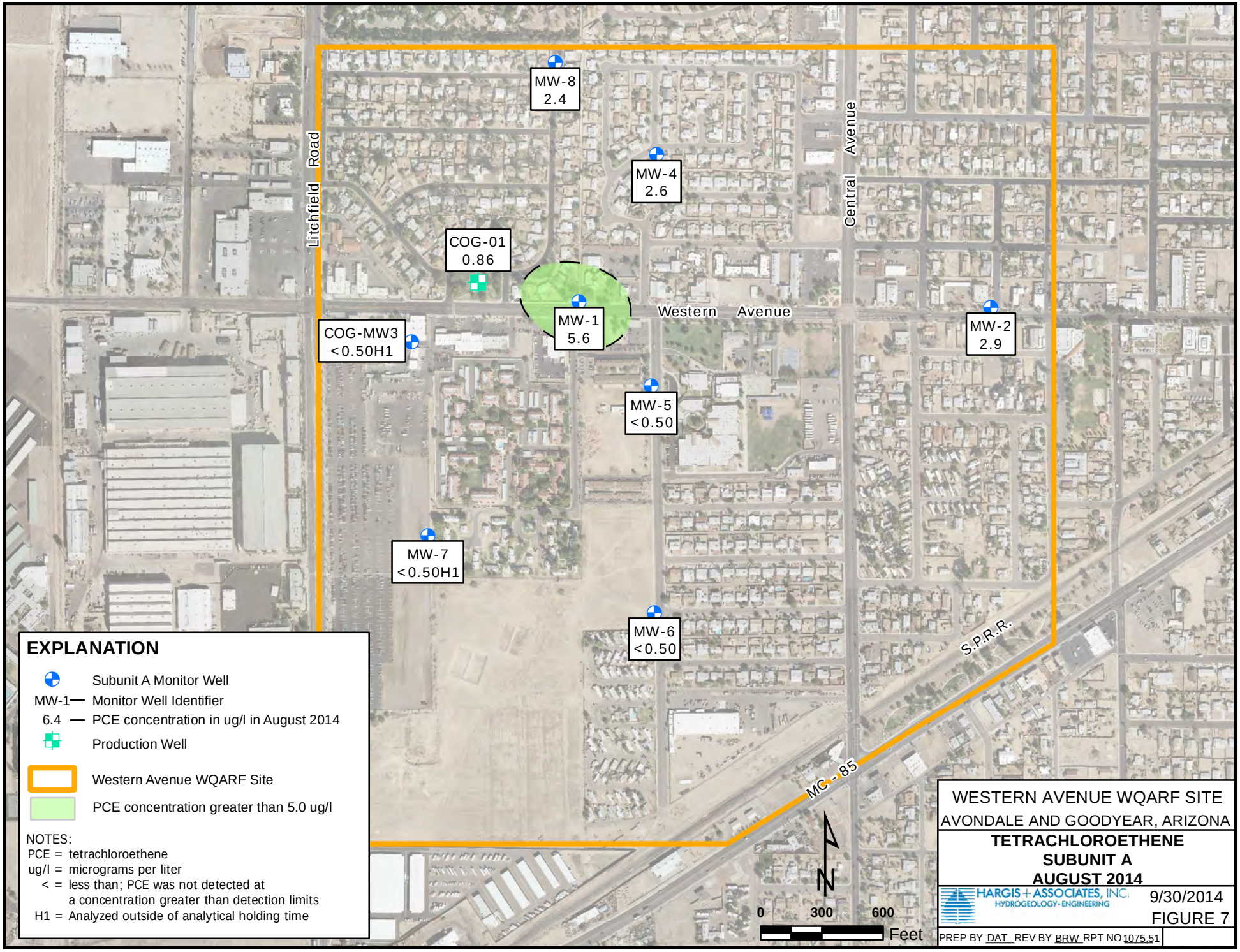

San Xavier Boulevard
Litchfield Road
Central Avenue
Western Avenue
3rd Street
S.P.R.R.
MC - 85
MW-8
890.69
MW-4
891.59
MW-1
891.96
MW-2
893.85
COG-MW3
891.18
GMW-4
891.30
MW-5
892.71
MW-7
891.95
MW-6
893.29
891
892
893
0.0015 ft/ft
EXPLANATION
Subunit A Monitor Well
Water Level Contour in feet above sea level
Groundwater Flow Direction
Western Avenue WQARF Site
N
0
300
600
Feet
WESTERN AVENUE WQARF SITE
AVONDALE AND GOODYEAR, ARIZONA
GROUNDWATER ELEVATIONS
SUBUNIT A
AUGUST 2014
HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING
9/30/2014
FIGURE 6
PREP BY DAT REV BY BRW RPT NO 1075.41
Path: K:\NKR\Western Ave\August-2014 GW Elevations.mxd



EXPLANATION

- Subunit A Monitor Well
- MW-1 — Monitor Well Identifier
- 6.4 — PCE concentration in ug/l in August 2014
- Production Well
- Western Avenue WQARF Site
- PCE concentration greater than 5.0 ug/l

NOTES:
PCE = tetrachloroethene
ug/l = micrograms per liter
< = less than; PCE was not detected at a concentration greater than detection limits
H1 = Analyzed outside of analytical holding time

WESTERN AVENUE WQARF SITE
AVONDALE AND GOODYEAR, ARIZONA
TETRACHLOROETHENE
SUBUNIT A
AUGUST 2014

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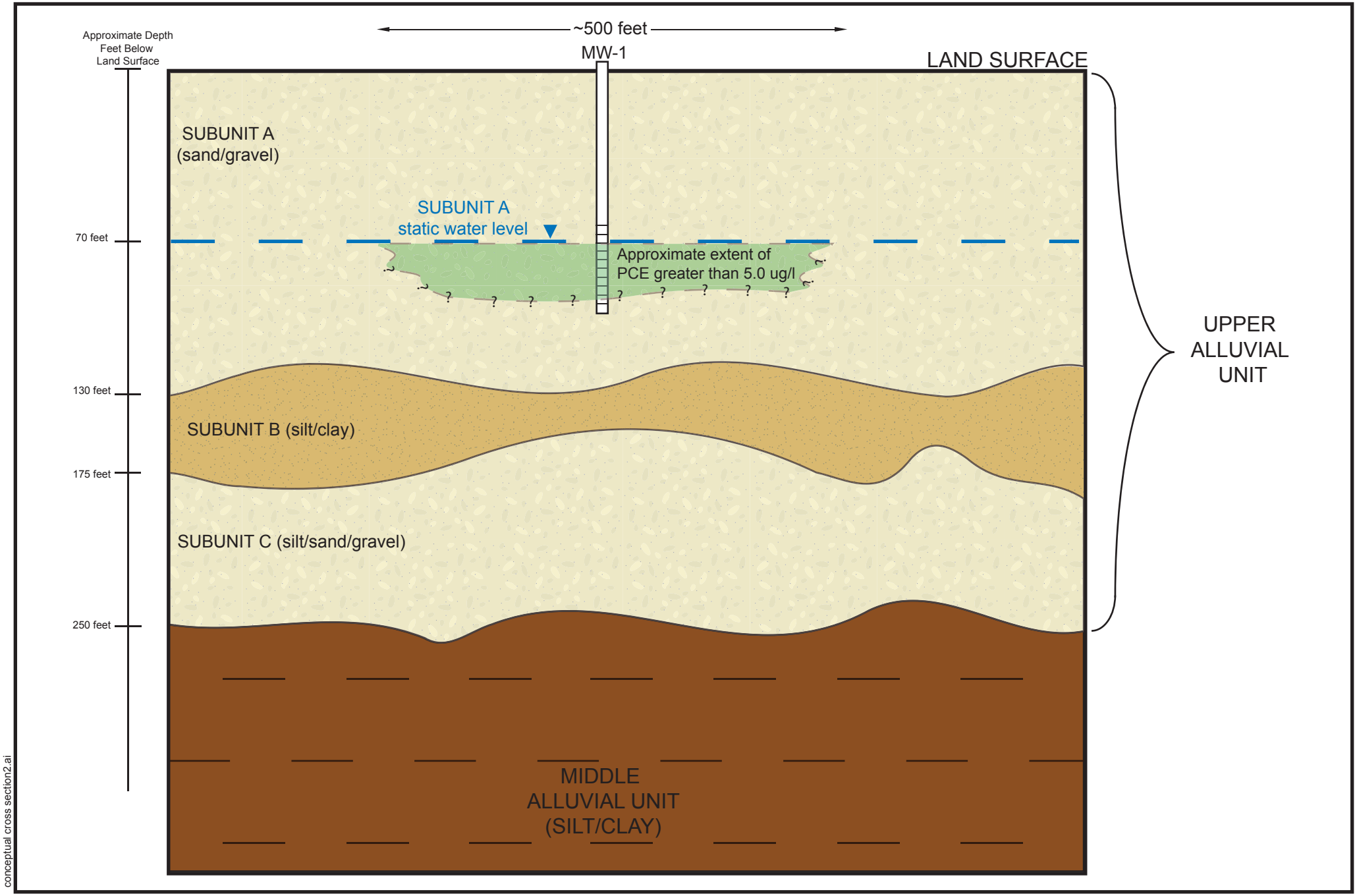
HYDROGEOLOGY · ENGINEERING

9/30/2014
FIGURE 7

PREP BY DAT REV BY BRW RPT NO 1075.51

Path: K:\NKR\Western Ave\August-2014 PCE.mxd



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NOT TO SCALE

FIGURE 8.
CONCEPTUAL DIAGRAM
EXTENT OF TETRACHLOROETHENE IN GROUNDWATER
WESTERN AVENUE WQARF SITE

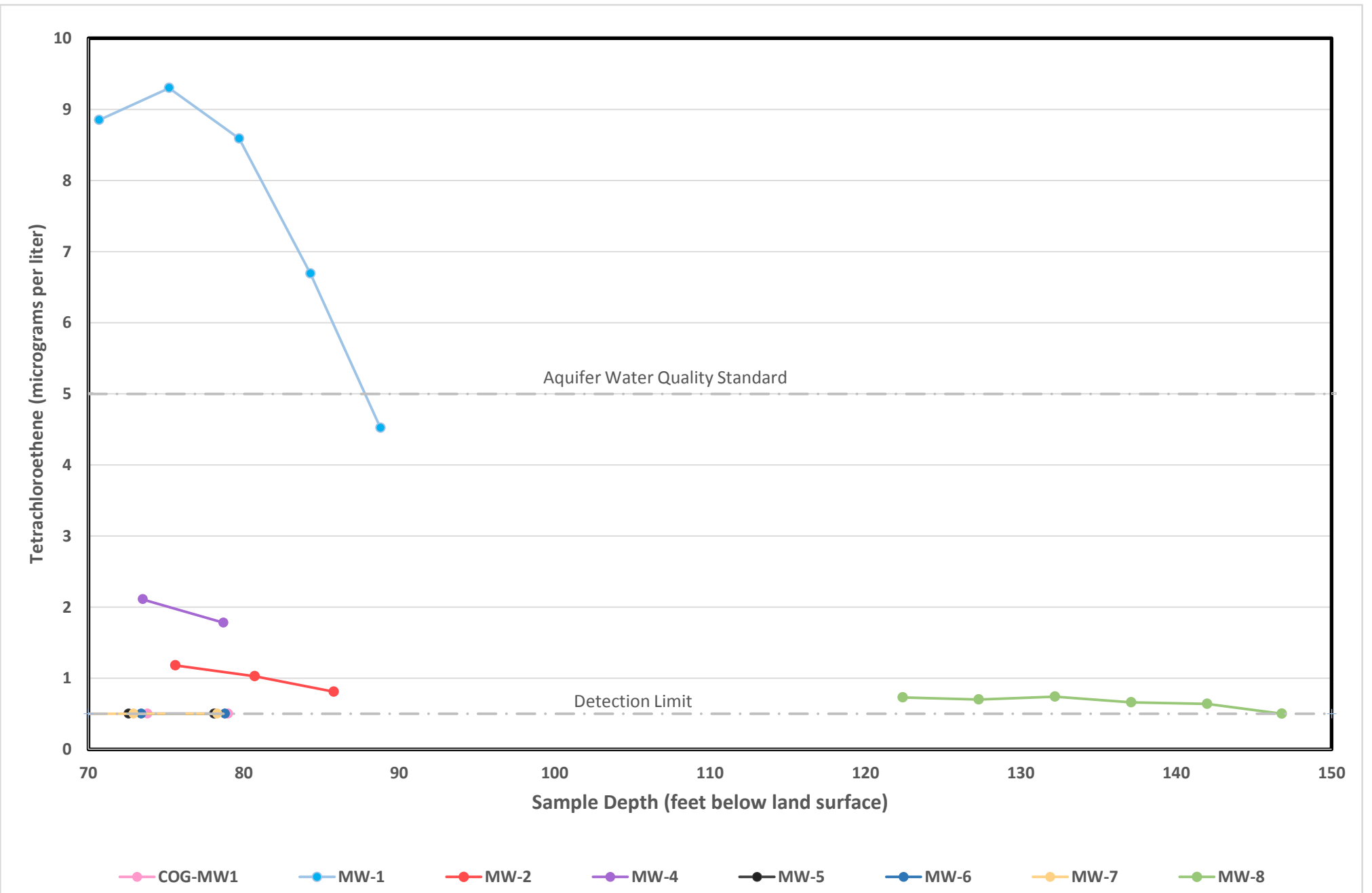

Figure 9. Results of Depth-Specific Groundwater Sampling – May 2011

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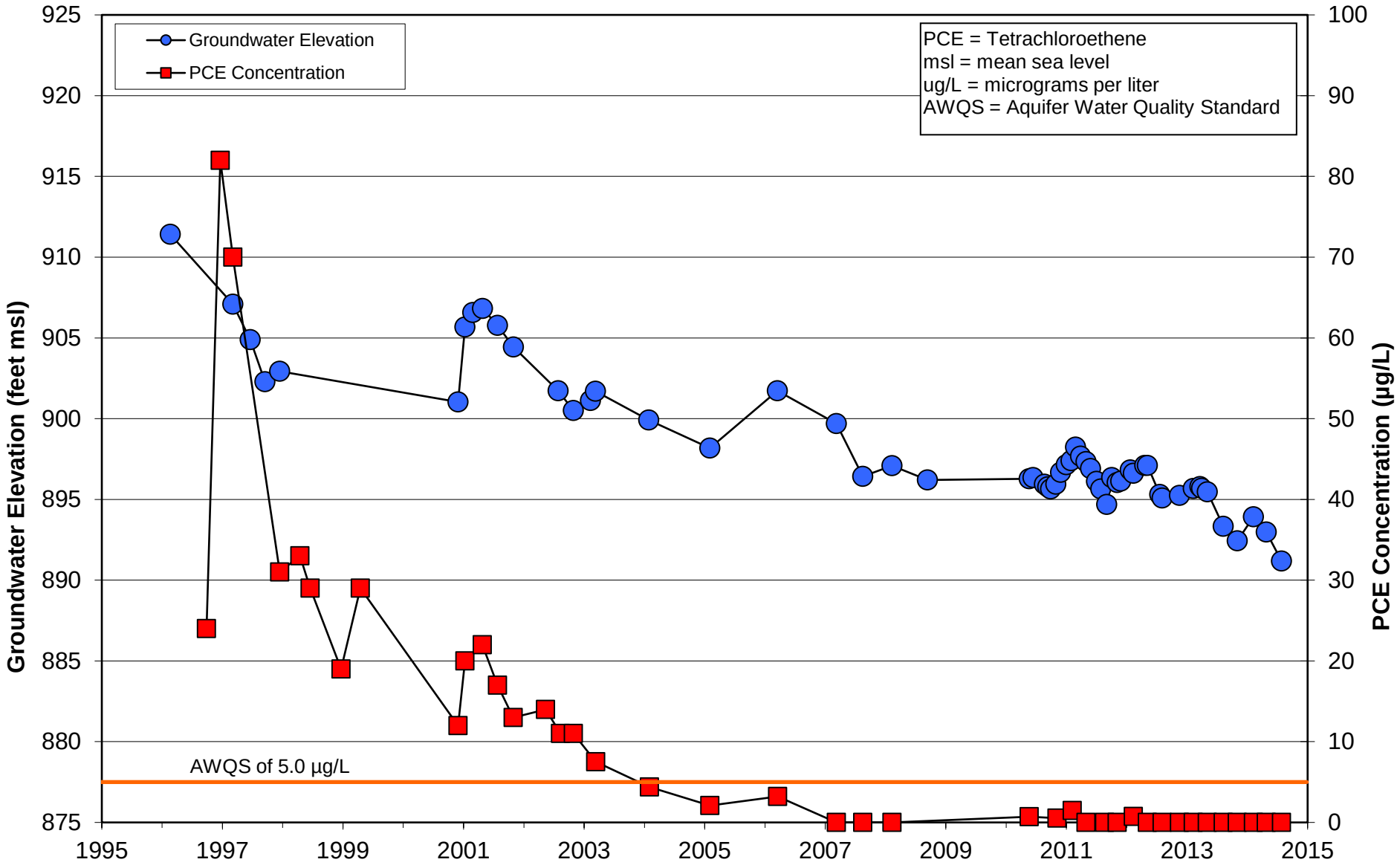
APPENDIX A

GROUNDWATER ELEVATION
AND
PCE CONCENTRATION GRAPHS



WESTERN AVENUE WQARF SITE
FIGURE A-1
GROUNDWATER ELEVATION AND TETRACHLOROETHENE CONCENTRATIONS
MONITOR WELL COG-MW3

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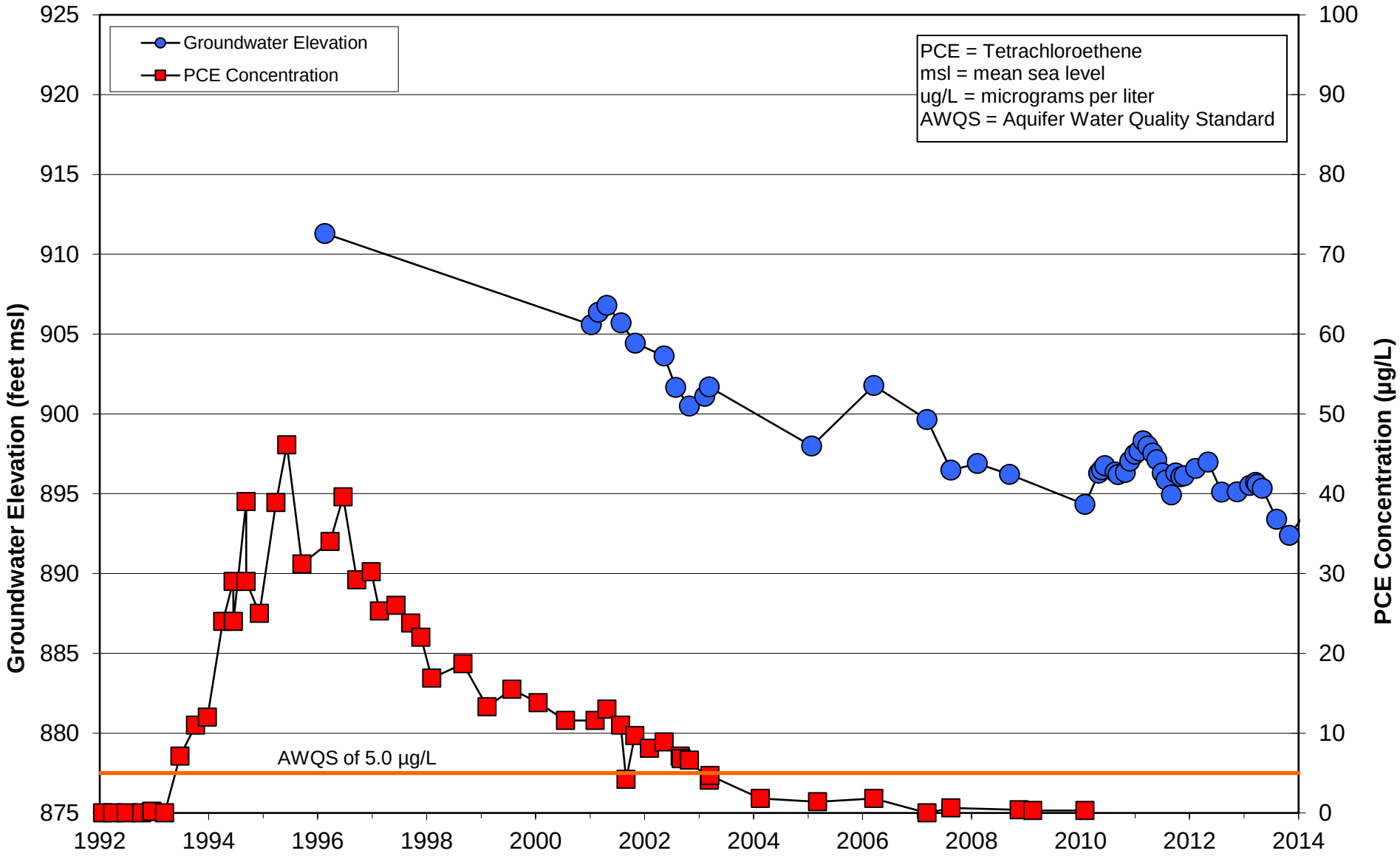
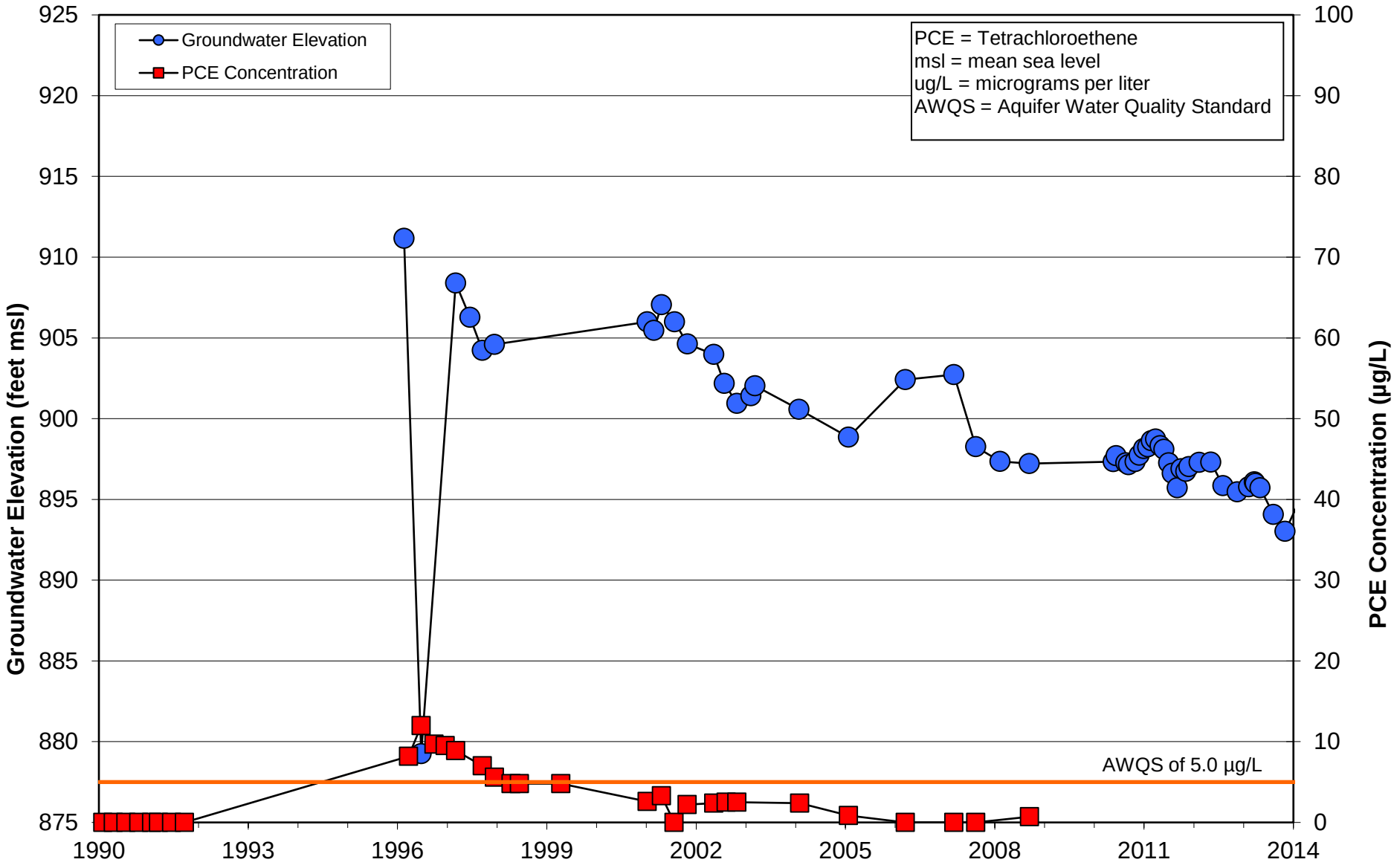
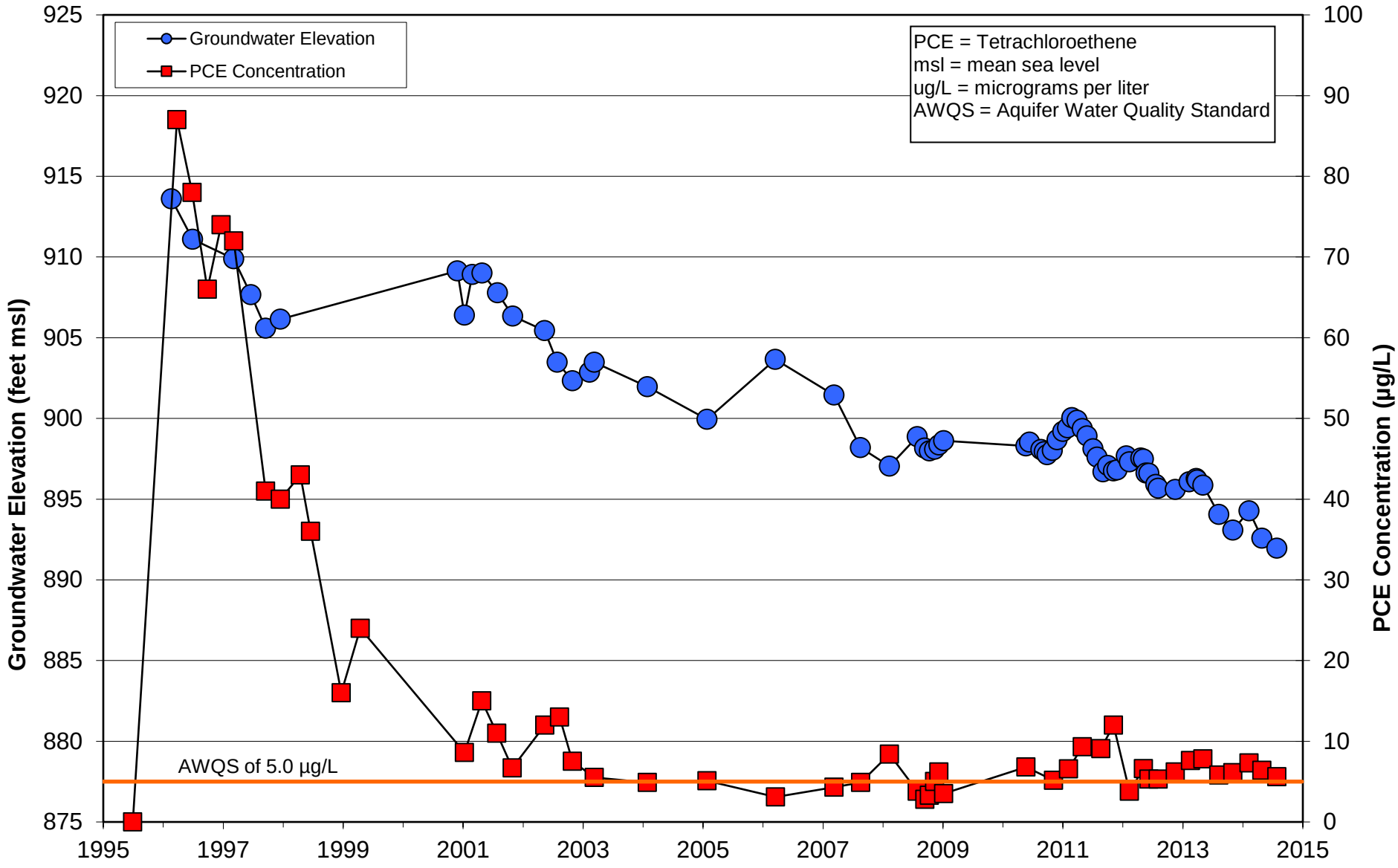


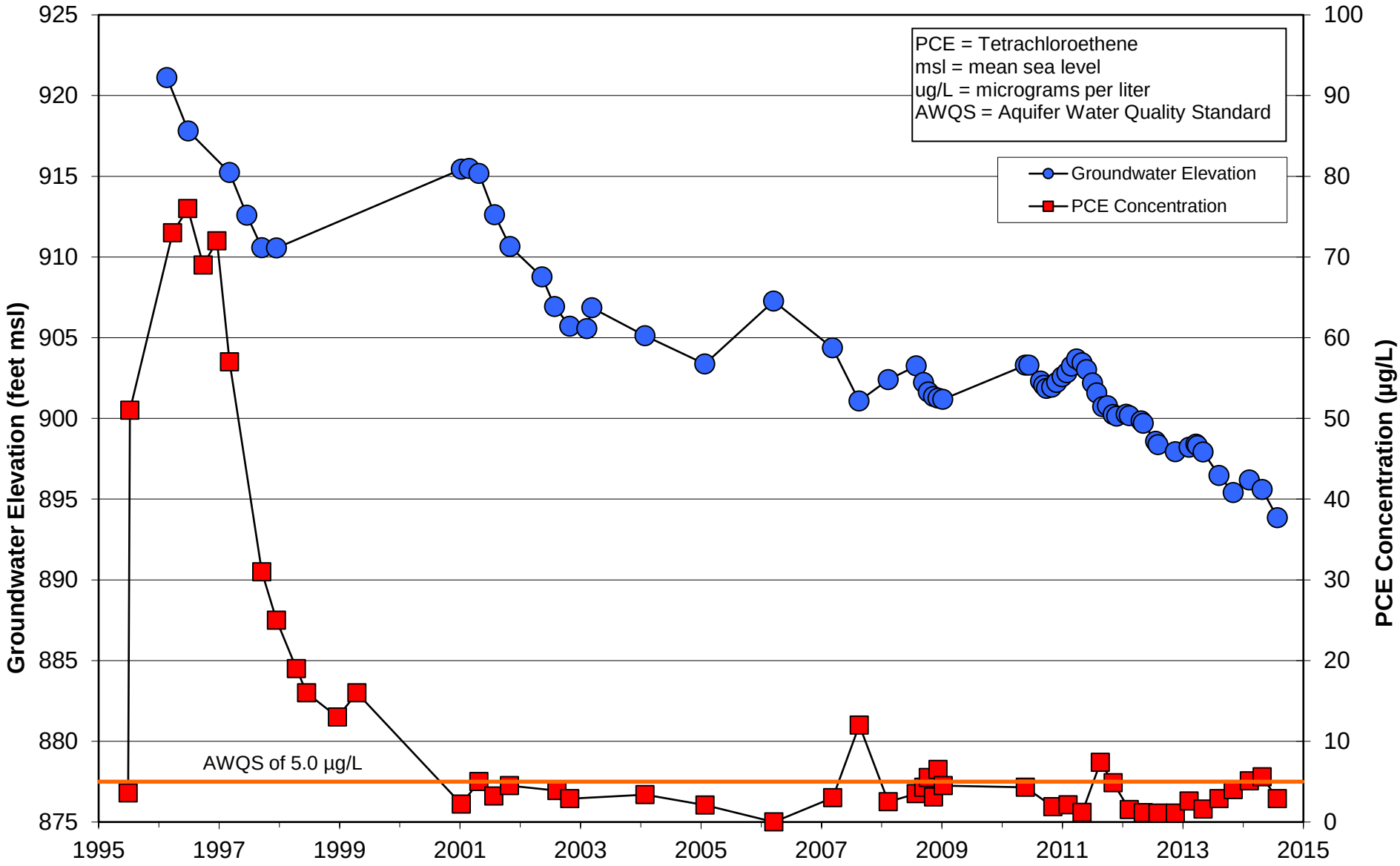
WESTERN AVENUE WQARF SITE
FIGURE A-2
GROUNDWATER ELEVATION AND TETRACHLOROETHENE CONCENTRATIONS
MONITOR WELL GMW-4



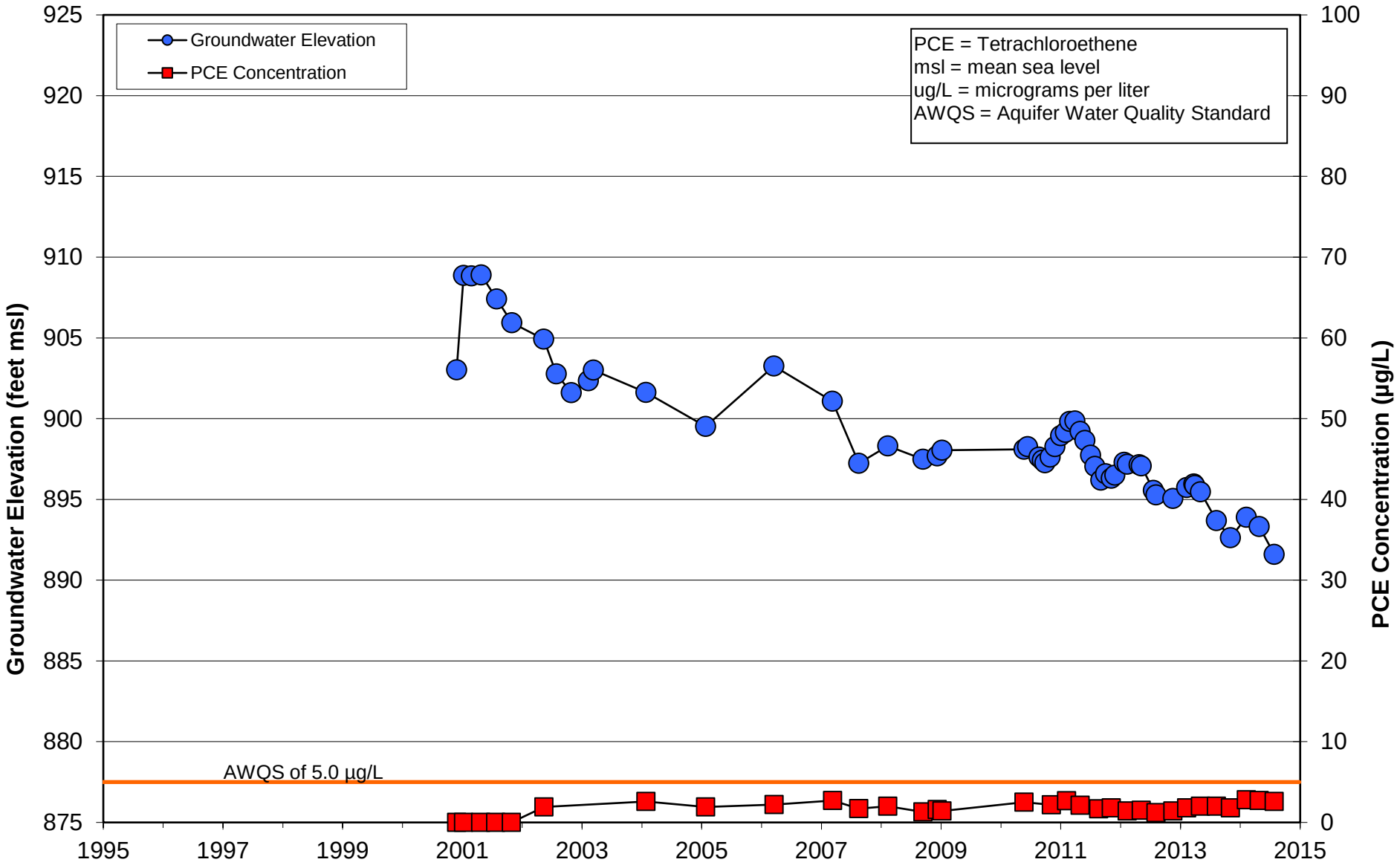
WESTERN AVENUE WQARF SITE
FIGURE A-3
GROUNDWATER ELEVATION AND TETRACHLOROETHENE CONCENTRATIONS
MONITOR WELL GMW-5



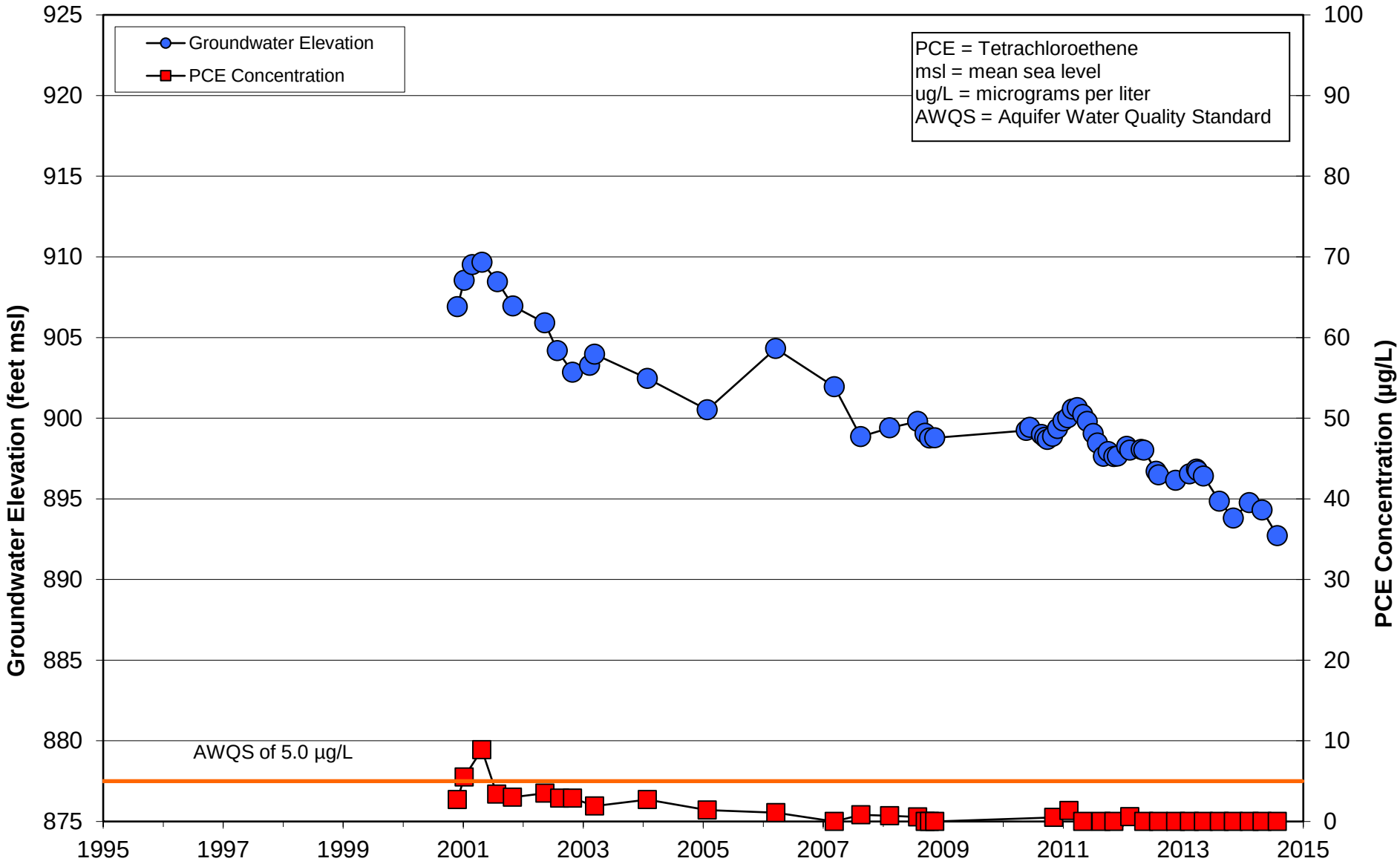
WESTERN AVENUE WQARF SITE
FIGURE A-4
GROUNDWATER ELEVATION AND TETRACHLOROETHENE CONCENTRATIONS
MONITOR WELL MW-1



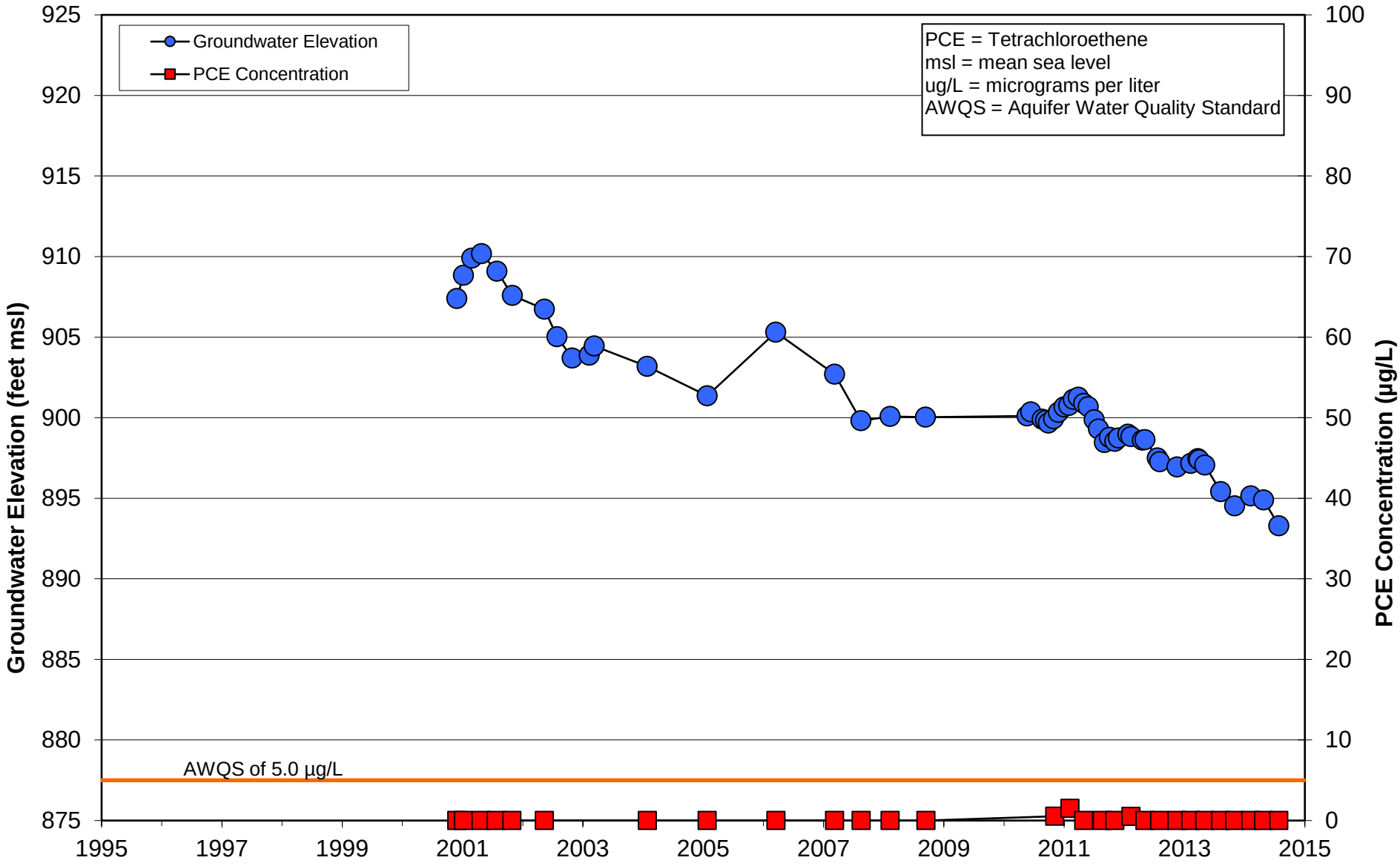
WESTERN AVENUE WQARF SITE
FIGURE A-5
GROUNDWATER ELEVATION AND TETRACHLOROETHENE CONCENTRATION0S
MONITOR WELL MW-2



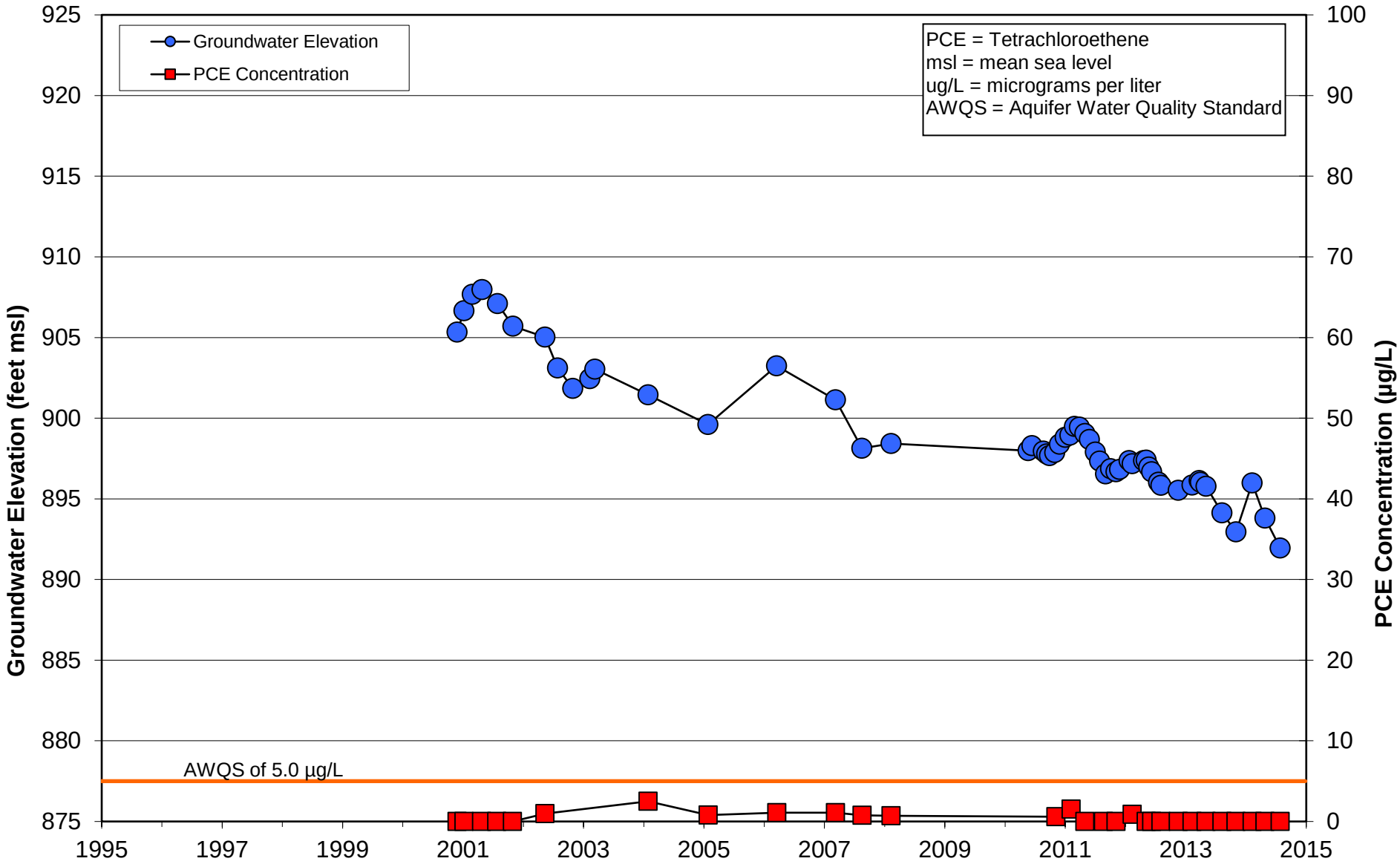
WESTERN AVENUE WQARF SITE
FIGURE A-6
GROUNDWATER ELEVATION AND TETRACHLOROETHENE CONCENTRATIONS
MONITOR WELL MW-4



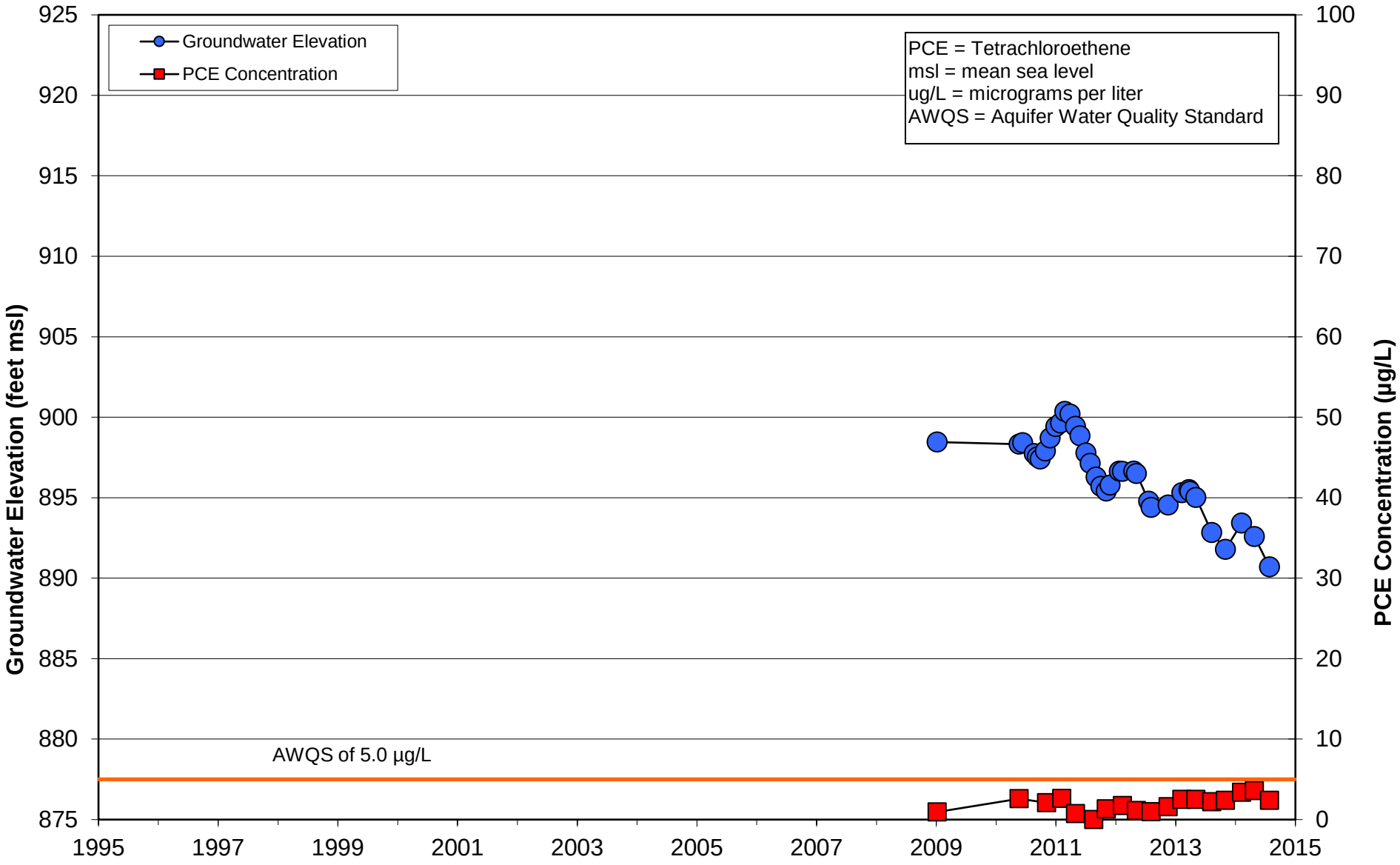
WESTERN AVENUE WQARF SITE
FIGURE A-7
GROUNDWATER ELEVATION AND TETRACHLOROETHENE CONCENTRATIONS
MONITOR WELLL MW-5



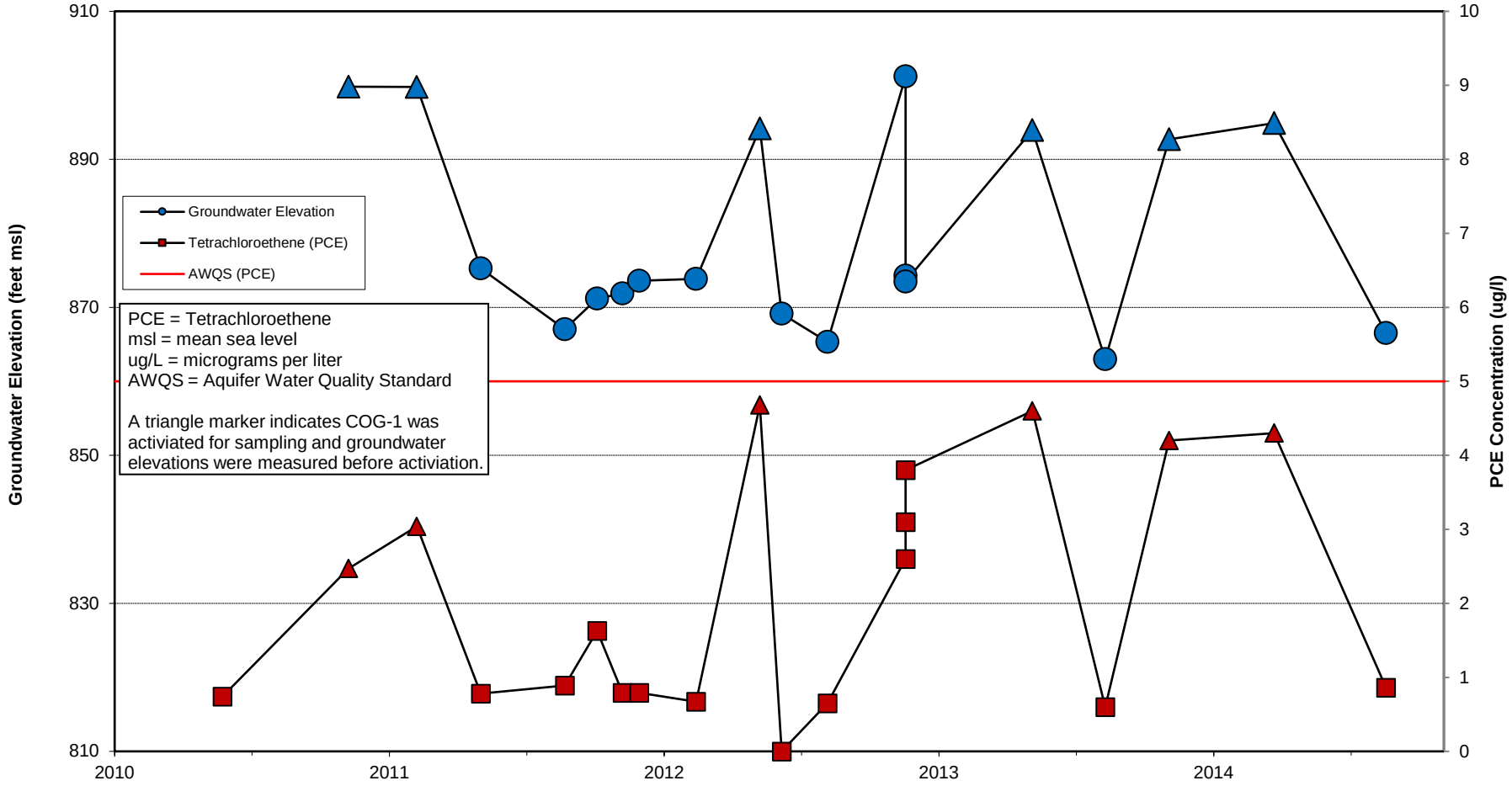
WESTERN AVENUE WQARF SITE
FIGURE A-8
GROUNDWATER ELEVATION AND TETRACHLOROETHENE CONCENTRATIONS
MONITOR WELL MW-6



WESTERN AVENUE WQARF SITE
FIGURE A-9
GROUNDWATER ELEVATION AND TETRACHLOROETHENE CONCENTRATIONS
MONITOR WELL MW-7



WESTERN AVENUE WQARF SITE
FIGURE A-10
GROUNDWATER ELEVATION AND TETRACHLOROETHENE CONCENTRATIONS
MONITOR WELL MW-8



WESTERN AVENUE WQARF SITE
FIGURE A-11
GROUNDWATER ELEVATION AND TETRACHLOROETHENE CONCENTRATIONS
PRODUCTION WELL COG-1

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APPENDIX B

SUMMARY OF REMEDIAL ALTERNATIVES
AND
COST INFORMATION

APPENDIX B

SUMMARY OF REMEDIAL ALTERNATIVES AND COST INFORMATION

A Feasibility Study (FS) was prepared for the Western Avenue Water Quality Assurance Revolving Fund (WQARF) Site (the Site) located in Avondale and Goodyear, Arizona on April 23, 2104 (H+A, 2014b). This FS report was prepared on behalf of the Arizona Department of Environmental Quality (ADEQ) in accordance with Arizona Administrative Code (A.A.C.) Title 18, Environmental Quality, Chapter 16, Section 407 (R18-16-407) to identify a reference remedy and alternative remedies capable of achieving the remedial objectives (ROs) proposed for the Site.

This FS report evaluated the identified remedies based on prescribed comparison criteria and proposed a preferred remedy that complies with relevant requirements and:

1) Assures the protection of public health, welfare, and the environment;
2) To the extent practicable, provides for the control, management, or cleanup of hazardous substances so as to allow for the maximum beneficial use of waters of the state;
3) Is reasonable, necessary, cost-effective, and technically feasible, and,
4) Addresses any well that either supplies water for municipal, domestic, industrial, irrigation or agricultural uses or is a part of a public water system, if the well currently, or in the foreseeable future would produce water that would not be fit for its current or reasonably foreseeable end use without treatment.

Tetrachloroethene or perchloroethene (PCE)-impacted groundwater was first discovered in the Site area as part of groundwater monitoring activities conducted at the adjacent Phoenix-Goodyear Airport (PGA)-South Superfund Site (PGA-South) in 1993. PCE was detected in monitor wells located upgradient (east) of PGA-South. Increasing concentrations of PCE over time in these monitor wells indicated a potential upgradient source.

APPENDIX B

SUMMARY OF REMEDIAL ALTERNATIVES AND COST INFORMATION

In 2009, ADEQ established remedial objectives (ROs) for the Site. In consideration of the ROs, alternative remedies were identified and evaluated as part of the FS report. The criteria applied for the purposes of the evaluation included:

- Contaminant treatment effectiveness;
- Compatibility with drinking water systems;
- Constructability;
- Flexibility/expandability;
- Operation and maintenance requirements;
- Management of residual waste products;
- Chemical use/operational hazards, and
- Cost/effectiveness.

Site assumptions and requirements were also used for the identification and screening of remedial technologies and alternatives.

Based on the above initial screening criteria, the remedial technologies that were identified for further screening for groundwater remediation at the Site included:

- Enhanced Bioremediation;
- In-situ Chemical Oxidation;
- Air Sparging;
- Pump and Treat Remediation;
- Soil Vapor Extraction, and
- Monitored Natural Attenuation (MNA).

APPENDIX B

SUMMARY OF REMEDIAL ALTERNATIVES AND COST INFORMATION

Proceeding through the screening and evaluation resulted in the identification of the following remedial alternatives for the Site:

- Alternative 1: No Action
- Alternative 2: MNA;
- Alternative 3: Alternative Water Supply
- Alternative 4: Wellhead Treatment;
- Alternative 5: Operational Strategies and Monitoring; and
- Alternative 6: Institutional Controls.

Based on the screening, Alternatives 2, 5, and 6 were retained for further evaluation. The study then proceeded to determine implementation strategies with regard to the retained alternatives such that a referenced remedy was selected and more and less aggressive remedy strategies were developed on the basis of the remaining two.

The resulting decision produced MNA as the reference remedy based on the following:

- Site data inferring that there does not appear to be any significant continuing source or sources of PCE within the Site area;
- Concentrations of PCE in Subunit A groundwater have decreased significantly during the last 15 to 20 years;
- The present day extent of PCE contamination in groundwater is decreasing, and
- Present information does not suggest there is any impact on local water supplies.

Based on the combination of remedial effectiveness, practicality, cost, risk, and benefit to achieve the groundwater ROs; MNA was judged to be protective of human health and the environment, compliant with cleanup standards, and state laws. If a further level of control is deemed appropriate, then MNA could be combined with institutional controls. A table summarizing costs for the retained remedies (alternatives 2, 5, and 6) is provided in Table B-1.

TABLE B-1
COST ESTIMATES FOR RETAINED REMEDIES

Reference Remedy - MNA

Description	Quantity	Unit	Unit Cost	Amount
Groundwater sampling and gauging labor	50	HR	$100	$5,000
Equipment (materials and rental)	2	LS	$2,000	$4,000
Project Management	20	HR	$120	$2,400
Reporting	60	HR	$120	$7,200
Hydrasleeves	9	EA	$25	$225
Laboratory Analysis – VOCs	9	EA	$130	$1,170
Laboratory Analysis – MNA	9	EA	$300	$2,700
Quality Control	$3,870		20%	$774
Waste Disposal	1,000	GAL	$0.20	$200
Annual Monitoring Cost (2014 to 2029) – Subtotal				$23,669
Contingency	$23,669		20%	$4,734
Annual Monitoring Cost – Total				$28,403
TOTAL (15 Years, 2014 to 2029)				**$426,042**

More Aggressive Remedy - Operational Strategies and Monitoring

Description	Quantity	Unit	Unit Cost	Amount
Groundwater sampling and gauging labor	50	HR	$100	$5,000
Equipment (materials and rental)	2	LS	$2,000	$4,000
Project Management	40	HR	$120	$4,800
Reporting/Correspondence	80	HR	$120	$9,600
PDBs	9	EA	$25	$225
Laboratory Analysis – VOCs	9	EA	$130	$1,170
Quality Control	$1,170		20%	$234
Waste Disposal	500	GAL	$0.20	$100
Annual Cost (2014 to 2029) – Subtotal				$25,129
Contingency	$25,129		20%	$5,026
Annual Monitoring Cost – Total				$30,155
TOTAL (15 Years, 2014 to 2029)				**$452,322.00**

Less Aggressive Remedy - Institutional Controls

Description	Quantity	Unit	Unit Cost	Amount
Annual Site inspections labor	8	HR	$100	$800
Annual Fees	1	LS	$1,000	$1,000
Project Management	40	HR	$155	$6,200
Reporting	20	HR	$155	$3,100
Annual Cost (2014 to 2029) – Subtotal				$11,100
Contingency	$11,100		20%	$2,220
Permitting Initial Costs	1	LS	$2,000	$2,000
Annual Monitoring Cost – Total				$13,320
TOTAL (15 Years, 2014 to 2029)				**$201,800.00**