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RECEIVED
By Alameda County Environmental Health 3:39 pm, Oct 02, 2015

Mr. Mark Detterman
Senior Hazardous Materials Specialist, PG, CEG
Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, California 94502

ENVIRONMENT

Subject:
Response to ACEH Comments Letter – August 19, 2015
Former ARCO Service Station No. 4931
731 W. MacArthur Boulevard
Oakland, California 94609
ACEH Site No.: RO0000076

Date:
September 30, 2015

Contact:
Hollis Phillips

Phone:
415.432.6903

Email:
Hollis.Phillips@arcadis.com

Our ref:
GP09BPNA.C110

Dear Mr. Detterman:

ARCADIS U.S., Inc. (ARCADIS) has prepared this response to comments letter for the former Atlantic Richfield Company (ARCO) service station No. 4931 located at 731 W. MacArthur Boulevard in Oakland, California (the 'Site'; Figure 1). This letter was prepared in response to the Alameda County Environmental Health (ACEH) directive dated August 19, 2015 (ACEH directive; ACEH 2015d) which responded to the Site Investigation Report (SI report) dated June 26, 2015 (ARCADIS 2015b). The ACEH directive states that the Site appears to meet State Water Resource Control Board's (SWRCB) Low-Threat Closure Policy (LTCP) for Media-Specific Criteria for Groundwater as well as the Direct Contact and Outdoor Air; however it does not meet the Media-Specific Criteria for Vapor Intrusion to Indoor Air (ACEH 2015d). The ACEH directive referred to ACEH's June 24, 2015 LTCP checklist (ACEH 2015c) on the SWRCB's GeoTracker website for details regarding their justification for denying low-threat closure (LTC) for the Site and requires the submittal of a work plan by October 12, 2015 to address the data gaps which ACEH contends prevent the Site from qualifying for closure as a low-threat underground storage tank (UST) site.

ACEH comments regarding the asserted data gaps are below in bold and are followed by ARCADIS responses.

The ACEH letter states that the Site partially meets the criteria for the SWRCB LTCP with the exception of the following:

1. **Media-specific criteria for vapor intrusion to indoor air due to presence of residential properties with partial basements directly adjacent to the Site.**

ACEH referred to the LTCP checklist on the SWRCB's GeoTracker website for specific details supporting their concern. A review of the LTCP checklist for the Site shows the following data gaps listed by ACEH:

a. **Soil Gas Samples:**
   - **Taken incorrectly**

b. **Exposure Type:**
   - **Residential**

c. **Free Product:**
   - **Unknown**

d. **TPH in the Bioattenuation Zone**
   - **Soil samples not taken at two depths within 5 ft zone (only for Scenario 4 with BioZone)**

e. **Bioattentuation Zone**
   - **<5 Feet (No BioZone)**
   - **Oxygen Data in Bioatttenuation Zone O_2 <4%**

f. **Benzene in Groundwater**
   - **≥1,000 µg/L**

g. **Soil Vapor Concentrations:**
   - **Benzene concentrations in soil vapor exceed 85,000 micrograms per cubed meter (µg/m^3) and are less than 280,000 µg/m^3.**
   - **Ethylbenzene concentrations in soil vapor exceed 3,600 µg/m^3 and are less than 1,100,000 µg/m^3.**
   - **Naphthalene concentrations in soil vapor exceed 310 µg/m^3 and are less than 93,000 µg/m^3.**

ARCADIS maintains the Site is a candidate for LTC based on recent and historical site investigation and groundwater monitoring activities. Below is a discussion that addresses both ACEH's concerns and the LTCP checklist data gaps.

a. Soil Gas Samples (Taken Incorrectly)

The installation and sampling of soil vapor probes SV-7 and SV-8 were completed correctly and in accordance with the Advisory - Active Soil Gas Investigations guidance (Soil Gas Advisory; Department of Toxic Substances Control [DTSC] 2012) as described in the SI report (ARCADIS 2015b). The locations and depths of SV-7 and SV-8 were also completed according to direction provided by ACEH. In the letter dated February 11, 2015, ACEH directed the probes to be installed to a depth of 5 feet below the adjacent residential foundations, unless the presence of groundwater precludes the vapor probe installation (ACEH 2015a). As discussed previously in the SI report, the adjacent residential foundation includes a half-basement which likely extends 3 to 5 feet bgs based on observations made during the recent site investigation (ARCADIS 2015b). ARCADIS field staff concluded that installation of a soil vapor probe 5 feet below the observed half-basement (probe placement likely 8 to 10 feet bgs) would have resulted in a submerged vapor probe based on depth to groundwater at nearby monitoring wells. ARCADIS field staff proceeded to install the probes at 5 feet bgs since the presence of groundwater precluded installation at a depth 5 feet below the adjacent residential foundation.

In email correspondence from ACEH to ARCADIS dated February 20, 2015, ACEH requested SV-7 and SV-8 be re-located 5 to 10 feet south (southwest) along the property line as this would allow SV-7 to be more protective of the residential house with the (at least) half-basement (and not as far from a probable source), and SV-8 would be more protective of the vapor detected at SV-6 (ACEH 2015b). ARCADIS field staff adjusted the soil vapor probe locations according to ACEH's specifications and results from a private utility survey. Additionally, both SV-7 and SV-8 were installed directly adjacent to the eastern site property boundary with probe depths likely at or a few feet below the foundation of the half-basement.

Prior to soil vapor probe installation in an April 21, 2015 email to ACEH ARCADIS indicated the groundwater was approximately 6 to 8 feet bgs and therefore soil vapor probes would be shallow (i.e., not below the partial basement). ACEH responded there was wording in their directive letter to acknowledge the effect of shallower water and that it may prevent installation to the full preferred depth.

b. Exposure Type (Residential)

Concentrations of constituents detected in soil vapor above laboratory reporting limits were compared to regulatory screening levels to assess potential risks.

Concentrations of constituents in soil vapor were compared to the San Francisco Bay–Regional Water Quality Control Board (SF-RWQCB) Environmental Screening Levels (ESLs) for Residential and Commercial/Industrial screening levels (SF-RWQCB 2013; Table E-2). SF-RWQCB ESLs are presented in the technical document titled *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater,* dated December 2013 (SF-RWQCB 2013). Soil vapor sample results were also compared to the SWRCB LTCP screening levels presented in *Scenario 4 - Direct Measurement of Soil Gas Concentrations* of the Petroleum Vapor Intrusion to Indoor Air criteria. The screening levels used are provided in Table 1 of this letter.

Residential screening levels have been included for assessment of soil vapor results from SV-7 and SV-8 at the request of ACEH as stated in their email dated February 20, 2015 (ACEH 2015b). However, the Site is currently an active Westco Gasoline-branded retail fuel dispensing facility. Based on the current site use the exposure type is more appropriately commercial/industrial, specifically regarding soil vapor results from the previously installed soil vapor probes (SV-1 through SV-6).

c. Free Product (Unknown)

Available groundwater monitoring data indicate that measureable free product was last observed at the Site in November 1994 at A-8 (1.75 feet thickness) and at AR-1 (0.06 feet thickness) (ARCADIS 2013). The 20+ year absence of free product in site groundwater monitoring wells suggests that the source area mass has been removed by the various petroleum system repairs/upgrades, soil excavation, remediation, and natural attenuation processes and that free product is no longer present at the Site.

It is unclear why ACEH lists Free Product as “unknown” since groundwater data does not support its presence.

d. TPH in the Bioattenuation Zone (Soil samples not taken at two depths within the 5 foot zone [only for scenario 4])

Soil samples were collected from two depths between 0 and 5 feet bgs during the recent site investigation. As stated in Section 4.2.3.1 and as presented in Table 1 of the SI report (ARCADIS 2015b) soil samples were collected at 2.5 to 3 feet bgs and 4.5 to 5 feet bgs from both SV-7 and SV-8. These soil samples were analyzed for gasoline range organics (GRO). As presented in Table 1 of the SI report, GRO was

not detected above laboratory reporting limits in any of the soil samples collected from SV-7 and SV-8 (ARCADIS 2015b).

e. Bioattentuation Zone

According to *Scenario 4 - Direct Measurement of Soil Gas Concentrations* of the SWRCB LTCP, the criteria requirements for a bioattenuation zone are satisfied with the following conditions:

1. There is a minimum of five vertical feet of soil between the soil vapor measurement and the foundation of an existing building or ground surface of future construction.

2. TPH (TPHg + TPHd) is less than 100 mg/kg (measured in at least two depths within the five-foot zone.)

3. Oxygen is greater than or equal to four percent measured at the bottom of the five-foot zone.

Thickness (<5 feet [No Bioattenuation Zone])

Although a minimum of five vertical feet of soil between the recent soil vapor measurements and the foundation of existing buildings was not completed, a bioattentuation zone greater than 5 feet thickness can be considered to occur across a majority of the Site with respect to the depth of first groundwater. With some exceptions, groundwater is generally greater than 5 feet below top of casing (btoc) as measured in site groundwater monitoring wells. Depth to first groundwater during drilling events is much greater than what is typically observed in gauging of the monitoring well network. Groundwater is first encountered during drilling events between approximately 15 and 25 feet bgs and roughly correlates to the intermittent sand/gravel layer that underlays the shallower clay layer. A nearly continuous clay layer (clay, clayey sand, and gravelly clay) extends from the surface to approximately 18 to 20 feet bgs. The clay layer is typically underlain by an approximately 4-foot thick intermittent sand/gravel layer which has been encountered between 18 and 23 feet bgs (ARCADIS 2013). This was recently demonstrated in the completion of soil boring SB-07 during the May 2015 site investigation. Although SB-07 is located offsite, its lithology is consistent with wells and borings located onsite. Wet formation materials, indicating first groundwater, were encountered at approximately 22 feet bgs. After placement of the temporary well screen for groundwater sampling

purposes, groundwater was measured at 8.04 feet bgs at SB-07. Although the deepest soil vapor probes completed at the Site are not quite 5 feet below existing building foundations, the depth to first groundwater does provide a sufficient separation between groundwater and building foundations at and nearby the Site.

When considering groundwater levels in site groundwater monitoring wells, with the exception of A-2, where groundwater was most recently measured at 4.41 feet bgs during the first quarter of 2015 (ARCADIS 2015a) a separation of 5 vertical feet of soil between the groundwater and the foundation of existing building is present beneath the Site. Given the seasonal fluctuations in groundwater levels, a bioattentuation zone is present during the summer and fall months when there is little to no recharge to shallow aquifers. With respect to the upgradient residential property, groundwater was not encountered during the installation of SV-7 and SV-8, which were installed at a depth of 5 feet bgs, indicating a bioattentuation zone is present in the immediate vicinity of residential property.

As noted above, GRO in soil has been measured in at least two depth intervals between 0 – 5 feet bgs at the Site. The GRO concentrations were not detected above laboratory reporting limits (<0.22 mg/kg to <0.25 mg/kg), and thus satisfy step #2 of the SWRCB LTCP criteria requirements for a bioattenuation zone.

On a whole, oxygen concentrations are above 4% below the Site in the eastern and upgradient portion of the Site, and thus satisfy step #3 of the SWRCB LTCP criteria requirements for a bioattenuation zone. Oxygen concentrations are discussed below.

Oxygen Data in Bioattenuation Zone

A total of 8 soil vapor locations (SV-1 through SV-8) have been sampled at the Site between June 2011 and May 2015 at a depth of 5 feet bgs (Figure 2). Oxygen concentrations in soil vapor samples ranged from 1 percent (%; SV-2) to 18% (SV-4 and SV-5). Based on historical soil vapor results and SWRCB LTCP's criteria for direct measurement of soil vapor concentrations (oxygen > 4%), a bioattenuation zone is established at the eastern property boundary adjacent to the upgradient residential property. The ACEH directive contests a sufficient bioattentuaion zone is not available at SV-8, due to an oxygen concentration of 1.3%. ARCADIS considers this result to be location specific, supported by the oxygen concentrations exceeding 4% at SV-4 through SV-7, which are all located in the eastern portion of the property and have oxygen concentrations ranging from 4.3% to 18% (Figure 2). Overall it appears that oxygen concentrations less than 4% are located in the western

(downgradient) portion of the Site (with exception of SV-8), and oxygen concentrations greater than 4% are observed in soil vapor probes completed in the eastern and upgradient portion of the Site (closer to the adjacent upgradient residential property). Furthermore, as stated in the ACEH email dated February 20, 2015, the intent of SV-7 is to be more protective of the residential house, and thus, oxygen concentrations measured at SV-7 (11%) are greater than the LTCP criteria requirement of 4% and sufficiently support a bioattenuation zone in the immediate area of the upgradient residential property.

f. Benzene in Groundwater

Current benzene concentrations in groundwater are below 1,000 µg/L. A review of historical groundwater monitoring results indicates that benzene has not been detected in any site groundwater monitoring wells at a concentration greater than 1,000 µg/L in over 3 years. The most recent detection of benzene above 1,000 µg/L was at A-8 on the western side of the site during the August 2012 groundwater sampling event (ARCADIS 2015a). Furthermore, results of the recent groundwater sampling have demonstrated that the benzene-affected plume is fully delineated to the SF-RWQCB ESL protective of a drinking water resource, is limited to the western portion of the Site, and does not extend to the adjacent upgradient residential property (ARCADIS 2015b).

g. Soil Vapor Concentrations (benzene, Ethylbenzene, and naphthalene)

The concentration ranges listed in the ACEH LTCP checklist for benzene (85,000 to 280,000 µg/m^3), ethylbenzene (3,600 to 1,100,000 µg/m^3) and naphthalene (310 to 93,000 µg/m^3) appear to be a combination of commercial and residential LTCP screening levels for direct measurement of soil vapor concentrations in areas with and without a bioattenuation zone. It is unclear which screening criteria ACEH is using to evaluate soil vapor concentrations in their LTCP checklist. However the focus of the recent site investigation is primarily on the soil vapor results from SV-7 and SV-8, which were installed to asses potential vapor intrusion to the upgradient residential property. The investigation was not focused on past results from SV-1 through SV-6. SV-1 through SV-6 were installed prior to SWRCB approval of Resolution No. 2012-0016 which established the LTCP and includes an exemption for active commercial petroleum fueling facilities from the requirement to satisfy the media-specific criteria for petroleum vapor intrusion to indoor air. As such at the time of installation, soil vapor results of SV-1 through SV-6 were used to assess on-site vapor concentrations.

Moreover, as stated in their objection to SWRCB's decision to approve LTC for the Site (SWRCB 2014), ACEH recommended a limited scope of investigation to evaluate soil vapor in proximity to upgradient residential dwellings in order to determine the potential soil vapor risk to offsite residents (ACEH 2014). If evaluation of soil vapor in proximity to the upgradient residential property was a final impediment to LTC for the Site, then the current data has satisfied this criteria considering ACEH February 20, 2015 email which states the soil vapor probe locations would allow SV-7 to be more protective of the residential house with the (at least) half-basement, and SV-8 would be more protective of vapor detected at SV-6.

Concentrations in soil vapor samples collected at SV-7 and SV-8 did not exceed the residential LTCP screening levels for direct measurement of soil vapor concentrations *with* a bioattentuation zone. When compared to residential LTCP screening levels *without* a bioattentuation zone, only benzene at SV-8 was potentially above the screening level (85 µg/m^3) based on a slightly elevated laboratory reporting limit (<180 µg/m^3). All detected constituent concentrations in soil vapor, as well as reporting limit concentrations at SV-7 are significantly less than residential LTCP screening levels without a bioattentuation zone.

During the installation of SV-7 and SV-8, groundwater was not encountered to a depth of 5 feet bgs and depth to first groundwater during drilling at the Site has been generally greater than 15 feet bgs, suggesting that there is a sufficient separation between groundwater and overlaying foundation structures when soils are not disturbed. Based on the overall oxygen concentrations in the eastern half of the Site, which primarily exceed 4% (Figure 2), a sufficient bioattentuation zone is present in the vicinity of the upgradient residential property, which indicates the soil vapor results at SV-7 and SV-8 are below the residential LTCP screening criteria.

Furthermore, significant attenuation of soil vapor concentrations from the Site toward the upgradient residential property is demonstrated between SV-6 and SV-8. As stated by ACEH in their February 20, 2015 email, SV-8 is to be more protective of vapor detected at SV-6 (ACEH 2015b). Concentrations of GRO are two orders of magnitude lower at SV-8 than at SV-6 and concentrations of benzene are at least one order of magnitude lower at SV-8 than at SV-6. These results successfully demonstrate degradation of petroleum hydrocarbon-affected soil vapor near the upgradient residential property. It's expected that concentrations of petroleum hydrocarbon-affected soil vapor will continue to attenuate to concentrations below LTCP residential screening levels upgradient of the Site.

Groundwater sampling at the Site has demonstrated that the dissolved phase constituent of potential concern (COPC) plume associated with the Site does not extend beneath the residential dwelling on the adjacent upgradient property. Given that the source of petroleum hydrocarbons detected in soil vapor described above is likely off-gassing from underlying shallow groundwater, vapor intrusion from the off-gassing of COPC-affected groundwater into upgradient residential dwelling is not expected to occur as (1) upgradient wells do not have concentrations of COPCs above SF-RWQCB groundwater screening levels for evaluation of potential vapor intrusion concerns (SF-RWQCB 2013; Table E-1) and (2) groundwater flows to the west, away from the residential dwelling.

Consistent with the SWRCB LTCP and as discussed previously in the ACEH Low Threat Closure Policy Checklist and Site Conceptual Model, the Site is considered a low-threat for vapor intrusion to indoor air since exposure to petroleum vapors associated with historical fuel system releases are comparatively insignificant relative to exposure from small surface spills and fugitive vapor releases that typically occur at active fueling facilities (SWRCB 2012; ARCADIS 2013).

Recommendations

ARCADIS is requesting the Site be reconsidered for LTC based on the low levels of petroleum hydrocarbon-affected groundwater at the Site and on the data presented in this letter to address ACEH's data gaps within the media-specific criteria for vapor intrusion. ACEH contests that data gaps present an unacceptable human health risk to the residential property located on the eastern site property boundary. The installation of SV-7 and SV-8 were originally proposed to assess the soil vapor concentrations proximal to the upgradient residential property line, and were installed at a depth to assess the potential for bioattentuation of soil vapor. The locations of SV-7 and SV-8 also served to be more protective of the residential property and the elevated vapor concentrations detected at SV-6, respectively (ACEH 2015b). Concentrations in soil vapor samples collected at SV-7 and SV-8 did not exceed residential LTCP screening levels when a bioattenuation is present, and only exceeded the non-bioattenuation zone screening level for benzene at SV-8 based on a slightly elevated laboratory reporting limit. Soil vapor concentrations observed at SV-7 demonstrate both the presence of a bioattentuation zone and that detected constituent concentrations and laboratory reporting limits are below health-based screening criteria that regulatory agencies consider to be protective of potential human health vapor intrusion exposures for residents in the immediate area of the upgradient residential property.

Given that groundwater flow direction is to the west and groundwater concentrations in upgradient monitoring wells (A-2, A-6, and A-13) do not indicate the presence of the COPC-affected groundwater plume near the residential property, potential vapor migration into the offsite upgradient residential dwelling is unlikely and not expected to pose adverse health effects to dwelling occupants.

If you have any questions or comments regarding the contents of this letter, please contact Hollis Phillips at 415.432.6903 or by e-mail at Hollis.Phillips@arcadis.com.

Sincerely,

ARCADIS U.S., Inc.

Hollis Phillips, P.G. (No. 6887)
Principal Geologist/Project Mana

REGISTERED GEOLOGIST
HOLLIS E. PHILLIPS
HEP
No. 6887
STATE OF CALIFORNIA

Attachments:
Table 1 – Soil Vapor Analytical F
Figure 1 – Site Location Map
Figure 2 – Soil Vapor Oxygen Concentrations
Figure 3 – Site Plan Showing Soil Vapor Analytical Results

Copies:
George Lockwood/SWRCB
Electronic Copy to Geotracker and ACEH ftp portal

References:

Alameda County Environmental Health (ACEH). 2014. Comment Letter – ARCO #04931 Case Closure Summary, State Water Resources Control Board Notice of Opportunity for Public Comment; Proposed Underground Storage Tank Case Closure: Fuel Leak Case No. RO0000076 and GeoTracker Global ID T0600100110, ARCO #04931, 731 W Macarthur Blvd., Oakland, CA 94609. September 30.

ACEH. 2015a. Conditional Work Plan Approval; Fuel Leak Case No. RO0000076 and GeoTracker Global ID T0600100110, ARCO #04931, 731 W Macarthur Blvd, Oakland, CA 94609. February 11.

ACEH. 2015b. Email from Mr. Mark Detterman of ACEH to Ms. Hollis Phillips of ARCADIS. Subject: RE: RO0000076 - Directive. February 20.

ACEH. 2015c. LTCP Checklist as of 6/24/2015. June 24. Viewed online on September 22, 2015: https://geotracker.waterboards.ca.gov/profile_report.asp?global_id=T0600100110&cmd=ltcpreport&ltcp_id=112590

ACEH. 2015d. Request for Brief Data Gap Work Plan; Fuel Leak Case No. RO0000076 and GeoTracker Global ID T0600100110, ARCO #04931, 731 W Macarthur Blvd, Oakland, CA 94609. August 19.

ARCADIS U.S., Inc. (ARCADIS) 2013. ACEH Low Threat Closure Policy Checklist and Site Conceptual Model, Former Atlantic Richfield Company Station No. 4931, 731 West MacArthur Boulevard, Oakland, California 94609. June 28.

ARCADIS 2015a. Fourth Quarter 2014 and First Quarter 2015 Semi-Annual Groundwater Monitoring Report, Former Atlantic Richfield Company Station No. 4931, 731 West MacArthur Boulevard, Oakland, California 94609. April 16.

ARCADIS 2015b. Site Investigation Report, Former ARCO Service Station No. 4931, 731 West MacArthur Boulevard, Oakland, California 94609. June 26.

Department of Toxic Substances Control (DTSC). 2012. Advisory: Active Soil Gas Investigations. April.

San Francisco Bay Regional Water Quality Control Board (SF-RWQCB). 2013. Environmental Screening Levels Workbook (Interim Final). December.

.

State Water Resources Control Board (SWRCB). 2012. Water Quality Control Policy for Low-Threat Underground Storage Tank Case Closure. May 1 (effective August 17, 2012). Viewed online on September 16, 2015: http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2012/rs2012_0016atta.pdf

SWRCB. 2014. Notice of Opportunity for Public Comment. Proposed Underground Storage Tank Case Closure, Pursuant to Health and Safety Code Section 25296.10 and the State Water Resources Control Board Low-Threat Underground Storage Tank Case Closure Policy: ARCO Station #04931, 731 West Macarthur Boulevard, Oakland, Alameda County. July 24.

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Tables

Table 1. Soil Vapor Analytical Results
Former ARCO Service Station No. 4931
731 W MacArthur Blvd, Oakland, CA

Sample ID	Depth (ft bgs)	Date Sampled	GRO (µg/m³)	Benzene (µg/m³)	Toluene (µg/m³)	Ethylbenzene (µg/m³)	Total Xylenes (µg/m³)	MTBE (µg/m³)	TBA (µg/m³)	Naphthalene (µg/m³)	Helium (%v)	Carbon Dioxide (%v)	Oxygen (%v)	Methane (%v)
EPA Analytical Method			TO-3, TO-15	TO-15	TO-15	TO-15	TO-15	TO-15	TO-15	TO-15, TO-17	D1946			
LTC No Bioattenuation Zone Soil Gas Criteria Residential[1] (µg/m³)			--	85	--	1,100	--	--	--	93	--	--	--	--
LTC No Bioattenuation Zone Soil Gas Criteria Commercial[1] (µg/m³)			--	280	--	3,600	--	--	--	310	--	--	--	--
LTC with Bioattenuation Zone Soil Gas Criteria Residential[1] (µg/m³)			--	85,000	--	1,100,000	--	--	--	93,000	--	--	--	--
LTC with Bioattenuation Zone Soil Gas Criteria Commercial[1] (µg/m³)			--	280,000	--	3,600,000	--	--	--	310,000	--	--	--	--
SF-RWQCB ESL (Res)[2] (µg/m³)			300,000	42	160,000	490	52,000	4,700	--	36	--	--	--	--
SF-RWQCB ESL (C/I)[3] (µg/m³)			2,500,000	420	1,300,000	4,900	440,000	47,000	--	360	--	--	--	--
SV-1-6911	5	6/9/2011	4,100	8.7	19	<5	<10	26	--	<24	4.40	2.50	--	0.01
SV-1B-6911	5	6/9/2011	16,000	16	9.4	<5.6	<11.2	52	--	<27	<0.13	4.80	--	0.02
SV-1	5	1/4/2013	<1,500	11 J	<27	<31	<62	<26	--	<150	<0.12	4.2	2.2	<0.00023
SV-2-6911	5	6/9/2011	**42,000,000**	**130,000**	<2200	**6,000**	3,500	<2100	--	<12000	<0.2	12.00	--	31.00
SV-2B-6911	5	6/9/2011	**44,000,000**	**120,000**	<2300	**5,500**	3,000	<2200	--	<13000	<0.12	12.00	--	30.00
SV-2	5	1/4/2013	**49,000,000**	**150,000**	<4400	<5000	<10000	<4200	--	<24000	<0.12	12	1.0	37
SV-3-6911	5	6/9/2011	**15,000,000**	**2,700**	<1200	<1300	<2600	3,200	--	<6500	<0.12	23.00	--	0.88
SV-3B-6911	5	6/9/2011	**14,000,000**	**2,500**	<2400	<2700	<5400	3,500	--	<13000	<0.13	22.00	--	0.82
SV-3	5	1/4/2013	**22,000,000**	**1,700 J**	<4200	<4900	<9800	<4000	--	<23000	<0.12	22	1.6	3.6
SV-4-6911	5	6/9/2011	<260	<4	<4.7	<5.5	<11	<4.5	--	<26	0.13	1.70	--	<0.00025
SV-4B-6911	5	6/9/2011	<260	<4.1	<4.9	<5.6	<11.2	<4.6	--	<27	<0.13	1.70	--	<0.00026
SV-4	5	2/15/2013	<240	2.2 J	<4.5	<5.2	<10.4	<4.3	--	--	<0.12	0.97	18	<0.00024
SV-5-6911	5	6/9/2011	**400,000**	**56**	<38	<44	<88	2,900	--	<210	<1	1.00	--	1.50
SV-5B-6911	--	6/9/2011	**Not collected during June 2011 sampling event due to observed groundwater intrusion in probe.**											
SV-5	5	2/15/2013	1,300	3.0 J	28	9.9	59	<5.2	--	--	<0.14	1.5	18	<0.00029
SV-6-6911	5	6/9/2011	**36,000,000**	**4,800**	<2200	<2600	<5200	<2100	--	<12000	<0.12	7.20	--	6.10
SV-6B-6911	5	6/9/2011	**25,000,000**	<3800	<4500	<5200	<10400	<4300	--	<25000	0.45	6.20	--	4.90
SV-6	5	1/9/2013	**26,000,000**	**3,400**	<2200	<2500	<5000	<2100	--	--	<0.12	12	4.3	5.0
SV-7	5	5/15/2015	460	13	9.7	<4.0	6.1	<3.3	ND (TIC)	<17	<0.19	0.25	11.0	<0.19
SV-8	5	5/15/2015	**490,000**	<180	<210	<240	<240	<200	ND (TIC)	<17	<0.19	3.4	1.3	1.4

Table 1. Soil Vapor Analytical Results
Former ARCO Service Station No. 4931
731 W MacArthur Blvd, Oakland, CA

Notes:

1. SWRCB- State Water Resources Control Board- Low-Threat Closure Policy Environmental Screening Levels (ESLs) for soil gas samples, commercial land use (Appendix 4).
2. Residential Exposure ESL - (Table E-2 Soil Gas Screening Levels for Evaluation of Potential Vapor Intrusion [volatile chemicals only], Lowest Residential, SF-RWQCB [Interim Final - December 2013]).
3. Commercial/ Industrial (C/I) Exposure ESL - (Table E-2 Soil Gas Screening Levels for Evaluation of Potential Vapor Intrusion [volatile chemicals only], Lowest C/I, SF-RWQCB [Interim Final - December 2013]).

All soil vapor sample concentrations and ESLs given in micrograms per cubic meter ($\mu g/m^3$) with the exception of fixed gases (helium, carbon dioxide, oxygen, and methane), which are given in percent by volume (%v).

Bold indicates detected values exceed appropriate SF-RWQCB ESLs.

ESLs for xylenes applied to m,p-Xylenes and o-Xylene.

EPA = United States Environmental Protection Agency

ESL = Environmental Screening Level

ft bgs = Feet below ground surface

GRO = Gasoline range organics (C6-C12)

MTBE = Methyl tertiary-butyl ether

ND (TIC) = Non Detect as a Tentatively Identified Compound

SF-RWQCB = San Francisco Bay Regional Water Quality Control Board

SV = Soil vapor

TBA = Tertiary-butyl alcohol

$\mu g/m^3$ = Micrograms per cubic meter

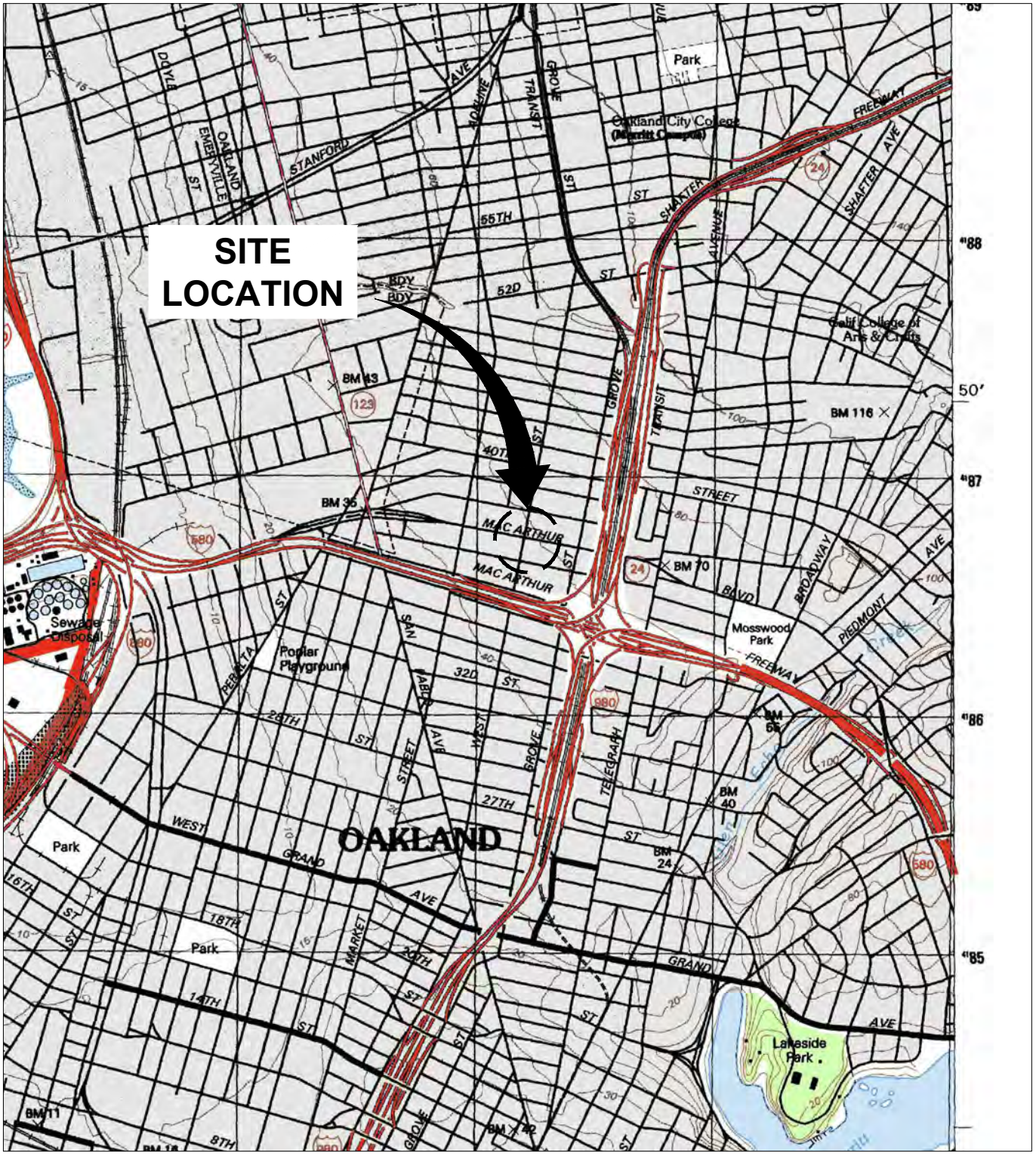
%v = Percent by volume

< = Analyte was not detected above the specified method reporting limit

-- = Not applicable or not available

ARCADIS Design & Consultancy for natural and built assets

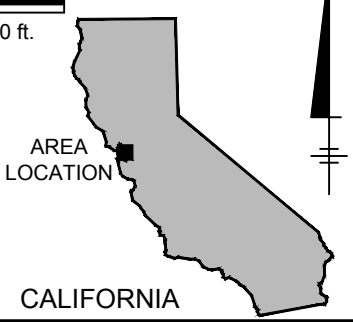
Figures



REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. UAD., OAKLAND WEST, CALIFORNIA, 1993.

0 2000' 4000'

Approximate Scale: 1 in. = 2000 ft.



FORMER ARCO STATION 4931
731 WEST MACARTHUR BOULEVARD
OAKLAND, CALIFORNIA

SITE LOCATION MAP

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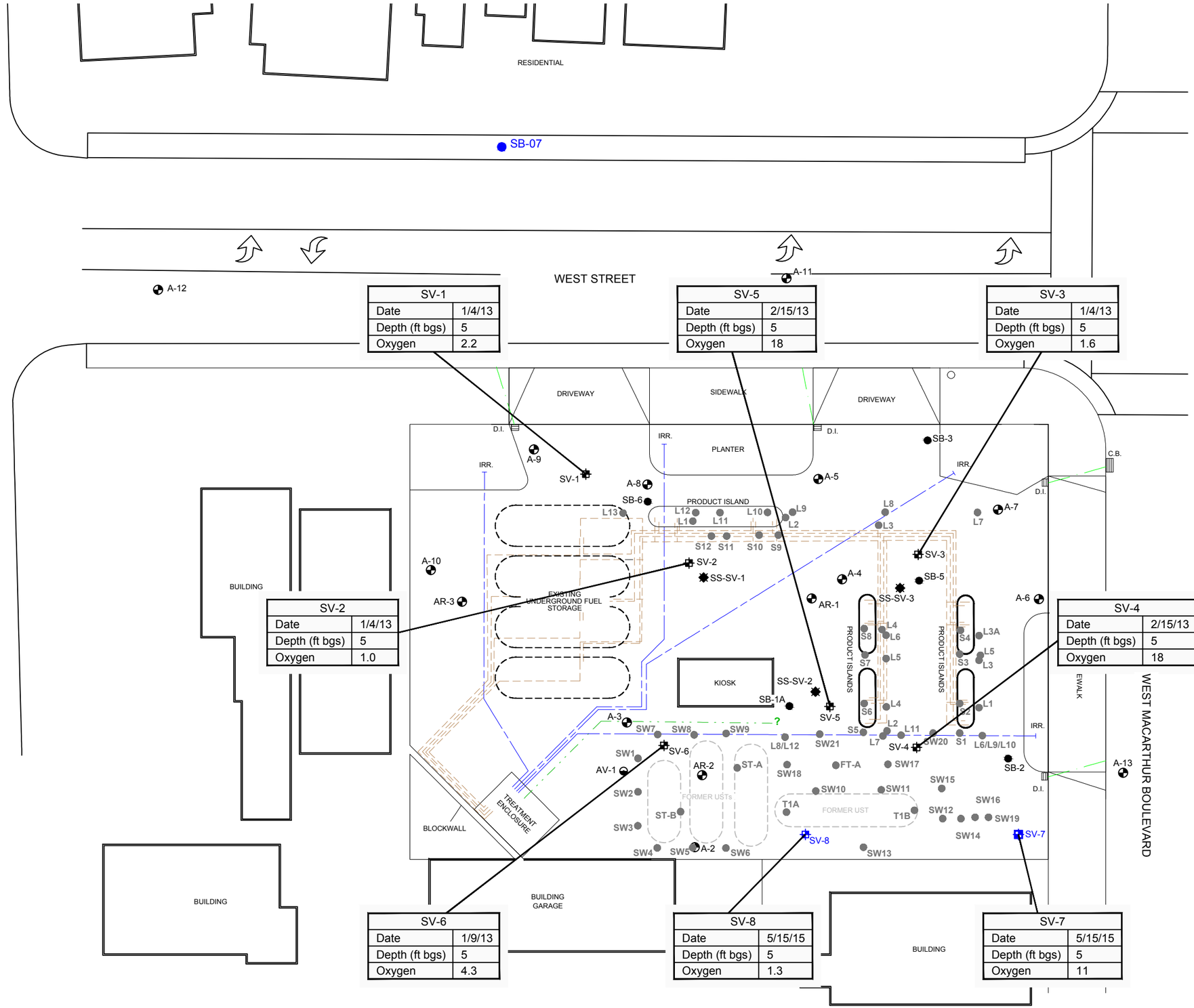
FIGURE
1

CITY: PETALUMA, CA DIV/GROUP: ENV DB: J. HARRIS
C:\Users\jharris\Desktop\ENVCAD\RETURN-TO\EMERYVILLE, CA\GP09BPNAIC110N00003 : 12\DWG\GP09BPNAC110-N01.dwg LAYOUT: 1 SAVED: 10/1/2012 11:40 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: SETUP1 PLOTSTYLETABLE: ARCADIS.CTB PLOTTED: 10/1/2012 11:59 AM BY: HARRIS, JESSICA
XREFS: IMAGES: PROJECTNAME: ---
Oakland West.jpg



LEGEND

- MONITORING WELL
- SOIL BORING (ARCADIS, OCTOBER 2010)
- SOIL SAMPLE LOCATION
- SOIL VAPOR EXTRACTION WELL
- SOIL VAPOR PROBE (ARCADIS, MAY-JUNE 2011)
- SUB-SLAB SOIL VAPOR PROBE (ARCADIS, DECEMBER 2012)
- SOIL VAPOR PROBE (ARCADIS, MAY 2015)
- SOIL BORING PROBE (ARCADIS, MAY 2015)
- PRODUCT/VENT LINE
- WATER
- SANITARY SEWER
- STORM DRAIN

NOTE:

ft bgs = feet below ground surface

Analytical Method: D1946 analysis in percent by volume (%v).

SITE MAP ADAPTED FROM FIGURES BY OTHERS.
ALL FEATURES AND LOCATIONS ARE APPROXIMATE.

N

0 25' 50'

Approximate Scale: 1 in. = 25 ft.

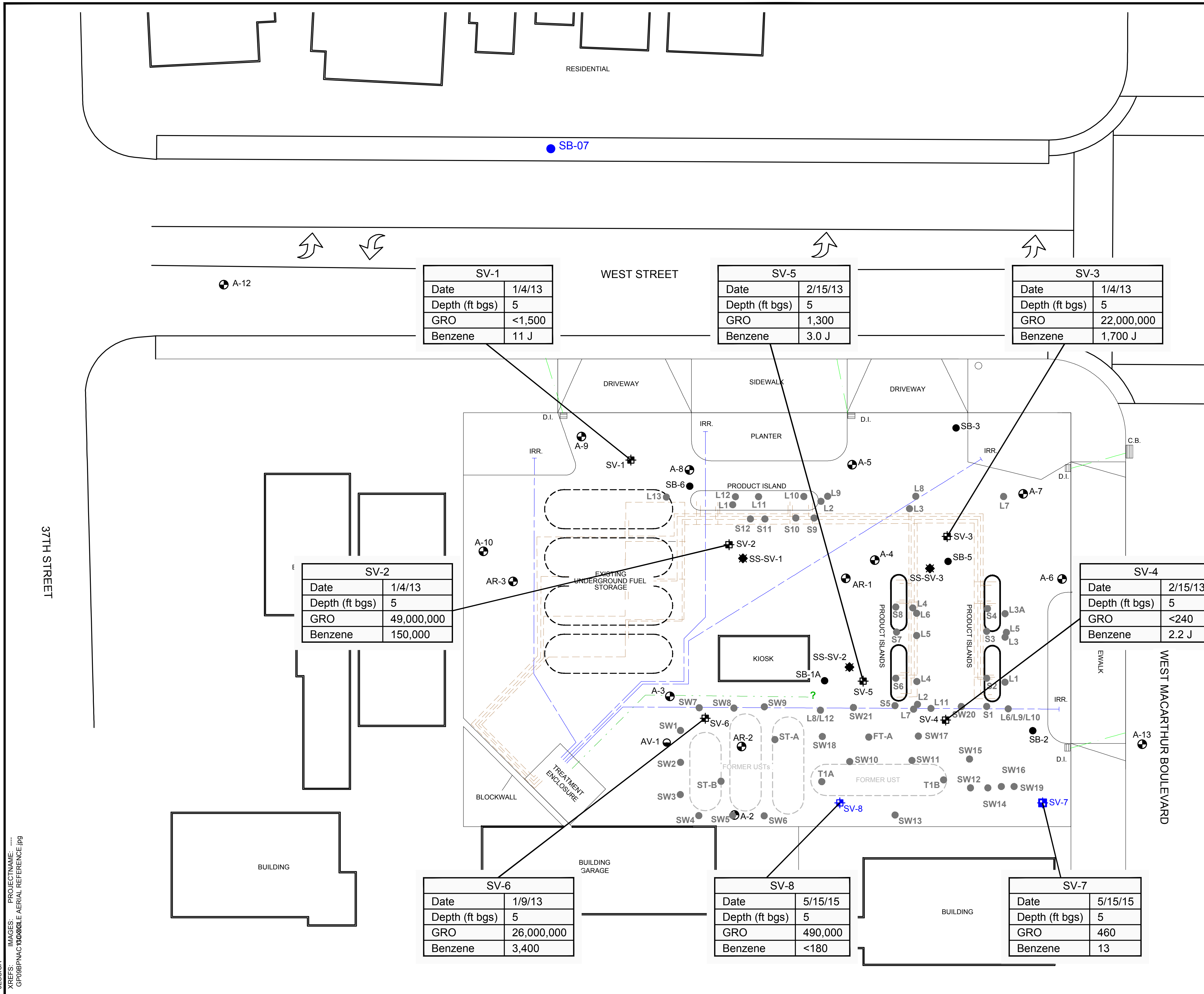
FORMER ARCO STATION No. 4391
731 WEST MACARTHUR BOULEVARD
OAKLAND, CALIFORNIA

SOIL VAPOR OXYGEN CONCENTRATIONS

ARCADIS

FIGURE 2

CITY: EMERYVILLE, CA DIV/GROUP: ENVCAD DB: A. REYES, J. HARRIS
C:\Users\jharris\Desktop\ENVCAD\RETURN-TO\EMERYVILLE, CA\GP09BPNAC110\C0000\DWG\GP09BPNAC110 C01.dwg LAYOUT: 2 SAVED: 9/28/2015 10:59 AM BY: HARRIS, JESSICA
XREFS: IMAGES: PROJECTNAME: ---
GP09BPNAC110-0001E AERIAL REFERENCE.jpg
PLOTTED: 9/28/2015 10:59 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: SETUP1 PLOTSTYLETABLE: ARCADIS.CTB



SV-1	
Date	1/4/13
Depth (ft bgs)	5
GRO	<1,500
Benzene	11 J

SV-5	
Date	2/15/13
Depth (ft bgs)	5
GRO	1,300
Benzene	3.0 J

SV-3	
Date	1/4/13
Depth (ft bgs)	5
GRO	22,000,000
Benzene	1,700 J

SV-2	
Date	1/4/13
Depth (ft bgs)	5
GRO	49,000,000
Benzene	150,000

SV-4	
Date	2/15/13
Depth (ft bgs)	5
GRO	<240
Benzene	2.2 J

SV-6	
Date	1/9/13
Depth (ft bgs)	5
GRO	26,000,000
Benzene	3,400

SV-8	
Date	5/15/15
Depth (ft bgs)	5
GRO	490,000
Benzene	<180

SV-7	
Date	5/15/15
Depth (ft bgs)	5
GRO	460
Benzene	13

LEGEND

- MONITORING WELL
- SOIL BORING (ARCADIS, OCTOBER 2010)
- SOIL SAMPLE LOCATION
- SOIL VAPOR EXTRACTION WELL
- SOIL VAPOR PROBE (ARCADIS, MAY-JUNE 2011)
- SUB-SLAB SOIL VAPOR PROBE (ARCADIS, DECEMBER 2012)
- SOIL VAPOR PROBE (ARCADIS, MAY 2015)
- SOIL BORING PROBE (ARCADIS, MAY 2015)
- PRODUCT/VENT LINE
- WATER
- SANITARY SEWER
- STORM DRAIN

NOTES:

ft bgs = feet below ground surface
GRO = Gasoline Range Organics (C6-C12)
J = Estimated value
< = Analyte not detected above reporting limit

Analytical Method: TO-15 analysis in micrograms per cubic meter (µg/m³), with the exception of SV-7 and SV-8 GRO which utilized TO-3 analytical method.

SITE MAP ADAPTED FROM FIGURES BY OTHERS. ALL FEATURES AND LOCATIONS ARE APPROXIMATE.

0 25' 50'
Approximate Scale: 1 in. = 25 ft.

FORMER ARCO STATION No. 4391
731 WEST MACARTHUR BOULEVARD
OAKLAND, CALIFORNIA

SITE PLAN SHOWING SOIL VAPOR ANALYTICAL RESULTS

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FIGURE
3