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September 4, 2013

Ms. Karel Detterman
Alameda County Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502

Subject: Perjury Statement and Correspondence Transmittal


1600 – 1630 Park Street
Alameda, California 94501
AEI Project No. 298931
ACEH RO#0000008

Dear Ms. Detterman:

I declare under penalty of perjury, that the information and/or recommendations contained in the attached correspondence for the above-referenced site are true and correct to the best of my knowledge.

If you have any questions or need additional information, please do not hesitate to call me or AEI Consultants, Mr. Robert Robitaille at (925) 746-6000.

Sincerely,



John Buestad
President

JB/rpr

Attachment: *Interim Source Removal Workplan, September 4, 2013.*

cc: Mr. Robert Robitaille, AEI Consultants, 2500 Camino Diablo, Walnut Creek, CA 94597



AEI Consultants

Environmental & Engineering Services

September 4, 2013

INTERIM SOURCE REMOVAL WORKPLAN

Property Identification:

1630 Park Street, Parcel B
Alameda, California

AEI Project No. 298931
ACEHD Fuel Leak Case No. RO0000008

Prepared for:

Foley Street Investments
Attn: Mr. John Buestad
2533 Clement Avenue
Alameda, CA 94501

Prepared by:

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TABLE OF CONTENTS

1.0 PROPERTY OVERVIEW	2
1.1 Property Description.....	2
1.2 Planned Development Project	2
2.0 GEOLOGIC SETTING AND HYDROLOGY	2
3.0 SITE HISTORY	3
3.1 Prior Environmental Work.....	3
3.2 Recent Site Investigations	5
4.0 INTERIM REMEDIAL ACTIONS.....	5
4.1 Dual Phase Extraction System Operation.....	5
4.2 Focused Soil Excavations	6
5.0 SCOPE OF WORK	7
5.1 Well Abandonment.....	7
5.2 Soil Excavation	7
5.2.1 Excavation Target Soil Concentrations.....	7
5.2.2 Excavation Extents	8
5.2.3 Excavation Pre-Field Work.....	8
5.2.4 Excavation Activities	8
5.2.5 Groundwater Handling and Disposal	9
5.2.6 Confirmation Sampling.....	9
5.2.7 Contingency Plan to Extend the Excavation	9
5.2.8 Excavation Backfilling	9
5.3 Soil Vapor Probe Installation and Sampling	10
6.0 SCHEDULE OF ACTIVITIES	10
7.0 REFERENCES	11
8.0 REPORT LIMITATIONS	12

FIGURES

<i>FIGURE 1</i>	<i>SITE LOCATION MAP</i>
<i>FIGURE 2</i>	<i>SITE PLAN</i>
<i>FIGURE 3</i>	<i>SOIL VAPOR DETECTIONS SV-1 TO SV-12</i>
<i>FIGURE 4</i>	<i>PROPOSED EXCAVATION EXTENTS AND SOIL SAMPLE DATA</i>
<i>FIGURE 5</i>	<i>PROPOSED SOIL VAPOR MONITORING POINT LOCATION</i>

TABLES

<i>TABLE 1</i>	<i>WELL CONSTRUCTION DETAILS</i>
<i>TABLE 2</i>	<i>SOIL SAMPLE ANALYTICAL DATA – TPH AND MBTEX</i>
<i>TABLE 3</i>	<i>SOIL SAMPLE ANALYTICAL DATA – VOC'S, OXYGENATES AND PCB'S</i>
<i>TABLE 4</i>	<i>SOIL SAMPLE ANALYTICAL DATA – METALS</i>
<i>TABLE 5</i>	<i>GRAB GROUNDWATER ANALYTICAL DATA – TPH AND MBTEX</i>
<i>TABLE 6</i>	<i>GRAB GROUNDWATER ANALYTICAL DATA – VOC'S, OXYGENATES AND LEAD</i>
<i>TABLE 7</i>	<i>GROUNDWATER ANALYTICAL DATA – TPH, MBTEX AND LEAD</i>
<i>TABLE 8</i>	<i>GROUNDWATER ANALYTICAL DATA – VOC'S</i>
<i>TABLE 9</i>	<i>SOIL VAPOR SAMPLE ANALYTICAL DATA</i>

APPENDICES

<i>APPENDIX A</i>	<i>CALIFORNIA STATE WATER RESOURCES CONTROL BOARD, TECHNICAL JUSTIFICATION FOR LOW-THREAT CLOSURE SCENARIOS FOR PETROLEUM VAPOR INTRUSION PATHWAY, JUNE 30, 2011</i>
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September 4, 2013

Alameda County Environmental Health Department
Attn: Ms. Karel Detterman
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

Subject: Interim Source Removal Workplan
1630 Park Street, Parcel B
Alameda, California
AEI Project No. 298931
ACEH Fuel Leak Case No. RO0000008

Dear Ms. Detterman:

AEI Consultants (AEI) has prepared this Interim Source Removal Workplan on behalf of Foley Street Investments (FSI), developer of the subject site (See Figure 1 and Figure 2). The subject of this Workplan is the leaking underground storage tank (LUST) case located at the property 1630 Park Street, known as the Good Chevrolet site. The Alameda County Environmental Health Department (ACEH) is the agency with regulatory oversight of the LUST case. This Workplan has been prepared to present the scope of work to ACEH as discussed in our meeting on August 27, 2013. The intent of the work is to remove oil-saturated soil discovered in the vicinity of well DPE-5 and which contains volatile hydrocarbons that could pose a vapor intrusion risk to the occupants of the planned site redevelopment. This Workplan includes the following key elements:

1. A summary of the case history including recent investigations performed to assess subsurface conditions at the site;
2. A scope of work to abandon one dual phase extraction well (DPE-5) and two temporary soil vapor monitoring points (VP-10 and VP-11);
3. A scope of work to excavate oil impacted soils;
4. A confirmation soil sampling plan;
5. A contingency plan to extend the excavation should additional impacts be discovered during the work;
6. Schedule for implementation of these tasks.

1.0 Property Overview

1.1 Property Description

The development site consisting of 1600 to 1630 Park Street is an irregularly shaped property totaling approximately 1.46 acres, of which the northern approximately 0.47 acres is the 1630 Park Street site, referred to as Parcel B. The development site is bound by Park Street to the northwest, 1650 Park Street to the northeast, Foley Street to the Southeast, and Tilden Way to the southwest in a mixed commercial and residential area of Alameda, California. Hereinafter, unless otherwise stated, the "site" will refer to Parcel B, the 1630 Park Street property.

The site is currently vacant and was formerly improved with a two-story showroom and office building totaling approximately 11,264 square feet and parking lot which was until approximately 2008 occupied by Good Chevrolet. Good Chevrolet also occupied the 1600 to 1618 property to the south, which is also vacant. Refer to Figure 2 for the property layout and major site features.

1.2 Planned Development Project

Foley Street Investments plans to construct an approximately 7,280 square foot slab-on-grade commercial building on the western side of the site along Park Street. The remainder of the development site will be improved with paved at-grade parking areas and landscaping.

2.0 Geologic Setting and Hydrology

The site is located on Alameda Island. The near surface sediments of the area are mapped as Holocene and Pleistocene Merritt Sands (Qms) deposits (Helley, et al). Depth to bedrock is estimated at 300 to 800 feet below land surface (Norfleet Consultants, 1998). According to information obtained from the U.S Geological Survey (USGS), the site is located at between 20 and 25 feet above mean sea level (amsl) with the local topography sloping gently to the northeast. The nearest surface water body is the tidal canal located approximately 1500 to 2000 feet to the northeast.

During the recent drilling conducted by AEI in July 2011, groundwater was first observed in the temporary direct push borings at depths of approximately 9 to 11 feet bgs and stabilized at between approximately 7.5 to 8.5 feet bgs. The depth to water in the groundwater monitoring wells has generally ranged from approximately 7.5 to 9.5 feet bgs since the wells were installed. Based on the groundwater monitoring conducted at the site, groundwater flows fairly consistently in a northwesterly direction at an approximate hydraulic gradient of 1×10^{-2} to 2×10^{-2} ft/ft and exists as an unconfined aquifer. Based on the logs of soil borings drilled at the site, sediments across the site are fairly consistent; consisting primarily of poorly graded fine to medium sand with varying clay and silt content to a depth of at least 25 feet bgs, the maximum depth explored. Logs of borings for remediation wells installed in November 2011 were consistent with these prior observations.

3.0 Site History

Based on historical research performed during a Phase I Environmental Site Assessment (ESA) conducted in June 2011, the recently demolished building at the site was constructed in the 1940s for use as an auto garage and showroom. Good Chevrolet occupied the site from the early 1960s through 2008.

3.1 Prior Environmental Work

According to records on file with the ACEH, one 300-gallon waste-oil underground storage tank (UST) and one 500-gallon gasoline UST were removed from adjacent to the northern side of the building in 1986 at which time a release of petroleum hydrocarbons, primarily gasoline, was discovered. Due to the discovery of a release, a case was opened with the ACEH. Following is a summary of investigation activities that followed.

- In 1987, Groundwater Technology Inc. installed three groundwater monitoring wells (MW-1 to MW-3) and drilled two soil borings (SB-4 and SB-5) to investigate soil and groundwater conditions around the former UST hold.
- In October 1993, Geoplexus collected and analyzed soil and groundwater samples from seven soil boring (EB1 to SB7) drilled around the UST hold along with up-gradient and down-gradient of the release. It should be noted that documents indicate that two other borings (HP-1 and HP-2) were drilled up-gradient of the release area in April 1993, however details are not available. Geoplexus installed monitoring wells MW-4 and MW-5 in April 1994 in Park Street to investigate the down-gradient extent of the hydrocarbon plume.
- In January 1997, Geoplexus drilled an additional eight soil borings (EB8 to EB12 and P1 to P3) onsite around and down-gradient of the former UST hold. Soil samples were analyzed from EB8 to EB12 and groundwater samples were analyzed for all eight borings.
- In November 1998, Geoplexus collected three soil gas samples from three borings (AGP-1 to AGP-3) in the release are and within the adjacent building. Geoplexus presented an argument for "low risk" closure; however, case closure was not granted.
- In April 2008, Blymyer Engineers collected soil and groundwater samples from 24 soil borings (GP1 to GP24) on and offsite to characterize the extent of soil and groundwater pollution. It should be noted that AEI was not able to locate a formal report of these activities, only tables of soil and groundwater data, boring logs, and figures have been located.
- Groundwater monitoring was conducted approximately quarterly from 1992 through 1995, then sporadically through 2003, once in 2008. Groundwater monitoring was conducted on an approximately quarterly basis by AEI beginning from June 2011 to May 2013 and as-needed to assess the extent of groundwater impacts.

Based on the reports available to AEI, no remedial activities had been performed at the site since backfilling of the UST excavation until 2011. Site data are summarized in Tables 1 to 9.

Following the Phase I ESA and in preparation for development of the site and property to the south (1600 to 1618 Park Street), AEI was retained by Foley Street Investments to perform a Phase II subsurface investigation of the property, relating to potential environmental issues aside from the Good Chevrolet LUST case. The areas of concern investigated include five former and five then existing underground hydraulic lifts, several floor drains, three then existing USTs (one

550-gallon waste-oil UST, one 10,000 gallon and one 4,000 gallon gasoline UST), and a former gasoline station identified in Sanborn maps on the southern end of the development site (Parcel A) at the intersection of Park Street and Tilden Way. A total of 19 soil borings (AEI-1 to AEI-19) were drilled for soil and groundwater sampling.

Results of the investigation are summarized in the August 16, 2011 *Phase II Subsurface Investigation Report*, prepared by AEI. The only significant release identified during this investigation was in the area of several former (removed) underground hydraulic lifts in the northern section of the 1630 Park Street building, just south of and on the other side of the building wall from the UST release area (Figure 2). Significant concentrations of total petroleum hydrocarbons (TPH) as gasoline (TPH-g), as diesel (TPH-d), and as motor oil (TPH-mo) were detected in borings AEI-3, AEI-4, and AEI-6 to AEI-8. Based on the presence of benzene, toluene, ethyl-benzene, and xylenes (BTEX) and TPH-g in several of the samples, it was apparent that the gasoline and possibly oil from the waste oil UST had migrated beneath the former Good Chevrolet building. PCBs were not detected. A more detailed discussion of the release conditions was presented in the September 28, 2011 ICAP.

As outlined in the ICAP and subsequent ICAP Addendum, in November, 2011, AEI installed DPE-1 to DPE-3 and AS-1, and on December 6, 2011 three soil vapor probes (VP-1 to VP-3) were installed. The remediation wells and vapor probes were installed as part of high vacuum dual phase extraction (HVDPE) pilot test and interim corrective action activities. On December 6, 2011, AEI developed the newly installed remediation wells and conducted a groundwater sampling event to determine baseline groundwater conditions prior to the HVDPE event.

On January 17, 2012, AEI advanced soil borings AEI-20 to AEI-28 to further delineate the extent of impacted soil and groundwater and to select additional extraction well locations. Based on the results of this investigation, the dissolved phase plume has been defined towards the south (AEI-24 to AEI-26). Monitoring results from well DPE-4 show significantly lower dissolved phase concentrations than borings AEI-21 and AEI-22 and, since the data from DPE-4 is now post-remediation, it is considered representative of dissolved phase conditions towards the southwest. This indicates that the dissolved phase plume is limited in extent to the west. This limitation on migration is also consistent with the GP-9 groundwater sample data from 2008.

Gasoline-impacted soil appears to have been centered on the former UST hold, extending laterally in each direction. To the east, south, and west, impacted soil extended approximately 20 to 40 feet from the former UST hold. To the northwest, impacted soil extended into and along Park Street up to 50 feet from the site and is reasonably defined by GP12. The vertical extent of impacted soil has been generally well defined by past investigations as the top of the impacted zone is at approximately 7 to 8 feet bgs and ends to between approximately 12 to 14 feet bgs. The impacted thickness of the approximately 4 to 8 feet corresponds to just above the water table (capillary fringe) to several feet below the average water table. At a distance from the release area, the thickness of impacted soil generally decreases to approximately 2 to 4 feet, as observed in recent pre-remediation borings AEI-22, AEI- 23, and AEI-28.

Beginning in February 2013, separate phase hydrocarbons (LNAPL) were discovered in well DPE-5, located approximately 35 feet south of the former UST hold near a former hydraulic lift. Forensic analysis of the LNAPL showed it to be composed primarily of oil (presumably hydraulic or

motor oil) mixed with degraded gasoline. The maximum thickness of the LNAPL was 0.17 feet, measured in May 2013. The most recent measurement found 0.09 feet of LNAPL on August 2, 2013.

3.2 Recent Site Investigations

Between April 16 and August 21, 2013, ten temporary soil vapor monitoring points (SV-3 to SV-12) were installed at the site to document subsurface vapor concentrations and evaluate the potential for vapor intrusion into the proposed building. Soil vapor analytical results showed concentrations of VOC's below the San Francisco Bay Regional Water Quality Control Board, Environmental Screening Levels (ESLs) at all but two locations. Vapor points SV-10 and SV-11, located near the former hydraulic lift and in the vicinity of the reported LNAPL, contained concentrations of VOCs that exceeded the ESLs including benzene at 7,500 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), ethyl-benzene at 5,700 $\mu\text{g}/\text{m}^3$ and tetrachloroethene (PCE) at 2100 $\mu\text{g}/\text{m}^3$.

The most recent soil vapor data are shown on Figure 3. A historical summary of soil vapor data collected at the site is included in Table 9.

4.0 Interim Remedial Actions

4.1 Dual Phase Extraction System Operation

From December 5, 2011 to January 9, 2012, CalClean, Inc. (CalClean) of Tustin, California was retained by FSI to perform a HVDPE pilot test event with oversight of AEI. The work was performed as part of an interim corrective action and feasibility study which was previously proposed (AEI 2011c and AEI 2011d). Preliminary results of this work were submitted to the ACEH in the Investigation and Remedial Action Workplan, dated January 12, 2012 (AEI 2012a).

In January, 2012, AEI installed seven additional DPE wells (DPE-4 to DPE-6 and DPE-8 to DPE-11). DPE-7 could not be completed due to a void in the subsurface discovered during well installation; therefore this well was not completed. The void was later confirmed not to be a utility or other structure and was filled with neat cement grout on March 9, 2012.

On January 23, 2012 AEI developed each of the newly installed DPE wells and on January 24, 2012 completed a groundwater monitoring event on wells MW-1 to MW-3, DPE-1 to DPE-4, DPE-6, and DPE-9. The sampling event was performed to assess groundwater conditions following the initial HVDPE event and prior to commencing a second HVDPE event. The second HVDPE event commenced operation on January 24, 2012, and was concluded on April 28, 2012.

During the operation of the HVDPE system (pilot test phase and operation periods combined) an estimated 18,134 pounds of hydrocarbons were removed from the subsurface by soil vapor extraction; equivalent to approximately 3,022 gallons of liquid hydrocarbons (using a density of 6 pounds per gallon). Further, an estimated 390,460 gallons of hydrocarbon impacted groundwater water was removed from the subsurface at the site.

4.2 Focused Soil Excavations

In October, 2012, source removal and backfilling activities were conducted at three excavations at the site as requested and approved by ACEH. A total of 447.52 tons of hydrocarbon-impacted soil were removed from the three excavation areas. The results were presented in the December 7, 2012, *Interim Source Removal Report and Well Abandonment and Replacement Workplan Addendum*. Observations made during the excavations and confirmation soil samples collected from the excavation bottoms and sidewalls indicated the following:

Excavation of Former UST-hold

A total of one bottom and four sidewall samples were analyzed from this excavation. The bottom sample (EB1-15') was non-detect for all analytes. TPH-g was present in all sidewall samples at concentrations below the Target Soil Concentration of 83 milligrams per kilogram (mg/kg) with one exception. Sample SW1-10' contained TPH-g at 110 mg/kg. TPH-mo was also detected in this sample at 15 mg/kg, well below the target soil concentration of 2,500 mg/kg. TPH-mo was not detected in the remaining samples. Various BTEX compounds were detected in all sidewall samples. Benzene exceeded the target concentration in two samples reaching a maximum of 0.18 mg/kg in NW1-12'. Xylenes exceeded the target concentration in one sample: SW1-10' at 4.1 mg/kg.

Excavation of Former Hydraulic Lifts (eastern portion of the site)

A total of three bottom and nine sidewall samples were analyzed from this excavation. The bottom samples (EB2-11.5', CB2-11.5', and WB2-11.5') were non-detect for all analytes. TPH-g was non-detect in all sidewall samples with one exception. Sample WW2-9.5' contained TPH-g at 1400 mg/kg. TPH-mo was also detected in this sample at 3400 mg/kg, above the target soil concentration of 2,500 mg/kg. TPH-mo was detected in only one of the remaining samples: EW2-9.5' at a concentration of 23 mg/kg. BTEX compounds were non-detect in all sidewall samples with one exception. Sample WW2-9.5' contained ethylbenzene and xylenes at 42 and 180 mg/kg, respectively.

Excavation of Former Hydraulic Lift (near DPE-5)

A total of one bottom and four sidewall samples were analyzed from this excavation. The bottom sample (EB3-12.5') was non-detect for all analytes. Staining and elevated PID readings were observed in the final sidewalls of this excavation from approximately 7 to 11.5 feet bgs. TPH-g was present in all sidewall samples at concentrations that exceed the target concentration. TPH-g concentrations ranged from 2000 to 7600 mg/kg. TPH-mo was also detected in all sidewall samples at concentrations that exceed the target concentration. TPH-mo concentrations ranged from 3500 to 14,000 mg/kg. BTEX compounds were detected in all sidewall samples at concentrations that exceed the target concentration. Benzene concentrations ranged from 20 to 54 mg/kg. Toluene ranged from 110 to 410 mg/kg. Ethylbenzene ranged from 33 to 150 mg/kg. Xylenes ranged from 100 to 680 mg/kg.

5.0 Scope of Work

The following scope of work has been developed to remove the remaining elevated concentration oil and VOC-impacted soils in the vicinity of the former hydraulic lift excavation to reduce leaching to groundwater and the potential for vapor migration into the proposed building. The additional removal action was discussed with ACEH in the meeting on August 27, 2013. The general strategy and objectives for conducting an additional excavation were tentatively agreed upon by ACEH and FSI during that meeting, and confirmed in email correspondence with ACEH on August 28, 2013, pending submittal of an appropriate workplan (this document).

5.1 Well Abandonment

One dual phase extraction well (DPE-5) and three temporary soil vapor monitoring points (SV-5, SV-10 and SV-11) will be abandoned to accommodate the proposed excavation. The wells will be abandoned under permit from the Alameda County Public Works Agency (ACPWA). Well DPE-5 will be pressure grouted in-place, or over-drilled as required by ACPWA. The soil vapor points are 5 feet and 6.5 feet deep, and will therefore be removed completely during the excavation activities.

5.2 Soil Excavation

Excavation is proposed to remove additional high-concentration material near DPE-5 that could produce LNAPL. Once the high-concentration material has been removed, leaching of additional hydrocarbons to groundwater is expected to significantly decrease, allowing for natural attenuation to degrade petroleum hydrocarbons in the dissolved phase plume. The removal of the source soil is also expected to reduce vapor concentrations to below the ESLs, decreasing the threat of vapor intrusion into buildings. The proposed excavation area is shown on Figures 3 and 4.

5.2.1 Excavation Target Soil Concentrations

Efforts will be made to remove the impacted soil vertically and laterally within the proposed excavation. The following target soil concentrations are proposed for soil at the base of the excavated area. Sidewall impacts may remain in a thin zone near the water table which could require post-excavation natural attenuation.

The proposed cleanup targets for the excavation confirmation samples are summarized below:

<u>Constituent</u>	<u>Target Soil Concentration</u>
TPH-g	580 mg/kg
TPH-d	530 mg/kg
TPH-mo	2,500 mg/kg*
Benzene	0.04 mg/kg
Toluene	2.9 mg/kg
Ethylbenzene	3.3 mg/kg
Total Xylenes	2.3 mg/kg
Tetrachloroethene	0.7 mg/kg

Note: Targets based on RWQCB ESLs, May 2013, Table A-2, Protection of Groundwater.

* TPH Residual Fuels Ceiling Value (no groundwater protection ESL established).

5.2.2 Excavation Extents

The lateral extent of the excavation is proposed based upon soil analytical data from previous investigations. The proposed excavation limits and soil analytical data used to estimate the extent of the excavation are shown on Figure 4. It is expected that the excavation may extend south as far as boring AEI-24; southwest to near AEI-25; east to near DPE-6; to the west to near AEI-23; north to near AEI-22 and northeast to boring GP-21. A summary of soil analytical results for all borings at the site is included as Tables 2 through 4.

The depth of the excavation is expected to be approximately 12 feet below the ground surface.

5.2.3 Excavation Pre-Field Work

As required, an excavation permit will be obtained from the Alameda County Public Works Agency (ACPWA) prior to beginning excavation activities, air permits will be obtained from the Bay Area Air Quality Management District (BAAQMD) and Underground Service Alert (USA) will be notified at least three (3) days in advance. Onsite underground utility locations will be reviewed and, if needed, a private utility locating service retained to clear proposed excavation locations.

5.2.4 Excavation Activities

Both the lateral extent and depth of the excavation may vary and will be determined based on field conditions during excavation activities. However, up to 360 in-situ cubic yards of soil are anticipated to be removed during the excavation activities. In addition to the AEI construction department who will be responsible for the excavation activities, an AEI geologist or project scientist will be onsite during the excavation activities in order to document the extents of the excavation.

Excavated soil will be "hot loaded" during the excavation. The soil will be pre-approved at an appropriate landfill prior to the start of the excavation activities. If temporary stockpiles are

necessary due to time or equipment constraints, they will be placed on and covered with plastic sheeting. The cover will be secured against the wind and will be managed to eliminate erosion.

5.2.5 Groundwater Handling and Disposal

If groundwater accumulates in the excavation during excavation activities, it will be removed from the excavations using a pump. Groundwater removed from the excavation will be stored in a tank onsite or loaded directly into a tanker truck for proper disposal.

5.2.6 Confirmation Sampling

Prior to backfilling the excavation, soil samples will be collected from the bottom and side walls of the excavation to confirm the extent to which impacted soil has been removed. The samples will be collected based on PID readings as well as visual observations and will be biased toward the zones of greatest observed impacts. At a minimum, one sidewall sample for every 20 linear feet of excavation sidewall and 1 bottom sample for every 20 feet of excavation bottom will be collected. The number of samples may increase based on field observations. The soil samples will be analyzed for TPH-multi-range by EPA Method 8015 and VOCs by EPA Method SW 8260B.

Confirmation soil samples will be submitted for laboratory analyses on 24-hour turn around. The results will be used to confirm that the excavation limits meet the proposed goals.

5.2.7 Contingency Plan to Extend the Excavation

During the excavation activities, soil screening will be conducted using a photo-ionization detector (PID) to determine the preliminary limits of the excavation. In general, the field screening protocol will consist of using a hand-held PID instrument and the headspace analysis method. This method involves placing a small volume of soil into a plastic zip-close baggie, sealing the baggie, and placing the PID probe tip into the baggie after a minimum waiting period of 30 seconds.

A field screening value of 100 ppmv above background using the headspace analysis method will be used as an action level to trigger additional excavation, as feasible. Rationale for the 100 ppmv level can be found in the California State Water Resources Control Board document entitled *Technical Justification for Low-threat Closure Scenarios for Petroleum Vapor Intrusion Pathway*, dated June 30, 2011 (Appendix A, page 3).

The final excavation extents will be based upon the confirmation soil sample laboratory analytical results. If the laboratory analyses show that the goals are not met, the excavation will be enlarged as feasible based on the proximity to the property line, underground utilities or other structures, and as may be approved by FSI.

5.2.8 Excavation Backfilling

The bottom several feet of the excavation will be backfilled with drain rock as determined necessary to bridge the water table. The exact thickness of the drain rock will be determined based on the final depths and conditions encountered during the excavation activities. Fabric

will be placed on top of the drain rock, and the upper portion of the excavation will be backfilled with compacted fine grained material.

5.3 Soil Vapor Probe Installation and Sampling

Upon completion of the excavation activities, a soil vapor probe (SV-13) will be installed at the location shown in Figure 5. Data collected from the new vapor point and from the remaining existing vapor points will be used to confirm a reduction in VOC concentrations beneath the site.

The probe will be installed using a hand auger or rotary hammer drill to a depth of approximately 6.5 feet bgs. The soil vapor probe will be constructed with 1/4-inch outside diameter by 1/8-inch inside diameter Teflon tubing and a 6-inch long soil gas implant with a 0.0057-inch stainless wire mesh screen. Approximately 6-inches of No. 30 Monterey sand will be placed in the bottom of the borehole. Then, the 6-inch long stainless steel soil gas implant with 1/4-inch tubing attached will be lowered to the terminus of the boring. A No. 30 Monterey sand will then be placed around the implant to approximately 6-inches above the top of the implant. Hydrated bentonite is placed above the sand pack to seal the probe interval from overlying soils. A gas-tight Swagelok® valve will be used to cap the sampling tube.

6.0 Schedule of Activities

The proposed schedule is provided below:

<u>Activity</u>	<u>Anticipated Start Date</u>
<i>Well Abandonment (DPE-5)</i>	<i>Week of September 16</i>
<i>Excavation and backfilling</i>	<i>Week of September 23</i>
<i>Soil Vapor Probe Installation</i>	<i>Immediately after backfilling</i>
<i>Soil Vapor Sampling</i>	<i>Approximately 2-weeks after installation</i>
<i>Report</i>	<i>Within 30-days of Soil Vapor Sampling</i>

7.0 References

- Alameda County Environmental Health Department (ACEH), November 4, 2011. *Request for Pilot Test Workplan*
- ACEH, November 23, 2011. *Conditional Approval of Pilot Test Workplan*
- ACEH, April 16, 2012. *Corrective Action Plan*
- AEI Consultants (AEI), August 16, 2011. *Phase II Subsurface Investigation, 1600 to 1630 Park Street, Alameda, California*
- AEI, September 28, 2011. *Interim Corrective Action Plan, 1630 Park Street, Alameda, California*
- AEI, November 14, 2011. *ICAP Comment Letter Response and Pilot Test Workplan Details, 1630 Park Street, Alameda, California*
- AEI, February 3, 2012. *Corrective Action Plan, 1630 Park Street, Alameda, California*
- AEI, March 30, 2012. *Subsurface Investigation and Well Installation Report, 1630 Park Street, Alameda, California*
- AEI, April 25, 2012. *Response to April 16, 2012 Comments, 1630 Park Street, Alameda, California*
- AEI, December 7, 2012, *Interim Source Removal Report and Well Abandonment and Replacement Workplan Addendum, 1630 Park Street, Alameda, California*
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- Helley, E.J. and R.W. Graymer, 1997. *Quaternary Geology of Alameda County and Surrounding Areas, California: Derived from the Digital Database Open-File 97-97, 1997*
- Norfleet Consultants, 1998. *Groundwater Study and Water Supply History of the East Bay Plain, Alameda and Contra Costa Counties, California*. Prepared for the Friends of the San Francisco Estuary, P.O. Box 791, Oakland, California, and dated June 15, 1998.

8.0 Report Limitations

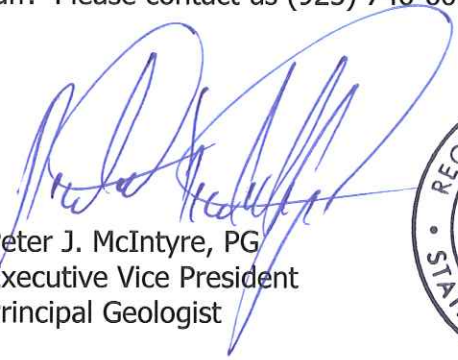
This report has been prepared by AEI Consultants relating to the property located at 1630 Park Street, in the City of Alameda, Alameda County, California. This report includes a summary of site conditions and relies heavily on information obtained from public records and other resources; AEI makes no warranty that the information summarized in this report includes consideration of all possible resources or information available for the site, whether referenced or not. Material samples have been collected and analyzed, and where appropriate conclusions drawn and recommendations made based on these analyses and other observations. This report may not reflect subsurface variations that may exist between sampling points. These variations cannot be fully anticipated, nor could they be entirely accounted for, in spite of exhaustive additional testing. This document should not be regarded as a guarantee that no further contamination, beyond that which could have been detected within the scope of past investigations is present beneath the property or that all contamination present at the site will be identified, treated, or removed. Undocumented, unauthorized releases of hazardous material(s) and petroleum products, the remains of which are not readily identifiable by visual inspection and/or are of different chemical constituents, are difficult and often impossible to detect within the scope of a chemical specific investigation and may or may not become apparent at a later time. This document may contain estimates of costs for various activities that could be implemented at the site. Such estimates are based on reasonably expected costs for similar activities; however, AEI provides no guarantee implicit or explicit that costs will not be significantly higher or lower than those estimated. All specified work has been performed in accordance with generally accepted practices in environmental engineering, geology, and hydrogeology and performed under the direction of appropriate California registered professionals.

We welcome comments and questions from ACEH staff. Please contact us (925) 746-6000.

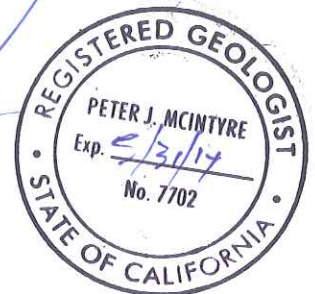
Sincerely,
AEI Consultants



Robert Robitaille
Sr. Project Manager



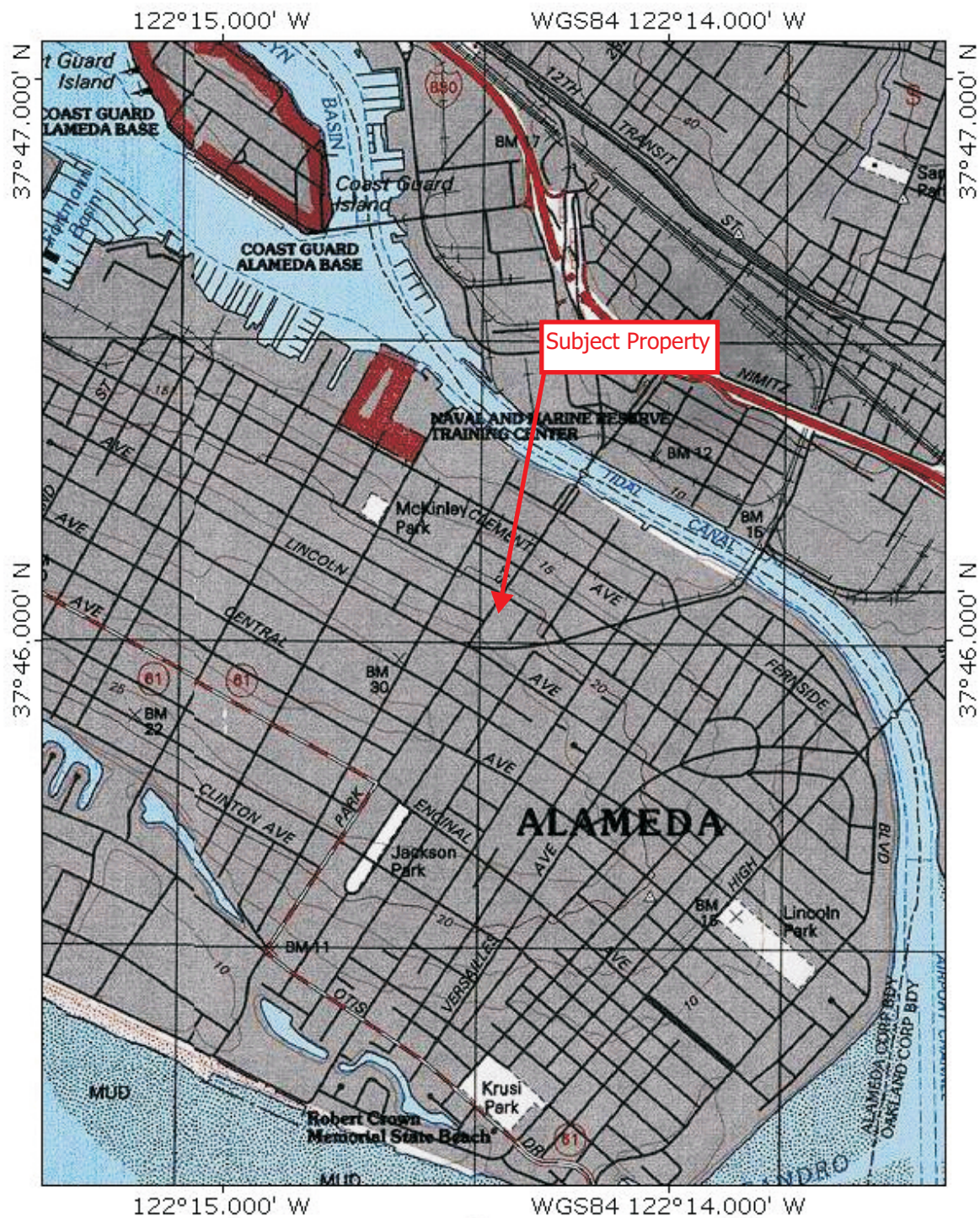
Peter J. McIntyre, PG
Executive Vice President
Principal Geologist



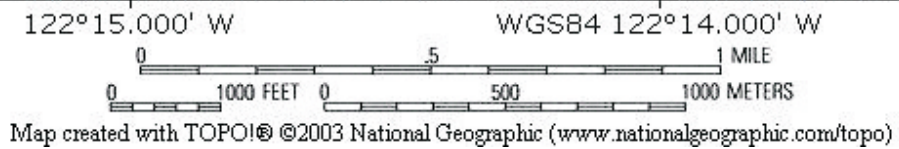
Distribution:

John Buestad, Foley Street Investments
Karel Detterman, Alameda County Environmental Health Department (FTP Upload)
GeoTracker (Upload)

FIGURES



TN
MN
15°



WELL

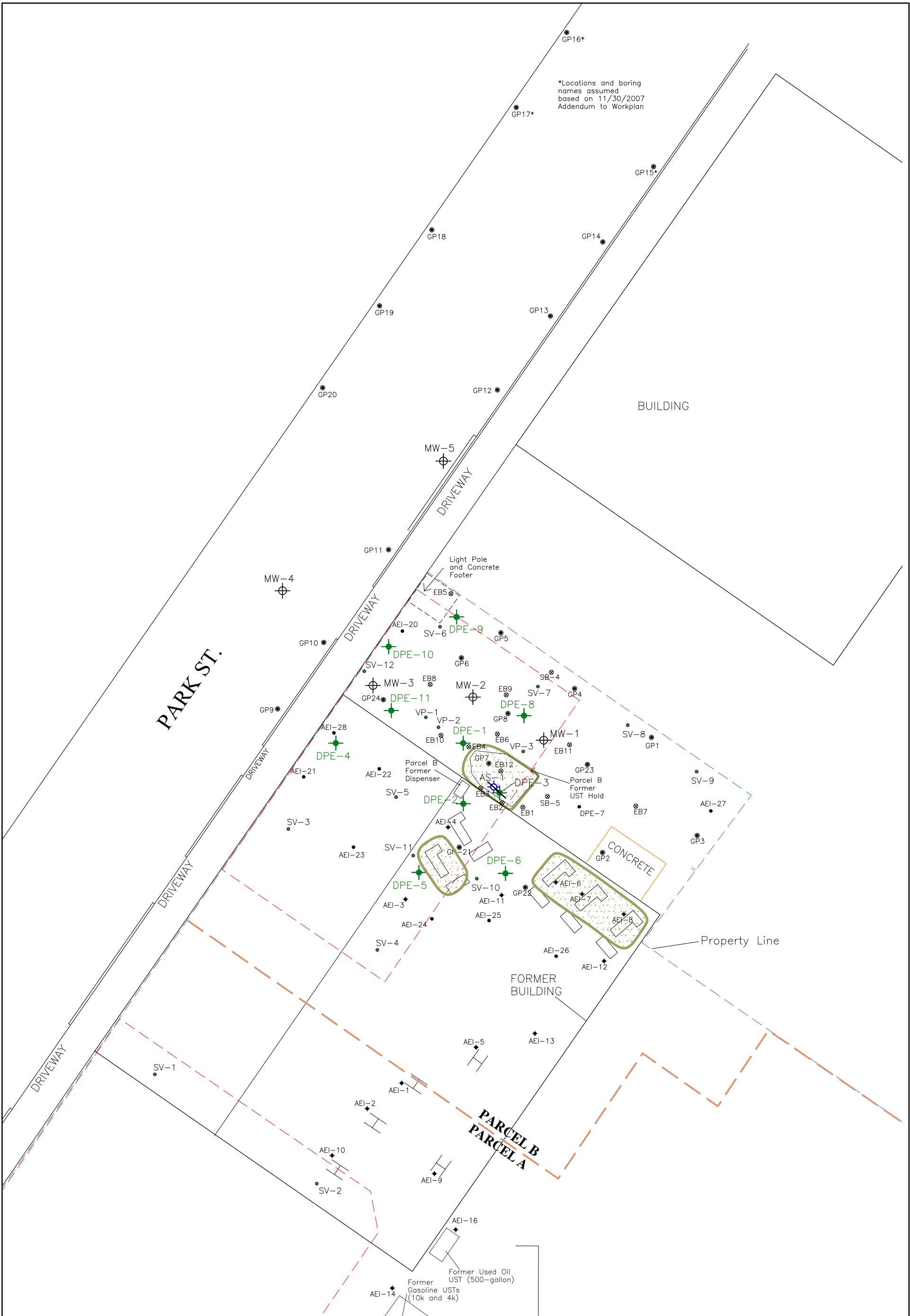
SITE LOCATION MAP

1630 Park Street, Alameda, California

FIGURE 1

Project Number: 298931





0 15 30

 Scale: 1" = 30'

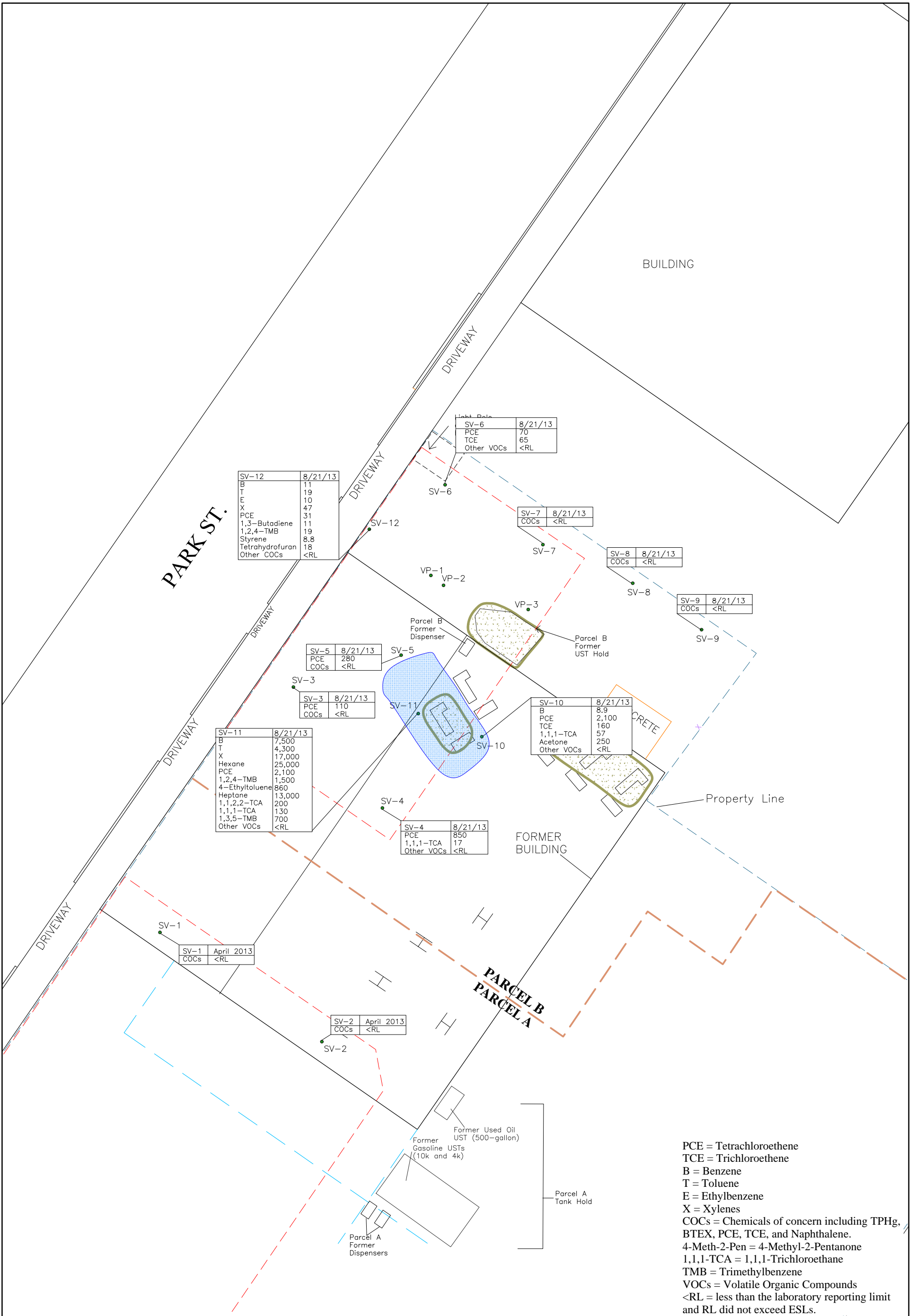
LEGEND	
	Remediation Well (12/11 and 1/12)
	AEI Soil Boring (1/12)
	Vapor Probe (12/11)
	AEI Soil Boring (7/11)
	Soil Boring (2008)
	Soil Boring (Pre-1997)
	Groundwater Monitoring Well
	Parcel Split
	Proposed Building Extents
	Former Building Extents
	Hydraulic Lift
	Former Hydraulic Lift w/ Excavation
	Abandoned Well
	Property Line

DRAFTED BY JAS 3-2-12
 REVISED BY JAS 5-9-13

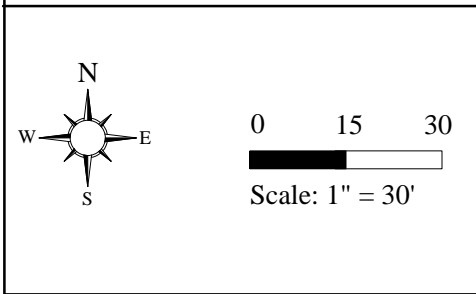
AEI CONSULTANTS
 2500 CAMINO DIABLO, WALNUT CREEK

**SITE PLAN -
 PARCEL B**

1620-1640 PARK STREET ALAMEDA, CALIFORNIA	FIGURE 2 PROJECT NO. 298931
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PCE = Tetrachloroethene
TCE = Trichloroethene
B = Benzene
T = Toluene
E = Ethylbenzene
X = Xylenes
COCs = Chemicals of concern including TPHg, BTEX, PCE, TCE, and Naphthalene.
4-Meth-2-Pen = 4-Methyl-2-Pentanone
1,1,1-TCA = 1,1,1-Trichloroethane
TMB = Trimethylbenzene
VOCs = Volatile Organic Compounds
<RL = less than the laboratory reporting limit and RL did not exceed ESLs.



LEGEND	
	Vapor Probe
	Parcel Split
	Excavation Extents
	Proposed Excavation
	Proposed Building Extents
	Former Hydraulic Lift
	Former Hydraulic Lift

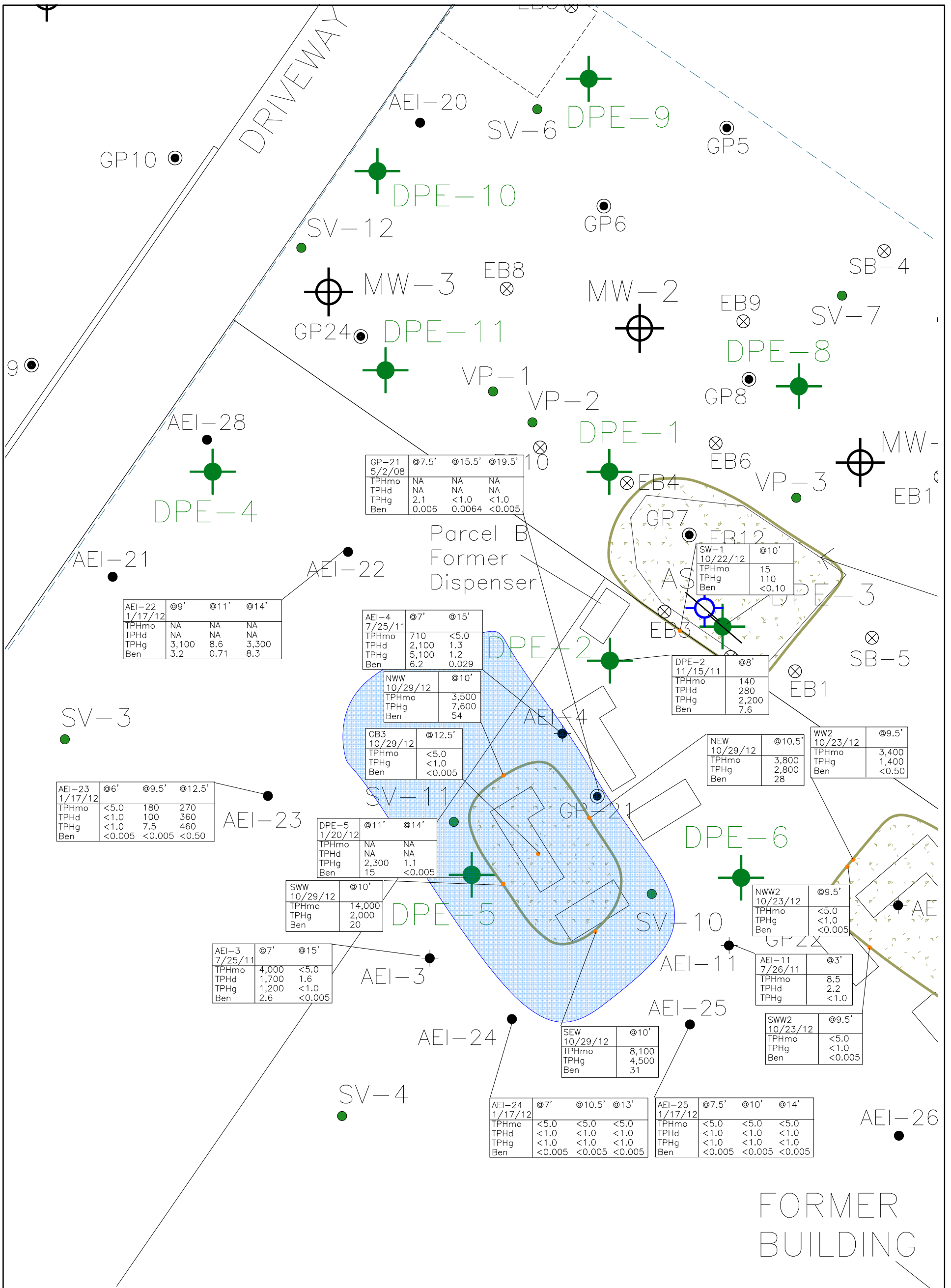
DRAFTED BY JAS 3-2-12
REVISED BY JAS 8-12-13

AEI CONSULTANTS
2500 CAMINO DIABLO, WALNUT CREEK

SOIL VAPOR DETECTIONS
SV-1 to SV-12

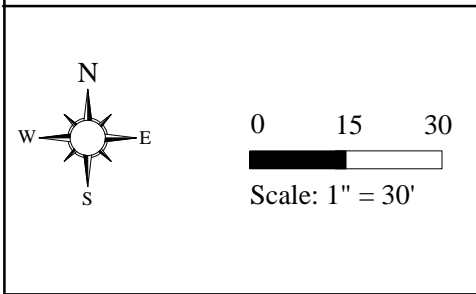
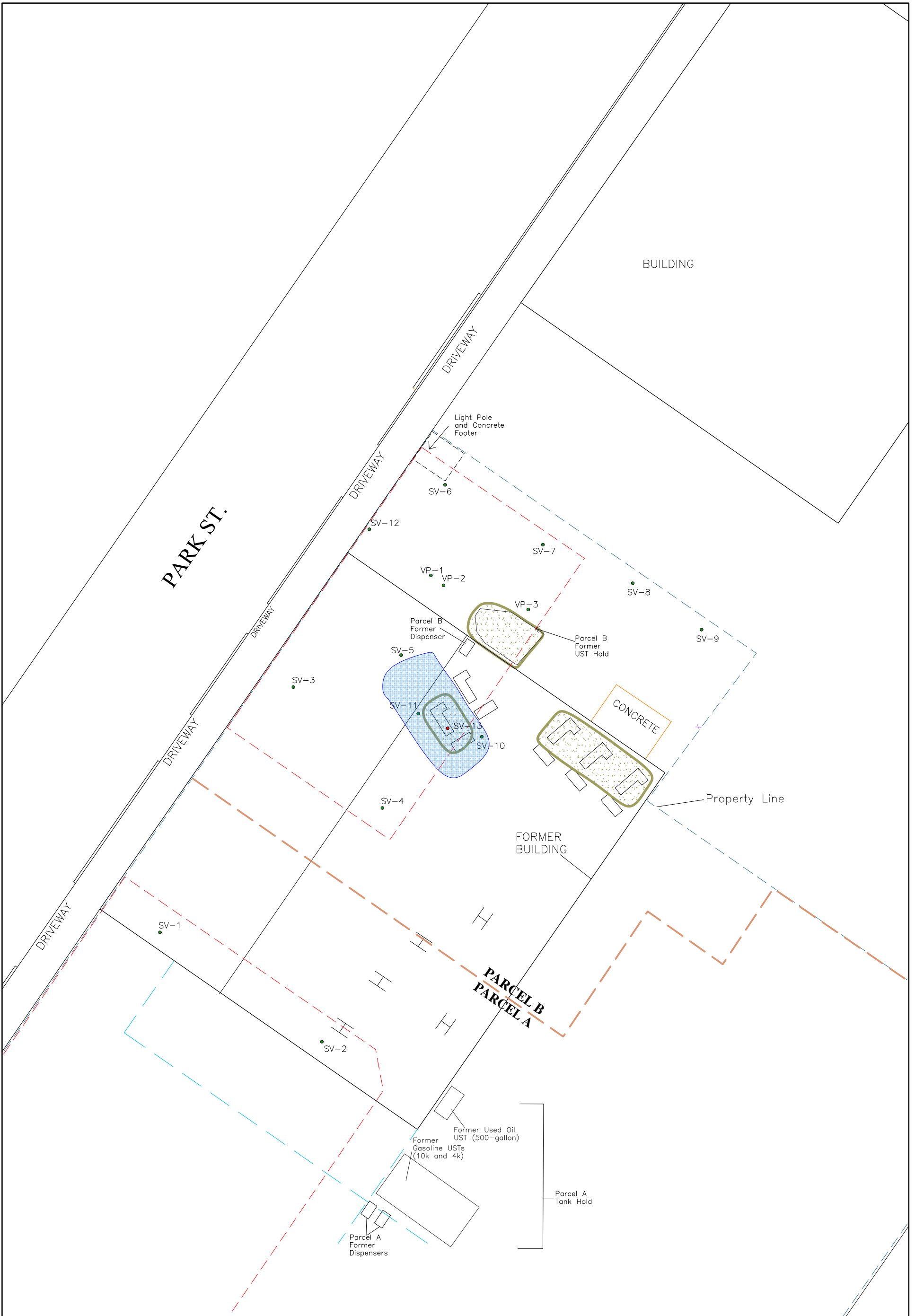
1630 PARK STREET
ALAMEDA, CALIFORNIA

FIGURE 3
PROJECT NO. 298931



TPHmo = Total Petroleum Hydrocarbons as Motor Oil
 TPHd = Total Petroleum Hydrocarbons as Diesel
 TPHg = Total Petroleum Hydrocarbons as Gasoline
 Ben = Benzene
 NA = Not Analyzed
 All results in milligrams per kilogram (ppm)

<p>Scale: 1" = 10'</p>	<p>LEGEND</p> <ul style="list-style-type: none"> Remediation Well (12/11 and 1/12) AEI Soil Boring (1/12) Vapor Probe AEI Soil Boring (7/11) Soil Boring (4/08) Soil Boring (1/97) Groundwater Monitoring Well Grab Sample 2012 Excavation Proposed Excavation Former Hydraulic Lift Former Hydraulic Lift 	<p>DRAFTED BY JAS 3-2-12 REVISED BY JAS 9-3-13</p>	
		<p>AEI CONSULTANTS 2500 CAMINO DIABLO, WALNUT CREEK</p> <p>PROPOSED EXCAVATION EXTENTS</p>	
<p>1620-1640 PARK STREET ALAMEDA, CALIFORNIA</p>		<p>FIGURE 4 PROJECT NO. 298931</p>	



LEGEND		DRAFTED BY JAS 3-2-12 REVISED BY JAS 8-12-13	
●	Vapor Probe		Proposed Building Extents
●	Proposed Vapor Probe		Former Hydraulic Lift
	2012 Excavation		Former Hydraulic Lift
	Proposed Excavation		Parcel Split

AEI CONSULTANTS 2500 CAMINO DIABLO, WALNUT CREEK	
PROPOSED SOIL VAPOR MONITORING POINT LOCATION	
1630 PARK STREET ALAMEDA, CALIFORNIA	FIGURE 5 PROJECT NO. 298931

TABLES

Table 1

Well Construction Details

AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Well ID Number	Well Installation Date	Elevation TOC (feet)	Casing Material	Total Depth (feet)	Well Depth (feet)	Borehole Diameter (inches)	Casing Diameter (inches)	Screened Interval (feet)	Slot Size (inches)	Filter Pack Interval (feet)	Filter Pack Material
AS-1	11/14/2011	-	PVC	25	25	8	2	20 - 25	0.02	20 - 25	#3 Sand
DPE-1	11/15/2011	25.88	PVC	16	15	10	4	7 - 15	0.01	6.5 - 16	#2/12 Sand
DPE-2	11/15/2011	26.22	PVC	16	15	10	4	7 - 15	0.01	6.5 - 16	#2/12 Sand
DPE-3	11/14/2011	25.27	PVC	16	14	10	4	7 - 14	0.01	6.5 - 16	#2/12 Sand
DPE-4	1/19/2012	26.06	PVC	17	17	10	4	8 - 17	0.01	7.5 - 17	#2/12 Sand
DPE-5	1/20/2012	26.25	PVC	18	18	10	4	8 - 18	0.01	7.5 - 18	#2/12 Sand
DPE-6	1/20/2012	26.13	PVC	18	18	10	4	8 - 18	0.01	7.5 - 18	#2/12 Sand
DPE-8	1/20/2012	25.36	PVC	18	18	10	4	8 - 18	0.01	7.5 - 18	#2/12 Sand
DPE-9	1/20/2012	25.09	PVC	18	18	10	4	8 - 18	0.01	7.5 - 18	#2/12 Sand
DPE-10	1/20/2012	25.14	PVC	17	17	10	4	8 - 17	0.01	7.5 - 17	#2/12 Sand
DPE-11	1/20/2012	25.57	PVC	18	18	10	4	8 - 18	0.01	7.5 - 18	#2/12 Sand
MW-1	1/15/1987	25.37	PVC	-	20	8	2	5 - 20	-	-	-
MW-2	1/15/1987	25.48	PVC	-	20	8	2	5 - 20	-	-	-
MW-3	1/15/1987	25.13	PVC	-	20	8	2	5 - 20	-	-	-
MW-4	4/20/1994	25.58	PVC	-	23	8	2	8 - 23	-	-	-
MW-5	4/20/1994	24.31	PVC	-	22	8	2	7 - 22	-	-	-
VP-1	12/6/2011	-	Poly/SS	6	6	1.25	1/4	5.1 - 5.6	Mesh	4.7 - 6	#30 Mesh Sand
VP-2	12/6/2011	-	Poly/SS	5.9	5.9	1.25	1/4	5.1-5.6	Mesh	4.7-5.9	#30 Mesh Sand
VP-3	12/6/2011	-	Poly/SS	5.75	5.75	1.25	1/4	5.1-5.6	Mesh	4.7-5.75	#30 Mesh Sand
SV-1	4/16/2013	-	Poly/SS	5.0	5.0	2.0	1/4	4.6-4.5	Mesh	5.0-4.0	#30 Mesh Sand
SV-2	4/17/2013	-	Poly/SS	5.0	5.0	2.0	1/4	4.6-4.5	Mesh	5.0-4.0	#30 Mesh Sand
SV-3	4/18/2013	-	Poly/SS	5.0	5.0	2.0	1/4	4.6-4.5	Mesh	5.0-4.0	#30 Mesh Sand
SV-4	4/19/2013	-	Poly/SS	5.0	5.0	2.0	1/4	4.6-4.5	Mesh	5.0-4.0	#30 Mesh Sand
SV-5	4/20/2013	-	Poly/SS	5.0	5.0	2.0	1/4	4.6-4.5	Mesh	5.0-4.0	#30 Mesh Sand

Table 1**Well Construction Details**

AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Well ID Number	Well Installation Date	Elevation TOC (feet)	Casing Material	Total Depth (feet)	Well Depth (feet)	Borehole Diameter (inches)	Casing Diameter (inches)	Screened Interval (feet)	Slot Size (inches)	Filter Pack Interval (feet)	Filter Pack Material
SV-6	4/21/2013	-	Poly/SS	5.0	5.0	2.0	1/4	4.6-4.5	Mesh	5.0-4.0	#30 Mesh Sand
SV-7	4/22/2013	-	Poly/SS	5.0	5.0	2.0	1/4	4.6-4.5	Mesh	5.0-4.0	#30 Mesh Sand
SV-8	8/5/2013	-	Teflon/SS	5.0	5.0	2.0	1/4	4.6-4.5	Mesh	5.0-4.0	#30 Mesh Sand
SV-9	8/5/2013	-	Teflon/SS	5.0	5.0	2.0	1/4	4.6-4.5	Mesh	5.0-4.0	#30 Mesh Sand
SV-10	8/5/2013	-	Teflon/SS	5.0	5.0	2.0	1/4	4.6-4.5	Mesh	5.0-4.0	#30 Mesh Sand
SV-11	8/21/2013	-	Teflon/SS	6.5	6.5	2.0	1/4	6.0-5.9	Mesh	6.5-5.5	#30 Mesh Sand
SV-12	8/21/2013	-	Teflon/SS	6.5	6.5	2.0	1/4	6.0-5.9	Mesh	6.5-5.5	#30 Mesh Sand

PVC = polyvinyl chloride

Poly/SS = Polyethelene tubing with stainless-steel tip

TOC = top of casing

"- " = not available

Table 2
Soil Sample Analytical Data
TPH and MBTEX

AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Sample ID	Date Collected	Approx. Depth (feet)	TPH-g (mg/kg)	TPH-d* (mg/kg)	TPH-mo* (mg/kg)	MTBE (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)
						EPA Method SW8021B/8015B/m				
MW-1-10	1/15/1987	10	24	-	-	-	2.9	3.6	-	1.8
MW-1-15	1/15/1987	15	<1.0	-	-	-	<0.1	<0.1	-	<0.1
MW-2-5	1/15/1987	5	<1.0	-	-	-	<0.1	<0.1	-	<0.1
MW-2-10	1/15/1987	10	350	-	-	-	14	22	-	23
MW-3-10	1/15/1987	10	200	-	-	-	9.8	16	-	16
MW-3-15	1/15/1987	15	<1.0	-	-	-	<0.1	<0.1	-	<0.1
SB-5-10	1/15/1987	10	6.5	-	-	-	<0.1	0.22	-	<0.1
EB1-S2	10/15/1993	8.5	510	-	-	-	0.89	10	5.8	41
EB1-S3	10/15/1993	11	2,300	-	-	-	22	190	57	280
EB2-2S	10/15/1993	10	15,000	-	-	-	84	710	260	1,400
EB2-S3	10/15/1993	11.5	200	-	-	-	4.3	15	3.9	20
EB3-S2	10/15/1993	10	2,200	-	-	-	9.4	71	42	200
EB3-S3	10/15/1993	12.5	610	-	-	-	1.2	3.2	4.5	2.9
EB4-S2	10/15/1993	8	4,900	-	-	-	32	230	84	440
EB4-S3	10/15/1993	10.5	7,600	-	-	-	60	390	130	630
EB5-S2	10/15/1993	9	1,800	-	-	-	<2.5	22	27	140
EB5-S3	10/15/1993	11.5	14	-	-	-	0.021	1.5	0.49	2.5
EB6-S2	10/15/1993	8.5	6,800	-	-	-	20	230	100	590
EB7-S2	10/15/1993	6.5	<1.0	-	-	-	<0.005	<0.005	<0.005	<0.005
EB7-S3	10/15/1993	8.5	1,000	-	-	-	3.8	45	21	110
MW4-S1	4/20/1994	4.5	<1.0	-	-	-	<0.005	<0.005	<0.005	0.013
MW4-S2	4/20/1994	9	9.7	-	-	-	1.1	0.82	0.42	1.3
MW4-S3	4/20/1994	14	<1.0	-	-	-	<0.005	0.008	<0.005	0.022
MW5-S1	4/20/1994	4.5	<1.0	-	-	-	<0.005	<0.005	<0.005	<0.5
MW5-S2	4/20/1994	9	1,100	-	-	-	12	43	20	93
MW5-S3	4/20/1994	14	1.1	-	-	-	0.033	0.17	0.044	0.22
EB8-S2	1/21/1997	9.5	2,000	-	-	<4	8.4	83	44	210
EB8-S3	1/21/1997	13.5	18	-	-	0.10	3.2	1.2	0.47	1.7
EB9-S1	1/21/1997	6.5	1.8	-	-	<5	0.071	0.052	0.026	0.074
EB9-S2	1/21/1997	9.5	1,300	-	-	<4	7.1	54	29	130
EB10-S1	1/21/1997	8.5	2,300	-	-	9.3	9.1	100	50	190

Table 2
Soil Sample Analytical Data
TPH and MBTEX

AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Sample ID	Date Collected	Approx. Depth (feet)	TPH-g (mg/kg)	TPH-d* (mg/kg)	TPH-mo* (mg/kg)	MTBE (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)
EB11-S1	1/21/1997	9.5	3,800	-	-	<9	8.8	190	97	510
EB11-S2	1/21/1997	12	13	-	-	<0.1	1.1	1.6	0.47	1.4
EB12-S1	1/21/1997	9.5	300	-	-	<0.6	0.95	0.59	3.5	18
EB12-S2	1/21/1997	12	1,300	-	-	6.2	9.4	23	35	130
GP1-11.5	4/29/2008	11.5	130	-	-	<0.005	<0.10	0.29	<0.10	0.42
GP1-15	4/29/2008	15	<1.0	-	-	<0.005	<0.005	0.0081	0.0065	0.028
GP2-11	4/29/2008	11	120	-	-	<0.010	<0.050	0.87	0.43	1.2
GP2-13.5	4/29/2008	13.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP3-6.75	4/29/2008	6.75	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP3-11.5	4/29/2008	11.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP4-11.5	4/29/2008	11.5	2.7	-	-	<0.005	0.14	0.052	0.072	0.17
GP4-14.5	4/29/2008	14.5	99	-	-	<0.020	0.48	1.4	1.0	4.5
GP5-11.5	4/29/2008	11.5	4.6	-	-	<0.005	0.12	0.078	0.14	0.48
GP5-19	4/29/2008	19	1.5	-	-	<0.005	<0.005	0.022	0.0069	0.032
GP6-11	4/29/2008	11	130	-	-	<0.10	0.11	1.0	1.1	5.4
GP7-8	4/30/2008	8	390	-	-	<0.050	0.84	2.2	4.3	18
GP7-19.5	4/30/2008	19.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP8-8.5	5/1/2008	8.5	1,100	-	-	<0.050	<0.10	3.2	7.3	45
GP8-19.5	5/1/2008	19.5	5.8	-	-	<0.005	0.0091	0.067	0.048	0.21
GP9-7.5	5/1/2008	7.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP9-11.25	5/1/2008	11.25	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP10-7.5	4/30/2008	7.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP10-19.5	4/30/2008	19.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP11-6	4/30/2008	6	<1.0	-	-	<0.005	<0.005	0.011	0.0053	0.026
GP11-15.5	4/30/2008	15.5	2,100	-	-	<0.10	5.7	71	38	180
GP11-18	4/30/2008	18	87	-	-	<0.020	0.059	0.93	0.67	4.2
GP12-7.5	4/30/2008	7.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP12-11	4/30/2008	11	4.7	-	-	<0.005	0.015	0.21	0.067	0.32
GP12-15.5	4/30/2008	15.5	<1.0	-	-	<0.005	<0.005	0.0071	0.0051	0.025
GP13-7.25	4/30/2008	7.25	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP13-11	4/30/2008	11	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP13-14	4/30/2008	14	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP14-7.5	4/30/2008	7.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005

Table 2
Soil Sample Analytical Data
TPH and MBTEX

AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Sample ID	Date Collected	Approx. Depth (feet)	TPH-g (mg/kg)	TPH-d* (mg/kg)	TPH-mo* (mg/kg)	MTBE (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)
GP14-11	4/30/2008	11	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP15-7.5	4/30/2008	7.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP16-7.5	5/1/2008	7.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP16-10.5	5/1/2008	10.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP17-7.5	5/1/2008	7.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP17-11.5	5/1/2008	11.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP18-7.5	5/1/2008	7.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP18-10	5/1/2008	10	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP19-7	5/1/2008	7	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP20-8	5/1/2008	8	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP21-7.5	5/2/2008	7.5	2.1	-	-	<0.005	0.006	0.028	0.012	0.065
GP21-15.5	5/2/2008	15.5	<1.0	-	-	<0.005	0.0064	0.022	0.0057	0.027
GP21-19.5	5/2/2008	19.5	<1.0	-	-	<0.005	<0.005	0.0092	<0.005	0.023
GP22-10.5	5/2/2008	10.5	1,100	-	-	<0.20	0.67	13	15	70
GP22-15.5	5/2/2008	15.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
GP23-7.5	5/2/2008	7.5	53	-	-	<0.005	<0.050	0.13	<0.050	0.37
GP23-11.5	5/2/2008	11.5	1.9	-	-	<0.005	0.062	0.041	0.043	0.18
GP23-16	5/2/2008	16	2	-	-	<0.005	<0.005	0.027	0.018	0.099
GP24-8.5	5/2/2008	8.5	3,600	-	-	<1.0	1.2	32	62	410
GP24-19.5	5/2/2008	19.5	<1.0	-	-	<0.005	<0.005	<0.005	<0.005	<0.005
AEI-3-7'	7/25/2011	7	1,200	1,700	4,000	<10	2.6	25	10	48
AEI-3-15'	7/25/2011	15	<1.0	1.6	<5.0	<10	<0.005	<0.005	<0.005	<0.005
AEI-4-7'	7/25/2011	7	5,100	2,100	710	<50	6.2	83.0	54.0	280.0
AEI-4-15'	7/25/2011	15	1.2	1.3	<5.0	<0.05	0.029	0.071	0.031	0.17
AEI-6-7'	7/25/2011	7	470	10,000	24,000	<5.0	<0.50	<0.50	<0.50	<0.50
AEI-6-14'	7/25/2011	14	<1.0	1.4	<5.0	<5.0	<0.50	<0.50	<0.50	<0.50
AEI-7-7'	7/25/2011	7	100	6,300	14,000	-	-	-	-	-
AEI-7-13'	7/25/2011	13	<1.0	3.7	7.4	<5.0	<0.50	<0.50	<0.50	<0.50
AEI-8-7'	7/25/2011	7	<1.0	720	2,900	-	-	-	-	-
AEI-8-14'	7/25/2011	14	<1.0	<1.0	<5.0	<5.0	<0.50	<0.50	<0.50	<0.50
AEI-11-3'	7/26/2011	3	<1.0	2.2	8.5	-	-	-	-	-

Table 2
Soil Sample Analytical Data
TPH and MBTEX

AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Sample ID	Date Collected	Approx. Depth (feet)	TPH-g (mg/kg)	TPH-d* (mg/kg)	TPH-mo* (mg/kg)	MTBE (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)
AEI-12-3'	7/26/2011	3	<1.0	2.6	<5.0	-	-	-	-	-
AEI-13-3'	7/26/2011	3	<1.0	4.2	<5.0	-	-	-	-	-
AEI-20-7.5'	1/17/2012	7.5	8.4	-	-	<0.05	0.0071	0.084	0.069	0.38
AEI-20-11'	1/17/2012	11	600	-	-	<0.50	0.89	2.9	10	39
AEI-20-15'	1/17/2012	15	3.3	-	-	<0.05	<0.005	0.028	<0.005	0.017
AEI-21-7'	1/17/2012	7	<1.0	-	-	<0.05	<0.005	<0.005	<0.005	<0.005
AEI-21-11'	1/17/2012	11	46	-	-	<0.05	0.020	0.42	0.27	0.60
AEI-21-14'	1/17/2012	14	<1.0	-	-	<0.05	<0.005	<0.005	<0.005	<0.005
AEI-22-9'	1/17/2012	9	3,100	-	-	<0.05	3.2	46	62	400
AEI-22-11'	1/17/2012	11	8.6	-	-	<0.10	0.71	0.77	0.31	1.3
AEI-22-14'	1/17/2012	14	3,300	-	-	<0.05	8.3	84	61	370
AEI-23-6'	1/17/2012	6	<1.0	<1.0	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
AEI-23-9.5'	1/17/2012	9.5	7.5	100	180	<0.05	<0.005	0.027	<0.005	0.0055
AEI-23-12.5'	1/17/2012	12.5	460	360	270	<5.0	<0.50	1.4	<0.50	0.80
AEI-24-7'	1/17/2012	7	<1.0	<1.0	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
AEI-24-10.5'	1/17/2012	10.5	<1.0	<1.0	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
AEI-24-13'	1/17/2012	13	<1.0	<1.0	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
AEI-25-7.5'	1/17/2012	7.5	<1.0	<1.0	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
AEI-25-10'	1/17/2012	10	<1.0	<1.0	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
AEI-25-14'	1/17/2012	14	<1.0	<1.0	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
AEI-26-7.5'	1/17/2012	7.5	<1.0	<1.0	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
AEI-26-10.5'	1/17/2012	10.5	<1.0	<1.0	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
AEI-26-14'	1/17/2012	14	<1.0	<1.0	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
AEI-27-3'	1/17/2012	3	<1.0	3.2	7.9	<0.05	<0.005	<0.005	<0.005	0.013
AEI-28-7'	1/17/2012	7	<1.0	<1.0	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
AEI-28-11'	1/17/2012	11	12,000	2,100	44	<10	21	210	210	1,000
AEI-28-13'	1/17/2012	13	7.8	2.0	<5.0	<0.05	0.050	0.29	0.31	1.4
DPE-1, 7-7.5'	11/15/2011	7	1,800	330	46	<50	9.7	64	29	150
DPE-2, 8-8.5'	11/15/2011	8	2,200	280	140	<15	7.6	57	34	170
DPE-3, 8-8.5'	11/14/2011	8	2,000	1,000	58	<50	6.7	48	47	240
DPE-5, 11'	1/20/2012	11	2,300	-	-	<10	15	99	33	140
DPE-5, 14'	1/20/2012	14	1.1	-	-	<0.05	<0.005	0.17	<0.005	0.016
DPE-6, 10'	1/20/2012	10	510	-	-	<1.0	<0.10	0.14	0.47	0.96

Table 2
Soil Sample Analytical Data
TPH and MBTEX

AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Sample ID	Date Collected	Approx. Depth (feet)	TPH-g (mg/kg)	TPH-d* (mg/kg)	TPH-mo* (mg/kg)	MTBE (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)
DPE-6, 14'	1/20/2012	14	<1.0	-	-	<0.05	<0.005	<0.005	<0.005	<0.005
DPE-7, 10'	1/19/2012	10	2,200	-	-	<5.0	<5.0	16	47	240
DPE-7, 14.5'	1/19/2012	14.5	610	-	-	<5.0	<5.0	3.9	9.5	55
EB1-15'	10/22/2012	15	<1.0	-	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
SW1-10'	10/22/2012	10	110	-	15	<1.0	<0.10	<0.10	<0.10	4.1
WW1-11'	10/22/2012	11	7.1	-	<5.0	<0.05	0.0084	<0.005	0.013	0.17
EW1-11.5'	10/22/2012	11.5	4.0	-	<5.0	<0.05	0.16	0.22	0.21	0.71
NW1-12'	10/22/2012	12	8.6	-	<5.0	<0.05	0.18	0.40	0.35	1.5
SEW2-9'	10/23/2012	9'	<1.0	-	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
EB2-11.5'	10/23/2012	11.5'	<1.0	-	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
EW2-9.5'	10/23/2012	9.5'	<1.0	-	23	<0.05	<0.005	<0.005	<0.005	<0.005
NEW2-9.5'	10/23/2012	9.5'	<1.0	-	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
CB2-11.5'	10/23/2012	11.5'	<1.0	-	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
CSW2-9.5'	10/23/2012	9.5'	<1.0	-	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
WB2-11.5'	10/23/2012	11.5'	<1.0	-	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
SWW2-9.5'	10/23/2012	9.5'	<1.0	-	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
WW2-9.5'	10/23/2012	9.5'	1,400	-	3,400	<5.0	<0.50	<0.50	42	180
WW2-6.5'	10/23/2012	6.5'	<1.0	-	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
NWW2-9.5'	10/23/2012	9.5'	<1.0	-	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
CNW2-9.5'	10/23/2012	9.5'	<1.0	-	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
CB3-12.5'	10/29/2012	12.5'	<1.0	-	<5.0	<0.05	<0.005	<0.005	<0.005	<0.005
SEW-10'	10/29/2012	10'	4,500	-	8,100	<25	31	270	100	460
NWW-10'	10/29/2012	10'	7,600	-	3,500	<50	54	410	150	680
NEW-10.5'	10/29/2012	10.5'	2,800	-	3,800	<5.0	28	180	65	290
SWW-10'	10/29/2012	10'	2,000	-	14,000	<5.0	20	110	33	100

mg/kg = milligrams per kilogram (equivalent to parts per million)
MDL = method detection limit
TPH = total petroleum hydrocarbons MTBE = methyl butyl tertiary ethyl
TPH-g = TPH as gasoline "<" = less than
TPH-d = TPH as diesel "*" = with silica gel cleanup
TPH-mo = TPH as motor oil "-" = not available

Table 3
Soil Sample Analytical Data
VOCs, Fuel Oxygenates, and PCBs
 AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Sample ID	Date Collected	Approx. Depth (feet)	All target VOCs (mg/kg) EPA Method SW8260	Fuel Oxygenates^ (mg/kg) EPA Method SW8260B	All other target PCBs (mg/kg) EPA Method SW8082
GP1-11.5	4/29/2008	11.5	-	<MDL	-
GP1-15	4/29/2008	15	-	<MDL	-
GP2-11	4/29/2008	11	-	<MDL	-
GP2-13.5	4/29/2008	13.5	-	<MDL	-
GP3-6.75	4/29/2008	6.75	-	<MDL	-
GP3-11.5	4/29/2008	11.5	-	<MDL	-
GP4-11.5	4/29/2008	11.5	-	<MDL	-
GP4-14.5	4/29/2008	14.5	-	<MDL	-
GP5-11.5	4/29/2008	11.5	-	<MDL	-
GP5-19	4/29/2008	19	-	<MDL	-
GP6-11	4/29/2008	11	-	<MDL	-
GP7-8	4/30/2008	8	-	<MDL	-
GP7-19.5	4/30/2008	19.5	-	<MDL	-
GP8-8.5	5/1/2008	8.5	-	<MDL	-
GP8-19.5	5/1/2008	19.5	-	<MDL	-
GP9-7.5	5/1/2008	7.5	-	<MDL	-
GP9-11.25	5/1/2008	11.25	-	<MDL	-
GP10-7.5	4/30/2008	7.5	-	<MDL	-
GP10-19.5	4/30/2008	19.5	-	<MDL	-
GP11-6	4/30/2008	6	-	<MDL	-
GP11-15.5	4/30/2008	15.5	-	<MDL	-
GP11-18	4/30/2008	18	-	<MDL	-
GP12-7.5	4/30/2008	7.5	-	<MDL	-
GP12-11	4/30/2008	11	-	<MDL	-
GP12-15.5	4/30/2008	15.5	-	<MDL	-
GP13-7.25	4/30/2008	7.25	-	<MDL	-
GP13-11	4/30/2008	11	-	<MDL	-
GP13-14	4/30/2008	14	-	<MDL	-
GP14-7.5	4/30/2008	7.5	-	<MDL	-
GP14-11	4/30/2008	11	-	<MDL	-
GP15-7.5	4/30/2008	7.5	-	<MDL	-
GP16-7.5	5/1/2008	7.5	-	<MDL	-
GP16-10.5	5/1/2008	10.5	-	<MDL	-
GP17-7.5	5/1/2008	7.5	-	<MDL	-
GP17-11.5	5/1/2008	11.5	-	<MDL	-

Table 3
Soil Sample Analytical Data
VOCs, Fuel Oxygenates, and PCBs
 AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Sample ID	Date Collected	Approx. Depth (feet)	All target VOCs (mg/kg) EPA Method SW8260	Fuel Oxygenates^ (mg/kg) EPA Method SW8260B	All other target PCBs (mg/kg) EPA Method SW8082
GP18-7.5	5/1/2008	7.5	-	<MDL	-
GP18-10	5/1/2008	10	-	<MDL	-
GP19-7	5/1/2008	7	-	<MDL	-
GP20-8	5/1/2008	8	-	<MDL	-
GP21-7.5	5/2/2008	7.5	-	<MDL	-
GP21-15.5	5/2/2008	15.5	-	<MDL	-
GP21-19.5	5/2/2008	19.5	-	<MDL	-
GP22-10.5	5/2/2008	10.5	-	<MDL	-
GP22-15.5	5/2/2008	15.5	-	<MDL	-
GP23-7.5	5/2/2008	7.5	-	<MDL	-
GP23-11.5	5/2/2008	11.5	-	<MDL	-
GP23-16	5/2/2008	16	-	<MDL	-
GP24-8.5	5/2/2008	8.5	-	<MDL	-
GP24-19.5	5/2/2008	19.5	-	<MDL	-
AEI-3-10'	7/25/2011	10	-	-	<1.0
AEI-4-10'	7/25/2011	10	-	-	<0.25
AEI-6-10'	7/25/2011	10	-	-	<0.05
AEI-7-11'	7/25/2011	11	-	-	<0.50
AEI-8-11'	7/25/2011	11	-	-	<0.05
AEI-11-3'	7/26/2011	3	<MDL	-	-
AEI-12-3'	7/26/2011	3	<MDL	-	-
AEI-13-3'	7/26/2011	3	<MDL	-	-
AEI-27-3'	1/17/2012	3	<MDL	-	-

mg/kg = milligrams per kilogram (equivalent to parts per million)

MDL = method detection limit

VOCs = volatile organic compounds

PCBs = polychlorinated biphenyls

"<" = less than

"-" = not available

"^" = fuel oxygenates tert-amyl methyl ether (TAME), t-butyl alcohol (TBA),

1,2-dibromomethane (EDB), 1,2-dichloroethane (1,2-DCA), diisopropyl ether (DIPE), methanol, ethanol, ethyl tert-butyl ether (ETBE), methyl tert-butyl ether (MTBE), and 1,2-Dichloroethane (EDC)

Table 4
Soil Sample Analytical Data
Metals

AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Sample ID	Date Collected	Approx. Depth (feet)	Cd mg/kg	Cr (total)* mg/kg	Pb mg/kg EPA Method SW6010B	Ni mg/kg	Zn mg/kg
AEI-11-3'	7/26/2011	3	<1.5	60	<5.0	24	16
AEI-12-3'	7/26/2011	3	<1.5	31	<5.0	15	10
AEI-13-3'	7/26/2011	3	<1.5	29	<5.0	14	9.7
*AEI-27-3'	1/17/2012	3	<0.25	38	140	17	140

Notes:

mg/kg = milligrams per kilogram

"-" = not available

Cd = Cadmium

Cr = Chromium

Pb = Lead

Ni = Nickel

Zn = Zinc

*AEI-27-3' = Antimony - 1.2 mg/kg, Arsenic - 4.0 mg/kg, Barium - 130 mg/kg, Cobalt - 3.7 mg/kg, Copper - 18 mg/kg, Mercury - 0.32 mg/kg and Vanadium - 28 mg/kg by CAM 17 EPA Method SW3050B.

Table 5

Grab Groundwater Analytical Data
 TPH and MBTEX
 AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Sample ID	Date Collected	TPH-g (µg/L)	TPH-d* (µg/L)	TPH-mo* (µg/L)	MTBE (µg/L) EPA Method SW8021B/8015Bm	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)
HP-1	4/23/1993	<50	-	-	-	<0.5	<0.5	<0.5	<0.5
HP-2	4/23/1993	<50	-	-	-	<0.5	<0.5	<0.5	<0.5
EB3-WSIA	10/15/1993	120,000	-	-	-	9,600	20,000	3,400	14,000
EB5-WSIA	10/15/1993	83,000	-	-	-	3,900	15,000	3,100	13,000
EB8-WS1	1/21/1997	25,000	-	-	<80	2,600	3,200	780	3,600
EB10-WS1	1/21/1997	81,000	-	-	<370	13,000	12,000	3,300	8,000
EB11-WS1	1/21/1997	49,000	-	-	<180	6,900	6,000	2,100	4,600
EB12-WS1	1/21/1997	38,000	-	-	110	1,400	1,400	1,800	7,400
P1-WS1	1/21/1997	74,000	-	-	<78	1,100	5,800	3,800	18,000
P2-WS1	1/21/1997	6,800	-	-	<10	2,200	290	310	560
P3-WS1	1/21/1997	220	-	-	<5.0	1.9	17	10	49
GP1W	4/29/2008	70,000	-	-	<500	6,800	6,600	2,300	12,000
GP2W	4/29/2008	910	-	-	<5.0	0.69	2.9	30	64
GP3W	4/29/2008	<50	-	-	<5.0	<0.5	<0.5	<0.5	<0.5
GP4W	4/29/2008	46,000	-	-	<500	570	3,200	1,500	7,500
GP5W	4/29/2008	12,000	-	-	<60	140	480	270	1,100
GP6W	4/29/2008	22,000	-	-	<170	920	1,600	900	3,500
GP7W	4/30/2008	22,000	-	-	<180	2,600	320	810	2,600
GP8W	5/1/2008	140,000	-	-	<650	9,000	20,000	4,300	21,000
GP9W	5/1/2008	550	-	-	<5.0	53	0.52	2.1	25
GP10W	4/30/2008	11,000	-	-	<100	1,900	490	480	770
GP11W	4/30/2008	42,000	-	-	<452	1,900	4,200	1,700	7,600
GP12W	4/30/2008	61,000	-	-	<500	4,500	11,000	1,700	7,700
GP13W	4/30/2008	6,200	-	-	<10	220	53	150	440
GP14W	4/30/2008	300	-	-	<5.0	46	1.9	19	11
GP15W	4/30/2008	<50	-	-	<5.0	<0.5	0.69	<0.5	1.1
GP16W	5/1/2008	<50	-	-	<5.0	<0.5	<0.5	<0.5	<0.5
GP17W	5/1/2008	<50	-	-	<5.0	<0.5	1.7	<0.5	2
GP18W	5/1/2008	<50	-	-	<5.0	<0.5	2.1	0.79	4
GP19W	5/1/2008	85	-	-	<5.0	<0.5	0.80	<0.5	<0.5
GP20W	5/1/2008	<50	-	-	<5.0	<0.5	<0.5	<0.5	<0.5
GP21W	5/2/2008	9,400	-	-	<50	560	1,400	260	1,300
GP22W	5/2/2008	3,900	-	-	<25	36	160	120	610
GP23W	5/2/2008	16,000	-	-	<90	830	1,900	540	2,600

Table 5

Grab Groundwater Analytical Data
 TPH and MBTEX
 AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Sample ID	Date Collected	TPH-g (µg/L)	TPH-d* (µg/L)	TPH-mo* (µg/L)	MTBE (µg/L) EPA Method SW8021B/8015Bm	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)
GP24W	5/2/2008	110,000	-	-	<450	6,500	4,200	3,100	13,000
AEI-3-W	7/25/2011	11,000	12,000	29,000	<50	1,100	1,900	210	860
AEI-4-W	7/25/2011	200,000	25,000	19,000	<500	21,000	30,000	3,600	16,000
AEI-5-W	7/25/2011	<50	<50	<250	-	-	-	-	-
AEI-6-W	7/25/2011	18,000	120,000	300,000	<50	<5.0	7.7	<5.0	28
AEI-7-W	7/25/2011	280	11,000	28,000	-	-	-	-	-
AEI-8-W	7/25/2011	<50	1,600	3,800	-	-	-	-	-
AEI-20	1/17/2012	130,000	-	-	<500	1,200	2,200	4,400	20,000
AEI-21	1/17/2012	110,000	-	-	<500	160	520	1,200	3,300
AEI-22	1/17/2012	61,000	-	-	<500	790	4,400	1,500	7,200
AEI-23	1/17/2012	9,000	8,400	1,500	<50	<5.0	16	12	<5.0
AEI-24	1/17/2012	<50	<50	<250	<0.5	<0.5	<0.5	<0.5	<0.5
AEI-25	1/17/2012	<50	<50	<250	<0.5	<0.5	<0.5	<0.5	<0.5
AEI-26	1/17/2012	<50	<50	<250	<0.5	<0.5	<0.5	<0.5	<0.5
AEI-27	1/17/2012	<50	<100	<500	<5.0	<0.5	<0.5	<0.5	<0.5
AEI-28	1/17/2012	16,000	4,500	<250	<100	160	690	540	2,500

µg/L = micrograms per liter
 TPH = total petroleum hydrocarbons
 TPH-g = TPH as gasoline
 TPH-d = TPH as diesel
 TPH-mo = TPH as motor oil
 MTBE = methyl tertiary butyl ether
 "*" = with silica gel cleanup
 "-" = not available

"<" = less than
 MDL = method detection limit

Table 6
Groundwater Analytical Data - Grab Samples
VOCs, Oxygenates, and PCBs
 AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Sample ID	Date Collected	1,4-Dioxane (µg/L)	TBA (µg/L)	EDB (µg/L)	EDC (µg/L) EPA Method SW8260B	MTBE (µg/L)	Fuel Oxygenates^ (µg/L)	All Target VOCs (µg/L)
GP1W	4/29/2008	-	<20	<5.0	<5.0	<5.0	<MDL	-
GP2W	4/29/2008	-	<2.0	<0.5	<0.5	<0.5	<MDL	-
GP3W	4/29/2008	-	<2.0	<0.5	<0.5	<0.5	<MDL	-
GP4W	4/29/2008	-	<20	<5.0	<5.0	<5.0	<MDL	-
GP5W	4/29/2008	-	<2.0	<0.5	<0.5	<0.5	<MDL	-
GP6W	4/29/2008	-	24	<5.0	<5.0	<5.0	<MDL	-
GP7W	4/30/2008	-	<20	<5.0	<5.0	<5.0	<MDL	-
GP8W	5/1/2008	-	<20	<5.0	<5.0	<5.0	<MDL	-
GP9W	5/1/2008	-	7.7	<0.5	1.1	1.2	<MDL	-
GP10W	4/30/2008	-	<20	<5.0	<5.0	<5.0	<MDL	-
GP11W	4/30/2008	-	<20	<5.0	<5.0	<5.0	<MDL	-
GP12W	4/30/2008	-	<20	<5.0	<5.0	<5.0	<MDL	-
GP13W	4/30/2008	-	8.9	<0.5	<0.5	<0.5	<MDL	-
GP14W	4/30/2008	-	<2.0	<0.5	<0.5	<0.5	<MDL	-
GP15W	4/30/2008	-	<2.0	<0.5	<0.5	<0.5	<MDL	-
GP16W	5/1/2008	-	<2.0	<0.5	<0.5	<0.5	<MDL	-
GP17W	5/1/2008	-	<2.0	<0.5	<0.5	<0.5	<MDL	-
GP18W	5/1/2008	-	<2.0	<0.5	<0.5	<0.5	<MDL	-
GP19W	5/1/2008	-	<2.0	<0.5	<0.5	<0.5	<MDL	-
GP20W	5/1/2008	-	<2.0	<0.5	<0.5	<0.5	<MDL	-

Table 6
Groundwater Analytical Data - Grab Samples
VOCs, Oxygenates, and PCBs
 AEI Project No. 298931, 1620-1640 Park Street, Alameda, California

Sample ID	Date Collected	1,4-Dioxane (µg/L)	TBA (µg/L)	EDB (µg/L)	EDC (µg/L) EPA Method SW8260B	MTBE (µg/L)	Fuel Oxygenates^ (µg/L)	All Target VOCs (µg/L)
GP21W	5/2/2008	-	<2.0	0.65	<0.5	<0.5	<MDL	-
GP22W	5/2/2008	-	<2.0	<0.5	<0.5	<0.5	<MDL	-
GP23W	5/2/2008	-	<20	<5.0	<5.0	<5.0	<MDL	-
GP24W	5/2/2008	-	75	<5.0	<5.0	<5.0	<MDL	-
AEI-27	1/17/2012	-	-	-	-	-	-	<MDL

mg/kg = milligrams per kilogram (equivalent to parts per million)

MDL = method detection limit

VOCs = volatile organic compounds

TBA = t-butyl alcohol

EDB = 1,2-dibromomethane

EDC = 1,2-dichloroethane

MTBE = methyl tert-butyl ether

"-" = not available

"<" = less than

"^" = fuel oxygenates tert-amyl methyl ether (TAME),
 1,2-dichloroethane (1,2-DCA), diisopropyl ether (DIPE), methanol,
 ethanol, and ethyl tert-butyl ether (ETBE)

Table 7

Groundwater Analytical Data (TPH, MBTEX & Lead) - Monitoring Wells
 AEI Project No. 298931, 1630 Park Street (Parcel B), Alameda, CA

Sample ID	Date	Notes	TPH-d	TPH-mo	TPH-g	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	Lead
			(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
MW-1	1/21/1987		-	-	21,020	1,148	8,627	1,792	6,012	-	-
	1/11/1989		-	-	1,400	74	10	13	5.0	-	-
	7/12/1989		-	-	1,200	470	49	45	33	-	-
	4/9/1991		-	-	850	260	10	15	12	-	-
	7/14/1992		-	-	13,000	2,300	1,200	1,200	1,200	-	-
	10/7/1992		-	-	3,600	1,600	80	120	120	-	-
	1/11/1993		-	-	1,200	410	16	23	19	-	-
	4/23/1993	a	-	-	2,200	720	180	82	150	-	-
	7/8/1993	a	-	-	3,200	1,200	110	97	100	-	-
	10/15/1993	a	-	-	3,700	1,400	43	94	36	-	-
	1/25/1994	a	-	-	1,600	680	16	41	35	-	-
	4/28/1994	a	-	-	6,100	1,900	380	250	340	-	-
	7/27/1994	a	-	-	6,000	1,800	510	220	450	-	-
	10/27/1994	a	-	-	3,000	1,100	79	82	87	-	-
	1/26/1995	a	-	-	1,600	660	100	82	87	-	-
	4/13/1995	a	-	-	3,800	1,200	270	120	260	-	-
	7/21/1995	a	-	-	5,200	1,500	450	190	400	-	-
	10/25/1995	a	-	-	5,900	1,800	450	210	400	-	-
	1/21/1997	a	-	-	3,100	1,100	87	160	180	<7.3	-
	11/12/1998	a	-	-	1,000	280	3	3.3	7.9	<30	-
	1/16/2001	a	-	-	4,700	1,200	18	150	49	<5	-
	6/27/2002	a	-	-	5,900	230	7.7	<5	1,500	<5	-
	11/18/2002	a	-	-	3,100	890	12	310	28	<2.5	-
	2/20/2003	d	-	-	260	100	0.72	<0.5	<0.5	<0.5	-
	6/11/2003	a	-	-	3,100	480	6.7	220	420	<2.5	-
	4/3/2008	a	-	-	2,700	280	21	130	230	<1.0	<0.5
	6/23/2011	a	-	-	610	100	6.2	46	77	<2.5	-
	12/6/2011	a	-	-	900	160	<5.0	68	76	<5.0	-
	1/24/2012	a	-	-	190	25	<1.0	1.4	4.6	<1.0	-
	5/18/2012	f	210	<250	2,600	200	51	93	610	<5.0	-
7/11/2012	a	700	<250	2,700	190	8.1	100	230	<5.0	-	
11/16/2012	c	140	<250	370	71	<1.7	<1.7	<1.7	<1.7	-	
2/27/2013		<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-	
5/1/2013		<50	<250	<50	3.1	<0.5	<0.5	<0.5	<0.5	-	

Table 7

Groundwater Analytical Data (TPH, MBTEX & Lead) - Monitoring Wells
 AEI Project No. 298931, 1630 Park Street (Parcel B), Alameda, CA

Sample ID	Date	Notes	TPH-d	TPH-mo	TPH-g	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	Lead
			(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
MW-2	1/21/1987		-	-	5,018	386	1,981	285	1,432	-	-
	1/11/1989		-	-	10,000	3,000	410	240	190	-	-
	7/12/1989		-	-	7,600	2,700	540	250	320	-	-
	4/9/1991		-	-	4,900	910	210	130	200	-	-
	7/14/1992		-	-	13,000	4,400	1,500	610	1,100	-	-
	10/7/1992		-	-	11,000	5,200	1,500	500	1,200	-	-
	1/11/1993		-	-	17,000	940	1,100	480	930	-	-
	4/23/1993	a	-	-	52,000	13,000	8,400	1,700	5,300	-	-
	7/8/1993	a	-	-	6,400	2,500	470	280	530	-	-
	10/15/1993	a	-	-	17,000	3,900	870	500	940	-	-
	1/25/1994	a	-	-	16,000	5,400	1,140	640	1,500	-	-
	4/28/1994	a	-	-	15,000	4,000	910	480	1,200	-	-
	7/27/1994	a	-	-	18,000	6,000	760	630	1,600	-	-
	10/27/1994	a	-	-	9,500	2,700	230	320	640	-	-
	1/26/1995	a	-	-	5,900	1,900	290	230	500	-	-
	4/13/1995	a	-	-	10,000	3,300	620	360	930	-	-
	7/21/1995	a	-	-	9,900	3,300	320	390	830	-	-
	10/25/1995	a	-	-	13,000	4,900	400	580	990	-	-
	1/21/1997	a	-	-	7,600	2,600	310	330	660	<20	-
	11/12/1998	a	-	-	31,000	11,000	750	1,500	2,300	<900	-
	1/16/2001	a	-	-	23,000	8,200	260	1,000	820	<30	-
	6/27/2002	a	-	-	39,000	7,000	1,800	690	4,000	<5	-
	11/18/2002	a	-	-	15,000	5,700	76	1,000	150	<12	-
	2/20/2003	a	-	-	26,000	6,300	1,100	1,300	1,900	<5.0	-
	6/11/2003	a	-	-	37,000	7,100	2,300	2,000	3,600	<25	-
	4/3/2008	a	-	-	4,100	760	96	250	130	<2.5	<0.5
	6/23/2011	a	-	-	6,500	2,100	210.0	560	310	<50	-
	12/6/2011	a	-	-	4,800	1,600	<50	260	<50	<50	-
	1/24/2012	a	-	-	2,500	100	22.0	<5.0	410	<5.0	-
	5/18/2012	f	68	<250	140	14	2.8	2.9	12	<0.5	-
7/11/2012	a	270	<250	930	170	<5.0	24	9.3	<5.0	-	
11/16/2012	c	200	<250	340	15	1.4	5.4	2.1	<0.5	-	
2/27/2013	a	<50	<250	53	1.8	<0.5	<0.5	1.4	<0.5	-	
5/1/2013	a,c	190	<250	280	2.2	<0.5	5.6	5.6	<0.5	-	

Table 7

Groundwater Analytical Data (TPH, MBTEX & Lead) - Monitoring Wells
 AEI Project No. 298931, 1630 Park Street (Parcel B), Alameda, CA

Sample ID	Date	Notes	by EPA Methods 8020, 8021B, or 8260B								Lead EPA 200.8 (µg/L)
			TPH-d (µg/L)	TPH-mo (µg/L)	TPH-g (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)	
MW-3	1/21/1987		-	-	10,287	1,428	3,281	610	2,761	-	-
	1/11/1989		-	-	5,300	1,800	340	150	160	-	-
	7/12/1989		-	-	7,800	3,100	900	300	480	-	-
	4/9/1991		-	-	9,400	1,400	730	200	510	-	-
	7/14/1992		-	-	17,000	3,500	390	390	260	-	-
	10/7/1992		-	-	9,200	4,300	470	390	610	-	-
	1/11/1993		-	-	2,000	740	29	58	28	-	-
	4/23/1993	a	-	-	6,500	2,600	280	260	190	-	-
	7/8/1993	a	-	-	5,200	2,100	260	250	180	-	-
	10/15/1993	a	-	-	11,000	3,500	580	430	370	-	-
	1/25/1994	a	-	-	6,200	2,500	270	160	28	-	-
	4/28/1994	a	-	-	5,300	1,700	190	210	180	-	-
	7/27/1994	a	-	-	5,900	2,000	360	260	330	-	-
	10/27/1994	a	-	-	8,000	2,200	580	260	170	-	-
	1/26/1995	a	-	-	3,700	1,200	150	150	190	-	-
	4/13/1995	a	-	-	4,000	1,400	200	180	210	-	-
	7/21/1995	a	-	-	5,700	2,000	280	270	280	-	-
	10/25/1995	a	-	-	11,000	3,500	1,100	460	680	-	-
	1/21/1997	a	-	-	2,200	860	63	71	80	<5.0	-
	11/12/1998	d	-	-	180	44	0.51	<0.5	0.92	<20	-
	1/16/2001	a	-	-	64	11	0.77	<0.5	<0.5	<5.0	-
	6/27/2002		-	-	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	11/18/2002	a	-	-	110	21	1	<0.5	<0.5	<0.5	-
	2/20/2003		-	-	<50	2.5	<0.5	<0.5	<0.5	<0.5	-
	6/11/2003		-	-	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	4/3/2008	a	-	-	7,600	2,400	58	250	170	<5.0	<0.5
	6/23/2011	a	-	-	1,300	560	21	86	150	<12	-
	12/6/2011	a	-	-	1,800	620	28	22	46	<17	-
	1/24/2012	a	-	-	3,700	1,200	68	34	130	<25	-
	5/18/2012	f	<50	<250	75	5.3	<0.5	<0.5	1.6	<0.5	-
	7/11/2012	a	<50	<250	78	1.4	0.66	<0.5	5.5	<0.5	-
	11/16/2012		<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	2/27/2013	g	<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	5/1/2013		<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	8/2/2013		-	-	-	<2.5	<2.5	<2.5	<2.5	<2.5	-

Table 7

Groundwater Analytical Data (TPH, MBTEX & Lead) - Monitoring Wells
 AEI Project No. 298931, 1630 Park Street (Parcel B), Alameda, CA

Sample ID	Date	Notes	TPH-d	TPH-mo	TPH-g	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	Lead
			(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
MW-4	4/28/1994	b,c	-	-	190	3.8	2.9	2.1	3.1	-	-
	7/27/1994	a	-	-	180	15	9.2	7.6	28	-	-
	10/27/1994	a	-	-	130	8.6	6.6	4.5	17	-	-
	1/26/1995		-	-	110	6.5	1.2	1.8	11	-	-
	4/13/1995		-	-	82	3.9	<0.5	<0.5	2.5	-	-
	7/21/1995		-	-	130	8.8	1.3	4.5	7.6	-	-
	10/25/1995		-	-	95	6.6	1.7	4.3	7	-	-
	4/3/2008		-	-	130	1.6	<0.5	0.89	0.85	<0.5	<0.5
	6/23/2011	a	-	-	53	2.7	<0.5	1.0	1.7	<0.5	-
	5/23/2012	f	<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	7/11/2012	g	<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	11/16/2012	c	360	<250	440	3.4	<0.5	1.2	2.1	<0.5	-
	2/27/2013		<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	5/1/2013		<50	<250	<50	1.8	<0.5	<0.5	<0.5	<0.5	-
	8/8/2013	g	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	-
	MW-5	4/28/1994	a	-	-	30,000	4,000	3,000	810	3,500	-
7/27/1994		a	-	-	9,300	2,000	800	290	940	-	-
10/27/1994		a	-	-	15,000	2,700	1,300	420	1,100	-	-
1/26/1995		a	-	-	7,900	2,100	680	240	860	-	-
4/13/1995		a	-	-	7,900	2,400	580	340	630	-	-
7/21/1995		a	-	-	11,000	3,400	760	610	1,200	-	-
10/25/1995		a	-	-	13,000	2,900	830	570	1,100	-	-
1/21/1997		a	-	-	2,600	750	65	1,860	280	<5.0	-
11/12/1998			-	-	<50	<0.5	<0.5	<0.5	<0.5	<5.0	-
1/16/2001			-	-	<50	11	<0.5	<0.5	0.82	<5.0	-
6/27/2002			-	-	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
11/18/2002		a	-	-	130	17	3.8	2.1	16	<0.5	-
2/20/2003			-	-	<50	5.6	0.51	<0.5	0.68	<0.5	-
6/11/2003		a	-	-	170	48	<0.5	<0.5	1.4	<0.5	-
4/3/2008		a	-	-	31,000	490	3,400	1,600	5,300	<10	<0.5
6/23/2011		a	-	-	82	5.1	<0.5	12.0	8.4	<0.5	-
5/18/2012		f	<50	<250	120	<0.5	<0.5	<0.5	<0.5	<0.5	-
7/11/2012		g	<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
11/16/2012		c	450	<250	580	27	1.7	6.7	7.1	<0.5	-
2/27/2013			<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
5/1/2013	a	<50	<250	64	3.4	<0.5	<0.5	<0.5	<0.5	-	
8/8/2013	g	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	-	

Table 7

Groundwater Analytical Data (TPH, MBTEX & Lead) - Monitoring Wells
 AEI Project No. 298931, 1630 Park Street (Parcel B), Alameda, CA

Sample ID	Date	Notes	TPH-d	TPH-mo	TPH-g	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	Lead
			(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
DPE-1	12/6/2011	a	-	-	9,200	1,800	570	460	1,100	<50	-
	1/24/2012	a	-	-	3,200	170	58	<5.0	620	<5.0	-
	5/18/2012	f	280	<250	540	49	<1.0	<1.0	17	<1.0	-
	7/11/2012	a	860	<250	2,300	240	15	98	88	<5.0	-
	11/16/2012	c	360	<250	580	3.3	<0.5	2.2	2.8	<0.5	-
	2/27/2013	a,c	110	<250	270	1.4	<0.5	0.53	5.3	<0.5	-
	5/1/2013	a,c	74	<250	330	0.90	<0.5	1.9	10	<0.5	-
	8/8/2013	g	-	-	-	18	<5.0	35	39	<5.0	-
DPE-2	12/6/2011	a	-	-	22,000	2,100	3,300	650	3,300	<100	-
	1/24/2012	a	-	-	1,100	44	26	11	150	<2.5	-
	5/18/2012	f	<50	<250	220	33	3.2	<0.5	30	<0.5	-
	7/11/2012	a	400	<250	2,600	300	12	45	390	<10	-
	11/16/2012		<50	<250	<50	3.4	<0.5	<0.5	<0.5	<0.5	-
	2/27/2013	h	99	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	5/1/2013	a,c	57	<250	180	37	1.3	3.1	3.2	<0.5	-
	8/8/2013	g	-	-	-	360	<5.0	30	11	<5.0	-
DPE-3	12/6/2011	a	-	-	6,400	550	560	180	1,000	<17	-
	1/24/2012	a	-	-	5,500	290	240	44	1,000	<5.0	-
	5/18/2012	f	260	<250	1,100	78	37	11	89	<1.7	-
	7/11/2012	a	720	<250	2,400	330	19	10	130	<10	-
DPE-4	1/24/2012	a	-	-	730	66	6.0	7.1	83	2.5	-
	5/18/2012	f	<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	7/11/2012		<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	11/16/2012		<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	2/27/2013		<50	<250	<50	0.63	<0.5	<0.5	<0.5	<0.5	-
	5/1/2013	a,h	53	<250	210	19	<0.5	<0.5	<0.5	<0.5	-
	8/2/2013		-	-	-	12	<0.5	<0.5	<0.5	<0.5	-
DPE-5	11/16/2012	h	560	1,400	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	2/27/2013	a,c,h	1,200	2,600	3,900	440	370	120	570	<10	-
	5/1/2013	Well not sampled due to the presence of free product (Thickness of 0.17')									
DPE-6	1/24/2012	a	-	-	64*	<0.5	<0.5	<0.5	3.2	<0.5	-
	5/18/2012	f	<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	7/11/2012	g	<50	<250	<50	0.93	<0.5	<0.5	<0.5	<0.5	-
	11/16/2012		<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	2/27/2013	h	160	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	5/1/2013	i	1,200	1,100	<50	0.58	<0.5	<0.5	<0.5	<0.5	-
8/2/2013		-	-	-	0.53	<0.5	<0.5	<0.5	<0.5	-	

Table 7

Groundwater Analytical Data (TPH, MBTEX & Lead) - Monitoring Wells
 AEI Project No. 298931, 1630 Park Street (Parcel B), Alameda, CA

Sample ID	Date	Notes	TPH-d	TPH-mo	TPH-g	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	Lead
			(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
DPE-8	11/16/2012	c	460	<250	630	13	<0.5	1.1	19	<0.5	-
	2/27/2013		<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	5/1/2013	a,c	92	<250	140	8.0	<0.5	<0.5	<0.5	<0.5	-
DPE-9	1/24/2012	a	<50	<250	4,400	160	390	93	1,100	<5.0	-
	7/11/2012	a	680	<250	1,300	47	3.1	4.0	100	<1.7	-
	11/16/2012	c	470	<250	530	4.7	<0.5	0.78	2.3	<0.5	-
	2/27/2013	b	2,200	<250	3,300	5.5	<0.5	5.7	<0.5	16	-
	5/1/2013	a,c	1,300	<250	1,700	5.4	<0.5	5.6	11	<0.5	-
	8/2/2013		-	-	-	3.9	<0.5	<0.5	<0.5	<0.5	-
DPE-10	5/18/2012	f	420	<250	1,700	150	<5.0	<5.0	<5.0	160	-
	7/11/2012	a	160	<250	360	40	<1.0	<1.0	<1.0	<1.0	-
	11/16/2012		<50	<250	79	4.9	<0.5	<0.5	<0.5	<0.5	-
	2/27/2013	a	660	<250	820	5.3	<0.5	6.0	<0.5	4.4	-
	5/1/2013	a,c	2,600	<250	3,700	56	<1.7	95	82	<1.7	-
	8/2/2013		-	-	-	8.2	<0.5	<0.5	<0.5	<0.5	-
DPE-11	5/18/2012	f	260	<250	930	6.4	4.6	4.6	160	<1.2	-
	7/11/2012	a	1,600	<250	2,400	16	<1.0	14	57	<1.0	-
	11/16/2012	c	540	<250	860	5.3	<0.5	0.81	1.2	<0.5	-
	2/27/2013		<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
	5/1/2013		<50	<250	<50	<0.5	<0.5	<0.5	<0.5	<0.5	-
ESL			100	100	100	1.0	40	30	20	5.0	2.5

TPH-g= total petroleum hydrocarbons as gasoline

TPH-d= total petroleum hydrocarbons as diesel

TPH-mo= total petroleum hydrocarbons as motor oil

BTEX= Benzene, Toluene, Ethylbenzene, Xylenes

MTBE = Methyl tertiary butyl ether

"-" = Not analyzed or data not available

µg/L = micrograms per liter (ppb)

ESL = Environmental Screening Levels, Table F-1a, Groundwater, Potential Drinking Water, San Francisco Regional Water Quality Control Board, Revised May 2013

a = Laboratory note indicates the unmodified or weakly modified gasoline is significant.

b = Laboratory note indicates heavier gasoline range compounds are significant (aged gas?).

c = Laboratory note indicates gasoline range compounds are significant with no recognizable pattern.

d = Laboratory note indicates that lighter gasoline range compounds (the most mobile fraction) are significant.

e = Laboratory note indicates that one to a few isolated non-targeted peaks are present.

f = Laboratory note indicates that low surrogate due to matrix interference.

g = Surrogate recovery exceeds the control limits due to dilution / matrix interference / coelution / presence of surrogate compound in the sample

h = Laboratory note indicates that diesel & oil range compounds are significant

i = Laboratory note indicates that aged diesel is significant

* Total petroleum hydrocarbons as diesel = <50; Total petroleum hydrocarbons as motor oil = <250

Table 8
Groundwater Analytical Data (VOCs) - Monitoring Wells
 AEI Project No. 298931, 1630 Park Street (Parcel B), Alameda, CA

Sample I.D.	Date	Notes	TAME	t-Butyl alcohol (TBA)	EDB	1,2-DCA	DIPE	Ethanol	ETBE	2-Butanone	n-Butyl benzene	sec-Butyl benzene	Isopropylbenzene	cis-1,2-Dichloroethene	1,2,3-Trichloropropane	1,2,4-Trimethylbenzene	Naphthalene	n-Propyl benzene	Methanol	PCE	TCE	Chloroform	Other VOCs
			by EPA Methods 8020, 8021B, or 8260B (µg/L)																				
MW-1	1/16/2001	a	<5.0	<25	<5.0	<5.0	<5.0	-	<5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6/27/2002	a	<5.0	<50	<5.0	<5.0	<5.0	-	<5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/18/2002	a	-	-	<2.5	<2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2/20/2003	d	-	-	<0.5	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6/11/2003	a	-	-	<2.5	<2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4/3/2008	a	<1.0	<4.0	<1.0	<1.0	<1.0	<100	<1.0	-	-	-	-	-	-	-	-	-	<1,000	-	-	-	-
	6/23/2011	a	<2.5	<10	-	-	<2.5	-	<2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/6/2011	a	<5.0	<20	-	-	<5.0	-	<5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-2	1/16/2001	a	<30	<150	<30	<30	<30	-	<30	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6/27/2002	a	<5.0	<5.0	<5.0	6.1	<5.0	-	<5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/18/2002	a	-	-	<12	<12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2/20/2003	a	-	-	<5.0	5.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6/11/2003	a	-	-	<25	<25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4/3/2008	a	<2.5	<10	<2.5	<2.5	<2.5	<250	<2.5	-	-	-	-	-	-	-	-	-	<2,500	-	-	-	-
	6/23/2011	a	<50	<200	-	-	<50	-	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/6/2011	a	<50	<200	-	-	<50	-	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW-3	1/16/2001	a	<1.0	<5.0	<1.0	1.4	<1.0	-	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6/27/2002		<0.5	<5.0	<0.5	<0.5	<0.5	-	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/18/2002	a	-	-	<0.5	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2/20/2003		-	-	<0.5	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6/11/2003		-	-	<0.5	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4/3/2008	a	<5.0	<20	<5.0	<5.0	<5.0	<500	<5.0	-	-	-	-	-	-	-	-	-	<5,000	-	-	-	-
	6/23/2011	a	<12	<50	-	-	<12	-	<12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/6/2011	a	<17	<67	-	-	<17	-	<17	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/2/2013	g	<2.5	22	<2.5	<2.5	<2.5	-	<2.5	<10	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	-	<2.5	63	<2.5

Table 8
Groundwater Analytical Data (VOCs) - Monitoring Wells
 AEI Project No. 298931, 1630 Park Street (Parcel B), Alameda, CA

Sample I.D.	Date	Notes	TAME	t-Butyl alcohol (TBA)	EDB	1,2-DCA	DIPE	Ethanol	ETBE	2-Butanone	n-Butyl benzene	sec-Butyl benzene	Isopropylbenzene	cis-1,2-Dichloroethene	1,2,3-Trichloropropane	1,2,4-Trimethylbenzene	Naphthalene	n-Propyl benzene	Methanol	PCE	TCE	Chloroform	Other VOCs
			by EPA Methods 8020, 8021B, or 8260B (µg/L)																				
MW-4	4/3/2008		<0.5	<2.0	<0.5	<0.5	<0.5	<50	<0.5	-	-	-	-	-	-	-	-	-	<500	-	-	-	-
	6/23/2011	a	<0.5	<2.0	-	-	<0.5	-	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/8/2013	g	<0.5	<2.0	<0.5	<0.5	<0.5	-	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	5.4	13	<0.5
MW-5	1/16/2001		<1.0	<5.0	<1.0	<1.0	<1.0	-	<1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6/27/2002		<0.5	<5.0	<0.5	<0.5	<0.5	-	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/18/2002	a	-	-	<0.5	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2/20/2003		-	-	<0.5	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6/11/2003	a	-	-	<0.5	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4/3/2008	a	<10	<40	<10	<10	<10	<1,000	<10	-	-	-	-	-	-	-	-	-	<10,000	-	-	-	-
	6/23/2011	a	<0.5	<2.0	-	-	<0.5	-	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/8/2013	g	<0.5	<2.0	<0.5	<0.5	<0.5	-	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	8.3	16	7.4
DPE-1	12/6/2011	a	<50	<200	-	-	<50	-	<50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/8/2013	g	<5.0	<20	<5.0	<5.0	<5.0	-	<5.0	<20	<5.0	<5.0	12	<5.0	<5.0	140	22	20	-	<5.0	<5.0	<5.0	<RL
DPE-2	12/6/2011	a	<100	<400	-	-	<100	-	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8/8/2013	g	<5.0	41	<5.0	<5.0	<5.0	<5.0	-	<20	<5.0	<5.0	8.9	<5.0	<5.0	87	8.7	6.6	-	11	<5.0	<5.0	<RL
DPE-3	12/6/2011	a	<17	<67	-	-	<17	-	<17	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DPE-4	8/2/2013	g	<0.5	13	<0.5	2.6	<0.5	-	<0.5	2.7	0.59	3.7	0.55	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	2.3	<0.5	<RL
DPE-5	5/1/2013	Well not sampled due to the presence of free product (Thickness of 0.17')																					
	8/2/2013	Well not sampled due to the presence of free product (Thickness of 0.09')																					
DPE-6	8/2/2013	g	<0.5	2.3	<0.5	<0.5	<0.5	-	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	1.5	1.6	<0.5	<RL
DPE-9	8/2/2013	g	<0.5	2.6	<0.5	<0.5	<0.5	-	<0.5	<2.0	0.62	1.2	<0.5	4.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	21	<0.5	<RL

Table 8
Groundwater Analytical Data (VOCs) - Monitoring Wells
 AEI Project No. 298931, 1630 Park Street (Parcel B), Alameda, CA

Sample I.D.	Date	Notes	TAME	t-Butyl alcohol (TBA)	EDB	1,2-DCA	DIPE	Ethanol	ETBE	2-Butanone	n-Butyl benzene	sec-Butyl benzene	Isopropylbenzene	cis-1,2-Dichloroethene	1,2,3-Trichloropropane	1,2,4-Trimethylbenzene	Naphthalene	n-Propyl benzene	Methanol	PCE	TCE	Chloroform	Other VOCs
			by EPA Methods 8020, 8021B, or 8260B (µg/L)																				
DPE-10	8/2/2013	g	<0.5	4.6	<0.5	<0.5	<0.5	-	<0.5	<2.0	<0.5	0.86	<0.5	1.5	1.0	<0.5	<0.5	<0.5	-	<0.5	26	<0.5	<RL
ESL			NE	12	0.05	0.5	NE	NE	NE	NE	NE	NE	NE	6.0	NE	NE	6.2	NE	NE	5.0	5.0	70	

VOCs= Volatile Organic Compounds
 PCE= Tetrachloroethene
 TCE= Trichloroethene
 TAME = Tertiary amyl methyl ether
 TBA = Tertiary butyl alcohol
 EDB = 1,2-Dibromoethane
 1,2-DCA = 1,2-Dichloroethane
 DIPE = Diisopropyl ether
 ETBE = Ethyl tertiary butyl ether

µg/L = micrograms per liter (ppb)
 <RL = Below the analytical laboratory reporting limit
 "-" = Not analyzed or data not available
12 = Values in bold exceed the ESL
 NE = No ESL value established

a = Laboratory note indicates the unmodified or weakly modified gasoline is significant.
 d = Laboratory note indicates that lighter gasoline range compounds (the most mobile fraction) are significant.
 g = Surrogate recovery exceeds the control limits due to dilution / matrix interference / coelution / presence of surrogate compound in the sample

ESL = Environmental Screening Levels, Table F-1a, Groundwater, Potential Drinking Water, San Francisco Regional Water Quality Control Board, Revised May 2013

Table 9

Soil Vapor Analytical Data

AEI Project No. 298931, 1630 Park Street (Parcel B), Alameda, CA

Sample ID	Date	Isopropyl Alcohol*	Helium* (<5% acceptable)	TPH-g & TVH	Benzene	Toluene	Ethyl-benzene	Xylenes	TBA	MTBE	TAME	DIPE	ETBE	PCE	TCE	Naphthalene (TO-17)	4-Ethyltoluene	4-Methyl-2-Pentanone	1,1,1-Trichloroethane	1,2,4-Trimethylbenzene	Tetrahydrofuran	1,3,5-Trimethylbenzene	Other VOCs	CO2	Methane	Nitrogen	Oxygen
ID		(µg/m³)	(%)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µg/m³)	(µL/L)	(µL/L)	(µL/L)	(µL/L)
VP-1	5/17/2012	<50	na	<1,800	<6.5	<7.7	<8.8	<27	<62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7/12/2012	<50	na	<1,800	<6.5	<7.7	<8.8	<27	<62	<7.3	<8.5	<8.5	<8.5	-	-	<11	-	-	-	-	-	-	-	17,000	<1.0	-	270,000
	11/16/2012	<50	na	<2,700	<9.7	<11	<13	<40	<93	<11	<13	<13	<13	63	<16	<16	<15	<12	<16	<15	<9.0	<15	500 ^a	25,000	<1.5	750,000	180,000
	2/27/2013	<50	na	<1,800	<6.5	<7.7	<8.8	<27	<62	<7.3	<8.5	<8.5	<8.5	30	<11	<11	<10	<8.3	<11	<10	<6.0	<10	<RL	15,000	<1.0	710,000	180,000
VP-2	5/17/2012	<50	na	<1,800	<6.5	<7.7	<8.8	<27	<62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7/12/2012	<50	na	<1,800	<6.5	<7.7	<8.8	<27	230	<7.3	<8.5	<8.5	<8.5	-	-	<11	-	-	-	-	-	-	-	13,000	<1.0	-	280,000
	11/16/2012	<50	na	<1,800	<6.5	<7.7	<8.8	<27	95	<7.3	<8.5	<8.5	<8.5	72	<11	<11	<10	<8.3	<11	<10	<6.0	<10	230 ^a , 110 ^b	23,000	<1.0	610,000	180,000
	2/27/2013	<50	na	<2,700	<9.7	<11	<13	<40	<93	<11	<13	<13	<13	28	<11	<16	<10	<8.3	<11	<10	<6.0	<10	<RL	13,000	<1.5	710,000	190,000
VP-3	5/17/2012	<50	na	<1,800	<6.5	<7.7	<8.8	<27	<62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7/12/2012	290	na	<1,800	<6.5	<7.7	<8.8	<27	<62	<7.3	<8.5	<8.5	<8.5	-	-	<11	-	-	-	-	-	-	-	24,000	1.1	-	280,000
	11/16/2012	<50	na	<1,900	<6.9	<8.2	<9.3	<29	<66	<7.7	<9.0	<9.0	<9.0	ND<15	<12	<12	<11	<8.8	<12	<11	<6.4	<11	260 ^a	8,500	1.5	630,000	210,000
	2/27/2013	<50	na	<2,700	<9.7	<11	<13	<40	<93	<11	<13	<13	<13	ND<14	<11	<16	<10	<8.3	<11	<10	<6.0	<10	<RL	3,700	1.1	710,000	190,000
SV-1	4/16/2013	na	0.017	<2500	<25	<25	<25	<25	-	-	-	-	-	<25	<25	<25	-	-	-	-	-	-	<RL	3,400	<2.0	-	170,000
SV-2	4/16/2013	na	0.018	<2500	<25	<25	<25	<25	-	-	-	-	-	<25	<25	<25	-	-	-	-	-	-	<RL	4,600	1.8	-	170,000
SV-3	4/16/2013	na	<0.005	<2500	<25	<25	<25	<25	-	-	-	-	-	<25	<25	<25	-	-	-	-	-	-	<RL	160	<2.0	-	170,000
	8/21/2013	<50	na	-	<6.5	<7.7	<8.8	<27	<6.2	<7.3	<8.5	<8.5	<8.5	110	<11	<11	<10	<8.3	<11	<10	<6.0	<10	<RL	-	-	-	-
SV-4	4/16/2013	na	<0.005	<2500	<25	<25	<25	<25	-	-	-	-	-	<25	<25	<25	-	-	-	-	-	-	<RL	4,200	<2.0	-	170,000
	8/21/2013	370	na	-	<6.5	<7.7	<8.8	<27	<6.2	<7.3	<8.5	<8.5	<8.5	850	<11	<11	<10	<8.3	17	<10	<6.0	<10	<RL	-	-	-	-
SV-5	5/3/2013	na	-	<2500	<25	<25	<25	<25	-	-	-	-	-	100	<25	<25	-	-	-	-	-	-	<RL	12,000	<2.0	-	170,000
	8/21/2013	<50	na	-	<6.5	<7.7	<8.8	<27	<6.2	<7.3	<8.5	<8.5	<8.5	280	<11	<11	<10	<8.3	<11	<10	<6.0	<10	<RL	-	-	-	-
SV-6	4/16/2013	na	0	<2500	<25	<25	<25	<25	-	-	-	-	-	<25	<25	<25	-	-	-	-	-	-	<RL	260	1.2	-	18,000
	8/21/2013	na	<0.005	-	<6.5	<7.7	<8.8	<27	<6.2	<7.3	<8.5	<8.5	<8.5	70	65	<11	<10	<8.3	<11	<10	<6.0	<10	<RL	-	-	-	-
SV-7	4/16/2013	na	0	<2500	<25	<25	<25	<25	-	-	-	-	-	<25	<25	<25	-	-	-	-	-	-	<RL	10,000	<2.0	-	160,000
	8/21/2013	na	0	-	<6.5	<7.7	<8.8	<27	<6.2	<7.3	<8.5	<8.5	<8.5	<14	<11	<11	<10	<8.3	<11	<10	<6.0	<10	<RL	-	-	-	-
SV-8	8/5/2013	na	0	-	16	23	<8.8	42	<6.2	<7.3	<8.5	<8.5	<8.5	<14	<11	<23	<10	23	<11	12	10	<10	<RL	18,000	-	-	160,000
	8/21/2013	na	<0.005	-	<6.5	<7.7	<8.8	<27	<6.2	<7.3	<8.5	<8.5	<8.5	<14	<11	<11	<10	<8.3	<11	<10	<6.0	<10	<RL	-	-	-	-

Table 9
Soil Vapor Analytical Data

AEI Project No. 298931, 1630 Park Street (Parcel B), Alameda, CA

Sample ID	Date	Isopropyl Alcohol* (µg/m ³)	Helium* (% <5% acceptable)	TPH-g & TVH (µg/m ³)	Benzene (µg/m ³)	Toluene (µg/m ³)	Ethyl-benzene (µg/m ³)	Xylenes (µg/m ³)	TBA (µg/m ³)	MTBE (µg/m ³)	TAME (µg/m ³)	DIPE (µg/m ³)	ETBE (µg/m ³)	PCE (µg/m ³)	TCE (µg/m ³)	Naphthalene (TO-17) (µg/m ³)	4-Ethyltoluene (µg/m ³)	4-Methyl-2-Pentanone (µg/m ³)	1,1,1-Trichloroethane (µg/m ³)	1,2,4-Trimethylbenzene (µg/m ³)	Tetrahydrofuran (µg/m ³)	1,3,5-Trimethylbenzene (µg/m ³)	Other VOCs (µg/m ³)	CO2 (µL/L)	Methane (µL/L)	Nitrogen (µL/L)	Oxygen (µL/L)
SV-9	8/5/2013	na	0	-	<6.5	10	<8.8	<27	<6.2	<7.3	<8.5	<8.5	<8.5	<14	<11	<6.2	<10	9	<11	<10	<6.0	<10	<RL	12,000	-	-	160,000
	8/21/2013	na	0	-	<6.5	<7.7	<8.8	<27	<6.2	<7.3	<8.5	<8.5	<8.5	<14	<11	<11	<10	<8.3	<11	<10	<6.0	<10	<RL	-	-	-	-
SV-10	8/5/2013	na	0	-	27	60	19	110	<6.2	<7.3	<8.5	<8.5	<8.5	720	100	<25	12	28	43	38	9	13	<RL ^c	6,300	-	-	170,000
	8/21/2013	<20,000	na	-	9	<7.7	<8.8	<27	<6.2	<7.3	<8.5	<8.5	<8.5	2,100	160	<11	<10	<8.3	57	<10	<6.0	<10	<RL ^c	-	-	-	-
SV-11	8/21/2013	na	0	-	7,500	4,300	5,700	17,000	<25	<29	<34	<34	<34	2,100	<44	<44	860	<33	130	1,500	<24	700	<RL ^{a,f,g}	-	-	-	-
SV-12	8/21/2013	na	0	-	11	19	10	47	<6.2	<7.3	<8.5	<8.5	<8.5	31	<11	<11	<10	<8.3	<11	19	18	<10	<RL ^{d,e}	-	-	-	-
ESL		na	NA	50,000	420	1,300,000	4,900	220,000	--	47,000	--	--	--	2,100	3,000	360	--	--	22,000,000	--	--	--	na	na	na	na	na

Notes:
µg/m³ = micrograms per cubic meter (ppbv)
* = Leak check compound
<1.0 = Not detected above the laboratory reporting limit shown
Bold = Result exceeds screening criteria (ESL)
na = Not applicable
- = Not analyzed
-- = No value established
<RL = Less than laboratory reporting limit
ESL = Environmental Screening Levels, Table E-2, San Francisco Regional Water Quality Control Board (Commercial/Industrial, Shallow Soil, Drinking Water Aquifer), Revised May 2013

TPH-g = total petroleum hydrocarbons as gasoline
TVH = Total volatile hydrocarbons -aliphatics
TBA = tert-Butyl-alcohol
MTBE = Methyl-tert-butyl ether
TAME = Tert-amyl methyl ether
DIPE = Di-isopropyl ether
ETBE = Ethyl tert-butyl ether

PCE = Tetrachloroethene
TCE = Trichloroethene
a = Hexane detected (no ESL established)
b = Ethanol detected (no ESL established)
c = Acetone detected below ESL
d = Styrene detected below ESL
e = 1,3-Butadiene detected (no ESL established)
f = Heptane detected (no ESL established)
g = 1,1,2,2-Tetrachloroethane detected below ESL

APPENDIX A

Technical Justification for Low-Threat Closure Scenarios for Petroleum Vapor Intrusion Pathway

1 EXECUTIVE SUMMARY

For petroleum-related volatile organic compounds (VOCs) at retail sites, current risk-based screening levels (such as the California Human Health Screening Levels [CHHSLs]) for evaluating risk from vapor intrusion at retail sites are extremely conservative. This conservatism is caused by excluding biodegradation in site screening and often drives further unnecessary site evaluation. Recent models and field studies show that bioattenuation of petroleum hydrocarbons at retail sites is significant. Petroleum VOCs (such as benzene, toluene, ethylbenzene and xylenes (BTEX)) concentrations can attenuate by 4 to 6 orders of magnitude within short vertical distances (e.g., < 2 m) in the unsaturated zone. The VOC attenuation increases by an additional order of magnitude (or more) if transport across the building foundation to indoor air is also considered. The sharp decrease in petroleum VOC concentrations within a short vertical distance of the unsaturated zone is amenable to use of exclusion distances as a site-screening methodology for vapor intrusion. Exclusion distances are defined as source (VOCs in soil or groundwater)-receptor (building) separation distances beyond which the risk of vapor intrusion is negligible. Exclusion distance criteria can be broadly defined for two types of sources: low-concentration and high-concentration sources which are defined below.

Recent modeling studies and evaluations of field (soil-gas) data from numerous retail sites and sampling locations demonstrate that biodegradation is sufficient to limit the potential for vapor intrusion at sites with “low concentration” hydrocarbon sources. For example, there is less than a 5% probability that benzene concentrations in soil gas would exceed a conservative screening level of 100 ug/m³ at a distance of 5 feet above the source. (Note the CHHSL for benzene in soil gas is 83 ug/m³.) The attenuation is predicted to increase with lateral displacement of the source from the building foundation. Vapor intrusion risks are thus expected to be rare to non-existent at sites with low-concentration sources.

At sites with “high concentration” volatile sources (unweathered residual LNAPL in soil and/or unweathered free-phase LNAPL on groundwater), transport modeling shows that hydrocarbons will attenuate in the unsaturated zone by approximately 6 orders of magnitude within 7 m (~20 ft) at sites. This result is achieved assuming reasonable approximations for source type and biodegradation rate. Analysis of soil-gas data collected from many retail sites with LNAPL sources indicate that the distance required to attenuate soil vapor concentrations to below typical screening levels are on the order of 8 – 13 ft. As with “low-concentration” sources (weathered residual LNAPL in soil and/or dissolved concentrations in groundwater), the bioattenuation is more significant for LNAPL sources separated laterally from building foundations (i.e. the soil gas concentrations would attenuate in even shorter distances).

The Stakeholder Group has proposed screening criteria for four basic scenarios that can be used to identify low-threat closure scenarios for vapor intrusion (VI). The purpose of this technical document is

to outline the intent of the Stakeholder Group for use of these screening criteria and to provide justification for the four scenarios below. These scenarios are:

- Scenario 1: Unweathered LNAPL on groundwater
- Scenario 2: Unweathered LNAPL in soil
- Scenario 3: Dissolved phase benzene concentrations in groundwater
- Scenario 4: Direct measurement of soil gas concentrations

For each of these scenarios, screening criteria have been proposed that, if met, would identify the site as a low-threat to human health from the vapor intrusion pathway.

It is important that the current state of the science as described herein be used to develop rational, technically defensible, approaches to address these potential vapor intrusion risk scenarios. In addition, many of the cited exclusion criteria are based on analysis of soil-gas data collected from retail sites. The screening criteria may therefore not be applicable for non-retail (e.g., pipeline, manufacturing, and terminal) sites where significantly larger volume petroleum hydrocarbon releases may have occurred. If conditions at non-retail sites are significantly different than would be encountered at a typical retail site, they should be evaluated on a site-specific basis. The materials referenced in this technical justification are consistent with the technical material being used to develop guidance by US EPA's Office of Underground Storage Tanks (OUST)'s Task Force on Petroleum Vapor Intrusion.

2 INTRODUCTION

Biodegradation is the most critical process governing the potential for vapor intrusion at petroleum release sites. The significance of biodegradation depends largely on the demand for oxygen (O₂) and its availability. Key factors that affect the O₂ demand/availability include source strength/type (e.g., LNAPL or dissolved phase), source location (i.e., above or below the capillary zone), soil type (DeVaul, 2007), variable and/or high soil-moisture saturation, building foundation type/size (Patterson and Davis, 2009; DeVaul (in press) and surface cover.

At sites with "low-concentration" sources (weathered residual in soil and/or dissolved concentrations in groundwater), the significance of biodegradation is most notable because biodegradation conditions in the unsaturated zone generally remain aerobic. At these sites, O₂ availability in the unsaturated zone generally exceeds O₂ demand resulting from biodegradation. Biodegradation under aerobic conditions has been shown to be rapid resulting in the development of sharp attenuation fronts where BTEX concentrations decrease by several orders of magnitude over relatively short (e.g. <1 m) vertical distances (Fischer et al., 1996; Lahvis et al., 1999; DeVaul, 2007; Davis, 2009; and Hartman, 2010). The hydrocarbon reaction fronts (the point at which most of the degradation is occurring) tend to develop very near the water table at sites with dissolved-phase only sources in groundwater (e.g., benzene concentrations < 15 mg/L). At these sites, effects of soil type, building foundation and surface cover will tend to be limited. Evidence to support these assertions exists both in the theory (modeling) (DeVaul, 2007, Abreu et. al. 2009, API, 2009) and in the field (Lahvis and Baehr, 1996; API, 2009; Davis, 2009).

Further attenuation is predicted for dissolved-phase sources displaced laterally from the building foundation (Abreu and Johnson, 2005).

At sites with LNAPL on the groundwater, biodegradation can also be quite notable. Exclusion distances for benzene and total petroleum hydrocarbons (TPH) determined from analysis of soil-gas data primarily collected at retail sites have been estimated to be in the range of 8 to 15 feet (Davis, 2009; Hartman, 2010; Lahvis, 2011)¹. The greater exclusion distance for LNAPL sites compared to dissolved-phase sites is in part related to the added demand for O₂ (noted above) for LNAPL sources and the tendency for LNAPL sources to be distributed above the capillary zone. For dissolved phase sources in groundwater, the capillary zone has been documented as an active zone for VOC attenuation (Lahvis and Baehr, 1996). Results from the analysis of the Davis (2010) soil-gas database are consistent with other large field studies (Lahvis, 2011). As noted above, the significance of bioattenuation is largely dependent on source type. Differentiation of residual-phase LNAPL (high concentration) sources from dissolved-phase (low concentration) sources can, however, be difficult. The following general rules of thumb could be used as indicators of residual-phase LNAPL sources in groundwater or in soil:

Presence of LNAPL

Direct evidence:

- sites with current or historical evidence of LNAPL in soil or LNAPL at the water table as evidenced in wells

Indirect evidence:

- chemicals of concern (COCs) approaching (> 0.2) effective solubilities (Bruce et al., 1991) in groundwater (e.g., benzene > 3 mg/L ; total benzene, toluene, ethylbenzene and xylenes (BTEX) > 20 mg/L; TPH diesel range organics (DRO) > 5 mg/L) and in soil (TPH gasoline range organics (GRO) > 100 - 200 mg/kg⁽²⁾; TPH DRO > 10 - 50 mg/kg) (see ASTM, 2006, Alaska DEC, 2011)³
- TPH vapor readings from a photo-ionization detector (PID) of > 1,000 ppm (recent gasoline release sites), > 100 ppm (recent diesel/historic gasoline release sites), and > 10 ppm (historic diesel sites) (Alaska DEC, 2011). Note weathered LNAPL typically has a significant reduction in the VOC content and therefore represents less of a concern for vapor intrusion.

The following rules-of-thumb for can be used to determine whether LNAPL is a concern for vapor intrusion risk:

Differentiating between Weathered and Unweathered LNAPL

- For groundwater impacted by LNAPL or where groundwater is in proximity to LNAPL, effective solubility is a key indicator for whether the LNAPL is depleted of VOCs. For

¹ It is important to note, that the soil-gas data were collected primarily at retail sites. Approximately 16% of the soil-gas sampling locations were directly below building foundations (i.e., sub-slab).

² TPH (GRO) between 100 to 200 mg/kg may indicate there may be a slight amount of LNAPL. TPH (GRO) less than 100 mg/kg is a good indication that there is no LNAPL present.

³ The primary driver for vapor intrusion is benzene. For petroleum-based fuels other than gasoline, benzene is not found at levels that would cause a vapor intrusion problem.

example, benzene's effective solubility is approximately 18 mg/L, if it constitutes 1% of gasoline. Therefore benzene concentrations < 1 mg/L are reasonable indicators that the LNAPL is weathered (depleted of VOCs).

- For soil sources, TPH (GRO) < 100 mg/kg is a good indication that there is a small or low concentration (VOC) source.

Naphthalene is currently considered a carcinogen via the inhalation exposure route and since it is also volatile, it can be considered a potential risk driver. The exclusion criteria defined for benzene are assumed to be conservative for naphthalene, which is also highly susceptible to biodegradation (Anderson et al., 2008; GSI, 2010). Naphthalene also has a much lower solubility value and Henry's Law coefficient (compared to benzene), thereby limiting the amount of naphthalene available to volatilize into the gas phase. For these reasons, the screening criteria described here, while developed for benzene, should also be protective of naphthalene vapor intrusion.

3 TECHNICAL BACKGROUND – Discussion of Biodegradation Effects

This section will present the results of model studies and field data that support the assumptions made in the vapor intrusion exclusion criteria. First, the results found at "low-concentration source" cases will be discussed followed by "high-concentration source" cases.

Lastly, it is important to note that once the groundwater concentrations are below effective solubility, the actual hydrocarbon concentrations in groundwater are not necessarily good predictors of vapor intrusion risk. Field site observations show that dissolved-phase hydrocarbon concentrations in shallow groundwater and soil gas concentrations overlying the water table are poorly correlated (Lahvis, 2011). The poor correlation at dissolved-phase only sites can be attributed to the inability to accurately measure hydrocarbon concentrations at the water table and to the considerable bioattenuation of hydrocarbon vapors between the water-table source and the soil-gas measurement location. At LNAPL (residual-phase) sites, soil-gas concentrations are also poorly correlated with groundwater concentrations because LNAPL sources are typically present above the water table. For these reasons, it is recommended to focus the development of screening criteria solely on the basis of source type (LNAPL and groundwater) rather than source (groundwater) concentration.

3.1 *Low-Concentration Sources (weathered residual in soil and/or dissolved concentrations in groundwater)*

For purposes of this technical justification, low concentration sources at hydrocarbon sites are defined as dissolved-phase concentrations. Low concentration sources will therefore be composed primarily of the more soluble (aromatic) LNAPL constituents, benzene, toluene, ethylbenzene, xylenes, and naphthalene. Of these constituents, benzene is the primary risk driver for vapor intrusion because of its relatively higher toxicity and vapor migration potential. Note, weathered LNAPL can behave like low-concentration sources because the LNAPL may be depleted of volatile chemicals.

3.1.1 Model Studies

Results from detailed numeric (3-dimensional) models (see Figure 3 from API below) indicate that complete attenuation of the hydrocarbons (approximately 10 orders of magnitude) is predicted between a relatively low concentration source (< 10 mg/L total hydrocarbon in soil gas) and indoor air where the source is separated from the receptor by > 3 meters (see API, 2009; Abreu et al., 2009)⁴. Note, the “hydrocarbon” modeled in these studies was assumed to have the same fate and transport properties as benzene. In addition, the simulations are based on assuming biodegradation takes place only in the aerobic portion of the unsaturated zone (i.e., when O₂ concentrations exceed 1%). An aerobic biodegradation rate of 0.79 hr⁻¹ is assumed for the hydrocarbon (benzene) based on a mean of published rates (DeVaul, 2007). Note, while a degradation rate of 0.75 hr⁻¹ may seem high, the model only allows degradation in the regions where there is enough O₂ to support it. The model cutoff for allowing degradation was 1% O₂. A 10 mg/L benzene vapor source is consistent with a dissolved-phase source of benzene (or BTEX) of around 40 mg/L assuming equilibrium partitioning between soil gas and groundwater and a Henry’s law coefficient of 0.25 for benzene (or BTEX). The attenuation with distance is increased for the latter condition because diffusion of the hydrocarbons will tend to be vertically upwards (toward the soil surface) rather than laterally towards the receptor. Hence, there is little potential for vapor intrusion to occur at sites with dissolved-phase sources separated laterally from building foundations.

The following two figures from API (2009) show hydrocarbon and O₂ profiles predicted by transport modeling for low-concentration vapor sources varying between 0.1 mg/L hydrocarbon (0.4 mg/L dissolved-phase equivalent) and 10 mg/L hydrocarbon (40 mg/L dissolved-phase equivalent) and two different foundation configurations, basement and slab, respectively. Note, the “hydrocarbon” modeled in these studies was again assumed to have the same fate and transport properties as benzene. The source concentration was assumed to be equal to the combined concentrations of all of the BTEX. This approach was used because it was conservative to consider the increased O₂ demand from the additional VOCs present (all of the BTEX). Therefore, these modeling study results can be considered conservative for benzene.

⁴ A 10 mg/L hydrocarbon soil gas source would equate to a ~40 mg/L source of BTEX in groundwater assuming a vapor/aqueous phase partition coefficient of around 0.25 (Morrison, 1999) assuming the source were dissolved.

Figure 3 API (2009)

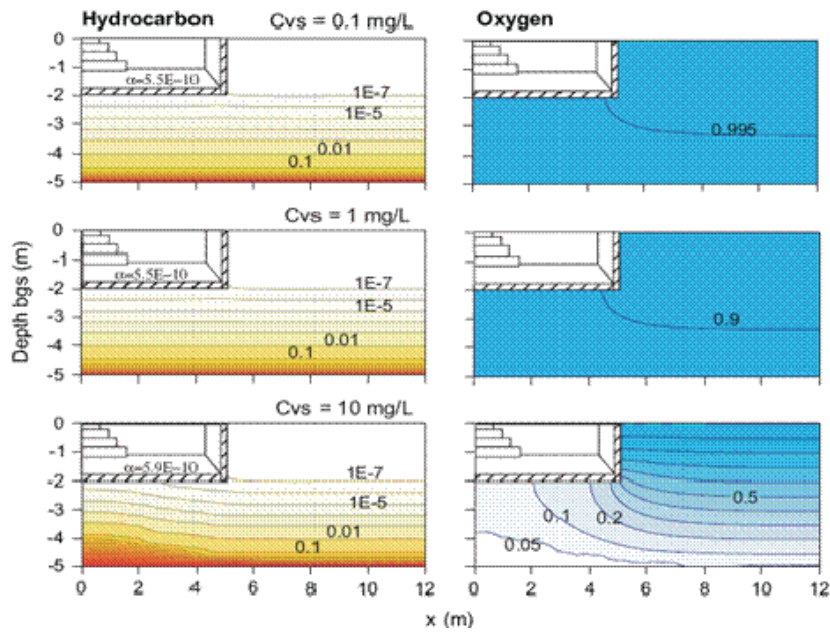


Figure 3. Effect of low vapor source concentration (C_{vs}) on soil-gas concentration distribution and vapor intrusion attenuation factors (z) for basement foundation scenarios and hydrocarbon biodegradation rate $\lambda = 0.79 \text{ h}^{-1}$. Hydrocarbon and oxygen concentrations are normalized by source and atmospheric concentrations, respectively.

Figure 4 API (2009)

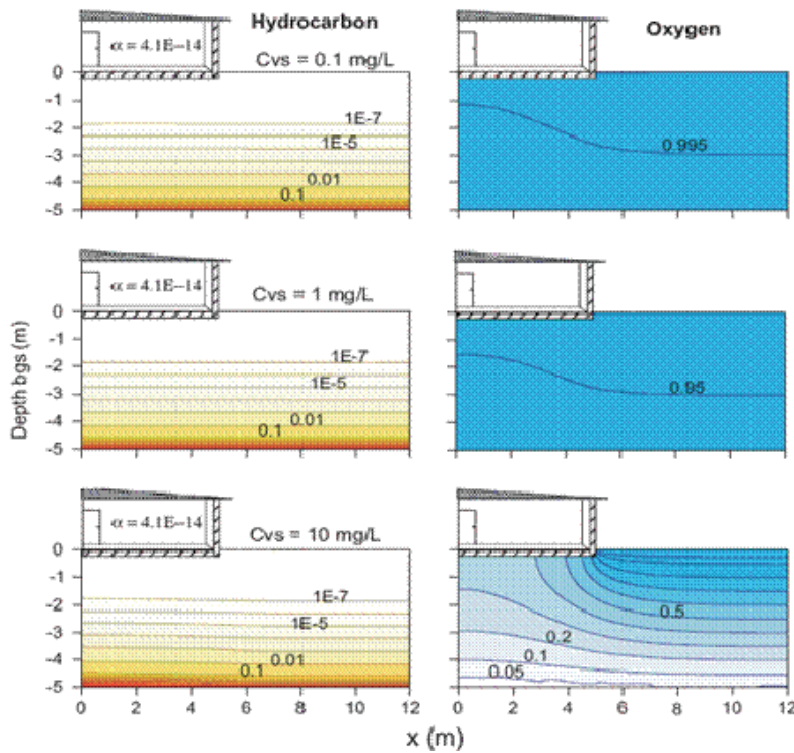
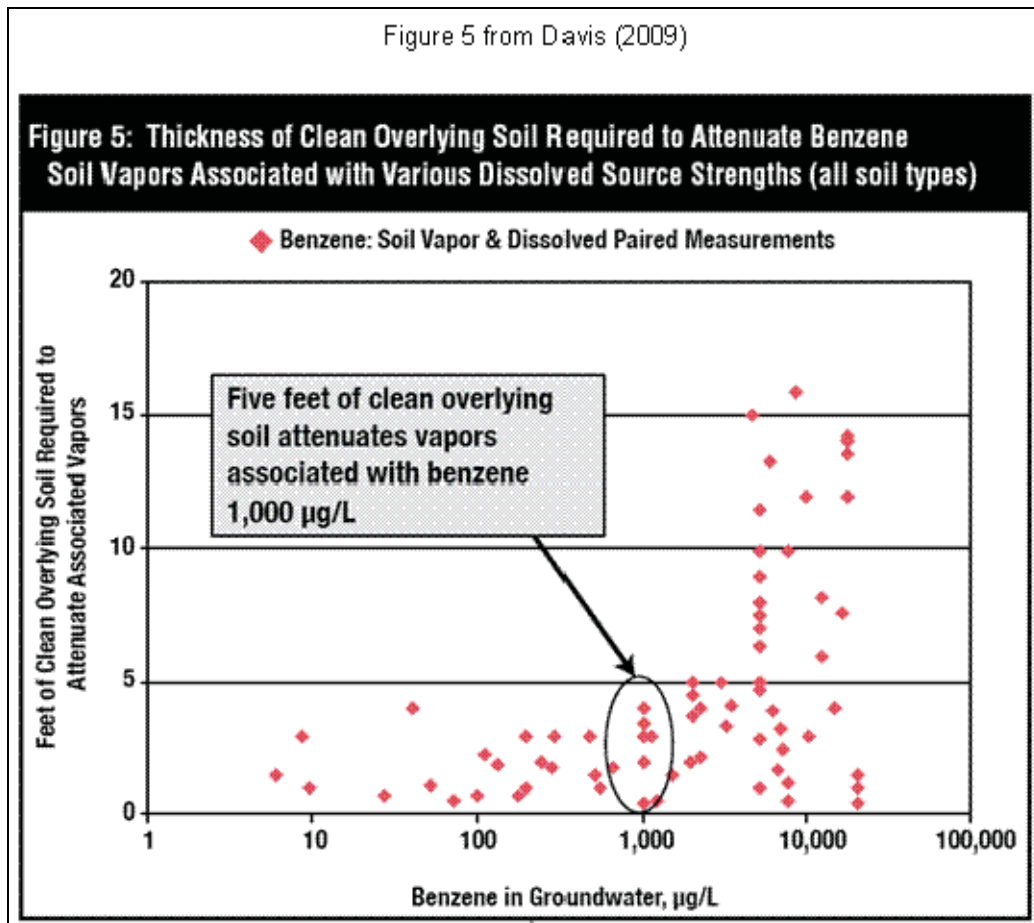


Figure 4. Effect of low vapor source concentration (C_{vs}) on soil-gas concentration distribution and vapor intrusion attenuation factors (z) for slab-on-grade foundation scenarios and hydrocarbon biodegradation rate $\lambda = 0.79 \text{ h}^{-1}$. Hydrocarbon and oxygen concentrations are normalized by source and atmospheric concentrations, respectively.

3.1.2 Field Data

A soil-gas database has been developed by Robin Davis (Utah Department of Environmental Quality - DEQ). The database was compiled from numerous retail, distribution, and manufacturing sites across several states, including California. The soil-gas data were collected from locations on and off-site. Approximately 16% of the soil-gas data were collected directly below building foundations (i.e., subslab). The data **from retail sites** are being used to support the development of new state (see http://www.swrcb.ca.gov/ust/luft_manual.shtml) and federal (US EPA OUST) vapor intrusion guidance. Analyses of the soil-gas data are described in Davis (2009) and Hartman (2010). The data analyses support the model results discussed in the previous section. The analyses indicate that “dissolved-phase” sources < 6 mg/L benzene in groundwater (or ~24,000,000 ug/m³ vapor phase equivalent⁵) are completely attenuated within distances of 5 ft. or less (see figure below from Davis, 2009).



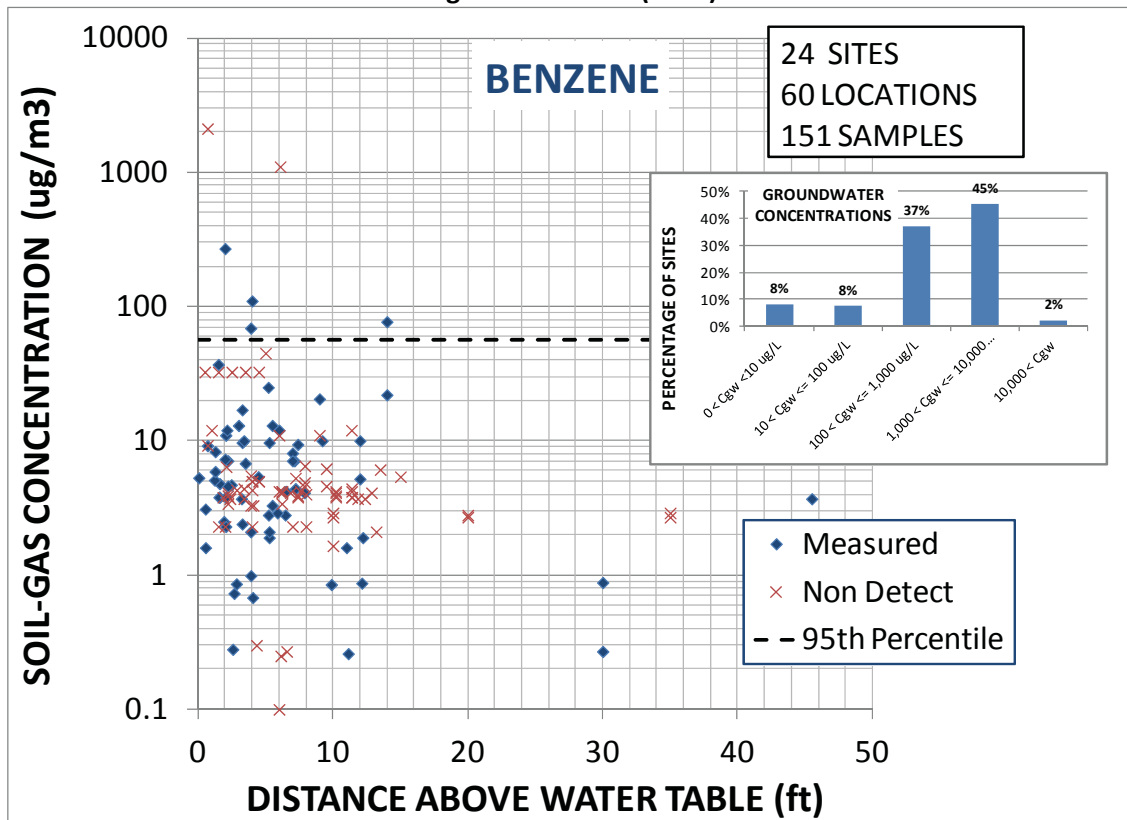
It is important to note, however, that the Davis (2009) analyses of thickness of clean overlying soil required to attenuate benzene vapors (or “exclusion distance”) did not rigorously screen out potential residual LNAPL sources above the water table. These sites pose a similar risk for vapor intrusion as sites

⁵ Assuming a Henry’s Law coefficient of 0.25 cm³/cm³ for benzene.

with free-phase LNAPL on groundwater (i.e., sites where LNAPL is observed in monitoring wells). The analysis shown in Figure 5 also includes data from “non-retail” locations. It is also important to note that the Davis (2009) results imply that the vapor intrusion risk is dependent on the source concentration in groundwater. Again, this dependence has not been observed at other sites and is not recommended to be used in developing groundwater concentration-based exclusion distances.

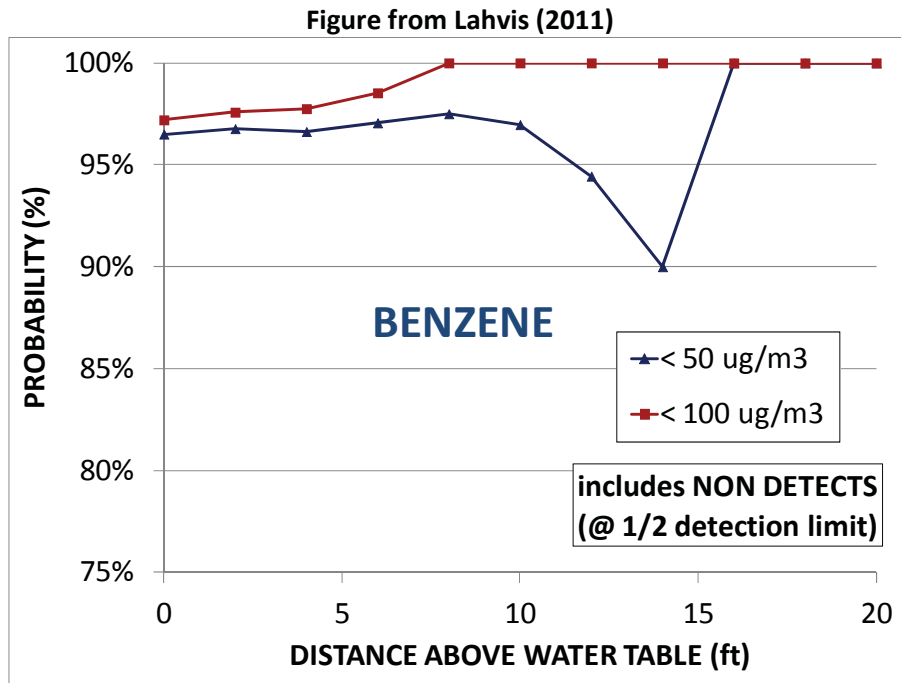
A slightly different analysis of the “retail-only” data from the Robin Davis database by Lahvis (2011) shows that benzene will be bioattenuated below a relatively conservative soil-gas screening level of 100 ug/m³ within 5 ft of the water table⁶. The analysis focused on identified sources of benzene in groundwater and filtered out sites with either direct evidence of LNAPL (current, historical) or indirect evidence of LNAPL (soil-gas measurements collected near potential sources (i.e., locations within 25 ft of USTs and dispensers), and also screened out sites with benzene concentrations in groundwater > 15 mg/L or BTEX > 75 mg/L). The vast majority (84%) of the soil-gas measurements were taken from sites with source concentrations of benzene in groundwater ranging from 0.1 mg/L (100 ug/L) to 15 mg/L.

Figure from Lavis (2011)



⁶ This value represents the attenuation between a benzene source in groundwater up to 15 mg/L (or 7,500,000 ug/m³ in soil-gas) and a conservative soil-gas screening level concentration of 100 ug/m³. This concentration is representative of a screening-level concentration in soil gas (assuming an indoor air risk-based concentration of 2 ug/m³ and a slab attenuation factor of 0.02).

From a probability standpoint, the results from the scatter plot can be defined as follows (Lahvis, 2011):



The probability of having benzene vapor concentrations near the receptor that exceed a conservative screening level (i.e., 100 ug/m³) at dissolved-phase (retail) sites is less than 5%. The water table would have to essentially be in contact with a building foundation for there to be a potential concern for vapor intrusion at low concentration sites.

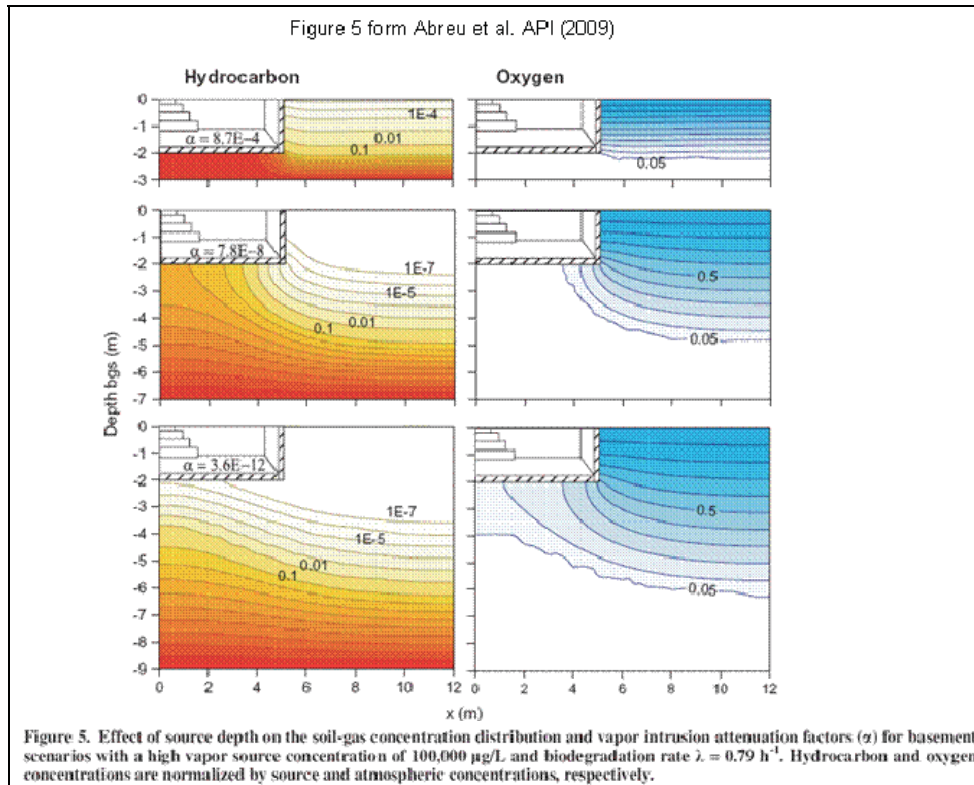
3.1.3 Summary of Low Concentration Sources

In summary, field data from retail sites shows that for low concentration (e.g., dissolved-phase only) sources, benzene will be attenuated to below screening levels within 5 ft above the water table. Vapor intrusion risks would be rare to non-existent at these retail sites provided the water table does not come in contact with the building foundation.

3.2 High-Concentration Sources (unweathered residual in soil and/or free-phase LNAPL on groundwater)

3.2.1 Model Studies

As shown in the attached figure from Abreu et al. (2009), hydrocarbons are predicted to completely attenuate in the unsaturated zone above an LNAPL source within ~ 7m of the source. Again, the model simulations use benzene as a surrogate for all of the TPH present. A mean biodegradation rate of 0.79 hr⁻¹ was again assumed (DeVaul, 2007) in model regions where the O₂ level was sufficiently high enough to support aerobic biodegradation.



Again, the attenuation is expected to increase for NAPL sources displaced laterally from the basement foundation (see Abreu and Johnson, 2005).

3.2.2 Field Data

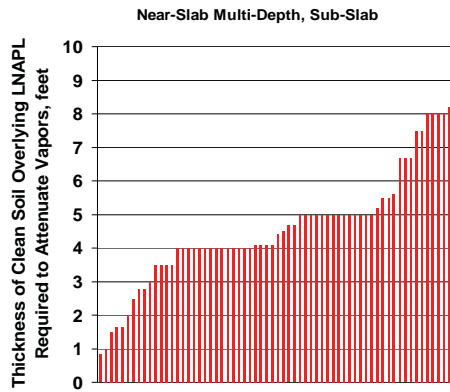
A more recent analysis of the soil-gas database by Davis (2010) indicates that the model predicted bioattenuation is conservative. Exclusion distances of only 8 ft. were found to be sufficient to attenuate LNAPL sources. This analysis takes into account residual LNAPL sources in the unsaturated zone (see the following figure from Davis (2010)).

Figure from Davis (2010)

LNAPL & Soil Sources

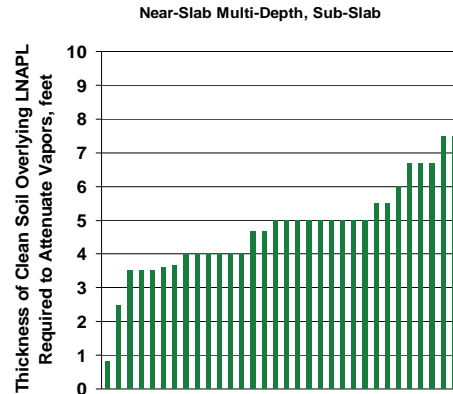
**Benzene: 48 exterior/near-slab +
22 sub-slab = 70 total**

■ Benzene SV Sample Event over LNAPL & Soil Sources



**TPH: 17 exterior/near-slab +
18 sub-slab = 35 total**

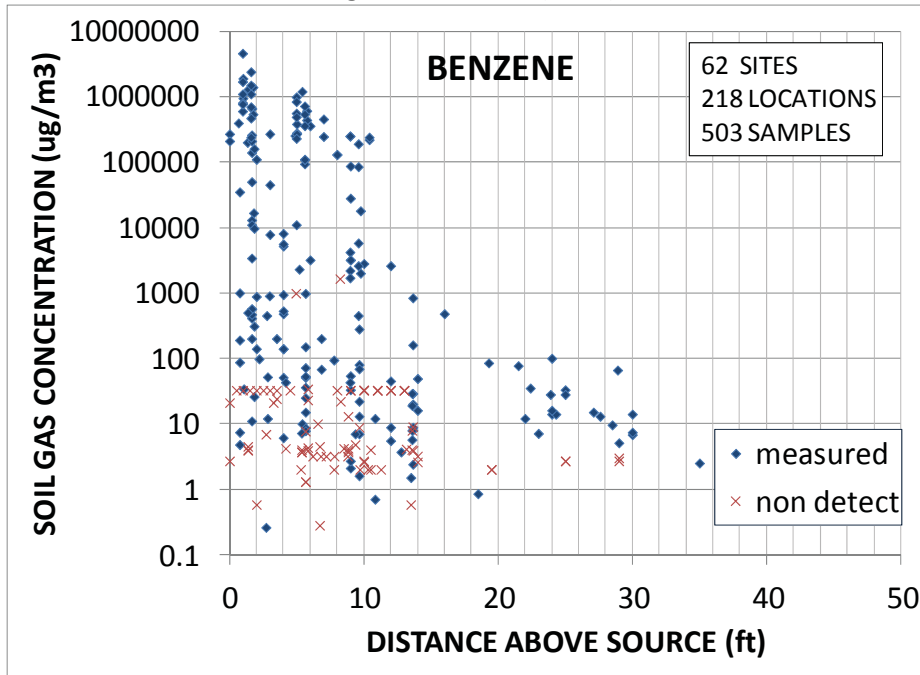
■ TPH SV Sample Event over LNAPL & Soil Sources



**~8 ft CLEAN overlying soil attenuates vapors
associated with LNAPL/Soil Sources**

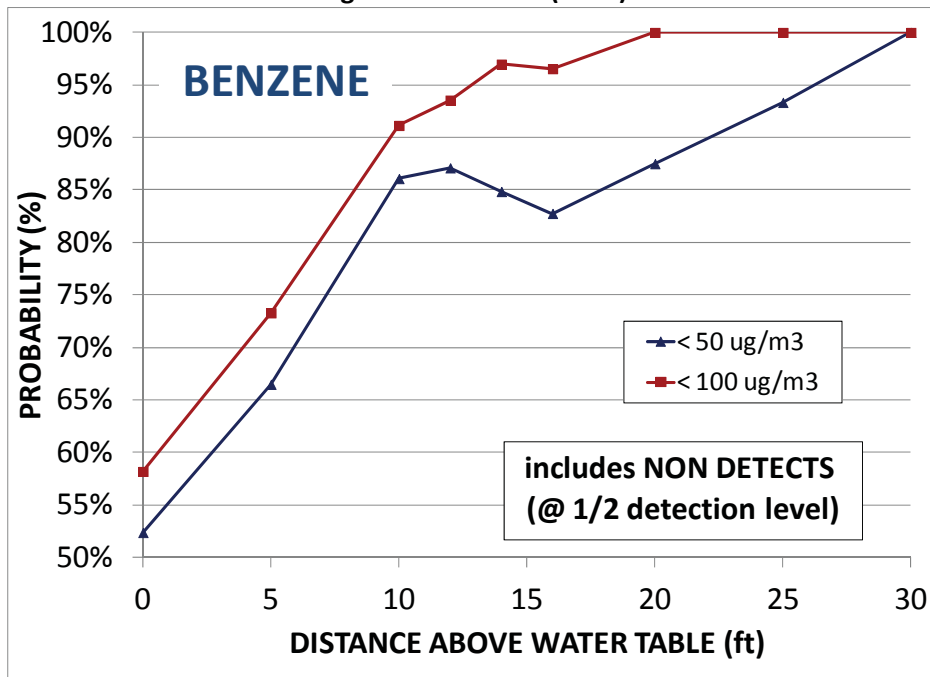
Lahvis (2011) has interpreted the soil-gas database compiled by Davis slightly differently. The next figure shows benzene concentrations in soil gas from retail-only sites plotted as a function of distance above the water table) (see following figure):

Figure from Lavis (2011)



As shown, benzene concentrations in soil gas generally attenuate by more than 4 orders of magnitude with at a source separation distance of > 12 ft from the source at LNAPL sites. The attenuation is most significant at distances > 12 ft above the source. A statistical analysis of these data shows a > 95% probability of encountering benzene concentration below 100 $\mu\text{g}/\text{m}^3$ in soil gas at distances >~ 13 ft above the source.

Figure from Lahvis (2011)



The lateral separation exclusion distances would be expected to be less than the vertical exclusion distances for the reasons previously explained.

3.2.2 Summary

Most recent field data analyses indicate that 8 to 13 ft of clean soil (soil with no LNAPL present) are sufficient to limit the risk for vapor intrusion at sites with LNAPL sources in either soil or groundwater.

3.3 Technical Background Conclusions

Low-concentration sources have been shown to attenuate up to 6 orders of magnitude in the unsaturated zone within short vertical distances (e.g., < 5 ft) due to biodegradation. Biodegradation is sufficient to essentially eliminate these sites from further vapor intrusion consideration.

At sites with unweathered LNAPL sources (“high-concentration sources”), 8 to 13 ft of clean soil are required to fully attenuate the hydrocarbon vapors. The attenuation due to biodegradation would be equally or more significant for LNAPL sources separated laterally from building foundations (i.e. a shorter distance would be required for attenuation). It is important that the current state of the science as described here be used in the development of more rational, technically defensible, approaches to vapor intrusion risk assessment.

4 THE FOUR LOW-THREAT VAPOR INTRUSION SCREENING SCENARIOS

The Stakeholder Group that was assembled by the Cal-EPA/SWRCB examined the available current and relevant scientific information and recommends the following low-threat guideline to manage the petroleum vapor intrusion pathway incorporating additional safety factors to protect human health in a state-wide policy document. The Stakeholder Group developed four basic scenarios for decision-making purposes and they are respectively:

- Scenario 1: Unweathered LNAPL on groundwater
- Scenario 2: Unweathered LNAPL in soil
- Scenario 3: Dissolved phase benzene concentrations in groundwater
- Scenario 4: Direct measurement of soil gas concentrations

Scenarios 1 and 2 are essentially “high-concentration sources”, while scenarios 3 and 4 are “low-concentration sources”. The following section details the specific justification(s) for each of the sets of exclusion criteria outlined in these four scenarios. Benzene is assumed to be the primary risk driver for vapor intrusion from petroleum hydrocarbon sites. Although naphthalene is not present in gasoline at levels as high as typical benzene levels, and is potentially present at very low concentrations (mass fraction of 0.0026) in diesel (TPHCWG, 1998), it is another volatile carcinogenic chemical, and could potentially be considered as an additional risk driver. Also, naphthalene has similar (if not, higher (GSI, 2010)) degradation rates as benzene and much lower aqueous solubility. The discussions below focus on benzene attenuation.

4.1 Scenario 1: Unweathered LNAPL on Groundwater

- 30 ft vertical bioattenuation zone between a unweathered LNAPL (residual or free-phase) source and a building foundation.

The proposed 30 ft exclusion distance⁷ is conservative based on:

- Model theory shows full attenuation within 7 m (~ 21 ft) of the source assuming reasonable approximations of the biodegradation rate (see figures below from Abreu et al., 2009).

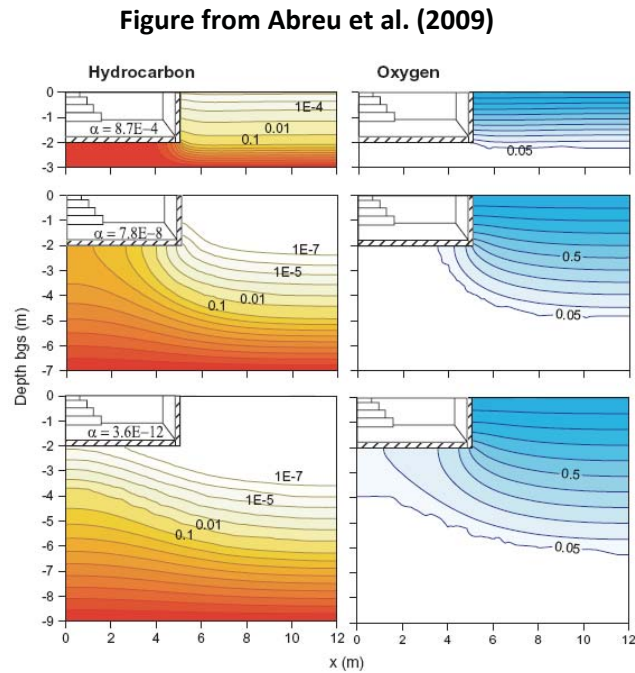


Figure 5. Effect of source depth on the soil-gas concentration distribution and vapor intrusion attenuation factors (α) for basement scenarios with a high vapor source concentration of 100,000 $\mu\text{g/L}$ and biodegradation rate $\lambda = 0.79 \text{ h}^{-1}$. Hydrocarbon and oxygen concentrations are normalized by source and atmospheric concentrations, respectively.

Abreu et al. (GWMR - 2009)

⁷ The top of the residual-phase source can generally be assumed to be consistent with the historic high water-table elevation.

Figure from Abreu et al. (2009)

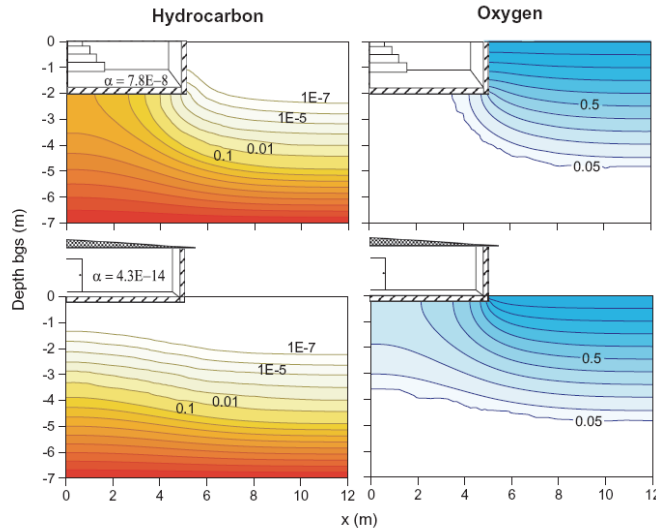
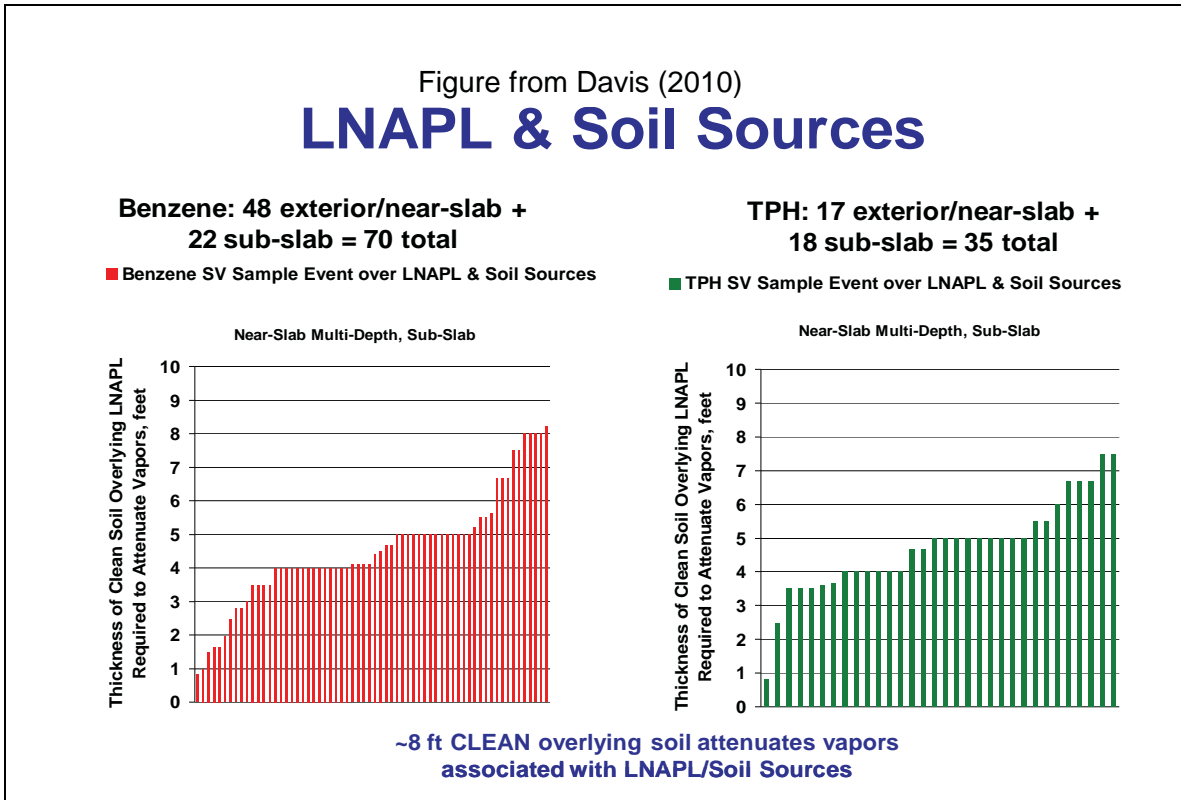


Figure 7. Effect of building type on soil-gas concentration distribution for high vapor source concentration (100,000 $\mu\text{g/L}$) and biodegradation rate $\lambda = 0.79 \text{ h}^{-1}$. Hydrocarbon and oxygen concentrations are normalized by source and atmospheric concentrations, respectively.

- Field soil-gas data show full attenuation within 8 ft of the source (see figure, below, from R. Davis (2010) – also published in Hartman (2010)).



- Analysis of the same soil-gas data by Lahvis (2011) that shows benzene is attenuated to concentrations in soil gas $< 100 \text{ ug/m}^3$ (a conservative risk-based screening level) at distances more than 13 ft from a LNAPL (residual or free-phase) source benzene (probability = 95%).

Figure from Lahvis (2011)

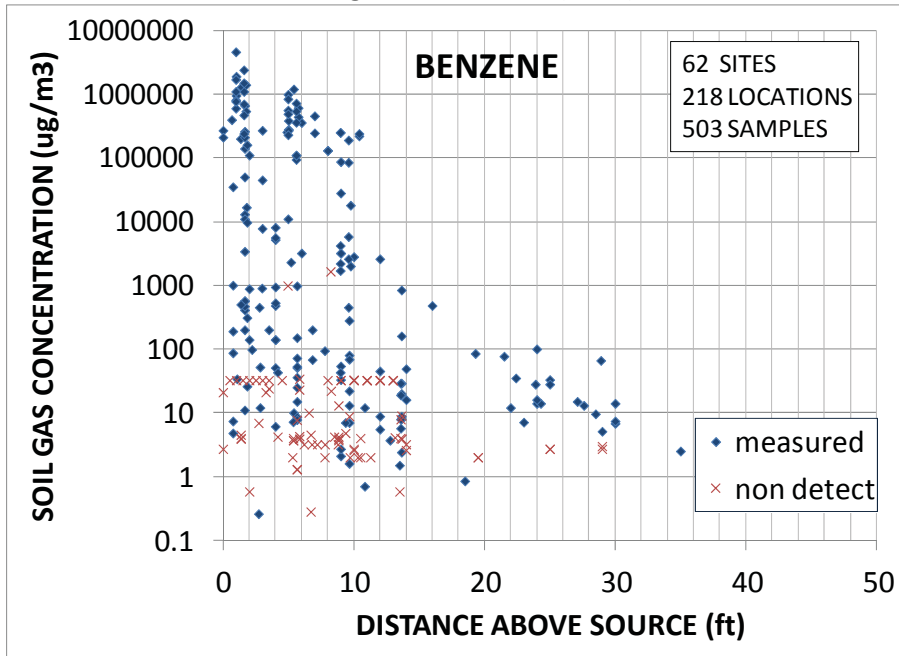
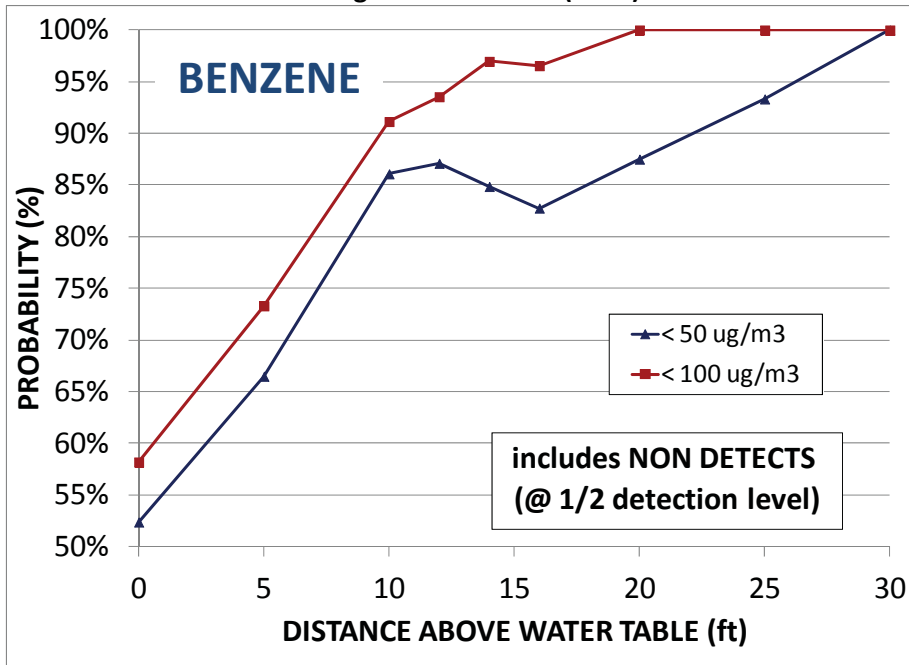


Figure from Lahvis (2011)



4.2 Scenario 2: Unweathered LNAPL in Soil

- 30 ft lateral and vertical separation distance between a unweathered LNAPL (residual or free-phase) source in soil and a building foundation.

The same technical justification provided for Scenario 1 applies to Scenario 2. The proposed 30 ft. lateral off-set distance is even more conservative for sources displaced laterally as shown in the following figure from Abreu and Johnson (2005). For example, an additional order of magnitude of attenuation is predicted for plume centerlines displaced 10 m (~30 ft). The attenuation would be significantly greater (e.g., several orders of magnitude) in cases where the plume (dissolved-phase) boundary was separated by 30 ft.

Figure from Abreu and Johnson (2005)

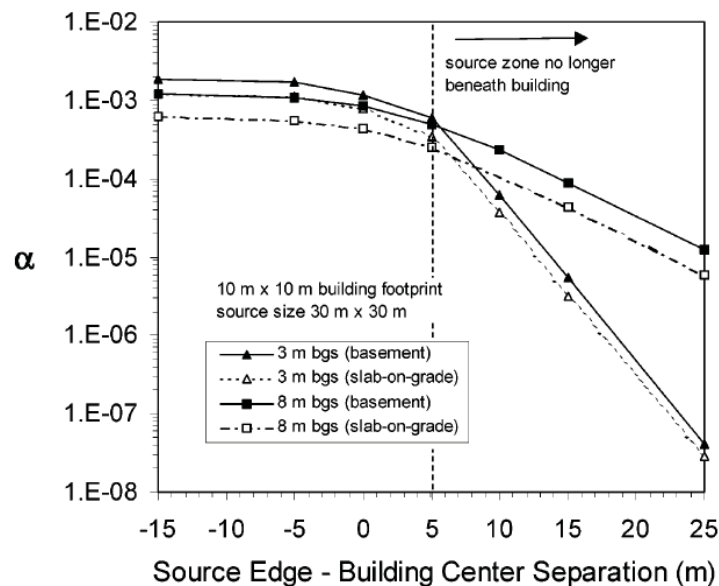


FIGURE 9. Changes in vapor attenuation coefficient (α) with vapor source—building separation and vapor source depth for basement and slab-on-grade foundation scenarios.

As discussed in the technical background section 3.2.2, 13 ft. is more than adequate to fully attenuate LNAPL sources in soil and groundwater, therefore assuming a 30' separation is very conservative.

4.3 Scenario 3: Dissolved Phase Benzene Concentrations in Groundwater

- No Oxygen Measurements - 5 ft. vertical separation distance between a dissolved-phase source < 100 ug/L benzene and a building foundation; 10 ft. vertical exclusion distance for a dissolved-phase source < 1,000 ug/L benzene.
- With Oxygen > 4% – 5 ft. vertical separation distance between a dissolved-phase source < 1,000 ug/L and a building foundation.

These separation distances are conservative with respect to protecting human health based on the following:

- Model theory shows 9 orders of magnitude (i.e., complete) attenuation (for reasonable approximations of the biodegradation rate) within a source/building separation distance of $L=3$ m (10 ft) for benzene vapor sources < 10 mg/L (or 40 mg/L dissolved phase concentration in groundwater assuming Henry's Law coefficient of 0.25) (see attached figure from Abreu et al., 2009). The attenuation is complete regardless of the dissolved-phase concentration (up to ~ 40 mg/L benzene in groundwater) for sources located 3 meters or more from a building foundation. The dissolved phase concentrations (especially) and required bioattenuation zone thickness specified in this scenario are therefore very conservative.

Figure from Abreu et al. (2009)

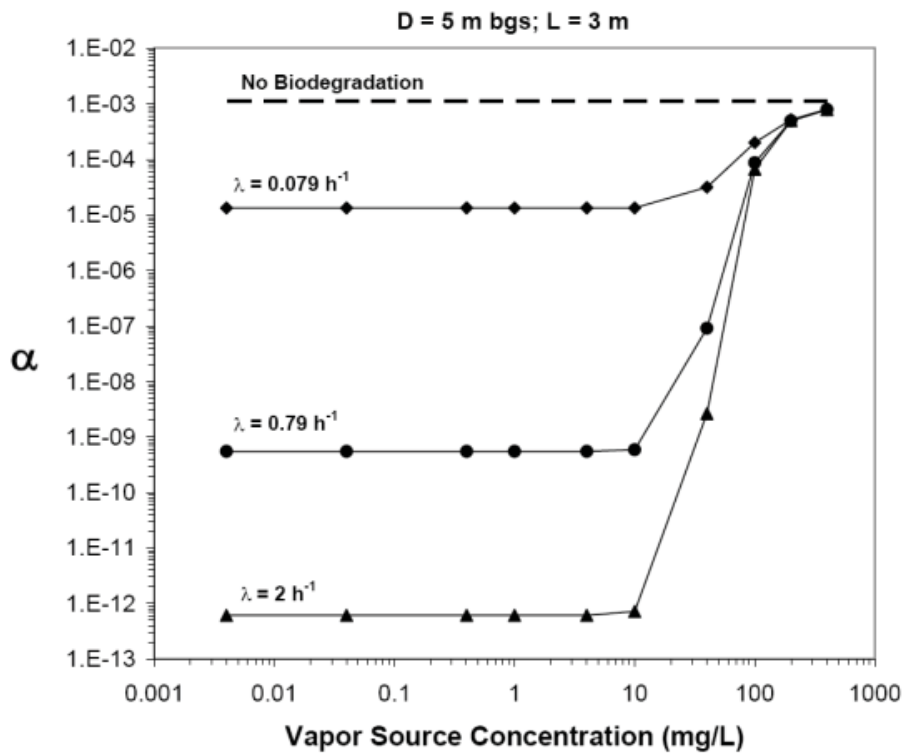


Figure 5—Influence of soil vapor source concentration and first-order biodegradation rates (λ) on vapor intrusion attenuation factors (α) for basement scenarios, homogeneous sand soil and source depth (D) of 5 m bgs (source-foundation separation $L = 3$ m).

- The attenuation is shown to be complete within 2 m (6 ft.) for a soil gas source of benzene < 10 mg/L (or 40 mg/L dissolved phase concentration in groundwater assuming Henry's Law coefficient of 0.25) (see attached figure from API (2009)).

Figure from API (2009)

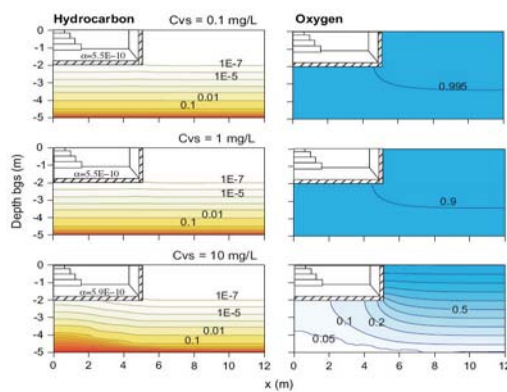


Figure 3 API

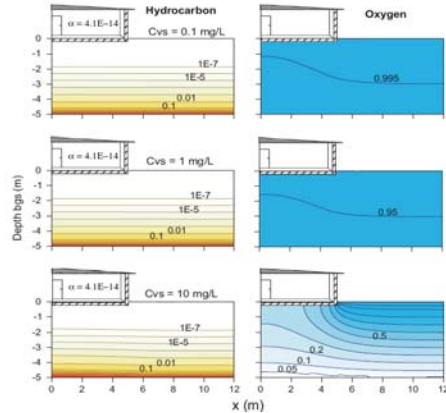


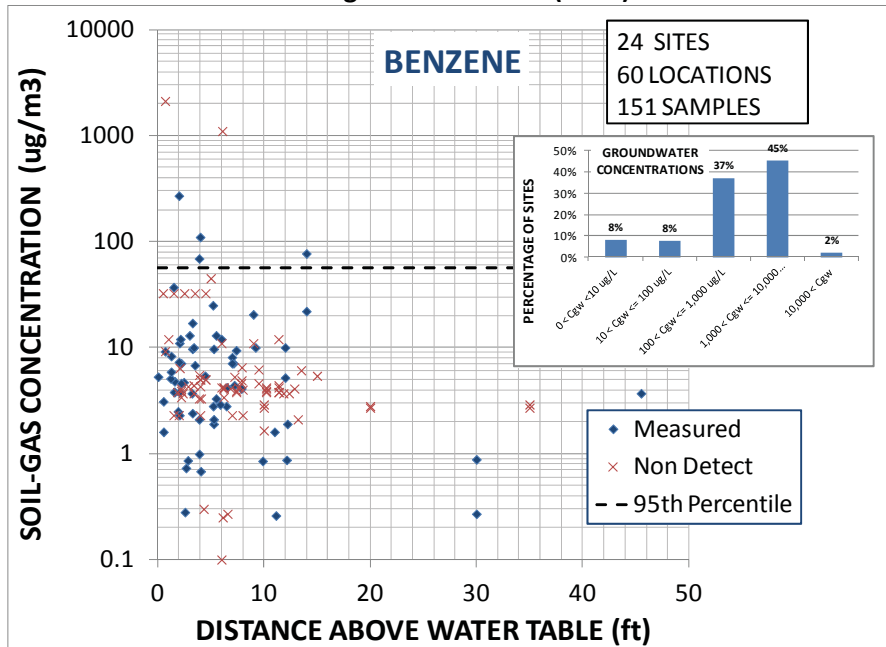
Figure 4 API

Figure 3. Effect of low vapor source concentration (C_{vs}) on soil-gas concentration distribution and vapor intrusion attenuation factors (α) for basement foundation scenarios and hydrocarbon biodegradation rate $\lambda = 0.79 \text{ h}^{-1}$. Hydrocarbon and oxygen concentrations are normalized by source and atmospheric concentrations, respectively.

Figure 4. Effect of low vapor source concentration (C_{vs}) on soil-gas concentration distribution and vapor intrusion attenuation factors (α) for slab-on-grade foundation scenarios and hydrocarbon biodegradation rate $\lambda = 0.79 \text{ h}^{-1}$. Hydrocarbon and oxygen concentrations are normalized by source and atmospheric concentrations, respectively.

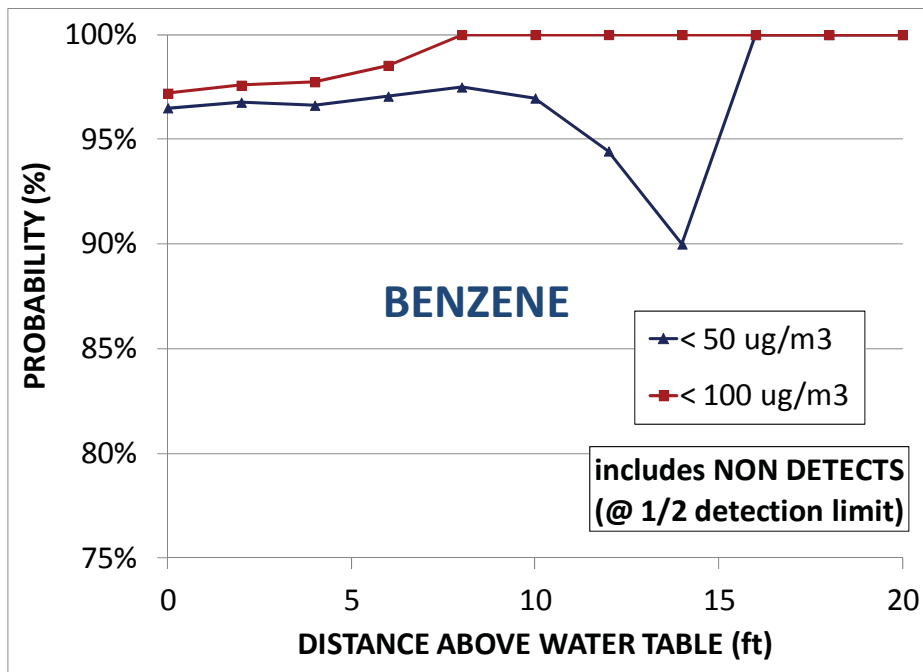
- Field soil-gas data from Robin Davis collected at retail sites (Lahvis, 2011) that show the proposed exclusion distances and groundwater concentrations are highly conservative. The data imply that the potential risk of vapor intrusion from dissolved-phase sources (up to 15 mg/L benzene in groundwater) is minimal unless groundwater is essentially in contact with the building foundation.

Figure from Lahvis (2011)



- From a probability standpoint, the soil-gas data show a > 95% probability of detecting benzene in soil gas at concentrations < 100 ug/m³ @ dissolved-phase sites; conversely, there is less than a 5% probability that benzene soil gas concentrations will exceed 100 ug/m³ (a conservative risk-based screening number for soil gas, Lahvis (2011)).

Figure from Lahvis (2011)



4.4 Scenario 4: Direct Measurement of Soil Gas Concentrations

- Application of a bioattenuation (additional attenuation) factor of 1000x to risk-based soil-gas criteria (i.e., vapor sources) located within 5 ft. of a building foundation.
- Model theory predicts that bioattenuation is significant for LNAPL sources provided vapor concentrations are < 0.1 ($1/10^{\text{th}}$) of a TPH vapor source of $100,000 \text{ ug/L}$ (or $10,000,000 \text{ ug/m}^3$). Therefore the proposed vapor screening criteria of $5,000 \text{ ug/m}^3$ for benzene is very conservative. (See the following figures from Abreu et al. 2009.)

Figure from Abreu et al. 2009

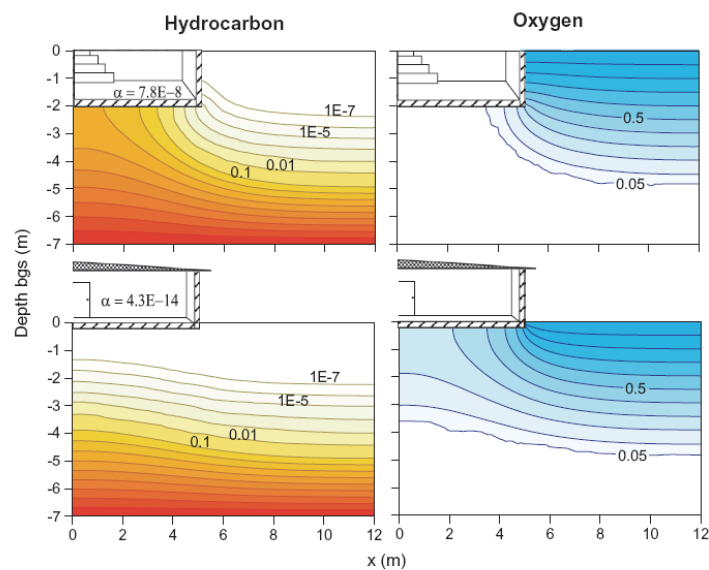


Figure 7. Effect of building type on soil-gas concentration distribution for high vapor source concentration ($100,000 \text{ ug/L}$) and biodegradation rate $\lambda = 0.79 \text{ h}^{-1}$. Hydrocarbon and oxygen concentrations are normalized by source and atmospheric concentrations, respectively.

Figure from Abreu et al. 2009

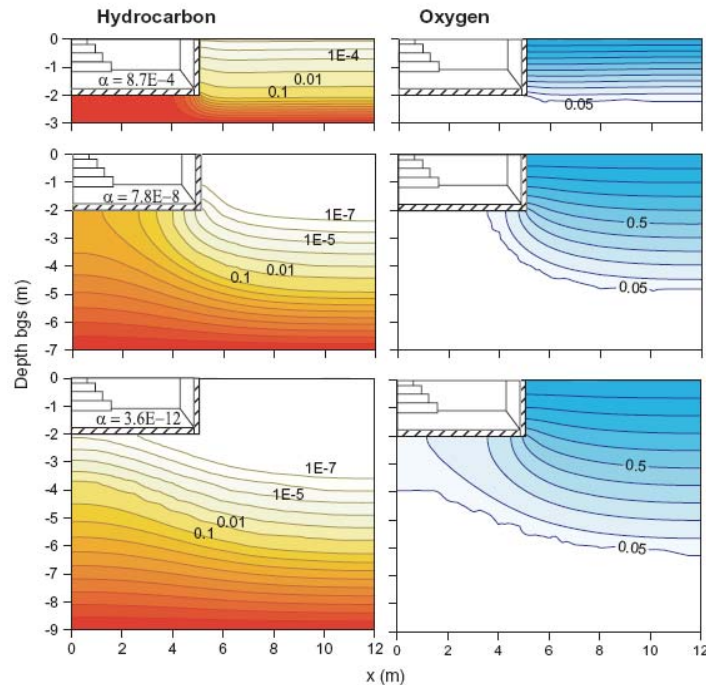


Figure 5. Effect of source depth on the soil-gas concentration distribution and vapor intrusion attenuation factors (α) for basement scenarios with a high vapor source concentration of 100,000 $\mu\text{g/L}$ and biodegradation rate $\lambda = 0.79 \text{ h}^{-1}$. Hydrocarbon and oxygen concentrations are normalized by source and atmospheric concentrations, respectively.

Abreu et al. /GWMR - 2009

- The 4% oxygen requirement in this scenario is also a very conservative level for biodegradation to occur. The numeric models used 1% as a conservative estimate.

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