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30 November 2001

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Mr. Barney Chan
Alameda County Department of Environmental Health
1131 Harbor Bay Parkway, #250
Alameda, California 94502-6577

Subject: Addendum to the Report on the Annual Groundwater Monitoring and Request for Closure at the Property Located at 3925 Alameda Avenue Oakland, California
(EKI 980074.02)

Dear Mr. Chan:

Erler and Kalinowski, Inc. ("EKI") is pleased to present this letter providing additional information related to environmental conditions at 3925 Alameda Avenue Site, Oakland, California ("Site"). This letter has been prepared on behalf of and for the sole benefit of Smooke & Sons Investment Co. This letter provides the results of screening-level human health risk calculations as requested by the Alameda County Department of Environmental Health ("ACDEH") during a telephone conversation with EKI on 21 August 2001.

The screening-level evaluation of human health risk presented herein examines potential risks to a hypothetical future residential population based on the assumption that the Site could theoretically be proposed for redevelopment for residential use at some future time. This residential use scenario was evaluated as required by the ACDEH in connection with its review for closure of underground storage tanks previously removed from the Site. Smooke & Sons Investment Co. does not plan to redevelopment the Site for residential use and believes that it is very unlikely that the Site will ever be redeveloped as residential property.

As discussed below, this report concludes with a request for Site closure based on existing data, which indicate that 1) benzene concentrations in groundwater are stable or decreasing, and 2) these concentrations are likely to attenuate over time. In addition, a deed restriction is proposed to prevent unrestricted future development of the Site for residential purposes.

1. EVALUATION OF POTENTIAL HUMAN HEALTH RISKS

EKI previously submitted the *Report on the Annual Groundwater Monitoring at the Property Located at 3925 Alameda Avenue Site, Oakland, California* ("Monitoring Report"), dated 31 May 2001, to the ACDEH. The Monitoring Report provides the

results of groundwater monitoring performed on 13 March 2001, which was the last of the annual groundwater monitoring events required by the ACDEH.

Based on our 21 August 2001 conversation, EKI understands that, assuming future industrial or commercial use of the Site, the ACDEH and the Regional Water Quality Control Board, San Francisco Bay Region ("RWQCB") have determined that no further assessment or cleanup is required at the Site prior to closure. However, we understand that the ACDEH is considering whether closure approval should be conditioned on the future use of the Site remaining commercial or industrial. To further assess whether a conditional closure is applicable to the Site, ACDEH requested that EKI evaluate the potential human health risks resulting from residual benzene in soil and groundwater considering the hypothetical future redevelopment of the Site for residential purposes. This letter provides the results of EKI's screening-level human health risk calculations and includes:

- the spreadsheet and backup tables used to evaluate potential human health risk from exposure to benzene volatilizing from soil into indoor air for a hypothetical residential scenario; and

- the spreadsheet and backup tables used to evaluate potential human health risk from exposure to benzene volatilizing from groundwater into indoor air for a hypothetical residential scenario.

A table summarizing these estimated human health risks for future hypothetical residential Site use is also attached.

A description of the general methodology EKI employed for the screening human health risk calculations and associated input parameters are presented below.

1.1 BACKGROUND

The potential human health risks associated with exposure to benzene-impacted soil and groundwater were evaluated by Smith-Emery Geoservices ("SEG") (SEG, 1997). In addition, the potential human health risks associated with exposure to benzene-impacted soil were evaluated for the Site by EKI (EKI, 1999). In these screening assessments, both EKI and SEG assessed the potential risk to individuals as a function of volatilization from subsurface soil or groundwater sources into outdoor air for an industrial / commercial use scenario. Residential scenarios were not evaluated because the current and likely future use of the Site was considered to be industrial based on the current use of the Site and surrounding area.

In this letter, EKI presents the results of a screening assessment of the potential risk to individuals assuming a hypothetical, future residential scenario. This risk was calculated assuming volatilization of benzene from subsurface soil and groundwater into indoor air.

Vapor intrusion into indoor air was modeled using the updated version of the Johnson and Ettinger ("J&E") model (J&E, 1991; EPA, 2000) as adapted into a series of spreadsheets by Environmental Quality Management, Inc. ("EQM"), on behalf of the United States Environmental Protection Agency ("U.S. EPA") (EQM, 2000). The J&E model is a screening level model that incorporates both convective and diffusive mechanisms to estimate vapor transport from groundwater and soil into indoor spaces located directly above or in close proximity to the source of contamination.

As described in the model user's manual (EQM, 2000), the conceptual model underlying the J&E model is a chemical vapor source located below the floor of an enclosed building constructed with a basement or slab-on-grade. Molecular diffusion moves the volatilized chemical from the subsurface to the zone of influence of the building, where convective movement in vadose zone soil transports vapors through cracks, assumed to exist between the foundation and slab floor. The convective effect is induced by negative pressure within the building, presumed to be caused by wind and heating stack effects.

The J&E model is a one-dimensional analytical solution to convective and diffusive transport into indoor air assuming a finite source for volatilization from soil and an infinite source for volatilization from groundwater. Input parameters include saturated and unsaturated zone soil properties, structural properties of the building, and chemical and physical properties of the contaminant. EKI used Site-specific values, when available, where noted. In the absence of Site-specific data, EKI used default values included in the model. EKI used the J&E database of chemical and physical properties included in the model. Input parameters in the model are summarized in Table 1.

1.2 Potentially Exposed Population

For purposes of this screening evaluation, residential users comprise the hypothetical, future population at the Site that is assumed to be exposed to benzene volatilizing from groundwater and soil. This screening risk-assessment was developed for both child and adult residential populations based upon their anticipated activity patterns (e.g., duration of exposure, inhalation rates, etc.). U.S. EPA residential screening criteria for children assume an exposure duration of 6 years as a child plus 24 years as an adult. Exposure assumptions are summarized in Table 2.

1.3 Potential Exposure Pathways

Unless otherwise indicated, the exposure assumptions used to calculate the potential risk are based on default values from U.S. EPA guidance. For residential populations, EKI has assumed that the complete exposure pathway is limited to inhalation of vapors volatilizing from groundwater or soil into buildings. EKI did not consider direct exposure to benzene in groundwater through ingestion to be a complete exposure pathway because the shallow groundwater at the Site is not used or likely to be used as a potable supply. EKI also did not consider direct contact with soil or incidental ingestion

of soil to be an exposure pathway. The soil contamination at the Site resulted from a subsurface underground storage tank ("UST") release, thus, the shallow soil, to which a residential population might be exposed through dermal contact or ingestion, is not likely to have been impacted by the release. Because of the nature and depth of the release, the shallowest soil sample collected at the Site was from 6 feet below ground surface ("ft bgs") and benzene was detected in the soil at the concentration of 11 micrograms per kilogram ("ug/kg") (SEG, 1997).

1.4 Representative Concentrations of Benzene in Groundwater and Soil

As documented in Table 1 of the Monitoring Report (EKI, 2001), analytical results for the groundwater samples collected from wells MW-1, MW-2, MW-3, and MW-4 in March 2001 provide the most recent groundwater data for the Site. For the purposes of this screening risk assessment, the arithmetic mean benzene concentration, which was calculated to be 1,500 micrograms per liter ("ug/L"), was used as the representative Site concentration (see Appendix A). In addition, for comparative purposes, the potential risk for the child residential scenario was also calculated using the maximum benzene concentration detected in groundwater at the Site in March 2001, which was 4,780 ug/L, as a more conservative representative source concentration (see Appendix C).

As documented in Appendix I of the SEG risk assessment (SEG, 1997), soil samples were taken at multiple intervals at MW-4 in 1996, and several geoprobe samples were taken throughout the Site. For the purposes of this risk assessment, the arithmetic mean concentration of the SEG soil sample results was calculated to estimate the representative Site concentration of benzene in soil, which was 240 ug/kg (see Appendix B). For comparison, the potential risk to a child in a residential population was also calculated using that the maximum benzene concentration for soil samples collected by SEG (SEG, 1997), which was 1,300 ug/kg, as a more conservative representative residual concentration (see Appendix D).

1.5 Volatilization from Groundwater Pathway

The input parameters for the volatilization from groundwater scenario are shown in Table 1. The depth to the groundwater table was estimated to be 10 ft bgs, based on the most recent groundwater monitoring data (EKI, 2001). The soil type was estimated based on well boring logs and default J&E soil properties were assumed. As the type or size of any potential future residential buildings is unknown, the J&E default building sizes and structural properties were used. The J&E input spreadsheets and results for the volatilization from groundwater are included in Appendices A and C.

1.6 Volatilization from Soil Pathway

The input parameters for the volatilization from soil scenario are shown in Table 1. The same input parameters as those described for the volatilization for groundwater were used

except that the depth to the benzene impacted subsurface soil was estimated to be 9 ft bgs based on historical detections of residual benzene concentrations (SEG, 1997). The J&E input spreadsheets and results for the volatilization from soil are included in Appendices B and D.

1.7 HUMAN HEALTH TOXICITY VALUES

The two broad categories of adverse human health effects recognized in the assessment of health risks are non-carcinogenic and carcinogenic effects. The non-carcinogenic and carcinogenic toxicity values used in this screening risk assessment for benzene are presented in Table 3.

Threshold levels for non-carcinogenic effects are expressed as reference doses ("RfDs"). An RfD, published in units of milligrams of chemical per kilogram of body weight per day ("mg/kg-day"), reflects the maximum chemical dose level that must be exceeded before adverse effects would be expected to occur, but generally incorporates a safety or uncertainty factor of two or more orders of magnitude. This definition suggests that an RfD represents the maximum "safe" dosage of a chemical. A low RfD indicates a low threshold dose level, and therefore a high chemical toxicity. Conversely, a chemical with a higher RfD value is less toxic relative to chemicals having lower RfDs

The toxicity criteria that indicate the potential carcinogenicity of chemicals are commonly called slope factors ("SFs"). U. S. EPA defines SFs as the "plausible upper-bound estimates of the probability of a carcinogenic response per unit of chemical intake over a lifetime" (U. S. EPA, 1989). Chemicals having a higher SF are believed to be inherently more carcinogenic, i.e., potent, than those with a lower SF. Benzene is considered by U.S. EPA to be a Group A or known human carcinogen.

2. RESULTS OF HUMAN HEALTH RISK CALCULATIONS

The potential risks calculated in this screening level assessment based on a hypothetical residential scenario are shown in Table 4. The cumulative potential risk associated with the mean concentration of benzene in groundwater (1,500 ug/L) and in soil (240 ug/kg) was calculated to be $2x10^{-5}$ for an adult and $3x10^{-5}$ for a child assuming 30 year on-site residency. The cumulative hazard index associated with these mean concentrations of benzene in groundwater and soil was calculated to be 0.02 for an adult and 0.06 for a child.

Also, as a more conservative scenario for comparison purposes, potential risks to a child were calculated based on the maximum concentrations of benzene detected in recent groundwater monitoring (4,780 ug/L) and historical soil sampling (1,300 ug/kg) at the Site. The cumulative potential risk associated with the maximum concentrations of

benzene in groundwater and soil was calculated to be $1x10^{-4}$ for a child. The cumulative hazard index was calculated to be 0.24 for a child resident.

For general reference, levels considered by U.S. EPA to be protective of public health are risk levels between 10^{-6} to 10^{-4} and hazard indices less than or equal to 1 (U.S. EPA, 1989).

3. SUMMARY AND REQUEST FOR CLOSURE

As discussed in the Monitoring Report, benzene concentrations detected in groundwater at the Site appear to be stable or decreasing. It is likely that, through natural degradation processes, the benzene concentrations in groundwater will naturally attenuate to lower concentrations over time. Therefore, the potential risk level and hazard index under future conditions is likely to be less than the levels calculated above, which are based on current data with the assumption of a continuous residual benzene concentration in groundwater.

Given the current industrial nature of the Site and of the surrounding area, it is unlikely that the Site will be redeveloped as a residential area. The Site is subject to an easement located along the railroad spurs for vehicular ingress and egress from the adjacent industrial property located at 411 High Street, Oakland, which would make it even more difficult to change Site use to residential.

Based on our recent conversation, EKI understands that the ACDEH and RWQCB have determined that no further assessment or cleanup is required prior to closure if Site use remains industrial or commercial as is currently the case. We also understand that a deed restriction to prevent unrestricted use of the Site for residential purposes would address ACDEH's concerns regarding potential future residential redevelopment of the Site. The deed restriction would prevent the redevelopment of the Site for residential use unless the ACDEH has been notified of such plans and has approved a Risk Management Plan for the Site before construction takes place. The Risk Management Plan would include a site health and safety plan for protection of construction and maintenance workers, soil management protocols for handling of excavated soil, and other risk management measures that may be appropriate given Site conditions at the time of the development.

On behalf of Smooke & Sons Investment Co., EKI requests that the ACDEH approve closure of the Site subject to the recording of a deed restriction to prevent unrestricted redevelopment of the Site for residential purposes. Environmental legal counsel for Smooke & Sons Investment Co. will prepare and submit the proposed deed restriction to ACDEH shortly. Please inform us whether this approach for Site closure is acceptable.

If you have any questions or wish to discuss these matters in greater detail, please call.

Very truly yours,

ERLER & KALINOWSKI, INC.

Steven G. Miller, P.E.
Project Engineer

cc: Richard Smooke, Smooke & Sons Investment Co.

References

EKI, 2001: Erler & Kalinowski, Inc., *Report on Annual Groundwater Monitoring at the Property Located at 3925 Alameda Avenue*, dated 31 May 2001.

EKI, 1999: Erler & Kalinowski, Inc., *Addendum #2 to the Report Regarding the 3925 Alameda Avenue Site, Oakland, California*, addressed to the Alameda County Department of Environmental Health, 12 April 1999.

EQM, 2000: Environmental Quality Management, Inc., *Users Guide for the Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings*, December 2000.

J&E, 1991: U.S. EPA's adaptation of the Johnson and Ettinger, *Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors Into Buildings*, Environmental Science and Technology, 1991, Vol. 25.

SEG, 1997: Smith-Emery GeoServices, *Tier-1 Risk Based Corrective Action Avenue, Oakland, California*, prepared for Smooke & Sons Investment Company, 15 May 1997.

U.S. EPA, 1989: United States Environmental Protection Agency, *Risk Assessment Guidance for Superfund: Volume 1 – Human Health Evaluation Manual (Part A), Interim*. Office of Solid Waste and Emergency Response. EPA/540/1-89/002, December 1989.

U.S. EPA, 1991; United States Environmental Protection Agency *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors, Interim Final,* OSWER Directive 9285.6-03, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, 25 March 1991.

U.S. EPA,1997: United States Environmental Protection Agency *Exposure Factors Handbook Volume I General Factors: Principles and Applications,* Office of Research and Development, EPA 600/P-95/002Fa, August 1997.

U.S. EPA, 2000: U.S. Environmental Protection Agency (EPA) 2000: *User's Guide for the Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings* (Revised), Washington. D.C. Office of Emergency and Remedial Response. December 2000.

TABLE 1
INPUT PARAMETERS FOR SOIL AND GROUNDWATER VOLATILIZATION MODEL (a)
3925 Alameda Ave.
Oakland, California

Input Parameter	Value	Units	EKI Source (b)
Benzene Soil Concentration	240	ug/kg	Smith Emery Geosciences, 1997
Benzene Groundwater Concentration	1,500	ug/L	Erler & Kalinowski, 2001
Depth to Top of Contamination Source in Soil	274	cm	Assumed that soil contamination occurred approximately 9 ft bgs based upon review of available data.
Depth to Top of Contamination Source in Groundwater	305	cm	Assumed that groundwater contamination occurred approximately 10 ft bgs based upon review of available data.
Soil Type	Silty Clay		Based on review of well logs
Soil Temperature	20	^{m}C	Based on review of well-purge logs (EKI, 2001).
Organic Carbon Fraction	0.01	g_{carbon}/g_{soil}	Best professional judgement (EKI, 2001).
Vapor Permeability	1.13E-09	cm^2	Estimated by the model (a) for silty clay.
Dry Bulk Density	1.7	g/cm^3	Best professional judgement (EKI, 2001).
Total Soil Porosity	0.38	cm^3/cm^3	Estimated by the model (a) for silty clay.
Soil Water-filled Porosity	0.27	cm^3/cm^3	Estimated by the model (a) for silty clay.

Notes:

(a) The model employed by EKI is the 2001 update of the U.S. EPA's adaptation of the Johnson and Ettinger, Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors Into Buildings, Environmental Science and Technology, 1991, Vol. 25. The U.S. EPA model is documented in the *Users Guide for the Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings*, prepared by Environmental Quality Management, Inc., Dec. 2000, on behalf of the U.S. EPA.

(b) Unless otherwise indicated, default Johnson & Ettinger (1991) parameters were used.

TABLE 2
EXPOSURE ASSUMPTIONS USED TO CALCULATE RISK-BASED CLEANUP LEVELS FOR THE RESIDENTIAL SCENARIO
3925 Alameda Ave.
Oakland, California

Soil Volatilization Inhalation Pathway Exposure Parameters	Residential Exposure Scenario		Reference used by EKI for Proposed Value (a)
	Value	Units	
Body Weight (BW)			
Adult	70	kg	U.S. EPA, 1991
Child (0-6 years old)	15	kg	U.S. EPA, 1991
Exposure Duration (ED)			
Carcinogenic	70	years	U.S. EPA, 1991
Adult Non-carcinogenic	30	years	U.S. EPA, 1991
Child Non-carcinogenic (0-6 years old)	6	years	U.S. EPA, 1997
Child Non-carcinogenic (6+ years old)	24	years	U.S. EPA, 1997
Exposure Frequency (EF)	350	days/yr	U.S. EPA, 1991
Averaging Time (AT)			
Carcinogenic	30	years	U.S. EPA, 1991
Adult Non-carcinogenic	30	years	U.S. EPA, 1991
Child Non-carcinogenic (0-6 years old)	6	years	U.S. EPA, 1997
Child Non-carcinogenic (6+ years old)	24	years	U.S. EPA, 1997
Inhalation Rate (IR)			
Adult	20	m^3/day	U.S. EPA, 1997
Child (0-6 years old)	10	m^3/day	U.S. EPA, 1997

Note:

(a) References for exposure assumptions employed by EKI are as follows:

- U.S. EPA, 25 March 1991, *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors*, Interim Final, OSWER Directive 9285.6-03, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response.
- U.S. EPA, August 1997, *Exposure Factors Handbook Volume I General Factors: Principles and Applications*, Office of Research and Development, EPA 600/P-95/002Fa.

TABLE 3
PRELIMINARY CARCINOGENIC AND NON-CARCINOGENIC CHEMICAL-SPECIFIC TOXICITY VALUES
3925 Alameda Ave.
Oakland, California

	Carcinogenic Information [a]			Non-Carcinogenic Information [a]		
Benzene	Inhalation Slope Factor (SF_i) $(mg/kg\text{-}day)^{-1}$	Inhalation Unit Risk Factor (URF_i) $(ug/m^3)^{-1}$	Weight-of-Evidence Classification	Oral Reference Dose (RfD_o) (mg/kg-day)	Reference Concentration (RfC) (mg/m^3)	Hazard Index Targets
Adult Population	0.1 [a](1)	0.000029 [a](1)	A [a](1)	-- [b]	0.06 [a](2)	Cardiovascular system; development; nervous system; immune system [a](2)
Child Population (0-6 years)	0.1 [a](1)	0.00010 [c]	A [a](1)	--	0.06 [a](2)	Cardiovascular system; development; nervous system; immune system [a](2)

Notes:

(a) Sources for chemical toxicity data are as follows

(1) CalEPA, 1999a: California Environmental Protection Agency Office of Environmental Health Hazard Assessment, April 1999, *Part II Technical Support Document for Describing Available Cancer Potency Factors,* updated March 2001.

(2) CalEPA, 1999b: California Environmental Protection Agency Office of Environmental Health Hazard Assessment, May 1999, *Part III Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels,* updated January 2001.

(b) A hyphen (--) indicates that the data were not available.

(c) The URF was adjusted for a child assuming a body weight of 15 kg and an inhalation rate of 10 m^3/day.

TABLE 4
CALCULATED HUMAN HEALTH RISK FOR HYPOTHETICAL RESIDENTIAL SCENARIO
3925 Alameda Ave.
Oakland, California

Calculated Risk Based on the Mean Benzene Concentration

	Groundwater [a]			Soil [b]			Estimated Cumulative	
Exposed Population	Mean Benzene Concentration[d] (ug/l)	Hazard Index	Risk	Mean Benzene Concentration[e] (ug/kg)	Hazard Index	Risk	Hazard Index	Risk
Adult	1,500	0.013	$9.9x10^{-6}$	240	0.010	$7.5x10^{-6}$	0.023	$2 x10^{-5}$
Child [c]	1,500	0.040	$2.3x10^{-5}$	240	0.020	$1.1x10^{-5}$	0.060	$3 x10^{-5}$

Calculated Risk Based on the Maximum Benzene Concentration

	Groundwater [a]			Soil [b]			Estimated Cumulative	
Exposed Population	Max. Benzene Concentration[f] (ug/l)	Hazard Index	Risk	Max. Benzene Concentration[g] (ug/kg)	Hazard Index	Risk	Hazard Index	Risk
Child [c]	4,780	0.13	$7.1x10^{-5}$	1,300	0.11	$6.1x10^{-5}$	0.24	$1 x10^{-4}$

Notes:

(a) See Appendices A and C for inputs to the Johnson & Ettinger Model (EPA, 2000) and the results.

(b) See Appendices B and D for inputs to the Johnson & Ettinger Model and the results.

(c) The risk to the child was estimated by summing the results calculated for exposure from years 0-6 and 6-24.

(d) The mean concentration for benzene is the arithmetic average of the four groundwater well samples collected on 13 March 2001.

(e) The mean soil concentration for benzene is the arithmetic average as reported by Smith-Emery GeoServices (SEG,1997).

(f) The maximum benzene concentration is the maximum detected concentration from the sampling of four groundwater wells on 13 March 2001.

(g) The maximum soil concentration for benzene is the maximum concentration as reported by Smith-Emery GeoServices (SEG, 1997).

APPENDIX A
RESIDENTIAL SCENARIO - ADULT POPULATION

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES	

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES	X

ENTER Chemical CAS No (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
71432	1500	Benzene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/groundwater temperature, T_S (°C)
15	304.8	sc	20

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
sc			1.7	0.38	0.26

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

APPENDIX A
RESIDENTIAL SCENARIO - ADULT POPULATION

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_c (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc , RfC (mg/m^3)
8 80E-02	9.80E-06	5.56E-03	25	7,342	353.24	562.16	5 89E+01	1.75E+03	2.9E-05	6.0E-02

APPENDIX A
RESIDENTIAL SCENARIO - ADULT POPULATION

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^v (cm^3/cm^3)	Vadose zon effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a\,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w\,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
289 8	0.120	0 571	4.52E-10	0 642	2.91E-10	30.00	0.38	0.034	0.346	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave groundwater temperature, $\Delta H_{v\,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5 63E+04	9.24E+05	4.16E-04	15	8,019	4 41E-03	1 83E-01	1 78E-04	5.27E-04	1 87E-05	1.38E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg , Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
289.8	15	2.75E+05	0 10	2.76E-01	5.27E-04	3 84E+02	7.42E+08	3.01E-06	8.28E-01	2.9E-05	6.0E-02

APPENDIX A
RESIDENTIAL SCENARIO - ADULT POPULATION

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS

Indoor exposure groundwater conc , carcinogen (µg/L)	Indoor exposure groundwater conc , noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	NA	NA

INCREMENTAL RISK CALCULATIONS

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
9.9E-06	1.3E-02

APPENDIX A
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

GW-SCREEN
Version 2 3 03/0

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc below)

YES [X]

ENTER Chemical CAS No (numbers only, no dashes)	ENTER Initial groundwater conc , C_w (µg/L)	Chemical
71432	1 50E+03	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)
15	304 8	sc	20

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)		ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
sc			1 7	0.38	0 27

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1 0E-05	1	70	6	6	350

Used to calculate risk-based groundwater concentration

END

APPENDIX A
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm·m^3/mol	Henry's law constant reference temperature, T_r (°C)	Enthalpy of vaporization at the normal boiling point, ΔH_{vb} (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_c (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
8 80E 02	9 80E-06	5 56E-03	25	7 342	353 24	562 16	5 89E+01	1 75E+03	1 0E-04	6 0E-02

END

APPENDIX A
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

Source-building separation, L_T (cm)	Vadose zone soil air filled porosity, θ_a* (cm^3/cm^3)	adose zon effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
289 8	0 110	0 582	1 77E 09	0 637	1 13E-09	30 00	0 38	0 025	0 355	3 844

Bldg ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5 63E+04	9 24E+05	4 16E-04	15	8.019	4 41E-03	1 83E-01	1 78E-04	3.96E-04	1 46E-05	1 07E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc , C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg , Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc , RfC (mg/m^3)
289 8	15	2 75E+05	0 10	1 07E+00	3.96E-04	3 84E+02	7 22E+45	4 59E-06	1 26E+00	1 0E-04	6.0E-02

APPENDIX A
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

RISK BASED GROUNDWATER CONCENTRATION CALCULATIONS

Indoor exposure groundwater conc , carcinogen (µg/L)	Indoor exposure groundwater conc , noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc , (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc , (µg/L)
NA	NA	NA	1 75E+06	NA

INCREMENTAL RISK CALCULATIONS

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1 1E-05	2 0E-02

APPENDIX A
RESIDENTIAL SCENARIO - CHILD POPULTAION (6-30 YEARS)

CALCULATE RISK BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES	

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc below)

YES	X

ENTER Chemical CAS No (numbers only, no dashes)	ENTER Initial groundwater conc, C_W (µg/L)	Chemical
71432	1 50E+03	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)
15	304 8	sc	20

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
sc			1.7	0 38	0 27

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	24	24	350
Used to calculate risk-based groundwater concentration					

APPENDIX A
RESIDENTIAL SCENARIO - CHILD POPULTAION (6-30 YEARS)

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
8 80E-02	9 80E-06	5 56E-03	25	7,342	353 24	552 16	5 89E+01	1 75E+03	2 9E-05	6 0E-02

END

APPENDIX A
RESIDENTIAL SCENARIO - CHILD POPULTAION (6-30 YEARS)

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zon effective total fluid saturation, S_e (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a\,cz}$ (cm^3/cm^3)	Water filled porosity in capillary zone, $\theta_{w\,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
289 8	0 110	0 582	1 77E-09	0 637	1 13E-09	30 00	0 38	0 025	0 355	3,844

Bldg ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5 63E+04	9 24E+05	4 16E-04	15	8,019	4 41E-03	1.83E-01	1 78E-04	3 96E-04	1 46E-05	1 07E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc , C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg , Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg conc , $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc , RfC (mg/m^3)
289 8	15	2 75E+05	0 10	1 07E+00	3.96E-04	3 84E+02	7.22E+45	4.59E-06	1 26E+00	2 9E-05	6 0E-02

APPENDIX A
RESIDENTIAL SCENARIO - CHILD POPULTAION (6-30 YEARS)

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS

Indoor exposure groundwater conc , carcinogen (µg/L)	Indoor exposure groundwater conc , noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc , (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc , (µg/L)
NA	NA	NA	1 75E+06	NA

INCREMENTAL RISK CALCULATIONS

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1 2E-05	2 0E-02

MESSAGE SUMMARY BELOW.

END

APPENDIX B
RESIDENTIAL SCENARIO - ADULT POPULATION

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-SCREEN
Version 2 3: 03/0

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil

YES [X]

ENTER Chemical CAS No (numbers only, no dashes)	ENTER Initial soil conc , C_S (µg/kg)	Chemical
71432	2 40E+02	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	274 32	20	sc		

MORE ↓

ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)
1 7	0 38	0 27	0 01

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1 0E-05	1
				Used to calculate risk-based soil concentration	

END

APPENDIX B
RESIDENTIAL SCENARIO - ADULT POPULATION

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
8 80E-02	9 80E-06	5 56E-03	25	7,342	353 24	562 16	5 89E+01	1 75E+03	2 9E-05	6 0E-02	L

END

APPENDIX B
RESIDENTIAL SCENARIO - ADULT POPULATION

Source building separation, L- (cm)	Vadose zone soil air-filled porosity, θ_a[1] (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability k (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (ug/kg)	Bldg ventilation rate, Q_{bldg} (cm^3/s)
259 32	0 110	0 582	1 77E-09	0 637	1 13E-09	3,844	2 40E+02	5 63E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization a ave soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave soil temperature, H_{TS} (atm m^3/mol)	Henry's law constant at ave soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Diffusion path length, L_d (cm)
9 24E+05	4 16E-04	15	8,019	4 41E-03	1 83E-01	1 78E-04	3 96E-04	259 32

Convection path length, L_p (cm)	Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc , C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg , Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg conc , $C_{building}$ ($\mu g/m^3$)
15	5 89E-01	5 80E+04	0 10	1.07E+00	3 96E-04	3,84E+02	7.22E+45	1 08E-05	6 27E-01

Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc , RfC (mg/m^3)
2.9E-05	6 0E-02

END

APPENDIX B
RESIDENTIAL SCENARIO - ADULT POPULATION

RISK-BASED SOIL CONCENTRATION CALCULATIONS					INCREMENTAL RISK CALCULATIONS	
Indoor *exposure* soil conc , carcinogen (µg/kg)	Indoor *exposure* soil conc , noncarcinogen (µg/kg)	Risk-based *indoor* exposure soil conc , (µg/kg)	*Soil* saturation conc , C_{sat} (µg/kg)	Final *indoor* exposure soil conc , (µg/kg)	Incremental risk from *vapor* intrusion to indoor air, carcinogen (unitless)	Hazard quotient *from vapor* intrusion to indoor air, noncarcinogen (unitless)
NA	NA	NA	1 33E+06	NA	7.5E-06	1 0E-02

APPENDIX B
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

CALCULATE RISK BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-SCREEN
Version 2 3, 03/01

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc below)

YES X

ENTER Chemical CAS No (numbers only, no dashes)	ENTER Initial soil conc, C_R (µg/kg)	Chemical
71432	2 40E+02	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	274.32	20	sc		

MORE ↓

ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)
1 7	0.38	0 27	0 01

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	6	6	350	1.0E-05	1
				Used to calculate risk-based soil concentration	

END

APPENDIX B
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm \cdot m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L G)
8 80E-02	9 80E-06	5 56E-03	25	7,342	353 24	562 16	5 89E+01	1 75E+03	1 0E-04	6 0E-02	L

END

APPENDIX B
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

Source-building separation, L- (cm)	Vadose zone soil air-filled porosity, θ_a' (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_e (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg ventilation rate, $Q_{building}$ (cm^3/s)
259 32	0 110	0 582	1 77E 09	0 637	1 13E-09	3,844	2 40E+02	5 63E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization a ave soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Diffusion path length, L_d (cm)
9 24E+05	4 16E-04	15	8,019	4.41E-03	1 83E-01	1 78E-04	3 96E-04	259 32

Convection path length, L_p (cm)	Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc , C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg , Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg conc , $C_{building}$ (µg/m^3)
15	5 89E-01	5.80E+04	0 10	1 07E+00	3 96E-04	3 84E+02	7 22E+45	1 08E-05	6 27E-01

Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc , RfC (mg/m^3)
1 0E-04	6 0E-02

END

APPENDIX B
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

RISK BASED SOIL CONCENTRATION CALCULATIONS

Indoor exposure soil conc , carcinogen (µg/kg)	Indoor exposure soil conc , noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc , (µg/kg)	Soil saturation conc , C_{sat}, (µg/kg)	Final indoor exposure soil conc , (µg/kg)
NA	NA	NA	1 33E+06	NA

INCREMENTAL RISK CALCULATIONS.

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
5 2E-06	1 0E 02

APPENDIX B
RESIDENTIAL SCENARIO - CHILD POPULATION (6-30 YEARS)

CALCULATE RISK BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-SCREEN
Version 2 3, 03/01

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc below)

YES [X]

ENTER Chemical CAS No (numbers only, no dashes)	ENTER Initial soil conc, C_R (µg/kg)	Chemical
71432	2 40E+02	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	274 32	20	sc		

MORE ↓

ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)
1 7	0 38	0 27	0 01

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	24	24	350	1 0E-05	1
				Used to calculate risk-based soil concentration	

END

APPENDIX B
RESIDENTIAL SCENARIO - CHILD POPULATION (6-30 YEARS)

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	*Henry's* law constant at reference temperature, H ($atm \cdot m^3/mol$)	*Henry's* law constant reference temperature, T_R (°C)	*Enthalpy of* vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	*Organic* carbon partition coefficient, K_{oc} (cm^3/g)	*Pure* component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	*Reference* conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
8 80E-02	9 80E-06	5 56E-03	25	7,342	353 24	562 16	5 89E+01	1 75E+03	2 9E-05	6.0E-02	L

END

APPENDIX B
RESIDENTIAL SCENARIO - CHILD POPULATION (6-30 YEARS)

Source-building separation, L_s (cm)	Vadose zone soil air-filled porosity, θ_a (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_s (ug/kg)	Bldg ventilation rate, $Q_{building}$ (cm^3/s)
259 32	0 110	0 582	1 77E-09	0 637	1 13E-09	3,844	2 40E+02	5 63E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization a ave soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Diffusion path length, L_d (cm)
9 24E+05	4 16E-04	15	8,019	4 41E-03	1 83E-01	1 78E-04	3 96E-04	259 32

Convection path length, L_p (cm)	Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc , C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg , Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe') (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg conc , $C_{building}$ ($\mu g/m^3$)
15	5 89E-01	5 80E+04	0 10	1.07E+00	3 96E-04	3 84E+02	7 22E+45	1 08E-05	6 27E-01

Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc , RfC (mg/m^3)
2 9E-05	6.0E-02

END

APPENDIX B
RESIDENTIAL SCENARIO - CHILD POPULATION (6-30 YEARS)

RISK-BASED SOIL CONCENTRATION CALCULATIONS

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	NA	NA	1.33E+06	NA

INCREMENTAL RISK CALCULATIONS

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
6.0E-06	1.0E-02

APPENDIX C
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

GW-SCREEN
Version 2 3 03/0

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc below)

YES [X]

ENTER Chemical CAS No (numbers only, no dashes)	ENTER Initial groundwater conc , C_w (µg/L)	Chemical
71432	4 78E+03	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)
15	304 8	sc	20

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone soil dry bulk density, ρ_b^v (g/cm^3)	ENTER Vadose zone soil total porosity, n^v (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^v (cm^3/cm^3)
sc			1 7	0 38	0 27

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1 0E-05	1	70	6	6	350

Used to calculate risk-based groundwater concentration

END

APPENDIX C
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm \cdot m^3/mol$)	Henry's law constant reference temperature, T_r ($^\circ C$)	Enthalpy of vaporization at the normal boiling point, ΔH_{vb} (cal/mol)	Normal boiling point, T_b ($^\circ K$)	Critical temperature, T_c ($^\circ K$)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
8 80E-02	9 80E-06	5 56E 03	25	7,342	353 24	562 16	5 89E+01	1 75E+03	1 0E-04	6 0E 02

END

APPENDIX C
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a (cm^3/cm^3)	adose zon effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a\,cz}$ (cm^3/cm^3)	Water filled porosity in capillary zone, $\theta_{w\,cz}$ (cm^3/cm^3)	Floor wall seam perimeter, X_{crack} (cm)
289 8	0 110	0 582	1 77E-09	0 637	1 13E 09	30 00	0 38	0 025	0 355	3 844

Bldg ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5 63E+04	9 24E+05	4 16E-04	15	8,019	4.41E-03	1 83E-01	1 78E-04	3 96E-04	1 46E-05	1 07E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc , C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg , Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc , RfC (mg/m^3)
289 8	15	8.77E+05	0 10	1 07E+00	3 96E-04	3 84E+02	7 22E+45	4.59E-06	4 03E+00	1 0E-04	6 0E-02

APPENDIX C
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS

Indoor exposure groundwater conc , carcinogen (µg/L)	Indoor exposure groundwater conc , noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc , (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc , (µg/L)
NA	NA	NA	1 75E+06	NA

INCREMENTAL RISK CALCULATIONS

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
3 3E-05	6 4E-02

APPENDIX C
RESIDENTIAL SCENARIO - CHILD POPULATION (6-30 YEARS)

CALCULATE RISK BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES	

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc below)

YES	X

ENTER Chemical CAS No (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
71432	4.78E+03	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)
15	304.8	sc	20

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
sc			1.7	0.38	0.27

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	24	24	350

Used to calculate risk-based groundwater concentration

APPENDIX C
RESIDENTIAL SCENARIO - CHILD POPULATION (6-30 YEARS)

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF (ug/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
8 80E-02	9 80E-06	5 56E-03	25	7,342	353 24	562 16	5 89E+01	1 75E-03	2 9E-05	6 0E-02

END

APPENDIX C
RESIDENTIAL SCENARIO - CHILD POPULATION (6-30 YEARS)

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^v (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a\,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w\,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
289 8	0 110	0 582	1 77E-09	0 637	1 13E-09	30 00	0 38	0 025	0 355	3,844

Bldg ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5 63E+04	9 24E+05	4 16E-04	15	8,019	4 41E-03	1 83E-01	1 78E-04	3 96E-04	1 46E-05	1 07E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg , Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg conc , $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc , RfC (mg/m^3)
289.8	15	8 77E+05	0 10	1 07E+00	3 96E-04	3 84E+02	7 22E+45	4.59E-06	4 03E+00	2 9E-05	6 0E-02

APPENDIX C
RESIDENTIAL SCENARIO - CHILD POPULATION (6-30 YEARS)

RISK BASED GROUNDWATER CONCENTRATION CALCULATIONS.

Indoor exposure groundwater conc , carcinogen (µg/L)	Indoor exposure groundwater conc , noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc , (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc , (µg/L)
NA	NA	NA	1 75E+06	NA

INCREMENTAL RISK CALCULATIONS

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
3 8E-05	6.4E-02

MESSAGE SUMMARY BELOW

END

APPENDIX D
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

CALCULATE RISK BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-SCREEN
Version 2 3. 03/01

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc below)

YES X

ENTER Chemical CAS No (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
71432	1 30E+03	Benzene

MORE

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	274 32	20	sc		

MORE

ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)
1.7	0 38	0 27	0 01

MORE

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	6	6	350	1 0E-05	1
				Used to calculate risk-based soil concentration	

END

APPENDIX D
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, ΔH_{vb} (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
8 80E-02	9 80E-06	5 56E-03	25	7,342	353 24	562 16	5 89E+01	1 75E+03	1 0E-04	6 0E-02	L

END

APPENDIX D
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

Source-building separation, L- (cm)	Vadose zone soil air-filled porosity, θ_a' (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_e (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg ventilation rate, $Q_{building}$ (cm^3/s)
259 32	0 110	0 582	1 77E-09	0 637	1 13E-09	3,844	1 30E+03	5 63E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization a ave soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Diffusion path length, L_d (cm)
9 24E+05	4.16E-04	15	8,019	4 41E-03	1.83E-01	1 78E-04	3 96E-04	259 32

Convection path length, L_p (cm)	Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc , C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg , Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg conc , $C_{building}$ (µg/m^3)
15	5 89E-01	3 14E+05	0 10	1 07E+00	3 96E-04	3 84E+02	7 22E+45	1.08E-05	3.39E+00

Unit risk factor, URF (µg/m^3)$^{-1}$	Reference conc , RfC (mg/m^3)
1.0E-04	6 0E-02

END

APPENDIX D
RESIDENTIAL SCENARIO - CHILD POPULATION (0-6 YEARS)

RISK-BASED SOIL CONCENTRATION CALCULATIONS

Indoor exposure soil conc , carcinogen (µg/kg)	Indoor exposure soil conc , noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc , (µg/kg)	Soil saturation conc , C_{sat}, (µg/kg)	Final indoor exposure soil conc , (µg/kg)
NA	NA	NA	1 33E+06	NA

INCREMENTAL RISK CALCULATIONS.

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
2 8E-05	5 4E-02

APPENDIX D
RESIDENTIAL SCENARIO - CHILD POPULTAION (6-30 YEARS)

CALCULATE RISK BASED SOIL CONCENTRATION (enter "X" in "YES" box)

SL-SCREEN
Version 2 3. 03/01

YES	

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc below)

YES	X

ENTER Chemical CAS No (numbers only, no dashes)	ENTER Initial soil conc, C_R (µg/kg)	Chemical
71432	1.30E+03	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	274 32	20	sc		

MORE ↓

ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)
1 7	0 38	0 27	0 01

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	24	24	350	1 0E-05	1
				Used to calculate risk-based soil concentration.	

END

APPENDIX D
RESIDENTIAL SCENARIO - CHILD POPULTAION (6-30 YEARS)

Diffusivity in air D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	*Henry's* law constant at reference temperature, H (atm-m^3/mol)	*Henry's* law constant reference temperature T_R (°C)	*Enthalpy of* vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	*Organic* carbon partition coefficient, K_{oc} (cm^3/g)	*Pure* component water solubility, S (mg/L)	Unit risk factor, *URF* ($\mu g/m^3$)$^{-1}$	Reference conc , *RfC* (mg/m^3)	Physical state at soil *temperature,* (S,L,G)
8 80E-02	9 80E-06	5 56E-03	25	7,342	353 24	562 16	5 89E+01	1 75E+03	2 9E-05	6 0E-02	L

END

APPENDIX D
RESIDENTIAL SCENARIO - CHILD POPULTAION (6-30 YEARS)

Source-building separation, L_s (cm)	Vadose zone soil air-filled porosity, θ_a^{vadose} (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{ra} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg ventilation rate, $Q_{building}$ (cm^3/s)
259 32	0 110	0 582	1 77E-09	0 637	1 13E-09	3,844	1 30E+03	5 63E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Entnalpy of vaporization a ave soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave soil temperature, H_{TS} ($atm \cdot m^3/mol$)	Henry's law constant at ave soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Diffusion path length, L_d (cm)
9 24E+05	4 16E-04	15	8,019	4 41E-03	1 83E-01	1 78E-04	3 96E-04	259 32

Convection path length, L_p (cm)	Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg , Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg conc., $C_{building}$ ($\mu g/m^3$)
15	5 89E-01	3 14E+05	0 10	1 07E+00	3 96E-04	3 84E+02	7 22E+45	1.08E-05	3 39E+00

Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc , RfC (mg/m^3)
2 9E-05	6 0E-02

END

APPENDIX D
RESIDENTIAL SCENARIO - CHILD POPULTAION (6-30 YEARS)

RISK-BASED SOIL CONCENTRATION CALCULATIONS

Indoor exposure soil conc , carcinogen (µg/kg)	Indoor exposure soil conc , noncarcinogen (µg/kg)	Risk based indoor exposure soil conc , (µg/kg)	Soil saturation conc , C_{sat} (µg/kg)	Final indoor exposure soil conc , (µg/kg)
NA	NA	NA	1 33E+06	NA

INCREMENTAL RISK CALCULATIONS

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
3 2E-05	5 4E-02