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Alameda County
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August 3, 2011

Paresh Khatri
Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, California 94502-6577

Re: **Work Plan Submittal**
Remedial Action Investigation Work Plan
76 (Former BP) Service Station No. 2611117
7210 Bancroft Avenue
Oakland, California

Dear Mr. Khatri,

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 call me at (408) 826-1874.

Sincerely,

Douglas K. Umland, P.G.
Senior Project Manager

Enc: Antea Group, *Remedial Action Investigation Work Plan*, dated August 3, 2011.

Remedial Action Investigation Work Plan

76 (Former BP) Service Station No. 11117
7210 Bancroft Avenue
Oakland, California

Alameda County Environmental Health Case No. RO0000356
San Francisco Bay Region Quality Control Board Case No. 01-0215

Antea Group Project No. I42611117
August 3, 2011

Prepared for:
Mr. Paresh Khatri
Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, California 94502-6577

Prepared by:
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Inogen Environmental Alliance

Antea USA, Inc.

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Remedial Action Investigation Work Plan

76 (Former BP) Service Station No. 11117
7210 Bancroft Avenue
Oakland, California

1.0 INTRODUCTION

Antea™Group (Antea Group), formerly Delta Consultants (Delta), is pleased to submit this *Remedial Action Investigation Work Plan*, for the referenced site in Oakland, California (**Figure 1**). The subject site is an active gasoline station that includes a service station building and three 12,000-gallon gasoline underground storage tanks (USTs) and one 10,000-gallon diesel UST with associated piping and dispensers. The site is covered with asphalt or concrete surfacing except for planters along the southeastern and southwestern property boundaries and at the north corner of the property (**Figure 2**). Please refer to **Appendix A** for additional site information and for a history of the environmental investigations and remedial actions.

Stantec Consulting Corporation (Stantec) installed a dual phase extraction (DPE) remediation system (equipped with down-hole stingers, a thermal oxidizer for vapors, and carbon for water treatment) at the site. Stantec installed the Atlantic Richfield Company-supplied equipment at the site with the intention of installing utilities at a later date. Electrical and natural gas service are required to operate the system. Three phase power is available from Pacific Gas and Electric (PG&E) from two transformers located greater than 350 feet north of the site.

Start-up efforts by Antea Group (formerly Delta) to supply 3-phase (208A/200V) electrical power to the to existing DPE system include feasibility and cost evaluation of trenching 600 feet across the Eastmont Mall parking lot, from AutoZone to the system compound, and, contracting PG&E to develop an estimate to provide a build-to from the neighboring Burger King restaurant to the site property boundary. Antea Group also evaluated costs with utilizing a step-up transformer that could utilize existing single-phase power at the site.

Antea Group has conducted an extensive review of the system power requirements, current on-site remediation well configuration, and the locations and magnitude of the remaining soil and groundwater impact at the site. The on-site DPE wells are generally located along the southeastern (down-gradient) boundary of the site and do not appear to aggressively target the core of the plume near the former UST complex. Additionally, these wells utilize a generic screened interval (**Table 1**) and should have very specific screened intervals to target the thickness of the underlying sand and gravel zone where the majority of impacted groundwater likely exists.

Antea Group's research and estimates obtained from PG&E and East Bay Municipal Utility District (EBMUD) estimate on-site system startup costs of the existing system at approximately $150,000 and operating costs of over $100,000 per year. The current on-site groundwater constituent concentrations of GRO (78.5 micrograms per liter [µg/L] to 15,900 µg/L), benzene (1.6 µg/L to 642 µg/L), MTBE (0.53 µg/L to 354 µg/L), and TBA (27.6 µg/L to 151 µg/L) (**Table 2**) are significantly lower than those at the time of the current system's installation. Antea Group feels that the existing system is over-rated given current groundwater concentrations, and the cost per pound of likely contaminant removal is unwarranted.

Antea Group suggests that by targeting the sands and gravels in the core of the contaminant plume with more focused air sparging (AS) and soil vapor extraction (SVE) methods would provide more effective and expedited remediation for the contaminant plume.

Antea Group believes remediation of the current on-site contaminant plume by targeting the sands and gravels in the core of the plume with other more focused remedial technologies such as air sparging combined with soil vapor extraction. These remedial technologies may also be able to utilize portions of the Portions of the existing well network may be utilized in areas where needed. Antea Group proposes the following additional investigation scope in preparation for modifications to the current Remedial Action Plan (RAP).

2.0 RAP MODIFICATION INVESTIGATION AND TESTING

2.1 Proposed Scope of Work

Antea Group proposes the following scope of work to be completed at the site. The proposed sampling locations are depicted on **Figure 2**.

- **Advance borings C-1 through C-5 for the collection of soil and groundwater samples.** The purpose of these borings is to refine lateral distribution of soil impact at the site and to refine the morphology of the sand and gravel units beneath the site. Depending on conditions observed in the field, Antea Group also proposes the possible conversion of boring C-2 into air sparge (AS) well AS-2.

- **Advancement and Installation of soil vapor extraction (SVE) well SVE-1 and AS well AS-1.** These wells will be used for AS/SVE pilot testing in the eastern portion of the site, which is historically impacted by petroleum hydrocarbons.

- **Collect additional soil and groundwater samples for engineering and remediation analyses. T**he purpose of these analyses is to better identify potential in-situ chemical oxidation (ISCO) remedial methods that may be effective in a comprehensive site remediation strategy.

- **Conduct an AS/SVE pilot test.** Antea Group proposes to conduct a 3 day to 5 day AS/SVE pilot test using the existing and proposed new wells at the site.

2.2 Pre-Field Activities

Prior to initiation of field activities, Antea Group will produce a Health and Safety Plan (HASP) in accordance with Title 8, Section 5192 of the California Code of Regulations. The HASP will contain a list of emergency contacts, as well as a hospital route map to the nearest emergency facility, and will be reviewed daily by field personnel. Antea Group will obtain all necessary soil boring and well installation permits from the Alameda County Environmental Health Department (ACEHD) and/or Alameda County Water District (ACWD). In addition, Antea Group will obtain all required permits associated with the proposed AS/SVE pilot test.

With the exception of boring C-4, all borings and wells are proposed on-site. Antea Group will negotiate access with the adjoining property owner to the northeast for advancement of boring C-4. Antea Group will notify the appropriate parties at least five (5) days prior to commencing field activities

2.3 Borehole Clearance

Prior to drilling, each boring and well location will be cleared to a depth of 5 feet below ground surface (bgs) with an air-knife provided by a California licensed well drilling company. Antea Group will contact Underground Service Alert (USA) North to mark the site for subsurface utilities. Antea Group will also employ the services of Cruz Brothers, a private underground utility locater, to verify utility locations marked by USA members and to identify any remaining unmarked underground utilities and structures near the proposed boring locations.

2.4 Proposed Soil Borings

A total of five soil borings (C-1 through C-5) will be advanced at the site by a California C-57 licensed drilling contractor under the supervision of Antea Group. The borings will be advanced using a Geoprobe® (or similar) drilling rig to the occurrence of the clay layer underlying the coarse-grained water bearing unit, anticipated to be at a depth of 30 feet to 35 feet bgs. Soil samples from the borings will be continuously logged and screened using the methods described in **Appendix B**. Upon completion of sampling activities, each boring will be backfilled with neat cement to just below ground surface. The borings will be completed with an asphalt cap dyed to match existing surface conditions. The proposed locations of C-1 through C-5 are depicted on **Figure 2**.

2.5 Proposed SVE Well

One SVE well (SVE-1) will be advanced and installed at the site by a California C-57 licensed drilling contractor under the supervision of Antea Group. The boring will initially be advanced using a Geoprobe® (or similar) drilling rig to approximately 3 feet below the top of the water table. During the last four monitoring events, depth to groundwater in well EX-1 (the nearest well) was between 15.20 and 20.55 feet below top of casing (BTOC). Therefore, Antea Group anticipates the boring to be advanced to an approximate total depth of 18 feet to 24 feet bgs. Soil samples from the borings will be continuously logged and screened using the methods described in **Appendix B**. The proposed location of SVE-1 is depicted on **Figure 2**.

Upon completion of the initial boring, Antea Group will review the lithologic data to determine the proper screened interval for SVE-1. Antea Group anticipates the SVE well to be screened from approximately 10 feet bgs to 3 feet below the water table. Once the final screened interval has been determined, the boring will be overdrilled using 10-inch diameter hollow stem auger drilling equipment to the bottom depth of the proposed screened interval. A SVE well constructed of 4-inch diameter Schedule 40 polyvinyl chloride (PVC) utilizing a 0.020-inch slot size across the screened interval will be placed in the borehole. A sand pack of RMC Lonestar #2/12 or equivalent will be used to fill the annular space to approximately two feet above the top of the screened interval. A two foot thick bentonite transition seal will be placed on top of the sand pack and hydrated in place. A neat cement annular seal will be placed from the top of the transition seal to approximately 1 foot bgs. The well will be outfitted with a locking well cap and a traffic-rated well box cemented in place. The cement will be dyed to match existing surface conditions.

2.6 Proposed AS Well

One AS well (AS-1) will be advanced and installed at the site by a California C-57 licensed drilling contractor under the supervision of Antea Group staff. The boring will initially be advanced using a Geoprobe® (or similar) drilling rig to approximately 10 feet below the top of the water table. Antea Group anticipates the boring to be advanced to the occurrence of the clay layer underlying the coarse-grained water-bearing unit, anticipated to be at a depth of 30 feet to 35 feet bgs. Antea Group field staff will log and screen continuously sampled soil from borings following the Unified Soil Classification System (USCS) and using the methods described in **Appendix B**. The proposed location of AS-1 is depicted on **Figure 2**.

Upon completion of the initial boring, Antea Group will review the lithologic data to determine the proper positioning for the sparge point to be used in AS-1. Antea Group will position the sparge point approximately 1 foot above the top of the underlying clay layer encountered at 33 feet bgs in nearby boring EX-1. Once the proper positioning of the sparge point has been determined, the boring will be overdrilled using an 8-inch diameter hollow stem auger drilling equipment to the top of the clay unit. An AS well constructed in the borehole of 2-inch diameter Schedule 40 PVC connected to a stainless steel sparge point with a 0.010-inch slot size. A sand pack of RMC Lonestar #2/12 or equivalent will be used to fill the annular space to approximately two feet above the top of the screened interval. A two foot thick bentonite transition seal will be placed on top of the sand pack and hydrated in place. A neat cement annular seal will be placed from the top of the transition seal to approximately 1 foot bgs. The well will be completed with a locking well cap and a traffic-rated well box cemented in place. The cement will be dyed to match existing surface conditions.

2.7 AS and SVE Well Survey

Subsequent to the completion of the proposed remediation wells, a California Licensed Land Surveyor will survey the northing/easting and latitude/longitude of each monitoring well using North American Datum 83. The top of casing elevations will be surveyed to North American Vertical Datum 88, with the precision of vertical survey data being at least 0.01 foot. Additionally, off-site monitoring well MW-6 was not surveyed with the well network in

2007. To accurately interpret groundwater flow direction and gradient during future monitoring events, the entire well network will be resurveyed with the newly installed remediation wells. The well survey data will be included in the final report and uploaded to the GeoTracker database.

2.8 Soil Sampling

Soil samples collected during boring advancement will be collected continuously with acetate liners or a split spoon sampler with brass rings using the field procedures outlined in **Appendix B**. Soils will be classified and logged according to the Unified Soil Classification System. A portion of each liner will be placed in a foil and ring sealed jar. Field staff will insert the sampling tube of a photoionization detector (PID) into the jar perforating the foil seal after approximately 30 minutes, and record the stabilized PID readings on the boring logs.

Select soil samples will be collected and retained for laboratory analysis using the following criteria:

- A shallow sample (less than 5 feet bgs) will be collected from each boring location.
- A sample will be collected from each boring from within the smear zone, generally encountered between 13 feet and 19 feet bgs.
- A sample will be collected from the bottom of each boring.
- Antea Group may submit additional samples based on historical occurrences of hydrocarbons (**Table 2**), field observations, and/or PID measurements observed in the field.

Soil samples retained for laboratory analysis will be given unique sample names, placed in an ice-cooled chest, and recorded on the chain of custody. All soil samples collected from boring advancement will be submitted to Pace Analytical (Pace), a California certified analytical laboratory (No. 01153CA), and analyzed for the following constituents:

- Total petroleum hydrocarbons – gasoline range organics (GRO), carbon chain range C_{05} – C_{12}, by California Leaking Underground Fuel Tank (LUFT) method;
- Benzene, toluene, ethylbenzene, and xylenes (collectively BTEX compounds), methyl tertiary-butyl ether (MTBE), tertiary-butyl alcohol (TBA), ethyl tertiary-butyl ether (ETBE), tertiary-amyl methyl ether (TAME), di-isopropyl ether (DIPE), ethylene dibromide (EDB), ethanol, and 1,2-dicholoethane (1,2-DCA) by Environmental Protection Agency (EPA) Method 8260.

2.9 Groundwater Sampling

2.9.1 Engineering Parameters

During the next regularly scheduled groundwater sampling event, Antea Group proposes to collect additional groundwater samples from existing remediation wells EX-1, EX-2, DPE-1, DPE-4, and DPE-5 using the standard procedures described in **Appendix B**. Groundwater samples collected from the wells will be analyzed for the following:

- Methane by Robert S. Kerr (RSK) Method 175
- Sulfate by EPA Method 300.0
- Sulfide by Standard Method 4500-S2E
- Total Iron by EPA Method 6010
- Ferrous Iron (Hach kit in the field)
- Nitrate by EPA Method 353.2
- Nitrite by EPA Method 352.2/354.1
- Biological Oxygen Demand (BOD) by Standard Method 5210B
- Chemical Oxygen Demand (COD) by EPA Method 410.4
- Total Organic Carbon (TOC) by Standard Method 5310C
- Total Kjeldhal Nitrogen by EPA Method 353.1
- Ammonia by EPA Method 350.1
- Ortho-phosphorus by EPA Method 365.1
- Total Phosphorus by EPA Method 365.4
- Chloride by EPA Method 300.0
- Chromium:

    Hexavalent Chromium (Cr^{6+}) by EPA Method 7199,
    Total Chromium by EPA Method 6010C or 6020A, and
    Trivalent Chromium (Cr^{3+}),will be determined by laboratory calculation

2.9.2 Monitored Natural Attenuation Parameters

In addition to the field parameters and groundwater samples being measured/collected during the next regularly scheduled groundwater sampling event, Antea Group proposes the collection of groundwater samples during subsequent semi-annual events for analysis of monitored natural attenuation parameters from monitoring wells MW-1 and MW-3 through MW-11 using the standard procedures described in **Appendix B**. Groundwater samples collected from the wells will be analyzed for the following:

- Methane by RSK Method 175
- Sulfate by EPA Method 300.0
- Nitrate by EPA Method 353.2
- Ferrous Iron (Hach kit in the field)

2.10 Additional Soil and Groundwater Sampling for ISCO Treatability Study

ISCO technologies can effectively mitigate typical petroleum hydrocarbons including BTEX and MTBE existing in dissolved phase in groundwater, sorbed to soil, or residual light non-aqueous phase liquid (LNAPL). ISCO can also result in the indirect decrease of petroleum contamination by increasing the dissolved oxygen content in groundwater and potential electron acceptors, which enhances biodegradation. Common ISCO technologies used at petroleum sites may include (but are not limited to) sodium percarbonate, Fenton's and modified Fenton's solutions (hydrogen peroxide plus iron catalyst), RegenOx™ (catalyzed sodium percarbonate), sodium persulfate ($Na_2S_2O_8$ known as Klozur™), ozone, and hydrogen peroxide.

A bench-scale treatability study is required to evaluate the efficacies of various ISCO technologies utilizing impacted soil and groundwater samples collected from the site. Test samples are analyzed over time and with varying doses of oxidant solution in order to measure the mass of COCs reduction. Secondary groundwater quality effects (pH change, metals formation or mobilization) for the ISCO technologies are also evaluated.

Specific goals of the study are to:

- Determine total oxidant demand (TOD[)] in order to quantify the treatment efficiencies of the oxidants with the COCs in the presence of natural organic and inorganic species;
- Assess removal of COCs for each type of ISCO treatment to effectively choose the best suited oxidizer;
- Evaluate the effect of treatment on secondary water quality parameters;
- Where applicable, assess the potential for the mobilization of metals such as iron, chromium, and selenium, during treatment;
- Determine oxidant injection volumes and concentrations.

Antea Group proposes to evaluate the viability of several ISCO strategies which may include, but not limited to, oxidants such as hydrogen peroxide, sodium percarbonate, and sodium persulfate, in combination of with various catalysts or activators. A bench-scale test will be performed by an environmental remediation contractor that specializes in treatability testing and technology evaluation. Impacted soil and groundwater samples collected from the site will be combined and prepared as test vessels. Each vessel will receive a different treatment and will be analyzed over time in order to measure the mass of COCs reduction.

To perform the study, approximately 30 liters (L) of groundwater and 2 kilograms (kg) of soil are required from the most impacted location(s). The groundwater will be collected from existing well DPE-4. Soil samples will be collected during the advancement of AS-1 and/or SVE-1 using brass tubes and will be field screened at 1-foot intervals utilizing a PID. If additional soil is necessary to achieve the required 2 kg mass, collection of additional soil samples will be based upon the highest PID screening results, in addition to field observations which indicate potentially impacted soils.

Test vessels will be prepared from the samples, treated, and allowed to react for approximately 30 days. Prior to and post-treatment, the contractor will submit the samples under chain-of-custody protocol to a state of California certified laboratory. Samples will be analyzed for the following:

- GRO by CA-LUFT GC/MS
- Benzene, MTBE, and TBA by EPA Method 8260B.
- For treatment options where there is a potential for mobilization of metals, select metals such as iron (ferric and ferrous), chromium (hexavalent and trivalent chromium), selenium, arsenic, barium, cadmium, copper, and lead.
- The soils will also be tested for TOD in order to quantify the treatment efficiencies of the oxidants with the COCs in the presence of natural organic and inorganic species. A laboratory specific protocol will be used for the test.

2.11 Disposal of Investigation Derived Waste

Soil cuttings and wastewater generated during drilling activities will be placed in Department of Transportation (DOT) approved 55-gallon drums, sealed and labeled in accordance with the corresponding DOT protocols for non-hazardous waste. The drums will be temporarily stored on-site, pending receipt of analytical results. Upon receipt of the results, the waste will be transported by Antea Group’s waste management contractor Belshire Environmental Services, Inc. for disposal at an appropriate facility.

2.12 Proposed AS/SVE Pilot Test

Antea Group proposes to conduct a three day to five day AS/SVE pilot study subsequent to well installation. The pilot test will be conducted using selected existing and the newly-installed remediation wells. Selected existing wells will be monitored during pilot testing activities. All appropriate permits will be obtained prior to testing activities.

3.0 SCHEDULE AND REPORTING

Pre field-activities will begin upon approval of this work plan. Once the boring permits are approved and received, scheduling of drilling equipment will require approximately 30 days. Depending on weather and subsurface conditions, the advancement of the borings and installation of the wells is anticipated to take approximately 6 days. Following installation of the remediation wells, scheduling of the pilot testing is anticipated to take approximately 30 days and a maximum 5 days to complete. Soil samples and groundwater will be submitted to the laboratory on a standard 14-day turnaround time.

A summary report can be issued within approximately 6 weeks of completion the pilot testing. Upon completion of the proposed scope of work, a report will be prepared that will contain the following:

- A map showing the final boring and well locations.
- A detailed description of boring advancement and well installation methods, soil sampling methods, well boring and construction logs, and well survey data.
- Laboratory and chain of custody documentation for soil samples, and a table summarizing laboratory analytical results. Analytical results form the additional groundwater sampling will be reported in the next semi-annual monitoring report for the site.
- The results of the ISCO treatability testing.
- The results of the AS/SVE pilot testing and conclusions regarding feasibility for continued use.
- Waste disposal manifests.
- Interpretation of the field and laboratory data, and recommendations for future site assessment activities (if necessary).

The proposed activities outlined in this work plan and the corresponding reports, will be performed and prepared under the direction of a California Professional Engineer, Certified Engineering Geologist, Registered Geologist, or

Certified Hydrogeologist. In accordance with State of California requirements, all reports, maps, and analytical data will be uploaded to the GeoTracker database.

4.0 REMARKS

The recommendations contained in this report represent Antea USA, Inc.'s professional opinions based upon the currently available information and are arrived at in accordance with currently accepted professional standards. This report is based upon a specific scope of work requested by the client. The contract between Antea USA, Inc. and its client outlines the scope of work, and only those tasks specifically authorized by that contract or outlined in this report were performed. This report is intended only for the use of Antea USA, Inc.'s client and anyone else specifically identified in writing by Antea USA, Inc. as a user of this report. Antea USA, Inc. will not and cannot be liable for unauthorized reliance by any other third party. Other than as contained in this paragraph, Antea USA, Inc. makes no express or implied warranty as to the contents of this report.

Date: 8/3/2011

Stephen A. Meninger
Project Geologist
California Registered Professional Geologist No. 8853

Information, conclusions, and recommendations provided by Antea Group in this document regarding the site have been prepared under the supervision of and reviewed by the licensed professional whose signature appears below.

Licensed Approver:

Date: 8-3-2011

PROFESSIONAL GEOLOGIST
DOUGLAS K. UMLAND
No. 6159
EXP. 12/31/2011
STATE OF CALIFORNIA

Douglas K. Umland, P.G.
Senior Project Manager
California Registered Professional Geologist No. 6159

cc: GeoTracker (upload)

5.0 REFERENCES AND PREVIOUS REPORTS

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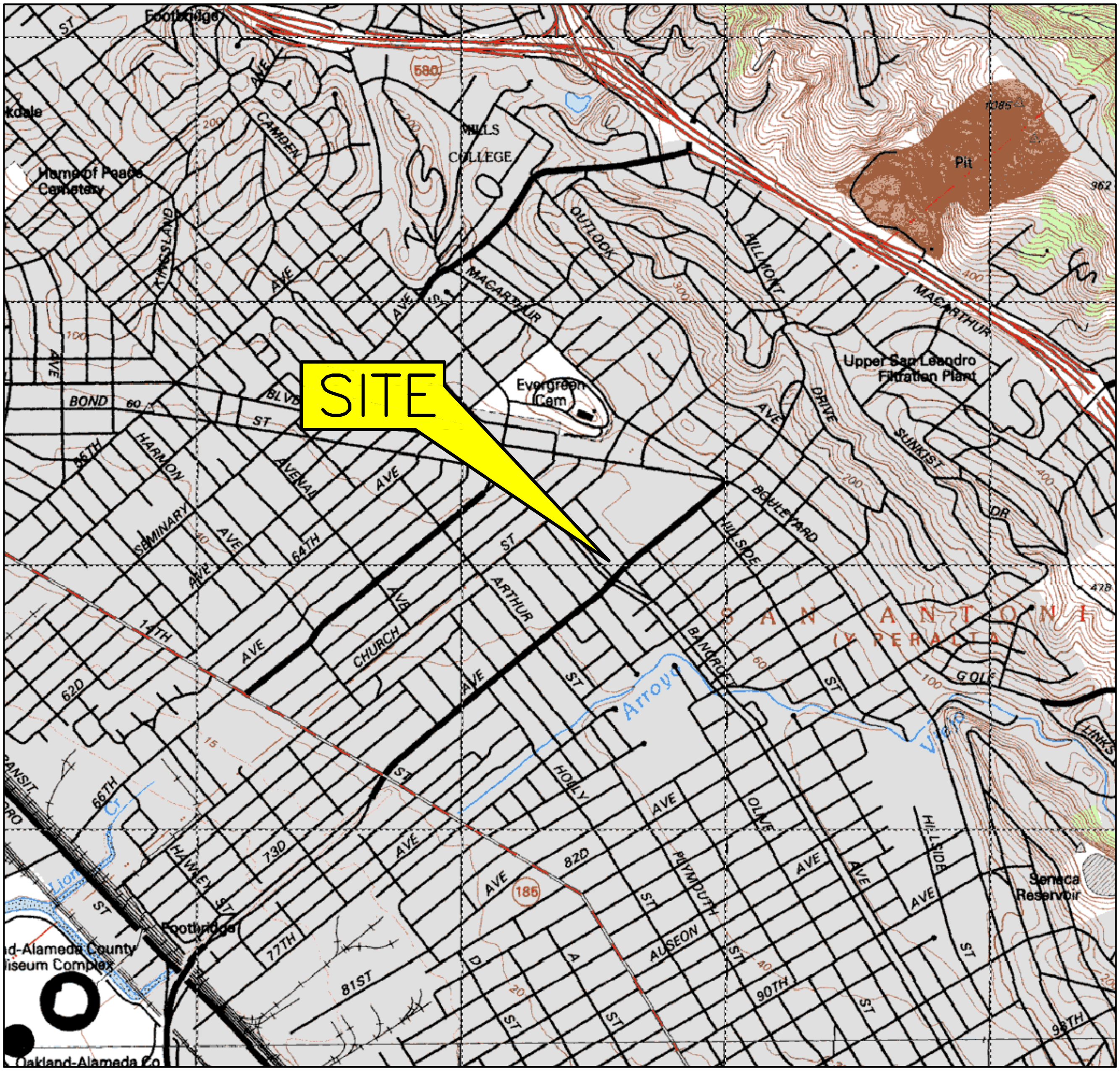
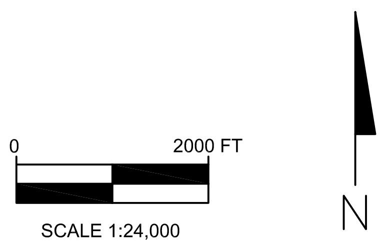
Figures





QUADRANGLE LOCATION

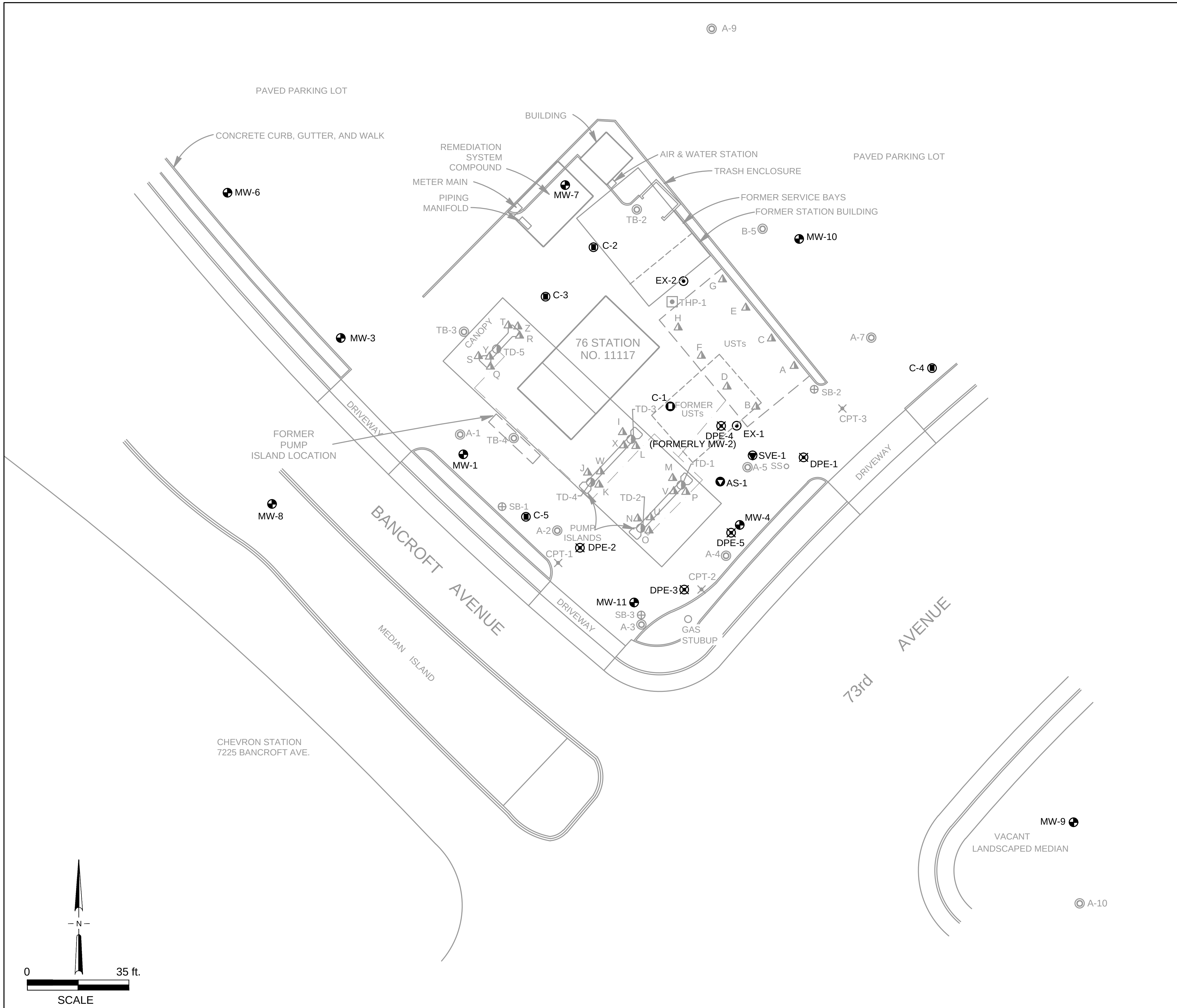
GENERAL NOTES:
BASE MAP FROM USGS, 7.5 MINUTE
TOPOGRAPHIC OAKLAND, CA. PHOTO REVISED 1980

FIGURE 1
SITE LOCATION MAP

76 (FORMER BP) STATION NO 11117
7210 BANCROFT AVENUE
OAKLAND CALIFORNIA

PROJECT NO.	PREPARED BY	DRAWN BY
I42611117	DK	JH
DATE	REVIEWED BY	FILE NAME
03/30/11	DU	11117-TOPO

anteagroup



EXPLANATION

MW-7	GROUNDWATER MONITORING WELL LOCATION
EX-1	SOIL VAPOR EXTRACTION WELL LOCATION
DPE-2	GROUNDWATER EXTRACTION WELL LOCATION
SS	SEWER CLEANOUT LOCATION
SB-2	FUTURE USE STUB-OUT LOCATION
A-1/TB-2	SOIL BORING LOCATION A BORINGS (URS, NOVEMBER 2005) B BORING (HEDI, 1992) T BORINGS (EMCON, 1994)
TD-1	DISPENSER GRAB SAMPLE LOCATION (EMCON, SEPTEMBER 1994)
THP-1	HYDROPUNCH BORING LOCATION (EMCON, SEPTEMBER 1994)
A	SOIL SAMPLES COLLECTED DURING ERI UST, PRODUCT LINE, AND DISPENSER REMOVAL (NOVEMBER, 1998)
CPT-1	CONE PENETROMETER TEST BORINGS BROADBENT & ASSOCIATES, INC. (JUNE, 2007)
	PRODUCT LINES
C-1	PROPOSED SOIL BORING LOCATION TO POSSIBLY BE COMPLETED AS AS-2 BASED ON FIELD DATA.
C-2	PROPOSED SOIL BORING LOCATION
AS-1	PROPOSED AIR SPARGE WELL LOCATION
SVE-1	PROPOSED SOIL VAPOR EXTRACTION WELL LOCATION

FIGURE 2
SITE PLAN

76 (FORMER BP) STATION NO 11117
7210 BANCROFT AVENUE
OAKLAND, CALIFORNIA

PROJECT NO.	PREPARED BY	DRAWN BY
I42611117	SM	JH
DATE	REVIEWED BY	FILE NAME
06/07/11	DU	11117-SMS

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Tables

TABLE 1
SOIL BORING AND MONITORING WELL CONSTRUCTION DETAILS
76 (FORMER BP) SERVICE STATION NO. 11117
7210 BANCROFT AVENUE
OAKLAND, CALIFORNIA

Updated 2/22/2011

Boring/Well ID	Well/Boring Completion Date	TOC Elevation[1] (ft)	Borehole Depth (ft bgs)	Borehole Diameter (in)	Well Depth (ft)	Well Casing Diameter (in)	Well Casing Material	Well Screen Slot Size (in)	Well Screen Interval (ft bgs)	Cement Grout Seal Interval (ft bgs)	Bentonite Seal Interval (ft bgs)	Filter Pack Interval (ft bgs)	Comments
Soil Borings													
B-5	Jul-92	NA	50.0	8.0	NA	NA	NA	NA	NA to NA	0.0 to 50.0	NA to NA	NA to NA	
THP-1	Sep-94	NA	45.0	1.75	NA	NA	NA	NA	NA to NA	0.0 to 45.0	NA to NA	NA to NA	
TB-2	Sep-94	NA	45.0	1.75	NA	NA	NA	NA	NA to NA	0.0 to 45.0	NA to NA	NA to NA	
TB-3	Sep-94	NA	45.0	1.75	NA	NA	NA	NA	NA to NA	0.0 to 45.0	NA to NA	NA to NA	
TB-4	Sep-94	NA	45.0	1.75	NA	NA	NA	NA	NA to NA	0.0 to 45.0	NA to NA	NA to NA	
A-1	Sep-05	NA	46.5	4.25	NA	NA	NA	NA	NA to NA	0.0 to 46.5	NA to NA	NA to NA	
A-2	Sep-05	NA	42.0	2.0	NA	NA	NA	NA	NA to NA	0.0 to 42.0	NA to NA	NA to NA	
A-3	Nov-05	NA	36.0	2.0	NA	NA	NA	NA	NA to NA	0.0 to 36.0	NA to NA	NA to NA	
A-4	Nov-05	NA	36.0	2.0	NA	NA	NA	NA	NA to NA	0.0 to 36.0	NA to NA	NA to NA	
A-5	Nov-05	NA	36.0	2.0	NA	NA	NA	NA	NA to NA	0.0 to 36.0	NA to NA	NA to NA	
A-7	Nov-05	NA	36.5	4.25	NA	NA	NA	NA	NA to NA	0.0 to 36.5	NA to NA	NA to NA	
A-8	Nov-05	NA	36.5	4.25	NA	NA	NA	NA	NA to NA	0.0 to 36.5	NA to NA	NA to NA	
A-9	Nov-05	NA	36.5	4.25	NA	NA	NA	NA	NA to NA	0.0 to 36.5	NA to NA	NA to NA	
A-10	Nov-05	NA	39.0	4.25	NA	NA	NA	NA	NA to NA	0.0 to 39.0	NA to NA	NA to NA	
CPT-1	Apr-07	NA	60.0	1.75	NA	NA	NA	NA	NA to NA	0.0 to 60.0	NA to NA	NA to NA	
CPT-2	Apr-07	NA	60.0	1.75	NA	NA	NA	NA	NA to NA	0.0 to 60.0	NA to NA	NA to NA	
CPT-3	Apr-07	NA	60.0	1.75	NA	NA	NA	NA	NA to NA	0.0 to 60.0	NA to NA	NA to NA	
Groundwater Monitoring Wells													
MW-1	Dec-91	37.41	40	8	40	2	PVC	0.02	20.0 to 40.0	0.0 to 17.0	17.0 to 18.0	18.0 to 40.0	
MW-2	Dec-91	51.07*	40	8	40	2	PVC	0.02	20.0 to 40.0	0.0 to 17.0	17.0 to 18.0	18.0 to 40.0	
MW-3	Dec-89	37.56	45	8	45	2	PVC	0.02	30.0 to 45.0	0.0 to 3.0	3.0 to 25.0	25.0 to 45.0	
MW-4	Jul-92	38.35	40	8	40	2	PVC	0.02	20.0 to 40.0	0.0 to 17.0	17.0 to 18.0	18.0 to 40.0	
MW-6	Jul-92	51.05*	40	8	40	2	PVC	0.02	20.0 to 40.0	0.0 to 17.0	17.0 to 18.0	18.0 to 40.0	
MW-7	Oct-94	38.99	45	8	45	2	PVC	0.02	25.0 to 45.0	0.0 to 21.0	21.0 to 23.0	23.0 to 45.0	
MW-8	Oct-94	38.44	40	8	40	2	PVC	0.02	25.0 to 40.0	0.0 to 21.0	21.0 to 23.0	23.0 to 40.0	
MW-9	Oct-94	38.63	40	8	40	2	PVC	0.02	25.0 to 40.0	0.0 to 21.0	21.0 to 23.0	23.0 to 40.0	
MW-10	Jul-97	40.45	37.5	8	35	2	PVC	0.02	15.0 to 35.0	0.0 to 13.0	13.0 to 14.0	14.0 to 37.5	
MW-11	Nov-07	37.64	40	10	40	4	PVC	0.02	15.0 to 40.0	0.0 to 10.0	10.0 to 13.0	13.0 to 40.0	Graphic log indicates TD = 35 ft bgs
Remediation Wells													
EX-1	Nov-99	38.98	39.5	10	40	4	PVC	0.02	18.0 to 38.0	0.0 to 15.0	15.0 to 16.0	16.0 to 39.5	
EX-2	Nov-99	39.63	36.5	10	40	4	PVC	0.02	15.0 to 35.0	0.0 to 13.0	13.0 to 13.0	13.0 to 36.5	
DPE-1	Nov-07	38.95	40	10	38	4	PVC	0.02	15.0 to 40.0	0.0 to 10.0	10.0 to 13.0	13.0 to 40.0	
DPE-2	Nov-07	37.64	40	10	40	4	PVC	0.02	15.0 to 40.0	0.0 to 10.0	10.0 to 13.0	13.0 to 40.0	
DPE-3	Nov-07	37.82	40	10	40	4	PVC	0.02	13.0 to 38.0	0.0 to 8.0	8.0 to 11.0	11.0 to 40.0	
DPE-4	Nov-07	38.46	45	10	38	4	PVC	0.01	15.0 to 40.0	0.0 to 10.0	10.0 to 13.0	13.0 to 45.0	
DPE-5	Nov-07	38.23	40	10	35	4	PVC	0.01	15.0 to 40.0	0.0 to 10.0	10.0 to 13.0	13.0 to 40.0	Log indicates Screen Interval at 15-38 ft bgs

Notes:

ft = feet | B = soil boring

in = inches | A = hydropunch boring

TABLE 1
SOIL BORING AND MONITORING WELL CONSTRUCTION DETAILS
76 (FORMER BP) SERVICE STATION NO. 11117
7210 BANCROFT AVENUE
OAKLAND, CALIFORNIA

Updated 2/22/2011

Boring/Well ID	Well/Boring Completion Date	TOC Elevation[1] (ft)	Borehole Depth (ft bgs)	Borehole Diameter (in)	Well Depth (ft)	Well Casing Diameter (in)	Well Casing Material	Well Screen Slot Size (in)	Well Screen Interval (ft bgs)	Cement Grout Seal Interval (ft bgs)	Bentonite Seal Interval (ft bgs)	Filter Pack Interval (ft bgs)	Comments

TOC = Top of Casing
bgs = below ground surface
NA = not applicable

CPT = cone pentrometer boring
MW = monitoring well
EX = extraction well
DPE = extraction well

[1] = TOC Elevations were surveyed to a local datum on the following dates:

MW-1 through MW-6 -- January 1, 1992 and July 27, 1992 by HETI

MW-1, MW-3, MW4, MW-6 through MW-11, EX-1, EX-2, DPE-1 through DPE-5 -- December 3, 2002 by Morrow Surveying

* = Wells not included in 2007 re-surveying.

TABLE 2
CURRENT GROUNDWATER GAUGING AND ANALYTICAL DATA
76 (FORMER BP) SERVICE STATION NO. 11117
7210 BANCROFT AVE
OAKLAND, CALIFORNIA

Well I.D.	Date	GROUNDWATER GAUGING DATA				GROUNDWATER ANALYTICAL DATA												
		TOC Elevation (ft)	Depth to Water (ft)	LNAPL Thickness (ft)	Water Elevation* (ft)	GRO (ug/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Total Xylenes (ug/L)	MTBE (ug/L)	TBA (ug/L)	Ethanol (ug/L)	DIPE (ug/L)	ETBE (ug/L)	TAME (ug/L)	1,2-Dibromoethane (EDB) (ug/L)	1,2-Dichloroethane (ug/L)
EX-1	2/7/2011	38.98	15.20	NP	23.78	15900	642	1100	846	2500	364	151	<250	<0.50	0.78	9.3	<1.0	<1.0
EX-2	2/7/2011	39.63	15.59	NP	24.04	<50.0	<0.50	<0.50	<0.50	<1.5	<0.50	<5.0	<250	<0.50	<0.50	<0.50	<1.0	<1.0
MW-1	2/7/2011	37.41	14.02	NP	23.39	<50.0	<0.50	<0.50	<0.50	<1.5	<0.50	<5.0	<250	<0.50	<0.50	<0.50	<1.0	<1.0
MW-3	2/7/2011	37.56	14.39	NP	23.17	<50.0	<0.50	<0.50	<0.50	<1.5	<0.50	<5.0	<250	<0.50	<0.50	<0.50	<1.0	<1.0
MW-4	2/7/2011	38.35	15.59	NP	22.76	3600	7.1	0.76	1.2	5.1	3.7	210	<250	<0.50	<0.50	<0.50	<1.0	<1.0
MW-6	2/7/2011	51.05	14.86	NP	36.19	<50.0	<0.50	<0.50	<0.50	<1.5	<0.50	<5.0	<250	<0.50	<0.50	<0.50	<1.0	<1.0
MW-8	2/7/2011	38.44	14.35	NP	24.09	<50.0	<0.50	<0.50	<0.50	<1.5	<0.50	<5.0	<250	<0.50	<0.50	<0.50	<1.0	<1.0
MW-9	2/7/2011	38.63	16.18	NP	22.45	78.5	1.6	<0.50	<0.50	<1.5	0.64	27.6	<250	<0.50	<0.50	<0.50	<1.0	<1.0
MW-10	2/7/2011	40.45	17.02	NP	23.43	<50.0	<0.50	<0.50	<0.50	<1.5	0.53	<5.0	<250	<0.50	<0.50	<0.50	<1.0	<1.0
MW-11	2/7/2011	37.64	13.55	NP	24.09	1530	<0.50	1.3	14.3	24.1	1.1	<5.0	<250	<0.50	<0.50	<0.50	<1.0	<1.0

Gauging Notes:
TOC - Top of Casing
ft - Feet
NP - LNAPL not present
LNAPL - Light non-aqueous phase liquid
* - Corrected for LNAPL if present (assumes LNAPL specific gravity = 0.75)
-- - No information available

Analytical Notes:
< - Not detected at or above indicated laboratory reporting limit
ug/L - micrograms/liter
GRO- gasoline range organics
MTBE- Methyl tertiary-butyl ether
TBA- Tertiary-butyl alcohol
DIPE- Di-isopropyl ether
ETBE- Ethyl tertiary-butyl ether
TAME- Tertiary-amyl methyl ether

Appendix A

Previous Investigation and Site History Summary

SITE LOCATION AND BACKGROUND

The Site is an active 76-brand gasoline retail outlet located on the northern corner of Bancroft Avenue and 73rd Avenue at 7210 Bancroft Avenue in Oakland, Alameda County, California (**Figure 1**). The site consists of a service station building, three 12,000-gallon gasoline underground storage tanks (USTs), and one 10,000-gallon diesel UST with associated piping and dispensers. The site is covered with asphalt or concrete surfacing except for planters along the southeastern and southwestern property boundaries and at the north corner of the property.

Land use in the immediate vicinity of the site is mixed commercial and residential. BP acquired the facility from Mobil Oil Corporation in 1989. In January 1994, BP transferred the property to TOSCO Marketing Company (TOSCO) and has not operated the facility since that time.

SUMMARY OF PREVIOUS ENVIRONMENTAL INVESTIGATIONS

1984 UST Replacement: In 1984, the pre-existing USTs at the site were removed and three single-walled fiberglass gasoline underground storage tanks (USTs) (6,000-gallon, 10,000-gallon, and 12,000-gallon) and one 6,000-gallon diesel UST were installed in a cavity immediately to the northeast of the former USTs. A UST removal/installation report is not on file, and it is unknown if one was ever prepared. No documentation was reportedly found referencing the conditions of the removed USTs or reporting evidence of the hydrocarbon impacts in the soil and groundwater, if any, at the time of the UST removal.

1989 Phase II Environmental Audit: In December 1989, Hunter Environmental Services, Inc. (Hunter) performed a Phase II Environmental Audit on the adjacent Eastmont Town Center site located to the north and northwest of the former BP Site. Part of the Phase II study included the installation monitoring well MW-3 near the western boundary of the former BP Site. Soil samples collected from 10 and 20 feet below ground surface (bgs) from MW-3 were analyzed for total petroleum hydrocarbons (TPH), benzene, toluene, ethyl benzene, and total xylenes (BTEX), and oil and grease. No analytes were reported above their respective laboratory reporting limits (LRLs). A groundwater sample collected from MW-3 was reported to contain TPH and benzene at concentrations of 2,700 micrograms per liter (µg/L) and 530 µg/L, respectively (Hunter, 1989).

1991 Phase I Subsurface Investigation: In December 1991, Hydro Environmental Technologies, Inc. (Hydro) drilled two on-site soil borings (MW-1 and MW-2) to total depths of 40 feet bgs, and soil samples were collected at 10-foot intervals between 5 and 25 feet bgs. First groundwater was encountered at approximately 30 feet bgs. The analytical results of the soil samples from MW-1 and MW-2 reported total petroleum hydrocarbons as gasoline (TPH-g) and BTEX at concentrations below their respective LRLs (Hydro, 1991).

1992 Phase I Subsurface Investigation: In July 1992, Hydro advanced boring MW-4 and MW-6 to total depths of 40 feet bgs, and boring B-5 was advanced to 50 feet bgs, First groundwater was encountered at approximately 30 feet bgs in borings MW-4 and MW-6, and no free water was encountered in boring B-5. The analytical results of soil samples collected at 30 feet bgs from B-5 and MW-6 reported TPH-g and BTEX at concentrations below their respective LRLs. The maximum TPH-g and BTEX concentrations in soil reported in MW-4 were 6,000 milligrams per kilogram (mg/kg) and 34 mg/kg, respectively, from a depth of 20 feet bgs. Borings MW-4 and MW-6 were subsequently converted into monitoring wells (Hydro, 1992).

1994 Baseline Assessment Report: In September 1994, EMCON performed a Supplemental Site Assessment at the site. Four exploratory soil borings (THP-1, TB-2, TB-3, TB-4) were advanced to a maximum depth of 45 feet bgs north of the former and existing UST complexes (THP-1), at the former service bays (TB-2), north of the northern pump island (TB-3), and at a former pump island (TB-4). Additionally, one soil sample was collected from beneath each of the five dispensers (TD-1 through TD-5). Groundwater was encountered in TB-2 and TB-3 at approximately 33 to 36 feet bgs and groundwater samples were collected from TB-2 and TB-3 via temporarily well points. Maximum concentrations of 16 mg/kg TPH-g (TD-3), TPH as diesel (TPH-d) at concentrations ranging from 110 mg/kg to 5,000 mg/kg (TD-1 through TD-5), and benzene at concentrations below LRLs were reported in soil samples. TPHg was not reported above the LRLs and a maximum concentration of 0.7 µg/L benzene (TB-3) was reported in groundwater samples (EMCON, 1994).

1994 Well Installation: In October 1994, Hydro advanced boring MW-7 to a total depth of 45 feet bgs, and borings MW-8 and MW-9 were advanced to total depths of 40 feet bgs. First encountered groundwater was at approximately 27 feet bgs to 32 feet bgs. TPH-g and BTEX were not detected above their respective LRLs in soil samples collected from 25 feet bgs in each boring. The three borings were subsequently converted into monitoring wells MW-7 through MW-9 (Hydro, 1995).

1997 Offsite Well Installation: In July 1997, Pacific Environmental Group (PEG) drilled one boring (MW-10) offsite to a depth of approximately 37.5 feet bgs. Soil samples were collected and the boring was subsequently converted into a monitoring well. First groundwater was encountered at approximately 26 feet bgs. No TPH-g, BTEX or methyl tertiary butyl ether (MTBE) was detected in soil samples at concentrations above their respective LRLs in MW-10. TPH-g and BTEX were not detected in the groundwater sample from MW-10 at concentrations above their respective LRLs. However, MTBE was detected at concentration of 13 µg/L using EPA Method 8020 (PEG, 1997).

1998 UST and Associated Piping and Dispenser Removal: In August 1998, Environmental Resolutions, Inc. (ERI) removed the three gasoline USTs (6,000-gallon, 10,000-gallon, and 12,000-gallon), one 6,000-gallon diesel UST, and associated dispensers and piping from the site. There was no visible evidence of leakage from the USTs removed. A total of eight native soil samples were collected from beneath each end of the removed USTs (denoted as A through H on **Figure 2**) at depths of 14 to 16 feet bgs, and a total of 18 soil samples (denoted as I through Z on **Figure 2**) were collected from the former dispenser locations and from beneath the associated product lines at three feet bgs (ERI, 1998).

TPH-g was reported in five of the eight UST excavation samples at concentrations ranging from 3.7 mg/kg (S-15-T2S) to 5,300 mg/kg (S-15-T1S). TPH-d was detected at 630 mg/kg (S-15-T1N) and 800mg/kg (S-15 T1S) into two samples, benzene concentrations ranged between 0.40 mg/kg (S-15-T1N) to 0.95 mg/kg (S-16-T3N) in three samples, MTBE concentrations ranged between 0.028 mg/kg (S-14-T4S) to 5.3 mg/kg (S-16-T3N) in seven samples, and lead was not reported in the sample analyzed for lead. TPH-g was reported in nine of the eighteen dispenser and product line samples with concentrations ranging between 1.4 mg/kg (S-3-PL12) to 7,200 mg/kg (S-3-D4). TPH-d was detected between 4.8 mg/kg (S-3-PL12) to 190 mg/kg (S-3-PL11) in five samples, benzene was detected between 0.0089 mg/kg (S-3-PL12) to 22 mg/kg (S-3-D4) in three samples and MTBE was detected between 0.048 mg/kg (S-3-PL12) to 15 mg/kg (S-3-PL1) in ten samples (ERI, 1998).

During the 1998 UST replacement activities, approximately 389 tons of soil and backfill were transported off-site disposal. The existing 10,000-gallon diesel and three 12,000-gallon gasoline USTs were installed as replacements (ERI, 1998).

1999 Groundwater Recovery Test: In April 1999, Alisto Engineering Group (Alisto) conducted groundwater recovery tests on wells MW-1 through MW-4, MW-6, MW-7 and MW-10 to assess the spatial variation in hydraulic conductivity in the shallow water-bearing zone across the Site. Testing by the Bouwer-Rice method yielded hydraulic conductivities of 2.46 x 10^{-2} ft/min for MW-1, 2.42 x 10^{-4} ft/min for MW-2, 3.82 x 10^{-4} ft/min for MW-3, 5.75 x 10-4 ft/min for MW-4, 1.99 x 10^{-2} ft/min for MW-6 1.09 x 10^{-4} ft/min for MW-7 and 8.78 x 10^{-5} ft/min for MW-10. The geometric mean of the hydraulic conductivity and flow velocity values were calculated to be 1.37 x 10-5 feet per second and 73.85 feet per year, respectively (Alisto, 1999).

1999 Extraction Well Installation: In November 1999, Cambria Environmental Technology, Inc. (Cambria) installed two 4-inch diameter wells (EX-1 and EX-2) on-site to facilitate potential remedial activities at the site. Well EX-1 was drilled to 39.5 feet bgs and EX-2 was drilled to 36.5 feet bgs. Groundwater was first encountered at 26 feet bgs. No TPH-G or BTEX, and relatively low MTBE concentrations (below 0.012 mg/kg) were reported in soil samples collected from EX-1 and EX-2 (Cambria, 2000).

2000 Interim Remedial Action and Recovery Testing: Between March 16 and April 30, 2000, Cambria conducted interim remedial activities at the site to evaluate the effectiveness of hydrocarbon and MTBE reduction using short-term groundwater extraction. During eight extraction events, approximately 10,900 gallons of groundwater was extracted from wells EX-1, EX-2 and MW-2. During the extraction events, stable to slightly decreasing hydrocarbon and MTBE concentration trends were reported in samples collected from wells MW-2 and EX-1, located immediately southwest of the existing USTs. Samples from well EX-2, located north of the existing USTs, exhibited lower hydrocarbon and MTBE concentrations than MW-2 and EX-1. In April 2000, during the batch extraction events, recovery tests were conducted on wells EX-1, EX-2 and MW-2. Based on the recovery test measurements, the calculated hydraulic conductivity values ranged from 1.85 x 10^{-4} ft/min to 8.33 x 10^4 ft/min with resulting flow velocities of 16 ft/year to 73 ft/year at well MW-2 (Cambria, 2000).

The calculated hydraulic conductivity values ranged from 2.02 x 10^{5} ft/min to 3.85 x 10^{-5} ft/min for well EX-1 with resulting flow velocities of 1.8 to 3.4 Ft/yr. And a well EX-2, the calculated hydraulic conductivity values ranged from 3.04 x 10^{-4} ft/min to 2.13 x 10^{-3} ft/min for resulting flow velocities of 27 ft/year to 187 ft/year. The geometric mean of these values is a hydraulic conductivity of 3.0 x 10^{-4} ft/min and resulting flow velocity of 26 ft/year (Cambria, 2000).

2001 Dual-Phase Extraction Pilot Test: From October 29, through November 2, 2001, Cambia performed a dual phase soil vapor and groundwater extraction (DPE) pilot test on the monitoring wells with the highest historical hydrocarbon concentrations (i.e., MW-2 and MW-4) and the extraction wells (EX-1 and EX-2) at the site. The DPE test results indicated that the vacuum influence was limited to within 18 to 28 feet of the extraction well. Water levels typically decreased several feet in the extraction wells and had a varied response in the observation wells. Estimated vapor-phase removal rates were approximately 200-pounds of hydrocarbon per day in wells MW-4 and EX-1, and less than 5-pounds of hydrocarbon per day in wells MW-2 and EX-2 (Cambria 2002).

Soil vapor concentrations showed a decreasing trend in wells MW-4 and EX-1 during the short-term pilot tests. Grab water samples collected before and after the pilot tests remained the same order of magnitude. A total of 6,500 gallons of water was extracted during the DPE pilot test and appropriately disposed off-site. Overall, the test results indicated that DPE is a feasible remedial alternative for the site (Cambria, 2002). Alameda County Environmental Health (ACEH) approved Cambria's August 8, 2002, *Dual Phase Extraction Pilot Test Report* as a Corrective Action Plan (CAP).

2005 Soil and Water Investigation: In Fall 2005, URS completed nine Geoprobe soil borings with co-located Hydropunch borings. The first phase of work was on-site source area characterization: five boring locations (A-1 through A-5) were advanced in the vicinity of the possible hydrocarbons source areas such as locations of former and current USTs, products dispensers, and in the vicinity of MW-4 to adequately characterize the lateral and vertical extent of petroleum hydrocarbons in soils in the identified source areas. An off-site assessment was completed during the second phase of work (borings A-7 through A-10) to further define the downgradient, cross-gradient, and up-gradient extent of the groundwater plume (soil boring A-6 was unable to be advanced due to close proximity to electric lines and product piping). Maximum concentrations of gasoline range organics (GRO), benzene, and MTBE were detected in soil at concentrations of 490 mg/kg [A-4 (23.5-24′)], 0.11 mg/kg [A-5 (35-35.5′)], and 0.84 mg/kg [A-1 (46-46.5′)], respectively. Maximum concentrations of GRO, benzene, and MTBE were detected in ground water at concentrations of 510,000 µg/L [A-2 (21.3′)], 11,000 µg/L [A-4 (34-36′)], and 39,000 ug/L [A-4 (34-36′)], respectively (URS, 2005).

The cross-gradient and downgradient lateral extents of the dissolved hydrocarbon plume were characterized during the last investigation. However, the vertical extent of the dissolved-phase hydrocarbons on the southern portion of the site was not defined. Specifically, significantly elevated concentrations were detected in Hydropunch groundwater samples collected from the bottom depths of soil borings A-2, A-3 and A-4. The bottom Hydropunch sample from boring A-2 (40-42 ft bgs) contained concentrations of GRO, benzene, and MTBE at 36,000 µg/L. 1,800 µg/L, and 110 µg/L, respectively. The bottom Hydropunch sample from boring A-3 (34-36 ft bgs) contained concentrations of GRO, benzene, and MTBE at 12,000µg/L, 21µg/L, and 8.3µg/L respectively. The bottom Hydropunch sample from boring A-4 (34-36 ft bgs) contained GRO, benzene, and MTBE concentrations of 120,000µg/L, 11,000µg/L and 39,000 µg/L respectively (URS, 2005).

Therefore, the vertical extent of dissolved phase petroleum hydrocarbon contamination remains unknown in this southern area of the site (URS, 2005). A work plan for soil and water investigation to delineate the vertical extent of contamination in the southern portion of the site was submitted to ACEH in October 2006.

2007 Soil and Groundwater Investigation: In April 2007, Stratus Environmental, Inc. (Stratus) advanced cone penetrometer test (CPT) borings in three locations onsite (CPT-1 through CPT-3) to maximum depths of 60 feet bgs. CPT-1 was advanced southwest of the dispenser islands and southeast of monitoring well MW-1; CPT-2 was advanced south of the dispenser islands and southwest of monitoring well MW-4; CPT-3 was advanced in the eastern corner of the side as requested by the ACEH. An Ultraviolet Induced Fluorescence (UVIF) module was used at each CPT boring location, analyzing the vertical extent of petroleum hydrocarbons in additional to providing soil profiling data. Groundwater samples were collected from multiple depths at each boring locations; physical soil samples were not collected during this investigation.

- GRO was detected above laboratory reporting limits in five of the seven groundwater samples, ranging from 170 µg/L (CPT-3-28-32') to 170,000 µg/L (CPT-1-37-41').
- Benzene was detected above laboratory reporting limits in four of the seven groundwater samples, ranging from 0.51 µg/L (CPT-3-23-27') to 7,700 µg/L (CPT-2-37-41').
- Toluene was detected above laboratory reporting limits in three of the seven groundwater samples, ranging from 57 µg/L (CPT-1-30-34') to 670 µg/L (CPT-2-28-32').

- Ethylbenzene was detected above laboratory reporting limits in four of the seven groundwater samples, ranging from 530 µg/L (CPT-2-37-41') to 2,600 µg/L (CPT-1-37-41').
- Total xylenes were detected above laboratory reporting limits in four of the seven groundwater samples, ranging from 290 µg/L (CPT-2-37-41') to 9,600 µg/L (CPT-1-37-41').
- MTBE was detected above laboratory reporting limits in five of the seven groundwater samples, ranging from 4.4 µg/L (CPT-3-56-60') to 6,500 µg/L (CPT-2-37-41').
- TBA was detected above laboratory reporting limits in groundwater sample CPT-2-37-41' at 2,400 µg/L.

2007-2008 DPE System Installation: Construction of the DPE system was started by Broadbent & Associates, Inc (BAI) and Stratus in late 2007. The system consists of a thermal/catalytic oxidizer with a 25 horsepower liquid ring blower designed to extract water and vapor from six on-site extraction wells. Extracted vapor were to be treated by thermal/catalytic oxidation and discharged to the atmosphere under the oversight of the Bay Area Air Quality Management District. Extracted groundwater was to be treated by a sediment filter and three 1,000 pounds carbon vessels before being discharged into the City of Oakland sanitary sewer system. DPE wells DPE-1 through DPE-5 were installed at the site to total depths ranging from 35 feet to 40 feet bgs. Well MW-2 was overdrilled and destroyed to allow DPE-4 to be installed in the same borehole. The system is currently connected to six wells (DPE-1 through DPE-5 and EX-1) (BAI, 2008a).

As of the end of the fourth quarter 2008 the system had not been started. BAI and Stratus were still coordinating with Pacific Gas & Electric (PG&E) to install electrical service to the system. Natural gas was completed to the site and system in third quarter 2008 (BAI, 2008a).

During DPE construction activities, on-site groundwater monitoring well MW-11 was installed to a total depth of 40 feet bgs on the southern corner of the site. Soil samples collected at 20 feet and 30 feet bgs reported maximum concentrations of 1.9 mg/kg GRO and 0.0089 mg/kg benzene. MTBE was not reported above the LRL in either of the soil samples (BAI, 2008a).

2009-2011 DPE System Startup Efforts: In 2009, Antea Group (formerly Delta Consultants) began coordinating with the neighboring Eastmont Mall to allow trenching for the 3-phase power across the parking lot from behind the AutoZone. The total cost for installation efforts was estimated at approximately $70,000, which did not include Antea Group's efforts for oversight or extensive negotiations of an access agreement with the mall's property management firm. Additionally, the cost of providing power from this distance would have been significantly increased due to line loss. Total utility cost to run the system was estimated at approximately $4,000 a month. Additionally, groundwater discharge fees were estimated at approximately $4,000 to $5,000 a month.

Due to the significant cost associated with running power lines through the mall parking lot, Antea Group also explored the possibility of having 3-phase power being provided for a transformer near the neighboring Burger King restaurant. This transformer provided 208V/200A power, and the system would have needed modifications due to the 230A/240V design requirements. The total cost of the installation efforts was estimated at $75,000. Additionally, the system would have still required an approximate $9,000 to $10,000 a month in utility and discharge costs.

Antea Group also explored another alternative for the startup of the DPE system, which included reconfiguring the current system for single phase power. Single phase power is available at an underutilized transformer south of the site across 73rd Avenue. Trenching would be required to install single phase power across the street and then across the site to the compound. A digital three phase converter would be required to convert single phase power to three phase power. PG&E would require a complete engineering evaluation to determine if our equipment will meet their specifications for single phase power (ie digital phase converter). The total cost of single phase power conversion and installation was estimated to be in excess of $110,000, and would have still required an approximate $9,000 to $10,000 a month in utility and discharge costs.

FREE PRODUCT RECOVERY DURING MONITORING AND SAMPLING EVENTS

Free product was observed in groundwater monitoring well MW-2 between the 1993 and 1998, at thicknesses ranging from 2.60 feet (3/30/1994) to less than 0.01 feet (10/2/1997 to 7/21/1998). When free product was observed in the well, it was removed by bailer. Between 1993 and 1998, a cumulative total of 24.90 gallons of free product had been removed from the well (Alisto, 1998).

Free product was also observed in well MW-4 during the third quarter 2001 (0.03 inches), fourth quarter 2006 (0.11 inches), first quarter 2008 (0.01 inches), and third quarter 2008 (0.05 inches); and in EX-2 during the second quarter 2007 (0.01 inch). With the exception of 1.5 gallons of a free product/water mixture recovered from MW-4 during the third quarter 2008 (BAI, 2008b), free product was not recovered from these wells when observed.

SENSTIVE RECEPTORS

2000 Potential Receptor Survey, Expanded Site Plan and Well Search: In October 2000, Alisto completed a potential receptor survey, prepared an expanded site plan with neighboring property parcel information and underground utilities mapped, and identified wells in the vicinity of the site. A review of the files of the California Department of Water Resources (DWR) was performed to identify all known wells within one-half mile radius of the site. The results of the well search revealed that there were 17 wells other than the on-site monitoring sells. Of these, 11 were offsite monitoring wells; four were cathodic protection wells, one an industrial well, and one irrigation well for a nearby cemetery. No domestic/municipal water supply wells were identified from review of the DWR files (Alisto, 2000).

2010 Sensitive Receptor Survey: Delta Consultants (Delta) submitted a *Sensitive Receptor Survey* in October 2010. As part of that receptor survey, Delta conducted a records review (environmental database search), a well radius search, and a search for other sensitive receptors which have the potential to be affected by the petroleum hydrocarbon release at the site. Delta's review of the historical aerial photographs indicated that the site in 1939 was primarily used for agricultural purposes with small family residences. In general, the site was developed to the current conditions with the station building in 1974. The historical topographic maps support the indication of residential houses and agriculture in the site region as early as 1915 to 1948. The well search indicated that 10 wells were within a one-mile radius of the site. DWR indicated the presence of 7 wells within a one-mile radius of the site. However, no records were found for the status of these wells as being active or abandoned. The main surface water bodies were Lake Merritt located northwest of the site and San Leandro Bay located west of the site. Several churches, schools and day care centers were located within a one-mile radius of the site. Based on the above identified receptors' distances form the site, directions from the site, and extent of hydrocarbon impact at the site, they were not anticipated to be affected by the petroleum hydrocarbon release at the site.

Appendix B

Standard Field and Laboratory Procedures

STANDARD OPERATING PROCEDURES

Utility Locating

Prior to drilling, boring and excavation locations and an approximate 15-foot by 15-foot box are marked with white paint or other distinct marking and cleared for underground utilities through Underground Service Alert (USA). In addition, Antea Group will contract an independent locator services to clear boring or excavation locations of subsurface assets. The first five feet (or more in instances where utilities are suspected in close proximity) of each borehole are air-knifed, or carefully advanced with a hand auger if shallow soil samples are necessary, to help evaluate the borehole location for underground structures or utilities in accordance with Antea Group's subsurface hazard avoidance policy.

Subsurface Investigation Methods – GeoProbe®, Sonic, Hollow Stem Auger Drilling, Sampling, and Borehole Completion

Borehole Advancement using Single-Wall GeoProbe®

Pre-cleaned push rods (typically one to two inches in diameter) are advanced using a hydraulic direct push-type rig for the purpose of collecting samples and evaluating subsurface conditions. The sample barrel located at the leading end of the drill rod serves as a soil sampler, and an acetate liner is inserted into the sample barrel rod prior to advancement of the push rod. Once the sample is collected, the rods and sampler are retracted and the acetate sample tubes are removed from the sampler. The sample barrel is then cleaned, filled with clean sample tubes, inserted into the borehole and advanced to the next sampling point where the sample collection process is repeated.

Undisturbed soil samples selected for laboratory analysis are cut away from the acetate sample liner using a hacksaw, or equivalent tool, in sections approximately 6 inches in length. The 6 inch samples are lined at each end with Teflon® sheets and capped with plastic caps. Labels documenting project number, borehole identification, collection date, and depth are affixed to each sample. The samples are then placed into an ice-filled cooler for delivery under chain-of-custody to a laboratory certified by the State of California for analysis. The remaining collected soil that has not been selected for laboratory analysis is logged using the United Soil Classification System (USCS) under the direction of a State Registered Professional Geologist, and is field screened for organic vapors using a photo ionization detector (PID), or an equivalent tool.

Borehole Advancement using Sonic Drilling

Pre-cleaned heavy-walled down-hole casings (typically 6 to 8 inches in diameter) are advanced using a sonic head. A smaller diameter core barrel (typically 4 to 6 inches in diameter) is advanced through the inside of the down-hole casings to remove the soil cuttings from the borehole for sample collection and evaluation of subsurface conditions.

During drilling, soil samples are collected continuously using the sonic core barrel. A physical description of soil characteristics (i.e. moisture content, consistency or density, odor, color, and plasticity), drilling difficulty, and soil type as a function of depth are described on boring logs. The soil cuttings are classified in accordance with the USCS and field screened for organic vapors using a PID.

Borehole Advancement using Hollow Stem Auger

Pre-cleaned hollow stem augers (typically 8 to 10 inches in diameter) are advanced using a drill rig for the purpose of collecting samples and evaluating subsurface conditions. A pre-cleaned split spoon sampler is lined with three 6-inch long brass or stainless steel tubes and attached to the drill rods. The sampler is then driven 18 inches into the underlying soils at the target sample interval by repeatedly dropping a 140-pound hammer over a 30-inch free fall distance. The number of blow counts to drive the sampler each 6-inch interval of sampler advancement are recorded on the field logs. The sampler is driven 18 inches or until the sampler has met refusal (typically 50 blows per six inches), then the sampler is retrieved. Alternatively, soil samples are retrieved by driving the sampler using a pneumatic hammer, when using a limited access rig.

Generally the bottom sample tube is selected for laboratory analysis. The middle tube is extruded for logging and PID screening, and the top tube is considered slough caved off from the sides of the boring prior to sampling.

The retained sample is carefully packaged for chemical analysis by capping each end of the sample with a Teflon sheet followed by a tight-fitting plastic cap and stored in a zip-type plastic bag. A label is affixed to the sample indicating the sample identification number, borehole number, sampling depth, sample collection date, and job number. The sample is then annotated on a chain-of-custody form and placed in an ice-filled cooler for transport to the laboratory.

During the drilling process, a physical description of the encountered soil characteristics (i.e. moisture content, consistency or density, odor, color, and plasticity), drilling difficulty, and soil type as a function of depth are described on boring logs. The soil cuttings are classified in accordance with the USCS.

Grab Groundwater Sample Collection

Once the target groundwater sampling depth has been reached, a Hydropunch™ tip is placed on leading end of the sampling rods. The Hydropunch™ tip is advanced approximately 2 feet to place the sample port within the target groundwater sampling zone (effort is made to position the center of the Hydropunch™ screen across the water table surface, if appropriate), and retracted to expose the Hydropunch™ screen. Grab groundwater samples are collected by lowering a pre-cleaned, single-sample polypropylene, disposable bailer or pre-cleaned stainless steel bailer down the inside of the sampler rod. The groundwater sample is decanted from the bailer to the sample container through a bottom emptying flow control valve to minimize volatilization. Alternatively, groundwater samples are collected by lowering a disposable bailer through the sampler rod or into the borehole.

Collected water samples are decanted directly into laboratory provided, pre-cleaned, vials or containers and sealed with Teflon-lined septum, screw-on lids. Labels documenting sample number, well identification, collection date, and type of preservative (if applicable, i.e. HCl for GRO, BTEX, and fuel oxygenates) are affixed to each sample. The samples are then placed into an ice-filled cooler for delivery under chain-of-custody to a laboratory certified by the State of California to perform the specified tests.

Borehole Completion

Upon completion of drilling and sampling, the inner casing rods are retracted. Neat cement grout, mixed at a ratio of 6 gallons of water per 94 pounds of Portland cement, is introduced via a tremie pipe to displace standing water in the borehole, through the annulus of the outer casing rods. The outer rods are retracted as the grout is introduced to bottom of the boring to prevent the cross contamination of encountered water bearing zones. Displaced groundwater is collected at the surface and placed into DOT approved 55-gallon steel drums, or an equivalent storage container. In areas where the borehole penetrates asphalt or concrete, the borehole is capped with an equivalent thickness of asphalt or concrete patch to match finished grade.

Well Construction (typical)

Selected borings will be converted to groundwater monitoring wells by the installation of 2-inch or 4-inch diameter Schedule 40 polyvinyl chloride well casing with 0.020-inch factory slotted well screen as stated in the body of the work plan. A filter pack of Monterey #3 grade sand (or equivalent) will be placed in the annular space of the monitoring well borings, extending from the bottom of each well casing to approximately 2-feet above the top of the screened casing. A sanitary seal consisting of a 2-foot bentonite will be placed on above the filter sand and charged with water to create a seal. Neat cement grout, mixed at a ratio of 6 gallons of water per 94 pounds of Portland cement, is introduced via a tremie pipe to displace standing water in the well annulus bentonite to within two feet of the ground surface. Antea Group will install a minimum of a 5-foot annual seal. A traffic-rated well box will be installed on each well to protect and finish the well to surface grade.

The groundwater monitoring wells will be allowed to stabilize for a minimum of 72 hours after installation prior to development. Following development, the wells will be allowed stabilize for a minimum of 48 hours prior to the collection of any groundwater samples.

Organic Vapor Procedures

Soil samples are collected for analysis in the field for ionizable organic compounds using a PID with a 10.2 eV lamp. The test procedure involves measuring approximately 30 grams from an undisturbed soil sample, placing this sub-sample in a Zip-type bag. The container is warmed for approximately 20 minutes in the sun; then the head-space within the container is tested for total organic vapor, measured in parts per million as benzene (ppm; volume/volume). The instrument is calibrated prior to drilling. The results of the field-testing are noted on the boring logs. PID readings are useful as a qualitative indication of relative levels of contamination, but cannot be used to quantify petroleum hydrocarbon concentrations with the confidence of laboratory analyses.

Equipment Decontamination

Equipment that could potentially come in contact subsurface media and compromise the integrity of the samples is carefully decontaminated prior to drilling and sampling. Drilling auger and other large pieces of equipment are decontaminated using high pressure hot water spray. Soil and groundwater sampling apparatus, groundwater pumps, liners and other equipment are decontaminated in an Alconox scrub solution and double rinsed in clean tap water rinse followed by a final distilled water rinse.

The rinsate and other wastewater are contained in 55-gallon DOT-approved drums, labeled (to identify the contents, generation date and project) and stored on-site pending waste profiling and disposal.

Waste Handling and Disposal *(Soil Cuttings and Rinsate/Purge Water)*

Soil cuttings and rinsate/purge water generated during drilling and sampling are stored on-site in DOT-approved 55-gallon steel drums pending characterization. A label is affixed to the drums indicating the contents of the drum, suspected contaminants, date of generation, and the boring number from which the waste is generated. The drums are removed from the site by a licensed waste disposal contractor to an appropriate facility for treatment/recycling.

SOIL VAPOR WELLS STANDARD FIELD AND SAMPLING PROCEDURES

Utility Locating

Prior to drilling, boring and excavation locations and an approximate 15-foot by 15-foot box are marked with white paint or other distinct marking and cleared for underground utilities through Underground Service Alert (USA). In addition, Antea Group will contract an independent locator services to clear boring or excavation locations of subsurface assets. Soil vapor wells are not air-knifed, and are instead carefully advanced using hand auger drilling techniques.

Borehole Advancement using Hand Auger

A pre-cleaned hand auger (typically three inches in diameter) is advanced by hand for the purpose of collecting samples and evaluating subsurface conditions. If required, soil samples are collected into one 6-inch brass or stainless steel tube inserted into the hand auger during advancement. Soil samples may also be collected into pre-cleaned certified laboratory-provided glass jars.

The retained sample is carefully packaged for chemical analysis by capping each end of the sample with a Teflon sheet followed by a tight-fitting plastic cap and stored in a zip-type plastic bag. A label is affixed to the sample indicating the sample identification number, borehole number, sampling depth, sample collection date, and job number. The sample is then annotated on a chain-of-custody form and placed in an ice-filled cooler for transport to the laboratory.

During the drilling process, a physical description of the encountered soil characteristics (i.e. moisture content, consistency or density, odor, color, and plasticity), drilling difficulty, and soil type as a function of depth are described on boring logs. The soil cuttings are classified in accordance with the USCS.

Soil Vapor Well Completion (Typical)

Shallow soil vapor well borings are typically advanced to 5.5 feet below ground surface (bgs), but may be completed deeper if necessary or shallower if groundwater is present. The borings will be completed into soil vapor wells by placing one foot of Monterey #3 or #30 sand into the borehole. A soil vapor probe connected to seven feet of 0.25-inch outside diameter Teflon® tubing and installed in center of the sand pack at a depth of five feet bgs. A one foot interval of dry granular bentonite transition seal is placed on top of the sand pack. A neat cement sanitary seal is placed on top of the transition seal to approximately one foot bgs. Concrete is placed from 1.0 feet bgs to approximately 4 inches below the surface and a traffic-rated well box is installed at the surface. The well is completed by installing a Swagelok® valve on the terminating end of the Teflon® tubing.

Organic Vapor Procedures

Soil samples are collected for analysis in the field for ionizable organic compounds using a PID with a 10.2 eV lamp. The test procedure involves measuring approximately 30 grams from an undisturbed soil sample, placing this sub-sample in a Zip-type bag. The container is warmed for approximately 20 minutes in the sun; then the head-space within the container is tested for total organic vapor, measured in parts per million as benzene (ppm; volume/volume). The instrument is calibrated prior to drilling. The results of the field-testing are noted on the boring logs. PID readings are useful as a qualitative indication of relative levels of contamination, but cannot be used to quantify petroleum hydrocarbon concentrations with the confidence of laboratory analyses.

Equipment Decontamination

Equipment that could potentially come in contact subsurface media and compromise the integrity of the samples is carefully decontaminated prior to drilling and sampling. Drilling auger and other large pieces of equipment are decontaminated using high pressure hot water spray. Soil and groundwater sampling apparatus, groundwater pumps, liners and other equipment are decontaminated in an Alconox scrub solution and double rinsed in clean tap water rinse followed by a final distilled water rinse.

The rinsate and other wastewater are contained in 55-gallon DOT-approved drums, labeled (to identify the contents, generation date and project) and stored on-site pending waste profiling and disposal.

Waste Handling and Disposal (Soil Cuttings and Rinsate/Purge Water)

Soil cuttings and rinsate/purge water generated during drilling and sampling are stored on-site in DOT-approved 55-gallon steel drums pending characterization. A label is affixed to the drums indicating the contents of the drum, suspected contaminants, date of generation, and the boring number from which the waste is generated. The drums are removed from the site by a licensed waste disposal contractor to an appropriate facility for treatment/recycling.

Soil Vapor Well Sampling

Following installation, the soil vapor wells will be allowed to equilibrate for a minimum of three days and then sampled using the standard operating procedure described below:

1. One-foot sections of 0.25-inch outside diameter Teflon tubing will be used to connect the Swagelok wellhead valve to a Swagelok T-union fitting, one 6-liter Summa canister (purge), and one 1-liter or 6-liter Summa canister (sample). Each Summa canister will be outfitted with its own particulate filter, vacuum gauge, and flow regulator calibrated to a flow rate of between 100 and 200 milliliters per minute (ml/min). With the exception of the 6-liter purge Summa canister, dedicated equipment and materials will be used at each well to avoid cross-contamination.

2. Once the sampling train is assembled, a vacuum test will be performed to ensure the integrity of the sampling train. With the Swagelok wellhead valve closed, the 6-liter purge Summa canister will be opened for a minimum of 10 minutes. If a vacuum is not maintained for at least 10 minutes, the fittings will be tightened and the vacuum test repeated.

3. Once the integrity of the sampling train has been verified by the vacuum test, the well will be purged. The purge

amount will be based on Department of Toxic Substances Control (DTSC) guidelines, which involves purging three dead space volumes (tubing volume + void space of the sand pack). Assuming a total well and sampling train tubing length of 10 feet and 35% porosity of the well's sand pack, the well will be purged approximately 1.4 liters (1,400 ml). Assuming a sustained flow rate of 150ml/min, a purging time of 9 minutes and 20 seconds should be anticipated. Total purge times may be adjusted based on actual flow rates observed in the field.

4. After purging activities are complete, Antea Group will construct a sampling shroud and place it over the well and wellhead valve. During sample collection, Antea Group field staff will continually utilize laboratory-grade helium as a leak check compound to evaluate the integrity of the system. Prior to vapor sample collection, the vapor sampling manifold where it exits the well will be enclosed in a vapor containment shroud that will be filled with a known concentration of helium in order to provide an accurate leak test. The shroud will be sealed with a bentonite slurry or appropriate substitute, and a helium detector will be used to verify the percent saturation within the shroud is achieved and maintained throughout the sampling process. It is recommended that a predetermined concentration of 10 to 30 percent by volume of helium be added to the shroud, and that concentration must then be maintained for the duration of sampling activities. If the percent helium cannot maintained at the desired concentration, all fittings, joints, and seals will be checked and helium reapplied until the concentration is maintained at a steady percent. Laboratory analytical results for the leak check compound will be used to determine the air-tightness of the sampling system.

5. Upon completion of shroud construction, the sample Summa canister will be opened and sample collected. Once the sample Summa canister is filled to -5 inches mercury (in Hg), the canister will be closed. All general sampling information, purge times, sample times, and PID readings will be recorded on field sampling forms.

6. After sampling, the Swagelok wellhead valve will be returned to the closed position. Collected samples will be given unique sample names and transported under chain of custody protocol to a California-certified analytical laboratory. Analyzed compounds will include the constituents of concern and the leak check compound used during sampling.