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June 17, 1998
Project 20805-130.006

Mr. Barney Chan
Alameda County Health Care Services Agency
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502-6577

Re: ARCO Facility No. 2185 located at 9800 E. 14th Street, Oakland, California,

Dear Mr. Chan:

As you have requested, Pinnacle Environmental Solutions, a division of EMCON (Pinnacle) is sending the enclosed Tier 1, Tier 2 Risk Based Corrective Action Evaluation (EMCON, October 6, 1997) for the above-referenced site.

If you have any questions regarding this site, please do not hesitate to contact Glen VanderVeen at (925) 977-9020.

Sincerely,

PINNACLE ENVIRONMENTAL SOLUTIONS



Glen VanderVeen
Project Manager

cc: Paul Supple, ARCO Products Company (without enclosure)





STIA #
3876.

October 6, 1997
Project 20805-130.006

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

Re: Tier 1, Tier 2 Risk-Based Corrective Action Evaluation for ARCO Service
Station 2185, 9800 East 14th Street, Oakland, California

Dear Mr. Supple:

This report presents the results of the Tier 1, Tier 2 risk-based corrective action (RBCA) evaluation prepared for ARCO Products Company (ARCO) Service Station 2185, 9800 East 14th Street, Oakland, California (the Site, Figures 1 and 2). This report addresses potential on-site and off-site exposures to current and future workers. The RBCA evaluation results indicate that no acceptable levels of risk are exceeded at this site,

The presence of petroleum hydrocarbons in soil and groundwater beneath the site have been investigated and the potential health risk posed by these impacts characterized. Based on the results of investigations performed to date, the Site qualifies as a low risk site as defined in the Regional Water Quality Control Board's (RWQCB) January 1996 Supplemental Instructions. The RWQCB's requirements are bulleted below, followed by a brief explanation of how each criterion has been met at this Site.

- Source must be removed

Source removal was performed in October and November 1991; underground storage tanks (USTs), associated piping, and impacted soil (approximately 1,050 cubic yards) were excavated and removed from the Site. These activities are documented in the report, *Underground Storage Tank Removal and Soil Sampling* (Roux Associates, June 17, 1992).

- Site is adequately characterized

Soil and groundwater investigations have been performed at the Site. These investigations characterized the lateral and vertical extent of residual gasoline and its constituents in soil and in groundwater both on- and off-site (*Report of Findings, Initial Offsite and Additional Onsite Subsurface Investigation and Aquifer Pumping Test* [RESNA



Industries, Inc. October 12, 1993], and subsequent quarterly groundwater monitoring reports [EMCON, 1995 to the present]). The groundwater gradient has ranged between 0.005 and 0.01 feet per foot toward the west. Historical groundwater elevation and analytical data are summarized in Appendix A.

- Plume is stable or receding

Petroleum constituents in groundwater have been monitored quarterly or semi-annually since March, 1995. Except for methyl tert butyl ether (MTBE), the concentrations of gasoline and related compounds (benzene, toluene, ethylbenzene and xylenes [BTEX]) have generally decreased since the third quarter of 1995, and are below analytical reporting limits both on-site and off-site. MTBE has been detected in three wells (MW-3, MW-5 and MW-8, Figure 2). **Although MTBE has decreased to non-detectable levels in MW-5, it has shown no clear increasing or decreasing trend in the remaining two wells.**

- No threat to surface water or deep aquifers

No creeks or rivers are located near the Site, and the nearest body of surface water (the San Francisco Bay) is more than 2 miles away.

The vertical extent of petroleum hydrocarbons have been investigated, and the results indicate that the extent of the dissolved gasoline plume is limited. Soil samples collected immediately down gradient from the source areas (i.e., the former underground storage tanks [Boring B-10], supply line and dispenser island excavations [Boring B-11]) show that petroleum hydrocarbons were either not detected or detected just above their method reporting levels at depths of 23 and 10 feet, respectively (Appendix A). The absence of petroleum hydrocarbons in the silty clay zone immediately below the first-encountered saturated zone (*Initial Subsurface Investigation at ARCO Station 2185, RESNA Industries, Inc., September 28, 1992*) indicates that that underlying groundwater has not been impacted.

- No threat to human health

Based on the results of this evaluation, no threat to human health exists.

- No threat to the environment

The site is located in an urban area developed for residential and commercial use, therefore no ecological receptors are considered to be threatened.

This RBCA evaluation was prepared in accordance with the guidance contained in the *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (American Society of Testing Materials [ASTM] E-1739-95, November, 1995). In general, the tiered approach recommended in the ASTM guidance is designed as a step-wise process to evaluate the potential risk posed by a chemical release, determine what corrective action is needed, if any, and tailor that action to those risks.

The steps that make up the tiered RBCA approach are summarized in Figure 3. This report will follow these steps, and refer to information summarized in tables, figures, and the historical groundwater and soil analytical data summarized in Appendix A.

INITIAL SITE ASSESSMENT AND SITE CLASSIFICATION

Steps 1 and 2 of a RBCA are designed to screen for the possibility that the site presents an imminent threat to public health and the environment. This refers, for example, to sites where an unconfined release of product to the surface has taken place, and potential receptors may come in direct contact with this product. No surface releases have taken place at this site which have not been immediately contained and cleaned up. Chemical impact to soil and groundwater at this site has been characterized in several investigations (*Report of Findings, Initial Offsite and Additional Onsite Subsurface Investigation and Aquifer Pumping Test* [RESNA Industries, Inc. October 12, 1993], and subsequent quarterly groundwater monitoring reports [EMCON, 1995 to the present]). Although petroleum hydrocarbons have been detected in the subsurface, they do not present a potential risk of direct contact.

Step 3 in the RBCA process is a comparison of site-measured soil and groundwater data to conservative, non-site-specific, health-based screening levels, in accordance with the ASTM RBCA guidance. This is referred to in the ASTM guidance as a Tier 1 evaluation.

TIER 1 EVALUATION

The first step in a Tier 1 evaluation is to determine the chemical nature of the release and to characterize the extent of the impact. Definition of impact to site soil and groundwater has been characterized and documented in previous reports, as stated above. The USTs, piping, and most of the impacted soil have been removed. **Petroleum constituents in the soil and groundwater are summarized in Appendix A.**

Exposure Pathways

The next step in a Tier 1 evaluation is to identify potentially significant environmental transport pathways by which receptors may be exposed to site-related chemicals in order to identify complete exposure pathways. For a potential exposure pathway to be considered complete, it must contain the following three elements:

- a source of specific chemicals (e.g., BTEX in groundwater) ✓
- a transport mechanism (e.g., volatilization of BTEX from groundwater to ambient air)
- a potential receptor (e.g., the presence of residential or industrial activity at or downwind from the point where BTEX is emitted from the soil into the air)

First encountered groundwater at this site is not considered potable. For this reason potential exposure pathways involving groundwater (e.g., infiltration from subsurface soil to groundwater and direct groundwater ingestion) were not considered reasonable exposure pathways, and thus were not evaluated further in this evaluation. Groundwater can, however, serve as an indirect source of exposure via volatilization of BTEX and MTBE to the Site surface. Currently, no structures are located over the areas of impacted groundwater. Thus, only workers and customers exposed to ambient air at the Site may be considered potential receptors. Since Site workers are potentially exposed to ambient air at the Site to a much greater degree than customers, it can be assumed that if the potential risk to workers is acceptable, then the potential risk for customers must also be acceptable. For this reason, this assessment will evaluate workers as the potential receptors. If future development were to result in a structure located over the impacted groundwater, then indoor workers may also be considered potential receptors. For the purpose of this assessment, we will assume that future development includes a structure located over impacted groundwater, and thus consider an indoor air exposure scenario.

Direct exposure to surface and subsurface soil at this site is not considered a complete exposure pathway because soil at this site is covered by asphalt or concrete. For this reason, these exposure pathways were not considered further in this evaluation. Subsurface soil can, however, serve as an indirect source of exposure via volatilization of BTEX and MTBE to the Site surface. Currently, no structures are located over the areas of impacted soil. Thus, only workers and customers exposed to ambient air at the Site may be considered potential receptors. If future development were to result in a structure located over the former USTs and piping, then indoor workers may also be considered potential receptors. For the purpose of this assessment, we will assume that future

development includes a structure located over impacted soil, and thus consider an indoor air exposure scenario.

To summarize, the only complete potential exposure pathways at this site are:

- Exposure, through volatilization of chemicals in groundwater, of current commercial receptors to ambient air, and future commercial receptors to indoor air
- Exposure, through volatilization of chemicals in subsurface soil, of current commercial receptors to ambient air, and future commercial receptors to indoor air

Site Concentrations

Groundwater

The results from quarterly groundwater monitoring events presented in Appendix A show a generally decreasing trend in BTEX levels in groundwater. In recognition of this trend and of the fact that the USTs and piping were removed and the associated soil over-excavated in 1991, the maximum groundwater concentrations for the past year were used to represent the source of BTEX to which hypothetical receptors may be exposed. This is a conservative representation of groundwater because it uses BTEX values that are as much as a year old in spite of more recent results indicating non-detect levels. The sample results used in the Tier 1 evaluation are summarized in Table 1. It should be noted that although emission of volatiles from the Site may result in off-site exposure via transport of site-related compounds downwind, such exposure is expected to correspond to a lower potential risk than on-site exposure. It can be assumed that if potential on-site exposure is determined to be acceptable, then the lower off-site exposure must also be acceptable. For this reason, only on-site exposure is evaluated.

The quarterly monitoring data in Appendix A show that MTBE has been detected in monitoring wells MW-3, MW-5 and MW-8. The concentration in Well MW-8 has been below the method reporting limit for the last two monitoring events. The levels in all three wells, however, have been characterized by marked fluctuation. For this reason, the highest value detected at the Site (2,200 µg/L, from August 1996 in Well MW-3) was conservatively selected to represent groundwater concentration for this evaluation.

Subsurface Soil

Following over-excavation of the former UST and dispenser piping areas, residual levels of petroleum constituents were detected in samples collected from the sidewalls of these excavations. The results from the dispenser area are used to represent residual soil impact for two reasons:

1. The highest BTEX concentrations were detected in samples from the dispenser area
2. Residual petroleum constituents were detected from soil adjacent to the former USTs, and the highest concentrations in this area were detected at a depth of 14 feet bgs. These values were not used in this assessment, however, because the water table rose following the 1992/1993 rainy season, and these soils have been submerged since that time.

*Just
come*

Samples from soil no deeper than 9.5 feet (samples L-5 through L-10 in Table 1) were used to represent potential site-wide contribution. These soil analytical results were also used to conservatively represent volatilization of chemicals to indoor air for the future exposure scenario. The future indoor area is assumed to be similar to the current building area (approximately 35 by 50 feet). To represent the indoor air exposure scenario, the average concentration of the samples listed above were used. The average concentrations are presented in Table 1.

Although MTBE was not measured at the time soil samples were analyzed, considering the high solubility and volatility of this chemical, it is likely MTBE is no longer in the soil, but has migrated to the groundwater.

Risk Target Levels

Only commercial receptors are evaluated in this assessment because the Site and the immediately surrounding area are currently used only for commercial purposes and are expected to remain commercial. Acceptable risk-based soil and groundwater levels were calculated based on a 1×10^{-5} (i.e., 1 in 100,000) target level for potential carcinogens such as benzene (consistent with guidance in the Safe Drinking Water and Toxic Enforcement Act of 1986), and a hazard quotient of 1 for non-cancer-causing substances. As with BTEX, inhalation is the only potential exposure route applicable for MTBE detected at this Site. For this reason, and in accordance with recommendation from the ACHCSA, MTBE was evaluated based on toxicity criteria established for inhalation.

Conservative Assumptions

The next step in this Tier 1 evaluation is to review the assumptions used to derive the risk-based screening levels (RBSLs). Although the default assumptions used to represent the potential transport mechanisms and exposures pathways are designed to be conservative, it is important to verify this assumption to assure that the RBSLs are as protective as they need to be.

The emission and air dispersion models, and the default modeling values used in the ASTM guidance to generate the RBSLs are suitable to generate conservative RBSLs for the following reasons:

- The assumptions used to generate the RBSLs contained in the ASTM guidance include a depth to subsurface soil impact of about 3 feet. In fact, the soil impact at the Site is deeper (between 5 and 9 feet below ground surface), with volatilization potentially taking place through 6 to 9 feet of relatively fine-grain material (e.g., silty clay and silty sand). Both of these site-specific features would result in significantly less impact to ambient and indoor air than would be reflected in the RBSLs for the respective pathways.
- The models used for this assessment assume a constant source of BTEX for 25 years. However, losses due to biodegradation and adsorption onto subsurface soil during volatilization from the groundwater and biodegradation from the unsaturated zone, are not accounted for by the models.
- Volatilization of BTEX to ambient air was considered a complete exposure pathway for the purposes of this assessment. This assumption is extremely conservative because the site is covered by concrete and asphalt, which although not completely impermeable, limits vapor diffusion to a much greater degree than accounted for by the vapor emission model.

The assumptions used to develop RBSLs for the pertinent potential exposure pathways are judged to be appropriately conservative for the purposes of screening. The only modification necessary to the RBSLs presented in Table X2.1 of the ASTM guidance is to adjust the RBSLs for benzene by multiplying them by 0.29 (California Regional Water Quality Control Board, San Francisco Bay Region, memorandum, January 5, 1996).

Tier 1 Results

Table 1 compares the maximum soil and groundwater concentrations of BTEX and MTBE to their appropriate RBSLs. As the table shows, the RBSLs for all of the exposure pathways evaluated except for benzene via the subsurface soil-to-indoor air pathway, were not exceeded by concentrations detected at the Site. In accordance with ASTM guidance, no further evaluation is necessary for the groundwater-to-ambient and -indoor air pathways and the subsurface soil-to-ambient air pathway, and for toluene, ethylbenzene, and total xylenes via the subsurface soil-to-indoor air pathway.

The results of the Tier 1 assessment show that the RBSL for benzene in the subsurface soil-to-indoor air pathway was exceeded. Although these results do not necessarily indicate a risk to public health (because of the very conservative nature of the evaluation), they indicate that further evaluation is necessary to determine if a risk to public health is present at this Site. The next step in the RBCA procedure (Step 5) is a Tier 2 evaluation of benzene for the subsurface soil-to-indoor air pathway. The Tier 2 evaluation is a more realistic determination of potential risk because it incorporates site-specific data. *part 2*

TIER 2 EVALUATION

In accordance with the ASTM guidance, the same conservative volatilization models used in the Tier 1 evaluation were used to further evaluate the potential risk, if any, associated with benzene in the Tier 2 evaluation. The Tier 2 evaluation, however, incorporates greater site-specificity in the values used for the model parameters compared to the conservative default values in the Tier 1 evaluation.

Tier 2 Site-Specific Parameters

Site-specific values for soil water content, bulk density, and total organic carbon were conservatively derived using values measured at another site about 2 miles away. The other site is located on clayey sand; which should provide a good estimate of soil properties for this Site (which contains silty and clayey sands and silty clays [*Initial Subsurface Investigation at ARCO Station 2185, RESNA, September 28, 1992*]). Soil porosity was reduced from the default value of 0.38 (representing a clean sand) to 0.30 to reflect the presence of the heavier soil at this site. The soil moisture content at the second site was measured to be 0.17 (by volume), and thus a value of 0.13 was used for the soil air content. The default for bulk density (1.7 grams per cubic centimeter) was used for this evaluation, while the default value for total organic carbon (1 percent) was reduced to 0.5

percent to conservatively model adsorptive losses during the transport process. The fraction of the foundation area for the future building assumed to be cracked was reduced from 1 to 0.5 percent to represent a more accurate, but still conservative, value for new construction. Additional information (e.g., minimum depth to water) used for the site-specific Tier 2 evaluation is presented in Table 2.

The parameters described above were used to calculate a risk-based, site-specific threshold level (SSTL) for the benzene in subsurface soil-to-indoor air potential exposure pathway in order to evaluate the potential risk associated with the future construction of a building over the area currently impacted by petroleum constituents. While more representative of actual site conditions than the Tier 1 results, the Tier 2 results are still conservative for several reasons:

- The evaluation of a future indoor air exposure scenario assumes that future construction takes place and builds a structure over the area with the highest residual petroleum levels.
- Soil BTEX concentrations are therefore likely to be considerably less now than when they were measured about 6 years ago, and even lower in the future when construction might take place.
- Even though the source of the petroleum has been removed from this site, the models used to estimate emission rates of BTEX from soil into indoor air assume a constant source of chemicals, and no losses due to biodegradation. The resulting SSTL will be significantly higher than if chemical losses were accounted for.

The results of this evaluation are summarized in Table 3.

Tier 2 Results

Table 3 compares the concentration of benzene in subsurface soil to its SSTL for inhalation of indoor air under a commercial exposure scenario. As the table shows, the SSTL is not exceeded by the concentration of benzene detected at the Site. In accordance with ASTM guidance, no further evaluation of these potential exposure pathways is necessary.

Mr. Paul Supple
October 6, 1997
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SUMMARY AND CONCLUSION

At this Site, ARCO has undertaken interim cleanup by removing the former USTs and piping, and has conducted further source removal by over-excavating much of the impacted soil. The impact of residual BTEX in the soil and BTEX and MTBE in groundwater was evaluated to determine what risk, if any, they might present to current and future Site receptors. This evaluation was conducted using the ASTM RBCA guidance. The results show that concentrations of BTEX detected in the soil and groundwater at the Site do not exceed concentrations that correspond to acceptable levels of risk. These results indicate that no additional remedial measures are necessary to protect the health of current or future Site receptors.

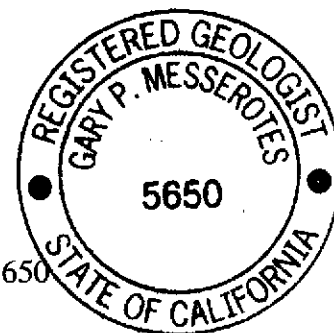
Based on the results of this Tier 1 and Tier 2 evaluation, this site does not present a significant health risk to potential receptors. EMCON proposes that this site be considered for closure.

Sincerely,

EMCON


Dr. Ray Kaminsky
Environmental Chemist


Gary P. Messerotes, R.G. 5650
Project Manager



Attachments: Table 1 - Tier 1 Results
Table 2 - Tier 2 Modeling Parameters
Table 3 - Tier 2 Results
Figure 1 - Site Location
Figure 2 - Site Plan
Figure 3 - Risk-Based Corrective Action Process Flowchart
Appendix A - Historical Groundwater and Soil Analytical Data

cc: Ms. Medula Logan, ACHCSA
Mr. Barney Chan, ACHCSA
Mr. Kevin Graves, RWQCB

Table 1
Tier 1 Results
ARCO Service Station 2185

Compounds	Groundwater to Ambient Air		Groundwater to Indoor Air	
	Representative Concentrations in Groundwater ¹ (mg/L)	RBSL Groundwater to Ambient Air (mg/L)	Representative Concentrations in Groundwater ¹ (mg/L)	RBSL Groundwater to Indoor Air (mg/L)
Benzene	0.084	53.4	0.084	0.214
Toluene	0.001	>S	0.001	85
Ethylbenzene	0.073	>S	0.073	>S
Xylenes	0.022	>S	0.022	>S
MtBE	2.200	>S	2.200	19,000
Compounds	Soil to Ambient Air		Soil to Indoor Air	
	Representative Concentrations in Soil ² (mg/kg)	RBSL Soil to Ambient Air (mg/kg)	Representative Concentrations in Soil ² (mg/kg)	RBSL Soil to Indoor Air (mg/kg)
Benzene	0.23	1.33	0.23	0.032
Toluene	1.5	RES	1.5	54.5
Ethylbenzene	1.1	RES	1.1	1,100
Xylenes	3.3	RES	3.3	RES

1. The highest concentration from the last four quarters of groundwater monitoring results
2. The average concentration from the samples collected in the dispenser area at the 8 to 9.5 feet depths.

RBSL: Risk-Based Screening Level

RBSLs for benzene are for 1×10^{-5} risk level, and have been multiplied by 0.29 to account for California's slope factor for benzene.

RES: The RBSL is greater than the holding capacity of the soil, and thus the soil can be saturated and not exceed the RBSL.

>S: The RBSL is greater than the solubility of that compound in water, and thus the water can be saturated and not exceed the RBSL.

■ Highlighted values indicate representative concentration exceeds respective RBSL.

RBCA TIER 1/TIER 2 EVALUATION

Table 2

Site Name: ARCO 2185
Site Location: dispenser data

Job Identification:
Date Completed:
Completed By: EMCON

Software: GSI RBCA Spreadsheet
Version: v 1.0

NOTE: values which differ from Tier 1 default values are shown in bold italics and underlined.

DEFAULT PARAMETERS

Exposure Parameter	Definition (Units)	Residential		Commercial/Industrial		
		Adult	(1-6yrs)	(1-16 yrs)	Chronic	Constructn
ATc	Averaging time for carcinogens (yr)					
ATn	Averaging time for non-carcinogens (yr)				25	1
BW	Body Weight (kg)				70	
ED	Exposure Duration (yr)				25	1
EF	Exposure Frequency (days/yr)				250	180
EF DERM	Exposure Frequency for dermal exposure				250	
IRgw	Ingestion Rate of Water (l/day)				1	
IRs	Ingestion Rate of Soil (mg/day)				50	100
IRadj	Adjusted soil ing. rate (mg/yr/kg*d)				9.4E+01	
IRa.in	Inhalation rate indoor (m ³ /day)				20	
IRa.out	Inhalation rate outdoor (m ³ /day)				20	10
SA	Skin surface area (dermal) (cm ²)				5.8E+03	5.8E+03
SAadj	Adjusted dermal area (cm ² yr/kg)				1.7E+03	
M	Soil to Skin adherence factor					
AAFs	Age adjustment on soil ingestion				FALSE	
AAFd	Age adjustment on skin surface area				FALSE	
tox	Use EPA tox data for air (or PEL based)					
gwMCL?	Use MCL as exposure limit in groundwater?					

Matrix of Exposed Persons to Complete Exposure Pathways	Residential		Commercial/Industrial	
	Chronic	Constructn	Chronic	Constructn
Groundwater Pathways:				
GW.i	Groundwater Ingestion		FALSE	
GW.v	Volatilization to Outdoor Air		TRUE	
GW.b	Vapor Intrusion to Buildings		TRUE	
Soil Pathways				
S.v	Volatiles from Subsurface Soils		TRUE	
SS.v	Volatiles and Particulate Inhalation		FALSE	FALSE
SS.d	Direct Ingestion and Dermal Contact		FALSE	FALSE
S.l	Leaching to Groundwater from all Soils		FALSE	
S.b	Intrusion to Buildings - Subsurface Soils		TRUE	

Matrix of Receptor Distance and Location on- or off-site	Residential		Commercial/Industrial	
	Distance	On-Site	Distance	On-Site
GW	Groundwater receptor (cm)			FALSE
S	Inhalation receptor (cm)			TRUE

Matrix of Target Risks	Target Risk (class A&B carcinogens)	Individual	Cumulative
		TRab	1.0E-05
TRc	Target Risk (class C carcinogens)	1.0E-05	
THQ	Target Hazard Quotient	1.0E+00	
Opt	Calculation Option (1, 2, or 3)	2	
Tier	RBCA Tier	2	

Surface Parameters	Definition (Units)	Residential		Commercial/Industrial	
		Chronic	Constructn	Chronic	Constructn
t	Exposure duration (yr)		30	25	1
A	Contaminated soil area (cm ²)		<u>1.6E+06</u>		<u>1.6E+06</u>
W	Length of affected soil parallel to wind (cm)		1.5E+03		1.0E+03
W' gw	Length of affected soil parallel to groundwater (cm)		1.5E+03		
Uair	Ambient air velocity in mixing zone (cm/s)		2.3E+02		
delta	Air mixing zone height (cm)		2.0E+02		
Lss	Definition of surficial soils (cm)		1.0E+02		
Pe	Particulate areal emission rate (g/cm ² /s)		2.2E-10		

Groundwater Parameters	Definition (Units)	Value
delta.gw	Groundwater mixing zone depth (cm)	2.0E+02
I	Groundwater infiltration rate (cm/yr)	3.0E+01
Ugw	Groundwater Darcy velocity (cm/yr)	<u>1.1E+02</u>
Ugw.tr	Groundwater Transport velocity (cm/yr)	<u>3.5E+02</u>
Ks	Saturated Hydraulic Conductivity (cm/s)	4.4E-04
grad	Groundwater Gradient (cm/cm)	8.0E-03
Sw	Width of groundwater source zone (cm)	6.1E+02
Sd	Depth of groundwater source zone (cm)	3.0E+02
BC	Biodegradation Capacity (mg/L)	1.6E+00
BIO?	Is Bioattenuation Considered	FALSE
phi.eff	Effective Porosity in Water-Bearing Unit	2.0E-01
loc.sat	Fraction organic carbon in water-bearing unit	1.0E-03

Soil Parameters	Definition (Units)	Value
hc	Capillary zone thickness (cm)	<u>2.0E+01</u>
hw	Vadose zone thickness (cm)	<u>2.4E+02</u>
rho	Soil density (g/cm ³)	1.72
loc	Fraction of organic carbon in vadose zone	<u>0.002</u>
phi	Soil porosity in vadose zone	<u>0.35</u>
Lgw	Depth to groundwater (cm)	<u>2.7E+02</u>
Ls	Depth to top of affected soil (cm)	<u>1.5E+02</u>
Lsubs	Thickness of affected subsurface soils (cm)	<u>1.2E+02</u>
pH	Soil/groundwater pH	6.5
		capillary vadose foundation
phi.w	Volumetric water content	<u>0.3</u>
phi.a	Volumetric air content	<u>0.05</u>
		<u>0.17</u> <u>0.17</u> <u>0.18</u>

Building Parameters	Definition (Units)	Residential	Commercial
Lb	Building volume/area ratio (cm)	2.0E+02	3.0E+02
ER	Building air exchange rate (h ⁻¹)	1.4E-04	2.3E-04
Lcrk	Foundation crack thickness (cm)	1.5E+01	
eta	Foundation crack fraction	<u>0.005</u>	

Dispersive Transport Parameters	Definition (Units)	Residential	Commercial
Groundwater			
ax	Longitudinal dispersion coefficient (cm)		
ay	Transverse dispersion coefficient (cm)		
az	Vertical dispersion coefficient (cm)		
Vapor			
dcy	Transverse dispersion coefficient (cm)		
dcz	Vertical dispersion coefficient (cm)		

Table 3
Tier 2 Results
ARCO Service Station 2185

Compound	Soil to Indoor Air	
	Representative Concentrations in Groundwater¹ (mg/kg)	Site-Specific Threshold Level (mg/kg)
Benzene	0.230	0.38

1. The most recent groundwater monitoring results from well EX-2 were used.
2. The maximum soil concentrations from the underground storage tank removal in June 1998. Site-specific threshold levels for benzene are for 1x10⁻⁵ risk level, and have been multiplied by slope factor for benzene.



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

Scale : 0 2000 4000 Feet



emcon

ARCO PRODUCTS COMPANY
SERVICE STATION 2185, 9800 E. 14TH STREET
TIER 1/TIER 2 RBCA EVALUATION
OAKLAND, CALIFORNIA

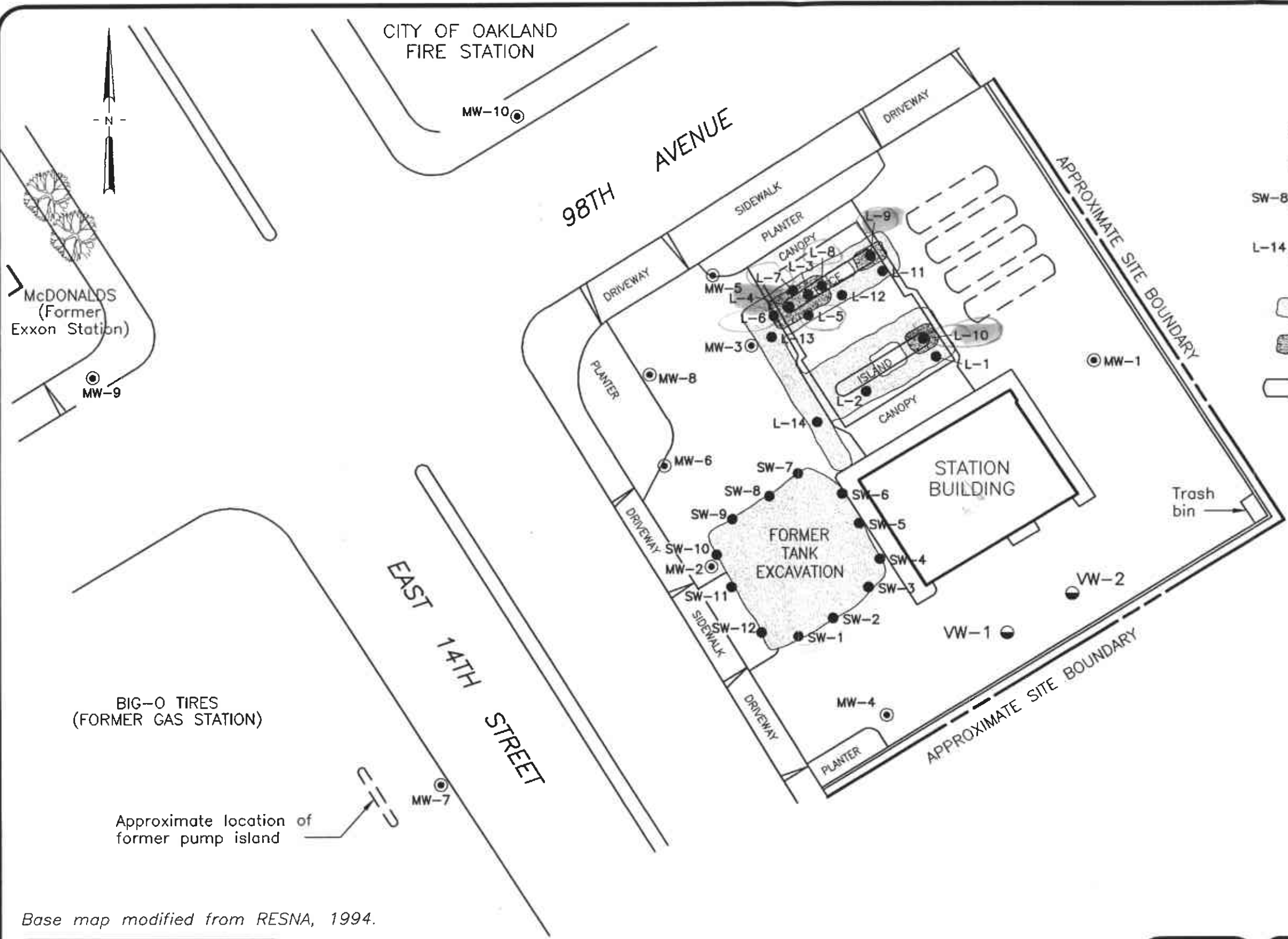
SITE LOCATION

FIGURE

1

PROJECT NO.
805-130.06

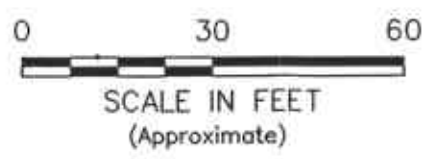
EA-SANJOSE-CAD/DRAWINGS: G:\805-130\SRBCA.dwg Xrefs: <NONE>
 Scale: 1 = 30.00 DimScale: 1 = 40.00 Date: 9/5/97 Time: 4:04 PM Operator: KLT



EXPLANATION

- ⊙ Groundwater monitoring well
- Vapor extraction well
- SW-8 ● Tank cavity soil sample location and designation
- L-14 ● Product line trench soil sample location and designation
- ▭ Excavated areas
- ▨ Extended excavated areas
- ▭ Existing underground gasoline storage tank

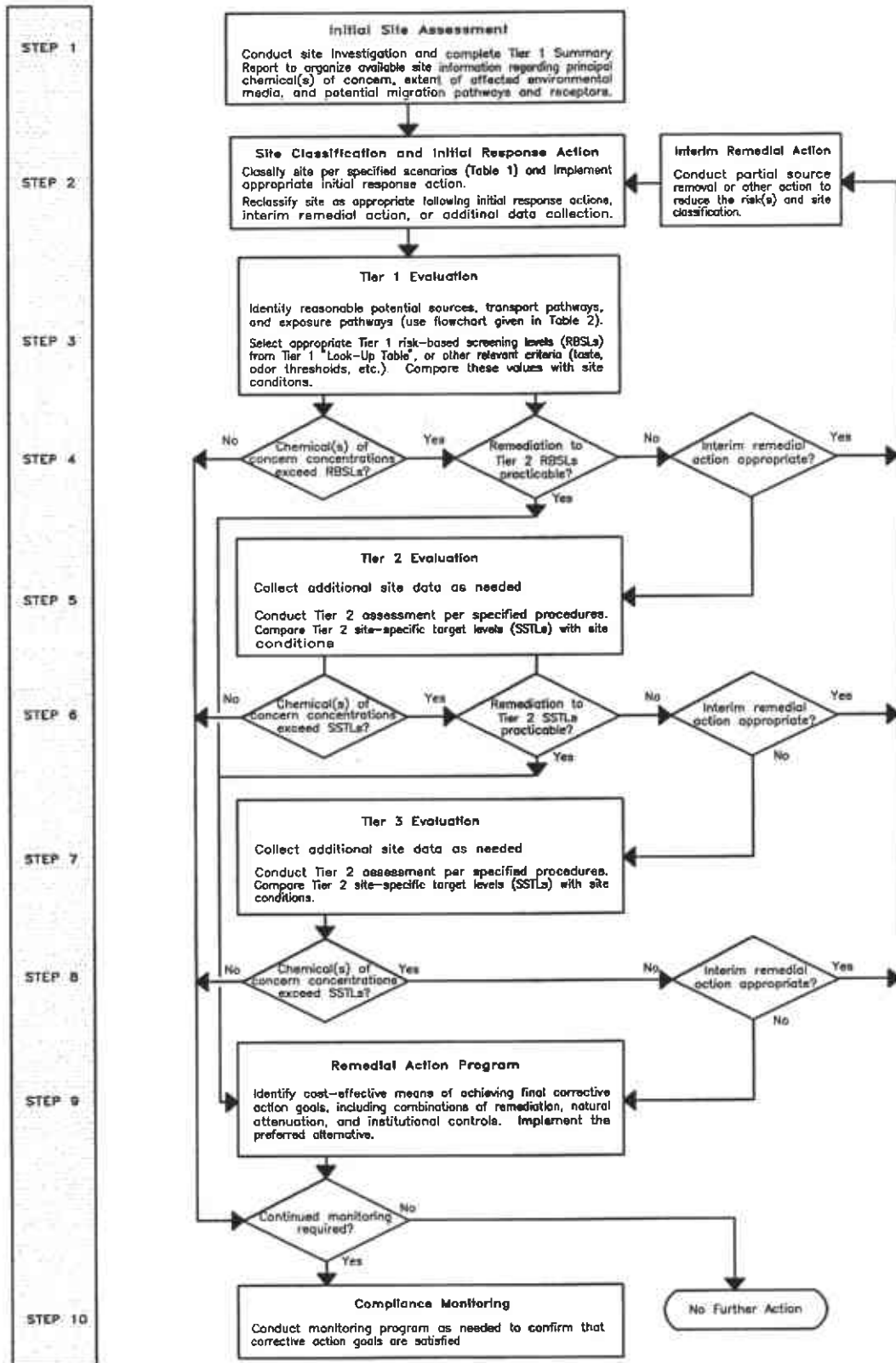
Base map modified from RESNA, 1994.



DATE AUG. 1997
 DWN KLT
 APP _____
 REV _____
 PROJECT NO.
 805-130.006

FIGURE 2
 ARCO PRODUCTS COMPANY
 SERVICE STATION 2185, 9800 E. 14TH ST.
 OAKLAND, CALIFORNIA
**TIER 1/TIER 2 RBCA EVALUATION
 EXCAVATED AREAS**

EA-SANJOSE-CAD/DRAWINGS: G:\805-130\RECAFLOW.dwg Xrefs: <NONE>
 Scale: 1 = 1.00 DimScale: 1 = 1.00 Date: 9/5/97 Time: 3:55 PM Operator: KLT



DATE AUG. 1997
 DWN KLT
 APP _____
 REV _____
 PROJECT NO.
 805-130.06

FIGURE 3
 ARCO PRODUCTS COMPANY
 SERVICE STATION 2185, 9800 E. 14TH STREET
 OAKLAND, CALIFORNIA
RISK-BASED CORRECTIVE ACTION PLAN
PROCESS FLOWCHART

APPENDIX A
HISTORICAL GROUNDWATER AND SOIL
ANALYTICAL DATA

TABLE 1
 CUMULATIVE RESULTS OF LABORATORY
 ANALYSES OF SOIL SAMPLES
 ARCO Station 2185
 Oakland, California
 (Page 1 of 2)

Sample ID	Depth	TPHg	B	T	E	X
<u>May 1991</u>						
B1-5	5	<1.0	0.021	<0.0050	<0.0050	<0.0050
B1-10	10	350	1.1	0.65	4.9	19
B2-5	5	<1.0	0.034	<0.0050	<0.0050	<0.0050
B2-10	10	280	1.3	0.34	3.4	10
B3-5	5	1.6	0.015	<0.0050	0.021	0.048
B3-10	10	38	<0.050	0.24	.031	2.0
B4-5	5	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
B4-10	10	110	0.40	0.20	0.72	0.24
<u>September 1991</u>						
B5-5	5	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
B5-11	11	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
B5-13	13	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
B6-5	5	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
B6-10	10	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
B7-5	5	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
B7-11	11	1.7	0.04	0.013	0.0079	0.078
B7-13	13	1.7	0.27	0.0083	0.04	0.028
B8-5	5	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
B8-11	11	1.7	0.054	0.0094	0.012	0.019
B8-13	13	1.3	0.013	0.0073	0.0053	0.0069
<u>Tank Excavation November 1991</u>						
SW-1	14	810	3.4	1.0	13	50
SW-2	6	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
SW-3	14	370	1.6	17	8.8	53
SW-4	14	220	0.73	1.2	2.8	15
SW-5	6	1.1	0.014	0.0069	0.012	0.034
SW-6	14	230	0.84	2.3	2.4	15
SW-7	14	1100	5.9	28	15	90
SW-8	6	1.3	0.11	0.0054	<0.0050	0.016
SW-9	14	500	3.7	0.92	7.1	32
SW-10	14	750	5.9	5.3	10	61
SW-11	6	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
SW-12	14	210	1.6	0.26	3.2	5.0
<u>Product Lines</u>						
L-1	3	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
L-2	3	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
L-3	5	1,400	0.51	87	55	350
L-4	11	450	2.6	24	8.7	56
L-5	8	18	<0.0050	0.029	0.042	0.38
L-6	8	<1.0	<0.0050	<0.0050	<0.0050	<0.0050

See notes on page 2 of 2.

*residual
 vadose
 soil conc
 to 9.5'
 in product
 line area*

TABLE 1
 CUMULATIVE RESULTS OF LABORATORY
 ANALYSES OF SOIL SAMPLES
 ARCO Station 2185
 Oakland, California
 (Page 2 of 2)

Sample ID	Depth	TPHg	B	T	E	X
<u>Product Lines (cont.)</u>						
L-7	8	5.1	0.032	0.047	0.058	0.13
L-8	8	240	0.17	2.8	2.8	15
L-9	9.5	5,400	22	330	120	640
L-10	8	2,600	5	130	53	29
L-11	3	1.4	<0.0050	0.014	0.012	0.1
L-12	3	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
L-13	3	13	<0.0050	0.026	0.05	0.7
L-14	3	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
<u>July 1992</u>						
S-10.5-B9	10.5	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
S-13-B9	13	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
S-23.5-B9	23.5	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
S-9.5-B10	9.5	9.3	0.034	0.023	0.014	0.059
S-12-B10	12	220	1.1	0.75	5.1	6.3
S-23-B10	23	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
S-10.5-B11	10.5	<1.0	0.0060	<0.0050	<0.0050	<0.0050
S-29-B11	29	<1.0	<0.0050	0.015	0.015	0.078
S-10-B12	10	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
S-13-B12	13	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
S-23.5-B12	23.5	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
<u>Composited Stockpile Sample</u>						
SPA-SPD	NA	<1.0	<0.0050	<0.0050	0.010	0.012

Results in parts per million (ppm).

Depth in feet below ground surface.

TPHg = Total petroleum hydrocarbons as gasoline using EPA Methc.d 5030/8020/8015

B = benzene, T = toluene, E = ethylbenzene, X = total xylenes (EPA Method 8020/8015)

< = Below indicated laboratory reporting limits.

NA = Not applicable

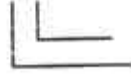
Sample Identification:

S-10-B12



Boring number
 Sample depth in feet below ground surface
 Soil sample

SW-1



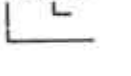
Sample number
 Former tank cavity sample

B1-5



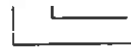
Sample depth in feet below ground surface
 Boring number

SPA-SPD



Composite sample
 Soil pile

Line-1



Sample number
 Product line sample

Handwritten notes: 13.7, 27.712, 2.1

Handwritten notes: 10.5, 13, 23.5, 9.5, 12, 23, 10.5, 29, 10, 13, 23.5

Table 1
Groundwater Monitoring Data
Second Quarter 1997

ARCO Service Station 2185
9800 East 14th Street, Oakland, California

Date: 08-27-97

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
MW-1	06-17-97	29.15	11.27	17.88	ND	W	0.001	06-17-97	Not sampled: well sampled annually, during the first quarter						
MW-2	06-17-97	28.47	10.99	17.48	ND	W	0.001	06-17-97	510	<7 [^]	0.9	1.1	<2 [^]	<3	--
MW-3	06-17-97	28.57	10.95	17.62	ND	W	0.001	06-17-97	<200 [^]	<2 [^]	<2 [^]	<2 [^]	<2 [^]	200	--
MW-4	06-17-97	29.21	11.60	17.61	ND	W	0.001	06-17-97	Not sampled: well sampled annually, during the first quarter						
MW-5	06-17-97	28.12	10.52	17.60	ND	W	0.001	06-17-97	Not sampled: well sampled semi-annually, during the first and third quarters						
MW-6	06-17-97	27.79	10.37	17.42	ND	W	0.001	06-17-97	Not sampled: well sampled semi-annually, during the first and third quarters						
MW-7	06-17-97	27.88	11.13	16.75	ND	W	0.001	06-17-97	Not sampled: well sampled annually, during the first quarter						
MW-8	06-17-97	28.08	10.67	17.41	ND	W	0.001	06-17-97	Not sampled: well sampled semi-annually, during the first and third quarters						
MW-9	06-17-97	27.73	11.30	16.43	ND	W	0.001	06-17-97	Not sampled: well sampled annually, during the first quarter						
MW-10	06-17-97	27.55	10.40	17.15	ND	W	0.001	06-17-97	Not sampled: well sampled annually, during the first 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

ND: none detected

W: west

--: not analyzed

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

Table 2
 Historical Groundwater Elevation and Analytical Data
 Petroleum Hydrocarbons and Their Constituents
 1995 - Present**

ARCO Service Station 2185
 9800 East 14th Street, Oakland, California

Date: 08-27-97

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	TPHC 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	
MW-1	03-15-95	29.15	8.50	20.65	ND	NW	0.01	03-15-95	<50	<0.5	<0.5	<0.5	<0.5	--	--	
MW-1	05-30-95	29.15	10.28	18.87	ND	SW	0.005	05-30-95	Not sampled: well sampled annually, during the first quarter						--	--
MW-1	09-20-95	29.15	11.70	17.45	ND	WSW	0.005	09-20-95	Not sampled: well sampled annually, during the first quarter						--	--
MW-1	11-07-95	29.15	12.12	17.03	ND	WSW	0.004	11-07-95	Not sampled: well sampled annually, during the first quarter						--	--
MW-1	02-28-96	29.15	8.54	20.61	ND	NW	0.009	02-28-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	
MW-1	05-30-96	29.15	10.05	19.10	ND	W	0.007	05-31-96	Not sampled: well sampled annually, during the first quarter						--	--
MW-1	08-20-96	29.15	11.35	17.80	ND	SW	0.005	08-20-96	Not sampled: well sampled annually, during the first quarter						--	--
MW-1	11-19-96	29.15	11.20	17.95	ND	WSW	0.005	11-19-96	Not sampled: well sampled annually, during the first quarter						--	--
MW-1	03-25-97	29.15	10.12	19.03	ND	WNW	0.006	03-25-97	<50	<0.5	<0.5	<0.5	<0.5	<3	--	
MW-1	06-17-97	29.15	11.27	17.88	ND	W	0.001	06-17-97	Not sampled: well sampled annually, during the first quarter						--	--
MW-2	03-15-95	28.47	8.37	20.10	ND	NW	0.01	03-15-95	2100	7.4	<2.5	130	39	--	--	
MW-2	05-30-95	28.47	9.95	18.52	ND	SW	0.005	05-30-95	1700	3.3	<2.5	120	31	--	--	
MW-2	09-20-95	28.47	11.37	17.10	ND	WSW	0.005	09-21-95	1200	1	<1	68	16	<5	--	
MW-2	11-07-95	28.47	11.73	16.74	ND	WSW	0.004	11-07-95	1100	<3	<3	74	14	<20	--	
MW-2	02-28-96	28.47	8.12	20.35	ND	NW	0.009	02-29-96	2200	<3	<3	130	27	<20	--	
MW-2	05-30-96	28.47	9.89	18.58	ND	W	0.007	05-31-96	970	<9	<1	29	3	<5	--	
MW-2	08-20-96	28.47	11.05	17.42	ND	SW	0.005	08-20-96	670	<1	<1	16	1	<5	--	
MW-2	11-19-96	28.47	10.96	17.51	ND	WSW	0.005	11-19-96	990	<1^	<1^	46	3	<5^	--	
MW-2	03-25-97	28.47	9.84	18.63	ND	WNW	0.006	03-25-97	540	<1^	<1^	<1^	<1^	<6^	--	
MW-2	06-17-97	28.47	10.99	17.48	ND	W	0.001	06-17-97	510	<7^	0.9	1.1	<2^	<3	--	

Table 2
 Historical Groundwater Elevation and Analytical Data
 Petroleum Hydrocarbons and Their Constituents
 1995 - Present**

ARCO Service Station 2185
 9800 East 14th Street, Oakland, California

Date: 08-27-97

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	TPHC LUFT Method	Benzene EPA 8020	Toluene EPA 8020	Ethylbenzene EPA 8020	Total Xylenes EPA 8020	MTBE EPA 8020	MTBE EPA 8240
		ft-MSL	feet	ft-MSL	feet	MWN	ft/ft		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-3	03-15-95	28.57	8.47	20.10	ND	NW	0.01	03-15-95	2000	<2.5	<2.5	88	82	--	--
MW-3	05-30-95	28.57	10.03	18.54	ND	SW	0.005	05-30-95	2000	3.2	<2.5	70	46	--	--
MW-3	09-20-95	28.57	11.30	17.27	ND	WSW	0.005	09-21-95	2100	12	<3	77	38	280	--
MW-3	11-07-95	28.57	11.65	16.92	ND	WSW	0.004	11-07-95	3000	18	<3	120	62	--	430
MW-3	02-28-96	28.57	8.35	20.22	ND	NW	0.009	02-29-96	5100	83	<5	160	57	640	--
MW-3	05-30-96	28.57	9.77	18.80	ND	W	0.007	05-31-96	2100	41	<5	57	15	890	--
MW-3	08-20-96	28.57	11.00	17.57	ND	SW	0.005	08-20-96	2500	94	<2.5	62	14	2200	--
MW-3	11-19-96	28.57	10.92	17.65	ND	WSW	0.005	11-19-96	2400	84	<2.5^	73	22	1300	--
MW-3	03-25-97	28.57	9.90	18.67	ND	WNW	0.006	03-25-97	<50	<0.5	<0.5	<0.5	<0.5	48	--
MW-3	06-17-97	28.57	10.95	17.62	ND	W	0.001	06-17-97	<200^	<2^	<2^	<2^	<2^	200	--
MW-4	03-15-95	29.21	8.69	20.52	ND	NW	0.01	03-15-95	<50	<0.5	<0.5	<0.5	<0.5	--	--
MW-4	05-30-95	29.21	10.57	18.64	ND	SW	0.005	05-30-95	Not sampled: well sampled annually, during the first quarter						
MW-4	09-20-95	29.21	12.02	17.19	ND	WSW	0.005	09-20-95	Not sampled: well sampled annually, during the first quarter						
MW-4	11-07-95	29.21	12.42	16.79	ND	WSW	0.004	11-07-95	Not sampled: well sampled annually, during the first quarter						
MW-4	02-28-96	29.21	8.66	20.55	ND	NW	0.009	02-28-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--
MW-4	05-30-96	29.21	10.34	18.87	ND	W	0.007	05-31-96	Not sampled: well sampled annually, during the first quarter						
MW-4	08-20-96	29.21	11.67	17.54	ND	SW	0.005	08-20-96	Not sampled: well sampled annually, during the first quarter						
MW-4	11-19-96	29.21	11.50	17.71	ND	WSW	0.005	11-19-96	Not sampled: well sampled annually, during the first quarter						
MW-4	03-25-97	29.21	10.42	18.79	ND	WNW	0.006	03-25-97	<50	<0.5	<0.5	<0.5	<0.5	<3	--
MW-4	06-17-97	29.21	11.60	17.61	ND	W	0.001	06-17-97	Not sampled: well sampled annually, during the first quarter						

Table 2
 Historical Groundwater Elevation and Analytical Data
 Petroleum Hydrocarbons and Their Constituents
 1995 - Present**

ARCO Service Station 2185
 9800 East 14th Street, Oakland, California

Date: 08-27-97

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	TPHC 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
MW-5	03-15-95	28.12	8.47	19.65	ND	NW	0.01	03-15-95	170	5.6	<0.5	17	11	--	--
MW-5	05-30-95	28.12	9.69	18.43	ND	SW	0.005	05-30-95	53	0.6	<0.5	4.8	2.8	--	--
MW-5	09-20-95	28.12	10.90	17.22	ND	WSW	0.005	09-21-95	1500	47	2	120	86	70	--
MW-5	11-07-95	28.12	11.20	16.92	ND	WSW	0.004	11-07-95	140	4.5	<0.5	8.3	16	10	--
MW-5	02-28-96	28.12	8.15	19.97	ND	NW	0.009	02-29-96	900	11	<1	59	29	99	--
MW-5	05-30-96	28.12	9.48	18.64	ND	W	0.007	05-31-96	Not sampled: well sampled semi-annually, during the first and third quarters						
MW-5	08-20-96	28.12	10.58	17.54	ND	SW	0.005	08-20-96	67	0.7	<0.5	3.6	0.6	27	--
MW-5	11-19-96	28.12	10.50	17.62	ND	WSW	0.005	11-19-96	Not sampled: well sampled semi-annually, during the first and third quarters						
MW-5	03-25-97	28.12	9.58	18.54	ND	WNW	0.006	03-25-97	<50	<0.5	<0.5	<0.5	<0.5	<3	--
MW-5	06-17-97	28.12	10.52	17.60	ND	W	0.001	06-17-97	Not sampled: well sampled semi-annually, during the first and third quarters						
MW-6	03-15-95	27.79	7.75	20.04	ND	NW	0.01	03-15-95	3600	77	<5	420	180	--	--
MW-6	05-30-95	27.79	9.48	18.31	ND	SW	0.005	05-30-95	5000	68	<5	530	250	--	--
MW-6	09-20-95	27.79	10.75	17.04	ND	WSW	0.005	09-21-95	3300	36	<5	360	120	<30	--
MW-6	11-07-95	27.79	11.06	16.73	ND	WSW	0.004	11-07-95	3500	33	<5	410	110	<30	--
MW-6	02-28-96	27.79	7.86	19.93	ND	NW	0.009	02-29-96	520	33	<5	480	160	<30	--
MW-6	05-30-96	27.79	9.35	18.44	ND	W	0.007	05-31-96	Not sampled: well sampled semi-annually, during the first and third quarters						
MW-6	08-20-96	27.79	10.43	17.36	ND	SW	0.005	08-20-96	1900	3.4	<2.5	150	21	<12	--
MW-6	11-19-96	27.79	10.36	17.43	ND	WSW	0.005	11-19-96	Not sampled: well sampled semi-annually, during the first and third quarters						
MW-6	03-25-97	27.79	9.35	18.44	ND	WNW	0.006	03-25-97	1100	<2^	<2^	5	5	<10^	--
MW-6	06-17-97	27.79	10.37	17.42	ND	W	0.001	06-17-97	Not sampled: well sampled semi-annually, during the first and third quarters						

Table 2
 Historical Groundwater Elevation and Analytical Data
 Petroleum Hydrocarbons and Their Constituents
 1995 - Present**

ARCO Service Station 2185
 9800 East 14th Street, Oakland, California

Date: 08-27-97

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
MW-7	03-15-95	27.88	8.13	19.75	ND	NW	0.01	03-15-95	150*	<0.5	<0.5	<0.5	<0.5	--	--
MW-7	05-30-95	27.88	10.14	17.74	ND	SW	0.005	05-30-95	110*	<0.5	<0.5	<0.5	<0.5	--	--
MW-7	09-20-95	27.88	11.52	16.36	ND	WSW	0.005	09-20-95	<400*	<0.8	<0.5	<0.5	<0.5	<7	--
MW-7	11-07-95	27.88	11.70	16.18	ND	WSW	0.004	11-07-95	<500	2	<1	<1	<1	<20	--
MW-7	02-28-96	27.88	8.19	19.69	ND	NW	0.009	02-29-96	<300*	<0.5	<0.5	<0.5	<0.5	<6	--
MW-7	05-30-96	27.88	9.98	17.90	ND	W	0.007	05-31-96	<100*	<0.5	<0.5	<0.5	<0.5	<3	--
MW-7	08-20-96	27.88	11.15	16.73	ND	SW	0.005	08-20-96	<200*	<0.5	<0.5	<0.5	<0.5	<5	--
MW-7	11-19-96	27.88	10.92	16.96	ND	WSW	0.005	11-19-96	Not sampled: well sampled annually, during the first quarter						
MW-7	03-25-97	27.88	9.88	18.00	ND	WNW	0.006	03-25-97	<50	<0.5	<0.5	<0.5	<0.5	<3	--
MW-7	06-17-97	27.88	11.13	16.75	ND	W	0.001	06-17-97	Not sampled: well sampled annually, during the first quarter						
MW-8	03-15-95	NR	8.43	NR	ND	NR	NR	03-15-95	280	<0.5	<0.5	0.7	0.7	--	--
MW-8	05-30-95	NR	9.86	NR	ND	NR	NR	05-30-95	390	<0.5	<0.5	<2	1.6	--	--
MW-8	09-20-95	28.08	11.07	17.01	ND	WSW	0.005	09-21-95	470	<0.5	<0.5	3	1.2	52	--
MW-8	11-07-95	28.08	11.40	16.68	ND	WSW	0.004	11-07-95	280	<0.5	<0.5	0.6	<0.5	94	--
MW-8	02-28-96	28.08	8.30	19.78	ND	NW	0.009	02-29-96	160	<0.5	<0.5	<0.9	<0.6	32	--
MW-8	05-30-96	28.08	9.68	18.40	ND	W	0.007	05-31-96	100	<0.5	<0.5	<0.6	<0.5	16	--
MW-8	08-20-96	28.08	10.72	17.36	ND	SW	0.005	08-20-96	140	<0.5	<0.5	<0.5	<0.5	190	--
MW-8	11-19-96	28.08	10.58	17.50	ND	WSW	0.005	11-19-96	Not sampled: well sampled semi-annually, during the first and third quarters						
MW-8	03-25-97	28.08	9.73	18.35	ND	WNW	0.006	03-25-97	63	<0.5	<0.5	<0.5	<0.5	38	--
MW-8	06-17-97	28.08	10.67	17.41	ND	W	0.001	06-17-97	Not sampled: well sampled semi-annually, during the first and third quarters						

Table 2
 Historical Groundwater Elevation and Analytical Data
 Petroleum Hydrocarbons and Their Constituents
 1995 - Present**

ARCO Service Station 2185
 9800 East 14th Street, Oakland, California

Date: 08-27-97

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	TPHC 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	
MW-9	09-20-95	27.73	11.67	16.06	ND	WSW	0.005	09-20-95	<50	<0.5	<0.5	<0.5	<0.5	<4	--	
MW-9	11-07-95	27.73	11.70	16.03	ND	WSW	0.004	11-07-95	<50	<0.5	<0.5	<0.5	<0.5	<4	--	
MW-9	02-28-96	27.73	9.23	18.50	ND	NW	0.009	02-29-96	<50	<0.5	<0.5	<0.5	<0.5	<4	--	
MW-9	05-30-96	27.73	10.50	17.23	ND	W	0.007	05-31-96	<50	0.6	<0.5	<0.5	<0.5	<4	--	
MW-9	08-20-96	27.73	11.33	16.40	ND	SW	0.005	08-20-96	<50	<0.5	<0.5	<0.5	<0.5	<4	--	
MW-9	11-19-96	27.73	11.20	16.53	ND	WSW	0.005	11-19-96	Not sampled: well sampled annually, during the first quarter						<4	--
MW-9	03-25-97	27.73	10.41	17.32	ND	WNW	0.006	03-25-97	<50	<0.5	<0.5	<0.5	<0.5	<4	--	
MW-9	06-17-97	27.73	11.30	16.43	ND	W	0.001	06-17-97	Not sampled: well sampled annually, during the first quarter							
MW-10	09-20-95	27.55	10.65	16.90	ND	WSW	0.005	09-21-95	<50	<0.5	<0.5	<0.5	<0.5	<3	--	
MW-10	11-07-95	27.55	10.85	16.70	ND	WSW	0.004	11-07-95	<50	<0.5	<0.5	<0.5	<0.5	<3	--	
MW-10	02-28-96	27.55	9.38	18.17	ND	NW	0.009	02-29-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	
MW-10	05-30-96	27.55	9.99	17.56	ND	W	0.007	05-31-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	
MW-10	08-20-96	27.55	10.47	17.08	ND	SW	0.005	08-20-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	
MW-10	11-19-96	27.55	10.44	17.11	ND	WSW	0.005	11-19-96	Not sampled: well sampled annually, during the first quarter							
MW-10	03-25-97	27.55	10.02	17.53	ND	WNW	0.006	03-25-97	<50	<0.5	<0.5	<0.5	<0.5	<3	--	
MW-10	06-17-97	27.55	10.40	17.15	ND	W	0.001	06-17-97	Not sampled: well sampled annually, during the first quarter							

Table 2
Historical Groundwater Elevation and Analytical Data
Petroleum Hydrocarbons and Their Constituents
1995 - Present**

ARCO Service Station 2185
 9800 East 14th Street, Oakland, California

Date: 08-27-97

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
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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

ND: none detected

NR: not reported; data not available or not measurable

SW: southwest

NW: northwest

WSW: west-southwest

WNW: west-northwest

W: west

*: chromatogram does not match the typical gasoline fingerprint

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

--: not analyzed or not applicable

** For previous historical groundwater elevation and analytical data please refer to *Fourth Quarter 1995 Groundwater Monitoring Program Results, ARCO Service Station 2185, Oakland, California*, (EMCON, February 27, 1996).