



April 7, 1992

APR 9 '92 T.L.H.

Ms. Nancy Vukelich
Chevron U.S.A. Products Company
P.O. Box 5004
San Ramon, CA 94583

Re: Soil Vapor Extraction Test Report
Former Chevron Service Station #9-1026
3701 Broadway
Oakland, California
WA Job #4-418-81

Dear Ms. Vukelich:

This letter presents the results of Weiss Associates' (WA) soil vapor extraction (SVE) test performed at the site referenced above (Figure 1). The purpose of the test, conducted on January 22, 1992, was to evaluate SVE feasibility, to assess system design requirements and to provide information for selecting cost-effective vapor treatment methods. The test used existing wells to provide data on vapor extraction flow rates, vacuum requirements, extent of vacuum influence, hydrocarbon concentrations in extracted vapor and hydrocarbon removal rates. Test results indicate that SVE will probably not effectively remove hydrocarbons from the site subsurface which consists primarily of low permeability sediments.

SITE CONDITIONS

The former Chevron facility is currently operating as a used car lot with a paved surface (Figure 2). Previous subsurface investigations indicate that the site is underlain by very low permeability silty clays to a depth of about 20 feet. Ground water is currently between 12 and 19 feet below ground surface with an onsite gradient in the southerly direction of approximately 0.017 ft/ft¹.

¹ Weiss Associates, February 28, 1992, Ground Water Monitoring Report, consultant's letter report, 2 pp., 2 figures, 2 tables, and 2 attachments.



SOIL VAPOR EXTRACTION TEST PROCEDURES

The rationale for selecting the wells used in this test, the test equipment, and data collection and interpretation methods are described below.

Extraction Wells and Test Procedures

WA extracted soil vapor from five (5) existing wells. The primary wells of concern were B and B-3 which are located near the downgradient property boundary. These wells historically contained floating hydrocarbons and are situated near the highest detected hydrocarbon concentrations in soil and ground water (Figure 2). We extracted from wells A, B-1 and B-2 to assess hydrocarbon concentrations in soil vapor and SVE feasibility from these secondary locations (Figure 2). B-1 is also located downgradient of the former pump island and underground fuel storage tanks where hydrocarbons in soil and ground water were detected.

Equipment

To evaluate SVE effectiveness from each test well, we applied a vacuum with our portable SVE test equipment to assess the vacuum required to achieve a preset vapor extraction flow rate. The equipment included a positive-displacement vacuum pump powered by a 3 horsepower explosion-proof motor, rated to produce a vacuum of 160 inches of water at various flow rates. We routed extracted vapor through the test system's moisture collection drum and two 200 lb carbon adsorption vessels connected in series.

Data Collection and Interpretation

Data collection included recording test system's operation parameters, collecting influent and effluent vapor samples, and measuring the induced vacuum and/or pressure in site wells. We recorded the system's operation parameters about every 2-4 minutes until stabilization occurred. Thereafter, we reduced monitoring frequency to about every 10 minutes. The influent vacuum gauge indicated the vacuum applied to each test well. We estimated vapor extraction flow rates based on applied vacuum, differential pressure gauge readings and performance curves supplied by the vacuum equipment manufacturer.



To record vacuum influence, WA sealed the site wellheads and measured the induced vacuum in each well with a differential pressure gauge which indicates the difference between well pressure and atmospheric pressure. After beginning each extraction test, we first measured vacuum in the closest well where influence was expected, and then measured vacuum in the other wells. For the remainder of the test, we measured vacuum in all wells and probes at about 10 minute intervals. Before and after each extraction event, we measured background vacuum in all sealed wells to distinguish between pressure differences induced by atmospheric change versus pressure differences induced by vapor extraction.

To normalize vacuum influence data from each well, we subtracted the measured background vacuum from the stabilized vacuum influence measurement. In some cases the background vacuum influence did not fully stabilize due to the low permeability materials and brief intervals between extraction tests.

WA measured hydrocarbon concentrations in extracted vapor and after each carbon adsorption vessel with a portable organic vapor analyzer/flame ionization detector (OVA/FID). To assess concentration trends, we measured hydrocarbon concentrations about every 10 minutes. We also submitted one-liter vapor samples to a state-certified analytical laboratory for analysis for total petroleum hydrocarbons as gasoline (TPH-G) by modified EPA Method 8015 and for benzene, toluene, ethyl benzene, and total xylenes (BTEX) by modified EPA Method 8020. We collected samples for laboratory analysis near the beginning and/or end of each extraction event. Samples collected from well B deflated, so an FID reading is provided in Table 1 instead.

Hydrocarbon removal rates were calculated using data on stabilized hydrocarbon concentrations in extracted vapor and vapor flow rates for each extraction event. Actual hydrocarbon removal rates for a dedicated SVE system may vary depending on the applied vacuum, extraction flow rates, ground water elevations and hydrocarbon concentration fluctuation during SVE project duration.



SVE TEST RESULTS

The vacuum applied by the test equipment to each well ranged from 150 to 170 inches of water and induced vapor extraction flow rates ranging from <2 to 4 standard cubic feet per minute (scfm). Hydrocarbon concentrations in extracted vapor ranged from 1,300 parts per million by volume (ppmv) to 110,000 ppmv. Hydrocarbon removal rates ranged from <1 pound per day (ppd) to <76 ppd of TPH-G and <0.05 ppd to 0.01 ppd of benzene. Table 1 summarizes test data and estimates hydrocarbon removal rates for extraction from each well. Table 2 presents test data and vacuum influence data for extraction from each well. Figure 2 presents the isobarometric contours for extraction from well B-3. The analytical report and chain of custody form is also attached.

During extraction from each well, the applied vacuum elevated the ground water table and induced ground water in the moisture collection drum. In each case we reduced the applied vacuum and the extraction flow rate until ground water no longer entered the moisture collection drum.

CONCLUSIONS AND RECOMMENDATIONS

Test results indicate that SVE will probably not effectively remove hydrocarbons from the site subsurface. The relatively large vacuum required to induce relatively small flow rates indicates that the subsurface soil permeabilities in the site's unsaturated zone are very low, and that inducing significant vapor flow without water-table mounding problems may be infeasible in these areas. SVE may be more effective by using ground water extraction to lower the water table while applying a higher vacuum to increase vapor flow rates from the wells; however, this may not significantly increase hydrocarbon removal by SVE. Additionally project duration for SVE may be prohibitive and SVE may not be cost-effective compared to other alternatives. Based on these results, low flow rates with limited vacuum influence and hydrocarbon removal rates, the potential for effective hydrocarbon removal by SVE is very limited at this site.

Nancy Vukelich
April 7, 1992

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WA is pleased to provide environmental remediation services to Chevron USA and we trust this submittal meets your needs. Please call if you have any questions regarding this test or our results.



Sincerely,
Weiss Associates

Thomas R. Berry for

Bob Riddell, E.I.T.
Project Engineer

Fatima S Lelic

Fatima Lelic, P.E., D.E.E.
Principal Engineer

BGR/FL:hmw

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Attachments: **Figures**
Tables
Analytical Report and Chain of Custody Form

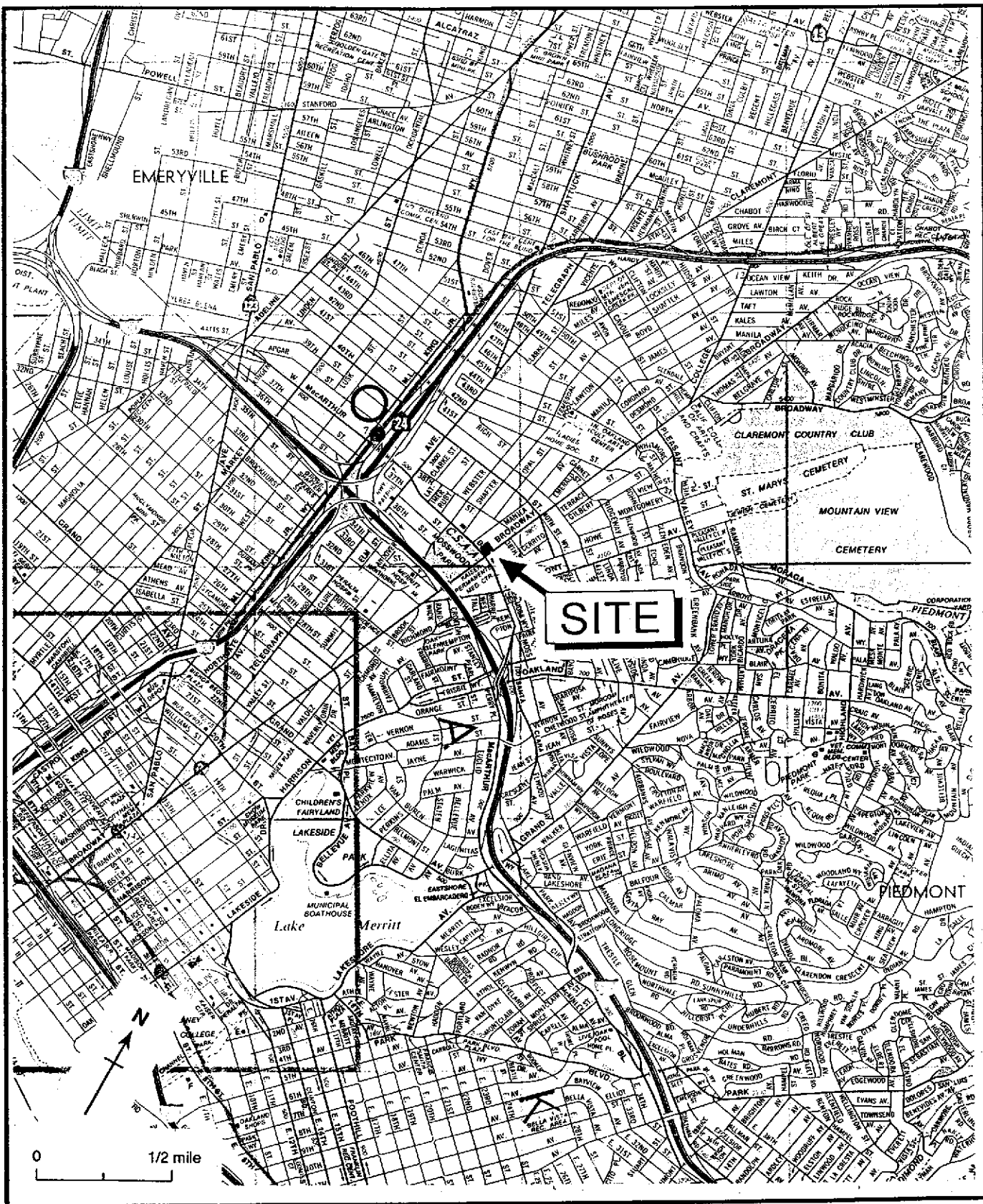


Figure 1. Site Location Map -Former Chevron Service Station #91026, 3701 Broadway, Oakland, California

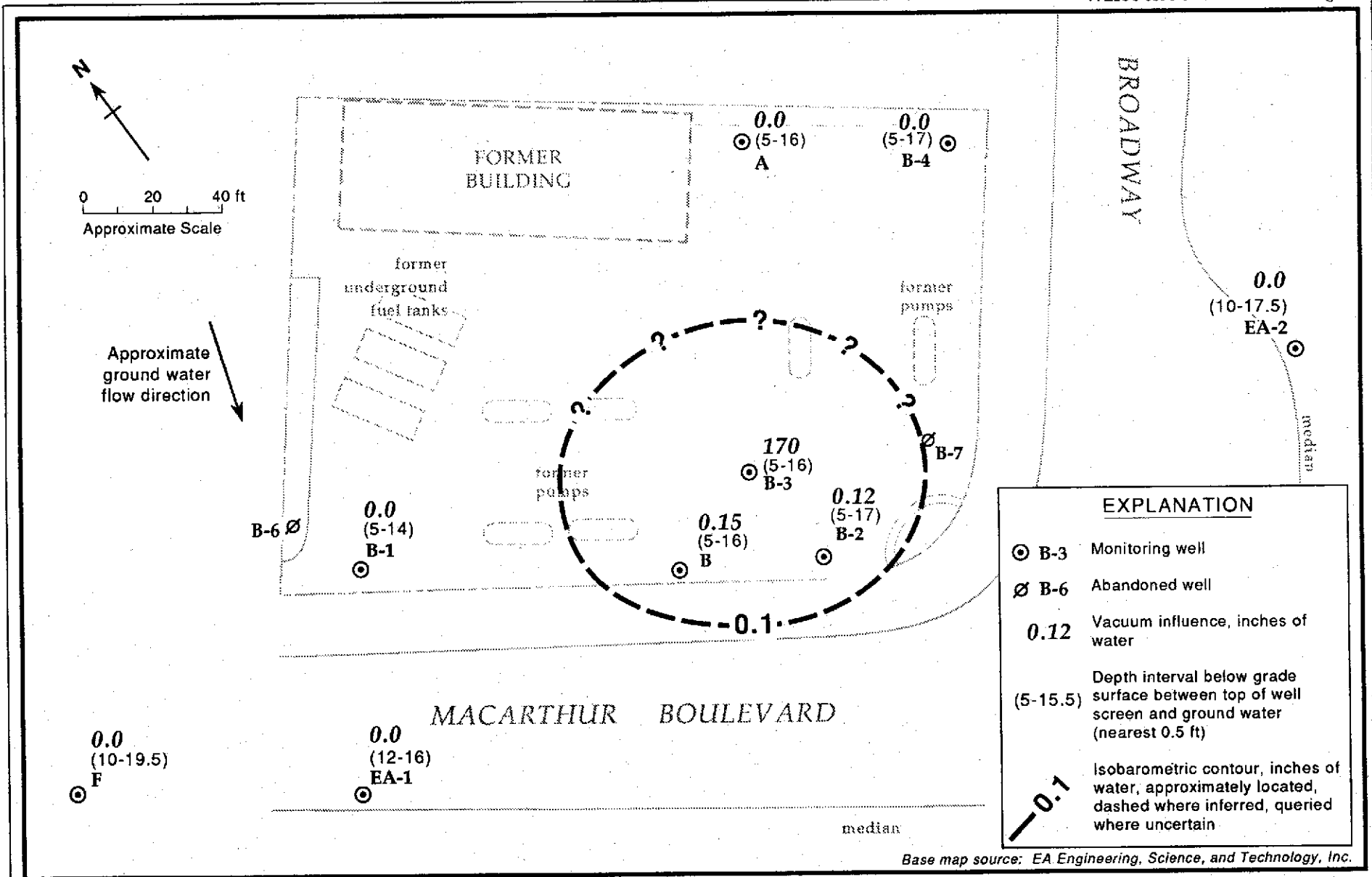


Figure 2. Well Locations and Isobarometric Contours for Vapor Extraction from Well B-3 - February 13, 1992 - Former Chevron Service Station #9-1026, 3701 Broadway, Oakland, California

Table 1. Soil Vapor Extraction Test Data and Analytic Results, Chevron Service Station #9-1026, 3701 Broadway Avenue, Oakland, California

WELL ID	EXPOSED SCREEN DEPTH (ft-ft) (a)	APPLIED VACUUM (inches water)	FLOW (scfm)	ELAPSED TIME (min)	FID (ppm)	INLET HYDROCARBON CONCENTRATIONS (ppmv)		MASS REMOVAL RATE (lbs./day)	
						TPH-G	BENZENE	TPH-G	BENZENE
A	5-16	163	<2	8	31,000	36,000	78	<25	<0.05
B	5-16	150	4	34	7,500	NA	NA	10(b)	NA
B-1	5-14	163	<2	8	10,500	1,300	ND	<1	ND
B-2	5-17	170	<2	8	>50,000	100,000	31	<69	<0.02
B-3	5-16	150	<2	37	>50,000	110,000	79	<76	<0.05
	5-16	170	3	75	>50,000	33,000	8.7	34	0.01

Notes:

scfm = Standard cubic feet per minute.

FID = Flame ionization detector (field equipment)

ppmv = Parts per million on volume to volume basis.

TPH-G = Total purgeable hydrocarbons as gasoline.

13.6" water = 1.0" Mercury = 0.033 atm

NA = Sample not analyzed, bags deflated prior to laboratory submittal.

(a) = Depth interval below grade surface between top of well screen and ground water (nearest 0.5 feet).

(b) = based on FID measurement

ND = Benzene not detected in sample at detection limit of 1.7 ppmv.

Table 2. SVE Vacuum Influence Data, Chevron Service Station #9-1026, 3701 Broadway, Oakland, California

Test Location (ID)	A		B		B-1			
Step Test (#)	1		1		1			
Applied Vacuum ("H ₂ O)	163		150		163			
Flow Rate (scfm)	<2		4		<2			
Step Test Duration (min)	20		40		15			
Probe/ Well ID	Exposed Screen Depth ^a (ft-ft)	Est. Perm. in Exposed Screen ^b	Distance from Test Point (ft)	Vacuum Influence ("H ₂ O)	Distance from Test Point (ft)	Vacuum Influence ("H ₂ O)	Distance from Test Point (ft)	Vacuum Influence ("H ₂ O)
A	5 - 15.5	L	---	---	127	0	166	0
B	5 - 15.5	L	129	0	---	---	92	0
B-1	5 - 13.5	L	166	0	92	0	---	0
B-2	5 - 16.5	L	124	0.06	42	0	133	0
B-3	5 - 15.5	L	96	0	35	0.60	115	0
B-4	5 - 17	L	60	0.015	147	0	230	0
EA-1	12 - 16	L	220	0	112	0.06	67	0
EA2	10 - 17	L	170	0	188	0	275	0
F	10 - 19	L	270	0	185	0	105	0

Notes:

a = Depth interval below grade surface between top of well screen and ground water (nearest 0.5 feet).

b = Estimated permeability of materials in unsaturated zone around well screen expressed as low, moderate or high; L = Low; M = Moderate; H = High

--- = Not measured

P = Denotes pressure measured in influence point instead of vacuum





Superior Precision Analytical, Inc.

1555 Burke, Unit I • San Francisco, California 94124 • (415) 647-2081 / fax (415) 821-7123

C E R T I F I C A T E O F A N A L Y S I S

LABORATORY NO.: 12727
CLIENT: Weiss Associates
CLIENT JOB NO.: 4-418-81

DATE RECEIVED: 01/23/92
DATE REPORTED: 01/27/92

ANALYSIS FOR BENZENE, TOLUENE, ETHYL BENZENE & XYLENES by EPA SW-846 Methods 5030 and 8020

LAB #	Sample Identification	Concentration(ppb)			
		Benzene	Toluene	Ethyl Benzene	Xylenes
1	012-A	78000	ND<13000	12000	38000
2	012-B1	ND<1700	ND<5000	7300	34000
3	012-B2	31000	400000	31000	140000
4	012-B3 PEAK	79000	320000	27000	94000
5	012-B3 FINAL	8700	300000	6200	19000

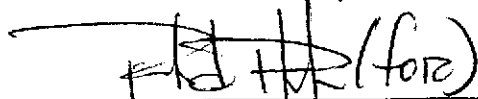
ppb - parts per billion in air

Minimum Detection Limit for Benzene in air = 85 ppb
Minimum Detection Limit for Toluene and Xylenes in air = 250 ppb
Minimum Detection Limit for Ethyl Benzene in air = 65 ppb
Concentration of BTXE in air is calculated based on 20 C and 1 ATM.
Reported as volume to volume.

QAQC Summary:

Daily Standard run at 20ug/L: %DIFF 8020 = <15
MS/MSD Average Recovery = 94% : Duplicate RPD = 3.4%

Richard Srna, Ph.D.


Laboratory Director



Superior Precision Analytical, Inc.

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C E R T I F I C A T E O F A N A L Y S I S

LABORATORY NO.: 12727
CLIENT: Weiss Associates
CLIENT JOB NO.: 4-418-81

DATE RECEIVED: 01/23/92
DATE REPORTED: 01/27/92

ANALYSIS FOR TOTAL PETROLEUM HYDROCARBONS
by Modified EPA SW-846 Method 5030 and 8015


LAB #	Sample Identification	Concentration (ppm) Gasoline Range
1	012-A	36000
2	012-B1	1300
3	012-B2	100000
4	012-B3 PEAK	110000
5	012-B3 FINAL	33000

ppm - parts per million in air
Minimum Detection Limit for Gasoline in Air: 30 ppm
Concentration of gasoline in air is calculated based on
20 C and 1 ATM and an assumed molecular weight of hexane.
Reported as volume to volume.

QAQC Summary:

Daily Standard run at 2mg/L: %DIFF Gasoline = <15
MS/MSD Average Recovery = 85%: Duplicate RPD = 4.7%

Richard Srna, Ph.D.


Laboratory Director



Superior Precision Analytical, Inc.

1555 Burke, Unit I • San Francisco, California 94124 • (415) 647-2081 / fax (415) 821-7123

MOCK INVOICE

Chevron USA
P.O. Box 5004
San Ramon, CA 94583

Date: 01/27/92
Date Rcvd: 01/23/92
Date Rptd: 01/27/92
Our Job #: 12727
Invoice #: 12727

Weiss Associates Job # 4-418-81
Chevron USA Release # 5003850

Facility #: 9-1026

QTY/MATRIX	ANALYSIS	EXT. PRICE
3 AIR	sample(s) for VBAIR @ \$0.00 (24HR RUSH)	0.00
2 AIR	sample(s) for VBAIR @ \$0.00 (48HR RUSH)	0.00
TOTAL INVOICE		0.00

Please Send Payment To:
Superior Analytical Labs
P.O. Box 1545
Martinez, CA 94553

TERMS: NET 30

A charge of 1.5% per month may be applied to unpaid balances

Fax copy of Lab Report and COC to Chevron Contact: Yes No

Chain-of-Custody-Record

Chevron U.S.A. Inc.
 P.O. BOX 5004
 San Ramon, CA 94583
 FAX (415)842-9591

Chevron Facility Number 9-1026
 Facility Address 3701 BROADWAY, OAKLAND
 Consultant Project Number 4-418-82 81 TRS 1/23/92
 Consultant Name WEISS ASSOCIATES
 Address 5500 SHELMOUND ST, EMERYVILLE, CA 94609
 Project Contact (Name) TOM BERRY
 (Phone) (510) 547-5420 (Fax Number) (510) 547-5043

Chevron Contact (Name) NANCY VUKELICH
 (Phone) (510) 847-9581
 Laboratory Name SUPERIOR ANALYTICAL
 Laboratory Release Number 5003850
 Samples Collected by (Name) B. BUSCH, B. BEALE
 Collection Date 1/22/92
 Signature Brian Busch

Sample Number	Lab Sample Number	Number of Containers	Matrix S = Soil W = Water A = Air C = Charcoal	Type G = Grab C = Composite D = Discrete	Time	Sample Preservation	Iced (Yes or No)	Analytes To Be Performed										Remarks
								BTEX + TPH GAS (8020 + 8015)	TPH Diesel (8015)	Oil and Grease (5520)	Purgeable Halocarbons (8010)	Purgeable Aromatics (8020)	Purgeable Organics (8240)	Extractable Organics (8270)	Metals Cd, Cr, Pb, Zn, Ni (ICAP or AA)			
012-A		1	A	G	17:06	NONE	NO	X	←	HOLD	→							
012-B1		1	↓	↓	16:27	↓	↓	X	←	HOLD	→							
012-B2		2	↓	↓	16:00	↓	↓	X	←	HOLD	→							
012-B3 peak		2	↓	↓	13:37	↓	↓	X										
012-B3 Final		1	↓	↓	14:15	↓	↓	X										

please analyze only one
 other is a duplicate

RUSH

Relinquished By (Signature) <u>Brian Busch</u>	Organization <u>WEISS</u>	Date/Time <u>1/22/92 19:30</u>	Received By (Signature) <u>Mameth Sh</u>	Organization <u>Weiss</u>	Date/Time <u>9:10 1/23/92</u>	Turn Around Time (Circle Choice) 24 Hrs. 48 Hrs. 72 HR. 5 Days 10 Days As Contracted
Relinquished By (Signature) <u>Mameth Sh</u>	Organization <u>Weiss</u>	Date/Time <u>1/23/92 11:19</u>	Received By (Signature) <u>Ron Brown</u>	Organization <u>Express It</u>	Date/Time <u>1/23/92 11:20</u>	
Relinquished By (Signature) <u>Ron Brown</u>	Organization <u>Express It</u>	Date/Time <u>1/23/92</u>	Received For Laboratory By (Signature) <u>Cecilia G. Jorgensen</u>		Date/Time <u>1/23/92 1:10 PM</u>	

COC-3.DWG/03 91/HCH