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January 20, 2012

Ms. Barbara Jakub
Alameda County Health Agency
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502

RE: Soil Vapor Investigation Work Plan
Former Unocal Service Station 0746
3943 Broadway Avenue
Oakland,California 94611
Fuel Leak Case No.: RO000203

Dear Ms. Jakub,

I declare under penalty of perjury that to the best of my knowledge the information and/or recommendations contained in the attached report is/are true and correct.

If you have any questions or need additional information, please contact me at (925) 790-6270.

Sincerely,

Roya Kambin
Union Oil of California – Project Manager

Attachment
Soil Vapor Investigation Work Plan

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ENVIRONMENTAL

Ms. Barbara Jakub
Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, California 94502

Subject:
Soil Vapor Investigation Work Plan
Former Unocal Service Station 0746
3943 Broadway Avenue
Oakland, California 94611
Case No: RO0000203

Date:
January 20, 2012

Contact:
Katherine Brandt

Phone:
510.596.9675

Email:
Katherine,Brandt@arcadis-us.com

Our ref:
B0047338.2012

Dear Ms. Jakub:

On behalf of Chevron Environmental Management Company, for itself and as Attorney-in-Fact for Union Oil Company of California (hereinafter "EMC"), ARCADIS is submitting the enclosed *Soil Vapor Investigation Work Plan* for the service station No. 0746 located at 3943 Broadway Avenue in Oakland, California (the "Site") (Figure 1). This work plan was prepared at the request of Alameda County Environmental Health (ACEH) in an email to ARCADIS dated January 9, 2012. The proposed scope of work includes installation and sampling of two onsite and two offsite permanent multilevel soil vapor probes. The ultimate goal of the investigation is to collect analytical data that may be used to evaluate the potential for vapor intrusion of subsurface volatile constituents at the Site into adjacent offsite buildings. The Site and surrounding area are shown on **Figure 1**. The results of the soil vapor investigation will be used to support risk-based management decisions for the Site.

This work plan summarizes the proposed soil vapor probe installation; concurrent soil sampling that will be used to support soil vapor intrusion modeling, soil vapor sampling and soil vapor data evaluation. Soil vapor probe installation and sampling will follow the guidelines presented in the California Environmental Protection Agency (CalEPA) *Advisory – Active Soil Gas Investigation* (agency review draft, March 2010).

Site Description

The Site is currently an operating service station located in a mixed commercial and residential area at 3943 Broadway in Oakland, California. Site features currently include two 12,000-gallon double-wall steel gasoline underground storage tanks (UST) in a common pit area, one 520-gallon double-wall steel waste oil UST, a station building including a service bay, a car wash building, and two dispensers islands as shown on **Figure 2**.

Site Geology and Hydrology

The Site is in the East Bay Plain Subbasin of the Santa Clara Valley Groundwater Basin. The Site is underlain by Holocene and Pleistocene-age eolian sand deposits referred to as the Merrit Sand. The Merrit Sand is described as typically consisting of fine grained, very well sorted, well-drained eolian sand, interfingering with Holocene Bay Mud. The sand deposits can extend to a depth of approximately 50 feet below ground surface (bgs) in the Oakland area (U.S. Geological Survey 2000). Soils encountered beneath the Site are predominately alternating layers of silt and clay.

In December 2011, groundwater elevations at the site ranged from 64.91 (MW-11) to 73.19 (MW-6) feet relative with mean sea level (MSL). Depth to water ranges onsite from 6.75 (MW-6) to 14.41 (MW-10) feet below top of casing (TOC). The groundwater flow direction was generally toward the south-southwest with a horizontal hydraulic gradient of 0.033 foot per foot (ft/ft).

Site Background

According to previous site histories, former facilities included two 10,000-gallon USTs and one 280-gallon waste oil UST. All former facilities including USTs and associated product lines were removed and replaced in August 1989 (TRC 2007). The product piping and dispenser islands were replaced in February 1998. Given that the former 10,000-gallon USTs were replaced with larger, 12,000-gallon USTs, approximately 350 cubic yards of soil were removed from the site during removal and installation of the second generation USTs (Kaprealian Engineering, Inc. [KEI] 1989). Constituents tested in the confirmation soil sample collected in the gasoline UST area were reported below laboratory reporting limits (LRLs). Confirmation soil samples collected beneath the product piping area near the waste oil tank contained relatively low levels of petroleum hydrocarbons. However, during tank removal, approximately 6,500 gallons of groundwater was pumped from the UST cavity. Concentrations of

total petroleum hydrocarbons in the gasoline range (TPH-g) and benzene in this groundwater were reported to be 1,200 micrograms per liter (µg/L) and 12 µg/L, respectively (Delta, 2009). Between October 1989 and June 1992, onsite and offsite monitoring wells MW-1 through MW-12 were installed. Recovery well RW-1 was installed onsite during this time after a groundwater recovery test was performed. In 1993, a soil vapor extraction (SVE) pilot test was performed on-site. Based on the low extraction rate, high groundwater levels, and fine-grained soil beneath the Site, SVE was deemed not a feasible remedial option (TRC 2007).

The product piping and dispenser islands were replaced in February 1998. Petroleum hydrocarbons were reported at low to moderate levels in four soil samples collected. Approximately 30 tons of stockpiled soil excavated during the piping and dispenser island replacement was transported from the Site to the Forward Inc. Landfill in Stockton, California (TRC 2007).

Between April 5 and April 8, 2005, a 68-hour dual phase extraction (DPE) test was conducted at the Site. During this test, approximately 30 pounds of hydrocarbons were removed with 6,500 gallons of water (TRC 2007).

A *Sensitive Receptor Survey* was conducted in February 2007 by TRC. The *Sensitive Receptor Survey* identified three wells located within 0.5 miles of the Site (two irrigation and one domestic). The three wells were located between 1,330 and 2,070 feet upgradient and/or crossgradient from the Site. In addition, this report determined that the only surface water body located within 0.5 miles of the Site is Glen Echo Creek, which is located approximately 1,630 feet crossgradient of the Site (Delta 2009).

A soil and groundwater investigation was performed by Delta Consultants (Delta) in August 2009. Historical soil samples collected at wells MW-3 through MW-5 indicated that the highest concentration of TPH-g, benzene, toluene, ethylbenzene, and xylenes (BTEX) were detected at MW-3 at a depth of 11 feet bgs (1,100 mg/kg, 16 mg/kg, 85 mg/kg, 35 mg/kg, and 150 mg/kg, respectively). Therefore, two soil borings, B-1 and B-2, were advanced using cone penetration test (CPT) on-site to determine the vertical extent of petroleum hydrocarbons adjacent to wells MW-3, MW-4, MW-5 and RW-1.

Both B-1 and B-2 were advanced to approximately 35 feet bgs and confirmation soil and grab groundwater samples were collected during CPT advancement. TPH-g, methyl tertiary butyl ether (MTBE), and lead were detected above the LRL in soil

samples collected from B-1. TPH-g, benzene, MTBE, ethylbenzene and xylenes were detected above the LRL in soil samples collected from B-2. The highest concentrations of TPH-g, benzene, MTBE, ethylbenzene and xylenes in soil samples collected were 760 mg/kg, 1.9 mg/kg, 0.0085 mg/kg, 42 mg/kg and 130 mg/kg, respectively. All analytes except for TPH-g (6.1 mg/kg) in the soil sample collected from B-1 were non-detect at 35 feet bgs.

The maximum concentration of TPH-g in groundwater samples collected was from B-2 at 12-15 feet bgs (3,200 µg/L). The highest concentrations of benzene, ethylbenzene, and total xylenes detected in groundwater samples collected from B-2 were 29 µg/L, 83 µg/L and 240 µg/L, respectively. The highest concentration of MTBE and tertiary butyl alcohol (TBA) were 59 µg/L (B-2) and 47 µg/L (B-1), respectively. BTEX compounds were not detected above the LRL in groundwater samples collected from B-1. In general, most of the constituents analyzed had concentrations that decreased with depth.

Groundwater monitoring has been performed on- and off-site at varying sampling frequency (i.e., quarterly/semiannually) since 1989. The most recent groundwater monitoring event occurred during the second quarter 2011. Measurable liquid phase hydrocarbons (LPH) were detected during the most recent monitoring event, approximately 0.21 feet of LPH was detected in MW-5.

Based on characterization data collected during previous investigations, the individual constituents of potential concern (COPCs) in Site media include TPH-g, BTEX, and MTBE and fuel oxygenates.

Soil Vapor Probe Installation

In order to assess the potential for vapor intrusion of volatile constituents into the indoor air of adjacent offsite buildings, ARCADIS proposes to install in two separate investigation phases two onsite (VP-1 and VP-2) and two offsite (VP-3 and VP-4) permanent multilevel soil vapor probes. The onsite soil vapor probes VP-1 and VP-2 will be completed in the first phase of work. VP-1 will be installed to the north north-east of the current used oil tank area and west of monitoring well MW-2. This location is downgradient of the UST complex. Soil vapor probe VP-2 will be installed north-west of monitoring well MW-5 and outside of the onsite trash enclosure. At monitoring well MW-5 measureable LPH had been observed and recovered in the most recent groundwater sampling event in December 2011.

The second phase of the soil vapor investigation will occur after ARCADIS has been granted site access to the offsite properties for the additional soil vapor locations VP-3 and VP-4. The location for offsite soil vapor probe VP-3 is proposed outside the back door area of the Ohgane Korean BBQ Restaurant building southwest of the service station onsite and near MW-8. The soil vapor location VP-4 will be located in the sidewalk area in front of the Ohgane Korean BBQ Restaurant south-west of MW-5.

The proposed locations of vapor probes VP-1 and VP-2 were selected based on historical detections of COPCs detected in groundwater that may be associated with the USTs and dispenser islands toward the north and northeast. The location of vapor probes VP-3 and VP-4 were selected to serve as downgradient points of the general groundwater flow direction of the site. The approximate proposed locations of soil vapor probes VP-1, VP-2, VP-3 and VP-4 are shown on **Figure 2**.

The locations of soil vapor probes VP-1, VP-2, VP-3 and VP-4 are expected to provide data that may be used for assessment of potential vapor intrusion into offsite buildings. The vapor probe locations are subject to change by the field team based on site access and maneuverability issues.

A soil vapor evaluation will not be conducted for current and future onsite workers because the site is an active service station and is expected to remain an active service station in the future. Vapor intrusion assessments for petroleum hydrocarbons should not be conducted to evaluate potential exposures to on-site workers at active service stations. The indoor air quality at these facilities is governed by California Code of Regulations, Title 8, and is covered under Section 5218, Subchapter 7, Section (a)(2)(A):

"The storage, transportation, distribution, dispensing, sale or use of gasoline, motor fuels, or other fuels containing benzene subsequent to their final discharge from bulk wholesale storage facilities, except that operations where gasoline or motor fuels are dispensed for more than 4 hours per day in an indoor location are covered by this section."

As such, gasoline service station workers are considered exempt from occupational exposures. Moreover, employers are required to communicate the hazards associated with petroleum hydrocarbons to employees and to train them in appropriate worker protection techniques.

Pre-Field Activities

Prior to initiation of subsurface activities, several pre-field tasks will be performed. These pre-field tasks will include the following:

- Update the site-specific health and safety plan (HASP);
- Mark the proposed soil vapor probe locations and contact Underground Services Alert (USA) a minimum of 72 hours prior to initiating the field activities;
- Use of the private utility locator to mark the locations of underground utilities in the vicinities of the proposed soil vapor probes;
- Secure the necessary permits from the City of Oakland and County of Alameda for installation of the proposed soil vapor probes; and
- Secure site access agreement from the Ohgane Korean BBQ Restaurant property owner prior to onsite investigation activities.

Construction of Soil Vapor Probes

The proposed soil vapor probes will be installed as permanent multilevel probes. Each vapor probe will contain two soil vapor screens set at depths of 5 and 8 feet bgs. The multiple depth intervals will assist in determining a soil vapor concentration gradient as well as the extent to which biodegradation of volatile COPCs may be occurring. The soil vapor probe depths may be adjusted in the field based on soil properties.

Each soil vapor probe location will be manually cleared to approximately 8 feet bgs with a hand auger. When each respective boring has been advanced to its final depth of approximately 8 feet bgs, a 6-inch long, 0.375-inch outer diameter stainless steel soil vapor screen will be set in a one foot interval of standard sand pack, allowing approximately three-inches of sand above and below the screen. Teflon tubing (or equivalent) will be connected to the soil vapor screen and capped with a vapor-tight 2-way valve or cap at the surface to eliminate the potential for barometric pressure fluctuations to induce vapor transport between the subsurface and the atmosphere. The 2-way valve will be installed in the closed position to allow equilibration of soil vapor concentrations to commence immediately after installation.

A one-foot interval of dry, granular bentonite will be placed above the sand pack followed by hydrated granular bentonite to the depth of the next sample probe. Sand pack is used around the screened interval of each sample probe to allow soil vapor from the adjacent soil to reach the probes. Dry granular bentonite is used to ensure that the hydrated bentonite does not seal the vapor probe screen and inhibit the collection of soil vapor. This process will be repeated for the 5 foot soil vapor screen. The surface of each multilevel probe cluster location will be fitted with a concrete cap and a flush mounted, traffic rated well box with sufficient room to store the tubing lines and valves**.**

Soil Sampling

Soil samples will be collected using a hand-operated slide hammer and undisturbed core sampler for geotechnical analysis for potential use in vapor transport modeling at a depth of approximately 5 and 8 feet bgs at soil vapor probes VP-1, VP-2, VP-3 and VP-4. The geotechnical soil samples will be analyzed for:

- Site specific physical properties such as soil dry bulk density, grain density, and soil moisture content; and
- Soil grain size distribution to interpret the moisture content data and soil type.

CalEPA recommended analytical methods will be used for these parameters as follows:

- Dry bulk soil density — ASTM D2937
- Grain density — ASTMD854
- Soil moisture — ASTM D2216
- Grain size Distribution (Sieve Method) — ASTM D422

Results from grain density and dry bulk soil density will be used to calculate total soil porosity.

Additionally, soil samples will be collected from a hand auger at each proposed soil vapor probe location at 2-foot intervals during borehole clearance. The collected intervals will be screened in the field using a photoionization detector (PID), and will

be described by the supervising geologist using visual and manual methods of the Unified Soil Classification System (USCS).

Soil Vapor Sampling

Due to the introduction of atmospheric oxygen into the vadose zone during soil vapor probe installation, an equilibration time is required to allow the sand pack and tubing to equilibrate with the subsurface. A minimum of 48 hours will be allowed for equilibration before purging and sampling of the soil vapor probes.

Purging will consist of removing approximately three volumes of stagnant soil vapor at a flow rate of • 200 milliliters per minute (mL/min). The purge volume will be calculated based on the dimensions of the above-ground gauges, tubing, sampling equipment, below-ground tubing and soil vapor probe. Purge volume calculation, field conditions, flow rate, pump specifics and other applicable information will be recorded by field personnel on soil vapor sample collection logs.

A leak test will be conducted to ensure the integrity of the sampling system. The well head and entire sampling train (valves, tubing, gauges, manifold and sample canister) will be placed in an enclosure with pliable weather stripping along the base. A tracer check compound (laboratory grade helium) will be permitted into the enclosure. Approximately 10 percent (%) helium will be maintained in the enclosure using a portable helium detector. Analysis for the tracer compound in the soil vapor sample will be used to assess if leakage occurred. The soil vapor samples will then be collected using 1-Liter batch certified SUMMA™ canisters (or an acceptable alternative) at a flow rate of • 200 mL/min. A vacuum of <10 inches of mercury (inHg) will be maintained throughout sampling. Soil vapor sampling will be stopped when the canister vacuum has dropped to no less than 5 inHg.

A duplicate sample collected in-line with its respective parent sample for each day of sampling and an equipment blank sample collected using a laboratory supplied air source will also be submitted to the laboratory for quality assurance purposes.

The soil vapor samples will be shipped under appropriate chain of custody protocols to Air Toxics Ltd. in Folsom, California for analysis of the following:

- TPH-G, BTEX, MTBE, TBA, diisopropyl ether (DIPE), ethyl teriary butyl ether (ETBE), tertiary amyl methyl ether (TAME), 1,2 - dichloroethane (1,2-DCA),

ethylene dibromide (EDB) and naphthalene by Modified USEPA Method TO-15; and

- Fixed gases, including oxygen, carbon dioxide, methane and helium by Modified American Society for Testing and Materials Method D-1946.

Management of Investigation-Derived Waste (IDW)

Soil cuttings and decontamination water from vapor probe installation will be temporarily stored on-site in properly labeled Department of Transportation approved 55-gallon steel drums pending waste profiling results. IDW will then be transported by Chevron EMC's disposal contractor to an appropriate disposal or treatment facility following waster characterization.

Soil Vapor Data Evaluation

Detected concentrations of constituents in soil vapor will be compared to health-based screening criteria. These screening criteria define levels that the regulatory agencies have deemed safe for human exposure under a vapor intrusion scenario. Soil vapor data collected from onsite probes will be compared to commercial/industrial and residential screening criteria to support risk-based decision making for the Site.

Soil vapor data will be compared with the CalEPA California Human Health Screening Levels (CHHSLs) based on potential vapor intrusion concerns presented in the 2005 *Use of CHHSLs in the Evaluation of Contaminated Properties*. Constituent soil vapor data will also be compared with the San Francisco Regional Water Quality Control Board (SFRWQCB) Environmental Screening Levels (ESLs) presented in the 2008 *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater*. If constituent concentrations in soil vapor exceed respective screening levels, then vapor intrusion of these constituents will be re-evaluated using DTSC's version of the Johnson and Ettinger-based vapor intrusion model incorporating site-specific soil properties analyzed during the investigation. Based on refined risk evaluation, if soil gas constituent concentrations result in estimated risks exceeding the USEPA and CalEPA established acceptable target risk range from one in one-million to one in ten-thousand (1×10^{-6} to 1×10^{-4}), then the need for additional vapor intrusion investigation at the Site will be considered.

It is recognized that petroleum hydrocarbon vapors rapidly biodegrade in the soil column when sufficient oxygen is present. Aerobic biodegradation consumes oxygen and generates carbon dioxide. Comparison of fixed gas concentrations relative to atmospheric levels will be discussed as a qualitative evaluation of the degree to which hydrocarbon vapors may be biodegrading at the Site.

Reporting

Following completion of the investigation, a technical report will be prepared and submitted to the ACEH. This report will document the results of the soil vapor investigation and will include the following:

- Site conditions and background information,
- A scaled site plan illustration soil vapor probe locations and other relevant site features,
- Documentation of soil vapor sampling and the collection of soil samples,
- Results of the laboratory analyses performed on the soil vapor samples,
- Comparison between the soil vapor data and human health risk-based screening levels,
- Qualitative evaluation of petroleum hydrocarbon biodegradation, and
- Conclusions and recommendations relevant to the investigation objectives.

Proposed Work Schedule

ARCADIS will initiate the pre-field activities upon receipt of work plan approval from the ACEH. The technical report will be submitted following receipt of the final laboratory reports.

If you have any questions or comments regarding the contents of this report, please contact David Lay of ARCADIS at 916.985.2079, extension 22 or by e-mail at David.Lay@arcadis-us.com or Katherine Brandt of ARCADIS at 510.596.9675or by e-mail at Katherine.Brandt@arcadis-us.com.

Sincerely,

ARCADIS U.S., Inc.

Katherine Brandt
Certified Project Manager

David W. Lay, P.G., C.P.G.
Principal Geologist

Enclosures:

Figure 1 Site Location Map
Figure 2 Proposed Soil Vapor Locations

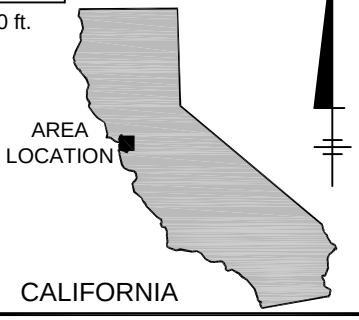
Copies:

Ms. Roya Kambin, EMC
Mr. Clement K Leung – CJS Leung, LLC, 3943 Broadway, Oakland, California 94611-5615
Ms. Cherie McCaulou, CRWQCB – San Francisco Bay Region, 1515 Clay Street, Suite 1400, Oakland, California 94612 (CD)

REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. QUAD., OAKLAND WEST, CALIFORNIA, 1993, AND OAKLAND EAST, CALIFORNIA, 1997.

0 2000' 4000'

Approximate Scale: 1 in. = 2000 ft.

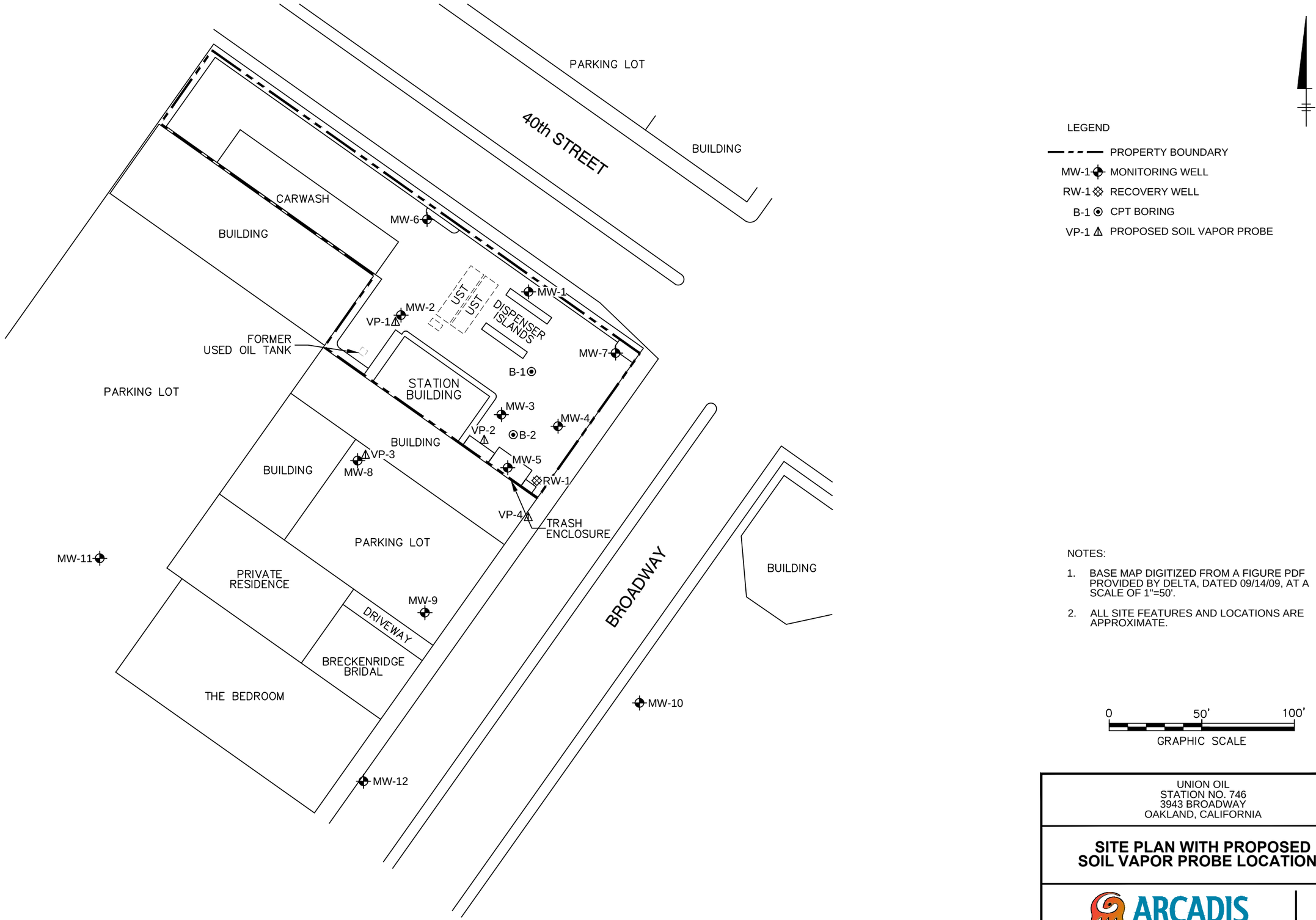


UNION OIL
STATION NO. 746
3943 BROADWAY
OAKLAND, CALIFORNIA

SITE LOCATION MAP

ARCADIS

FIGURE
1



LEGEND

- PROPERTY BOUNDARY
- MW-1 MONITORING WELL
- RW-1 RECOVERY WELL
- B-1 CPT BORING
- VP-1 PROPOSED SOIL VAPOR PROBE

NOTES:

1. BASE MAP DIGITIZED FROM A FIGURE PDF PROVIDED BY DELTA, DATED 09/14/09, AT A SCALE OF 1"=50'.
2. ALL SITE FEATURES AND LOCATIONS ARE APPROXIMATE.

0 50' 100'

GRAPHIC SCALE

UNION OIL
STATION NO. 746
3943 BROADWAY
OAKLAND, CALIFORNIA

SITE PLAN WITH PROPOSED SOIL VAPOR PROBE LOCATIONS

ARCADIS

FIGURE 2