



**EMCON**

1921 Ringwood Avenue • San Jose, California 95131-1721 • (408) 453-7300 • Fax (408) 437-9526

EMCON  
March 21, 1997

Date March 21, 1997  
Project 20805-135.006

To:

Ms. Susan Hugo  
Alameda County Health Care Services Agency  
Department of Environmental Health  
1131 Harbor Bay Parkway, Suite 250  
Alameda, California 94502-6577

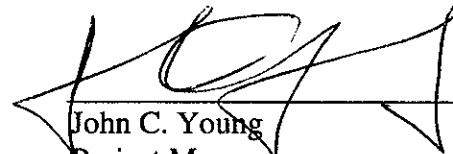
We are enclosing:

Copies	Description
<u>1</u>	<u>Fourth quarter 1996 groundwater monitoring results and</u>
<u>          </u>	<u>remediation system performance evaluation report for</u>
<u>          </u>	<u>ARCO service station 6148, Oakland, California</u>
<u>          </u>	<u>          </u>

For your:	<u>  X  </u>	Use	Sent by:	<u>  X  </u>	Regular Mail
	<u>      </u>	Approval		<u>      </u>	Standard Air
	<u>      </u>	Review		<u>      </u>	Courier
	<u>      </u>	Information		<u>      </u>	Other:

Comments:

The enclosed groundwater monitoring report is being sent to you per the request of ARCO Products Company. Please call if you have questions or comments.

  
John C. Young  
Project Manager

cc: Kevin Graves, RWQCB - SFBR  
Paul Supple, ARCO Products Company  
File





Date: March 14, 1997

Re: ARCO Station #

6148 • 5131 Shattuck Avenue • Oakland, CA  
Fourth Quarter 1996 Groundwater Monitoring Results and  
Remediation System Performance Evaluation Report

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

Submitted by:

A handwritten signature in black ink that reads "Paul Supple". The signature is written in a cursive, flowing style.

Paul Supple  
Environmental Engineer



**EMCON**

1921 Ringwood Avenue • San Jose, California 95131-1721 • (408) 453-7300 • Fax (408) 437-9526

March 17, 1997  
Project 20805-135.006

Mr. Paul Supple  
ARCO Products Company  
P.O. Box 6549  
Moraga, California 94570

Re: Fourth quarter 1996 groundwater monitoring program results and remediation system performance evaluation report, ARCO service station 6148, Oakland, California

Dear Mr. Supple:

This letter presents the results of the fourth quarter 1996 groundwater monitoring program at ARCO Products Company (ARCO) service station 6148, 5131 Shattuck Avenue, Oakland, California (Figure 1). Operation and performance data for the on-site soil-vapor extraction (SVE), air-sparge (AS), and air-bubbling remediation systems are also presented. The quarterly monitoring program complies with Alameda County Health Care Services Agency (ACHCSA) requirements regarding underground tank investigations.

### LIMITATIONS

No monitoring event is thorough enough to describe all geologic and hydrogeologic conditions of interest at a given site. If conditions have not been identified during the monitoring event, such a finding should not therefore be construed as a guarantee of the absence of such conditions at the site, but rather as the result of the scope, limitations, and cost of work performed during the monitoring event.

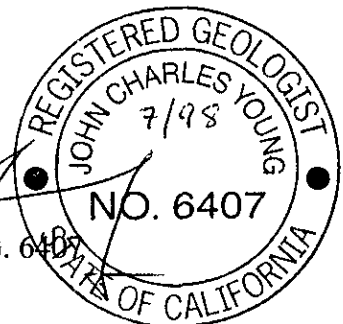
Please call if you have questions.

Sincerely,

EMCON

*Krishnaveni M.*  
Krishnaveni Meka  
Staff Engineer

*John C. Young*  
John C. Young, R.G. 6407  
Project Manager



EMCON



March 17, 1997

## ARCO QUARTERLY REPORT

Station No.: 6148 Address: 5131 Shattuck Avenue, Oakland, California  
EMCON Project No. 20805-135.006  
ARCO Environmental Engineer/Phone No.: Paul Supple /(510) 299-8891  
EMCON Project Manager/Phone No.: John C. Young /(408) 453-7300  
Primary Agency/Regulatory ID No.: ACHCSA /Susan Hugo  
Reporting Period: October 1, 1996 to January 1, 1997

### WORK PERFORMED THIS QUARTER (Fourth- 1996):

1. Conducted quarterly groundwater monitoring and sampling for fourth quarter 1996.
2. Prepared and submitted quarterly report for third quarter 1996.
3. Operated air-bubbling system.

### WORK PROPOSED FOR NEXT QUARTER (First- 1997):

1. Perform quarterly groundwater monitoring and sampling for first quarter 1997.
2. Continue operation air-bubbling system.
3. Restart soil-vapor extraction (SVE) and air-sparge systems if hydrocarbon concentrations warrant.
4. Prepare and submit quarterly report for fourth quarter 1996.

### QUARTERLY MONITORING:

Current Phase of Project: Quarterly Groundwater Monitoring and Operation and Maintenance of Remediation Systems  
The SVE system was shut down on October 3, 1996, because of maintenance problems. The SVE system remained shut down because of low TVHg concentrations in the extracted soil vapor.

Frequency of Sampling: Quarterly (groundwater), Monthly (SVE)

Frequency of Monitoring: Quarterly (groundwater),  
Monthly (SVE, air-sparge, and air-bubbling)

Is Floating Product (FP) Present On-site:  Yes  No

Bulk Soil Removed to Date : 560 cubic yards of TPH-impacted soil

Bulk Soil Removed This Quarter : None

Water Wells or Surface Waters,  
within 2000 ft., impacted by site: None

Current Remediation Techniques: SVE, Air-Sparge, and Air-Bubbling Systems

Approximate Depth to Groundwater: 16.19 feet

Groundwater Gradient (Average): 0.015 ft/ft toward southwest (consistent with past events)

### SVE QUARTERLY OPERATION AND PERFORMANCE:

Equipment Inventory: Therm Tech Model CATVAC-10E, Electric/Catalytic Oxidizer  
The SVE system was shut down on October 3, 1996, because of maintenance problems. The SVE system remained shut down because of low TVHg concentrations in the extracted soil vapor.

Operating Mode: Catalytic Oxidation

BAAQMD Permit #: 25126

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TPH Conc. End of Period (lab):	450 ppmv (10-3-96)
Benzene Conc. End of Period (lab):	<1 ppmv (10-3-96)
Flowrate End of Period:	63.7 scfm (10-3-96)
HC Destroyed This Period:	3.4 pounds
HC Destroyed to Date:	1885.6 pounds
Utility Usage	
Electric (KWH):	4553
Operating Hours This Period:	8.1 hours
Percent Operational:	0.4% System was down for quarterly monitoring and maintenance issues with blower controller.
Operating Hours to Date:	2694.1 hours
Unit Maintenance:	NA
Number of Auto Shut Downs:	1
Destruction Efficiency Permit Requirement:	90%
Percent TPH Conversion:	94.1% (10-3-96)
Stack Temperature:	742°F (10-3-96)
Source Flow:	63.7 scfm (10-3-96)
Process Flow:	63.3 scfm (10-3-96)
Source Vacuum:	15 inches of water (10-3-96)

#### ATTACHED:

- Table 1 - Groundwater Monitoring Data, Fourth Quarter 1996
- Table 2 - Historical Groundwater Elevation and Analytical Data, Petroleum Hydrocarbons and Their Constituents
- Table 3 - Historical Groundwater Analytical Data, Volatile and Semivolatile Organic Compounds
- Table 4 - Historical Groundwater Analytical Data, Metals
- Table 5 - Soil-Vapor Extraction System Operation and Performance Data
- Table 6 - Soil-Vapor Extraction Well Data
- Table 7 - Air-Sparge and Air-Bubbling Systems Operation and Performance Data
- Figure 1 - Site Location
- Figure 2 - Site Plan
- Figure 3 - Groundwater Data, Fourth Quarter 1996
- Figure 4 - Soil-Vapor Extraction and Treatment System, Historical System Influent TVHG and Benzene Concentrations
- Figure 5 - Soil-Vapor Extraction and Treatment System, Historical Hydrocarbon Removal Rates
- Appendix A - Analytical Results and Chain of Custody Documentation, Fourth Quarter 1996 Groundwater Monitoring Event
- Appendix B - SVE System Monitoring Data Log Sheets
- Appendix C - Analytical Results and Chain-of-Custody Documentation for Soil Vapor Extraction System, Fourth Quarter 1996

cc: Susan Hugo, ACHCSA  
Kevin Graves, RWQCB-SFBR

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Table 1  
Groundwater Monitoring Data  
Fourth Quarter 1996

ARCO Service Station 6148  
5131 Shattuck Avenue, Oakland, California

Date: 2-17-97

Well Designation	Water Level Field Date	Top of Casing Elevation ft-MSL	Depth to Water feet	Groundwater Elevation ft-MSL	Floating Product Thickness feet	Groundwater Flow Direction MWN	Hydraulic Gradient ft/ft	Water Sample Field Date	TPHG LUFT Method µg/L	Benzene EPA 8020 µg/L	Toluene EPA 8020 µg/L	Ethylbenzene EPA 8020 µg/L	Total Xylenes EPA 8020 µg/L	MTBE EPA 8020 µg/L	MTBE EPA 8240 µg/L	Oil & Grease SM 5520C mg/L	TRPH EPA 418.1 mg/L	TPHD LUFT Method µg/L
MW-1	11-11-96	107.80	17.78	90.02	ND	SW	0.015	11-11-96	Not sampled	well sampled semi-annually, during the first and third quarter								
MW-2	11-11-96	107.28	17.55	89.73	ND	SW	0.015	11-11-96	1200	150	120	21	160	110	--	--	--	--
MW-3	11-11-96	107.61	17.73	89.88	ND	SW	0.015	11-11-96	500	28	3	12	13	150	--	--	--	--
MW-4	11-11-96	106.71	16.19	90.52	ND	SW	0.015	11-11-96	Not sampled	well sampled semi-annually, during the first and third quarter								
MW-5	11-11-96	106.60	16.62	89.98	ND	SW	0.015	11-11-96	1200	31	1	8	2	130	--	--	--	--
MW-6	11-11-96	105.13	14.11	91.02	ND	SW	0.015	11-11-96	Not sampled	well sampled annually, during the third quarter								
MW-7	11-11-96	107.05	14.92	92.13	ND	SW	0.015	11-11-96	Not sampled	well sampled annually, during the third quarter								

ft-MSL elevation in feet, relative to mean sea level

MWN ground-water flow direction and gradient apply to the entire monitoring well network

ft/ft. foot per foot

TPHG total petroleum hydrocarbons as gasoline, California DHS LUFT Method

µg/L. micrograms per liter

EPA: United States Environmental Protection Agency

MTBE. methyl-tert-butyl ether

SM standard method

mg/L milligrams per liter

TRPH total recoverable petroleum hydrocarbons

TPHD total petroleum hydrocarbons as diesel, California DHS LUFT Method

ND none detected

SW southwest

-- not analyzed or not applicable

Table 2  
 Historical Groundwater Elevation and Analytical Data  
 Petroleum Hydrocarbons and Their Constituents  
 1994 - Present\*\*

ARCO Service Station 6148  
 5131 Shattuck Avenue, Oakland, California

Date: 02-17-97

Well Designation	Water Level Field Date	Top of Casing Elevation	Depth to Water	Groundwater Elevation	Floating Product Thickness	Groundwater Flow Direction	Hydraulic Gradient	Water Sample Field Date	TPHG LUFT Method	Benzene EPA 8020	Toluene EPA 8020	Ethylbenzene EPA 8020	Total Xylenes EPA 8020	MTBE EPA 8020	MTBE EPA 8240	Oil & Grease SM 5520C	TRPH EPA 418.1	TPHD LUFT Method
MW-1	02-02-94	108.03	17.31	90.72	ND	NR	NR	02-02-94	250	93	<0.5	1.9	1	--	--	--	--	--
MW-1	04-29-94	108.03	17.31	90.72	ND	NR	NR	04-29-94	350	99	1.3	3.9	11	--	--	--	--	--
MW-1	08-02-94	108.03	17.95	90.08	ND	SW	0.017	08-02-94	210	82	<1	<1	2.5	--	--	--	--	--
MW-1	11-16-94	108.03	17.04	90.99	ND	SW	0.02	11-16-94	650	260	38	6.1	15	--	--	--	--	--
MW-1	03-20-95	108.03	15.75	92.28	ND	SW	0.02	03-20-95	830	140	5	4.1	110	--	--	--	--	--
MW-1	06-06-95	108.03	17.68	90.35	ND	SW	0.016	06-06-95	210	30	<0.5	7.3	16	--	--	--	--	--
MW-1	08-24-95	107.80	17.45	90.35	ND	SW	0.014	08-24-95	Not sampled: well was inaccessible due to construction									
MW-1	11-16-95	107.80	17.64	90.16	ND	SW	0.012	11-16-95	<50	5.6	<0.5	1.4	1.2	55	--	--	--	--
MW-1	02-27-96	107.80	15.21	92.59	ND	SW	0.016	02-27-96	1400	240	88	44	110	200	--	--	--	--
MW-1	05-15-96	107.80	17.53	90.27	ND	SW	0.015	05-15-96	Not sampled: not scheduled for chemical analysis									
MW-1	08-14-96	107.80	17.15	90.65	ND	SW	0.021	08-14-96	98	18	<0.5	1.9	1	45	--	--	--	--
MW-1	11-11-96	107.80	17.78	90.02	ND	SW	0.015	11-11-96	Not sampled: well sampled semi-annually, during the first and third quarter									
MW-2	02-02-94	107.43	16.96	90.47	ND	NR	NR	02-02-94	16000	1300	2500	540	2700	--	--	--	--	--
MW-2	04-29-94	107.43	16.95	90.48	ND	NR	NR	04-29-94	11000	1400	1200	360	1400	--	--	--	--	--
MW-2	08-02-94	107.43	17.59	89.84	ND	SW	0.017	08-02-94	4900	800	290	120	620	--	--	--	--	--
MW-2	11-16-94	107.43	16.73	90.70	ND	SW	0.02	11-16-94	49000	3300	8300	1400	7200	--	--	--	--	--
MW-2	03-20-95	107.43	15.50	91.93	ND#	SW	0.02	03-20-95	Not sampled: floating product entered well during purging									
MW-2	06-06-95	107.43	17.43	90.00	ND	SW	0.016	06-06-95	1200	60	21	35	140	--	--	--	--	--
MW-2	08-24-95	107.28	17.22	90.06	ND	SW	0.014	08-24-95	Not sampled: well was inaccessible due to construction									
MW-2	11-16-95	107.28	17.36	89.92	ND	SW	0.012	11-16-95	360	45	1.3	7.1	7.5	210	--	--	--	--
MW-2	02-27-96	107.28	14.82	92.46	ND	SW	0.016	02-27-96	8900	1400	980	150	550	940	--	--	--	--
MW-2	05-15-96	107.28	17.40	89.88	ND	SW	0.015	05-15-96	480	82	48	8	48	87	--	--	--	--
MW-2	08-14-96	107.28	17.00	90.28	ND	SW	0.021	08-14-96	130	22	4	2	9	120	--	--	--	--
MW-2	11-11-96	107.28	17.55	89.73	ND	SW	0.015	11-11-96	1200	150	120	21	160	110	--	--	--	--

Table 2  
 Historical Groundwater Elevation and Analytical Data  
 Petroleum Hydrocarbons and Their Constituents  
 1994 - Present\*\*

ARCO Service Station 6148  
 5131 Shattuck Avenue, Oakland, California

Date: 02-17-97

Well Designation	Water Level Field Date	Top of Casing Elevation ft-MSL	Depth to Water feet	Groundwater Elevation ft-MSL	Floating Product Thickness feet	Groundwater Flow Direction MWN	Hydraulic Gradient ft/ft	Water Sample Field Date	TPHG LUFT Method µg/L	Benzene EPA 8020 µg/L	Toluene EPA 8020 µg/L	Ethylbenzene EPA 8020 µg/L	Total Xylenes EPA 8020 µg/L	MTBE EPA 8020 µg/L	MTBE EPA 8240 µg/L	Oil & Grease SM 5520C mg/L	TRPH EPA 418.1 mg/L	TPHD LUFT Method µg/L
MW-3	02-02-94	107.77	17.16	90.61	ND	NR	NR	02-02-94	26000	1400	1200	1200	4400	--	--	7.7	7.8	--
MW-3	04-29-94	107.77	17.14	90.63	ND	NR	NR	04-29-94	22000	1400	620	910	3400	--	--	10	--	--
MW-3	08-02-94	107.77	17.81	89.96	ND	SW	0.017	08-02-94	17000	530	410	720	2600	--	--	--	6.6	--
MW-3	11-16-94	107.77	16.91	90.86	ND	SW	0.02	11-16-94	18000	1400	560	790	2800	--	--	--	2.3	--
MW-3	03-20-95	107.77	15.60	92.17	ND	SW	0.02	03-20-95	29000	880	190	760	2000	--	--	--	16	--
MW-3	06-06-95	107.77	17.54	90.23	ND	SW	0.016	06-06-95	22000	450	54	380	1300	--	--	--	7.1	--
MW-3	08-24-95	107.61	17.42	90.19	ND	SW	0.014	08-24-95	Not sampled. well was inaccessible due to construction									
MW-3	11-16-95	107.61	17.58	90.03	ND	SW	0.012	11-16-95	13000	210	<20	320	1000	790	--	--	8.3	--
MW-3	02-27-96	107.61	15.03	92.58	ND	SW	0.016	02-27-96	9700	94	15	290	720	430	--	--	10	--
MW-3	05-15-96	107.61	17.35	90.26	ND	SW	0.015	05-15-96	5600	66	12	37	67	230	--	--	--	--
MW-3	08-14-96	107.61	17.10	90.51	ND	SW	0.021	08-14-96	830	17	<1*	8	7	110	--	--	--	--
MW-3	11-11-96	107.61	17.73	89.88	ND	SW	0.015	11-11-96	500	28	3	12	13	150	--	--	--	--
MW-4	02-02-94	106.58	15.36	91.22	ND	NR	NR	02-02-94	<50	3.9	<0.5	<0.5	<0.5	--	--	--	--	--
MW-4	04-29-94	106.58	15.36	91.22	ND	NR	NR	04-29-94	<50	4.2	<0.5	<0.5	<0.5	--	--	--	--	--
MW-4	08-02-94	106.58	15.94	90.64	ND	SW	0.017	08-02-94	<50	3.8	<0.5	<0.5	<0.5	--	--	--	--	--
MW-4	11-16-94	106.58	14.99	91.59	ND	SW	0.02	11-16-94	110	31	<0.5	<0.5	<0.5	--	--	--	--	--
MW-4	03-20-95	106.58	13.85	92.73	ND	SW	0.02	03-20-95	88	1	<0.5	<0.5	0.7	--	--	--	--	--
MW-4	06-06-95	106.58	15.70	90.88	ND	SW	0.016	06-06-95	<50	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--
MW-4	08-24-95	106.71	15.86	90.85	ND	SW	0.014	08-24-95	Not sampled: well was inaccessible due to construction									
MW-4	11-16-95	106.71	16.10	90.61	ND	SW	0.012	11-16-95	<50	<0.5	<0.5	<0.5	<0.5	6	--	--	--	--
MW-4	02-27-96	106.71	13.72	92.99	ND	SW	0.016	02-27-96	<50	<0.5	<0.5	<0.5	<0.5	10	--	--	--	--
MW-4	05-15-96	106.71	15.90	90.81	ND	SW	0.015	05-15-96	Not sampled: not scheduled for chemical analysis									
MW-4	08-14-96	106.71	15.68	91.03	ND	SW	0.021	08-14-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	--
MW-4	11-11-96	106.71	16.19	90.52	ND	SW	0.015	11-11-96	Not sampled: well sampled semi-annually, during the first and third quarter									



Table 2  
 Historical Groundwater Elevation and Analytical Data  
 Petroleum Hydrocarbons and Their Constituents  
 1994 - Present\*\*

ARCO Service Station 6148  
 5131 Shattuck Avenue, Oakland, California

Date: 02-17-97

Well Designation	Water Level Field Date	Top of Casing Elevation ft-MSL	Depth to Water feet	Groundwater Elevation ft-MSL	Floating Product Thickness feet	Groundwater Flow Direction MWN	Hydraulic Gradient ft/ft	Water Sample Field Date	TPHG LUFT Method µg/L	Benzene EPA 8020 µg/L	Toluene EPA 8020 µg/L	Ethylbenzene EPA 8020 µg/L	Total Xylenes EPA 8020 µg/L	MTBE EPA 8020 µg/L	MTBE EPA 8240 µg/L	Oil & Grease SM 5520C mg/L	TRPH EPA 418.1 mg/L	TPHD LUFT Method µg/L
MW-5	02-02-94	106.68	16.38	90.30	ND	NR	NR	02-02-94	10000	3000	65	240	78	--	--	--	--	--
MW-5	04-29-94	106.68	16.41	90.27	ND	NR	NR	04-29-94	7600	2400	27	130	44	--	--	--	--	--
MW-5	08-02-94	106.68	16.81	89.87	ND	SW	0.017	08-02-94	1900	680	<10	24	<10	--	--	--	--	--
MW-5	11-16-94	106.68	16.12	90.56	ND	SW	0.02	11-16-94	17000	5900	700	440	320	--	--	--	--	--
MW-5	03-20-95	106.68	14.92	91.76	ND	SW	0.02	03-20-95	21000	6900	450	800	1300	--	--	--	--	--
MW-5	06-06-95	106.68	16.61	90.07	ND	SW	0.016	06-06-95	6500	1700	<20	120	69	--	--	--	--	--
MW-5	08-24-95	106.60	16.47	90.13	ND	SW	0.014	08-24-95	Not sampled well was inaccessible due to construction									
MW-5	11-16-95	106.60	16.69	89.91	ND	SW	0.012	11-16-95	1800	470	<5	17	5	1000	--	--	--	--
MW-5	02-27-96	106.60	14.35	92.25	ND	SW	0.016	02-27-96	10000	1000	71	690	1000	440	450	--	--	--
MW-5	05-15-96	106.60	16.58	90.02	ND	SW	0.015	05-15-96	3400	350	6	72	20	220	--	--	--	--
MW-5	08-14-96	106.60	17.26	89.34	ND	SW	0.021	08-14-96	2100	130	2.7	47	4.7	220	--	--	--	--
MW-5	11-11-96	106.60	16.62	89.98	ND	SW	0.015	11-11-96	1200	31	1	8	2	130	--	--	--	--
MW-6	02-02-94	105.16	13.60	91.56	ND	NR	NR	02-02-94	61	2.2	<0.5	<0.5	<0.5	--	--	--	--	--
MW-6	04-29-94	105.16	13.66	91.50	ND	NR	NR	04-29-94	<50	0.6	<0.5	<0.5	<0.5	--	--	--	--	--
MW-6	08-02-94	105.16	13.99	91.17	ND	SW	0.017	08-02-94	<50	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--
MW-6	11-16-94	105.16	13.11	92.05	ND	SW	0.02	11-16-94	<50	1.1	<0.5	<0.5	<0.5	--	--	--	--	--
MW-6	03-20-95	105.16	12.13	93.03	ND	SW	0.02	03-20-95	<50	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--
MW-6	06-06-95	105.16	13.95	91.21	ND	SW	0.016	06-06-95	<50	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--
MW-6	08-24-95	105.13	14.07	91.06	ND	SW	0.014	08-24-95	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	--
MW-6	11-16-95	105.13	14.34	90.79	ND	SW	0.012	11-16-95	<60	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--
MW-6	02-27-96	105.13	12.00	93.13	ND	SW	0.016	02-27-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	--
MW-6	05-15-96	105.13	14.10	91.03	ND	SW	0.015	05-15-96	Not sampled: not scheduled for chemical analysis									
MW-6	08-14-96	105.13	13.70	91.43	ND	SW	0.021	08-14-96	Not sampled: not scheduled for chemical analysis									
MW-6	11-11-96	105.13	14.11	91.02	ND	SW	0.015	11-11-96	Not sampled well sampled annually, during the third quarter									

Table 2  
 Historical Groundwater Elevation and Analytical Data  
 Petroleum Hydrocarbons and Their Constituents  
 1994 - Present\*\*

ARCO Service Station 6148  
 5131 Shattuck Avenue, Oakland, California

Date: 02-17-97

Well Designation	Water Level Field Date	Top of Casing Elevation ft-MSL	Depth to Water feet	Groundwater Elevation ft-MSL	Floating Product Thickness feet	Groundwater Flow Direction MWN	Hydraulic Gradient ft/ft	Water Sample Field Date	TPHG LUFT Method µg/L	Benzene EPA 8020 µg/L	Toluene EPA 8020 µg/L	Ethylbenzene EPA 8020 µg/L	Total Xylenes EPA 8020 µg/L	MTBE EPA 8020 µg/L	MTBE EPA 8240 µg/L	Oil & Grease SM 5520C mg/L	TRPH EPA 418.1 mg/L	TPHD LUFT Method µg/L
MW-7	02-02-94	107.08	14.04	93.04	ND	NR	NR	02-02-94	<50	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--
MW-7	04-29-94	107.08	14.10	92.98	ND	NR	NR	04-29-94	<50	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--
MW-7	08-02-94	107.08	14.61	92.47	ND	SW	0.017	08-02-94	<50	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--
MW-7	11-16-94	107.08	13.37	93.71	ND	SW	0.02	11-16-94	<50	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--
MW-7	03-20-95	107.08	12.32	94.76	ND	SW	0.02	03-20-95	<50	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--
MW-7	06-06-95	107.08	14.59	92.49	ND	SW	0.016	06-06-95	Not sampled: not scheduled for chemical analysis									
MW-7	08-24-95	107.05	14.64	92.41	ND	SW	0.014	08-24-95	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	--
MW-7	11-16-95	107.05	15.30	91.75	ND	SW	0.012	11-16-95	Not sampled: not scheduled for chemical analysis									
MW-7	02-27-96	107.05	12.24	94.81	ND	SW	0.016	02-27-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	--
MW-7	05-15-96	107.05	14.65	92.40	ND	SW	0.015	05-15-96	Not sampled: not scheduled for chemical analysis									
MW-7	08-14-96	107.05	14.35	92.70	ND	SW	0.021	08-14-96	Not sampled: not scheduled for chemical analysis									
MW-7	11-11-96	107.05	14.92	92.13	ND	SW	0.015	11-11-96	Not sampled: well sampled annually, during the third quarter									

Table 2  
 Historical Groundwater Elevation and Analytical Data  
 Petroleum Hydrocarbons and Their Constituents  
 1994 - Present\*\*

ARCO Service Station 6148  
 5131 Shattuck Avenue, Oakland, California

Date: 02-17-97

Well Designation	Water Level Field Date	Top of Casing Elevation	Depth to Water	Groundwater Elevation	Floating Product Thickness	Groundwater Flow Direction	Hydraulic Gradient	Water Sample Field Date	TPHG LUFT Method	Benzene EPA 8020	Toluene EPA 8020	Ethylbenzene EPA 8020	Total Xylenes EPA 8020	MTBE EPA 8020	MTBE EPA 8240	Oil & Grease SM 5520C	TRPH EPA 418.1	TPHD LUFT Method
		ft-MSL	feet	ft-MSL	feet	MWN	ft/ft		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	µg/L

ft-MSL: elevation in feet, relative to mean sea level

MWN: ground-water flow direction and gradient apply to the entire monitoring well network

ft/ft foot per foot

TPHG: total petroleum hydrocarbons as gasoline, California DHS LUFT Method

µg/L micrograms per liter

EPA: United States Environmental Protection Agency

MTBE Methyl-tert-butyl ether

SM: standard method

mg/L milligrams per liter

TRPH: total recoverable petroleum hydrocarbons

TPHD: total petroleum hydrocarbons as diesel, California DHS LUFT Method

NR: not reported; data not available

ND: none detected

SW: southwest

^ groundwater elevation (GWE) and depth to water (DTW) adjusted to include 80 percent of the floating product thickness (FPT)

$$\{GWE: (TOC - DTW) + (FPT \times 0.8)\}$$

# floating product entered the well during purging

- - not analyzed or not applicable

\* method reporting limit was raised due to: (1) high analyte concentration requiring sample dilution, or (2) matrix interference

\*\* For previous historical groundwater elevation and analytical data please refer to *Fourth Quarter 1995 Groundwater Monitoring Program Results and Remediation System Performance Evaluation Report*, ARCO Service Station 6148, Oakland, California, (EMCON, March 4, 1996)

Table 3  
 Historical Groundwater Analytical Data  
 Volatile and Semivolatile Organic Compounds  
 1994 - Present\*\*

ARCO Service Station 6148

5131 Shattuck Avenue, Oakland, California

Date 02-17-97

Well Designation	Water Sample Field Date	Halogenated Volatile Organic Compounds by EPA Method 5030/601						Semivolatile Organic Compounds by EPA Method 3510/8270			
		Tetrachloro-ethene µg/L	Trichloro-ethene µg/L	Chloroform µg/L	cis-1,2-Dichloro-ethene µg/L	Vinyl Chloride µg/L	1,1-Dichloro-ethene µg/L	Naphthalene µg/L	2-Methyl-naphthalene µg/L	Bis (2ethylhexyl) Phthalate µg/L	Di-n-octyl Phthalate µg/L
MW-1	02-02-94	11	1.1	ND	ND	ND	ND	--	--	--	--
MW-1	04-29-94	13	1.3	0.5	<0.5	<0.5	<0.5	--	--	--	--
MW-1	08-02-94	15	1.4	0.7	0.7	<0.5	<0.5	--	--	--	--
MW-1	11-16-94	12	1.1	0.5	1.2	<0.5	<0.5	--	--	--	--
MW-1	03-20-95	Not analyzed: sampling for additional parameters was discontinued									
MW-2	02-02-94	13	ND	ND	ND	ND	ND	--	--	--	--
MW-2	04-29-94	9.4	1.9	<0.5	2.2	<0.5	<0.5	--	--	--	--
MW-2	08-02-94	15	2	<0.5	2.9	<0.5	<0.5	--	--	--	--
MW-2	11-16-94	9.6	1.8	<0.5	2.1	<0.5	<0.5	--	--	--	--
MW-2	03-20-95	Not analyzed: sampling for additional parameters was discontinued									
MW-3	02-02-94	ND*	ND*	ND*	ND*	ND*	ND*	160	91	9	ND
MW-3	04-29-94	1.7	<0.5	<0.5	<0.5	<0.5	<0.5	110	50	<10	<10
MW-3	08-02-94	1	<0.5	<0.5	<0.5	<0.5	<0.5	120	53	10	<10
MW-3	11-16-94	1.3	<0.5	<0.5	<0.5	<0.5	<0.5	100	53	<10	<10
MW-3	03-20-95	Not analyzed: sampling for additional parameters was discontinued									
MW-4	02-02-94	1.4	ND	ND	ND	ND	ND	--	--	--	--
MW-4	04-29-94	1.9	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--
MW-4	08-02-94	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--
MW-4	11-16-94	1.8	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--
MW-4	03-20-95	Not analyzed: sampling for additional parameters was discontinued									
MW-5	02-02-94	2.7	ND	ND	ND	ND	ND	--	--	--	--
MW-5	04-29-94	10	2.7	<0.5	2.4	<0.5	<0.5	--	--	--	--
MW-5	08-02-94	13	5.4	<0.5	5.7	<0.5	<0.5	--	--	--	--
MW-5	11-16-94	1.1	1	<0.5	3.5	1.3	<0.5	--	--	--	--
MW-5	03-20-95	Not analyzed: sampling for additional parameters was discontinued									

Table 3  
 Historical Groundwater Analytical Data  
 Volatile and Semivolatile Organic Compounds  
 1994 - Present\*\*

ARCO Service Station 6148

5131 Shattuck Avenue, Oakland, California

Date: 02-17-97

Well Designation	Water Sample Field Date	Halogenated Volatile Organic Compounds by EPA Method 5030/601						Semivolatile Organic Compounds by EPA Method 3510/8270			
		Tetrachloro-ethene µg/L	Trichloro-ethene µg/L	Chloroform µg/L	cis-1,2-Dichloro-ethene µg/L	Vinyl Chloride µg/L	1,1-Dichloro-ethane µg/L	Naphthalene µg/L	2-Methyl-naphthalene µg/L	Bis (2ethylhexyl) Phthalate µg/L	Di-n-octyl Phthalate µg/L
MW-6	02-02-94	100	ND	6.7	ND	ND	ND	--	--	--	--
MW-6	04-29-94	95	6.6	7.2	<2.5	<2.5	<2.5	--	--	--	--
MW-6	08-02-94	87	6.1	4.6	<2.5	<2.5	<2.5	--	--	--	--
MW-6	11-16-94	86	6.8	8.9	<2.5	<2.5	<2.5	--	--	--	--
MW-6	03-20-95	Not analyzed. sampling for additional parameters was discontinued									
MW-7	02-02-94	3.4	ND	0.8	ND	ND	ND	--	--	--	--
MW-7	04-29-94	3.4	<0.5	1.1	<0.5	<0.5	<0.5	--	--	--	--
MW-7	08-02-94	3.3	<0.5	0.8	<0.5	<0.5	<0.5	--	--	--	--
MW-7	11-16-94	3.3	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--
MW-7	03-20-95	Not analyzed. sampling for additional parameters was discontinued									
AS-1	09-30-93	29	1.5	1	ND	ND	ND	--	--	--	--
AS-2	08-11-95	Not analyzed: sampling for additional parameters was not initiated									
AS-3	08-11-95	Not analyzed: sampling for additional parameters was not initiated									
AS-4	08-11-95	Not analyzed: sampling for additional parameters was not initiated									
AS-5	08-11-95	Not analyzed. sampling for additional parameters was not initiated									

EPA: United States Environmental Protection Agency

µg/L: micrograms per liter

ND: none detected

--: not analyzed or not applicable

\*: sample was analyzed for volatile organic compounds using USEPA Method 624 (only BTEX was detected)

\*\* : For previous historical analytical data please refer to *Fourth Quarter 1995 Groundwater Monitoring Program Results and Remediation System Performance Evaluation Report, ARCO Service Station 6148, Oakland, California*, (EMCON, March 4, 1996)

Table 4  
Historical Groundwater Analytical Data  
Metals

ARCO Service Station 6148  
5131 Shattuck Avenue, Oakland, California

Date: 02-17-97

Well Designation	Water Sample Field Date	Cadmium EPA 6010  µg/L	Chromium EPA 6010  µg/L	Lead EPA 7421  µg/L	Zinc EPA 6010  µg/L	Nickel EPA 6010  µg/L
MW-1	03-18-92	<3	5	3	31	<20
MW-1	06-12-92	--	--	--	--	--
MW-1	09-14-92	--	--	--	--	--
MW-1	10-07-92	--	--	--	--	--
MW-1	01-22-93	--	--	--	--	--
MW-1	04-14-93	<3	<5	3	25	<20
MW-1	09-30-93	Not analyzed: sampling for additional parameters was discontinued				
MW-2	03-18-92	<3	21	9	54	38
MW-2	06-12-92	Not analyzed: sampling for additional parameters was discontinued				
MW-3	03-18-92	<3	67	27	156	113
MW-3	06-12-92	--	--	--	--	--
MW-3	09-14-92	--	--	--	--	--
MW-3	10-07-92	Not sampled well contained floating product				
MW-3	01-22-93	<3	10	8	28	23
MW-3	04-14-93	<3	<5	3	25	<20
MW-3	09-30-93	<5	50	26	100	70
MW-3	11-16-93	Not analyzed: sampling for additional parameters was discontinued				
MW-4	11-12-92	Not analyzed: sampling for additional parameters was not initiated				
MW-5	11-12-92	Not analyzed: sampling for additional parameters was not initiated				
MW-6	11-12-92	Not analyzed: sampling for additional parameters was not initiated				
MW-7	11-12-92	Not analyzed: sampling for additional parameters was not initiated				
AS-1	09-30-93	Not analyzed: sampling for additional parameters was not initiated				
AS-2	08-11-95	Not analyzed: sampling for additional parameters was not initiated				
AS-3	08-11-95	Not analyzed: sampling for additional parameters was not initiated				
AS-4	08-11-95	Not analyzed: sampling for additional parameters was not initiated				
AS-5	08-11-95	Not analyzed: sampling for additional parameters was not initiated				

EPA: United States Environmental Protection Agency  
µg/L: micrograms per liter  
--: not analyzed

Table 5  
Soil-Vapor Extraction System  
Operation and Performance Data

Facility Number: 6148 Location: 5131 Shattuck Avenue Oakland, California  Consultant: EMCON 1921 Ringwood Avenue San Jose, California		Vapor Treatment Unit: ThermTech Model CATVAC-10E electric/ catalytic oxidizer  Start-Up Date: 09-27-95 Operation and Performance Data From: 09-27-95 To: 01-01-97			
Date Begin:	09-27-96	10-01-95	01-01-96	02-01-96	03-01-96
Date End:	10-01-95	01-01-96	02-01-96	03-01-96	04-01-96
Mode of Oxidation:	Cat-ox	Cat-ox	Cat-ox	Cat-ox	Cat-ox
Days of Operation:	3	11	16	7	11
Days of Downtime:	1	81	15	22	20
<b><u>Average Vapor Concentrations (1)</u></b>					
Well Field Influent: ppmv (2) as gasoline	3800	1200	670	230	320
mg/m3 (3) as gasoline	14000	4400	2790	830	1300
ppmv as benzene	81	19	NA (13)	0.6	1.6
mg/m3 as benzene	260	61	NA	2	5.2
System Influent: ppmv as gasoline	1800	600	415	230	320
mg/m3 as gasoline	6700	2200	1730	830	1300
ppmv as benzene	41	11	NA	0.6	1.6
mg/m3 as benzene	130	34	NA	2	5.2
System Effluent: ppmv as gasoline	52	30	3.8*	21	26
mg/m3 as gasoline	190	110	20	76	110
ppmv as benzene	1.1	0.5	NA	<0.1	<0.1
mg/m3 as benzene	3.5	1.5	NA	<0.5	<0.5
Average Well Field Flow Rate (4), scfm (5):	75.0	104.0	124.6	128.2	126.4
Average System Influent Flow Rate (4), scfm:	103.6	132.3	111.9	128.2	126.4
Average Destruction Efficiency (6), percent (7):	97.2	95.0	98.8	90.8	91.5
<b><u>Average Emission Rates (8), pounds per day (9)</u></b>					
Gasoline:	1.77	1.31	0.20	0.88	1.25
Benzene:	0.03	0.02	0.00	0.01	0.01
Operating Hours This Period:	<u>74.9</u>	<u>255.3</u>	<u>381.7</u>	<u>157.2</u>	<u>253.0</u>
Operating Hours To Date:	74.9	330.2	711.9	869.1	1122.2
Pounds/ Hour Removal Rate, as gasoline (10):	3.93	1.71	1.30	0.40	0.62
Pounds Removed This Period, as gasoline (11):	<u>294.4</u>	<u>437.3</u>	<u>496.6</u>	<u>62.6</u>	<u>155.6</u>
Pounds Removed To Date, as gasoline:	294.4	731.7	1228.3	1290.9	1446.5
Gallons Removed This Period, as gasoline (12):	<u>47.5</u>	<u>70.5</u>	<u>80.1</u>	<u>10.1</u>	<u>25.1</u>
Gallons Removed To Date, as gasoline:	47.5	118.0	198.1	208.2	233.3

Table 5  
Soil-Vapor Extraction System  
Operation and Performance Data

Facility Number: 6148 Location: 5131 Shattuck Avenue Oakland, California  Consultant: EMCON 1921 Ringwood Avenue San Jose, California		Vapor Treatment Unit: ThermTech Model CATVAC-10E electric/ catalytic oxidizer  Start-Up Date: 09-27-95 Operation and Performance Data From: 09-27-95 To: 01-01-97				
Date Begin:	04-01-96	05-01-96	06-01-96	07-01-96	08-01-96	
Date End:	05-01-96	06-01-96	07-01-96	08-01-96	09-01-96	
Mode of Oxidation:	Cat-ox	Cat-ox	Cat-ox	Cat-ox	Cat-ox	
Days of Operation:	22	3	3	20	11	
Days of Downtime:	8	28	27	11	20	
<b>Average Vapor Concentrations (1)</b>						
Well Field Influent: ppmv (2) as gasoline	190	160	180	170	170	
mg/m3 (3) as gasoline	760	650	740	690	710	
ppmv as benzene	0.9	0.6	<1	0.4	<1	
mg/m3 as benzene	3	2	<2.5	1.3	<2.5	
System Influent: ppmv as gasoline	190	160	180	170	170	
mg/m3 as gasoline	760	650	740	690	710	
ppmv as benzene	0.9	0.6	<1	0.4	<1	
mg/m3 as benzene	3	2	<2.5	1.3	<2.5	
System Effluent: ppmv as gasoline	10	10	<5	6	9	
mg/m3 as gasoline	41	39	<20	23	38	
ppmv as benzene	<0.2	<0.2	<0.2	<0.2	<0.2	
mg/m3 as benzene	<0.5	<0.5	<0.5	<0.5	<0.5	
Average Well Field Flow Rate (4), scfm (5):	100.3	91.8	116.7	125.7	125.4	
Average System Influent Flow Rate (4), scfm:	100.3	91.8	116.7	125.7	125.4	
Average Destruction Efficiency (6), percent (7):	94.6	94.0	97.3	96.7	94.6	
<b>Average Emission Rates (8), pounds per day (9)</b>						
Gasoline:	0.37	0.32	0.21	0.26	0.43	
Benzene:	0.00	0.00	0.01	0.01	0.01	
Operating Hours This Period:	<u>532.5</u>	<u>72.9</u>	<u>83.7</u>	<u>478.9</u>	<u>255.2</u>	
Operating Hours To Date:	1654.6	1727.6	1811.3	2290.1	2545.3	
Pounds/ Hour Removal Rate, as gasoline (10):	0.29	0.22	0.32	0.32	0.33	
Pounds Removed This Period, as gasoline (11):	<u>151.9</u>	<u>16.3</u>	<u>27.1</u>	<u>155.4</u>	<u>85.0</u>	
Pounds Removed To Date, as gasoline:	1598.4	1614.7	1641.8	1797.2	1882.2	
Gallons Removed This Period, as gasoline (12):	<u>24.5</u>	<u>2.6</u>	<u>4.4</u>	<u>25.1</u>	<u>13.7</u>	
Gallons Removed To Date, as gasoline:	257.8	260.5	264.8	289.9	303.6	



Table 5  
Soil-Vapor Extraction System  
Operation and Performance Data

Facility Number: 6148	Vapor Treatment Unit: ThermTech Model			
Location: 5131 Shattuck Avenue Oakland, California	CATVAC-10E electric/ catalytic oxidizer			
Consultant: EMCON	Start-Up Date: 09-27-95			
1921 Ringwood Avenue	Operation and Performance Data From: 09-27-95			
San Jose, California	To: 01-01-97			
Date Begin:	09-01-96	10-01-96	11-01-96	12-01-96
Date End:	10-01-96	11-01-96	12-01-96	01-01-97
Mode of Oxidation:	Cat-ox	Cat-ox	Cat-ox	Cat-ox
Days of Operation:	6	0	0	0
Days of Downtime:	24	31	30	31
<b>Average Vapor Concentrations (1)</b>				
Well Field Influent: ppmv (2) as gasoline	NA	450	NA	NA
mg/m3 (3) as gasoline	NA	1900	NA	NA
ppmv as benzene	NA	<1	NA	NA
mg/m3 as benzene	NA	<4	NA	NA
System Influent: ppmv as gasoline	NA	330	NA	NA
mg/m3 as gasoline	NA	1400	NA	NA
ppmv as benzene	NA	<1	NA	NA
mg/m3 as benzene	NA	<4	NA	NA
System Effluent: ppmv as gasoline	NA	20	NA	NA
mg/m3 as gasoline	NA	83	NA	NA
ppmv as benzene	NA	<0.1	NA	NA
mg/m3 as benzene	NA	<0.4	NA	NA
Average Well Field Flow Rate (4), scfm (5):	125.2	63.7	0.0	91.8
Average System Influent Flow Rate (4), scfm:	125.2	63.3	0.0	81.9
Average Destruction Efficiency (6), percent (7):	NA	94.1	NA	NA
<b>Average Emission Rates (8), pounds per day (9)</b>				
Gasoline:	NA	0.47	NA	NA
Benzene:	NA	0.00	NA	NA
Operating Hours This Period:	<u>140.7</u>	<u>7.5</u>	<u>0.0</u>	<u>0.6</u>
Operating Hours To Date:	2686.0	2693.5	2693.5	2694.1
Pounds/ Hour Removal Rate, as gasoline (10):	0.00	0.45	0.00	0.00
Pounds Removed This Period, as gasoline (11):	<u>0.0</u>	<u>3.4</u>	<u>0.0</u>	<u>0.0</u>
Pounds Removed To Date, as gasoline	1882.2	1885.6	1885.6	1885.6
Gallons Removed This Period, as gasoline (12):	<u>0.0</u>	<u>0.5</u>	<u>0.0</u>	<u>0.0</u>
Gallons Removed To Date, as gasoline.	303.6	304.2	304.2	304.2

Table 5  
Soil-Vapor Extraction System  
Operation and Performance Data

Facility	Number: 6148 Location: 5131 Shattuck Avenue Oakland, California	Vapor Treatment Unit: ThermTech Model CATVAC-10E electric/ catalytic oxidizer
	Consultant: EMCON 1921 Ringwood Avenue San Jose, California	Start-Up Date: 09-27-95 Operation and Performance Data From: 09-27-95 To: 01-01-97

CURRENT REPORTING PERIOD:	10-01-96	to	01-01-97
DAYS / HOURS IN PERIOD:	92		2208.0
DAYS / HOURS OF OPERATION:	0		8.1
DAYS / HOURS OF DOWN TIME:	92		2199.9
PERCENT OPERATIONAL:			0.4 %
PERIOD POUNDS REMOVED:	3.4		
PERIOD GALLONS REMOVED:	0.5		
AVERAGE WELL FIELD FLOW RATE (scfm):			65.9
AVERAGE SYSTEM INFLUENT FLOW RATE (scfm):			64.7

1. Average concentrations are based on discrete sample results reported during the month; refer to Appendix B for discrete sample results.  
For the period of January 1, 1996 to February 1, 1996, laboratory analytical results were unavailable. The average concentrations were based on photoionization d (PID) field readings taken during the month of January 1996
2. ppmv: parts per million by volume
3. mg/m3: milligrams per cubic meter
4. Average flow rates (time weighted average) are based on instantaneous flow rates recorded during the month; refer to Appendix B for instantaneous flow data
5. scfm, flow in standard cubic feet per minute at one atmosphere and 70 degrees Fahrenheit
6. Average destruction efficiencies are calculated using monthly average concentrations; refer to Appendix B for instantaneous destruction efficiency data
7. destruction efficiency, percent =  $(\text{system influent concentration (as gasoline in mg/m}^3) - \text{system effluent concentration (as gasoline in mg/m}^3) / \text{system influent concentration (as gasoline in mg/m}^3) \times 100$  percent
8. Average emission rates are calculated using monthly average concentrations and flow rates, refer to Appendix B for instantaneous emission rate data.
9. emission rates (pounds per day) = system effluent concentration (as gasoline or benzene in mg/m3) x system influent flow rate (scfm) x 0.02832 m3/ft3 x 1440 minutes/day x 1 pound/454,000 mg
10. pounds/ hour removal rate (as gasoline) = well field influent concentration (as gasoline in mg/m3) x well field influent flow rate (scfm) x 0.02832 m3/ft3 x 60 minutes/hour x 1 pound/454,000 mg
11. pounds removed this period (as gasoline) = pounds/ hour removal rate x hours of operation
12. gallons removed this period (as gasoline) = pounds removed this period (as gasoline) x 0.1613 gallons/pound of gasoline
13. not available

Table 6  
Soil-Vapor Extraction Well Data

ARCO Service Station 6148  
5131 Shattuck Avenue, Oakland, California

Date: 02-17-97

Date	Well Identification											
	VW-1			VW-2			VW-3			VW-4		
	Valve Position	TVHG	Vacuum Response	Valve Position	TVHG	Vacuum Response	Valve Position	TVHG	Vacuum Response	Valve Position	TVHG	Vacuum Response
		ppmv	in-H2O		ppmv	in-H2O		ppmv	in-H2O		ppmv	in-H2O
For SVE monitoring well data prior to January 1, 1996, please refer to the fourth quarter 1995 groundwater monitoring report for this site.												
01-12-96	open	300 PID	25.0	open	500 PID	25.0	open	430 PID	25.0	open	580 PID	25.0
02-15-96	open	NA	27.0	open	NA	27.0	open	NA	26.0	open	NA	26.0
03-19-96	closed	14.1 PID	0.0	closed	18.8 PID	0.0	closed	30.2 PID	0.0	closed	16.6 PID	0.0
05-08-96	closed	NA	NA	closed	NA	NA	closed	NA	NA	closed	NA	NA
05-16-96	open	190 PID	10.0	open	183 PID	10.0	open	167 PID	10.0	open	128 PID	10.0
06-07-96	open	NA	11.0	open	NA	10.0	open	NA	11.0	open	NA	11.0
06-28-96	open	290 PID	NA	open	550 PID	NA	open	400 PID	NA	closed	210 PID	NA
07-10-96	open	361 PID	8.0	open	302 PID	8.0	open	247 PID	8.0	closed	54 PID	0.0
08-05-96	open	NA	8.0	open	NA	7.0	open	NA	6.0	closed	NA	0.0
08-12-96	closed	NA	0.0	closed	NA	0.0	closed	NA	0.0	closed	NA	0.0
09-27-96	open (b)	NA	NA	open (b)	NA	NA	open	NA	NA	closed	NA	NA
09-30-96	open	200 FID	NA	open	220 FID	NA	open	800 FID	NA	open	>1000 FID	NA
10-03-96	open	NA	9.0	open	NA	10.0	open	NA	9.0	open	NA	10.0
12-04-96	open	NA	NA	open	NA	NA	open	NA	NA	open	NA	NA
<p>TVHG: concentration of total volatile hydrocarbons as gasoline                      ppmv: parts per million by volume                      in-H2O: inches of water                      open: open to the system                      open (b): open to the system and bubbling air at 1 scfm per well                      passive: open to the atmosphere                      closed: closed to the system and atmosphere                      NA: not analyzed or not measured                      FID: TVHG concentration was measured with a portable flame ionization detector                      LAB: TVHG concentration was analyzed in the laboratory                      PID: TVHG concentration was measured with a portable photoionization detector</p>												

Table 6  
Soil-Vapor Extraction Well Data

ARCO Service Station 6148  
5131 Shattuck Avenue, Oakland, California

Date: 02-17-97

Date	Well Identification											
	VW-5			VW-6			VW-7			VW-8		
	Valve Position	TVHG	Vacuum Response	Valve Position	TVHG	Vacuum Response	Valve Position	TVHG	Vacuum Response	Valve Position	TVHG	Vacuum Response
		ppmv	in-H2O		ppmv	in-H2O		ppmv	in-H2O		ppmv	in-H2O
For SVE monitoring well data prior to January 1, 1996, please refer to the fourth quarter 1995 groundwater monitoring report for this site.												
01-12-96	open	350 PID	25.0	open	2210 PID	25.0	open	300 PID	22.0	open	225 PID	25.0
02-15-96	open	NA	26.0	open	NA	26.0	open	NA	24.0	open	NA	25.0
03-19-96	closed	8.9 PID	0.0	open (b)	512 PID	38.0	open (b)	156 PID	37.0	open (b)	60.1 PID	38.0
05-08-96	closed	NA	NA	closed	NA	NA	closed	NA	NA	closed	NA	NA
05-16-96	open	240 PID	10.0	open	191 PID	10.0	open	198 PID	10.0	open	220 PID	10.0
06-07-96	open	NA	11.0	open	NA	10.0	open	NA	10.0	open	NA	11.0
06-28-96	closed	95 PID	NA	open	430 PID	NA	open	460 PID	NA	closed	12 PID	NA
07-10-96	open	233 PID	8.0	open	371 PID	8.0	open	511 PID	8.0	open	113 PID	8.0
08-05-96	open	NA	8.0	open	NA	8.0	open	NA	6.0	open	NA	8.0
08-12-96	closed	NA	0.0	closed	NA	0.0	closed	NA	0.0	closed	NA	0.0
09-27-96	open	NA	NA	open (b)	NA	NA	open (b)	NA	NA	open	NA	NA
09-30-96	closed	48 FID	NA	closed	140 FID	NA	open	480 FID	NA	closed	120 FID	NA
10-03-96	closed	NA	NA	closed	NA	NA	open	NA	8.0	closed (b)	NA	0.0
12-04-96	closed	NA	NA	closed	NA	NA	open	NA	NA	closed (b)	NA	NA

TVHG: concentration of total volatile hydrocarbons as gasoline  
ppmv: parts per million by volume  
in-H2O: inches of water  
open: open to the system  
open (b): open to the system and bubbling air at 1 scfm per well  
passive: open to the atmosphere  
closed: closed to the system and atmosphere  
NA: not analyzed or not measured  
FID: TVHG concentration was measured with a portable flame ionization detector  
LAB: TVHG concentration was analyzed in the laboratory  
PID: TVHG concentration was measured with a portable photoionization detector

Table 6  
Soil-Vapor Extraction Well Data

ARCO Service Station 6148  
5131 Shattuck Avenue, Oakland, California

Date 02-17-97

Date	Well Identification											
	VW-9			VW-10			MW-1			MW-5		
	Valve Position	TVHG	Vacuum Response	Valve Position	TVHG	Vacuum Response	Valve Position	TVHG	Vacuum Response	Valve Position	TVHG	Vacuum Response
	ppmv	in-H2O		ppmv	in-H2O		ppmv	in-H2O		ppmv	in-H2O	
For SVE monitoring well data prior to January 1, 1996, please refer to the fourth quarter 1995 groundwater monitoring report for this site												
01-12-96	open	930 PID	22.0	open	170 PID	5.0	closed	13 PID	0.0	open	172 PID	5.0
02-15-96	open	NA	24.0	open	NA	10.0	closed	NA	0.0	open	NA	6.0
03-19-96	open (b)	50.2 PID	38.0	open (b)	22.4 PID	38.0	closed	32.6 PID	0.0	open (b)	43.2 PID	38.0
05-08-96	closed	NA	NA	closed	NA	NA	closed	NA	NA	closed	NA	NA
05-16-96	open	175 PID	10.0	closed	40 PID	0.0	open	152 PID	10.0	closed	28.5 PID	0.0
06-07-96	open	NA	11.0	closed	NA	0.0	open	NA	10.0	closed	NA	0.0
06-28-96	open	310 PID	NA	closed	120 PID	NA	closed	100 PID	NA	closed	68 PID	NA
07-10-96	open	173 PID	8.0	closed	51 PID	0.0	closed	50 PID	0.0	closed	50 PID	0.0
08-05-96	open	NA	6.0	closed	NA	0.0	closed	NA	0.0	closed	NA	0.0
08-12-96	closed	NA	0.0	closed	NA	0.0	closed	NA	0.0	closed	NA	0.0
09-27-96	open (b)	NA	NA	closed	NA	NA	closed (b)	NA	NA	open (b)	NA	NA
09-30-96	open	600 FID	NA	open	>1000 FID	NA	closed	NA	NA	open	250 FID	NA
10-03-96	open	NA	9.0	open	NA	8.0	closed (b)	NA	0.0	open	NA	8.0
12-04-96	open	NA	NA	closed	NA	NA	closed (b)	NA	NA	open	NA	NA

TVHG: concentration of total volatile hydrocarbons as gasoline  
ppmv, parts per million by volume  
in-H2O: inches of water  
open, open to the system  
open (b), open to the system and bubbling air at 1 scfm per well  
passive: open to the atmosphere  
closed: closed to the system and atmosphere  
NA, not analyzed or not measured  
FID: TVHG concentration was measured with a portable flame ionization detector  
LAB: TVHG concentration was analyzed in the laboratory  
PID: TVHG concentration was measured with a portable photoionization detector

Table 7  
Air-Sparge and Air-Bubbling Systems  
Operation and Performance Data

Facility Number: 6148	Air-Sparge and Air-Bubbling Unit:					
Location: 5131 Shattuck Avenue Oakland, California	5 Hp Powerex Rotary Oilless Compressor					
Consultant: EMCON	Air-Bubbling Start-Up Date: 03-19-96					
1921 Ringwood Avenue	Air-Sparge Start-Up Date: 06-07-96					
San Jose, California	Operation and Performance Data From: 03-19-96					
	To: 01-01-97					
Date Begin:	03-19-96	03-19-96	04-02-96	05-08-96	05-16-96	06-07-96
Date End:		04-02-96	05-08-96	05-16-96	06-07-96	06-28-96
Air-Bubbling Well Status:	See Table 6 for the status of the 12 SVE/air-bubbling wells Air is bubbled at an average flow rate of 1 scfm per well.					
MW-2	off	on	on	off	on	on
MW-3	off	on	on	off	on	on
MW-4	off	off	off	off	off	on
Air-Sparge Well Status:						
AS-1	off	off	off	off	off	on
AS-2	off	off	off	off	off	on
AS-3	off	off	off	off	off	on
AS-4	off	off	off	off	off	on
AS-5	off	off	off	off	off	on
Air-Bubbling Well Pressure (psig) (1):						
MW-2	-- (4)	2.5	2.5	--	2.5	--
MW-3	--	3.0	3.0	--	3.0	--
MW-4	--	--	--	--	--	--
Air-Sparge Well Pressure (psig) (1):						
AS-1	--	--	--	--	--	--
AS-2	--	--	--	--	--	--
AS-3	--	--	--	--	--	--
AS-4	--	--	--	--	--	--
AS-5	--	--	--	--	--	--
Total Air-Sparge and Air-Bubbling Pressure (psig) (1):	--	20.0	20.0	0.0	20.0	20.0
Total Air-Sparge and Air-Bubbling Flow Rate (scfm) (2):	--	--	--	--	--	--
Dissolved Oxygen (ppm) (3):						
Air-Bubbling Wells:						
MW-2	--	--	--	--	--	--
MW-3	--	--	--	--	--	--
MW-4	--	--	--	--	--	--

Table 7  
Air-Sparge and Air-Bubbling Systems  
Operation and Performance Data

Facility Number: 6148	Air-Sparge and Air-Bubbling Unit:					
Location: 5131 Shattuck Avenue Oakland, California	5 Hp Powerex Rotary Oilless Compressor					
Consultant: EMCON 1921 Ringwood Avenue San Jose, California	Air-Bubbling Start-Up Date: 03-19-96 Air-Sparge Start-Up Date: 06-07-96 Operation and Performance Data From: 03-19-96 To: 01-01-97					
Date Begin:	06-28-96	07-10-96	08-12-96	09-27-96	10-01-96	10-03-96
Date End:	07-10-96	08-12-96	09-27-96	10-01-96	10-03-96	10-07-96
Air-Bubbling Well Status:						
	See Table 6 for the status of the 12 SVE/air-bubbling wells. Air is bubbled at an average flow rate of 1 scfm per well.					
MW-2	on	on	off	on	on	on
MW-3	on	on	off	on	on	on
MW-4	on	on	off	on	on	on
Air-Sparge Well Status:						
AS-1	on	on	off	off	on	off
AS-2	on	on	off	off	on	off
AS-3	on	on	off	off	on	off
AS-4	on	on	off	off	on	off
AS-5	on	on	off	off	on	off
Air-Bubbling Well Pressure (psig) (1):						
MW-2	4.0	5.0	0.0	2.6	2.0	--
MW-3	4.0	5.5	0.0	2.5	2.5	--
MW-4	4.0	5.5	0.0	4.1	3.5	--
Air-Sparge Well Pressure (psig):						
AS-1	4.0	5.0	0.0	0.0	8.0	0.0
AS-2	3.0	5.5	0.0	0.0	4.0	0.0
AS-3	4.0	4.0	0.0	0.0	7.0	0.0
AS-4	3.0	4.5	0.0	0.0	4.0	0.0
AS-5	3.5	5.0	0.0	0.0	12.0	0.0
Total Air-Sparge and Air-Bubbling Pressure (psig):						
	20.0	30.0	0.0	40.0	32.0	50.0
Total Air-Sparge and Air-Bubbling Flow Rate (scfm) (2):						
	--	--	--	--	--	--
Dissolved Oxygen (ppm) (3):						
Air-Bubbling Wells:						
MW-2	--	--	--	--	--	--
MW-3	--	--	--	--	--	--
MW-4	--	--	--	--	--	--

Table 7  
Air-Sparge and Air-Bubbling Systems  
Operation and Performance Data

Facility Number: 6148	Air-Sparge and Air-Bubbling Unit:		
Location: 5131 Shattuck Avenue Oakland, California	5 Hp Powerex Rotary Oilless Compressor		
Consultant: EMCON	Air-Bubbling Start-Up Date: 03-19-96		
1921 Ringwood Avenue	Air-Sparge Start-Up Date: 06-07-96		
San Jose, California	Operation and Performance Data From: 03-19-96		
	To: 01-01-97		
Date Begin:	10-07-96	11-06-96	12-04-96
Date End:	11-06-96	12-04-96	01-01-97
Air-Bubbling Well Status:	See Table 6 for the status of the 12 SVE/air-bubbling wells. Air is bubbled at an average flow rate of 1 scfm per well.		
MW-2	on	off	on
MW-3	off	off	off
MW-4	off	off	off
Air-Sparge Well Status:			
AS-1	off	off	off
AS-2	off	off	off
AS-3	off	off	off
AS-4	off	off	off
AS-5	off	off	off
Air-Bubbling Well Pressure (psig) (1):			
MW-2	3.0	0.0	--
MW-3	0.0	0.0	0.0
MW-4	0.0	0.0	0.0
Air-Sparge Well Pressure (psig):			
AS-1	0.0	0.0	0.0
AS-2	0.0	0.0	0.0
AS-3	0.0	0.0	0.0
AS-4	0.0	0.0	0.0
AS-5	0.0	0.0	0.0
Total Air-Sparge and Air-Bubbling Pressure (psig):	50.0	0.0	60.0
Total Air-Sparge and Air-Bubbling Flow Rate (scfm) (2):	--	--	--
Dissolved Oxygen (ppm) (3):			
Air-Bubbling Wells:			
MW-2	--	--	--
MW-3	--	--	--
MW-4	--	--	--



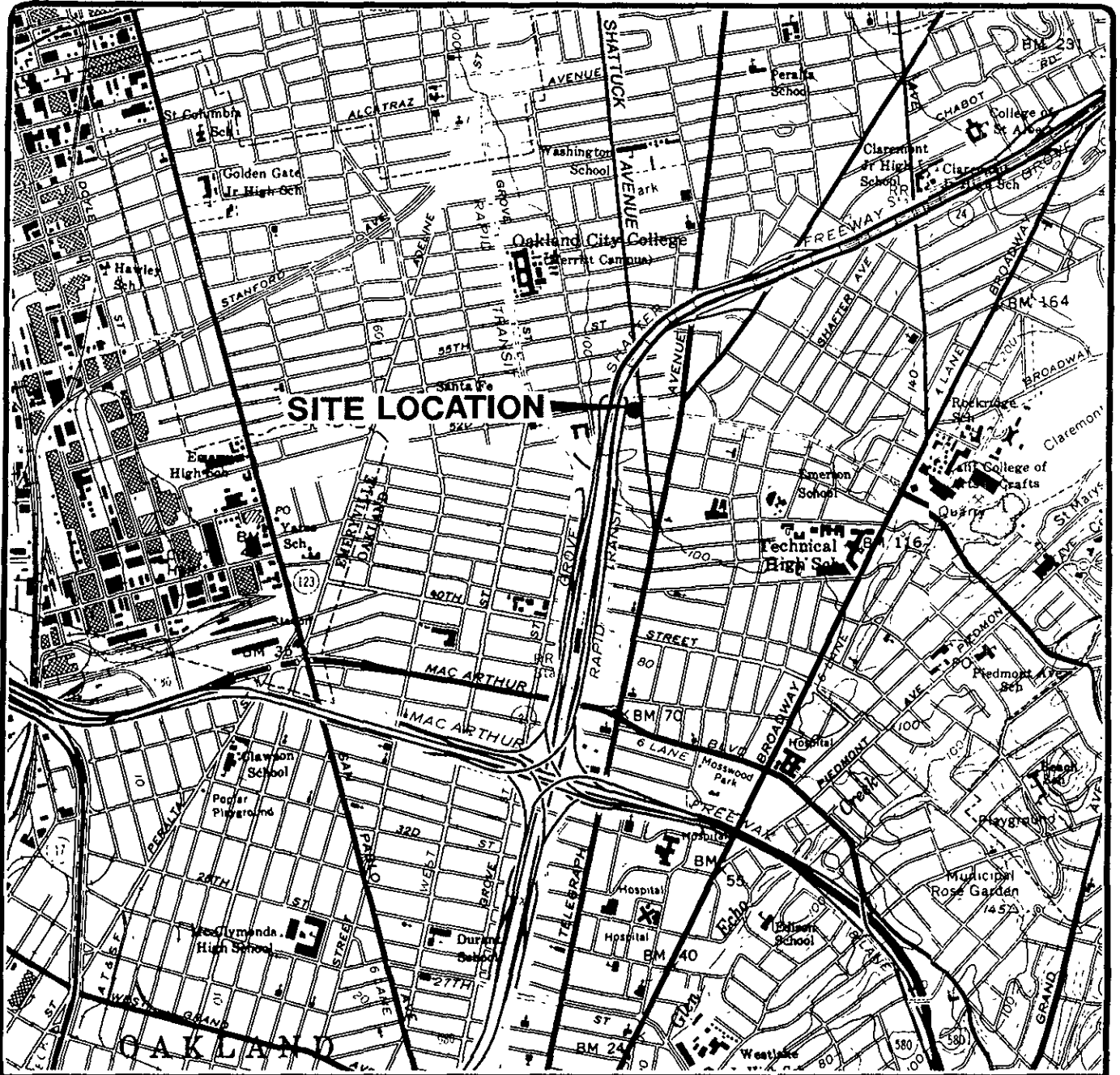
Table 7  
Air-Sparge and Air-Bubbling Systems  
Operation and Performance Data

Facility Number: 6148 Location: 5131 Shattuck Avenue Oakland, California	Air-Sparge and Air-Bubbling Unit: 5 Hp Powerex Rotary Oilless Compressor
Consultant: EMCON 1921 Ringwood Avenue San Jose, California	Air-Bubbling Start-Up Date: 03-19-96 Air-Sparge Start-Up Date: 06-07-96 Operation and Performance Data From: 03-19-96 To: 01-01-97

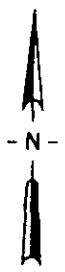
CURRENT REPORTING PERIOD:	10-01-96	to	01-01-97
DAYS / HOURS IN PERIOD:	92.0		2208

- 
- 1. psig: pounds per square inch gauge
  - 2. scfm: standard cubic feet per minute at 14.7 psi and 70° F
  - 3. ppm: parts per million
  - 4. - - - not analyzed, not applicable, or not available
-



Base map from USGS 7.5' Quad. Maps:  
Oakland East and Oakland West, California.  
Photorevised 1980.

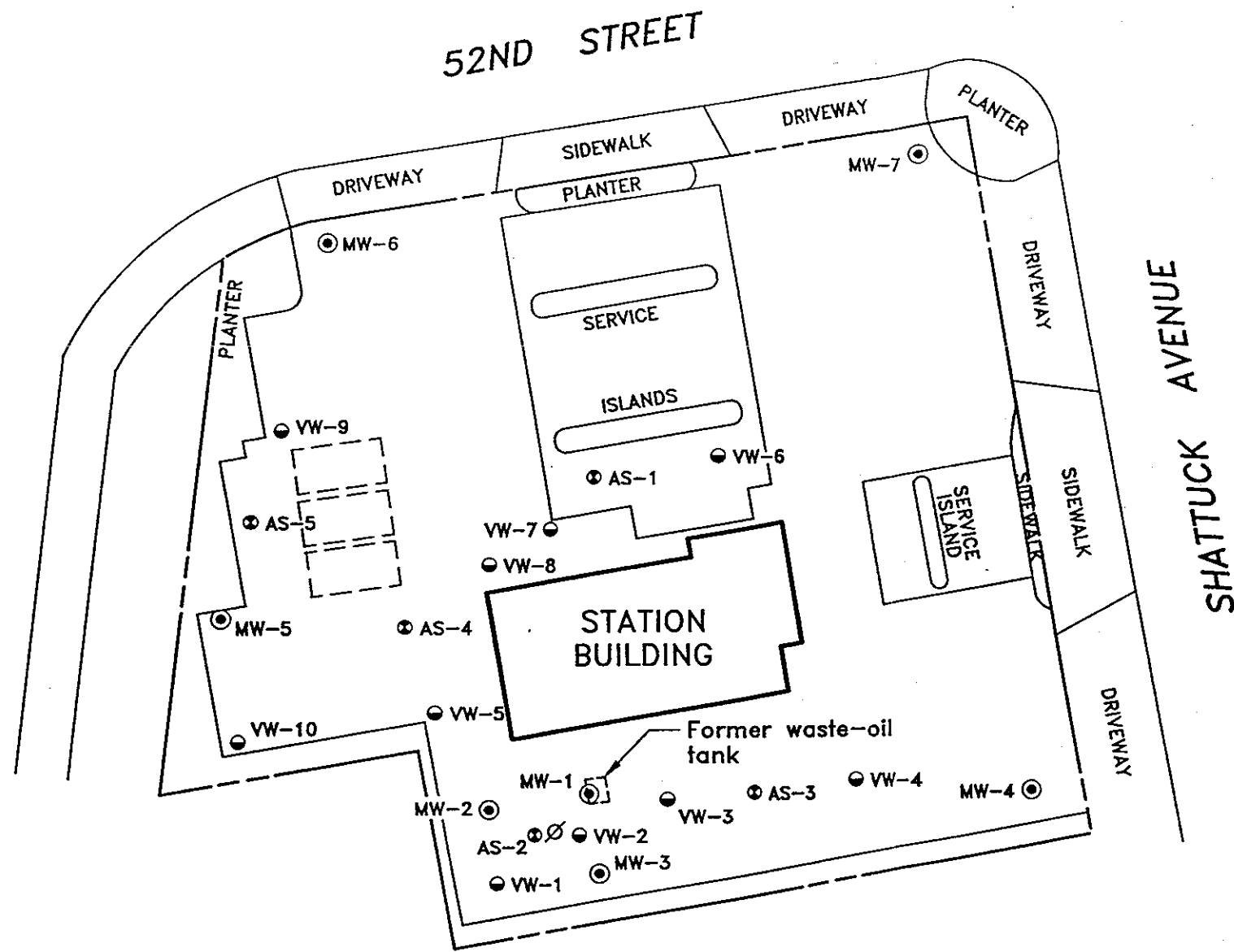
Scale : 0 2000 4000 Feet



ARCO PRODUCTS COMPANY  
SERVICE STATION 6148, 5131 SHATTUCK AVENUE  
QUARTERLY GROUNDWATER MONITORING  
OAKLAND, CALIFORNIA

FIGURE  
**1**  
PROJECT NO.  
805-135.06

SITE LOCATION



EXPLANATION

- ⊙ Groundwater monitoring well
- Vapor extraction well
- ⊕ Air-sparge well
- ∅ Decommissioned well
- ⌚ Existing underground gasoline storage tank



SCALE: 0 30 60 FEET  
(Approximate)

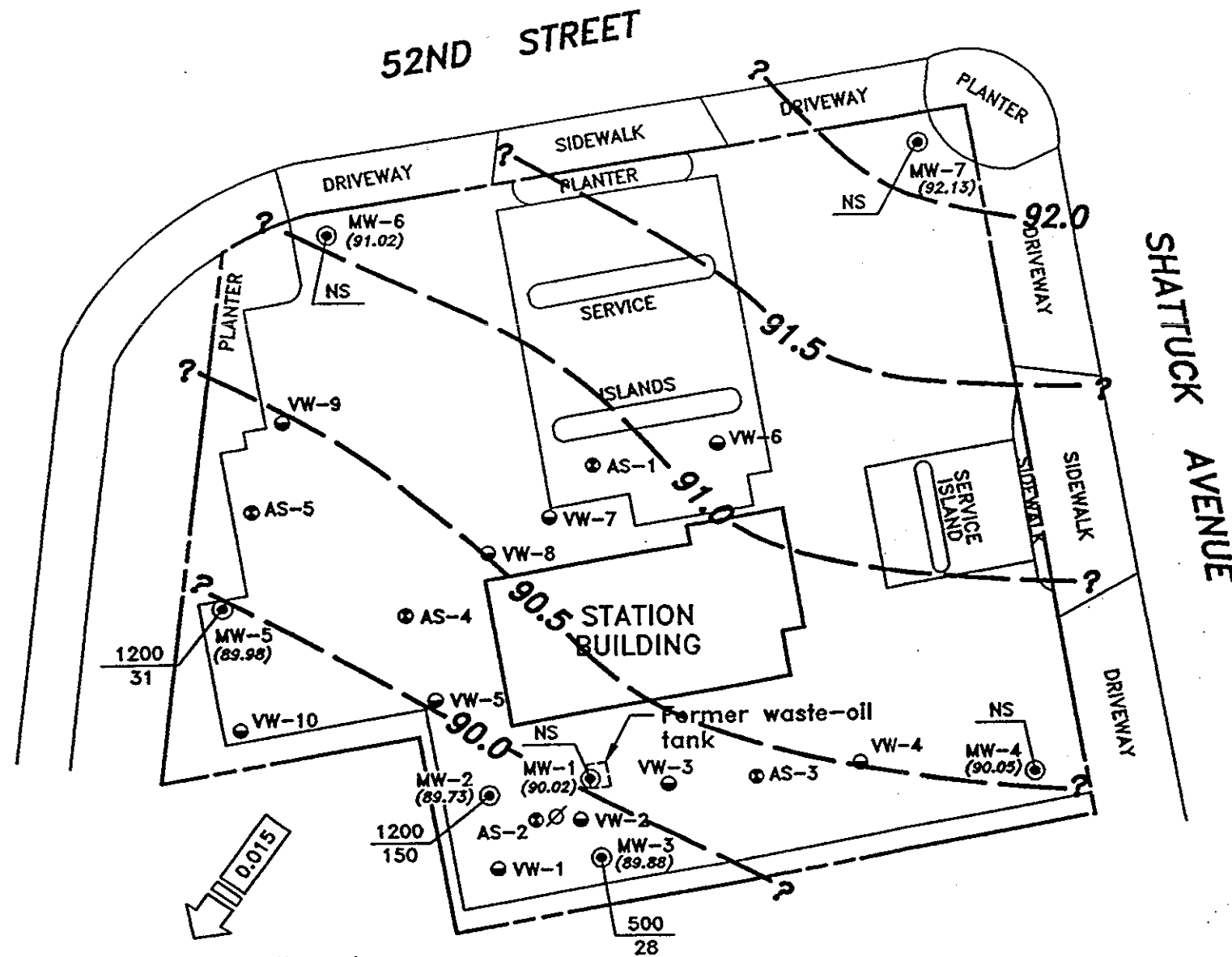
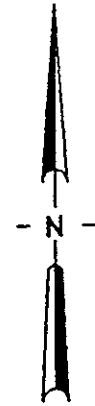
ARCO PRODUCTS COMPANY  
SERVICE STATION 6148, 5131 SHATTUCK AVENUE  
QUARTERLY GROUNDWATER MONITORING  
OAKLAND, CALIFORNIA

SITE PLAN

FIGURE NO.

**2**

PROJECT NO.  
805-135.06



Approximate direction of groundwater flow showing gradient (calculated using MW-3, MW-5, and MW-7)

**EXPLANATION**

- ⊙ Groundwater monitoring well
- Vapor extraction well
- ⊕ Air-sparge well
- ∅ Decommissioned well
- Existing underground gasoline storage tank
- (90.52) Groundwater elevation (Ft.-MSL) measured 11/11/96
- Groundwater elevation contour (Ft.-MSL)
- ND / ND TPHG concentration in groundwater (ug/L); sampled 11/11/96
- ND / ND Benzene concentration in groundwater (ug/L); sampled 11/11/96
- NS Not sampled; not scheduled for chemical analysis
- ND Not detected at or above the method reporting limit for TPHG (50 ug/L) and benzene (0.5 ug/L)



SCALE: 0 30 60 FEET  
(Approximate)

ARCO PRODUCTS COMPANY  
SERVICE STATION 6148, 5131 SHATTUCK AVENUE  
QUARTERLY GROUNDWATER MONITORING  
OAKLAND, CALIFORNIA  
GROUNDWATER DATA  
FOURTH QUARTER 1996

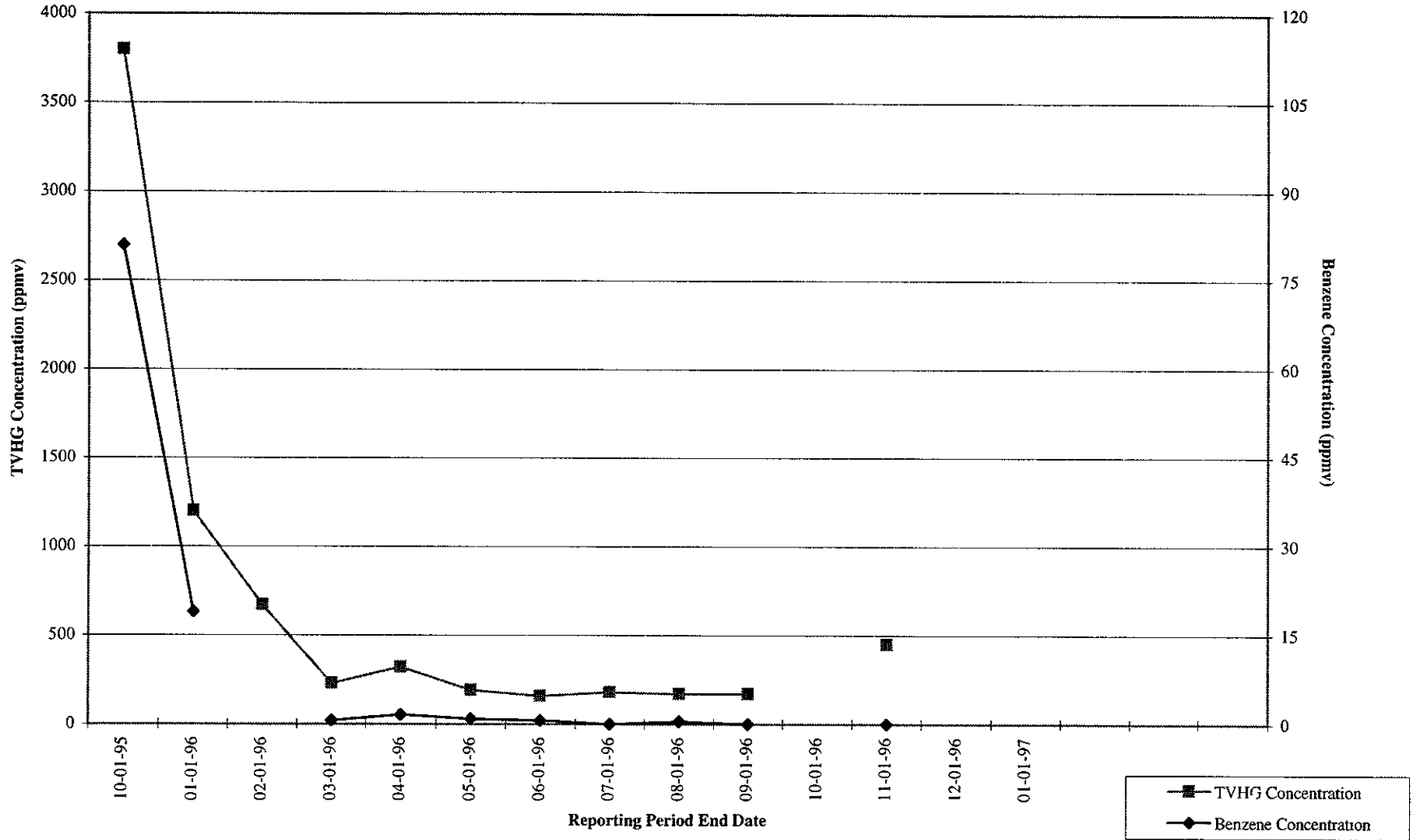
FIGURE NO.

**3**

PROJECT NO.  
805-135.006

Figure 4

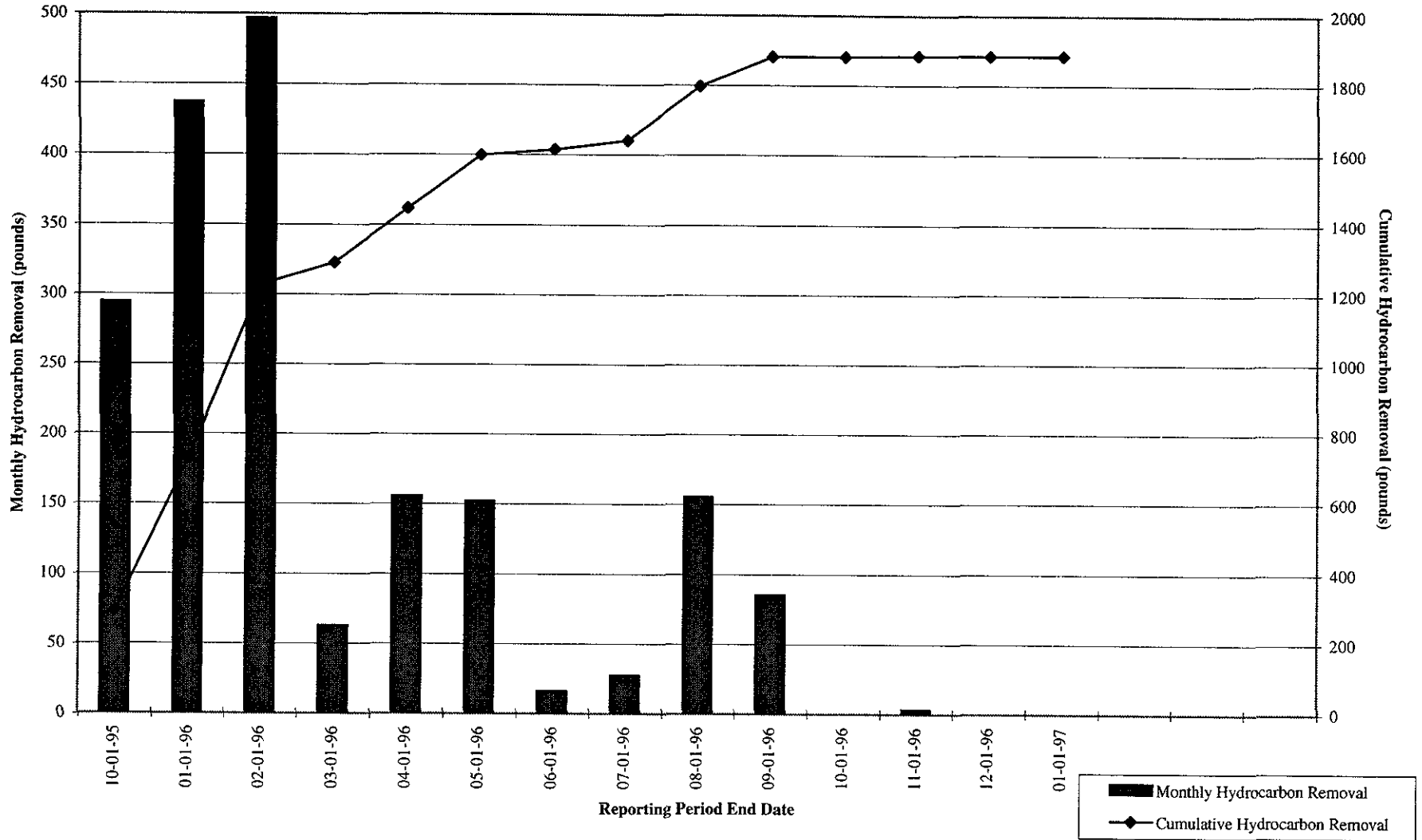
ARCO Service Station 6148  
Soil-Vapor Extraction and Treatment System  
Historical Well Field Influent TVHG and Benzene Concentrations



TVHG: total volatile hydrocarbons as gasoline  
ppmv: parts per million by volume

Figure 5

ARCO Service Station 6148  
Soil-Vapor Extraction and Treatment System  
Historical Hydrocarbon Removal Rates



**APPENDIX A**

**ANALYTICAL RESULTS AND CHAIN OF CUSTODY  
DOCUMENTATION, FOURTH QUARTER 1996  
GROUNDWATER MONITORING EVENT**

**Columbia  
Analytical  
Services<sup>INC.</sup>**

November 22, 1996

Service Request No.: S9601881

Mr. John Young  
EMCON  
1921 Ringwood Avenue  
San Jose, CA 95131

**RE: 6148 OAKLAND/20805-135.006/TO#19350.00**

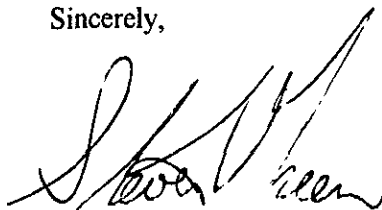
Dear Mr. Young:

The following pages contain analytical results for sample(s) received by the laboratory on November 11, 1996. Results of sample analyses are followed by Appendix A which contains sample custody documentation and quality assurance deliverables requested for this project. The work requested has been assigned the Service Request No. listed above. To help expedite our service, please refer to this number when contacting the laboratory.

Analytical results were produced by procedures consistent with Columbia Analytical Services' (CAS) Quality Assurance Manual (with any deviations noted). Signature of this CAS Analytical Report below confirms that pages 2 through 8, following, have been thoroughly reviewed and approved for release in accord with CAS Standard Operating Procedure ADM-DatRev3.

Please feel welcome to contact me should you have questions or further needs.

Sincerely,



Steven L. Green  
Project Chemist



**COLUMBIA ANALYTICAL SERVICES, Inc.**

**Acronyms**

<b>A2LA</b>	American Association for Laboratory Accreditation
<b>ASTM</b>	American Society for Testing and Materials
<b>BOD</b>	Biochemical Oxygen Demand
<b>BTEX</b>	Benzene, Toluene, Ethylbenzene, Xylenes
<b>CAM</b>	California Assessment Metals
<b>CARB</b>	California Air Resources Board
<b>CAS Number</b>	Chemical Abstract Service registry Number
<b>CFC</b>	Chlorofluorocarbon
<b>CFU</b>	Colony-Forming Unit
<b>COD</b>	Chemical Oxygen Demand
<b>DEC</b>	Department of Environmental Conservation
<b>DEQ</b>	Department of Environmental Quality
<b>DHS</b>	Department of Health Services
<b>DLCS</b>	Duplicate Laboratory Control Sample
<b>DMS</b>	Duplicate Matrix Spike
<b>DOE</b>	Department of Ecology
<b>DOH</b>	Department of Health
<b>EPA</b>	U. S. Environmental Protection Agency
<b>ELAP</b>	Environmental Laboratory Accreditation Program
<b>GC</b>	Gas Chromatography
<b>GC/MS</b>	Gas Chromatography/Mass Spectrometry
<b>IC</b>	Ion Chromatography
<b>ICB</b>	Initial Calibration Blank sample
<b>ICP</b>	Inductively Coupled Plasma atomic emission spectrometry
<b>ICV</b>	Initial Calibration Verification sample
<b>J</b>	Estimated concentration. The value is less than the MRL, but greater than or equal to the MDL. If the value is equal to the MRL, the result is actually <MRL before rounding.
<b>LCS</b>	Laboratory Control Sample
<b>LUFT</b>	Leaking Underground Fuel Tank
<b>M</b>	Modified
<b>MBAS</b>	Methylene Blue Active Substances
<b>MCL</b>	Maximum Contaminant Level. The highest permissible concentration of a substance allowed in drinking water as established by the U. S. EPA.
<b>MDL</b>	Method Detection Limit
<b>MPN</b>	Most Probable Number
<b>MRL</b>	Method Reporting Limit
<b>MS</b>	Matrix Spike
<b>MTBE</b>	Methyl tert-Butyl Ether
<b>NA</b>	Not Applicable
<b>NAN</b>	Not Analyzed
<b>NC</b>	Not Calculated
<b>NCASI</b>	National Council of the paper industry for Air and Stream Improvement
<b>ND</b>	Not Detected at or above the method reporting/detection limit (MRL/MDL)
<b>NIOSH</b>	National Institute for Occupational Safety and Health
<b>NTU</b>	Nephelometric Turbidity Units
<b>ppb</b>	Parts Per Billion
<b>ppm</b>	Parts Per Million
<b>PQL</b>	Practical Quantitation Limit
<b>QA/QC</b>	Quality Assurance/Quality Control
<b>RCRA</b>	Resource Conservation and Recovery Act
<b>RPD</b>	Relative Percent Difference
<b>SIM</b>	Selected Ion Monitoring
<b>SM</b>	Standard Methods for the Examination of Water and Wastewater, 18th Ed., 1992
<b>STLC</b>	Solubility Threshold Limit Concentration
<b>SW</b>	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Ed., 1986 and as amended by Updates I, II, IIA, and IIB.
<b>TCLP</b>	Toxicity Characteristic Leaching Procedure
<b>TDS</b>	Total Dissolved Solids
<b>TPH</b>	Total Petroleum Hydrocarbons
<b>tr</b>	Trace level. The concentration of an analyte that is less than the PQL but greater than or equal to the MDL. If the value is equal to the PQL, the result is actually <PQL before rounding.
<b>TRPH</b>	Total Recoverable Petroleum Hydrocarbons
<b>TSS</b>	Total Suspended Solids
<b>TTLc</b>	Total Threshold Limit Concentration
<b>VOA</b>	Volatile Organic Analyte(s)

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

**Client:** ARCO Products Company  
**Project:** 6148 Oakland / #20805-135.006/TO#19350.00  
**Sample Matrix:** Water

**Service Request:** S9601881  
**Date Collected:** 11/11/96  
**Date Received:** 11/11/96  
**Date Extracted:** NA

BTEX, MTBE and TPH as Gasoline  
EPA Methods 5030/8020/California DHS LUFT Method  
Units: ug/L (ppb)

Sample Name:	MW-2 (25)	MW-3 (25)	MW-5 (24)
Lab Code:	S9601881-001	S9601881-002	S9601881-003
Date Analyzed:	11/19/96	11/18/96	11/19/96

Analyte	MRL			
TPH as Gasoline	50	1,200	500	1,200
Benzene	0.5	150	28	31
Toluene	0.5	120	3	1
Ethylbenzene	0.5	21	12	8
Total Xylenes	0.5	160	13	2
Methyl <i>tert</i> -Butyl Ether	3	110	150	130

**COLUMBIA ANALYTICAL SERVICES, INC.**

Analytical Report

**Client:** ARCO Products Company  
**Project:** 6148 Oakland / #20805-135.006/TO#19350.00  
**Sample Matrix:** Water

**Service Request:** S9601881  
**Date Collected:** 11/11/96  
**Date Received:** 11/11/96  
**Date Extracted:** NA

BTEX, MTBE and TPH as Gasoline  
EPA Methods 5030/8020/California DHS LUFT Method  
Units: ug/L (ppb)

Sample Name:	Method Blank	Method Blank
Lab Code:	S961118-WB1	S961119-WB1
Date Analyzed:	11/18/96	11/19/96

Analyte	MRL		
TPH as Gasoline	50	ND	ND
Benzene	0.5	ND	ND
Toluene	0.5	ND	ND
Ethylbenzene	0.5	ND	ND
Total Xylenes	0.5	ND	ND
Methyl <i>tert</i> -Butyl Ether	3	ND	ND

APPENDIX A

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

**Client:** ARCO Products Company  
**Project:** 6148 Oakland / #20805-135.006/TO#19350.00  
**Sample Matrix:** Water

**Service Request:** S9601881  
**Date Collected:** 11/11/96  
**Date Received:** 11/11/96  
**Date Extracted:** NA  
**Date Analyzed:** NA

Surrogate Recovery Summary  
BTEX, MTBE and TPH as Gasoline  
EPA Methods 5030/8020/California DHS LUFT Method

Sample Name	Lab Code	PID Detector	FID Detector
		Percent Recovery 4-Bromofluorobenzene	Percent Recovery $\alpha,\alpha,\alpha$ -Trifluorotoluene
MW-2 (25)	S9601881-001	98	95
MW-3 (25)	S9601881-002	95	109
MW-5 (24)	S9601881-003	94	112
Batch QC (MS)	S0601886-001MS	99	106
Batch QC (DMS)	S9601886-001DMS	98	110
Method Blank	S961118-WB1	99	91
Method Blank	S961119-WB1	100	99

CAS Acceptance Limits:

69-116

69-116

**COLUMBIA ANALYTICAL SERVICES, INC.**

QA/QC Report

<b>Client:</b>	ARCO Products Company	<b>Service Request:</b>	S9601881
<b>Project:</b>	6148 Oakland / #20805-135.006/TO#19350.00	<b>Date Collected:</b>	11/11/96
<b>Sample Matrix:</b>	Water	<b>Date Received:</b>	11/11/96
		<b>Date Extracted:</b>	NA
		<b>Date Analyzed:</b>	11/18/96

Matrix Spike/Duplicate Matrix Spike Summary  
 TPH as Gasoline  
 EPA Methods 5030/California DHS LUFT Method  
 Units: ug/L (ppb)

Sample Name: Batch QC  
 Lab Code: S9601886-001MS, DMS

Analyte	Spike Level		Sample Result	Spike Result		Percent Recovery		CAS Acceptance Limits	Relative Percent Difference
	MS	DMS		MS	DMS	MS	DMS		
	Gasoline	250		250	ND	240	240		

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: ARCO Products Company  
Project: 6148 Oakland / #20805-135.006/TO#19350.00

Service Request: S9601881  
Date Analyzed: 11/18/96

Initial Calibration Verification (ICV) Summary  
BTEX, MTBE and TPH as Gasoline  
EPA Methods 5030/8020/California DHS LUFT Method  
Units: ppb

Analyte	True Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Benzene	25	24.2	97	85-115
Toluene	25	24.1	96	85-115
Ethylbenzene	25	26.7	107	85-115
Xylenes, Total	75	71.3	95	85-115
Gasoline	250	228	91	90-110
Methyl <i>tert</i> -Butyl Ether	50	47	94	85-115

**ARCO Products Company**  
Division of AtlanticRichfieldCompany

Task Order No. 19350.00

Chain of Custody

ARCO Facility no. 6148  
ARCO engineer Paul Supple

City (Facility) Oakland  
Telephone no. (ARCO)

Project manager (Consultant) John Young  
Telephone no. (Consultant) (408)453-7300  
Fax no. (Consultant) (408)453-0457

Laboratory name CAS  
Contract number

Consultant name EMCON  
Address (Consultant) 1971 Ringwood Ave, San Jose, CA 95131

Sample I.D.	Lab no.	Container no.	Matrix			Preservation		Sampling date	Sampling time	BTEX 602/EPA 8020	BTEX/TPH (X) GC-MIBS EPA 1862/42/28015	TPH Modified 8015 Gas Diesel	Oil and Grease 413.1 413.2	TPH EPA 418.1/SM603E	EPA 601/6010	EPA 624/8240	EPA 625/8270	Semi Metals VOA VOA	CAM Metals EPA 8007/000 TTLC STLC	Lead Org./DHS Lead EPA 7420/7421
			Soil	Water	Other	Ice	Acid													
<u>MW-2(25)①</u>		<u>2</u>		<u>X</u>		<u>X</u>	<u>HCL</u>	<u>11/11/96</u>	<u>1150</u>		<u>X</u>									
<u>MW-3(25)②</u>		<u>2</u>		<u>X</u>		<u>X</u>	<u>HCL</u>		<u>1215</u>		<u>X</u>									
<u>MW-5(24)③</u>		<u>7</u>		<u>X</u>		<u>X</u>	<u>HCL</u>	<u>↓</u>	<u>1256</u>		<u>X</u>									

Method of shipment  
Sampler will deliver

Special detection Limit/reporting  
Lowest Possible

Special QA/QC  
As Normal

Remarks  
2-40ml HCL VOAs

Lab number  
#20805-135.006  
59601881

Condition of sample: ok

Temperature received: cool

Relinquished by sampler  
[Signature]

Date 11/11/96 Time 14:03

Received by

Turnaround time  
Priority Rush 1 Business Day   
Rush 2 Business Days   
Expedited 5 Business Days   
Standard 10 Business Days

Relinquished by

Date Time

Received by

Relinquished by

Date Time

Received by laboratory  
Jane Brown

Date 11-11-96 Time 14:03

RS



**APPENDIX B**  
**SVE SYSTEM MONITORING DATA LOG SHEETS**







**APPENDIX C**

**ANALYTICAL RESULTS AND CHAIN-OF-CUSTODY  
DOCUMENTATION FOR SOIL-VAPOR EXTRACTION SYSTEM,  
FOURTH QUARTER 1996**

**Columbia  
Analytical  
Services<sup>inc.</sup>**

October 9, 1996

Service Request No.: S9601626

Valli Voruganti  
EMCON  
1921 Ringwood Avenue  
San Jose, CA 95131

**RE: 6148 OAKLAND/20805-135.003/TO#18336.00**

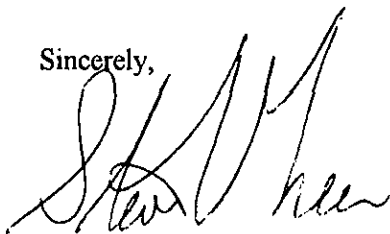
Dear Valli Voruganti:

Attached are the results of the samples submitted to our lab on October 4, 1996.  
For your reference, our service request number for this work is S9601626.

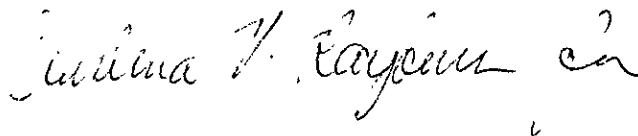
Analytical results were produced by procedures consistent with Columbia Analytical Services' (CAS) Quality Assurance Manual (with any deviations noted). Signature of this CAS Analytical Report below confirms that pages 2 through 9, following, have been thoroughly reviewed and approved for release in accord with CAS Standard Operating Procedure ADM-DatRev3.

If you have questions or further needs, please call me at (408) 428-1283.

Sincerely,



Steven L. Green  
Project Chemist



Greg Anderson  
Regional QA Coordinator

SG/sh

**COLUMBIA ANALYTICAL SERVICES, Inc.**

**Acronyms**

<b>A2LA</b>	American Association for Laboratory Accreditation
<b>ASTM</b>	American Society for Testing and Materials
<b>BOD</b>	Biochemical Oxygen Demand
<b>BTEX</b>	Benzene, Toluene, Ethylbenzene, Xylenes
<b>CAM</b>	California Assessment Metals
<b>CARB</b>	California Air Resources Board
<b>CAS Number</b>	Chemical Abstract Service registry Number
<b>CFC</b>	Chlorofluorocarbon
<b>CFU</b>	Colony-Forming Unit
<b>COD</b>	Chemical Oxygen Demand
<b>DEC</b>	Department of Environmental Conservation
<b>DEQ</b>	Department of Environmental Quality
<b>DHS</b>	Department of Health Services
<b>DLCS</b>	Duplicate Laboratory Control Sample
<b>DMS</b>	Duplicate Matrix Spike
<b>DOE</b>	Department of Ecology
<b>DOH</b>	Department of Health
<b>EPA</b>	U. S. Environmental Protection Agency
<b>ELAP</b>	Environmental Laboratory Accreditation Program
<b>GC</b>	Gas Chromatography
<b>GC/MS</b>	Gas Chromatography/Mass Spectrometry
<b>IC</b>	Ion Chromatography
<b>ICB</b>	Initial Calibration Blank sample
<b>ICP</b>	Inductively Coupled Plasma atomic emission spectrometry
<b>ICV</b>	Initial Calibration Verification sample
<b>J</b>	Estimated concentration. The value is less than the MRL, but greater than or equal to the MDL. If the value is equal to the MRL, the result is actually <MRL before rounding.
<b>LCS</b>	Laboratory Control Sample
<b>LUFT</b>	Leaking Underground Fuel Tank
<b>M</b>	Modified
<b>MBAS</b>	Methylene Blue Active Substances
<b>MCL</b>	Maximum Contaminant Level. The highest permissible concentration of a substance allowed in drinking water as established by the U. S. EPA.
<b>MDL</b>	Method Detection Limit
<b>MPN</b>	Most Probable Number
<b>MRL</b>	Method Reporting Limit
<b>MS</b>	Matrix Spike
<b>MTBE</b>	Methyl tert-Butyl Ether
<b>NA</b>	Not Applicable
<b>NAN</b>	Not Analyzed
<b>NC</b>	Not Calculated
<b>NCASI</b>	National Council of the paper industry for Air and Stream Improvement
<b>ND</b>	Not Detected at or above the method reporting/detection limit (MRL/MDL)
<b>NIOSH</b>	National Institute for Occupational Safety and Health
<b>NTU</b>	Nephelometric Turbidity Units
<b>ppb</b>	Parts Per Billion
<b>ppm</b>	Parts Per Million
<b>PQL</b>	Practical Quantitation Limit
<b>QA/QC</b>	Quality Assurance/Quality Control
<b>RCRA</b>	Resource Conservation and Recovery Act
<b>RPD</b>	Relative Percent Difference
<b>SIM</b>	Selected Ion Monitoring
<b>SM</b>	Standard Methods for the Examination of Water and Wastewater, 18th Ed., 1992
<b>STLC</b>	Solubility Threshold Limit Concentration
<b>SW</b>	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Ed., 1986 and as amended by Updates I, II, IIA, and IIB.
<b>TCLP</b>	Toxicity Characteristic Leaching Procedure
<b>TDS</b>	Total Dissolved Solids
<b>TPH</b>	Total Petroleum Hydrocarbons
<b>tr</b>	Trace level. The concentration of an analyte that is less than the PQL but greater than or equal to the MDL. If the value is equal to the PQL, the result is actually <PQL before rounding.
<b>TRPH</b>	Total Recoverable Petroleum Hydrocarbons
<b>TSS</b>	Total Suspended Solids
<b>TTLC</b>	Total Threshold Limit Concentration
<b>VOA</b>	Volatile Organic Analyte(s)

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: EMCON  
Project: ARCO Products Company #6148/#20805-135.006  
Sample Matrix: Vapor

Service Request: L9604137  
Date Collected: 10/3/96  
Date Received: 10/4/96  
Date Extracted: NA  
Date Analyzed: 10/6/96

BTEX and Total Volatile Hydrocarbons  
EPA Methods 8020/Modified 8015

Sample Name: I-1  
Lab Code: L9604137-001\*\*

	MRLs		Results	
	mg/m3	uL/L (ppmv)	mg/m3	uL/L (ppmv)
Benzene	0.4	0.1	<4	<1
Toluene	0.4	0.1	<4	<1
Ethylbenzene	0.5	0.1	6.6	1.5
Xylenes, Total	0.9	0.2	19	4.4
Total Volatile Hydrocarbons:				
C1 - C5	20	5	2900	680
C6 - C12*	20	5	1900	450

\* TPH as gasoline is defined as C6 (benzene) through C12 (dodecane) and uses a molecular weight of 100 to calculate the ppmv.

\*\* The MRL is elevated because of matrix interferences.



COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

**Client:** EMCON  
**Project:** ARCO Products Company #6148/#20805-135.006  
**Sample Matrix:** Vapor

**Service Request:** L9604137  
**Date Collected:** 10/3/96  
**Date Received:** 10/4/96  
**Date Extracted:** NA  
**Date Analyzed:** 10/6/96

BTEX and Total Volatile Hydrocarbons  
EPA Methods 8020/Modified 8015

**Sample Name:** I-2  
**Lab Code:** L9604137-002\*\*

	MRLs		Results	
	mg/m3	uL/L (ppmv)	mg/m3	uL/L (ppmv)
Benzene	0.4	0.1	<4	<1
Toluene	0.4	0.1	<4	<1
Ethylbenzene	0.5	0.1	2.8	0.6
Xylenes, Total	0.9	0.2	6.0	1.4
Total Volatile Hydrocarbons:				
C1 - C5	20	5	2400	580
C6 - C12*	20	5	1400	330

\* TPH as gasoline is defined as C6 (benzene) through C12 (dodecane) and uses a molecular weight of 100 to calculate the ppmv.

\*\* The MRL is elevated because of matrix interferences.

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

**Client:** EMCON  
**Project:** ARCO Products Company #6148/#20805-135.006  
**Sample Matrix:** Vapor

**Service Request:** L9604137  
**Date Collected:** 10/3/96  
**Date Received:** 10/4/96  
**Date Extracted:** NA  
**Date Analyzed:** 10/6/96

BTEX and Total Volatile Hydrocarbons  
EPA Methods 8020/Modified 8015

**Sample Name:** E-1  
**Lab Code:** L9604137-003

	MRLs		Results	
	mg/m3	uL/L (ppmv)	mg/m3	uL/L (ppmv)
Benzene	0.4	0.1	ND	ND
Toluene	0.4	0.1	ND	ND
Ethylbenzene	0.5	0.1	ND	ND
Xylenes, Total	0.9	0.2	ND	ND
Total Volatile Hydrocarbons:				
C1 - C5	20	5	910	220
C6 - C12*	20	5	83	20

\* TPH as gasoline is defined as C6 (benzene) through C12 (dodecane) and uses a molecular weight of 100 to calculate the ppmv.

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

**Client:** EMCON  
**Project:** ARCO Products Company #6148/#20805-135.006  
**Sample Matrix:** Vapor

**Service Request:** L9604137  
**Date Collected:** NA  
**Date Received:** NA  
**Date Extracted:** NA  
**Date Analyzed:** 10/6/96

BTEX and Total Volatile Hydrocarbons  
EPA Methods 8020/Modified 8015

**Sample Name:** Method Blank  
**Lab Code:** L9604137-MB

	MRLs		Results	
	mg/m3	uL/L (ppmv)	mg/m3	uL/L (ppmv)
Benzene	0.4	0.1	ND	ND
Toluene	0.4	0.1	ND	ND
Ethylbenzene	0.5	0.1	ND	ND
Xylenes, Total	0.9	0.2	ND	ND
Total Volatile Hydrocarbons:				
C1 - C5	20	5	ND	ND
C6 - C12*	20	5	ND	ND

\* TPH as gasoline is defined as C6 (benzene) through C12 (dodecane) and uses a molecular weight of 100 to calculate the ppmv.

APPENDIX A

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

**Client:** EMCON  
**Project:** ARCO Products Company #6148/#20805-135.006  
**LCS Matrix:** Vapor

**Service Request:** L9604137  
**Date Collected:** NA  
**Date Received:** NA  
**Date Extracted:** NA  
**Date Analyzed:** 10/6/96

Laboratory Control Sample Summary  
BTEX and Total Volatile Hydrocarbons  
EPA Methods 8020/Modified 8015  
Units: uL/L (ppmv)

Analyte	True Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Benzene	10.0	8.01	80	60-140
Toluene	10.0	8.46	85	60-140
Ethylbenzene	10.0	8.20	82	60-140
TPH as Gasoline*	710	519	73	60-140

\* TPH as gasoline is defined as C6 (Benzene) through C12 (Dodecane) and uses a molecular weight of 100 to calculate the ppmV.

**COLUMBIA ANALYTICAL SERVICES, INC.**

QA/QC Report

**Client:** EMCON  
**Project:** ARCO Products Company #6148/#20805-135.006  
**Sample Matrix:** Vapor

**Service Request:** L9604137  
**Date Collected:** NA  
**Date Received:** NA  
**Date Extracted:** NA  
**Date Analyzed:** 10/4/96

Duplicate Summary  
 BTEX and Total Volatile Hydrocarbons  
 EPA Methods 8020/Modified 8015  
 Units: uL/L (ppmv)

**Sample Name:** BATCH QC  
**Lab Code:** L9604114-001

Analyte	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Benzene	0.1	0.41	0.44	0.42	7
Toluene	0.1	2.60	2.65	2.62	2
Ethylbenzene	0.1	1.63	1.62	1.62	<1
Total Xylenes	0.2	5.23	5.17	5.20	1
<b>Total Volatile Hydrocarbon:</b>					
C1-C5	5	13.5	12.7	13.1	6
C6-C12*	5	154	146	150	5

\* TPH as gasoline is defined as C6 (Benzene) through C12 (Dodecane) and uses a molecular weight of 100 to calculate the ppmV.

**ARCO Products Company**

Division of Atlantic Richfield Company

Task Order No. **18336.00**

**Subcontract**

Chain of Custody

ARCO Facility no **6048** City (Facility) **Oakland** Project manager (Consultant) **Valli Voruganti** Laboratory name **LLAB CAS**  
 ARCO engineer **Paul Supple** Telephone no (ARCO) **408 3778697** Telephone no (Consultant) **408 453 7300** Fax no (Consultant) **408 453 0452** Contract number  
 Consultant name **EMCON** Address (Consultant) **1921 Ringwood Ave. San Jose, CA 95131**

Sample ID	Lab no.	Container no.	Matrix			Preservation		Sampling date	Sampling time	BTEX EPA 821/822/823/824	BTEX/TPH EPA 821/822/823/824/825	TPH Modified 8015 Gas <input type="checkbox"/> Diesel <input type="checkbox"/>	Oil and Grease 413.1 <input type="checkbox"/> 413.2 <input type="checkbox"/>	TPH EPA 418 1/5/8/2/6	EPA 601/6010	EPA 62/602/60	EPA 625/6270	TCUP Mesa <input type="checkbox"/> VOA <input type="checkbox"/> VOA <input type="checkbox"/>	Semi VOC <input type="checkbox"/> VOC <input type="checkbox"/>	CAN Meth EPA 801/700	MTC <input type="checkbox"/> STIC <input type="checkbox"/>	Lead Org PMS <input type="checkbox"/>	Lead EPA 7420/7421 <input type="checkbox"/>	
			Soil	Water	Other <i>Vapor</i>	Ice	Acid																	
I-1	1	1			X			10-3-96	1528	X														
I-2	2	1			X			↓	1530	X														
E-1	3	1			X			↓	1532	X														

Method of shipment

Special detection Limit/reporting  
 Please report all results in ppmv and mg/m<sup>3</sup>

Special QA/QC

Remarks  
 20805-135.006  
 (see attached)  
 L9604137

Lab number  
 59601626

Turnaround time  
 Priority Rush   
 1 Business Day  
 Rush   
 2 Business Days  
 Expedited   
 5 Business Days  
 Standard   
 10 Business Days

Condition of sample: **Inflated** Temperature received: **Ambient**

Relinquished by sampler **Paul Supple** Date **10-4-96** Time **1135** Received by **SLAB (CAS) Joanne Brown**

Relinquished by **Joanne Brown** Date **10-4-96** Time **1800** Received by laboratory **LLAB** Date **10/5/96** Time **1100**

10/08/98 10:40 FAX  
 2005/005  
 2005/005

**ARCO Products Company**

Division of AtlanticRichfieldCompany

Task Order No.

18336.00

**Chain of Custody**

ARCO Facility no. <b>6148</b>	City (Facility) <b>Oakland</b>	Project manager (Consultant) <b>Valli Voruganti</b>	Laboratory name <b>CAS</b>
ARCO engineer <b>Paul Supple</b>	Telephone no. (ARCO) <b>4083778697</b>	Telephone no. (Consultant) <b>4084537300</b>	Contract number
Consultant name <b>EMCON</b>	Address (Consultant) <b>1921 Ringwood Ave. San Jose, CA 95131</b>		

Sample I.D.	Lab no.	Container no.	Matrix			Preservation		Sampling date	Sampling time	BTEX 602/EPA 8020	BTEX/TPH EPA M602/6020/8015	TPH Modified 8015 Gas Diesel	Oil and Grease 413.1 413.2	TPH EPA 418.1/SM503E	EPA 801/8010	EPA 824/8240	EPA 825/8270	TCLP Metals VOA VOA	Semi Metals VOA VOA	CAM Metals EPA 801/8010/7000	TTLCL STLCL	Lead Org./DHS Lead EPA 7420/7421	Method of shipment	
			Soil	Water	Other Vapor	Ice	Acid																	
I-1		1			X			10-3-96	1528		X													
I-2		1			X			↓	1530		X													
E-1		1			X			↓	1532		X													

Special detection Limit/reporting  
Please report all results in ppmv and mg/m<sup>3</sup>

Special QA/QC

Remarks  
**20805-135.006**

Lab number  
**59601626**

Turnaround time

Priority Rush 1 Business Day

Rush 2 Business Days

Expedited 5 Business Days

Standard 10 Business Days

Condition of sample: <b>Inflated</b>	Temperature received: <b>Ambient</b>				
Relinquished by sampler <b>Paul Supple</b>	Date 10-4-96 Time 1135	Received by <b>SLAB (CAS) Joanne Brown</b>			
Relinquished by	Date	Time	Received by		
Relinquished by	Date	Time	Received by laboratory	Date	Time