Atlantic Richfield Company
(a BP affiliated company)

P.O. Box 1257
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9 January 2009

Re: Dual-Phase Extraction Pilot Testing and
Soil & Ground-Water Investigation Work Plan
Former BP Station # 11132
3201 35th Avenue
Oakland, California
ACEH Case #RO0000014

"I declare, that to the best of my knowledge at the present time, that the information and/or recommendations contained in the attached document are true and correct."

Submitted by:

Paul Supple
Environmental Business Manger

Dual-Phase Extraction Pilot Testing and
Soil & Ground-Water Investigation Work Plan
Former BP Station No. 11132
3201 35th Avenue, Oakland, California
ACEHS Case No. RO0000014

Prepared for

Mr. Paul Supple
Environmental Business Manager
Atlantic Richfield Company
P.O. Box 1257
San Ramon, California 94583

Prepared by

BROADBENT & ASSOCIATES, INC.
ENGINEERING, WATER RESOURCES & ENVIRONMENTAL

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9 January 2009

Project No. 06-08-610

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BROADBENT & ASSOCIATES, INC
ENVIRONMENTAL, WATER RESOURCES & ENGINEERING

9 January ~~2008~~ 2009

Project No. 06-08-610

Atlantic Richfield Company
P.O. Box 1257
San Ramon, CA 94583
Submitted via ENFOS

Attn.: Mr. Paul Supple

Re: Dual-Phase Extraction Pilot Testing and Soil & Ground-Water Investigation Work Plan, Former BP Station No.11132, 3201 35th Avenue, Oakland, California; ACEH Case No.RO0000014

Dear Mr. Supple:

Broadbent & Associates, Inc. (BAI) is pleased to present this Dual-Phase Extraction Pilot Testing and Soil & Ground-Water Investigation Work Plan for the Former BP Station No. 11132, located at 3201 35th Avenue, Oakland, California (Site). BAI prepared this work plan in response to the 16 October 2008 letter request from Mr. Paresh Khatri of Alameda County Environmental Health Services (ACEH). This work plan includes the proposed scope of work for vapor intrusion assessment and dual-phase extraction pilot testing with a proposed completion schedule.

Should you have questions or require additional information, please do not hesitate to contact us at (530) 566-1400.

Sincerely,
BROADBENT & ASSOCIATES, INC.

Thomas A. Venus, P.E.
Senior Engineer

Robert H. Miller, P.G., C.HG.
Principal Hydrogeologist

PROFESSIONAL GEOLOGIST
ROBERT H. MILLER
No. 561
CERTIFIED HYDROGEOLOGIST
exp. 4-30-10
STATE OF CALIFORNIA

Enclosures

cc: Mr. Paresh Khatri, Alameda County Environmental Health (Submitted via ACEH ftp site)
Ms. Shelby Lathrop, Conoco Phillips, 76 Broadway, Sacramento, CA 95818
Electronic copy uploaded to GeoTracker

DUAL-PHASE EXTRACTION PILOT TESTING AND
SOIL & GROUND-WATER INVESTIGATION WORK PLAN
Former BP Station No. 11132
3201 35th Avenue, Oakland, California
ACEH Fuel Leak Case No. RO000014

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DUAL-PHASE EXTRACTION PILOT TESTING AND
SOIL & GROUND-WATER INVESTIGATION WORK PLAN
Former BP Station No. 11132
3201 35th Avenue, Oakland, California
ACEH Fuel Leak Case No. RO000014

1.0 INTRODUCTION

Broadbent & Associates, Inc. (BAI) has prepared this Dual-Phase Extraction Pilot Testing and Soil & Ground-Water Investigation Work Plan for the Former BP Station No. 11132, located at 3201 35th Avenue, Oakland, California (Site). This work plan was prepared in response to the 16 October 2008 letter request from Mr. Paresh Khatri of Alameda County Environmental Health Services (ACEH). It has also been prepared for the benefit of Stratus Environmental, Inc. (Stratus), who will be performing the scope of work provided herein, under the direction of BAI.

This work plan includes the proposed scope of work for vapor intrusion assessment and dual-phase extraction (DPE) pilot testing and a completion schedule. Vapor intrusion assessment is to be performed in the source area to determine if the indoor air migration pathway is a complete and viable exposure scenario for employees in the station building. The potential for vapor intrusion from the downgradient ground-water contamination plume area is also assessed to determine if the indoor air migration pathway is a complete and viable exposure scenario for offsite residents. Finally, pilot testing activities are to be performed to assist with evaluation of DPE as a viable remedial method to address soil and ground-water contamination at the Site.

2.0 SITE BACKGROUND

The Site is currently an active 76-brand gasoline retail outlet located on the northeast corner of 35th Avenue and Suter Street, southwest of Interstate 580, in Oakland. A Site Location Map is provided as Drawing 1 following the text conclusion. The Site has operated as a gasoline service station since at least the early 1970's. It was acquired in 1989 from Mobil Oil Company by BP and operated under the BP brand. BP sold the station in 1994 to Tosco, which was acquired by Conoco Phillips who now operates the 76-branded station. The original underground storage tank (UST) system release was reported on 15 April 1986, following a failed UST integrity test on 5 March 1986. The ACEH-assigned Fuel Leak Case No. is RO0000014 / GeoTracker Global ID No. T0600100213.

The Site is located in a mixed commercial and residential area. A Quik Stop convenience/ gasoline station is located at 3130 35th Avenue across the street approximately 150 feet to the southwest of the Site. Two former gasoline service stations are located slightly further west of the Site along 35th Avenue: A former Texaco-branded gasoline service station on the northeast corner of 35th Avenue and School Street, now operated as Tito's Car Washing & Detail Shop at 3101 35th Avenue; and a former Exxon-branded gasoline service station on the northwest corner of 35th Avenue and School Street but presently a vacant lot. The former Exxon station is an active leaking UST case, ACEH Fuel Leak Case No. RO0000271 / GeoTracker Global ID No. T0600100538. An Area Development Photo is provided as Drawing 2.

A substantial summary of previous environmental investigations with Site characterization, local and area geology and hydrogeology, remediation status, and preliminary Site conceptual exposure model was recently submitted in the Site Conceptual Model with Feasibility Study Report (BAI, 21 July 2008).

3.0 VAPOR INTRUSION ASSESSMENT

3.1 Source Area Indoor Air Migration Pathway Assessment

In his letter dated 16 October 2008, Mr. Paresh Khatri thought it conceivable that the ground-water contaminant plume (which included separate phase hydrocarbons – SPH) and the soil "smear zone" beneath the building might pose a potential contaminant volatilization to indoor air exposure risk onsite. In addition, the installation report for well MW-1(located adjacent to the Station Building) reportedly referenced finding petroleum-contaminated soil in the vadose zone. However, a copy of this report was unable to be reviewed as it is absent from the file record (KEI, 1986). BAI proposes to perform a vapor intrusion assessment using active subsurface soil gas sampling in the vicinity of the Station Building. Two soil gas borings locations are proposed on the south side of the Station Building. The first soil gas boring location (SG-1) will be located roughly halfway between well MW-1 and the southwest corner of the Station building. Extra precaution will need to be exercised here as the natural gas service to the building and the UST vent risers are located at this corner, on the west side of the Station Building. The second soil gas boring location (SG-2) will be located approximately 10 to 15 feet to the east of SG-1. Both SG-1 and SG-2 will be at least five feet away from well MW-1 to prevent short-circuiting when under vacuum, and at least five feet away from the Station Building. The soil gas boring locations are presented in Drawing 3.

The proposed soil gas investigation methodology is consistent with the guidelines published by the California Regional Water Quality Control Board – Los Angeles Region (LARWQCB) in the 25 February 1997 *Interim Guidance for Active Soil Gas Investigation*, the Department of Toxic Substances Control (DTSC) and LARWQCB 28 January 2003 *Advisory – Active Soil Gas Investigations*, and the American Petroleum Institute's (API) November 2005 Publication No. 4741 – *Collecting and Interpreting Soil Gas Samples from the Vadose Zone*. In accordance with this guidance, soil gas sampling should not be performed during or immediately after a rainfall event of 0.5 inches or more. If a rainfall event of this magnitude occurs within 24 hours of the scheduled soil gas sampling activities, the field work shall be rescheduled.

The near surface soils at the Site generally consist of silty clays or clayey silts with varying amounts of sand and gravel, extending from the ground surface to at least the water table, measured at approximately 21 to 22 feet below ground surface (ft bgs) in MW-1 within the last twelve months.

The soil gas borings will be advanced using the direct push method. Each soil gas boring location will have several depth-discrete samples collected at specific intervals to prepare a soil gas profile for the location: Targeted depth-discrete sample collection depths will be 7 ft bgs, 10 ft bgs, 15 ft bgs, and 20 ft bgs. Sample identification numbers will be a combination of the soil gas boring location followed by the depth (e.g., SG-2-20 would be the 20 ft bgs sample from SG-2). The soil gas sampling probe will be pushed to the target depth and the sampling line tubing will be installed with a vapor tight valve. Hydrated bentonite will then be placed around the drive rod at the ground surface to prevent ambient air intrusion. A minimum of 20 minutes will pass after the bentonite is placed and prior to purging to allow the subsurface conditions to equilibrate and the bentonite to adequately cure and seal the annular space.

A 1-liter Summa® canister will be collected at each targeted sampling depth for analysis by an off-site laboratory. The Summa® canisters will be shipped to the laboratory under high vacuum, leak checked, and batch certified to be free of contaminants.

The initial canister vacuum will be measured before use and should be approximately 30 inches of Mercury (in.Hg). If the initial vacuum is less than 28 in.Hg, the affected canisters will not be used. A purge canister will be used to purge the sampling train (sampling point and tubing) a minimum of three volumes prior to sample collection. Swagelock fittings will be used to connect the canisters to the tubing (Teflon or NylaFlow, not Tygon). Once the purge canister is connected to the tubing, the sample train will be checked for leaks by applying a vacuum for a minimum of 10 minutes. If the pressure in the canister does not drop, this indicates the sample train is not leaking. Once the leak test is complete, the in-line valve will be closed and the sample canister connected to the tubing. The in-line valve will then be opened and the sample collected. The sample flow rate will not exceed 200 milliliters per minute (mL/minute) as measured by a flow regulator. Samples will be collected until the pressure in the canisters reach approximately 5 in.Hg or 30 minutes has elapsed. If low-flow or no-flow conditions are encountered, a soil matrix sample will be collected and analyzed using EPA Method 5035A. A measurement with a photo-ionization detector (PID) will also be collected from each sampling point following sample collection.

A leak test will be performed as a further check to make sure significant ambient air is not leaking into the sample train. Prior to sample collection, a leak test compound (e.g., Helium) will be applied and temporarily secured at locations where ambient air could enter the sampling system including sample system connections, the surface bentonite seal, and the top of the drill rod. The leak test compound will be included in the laboratory analysis. A single duplicate sample will be collected per field day of work from a sample point likely to have been impacted by petroleum hydrocarbons. The duplicate sample will serve as a means to validate the sample collection methods and laboratory analytical data. Soil gas samples will not be chilled. In addition, one ambient air sample will be collected outside the Station Building entrance door using a Summa® canister. This sample will also be submitted to the off-site laboratory to compare soil gas analytical results with ambient air results.

Collected samples will be submitted promptly under chain-of-custody protocol to Calscience Environmental Laboratories, Inc. in Garden Grove, California (CA-ELAP #1230, NELAP #03220CA). Soil gas samples will be analyzed for Gasoline Range Organics (GRO), Benzene, Toluene, Ethylbenzene, and Total Xylenes (BTEX), Methyl Tertiary Butyl Ether (MTBE), Ethanol, Tertiary Butyl Alcohol (TBA), Di-Isopropyl Ether (DIPE), Ethyl Tertiary Butyl Ether (ETBE), and Tertiary Amyl Methyl Ether (TAME) by EPA Method TO-15. Soil gas samples will also be analyzed for Oxygen (O_2), Carbon Dioxide (CO_2), Methane (CH_4), and the leak check compound. Laboratory analyses for soil gas samples will be performed in accordance with the EPA standard holding times for Summa® canisters.

The drive rods, screens, and other reusable components will be properly decontaminated to minimize the potential for cross-contamination between temporary soil gas sampling points. As outlined in the DTSC/LARWQCB and API guidance documents, these methods will include three-stage wash and rinse (i.e., wash equipment with a non-phosphate detergent, rinse with potable water, and a final rinse with distilled water) and/or steam cleaning.

3.2 Distal Plume Area Indoor Air Migration Pathway Assessment

The US EPA's draft guidance *Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (Office of Solid Waste and Emergency Response – OSWER, 2002) uses the Johnson-Ettinger model (1991) to calculate ground-water screening levels for the vapor-intrusion pathway that are expected to be protective of overlying receptors. The guide also presented conservative shallow and deep soil-gas concentrations that are expected to be equally protective (Table 2C, EPA, 2002). However, the EPA recognized that the Johnson-Ettinger model often predicted that the vapor-intrusion pathway was complete when it was not, because the model did not account for biodegradation, which is more prevalent for petroleum hydrocarbon contaminant cases but less so for halogenated solvent contaminant cases.

Significant subsequent research has indicated that substantial attenuation occurs when accompanied by predictable signature characteristics of vapor biodegradation. These are specifically the presence of clean overlying soil with oxygen content above three to five percent and a separation distance dependent upon soil type but of at least five feet for coarse-grained soils and as little as two feet for fine-grained soils (EPA 2008; Davis, 2006; Davis 2005; Ririe et al, 2002; Roggemans et al, 2001). A recommended ten to 100-fold increase in attenuation factor to the EPA 2002 OWSER guide was observed 98 percent of the time in 102 Benzene cases and 92 percent of the time in 71 Total Petroleum Hydrocarbon (TPH) cases (Davis 2005, Davis 2006). These recent findings push the Johnson-Ettinger model's predicted ground-water concentration screening levels in fine-grained soil for Benzene at 10 ft bgs from 32.3 micro-grams per liter (µg/L) to 3,230 µg/L, and for TPH at 10 ft bgs from 1,060 µg/L to 106,000 µg/L. However, it must be noted that this increase in the attenuation factors was valid for sites with clean overlying soil, but included cases with SPH in ground water.

These screening levels should be considered for the offsite residences around Station No.11132, i.e. where clean soil overlying impacted ground water is present off-site. The nearest residences in the offsite downgradient direction from Station No.11132 are those across or on the south side of 35th Avenue, specifically those between Suter Street and Mangels Avenue (with given addresses of 3202, 3210, and 3214 35th Avenue), and across or on the west side of Suter Street (with given addresses of 3123 and 3125 35th Avenue). As exhibited in Drawing 3, well MW-10 is located in front of 3202, 3210, and 3214 35th Avenue, while well MW-8 is located in close proximity to 3123 and 3125 35th Avenue. Recent concentrations (within the last three years) of TPH (GRO) in well MW-10 have been as high as 40,000 µg/L with Benzene up to 1,500 µg/L. Recent concentrations (within the last three years) of TPH (GRO) in well MW-8 have been as high as 40,000 µg/L with Benzene up to 1,100 µg/L. These concentrations are below the screening level concentrations discussed above. In addition, the depth to water below the measuring points in these wells substantially exceeds 10 feet, usually over 15 to 20 feet. The "clean overlying soil" scenario may be used as soil sampling during installation of wells MW-8 and MW-10 did not detect petroleum hydrocarbons in the vadose zone. And lastly, the offsite residential buildings identified above appear from the street to be built on raised-perimeter foundations, without subsurface basements that would lessen the separation distances. Therefore, the vapor intrusion to indoor air migration pathway into the neighboring offsite residences does not appear to be a valid and complete pathway.

4.0 DUAL-PHASE EXTRACTION PILOT TESTING

4.1 Description of DPE Pilot Testing Activities

A DPE unit with a liquid-ring pump and a thermal oxidizer will be mobilized to the Site to facilitate pilot testing activities. Air and water will be extracted from selected recovery wells using an approximate one-inch diameter stinger lowered into each well. Extracted ground water and soil vapors will be directed to a water knockout tank. Processor air will be treated by the thermal oxidizer prior to discharge while ground water will be transferred to an on-site holding tank, temporarily accumulated, until transportation for disposal/treatment at an appropriate facility. Based on historical ground-water contaminant concentrations and location relative to the former UST complex, pilot testing activities will be performed on wells RW-1, MW-1, MW-2, MW-8, MW-9, and MW-10. Pilot testing activities will include individual well step tests, individual well constant rate tests, followed by a combined multiple well evaluation test.

The stinger depth in each well will be set at approximately two feet below static ground-water levels for testing activities. It is expected that the depth of the stinger will be adjusted during each extraction in order to maximize recovery of soil vapors. Once ground water has been dewatered to the end of the stinger, the applied vacuum will be incrementally increased as a means to evaluate the optimal extraction rate (maximum air flow rate) during the step test. A PID will be used to record concentrations of recovered vapors during the step test. A step test is not anticipated to exceed six hours in duration consisting of various applied vacuum for one to two hour periods. After the optimum extraction flow rate from the step test has been determined, an up to 12 hour constant rate DPE pilot test will be performed on the extraction well to observe influence, if any, in adjacent observation wells, and to observe the sustainability of recovered hydrocarbon vapors.

Individual well DPE testing (step and constant) is not expected to exceed 12 hours for each well. This is also dependent upon ability to run the test equipment prior to 7 a.m. or after 7 p.m. However, individual extractions may be terminated early based on observed conditions and decreased vapor extraction recovery rates. If hourly OVA readings decrease to values below 250 parts per million volume (ppmv) and adjustment of the stinger depth does not influence OVA readings for two to three continuous hours, the individual DPE constant rate extraction may be terminated after notification and discussion with BAI.

After individual well DPE testing activities have been completed, a multiple well DPE step and constant rate test using a combination of the three on-site test wells will be performed (RW-1, MW-1, and MW-2). Accordingly, it is requested that additional supplies be available at the Site to accommodate a multiple extraction event (e.g., stingers and hoses). The multiple well extraction pilot test will be performed following the same protocol as the individual DPE pilot tests conducted on wells RW-1, MW-1, MW-2, MW-8, MW-9, and MW-10, and shall not exceed 12 hours in duration.

Pilot testing activities are not expected to exceed seven work days in duration. Early termination (i.e., prior to five days) of this DPE pilot test may be warranted based on field observations and decreased recovery rates, however it is requested that BAI personnel be contacted prior to early termination of the DPE testing.

4.2 Vapor and Ground-Water Sample Collection

Vapor and ground-water samples will be collected after the first hour and every three to four hours after the initial hour of operation during each constant rate extraction. For example, if an extraction is performed for 12 hours, samples will be collected at one hour, three hours, six hours, nine hours, and twelve hours. Not all collected samples will be submitted for analysis. It is anticipated that a minimum of three vapor and three ground-water samples will be submitted for laboratory analysis for that test. Submitted samples will likely include the one hour sample, an approximate mid-point sample, and the approximate end-point sample of each extraction.

Collected samples will be submitted promptly under chain-of-custody protocol to Calscience Environmental Laboratories, Inc. in Garden Grove, California (CA-ELAP #1230, NELAP #03220CA). Submitted samples will be analyzed for GRO by EPA Method 8015M and BTEX and MTBE by EPA Method 8260B. Ground-water samples will also be analyzed for TBA, DIPE, ETBE, TAME and Ethanol by EPA Method 8260B.

4.3 Background Conditions and Observation Well Monitoring

Prior to initiating each DPE extraction, background depth to water level measurements will be recorded for each well associated with the Site, and the hour meter on the DPE equipment will be recorded. Field personnel will record the DPE equipment hour meter reading, applied vacuum, air flow, totalizer reading, and collect a PID reading of recovered vapors on an hourly basis during each DPE step and constant rate test.

Remaining wells associated with the Site will be used as observation wells during step and constant rate extraction tests. Periodic monitoring activities in surrounding observation wells will include determining if vacuum influence is observed using Magnehelic gauges (with appropriate sensitivity) installed on each observation well head for the duration of an extraction in addition to recording the depth to ground water. Periodic monitoring activities on observation wells should be conducted on an hourly basis during testing activities.

5.0 PRE-MOBILIZATION ACTIVITIES

Prior to initiating field activities, Stratus will obtain the necessary permits from Alameda County; prepare a site health and safety plan (HASP) for the proposed work; clear the Site for subsurface utilities; and provide 72-hour advance written notification(s) to ACEH (email preferred to paresh.khatri@acgov.org) and BAI (email tvenus@broadbentinc.com or mobile phone 530-588-5887) prior to the start of field activities. The utility clearance will include notifying Underground Service Alert (USA) of the pending work a minimum of 48 hours prior to initiating the subsurface field investigation. In addition, the services of a private underground utility locator will be utilized with soil gas boring locations cleared by hand auger to five ft bgs.

The Site-specific HASP will be prepared for use by personnel implementing the work plan. The HASP will address the proposed soil-gas boring and DPE pilot testing scope of work. A copy of the HASP will be available on-site during work. The subcontractor(s) performing field activities will be provided with a copy of the HASP prior to initiating work. A safety tailgate meeting will also be conducted daily to review the Site hazards and work scope.

6.0 DOCUMENTATION AND REPORTING

Upon completion of the work activities described above and after receipt of laboratory analytical data, it is expected that Stratus will submit a data package including the following information at a minimum:

- Brief descriptions of the work performed;
- Copies of the required permits;
- Copies of all field notes;
- Tabulated results and measurements; and
- Laboratory analytical reports with copies of chain-of-custody records.

BAI shall use the data and information provided above to prepare a DPE Feasibility Study Results with Soil Gas Investigation Report.

7.0 PROPOSED SCHEDULE

The schedule for the above-noted work shall proceed as follows:

- Implement Soil Gas Investigation – Upon approval of this work plan and obtaining the necessary permits.
- Implement DPE Pilot Testing – Upon approval of this work plan and obtaining the necessary permits.
- Submittal of DPE Feasibility Study Results and Soil Gas Investigation Report – Within 60 days after receipt of data package following completion of fieldwork.

8.0 CLOSURE

Discovery of hazardous or regulated materials constitutes a changed condition mandating a renegotiation of the scope of work described herein or termination of services. BAI will endeavor to alert the client of matters which, in the opinion of BAI, require immediate attention to protect the public health, safety, and environment. BAI will endeavor to advise the client of matters which should be reported to proper governmental entities. However, the client is solely responsible for reporting such matters and BAI shall not be held liable in the event the proper agency is not notified. Our services will be performed in accordance with the generally accepted practice at the time work commences. Results and recommendations will be based on laboratory results, observations of Stratus field personnel, and the points investigated. No other warranty, expressed on implied was made. This report has been prepared for the exclusive use of Atlantic Richfield Company.

9.0 REFERENCES

ACEH, 16 October 2008. *Fuel Leak Case No. RO0000014 and Geotracker Global ID T0600100213, BP #11132, 3201 35th Avenue, Oakland, CA 94619.* Submitted by Mr. Paresh Khatri to Messrs. Paul Supple for Atlantic Richfield company, Terry Grayson for Conoco Phillips, and Rajinder S. & Sukhvinder Sull of Union City.

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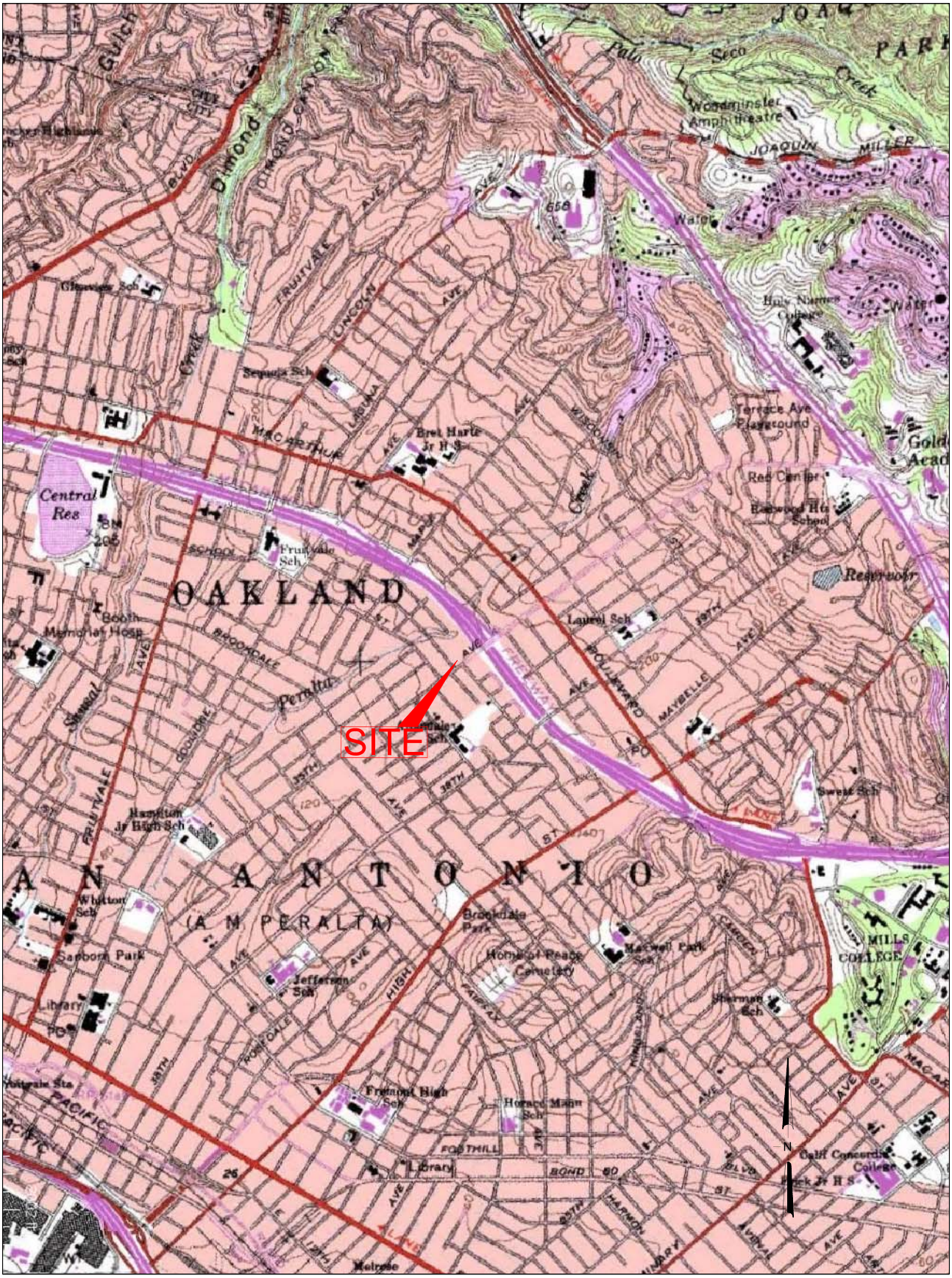

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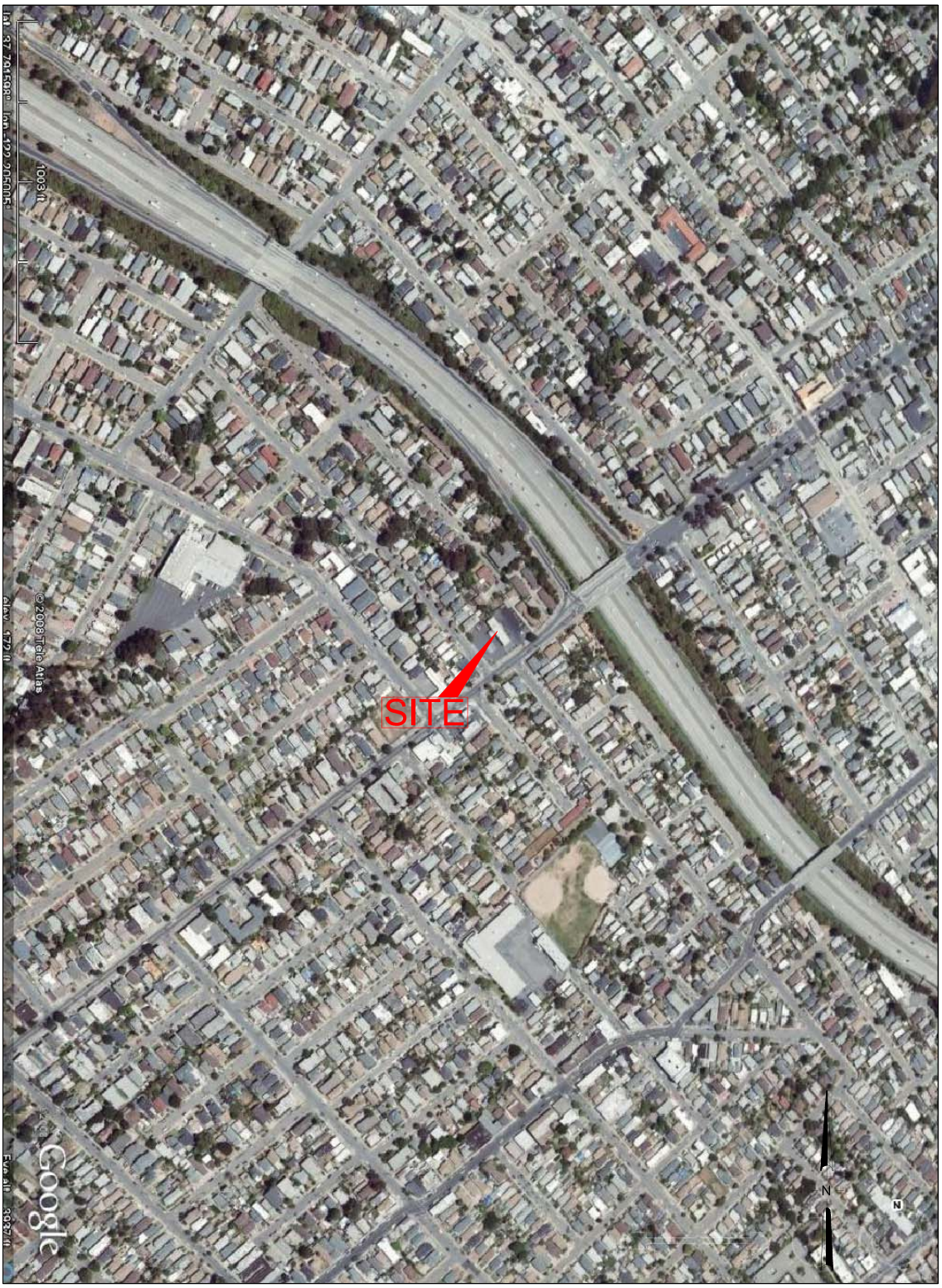
SCALE (feet)

BROADBENT & ASSOCIATES, INC.
ENGINEERING, WATER RESOURCES & ENVIRONMENTAL
1324 Mangrove Ave. Suite 212, Chico, California
Project No.: 06-08-655 Date: 01/07/09

Former BP Service Station #11132
3201 35th Avenue
Oakland, California

Site Location Map

Drawing
1



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BROADBENT & ASSOCIATES, INC.
ENGINEERING, WATER RESOURCES & ENVIRONMENTAL
1324 Mangrove Ave. Suite 212, Chico, California
Project No.: 06-08-655 Date: 01/07/09

Former BP Service Station #11132
3201 35th Avenue
Oakland, California

Area Development Photo

Drawing
2

NOTES: 1. SITE MAP ADAPTED FROM CAMBRIA ENVIRONMENTAL FIGURES. SITE DIMENSIONS AND FIGURES FACILITY LOCATIONS NOT VERIFIED.
2. WELL MW-7 AND SUTER STREET LOCATIONS HAVE BEEN CORRECTED FROM PREVIOUS MAPS.

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SCALE (ft)

BROADBENT & ASSOCIATES, INC.
ENGINEERING, WATER RESOURCES & ENVIRONMENTAL
1324 Mangrove Ave. Suite 212, Chico, California 95926
Project No.: 06-08-655 Date: 1/8/08

Former BP Service Station #11132
3201 35th Avenue
Oakland, California

Site Layout Plan with
Proposed Soil Gas Boring Locations

Drawing
3