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Alameda County
Environmental Health

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Alameda County Health Care Services
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Re: Former Texaco Service Station No. 30-7233
2259 First Street
Livermore, California
ACEHS Case No. RO0002908

I accept the **Work Plan for Feasibility Testing and Additional Assessment** dated October 28, 2011.

I agree with the conclusions and recommendations presented in this document. The information included is accurate to the best of my knowledge, and appears to meet local agency and Regional Board guidelines. This **Work Plan for Feasibility Testing and Additional Assessment** was prepared by Conestoga Rovers & Associates, upon whose assistance and advice I have relied.

This letter is submitted pursuant to the requirements of California Water Code Section 13267(b)(1) and the regulating implementation entitled Appendix A pertaining thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

Sincerely,

Eric Frohnapple

Eric Frohnapple
Project Manager

Attachment: Work Plan for Feasibility Testing and Additional Assessment

CONESTOGA-ROVERS & ASSOCIATES

5900 Hollis Street, Suite A
Emeryville, California 94608
Telephone: (510) 420-0700 Fax: (510) 420-9170
http://www.craworld.com

October 28, 2011 Reference No. 312264

Mr. Jerry Wickham
Alameda County Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502-6577

Re: Work Plan for Feasibility Testing and Additional Assessment
Former Chevron Service Station 30-7233
2259 First Street
Livermore, California
Agency Case No. RO2908

Dear Mr. Jerry Wickham:

Conestoga-Rovers & Associates (CRA) is submitting this *Work Plan for Feasibility Testing and Additional Assessment* on behalf of Chevron Environmental Management Company (Chevron) for the site referenced above (Figures 1 through 6) in response to Alameda County Environmental Health (ACEH) June 9, 2011 letter (Attachment A) and our meeting with Jerry Wickham of ACEH on August 3, 2011.

On May 3, 2011, CRA submitted the *Draft Corrective Action Plan* that discussed the site background, previous investigations at the site, quarterly monitoring activities, distribution of chemicals of concern, remediation goals, evaluation of remedial alternatives, and final remediation recommendations. CRA recommended that monitored natural attenuation (MNA) was the most cost-effective and feasible remedial alternative to remediate shallow groundwater. In addition, CRA noted that shallow groundwater has not been fully delineated downgradient of the site. Therefore, CRA proposed installing two shallow groundwater monitoring wells downgradient of MW-7 and MW-8 to further delineate hydrocarbons in shallow groundwater, and to conduct a preferential pathway study and sensitive receptor survey.

Based on ACEH's June 9, 2011 response letter to CRA's *Draft Corrective Action Plan*, Chevron and CRA requested a meeting with ACEH to discuss the site conditions and determine a pathway forward that was acceptable to all parties. On August 3, 2011, ACEH, Chevron, and CRA met and discussed remedial and assessment options at the site. Based on the meeting, CRA proposes to enhance bioremediation by inserting a sulfate canister in well MW-7 and applying calcium sulfate dihydrate (agricultural gypsum) over the landscaped area of the park to increase the amount of sulfate in the shallow water-bearing zone. CRA proposes to install one monitoring well approximately 25 feet southwest of monitoring well MW-7, to be used to monitor the effectiveness of the proposed sulfate applications. Well MW-8 will also be used to monitor the effectiveness of the proposed sulfate applications. Additionally, as stated in the May 3, 2011 *Draft Corrective Action Plan,* CRA proposes two wells across Livermore Avenue to monitor hydrocarbon concentrations downgradient of the site.

On September 12, 2011, 0.12 foot of light non-aqueous phase liquid (LNAPL) was detected in well MW-7. Therefore, CRA proposes surfactant enhanced recovery treatment (SERT) to extract LNAPL prior to inserting the sulfate canister in well MW-7. A work plan for the newly proposed activities is detailed below.

PROPOSED FEASIBILITY TESTING AND ASSESSMENT

CRA proposes a phased remedial approach that consists of installing one monitoring well approximately 25 feet southwest of monitoring well MW-7 to monitor remedial effectiveness, completing a SERT in well MW-7, and applying calcium sulfate dihydrate (agricultural gypsum) over the landscaped area of the park to increase the amount of sulfate in the shallow water-bearing zone. Once LNAPL has been removed, CRA proposes to install a sulfate canister in well MW-7. In addition, CRA proposes to install the two downgradient monitoring wells, and complete the sensitive receptor and conduit study as proposed in CRA's May 3, 2011 *Draft Corrective Action Plan.* The newly proposed activities are discussed below.

SURFACTANT-ENHANCED RECOVERY TREATMENT (SERT)

The objective of SERT is to remove residual LNAPL from the subsurface and prevent LNAPL recurrence. SERT consists of applying a low concentration solution of a surfactant and water to affected monitoring wells, and recovering the resulting mixture of groundwater, surfactant, and liberated hydrocarbons using groundwater extraction. Surfactants are wetting agents with the ability to lower the interfacial surface tension between two liquids (such as oil and water). Surfactants can effectively emulsify and release LNAPL adsorbed to soil, thereby allowing subsequent removal by fluid extraction. Specific procedures are detailed below.

PROPOSED SURFACTANT

The proposed surfactant is Ivey-Sol®. As presented in Appendix C, Ivey-Sol® is listed as non-hazardous and non-toxic, and is not regulated by the Department of Transportation. Ivey-Sol® is non-ionic and as such is not expected to act as a germicide or cause exothermic reactions in the subsurface. Ivey-Sol® does not contain salts or phosphates and is pH neutral. Manufacturer-provided laboratory analytical results indicate that any residual surfactant will achieve 90 percent biodegradation within 28 days. The byproducts of this biodegradation process are carbon dioxide and water. A copy of the Material Safety Data Sheet, specifications, and a biodegradability study for Ivey-Sol® surfactant is included as Appendix C.

SURFACTANT PREPARATION AND APPLICATION

CRA will prepare 50 gallon batches of a 4 percent surfactant solution onsite by mixing 2 gallons of concentrated surfactant with 48 gallons of potable water. The resulting 4 percent solution will be gravity fed into well MW-7. The application rate will be controlled with a valve to prevent overflow in the application well. The maximum amount of surfactant solution to be applied will be 500 gallons. The final volume of surfactant applied to the well will be determined by the rate at which the formation accepts the solution. Application will cease after 6 hours if the maximum volume has not been injected into the well. The surfactant solution will be allowed to soak in the formation for a maximum of 24 hours to envelop and micro-emulsify the residual LNAPL prior to recovery.

Wells MW-8 and the new shallow well located 25 feet southwest of MW-7 will be monitored for changes in water level and the presence of surfactant during the application process. The wells will be monitored for water level changes during the application and equilibration periods to assess the radial influence of the surfactant application. A field test for the presence of surfactant will be performed during injection, at the completion of injection and prior to extraction in each of the monitoring wells listed above. This test is a qualitative visual analysis, based on an observation of suds when a sample of the groundwater is shaken vigorously in a sample bottle. The injection will be stopped immediately if surfactant foaming occurs in any monitoring well other than well MW-7 during the event.

LIQUID RECOVERY

After the surfactant solution has soaked in the aquifer for no longer than 24 hours, the resulting mixture of surfactant, LNAPL, and groundwater will be recovered using a vacuum truck or submersible pump. The recovery will be complete when the volume of recovery is at least four times the volume of surfactant solution applied. Groundwater levels will be monitored in wells MW-8 and the new shallow well located 25 feet southwest of MW-7 during fluid recovery to assess the recovery radial influence.

GROUNDWATER MONITORING

Prior to surfactant application, groundwater in wells MW-7 through MW-9 and the new shallow wells will be gauged. CRA will continue with routine groundwater monitoring pursuant to regulatory requirements. Follow-up LNAPL gauging of well MW-7 will occur monthly for three months to monitor LNAPL presence. CRA will evaluate additional SERT should LNAPL be detected in the wells after three months of monitoring.

SULFATE CANISTER

After LNAPL has been successfully removed, CRA proposes to install a sulfate canister in well MW-7. The canister is similar to those used in ORC applications and is 5 feet long. The canister will be placed inside the monitoring well at the elevation of the screened interval. Construction details for canisters are presented in Attachment B. The canister will contain 150 micron mesh bags with a mixture of 50 percent v/v calcium sulfate dihydrate (agricultural gypsum) and 50 percent v/v sand. The gypsum (sparingly soluble sulfate salt), with a 2.1 grams per liter (g/L) aqueous solubility, is intended to create a sustained sulfate concentration.

When groundwater samples are collected from well MW-7 during the semi-annual sampling events, the canister is temporarily removed from the well to allow purging and sampling, and then placed back in the well. During these times, the mesh socks will be removed and replaced. The data will be assessed after two sampling rounds to determine if the pilot test should continue and at what frequency the canisters should be replaced.

SULFATE LAND APPLICATION

In addition to the sulfate canister, CRA proposes spreading agricultural gypsum over the landscaped area around and upgradient of MW-7. The depth to water (DTW) and precipitation chart in Attachment C indicates that the water table is responsive to precipitation and that land application of gypsum has a likelihood of success. It is expected that gypsum applied to the ground surface will dissolve during the irrigation and the sulfate-laden water will infiltrate through the vadose zone to the water table. Such surface recharge to groundwater has been reported in natural settings[1 2] as well as demonstrated to be effective in remedial setting[3]. The quantity of water used for irrigation is meant to simulate the maximum precipitation intensity observed at the site (that also resulted in a response in depth to water change). The typical application rate for agriculture gypsum 60 pounds per 200 square feet (ft^2). The minimum land application area would be approximately 1,000 ft^2 around well MW-7, which, according to the calculation in Attachment D, would require approximately 2,100 gallons of irrigation water. However, if the City of Livermore requires the entire grass area of the park to be evenly treated for even grass growth, the maximum land application area would be approximately 5,500 ft^2, which would require approximately 12,000 gallons of irrigation water. The irrigation water will be applied over a suitable time to minimize surface ponding and run-off.

HEALTH AND SAFETY PLAN

CRA will prepare a site- and activity-specific health and safety plan (HASP) to protect site workers during surfactant injection and recovery, sulfate canister placement, and sulfate land application. The plan will be kept onsite and followed during all field activities, reviewed and signed by all site workers and visitors.

MONITORING WELL

To monitor the effect of the sulfate canister downgradient of well MW-7, CRA proposes installing a monitoring well approximately 25 feet to the southwest in the northern parking lane of Livermore Avenue (Figure 2). In order to accomplish this scope of work, Chevron and CRA propose to conduct the following activities:

Permits
CRA will obtain a drilling permit from the Zone 7 water agency prior to beginning field operations. A minimum of 48 hours of notice will be given to ACEH prior to beginning

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1 Scholl, M. A., Cozzarelli, I. M. and Christenson, S. C. Journal of Contaminant Hydrology 86, 2006, 239–261, Recharge processes drive sulfate reduction in an alluvial aquifer contaminated with landfill leachate.

2 Stempvoort, D. R. V., Armstrong, J. and Mayer, B. 2007. Seasonal Recharge and Replenishment of Sulfate Associated with Biodegradation of a Hydrocarbon Plume. Ground Water Monitoring & Remediation 27(4), 110–121.

3 Hutchins, S. R. and Miller, D. E. 1998. Combined Laboratory/Field Study on the Use of Nitrate for In-situ Bioremediation of a Fuel-Contaminated Aquifer. Environ. Sci. Technol., 32, 1832-1840.

activities. Additionally, CRA will obtain encroachment permits for the work in the street and sidewalk as well as to access Mills Square Park.

Site Health and Safety Plan
CRA will prepare a site health and safety plan to provide safety guidelines to all site workers and visitors. The plan will be kept onsite at all times and followed by all site workers and visitors each day of operation.

Utility Location
CRA will mark the site for Underground Service Alert (USA) clearance. USA and a licensed geophysicist will be contacted a minimum of 48 hours prior to field activities to mark and identify locations of utilities near the well locations and identify any potential preferential pathways.

Utility Clearance
Per Chevron and CRA safety requirements, each boring and well location will be cleared to 8 feet below grade (fbg) using an air-knife assisted vacuum truck and/or hand augers to detect any unknown utilities prior to drilling.

Soil Boring and Monitoring Well Installation
After clearing to 8 fbg, the well boring will be advanced to 40 fbg using 8-inch diameter hollow stem augers. After soil samples are collected, the boring will be completed as 2-inch diameter well MW-12 screened from approximately 35 to 40 fbg and constructed using 0.010 slotted 2-inch diameter Schedule 40 PVC pipe with Monterey Sand #2/12. The sand pack will be placed to a minimum of 1-foot above the screen. The well annulus will have a 2-foot hydrated bentonite seal above the sand pack and be filled with neat Portland cement to approximately 1 fbg. The screen interval and well construction may be modified based on conditions encountered in the field. A well box equipped with a traffic rated lid will be installed at grade. Exact well location will be based on site and utility constraints. CRA's *Standard Field Procedures for Soil Boring and Monitoring Well Installation* is presented in Attachment D.

Well Development and Sampling
The well will be developed using agitation and pumping. Gettler-Ryan, Inc. will develop and sample the wells no sooner than 72 hours after installation.

Soil Sampling Protocol
CRA geologists will log collected soils using the ASTM D 2488-06 Unified Soil Classification System. Soil samples will be field-screened using a photo ionization detector (PID) and visual

observations. Approximately one 6-inch soil sample will be collected every 5 feet for laboratory analysis and at obvious changes in soils, and where hydrocarbon staining or PID readings are observed. Soil samples above 8 fbg will be collected by driving steel tubes into disturbed sediments removed by a hand auger bucket. Soil samples below 8 fbg will be collected by either driving a modified California split spoon sampler lined with three 6-inch brass tubes or a 4-foot acetate lined direct push sampler into undisturbed sediments. All samples will be capped using Teflon tape and plastic caps, labeled, placed in a cooler with ice, and transported under chain-of-custody to a Chevron and State-approved laboratory for analysis.

Chemical Analysis
Selected soil and groundwater samples will be analyzed for the following:

- TPHd by EPA Method 8015 modified with 10 g silica gel cleanup
- TPHg by EPA Method 8015 modified
- Benzene, toluene, ethylbenzene, and xylenes by EPA Method 8260B
- Total lead by EPA Method 6010 (waste composite soil samples only)

DATA COLLECTION FOR EFFECTIVENSS EVALUATION

Groundwater samples will be collected on a quarterly basis from shallow wells MW-7, MW-8, and the new well, approximately 25 feet southwest of MW-7, for one year, to evaluate the effectiveness of the sulfate canister and land application on groundwater. The groundwater samples will be submitted to Lancaster Laboratories in Lancaster, Pennsylvania and analyzed for the following:

- TPHd by EPA Method 8015 modified with 10g silica gel cleanup
- TPHg by EPA Method 8015 modified
- BTEX by EPA Method 8260B
- Sulfate by EPA Method 300.0
- Dissolved sulfide by EPA Method 9034 (or similar method)
- Total alkalinity (as $CaCO_3$) by method SM 2320B
- Calcium by EPA Method 6010 (qualitative indicator of gypsum migration)
- Ferrous iron by method SM3500-FeD
- Dissolved methane by RSK 175

REPORTING

Upon completion of field activities and review of the analytical results, we will prepare an investigation report that at a minimum will contain:

- Preferential Pathway Survey
- Sensitive Receptor Survey
- Descriptions of drilling and sampling methods
- Well installation details
- Tabulated soil and groundwater analytical results
- A figure illustrating the well locations
- Analytical reports and chain-of-custody forms
- Soil disposal methods
- An updated SCM with discussion of the hydrocarbon distribution in soil and groundwater
- Details of the sulfate canister and land application activities
- Conclusions and recommendations

CRA will conduct this work following approval from the ACEH. CRA will submit the investigation report approximately 8 weeks after completion of field activities, which includes the development, monitoring, and sampling of the newly installed wells. CRA will submit a remedial report after two quarters of post sulfate application groundwater data have been collected.

Please contact Kiersten Hoey at (510) 420-3347 if you have any questions or require additional information.

Sincerely,

CONESTOGA-ROVERS & ASSOCIATES

PROFESSIONAL GEOLOGIST
BRANDON S. WILKEN
No. 7564
STATE OF CALIFORNIA

Kiersten Hoey

Kiersten Hoey

Brandon S Wilken

Brandon S. Wilken, PG 7564

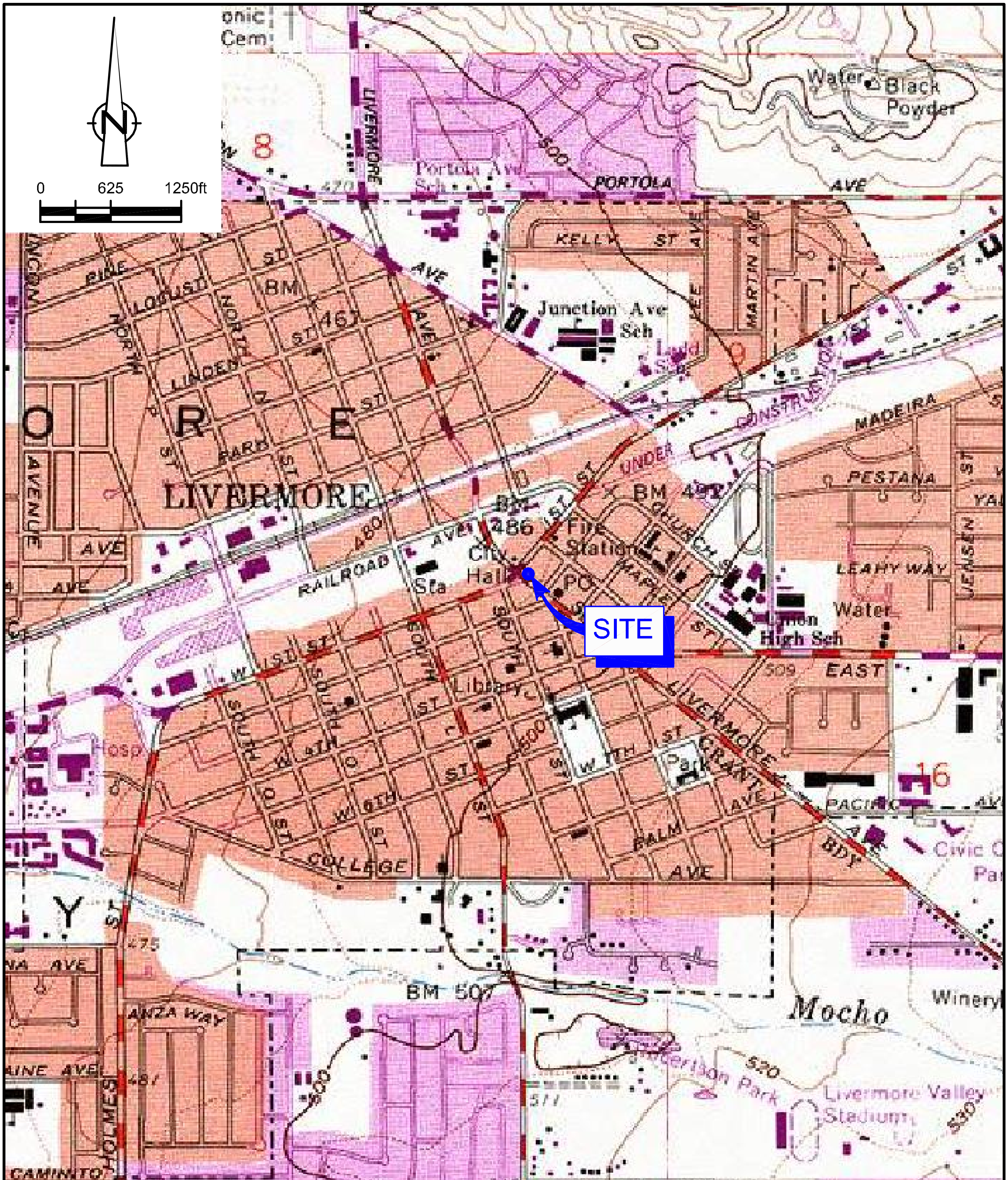
KH/cm/13
Encl.

Figure 1	Vicinity Map
Figure 2	Site Plan with Proposed Monitoring Well Locations
Figure 3	TPHd, TPHg, and Benzene Concentrations in Deep Groundwater – June 6, 2011
Figure 4	TPHd Concentrations in Shallow Groundwater – June 6, 2011
Figure 5	TPHg Concentrations in Shallow Groundwater – June 6, 2011
Figure 6	Benzene Concentrations in Shallow Groundwater – June 6, 2011

Attachment A	Regulatory Correspondence
Attachment B	Sulfate Canister Figures
Attachment C	DTW and Precipitation Chart and Irrigation Water Calculation
Attachment D	Standard Field Procedures for Soil Boring and Monitoring Well Installation

cc: Mr. Eric Frohnapple, Chevron
Mr. Eric Uranaga, City of Livermore Economic Development

FIGURES



SOURCE: TOPO! MAPS.

Figure 1

VICINITY MAP
FORMER TEXACO STATION 30-7233
2259 FIRST STREET
Livermore, California

CRA

312264-95(010)GN-WA001 APR 06/2011

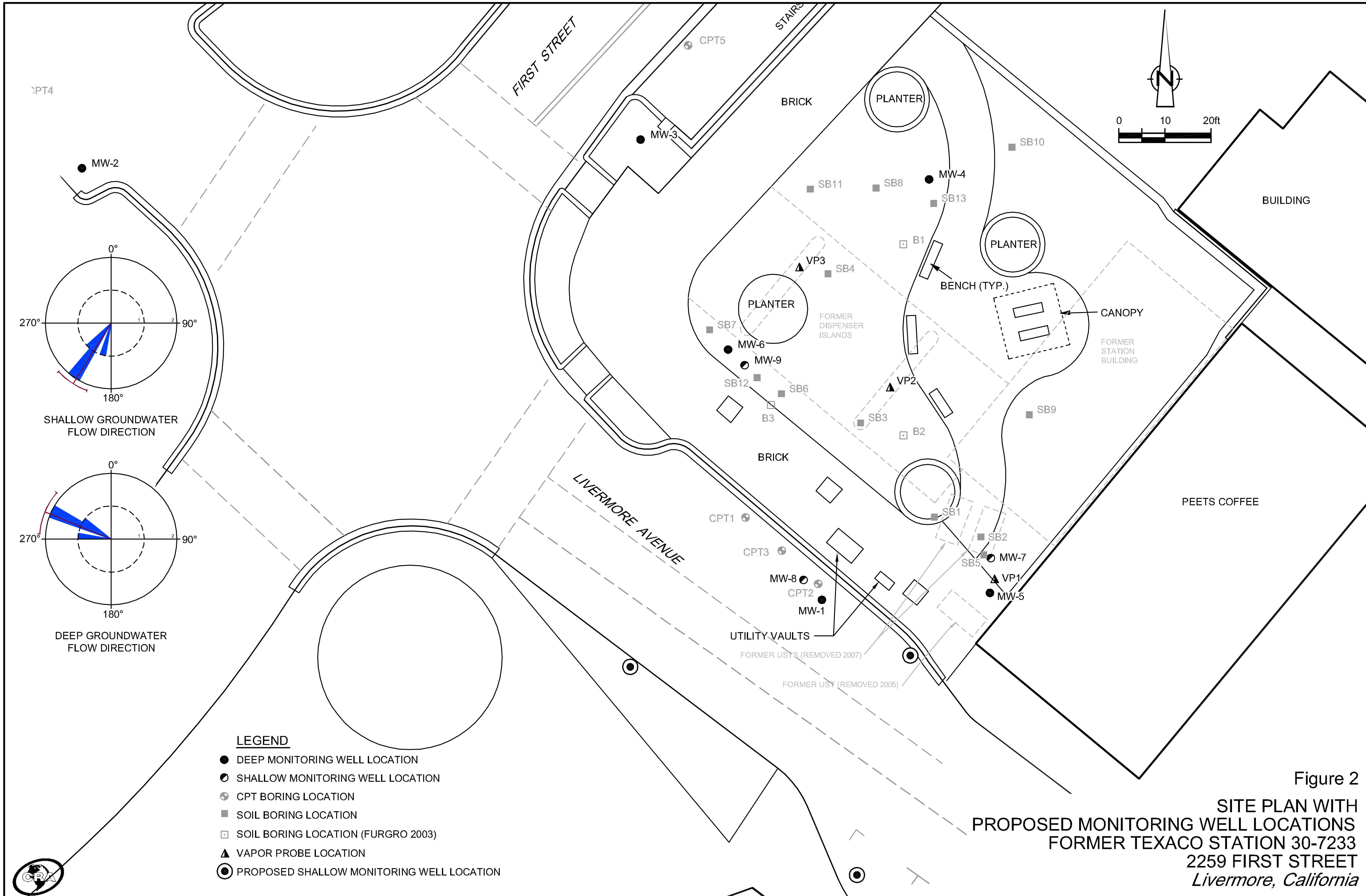
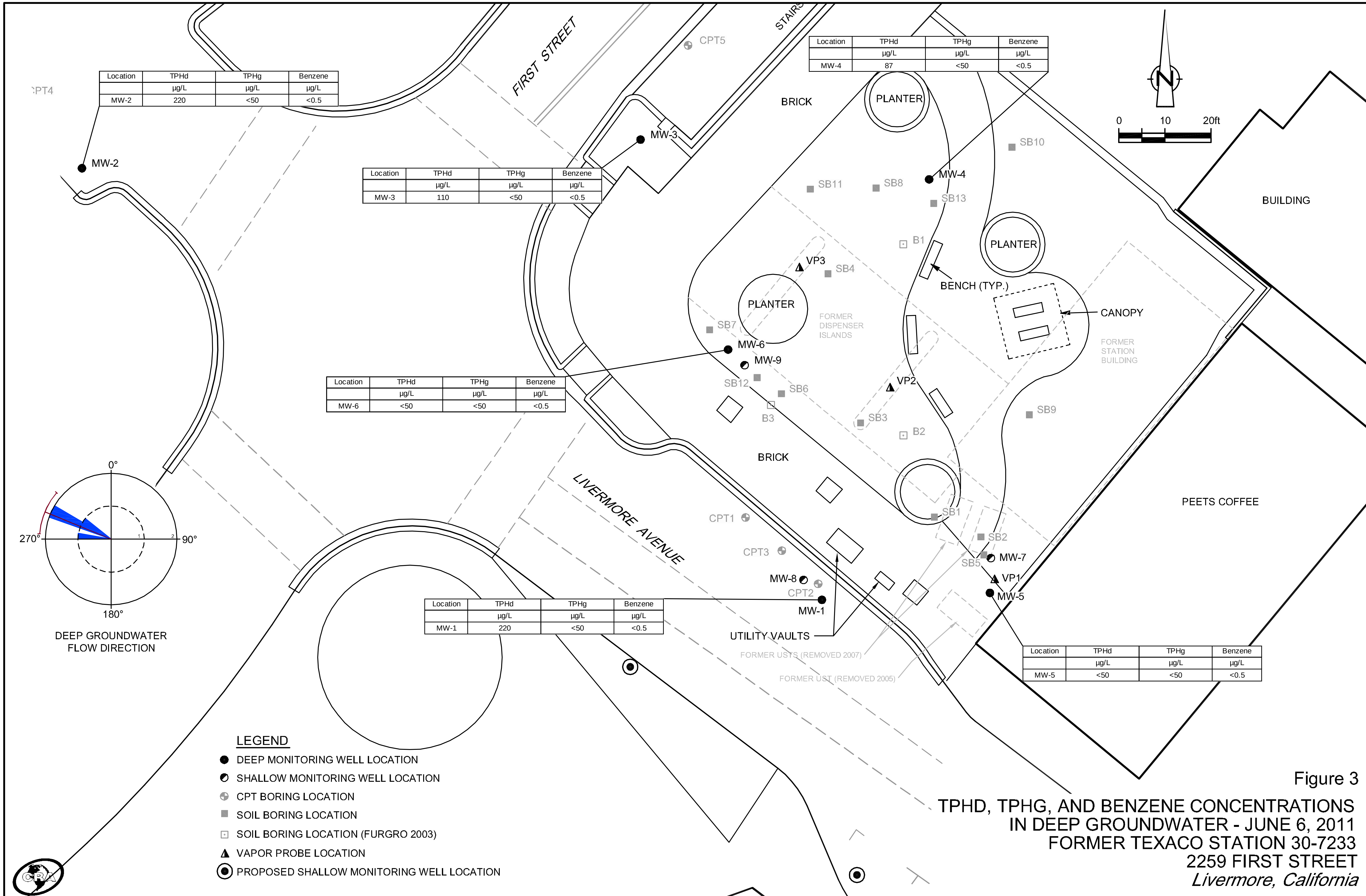


Figure 2

SITE PLAN WITH
PROPOSED MONITORING WELL LOCATIONS
FORMER TEXACO STATION 30-7233
2259 FIRST STREET
Livermore, California

312264-2011(013)GN-WA005 AUG 31/2011



Location	TPHd	TPHg	Benzene
	μg/L	μg/L	μg/L
MW-2	220	<50	<0.5

Location	TPHd	TPHg	Benzene
	μg/L	μg/L	μg/L
MW-3	110	<50	<0.5

Location	TPHd	TPHg	Benzene
	μg/L	μg/L	μg/L
MW-4	87	<50	<0.5

Location	TPHd	TPHg	Benzene
	μg/L	μg/L	μg/L
MW-6	<50	<50	<0.5

Location	TPHd	TPHg	Benzene
	μg/L	μg/L	μg/L
MW-1	220	<50	<0.5

Location	TPHd	TPHg	Benzene
	μg/L	μg/L	μg/L
MW-5	<50	<50	<0.5

Figure 3

TPHD, TPHG, AND BENZENE CONCENTRATIONS
IN DEEP GROUNDWATER - JUNE 6, 2011
FORMER TEXACO STATION 30-7233
2259 FIRST STREET
Livermore, California

312264-2011(013)GN-WA001 AUG 29/2011

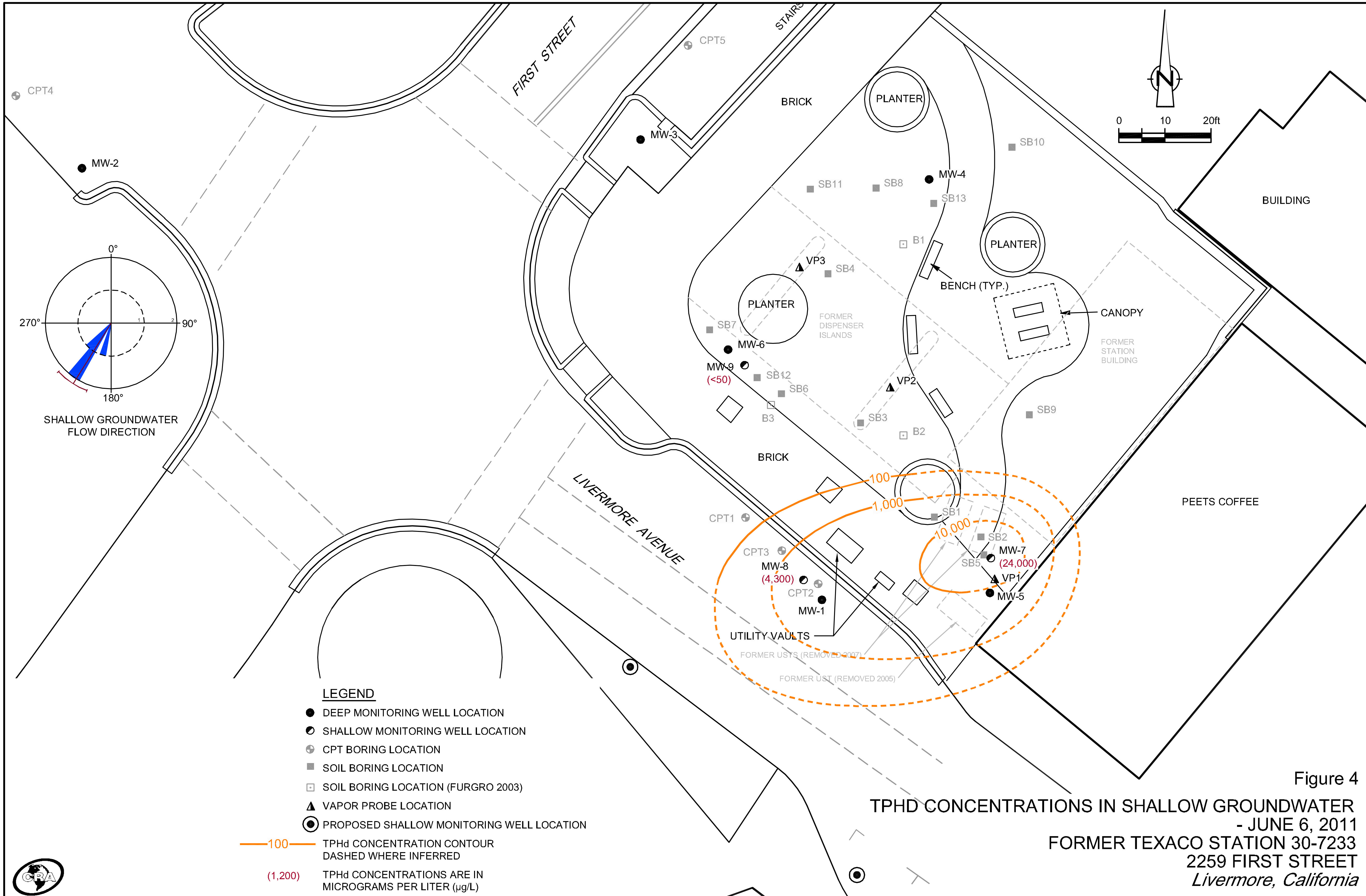
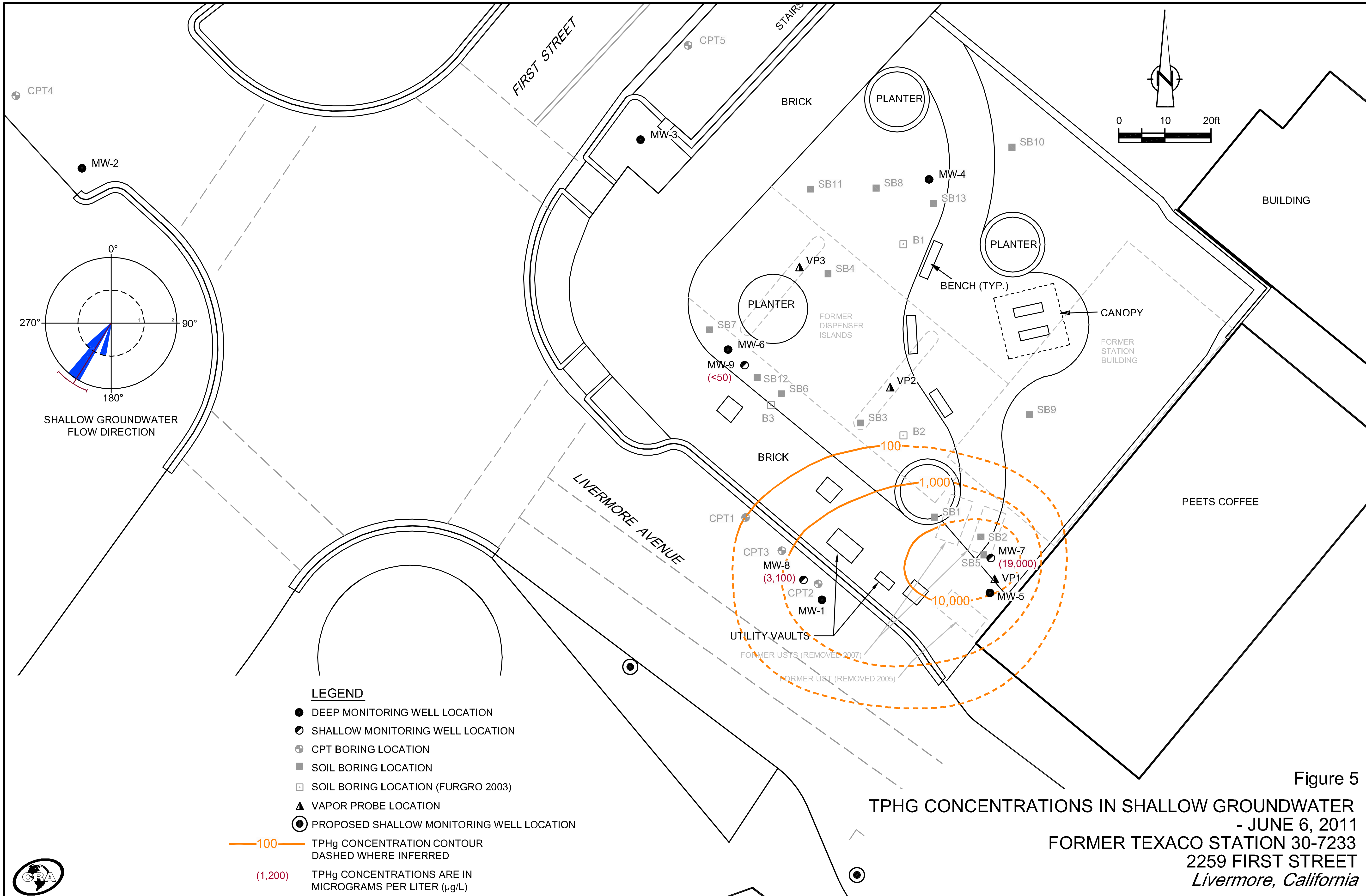


Figure 4

TPHD CONCENTRATIONS IN SHALLOW GROUNDWATER - JUNE 6, 2011
FORMER TEXACO STATION 30-7233
2259 FIRST STREET
Livermore, California

312264-2011(013)GN-WA002 AUG 29/2011



LEGEND

- DEEP MONITORING WELL LOCATION
- SHALLOW MONITORING WELL LOCATION
- CPT BORING LOCATION
- SOIL BORING LOCATION
- SOIL BORING LOCATION (FURGRO 2003)
- VAPOR PROBE LOCATION
- PROPOSED SHALLOW MONITORING WELL LOCATION
- 100 — TPHg CONCENTRATION CONTOUR DASHED WHERE INFERRED
- (1,200) TPHg CONCENTRATIONS ARE IN MICROGRAMS PER LITER (µg/L)

Figure 5

TPHG CONCENTRATIONS IN SHALLOW GROUNDWATER - JUNE 6, 2011
FORMER TEXACO STATION 30-7233
2259 FIRST STREET
Livermore, California

312264-2011(013)GN-WA003 AUG 29/2011

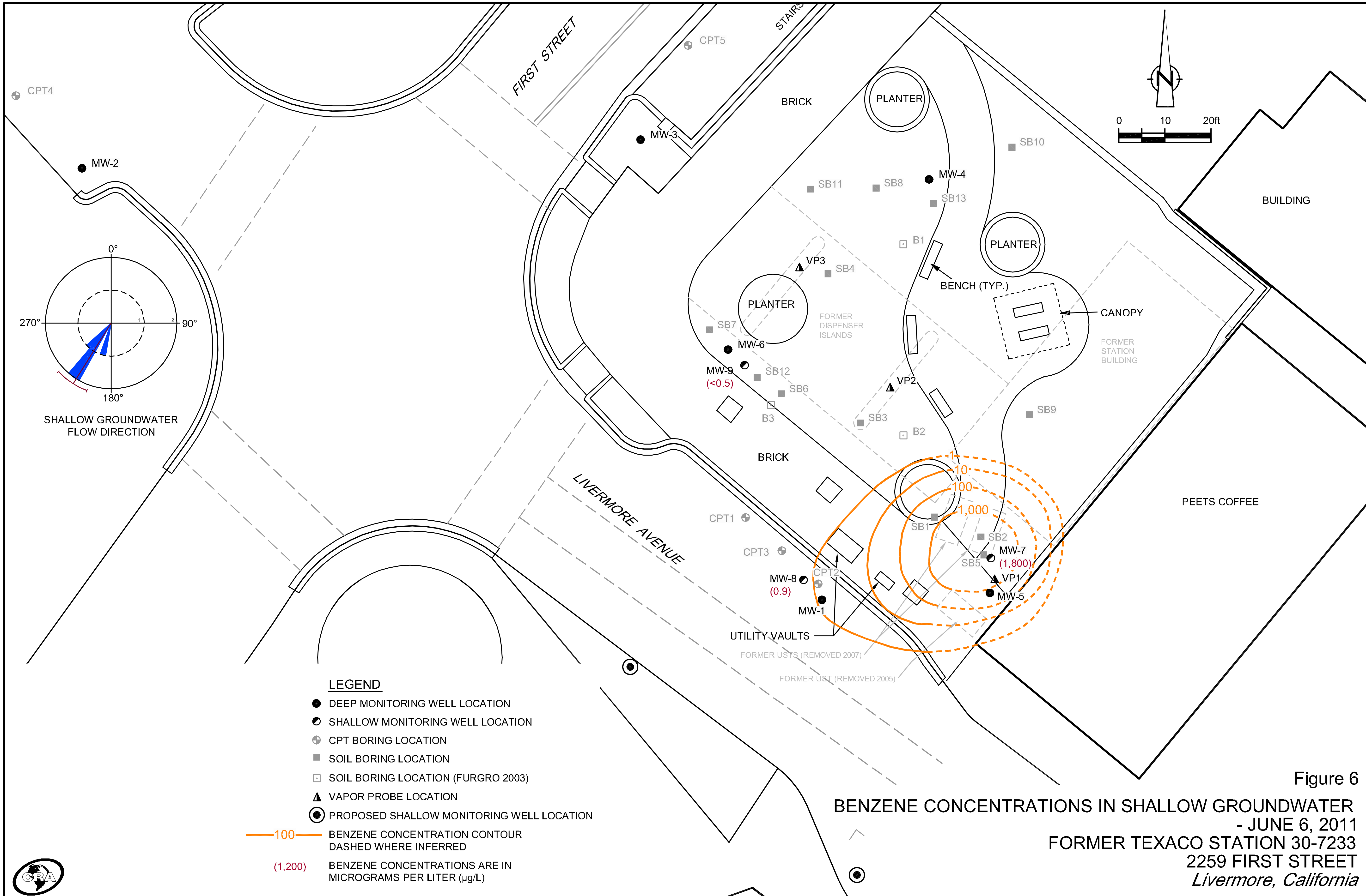


Figure 6

BENZENE CONCENTRATIONS IN SHALLOW GROUNDWATER
- JUNE 6, 2011
FORMER TEXACO STATION 30-7233
2259 FIRST STREET
Livermore, California

312264-2011(013)GN-WA004 AUG 29/2011

ATTACHMENT A

REGULATORY CORRESPONDENCE

ALAMEDA COUNTY
HEALTH CARE SERVICES
AGENCY
ALEX BRISCOE, Director

ENVIRONMENTAL HEALTH SERVICES
ENVIRONMENTAL PROTECTION
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577
(510) 567-6700
FAX (510) 337-9335

June 9, 2011

Mr. Thomas Bauhs (*Sent via E-mail to: tbauhs@chevron.com*)
Chevron Environmental Management Company
6001 Bollinger Canyon Road
San Ramon, CA 94583-2324

Mr. Eric Uranga (*Sent via E-mail to: ejuranga@ci.livermore.ca.us*)
City of Livermore Economic Development
1052 S. Livermore Ave.
Livermore, CA 94550

Subject: Draft Corrective Action Plan for Fuel Leak Case No. RO0002908 and GeoTracker Global ID T0600196622, Miller Square Park, 2259 First Street, Livermore, CA 94550

Dear Mr. Bauhs and Mr. Uranga:

Alameda County Environmental Health (ACEH) staff has reviewed the fuel leak case file for the above referenced site including the most recently submitted document entitled, "*Draft Corrective Action Plan, Former Texaco Station, 30-7233, 2259 First Street, Livermore, California*," dated May 3, 2011 (CAP). The CAP, which was prepared on behalf of Chevron by Conestoga-Rovers & Associates (CRA), is inadequate in scope, presents unsupported and questionable conclusions regarding the feasibility of remedial alternatives, and is generally biased in promoting a monitored natural attenuation (MNA) alternative. Due to the inadequacies of the CAP, which are discussed in detail in the technical comments below, the CAP is not acceptable in its current form.

The CAP concludes with little supporting information that all active remedial alternatives considered are not feasible and that only monitored natural attenuation is viable. Active remediation is ongoing at several nearby sites with similar conditions. It appears that active remediation was not given fair and serious consideration. The conclusions regarding the feasibility of active remedial alternatives are flawed and unconvincing as discussed in the technical comments below.

The CAP concludes that soil vapor extraction and air sparging cannot be adequately evaluated because the site is not fully characterized. The conclusion that the site is not fully characterized is both unexpected and untimely since ACEH has requested since April 2009 that remedial alternatives be evaluated for the site. It is not clear why Chevron and CRA would delay submittal of the CAP for two years and then conclude that the site is not characterized. There has been ample time and opportunity to conduct whatever characterization activities are needed to complete site characterization and evaluate remedial alternatives. To illustrate this point, please see the Chronology of Recent Site Activities.

CHRONOLOGY OF RECENT SITE ACTIVITIES

- September 2003. Fugro West, Inc. conducts an investigation of soil and groundwater on behalf of the City of Livermore Engineering Division. Elevated concentrations of fuel hydrocarbons were detected in groundwater and lead was detected at an elevated concentration in shallow soil from Mill Square Park. ACEH discovered these results in February 2007 as an attachment to a drilling permit. Reporting of these results is a regulatory requirement that apparently was not met by the City of Livermore.

- September 2005. Removal of a previously unknown UST.
- August 2006. A geophysical investigation located two additional suspected USTs.
- September and October 2006. Five soil borings were advanced in the vicinity of the former dispenser islands and suspected USTs. The borings were terminated at 40 feet bgs without encountering groundwater or getting beyond the vertical extent of contamination even though the June 26, 2006 Work Plan proposed advancing borings to first encountered groundwater or approximately 10 feet below the deepest identified indication of hydrocarbon impacts.
- December 22, 2006. Cambria Environmental Technology, Inc. submits the results of the September and October 2006 investigation in a report entitled, "*Subsurface Investigation Report*." The Report recommends abandoning the two suspected USTs in place until site redevelopment activities occur.
- June 2007. At the direction of ACEH and Livermore-Pleasanton Fire Department, the two additional USTs and piping were removed.
- July 20, 2007. Site Investigation Workplan
- October 2, 2007. Revised Site Investigation Workplan. The Work Plan proposes delaying evaluation of potential future vapor intrusion until the site is redeveloped.
- October 29, 2007. Revised Site Investigation Workplan.
- February 2008. Subsurface investigation that included two CPT borings, three soil vapor probes, and 11 soil borings was completed. The CPT borings were planned to go to 80 feet bgs to define the vertical extent of contamination but due to miscommunication with field staff were limited to 55 feet bgs.
- March 27, 2008. Subsurface Investigation Report and Well Installation Workplan
- May 9, 2008. ACEH Directive Letter requests additional horizontal and vertical delineation of the extent of contamination.
- July 9, 2008. Soil Boring Workplan proposes advancing soil borings for horizontal and vertical delineation prior to installing monitoring wells to assure that the wells are best located for monitoring of the plume.
- December 17, 208. Chevron and CRA request a schedule extension from January 6, 2009 to March 6, 2009, which is approved by ACEH.
- March 5, 2009. Subsurface Investigation Report is submitted. However, planned boring CPT6 was not advanced due to access issues with an off-site property owner. The Report did not include conclusions or recommendations because CPT6 was not advanced.
- April 3, 2009. ACEH directive letter requests a Pilot Test Work Plan or Draft Corrective Action Plan. Based on the crossgradient location of CPT6, ACEH indicates that CPT6 may not be required. ACEH requests a Pilot Test Work Plan or Draft CAP to begin site cleanup by June 10, 2009. The Pilot Test Work Plan is to include plans for groundwater monitoring to evaluate the effectiveness of site cleanup.
- June 10, 2009. Chevron and CRA submit a document entitled, "*Pilot Test Work Plan or Draft Corrective Action Plan*." However, the document only proposes the installation of four monitoring wells and one year of monitoring. No pilot tests, data collection to evaluate remedial alternatives, or site cleanup is proposed.
- August 4, 2009 ACEH Directive Letter. ACEH indicates that based on the nature and extent of contamination, remedial action will be required for the site. ACEH does not object to the collection of additional data that are necessary for the more effective or more efficient

development of feasible remedial alternatives for the site. However, the data collection must be necessary for and focused towards the development of remedial alternatives. ACEH requests that Chevron and CRA review and discuss specific possible remedial options for the site. For each remedial option, any additional data collection that is necessary for evaluation of the remedial options is to be identified.

- September 28, 2009. A Revised Work Plan is submitted. However, the Revised Work Plan only proposes the installation and monitoring of four monitoring wells. The Closing section of the Revised Work Plan indicates, "We appreciate ACHE's desire to accelerate site remediation. Chevron also has a strong desire to address this situation, but in order to implement the most effective solution, sufficient data must be collected to make an informed remedial decision. We will review remedial options once we have collected the data proposed herein."
- November 6, 2009. ACEH rejects the September 28, 2009 Revised Work Plan because it does not address ACEH's technical comments.
- January 6, 2009. Revised Work Plan is submitted.
- January 29, 2010. ACHE approves the Revised Work Plan.
- June 3, 2010. Well Installation Report is submitted. Chevron and CRA propose monitoring for four consecutive quarters before evaluating the data to assess the need for additional work.
- July 26, 2010. ACEH indicates that four quarters of data are not needed before developing and assessing remedial alternatives and requests that a Pilot Test Work Plan or Draft Corrective Action Plan be submitted no later than October 15, 2010.
- October 12 2010. Chevron and CRA submit a Response to Technical Comments. The Response indicates that CRA believes it is necessary to understand seasonal groundwater and hydrocarbon fluctuations prior to performing remedial pilot testing or evaluating potential remedial alternatives. Submittal of a Pilot Test Work Plan or Draft CAP by May 1, 2011 is proposed.
- November 15, 2010. ACEH Directive Letter. ACEH does not agree that delaying evaluation of remedial alternatives for four quarters is necessary but reluctantly agrees to an extension to May 3, 2001 for submittal of a Pilot Test Work Plan or Draft CAP. ACEH requests assurance that no further delays occur in the submittal.
- May 3, 2011. Chevron and CRA submit the "*Draft Corrective Action Plan.*" .

FUTURE ACTIONS

The May 3, 2011 Draft CAP is inadequate in scope, presents unsupported and questionable conclusions regarding the feasibility of remedial alternatives, and is generally biased in promoting a monitored natural attenuation (MNA) alternative. The installation of two additional monitoring wells and two years of monitoring is proposed before considering any active remedial alternatives. There is no valid reason for this proposed two to three year delay. The continued series of delays in considering active remediation must be stopped to allow the case to move to cleanup.

Therefore, we request one of the two courses of action outlined below:

1. **Work Plan to Address Data Gaps**. If there are legitimate data gaps or reasons that you are unable to evaluate active remedial alternatives, please specifically identify those data gaps and propose investigation activities to address them. Please focus the proposed activities on the data needed to complete site characterization and evaluate active remedial alternatives. Please

consider the use of continuous methods such as a Membrane Interface Probe to provide a detailed delineation of the extent of contamination within both the shallow and deep water-bearing zones. Limiting the investigation to well installation and monitoring of MNA parameters is not acceptable. **The Work Plan is to be submitted no later than August 10, 2011.**

2. **Pilot Test Work Plan or Revised Draft CAP**. If there are no data gaps that prevent evaluation of active remedial alternatives, please submit a Pilot Test Work Plan or Revised Draft CAP. A Revised Draft CAP must address the technical comments below and provide an objective evaluation of active remedial alternatives**. The Pilot Test Work Plan or Revised Draft CAP is to be submitted no later than August 10, 2011.**

TECHNICAL COMMENTS

1. **Dissolved Oxygen (DO) and Oxygen Reduction Potential (ORP) Data**. The CAP includes graphs of DO and ORP versus petroleum hydrocarbon concentrations in various wells and concludes from an inverse relationship that active biodegradation is occurring. The DO and ORP data were measured once in the field prior to purging. It is not clear that the water quality parameters are representative or were stable at the time of measurement prior to purging. In attempting to compare these measurements to data from previous sampling events, we noted that DO and ORP were not measured during previous sampling events. Given that only one DO and ORP measurement of uncertain accuracy appears to have been collected, the validity of the conclusions based on a single measurement is also uncertain.

2. **Depletion of Electron Acceptors in Shallow Zone**. The CAP concludes that anaerobic biodegradation is occurring in the core of the shallow plume (MW-7 and MW-8) based on an inverse relationship between nitrate and sulfate concentrations and petroleum hydrocarbons concentrations. We concur that anaerobic biodegradation utilizing nitrate and sulfate appears to have taken place but the current and more significantly the future rate is not clear. In the Summary of Alternatives section, the CAP uses the inverse relationship between nitrate and sulfate concentrations and petroleum hydrocarbons concentrations to infer that MNA is a feasible alternative for restoring groundwater quality. Given that groundwater quality has not been restored within the past 50 years and that the electron acceptors are now depleted, it is difficult to comprehend how anaerobic biodegradation processes would now restore water quality within a reasonable time period. Instead, it would appear that with the electron acceptors depleted, the biodegradation processes would occur at lower rates in the future and would require source treatment or augmentation at a minimum to restore water quality.

3. **Petroleum Hydrocarbon Concentrations in Deep Water-Bearing Zone**. In Section 4.4 – Remedial Alternatives Discussion and Approach, the CAP proposes that remediation should focus on shallow water-bearing zone because dissolved petroleum hydrocarbons were not detected or were detected at concentrations less than drinking water ESLs during the most recent sampling event. Elevated concentrations of TPHg, TPHd, and BTEX have been detected in soil and grab groundwater samples collected from the deep water-bearing zone and have also been detected in groundwater from the deep wells during previous events. The apparent decreases in concentrations noted in groundwater from the deep wells appear suspect. It seems highly unlikely that petroleum hydrocarbons would initially be detected at elevated concentrations in three deep wells but then disappear from the lower

water-bearing zone after the monitoring wells were installed. We request that you propose modified groundwater sampling methods or additional investigation to evaluate whether the groundwater sampling data are representative.

4. **Focus of Remediation.** As discussed in technical comment 3, further evaluation is needed to determine whether the focus of remediation can be limited to the shallow water-bearing zone.

5. **Feasibility of In-Situ Chemical Oxidation (ISCO)**. The CAP concludes that ISCO is not feasible due to the potential for fugitive vapors to enter the adjacent building and the potential exothermic reactions beneath the building. No supporting information is provided to indicate how this conclusion was reached. No possible mitigation measures are mentioned such as controlling reactions by controlling injection volumes and rates, various types of slow release oxidants, and the fact that the treatment zone would be more than 20 feet below ground surface. We do not understand how ISCO would be dismissed as not feasible without consideration of any techniques to control, monitor, or mitigate the perceived threats. We reject this analysis based on its incompleteness and lack of technical merit.

6. **Inability to Evaluate Soil Vapor Extraction with Air Sparging (SVE/AS)**. The CAP indicates that the site is not fully characterized and therefore, the equipment required for SVE/AS cannot be adequately evaluated. It is not clear what data gaps this statement refers to and why these data gaps would not be addressed in a pilot test. Please specifically identify those data gaps and propose investigation or pilot test activities to address them.

7. **Feasibility of Soil Vapor Extraction with Air Sparging (SVE/AS)**. SVE/AS is not considered viable because the CAP reports that the City of Livermore will not allow a system to be placed in the park. No reason is given as to why a remediation system would not be permitted. The City of Livermore is a responsible party for this site and must, at a minimum, cooperate to investigate and cleanup the site. We reject the analysis regarding SVE/AS based on the lack of any apparent reason that a system cannot be installed.

8. **Proposed Off-Site Investigation**. The CAP recommends installing two shallow groundwater monitoring wells and sampling them for two years before considering active remediation. This proposal is entirely unacceptable. Monitoring wells are not an effective method for defining plume extent. As discussed on pages 3 and 4 of this letter, we request that you either submit a Work Plan to address data gaps to complete site characterization and evaluate active remedial alternatives or submit a Pilot Test Work Plan or Revised Draft CAP. Please consider the use of continuous methods such as a Membrane Interface Probe to provide a detailed delineation of the extent of contamination within both the shallow and deep water-bearing zone.

9. **Groundwater Monitoring**. The most recent groundwater monitoring report entitled, “First Quarter 2011 Groundwater Monitoring and Sampling Report,” dated April 9, 2011 recommends reducing the sampling frequency to semiannual during the first and third quarters. We have no objection to this recommendation at this time. More frequent sampling may be required during pilot test or site cleanup activities or following the installation of additional monitoring wells.

TECHNICAL REPORT REQUEST

Please submit technical reports to Alameda County Environmental Health (Attention: Jerry Wickham), according to the following schedule:

- **August 10, 2011** – Work Plan to Address Data Gaps or Pilot Test Work Plan or Revised Draft Corrective Action Plan

- **October 28, 2011** – Semi-Annual Groundwater Monitoring Report – Third Quarter 2011

If you have any questions, please call me at (510) 567-6791 or send me an electronic mail message at jerry.wickham@acgov.org.

Sincerely,

Jerry Wickham

Digitally signed by Jerry Wickham
DN: cn=Jerry Wickham, o=Alameda County Environmental Health, ou, email=jerry.wickham@acgov.org, c=US
Date: 2011.06.09 18:41:58 -07'00'

Jerry Wickham, California PG 3766, CEG 1177, and CHG 297
Senior Hazardous Materials Specialist

Attachment: Responsible Party(ies) Legal Requirements/Obligations

Enclosure: ACEH Electronic Report Upload (ftp) Instructions

cc: Cheryl Dizon, QIC 80201, Zone 7 Water Agency, 100 North Canyons Parkway
Livermore, CA 94551 (*Sent via E-mail to: cdizon@zone7water.com*)

Danielle Stefani, Livermore-Pleasanton Fire Department, 3560 Nevada Street
Pleasanton, CA 94566 (*Sent via E-mail to: DStefani@lpfire.org*)

John Rigter, Livermore-Pleasanton Fire Department, 3560 Nevada Street
Pleasanton, CA 94566(*Sent via E-mail to: jrigter@lpfire.org*)

Brandon Wilken, Conestoga-Rovers & Associates, 5900 Hollis Street, Suite A
Emeryville, CA 94608 (*Sent via E-mail to: BWilken@craworld.com*)

Kiersten Hoey, Conestoga-Rovers & Associates, 5900 Hollis Street, Suite A
Emeryville, CA 94608 (*Sent via E-mail to: Khoey@craworld.com*)

Donna Drogos, ACEH (*Sent via E-mail to: donna.drogos@acgov.org*)
Jerry Wickham, ACEH (*Sent via E-mail to: jerry.wickham@acgov.org*)
Mark Detterman, ACEH (*Sent via E-mail to: mark.detterman@acgov.org*)

GeoTracker, eFile

Attachment 1

Responsible Party(ies) Legal Requirements / Obligations

REPORT REQUESTS

These reports are being requested pursuant to California Health and Safety Code Section 25296.10. 23 CCR Sections 2652 through 2654, and 2721 through 2728 outline the responsibilities of a responsible party in response to an unauthorized release from a petroleum UST system, and require your compliance with this request.

ELECTRONIC SUBMITTAL OF REPORTS

ACEH's Environmental Cleanup Oversight Programs (LOP and SLIC) require submission of reports in electronic form. The electronic copy replaces paper copies and is expected to be used for all public information requests, regulatory review, and compliance/enforcement activities. Instructions for submission of electronic documents to the Alameda County Environmental Cleanup Oversight Program FTP site are provided on the attached "Electronic Report Upload Instructions." Submission of reports to the Alameda County FTP site is an addition to existing requirements for electronic submittal of information to the State Water Resources Control Board (SWRCB) GeoTracker website. In September 2004, the SWRCB adopted regulations that require electronic submittal of information for all groundwater cleanup programs. For several years, responsible parties for cleanup of leaks from underground storage tanks (USTs) have been required to submit groundwater analytical data, surveyed locations of monitoring wells, and other data to the GeoTracker database over the Internet. Beginning July 1, 2005, these same reporting requirements were added to Spills, Leaks, Investigations, and Cleanup (SLIC) sites. Beginning July 1, 2005, electronic submittal of a complete copy of all reports for all sites is required in GeoTracker (in PDF format). Please visit the SWRCB website for more information on these requirements (http://www.waterboards.ca.gov/water_issues/programs/ust/electronic_submittal/).

PERJURY STATEMENT

All work plans, technical reports, or technical documents submitted to ACEH must be accompanied by a cover letter from the responsible party that states, at a minimum, the following: "I declare, under penalty of perjury, that the information and/or recommendations contained in the attached document or report is true and correct to the best of my knowledge." This letter must be signed by an officer or legally authorized representative of your company. Please include a cover letter satisfying these requirements with all future reports and technical documents submitted for this fuel leak case.

PROFESSIONAL CERTIFICATION & CONCLUSIONS/RECOMMENDATIONS

The California Business and Professions Code (Sections 6735, 6835, and 7835.1) requires that work plans and technical or implementation reports containing geologic or engineering evaluations and/or judgments be performed under the direction of an appropriately registered or certified professional. For your submittal to be considered a valid technical report, you are to present site specific data, data interpretations, and recommendations prepared by an appropriately licensed professional and include the professional registration stamp, signature, and statement of professional certification. Please ensure all that all technical reports submitted for this fuel leak case meet this requirement.

UNDERGROUND STORAGE TANK CLEANUP FUND

Please note that delays in investigation, later reports, or enforcement actions may result in your becoming ineligible to receive grant money from the state's Underground Storage Tank Cleanup Fund (Senate Bill 2004) to reimburse you for the cost of cleanup.

AGENCY OVERSIGHT

If it appears as though significant delays are occurring or reports are not submitted as requested, we will consider referring your case to the Regional Board or other appropriate agency, including the County District Attorney, for possible enforcement actions. California Health and Safety Code, Section 25299.76 authorizes enforcement including administrative action or monetary penalties of up to $10,000 per day for each day of violation.

Alameda County Environmental Cleanup Oversight Programs (LOP and SLIC)	**REVISION DATE:** July 20, 2010 **ISSUE DATE:** July 5, 2005 **PREVIOUS REVISIONS:** October 31, 2005; December 16, 2005; March 27, 2009; July 8, 2010
SECTION: Miscellaneous Administrative Topics & Procedures	**SUBJECT:** Electronic Report Upload (ftp) Instructions

The Alameda County Environmental Cleanup Oversight Programs (LOP and SLIC) require submission of all reports in electronic form to the county's ftp site. Paper copies of reports will no longer be accepted. The electronic copy replaces the paper copy and will be used for all public information requests, regulatory review, and compliance/enforcement activities.

REQUIREMENTS

- **Please do not submit reports as attachments to electronic mail.**
- Entire report including cover letter must be submitted to the ftp site as **a single portable document format (PDF) with no password protection**.
- It is **preferable** that reports be converted to PDF format from their original format, (e.g., Microsoft Word) rather than scanned.
- **Signature pages and perjury statements must be included and have either original or electronic signature.**
- **Do not password protect the document**. Once indexed and inserted into the correct electronic case file, the document will be secured in compliance with the County's current security standards and a password. **Documents with password protection will not be accepted**.
- Each page in the PDF document should be rotated in the direction that will make it easiest to read on a computer monitor.
- Reports must be named and saved using the following naming convention:

  RO#_Report Name_Year-Month-Date (e.g., RO#5555_WorkPlan_2005-06-14)

Submission Instructions

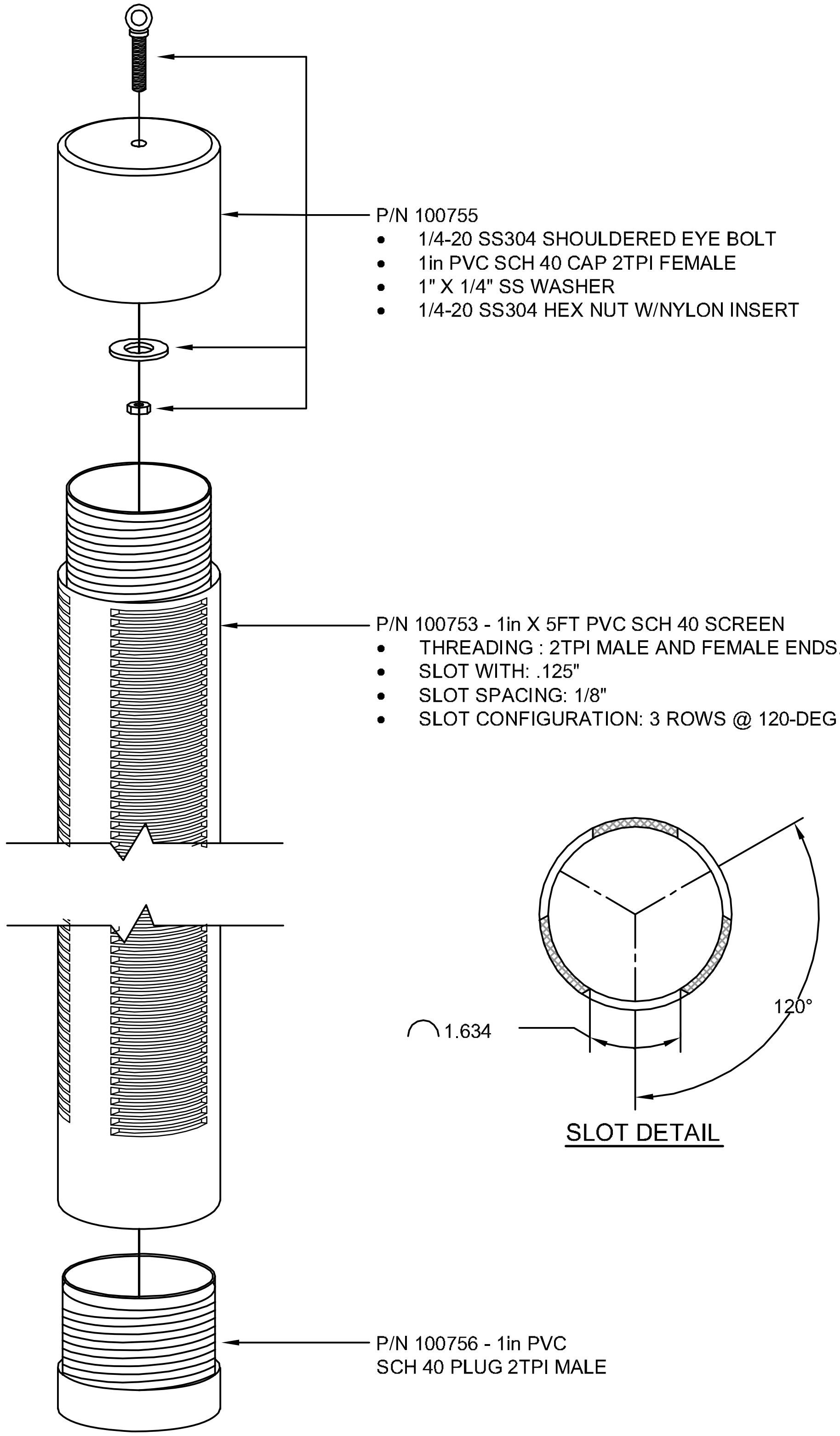
1) Obtain User Name and Password
   a) Contact the Alameda County Environmental Health Department to obtain a User Name and Password to upload files to the ftp site.
      i) Send an e-mail to deh.loptoxic@acgov.org
   b) In the subject line of your request, be sure to include **"ftp PASSWORD REQUEST"** and in the body of your request, include the **Contact Information, Site Addresses**, and the **Case Numbers (RO# available in Geotracker) you will be posting for**.

2) Upload Files to the ftp Site
   a) Using Internet Explorer (IE4+), go to ftp://alcoftp1.acgov.org
      (i) Note: Netscape, Safari, and Firefox browsers will not open the FTP site as they are NOT being supported at this time.
   b) Click on Page located on the Command bar on upper right side of window, and then scroll down to Open FTP Site in Windows Explorer.
   c) Enter your User Name and Password. (Note: Both are Case Sensitive.)
   d) Open "My Computer" on your computer and navigate to the file(s) you wish to upload to the ftp site.
   e) With both "My Computer" and the ftp site open in separate windows, drag and drop the file(s) from "My Computer" to the ftp window.

3) Send E-mail Notifications to the Environmental Cleanup Oversight Programs
   a) Send email to deh.loptoxic@acgov.org notify us that you have placed a report on our ftp site.
   b) Copy your Caseworker on the e-mail. Your Caseworker's e-mail address is the entire first name then a period and entire last name @acgov.org. (e.g., firstname.lastname@acgov.org)
   c) The subject line of the e-mail must start with the RO# followed by **Report Upload**. (e.g., Subject: RO1234 Report Upload) If site is a new case without an RO#, use the street address instead.
   d) If your document meets the above requirements and you follow the submission instructions, you will receive a notification by email indicating that your document was successfully uploaded to the ftp site.

ATTACHMENT B

SULFATE CANISTER FIGURES



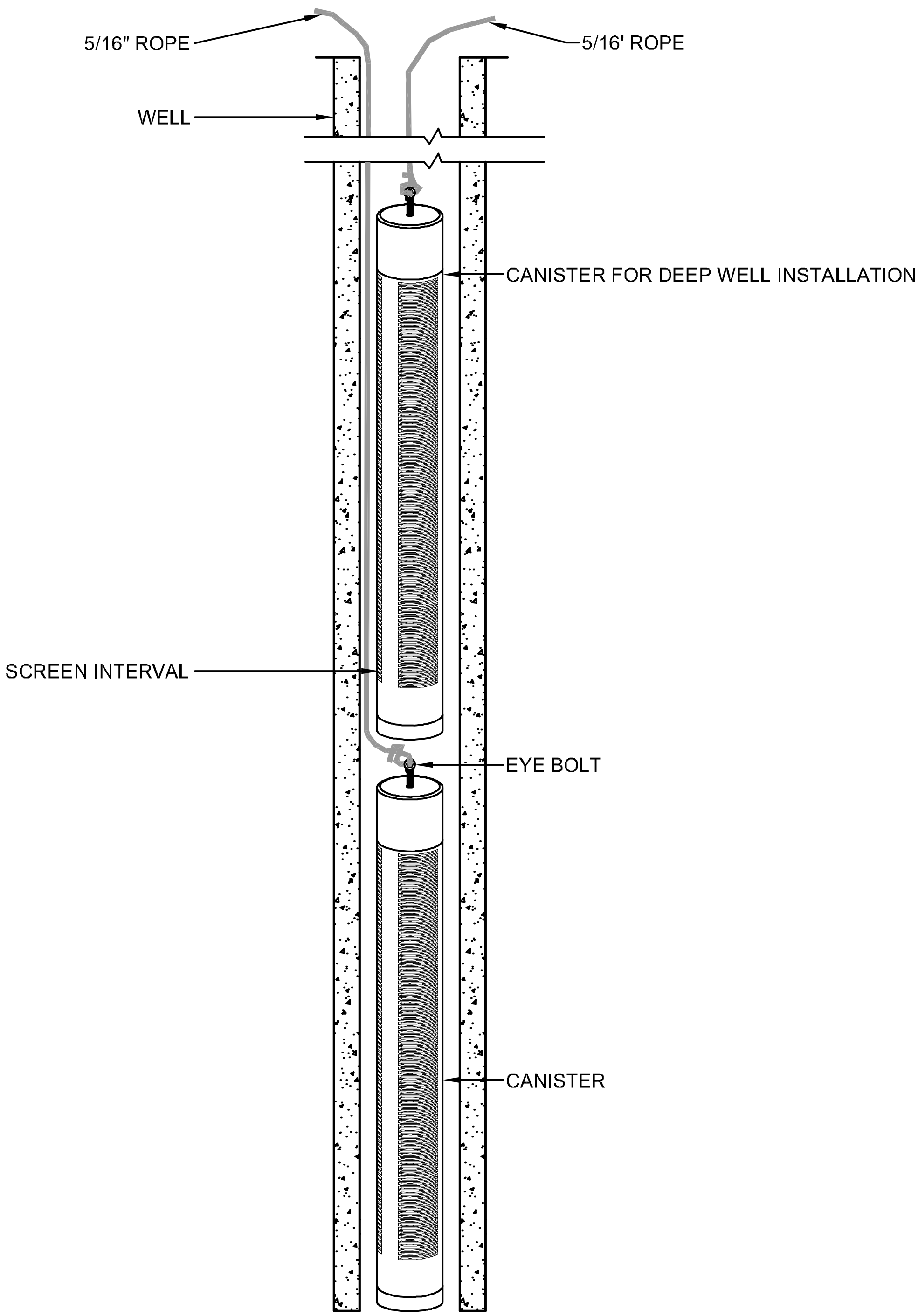
N.T.S.

Figure 1

GYPSUM CANISTER DIAGRAM
FORMER TEXACO STATION 30-7233
2259 FIRST STREET
Livermore, California

SOURCE: AECOM

312264-2011(013)GN-WA006 AUG 31/2011



N.T.S.

Figure 2

GYPSUM CANISTERS SETUP
FORMER TEXACO STATION 30-7233
2259 FIRST STREET
Livermore, California

SOURCE: AECOM

312264-2011(013)GN-WA007 AUG 31/2011

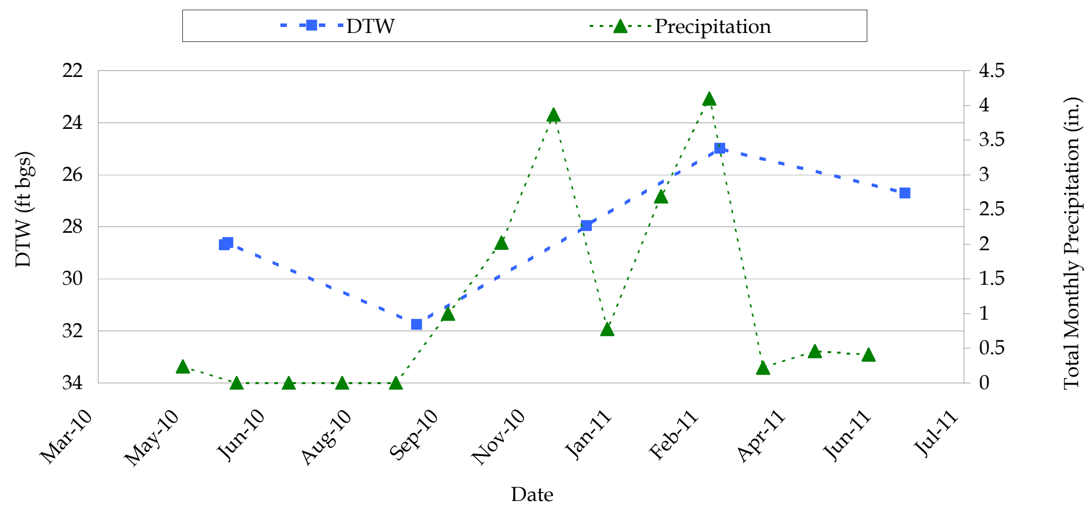
ATTACHMENT C

DTW AND PRECIPITATION CHART AND IRRIGATION WATER CALCULATION

MW-7
DEPTH TO WATER AND PRECIPITATION CHART
CALCULATION FOR IRRIGATION WATER

Date	DTW
5/25/2010	28.69
5/27/2010	28.61
9/13/2010	31.75
12/20/2010	27.96
3/7/2011	24.98
6/22/2011	26.71

Month	Actual Monthly Precipitation (inches) from www.elivermore.com
May-10	0.24
Jun-10	0
Jul-10	0
Aug-10	0
Sep-10	0
Oct-10	1.00
Nov-10	2.02
Dec-10	3.87
Jan-11	0.78
Feb-11	2.69
Mar-11	4.10
Apr-11	0.22
May-11	0.46
Jun-11	0.41



FORMER TEXACO STATION 307233
2259 FIRST STREET
LIVERMORE, CALIFORNIA

CONESTOGA-ROVERS & ASSOCIATES

MW-7: DTW VERSUS PRECIPITATION

Basis for quantity of irrigation water for land application		
Monthly maximum rainfall	3.5	inches
Land Application Area	1000	ft^2
Assumed duration of maximum rainfall	30	days
Assume safety factor (to account for evapotranspiration)	0%	%
Total irrigation water (gallons)	**2182**	**gal**

Basis for quantity of irrigation water for land application		
Monthly maximum rainfall	3.5	inches
Land Application Area	5500	ft^2
Assumed duration of maximum rainfall	30	days
Assume safety factor (to account for evapotranspiration)	0%	%
Total irrigation water (gallons)	**12001**	**gal**

ATTACHMENT D

STANDARD FIELD PROCEDURES FOR SOIL BORING AND MONITORING WELL INSTALLATION

STANDARD FIELD PROCEDURES FOR SOIL BORING AND MONITORING WELL INSTALLATION

This document presents standard field methods for drilling and sampling soil borings and installing, developing and sampling groundwater monitoring wells. These procedures are designed to comply with Federal, State and local regulatory guidelines. Specific field procedures are summarized below.

SOIL BORINGS

Objectives

Soil samples are collected to characterize subsurface lithology, assess whether the soils exhibit obvious hydrocarbon or other compound vapor or staining, and to collect samples for analysis at a State-certified laboratory. All borings are logged using the ASTM D2488-06 Unified Soil Classification System by a trained geologist working under the supervision of a California Professional Geologist (PG).

Soil Boring and Sampling

Prior to drilling, the first 8 feet of the boring are cleared using an air or water knife and vacuum extraction or hand auger. This minimizes the potential for impacting utilities. Soil borings are typically drilled using hollow-stem augers or direct-push technologies such as the Geoprobe®. Soil samples are collected at least every five ft to characterize the subsurface sediments and for possible chemical analysis. Additional soil samples are collected near the water table and at lithologic changes. Samples are collected using lined split-barrel or equivalent samplers driven into undisturbed sediments at the bottom of the borehole.

Drilling and sampling equipment is steam-cleaned prior to drilling and between borings to prevent cross-contamination. Sampling equipment is washed between samples with trisodium phosphate or an equivalent EPA-approved detergent.

Sample Analysis

Sampling tubes chosen for analysis are trimmed of excess soil and capped with Teflon tape and plastic end caps. Soil samples are labeled and stored at or below 4° C on either crushed or dry ice, depending upon local regulations. Samples are transported under chain-of-custody to a State-certified analytic laboratory.

Field Screening

One of the remaining tubes is partially emptied leaving about one-third of the soil in the tube. The tube is capped with plastic end caps and set aside to allow hydrocarbons to volatilize from the soil. After ten to fifteen minutes, a portable volatile vapor analyzer measures volatile hydrocarbon vapor concentrations in the tube headspace, extracting the vapor through a slit in the cap. Volatile vapor analyzer measurements are used along with the field observations, odors, stratigraphy and groundwater depth to select soil samples for analysis.

Water Sampling
Water samples, if they are collected from the boring, are either collected using a driven Hydropunch® type sampler or are collected from the open borehole using bailers. The groundwater samples are decanted into the appropriate containers supplied by the analytic laboratory. Samples are labeled, placed in protective foam sleeves, stored on crushed ice at or below 4°C, and transported under chain-of-custody to the laboratory. Laboratory-supplied trip blanks accompany the samples and are analyzed to check for cross-contamination. An equipment blank may be analyzed if non-dedicated sampling equipment is used.

Grouting
If the borings are not completed as wells, the borings are filled to the ground surface with cement grout poured or pumped through a tremie pipe.

MONITORING WELL INSTALLATION, DEVELOPMENT AND SAMPLING

Well Construction and Surveying
Groundwater monitoring wells are installed to monitor groundwater quality and determine the groundwater elevation, flow direction and gradient. Well depths and screen lengths are based on groundwater depth, occurrence of hydrocarbons or other compounds in the borehole, stratigraphy and State and local regulatory guidelines. Well screens typically extend 10 to 15 feet below and 5 feet above the static water level at the time of drilling. However, the well screen will generally not extend into or through a clay layer that is at least three feet thick.

Well casing and screen are flush-threaded, Schedule 40 PVC. Screen slot size varies according to the sediments screened, but slots are generally 0.010 or 0.020 inches wide. A rinsed and graded sand occupies the annular space between the boring and the well screen to about one to two feet above the well screen. A two feet thick hydrated bentonite seal separates the sand from the overlying sanitary surface seal composed of Portland type I, II cement.

Well-heads are secured by locking well-caps inside traffic-rated vaults finished flush with the ground surface. A stovepipe may be installed between the well-head and the vault cap for additional security.

The well top-of-casing elevation is surveyed with respect to mean sea level and the well is surveyed for horizontal location with respect to an onsite or nearby offsite landmark.

Well Development
Wells are generally developed using a combination of groundwater surging and extraction. Surging agitates the groundwater and dislodges fine sediments from the sand pack. After about ten minutes of surging, groundwater is extracted from the well using bailing, pumping and/or reverse air-lifting through an eductor pipe to remove the sediments from the well. Surging and extraction continue until at least ten well-casing volumes of groundwater are extracted and the sediment volume in the groundwater is negligible. This process usually occurs prior to installing the sanitary surface seal to ensure sand pack stabilization. If development occurs after surface seal installation, then development occurs 24 to 72 hours after seal installation to ensure that the Portland cement has set up correctly.

All equipment is steam-cleaned prior to use and air used for air-lifting is filtered to prevent oil entrained in the compressed air from entering the well. Wells that are developed using air-lift evacuation are not sampled until at least 24 hours after they are developed.

Groundwater Sampling
Depending on local regulatory guidelines, three to four well-casing volumes of groundwater are purged prior to sampling. Purging continues until groundwater pH, conductivity, and temperature have stabilized. Groundwater samples are collected using bailers or pumps and are decanted into the appropriate containers supplied by the analytic laboratory. Samples are labeled, placed in protective foam sleeves, stored on crushed ice at or below 4°C, and transported under chain-of-custody to the laboratory. Laboratory-supplied trip blanks accompany the samples and are analyzed to check for cross-contamination. An equipment blank may be analyzed if non-dedicated sampling equipment is used.

Waste Handling and Disposal
Soil cuttings from drilling activities are usually stockpiled onsite and covered by plastic sheeting. At least three individual soil samples are collected from the stockpiles and composited at the analytic laboratory. The composite sample is analyzed for the same constituents analyzed in the borehole samples in addition to any analytes required by the receiving disposal facility. Soil cuttings are transported by licensed waste haulers and disposed in secure, licensed facilities based on the composite analytic results.

Groundwater removed during development and sampling is typically stored onsite in sealed 55-gallon drums. Each drum is labeled with the drum number, date of generation, suspected contents, generator identification and consultant contact. Upon receipt of analytic results, the water is either pumped out using a vacuum truck for transport to a licensed waste treatment/disposal facility or the individual drums are picked up and transported to the waste facility where the drum contents are removed and appropriately disposed.