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

ENVIRONMENTAL PROTECTION
96 NOV 12 AM 9:18

Date November 7, 1996
Project 20805-127.004

To:

Ms. Medula Logan
Alameda County Health Care Services Agency
Department of Environmental Health
1131 Harbor Bay Parkway
Alameda, California 94502

STID 744

We are enclosing:

| Copies | Description |
|---|---|
| 1 | Revised copies of pages 6 and 7, Table 2, and Worksheet 5.1 of *Tier 1, Tier 2 Risk-Based Corrective Action Evaluation for ARCO Service Station 2111, 1156 Davis Street, San Leandro, California* |

| For your: | | | Sent by: | | |
|---|---|---|---|---|---|
| | X | Use | | X | Regular Mail |
| | | Approval | | | Standard Air |
| | | Review | | | Courier |
| | | Information | | | Other |

Comments:

Please replace the corresponding pages in the original submittal with these pages. The changes reflected in these pages result from the use, at your request, of default values for soil water and air content proportioned to correspond to a total porosity of 0.30. Please note that these changes did not alter the conclusions of the report.

Ray Kaminsky
Senior Environmental Chemist

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

RWQCB benzene correction

- 0.074 mg/l x 0.29 = 0.021 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 based on our knowledge of the type of soil present at this site. For example, oil 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. Soil water and air content were sealed down from the default values to total 0.30. The values used for soil water and air content

Site Name: ARCO 2111 | Date Completed: 9-11-96

Site Location: 1156 Davis Street, San Leandro, CA | Completed By: EMCON



## 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.**

| | | Default Value Used | | Site-Specific Value Used | | |
|---|---|---|---|---|---|---|
| **Soil Parameters** | | | | | | |
| | soil type | ☐ | sandy soil | ■ | clayey sand | *§ |
| $\Theta_T$ | Soil porosity | ☐ | 0.38 (dim) | ■ | 0.30 | § |
| $\Theta_{ws}$ | water content - vadose zone | ☐ | 0.12 (dim) | ■ | 0.09 | § |
| $\Theta_{as}$ | air content - vadose zone ( $= \Theta_T - \Theta_{ws}$ ) | ☐ | 0.26 (dim) | ■ | 0.21 | |
| $\Theta_{wcap}$ | water content - capillary fringe | ☐ | 0.342 (dim) | ■ | 0.25 | |
| $\Theta_{acap}$ | air content - capillary fringe ( $= \Theta_T - \Theta_{wcap}$ ) | ☐ | 0.038 (dim) | ■ | 0.05 | |
| $\rho_s$ | Soil density | ■ | 1.7 g/cm$^3$ | ☐ | | § |
| foc | mass fraction of organic carbon in soil | ■ | 0.01 (dim) | ☐ | | § |
| Ls | Depth to contaminated soil | ☐ | 100 cm | ☐ | | § |
| Lgw | Depth to groundwater | ☐ | 300 cm | ■ | 366 | § |
| $h_{cap}$ | capillary zone thickness | ☐ | 5 cm | ■ | 30.5 | |
| hv | vadose zone thickness ( = Lgw - hc ) | ☐ | 295 cm | ■ | 335 | |
| pH | Soil/water pH | ■ | 6.5 | ☐ | | |
| **Groundwater Parameters** | | | | | | |
| I | Water infiltration rate | ☐ | 30 cm/yr | ☐ | | § |
| $V_{gw}$ | groundwater velocity | ☐ | 82.0 ft/yr | ☐ | | *§ |
| $\delta_{gw}$ | groundwater mixing zone depth | ☐ | 200 cm | ☐ | | *§ |
| DF | aquifer dilution factor ( $= 1 + V_{gw}\,\delta_{gw}/(IW)$ ) | ☐ | 12.1 | ☐ | | |
| **Surface Parameters** | | | | | | |
| $U_{air}$ | Amb. air velocity in mixing zone | ☐ | 225 cm/s | ☐ | | *§ |
| $\delta_{air}$ | Mixing zone height | ☐ | 200 cm | ☐ | | *§ |
| A | Contaminated Area | ☐ | 2250000 cm$^2$ | ☐ | | |
| W | Width of Contaminated Area | ☐ | 1500 cm | ☐ | | § |
| d | Thickness of Surficial Soils | ☐ | 100 cm | ☐ | | § |
| Pe | Particulate areal emission rate | ☐ | 2.17E-10 g/cm$^2$-s | ☐ | | § |
| **Building Parameters** | | | | | | |
| $L_{crack}$ | Foundation crack thickness | ■ | 15 cm | ☐ | | |
| $\eta$ | Foundation crack fraction | ☐ | 0.01 (dim) | ■ | 0.005 | |
| $Lb_r$ | Building Volume/Foundation Area Ratio (res.) | ☐ | 200 cm | ☐ | | |
| $Lb_c$ | Building Volume/Foundation Area Ratio (com./ind.) | ■ | 300 cm | ☐ | | |
| $ER_r$ | Building vapor volume exchange rate (res.) | ☐ | 12 dy$^{-1}$ | ☐ | | |
| $ER_c$ | Building vapor volume exchange rate (com./ind.) | ■ | 20 dy$^{-1}$ | ☐ | | |

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

*(continue on next page if needed)*

# Table 2
# Tier 2 Results
# ARCO Service Station 2111

| Compound | Concentration at Point of Exposure (mg/L) | Site-Specific Threshold Level (mg/L) |
|---|---|---|
| Onsite | | |
| Benzene | 0.34 | 0.52 [1] |
| Offsite | | |
| Benzene | 0.0049 | 0.05 [2] |

1 Based on 1.00E-05 risk

2 Based on 1.00E-06 risk

were 0.09 and 0.21, respectively. 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 times less than the SSTL (0.52 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 (0.05 mg/l) calculated for the groundwater-to-indoor air pathway. The estimated groundwater benzene concentration is about 11-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

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

Date September 27, 1996
Project 20805-127.004

To:

Mr. Dale Klettke
Alameda County Health Care Services Agency
Department of Environmental Health
1131 Harbor Bay Parkway
Alameda, California 94502



We are enclosing:

| Copies | Description |
|---|---|
| 1 | Tier 1, Tier 2 Risk-Based Corrective Action Evaluation for ARCO Service Station 2111, 1156 Davis Street, San Leandro, California |

| For your: | | Sent by: | |
|---|---|---|---|
| X | Use | X | Regular Mail |
| | Approval | | Standard Air |
| | Review | | Courier |
| | Information | | Other: |

Comments:

The enclosed risk-based corrective action evaluation is being sent to you per the request of ARCO Products Company. Please call if you have questions or comments.

John C. Young
Project Manager

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

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

STID 744

September 10, 1996
Project 20805-127.003

Mr. Dale Klettke
Alameda County Health Care Services Agency
Department of Environmental Health
1131 Harbor Bay Parkway
Alameda, California 94502

Re: Submittal of Tier 2 Risk-Based Corrective Action (RBCA) evaluation, for ARCO service station 2111, 1156 Davis Street, San Leandro, California

Dear Mr. Klettke:

EMCON, on behalf of ARCO Products Company (ARCO), requested the submittal date for the Tier 2 RBCA evaluation for ARCO service station 2111 be postponed from September 11, 1996 to September 27, 1996. This letter documents your verbal approval for submitting the Tier 2 evaluation on September 27, 1996, based on a phone message to John Young of EMCON on September 10, 1996.

Sincerely,

EMCON

Ivy Inouye
Project Coordinator

cc: Paul Supple, ARCO Products Company

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

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.

For on-site receptors, acceptable risk-based soil and groundwater levels were calculated based on a $1 \times 10^{-5}$ (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 $1 \times 10^{-6}$ (i.e., 1 in 100,000) probability of developing cancer from cancer-causing substances, and a hazard quotient of 1 for noncancer-causing substances

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.

<u>For Commercial/Industrial Receptor Scenario:</u>

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

modified fig #6

- 0.074 mg/l x 0.29 = 0.021 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 based on our knowledge of the type of soil present at this site. For example, oil 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. Soil water and air content were sealed down from the default values to total 0.30. The values used for soil water and air content

RWQCB benzene correction

- 0.074 mg/l x 0.29 = 0.021 mg/l

RBSL = 0.021 mg/l

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- 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

marked pg #7



were 0.09 and 0.21, respectively. 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 times less than the SSTL (0.52 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 (0.05 mg/l) calculated for the groundwater-to-indoor air pathway. The estimated groundwater benzene concentration is about 11-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

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

REGISTERED GEOLOGIST
JOHN CHARLES YOUNG
RKP 7/98
NO. 6407
STATE OF CALIFORNIA

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
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-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
# ARCO Service Station 2111

Modified Pg 1 - Table 2

| Compound | Concentration at Point of Exposure (mg/L) | Site-Specific Threshold Level (mg/L) |
|---|---|---|
| Onsite | | |
| Benzene | 0.34 | 0.52 [1] |
| Offsite | | |
| Benzene | 0.0049 | 0.05 [2] |

1 Based on 1.00E-05 risk

2 Based on 1.00E-06 risk

# 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] |

1 Based on 1.00E-05 risk

2 Based on 1.00E-06 risk

# 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



# TIER 1 EXECUTIVE SUMMARY CHECKLIST

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

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

**TIER 1 TASKS COMPLETED**

- ■ Visual / historical assessment
- ■ Initial (screening) site assessment
- ■ Site prioritization / classification
- ■ Detailed site characterization
- ■ RBSL comparison
- ☐ Initial ecological assessment
- ■ 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 |

**TIER 1 CORRECTIVE ACTION CRITERIA**

| | Screening Level Criteria Exceeded? (■ if yes) | | | | | | |
|---|---|---|---|---|---|---|---|
| Affected Medium | Risk-Based | Other (MCL) | Others: (specify) | _____ | _____ | _____ | None Exceeded |
| • Surface Soil (< 3ft BGS) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ■ |
| • Subsurface Soil (>3ft BGS) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ■ |
| • Groundwater (potable/nonpotable) | ■ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| • Surface waters | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ■ |

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

**PROPOSED TIER 1 ACTION**

- ☐ ***No Action:*** Site does not exceed Tier 1 criteria. - Apply for closure.
- ☐ ***Interim Corrective Action:*** Site exceeds some Tier 1 criteria. - Propose interim corrective action and reprioritize site.
- ☐ ***Final Corrective Action:*** Site exceeds some Tier 1 criteria. - Propose corrective action to achieve Tier 1 criteria.
- ■ ***Tier 2 Evaluation:*** Site exceeds some Tier 1 criteria. - Re-evaluate corrective action goals per Tier 2 risk assessment.

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

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

Site Name: ARCO 2111 Date Completed: 9-11-96

Site Location: 1156 Davis Street, San Leandro, CA Completed By: EMCON



# 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., ≤ 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 1 Interim Corrective Action
- ■ Tier 2 Evaluation
- ❑ Tier 2 Interim Corrective Action
- ❑ Tier 2 Final 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) | ❑ | ❑ | | | | | |
| • Subsurface Soil (>3ft BGS | ❑ | ❑ | | | | | |
| • Groundwater | ❑ | ■ | 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:*

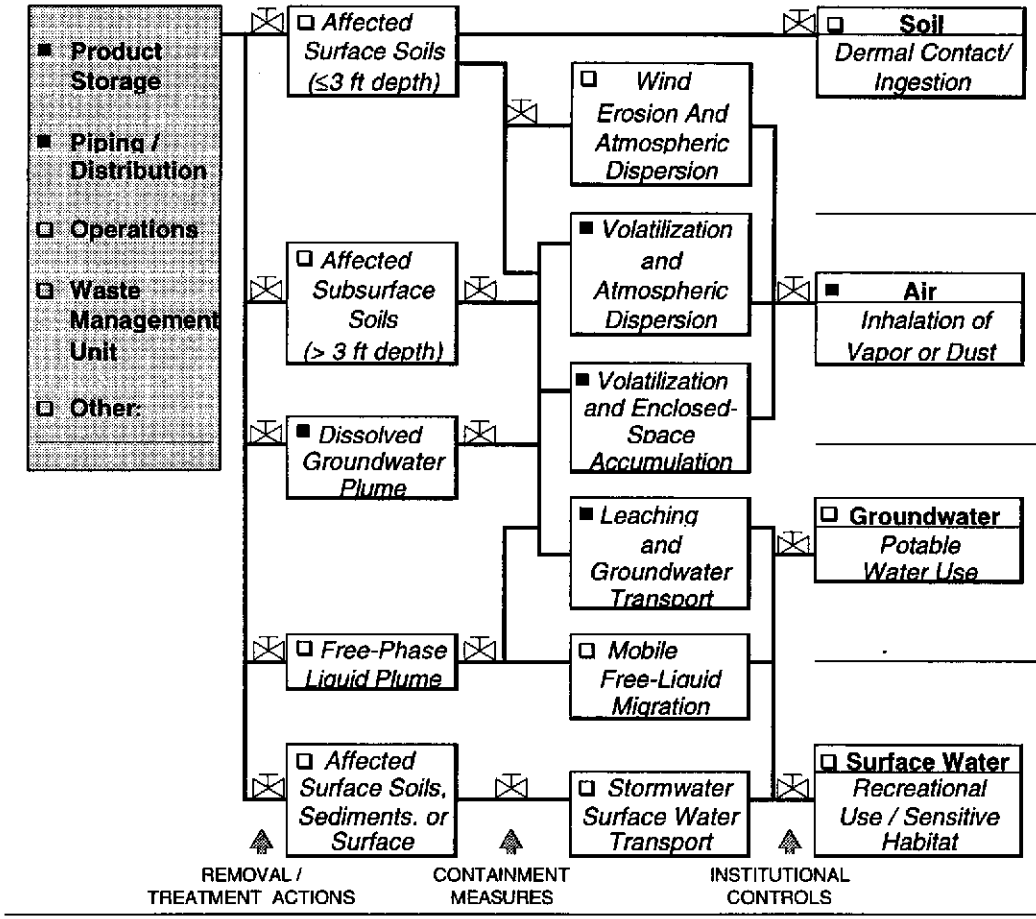
*Rationale for proposed action documented on Worksheets 1.3 and 10.1-10.3.*

Site Name: ARCO 2111 | Date Completed: 9-11-96
Site Location: 1156 Davis Street, San Leandro, CA | Completed By: EMCON



# 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).*




| POTENTIAL RECEPTORS | REMEDIAL ACTION TECHNOLOGY OPTIONS |
|---|---|
| **Exposed Receptors**<br>*On-Site:* □ Residential □ Non-Resid. ■ N/A<br>□ Sensitive Habitat □ Recreation<br>*Off-Site:* □ Residential □ Non-Resid. ■ N/A<br>□ Sensitive Habitat □ Recreation | □ Complete Pathway: ○ Current ○ Potential<br>⋈ Action Required: □Yes ■ No<br>If yes, list technology options for ⋈: |
| **Exposed Persons**<br>*On-Site:* □Residential ■ Non-Resid. □ N/A<br>*Off-Site:* □Residential ■ Non-Resid. □ N/A | ■ Complete Pathway: ● Current ○ Potential<br>⋈ Action Required: □Yes ■ No<br>If yes, list technology options for ⋈: |
| **Groundwater Users**<br>*On-Site:* □Residential □ Non-Resid. ■ N/A<br>*Off-Site:* □Residential □ Non-Resid. ■ N/A | □ Complete Pathway: ○ Current ○ Potential<br>⋈ Action Required: □Yes ■ No<br>If yes, list technology options for ⋈: |
| **Surface Water Users**<br>*On-Site:* □ Residential □ Non-Resid. ■ N/A<br>□ Sensitive Habitat □ Recreation<br>*Off-Site:* □ Residential □ Non-Resid. ■ N/A<br>□ Sensitive Habitat □ Recreation | □ Complete Pathway: ○ Current ○ Potential<br>⋈ Action Required: □Yes ■ No<br>If yes, list technology options for ⋈: |

*( ■ OR ● OR ⋈ TO SELECT )*

Site Name: ARCO 2111 Date Completed: 9-11-96

Site Location: 1156 Davis Street, San Leandro, CA Completed By: EMCON



## SITE DESCRIPTION

**Location Description** (see Figure 1)

Address: 1156 Davis Street

Cross-Street: Preda 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: Regioual 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* )

*Discuss options for listed items (including anticipated future use)*

| On-Site Use | Current | Potential | Prior |
|---|---|---|---|
| Commercial | ■ | ❑ | ❑ |
| Residential | ❑ | ❑ | ❑ |
| Industrial | ❑ | ❑ | ❑ |
| Sensitive Habitat | ❑ | ❑ | ❑ |
| Other: (below) | ❑ | ❑ | ❑ |

**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 | Date Completed: 9-11-96

Site Location: 1156 Davis Street, San Leandro, CA | Completed by: EMCON



# 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? |
|---|---|---|---|---|---|
| ■ Product Storage<br>■ Piping / Distribution<br>☐ Operations<br>☐ Waste Management Unit<br>☐ Other: | ☐ Affected Surface Soils (≤3 ft depth) | ☐ Wind Erosion and Atmospheric Dispersion | ☐ Soil<br>Dermal Contact/ Ingestion | **Exposed Receptors**<br>On-Site: ☐ Residential ☐ Non-Resid. ■ N/A ☐ Sensitive Habitat ☐ Recreation<br>Off-Site: ☐ Residential ☐ Non-Resid. ■ N/A ☐ Sensitive Habitat ☐ Recreation | ■ No ☐ Yes ○ Current ○ Potential<br>■ No ☐ Yes ○ Current ○ Potential |
| | ☐ Affected Subsurface Soils (> 3 ft depth) | ■ Volatilization and Atmospheric Dispersion | ■ Air<br>Inhalation of Vapor or Dust | **Exposed Persons**<br>On-Site: ☐ Residential ■ Non-Resid. ☐ N/A<br>Off-Site: ☐ Residential ■ Non-Resid. ☐ N/A | ☐ No ■ Yes ● Current ○ Potential<br>☐ No ■ Yes ○ Current ● Potential |
| | ■ Dissolved Groundwater Plume | ■ Volatilization and Enclosed-Space Accumulation | | | |
| | | ■ Leaching and Groundwater Transport | ☐ Groundwater<br>Potable Water Use | **Groundwater Users**<br>On-Site: ☐ Residential ☐ Non-Resid. ■ N/A<br>Off-Site: ☐ Residential ☐ Non-Resid. ■ N/A | ■ No ☐ Yes ○ Current ○ Potential<br>■ No ☐ Yes ○ Current ○ Potential |
| | ■ Free-Phase Liquid Plume | ☐ Mobile Free-Liquid Migration | | | |
| | ☐ Affected Surface Soils, Sediments, or Surface Water | ☐ Stormwater/ Surface Water Transport | ☐ Surface Water<br>Recreational Use / Sensitive Habitat | **Surface Water Users**<br>On-Site: ☐ Residential ☐ Non-Resid. ■ N/A ☐ Sensitive Habitat ☐ Recreation<br>Off-Site: ☐ Residential ☐ Non-Resid. ■ N/A ☐ Sensitive Habitat ☐ Recreation | ■ No ☐ Yes ○ Current ○ Potential<br>■ No ☐ Yes ○ Current ○ Potential |

*( ■ OR ● TO SELECT )*

Site Name: ARCO 2111 | Date Completed: 9-11-96

Site Location: 1156 Davis Street, San Leandro, CA | Completed By: EMCON



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

Site Name: ARCO 2111 | Date Completed: 9-11-96

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## TIER 2 EXPOSURE PATHWAY SCREENING *CONTINUED*

| PATHWAY | A) SOURCE MEDIUM: Type | A) SOURCE MEDIUM: Pathway Tier 1 RBSL Exceeded? | B) TRANSPORT MECHANISM: Type | B) TRANSPORT MECHANISM: Active at Site? | C) EXPOSURE MEDIUM: Type | C) EXPOSURE MEDIUM: Exposure Limit Exceeded at POE? | COMPLETE PATHWAY? (Check if yes & specify status) |
|---|---|---|---|---|---|---|---|
| ***SURFACE WATER PATHWAYS*** | | | | | | | |
| 9) *Soil:* Leaching to Groundwater /Discharge to Surface Water: Recreation or Fish | Surface or Subsurface Soils | ☐ Yes ■ No | Leaching /Groundwater Flow | ■ No ☐ Yes - Current ☐ Yes - Future | Surface Water | ■ NM ☐ No ☐ Yes | ☐ Current ☐ Potential |
| 10) *Groundwater Plume:* Discharge to Surface Water: Recreation or Fish | Groundwater | ☐ Yes ■ No | Groundwater Flow | ■ No ☐ Yes - Current ☐ Yes - Future | Surface Water | ■ NM ☐ No ☐ Yes | ☐ Current ☐ Potential |
| 11) *Soil :* Leaching to Stormwater / Discharge to Surface Water: Recreation or Fish | Surface Soils | ☐ Yes ■ No | Overland Flow | ■ No ☐ Yes - Current ☐ Yes - Future | Surface Water | ■ NM ☐ No ☐ Yes | ☐ Current ☐ 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 Groundwater to -Indoor Air (mg/L) | Site Concentration (Well MW-2) (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 Groundwater to -Ambient Air (mg/L) | Site Concentration (Average of wells MW-2 and MW-7) (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 $1x10^{-5}$ 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 — Indiv. Risk | Individual Constituent Effects — HQ | Cumulative Constituent Effects — Additive Risk | Cumulative Constituent Effects — HI | Other Exposure Limit (specify if applicable) |
|---|---|---|---|---|---|---|---|
| **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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## SUMMARY OF MEDIA INVESTIGATION & CHEMICAL ANALYSES

| | | Site Media Analyzed ( ■ *TO SELECT* ) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ground-water | Surface Soil | Subsurf. Soil | Soil Vapor | Ambient Vapor | Surface Water |
| | ***Applicable?*** | ■ | ❑ | ❑ | ❑ | ❑ | ❑ |
| | ***Sampled?*** | ■ | ❑ | ❑ | ❑ | ❑ | ❑ |
| **Chemical Analysis** | **EPA Analysis Method** | **•ana. = chemical analyzed; •det. = chemical detected** | | | | | |
| ***Organic Chemicals*** | | 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* | ■ ■ | ❑ ❑ | ❑ ❑ | ❑ ❑ | ❑ ❑ | ❑ ❑ |
| ***Halogenated Organic Chemicals*** | | ana./det. | ana./det. | ana./det. | ana./det. | ana./det. | ana./det. |
| Halogenated Volatile Organics | *8010 / 601* | ❑ ❑ | ❑ ❑ | ❑ ❑ | ❑ ❑ | ❑ ❑ | ❑ ❑ |
| Organochlorine & PCBs | *8080* | ❑ ❑ | ❑ ❑ | ❑ ❑ | ❑ ❑ | ❑ ❑ | ❑ ❑ |
| ***Inorganic Chemicals*** | | ana./det. | ana./det. | ana./det. | ana./det. | ana./det. | ana./det. |
| Metals | *6010 / 7xxx series* | ❑ ❑ | ❑ ❑ | ❑ ❑ | ❑ ❑ | ❑ ❑ | ❑ ❑ |
| ***Others*** | | 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* | |
|---|---|
| | |

Site Name: ARCO 2111 | Date Completed: 9-11-96

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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)

- ☐ Present
- ■ Not Present
- ☐ Not Measured

*If present, complete the following:*

- Maximum areal extent ($ft^2$):
- Width of affected zone (ft):
- Length of affected zone (ft) :
- Depth interval (ft,BGS):

*(Provide COC data on Worksheet 5.4)*

## AFFECTED SUBSURFACE SOILS (> 3 ft BGS)

- ☐ Present
- ■ Not Present
- ☐ Not Measured

*If present, complete the following:*

- Depth to top of affected soil (ft) (min. 3 ft, BGS):
- Depth to base of affected soil (ft, BGS):
- Maximum areal extent ($ft^2$):

*(Provide COC data on Worksheet 5.5)*

## AFFECTED GROUNDWATER

- ■ Present
- ☐ Not Present
- ☐ Not Measured

*If present, complete the following:*

- Maximum areal extent ($ft^2$): 15,080
- Length of plume (ft): 160 (maximum)
- Width of plume (ft): 120 (estimate)
- Depth to top of affected water-bearing unit (ft, BGS): 12
- Depth to base of plume (ft, BGS):

*(Provide COC data on Worksheet 5.6)*

## OTHER SOURCE MEDIUM

- ☐ Present
- ■ Not Present

*If present, describe nature of material and dimensions:*

*(Provide COC data on separate table)*

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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) |
|---|---|---|---|---|---|---|---|---|---|
| CAS No. | Name | 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) | |
| | **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 |
| | | | | | | | | | |

1.300
0.196
1.496
2
7

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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** | | | |
| $\delta_{air}$ | 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 |
| $\sigma_y$ | Transverse air dispersion coeff. (m) | | ■ 100 |
| $\sigma_z$ | Vertical air dispersion coeff. (m) | | ■ 10 |
| **GROUNDWATER PARAMETERS** | | | |
| $\delta_{gw}$ | 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) | | |
| $\alpha_x$ | Longitudinal groundwater dispersion coeff. (cm) | | ❑ 10% of x |
| $\alpha_y$ | Transverse groundwater dispersion coeff. (cm) | | ❑ 33% of $\alpha_x$ |
| $\alpha_z$ | Vertical groundwater dispersion coeff. (cm) | | ❑ 5% of $\alpha_z$ |
| **SOIL PARAMETERS** | | | |
| $h_{cap}$ | Capillary zone thickness (cm) | | ❑ 5 |
| $h_v$ | Vadose zone thickness (cm) | | |
| $\rho_s$ | 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 |
| Lgw | Depth to groundwater (cm) | | |
| $\Theta_T$ | Soil porosity (dim) | | ❑ 0.38 |
| | Soil volumetric watecr content (dim) | | |
| $\Theta_{wcap}$ | • Capillary zone | | ❑ 0.342 |
| $\Theta_{ws}$ | • Vadose zone | | ❑ 0.12 |
| $\Theta_{wcrack}$ | • Foundation crack | | ❑ 0.12 |

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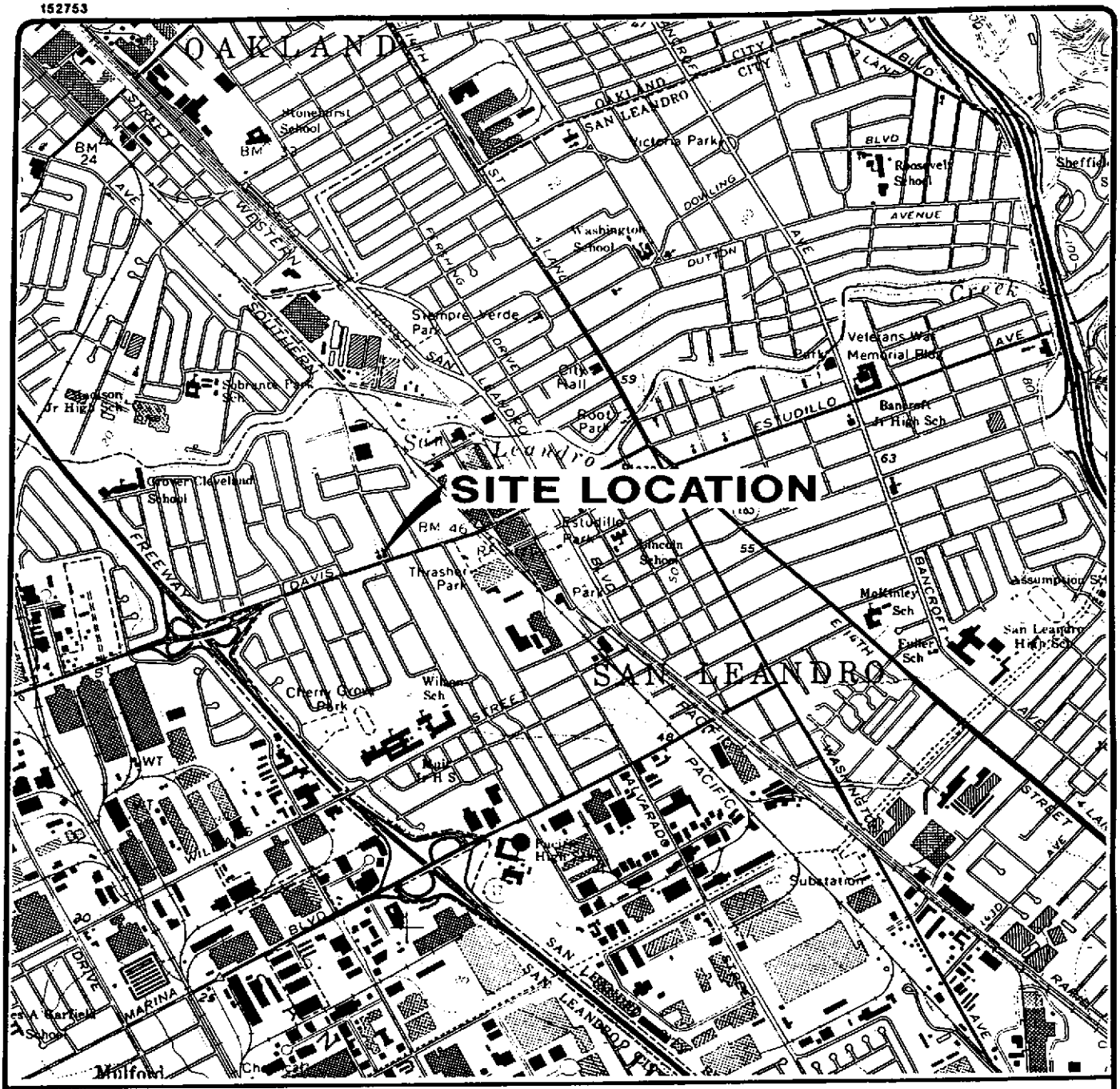
**TIER 2 EXPOSURE PATHWAY TRANSPORT PARAMETERS *CONTINUED***

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

**Additional Information:**

152753

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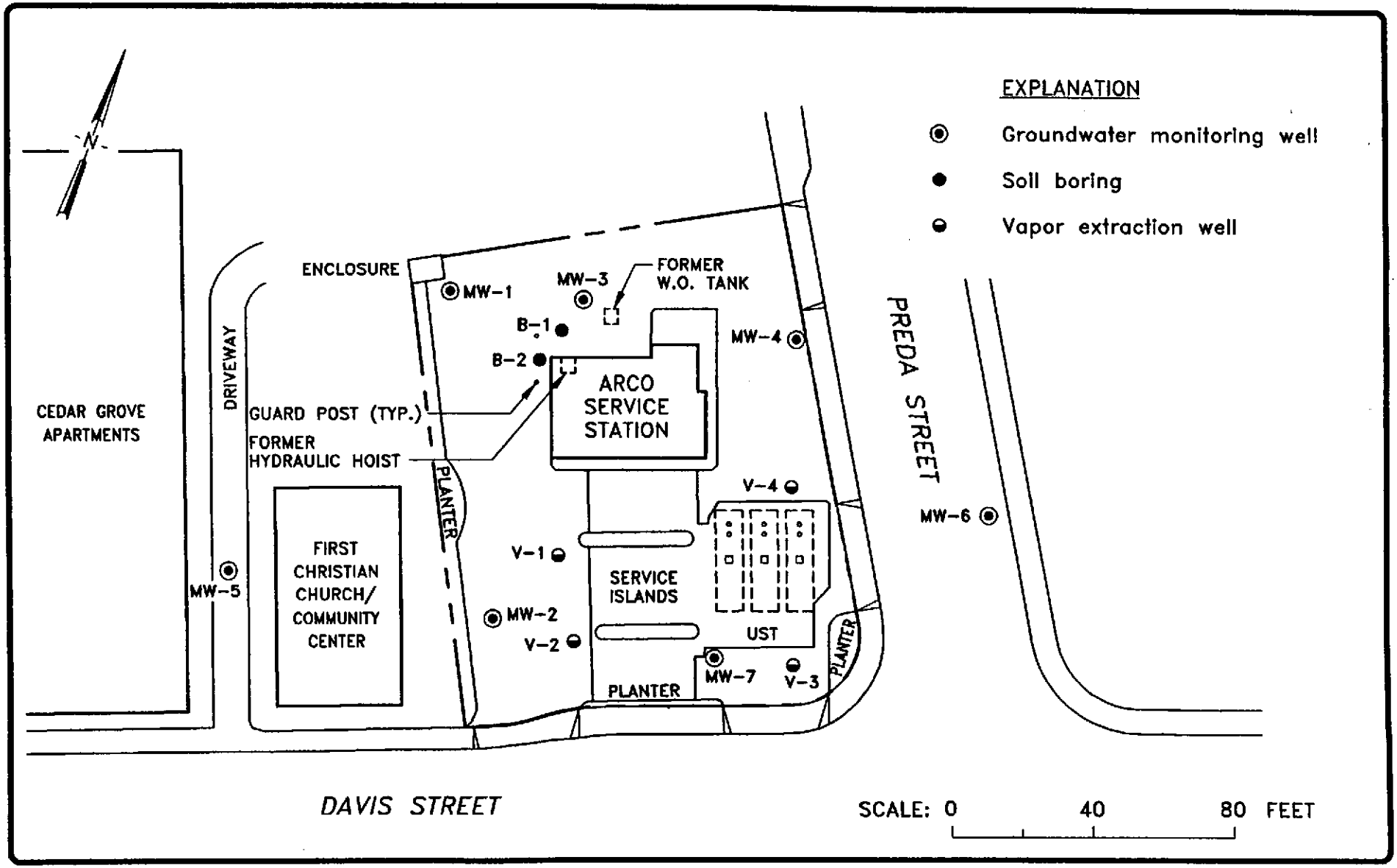
SERVICE STATION 2111, 1156 DAVIS STREET
SAN LEANDRO, CALIFORNIA

SITE LOCATION

FIGURE
1
PROJECT NO.
805-127.04

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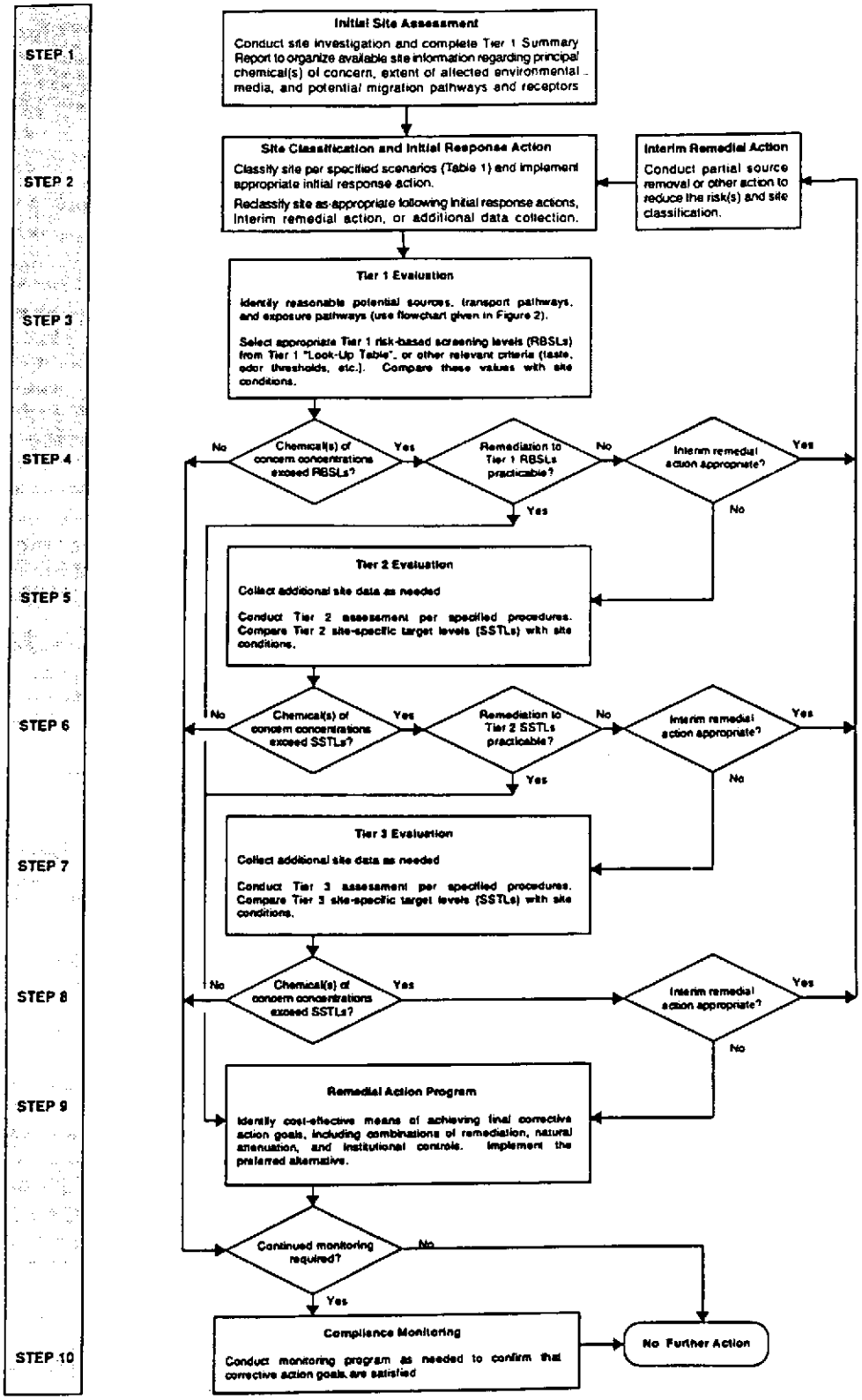
SAN LEANDRO, CALIFORNIA

SITE PLAN

FIGURE
**2**
PROJECT NO.
805-127.04

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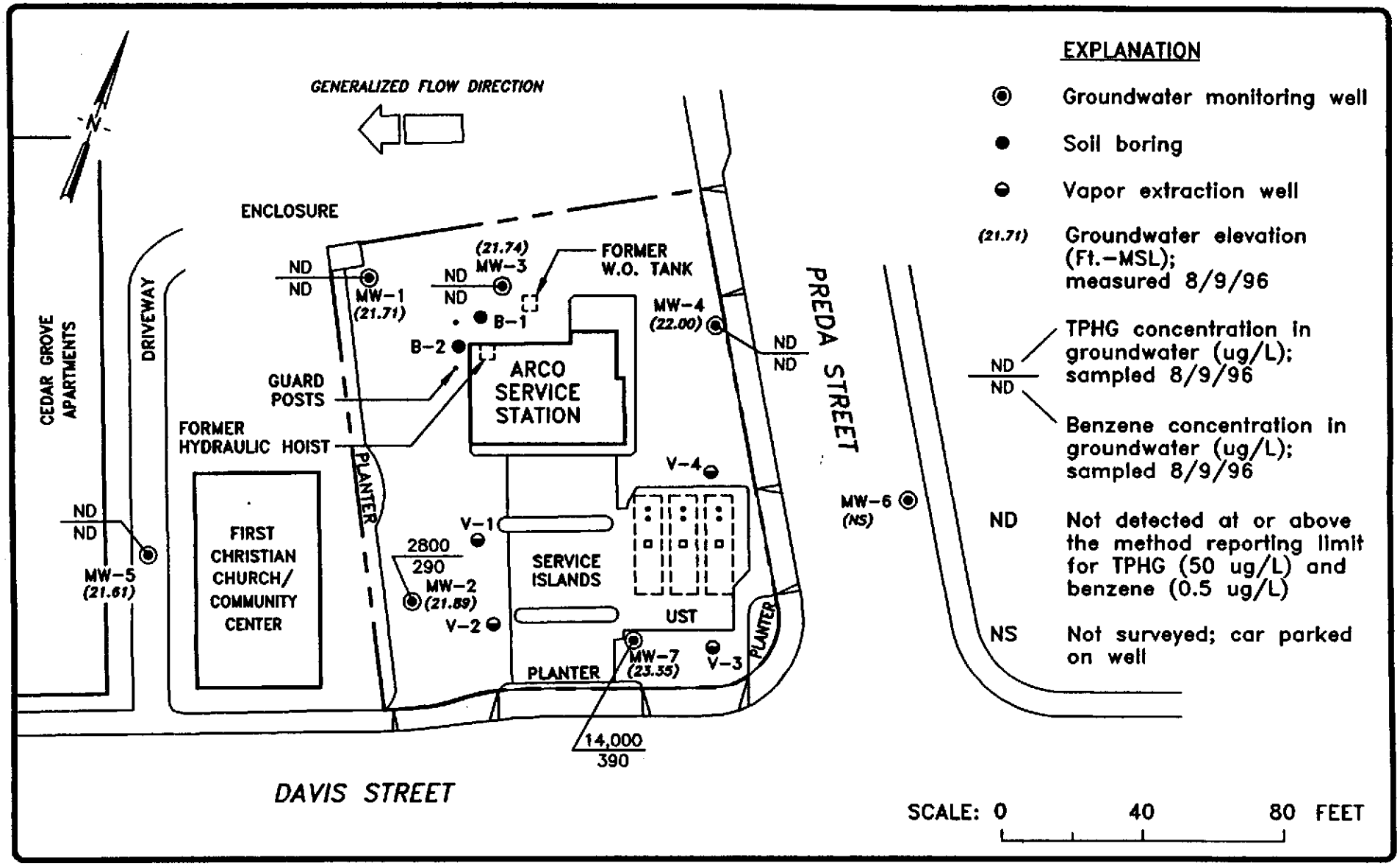
RISK-BASED CORRECTIVE ACTION PLAN
PROCESS FLOWCHART

FIGURE
3

PROJECT NO.
805-127.04

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SAN LEANDRO, CALIFORNIA

GROUNDWATER DATA
THIRD QUARTER 1996

FIGURE
**4**
PROJECT NO.
805-127.04

Site Name: ARCO 2111 Date Completed: 9-11-96

Site Location: 1156 Davis Street, San Leandro, CA Completed By: EMCON



## 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 a 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 | ☐ 70 yrs | ☐ _____ | ■ 70 yrs | ☐ _____ |
| $AT_n$ | Averaging time for non-carcinogens | ☐ = ED | ☐ _____ | ■ = ED | ☐ _____ |
| BW | Body weight -Adult | ☐ 70 kg | ☐ _____ | ■ 70 kg | ☐ _____ |
| | -Child (1-6 yrs) | ☐ 15 kg | ☐ _____ | ☐ NA | ☐ _____ |
| ED | Exposure duration | ☐ 30 yrs | ☐ _____ | ■ 25 yrs | ☐ _____ |
| **AIR EXPOSURE FACTORS** | | ■ COMPLETE (provide data) | | ☐ NOT COMPLETE (skip) | |
| EF | Exposure frequency (inhalation) | ☐ 350 dy/yr | ☐ _____ | ■ 250 dy/yr | ☐ _____ |
| $IR_{ai}$ | Daily indoor inhalation rate | ☐ 15 $m^3$/dy (24-hr/dy) | ☐ | ■ 20 $m^3$/dy (8-hr/dy) | ☐ |
| $IR_{ao}$ | Daily outdoor inhalation rate | ☐ 20 $m^3$/dy (24-hr/dy) | ☐ | ■ 20 $m^3$/dy (8-hr/dy) | ☐ |
| **POTABLE WATER USE EXPOSURE FACTORS** | | ☐ COMPLETE (provide data) | | ■ NOT COMPLETE (skip) | |
| EF | Exposure frequency (ingestion/showering) | ☐ 350 dy/yr | ☐ _____ | ☐ 250 dy/yr | ☐ _____ |
| $IR_W$ | Daily water ingestion rate | ☐ 2 L/dy (24-hr/dy) | ☐ _____ | ☐ 1 L/dy (8-hr/dy) | ☐ _____ |
| $EP_{sh}$ | Exposure period (showering) | ☐ 12 min/dy | ☐ _____ | ☐ 12 min/day | ☐ _____ |
| $SA_W$ | Skin surface area (showering) -Adult (70 kg) | ☐ 0.86 $m^2$ | ☐ _____ | ☐ 0.86 $m^2$ | ☐ _____ |
| **SOIL EXPOSURE FACTORS** | | ☐ COMPLETE (provide data) | | ■ NOT COMPLETE (skip) | |
| EF | Exposure Frequency -Dermal Contact | ☐ 350 dy/yr | ☐ _____ | ☐ 40 dy/yr | ☐ _____ |
| | -Soil ingestion | ☐ 350 dy/yr | ☐ _____ | ☐ 250 dy/yr | ☐ _____ |
| $SA_S$ | Skin surface area (soil contact) -Adult (18 to 31 yrs, 70 kg) | ☐ 0.58 $m^2$ | ☐ _____ | ☐ 0.58 $m^2$ | ☐ _____ |
| | -Child (1 - 17 yrs, 35 kg) | ☐ 0.20 $m^2$ | ☐ _____ | ☐ NA | ☐ _____ |
| M | Soil to skin adherance factor | ☐ 1.0 mg/$cm^2$ | ☐ _____ | ☐ 1.0 mg/$cm^2$ | ☐ _____ |
| $IR_S$ | Soil ingestion rate - Age-adjusted average | ☐ 114 mg-yr /kg-dy | ☐ _____ | o NA | ☐ _____ |
| | -Adult (7 to 31 yrs, 70 kg) | ☐ 100 mg/dy (24-hr/dy) | ☐ _____ | ☐ 50 mg/dy (8-hr/dy) | ☐ _____ |
| | -Child (1 - 6 yrs, 15 kg) | ☐ 200 mg/dy (24-hr/dy) | ☐ _____ | ☐ NA | ☐ _____ |
| **SURFACE WATER EXPOSURE FACTORS** | | ☐ COMPLETE (provide data) | | ■ NOT COMPLETE (skip) | |
| EF | Exposure Frequency -Fish consumption | ☐ 350 dy/yr | ☐ _____ | ☐ NA | ☐ _____ |
| | -Swimming | ☐ 7 dy/yr | ☐ _____ | ☐ NA | ☐ _____ |
| $IR_f$ | Daily fish intake rate -Freshwater | ☐ 10 g/dy | ☐ _____ | ☐ NA | ☐ _____ |
| | -Saltwater | ☐ 15 g/dy | ☐ _____ | ☐ NA | ☐ _____ |
| $SA_W$ | Skin surface area (swimming) -Adult (70 kg) | ☐ 0.86 $m^2$ | ☐ _____ | ☐ NA | ☐ _____ |
| $EP_{SW}$ | Exposure period (swimming) | ☐ 2.6 hrs/dy | ☐ _____ | ☐ NA | ☐ _____ |

Modified sheet 5.1

**RBCA SUMMARY REPORT** | **Worksheet 5.1**

Site Name: ARCO 2111 | Date Completed: 9-11-96

Site Location: 1156 Davis Street, San Leandro, CA | Completed By: EMCON



## 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 | ☐ | sandy soil | ■ clayey sand | *§ |
| $\Theta_T$ | Soil porosity | ☐ | 0.38 (dim) | ■ 0.30 | § |
| $\Theta_{ws}$ | water content - vadose zone | ☐ | 0.12 (dim) | ■ 0.09 | § |
| $\Theta_{as}$ | air content - vadose zone ( $= \Theta_T - \Theta_{ws}$) | ☐ | 0.26 (dim) | ■ 0.21 | |
| $\Theta_{wcap}$ | water content - capillary fringe | ☐ | 0.342 (dim) | ■ 0.25 | |
| $\Theta_{acap}$ | air content - capillary fringe ( $= \Theta_T - \Theta_{wcap}$ ) | ☐ | 0.038 (dim) | ■ 0.05 | |
| $\rho_s$ | Soil density | ■ | 1.7 g/cm$^3$ | ☐ | § |
| foc | mass fraction of organic carbon in soil | ■ | 0.01 (dim) | ☐ | § |
| Ls | Depth to contaminated soil | ☐ | 100 cm | ☐ | § |
| Lgw | Depth to groundwater | ☐ | 300 cm | ■ 366 | § |
| $h_{cap}$ | capillary zone thickness | ☐ | 5 cm | ■ 30.5 | |
| hv | vadose zone thickness ( = Lgw - hc ) | ☐ | 295 cm | ■ 335 | |
| pH | Soil/water pH | ■ | 6.5 | ☐ | |
| | **Groundwater Parameters** | | | | |
| I | Water infiltration rate | ☐ | 30 cm/yr | ☐ | § |
| $V_{gw}$ | groundwater velocity | ☐ | 82.0 ft/yr | ☐ | *§ |
| $\delta_{gw}$ | groundwater mixing zone depth | ☐ | 200 cm | ☐ | *§ |
| DF | aquifer dilution factor ( $= 1 + V_{gw}\,\delta_{gw}/(IW)$ ) | ☐ | 12.1 | ☐ | |
| | **Surface Parameters** | | | | |
| $U_{air}$ | Amb. air velocity in mixing zone | ☐ | 225 cm/s | ☐ | *§ |
| $\delta_{air}$ | Mixing zone height | ☐ | 200 cm | ☐ | *§ |
| A | Contaminated Area | ☐ | 2250000 cm$^2$ | ☐ | |
| W | Width of Contaminated Area | ☐ | 1500 cm | ☐ | § |
| d | Thickness of Surficial Soils | ☐ | 100 cm | ☐ | § |
| Pe | Particulate areal emission rate | ☐ | 2.17E-10 g/cm$^2$-s | ☐ | § |
| | **Building Parameters** | | | | |
| $L_{crack}$ | Foundation crack thickness | ■ | 15 cm | ☐ | |
| $\eta$ | Foundation crack fraction | ☐ | 0.01 (dim) | ■ 0.005 | |
| $Lb_r$ | Building Volume/Foundation Area Ratio (res.) | ☐ | 200 cm | ☐ | |
| $Lb_c$ | Building Volume/Foundation Area Ratio (com./ind.) | ■ | 300 cm | ☐ | |
| $ER_r$ | Building vapor volume exchange rate (res.) | ☐ | 12 dy$^{-1}$ | ☐ | |
| $ER_c$ | Building vapor volume exchange rate (com./ind.) | ■ | 20 dy$^{-1}$ | ☐ | |

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

*(continue on next page if needed)*

Site Name: ARCO 2111 | Date Completed: 9-11-96

Site Location: 1156 Davis Street, San Leandro, CA | Completed By: EMCON



## 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.**

| | | Default Value Used | | Site-Specific Value Used | | |
|---|---|---|---|---|---|---|
| **Soil Parameters** | | | | | | |
| | soil type | ☐ | sandy soil | ■ | clayey sand | *§ |
| $\Theta_T$ | Soil porosity | ☐ | 0.38 (dim) | ■ | 0.30 | § |
| $\Theta_{ws}$ | water content - vadose zone | ☐ | 0.12 (dim) | ■ | 0.17 | |
| $\Theta_{as}$ | air content - vadose zone ( = $\Theta_T$ - $\Theta_{ws}$) | ☐ | 0.26 (dim) | ■ | 0.13 | |
| $\Theta_{wcap}$ | water content - capillary fringe | ☐ | 0.342 (dim) | ■ | 0.25 | |
| $\Theta_{acap}$ | air content - capillary fringe ( = $\Theta_T$ - $\Theta_{wcap}$ ) | ☐ | 0.038 (dim) | ■ | 0.05 | |
| $\rho_s$ | Soil density | ■ | 1.7 g/cm$^3$ | ☐ | | § |
| foc | mass fraction of organic carbon in soil | ■ | 0.01 (dim) | ☐ | | § |
| Ls | Depth to contaminated soil | ☐ | 100 cm | ☐ | | § |
| Lgw | Depth to groundwater | ☐ | 300 cm | ■ | 366 | § |
| $h_{cap}$ | capillary zone thickness | ☐ | 5 cm | ■ | 30.5 | |
| hv | vadose zone thickness ( = Lgw - hc ) | ☐ | 295 cm | ■ | 335 | |
| pH | Soil/water pH | ■ | 6.5 | ☐ | | |
| **Groundwater Parameters** | | | | | | |
| I | Water infiltration rate | ☐ | 30 cm/yr | ☐ | | § |
| $V_{gw}$ | groundwater velocity | ☐ | 82.0 ft/yr | ☐ | | *§ |
| $\delta_{gw}$ | groundwater mixing zone depth | ☐ | 200 cm | ☐ | | *§ |
| DF | aquifer dilution factor ( = 1 + $V_{gw}$ $\delta_{gw}$/ ( IW ) ) | ☐ | 12.1 | ☐ | | |
| **Surface Parameters** | | | | | | |
| $U_{air}$ | Amb. air velocity in mixing zone | ☐ | 225 cm/s | ☐ | | *§ |
| $\delta_{air}$ | Mixing zone height | ☐ | 200 cm | ☐ | | *§ |
| A | Contaminated Area | ☐ | 2250000 cm$^2$ | ☐ | | |
| W | Width of Contaminated Area | ☐ | 1500 cm | ☐ | | § |
| d | Thickness of Surficial Soils | ☐ | 100 cm | ☐ | | § |
| Pe | Particulate areal emission rate | ☐ | 2.17E-10 g/cm$^2$-s | ☐ | | § |
| **Building Parameters** | | | | | | |
| $L_{crack}$ | Foundation crack thickness | ■ | 15 cm | ☐ | | |
| $\eta$ | Foundation crack fraction | ☐ | 0.01 (dim) | ■ | 0.005 | |
| $Lb_r$ | Building Volume/Foundation Area Ratio (res.) | ☐ | 200 cm | ☐ | | |
| $Lb_c$ | Building Volume/Foundation Area Ratio (com./ind.) | ■ | 300 cm | ☐ | | |
| $ER_r$ | Building vapor volume exchange rate (res.) | ☐ | 12 dy$^{-1}$ | ☐ | | |
| $ER_c$ | Building vapor volume exchange rate (com./ind.) | ■ | 20 dy$^{-1}$ | ☐ | | |

why?

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

*(continue on next page if needed)*