Remediation System Installation and Pilot Testing
ConocoPhillips 76 Service Station 5353
600 Westlake Avenue North
Seattle, Washington

October 27, 2003

For

ConocoPhillips

webX 255353

GEOENGINEERS

GeoEngineers

October 27, 2003

ConocoPhillips
Risk Management and Remediation, West Division
3977 Leary Way Northwest
Seattle, Washington 98107

Attention: Tim Johnson

Subject: Remediation System Installation and Pilot Testing
ConocoPhillips 76 Service Station Site
600 Westlake Avenue North
Seattle, Washington
File No. 4823-517-05

EXECUTIVE SUMMARY

Residual petroleum-contaminated soil and a petroleum-contaminated groundwater plume are present beneath the ConocoPhillips 76 service station site located at 600 Westlake Avenue in Seattle, Washington. Remedial activities and groundwater monitoring have been ongoing at this site since 1980 when an 80,000 unleaded gasoline release was identified. After free product removal in 1980, an in-site vapor extraction system was installed (during the mid 1980's). Between March and April 2003, additional in-site remedial system components (air sparging wells and a biosparging treatment curtain with vapor extraction) were installed. The objective of the remediation system is to (1) decrease and/or manage offsite impacts from migration of the petroleum-contaminated groundwater plume, and (2) treat residual contaminated soil and groundwater in areas around the 76 station building and facilities. The newly installed remediation system components include a biosparge treatment curtain trench near the northern (downgradient) site boundary, and four air sparge wells located on the western portion of the site (three of which were installed during this phase of work). The biosparge treatment curtain trench is approximately 235 feet long, 5 feet wide, and 16 to 18 feet deep, is backfilled with pea gravel, and contains 15 biosparge wells, 8 multipurpose wells, and shallow horizontal vapor extraction piping. Remediation system equipment includes an air sparge blower (for the 15 trench biosparge wells), four compressors and a heat exchanger (for the four air sparge wells), and a vapor extraction blower and knockout tank (for the biosparge trench horizontal vapor extraction system). Five existing on-site vapor extraction wells and three existing off-site vapor extraction wells also were connected to the remediation system vapor extraction equipment.

The remediation system was pilot tested during May 2003. The pilot test consisted of operating and monitoring the air sparge and vapor extraction systems, and monitoring nearby observation wells. Based on the results of the pilot test, it appears that the system performance is adequate to decrease hydrocarbon concentrations in groundwater north of the curtain trench and to enhance biodegradation of hydrocarbons near each vertical air sparge well. Additionally, it appears that the vapor extraction system will be effective at collecting hydrocarbon vapors generated by air sparging. The pilot study results also indicate

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that an air discharge permit and system off-gas treatment will be required. Based on our performance and cost analysis of granular activited carbon (GAC) versus catalytic oxidizers, GAC appears to be the more cost efficient and effective off-gas treatment option.

INTRODUCTION AND BACKGROUND

This report presents the results of remediation system installation and pilot testing activities for the above-referenced site. The site currently consists of a 76 gasoline service station, including underground storage tank (UST) facilities, pump islands, convenience store, and an adjacent vacant restaurant building (formerly Denny's). The general layout of the site is shown in Figure 1.

Several phases of environmental studies have been completed to address petroleum-contaminated soil and groundwater beneath the site. A significant gasoline release (about 80,000 gallons) was documented in 1980 as a result of leaking fuel supply piping. Over 40,000 gallons of gasoline was recovered within the initial response. Remedial activities since the 1980s have consisted primarily of vapor extraction and treatment of vadose zone soil in accessible portions of the site (via eight vapor extraction wells), and on the adjacent property to the north (via three vapor extraction wells). Currently free product remains in one localized area (near MW-37) immediately south of the site beneath Mercer Street. Dissolved phase hydrocarbon contamination in groundwater remains beneath the 76 station and former Denny's parcels of the site. The groundwater flow direction beneath the site is to the north, towards Lake Union.

Remediation at the source area has been limited because of (1) the complexities of the subsurface facilities, (2) heterogeneous soil conditions, and (3) limitations in disrupting business activities. As a result, the remedial actions described in this report were implemented to decrease and/or manage offsite impacts from migration of the petroleum-contaminated groundwater plume and enhance biodegration of gasoline-contaminated groundwater in the central portion of the site.

To facilitate the implementation of this multi-component remedial system, GeoEngineers also completed (1) the installation and pilot testing of two air sparge wells (AS-1 and AS-2) located near the south boundary of the site, and (2) preliminary design of the remedial system. The results are presented in the following report: "Air Sparging Pilot Test and Preliminary Remediation Curtain Design", dated June 12, 2003. The pilot testing results indicated that air sparging into the deeper well (AS-2, screened from 28 to 30 feet) would be more effective (more oxygen distributed with a larger radius of influence) than the shallower well (AS-1, screened from 15 to 17 feet).

As a result of the pilot testing and preliminary remedial system design activities completed in September 2002, GeoEngineers also assisted Conocophillips during the winter of 2002 and 2003 in:

1. Preparing remedial design specifications and contractor selection.
2. Preparation of a SEPA exemption.
3. Coordinating construction activities to coincide with service station remodeling and upgrades planned for February 2003.

The following describes construction and pilot testing activities.

BIOSPARGE TREATMENT CURTAIN TRENCH

GeoEngineers monitored the excavation and construction of a biosparge treatment curtain trench near the northern site boundary between February and March 2003. The purpose of the biosparge treatment curtain trench is to intercept and treat (by air sparging and vapor extraction) the dissolved phase hydrocarbon plume before it migrates off-site. The biosparge treatment curtain trench was excavated in sections using stacked shoring boxes and a tracked excavator operated by Custom Backhoe of Bellevue, Washington. The trench is located parallel to, and south of, the northern (downgradient) site boundary (see Figure 1). The trench is approximately 16 to 18 feet deep, 5 feet wide, and 235 feet long. The upper portion of the trench is up to 16 feet in some areas due to sloughing that occurred during excavation.

Three existing vapor extraction wells located in the vicinity of the biosparge treatment curtain trench were removed during excavation activities. The shallow header pipe between the three removed vapor extraction wells was replaced within the biosparge treatment curtain trench.

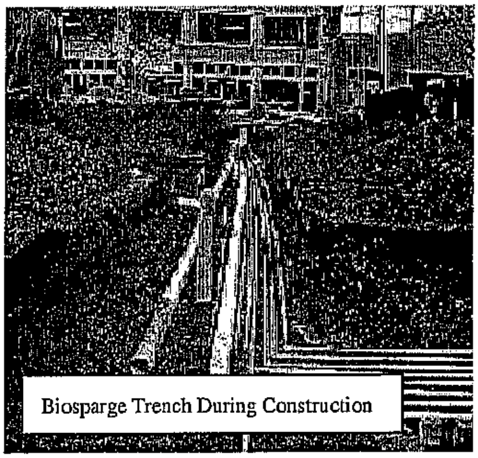
Soil encountered during trench excavation activities generally consisted of sand with varying amounts of silt and gravel. Wood debris was encountered at depths from approximately 10 to 18 feet below ground surface (bgs). Evidence of petroleum contamination (odors, staining) was observed in soil from depths of approximately 8 to 11 feet bgs. Soil samples were not obtained for chemical analysis.

Groundwater was encountered during trench excavation activities at a depth of approximately 11 feet bgs. Groundwater samples were not obtained for chemical analysis. Dewatering was not necessary during trench excavation activities. Water was squeezed from the excavated soil (back into the trench), prior to loading onto trucks, using a plate on the thumb of the excavator bucket. The trench sections were backfilled with pea gravel and compacted upon completion.

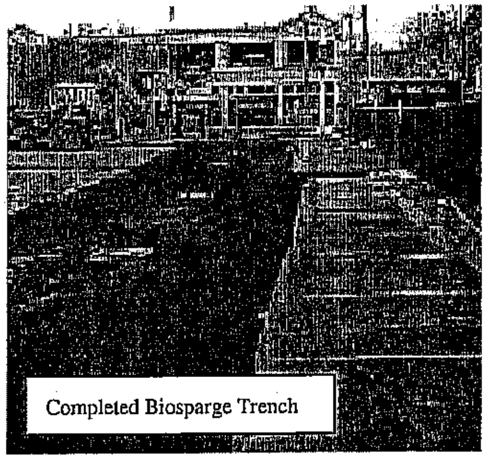
1,410 tons of soil were generated during the trench excavation and remedial system installation activities at the site. The soil was transported to TPS Technologies in Tacoma, Washington for thermal treatment and recycling. TPS' soil disposal manifest summary is attached.

Fifteen biosparge wells (SAS-1 through SAS-15) and eight multi-purpose monitoring wells (MP-1 through MW-8) were installed through the biosparge trench pea gravel backfill to the base of the trench (approximately 16 to 18 feet bgs) during March 2003 using hollow stem auger drilling equipment. Our field exploration program and typical boring/construction logs are attached.

The site service station building was being renovated during the biosparge trench construction activities. A subsurface electrical vault associated with the service station building and new remediation system was installed by the service station building electrician along the south edge of the biosparge trench near the northeast corner of the service station building. Electrical conduit was installed from a utility pole located near the northwest corner of the site, along and inside of the south edge of the biosparge trench, and into the vault. Electrical conduits were then installed from the vault to the service station building and new remediation system enclosure. The electrical conduit joints were sealed with Stego Wrap vapor barrier tape, and the vault/conduit connections were sealed with grout to minimize trench vapors from entering the electrical conduits/vault. A grout seal also was constructed around the electrical conduit at the western end of the biosparge trench to minimize trench vapors from migrating off-site along the electrical conduit and adjacent electrical utility trench to the west.



Biosparge Trench During Construction



Completed Biosparge Trench

AIR SPARGE WELL INSTALLATION

Three air sparge wells (AS-3 through AS-5) were installed in the western portion of the site to depths of approximately 31.5 feet using hollow stem auger drilling equipment during March 2003. The purpose of the air sparge wells is to supply oxygen to the groundwater to increase the rate of degradation of the dissolved phase hydrocarbon plume in the western portion of the site (around the 76 station parcel).

Soil encountered during drilling generally consisted of sand with varying amounts of silt, gravel and wood debris. Field screening evidence of petroleum contamination (sheen, and headspace vapors) was observed in soil from two of the borings (AS-4 and AS-5) at depths ranging between approximately 10 to 20 feet bgs. Soil samples were not submitted for chemical analysis. Our field exploration program and soil boring/well construction logs are attached.

Groundwater was encountered in the borings during drilling at a depth of approximately 12 feet bgs. Groundwater samples were not obtained for chemical analysis.

Soil cuttings generated during drilling activities were transported along with the trench excavation soil to TPS Technologies for thermal treatment and recycling. Decontamination water generated during drilling was transported to and disposed by Marine Vacuum Services of Seattle, Washington. The disposal manifest is attached.

REMEDIATION SYSTEM INSTALLATION

Remediation system equipment, including two air sparge systems and a vapor extraction system, were installed during March/April 2003. The remediation system equipment was supplied, installed and tested by H2Oil Inc. of Bend, Oregon. The equipment was installed within a new 10-foot by 30-foot fenced enclosure with concrete pad constructed in the north central portion of the site. The existing vapor extraction equipment and enclosure was demolished. The former vapor extraction equipment had been connected to eight vapor extraction wells located on the site (three of which were removed during trench excavation activities), and three vapor extraction wells located on the adjacent property to the north of the site. The new air sparge piping and the new and existing vapor extraction piping was directed to the new enclosure. The piping runs were constructed and pressure tested by custom Backhoe.

Because of different subsurface soil conditions between the curtain trench (pea gravel) and area around the service station (silty sand and wood fill) two different types of air sparging equipment was required. One air sparge system (Sutor built regenerative blower) was connected to the biosparge treatment curtain trench sparge wells (SAS-1 through SAS-15). The other air sparge system (four Gast piston oil-less compressors) was connected to air sparge wells AS-2 through AS-5 via piping installed in shallow trenches excavated along the west, south and central portions of the site. The vapor extraction system was connected to (1) shallow horizontal extraction piping located in the biosparge treatment curtain trench (for biosparge vapor recovery), (2) the five vertical site vapor extraction wells, and (3) three vertical vapor extraction wells located on the adjacent property to the north of the site. Additional system details are shown in Figures 1 through 4.

The ground surface in the vicinities of the biosparge treatment curtain trench and shallow air sparge piping trenches was backfilled, compacted, and capped with asphalt or concrete pavement to meet existing grade.

PILOT TESTING

A six-hour remediation system pilot test, including the vapor extraction and air sparge systems, was conducted on April 28, 2003. The remediation systems were monitored for vacuum/pressure, air flow and/or effluent vapors throughout the duration of the pilot test. Monitoring wells MW-52, MW-35, MW-3, MW-45, MW-33, MW-50, MW-53, MW-34 and MW-32A were used as observations wells during the pilot test. Selected observation wells were monitored for induced vacuum, depth to water, dissolved oxygen (DO) and/or headspace vapors at approximately one-hour intervals throughout the duration of the pilot test. Monitoring data are presented in Table 1.

VAPOR EXTRACTION SYSTEM - AIR FLOW AND VACUUM

The vapor extraction system was started after baseline measurements were obtained from the observation wells. Vacuum at the knockout tank, biosparge trench vapor extraction manifold, and existing vapor extraction wells manifold was measured at 2 inches of water (iow) with the dilution valve closed, with an associated air flow of 220 cubic feet per minute (cfm). The entire pilot test was conducted with the vacuum dilution valve closed due to the low vacuum and high flow rates measured at the beginning of the test. Vacuum and airflow remained at about 2 iow and 220 cfm, respectively, throughout the duration of the pilot test.

AIR SPARGE SYSTEMS – AIR FLOW AND PRESSURE

The air sparge systems were started approximately 30 minutes after the vapor extraction system was started. Air flow to the biosparge treatment curtain trench air sparge wells (SAS-1 through SAS-15) was set at 10 cfm, resulting in pressures of about 2 to 4 pounds per square inch (psi), with two exceptions. Air flow to wells SAS-1 and SAS-9 was set at 6 and 7 cfm, respectively, due to relatively higher pressures (about 5 psi) exhibited in these wells during the pilot test. As a result, air flow was adequately delivered throughout the sparge curtain trench as exhibited by bubbling in all monitoring points within the trench (Table 1).

Air sparge wells AS-2 through AS-5 were all utilized during the beginning of the pilot test. With air flows set at 5 to 6 cfm, air sparge wells AS-2 and AS-4 exhibited higher pressures (16 and 20 psi, respectively) relative to AS-3 and AS-5 (11 and 13 psi, respectively). Air sparge wells AS-3 and AS-5 were not utilized during the remainder of the pilot test, in order to evaluate whether pressures would decrease in AS-2 and AS-4. Pressures in AS-2 and AS-4 remained at 16 and 20 psi, respectively, for the remainder of the pilot test. It is likely that all wells will be operated at higher pressure in order to deliver air to each of these wells. As observed during the air sparge pilot test in September 2002, it appears that radius of influence of 20 to 40 feet (or more) can be achieved. Additional optimization of air sparge wells AS-3 and AS-5 will be needed to evaluate the high pressures required to inject low air flows. It is possible that additional well development may be required at these wells in the future.

VACUUM / PRESSURE AND DO RESPONSE IN OBSERVATION WELLS

Vacuum response was observed in two observation wells during the pilot test. MW-3 (located adjacent to the biosparge trench) exhibited a vacuum response (0.04 to 0.07 iow) for approximately 2.5 hours after the vapor extraction system was started. MW-53 (located near an existing vapor extraction well) exhibited a vacuum response of 0.35 iow for approximately 0.5 hours after the vapor extraction system was started. MW-3 and MW-53 subsequently exhibited positive pressure and groundwater bubbling. Positive pressure and groundwater bubbling was exhibited in MW-45 (located adjacent to the biosparge trench), and MW-33 and MW-50 (located in the vicinity of AS-4) upon startup of the air sparge systems. Groundwater bubbling also was observed in biosparge trench wells MP-1, MP-3, MP-6 and MP-8 upon startup of the air sparge systems and throughout the pilot test. Positive pressure without groundwater bubbling was exhibited in MW-52 and MW-35 (located adjacent to the biosparge trench) upon startup of the air sparge systems. Vacuum response, positive pressure or groundwater bubbling were not exhibited in MW-34 or MW-32A (located in the vicinities of AS-3 and AS-5, respectively) during the pilot test.

DO increased during the pilot test relative to baseline measurements in all observation wells with four exceptions. DO in observation wells MW-52, MW-35, MW-34 and MW-32A generally remained similar to baseline measurements.

GROUNDWATER LEVEL RESPONSE IN OBSERVATION WELLS

Groundwater levels increased (rose) relative to baseline measurements during the pilot test in observation wells MW-35 (by 0.52 feet), MW-3 (by up to 0.22 feet), MW-50 (by up to 0.11 feet), MW-53 (by 0.58 feet), MW-34 (by 0.05 feet), and MW-32A (by 0.14 feet). Groundwater levels decreased (fell) relative to baseline measurements during the pilot test in observation wells MW-52 (by up to 0.92 feet) and MW-45 (by up to 1.63 feet). Groundwater level variability may be due, in part, to difficulty in measuring while bubbling was occurring in some wells. Groundwater trends (such as mounding) will need to be evaluated over a longer time period. Observation well measurements are summarized in Table 1.

SYSTEM VAPOR CONCENTRATIONS

System vapor concentrations were measured during the pilot test at the manifolds for the west and east portions of the biosparge trench vapor extraction piping, the manifold for the existing vapor extraction wells, and at the system effluent stack, as summarized below.

Vapor Measurements with Photoionization Detector (ppm)				
Time	Horizontal VE in West Half of Biosparge Trench (at manifold)	Horizontal VE in East Half of Biosparge Trench (at manifold)	On- and Off-Site Vertical VE Wells (at manifold)	Stack (combined VE system effluent)
10:00	217	117	5.5	161
11:00	220	175	56.0	187
12:00	231	186	54.2	196
13:00	230	177	51.2	212
14:00	230	179	53.1	220
15:00	230	181	52.6	222
16:00	231	178	51.4	223

Effluent vapor samples were obtained at the end of the pilot test and submitted to Air Toxics of Folsom, California for chemical analysis of benzene, toluene, ethylbenzene, and xylenes (BTEX), methyl tert-butyl ether (MTBE), and gasoline-range petroleum hydrocarbons (GRPH) by Modified T03, and methane by Modified ASTM D-1946. The two samples were obtained at the same time to evaluate the potential variability of analytical results. Analytical results are summarized below.

Sample Name	Benzene (ppmv)	Toluene (ppmv)	Ethylbenzene (ppmv)	Total Xylenes (ppmv)	GRPH (ppmv)	MTBE (ppmv)	Methane (%)
EFF050903-1	6.7	4.4	2.0	11	490	2.4	0.089
EFF050903-2	6.9	4.8	2.2	13	500	2.5	0.092

Note: ppmv = parts per million volume

Effluent system vapor discharge is regulated by Puget Sound Clean Air Authority (PSCAA). A PSCAA discharge permit is required for soil and groundwater remediation projects involving greater than 15 pounds per year of benzene and 1,000 pounds per year of "toxic air contaminants", including GRPH. Based on the results of the system effluent vapor samples obtained during the pilot test, and an assumed air flow of 220 cfm, uncontrolled emissions of benzene and GRPH are estimated to be approximately 160 and 10,680 pounds per year, respectively. These estimated "worse case" annual emissions are approximately ten times higher than the permit threshold amounts. Therefore, off-gas treatment and a PSCAA permit will be required.

VAPOR MONITORING AND TREATMENT OPTIONS

Remediation system off-gas treatment options were evaluated based on the results of the pilot test. Off-gas treatment options evaluated included granular activated carbon (GAC) and gas-powered catalytic oxidizers (catox). An assumed system flow rate of 220 cfm, and effluent hydrocarbon concentrations measured during the pilot test were used to evaluate off-gas treatment options. We recommended utilizing two in-series 1,800-pound GAC units at this site. Capital costs for the GAC units are lower than a catox unit. Although annual routine O&M and power consumption costs are similar, replacement or repair costs are much higher for catox units. GAC units generally require less space than a catox unit, and generally are not subject to the same explosion considerations with regards to placement of the GAC unit nears vent stacks and other facility structures.

We have assumed that off-gas treatment will be necessary for up to two years, depending on system configuration and operational performance. We have also assumed that the GAC units are 99% efficient and will meet PSCAA discharge requirements.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our remediation system pilot testing, we conclude the following:

- Groundwater bubbling and/or positive pressure occurred in the vicinities of the biosparge trench and (operating) air sparge wells indicating significant supply of air to the subsurface.
- Air sparge well AS-4 has an apparent radius of influence of at least 50 feet, based on bubbling and positive pressure observed in observation well MW-50.
- Groundwater dissolved oxygen increased in observation wells located downgradient of the eastern two-thirds of the biosparge trench and in the vicinities of the (operating) air sparge wells during the six-hour pilot test.
- Apparent groundwater mounding occurred in the vicinities of the central portion of the biosparge trench and operating air sparge wells. Groundwater levels fell in the east and west portions of the biosparge trench. However, long term measurements will be necessary to understand groundwater mounding effects, especially in the vicinity of wells where bubbling occurs.
- Relatively high hydrocarbon vapor concentrations were generated and effectively captured by the vapor excavation system during the pilot test. Therefore off-gas treatment will be required prior to system startup. We recommend utilizing two in-series 1,800-pound GAC canisters.

The long term remedial goals are to (1) operate the remediation system with limited shut downs, (2) decrease the potential for offsite groundwater contaminant plume migration, and (3) degrade the contaminant source in the vicinities of the air sparge wells and biosparge trench by groundwater stripping and microbial enhancement, and vadose zone soil treatment by vapor extraction, and (4) capture and treat hydrocarbon vapors generated as a result of air sparging.

We recommend the following to optimize system effectiveness:

- Conduct system O&M and reconfiguration visits weekly for first four weeks after startup, and monthly thereafter.
- Upon system startup, run each component of the remediation system (trench biosparge wells, air sparge wells, trench horizontal vapor extraction, and on- and off-site vapor extraction wells) separately for a brief period until conditions associated with each component stabilize. Once the individual operating conditions for each component have been further evaluated, gradually combine the components.
- Continue to evaluate the potential of pulsing the air sparge systems during continuous operation of the vapor extraction system and establish the optimal air sparge system operation frequency. If effective, this will (1) limit long term mounding effects, (2) increase aeration of the groundwater table by causing increased pore water changes, and (3) decrease off-gas treatment breakthrough and extend the life of the GAC.
- Monitor groundwater monthly for a period of six months. Monitoring parameters should include headspace vapors, groundwater dissolved oxygen, oxidation-reduction potential, BTEX and GRPH.
- Test vapor effluent during air sparge and vapor extraction system operations, immediately after an air sparge pulsing cycle, and/or after any system modification during the first two months.
- Monitor vapors in catch basins, utility vaults, or other confined spaces at the site while the remediation system is operating to further evaluate the effectiveness of the vapor extraction system.

LIMITATIONS

We have prepared this report for use by ConocoPhillips as part of their evaluation of environmental conditions at the subject site.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted environmental science practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

Please refer to the attachment titled "Report Limitations and Guidelines for Use" for additional information pertaining to the use of this report.

We appreciate the opportunity to provide you with these services. Please contact us if you have questions regarding information presented in this report, or if you require additional services.

Yours very truly,

GeoEngineers, Inc.

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Project Geologist

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State of Washington
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Attachments

Five copies submitted

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TABLE 1 (Page 1 of 3)
SUMMARY OF REMEDIATION SYSTEM PILOT TEST[1]
OBSERVATION WELL DATA
CONOCOPHILLIPS SERVICE STATION 5353
600 WESTLAKE AVENUE NORTH
SEATTLE, WASHINGTON

Observation Well	Nearest Remediation System Component(s)	Distance to Nearest System Component(s) (feet)	Approximate Measurement Time	Induced Vacuum[2] (iow)	Depth to Water[3] (feet)	Change in Water Level[4] (feet)	Groundwater Dissolved Oxygen[5] (mg/l)	Headspace Vapors TLV (ppm)	Headspace Vapors PID (ppm)	Comments
MW-52	Biosparge Trench	6	9:00	--	10.43	0.00	0.60	>10,000	66.1	Baseline
			10:30	0	--	--	--	--	--	VE system on
			10:45	(pressure)	--	--	--	--	--	Sparge systems on
			11:00	(pressure)	10.49	--	0.50	--	--	
			12:00	(pressure)	10.39	0.04	0.53	--	--	
			13:00	(pressure)	11.35	-0.92	0.56	--	--	
			14:00	(pressure)	11.29	-0.86	0.60	--	--	
			15:00	(pressure)	11.28	-0.85	0.62	--	--	
			16:00	(pressure)	11.28	-0.85	0.63	--	--	
MW-35	Biosparge Trench	10	9:00	--	10.79	0.00	0.65	1,000	--	Baseline
			10:30	0	--	--	--	--	--	VE system on
			10:45	(pressure)	--	--	--	--	--	Sparge systems on
			11:00	(pressure)	10.63	0.16	0.53	--	--	
			12:00	(pressure)	10.55	0.24	0.55	--	--	
			13:00	(pressure)	10.51	0.28	0.55	--	--	
			14:00	(pressure)	10.49	0.30	0.55	--	--	
			15:00	(pressure)	10.27	0.52	0.56	--	--	
			16:00	(pressure)	10.27	0.52	0.55	--	--	
MW-3	Biosparge Trench	9	9:00	--	9.68	0.00	0.57	3,000	--	Baseline
			10:30	0.06	--	--	--	--	--	VE system on
			10:45	0.06	--	--	--	--	--	Sparge systems on
			11:00	0.07	9.55	0.13	6.37	--	--	
			12:00	0.07	9.55	0.13	6.49	--	--	
			13:00	0.04	9.46	0.22	--(bubbling)	--	--	
			14:00	(pressure)	9.50	0.18	--(bubbling)	--	--	
			15:00	(pressure)	9.52	0.16	--(bubbling)	--	--	
			16:00	(pressure)	9.66	0.02	--(bubbling)	--	--	

TABLE 1 (Page 2 of 3)

Observation Well	Nearest Remediation System Component(s)	Distance to Nearest System Component(s) (feet)	Approximate Measurement Time	Induced Vacuum[2] (iow)	Depth to Water[3] (feet)	Change in Water Level[4] (feet)	Groundwater Dissolved Oxygen[5] (mg/l)	Headspace Vapors TLV (ppm)	Headspace Vapors PID (ppm)	Comments
MW-45	Biosparge Trench	7	9:00	--	8.94	0.00	0.54	>10,000	--	Baseline
			10:30	0	--	--	--	--	--	VE system on
			10:45	(pressure)	--	--	--(bubbling)	--	--	Sparge systems on
			11:00	(pressure)	10.52	-1.58	--(bubbling)	--	--	
			12:00	(pressure)	10.57	-1.63	--(bubbling)	--	--	
			13:00	(pressure)	10.11	-1.17	--(bubbling)	--	--	
			14:00	(pressure)	9.02	-0.08	--(bubbling)	--	--	
			15:00	(pressure)	9.11	-0.17	--(bubbling)	--	--	
			16:00	(pressure)	9.45	-0.51	--(bubbling)	--	--	
MW-33	AS-4	11	9:00	--	11.43	0.00	0.45	800	--	Baseline
			10:30	0	--	--	--	--	--	VE system on
			10:45	(pressure)	--	--	--(bubbling)	--	--	Sparge systems on
MW-50	AS-4	50	9:00	--	10.62	0.00	0.49	>10,000	--	Baseline
			10:30	(car on well)	--	--	--	--	--	VE system on
			10:45	(car on well)	--	--	--	--	--	Sparge systems on
			11:00	(pressure)	10.56	0.06	0.47	--	--	
			12:00	(pressure)	10.51	0.11	0.48	--	--	
			13:00	(pressure)	10.57	0.05	0.55	--	--	
			14:00	(pressure)	10.55	0.07	0.65	--	--	
			15:00	(pressure)	10.54	0.08	--(bubbling)	--	--	
			16:00	(pressure)	10.59	0.03	--(bubbling)	--	--	
MW-53	Existing VE Well	9	9:00	--	11.70	0.00	0.37	700	--	Baseline
	AS-2	15	10:30	0.35	--	--	--	--	--	VE system on
			10:45	0.35	--	--	--	--	--	Sparge systems on
			11:00	(pressure)	11.53	0.17	1.25(bubbling)	--	--	
			12:00	(pressure)	11.54	0.16	1.31(bubbling)	--	--	
			13:00	(pressure)	11.54	0.16	1.31(bubbling)	--	--	
			14:00	(pressure)	11.54	0.16	1.33(bubbling)	--	--	
			15:00	(pressure)	11.54	0.16	--(bubbling)	--	--	
			16:00	(pressure)	11.32	0.38	--(bubbling)	--	--	

TABLE 1 (Page 3 of 3)

Observation Well	Nearest Remediation System Component(s)	Distance to Nearest System Component(s) (feet)	Approximate Measurement Time	Induced Vacuum[2] (iow)	Depth to Water[3] (feet)	Change in Water Level[4] (feet)	Groundwater Dissolved Oxygen[5] (mg/l)	Headspace Vapors TLV (ppm)	Headspace Vapors PID (ppm)	Comments
MW-34	AS-3	8	9:00	--	11.79	0.00	0.58	110	3.2	Baseline
			10:30	0	--	--	--	--	--	VE system on
			10:45	0	--	--	--	--	--	Sparge systems on
			11:00	0	11.77	0.02	0.58	--	--	
			12:00	0	11.74	0.05	0.55	--	--	
			13:00	0	11.75	0.04	0.55	--	--	
			14:00	0	11.74	0.05	0.55	--	--	
			15:00	0	11.74	0.05	0.55	--	--	
			16:00	0	11.74	0.05	0.56	--	--	
MW-32A	AS-5	15	9:00	--	11.51	0.00	0.54	>10,000	65.9	Baseline
	Biosparge Trench	18	10:30	0	--	--	--	--	--	VE system on
			10:45	0	--	--	--	--	--	Sparge systems on
			11:00	0	11.42	0.09	0.42	--	--	
			12:00	0	11.40	0.11	0.43	--	--	
			13:00	0	11.39	0.12	0.44	--	--	
			14:00	0	11.37	0.14	0.45	--	--	
			15:00	0	11.37	0.14	0.45	--	--	
			16:00	0	11.37	0.14	0.44	--	--	
MP-1[6]	Biosparge Trench	0	9:00	--	10.54	--	0.63	>10,000	265	Baseline
MP-3[6]	Biosparge Trench	0	9:00	--	10.69	--	0.56	3,000	--	Baseline
MP-6[6]	Biosparge Trench	0	9:00	--	8.75	--	0.59	>10,000	--	Baseline
MP-8[6]	Biosparge Trench	0	9:00	--	9.00	--	1.44	3,500	--	Baseline

Notes:

[1]Pilot test conducted on May 5, 2003.

[2]Measured with a Magnahelic vacuum gauge.

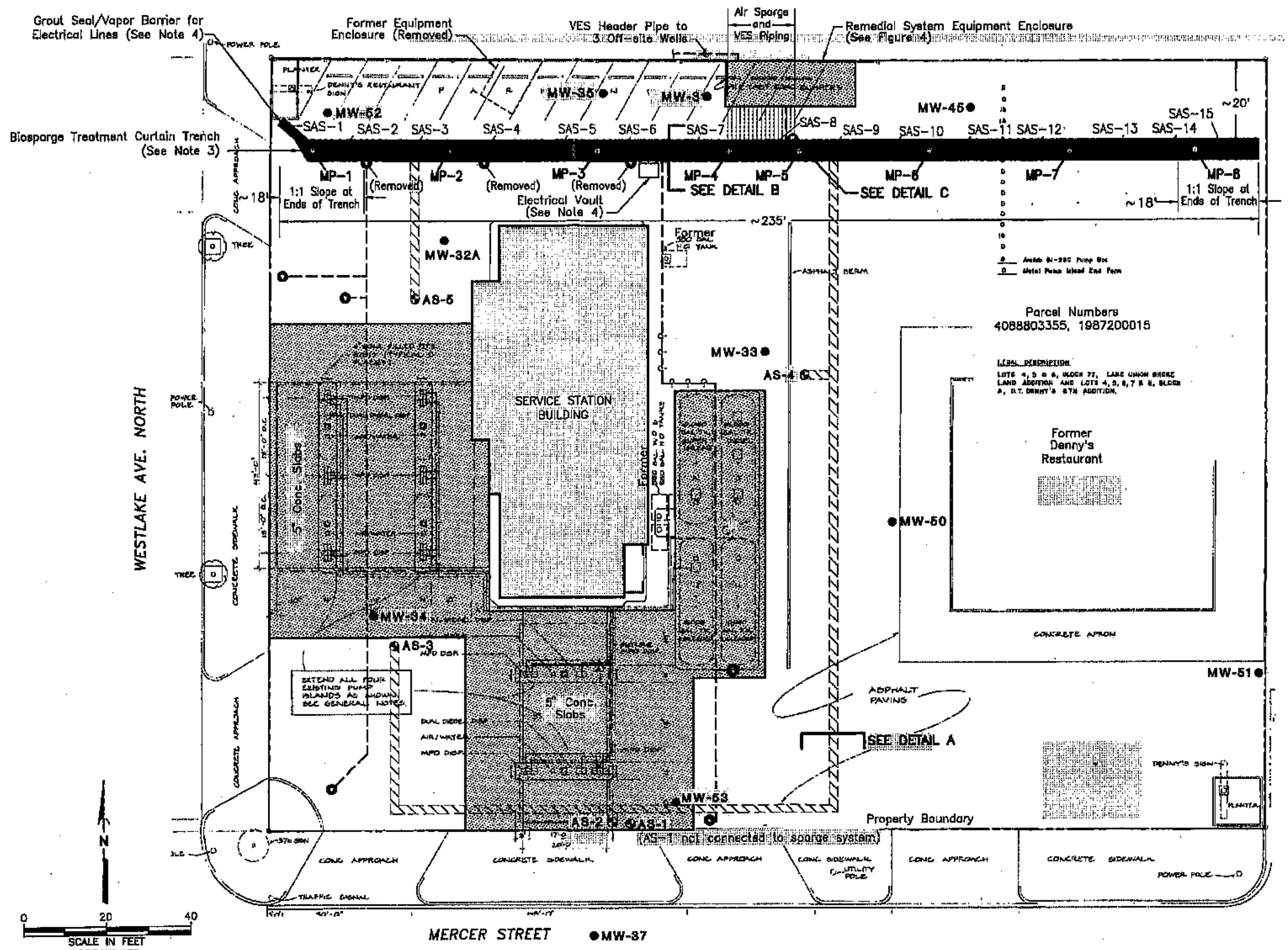
[3]Measured with an electronic water level indicator relative to the top of the well casing.

[4]Measured relative to baseline measurements. Positive values indicate groundwater levels rose. Negative values indicate groundwater levels fell.

[5]Measured with a YSI dissolved oxygen meter.

[6]Bubbling was observed in this well upon startup of the airsparge system and throughout the remainder of the pilot test.

TLV = Bacharach TLV Sniffer
PID = photoionization detector
iow = inches of water
mg/l = milligrams per liter
ppm = parts per milion
VE = vapor extraction



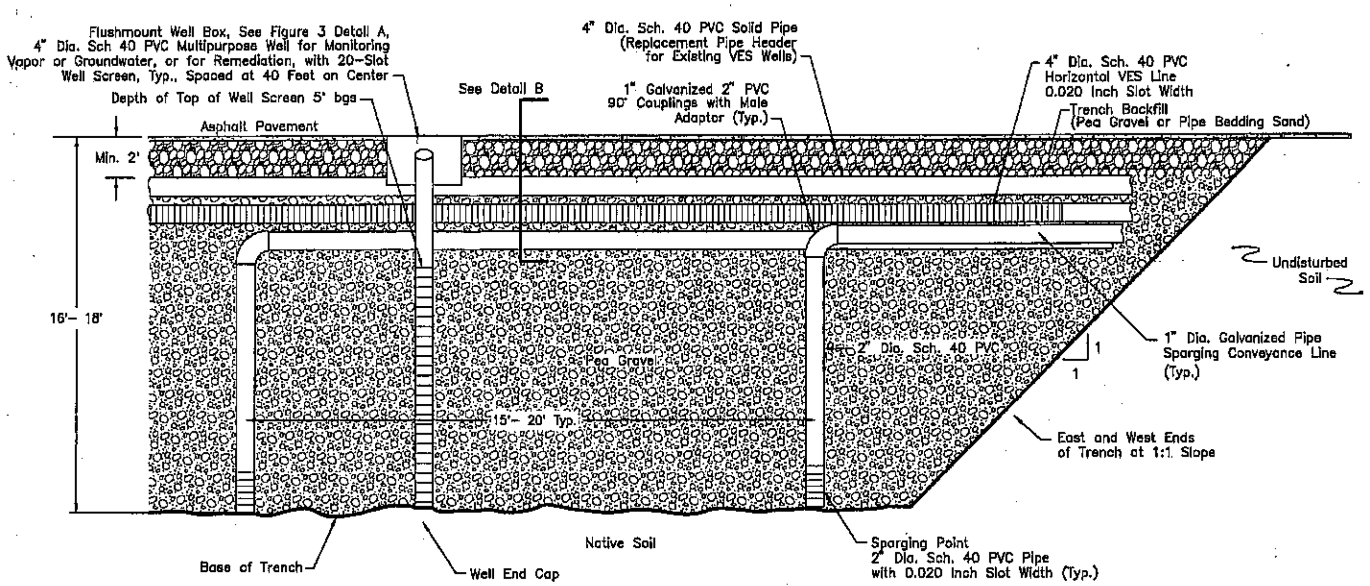
Utility Note: Public water and sewer mains are located beneath Westlake Avenue and/or Mercer Street. Public water or sewer mains are not known to exist beneath the site or adjacent sidewalks.

SITE PLAN (REMEDIATION SYSTEM LAYOUT)

APPROXIMATE SCALE: 1"=20'

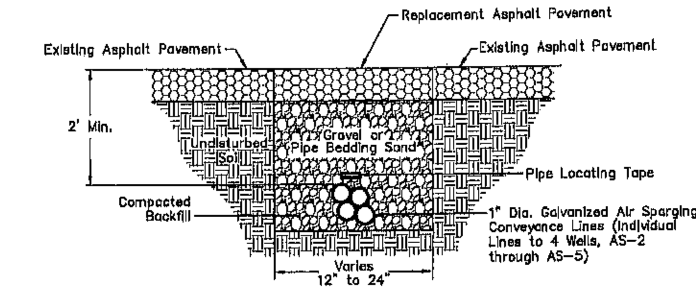
EXPLANATION:

- AS-3 ⊙ AIR SPARGING WELL
- SAS-1● BIOSPARGE TREATMENT CURTAIN TRENCH AIR SPARGING WELL
- MP-1○ MULTIPURPOSE WELL (MONITORING OR REMEDIATION)
- MW-37 ● MONITORING WELL
- ----○ EXISTING VES WELL & APPROXIMATE LOCATION OF CONVEYANCE PIPING (PIPE HEADER)
- SHALLOW AIR SPARGE PIPING TRENCH (APPROXIMATELY 2.5' DEEP)
- BIOSPARGE TREATMENT CURTAIN TRENCH (APPROXIMATELY 16' DEEP)
- EXISTING CONCRETE PAVED AREA



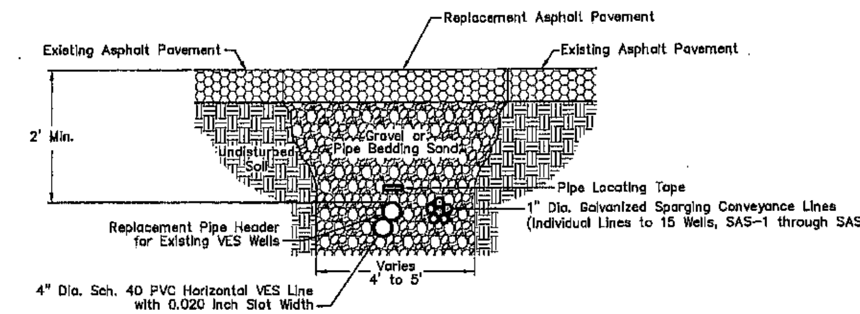
BIOSPARGE TREATMENT CURTAIN TRENCH LONGITUDINAL CROSS SECTION

NOT TO SCALE



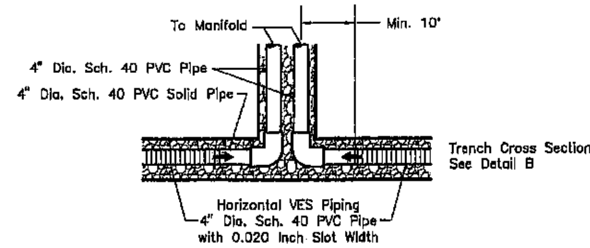
DETAIL A – REMEDIATION PIPING SHALLOW TRENCH CROSS SECTION

NOT TO SCALE



DETAIL B – UPPER 2.5' OF BIOSPARGE CURTAIN PIPING TRENCH CROSS SECTION

NOT TO SCALE



NOTE: Other piping entering enclosure not shown.

DETAIL C – PLAN VIEW HORIZONTAL VES PIPING

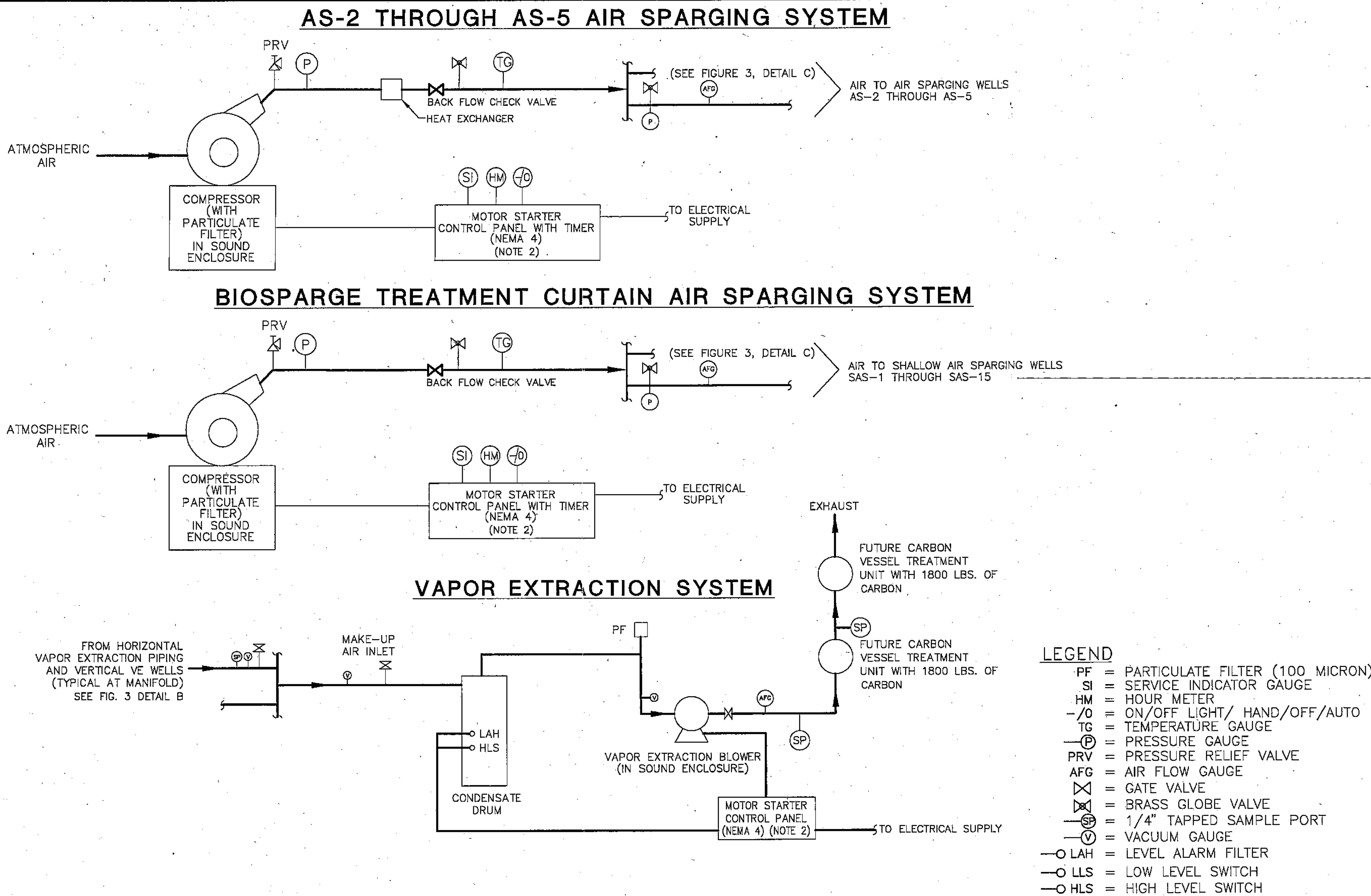
NOT TO SCALE

Notes:
1. The locations of all features shown are approximate.
2. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The master hard copy isstored by GeoEngineers, Inc. and will serve as the official document of record.
3. The width of the biosparge treatment curtain trench is about 5 feet wide, but the upper few feet of the trench extend to widths of up to 16 feet wide in some locations due to sloughing during excavation.
4. Electrical conduits enter the western end of biosparge trench and connect to the electrical vault located along the southern edge of the biosparge trench. Conduits from the vault run to the service station building and the remedial system enclosure. Grout seal/vapor barriers are present at the western end to the biosparge trench, and where the conduits enter/exit the electrical vault. The locations of the electrical conduits are not shown.

Reference: Drawing entitled "General Arrangement Service Station 5353 Westlake Ave. & Mercer St. Seattle, Washington" dated 10/28/87.

ConocoPhillips	PROJECT: Remediation System FACILITY: Tosco Service Station 5353 601 Terry Avenue North Seattle, Washington	TITLE: REMEDIATION SYSTEM & PIPING TRENCH DETAILS
GEOENGINEERS Earth Science + Technology	DATE: 10/29/03 REV.	FIGURE 1

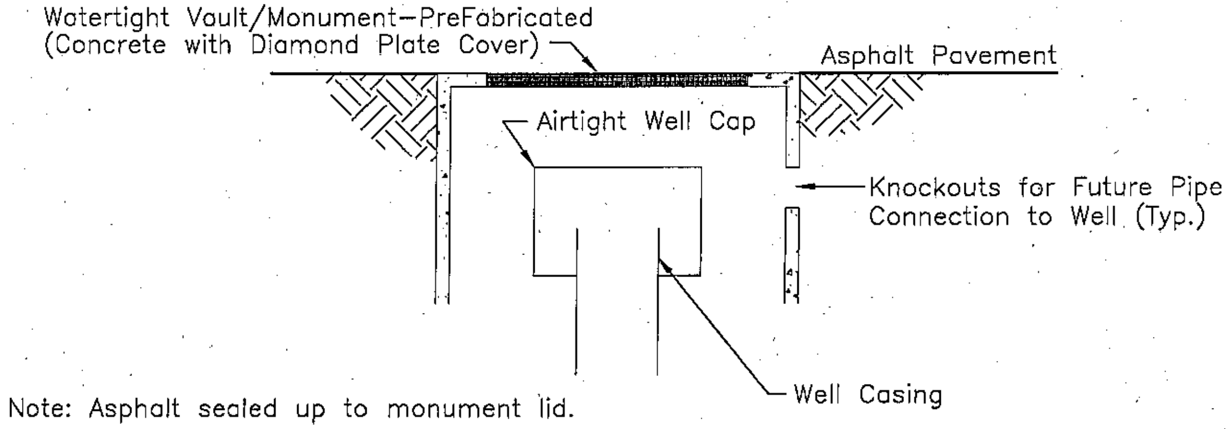
SEA\P:\4823517\05\CAD\73001\482351705T3001A.DWG BPP:HLA:AUB 10/29/03



Notes: 1. All electrical equipment and wiring UL approved and in compliance with NEC and local code requirements.
2. With fail–safe controls and shut downs.
3. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. The master hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.

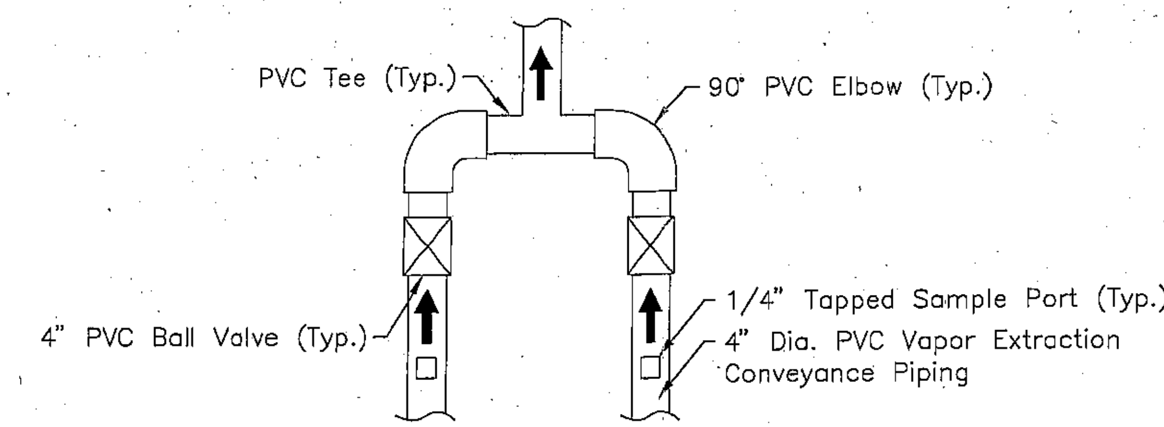
ConocoPhillips	PROJECT: Remediation System	TITLE: REMEDIATION SYSTEM PROCESS FLOW DIAGRAM
	FACILITY: Tosco Service Station 5353	
GeoEngineers	Seattle, Washington	
	DATE: 07/07/03 REV.	FIGURE 2

SEAT\P:\4823517\05\CAD\T3001\4823517O5T3001B.DWG BPP:HLA:AUB 07/07/03



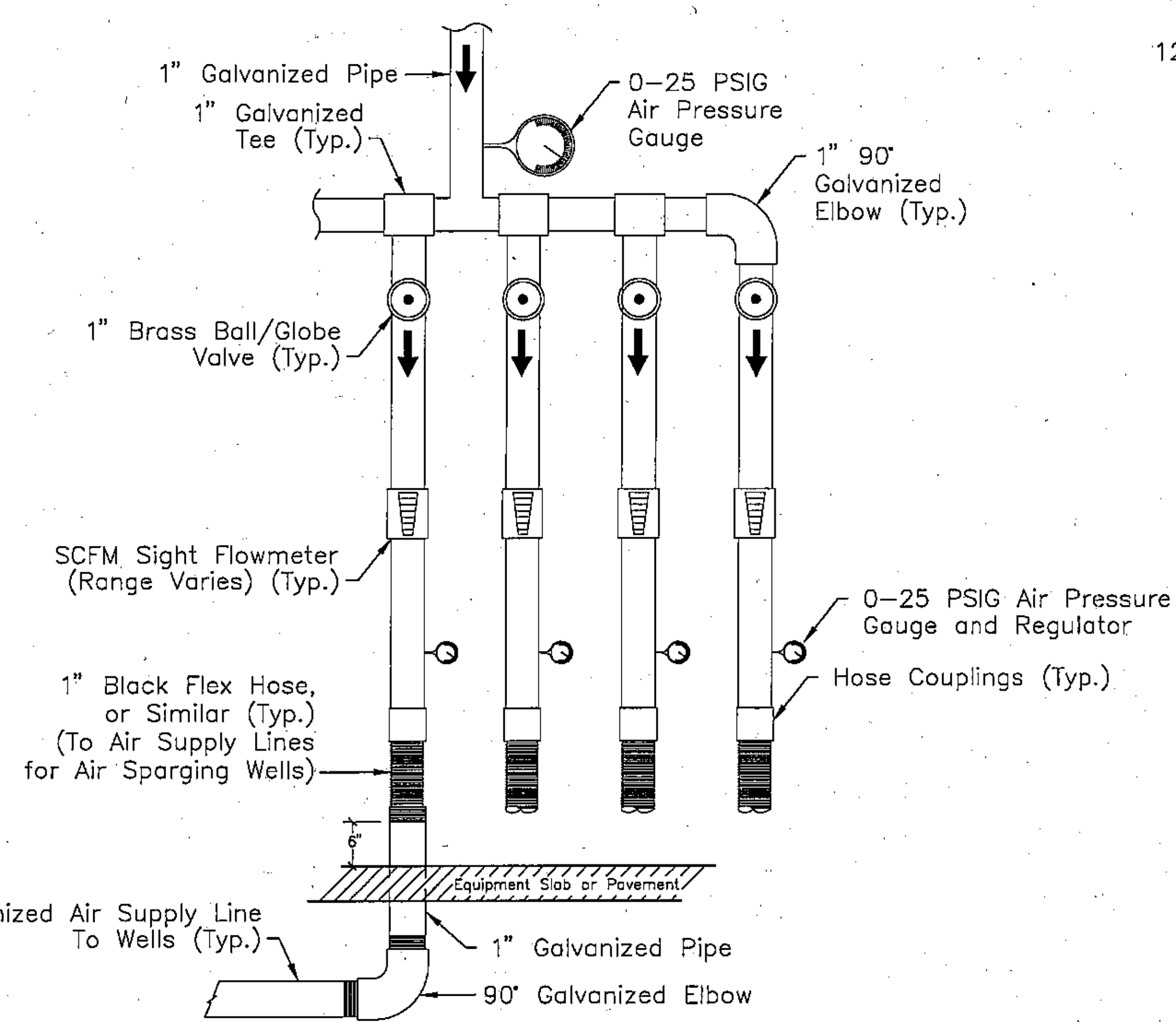
DETAIL A – FLUSHMOUNT WELL BOX FOR 4" DIAMETER MULTIPURPOSE WELL

NOT TO SCALE



DETAIL B – HORIZONTAL VES SCHEMATIC MANIFOLD

NOT TO SCALE

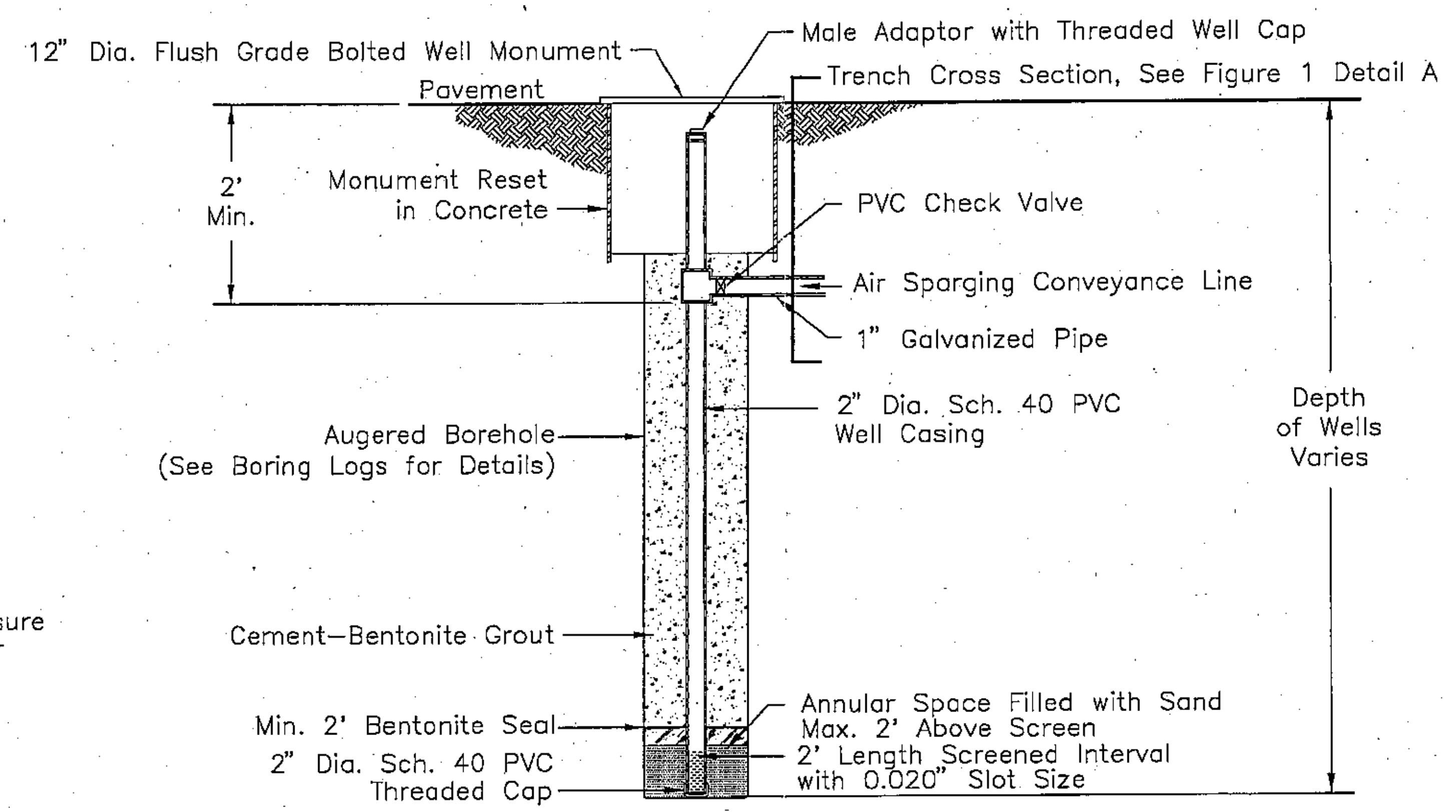


DETAIL C – AIR SPARGING SYSTEM SCHEMATIC MANIFOLD (AS–2 THROUGH AS–5 & BIOSPARGE TRENCH, SEPARATE MANIFOLDS)

NOT TO SCALE

EXPLANATION:

→ AIR FLOW DIRECTION



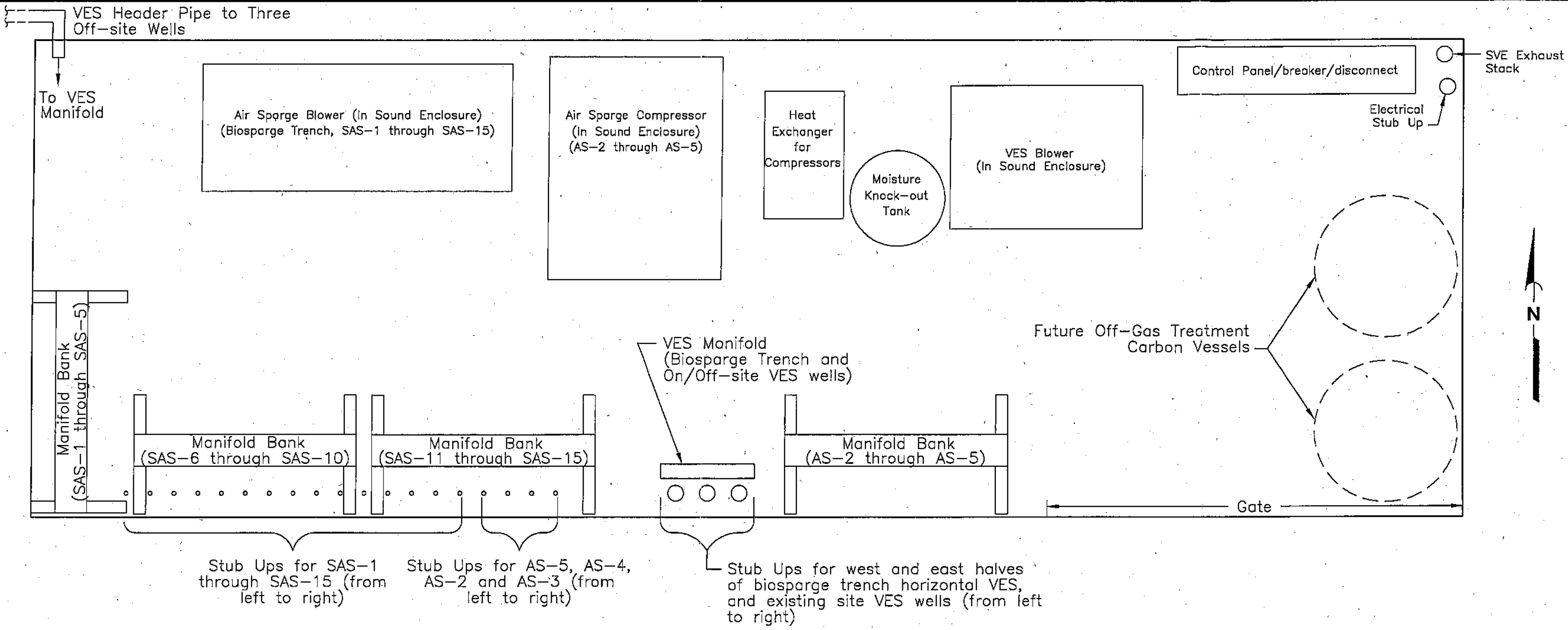
DETAIL D – VERTICAL AIR SPARGING WELL (AS–2 THROUGH AS–5) TYPICAL CROSS SECTION

NOT TO SCALE

Notes: 1. The locations of all features shown are approximate.
2. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. The master hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.

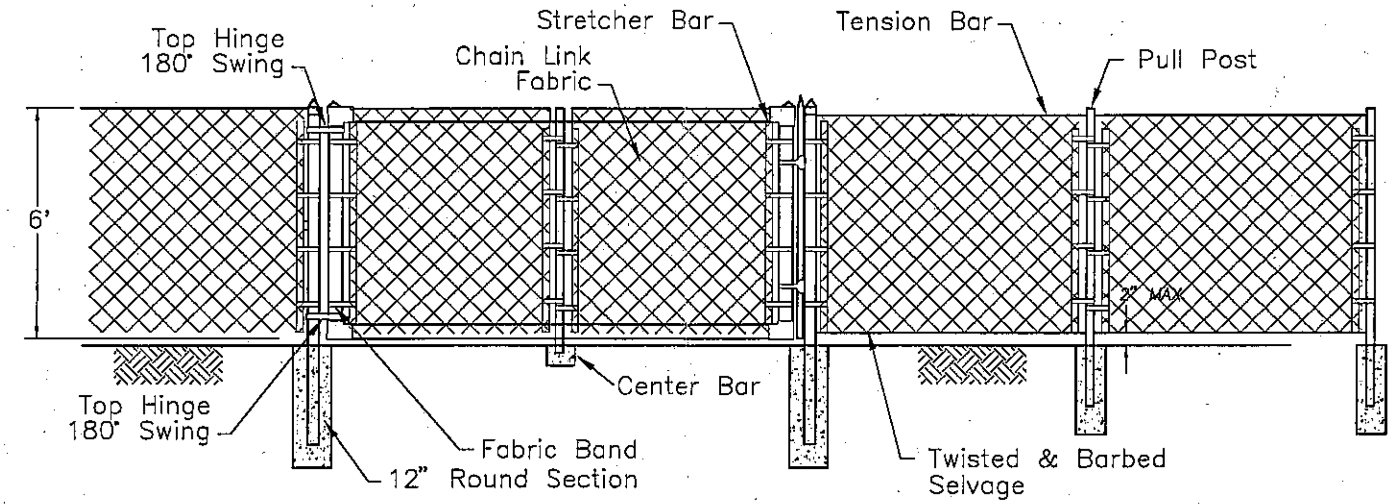
Reference: Drawing produced from sketch provided by GeoEngineer's staff, October 2002.

ConocoPhillips	PROJECT: Remediation System FACILITY: Tosco Service Station 5353 Seattle, Washington	TITLE: MANIFOLD AND WELLHEAD DETAILS
GeoEngineers	DATE: 06/30/03 REV.	FIGURE 3



DETAIL A – PLAN VIEW-SCHEMATIC LAYOUT, NEW REMEDIATION EQUIPMENT ENCLOSURE INTERIOR

NOT TO SCALE



DETAIL B – EQUIPMENT ENCLOSURE SCHEMATIC CHAIN LINK FENCE WITH DOUBLE GATE

NOT TO SCALE

Notes
1. Conveyance piping between the piping stub ups and remediation equipment not shown.
2. Sight obscuring slats installed in fence.
3. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. The master hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.

ConocoPhillips	PROJECT: Remediation System	TITLE: REMEDIATION EQUIPMENT ENCLOSURE
GeoEngineers	FACILITY: Tosco Service Station 5353 Seattle, Washington	
	DATE: 07/07/03 REV.	FIGURE 4

SEAT\P:\4823517\05\CAD\T3001\48235170ST3001D.DWG BPP:HLA:AUB 07/07/03

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ATTACHMENT A

WASTE DISPOSAL DOCUMENTATION

Amethyst© TPS Technologies, Inc.

Customer Job Report

Weight Codes: M=Manual; S=Scale; T=Truck File

Job #	Name	Address	City	State	ZIP
A03 - 4199	PHILLIPS 66 SITE # 255353	600 WESTLAKE AVE N	SEATTLE	WA	00000

Load#	Date/Time Out	Transporter#	Truck/Trailer#	Gross (lb)	Tare (lb)	Net (lb)	Net Wt (tons)
1	02-24-2003 17:42:54	1002109	JASON	71,640.00M	38,160.00M	33,480.00	16.74
2	02-25-2003 17:43:05	1002109	JASON	112,340.00M	38,160.00M	74,180.00	37.09
3	02-25-2003 17:43:14	1002109	CRUZ	114,300.00M	37,520.00M	76,780.00	38.39
4	02-25-2003 17:43:25	1002109	DAVE	98,300.00M	37,820.00M	60,480.00	30.24
5	02-25-2003 17:43:38	1002109	DAVE	108,200.00M	38,880.00M	69,320.00	34.66
6	02-25-2003 17:43:52	1002109	DUSTIN	96,020.00M	37,860.00M	58,160.00	29.08
7	02-25-2003 17:44:02	1002109	JASON	103,960.00M	38,160.00M	65,800.00	32.90
8	02-25-2003 17:44:11	1002109	CRUZ	107,560.00M	37,520.00M	70,040.00	35.02
9	02-25-2003 17:44:21	1002109	DARC	106,200.00M	37,700.00M	68,500.00	34.25
10	02-25-2003 17:44:32	1002109	JASON	107,300.00M	37,800.00M	69,500.00	34.75
11	02-26-2003 17:44:47	1002109	DAVE	101,380.00M	38,880.00M	62,500.00	31.25
12	02-26-2003 17:44:58	1002109	DAVE	97,440.00M	37,820.00M	59,620.00	29.81
13	02-26-2003 17:45:13	1002109	CRUZ	100,280.00M	37,520.00M	62,760.00	31.38
14	02-26-2003 17:45:24	1002109	JASON	103,900.00M	37,860.00M	66,040.00	33.02
15	02-26-2003 17:45:37	1002109	DAVE	109,280.00M	38,880.00M	70,400.00	35.20
16	02-26-2003 17:45:48	1002109	JASON	105,500.00M	37,860.00M	67,640.00	33.82
17	02-26-2003 17:45:56	1002109	DAVID	114,560.00M	37,820.00M	76,740.00	38.37
18	02-26-2003 17:46:44	1002109	DARC	118,000.00M	37,700.00M	80,300.00	40.15
19	02-27-2003 17:46:51	1002109	DAVE	106,920.00M	38,880.00M	68,040.00	34.02
20	02-27-2003 17:47:01	1002109	DAVE	103,980.00M	37,820.00M	66,160.00	33.08
21	02-27-2003 17:47:13	1002109	DARC	101,380.00M	37,520.00M	63,860.00	31.93
22	02-27-2003 17:47:23	1002109	BOB	102,260.00M	37,860.00M	64,400.00	32.20
23	02-27-2003 17:47:32	1002109	DAVE	105,540.00M	38,880.00M	66,660.00	33.33
24	02-27-2003 17:47:40	1002109	DAVE	97,700.00M	37,820.00M	59,880.00	29.94
25	02-28-2003 17:47:50	1002109	DAVE	108,800.00M	38,880.00M	69,920.00	34.96
26	02-28-2003 17:48:00	1002109	DAVE	106,880.00M	37,820.00M	69,060.00	34.53
27	02-28-2003 17:48:12	1002109	BOB	101,100.00M	37,860.00M	63,240.00	31.62
28	02-28-2003 17:48:22	1002109	DAVE	104,520.00M	37,820.00M	66,700.00	33.35
29	02-28-2003 17:48:38	1002109	DAVE	104,600.00M	38,880.00M	65,720.00	32.86
30	02-28-2003 17:48:45	1002109	JASON	105,680.00M	37,800.00M	67,880.00	33.94
31	02-28-2003 17:49:33	1002109	JASON	103,120.00M	37,800.00M	65,320.00	32.66

Completed Loads	Manifests Recv.	Completed Weight	Estimated Weight	TOTAL Net Wt.
62.00%	31	68.30%	1,500.00(tons)	1,024.54(tons)

CUSTOMER JOB DETAIL:

Amethyst© TPS Technologies, Inc.

Customer Job Report

Weight Codes: M=Manual; S=Scale; T=Truck File

Job #	Name	Address	City	State	ZIP
A03 - 4199	PHILLIPS 66 SITE # 255353	600 WESTLAKE AVE N	SEATTLE	WA	00000

Load#	Date/Time Out	Transporter#	Truck/Trailer#	Gross (lb)	Tare (lb)	Net (lb)	Net Wt (tons)
32	03-03-2003 09:18:58	1002109	DAVE	106,320.00M	38,880.00M	67,440.00	33.72
33	03-03-2003 09:19:18	1002109	JASON	107,580.00M	37,860.00M	69,720.00	34.86
34	03-03-2003 09:22:15	1002109	DAVE	107,280.00M	37,820.00M	69,460.00	34.73
35	03-03-2003 09:22:29	1002109	DAVE	108,880.00M	38,800.00M	70,080.00	35.04
36	03-03-2003 09:22:51	1002109	JASON	106,480.00M	37,860.00M	68,620.00	34.31
37	03-03-2003 09:23:06	1002109	DAVE	106,460.00M	37,820.00M	68,640.00	34.32
38	03-03-2003 09:23:31	1002109	DAVID	107,580.00M	38,800.00M	68,780.00	34.39
39	03-03-2003 09:23:49	1002109	JASON	106,220.00M	37,860.00M	68,360.00	34.18
40	03-06-2003 16:39:44	1002109	JASON	99,240.00M	37,860.00M	61,380.00	30.69
41	03-10-2003 10:15:52	1002109	JASON	99,460.00M	37,860.00M	61,600.00	30.80
42	03-10-2003 10:17:18	1002109	JASON	105,900.00M	37,800.00M	68,100.00	34.05
43	03-12-2003 17:04:09	1002109	JASON	67,460.00M	38,160.00M	29,300.00	14.65

Completed Loads	Manifests Recv.	Completed Weight	Estimated Weight	TOTAL Net Wt.
86.00%	43	94.02%	1,500.00(tons)	385.74(tons)

GeoEngineers

ATTACHMENT B

FIELD EXPLORATION PROGRAM

ATTACHMENT B

FIELD EXPLORATION PROGRAM

GENERAL

Fifteen trench biosparge wells (SAS-1 through SAS-15), eight trench multipurpose wells (MP-1 through MP-8), and three air sparge wells (AS-3 through AS-5) were installed at the site during March/April 2003 using hollow stem auger drilling equipment operated by Geo-Tech Explorations of Tualatin, Oregon (trench wells) and Holt Drilling of Puyallup, Washington (air sparge wells). A representative from our staff selected the boring locations, and observed and classified the soil encountered. Soil in the borings was visually classified in general accordance with American Society of Testing and Materials (ASTM) D2488-90, which is described in Figure A-1. A key to the boring log symbols is presented in Figure A-2. A detailed (or typical) log was prepared for each boring. The boring logs are presented in Figures A-3 through A-11.

The biosparge trench borings were completed through the pea gravel backfill to depths ranging from 16 to 18 feet bgs. The three air sparge wells were completed to depths of approximately 31.5 feet bgs. Soil samples were obtained from the three air sparge borings at approximately 5-foot-depth intervals using a Dames & Moore split spoon sampler. The sampler was driven by a 300-pound hammer falling a vertical distance of approximately 30 inches. The number of blows required to advance the sampler the final 12 inches or other specified distance is indicated to the left of the corresponding sample notations on the boring logs. The sampling equipment was decontaminated before each sampling attempt with a Liqui-Nox solution wash, and a distilled water rinse. The samples were obtained for field screening purposes and were not submitted for chemical analysis.

FIELD SCREENING OF SOIL SAMPLES

Soil samples obtained from the site were evaluated for the potential presence of petroleum contamination using field screening techniques. Field screening results can be used as a general guideline to delineate areas of potential petroleum-related contamination in soils. In addition, screening results are often used as a basis for selecting soil samples for chemical analysis. The screening methods employed included: (1) visual examination, (2) water sheen testing, and (3) headspace vapor testing using a Bacharach TLV Sniffer.

Visual screening consists of inspecting the soil for stains indicative of petroleum-related contamination. Visual screening is generally more effective when contamination is related to heavy petroleum hydrocarbons such as motor oil, or when hydrocarbon concentrations are high. Sheen screening is a more sensitive screening method that can be effective in detecting petroleum based products in concentrations lower than regulatory cleanup guidelines.

Water sheen testing involves placing soil in water and observing the water surface for signs of sheen. The results of water sheen testing on soil samples from the borings are presented on the test pit logs. Sheens are classified as follows:

No Sheen (NS)	No visible sheen on water surface.
Slight Sheen (SS)	Light, colorless, dull sheen; spread is irregular, not rapid; sheen dissipates rapidly.
Moderate Sheen (MS)	Light to heavy sheen, may have some color/iridescence; spread is irregular to flowing; few remaining areas of no sheen on water surface.
Heavy Sheen (HS)	Heavy sheen with color/iridescence; spread is rapid; entire water surface may be covered with sheen.

Headspace vapor screening involves placing a soil sample in a plastic bag. Air is captured in the bag and the bag is shaken to expose the soil to the air trapped in the bag. The probe of the Bacharach TLV Sniffer is inserted into the bag and the TLV Sniffer measures the concentration of combustible vapor in the sample bag headspace. The TLV Sniffer is designed to quantify combustible gas concentrations in the 100 to 10,000 parts per million (ppm) range.

WELL CONSTRUCTION

Biosparge wells were constructed in borings SAS-1 through SAS-15 at the completion of drilling. Two-inch-diameter, Schedule 40 polyvinyl chloride (PVC) pipe was installed in the borings. The lower two to three feet of the PVC pipe is machine-slotted (0.02-inch slot width) to allow sparging of air into the subsurface. Medium sand was placed in the borehole annulus surrounding the slotted portion of the well. The biosparge wells are connected subgrade to air sparge conveyance lines.

Multipurpose wells were constructed in borings MP-1 through MP-8 at the completion of drilling. Four-inch-diameter, Schedule 40 polyvinyl chloride (PVC) pipe was installed in the borings. The lower portion of the PVC pipe is machine-slotted (0.02-inch slot width) to allow sparging of air into the subsurface. Medium sand was placed in the borehole annulus surrounding the slotted portion of the well. The well casings are secured with lockable compression caps and flush-grade monuments.

Air sparge wells were constructed in borings AS-3 through AS-5 at the completion of drilling. Two-inch-diameter, Schedule 40 polyvinyl chloride (PVC) pipe was installed in the borings. The lower two feet of the PVC pipe is machine-slotted (0.02-inch slot width) to allow sparging of air into the subsurface. Medium sand was placed in the borehole annulus surrounding the slotted portion of the well. The well casings are secured with lockable compression caps and flush-grade monuments.

Well construction details are shown in Figures A-3 through A-11.

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More Than 50% Retained on No. 200 Sieve	GRAVEL More Than 50% of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More Than 50% of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More Than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less Than 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY Liquid Limit 50 or More	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.
2. Soil classification using laboratory tests is in general accordance with ASTM D2487-90.
3. Descriptions of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS:

Dry - Absence of moisture, dusty, dry to the touch

Moist - Damp, but no visible water

Wet - Visible free water or saturated, usually soil is obtained from below water table

GEOENGINEERS

SOIL CLASSIFICATION SYSTEM

FIGURE B-1

LABORATORY TESTS

- AL Atterberg limits
- CA Chemical analysis
- CP Compaction
- CS Consolidation
- DS Direct shear
- GS Sieve Analysis
- %F Percent fines
- HA Hydrometer analysis
- SK Permeability
- SM Moisture content
- MD Moisture and density
- ST Swelling test
- TX Triaxial compression
- UC Unconfined compression

FIELD SCREENING TESTS

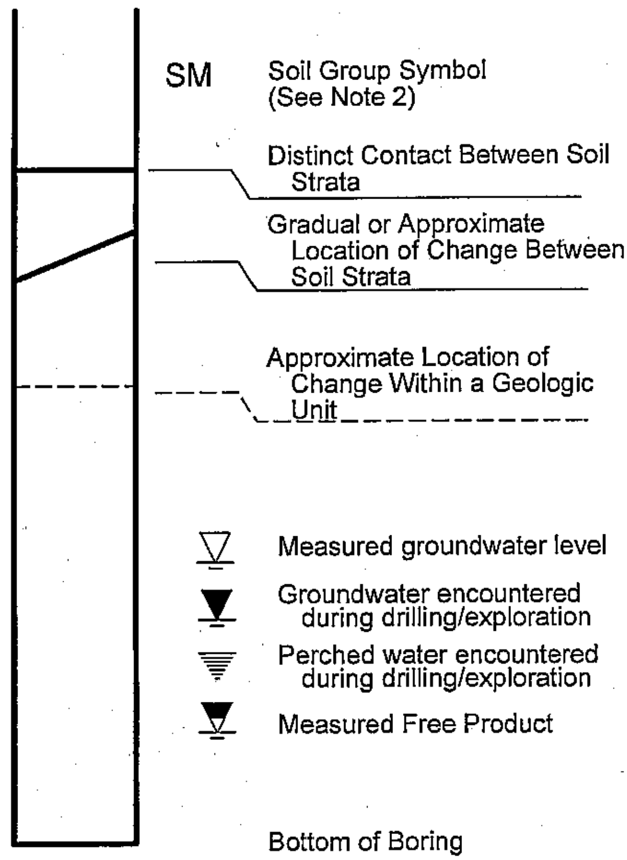
Visual Sheen Test Classifications

- NS No Visible Sheen
- SS Slight sheen
- MS Moderate sheen
- HS Heavy sheen
- -- Not tested

Vapor Measurements

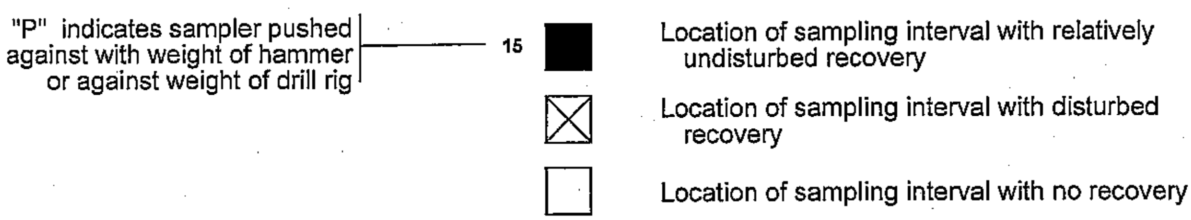
- TLV TLV™ sniffer
- PID Photo ionization detector
- FID Flame ionization detector
- OVA Organic vapor analyzer
- -- Not tested

SOIL GRAPHICS



BLOW-COUNT

SAMPLE GRAPHICS



NOTES:

1. The reader must refer to the discussion in the report text, the Key to Log Symbols and the exploration logs for a proper understanding of subsurface conditions.
2. Soil classification system is summarized in Figure B-1.

KEY TO LOG SYMBOLS

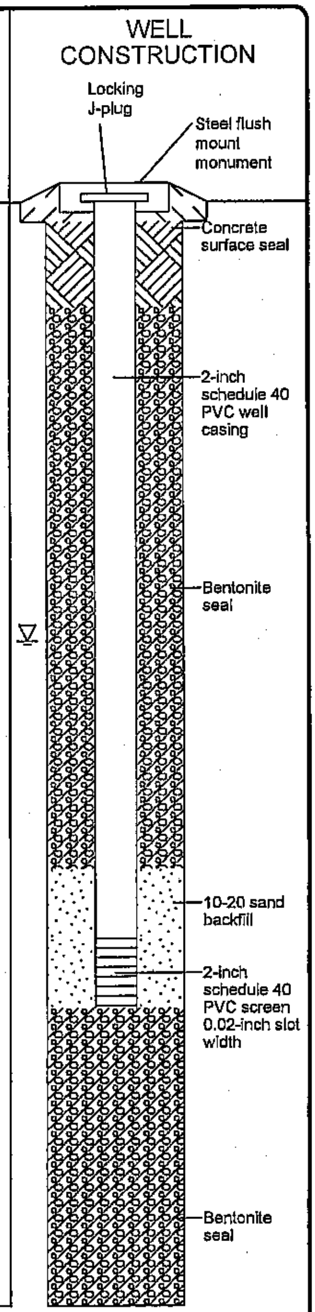
GEOENGINEERS

Project: Westlake & Mercer
Project Location: Seattle, Washington
Project Number: 4823-517-05

Figure: B-2
Sheet 1 of 1

Date(s) Drilled	03/04/03	Logged By	GJA	Checked By	BPP
Drilling Contractor	Holt Drilling	Drilling Method	Hollow Stem Auger	Sampling Methods	Dames and Moore
Total Boring Depth (ft)	31.5	Hammer Data	300 (lb) hammer/ 30 (in) drop	Drilling Equipment	Truck-mounted Rig
Well Depth (ft)	31.5	Top of Well Elevation (ft)		Groundwater Level (ft. bgs)	12.5
System/ Datum					

Depth feet	SAMPLES Interval	Testing	Recovered (in)	Blows/foot	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV(ppm)
0					AC	Asphalt		
					SM	Gray silty fine sand with occasional gravel (medium dense, moist)		
5	■		18	25			NS	<100
10	■		18	9		Gray silty fine sand (loose, moist)	SS	<100
					SP-SM	Gray fine to medium sand with silt and occasional gravel (loose, wet)		
15	■		18	7			SS	<100
					SM	Gray silty fine to medium sand with occasional gravel and wood debris (medium dense, wet)		
20	■		18	12			SS	<100
					ML	Gray silty with wood debris (soft, moist)		
25	■		18	5			NS	<100
					SP-SM	Gray fine to medium sand with silt and occasional gravel (loose, wet)		
30	■		18	8			NS	<100



Note: See Figure B-2 for explanation of symbols

LOG OF MONITORING WELL AS-3

GEOENGINEERS

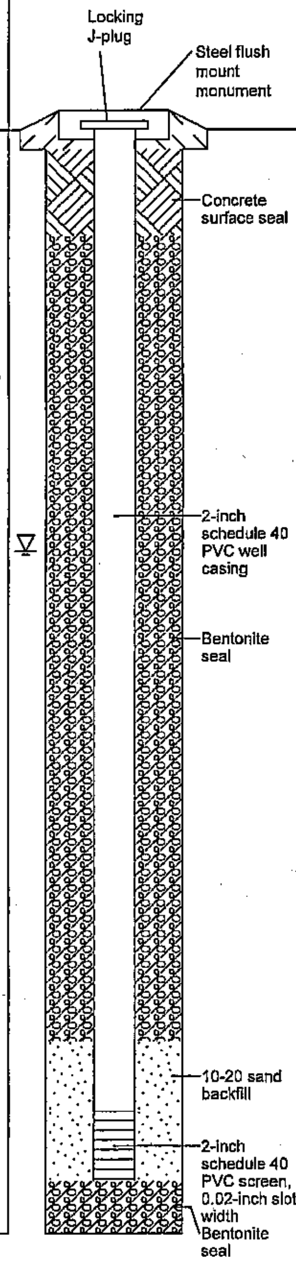
Project: Westlake & Mercer
Project Location: Seattle, Washington
Project Number: 4823-517-05

Figure: B-3
Sheet 1 of 1

Date(s) Drilled	03/05/03	Logged By	GJA	Checked By	BPP
Drilling Contractor	Holt Drilling	Drilling Method	Hollow Stem Auger	Sampling Methods	Dames and Moore
Total Boring Depth (ft)	31.5	Hammer Data	300 (lb) hammer/ 30 (in) drop	Drilling Equipment	Truck-mounted Rig
Well Depth (ft)	31.5	Top of Well Elevation (ft)		Groundwater Level (ft. bgs)	12
System/ Datum					

Depth feet	SAMPLES Recovered (in)	SAMPLES Blows/foot	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV(ppm)
0			AC	Asphalt		
			SM	Gray silty fine sand with occasional gravel (loose, moist)		
5	18	7			NS	<100
10	18	12		Becomes medium dense and moist	MS	700
15	5	5		Becomes loose and wet	SS	400
			OL			
20	0	5		No recovery		
	18	19		Brown organic silt with wood debris (stiff, wet)	NS	<100
			SP	Gray fine to medium sand with trace silt (medium dense, wet)		
25	18	26			NS	<100
			SP-SM	Gray fine sand with silt (loose, wet)		
30	18	10			NS	<100

WELL CONSTRUCTION



Note: See Figure B-2 for explanation of symbols

LOG OF MONITORING WELL AS-4

GeoEngineers

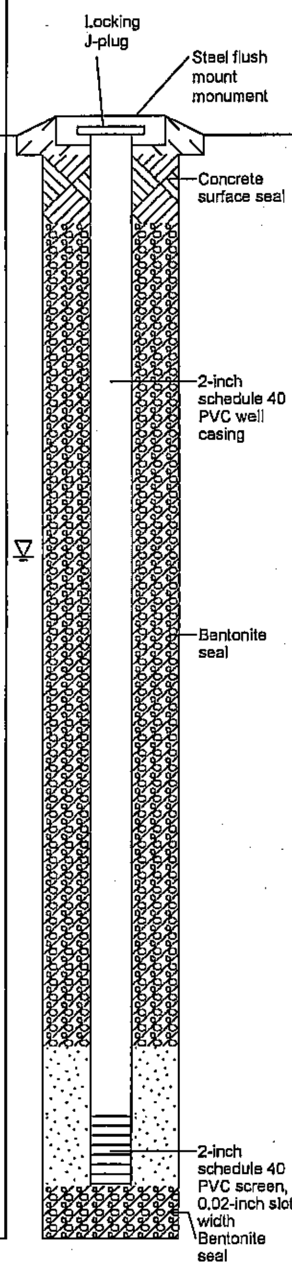
Project: Westlake & Mercer
Project Location: Seattle, Washington
Project Number: 4823-517-05

Figure: B-4
Sheet 1 of 1

Date(s) Drilled	03/04/03	Logged By	GJA	Checked By	BPP
Drilling Contractor	Holt Drilling	Drilling Method	Hollow Stem Auger	Sampling Methods	Dames and Moore
Total Boring Depth (ft)	31.5	Hammer Data	300 (lb) hammer/ 30 (in) drop	Drilling Equipment	Truck-mounted Rig
Well Depth (ft)	31.5	Top of Well Elevation (ft)		Groundwater Level (ft. bgs)	12
System/ Datum					

Depth feet	SAMPLES: Interval	SAMPLES: Testing	SAMPLES: Recovered (in)	SAMPLES: Blows/foot	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV(ppm)
0					AC	Asphalt		
					SM	Gray to dark gray silty fine to medium sand with occasional gravel (medium dense, moist)		
5	■		18	11			SS	<100
10	■		18	10			MS	<100
15	■		18	5		Becomes loose and wet	MS	<100
20	■		18	5		Gray silt fine to medium sand with occasional gravel and wood debris (loose, wet)	MS	<100
					SP-SM	Gray fine to medium sand with silt (medium dense, wet)		
25	■		18	11			NS	<100
30	■		18	10			NS	<100

WELL CONSTRUCTION



Note: See Figure B-2 for explanation of symbols

LOG OF MONITORING WELL AS-5

GEOENGINEERS

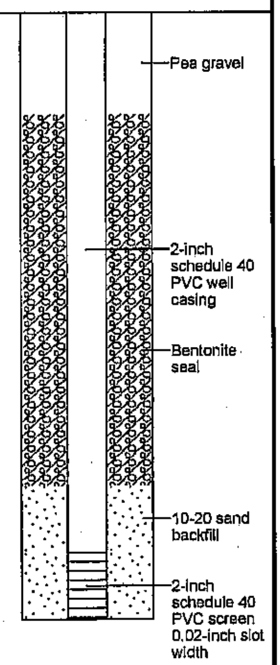
Project: Westlake & Mercer
Project Location: Seattle, Washington
Project Number: 4823-517-05

Figure: B-5
Sheet 1 of 1

Date(s) Drilled	03/11/03 - 03/12/03	Logged By	GJA	Checked By	BPP
Drilling Contractor	GeoTech Explorations	Drilling Method	Hollow Stem Auger	Sampling Methods	N/A
Total Boring Depth (ft)	18	Hammer Data		Drilling Equipment	Truck-mounted Rig
Well Depth (ft)	18	Top of Well Elevation (ft)		Groundwater Elevation (ft)	Not Measured
System/ Datum					

Depth feet	SAMPLES Interval	Testing	Recovered (in)	Blows/foot	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV(ppm)
0						SW	Existing soil. Soil samples were not obtained during drilling, therefore soil descriptions are not available.		
5									
10									
15									

WELL CONSTRUCTION



Note: See Figure B-2 for explanation of symbols

LOG OF MONITORING WELL SAS-1

GEOENGINEERS

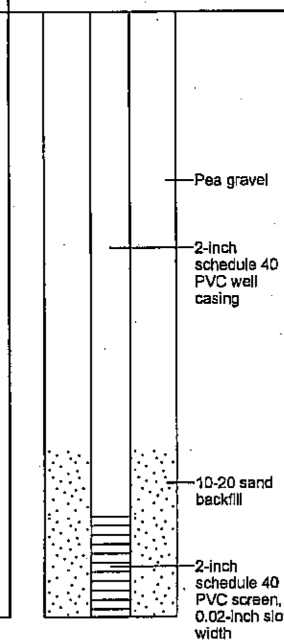
Project: Westlake & Mercer
Project Location: Seattle, Washington
Project Number: 4823-517-05

Figure: B-6
Sheet 1 of 1

Date(s) Drilled	03/11/03 - 03/12/03	Logged By	GJA	Checked By	BPP
Drilling Contractor	GeoTech Explorations	Drilling Method	Hollow Stem Auger	Sampling Methods	N/A
Total Boring Depth (ft)	18	Hammer Data		Drilling Equipment	Truck-mounted Rig
Well Depth (ft)	18	Top of Well Elevation (ft)		Groundwater Elevation (ft)	Not Measured
System/ Datum					

Depth feet	SAMPLES: Interval	SAMPLES: Testing	SAMPLES: Recovered (in)	SAMPLES: Blows/foot	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV(ppm)
0						GW	Pea gravel (remediation trench backfill)		
5									
10									
15						SW	Native soil observed on base of augers at depths ranging from 16 to 18 feet below ground surface.		

WELL CONSTRUCTION



Note: See Figure B-2 for explanation of symbols

LOG OF MONITORING WELL SAS-2 through SAS-14

GeoEngineers

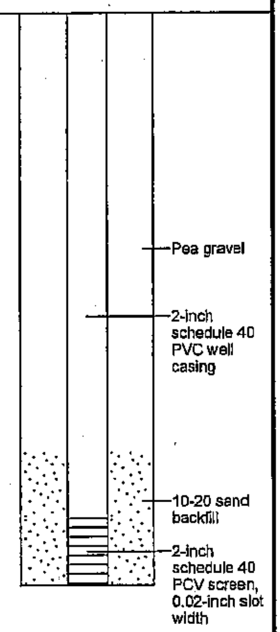
Project: Westlake & Mercer
Project Location: Seattle, Washington
Project Number: 4823-517-05

Figure: B-7
Sheet 1 of 1

Date(s) Drilled	03/11/03 - 03/12/03	Logged By	GJA	Checked By	BPP
Drilling Contractor	GeoTech Explorations	Drilling Method	Hollow Stem Auger	Sampling Methods	N/A
Total Boring Depth (ft)	17	Hammer Data		Drilling Equipment	Truck-mounted Rig
Well Depth (ft)	17	Top of Well Elevation (ft)		Groundwater Elevation (ft)	Not Measured
System/ Datum					

Depth feet	SAMPLES: Interval	Testing	Recovered (in)	Blows/foot	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV(ppm)
0						GW	Pea gravel (remediation trench backfill)		
5									
10						SW	Existing soil. Soil samples were not obtained during drilling, therefore soil descriptions are not available.		
15									

WELL CONSTRUCTION



Note: See Figure B-2 for explanation of symbols

4823-517-05 GEI_ENVWELL_2.1.0 P:\TOSCO~1\4823517\05\FINALS\482351 7S.GPJ GEIV2_2.GDT 10/27/03

LOG OF MONITORING WELL SAS-15

GEOENGINEERS

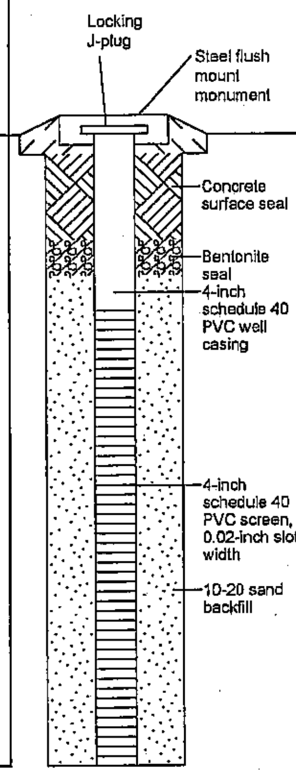
Project: Westlake & Mercer
Project Location: Seattle, Washington
Project Number: 4823-517-05

Figure: B-8
Sheet 1 of 1

Date(s) Drilled	03/11/03 - 03/12/03	Logged By	GJA	Checked By	BPP
Drilling Contractor	GeoTech Explorations	Drilling Method	Hollow Stem Auger	Sampling Methods	N/A
Total Boring Depth (ft)	18	Hammer Data		Drilling Equipment	Truck-mounted Rig
Well Depth (ft)	18	Top of Well Elevation (ft)		Groundwater Elevation (ft)	Not Measured
System/ Datum					

Depth feet	SAMPLES: Interval	SAMPLES: Testing	SAMPLES: Recovered (in)	SAMPLES: Blows/foot	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV(ppm)
0						SW	Existing soil. Soil samples were not obtained during drilling, therefore soil descriptions are not available.		
5									
10									
15									

WELL CONSTRUCTION



Note: See Figure B-2 for explanation of symbols

LOG OF MONITORING WELL MP-1

GEOENGINEERS

Project: Westlake & Mercer
Project Location: Seattle, Washington
Project Number: 4823-517-05

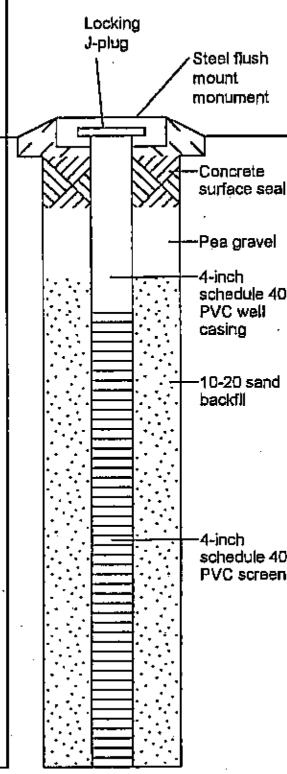
Figure: B-9
Sheet 1 of 1

4823-517-05 GEI ENVWELL 2.1.0 P:\TOSCO-1\4823517\05\FINALS\4823517S.GPJ GEIV2 2.GDT 10/27/03

Date(s) Drilled	03/11/03 - 03/12/03	Logged By	GJA	Checked By	BPP
Drilling Contractor	GeoTech Explorations	Drilling Method	Hollow Stem Auger	Sampling Methods	N/A
Total Boring Depth (ft)	18	Hammer Data		Drilling Equipment	Truck-mounted Rig
Well Depth (ft)	18	Top of Well Elevation (ft)		Groundwater Elevation (ft)	Not Measured
System/ Datum					

Depth feet	SAMPLES: Interval	SAMPLES: Testing	SAMPLES: Recovered (in)	SAMPLES: Blows/foot	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV(ppm)
0						GW	Pea gravel (remediation trench backfill)		
5									
10									
15									
						SW	Native soil observed on base of augers at depths ranging from 16 to 18 feet below ground surface.		

WELL CONSTRUCTION



Note: See Figure B-2 for explanation of symbols

LOG OF MONITORING WELL MP-2 through MP-7

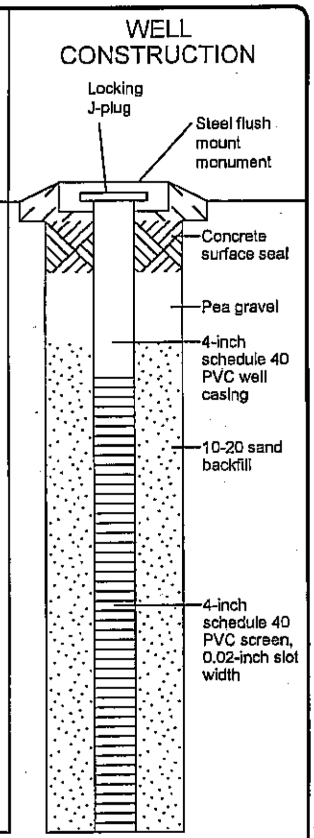
GEOENGINEERS

Project: Westlake & Mercer
Project Location: Seattle, Washington
Project Number: 4823-517-05

Figure: B-10
Sheet 1 of 1

Date(s) Drilled	03/11/03 - 03/12/03	Logged By	GJA	Checked By	BPP
Drilling Contractor	GeoTech Explorations	Drilling Method	Hollow Stem Auger	Sampling Methods	N/A
Total Boring Depth (ft)	18	Hammer Data		Drilling Equipment	Truck-mounted Rig
Well Depth (ft)	18	Top of Well Elevation (ft)		Groundwater Elevation (ft)	Not Measured
System/ Datum					

Depth feet	SAMPLES Interval	Testing	Recovered (in)	Blows/foot	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Sheen	Headspace Vapor TLV(ppm)
0						GW	Pea gravel (remediation trench backfill)		
5									
10									
						SW	Existing soil. Soil samples were not obtained during drilling, therefore soil descriptions are not available.		
15									



Note: See Figure B-2 for explanation of symbols

LOG OF MONITORING WELL MP-8

GEOENGINEERS

Project: Westlake & Mercer
Project Location: Seattle, Washington
Project Number: 4823-517-05

Figure: B-11
Sheet 1 of 1

GeoEngineers

ATTACHMENT C

REPORT LIMITATIONS AND GUIDELINES FOR USE

ATTACHMENT C

REPORT LIMITATION AND GUIDELINES FOR USE[1]

This attachment provides information to help you manage your risks with respect to the use of this report.

ENVIRONMENTAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS AND PROJECTS

This report has been prepared for use by ConocoPhillips, their authorized agents and regulatory agencies. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

GeoEngineers structures our services to meet the specific needs of our clients. For example, an environmental site assessment or remedial action study conducted for a property owner may not fulfill the needs of a prospective purchaser of the same property. Because each environmental study is unique, each environmental report is unique, prepared solely for the specific client and project site. No one except ConocoPhillips should rely on this environmental report without first conferring with GeoEngineers. This report should not be applied for any purpose or project except the one originally contemplated.

THIS ENVIRONMENTAL REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

This report has been prepared for use by ConocoPhillips, their authorized agents and regulatory agencies. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, do not rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

If important changes are made after the date of this report, GeoEngineers should be given the opportunity to review our interpretations and recommendations and provide written modifications or confirmation, as appropriate.

RELIANCE CONDITIONS FOR THIRD PARTIES

If a lending agency or other parties intend to place legal reliance on the product of our services, we require that those parties indicate in writing their acknowledgement that the scope of services provided, and the general conditions under which the services were rendered, are understood and accepted by them. We also require that any third party placing legal reliance on this product agree in writing to limit our professional liability to $50,000 or the amount of our fees on the project whichever is more. This is to

[1] Developed based on material provided by ASFE, Professional Firms Practicing in the GeoSciences, www.asfe.org.

provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions.

ENVIRONMENTAL REGULATIONS ARE ALWAYS EVOLVING

Some substances may be present in the site vicinity in quantities or under conditions that may have led, or may lead, to contamination of the subject site, but are not included in current local, state or federal regulatory definitions of hazardous substances or do not otherwise present current potential liability. GeoEngineers cannot be responsible if the standards for appropriate inquiry, or regulatory definitions of hazardous substance, change or if more stringent environmental standards are developed in the future.

SUBSURFACE CONDITIONS CAN CHANGE

This environmental report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, by new releases of hazardous substances, or by natural events such as floods, earthquakes, slope instability or ground water fluctuations. Always contact GeoEngineers before applying this report to determine if it is still applicable.

MOST ENVIRONMENTAL FINDINGS ARE PROFESSIONAL OPINIONS

Our interpretations of subsurface conditions are based on field observations and chemical analytical data from the sampling locations at the site documented in this report. Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied our professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ – sometimes significantly – from those indicated in this report. There is always a potential that areas of contamination exist in portions of the site that were not sampled or tested during this or previous studies. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

DO NOT REDRAW THE EXPLORATION LOGS

Environmental scientists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in an environmental report should never be redrawn for inclusion in other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

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Some clients, design professionals and contractors may not recognize that the geoscience practices (geotechnical engineering, geology and environmental science) are far less exact than other engineering and natural science disciplines. This lack of understanding can create unrealistic expectations that could lead to disappointments, claims and disputes. GeoEngineers includes these explanatory "limitations" provisions in our reports to help reduce such risks. Please confer with GeoEngineers if you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or site.