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Alameda County
Environmental Health

June 10, 2012

Ms. Donna Drogos
Alameda County Environmental Health
1131 Harbor Parkway, Suite 250
Oakland, CA 94502-6577

Subject: Corrective Action Plan
Shore Acres Gas
403 East 12th Street, Oakland, Alameda County, California
RO #0002931
ECG # GHA.19009

Dear Ms. Drogos:

Enclosed please find a copy of the June 10, 2012 Corrective Action Plan for the above referenced site prepared by our consultant Environmental Compliance Group, LLC.

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

Respectfully,

Rashid Ghafoor

Environmental Compliance Group, LLC

270 Vintage Drive
Turlock, CA 95382
P: 209.664.1035
F: 209.664.1040

CORRECTIVE ACTION PLAN

SHORE ACRES GAS
403 EAST 12TH STREET
OAKLAND, CALIFORNIA

Prepared for: Rashid Ghafoor

ECG Project Number: GHA.19009
Alameda County Fuel Leak Case No. RO0002931

June 10, 2012

REGISTERED GEOLOGIST
MICHAEL S. SGOURAKIS
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STATE OF CALIFORNIA

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CA P.G. No. 7194

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INTRODUCTION

Environmental Compliance Group (ECG) has been authorized by Mr. Rashid Ghafoor to provide this Corrective Action Plan (CAP) for the site. This report was requested by the Alameda County Health Care Services (ACHCS) Agency in their directive letter dated May 11, 2012 (Appendix A).

Site information is as follows:

Site Location:	403 East 12th Street Oakland, California
Geotracker Global ID:	T0600174667

LIMITATIONS

This report has been prepared for use by Rashid Ghafoor and the relevant regulatory agencies. The conclusions in this report are professional opinions based on the data presented in this report. This report was prepared in general accordance with hydrogeologic and engineering methods and standards. No other warranties are made as to the findings or conclusions presented in this report. The work described in this report was performed under the direct supervision of the professional geologist whose signature and State of California registration are shown above.

SITE DESCRIPTION AND HYDROGEOLOGIC CONDITIONS

SITE DESCRIPTION

The site occupies a parcel on the southeast corner of 4th Avenue and East 12th Street in Oakland, Alameda County, California (Figure 1). The site is situated in a commercial and residential area in central Oakland and is currently vacant. The site was historically used as a gasoline station. The area of interest at the site is the former location of three underground storage tanks (USTs) and fuel dispensers where impacted soil and groundwater was first identified in 2006. A detailed site plan is shown on Figure 2.

HYDROGEOLOGIC CONDITIONS

The site is underlain by Quaternary-age dune sand deposits referred to as the Merritt Sand. The Merritt Sand is typically described as loose, well-sorted fine- to medium-grained sand with a large silt component. The sand is reported to reach a maximum depth of 50-feet bgs in the area.

Based on boring logs from the advancement of 11 soil borings and the installation of six monitoring wells and two extraction wells, the stratigraphy of the site and vicinity consists of silt to approximately 30-feet bgs with discontinuous thin intervals of sandy silt and clayey sand present in the area. A cross section location map is shown on Figure 3 and cross sections are shown on Figures 4 through 6...

Groundwater monitoring has been ongoing for two years. Depth to groundwater is shallow, ranging between 10- to 13-feet bgs. The groundwater flow direction appears to be toward the southwest. The latest groundwater gradient map is provided on Figure 6.

CLEANUP CRITERIA

It is prudent to establish cleanup goals for soil and groundwater based upon reaching the residential Environmental Screening Levels (ESLs) established by Region II for sites with shallow soil where groundwater is not a current or potential drinking water source. The primary constituents of concern relative to the site appear to be total petroleum hydrocarbons as diesel (TPHd) and gasoline (TPHg) benzene, toluene, ethylbenzene, and xylenes (BTEX), methyl tertiary butyl ether (MTBE), and tertiary butyl alcohol (TBA). Accordingly, the following cleanup goals are proposed:

Constituent	Soil (mg/kg)	Groundwater (ug/L)
TPHd	100	210
TPHg	100	210
Benzene	0.12	46
Toluene	9.3	130
Ethylbenzene	2.3	43
Xylenes	11	100
MTBE	8.4	1,800
TBA	100	18,000

PROJECT BACKGROUND

INVESTIGATIONS

In July 2006, Geofon Incorporated (Geofon) advanced soil borings GP-1 and GP-2 and collected and analyzed soil samples. Results are detailed in Geofon's report entitled *Summary of Phase II Assessment Activities,* dated July 25, 2006.

In August 2009, Wright Environmental Services, Inc. (Wright) removed three USTs, associated fuel dispensers, and all associated piping. Results are detailed in Wright's *Closure Report for Three Underground Storage Tanks,* dated September 2009.

In April 2010, Apex Envirotech, Inc. (Apex) advanced nine soil borings to evaluate the lateral extent of impacted soil and groundwater. Results are documented in Apex's *Subsurface Investigation Results Report* dated June 23, 2010.

In June 2011, ECG supervised the installation of six groundwater monitoring wells (MW-1 through MW-6) and two extraction wells (VW-1 and VW-2). Results are documented in ECG's *Interim Results and Second Quarter 2011 Monitoring Report,* dated August 17, 2011.

In December 2011, ECG supervised the advancement of twelve soil borings (SB-10 through SB-21) for the collection of grab groundwater samples. Results are documented in ECG's *Off-Site*

Investigation and Dual Phase Pilot Test Results with Fourth Quarter 2011 Monitoring Report, dated January 26, 2012.

Well construction details are provided on Table 1.

DISTRIBUTION OF MASS CONTAMINANTS

Six monitoring wells, two extraction wells, and 22 soil borings have been advanced at the site and the lateral extent of impacted soil has been adequately characterized. The boring and well locations are shown on Figures 2 and 3 and cross sections are shown on Figures 4 through 6. Soil analytical results are summarized on Tables 2a and 2b and they show reported soil concentrations did exceed ESLs for TPHg at locations GP-1, GP-2, SB-1, SB-4, SB-5, SB-6, SB-7, SB-8, SB-9, MW-3, MW-4, MW-5, VW-1, and VW-2 and did exceed ESLs for benzene at locations GP-1, GP-2, SB-1, SB-2, SB-4, SB-6, SB-7, SB-8, SB-9, MW-1, MW-3, MW-4, MW-5, VW-1, and VW-2 at depths of approximately 10- feet (below ground surface) bgs or greater. In addition, soil concentrations did exceed ESLs for toluene, ethyl benzene, and xylenes at multiple locations. The TPHg and BTEX soil concentrations do appear to be vertically defined and the lithology at the site would discourage vertical migration. All soil results above ESLs are located in or just adjacent to the transmissive zone located between approximately 10- to 20-feet bgs

Groundwater concentrations have not been defined vertically or horizontally to the north of the site. Reported concentrations in groundwater have exceeded ESLs for TPHg, BTEX, and MTBE. Groundwater samples were collected from 21 direct-push borings, six monitoring wells, and two extraction wells and the analytical results (Tables 3a, 3b, 4a, and 4b) showed ESLs were exceeded for TPHg in SB-4, SB-6, SB-7, SB-11, SB-12, SB-13, SB-15 through SB-19, MW-1 through MW-6, VW-1, and VW-2. ESLs for benzene were exceeded in SB-4, SB-11, SB-12, SB-13, SB-16, and SB-17, MW-1 through MW-6, VW-1, and VW-2. . ESLs for MTBE were exceeded in SB-6, SB-7, and SB-19, MW-1, MW-3, MW-5, MW-6, and VW-2. Groundwater isoconcentration maps using the most recent data are provided as Figures 8 and 10.

RISK ASSESSMENTS

In January 2011, ECG conducted a preferential pathway study for the site. Results are detailed in ECG's *Site Assessment and Soil Vapor Extraction Pilot Test Workplan*, dated February 9, 2011.

In January 2011, ECG conducted a sensitive receptor survey for the site. Results are detailed in ECG's *Site Assessment and Soil Vapor Extraction Pilot Test Workplan*, dated February 9, 2011.

A soil vapor survey has not been completed for the site.

CORRECTIVE ACTIONS

In June 2011, ECG supervised the installation of six groundwater monitoring wells (MW-1 through MW-6) and two extraction wells (VW-1 and VW-2)). ECG also performed a 5-day dual phase extraction (DPE) test in June 2011. Results are documented in ECG's *Off-Site Investigation and Dual Phase Pilot Test Results with Fourth Quarter 2011 Monitoring Report*, dated January 26, 2012.

FEASIBILITY STUDY

Based on the results of site assessment and pilot testing activities, three remedial options are being evaluated for the treatment of petroleum hydrocarbon impacted soil at the site: soil vapor extraction, soil excavation, and DPE. The site currently has a well network to monitor soil and groundwater conditions. The network consists of six groundwater monitoring wells and two DPE wells (Table 1). These engineering controls will be available regardless of the recommendation made in this CAP.

SOIL VAPOR EXTRACTION

A SVE system can remove volatile organic compounds (VOCs) vapors from the subsurface by creating a vacuum in the vadose zone to directly remove VOCs.

The results of the DPE pilot test indicated that SVE would be effective at recovering fugitive soil vapors in the impacted soil. Test results showed that vapor flow rates exceeding 150 standard cubic feet per minute (scfm) and vapor influence was seen at observation wells approximately 30 feet away from the extraction well. During the DPE test, influent vapor results ranged from 190 parts per million by volume (ppmv) to 11,000 ppmv. Field and analytical data from the DPE pilot test are contained in Tables 6 through 8.

Although the SVE system would reduce contaminants from the vadose zone, it would not effectively remove contaminants from the saturated zone or control impacted groundwater migration. An air sparge or ozone sparge component could be added to increase the effectiveness of SVE at remediating impacted groundwater, but due to the large amounts of silt in the subsurface (Figures 4, 5, and 6) it is likely that air sparge radius of influence (ROI) would be minimal and ineffective. In addition, air or ozone sparge would not control impacted groundwater migration resulting in potential offsite remediation requirements.

SOIL EXCAVATION

As discussed previously soil analytical results (Tables 2a and 2b) show reported soil concentrations did exceed ESLs for TPHg, BTEX, and MTBE. The majority of soil concentrations exceeding ESLs are between 11- and 20-feet bgs in the first encountered groundwater zone. Utilizing data on Figures 4, 5, 6, 8, 9, and 10 the masses of TPHg, benzene, and MTBE calculations were performed and show approximately 11,217 pounds of TPHg, 18.1 pounds of benzene, and 10.5 pounds of MTBE were present in the soil Table 9.

To remove the impacted soil on site only to a depth of 20-feet bgs, a volume of approximately 40,000 cubic feet or 2,000 tons of material would have to be excavated and transported off site. During tank removal activities the odor from the excavated material was impacting nearby residences and Alameda County directed Mr. Ghafoor to put the material back in the pit and resurface the area.

As shown on Figures 4 through 6, the entire soil column to 20-feet bgs would need to be removed. In addition, shoring to protect the adjacent buildings and the right-of way would have to be completed utilizing a registered engineering company. Wells MW-1 through MW-6, VW-1 and VW-2 would have to be removed and reinstalled. The surface of the site would need to be restored for reuse...

Due to the area of the soil contamination, the close proximity of the building and the roads, the additional engineering/shoring costs, and the presence of potential contamination under 4th Avenue and the adjacent property west of the site, excavation is not a cost effective method to remediate the site.

DUAL PHASE EXTRACTION

A DPE system can remove volatile organic compounds (VOCs) vapors from the subsurface by creating a vacuum in the vadose zone and from groundwater by direct extraction.

In the January 2012 *Off Site Investigation and Dual Phase Pilot Test Results With Fourth Quarter 2011 Groundwater Monitoring Report*, ECG recommended DPE as a viable option for the site. During the DPE pilot test, vapor flow rates exceeding 150 cubic feet per minute were observed and vapor influence was seen at observation wells approximately 30 feet away from the extraction well. During the DPE test, influent vapor results ranged from 190 parts per million by volume (ppmv) to 11,000 ppmv.

Groundwater extraction rates of greater than 2-gallon per minute were recorded, and drawdown of 1-foot to 5-feet was measured in observation wells approximately 30 feet away from extraction wells. Groundwater concentrations in extraction wells VW-1 and VW-2 and all monitoring wells are substantial. Groundwater extraction would effectively lower the mass while controlling off site migration. It was determined that groundwater extraction was the best remedial alternative.

The proposed SVE system is a Mako brand 400 scfm catalytic oxidizer. The DPE system will utilize the two existing extraction wells, VW-1 and VW-2, and at least two additional extraction wells, one located near monitoring well MW-5 and one on the western edge of the property. The ROI measured during the pilot test was approximately 68 feet and placing extraction wells along the western edge of the property would extend the site ROI to beneath the adjacent property building downgradient from the site. The oxidizer contains a 25-horse power blower with an air/water separator. Extracted soil vapor enters the oxidizer for destruction at a minimum temperature of 600 degrees Fahrenheit. The catalytic oxidizer uses electricity as the supplemental fuel and has a destruction efficiency of greater than 98 percent.

Assuming the DPE system operates as expected, the site would be remediated in approximately two years and would require one year of semi-annual post remedial monitoring. The DPE system installation and operation costs are shown below:

DPE System Fixed Costs

▪ Permitting and Remediation System Design	$ 15,900
▪ Construction of Trenches, Enclosure, and Piping	$ 42,000
▪ Remediation System Accessories and Parts	$ 2,250
▪ Remediation System Troubleshoot and Startup	$ 15,500
▪ Installation Results Report	$ 3,500
Total Fixed Costs	**$79,150**

SVE System O&M Costs

▪ Professional Services	$ 2,200
▪ Remediation Equipment Rental	$ 2,500

- Equipment, Travel, and Discharge Expenses $ 1,900
- Analytical Fees $ 150
- Electricity to Operate Equipment $ 2,700

Total O&M Costs (Per Month) $ 9,450
Total O&M Costs (One Year) $113,400

Groundwater Monitoring and Reporting Costs (2 years)

Total (Per Event) $ 4,320
Total (2 years) $ 17,280

Total DPE Option (2 Years) $323,230

ECG plans to rent the remediation equipment to the site. The SVE system rental will be invoiced monthly and the USTCF claim will only be charged for the time the SVE system remains onsite. If the system operates for one year or longer, the SVE system rental costs will reach 10% more than the purchase price of the SVE system, but no additional charges will be made to the USTCF claim.

RECOMENDATIONS

ECG recommends installing and operating a DPE system to remediate petroleum hydrocarbons from soil beneath the site. Soil excavation and disposal is not a cost effective remedial option and soil vapor extraction would inadequately address the groundwater contamination.

CORRECTIVE ACTION PLAN

Based on the results of site assessment and pilot testing activities, a DPE system is proposed for the site. The site currently has a well network to monitor soil and groundwater conditions. The network consists of six groundwater monitoring wells and two DPE wells (Table 1). ECG recommends installing two additional extraction wells (VW-3 and VW-4) at the locations shown on Figure 11 to adequately cover the impacted areas of the site.

DPE TREATMENT SYSTEM DESIGN

The proposed DPE system is a Mako brand 400 scfm high vacuum catalytic oxidizer. The DPE system will utilize four extraction wells (EW-1 through EW-4). The oxidizer contains a 25-horse power blower with an air/water separator. Extracted soil vapor enters the oxidizer for destruction at a minimum temperature of 600 degrees Fahrenheit in catalytic mode. The catalytic oxidizer uses electricity as the supplemental fuel and has a destruction efficiency of greater than 98 percent. Extracted groundwater will be pumped through an air stripper and then through granular activated carbon prior to discharge to the sanitary sewer. The Mako specification sheet is contained in Appendix B.

The oxidizer is equipped with various safety controls including interlocks from the oxidizer to the blower, high and low temperature shut down, automatic supplemental fuel delivery, and process flow sensors. Piping will be equipped with monitoring ports for collection of differential pressure, vacuum, and VOC measurements during DPE system operation. A groundwater flow totalizer will measure the volume of groundwater treated and discharged. A process and instrument diagram has been included as Figure 12.

Well head connections will be made at DPE wells at approximately 18-inches bgs. Two-inch PVC, schedule 40 pipe will be connected to the well casing at a T-fitting and routed to the remediation compound. New 12-inch traffic rated well boxes will be set in a nine-inch concrete collars. DPE well head details are shown on Figure 13.

DPE WELL INSTALLATION

ECG will supervise Cascade Drilling of Sacramento, California, during the installation of two 6-inch diameter extraction wells (VW-3 and VW-4) at the locations shown on Figure 11. The DPE wells will then be installed to 20-feet bgs with 15-feet of 0.020 screen and #3 sand. A two-foot bentonite seal will separate the filter pack from the neat cement grout installed to the surface.

Soil samples will be collected at five-foot interval from 5- to 20-feet bgs for classification and field screening with a photoionization device (PID). A minimum of two samples from each boring will be submitted to the laboratory for analysis of the site constituents shown on Tables 2a and 2b.

Prior to drilling, permits will be obtained from Alameda County and Underground Services Alert will be notified a minimum of 48-hours prior to drilling. As a further precaution to avoid underground utilities, the first 5-feet of every boring will be hand cleared.

SCHEDULE

Pending approval of this CAP, ECG will obtain an Authority-to-Construct permit from the Bay Area Air Quality Management District (BAAQMD) prior to construction of the system. Building permits will be obtained from City of Oakland Public Works Department. ECG will contact the appropriate local utility providers to arrange for utility service to operate the remediation system.

After construction and installation is complete, a startup source test will be completed with the BAAQMD. The sewer authority in Oakland will be contacted to receive the effluent water via the sanitary sewer connection made onsite. Upon receiving a Permit to Operate (PTO) from the BAAQMD, the system will be operational.

System startup should be accomplished by September 2012.

DPE OPERATIONS AND MAINTENANCE

When full time operation of the DPE system begins, ECG personnel will perform biweekly site visits and collect vapor samples for analysis monthly. Samples will be submitted under chain of custody documentation to a California State certified laboratory for analysis as required in typical PTOs. In addition, each vapor well will be individually sampled approximately two-months after system startup. Compliance sampling of the groundwater treatment portion of the DPE will also be performed.

All fieldwork and sampling will be conducted following standard operating procedures included as Appendix C.

0 1,000 2,000

Approximate Scale In Feet
1 inch = 1,000 Feet

FIGURE 1	SITE LOCATION MAP	Environmental Compliance Group, LLC
Project Number: GHA.19009	Shore Acre Gas 403 East 12th Street Oakland, California	270 Vintage Drive, Turlock, CA 95382 Phone: (209) 664-1035
Date: February 9, 2011		

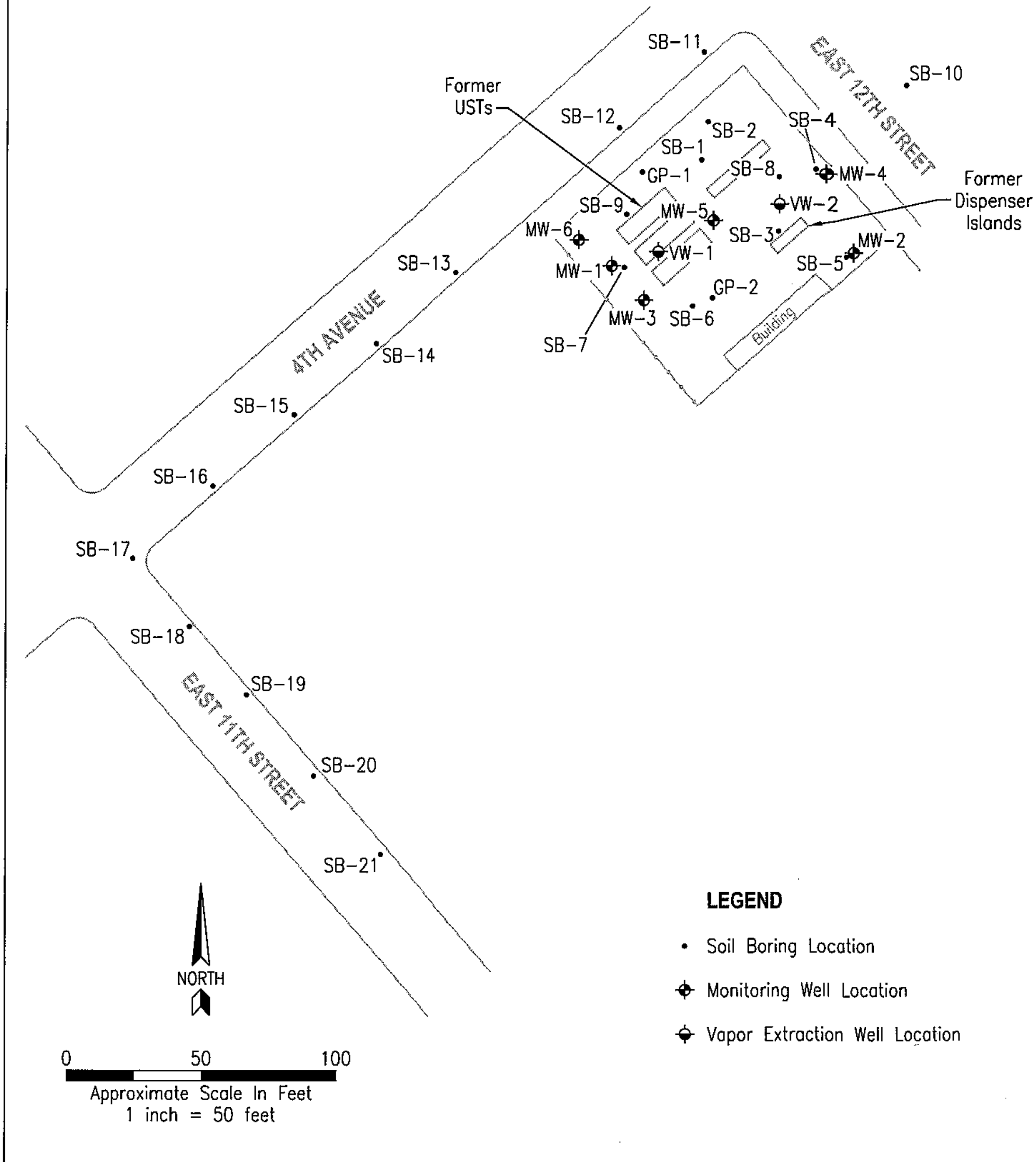


FIGURE 2

Project Number: GHA.19009

Date: January 4, 2012

SITE MAP

Shore Acre Gas
403 East 12th Street
Oakland, California

Environmental Compliance Group, LLC
270 Vintage Drive, Turlock, CA 95382
Phone: (209) 664-1035

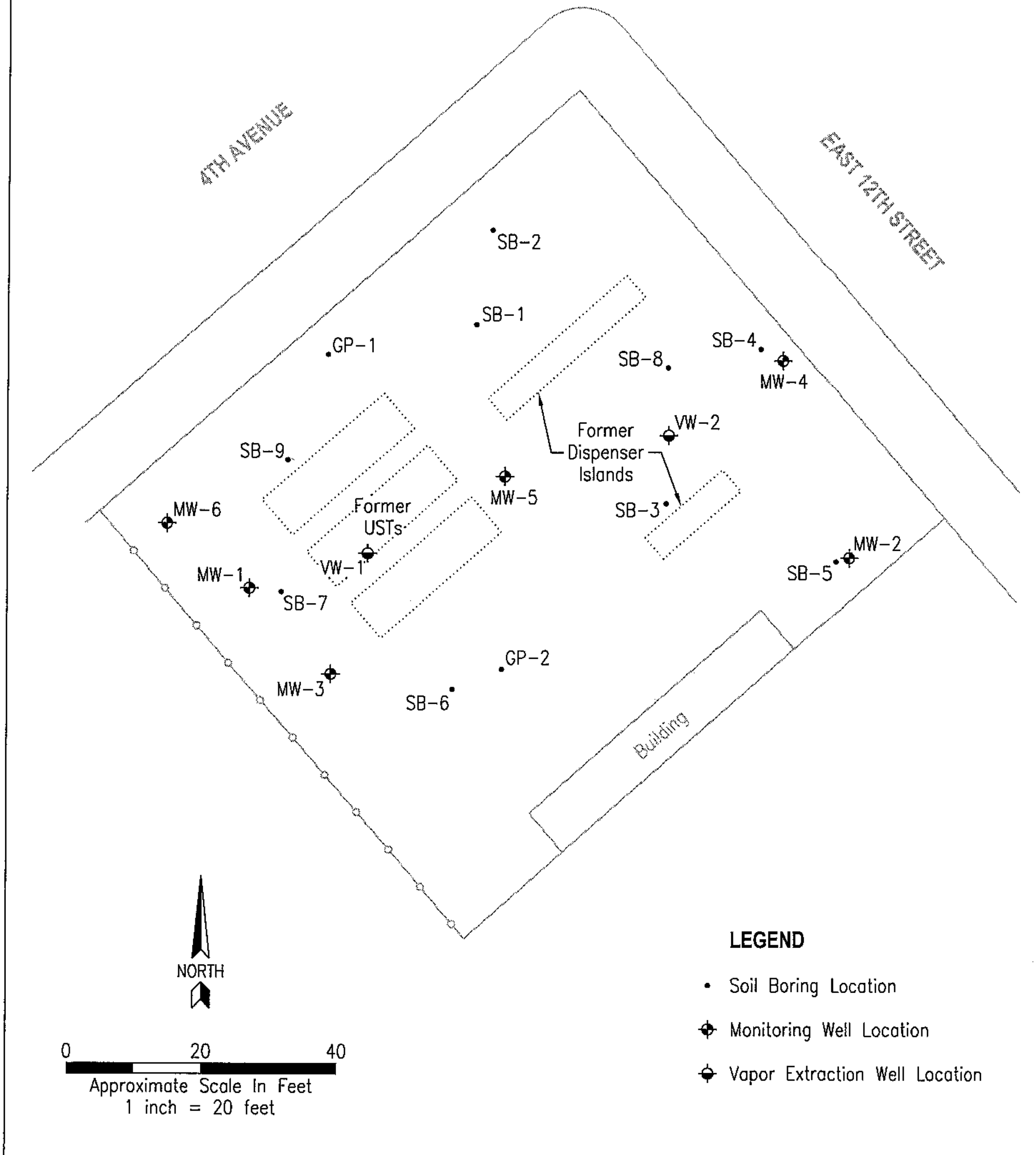


FIGURE 2	**SITE MAP**	**Environmental Compliance Group, LLC**
Project Number: GHA.19009	Shore Acre Gas	270 Vintage Drive, Turlock, CA 95382
Date: July 21, 2011	403 East 12th Street Oakland, California	Phone: (209) 664-1035

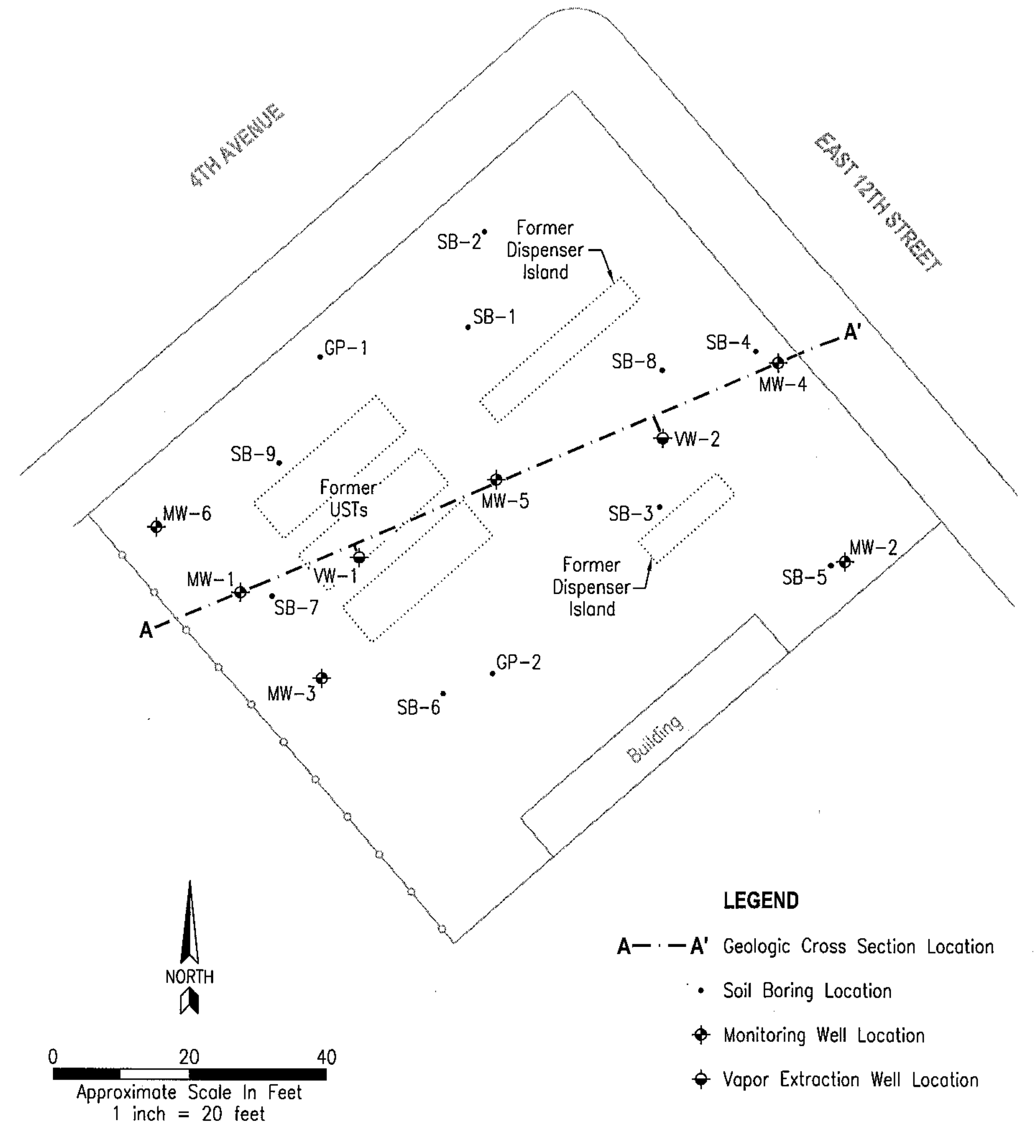
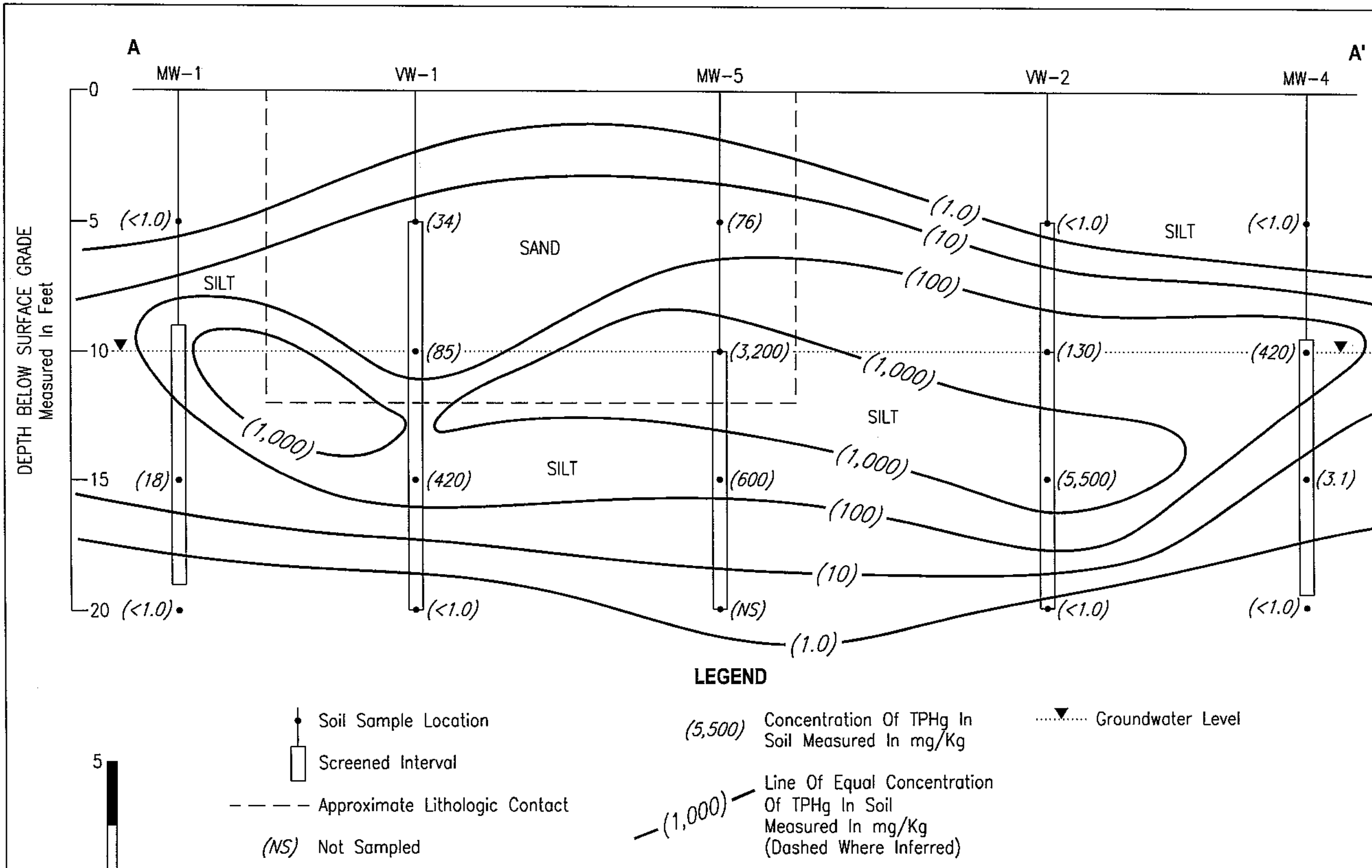


FIGURE 3	CROSS SECTION LOCATION MAP	Environmental Compliance Group, LLC
Project Number: GHA.19009	Shore Acre Gas 403 East 12th Street Oakland, California	270 Vintage Drive, Turlock, CA 95382 Phone: (209) 664-1035
Date: June 8, 2012		



5

0

0 10

Approximate Scale In Feet
(Vertical Exaggeration = 2X)

FIGURE 4

Project Number:
GHA.19009

Date:
August 16, 2011

TPHg IN SOIL ISOCONCENTRATION MAP
CROSS SECTION A-A'

Shore Acre Gas
403 East 12th Street
Oakland, California

Environmental Compliance Group, LLC
270 Vintage Drive, Turlock, CA 95382
Phone: (209) 664-1035

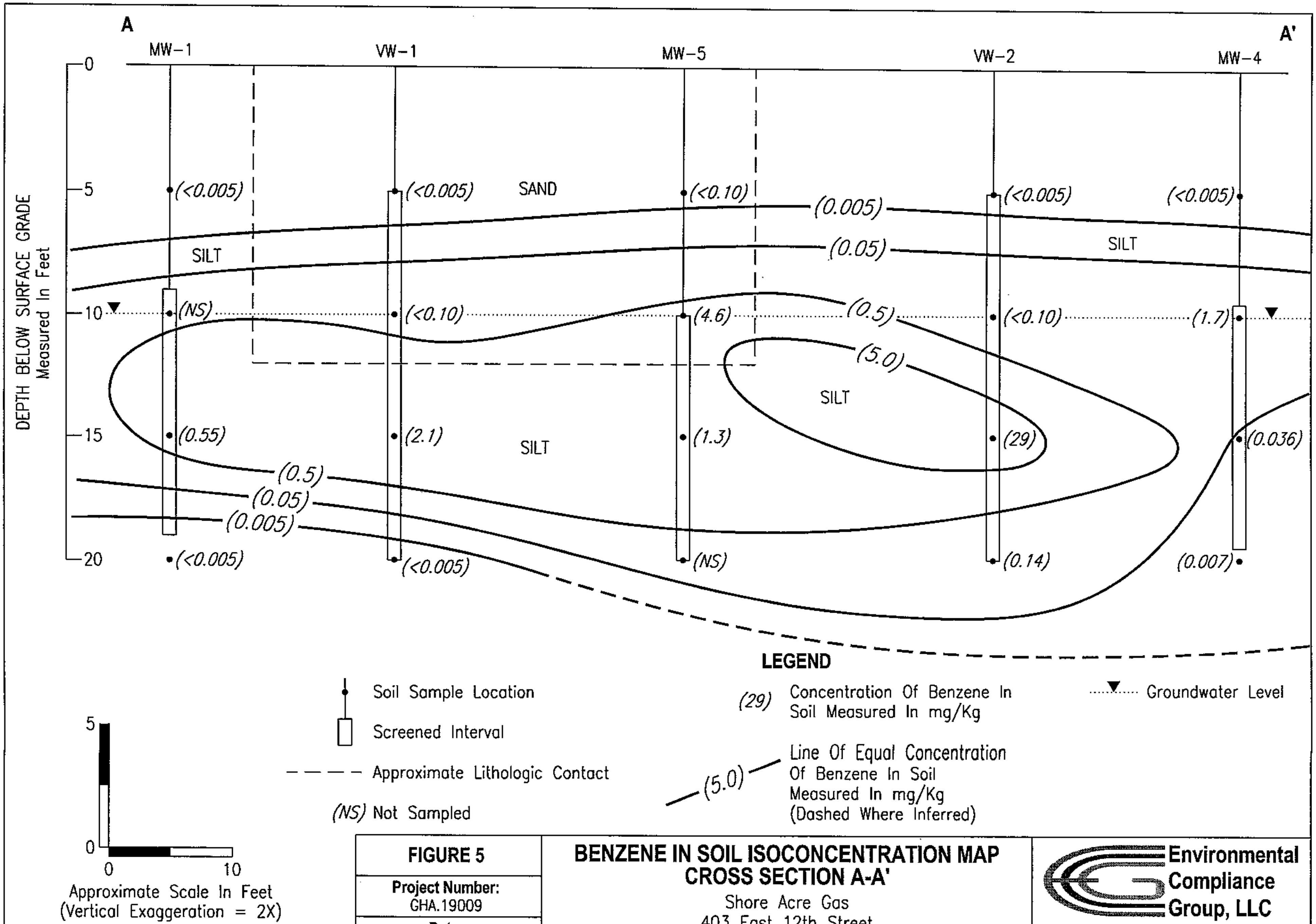


FIGURE 5

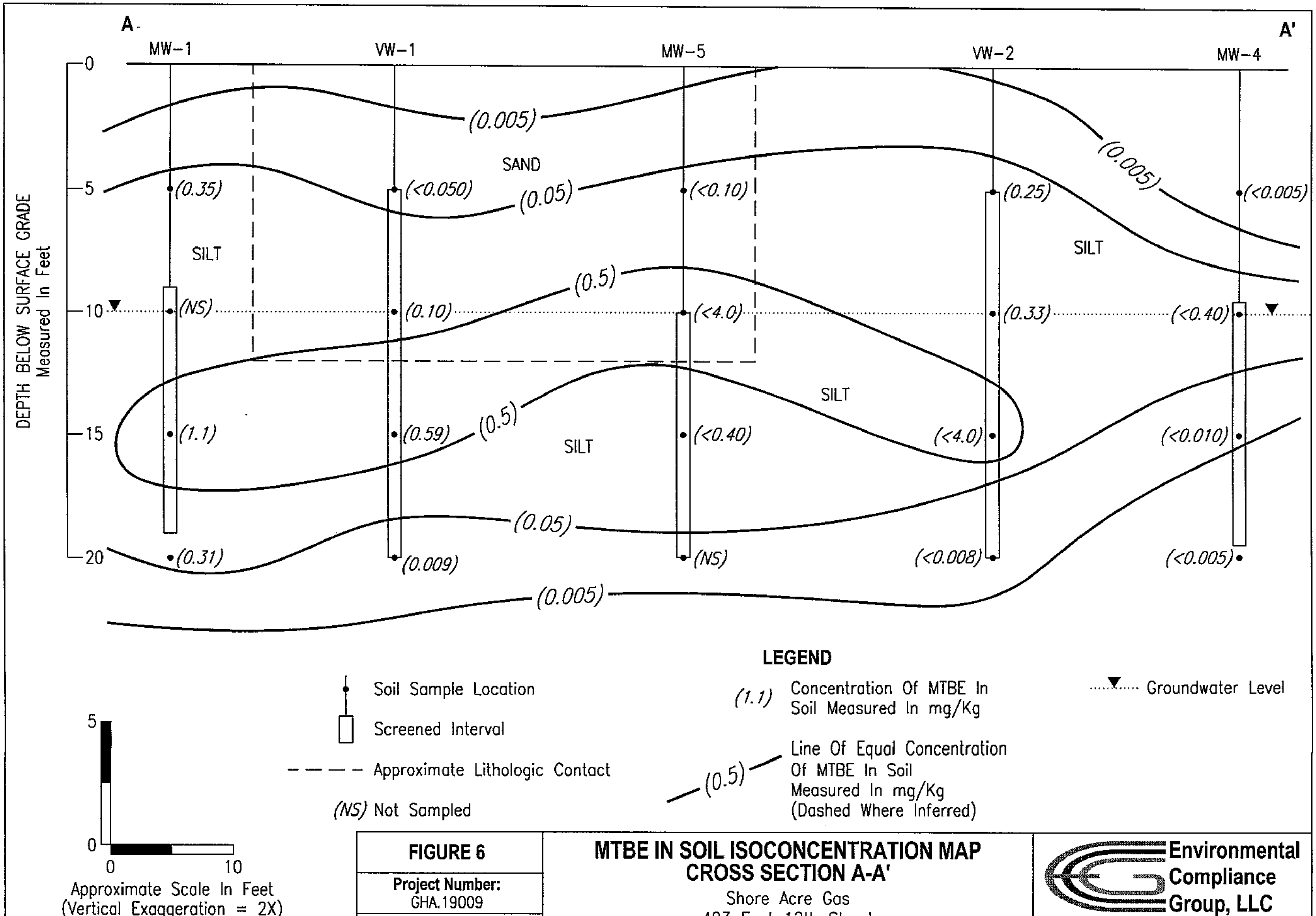
Project Number: GHA.19009

Date: August 16, 2011

BENZENE IN SOIL ISOCONCENTRATION MAP
CROSS SECTION A-A'

Shore Acre Gas
403 East 12th Street
Oakland, California

Environmental Compliance Group, LLC
270 Vintage Drive, Turlock, CA 95382
Phone: (209) 664-1035



LEGEND

- Soil Sample Location
- Screened Interval
- Approximate Lithologic Contact
- (NS) Not Sampled
- (1.1) Concentration Of MTBE In Soil Measured In mg/Kg
- (0.5) Line Of Equal Concentration Of MTBE In Soil Measured In mg/Kg (Dashed Where Inferred)
- Groundwater Level

FIGURE 6	MTBE IN SOIL ISOCONCENTRATION MAP CROSS SECTION A-A'	Environmental Compliance Group, LLC
Project Number: GHA.19009	Shore Acre Gas 403 East 12th Street Oakland, California	270 Vintage Drive, Turlock, CA 95382 Phone: (209) 664-1035
Date: June 8, 2012		

LEGEND

NORTH

- Monitoring Well Location
- Vapor Extraction Well Location

(23.40) Elevation Of Groundwater Measured In Feet Above Mean Sea Level

(23.25) Lines Of Equipotential Measured In Feet Above Mean Sea Level (Dashed Where Inferred)

Flow Lines

$i = 0.014$ General Gradient

(NM) Not Measured

0 50 100

Approximate Scale In Feet
1 inch = 50 feet

FIGURE 7	**POTENTIOMETRIC SURFACE MAP** **MARCH 30, 2012** Shore Acre Gas 403 East 12th Street Oakland, California	**Environmental Compliance Group, LLC** 270 Vintage Drive, Turlock, CA 95382 Phone: (209) 664-1035
Project Number: GHA.19009		
Date: June 8, 2012		

LEGEND

NORTH

Monitoring Well Location

Vapor Extraction Well Location

(100,000) Concentration Of TPHg In Groundwater Measured In ug/L

(50,000) Line Of Equal Concentration Of TPHg In Groundwater Measured In ug/L (Dashed Where Inferred)

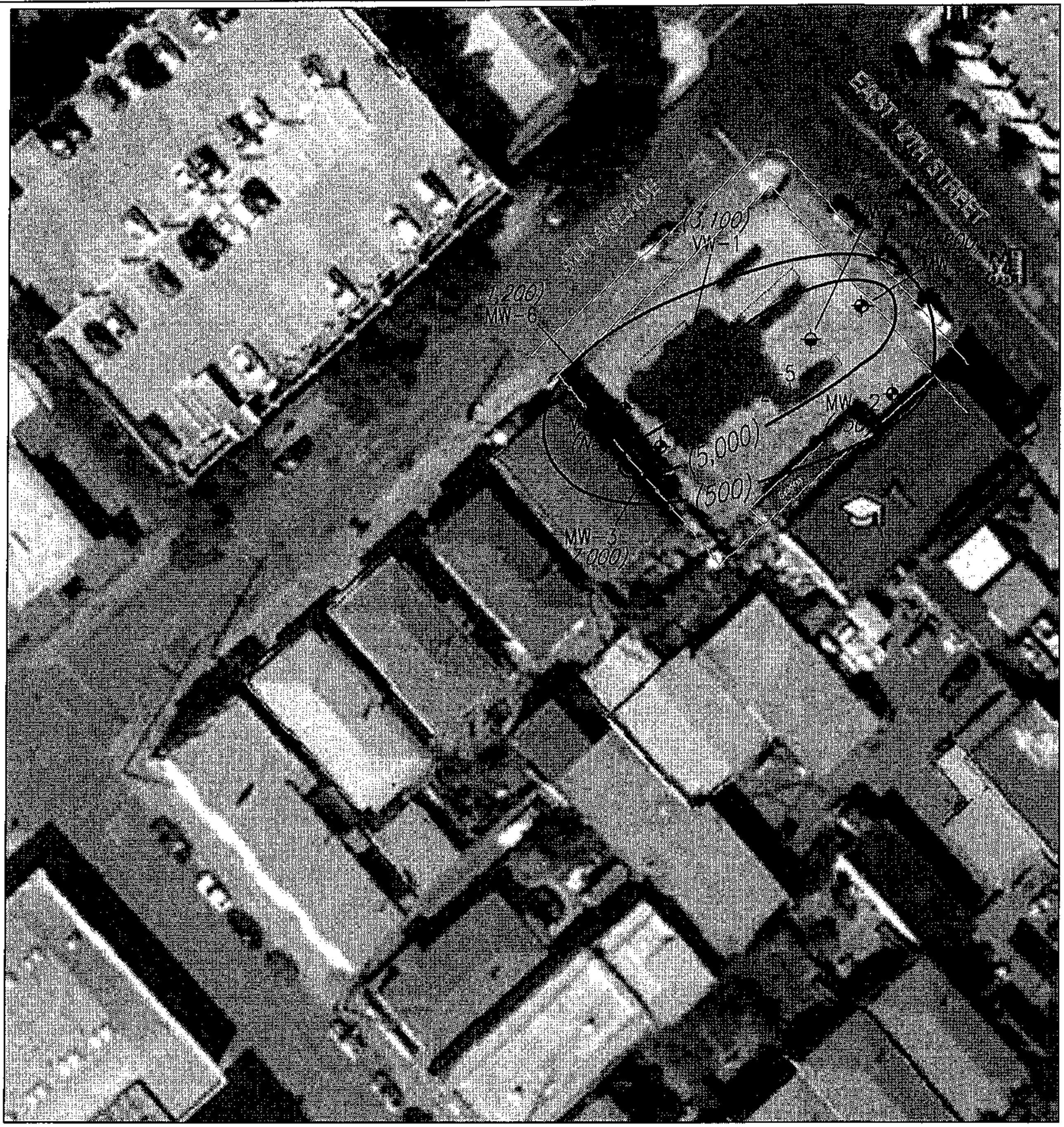
(NS) Not Sampled

(FLH) Floating Liquid Hydrocarbons

0 50 100

Approximate Scale In Feet
1 inch = 50 feet

FIGURE 8	TPHg IN GROUNDWATER ISOCONCENTRATION MAP MARCH 30, 2012 Shore Acre Gas 403 East 12th Street Oakland, California	Environmental Compliance Group, LLC 270 Vintage Drive, Turlock, CA 95382 Phone: (209) 664-1035
Project Number: GHA.19009		
Date: June 8, 2012		



LEGEND

NORTH

Monitoring Well Location

Vapor Extraction Well Location

(17,000) Concentration Of Benzene In Groundwater Measured In ug/L

(5,000) Line Of Equal Concentration Of Benzene In Groundwater Measured In ug/L (Dashed Where Inferred)

(NS) Not Sampled

(FLH) Floating Liquid Hydrocarbons

0 50 100

Approximate Scale In Feet
1 inch = 50 feet

FIGURE 9	BENZENE IN GROUNDWATER ISOCONCENTRATION MAP MARCH 30, 2012 Shore Acre Gas 403 East 12th Street Oakland, California	Environmental Compliance Group, LLC 270 Vintage Drive, Turlock, CA 95382 Phone: (209) 664-1035
Project Number: GHA.19009		
Date: June 8, 2012		

LEGEND

NORTH

Monitoring Well Location

Vapor Extraction Well Location

(13,000) Concentration Of MTBE In Groundwater Measured In ug/L

(5,000) Line Of Equal Concentration Of MTBE In Groundwater Measured In ug/L (Dashed Where Inferred)

(NS) Not Sampled

(FLH) Floating Liquid Hydrocarbons

0 50 100

Approximate Scale In Feet
1 inch = 50 feet

FIGURE 10	**MTBE IN GROUNDWATER ISOCONCENTRATION MAP** **MARCH 30, 2012** Shore Acre Gas 403 East 12th Street Oakland, California	**Environmental Compliance Group, LLC** 270 Vintage Drive, Turlock, CA 95382 Phone: (209) 664-1035
Project Number: GHA.19009		
Date: June 8, 2012		

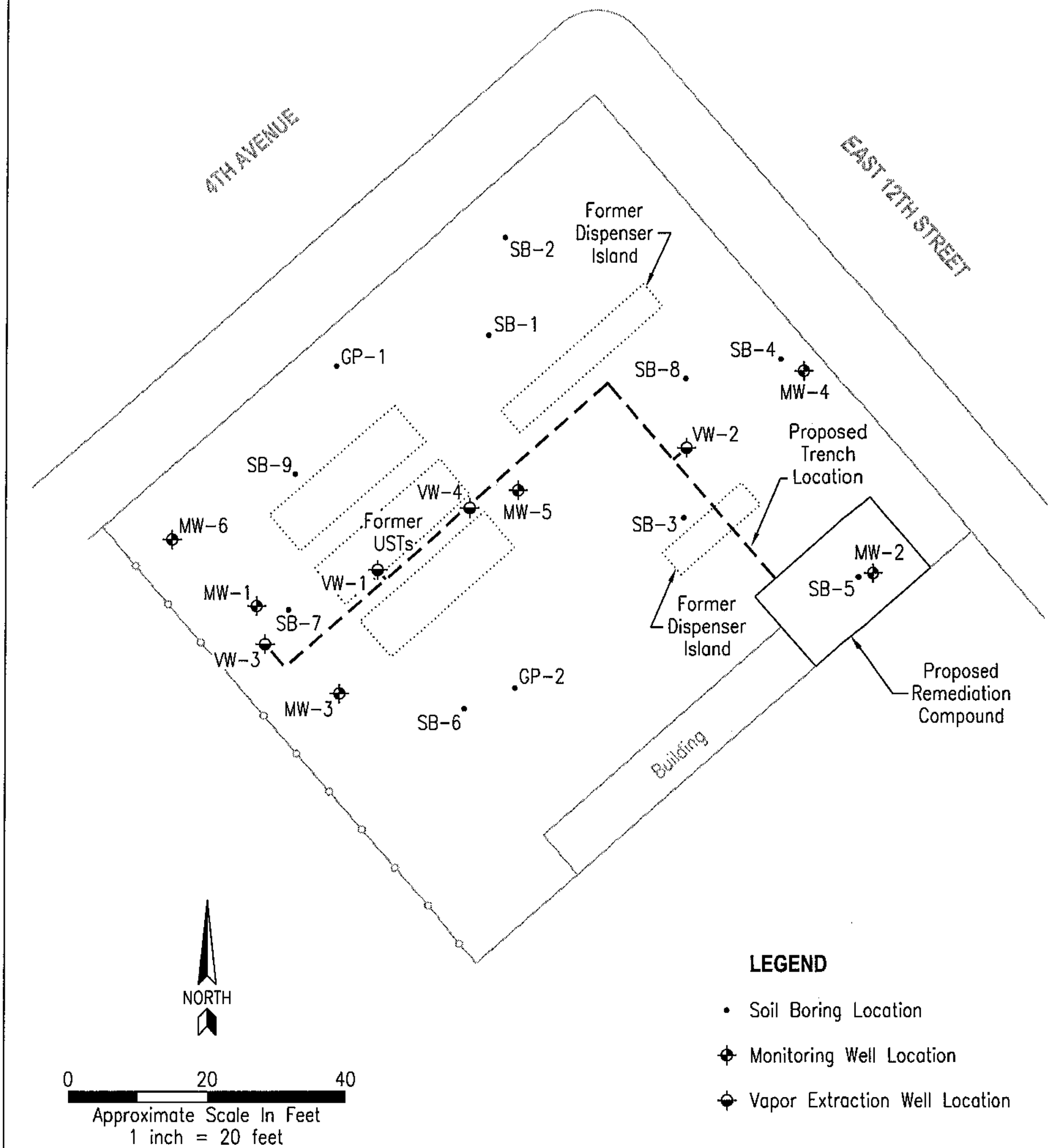


FIGURE 11

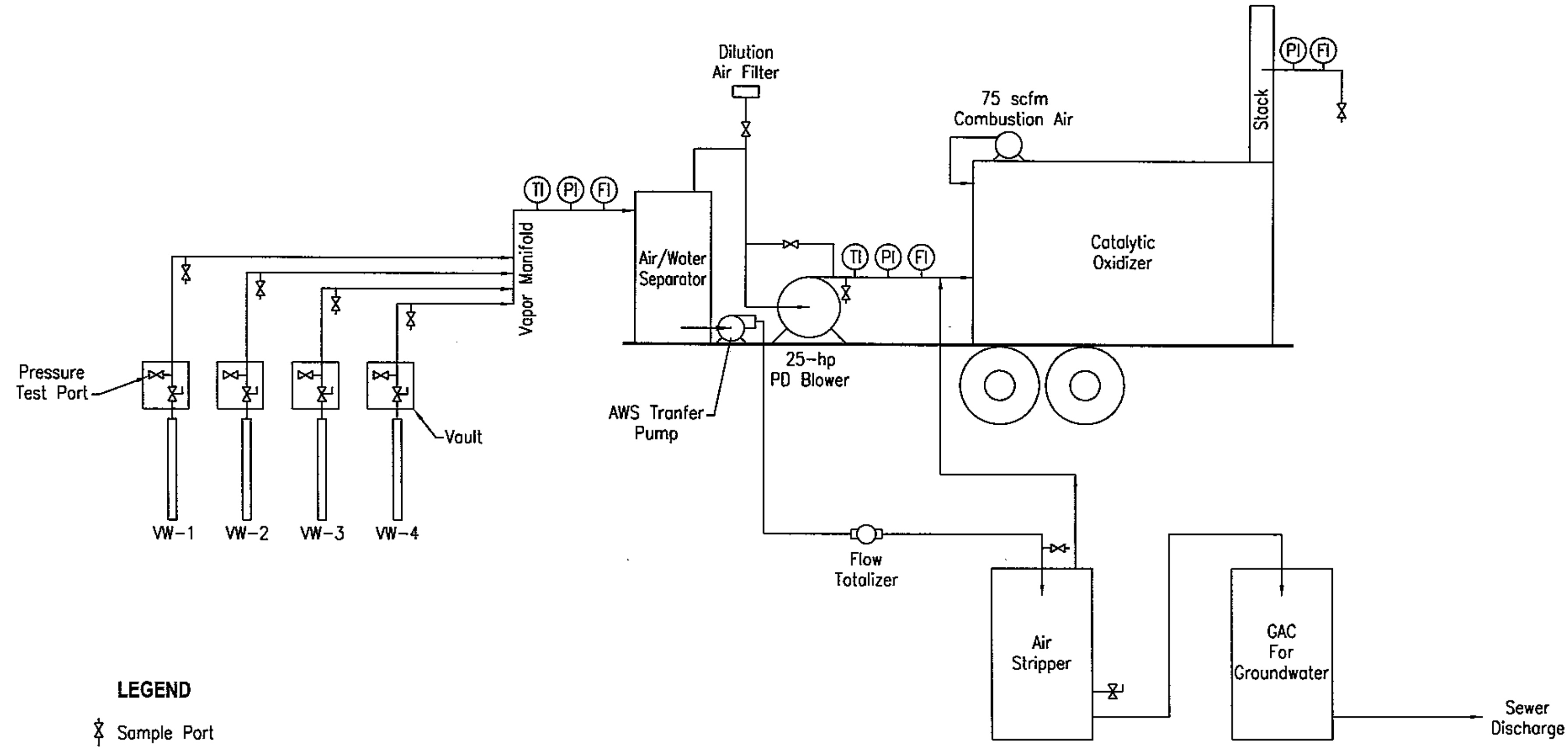
Project Number: GHA.19009

Date: June 8, 2012

PROPOSED EXTRACTION WELL TRENCH AND REMEDIATION COMPOUND LOCATION MAP

Shore Acre Gas
403 East 12th Street
Oakland, California

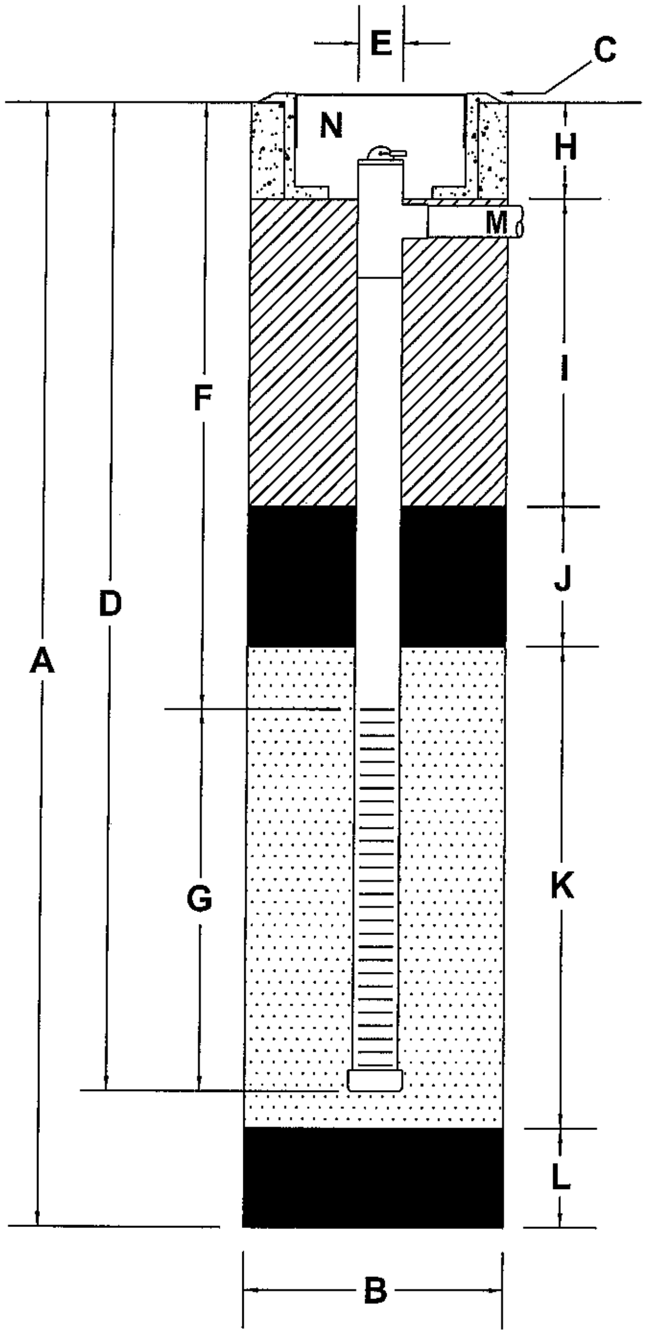
Environmental Compliance Group, LLC
270 Vintage Drive, Turlock, CA 95382
Phone: (209) 664-1035



LEGEND

- Sample Port
- Check Valve
- Ball Valve
- (PI) Pressure Indicator
- (FI) Flow Indicator
- (TI) Temperature Indicator
- (abv) Air Bypass Valve

FIGURE 12	**PROCESS FLOW DIAGRAM**	Environmental Compliance Group, LLC
Project Number: GHA.19009	Shore Acre Gas 403 East 12th Street Oakland, California	270 Vintage Drive, Turlock, CA 95382 Phone: (209) 664-1035
Date: June 8, 2012		



A	Total Depth Of Boring	20	ft.
B	Diameter Of Boring	12	in.
	Drilling Method	Hollow Stem Auger	
C	Top Of Box Elevation		ft.
	☒ Referenced To Mean Sea Level		
	☐ Referenced To Project Datum		
D	Casing Length	20	ft.
	Material	Sch 40 PVC	
E	Casing Diameter	6	in.
F	Depth To Top Perforations	5	ft.
G	Perforated Length	15	ft.
	Perforated Interval From	5 to 20	ft.
	Perforation Type	Machine Slotted	
	Perforation Size	0.02	in.
H	Surface Seal From	0 to 2	ft.
	Seal Material	Neat Cement	
I	Sanitary Seal From	2 to 3	ft.
	Seal Material	Grout	
J	Seal From	3 to 4	ft.
	Seal Material	Bentonite	
K	Filter Pack From	4 to 20	ft.
	Pack Material	No. 3 Lonestar Sand	
L	Bottom Seal	N/A	ft.
	Seal Material	N/A	
M	Dual Phase Extraction Piping		
N	12-inch Diameter Traffic Rated Christy Box And Locking Well Cap		

FIGURE 13

Project Number: GHA.19009

Date: June 8, 2012

PROPOSED VAPOR EXTRACTION WELL CONSTRUCTION DETAIL

Shore Acre Gas
403 East 12th Street
Oakland, California

Environmental Compliance Group, LLC
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Table 1
Well Construction Details
Shore Acres Gas
403 East 12th Street
Oakland, California

Well ID	Date Installed	TOC Elevation (ft amsl)	Well Depth (ft bgs)	Casing Diameter (inches)	Casing Material	Screen/ Filter	Screen Interval (ft bgs)
Monitoring Wells							
MW-1	June 2011	30.81	20	2	PVC	0.020/#3	10-20
MW-2		31.29	20	2	PVC	0.020/#3	10-20
MW-3		31.30	18	2	PVC	0.020/#3	8-18
MW-4		31.21	19	2	PVC	0.020/#3	9-19
MW-5		31.35	20	2	PVC	0.020/#3	10-20
MW-6		30.79	20	2	PVC	0.020/#3	10-20
Dual Phase Extraction Wells							
VW-1	June 2011	31.26	20	4	PVC	0.020/#3	5-20
VW-2		31.40	20	4	PVC	0.020/#3	5-20

Notes:

TOC - denotes top of casing
ft - denotes feet
amsl - denotes above mean sea level
bgs - denotes below ground surface
PVC - denotes polyvinyl chloride

Table 2a
Historical Soil Analytical Data
TPH and BTEX
Shore Acres Gas
403 East 12th Street
Oakland, California

Boring ID	Sample Depth (feet)	Collection Date	TPHd (mg/kg)	TPHg (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethyl-benzene (mg/kg)	Total xylenes (mg/kg)
UST Removal Samples								
SS-D1	2	August 2009	**1,800***	**3,000**	<0.25	**0.34**	**39**	**180**
SS-D2	2		**900***	**2,400**	<0.25	<0.25	**36**	**120**
SS-D3	2		**460***	**1,000**	<0.15	<0.15	**12**	**14**
SS-D4	2		**540***	**640**	<0.090	**1.0**	**6.1**	**51**
SS-D5	2		**320**	**140**	<0.025	<0.025	**1.3**	**3.2**
SS-D6	2.0		**320***	**260**	<0.025	**0.054**	**1.0**	**8.0**
SS-J1	2.0		**39***	**160**	<0.025	<0.025	**0.71**	**0.94**
SS-Isle	4.0		**560***	**100**	<0.025	<0.025	**0.30**	**0.084**
SS-7	18.0		**310***	**1,600**	**6.9**	**76**	**39**	**200**
Tank 1-SS-1	14.0		**830***	**2,500**	**4.2**	**100**	**69**	**360**
Tank 1-SS-2	14.0		**62***	**480**	**1.8**	**5.3**	**14**	**62**
Tank 2-SS-1	14.0		**120***	**290**	**0.37**	**2.4**	**6.3**	**31**
Tank 2-SS-2	14.0		**330***	**80**	**0.074**	**0.051**	**1.2**	**5.8**
Tank 3-SS-1	14.0		**480***	**2,100**	**2.4**	**41**	**62**	**320**
Tank 3-SS-2	14.0		**75***	**130**	**0.23**	**0.26**	**3.1**	**15**
Soil Borings								
GP-1-15.5	15.5	July 2006	**13.0**	**18.0**	**0.63**	**0.052**	**0.69**	**0.13**
GP-1-18.0	18.0		<1.0	<1.0	**0.0056**	**0.0082**	<0.005	**0.019**
GP-2-12.0	12.0		**600**	**3,600**	**17**	**180**	**98**	**440**
GP-2-20.0	20.0		**79**	**1,100**	**3.2**	**41**	**25**	**130**
SB-1-9.5	9.5	April 2010	---	**1,600**	**5.1**	**43**	**30**	**180**
SB-1-24.5	24.5		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-1-29.5	29.5		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-2-9.5	9.5		---	**2.2**	**0.26**	**<0.010**	**0.066**	<0.020
SB-2-24.5	24.5		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-2-29.5	29.5		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-3-14.5	14.5		---	**17**	**17**	**100**	**42**	**240**
SB-3-24.5	24.5		---	<1.0	<0.005	**0.005**	<0.005	**0.013**
SB-3-29.5	29.5		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-4-14.5	14.5		---	**1,700**	**13**	**79**	**28**	**170**
SB-4-19.5	19.5		---	<1.0	<0.005	0.009	<0.005	**0.026**
SB-4-29.5	29.5		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-5-14.5	14.5		---	**470**	<0.20	**0.45**	**6.2**	**37**
SB-5-24.5	24.5		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-5-29.5	29.5		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-6-9.5	9.5		---	**6,100**	**21**	**170**	**95**	**580**
SB-6-29.5	29.5		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-6-32	32.0		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-7-9.5	9.5		---	**4,000**	**12**	**46**	**55**	**360**
SB-7-29.5	29.5		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-7-32	32.0		---	<1.0	<0.005	<0.005	<0.005	<0.010

Table 2a
Historical Soil Analytical Data
TPH and BTEX
Shore Acres Gas
403 East 12th Street
Oakland, California

Boring ID	Sample Depth (feet)	Collection Date	TPHd (mg/kg)	TPHg (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethyl-benzene (mg/kg)	Total xylenes (mg/kg)
SB-8-9.5	9.5	April 2010	---	**2,500**	**16**	**110**	**63**	**370**
SB-8-24.5	24.5		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-8-29.5	29.5		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-9-14.5	14.5		---	**390**	**3.0**	**3.0**	**9.1**	**41**
SB-9-29.5	29.5		---	<1.0	<0.005	<0.005	<0.005	<0.010
SB-9-32	32.0		---	<1.0	<0.005	<0.005	<0.005	<0.010
Groundwater Wells								
MW-1-5	5	June 2011	<5.0	<1.0	<0.005	<0.005	<0.005	<0.010
MW-1-15	15		<5.0	**18**	**0.55**	<0.050	**0.87**	**1.2**
MW-1-20	20		<5.0	<1.0	<0.005	<0.005	<0.005	<0.010
MW-2-5	5		<5.0	<1.0	<0.005	<0.005	<0.005	<0.010
MW-2-10	10		<5.0	**69**	<0.005	<0.005	<0.005	<0.010
MW-2-15	15		<5.0	**50**	<0.050	**0.48**	**3.1**	**19**
MW-2-20	20		<5.0	<1.0	<0.005	<0.005	<0.005	<0.010
MW-3-5	5		<5.0	<1.0	<0.010	<0.010	<0.010	<0.020
MW-3-10	10		<15	**840**	**3.4**	**33**	**20**	**140**
MW-3-15	15		<5.0	**380**	**3.0**	**4.5**	**7.3**	**41**
MW-3-20	20		<5.0	<1.0	**0.019**	<0.005	**0.006**	<0.010
MW-4-5	5		<5.0	<1.0	<0.005	<0.005	<0.005	<0.010
MW-4-10	10		<15	**420**	**1.7**	**2.6**	**9.2**	**51**
MW-4-15	15		<5.0	**3.1**	**0.036**	**0.20**	**0.15**	**0.95**
MW-4-20	20		<5.0	<1.0	**0.007**	**0.017**	**0.010**	**0.039**
MW-5-5	5		<5.0	**76**	<0.10	<0.10	**1.3**	**0.76**
MW-5-10	10		<15	**3,200**	**4.6**	**6.5**	**72**	**410**
MW-5-15	15		<5.0	**600**	**1.3**	**13**	**15**	**110**
MW-6-5	5		<5.0	<1.0	<0.005	<0.005	<0.005	<0.010
MW-6-10	10		<5.0	**5.1**	**0.015**	<0.010	**3.4**	**1.0**
MW-6-15	15		<5.0	<1.0	<0.005	<0.005	<0.005	<0.010
MW-6-20	20		<5.0	<1.0	<0.005	<0.005	<0.005	<0.010
VW-1-5	5		<5.0	**34**	<0.005	<0.005	**0.16**	**0.31**
VW-1-10	10		<15	**85**	<0.10	<0.10	**2.2**	**0.89**
VW-1-15	15		<15	**420**	**2.1**	**4.1**	**9.4**	**55**
VW-1-20	20		<5.0	<1.0	<0.005	<0.005	<0.005	<0.010
VW-2-5	5		<5.0	<1.0	<0.005	<0.005	<0.005	<0.010
VW-2-10	10		<5.0	**130**	<0.10	<0.10	**2.9**	**15**
VW-2-15	15		<15	**5,500**	**29**	**430**	**120**	**910**
VW-2-20	20		<5.0	<1.0	**0.14**	**0.054**	**0.025**	**0.14**

Notes:

TPHd - denotes total petroleum hydrocarbons as diesel
TPHg - denotes total petroleum hydrocarbons as gasoline
mg/kg - denotes milligrams per kilogram
< - denotes less than the detection limit
--- denotes no data

Table 2b
Historical Soil Analytical Data
Oxygenates and Lead Scavengers
Shore Acres Gas
403 East 12th Street
Oakland, California

Boring ID	Sample Depth (feet)	Collection Date	DIPE (mg/kg)	ETBE (mg/kg)	MTBE (mg/kg)	TAME (mg/kg)	TBA (mg/kg)	1,2-DCA (mg/kg)	EDB (mg/kg)
UST Removal Samples									
SS-D1	2	August 2009	<0.25	<0.25	<0.25	<0.25	<1.5	---	---
SS-D2	2		<0.25	<0.25	<0.25	<0.25	<1.5	---	---
SS-D3	2		<0.15	<0.15	<0.15	<0.15	<0.70	---	---
SS-D4	2		<0.090	<0.090	<0.090	<0.090	<0.50	---	---
SS-D5	2		<0.025	<0.025	<0.025	<0.025	<0.15	---	---
SS-D6	2		<0.025	<0.025	<0.025	<0.025	<0.15	---	---
SS-J1	2		<0.025	<0.025	<0.025	<0.025	<0.15	---	---
SS-Isle	4		<0.025	<0.025	<0.025	<0.025	<0.15	---	---
SS-7	18		<0.25	<0.25	<0.25	<0.25	<1.5	<0.25	<0.25
Tank 1-SS-1	14		<0.50	<0.50	<0.50	<0.50	<2.5	<0.50	<0.50
Tank 1-SS-2	14		<0.040	<0.040	**0.37**	<0.040	**0.51**	<0.040	<0.040
Tank 2-SS-1	14		<0.050	<0.050	**0.18**	<0.050	**0.35**	<0.050	<0.050
Tank 2-SS-2	14		<0.025	<0.025	**0.090**	<0.025	**0.16**	<0.025	<0.025
Tank 3-SS-1	14		<0.50	<0.50	<0.50	<0.50	<2.5	<0.50	<0.50
Tank 3-SS-2	14		<0.025	<0.025	**0.19**	<0.025	**0.15**	<0.025	<0.025
Soil Borings									
GP-1-15.5	15.5	July 2006	<0.005	<0.005	**0.029**	<0.005	**0.27**	---	---
GP-1-18.0	18.0		<0.005	<0.005	**0.54**	<0.005	**0.33**	---	---
GP-2-12.0	12.0		<0.50	<0.50	<0.50	<0.50	<2.5	---	---
GP-2-20.0	20.0		<0.025	<0.025	**0.041**	<0.025	<0.15	---	---
SB-1-9.5	9.5	April 2010	<0.80	<0.80	<0.80	<0.80	<8.0	<0.80	<0.80
SB-1-24.5	24.5		<0.005	<0.005	**0.11**	<0.005	<0.050	<0.005	<0.005
SB-1-29.5	29.5		<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005
SB-2-9.5	9.5		<0.010	<0.010	<0.010	<0.010	<0.10	<0.010	<0.010
SB-2-24.5	24.5		<0.005	<0.005	**0.053**	<0.005	<0.050	<0.005	<0.005
SB-2-29.5	29.5		<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005
SB-3-14.5	14.5		<2.0	<2.0	<2.0	<2.0	<20	<2.0	<2.0
SB-3-24.5	24.5		<0.005	<0.005	**0.10**	<0.005	<0.050	<0.005	<0.005
SB-3-29.5	29.5		<0.005	<0.005	**0.010**	<0.005	<0.050	<0.005	<0.005
SB-4-14.5	14.5		<1.0	<1.0	<1.0	<1.0	<10	<1.0	<1.0
SB-4-19.5	19.5		<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005
SB-4-29.5	29.5		<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005
SB-5-14.5	14.5		<0.20	<0.20	<0.20	<0.20	<2.0	<0.20	<0.20
SB-5-24.5	24.5		<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005
SB-5-29.5	29.5		<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005
SB-6-9.5	9.5		<2.0	<2.0	<2.0	<2.0	<20	<2.0	<2.0
SB-6-29.5	29.5		<0.005	<0.005	**0.20**	<0.005	<0.050	<0.005	<0.005
SB-6-32	32.0		<0.005	<0.005	**0.18**	<0.005	<0.050	<0.005	<0.005
SB-7-9.5	9.5		<1.0	<1.0	**4.0**	<1.0	<10	<1.0	<1.0
SB-7-29.5	29.5		<0.005	<0.005	**0.18**	<0.005	<0.050	<0.005	<0.005
SB-7-32	32.0		<0.005	<0.005	**0.11**	<0.005	<0.050	<0.005	<0.005

Table 2b
Historical Soil Analytical Data
Oxygenates and Lead Scavengers
Shore Acres Gas
403 East 12th Street
Oakland, California

Boring ID	Sample Depth (feet)	Collection Date	DIPE (mg/kg)	ETBE (mg/kg)	MTBE (mg/kg)	TAME (mg/kg)	TBA (mg/kg)	1,2-DCA (mg/kg)	EDB (mg/kg)
SB-8-9.5	9.5	April 2010	<2.0	<2.0	<2.0	<2.0	<20	<2.0	<2.0
SB-8-24.5	24.5		<0.005	<0.005	**0.033**	<0.005	<0.050	<0.005	<0.005
SB-8-29.5	29.5		<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005
SB-9-14.5	14.5		<0.20	<0.20	**5.5**	<0.20	<2.0	<0.20	<0.20
SB-9-29.5	29.5		<0.005	<0.005	**0.090**	<0.005	**0.15**	<0.005	<0.005
SB-9-32	32.0		<0.005	<0.005	**0.11**	<0.005	<0.050	<0.005	<0.005
Groundwater Wells									
MW-1-5	5	June 2011	<0.005	<0.005	**0.35**	<0.005	**0.093**	<0.005	<0.005
MW-1-15	15		<0.050	<0.050	**1.1**	<0.050	<0.50	<0.050	<0.050
MW-1-20	20		<0.005	<0.005	**0.31**	<0.005	**0.58**	<0.005	<0.005
MW-2-5	5		<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005
MW-2-10	10		<0.050	<0.050	<0.050	<0.050	<0.50	<0.050	<0.050
MW-2-15	15		<0.050	<0.050	<0.050	<0.050	<0.50	<0.050	<0.050
MW-2-20	20		<0.005	<0.005	**0.006**	<0.005	<0.050	<0.005	<0.005
MW-3-5	5		<0.010	<0.010	**1.5**	<0.010	**0.37**	<0.010	<0.010
MW-3-10	10		<0.80	<0.80	**1.3**	<0.80	<8.0	<0.80	<0.80
MW-3-15	15		<0.20	<0.20	**3.0**	<0.20	<2.0	<0.20	<0.20
MW-3-20	20		<0.005	<0.005	**0.036**	<0.005	**0.16**	<0.005	<0.005
MW-4-5	5		<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005
MW-4-10	10		<0.40	<0.40	<0.40	<0.40	<4.0	<0.40	<0.40
MW-4-15	15		<0.010	<0.010	<0.010	<0.010	<0.10	<0.010	<0.010
MW-4-20	20		<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005
MW-5-5	5		<0.10	<0.10	<0.10	<0.10	<1.0	<0.10	<0.10
MW-5-10	10		<4.0	<4.0	<4.0	<4.0	<40	<4.0	<4.0
MW-5-15	15		<0.40	<0.40	<0.40	<0.40	<4.0	<0.40	<0.40
MW-6-5	5		<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005
MW-6-10	10		<0.010	<0.010	<0.010	<0.010	<0.10	<0.010	<0.010
MW-6-15	15		<0.005	<0.005	**0.026**	<0.005	**0.088**	<0.005	<0.005
MW-6-20	20		<0.005	<0.005	**0.010**	<0.005	**0.37**	<0.005	<0.005
VW-1-5	5		<0.050	<0.050	<0.050	<0.050	<0.50	<0.050	<0.050
VW-1-10	10		<0.10	<0.10	<0.10	<0.10	<1.0	<0.10	<0.10
VW-1-15	15		<0.40	<0.40	**0.59**	<0.40	<4.0	<0.40	<0.40
VW-1-20	20		<0.005	<0.005	**0.009**	<0.005	**0.16**	<0.005	<0.005
VW-2-5	5		<0.005	<0.005	**0.25**	<0.005	**0.14**	<0.005	<0.005
VW-2-10	10		<0.10	<0.10	**0.33**	<0.10	<1.0	<0.10	<0.10
VW-2-15	15		<4.0	<4.0	<4.0	<4.0	<40	<4.0	<4.0
VW-2-20	20		<0.005	<0.005	**0.008**	<0.005	**0.26**	<0.005	<0.005

Notes:

mg/kg - denotes milligrams per kilogram
< - denotes less than the detection limi
--- - denotes not analyzed/applicable
DCA - denotes dichloroethane
EDB - denotes ethylene dibromide

MTBE - denotes methyl tertiary butyl ether
DIPE - denotes di-isopropyl ether
ETBE - denotes ethyl tertiary butyl ether
TAME - denotes tertiary amyl ether
TBA - denotes tertiary butyl alcohol

Table 3a
Grab Groundwater Sample Results
TPH and BTEX
Shore Acres Gas
403 East 12th Street
Oakland, California

Sample ID	Collection Date	TPHd (ug/L)	TPHg (ug/L)	Benzene (ug/L)	Toluene (ug/L)	Ethyl-benzene (ug/L)	Total Xylenes (ug/L)
Excavation							
Pit Sample 1	August 2009	**21,000**	**21,000**	**3,800**	**1,000**	**1,200**	**3,700**
Direct Push Grab Groundwater Samples							
SB-1	April 2010	---	**60**	**2.9**	**6.7**	**2.1**	**9.7**
SB-2		---	<50	<0.5	<0.5	<0.5	<1.0
SB-3		---	**170**	**1.5**	**11**	**4.8**	**27**
SB-4		---	**6,500**	**78**	**440**	**190**	**960**
SB-5		---	<50	<0.5	<0.5	<0.5	<1.0
SB-6		---	**440**	<20	<20	<20	<40
SB-7		---	**270**	<12	<12	<12	<25
SB-8		---	<50	**0.6**	**1.3**	**0.6**	**3.3**
SB-9		---	<50	<10	<10	<10	<20
SB-10	Dec-11	---	<50	<0.5	<0.5	<0.5	<1.0
SB-11		---	**2,300**	**83**	**1.9**	**140**	**43**
SB-12		---	**4,700**	**620**	**290**	**84**	**400**
SB-13		---	**400**	**51**	**2.4**	**4.2**	**9.7**
SB-14		---	<50	**1.7**	<0.5	**2.1**	<1.0
SB-15		---	**320**	**32**	**0.7**	**33**	**25**
SB-16		---	**4,800**	**1,600**	**10**	**49**	<20
SB-17		---	**990**	**290**	**7.2**	**27**	**4.3**
SB-18		---	**560**	**8.7**	**4.9**	**23**	**83**
SB-19		---	**260**	**7.1**	<0.5	**16**	**7.0**
SB-21		---	<50	<0.5	<0.5	<0.5	<1.0

Notes:

TPHd - denotes total petroleum hydrocarbons as diesel
TPHg - denotes total petroleum hydrocarbons as gasoline
ug/L - denotes micrograms per liter
< - denotes less than the detection limit
--- - denotes not analyzed/applicable

Table 3b
Grab Groundwater Sample Results
Oxygenates and Lead Scavengers
Shore Acres Gas
403 East 12th Street
Oakland, California

Sample ID	Collection Date	DIPE (ug/L)	ETBE (ug/L)	MTBE (ug/L)	TAME (ug/L)	TBA (ug/L)	1,2-DCA (ug/L)	EDB (ug/L)
Excavation								
Water	February 2000	<10	<10	**15,000**	**39**	**17,000**	<10	<10
Direct Push Grab Groundwater Samples								
SB-1	April 2010	<0.5	<0.5	**14**	<0.5	<5.0	<0.5	<0.5
SB-2		<0.5	<0.5	**45**	<0.5	<5.0	<0.5	<0.5
SB-3		<0.5	<0.5	**110**	<0.5	**32**	<0.5	<0.5
SB-4		<5.0	<5.0	<5.0	<5.0	<50	<5.0	<5.0
SB-5		<0.5	<0.5	**0.6**	<0.5	<5.0	<0.5	<0.5
SB-6		<20	<20	**4,000**	<20	<200	<20	<20
SB-7		<12	<12	**2,500**	<12	<120	<12	<12
SB-8		<0.5	<0.5	**26**	<0.5	**98**	<0.5	<0.5
SB-9		<10	<10	**1,800**	<10	**5,300**	<10	<10
SB-10	Dec-11	<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5
SB-11		<1.0	<1.0	**22**	<1.0	**140**	<1.0	<1.0
SB-12		<5.0	<5.0	**100**	<5.0	**550**	<5.0	<5.0
SB-13		<2.0	<2.0	**39**	<2.0	**3,900**	<2.0	<2.0
SB-14		<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5
SB-15		<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5
SB-16		<10	<10	<10	<10	<100	<10	<10
SB-17		<2.0	<2.0	<2.0	<2.0	<20	<2.0	<2.0
SB-18		<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5
SB-19		<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5
SB-21		<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5

Notes:

ug/L - denotes micrograms per liter
< - denotes less than the detection limit
DCA - denotes dichloroethane
EDB - denotes ethylene dibromide
MTBE - denotes methyl tertiary butyl ether
DIPE - denotes di-isopropyl ether
ETBE - denotes ethyl tertiary butyl ether
TAME - denotes tertiary amyl ether
TBA - denotes tertiary butyl alcohol

Table 4a
Monitoring Well Data
Water Level, TPH, and BTEX
Shore Acres Gas
403 East 12th Street
Oakland, California

Well ID TOC	Date Measured	Depth to Groundwater (ft bgs)	Groundwater Elevation (ft amsl)	TPHd (ug/L)	TPHg (ug/L)	Benzene (ug/L)	Toluene (ug/L)	Ethyl-benzene (ug/L)	Total Xylenes (ug/L)
Monitoring Wells									
MW-1	6/23/2011	10.46	20.35	<250	23,000	4,500	820	1,700	3,800
	9/22/2011	12.13	18.68	<50	21,000	4,000	1,500	980	3,000
	12/11/2011	11.69	19.12	---	23,000	2,900	1,000	720	3,000
	3/30/2012	Inaccessible							
MW-2	6/23/2011	10.70	20.59	<250	13,000	1,000	160	370	1,600
	9/22/2011	12.42	18.87	<50	12,000	300	130	470	1,400
	12/11/2011	11.98	19.31	---	8,300	170	120	450	1,500
	3/30/2012	8.55	22.74	<250	**17,000**	**850**	**700**	**710**	**2,900**
MW-3	6/23/2011	10.79	20.51	<250	55,000	15,000	3,600	2,000	4,300
	9/22/2011	12.60	18.70	<250	77,000	15,000	3,900	1,700	4,900
	12/11/2011	12.13	19.17	---	64,000	12,000	3,100	1,600	4,500
	3/30/2012	7.90	23.40	<120	**100,000**	**17,000**	**10,000**	**2,000**	**8,400**
MW-4	6/23/2011	10.62	20.59	<250	47,000	3,500	7,100	2,300	11,000
	9/22/2011	12.25	18.96	<250	46,000	2,000	2,400	1,100	5,300
	12/11/2011	11.89	19.32	---	46,000	2,100	3,400	1,800	7,000
	3/30/2012	8.51	22.70	<250	**60,000**	**6,800**	**8,200**	**1,200**	**5,700**
MW-5	6/23/2011	10.12	21.23	<250	130,000	7,100	25,000	13,000	94,000
	9/22/2011	12.53	18.82	<250	120,000	6,900	7,600	3,800	17,000
	12/11/2011	12.09	19.26	---	110,000	7,800	14,000	4,200	20,000
	3/30/2012	8.06	23.29	Sheen - not sampled					
MW-6	6/23/2011	10.43	20.36	<250	11,000	2,400	120	480	840
	9/22/2011	12.10	18.69	<50	15,000	1,500	270	880	2,500
	12/11/2011	11.69	19.10	---	13,000	660	190	610	1,500
	3/30/2012	7.50	23.29	<250	**9,500**	**1,200**	**160**	**250**	**520**
DPE Wells									
VW-1	6/28/2011	---	---	---	20,000	2,000	490	1,000	2,400
	9/22/2011	12.55	18.71	<120	39,000	3,900	610	1,400	4,600
	12/11/2011	12.09	19.17	---	27,000	2,600	270	1,400	4,400
	3/30/2012	8.06	23.20	<120	**21,000**	**3,100**	**160**	**910**	**2,300**
VW-2	6/28/2011	---	---	---	33,000	3,100	2,000	790	3,500
	9/22/2011	12.50	18.90	<250	66,000	2,400	4,500	2,000	11,000
	12/11/2011	12.12	19.28	---	70,000	2,800	6,900	2,700	13,000
	3/30/2012	8.48	22.92	<250	**57,000**	**5,800**	**5,500**	**1,200**	**5,400**

Table 4a
Monitoring Well Data
Water Level, TPH, and BTEX
Shore Acres Gas
403 East 12th Street
Oakland, California

Well ID TOC	Date Measured	Depth to Groundwater (ft bgs)	Groundwater Elevation (ft amsl)	TPHd (ug/L)	TPHg (ug/L)	Benzene (ug/L)	Toluene (ug/L)	Ethyl-benzene (ug/L)	Total Xylenes (ug/L)

Notes:

TOC - denotes top of casing elevation
TPHg - denotes total petroleum hydrocarbons as gasoline
TPHd - denotes total petroleum hydrocarbons as diesel
ft bgs - denotes feet below top of casing
ft amsl - denotes feet above mean sea level
ug/L - denotes micrograms per liter
< - denotes less than the detection limit
---- - denotes not available/applicable
FLH - denotes floating liquid hydrocarbons
* - denotes less than six inches of water and considered dry

Table 4b
Monitoring Well Data
Oxygenates and Lead Scavengers
Shore Acres Gas
403 East 12th Street
Oakland, California

Well ID TOC	Date Measured	DIPE (ug/L)	ETBE (ug/L)	MTBE (ug/L)	TAME (ug/L)	TBA (ug/L)	1,2-DCA (ug/L)	EDB (ug/L)
Monitoring Wells								
MW-1	6/23/2011	<25	<25	3,000	<25	3,900	<25	<25
	9/22/2011	<50	<50	2,600	<50	2,500	<50	<50
	12/11/2011	<20	<20	1,800	<20	1,600	<20	<20
	3/30/2012	Inaccessible						
MW-2	6/23/2011	<10	<10	240	<10	640	<10	<10
	9/22/2011	<5.0	<5.0	110	<5.0	260	<5.0	<5.0
	12/11/2011	<2.5	<2.5	45	<2.5	110	<2.5	<2.5
	3/30/2012	<5.0	<5.0	**140**	<5.0	**490**	<5.0	<5.0
MW-3	6/23/2011	<100	<100	8,200	<100	6,400	<100	<100
	9/22/2011	<100	<100	11,000	<100	2,800	<100	<100
	12/11/2011	<100	<100	7,400	<100	1,800	<100	<100
	3/30/2012	<100	<100	**13,000**	<100	<1,000	<100	<100
MW-4	6/23/2011	<50	<50	<50	<50	<500	<50	<50
	9/22/2011	<25	<25	<25	<25	<250	<25	<25
	12/11/2011	<25	<25	<25	<25	<250	<25	<25
	3/30/2012	<50	<50	**56**	<50	<500	<50	<50
MW-5	6/23/2011	<120	<120	440	<120	<1,200	<120	<120
	9/22/2011	<50	<50	670	<50	1,500	<50	<50
	12/11/2011	<120	<120	690	<120	1,600	<120	<120
	3/30/2012	Sheen - not sampled						
MW-6	6/23/2011	<25	<25	1,100	<25	4,000	<25	<25
	9/22/2011	<12	<12	600	<12	2,800	<12	<12
	12/11/2011	<10	<10	290	<10	1,300	<10	<10
	3/30/2012	<10	<10	**990**	<10	**3,500**	<10	<10

Table 4b
Monitoring Well Data
Oxygenates and Lead Scavengers
Shore Acres Gas
403 East 12th Street
Oakland, California

Well ID TOC	Date Measured	DIPE (ug/L)	ETBE (ug/L)	MTBE (ug/L)	TAME (ug/L)	TBA (ug/L)	1,2-DCA (ug/L)	EDB (ug/L)
DPE Wells								
VW-1	6/28/2011	<25	<25	1,500	<25	5,300	<25	<25
	9/22/2011	<50	<50	640	<50	1,800	<50	<50
	12/11/2011	<25	<25	490	<25	1,000	<25	<25
	3/30/2012	<20	<20	**370**	<20	**1,100**	<20	<20
VW-2	6/28/2011	<25	<25	670	<25	4,100	<25	<25
	9/22/2011	<50	<50	740	<50	1,600	<50	<50
	12/11/2011	<50	<50	540	<50	880	<50	<50
	3/30/2012	<50	<50	**1,800**	<50	**2,800**	<50	<50

Notes:

ug/L - denotes micrograms per liter
< - denotes less than the detection limit
DCA - denotes dichloroethane
EDB - denotes ethylene dibromide
MTBE - denotes methyl tertiary butyl ether
DIPE - denotes di-isopropyl ether
ETBE - denotes ethyl tertiary butyl ether
TAME - denotes tertiary amyl ether
TBA - denotes tertiary butyl alcohol
--- - denotes no data available

Table 5
Sensitive Receptor Survey Data
Shore Acres Gas
403 East 12th Street
Oakland, California

Figure ID	Well Owner	Well Location Description on DWR Log	Well Type	Total Depth (feet bgs.)	Screen Interval (feet bgs.)	Seal Inteval (feet bgs.)	Installation Date	Distance/ Direction (feet)	Notes:
1	Port of Oakland	251 5th Avenue, Oakland	Monitoring	13.0	8-13	0-8	6/14/05	1000/SW	
2-3	Kaiser Paving Company	5th Avenue and S.P. Tracks, Oakland	Test Hole	15.0	None	Unknown	4/20/05	1,200/SW	

Notes:

DWR - denotes Department of Water Resources
--- - denotes no data available
bgs - denotes below ground surface

Table 6
Dual Phase Extraction Pilot Test
Vapor Analytical Results
Shore Acres Gas
403 East 12th Street
Oakland, California

Sample ID	Date Measured	TPHg (ppmv)	Benzene (ppmv)	Toluene (ppmv)	Ethyl-benzene (ppmv)	Total Xylenes (ppmv)	MTBE (ppmv)
VW-1-INIT	6/24/2011	190	9.4	1.1	1.3	2.7	1.3
VW-1-DAY 2	6/25/2011	500	15	5.8	4.5	10	2.1
VW-1-END	6/26/2011	1,400	21	13	9.0	23	1.9
VW-2-INIT	6/26/2011	11,000	140	240	84	220	9.2
VW-2-DAY 2	6/27/2011	4,700	68	99	24	64	3.6
VW-2-END	6/28/2011	3,200	44	68	16	43	3.1

Notes:

TPHg - denotes total petroleum hydrocarbons as gasoline
MTBE - denotes methyl tertiary butyl ether
ppmv - parts per million by volume
< - denotes less than the detection limit

Table 7
Dual Phase Extraction Pilot Test
Vapor Extraction Summary

Shore Acres Gas
403 East 12th Street
Oakland, California

Well	Meter (hours)	Influent Flow Rate (scfm)	Influent Sample Results		Extraction Rates (lb/day)		Extraction Mass (lb/day)	
			TPHg (ppmv)	Benzene (ppmv)	TPHg (lb/day)	Benzene (lb/day)	TPHg (lb)	Benzene (lb)
VW-1-INIT	3	150	190	9.4	10.29	0.44	1.29	0.06
VW-1-DAY 2	15	150	500	15	27.08	0.00	13.54	0.00
VW-1-END	39	150	1,400	21	75.81	0.99	75.81	0.99
VW-2-INIT	3.0	50	11,000	140	198.55	2.19	24.82	0.27
VW-2-DAY 2	18.5	50	4,700	68	84.84	1.07	54.79	0.69
VW-2-END	42.5	50	3,200	44	57.76	0.69	57.76	0.69
Total							228.0	2.69

MW_{TPHg} = Molecular Weight of TPHg = 90

$MW_{Benzene}$ = Molecular Weight of Benzene = 78.11

MW_{MTBE} = Molecular Weight of Methyl tert-butyl ether = 88.15

ft^3 = cubic feet

min = minutes

lb/day = pounds per day

ppmv = parts per million by volume = $ft^3 / 1x10^6 ft^3$

scfm = standard cubic feet per minute

NS = not sampled

NA = not analyzed

NC = not calculated

Extraction rate = (flow rate(ft^3/min) x concentration ($ft^3 / 1x10^6 ft^3$) x MW_{TPHg}(lb/lb-mol) x 1440 min/day)/(359 ft^3/lb-mol*)

Table 8
Dual Phase Extraction Pilot Test
Groundwater Extraction Summary
Shore Acres Gas
403 East 12th Street
Oakland, California

Sample ID	Date	Water Extracted (gals.)	Influent Concentration		Extraction Mass	
			TPHg (ug/L)	Benzene (ug/L)	TPHg (lb/day) (lb)	Benzene (lb/day) (lb)
VW-1	6/28/2011	8,200	**20,000**	**2,000**	**1.37**	**0.14**
VW-2	6/28/2011	5,700	**33,000**	**3,100**	**1.57**	**0.15**
Totals					**2.9**	**0.3**

gals. - denotes gallons
ug/L - denotes micrograms per liter
lb- denotes pounds
< - denotes less than the detection limit

Water extracted values are total gallons of water extracted
Averageof the March 11 and 18 concentrations were used to determin mass

Table 9

TPHg, Benzene, and MTBE Masses in Soil

Shore Acres Gas

403 East 12th Street

Oakland, California

TPHg Average[1] Concentration (mg/kg)	Area (ft^2)	Thickness (ft)	Volume (ft^3)	Mass[2] (lbs)
11-20 feet bgs				
3,250	4,900	4	19,600	6,370
550	8,100	12	77,600	4,268
55	12,100	15	84,300	464
5.5	19,600	20	210,500	116
Total TPHg Mass				**11,217**

Benzene Average Concentration (mg/kg)	Area (ft^2)	Thickness (ft)	Volume (ft^3)	Mass (lbs)
11-27 feet bgs				
17	625	5	3,125	5
2.75	4,900	10	45,875	13
0.275	19,600	16	264,600	7
0.0275	19,600	20	78,400	0
Total Benzene Mass				**18.1**

MTBE Average Concentration (mg/kg)	Area (ft^2)	Thickness (ft)	Volume (ft^3)	Mass (lbs)
11-27 feet bgs				
0.8	6,400	5	32,000	2.6
0.275	19,600	15	262,000	7.2
0.0275	28,900	20	284,000	0.8
Total MTBE Mass				**10.5**

Notes

(1) Average of highest area = average of all concentrations plus isoconcentration value / (number of concentrations + 1)

(2) Assumes a soil bulk density of 100 pounds per cubic foot

Table 10

TPHg, Benzene, and MTBE Masses in Groundwater

Shore Acres Gas

403 East 12th Street

Oakland, California

TPHg Average[1] Concentration (ug/L)	Area (ft2)	Depth (ft)	Mass[2] (lbs)
75,000	2,142	20	60.11
27,500	7,900	20	81.29
Total TPHg Mass			**141.40**

Benzene Average Concentration (ug/kg)	Area (ft2)	Depth (ft)	Mass (lbs)
11,000	2,456	20	10.11
2,750	5,177	20	5.33
Total Benzene Mass			**15.44**

MTBE Average Concentration (ug/kg)	Area (ft2)	Depth (ft)	Mass (lbs)
9,000	240	20	0.81
2,750	3,137	20	3.23
275	4,943	20	0.51
Total MTBE Mass			**4.54**

Notes

(1) Average of highest area = $\frac{\text{average of all concentrations plus isoconcentration value}}{\text{(number of concentrations + 1)}}$

(2) Assumes a porosity of 30%

ALAMEDA COUNTY
HEALTH CARE SERVICES
AGENCY
ALEX BRISCOE, Director

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

May 11, 2012

Rashid Ghafoor and Waseem Iqbal (Sent via e-mail to rashidz1@aol.com)
226 Havenwood Circle
Pittsburg, CA 94567

Subject: Work Plan Approval for Fuel Leak Case No. RO0002931 and GeoTracker Global ID T0600174667, Shore Acres Gas, 403 E 12th St., Oakland, CA 94606

Dear Messrs. Ghafoor and Iqbal:

Alameda County Environmental Health (ACEH) staff has reviewed the recently submitted documents entitled, Offsite Investigation and DPE Pilot Test with Fourth Quarter 2011 Monitoring Report dated January 26, 2012 and *Letter Report- Offsite Findings* dated April 3, 2012, which was prepared by Environmental Compliance Group (ECG), LLC for the subject site. The report presents the results of the off-site investigation, the fourth quarter 2011 monitoring event, the results from a five-day dual-phase extraction (DPE) pilot test and proposes preparing a corrective action plan.

ACEH generally concurs with the proposed scope of work and requests that you address the following technical comments, and send us the technical reports described below.

TECHNICAL COMMENTS

1. **Corrective Action Plan** - At this time, a Corrective Action Plan (CAP) prepared in accordance with Title 23, California Code of Regulations, Section 2725 appears warranted. The FS/CAP must include a concise background of soil and groundwater investigations performed in connection with this case and an assessment of the residual impacts of the chemicals of concern (COCs) for the site and the surrounding area where the unauthorized release has migrated or may migrate. The CAP is to also include, but is not limited to, a detailed description of site lithology, including soil permeability, and most importantly, contamination cleanup levels and cleanup goals, in accordance with the San Francisco Regional Water Quality Control Board (SFRWQCB) Basin Plan and appropriate ESL guidance for all COCs and for the appropriate groundwater designation. Please note that soil cleanup levels should ultimately (within a reasonable timeframe) achieve water quality objectives (cleanup goals) for groundwater in accordance with the SFRWQCB Basin Plan. Please specify appropriate cleanup levels and cleanup goals in accordance with 23 CCR Section 2725, 2726, and 2727 in the CAP.

The CAP must evaluate at least three viable alternatives for remedying or mitigating the actual or potential adverse affects of the unauthorized release(s) besides the 'no action' and 'monitored natural attenuation' remedial alternatives. Each alternative shall be evaluated not only for cost-effectiveness but also its timeframe to reach cleanup levels and cleanup goals, and ultimately the Responsible Party must propose the most cost-effective corrective action.

2. **Conversion of MW-5 to an Extraction Well** – ECG recommends converting MW-5 to an extraction well. While ACEH agrees that this location appears ideal, this would leave the area without a monitoring well in the area with the highest concentration. Also, the well is constructed with solid casing to 10 feet. The other two vapor wells are constructed with a screened interval from 5 to 20 feet. ACEH recommends installing an additional vapor extraction well in the same area as MW-5, if this remediation method is selected and approved. ACEH does not approve using wells used for the monitoring network as extraction wells.

3. **Expanded Site Plan** – Please continue plotting data on an expanded site map that uses an aerial photograph as a basemap such as the one presented in the October 13, 2011 *Third Quarter 2011 Monitoring and Interim Results Report Addendum* in all future reports.

4. **Geotracker Compliance** – The Geotracker submittals for the interim report did not include the well survey, analytical data and Geowell data as required by California Code of Regulations, Title 23, Division 3, Chapter 16, Article 12, Sections 2729 and 2729.1. The requirement is that beginning September 1, 2001, all analytical data, including monitoring well samples, submitted in a report to a regulatory agency as part of the UST or LUST program, must be transmitted electronically to the SWRCB GeoTracker system via the internet. Also, beginning January 1, 2002, all permanent monitoring points utilized to collect groundwater samples (i.e. monitoring wells) and submitted in a report to a regulatory agency, must be surveyed (top of casing) to mean sea level and latitude and longitude to sub-meter accuracy using NAD 83. Please ensure that the well survey and analytical data is uploaded to the Geotracker website by the due date requested below.

TECHNICAL REPORT REQUEST

Please submit technical reports to ACEH (Attention: Barbara Jakub), according to the following schedule:

- **June 4, 2012** – Geotracker Compliance
-
- **July 10, 2012** – Corrective Action Plan

Should you have any questions or concerns regarding this correspondence or your case, please call me at (510) 639-1287 or send me an electronic mail message at barbara.jakub@acgov.org.

Sincerely,

Digitally signed by Barbara J. Jakub
DN: cn=Barbara J. Jakub, o, ou, email=barbara.jakub@acgov.org, c=US
Date: 2012.05.11 12:05:04 -07'00'

Barbara J. Jakub, P.G.
Hazardous Materials Specialist

Enclosure: Responsible Party(ies) Legal Requirements/Obligations
ACEH Electronic Report Upload (ftp) Instructions

cc: Michael S. Sgourakis, Environmental Compliance Group, LLC, 270 Vintage Drive, Turlock, CA 95382 *(Sent via E-mail to: ecg.ust@gmail.com)*
Leroy Griffin, Oakland Fire Department, 250 Frank H. Ogawa Plaza, Ste. 3341, Oakland, CA 94612-2032 (*Sent via E-mail to: lgriffin@oaklandnet.com*)
Donna Drogos, ACEH (*Sent via E-mail to: donna.drogos@acgov.org*)
Barbara Jakub, ACEH (*Sent via E-mail to: barbara.jakub@acgov.org*)
GeoTracker, e-file

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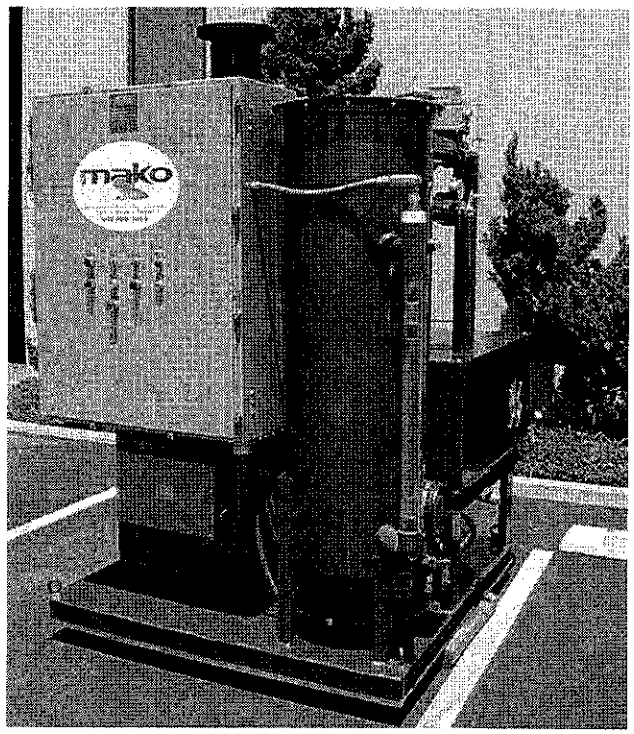
400 CFM Makocat (HV)
Electric Catalytic Oxidizer / High Vacuum System



Standard Features:

- Small Footprint Skid Mounting
- Entrained Liquid Separator
- Dilution / Process Valves
- Stainless Steel Transfer Pump
- Oil Sealed Liquid Ring Blower
- Oil Cooler Assembly
- 25 Horsepower TEFC Motor
- Sound Enclosure
- Oxidizer Chamber
- Platinum Coated Catalyst Cell
- Nickel Chrome Heating Element
- Stainless Steel Heat Exchanger
- Flame Arrestor
- Digital Temperature Controller
- Digital Dilution Controller
- Pitot Tube / Pressure Transmitter
- Digital Chart Recorder

Standard Options:

Trailer Mounted System • Remote Telemetry
Totally Enclosed System • Single Phase System
UL Listed Electrical Enclosure E306379

Standard Performance Specifications:

Skid Dimensions = 7' Width x 7' Length x 13' Height

3/16" Heavy Duty Steel Construction Throughout

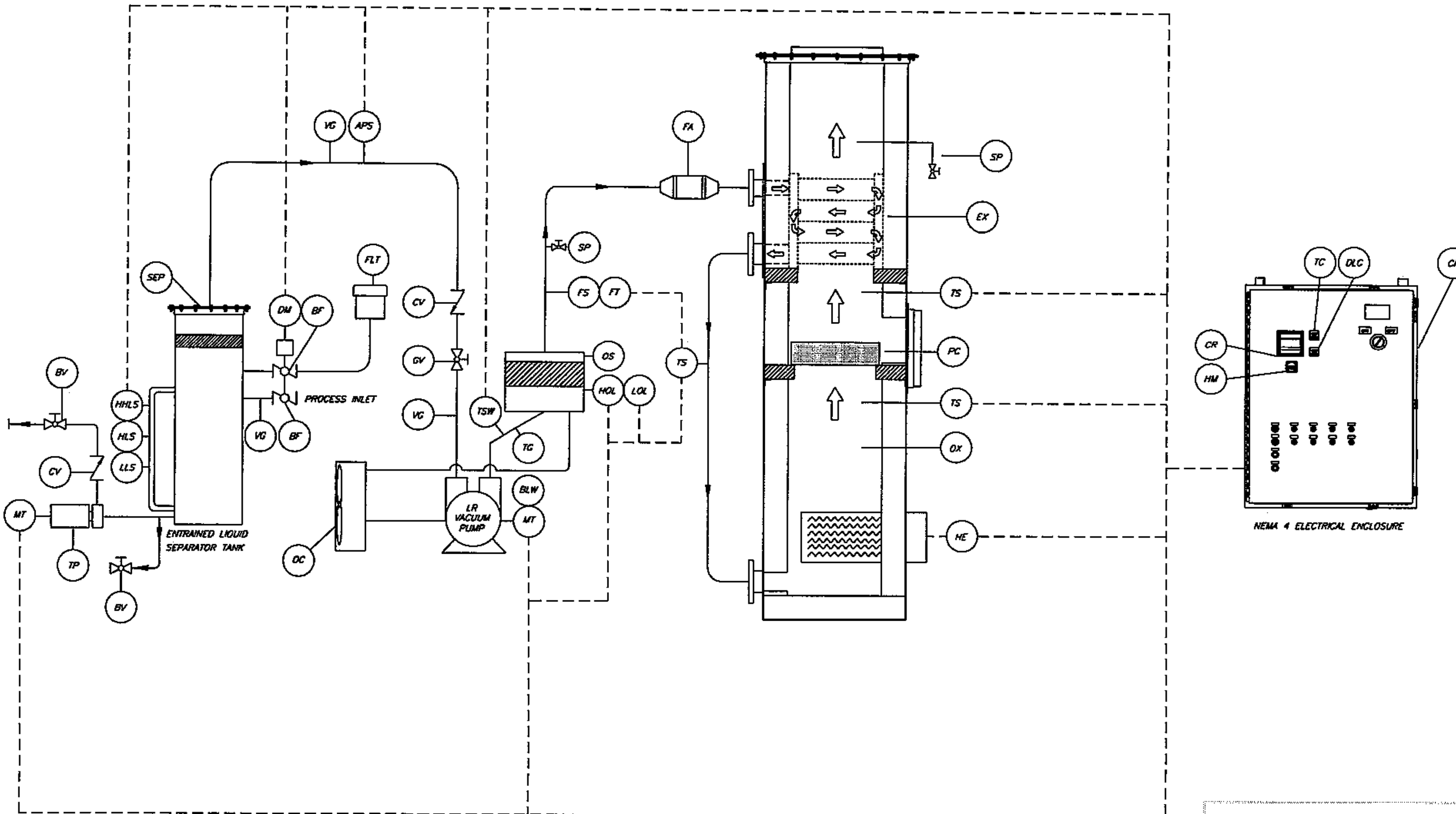
Electrical Requirement = 208/240 Volt/3 Phase/200 Amp

Electrical Requirement = 208/240 Volt/1 Phase/250 Amp

Process Flow = 400 CFM and up to 28" Hg. Vacuum

VOC Loading = 3,500 PPMV Maximum

Destruction Efficiency = 98%+



MAKO INDUSTRIES

ELECTRIC CATALYTIC OXIDIZER

PROCESS INSTRUMENTATION DRAWING

DATE:	FILE:
9/15/08	400 Makocat.PID

400 CFM Makocat (HV)

ENVIRONMENTAL COMPLIANCE GROUP, LLC
STANDARD OPERATING AND SAFETY AND LOSS CONTROL PROCEDURES

1.0 SOIL BORING/DRILLING SAMPLE COLLECTION AND CLASSIFICATION PROCEDURES

ECG will prepare a site-specific Health and Safety Plan as required by the Occupational Health and Safety Administration (OSHA) Standard "Hazardous Waste Operations and Emergency Response" guidelines (29 CFR.1910.120). The document will be reviewed and signed by all ECG personnel and subcontractors prior to performing work at the site.

Prior to conducting and subsurface work at the site, Underground Services Alert (USA) will be contacted to delineate subsurface utilities near the site with surface markings. In addition, the first five feet of every location will be hand cleared to a diameter larger than the diameter of the auger or probe as a further precaution against damaging underground utilities. Sites that are currently operated as gas stations will be cleared with a private utility locator prior to drilling activities.

Soil samples to be submitted for chemical analyses are collected into brass or stainless steel tubes. The tubes are placed in an 18-inch long split-barrel sampler. The split-barrel sampler is driven its entire length hydraulically or by 140-pound drop hammer. The split-barrel sampler is removed from the borehole and the tubes are removed. When the tubes are removed from the split-barrel sampler, the tubes are trimmed and capped with Teflon sheets and plastic caps or the soil is removed from the tubes and placed in other appropriate sample containers. The samples are sealed, labeled, and placed in ice under chain-of-custody to be delivered to the analytical laboratory. All samples will be kept refrigerated until their delivery to the analytical laboratory.

One soil sample collected from each split-barrel sampler is field screened with a photoionization detector (PID), flame ionization detector (FID), or other equivalent field screening meter. The soil sample is sealed in a plastic bag or other appropriate container to allow volatilization of volatile organic compounds (VOCs). The field meter is used to measure the VOC concentration in the container's headspace and is recorded on the boring logs at the appropriate depth interval.

Other soil samples collected from each split-barrel sampler are inspected and documented to identify the soil stratigraphy beneath the site and classify the soil types according to the United Soil Classification System. The soil types are recorded on boring logs with the appropriate depth interval and any pertinent field observations. Drilling and sampling equipment are steam cleaned or washed in solution and rinsed in deionized water prior to use, between sample collections and boreholes and after use.

2.0 SOIL EXCAVATION SAMPLE COLLECTION AND CLASSIFICATION PROCEDURES

Soil samples to be submitted for chemical analyses are collected into brass or stainless steel tubes or other appropriate containers. The samples are sealed, labeled, and placed in ice under chain-of-custody (COC) to be delivered to the analytical laboratory. All samples will be kept refrigerated until their delivery to the analytical laboratory.

Select soil samples are placed into a sealed plastic bag or other appropriate container and field screened using a PID, FID, or equivalent meter. Other soil samples collected are inspected and documented to identify the soil stratigraphy beneath the site and classify the soil types according to the United Soil Classification System. The soil types are recorded field notes with the appropriate depth interval and any pertinent field observations. Sampling equipment are steam cleaned or washed in solution and rinsed in deionized water prior to use, between sample collections, and after use. Soil cuttings and rinseate water are temporarily stored onsite pending laboratory analytical results and proper transport and disposal.

3.0 SAMPLE IDENTIFICATION AND COC PROCEDURES

Sample containers are labeled with job number, job name, sample collection time and date, sample collection point, and analyses requested. Sampling method, sampler's name, and any pertinent field observations are recorded on boring logs or excavation field notes. COC forms track the possession of the sample from the time of its collection until the time of its delivery to the analytical laboratory. During sample transfers, the person with custody of the samples will relinquish them to the next person by signing the COC and documenting the time and date. The analytical laboratory Quality Control/Quality Assurance (QA/QC) staff will document the receipt of the samples and confirm the analyses requested on the COC matches the sample containers and preservative used, if any. The analytical laboratory will assign unique log numbers for identification during the analyses and reporting. The log numbers will be added to the COC form and maintained in a log book maintained by the analytical laboratory.

4.0 ANALYTICAL LABORATORY QA/QC PROCEDURES

The analytical laboratory analyzes spikes, replicates, blanks, spiked blanks, and certified reference materials to verify analytical methods and results. The analytical laboratory QA/QC also includes:

Routine instrument calibration,
Complying with state and federal laboratory accreditation and certification programs,
Participation in U.S. EPA performance evaluation studies,
Standard operating procedures, and
Multiple review of raw data and client reports

5.0 HOLLOW STEM AUGER WELL INSTALLATION

Boreholes for wells are often drilled with a truck-mounted hollow stem auger drill rig. The borehole diameter is at least 4 inches wider than the outside diameter of the well casing. Soil samples are collected and screened as described in **Section 1.0** and decontamination procedures are also the same as described in **Section 1.0**.

Wells are cased with both blank and factory-perforated Schedule 40 PVC. The factory perforations are typically 0.020 inches wide by 1.5 inch long slots, with 42 slots per foot. A PVC cap is typically installed at the bottom of the casing with stainless steel screws. No solvents or cements are used in the construction of the wells. Well stabilizers or centering devices may be installed around the casing to ensure the filter material and grout in the annulus are evenly distributed. The casing is purchased pre-cleaned or steam cleaned and washed prior to installation in the borehole.

The casing is set inside the augers and sand, gravel, or other filter material is poured into the annulus to fill the borehole from the bottom to approximately 1-2 feet above the perforations. A two foot thick bentonite plug is placed above the filter material to prevent the grout from filling the filter pack. Neat cement or sand-cement grout is poured into the annulus from the top of the bentonite plug to the surface. For wells located in parking lots or driveways, or roads, a traffic rated well box is installed around the well. For wells located in landscaped areas or fields, a stovepipe well protection device is installed around the well. Soil cuttings and rinseate water are temporarily stored onsite pending laboratory analytical results and proper transport and disposal.

6.0 MUD AND AIR ROTARY WELL INSTALLATION

Boreholes for wells can also be drilled with a truck-mounted air rotary or mud rotary drill rig. Air or mud can be used as a drill fluid to fill the borehole and prevent the borehole from caving in and remove drill cuttings. Mud or air can be chosen depending on the subsurface conditions. Soil samples are collected and screened as described in **Section 1.0** and decontamination procedures are also the same as described in **Section 1.0**.

Wells are cased with both blank and factory-perforated Schedule 40 PVC. The factory perforations are typically 0.020 inches wide by 1.5 inch long slots, with 42 slots per foot. A PVC cap is typically installed at the bottom of the casing with stainless steel screws. No solvents or cements are used in the construction of the wells. Well stabilizers or centering devices may be installed around the casing to ensure the filter material and grout in the annulus are evenly distributed. The casing is purchased pre-cleaned or steam cleaned and washed prior to installation in the borehole. Soil cuttings and drilling fluids are temporarily stored onsite pending laboratory analytical results and proper transport and disposal.

The casing is set inside the augers and sand, gravel, or other filter material is poured into the annulus to fill the borehole from the bottom to approximately 1-2 feet above the perforations. A two foot thick bentonite plug is placed above the filter material to prevent the grout from filling the filter pack. Neat cement or sand-cement grout is poured into the annulus from the top of the bentonite plug to the surface. For wells located in parking lots or driveways, or roads, a traffic rated well box is installed around the well. For wells located in landscaped areas or fields, a stovepipe well protection device is installed around the well. Soil cuttings and rinseate water are temporarily stored onsite pending laboratory analytical results and proper transport and disposal.

7.0 WELL DEVELOPMENT

After well installation, the wells are developed to remove residual drilling materials from the annulus and to improve well production by fine materials from the filter pack. Possible well development methods include pumping, surging, bailing, jetting, flushing, and air lifting. Development water is temporarily stored onsite pending laboratory analytical results and proper transport and disposal. Development equipment are steam cleaned or washed in solution and rinsed in deionized water prior to use, between sample collections and after use. After well development the wells are typically allowed to stabilize for at least 24 hours prior to purging and sampling.

8.0 LIQUID LEVEL MEASUREMENTS

Liquid level measurements are made with a water level meter and/or interface probe and disposable bailers. The probe tip attached to a measuring tape is lowered into the well and into the groundwater when a beeping tone indicates the probe is in the groundwater. The probe and measuring tape (graduated to hundredths of a foot) are slowly raised until the beeping stops and the depth to water measurement is recorded. If the meter makes a steady tone, this indicates the presence of floating liquid hydrocarbons (FLH) and the probe and measuring tape are raised until the steady tone stops and the depth to the FLH is measured. Once depth to water and depth to FLH (if present) has been recorded, the probe and measuring tape are lowered to the bottom of the well where the total depth of the well is measured. The depth to water, depth to FLH, and depth to bottom are measured again to confirm the results.

If FLH is encountered in the well, a disposable bailer is lowered into the well and brought back to the surface to confirm the thickness/presence of FLH. To minimize potential for cross contamination between wells, all measurements are done from cleanest to dirtiest well. Prior to beginning liquid level measurements, in between measurements in all wells, and at the completion of liquid level measurements, the water level probe and measuring tape is cleaned with solution (Alconox, Simple Green, or equivalent) and rinsed with deionized water.

9.0 WELL PURGING AND SAMPLING

Each well is typically purged of at least three well casing volumes of groundwater prior to collecting a groundwater sample. Purging can continue beyond three well casing volumes if field parameters including pH, temperature, electrical conductivity are not stabilizing during the purging process. If the well is purged dry before the three well casing volumes has been purged, the well is typically allowed to recharge to 80 percent of its initial water level before a groundwater sample is collected.

Purging equipment can include submersible pumps, PVC purging bailers, disposable bailers, air lift pumps, or pneumatic pumps. Prior to beginning well purging, in between each well purging, and at the completion of purging activities, all non-dedicated purging equipment is cleaned with solution (Alconox, Simple Green, or equivalent) and rinsed with deionized water.

Once the well has been purged, it will be sampled with a disposable bailer, PVC bailer, stainless steel bailer, or through a low flow groundwater pump. The groundwater sample is transferred from the bottom of the bailer to reduce volatilization to the appropriate sample container. The sample containers are specified by the analytical laboratory depending on the analyses requested. Sample containers typically include volatile organic compound (VOA) vials with septa of Teflon like materials. The groundwater sample is collected into the VOAs to minimize air bubbles and once the cap has been placed on the VOA, the VOA is tipped upside down to see if air bubbles are present in the VOA. Typically a duplicate VOA is collected from each well to be analyzed by the analytical laboratory, if warranted, to verify results.

Sample containers are labeled as described in **Section 3.0** and placed immediately in an ice chest and kept refrigerated until its delivery to the analytical laboratory. A trip blank may also be prepared by the analytical laboratory to travel with the ice chest during transport to the laboratory. Field blanks from equipment that has been decontaminated may be collected in between use in different wells to verify the decontamination procedure is effective. To minimize potential for cross contamination between wells, all wells are purged and sampled from cleanest to dirtiest well.

10.0 TEDLAR BAG SOIL VAPOR SAMPLING

Sampling equipment to collect Tedlar bag soil vapor samples includes an air pump, a Tedlar bag which can range in size from 1 to 10 liters, and 3/16-inch diameter polyethylene tubing. The air pump should be equipped with 3/16-inch hose barbs for the polyethylene tubing to attach to. The Tedlar bag must be equipped with a valve for filling and sealing the bag.

When soil vapor samples are collected from remediation equipment, the sample collection port on the remediation equipment is typically fitted with a 3/16-inch hose barb. Prior to collecting soil vapor samples from remediation equipment, air flow, temperature, and pressure or vacuum of the sampling point/remediation equipment are recorded. One end of the polyethylene tubing is connected to the sample collection port and one end is connected to the influent of the air pump, creating an air tight seal. The air pump is turned on and soil vapor from the sample collection port is pumped through the air pump for at least one minute. The air pump is turned off and one end of another piece of polyethylene tubing is connected to the effluent of the air pump and one end is connected to the valve on the Tedlar bag. The valve is opened and the air pump is turned on filling the Tedlar bag with the soil vapor sample until the bag has reached 75% capacity, when the valve on the Tedlar bag is closed and the air pump is turned off.

Tedlar bags are labeled as described in **Section 3.0** and placed immediately in an empty ice chest and kept dry and unrefrigerated until its delivery to the analytical laboratory. After each soil vapor sample collection, the air pump is turned on for five minutes to allow ambient air to clear the air pump and polyethylene tubing.

11.0 SUMMA CANISTER SOIL VAPOR SAMPLING

Sampling equipment to collect Summa canister soil vapor samples includes a sterilized Summa stainless steel canister under vacuum, ¼-inch diameter polyethylene tubing, and a laboratory calibrated flow meter, if required.

When soil vapor samples are collected from remediation equipment, the sample collection port on the remediation equipment is typically fitted with brass connection with silicone septa that has been threaded into a tapped hole on the piping network. Prior to collecting soil vapor samples from remediation equipment, air flow, temperature, and pressure or vacuum of the sampling point/remediation equipment are recorded. One end of the polyethylene tubing is connected to the brass sample collection port and one end is connected to the canister valve or flow meter, creating an air tight seal. Prior to collecting the soil vapor sample, the valve on the Summa canister is opened to verify the Summa canister has the required vacuum which is recorded. The sample valve or flow meter is opened and the soil vapor sample is collected into the Summa canister and the sample valve is closed and the final vacuum reading (typically greater than 5 inches per square inch) on the Summa canister is recorded.

Summa canisters are labeled as described in **Section 3.0** and placed immediately in an empty ice chest and kept dry and unrefrigerated until its delivery to the analytical laboratory.

12.0 SYRINGE SOIL VAPOR SAMPLING

Sampling equipment to collect syringe soil vapor samples includes a sterilized, 100 cubic centimeter, gas tight syringe and silicone septa.

When soil vapor samples are collected from remediation equipment, the sample collection port on the remediation equipment is typically fitted with brass connection with silicone septa that has been threaded into a tapped hole on the piping network. Prior to collecting soil vapor samples from remediation equipment, air flow, temperature, and pressure or vacuum of the sampling point/remediation equipment are recorded. The syringe is inserted into the silicone septa and the plunger is purged or pumped at least three times. The sample is collected the fourth time the syringe plunger is extracted and the syringe is removed from the sample collection port and the needle on the syringe is capped with a rubber stopper.

Syringes are labeled as described in **Section 3.0** and placed immediately in an empty ice chest and kept dry and unrefrigerated until its delivery to the analytical laboratory.

13.0 TEDLAR BAG SOIL VAPOR SURVEY, TEMPORARY SAMPLING POINTS

Sampling equipment to collect Tedlar bag soil vapor survey samples includes an air pump, a Tedlar bag which can range in size from 1 to 10 liters, 3/16-inch diameter polyethylene tubing, and possibly a soil vapor probe. The air pump should be equipped with 3/16-inch hose barbs for the polyethylene tubing to attach to. The Tedlar bag must be equipped with a valve for filling and sealing the bag.

A temporary borehole is advanced using either a slam bar or a direct push drill rig. In the case of the slam bar, once the borehole has been created, a temporary soil vapor probe is inserted into the borehole and advanced with a slide hammer or other physical force two additional feet. A bentonite seal is then placed in the borehole above the soil vapor probe to create an air tight seal and prevent ambient air from entering the sample collection space. In the case of the direct push drill rig, the sampling rod is advanced to the desired depth with a 6-inch retractable vapor screen at the tip. The sample screen on the 6-inch vapor screen is removed and a bentonite seal is then placed in the borehole above the soil vapor probe to create an air tight seal and prevent ambient air from entering the sample collection space.

Once the bentonite seal has set, at least one hour, the soil vapor survey samples are collected into Tedlar bags as described in **Section 10.0.** Tedlar bags are labeled as described in **Section 3.0** and placed immediately in an empty ice chest and kept dry and unrefrigerated until its delivery to the analytical laboratory. After each soil vapor sample collection, the air pump is turned on for five minutes to allow ambient air to clear the air pump and polyethylene tubing.

13.0 TEDLAR BAG SOIL VAPOR SURVEY, TEMPORARY AND REPEATABLE SAMPLING POINTS

Sampling equipment to collect Tedlar bag soil vapor survey samples includes an air pump, a Tedlar bag which can range in size from 1 to 10 liters, 3/16-inch diameter polyethylene tubing, and possibly a soil vapor probe. The air pump should be equipped with 3/16-inch hose barbs for the polyethylene tubing to attach to. The Tedlar bag must be equipped with a valve for filling and sealing the bag.

13.1 TEMPORARY SAMPLING POINTS

A temporary borehole is advanced using either a slam bar or a direct push drill rig. In the case of the slam bar, once the borehole has been created, a temporary soil vapor probe is inserted into the borehole and advanced with a slide hammer or other physical force two additional feet. A bentonite seal is then placed in the borehole above the soil vapor probe to create an air tight seal and prevent ambient air from entering the sample collection space. In the case of the direct push drill rig, the sampling rod is advanced to the desired depth with a 6-inch retractable vapor screen at the tip. The sample screen on the 6-inch vapor screen is removed and a bentonite seal is then placed in the borehole above the soil vapor probe to create an air tight seal and prevent ambient air from entering the sample collection space.

Once the bentonite seal has set, at least one hour, the soil vapor survey samples are collected into Tedlar bags as described in **Section 10.0.** Tedlar bags are labeled as described in **Section 3.0** and placed immediately in an empty ice chest and kept dry and unrefrigerated until its delivery to the analytical laboratory. After each soil vapor sample collection, the air pump is turned on for five minutes to allow ambient air to clear the air pump and polyethylene tubing.

13.2 REPEATABLE SAMPLING POINTS

A borehole is advanced using either a hand auger or a drill rig. A 6-inch slotted probe with caps on both ends is placed in the borehole. A Swagelok fitting is attached to one end cap and 3/16-inch diameter Nylon tubing is attached to the Swagelok fitting. A one foot sand pack is placed around the probe and the remainder of the borehole is sealed with a layer of dry bentonite powder, followed by a layer of bentonite chips, and an additional layer of dry bentonite powder. A well box is placed on the surface of the repeatable sampling point and the excess Nylon tubing is placed inside the well box.

Soil vapor survey samples will be collected at least one week after probe installation. In addition, soil vapor survey samples will only be collected after five consecutive precipitation free days and after any onsite irrigation has been suspended.

The soil vapor survey samples are collected into Tedlar bags as described in **Section 10.0** or Summa canisters as described in **Section 11.0.** Tedlar bags or Summa canisters are labeled as described in **Section 3.0** and placed immediately in an empty ice chest and kept dry and unrefrigerated until its delivery to the analytical laboratory. After each soil vapor sample collection, the air pump is turned on for five minutes to allow ambient air to clear the air pump and polyethylene tubing.