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97 JUN -2 PM 4:35

STID #
744

May 23, 1997
Project 20174-127.004

Mr. Kevin Tinsley
Alameda County Health Care Services Agency
1131 Harbor Bay Parkway
Alameda, California, 94502

Re: Resubmittal of Tier 1, Tier 2 Risk-based Corrective Action Evaluation for ARCO
Service Station 2111, 1156 Davis Street, San Leandro, California

Dear Mr. Tinsley:

The Tier 1, Tier 2 Risk-Based Corrective Action Evaluation for ARCO Service Station 2111 was submitted to the Alameda County Health Care Services Agency (ACHCSA) on September 27, 1996. It was originally submitted to the attention of Mr. Dale Klettke. It is our understanding, however, that you have assumed Mr. Klettke's responsibilities. We have contacted you and Ms. Medula Logan of your office, and have learned from Ms. Logan that this report has not been forwarded to her for review. Because it has been nearly eight months since this report was submitted, we are resubmitting this report for your review. In addition, a copy of this report is being forwarded to Ms. Logan for her review.

We hope the ACHCSA can review this report in a timely manner. If you have any questions, please do not hesitate to call.

Sincerely,

EMCON

Valli Voruganti
Project Manager

Dr. Ray Kaminsky
Environmental Chemist

cc: Ms. Medula Logan, ACHCSA
Mr. Paul Supple, ARCO Products Company
File





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Mr. Paul Supple, ARCO Products Company
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September 27, 1996
Project 20805-127.004

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

Re: Tier 1, Tier 2 Risk-Based Corrective Action Evaluation for ARCO Service
Station 2111, 1156 Davis Street, San Leandro, 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 2111, 1156 Davis Street, San Leandro, California (Figures 1 and 2). This report addresses potential exposures to current and future workers on the commercial property and to visitors to the First Christian Church/Community Center. The RBCA evaluation results indicate that no acceptable levels of risk are exceeded at this site.

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 as follows:

- Source must be removed

The waste oil tank and petroleum impacted soils to the north of the service station building were removed in August 1994, and no petroleum hydrocarbons have been detected in the two monitoring wells downgradient of the former tank. Although source removal has not been performed to address the impacted groundwater associated with the fuel tanks, the declining levels of petroleum hydrocarbons in groundwater monitoring wells downgradient of the tanks suggests the presence of a temporary or diminishing source which is, in effect, equivalent to source removal.

- Site is adequately characterized

Soil and groundwater investigations have been performed at the site and have investigated the lateral and vertical extent of gasoline hydrocarbons in soil and groundwater (*Soil and Groundwater Assessment Report, Arco Service Station 2111, San Leandro, California, EMCON, September 1996*).

- Plume is stable or receding



Concentrations of gasoline and its constituents (i.e., benzene, toluene, ethylbenzene, and xylenes [BTEX]) dissolved in groundwater have been decreasing in groundwater monitoring wells since the monitoring program was initiated in the third quarter of 1995 (Table 1).

- No threat to surface water or deep aquifers

Groundwater investigations have defined the vertical extent of the dissolved gasoline plume to be contained within the shallow water bearing zone (EMCON, September 1996). No deep aquifers or surface waters are impacted or threatened.

- No threat to human health

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

- No threat to the environment

No ecological receptors have been identified as threatened.

This RBCA evaluation was prepared in accordance with the guidelines contained in *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 guidelines is designed as a step-wise process to evaluate the potential risk posed by a chemical release, determine what corrective action, if any, is needed, 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 *Tier 2 RBCA Tool Kit* worksheets contained in Attachment A. This report should be read in conjunction with reviewing these worksheets.

INITIAL SITE ASSESSMENT AND SITE CLASSIFICATION

Steps 1 and 2 of 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 to the surface has taken place in which direct contact to product is a possibility, or where a release presents a potential for an explosion to occur. Chemical impact to soil and groundwater at this site has been characterized (EMCON, September 1996) and summarized in Worksheet 4.2. No surface releases have taken place at this site which have not been immediately contained and cleaned. Although gasoline has been detected in the subsurface, these hydrocarbons do not present a potential risk of direct contact. A comparison of site-measured soil and groundwater data

to conservative, onsite-specific, health-based screening levels, in accordance with the ASTM RBCA guidelines, was undertaken. This is referred to in the ASTM guidelines 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 the on-site and off-site impact has been established, and is documented in the site assessment and quarterly monitoring reports, and is summarized in Worksheet 1.1. Current benzene concentrations dissolved in groundwater are summarized in Figure 4. Soil and additional analytical information is summarized in Worksheets 5.2, 5.3, and 5.6.

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 (i.e., benzene, toluene, ethylbenzene, and, xylenes [BTEX])
- a transport mechanism (e.g., groundwater migration)
- a potential receptor (e.g., groundwater must be considered potable for a groundwater ingestion exposure pathway to be considered complete)

First encountered groundwater at this site is not considered potable due to the sites location within a regional solvent plume, and for this reason potential exposure pathways involving groundwater (e.g., infiltration from subsurface soil to groundwater and direct groundwater ingestion) were not evaluated further. Similarly, direct exposure to surface and subsurface soil at this site is not considered a complete exposure pathway because this site is covered by asphalt and a concrete slab structure. In addition, although subsurface soil sampled during the installation of monitoring wells MW-5, MW-6 and MW-7 and vapor extraction wells V-1 through V-4 was found to contain relatively low concentrations of petroleum hydrocarbons (a maximum of 0.3 milligram per kilogram [mg/kg] benzene), these were detected exclusively within the groundwater fluctuation zone (EMCON, September 1996). These results indicate that the impacted soil does not represent a significant source, but rather the groundwater is the only potential source of hydrocarbons to both the soil and possible receptors. For this reason, potential exposure routes involving subsurface soil were not considered significant for the purpose of this investigation.

As summarized in Worksheet 1.4, the only complete potential exposure pathways at this site are:

- volatilization of chemicals in groundwater through the unsaturated zone to ambient air
- volatilization of chemicals in groundwater through the unsaturated zone to indoor air

Quarterly groundwater monitoring events have shown a decreasing trend in BTEX levels in the groundwater. As a result of this trend, the most recent groundwater concentrations were used to represent the magnitude of the chemical source. Benzene, toluene, ethylbenzene and total xylene (BTEX) concentrations from the well nearest the service station and the church (i.e., well MW-2) were used to represent the source of BTEX to which hypothetical indoor receptors may be exposed. For exposure through volatilization of chemicals in groundwater to ambient air, the average groundwater concentrations detected in wells MW-2 and MW-7 were used to represent the concentration of dissolved constituents over the area of groundwater impact. This is a conservative approach because these are the only wells for which petroleum hydrocarbons have been detected.

The site is currently operated as a service station, and is assumed to remain a service station for the purpose of this evaluation. People using the church are expected to occupy the structure less than either the 24 hour/day, 7 day/week for 30 years assumed for the residential exposure scenario or the 8 hour /day, 5 days/week for 25 years assumed for the commercial/industrial exposure scenario. For the purpose of this evaluation, however, the commercial/industrial exposure assumptions were conservatively assumed for the potential receptors in both these indoor spaces. The values for the exposure parameters used in this evaluation are summarized in Worksheet 4.3.

*no-one
lives
church.*

For on-site receptors, acceptable risk-based soil and groundwater levels were calculated based on a 1×10^{-5} (i.e., 1 in 100,000) probability of developing cancer from cancer-causing substances, and a hazard quotient of 1 for noncancer-causing substances. For off-site receptors, which include workers and children at the daycare center as well as visitors to the church and community center, acceptable risk-based soil and groundwater levels were calculated based on a 1×10^{-6} (i.e., 1 in 100,000) probability of developing cancer from cancer-causing substances, and a hazard quotient of 1 for noncancer-causing substances

*Where
daycare
center*

The next step in this Tier 1 evaluation is to review the assumptions used to derive the risk-based screening levels (RBSLs) for contaminated media (i.e., groundwater) and potential exposure routes (i.e., inhalation of indoor and ambient air), and determine whether they are likely to be conservative for this site.

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

- Losses due to biodegradation and adsorption onto soil during volatilization from the unsaturated zone are not accounted for by the models.
- Volatilization of BTEX to ambient air was considered a complete 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 RBSLs for volatilization from soil and groundwater to ambient air are based on the assumption that volatilization takes place through a sandy material. In fact, the soils at this site are clays with gravelly lenses. The RBSLs, therefore, are based on significantly higher rates of volatilization than are expected at this site.

The assumptions used to develop RBSLs for the pertinent potential exposure pathways are judged to be appropriate for the purposes of screening. The only modification necessary to the RBSLs presented in Table X2.1 of the ASTM guidelines 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). For example, the adjusted RBSL from Table X2.1 for exposure to benzene through volatilization from groundwater to ambient air is presented below.

For Commercial/Industrial Receptor Scenario:

Vapor intrusion from groundwater into indoor air

Target Levels from Lookup Table X2.1 for Benzene (mg/l)

- 10^{-6} risk - (i.e., $1E-06$) = $7.39E-02$

Selected a RBSL corresponding to a on-site 10^{-5} risk

- $1E-05$ risk = $7.39E-01$ or 0.074 mg/l

RWQCB benzene correction

- $0.074 \text{ mg/l} \times 0.29 = 0.021 \text{ mg/l}$

RBSL = 0.021 mg/l

As shown in Worksheet 4.4, comparing the appropriate groundwater concentrations of benzene, toluene, ethylbenzene and xylenes to the RBSLs for each respective pathway, the RBSLs for groundwater-to-ambient air pathway was not exceeded. In accordance with ASTM guidelines, no further evaluation is necessary for the ambient air pathway, or for toluene, ethylbenzene or xylenes via the groundwater-to-indoor air pathway.

The results in Worksheet 4.4, however, show that the RBSLs for benzene in the groundwater-to-indoor air scenario for both the service station and the church were exceeded. Although these results do not necessarily indicate a risk to public health (because they are only screening levels), they indicate that further evaluation is needed to determine if a risk to public health is present at this site. The next step (Step 5) in the RBCA procedure is a Tier 2 evaluation of benzene for the indoor pathways from groundwater to the service station and the church.

TIER 2 EVALUATION

In accordance with the ASTM guidelines, the same conservative volatilization models used in the Tier 1 evaluation were used to evaluate the presence of benzene in the groundwater-to-indoor air potential exposure pathway to the service station and the church. The Tier 2 evaluation, however, incorporates greater site-specificity in the values used for the model parameters. Greater site-specificity was achieved in two main areas.

- Accounting for the type of soil present at the site, and the thickness of the unsaturated zone.
- Accounting for the fact that the BTEX concentrations used in the Tier 1 assessment were from a well that is about 40 feet upgradient from the center of the church, and thus the concentrations were probably significantly greater than those beneath the church.

Soil parameter values for soil water content, bulk density and total organic carbon were not measured at this site. Conservative values for some of these parameters were estimated by using values measured at another site. The second site is located on clayey sand; therefore, the water content and bulk density of the unsaturated zone soil from the second site would tend to be less than that expected for a site, such as ARCO 2111, located on clay with gravelly lenses (EMCON, September 1996). Soil porosity was also

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. Similarly, capillary thickness was increased from 5 to 30.5 centimeters to account for the heavier soils. The default for bulk density (1.7 grams per cubic centimeter) and total organic carbon (1 percent) were used for this evaluation. The foundation at the site was found to be competent, based on an observation made by EMCON, during a site inspection in September 1996. As a result, the fraction of the foundation areas for the service station and church assumed to be cracked were reduced from 1 to 0.5 percent, to represent a more accurate but still conservative estimate of this parameter. Additional information (e.g., minimum depth to water) used for the site-specific Tier 2 evaluation is presented in Worksheets 5.1 and 5.3, and in Figure 4.

The parameters described above were used to calculate risk-based, site-specific threshold levels (SSTLs) for the service station and church groundwater-to-indoor air pathway. The results of this evaluation are summarized in Table 2. These results show that the concentration of benzene representing the source of the groundwater impact (i.e., the average concentration detected in wells MW-7 and MW-2; 0.34 mg/l) is about 4-times less than the SSTL (1.54 mg/l).

In the Tier 1 evaluation of the potential risk to occupants of the church, the data for the nearest upgradient well (MW-2) was used to estimate the strength of the source. This estimate, however, probably over-estimates the concentration beneath the church because benzene was not detected in monitoring well MW-5 less than 20 feet downgradient of the church. To better estimate the sources strength for the Tier 2 evaluation, we used a feature in the ASTM RBCA software that uses site-specific groundwater results to interpolate between two measured points. The calculation of a dilution attenuation factor (DAF) can be used if data are available from wells that are positioned roughly along the center of the axis of migration of the groundwater plume. Wells MW-7, MW-2, and MW-5 are reasonably well-positioned for this purpose. The saturated zone transport model recommended in the ASTM guidelines was essentially calibrated to this site using actual site data to estimate the benzene concentration beneath the center of the church. The concentration determined in this manner (0.0049 mg/l) was compared to the SSTL (0.15 mg/l) calculated for the groundwater-to-indoor air pathway. The estimated groundwater benzene concentration is about 31-times less than the SSTL.

While more representative of actual site conditions than the Tier 1 results, the Tier 2 results are still conservative for several reasons, the most important of which are:

- As previously discussed for the Tier 1 evaluation, the source of the petroleum to the groundwater is diminishing. Because the models used to estimate emission rates of BTEX from groundwater and transport within the groundwater assume a

constant source of chemicals, and no losses due to biodegradation, the resulting cleanup levels (i.e. SSTLs) will be significantly over-estimated.

- The model used to estimate the benzene concentration in indoor air is likely to overestimate these values because it assumes air exchange rates more appropriate for a modern business building with a controlled rate of makeup air rather than a service station with rollup doors or a church with windows that open. In both cases, the indoor air is likely to be exchanged with outdoor air at a much higher rate than a modern business building.

SUMMARY AND CONCLUSION

At ARCO Station 2111, the former waste oil tank and impacted soil were removed from the site. The BTEX in the soil and groundwater associated with the current underground fuel storage tanks was evaluated to determine what risk, if any, it might present to current and future on-site and off-site receptors. This evaluation was conducted using the ASTM RBCA guidelines. The results show concentrations of BTEX detected at this site do not exceed levels that correspond to an acceptable level of risk. These results indicate that no additional remedial measures are necessary to protect the health of current or future on-site and off-site receptors.

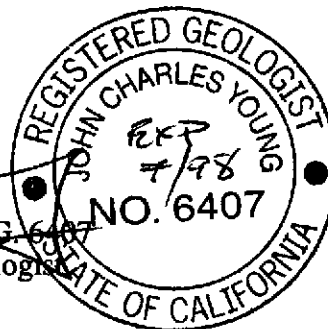
Based on the results of this evaluation, and the designation of this property as a "low risk" site, we propose that future work at this site consist of groundwater monitoring to verify that BTEX levels continue to decrease.

Sincerely,

EMCON


Dr. Ray Kaminsky
Environmental Chemist


John C. Young, R.G. 6407
Senior Project Geologist



Mr. Paul Supple
September 23, 1996
Page 9

Project 20805-127.004

Attachments: Table 1 - Historical Groundwater Elevation and Analytical Data
Table 2 - Tier 2 Results, Groundwater to Indoor Air Pathway
Figure 1 - Site Location
Figure 2 - Site Plan
Figure 3 - Risk-Based Corrective Action Process Flowchart
Figure 4 - Groundwater Data, Third Quarter of 1996
Attachment A - ASTM RBCA Worksheets

cc: Mr. Dale Klettke, ACHCSA
Mr. Kevin Graves, RWQCB

Table 1
 Historical Groundwater Elevation and Analytical Data
 Petroleum Hydrocarbons and Their Constituents

ARCO Service Station 2111
 1156 Davis Street, San Leandro, California

Date: 09-17-96

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	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	µg/L
MW-1	08-01-95	39.60	17.45	22.15	ND	NR	NR	08-01-95	<50	<0.5	<0.5	<0.5	<0.5	--	--	--
MW-1	12-14-95	39.60	17.09	22.51	ND	W	0.002	12-14-95	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--
MW-1	03-21-96	39.60	14.72	24.88	ND	WSW	0.005	03-21-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--
MW-1	05-24-96	39.60	15.94	23.66	ND	W	0.003	05-24-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--
MW-1	08-09-96	39.60	17.89	21.71	ND	WNW	0.01	08-09-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--
MW-2	08-01-95	37.99	15.67	22.32	ND	NR	NR	08-01-95	23000	1300	310	500	3500	--	--	--
MW-2	12-14-95	37.99	15.36	22.63	ND	W	0.002	12-14-95	7300	900	25	180	1000	<200*	--	--
MW-2	03-21-96	37.99	12.84	25.15	ND	WSW	0.005	03-21-96	9600	850	30	280	1400	250	--	--
MW-2	05-24-96	37.99	14.03	23.96	ND	W	0.003	05-24-96	2300	300	<5*	73	310	<25*	--	--
MW-2	08-09-96	37.99	16.10	21.89	ND	WNW	0.01	08-09-96	2800	290	6	75	320	50	--	--
MW-3	08-01-95	39.32	17.00	22.32	ND	NR	NR	08-01-95	<50	<0.5	<0.5	<0.5	<0.5	--	600	76^
MW-3	12-14-95	39.32	16.70	22.62	ND	W	0.002	12-14-95	<50	<0.5	<0.5	<0.5	<0.5	<3	<500	<50
MW-3	03-21-96	39.32	14.17	25.15	ND	WSW	0.005	03-21-96	<50	<0.5	<0.5	<0.5	<0.5	<3	<500	<50
MW-3	05-24-96	39.32	15.30	24.02	ND	W	0.003	05-24-96	<50	<0.5	<0.5	<0.5	<0.5	<3	<500	<50
MW-3	08-09-96	39.32	17.58	21.74	ND	WNW	0.01	08-09-96	<50	<0.5	<0.5	<0.5	<0.5	<3	<0.5	--
MW-4	08-01-95	38.10	15.65	22.45	ND	NR	NR	08-01-95	<50	<0.5	<0.5	<0.5	<0.5	--	--	--
MW-4	12-14-95	38.10	15.35	22.75	ND	W	0.002	12-14-95	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--
MW-4	03-21-96	38.10	12.74	25.36	ND	WSW	0.005	03-21-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--
MW-4	05-24-96	38.10	14.03	24.07	ND	W	0.003	05-24-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--
MW-4	08-09-96	38.10	16.10	22.00	ND	WNW	0.01	08-09-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--
MW-5	03-21-96	37.21	12.60	24.61	ND	WSW	0.005	03-22-96	<50	<0.5	<0.5	<0.5	<0.5	82	--	--
MW-5	05-24-96	37.21	13.71	23.50	ND	W	0.003	05-24-96	<50	<0.5	<0.5	<0.5	<0.5	7	--	--
MW-5	08-09-96	37.21	15.60	21.61	ND	WNW	0.01	08-09-96	<50	<0.5	<0.5	<0.5	<0.5	8	--	--

Table 1
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Petroleum Hydrocarbons and Their Constituents

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		ft-MSL	feet	ft-MSL	feet	MWN	ft/ft		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-6	03-21-96	37.11	11.55	25.56	ND	WSW	0.005	03-22-96	<50	<0.5	1.9	<0.5	<0.5	<3	--	--
MW-6	05-24-96	37.11	12.80	24.31	ND	W	0.003	05-24-96	<50	<0.5	<0.5	<0.5	<0.5	6	--	--
MW-6	08-09-96	37.11 Not surveyed: Car parked on well							08-09-96	Not sampled: Car parked on well						
MW-7	03-21-96	38.68	13.32	25.36	ND	WSW	0.005	03-22-96	32000	870	450	970	4900	280	--	--
MW-7	05-24-96	38.68	14.58	24.10	ND	W	0.003	05-24-96	22000	570	40	42	1900	<200*	--	--
MW-7	08-09-96	38.68	15.33	23.35	ND	WNW	0.01	08-09-96	14000	390	<10*	180	470	<200*	--	--

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

TRPH: total recoverable petroleum hydrocarbons

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

NR: not reported; data not available or not measurable

ND: none detected

W: west

WSW: west-southwest

NW: northwest

^: chromatogram fingerprint is not characteristic of diesel

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

--: not available

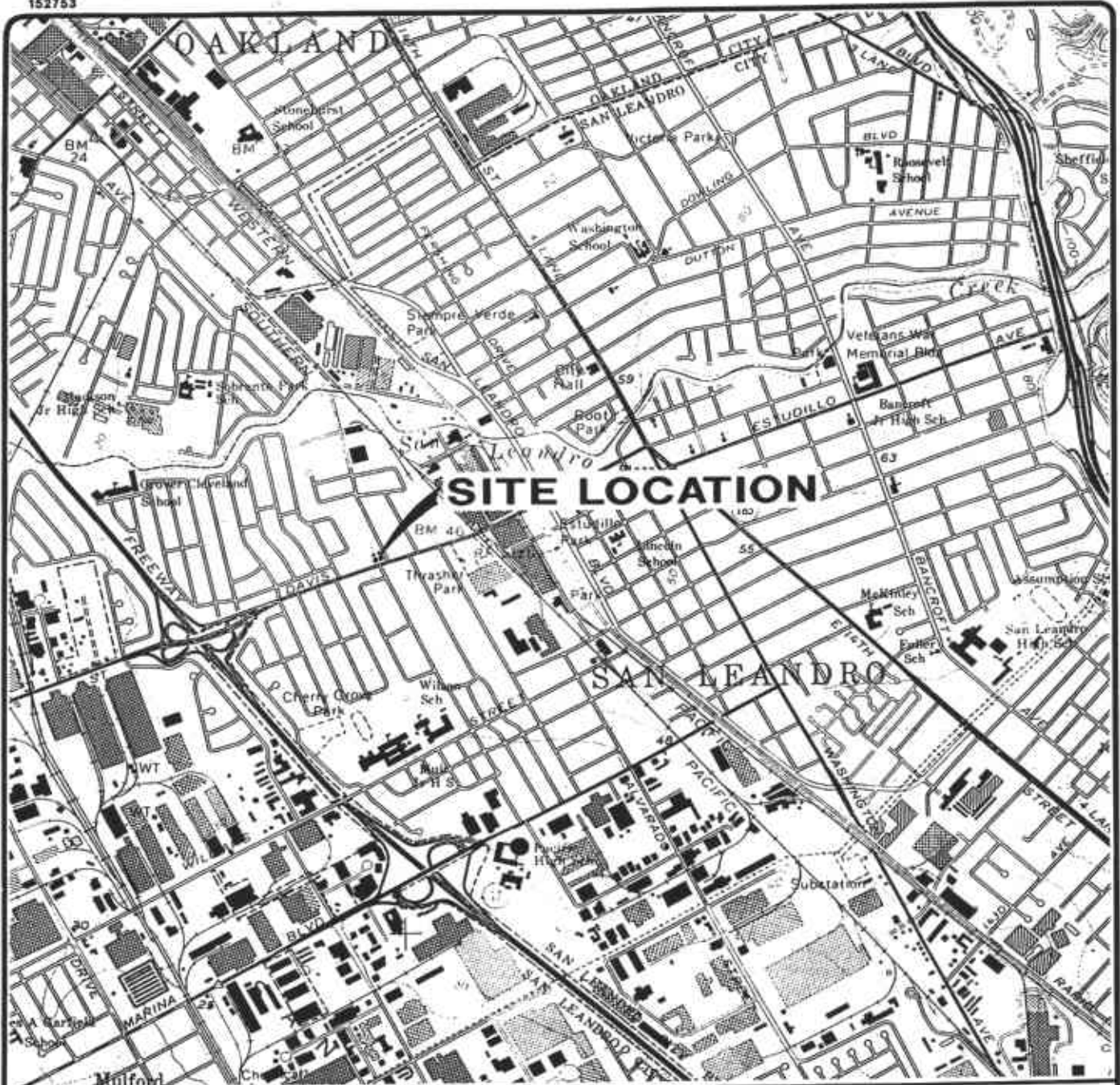
Table 2
Tier 2 Results
Groundwater to Indoor Air Pathway
ARCO Service Station 2111

Compound	Concentration at Point of Exposure (mg/L)	Site-Specific Threshold Level (mg/L)
Onsite		
Benzene	0.34	1.54 ¹ →
Offsite		
Benzene	0.0049	0.15 ² <

10⁻⁵

10⁻⁶

1 Based on 1.00E-05 risk
2 Based on 1.00E-06 risk

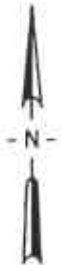


Base map from USGS 7.5' Quad. Map:
San Leandro, California. (PR 1980).



CALIF

Scale : 0 2000 4000 Feet



EMCON

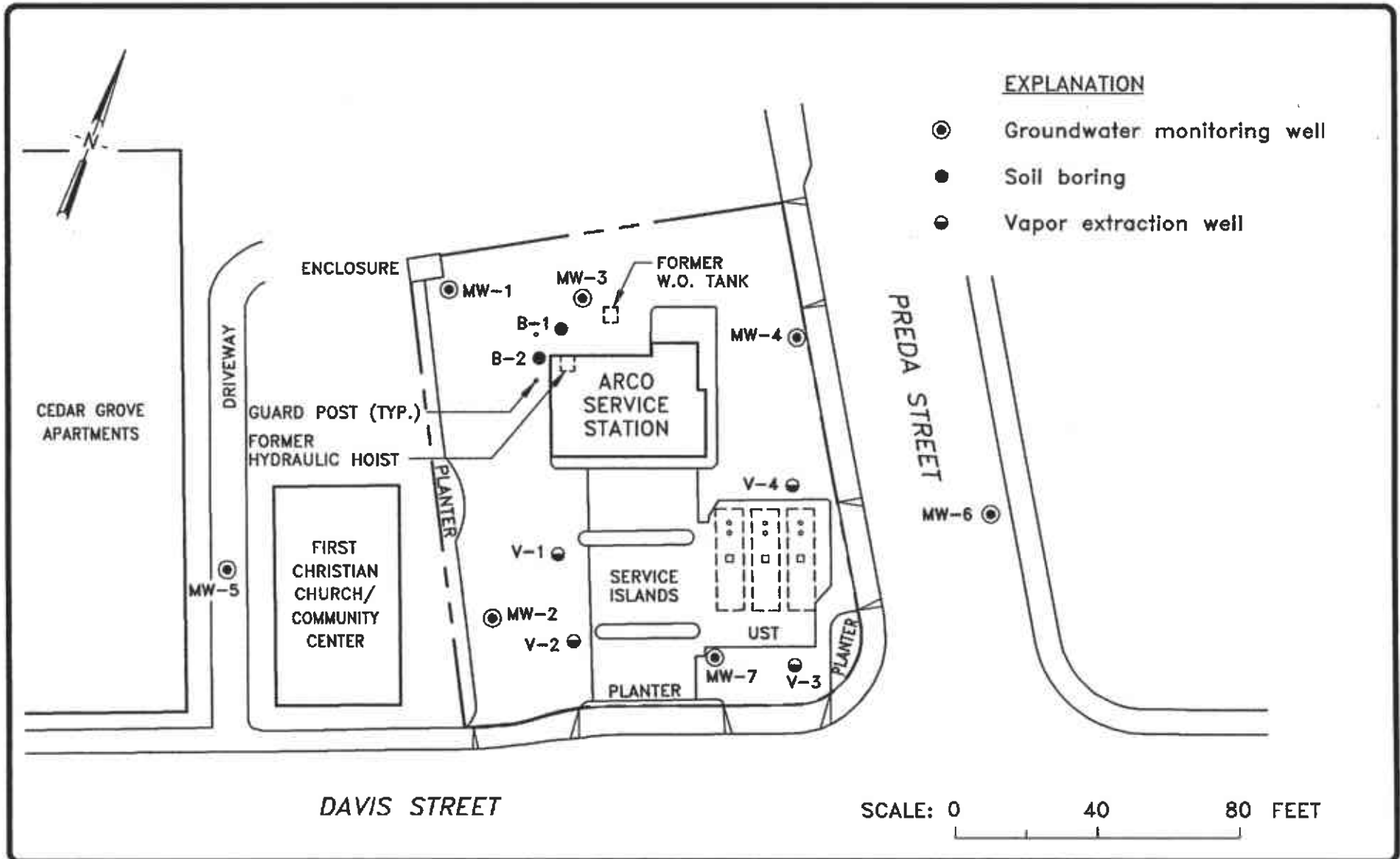
**ARCO PRODUCTS COMPANY
SERVICE STATION 2111, 1156 DAVIS STREET
SAN LEANDRO, CALIFORNIA**

SITE LOCATION

FIGURE

1

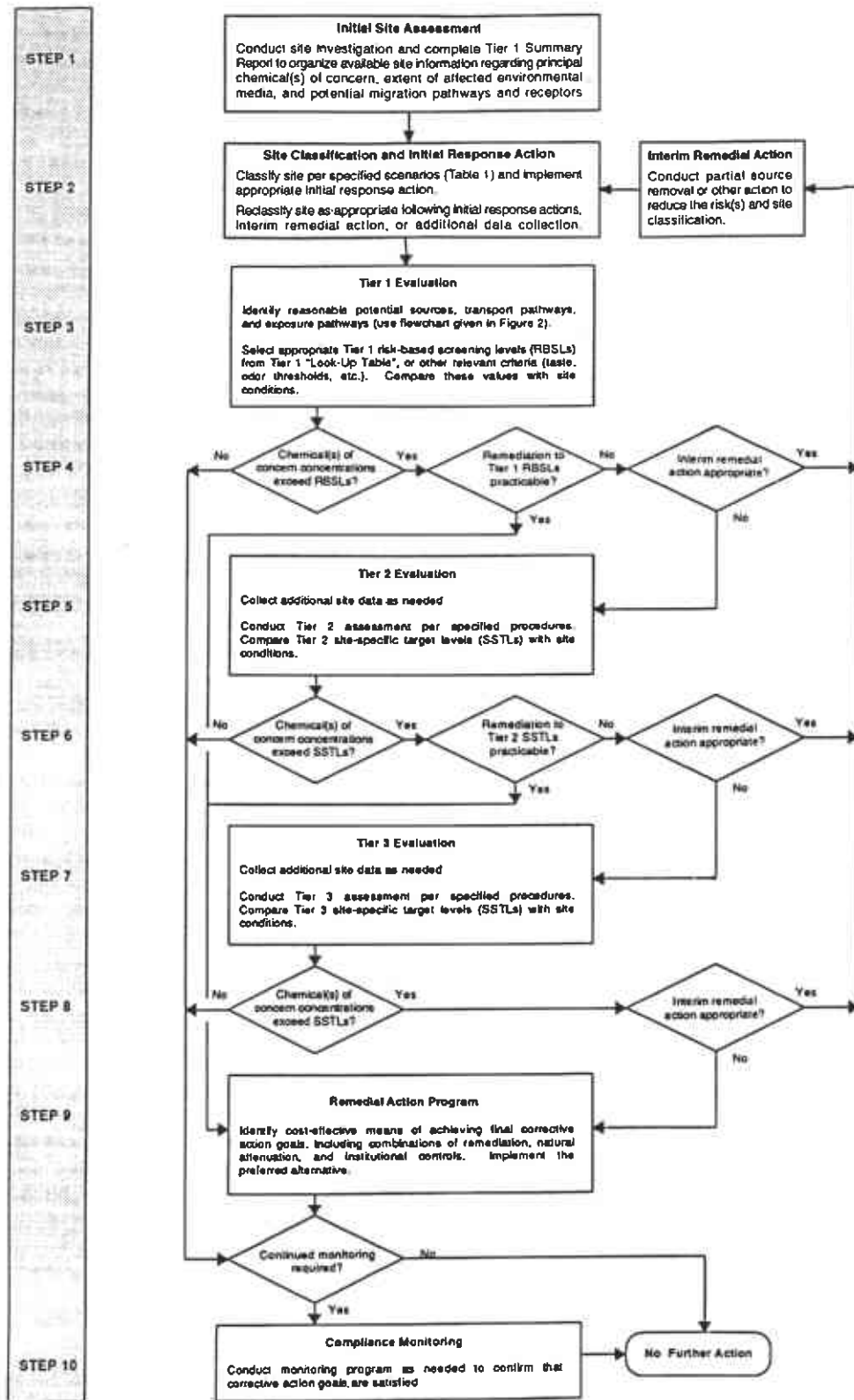
**PROJECT NO.
805-127.04**



ARCO PRODUCTS COMPANY
 SERVICE STATION 2111, 1156 DAVIS STREET
 SAN LEANDRO, CALIFORNIA

SITE PLAN

FIGURE
2
 PROJECT NO.
 805-127.04



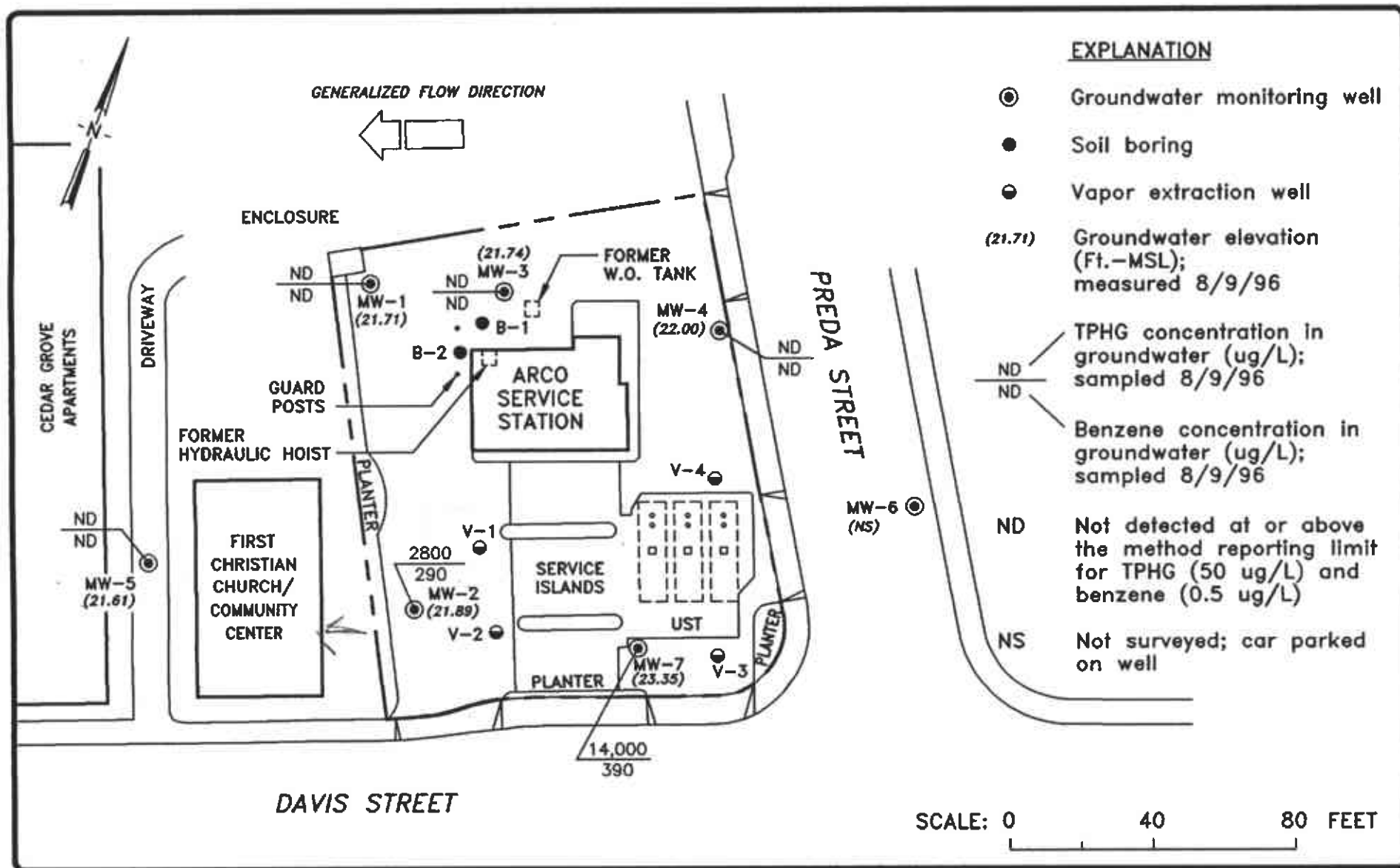
ARCO PRODUCTS COMPANY
 SERVICE STATION 2111, 1156 DAVIS STREET
 SAN LEANDRO, CALIFORNIA

RISK-BASED CORRECTIVE ACTION PLAN
 PROCESS FLOWCHART

FIGURE

3

PROJECT NO.
 805-127.04



ARCO PRODUCTS COMPANY
 SERVICE STATION 2111, 1156 DAVIS STREET
 SAN LEANDRO, CALIFORNIA

GROUNDWATER DATA
 THIRD QUARTER 1996

FIGURE
4
 PROJECT NO.
 805-127.04

ATTACHMENT A
ASTM RBCA WORKSHEETS

Site Name: ARCO 2111

Date Completed: 9-11-96

Site Location: 1156 Davis Street, San Leandro, CA

Completed By: EMCON

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TIER 1 EXECUTIVE SUMMARY CHECKLIST

VISUAL/HISTORICAL ASSESSMENT (■ TO SELECT)			
Site size (acres)	<input checked="" type="checkbox"/> <1	<input type="checkbox"/> <10	<input type="checkbox"/> >10
Site setting	<input type="checkbox"/> undeveloped	<input checked="" type="checkbox"/> industrial	<input type="checkbox"/> residential
Site access	<input checked="" type="checkbox"/> capped	<input type="checkbox"/> fenced-in	<input type="checkbox"/> open
Visual evidence of environmental impact	<input checked="" type="checkbox"/> none	<input type="checkbox"/> limited	<input type="checkbox"/> extensive
Current site land use	<input type="checkbox"/> undeveloped	<input checked="" type="checkbox"/> indust./comm.	<input type="checkbox"/> residential
Contaminant sources	<input checked="" type="checkbox"/> tanks/spills	<input type="checkbox"/> trench/drums	<input type="checkbox"/> ponds/pits
Affected environmental media	<input type="checkbox"/> soil (>3 ft BGS)	<input checked="" type="checkbox"/> groundwater	<input type="checkbox"/> surficial soil (≤3 ft BGS)
Types of compounds likely to be present	<input checked="" type="checkbox"/> petroleum hydrocarbons	<input type="checkbox"/> metals	
	<input type="checkbox"/> inorganic (nitrates)	<input type="checkbox"/> other (pesticides)	

BASELINE RECEPTOR IDENTIFICATION			
Reasonable potential receptors (greatest concern)	<input type="checkbox"/> none	<input type="checkbox"/> ecological	<input checked="" type="checkbox"/> human
Distance from fenceline to nearest off-site receptor (ft)	<input type="checkbox"/> >500	<input type="checkbox"/> 100 - 500	<input checked="" type="checkbox"/> <100
Travel time to closest groundwater receptor (yr)	<input type="checkbox"/> >10	<input type="checkbox"/> 2 - 10	<input checked="" type="checkbox"/> <2
Depth to first encountered groundwater (ft)	<input type="checkbox"/> >150	<input type="checkbox"/> 50 - 150	<input checked="" type="checkbox"/> <50
Complete exposure pathways	<input type="checkbox"/> none	<input type="checkbox"/> ingestion	<input checked="" type="checkbox"/> inhalation
	<input type="checkbox"/> ecological	<input type="checkbox"/> dermal	<input type="checkbox"/> absorption

TIER 1 TASKS COMPLETED		
<input checked="" type="checkbox"/> Visual / historical assessment	<input checked="" type="checkbox"/> Initial (screening) site assessment	<input checked="" type="checkbox"/> Site prioritization / classification
<input checked="" type="checkbox"/> Detailed site characterization	<input checked="" type="checkbox"/> RBSL comparison	<input type="checkbox"/> Initial ecological assessment
<input checked="" type="checkbox"/> Corrective action planned or implemented		

TIER 1 CLASSIFICATION EVALUATION			
Classification No.	Scenario Description	Prescribed Interim Action	Date Implemented
3	Dissolved BTEX in groundwater. Potential exposure via volatilization from groundwater to indoor and ambient air.	Tier 2 evaluation	9-6-96

Affected Medium	Screening Level Criteria Exceeded? (■ if yes)						
	Risk-Based	Other (MCL)	Others: (specify)				None Exceeded
• Surface Soil (< 3ft BGS)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
• Subsurface Soil (> 3ft BGS)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
• Groundwater (potable/nonpotable)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Surface waters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

NOTES: (List and discuss chemicals for which a Tier 1 exceedance is found.)

PROPOSED TIER 1 ACTION	
<input type="checkbox"/> No Action: Site does not exceed Tier 1 criteria. - Apply for closure.	<p>NOTE: Rationale for proposed action documented on Worksheets 1.3 and 10.1-10.3.</p>
<input type="checkbox"/> Interim Corrective Action: Site exceeds some Tier 1 criteria. - Propose interim corrective action and reprioritize site.	
<input type="checkbox"/> Final Corrective Action: Site exceeds some Tier 1 criteria. - Propose corrective action to achieve Tier 1 criteria.	
<input checked="" type="checkbox"/> Tier 2 Evaluation: Site exceeds some Tier 1 criteria. - Re-evaluate corrective action goals per Tier 2 risk assessment.	

ALL WORKSHEETS ENCLOSED IN THIS REPORT ARE IDENTIFIED ON THE TABLE OF CONTENTS FORM.

Site Name: ARCO 2111

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TIER 2 EXECUTIVE SUMMARY CHECKLIST

TIER 2 SSTL CALCULATION METHOD (OR TO SELECT)

SSTL Calculation Option

- Option 1: Site-Specific Screening Levels
- Option 2: Individual Constituent SSTL Values
- Option 3: Cumulative Constituent SSTL Values

NAF Calculation Method

- Fate and Transport Modeling:
 - RBCA Spreadsheet System
 - Other Model(s)
- Empirical NAF Calculation

SITE DATA INVENTORY

Source Zone Investigation Complete:

- Surface Soil (e.g., ² 3 ft BGS)
- Subsurface Soil (e.g., > 3 ft BGS)
- Groundwater

Exposure Pathway Information Compiled:

- Air Pathway
- Groundwater Pathway
- Soil Pathway
- Surface Water Pathway
- Land Use Classification (on-site and off-site)

TIER 1 WORKSHEETS 1.3 - 4.2 AND 5.2 - 5.6 HAVE BEEN UPDATED TO INCLUDE NEW TIER 2 INFORMATION.

TASKS COMPLETED

- Tier 1 Evaluation
- Tier 2 Evaluation
- Tier 2 Final Corrective Action
- Tier 1 Interim Corrective Action
- Tier 2 Interim Corrective Action
- Tier 3 Evaluation

CURRENT SITE CLASSIFICATION

Classification No.	Scenario Description	Prescribed Interim Action	Date Implemented
4	No long-term threat to human health or safety or sensitive environmental receptors.	Continue monitoring	

TIER 2 CORRECTIVE ACTION CRITERIA

Affected Medium	Tier 2 SSTL Exceeded ?		Applicable Excess Risk Limits (specify value)				Other Applicable Exposure Limit
	Yes	No	Indiv. Risk	Total Risk	Hazard Index	Hazard Quotient	(specify, if any)
• Surface Soil (≤ 3ft BGS)	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	_____	_____	_____
• Subsurface Soil (> 3ft BGS)	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	_____	_____	_____
• Groundwater	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1.0E-05	_____	_____	1	_____

PROPOSED ACTION

- No Action:** Tier 2 SSTLs not exceeded. Apply for closure.
- Interim Corrective Action:** Address principal, near-term risks sources.
- Final Corrective Action:** Remediate/control site to meet Tier 2 criteria.
- Tier 3 Evaluation:** Improve baseline risk and SSTL estimates.

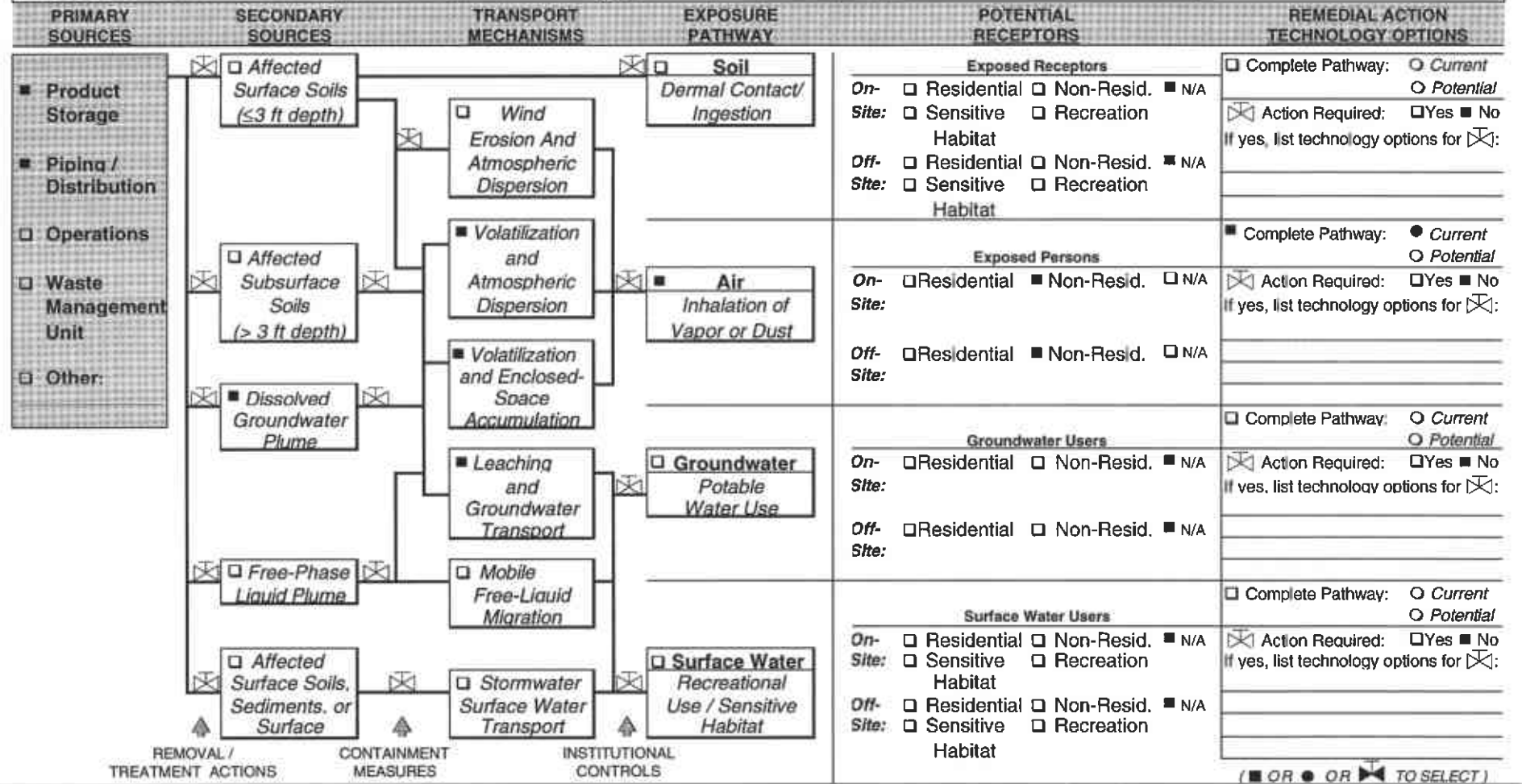
NOTE:
Rationale for proposed action documented on Worksheets 1.3 and 10.1-10.3.

Site Name: ARCO 2111
 Site Location: 1156 Davis Street, San Leandro, CA

Date Completed: 9-11-96
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EXPOSURE CONTROL FLOWCHART

Instructions: Identify remedial measures to be implemented to prevent exposure, as follows:
 • **Step 1 – Baseline Exposure:** Identify applicable sources, transport mechanisms, and receptors as shown on Worksheet 4.2 (■ = applicable to site).
 • **Step 2 – Remedial Measures:** Fill in shut-off valves (◀▶) to indicate removal / treatment action, containment measure, or institutional controls to be used to “shut off” exposure pathway.
 • **Step 3 – Remedial Technology Options:** For each complete pathway, identify category of corrective measure to be applied and list possible technology options in space provided (see options list in RBCA Guidance Manual).



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SITE DESCRIPTION

Location Description (see Figure 1)

Address: 1156 Davis Street
 Cross-Street: Prada Street
 City: San Leandro
 County: Alameda
 State: California

Notes:

Regulatory Agencies

Identify regulatory authorities and regulatory / legal status of site.

- 1) Agency: Alameda County Health Care Services Agency
 Contact: Dale Klettke
 Agency: Regional Water Quality Control Board, San Francisco Bay Region
 Contact: Kevin Graves
- 3) Other Involved Parties: _____
 TO SELECT Consent order Lawsuit

Discussion:

Local Land Use (See Figure 2)

Other Comments:

(TO SELECT)

On-Site Use	Current	Potential	Prior
Commercial	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Residential	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Industrial	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sensitive Habitat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other: (below)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Discuss options for listed items (including anticipated future use)

Topography (See Figures 1 and 3)

Other Comments:

Terrain Flat Steep Variable
Site Elevation Interval (ft-MSL)
 High Pt. 25.36 Low Pt. 21.71
Average Ground Surface Slope
 Direction west Grade (ft/ft) 0.003

Local Climate

Other Comments:

Average Annual Rainfall (in): 20
 Annual Average
 Evapotranspiration (in): _____
 Within 100 Year Floodplain?: yes / no
 Summer Temperature Range (°F): 71-74
 Winter Temperature Range (°F): 56-64

Site Name: ARCO 2111

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BASELINE EXPOSURE FLOWCHART

Instructions: To characterize baseline exposure conditions, check boxes to identify applicable primary sources, secondary sources (affected media), potential transport mechanisms, and current or potential exposure pathways and receptors (■ = applicable to site). Identify types(s) of both on-site and off-site receptors, if applicable. Provide detailed information on complete pathways, exposure factors, and risk goals on Worksheets 4.3 - 4.5.

PRIMARY SOURCES	SECONDARY SOURCES	TRANSPORT MECHANISMS	EXPOSURE PATHWAY	POTENTIAL RECEPTORS	COMPLETE PATHWAY?	
<input checked="" type="checkbox"/> Product Storage <input checked="" type="checkbox"/> Piping / Distribution <input type="checkbox"/> Operations <input type="checkbox"/> Waste Management Unit <input type="checkbox"/> Other:	<input type="checkbox"/> Affected Surface Soils (≤3 ft depth)	<input type="checkbox"/> Wind Erosion and Atmospheric Dispersion <input checked="" type="checkbox"/> Volatilization and Atmospheric Dispersion <input checked="" type="checkbox"/> Volatilization and Enclosed-Space Accumulation	<input type="checkbox"/> Soil Dermal Contact/ Ingestion <input checked="" type="checkbox"/> Air Inhalation of Vapor or Dust	Exposed Receptors On-Site: <input type="checkbox"/> Residential <input type="checkbox"/> Non-Resid. <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Sensitive Habitat <input type="checkbox"/> Recreation Off-Site: <input type="checkbox"/> Residential <input type="checkbox"/> Non-Resid. <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Sensitive Habitat <input type="checkbox"/> Recreation	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes <input type="radio"/> Current <input type="radio"/> Potential <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes <input type="radio"/> Current <input type="radio"/> Potential	
	<input type="checkbox"/> Affected Subsurface Soils (> 3 ft depth)	<input checked="" type="checkbox"/> Dissolved Groundwater Plume <input checked="" type="checkbox"/> Free-Phase Liquid Plume	<input checked="" type="checkbox"/> Leaching and Groundwater Transport <input type="checkbox"/> Mobile Free-Liquid Migration	<input type="checkbox"/> Groundwater Potable Water Use	Exposed Persons On-Site: <input type="checkbox"/> Residential <input checked="" type="checkbox"/> Non-Resid. <input type="checkbox"/> N/A Off-Site: <input type="checkbox"/> Residential <input checked="" type="checkbox"/> Non-Resid. <input type="checkbox"/> N/A	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes <input type="radio"/> Current <input type="radio"/> Potential <input type="checkbox"/> No <input checked="" type="checkbox"/> Yes <input type="radio"/> Current <input type="radio"/> Potential
	<input type="checkbox"/> Affected Surface Soils, Sediments, or Surface Water	<input type="checkbox"/> Stormwater/ Surface Water Transport	<input type="checkbox"/> Stormwater/ Surface Water Transport	<input type="checkbox"/> Surface Water Recreational Use / Sensitive Habitat	Groundwater Users On-Site: <input type="checkbox"/> Residential <input type="checkbox"/> Non-Resid. <input checked="" type="checkbox"/> N/A Off-Site: <input type="checkbox"/> Residential <input type="checkbox"/> Non-Resid. <input checked="" type="checkbox"/> N/A	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes <input type="radio"/> Current <input type="radio"/> Potential <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes <input type="radio"/> Current <input type="radio"/> Potential
					Surface Water Users On-Site: <input type="checkbox"/> Residential <input type="checkbox"/> Non-Resid. <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Sensitive Habitat <input type="checkbox"/> Recreation Off-Site: <input type="checkbox"/> Residential <input type="checkbox"/> Non-Resid. <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Sensitive Habitat <input type="checkbox"/> Recreation	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes <input type="radio"/> Current <input type="radio"/> Potential <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes <input type="radio"/> Current <input type="radio"/> Potential

(■ OR ● TO SELECT)

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EXPOSURE FACTOR CHECKLIST

Instructions: • **Tier 1 Evaluation:** Indicate use of either residential or commercial / industrial Reasonable Maximum Exposure (RME) factors at on-site points of exposure (POEs) for complete exposure pathways. • **Tier 2 Evaluation:** Indicate use of either 1 Reasonable Maximum Exposure (RME) factor or a site-specific exposure factor for both residential and commercial / industrial points of exposure (POEs), as appropriate for each exposure pathway. For Tier 2, data is required for Global Factors and for complete pathways only (see Worksheet 4.4).

	RESIDENTIAL POE		COMMERCIAL/ INDUSTRIAL POE	
	RME	Site-Specific	RME	Site-Specific
GLOBAL FACTORS (■ TO SELECT)				
AT _c Averaging time for carcinogens	<input type="checkbox"/> 70 yrs	<input type="checkbox"/>	■ 70 yrs	<input type="checkbox"/>
AT _n Averaging time for non-carcinogens	<input type="checkbox"/> = ED	<input type="checkbox"/>	■ = ED	<input type="checkbox"/>
BW Body weight	-Adult <input type="checkbox"/> 70 kg	<input type="checkbox"/>	■ 70 kg	<input type="checkbox"/>
	-Child (1-6 yrs) <input type="checkbox"/> 15 kg	<input type="checkbox"/>	<input type="checkbox"/> NA	<input type="checkbox"/>
ED Exposure duration	<input type="checkbox"/> 30 yrs	<input type="checkbox"/>	■ 25 yrs	<input type="checkbox"/>
AIR EXPOSURE FACTORS ■ COMPLETE (provide data) □ NOT COMPLETE (skip)				
EF Exposure frequency (inhalation)	<input type="checkbox"/> 350 dy/yr	<input type="checkbox"/>	■ 250 dy/yr	<input type="checkbox"/>
IR _{ai} Daily indoor inhalation rate	<input type="checkbox"/> 15 m ³ /dy (24-hr/dy)	<input type="checkbox"/>	■ 20 m ³ /dy (8-hr/dy)	<input type="checkbox"/>
IR _{ao} Daily outdoor inhalation rate	<input type="checkbox"/> 20 m ³ /dy (24-hr/dy)	<input type="checkbox"/>	■ 20 m ³ /dy (8-hr/dy)	<input type="checkbox"/>
POTABLE WATER USE EXPOSURE FACTORS □ COMPLETE (provide data) ■ NOT COMPLETE (skip)				
EF Exposure frequency (ingestion/showering)	<input type="checkbox"/> 350 dy/yr	<input type="checkbox"/>	<input type="checkbox"/> 250 dy/yr	<input type="checkbox"/>
IR _w Daily water ingestion rate	<input type="checkbox"/> 2 L/dy (24-hr/dy)	<input type="checkbox"/>	<input type="checkbox"/> 1 L/dy (8-hr/dy)	<input type="checkbox"/>
EP _{sh} Exposure period (showering)	<input type="checkbox"/> 12 min/dy	<input type="checkbox"/>	<input type="checkbox"/> 12 min/day	<input type="checkbox"/>
SA _w Skin surface area (showering)	-Adult (70 kg) <input type="checkbox"/> 0.86 m ²	<input type="checkbox"/>	<input type="checkbox"/> 0.86 m ²	<input type="checkbox"/>
SOIL EXPOSURE FACTORS □ COMPLETE (provide data) ■ NOT COMPLETE (skip)				
EF Exposure Frequency	-Dermal Contact <input type="checkbox"/> 350 dy/yr	<input type="checkbox"/>	<input type="checkbox"/> 40 dy/yr	<input type="checkbox"/>
	-Soil ingestion <input type="checkbox"/> 350 dy/yr	<input type="checkbox"/>	<input type="checkbox"/> 250 dy/yr	<input type="checkbox"/>
SA _s Skin surface area (soil contact)	-Adult (18 to 31 yrs, 70 kg) <input type="checkbox"/> 0.58 m ²	<input type="checkbox"/>	<input type="checkbox"/> 0.58 m ²	<input type="checkbox"/>
	-Child (1 - 17 yrs, 35 kg) <input type="checkbox"/> 0.20 m ²	<input type="checkbox"/>	<input type="checkbox"/> NA	<input type="checkbox"/>
M Soil to skin adherence factor	<input type="checkbox"/> 1.0 mg/cm ²	<input type="checkbox"/>	<input type="checkbox"/> 1.0 mg/cm ²	<input type="checkbox"/>
IR _s Soil ingestion rate	- Age-adjusted average <input type="checkbox"/> 114 mg-yr /kg-dy	<input type="checkbox"/>	o NA	<input type="checkbox"/>
	-Adult (7 to 31 yrs, 70 kg) <input type="checkbox"/> 100 mg/dy (24-hr/dy)	<input type="checkbox"/>	<input type="checkbox"/> 50 mg/dy (8-hr/dy)	<input type="checkbox"/>
	-Child (1 - 6 yrs, 15 kg) <input type="checkbox"/> 200 mg/dy (24-hr/dy)	<input type="checkbox"/>	<input type="checkbox"/> NA	<input type="checkbox"/>
SURFACE WATER EXPOSURE FACTORS □ COMPLETE (provide data) ■ NOT COMPLETE (skip)				
EF Exposure Frequency	-Fish consumption <input type="checkbox"/> 350 dy/yr	<input type="checkbox"/>	<input type="checkbox"/> NA	<input type="checkbox"/>
	-Swimming <input type="checkbox"/> 7 dy/yr	<input type="checkbox"/>	<input type="checkbox"/> NA	<input type="checkbox"/>
IR _f Daily fish intake rate	-Freshwater <input type="checkbox"/> 10 g/dy	<input type="checkbox"/>	<input type="checkbox"/> NA	<input type="checkbox"/>
	-Saltwater <input type="checkbox"/> 15 g/dy	<input type="checkbox"/>	<input type="checkbox"/> NA	<input type="checkbox"/>
SA _w Skin surface area (swimming)	-Adult (70 kg) <input type="checkbox"/> 0.86 m ²	<input type="checkbox"/>	<input type="checkbox"/> NA	<input type="checkbox"/>
EP _{sw} Exposure period (swimming)	<input type="checkbox"/> 2.6 hrs/dy	<input type="checkbox"/>	<input type="checkbox"/> NA	<input type="checkbox"/>

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TIER 2 EXPOSURE PATHWAY SCREENING

Instructions: Exposure pathways screening involves the following steps:

- 1) **Source Medium:** Compare maximum constituent concentration in relevant source medium to applicable Tier 1 RBSL value for designated pathway.
- 2) **Transport Mechanism:** Transport is active at site if: a) relevant source medium is affected, b) exposure medium or receptor exists, and c) constituent transport from source to receptor could occur under current or anticipated future use.
- 3) **Exposure Medium:** For pathways under steady-state transport conditions (e.g., air), compare measured COC concentration at POE to applicable Tier 1 exposure limit for air, groundwater, or soil. Surface water concentrations should be compared to applicable state or federal water quality criteria.
- 4) **Complete Pathway:** For screening, pathway considered complete if "Yes" reported in Column A and either Column B or C.

Notes:

- RBSL = Risk-Based Screening Level
- POE = Point of Exposure
- COC = Constituent of Concern
- NM = Not Measured

PATHWAY	A) SOURCE MEDIUM		B) TRANSPORT MECHANISM		C) EXPOSURE MEDIUM		COMPLETE PATHWAY? (Check if yes & specify status)
	Type	Pathway Tier 1 RBSL Exceeded?	Type	Active at Site?	Type	Exposure Limit Exceeded at POE?	
AIR EXPOSURE PATHWAYS (TO SELECT)							
1) <i>Surface Soils:</i> Vapor Inhalation and Dust Ingestion	Surface Soil	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Volatilization /Dust Transport	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes - Current <input type="checkbox"/> Yes - Future	Ambient Air	<input checked="" type="checkbox"/> NM <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> Current <input type="checkbox"/> Potential
2) <i>Subsurface Soils:</i> Volatilization to Ambient Air	Subsurface Soil	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Volatilization	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes - Current <input type="checkbox"/> Yes - Future	Ambient Air	<input checked="" type="checkbox"/> NM <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> Current <input type="checkbox"/> Potential
3) <i>Subsurface Soils:</i> Volatilization to Enclosed Space	Subsurface Soil	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Volatilization	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes - Current <input type="checkbox"/> Yes - Future	Indoor Air	<input checked="" type="checkbox"/> NM <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> Current <input type="checkbox"/> Potential
4) <i>Groundwater:</i> Volatilization to Ambient Air	Groundwater	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Volatilization	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes - Current <input checked="" type="checkbox"/> Yes - Future	Ambient Air	<input checked="" type="checkbox"/> NM <input type="checkbox"/> No <input type="checkbox"/> Yes	<input checked="" type="checkbox"/> Current <input type="checkbox"/> Potential
5) <i>Groundwater:</i> Volatilization to Enclosed Space	Groundwater	<input checked="" type="checkbox"/> Yes* <input type="checkbox"/> No	Volatilization	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes - Current <input checked="" type="checkbox"/> Yes - Future	Indoor Air	<input checked="" type="checkbox"/> NM <input type="checkbox"/> No <input type="checkbox"/> Yes	<input checked="" type="checkbox"/> Current <input type="checkbox"/> Potential
GROUNDWATER EXPOSURE PATHWAYS							
6) <i>Soil:</i> Leaching to Groundwater: Ingestion	Surface or Subsurface Soils	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Leaching /Groundwater Flow	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes - Current <input type="checkbox"/> Yes - Future	Groundwater	<input checked="" type="checkbox"/> NM <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> Current <input type="checkbox"/> Potential
7) <i>Dissolved or Free-Phase Groundwater Plume:</i> Ingestion	Groundwater	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Groundwater Flow	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes - Current <input type="checkbox"/> Yes - Future	Groundwater	<input checked="" type="checkbox"/> NM <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> Current <input type="checkbox"/> Potential
SOIL EXPOSURE PATHWAY							
8) <i>Surface Soils:</i> Dermal Contact /Ingestion	Surface Soil	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Direct Contact	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes - Current <input type="checkbox"/> Yes - Future	Soil	<input checked="" type="checkbox"/> NM <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> Current <input type="checkbox"/> Potential

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TIER 2 EXPOSURE PATHWAY SCREENING CONTINUED

PATHWAY	A) SOURCE MEDIUM		B) TRANSPORT MECHANISM		C) EXPOSURE MEDIUM		COMPLETE PATHWAY? (Check if yes & specify status)
	Type	Pathway Tier 1 RBSL Exceeded?	Type	Active at Site?	Type	Exposure Limit Exceeded at POE?	
SURFACE WATER PATHWAYS							
9) Soil: Leaching to Groundwater / Discharge to Surface Water: Recreation or Fish	Surface or Subsurface Soils	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Leaching /Groundwater Flow	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes - Current <input type="checkbox"/> Yes - Future	Surface Water	<input checked="" type="checkbox"/> NM <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> Current <input type="checkbox"/> Potential
10) Groundwater Plume: Discharge to Surface Water: Recreation or Fish	Groundwater	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Groundwater Flow	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes - Current <input type="checkbox"/> Yes - Future	Surface Water	<input checked="" type="checkbox"/> NM <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> Current <input type="checkbox"/> Potential
11) Soil: Leaching to Stormwater / Discharge to Surface Water: Recreation or Fish	Surface Soils	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Overland Flow	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes - Current <input type="checkbox"/> Yes - Future	Surface Water	<input checked="" type="checkbox"/> NM <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> Current <input type="checkbox"/> Potential

Additional Information: Provide necessary background discussion for data provided above. Also, if ecological exposure pathway identified on Worksheet 3.5, identify relevant source medium, transport mechanism, exposure medium, and receptor type below.

Tier 1 Results:

	RBSL	Site Concentration
Groundwater to -Indoor Air		(Well MW-2)
	(mg/L)	(mg/L)
Benzene	2.14E-01	2.9E-01
Toluene	8.50E+01	6.0E-03
Ethyl benzene	>1.61E+02	7.5E-02
Xylenes	>2.00E+02	3.2E-01

	RBSL	Site Concentration
Groundwater to -Ambient Air		(Average of wells MW-2 and MW-7)
	(mg/L)	(mg/L)
Benzene	5.34E+01	3.4E-01
Toluene	>5.35E+02	6.0E-03
Ethyl benzene	>1.61E+02	1.3E-01
Xylenes	>2.00E+02	4.0E-01

Notes:

1. RBSLs for benzene are for 1×10^{-5} risk level, and have been multiplied by 0.29 to account for California slope factor for benzene.
2. Concentrations from well MW-2 were used to represent the source of BTEX from groundwater to indoor air.
3. Concentrations from wells MW-2 and MW-7 were averaged to represent the source of BTEX from groundwater to ambient air.

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TIER 2 EXPOSURE SCENARIOS AND RISK GOALS

Instructions: For each exposure pathway, indicate i) Point of Exposure (POE) location (on-site, off-site, or both), ii) applicable exposure scenario at each POE (residential or commercial/ industrial), and iii) applicable risk goals. Distance from source corresponds to shortest lateral distance to applicable POE from point of maximum COC concentration in source medium along possible migration pathway. Provide exposure limit information if applicable (e.g., OSHA Limits, MCLs, etc.). (■ TO SELECT)

EXPOSURE PATHWAY	DISTANCE FROM SOURCE	EXPOSURE SCENARIO AT POE	TARGET RKSKS AT POE			
			Individual Constituent Effects		Cumulative Constituent Effects	Other Exposure Limit
			Indiv. Risk	HQ	Additive Risk	HI
AIR EXPOSURE PATHWAYS ■ COMPLETE (provide data) □ NOT COMPLETE (skip to next pathway)						
■ On-Site POE: 0 ft	□ Residential	■ Commercial /Industrial	1.0E-05	1		□ PEL/TLV
■ Off-Site POE: 15 ft	□ Residential	■ Commercial /Industrial	1.0E-05	1		□ PEL/TLV
GROUNDWATER EXPOSURE PATHWAYS □ COMPLETE (provide data) ■ NOT COMPLETE (skip to next pathway)						
□ On-Site POE: _____ ft	□ Residential	□ Commercial /Industrial				□ MCL
□ Off-Site POE _____ ft	□ Residential	□ Commercial /Industrial				□ MCL
SOIL EXPOSURE PATHWAY □ COMPLETE (provide data) ■ NOT COMPLETE (skip to next pathway)						
□ On-Site POE: (at source)	□ Residential	□ Commercial /Industrial				□ _____
□ Off-Site POE (at source)	□ Residential	□ Commercial /Industrial				□ _____
SURFACE WATER EXPOSURE PATHWAYS □ COMPLETE (provide data) □ NOT COMPLETE (skip to next pathway)						
□ On-Site POE: _____ ft	□ Recreational	□ Ecological (specify exp. limit only)				□ _____
□ Off-Site POE _____ ft	□ Recreational	□ Ecological (specify exp. limit only)				□ _____

ADDITIONAL INFORMATION:

If exposure limit is specified, provide reference for concentration limits to be applied to each COC (e.g., OSHA limits, water quality criteria, etc.):

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SITE PARAMETER CHECKLIST FOR RISK-BASED SCREENING LEVELS

Instructions: For Tier 1 evaluation (generic screening levels), review specified default parameters (*) to ensure values are conservative for site. For Tier 2 Option 1 SSTL calculation (site-specific screening levels), provide site-specific values for sensitive parameters (§). Indicate parameter value used in evaluation by completing check box (■).

Note: * Confirm conservatism of these values for Tier 1 evaluation.

§ Provide site-specific measurement or estimate for Tier 2 evaluation.

Soil Parameters	Default Value Used	Site-Specific Value Used
soil type	<input type="checkbox"/> sandy soil	■ <u>clayey sand</u> *§
Θ_T Soil porosity	<input type="checkbox"/> 0.38 (dim)	■ <u>0.30</u> §
Θ_{ws} water content - vadose zone	<input type="checkbox"/> 0.12 (dim)	■ <u>0.17</u> §
Θ_{as} air content - vadose zone (= $\Theta_T - \Theta_{ws}$)	<input type="checkbox"/> 0.26 (dim)	■ <u>0.13</u>
Θ_{wcap} water content - capillary fringe	<input type="checkbox"/> 0.342 (dim)	■ <u>0.25</u>
Θ_{acap} air content - capillary fringe (= $\Theta_T - \Theta_{wcap}$)	<input type="checkbox"/> 0.038 (dim)	■ <u>0.05</u>
ρ_c Soil density	■ 1.7 g/cm ³	<input type="checkbox"/> _____ §
foc mass fraction of organic carbon in soil	■ 0.01 (dim)	<input type="checkbox"/> _____ §
Ls Depth to contaminated soil	<input type="checkbox"/> 100 cm	<input type="checkbox"/> _____ §
Lgw Depth to groundwater	<input type="checkbox"/> 300 cm	■ <u>366</u> §
h _{cap} capillary zone thickness	<input type="checkbox"/> 5 cm	■ <u>30.5</u>
h _v vadose zone thickness (= L _{gw} - h _c)	<input type="checkbox"/> 295 cm	■ <u>335</u>
pH Soil/water pH	■ 6.5	<input type="checkbox"/> _____
Groundwater Parameters		
I Water infiltration rate	<input type="checkbox"/> 30 cm/yr	<input type="checkbox"/> _____ §
V _{gw} groundwater velocity	<input type="checkbox"/> 82.0 ft/yr	<input type="checkbox"/> _____ *§
δ_{gw} groundwater mixing zone depth	<input type="checkbox"/> 200 cm	<input type="checkbox"/> _____ *§
DF aquifer dilution factor (= $1 + V_{gw} \delta_{gw} / (IW)$)	<input type="checkbox"/> 12.1	<input type="checkbox"/> _____
Surface Parameters		
U _{air} Amb. air velocity in mixing zone	<input type="checkbox"/> 225 cm/s	<input type="checkbox"/> _____ *§
δ_{air} Mixing zone height	<input type="checkbox"/> 200 cm	<input type="checkbox"/> _____ *§
A Contaminated Area	<input type="checkbox"/> 2250000 cm ²	<input type="checkbox"/> _____
W Width of Contaminated Area	<input type="checkbox"/> 1500 cm	<input type="checkbox"/> _____ §
d Thickness of Surficial Soils	<input type="checkbox"/> 100 cm	<input type="checkbox"/> _____ §
Pc Particulate areal emission rate	<input type="checkbox"/> 2.17E-10 g/cm ² -s	<input type="checkbox"/> _____ §
Building Parameters		
L _{crack} Foundation crack thickness	■ 15 cm	<input type="checkbox"/> _____
η Foundation crack fraction	<input type="checkbox"/> 0.01 (dim)	■ <u>0.005</u>
L _{bT} Building Volume/Foundation Area Ratio (res.)	<input type="checkbox"/> 200 cm	<input type="checkbox"/> _____
L _{bC} Building Volume/Foundation Area Ratio (com./ind.)	■ 300 cm	<input type="checkbox"/> _____
ER _T Building vapor volume exchange rate (res.)	<input type="checkbox"/> 12 dy ⁻¹	<input type="checkbox"/> _____
ER _C Building vapor volume exchange rate (com./ind.)	■ 20 dy ⁻¹	<input type="checkbox"/> _____

Discussion: Provide rationale for default parameter revision; discuss additional site-specific features of note; etc.

(continue on next page if needed)

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SUMMARY OF MEDIA INVESTIGATION & CHEMICAL ANALYSES

		Site Media Analyzed (■ TO SELECT)					
		Ground-water	Surface Soil	Subsurf. Soil	Soil Vapor	Ambient Vapor	Surface Water
<i>Applicable?</i>		■	□	□	□	□	□
<i>Sampled?</i>		■	□	□	□	□	□
Chemical Analysis	EPA Analysis Method	•ana. = chemical analyzed; •det. = chemical detected					
<i>Organic Chemicals</i>		ana./det.	ana./det.	ana./det.	ana./det.	ana./det.	ana./det.
Volatile Organics	8240 / 624	□ □	□ □	□ □	□ □	□ □	□ □
Semi-Volatile Organics	8270 / 625	□ □	□ □	□ □	□ □	□ □	□ □
Polynuclear Aromatic Hydrocarbons	8310 / 8270	□ □	□ □	□ □	□ □	□ □	□ □
Purgeable Aromatics	5030/8020	■ ■	□ □	□ □	□ □	□ □	□ □
Total Petroleum Hydrocarbons (GC)	5030/8020	■ ■	□ □	□ □	□ □	□ □	□ □
<i>Halogenated Organic Chemicals</i>		ana./det.	ana./det.	ana./det.	ana./det.	ana./det.	ana./det.
Halogenated Volatile Organics	8010 / 601	□ □	□ □	□ □	□ □	□ □	□ □
Organochlorine & PCBs	8080	□ □	□ □	□ □	□ □	□ □	□ □
<i>Inorganic Chemicals</i>		ana./det.	ana./det.	ana./det.	ana./det.	ana./det.	ana./det.
Metals	6010 / 7xxx series	□ □	□ □	□ □	□ □	□ □	□ □
<i>Others</i>		ana./det.	ana./det.	ana./det.	ana./det.	ana./det.	ana./det.
• _____		□ □	□ □	□ □	□ □	□ □	□ □
• _____		□ □	□ □	□ □	□ □	□ □	□ □
• _____		□ □	□ □	□ □	□ □	□ □	□ □
• _____		□ □	□ □	□ □	□ □	□ □	□ □

DISCUSSION OF MEDIA INVESTIGATION & CHEMICAL ANALYSES

Items for discussion include: •Selection of sampled media •Selected analysis methods •Planned additional sampling

Items

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SUMMARY OF SOURCE ZONE CHARACTERISTICS

Instructions: Provide information regarding presence and dimensions of affected soil and groundwater zones. For each affected medium, list constituents of concern (COCs) and representative concentration data on Worksheets 5.4 - 5.6. Describe source area histories on Worksheets 2.2 and 2.3 and show locations on Figures 3 through 7. (Under RBCA, the affected soil or groundwater zone is defined as the area or volume containing COC concentrations in excess of Tier 1 screening levels.)

AFFECTED SURFACE SOILS (≤ 3 ft BGS) (■ TO SELECT)	
<input type="checkbox"/> Present	<i>If present, complete the following:</i> • Maximum areal extent (ft ²): _____ • Width of affected zone (ft): _____ (Provide COC data on Worksheet 5.4) • Length of affected zone (ft): _____ • Depth interval (ft,BGS): _____
<input checked="" type="checkbox"/> Not Present	
<input type="checkbox"/> Not Measured	

AFFECTED SUBSURFACE SOILS (> 3 ft BGS)	
<input type="checkbox"/> Present	<i>If present, complete the following:</i> • Depth to top of affected soil (ft) (min. 3 ft, BGS): _____ (Provide COC data on Worksheet 5.5) • Depth to base of affected soil (ft, BGS): _____ • Maximum areal extent (ft ²): _____
<input checked="" type="checkbox"/> Not Present	
<input type="checkbox"/> Not Measured	

AFFECTED GROUNDWATER	
<input checked="" type="checkbox"/> Present	<i>If present, complete the following:</i> • Maximum areal extent (ft ²): <u>15,080</u> • Length of plume (ft): <u>160 (maximum)</u> (Provide COC data on Worksheet 5.6) • Width of plume (ft): <u>120 (estimate)</u> • Depth to top of affected water-bearing unit (ft, BGS): <u>12</u> • Depth to base of plume (ft, BGS): _____
<input type="checkbox"/> Not Present	
<input type="checkbox"/> Not Measured	

OTHER SOURCE MEDIUM	
<input type="checkbox"/> Present	<i>If present, describe nature of material and dimensions:</i> _____ _____ (Provide COC data on separate table) _____ _____
<input checked="" type="checkbox"/> Not Present	

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GROUNDWATER CONCENTRATION DATA SUMMARY

Instructions: Indicate type and concentrations of hazardous constituents detected in groundwater. Provide statistical data (maximum value, mean value, upper 90% confidence limit on mean) on detectable concentrations only. Do not include non-detects from outside of source zone. Select "representative concentration" value for comparison to cleanup standard (SSTL or RBSL) and calculation of baseline risk. Provide detailed lab data table(s) as Appendix A to this report.

CONSTITUENTS DETECTED		ANALYTICAL METHOD		SAMPLE POPULATION		DETECTED CONCENTRATIONS			SELECTED REPRESENTATIVE CONC. (mg/L)
		Method No.	Typical Detection Limit (mg/L)	No. of Samples	No. of Detects	Max Conc. (mg/L)	Mean Conc. (mg/L)	Upper 90% CL Conc. (mg/L)	
CAS No.	Name								
	Volatilization from Groundwater to Indoor Air								
	Benzene	5030/8020	0.0005	28	8	1.30	0.196		0.290
	Toluene	5030/8020	0.0005	28	7	0.450	0.031		0.006
	Ethyl benzene	5030/8020	0.0005	28	8	0.970	0.082		0.075
	Xylenes	5030/8020	0.0005	28	8	4.90	0.493		0.032
	Volatilization from Groundwater to Ambient Air								
	Benzene	5030/8020	0.0005	28	8	1.30	0.196		0.340
	Toluene	5030/8020	0.0005	28	7	0.450	0.031		0.006
	Ethyl benzene	5030/8020	0.0005	28	8	0.970	0.082		0.128
	Xylenes	5030/8020	0.0005	28	8	4.90	0.493		0.395

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TIER 2 EXPOSURE PATHWAY TRANSPORT PARAMETERS

Instructions: For complete exposure pathways, provide site-specific values for transport parameters. In absence of direct measurements, default values may be selected for some parameters, as shown below. If no default value shown, site-specific value must be provided.

TRANSPORT PARAMETER	SITE-SPECIFIC VALUE (INPUT VALUE BELOW)	DEFAULT VALUE (■ TO SELECT)
AIR PARAMETERS		
δ_{air} Air mixing zone height (cm)		■ 200
U_{air} Ambient air velocity in mixing zone (cm/sec)		■ 225
Pe Soil particulate areal emission rate (g/cm ² -sec)		□ 2.17E-10
σ_y Transverse air dispersion coeff. (m)		■ 100
σ_z Vertical air dispersion coeff. (m)		■ 10
GROUNDWATER PARAMETERS		
δ_{gw} Groundwater mixing zone depth (cm)		□ 200
I Water infiltration rate (cm/yr)		□ 30
V_{gw} Groundwater Darcy velocity (ft/yr)		
K Saturated hydraulic conductivity (cm/sec)		
i_{grad} Lateral groundwater flow gradient (dim)		
$(BC)_i$ Available biodegradation capacity of electron acceptors for constituent i		
x Distance to POE from point of maximum COC concentration in groundwater (ft)		
α_x Longitudinal groundwater dispersion coeff. (cm)		□ 10% of x
α_y Transverse groundwater dispersion coeff. (cm)		□ 33% of α_x
α_z Vertical groundwater dispersion coeff. (cm)		□ 5% of α_z
SOIL PARAMETERS		
h_{cap} Capillary zone thickness (cm)		□ 5
h_v Vadose zone thickness (cm)		
ρ_s Soil bulk density (g/cm ³)		□ 1.7
foc_s Fraction organic carbon in soil leaching zone (dim)		□ 0.01
foc_{gw} Fraction organic carbon in water-bearing unit (dim)		□ 0.001
L_{gw} Depth to groundwater (cm)		
Θ_T Soil porosity (dim)		□ 0.38
Soil volumetric water content (dim)		
Θ_{wcap} • Capillary zone		□ 0.342
Θ_{ws} • Vadose zone		□ 0.12
Θ_{wcrack} • Foundation crack		□ 0.12

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TIER 2 EXPOSURE PATHWAY TRANSPORT PARAMETERS CONTINUED

TRANSPORT PARAMETER		SITE-SPECIFIC VALUE (INPUT VALUE BELOW)	DEFAULT VALUE (■ TO SELECT)
SOIL PARAMETERS (Continued)			
Soil volumetric air content (dim)			
θ_{acap}	•Capillary zone		<input type="checkbox"/> 0.038
θ_{as}	•Vadose zone		<input type="checkbox"/> 0.26
θ_{acrack}	•Foundation crack		<input type="checkbox"/> 0.26
d	Thickness of surficial soil zone (cm)		<input type="checkbox"/> 100 cm
BUILDING PARAMETERS			
			Resid. Comm/ Ind.
L_b	Building volume/area ratio (cm)		<input type="checkbox"/> 200 ■ 300
ER	Building air exchange rate (dy-1)		<input type="checkbox"/> 12 ■ 20
L_{crack}	Foundation crack thickness (cm)		■ 15
η	Foundation crack fraction		■ 0.005

Additional Information: