ATTACHMENT D

APPROACH FOR THE DEVLEOPMENT OF REMEDIATION GOALS FOR THE VAPOR INTRUSION TO INDOOR AIR EXPOSURE PATHWAY

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DEVELOPMENT OF REMEDIATION GOALS – VAPOR INTRUSION TO INDOOR AIR

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ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
ACH	Air changes per hour
bgs	below ground surface
CalEPA	California Environmental Protection Agency
cm	Centimeter
COPC	Chemical of potential concern
dP	Pressure difference
U.S. EPA	U.S. Environmental Protection Agency
$g/cm\text{-}s^2$	Grams per centimeter per second squared
L/m	Liters per minute
NDEQ	Nebraska Department of Environmental Quality
OSHA	Occupational Safety and Health Administration
Q_{soil}	Average vapor flow rate into a building
VCP	Voluntary Cleanup Program

1.0 INTRODUCTION

The Nebraska Department of Environmental Quality (NDEQ) Voluntary Cleanup Program (VCP) has previously developed remediation goals (RGs) for soil and groundwater exposure to residents and commercial/industrial receptors via ingestion, dermal contact, and inhalation of outdoor dust and vapors. 2011 revisions to the VCP guidance documents now include RGs for the potential impacts of vapor intrusion to indoor air from soil gas and groundwater. This attachment presents the methodology for estimating concentrations of volatile chemicals of potential concern (COPC) in indoor air migrating from underlying contaminated soil or groundwater by vapor intrusion. For example, volatile organic compounds in soil can vaporize into soil gas and migrate into indoor air through cracks in a building's foundation. NDEQ has developed remediation goals for volatile COPCs in groundwater and/or soil gas that would be protective for humans exposed via vapor intrusion into indoor air.

Current U.S. Environmental Protection Agency (U.S. EPA) guidance does not recommend using soil data to evaluate vapor intrusion to indoor air (U.S. EPA 2004). U.S. EPA notes concerns with how the data would be obtained and the number of variables that would impact volatilization of compounds from a soil matrix to soil gas followed by migration to indoor air. U.S. EPA recommends use of only soil gas or groundwater data to estimate indoor air concentrations from vapor intrusion. Therefore, this approach assumes U.S. EPA's position and develops vapor intrusion-based remediation goals for soil gas and groundwater media.

1.1 INDOOR AIR MIGRATION PATHWAY AND MODELING ANALYSES

To develop remediation goals for this pathway, U.S. EPA's advanced 2004 vapor intrusion model (U.S. EPA 2004) is used to estimate indoor air concentrations from concentrations of volatile COPCs in soil gas and groundwater. This screening vapor intrusion model is based on Johnson and Ettinger (1991) and uses a standard set of default parameters for the calculations.

The vapor intrusion model is a one-dimensional model that estimates convective and diffusive transport of chemical vapors emanating from groundwater and soil gas into indoor spaces located directly above or near the source of contamination. A detailed description of the vapor intrusion model is provided in U.S. EPA's "Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)" (U.S. EPA 2002).

The model assumes: (1) the chemical concentration in the soil gas or groundwater is not decreased by transport of the chemical to the surface; and (2) the depth to the pollutant source remains constant. The

model also ignores attenuation factors, such as biological degradation. For this reason, it is a conservative screening tool to identify maximum indoor air concentrations and potential risks.

Remediation goals for vapor intrusion are limited to volatile chemicals. Volatile chemicals are identified using the definition of volatility (a molecular weight less than 200 grams per mole and a Henry's Law constant greater than 1 x 10^{-5} atmosphere-cubic meter per mole) adopted from U.S. EPA (2004). The chemicals that meet the volatile definition are identified in the lookup table in Attachment A. The model incorporates chemical-specific fate and transport values as needed. Consistent with the current remediation goals, the vapor intrusion goals are calculated using exposure factors established in the VCP guidance and based on standard target risks and hazards (residential—1 E-06 and 0.25, and commercial/industrial—1 E-05 and 1) (NDEQ 2006). There are chemicals for which toxicity values are not provided due to U.S. EPA guidance indicating the current opinion that route-to-route extrapolation of toxicity data is not appropriate, and that those chemicals for which no values are provided have no viable toxicity data for the inhalation exposure route. If there is a specific volatile chemical present at a VCP site for which no toxicity data is available, either a Tier 3 assessment should be performed or a proposed remediation goal should be calculated using U.S. EPA vapor intrusion guidance, with an inhalation toxicity value reviewed and ultimately approved by the NDEQ.

1.2 EXPOSED POPULATIONS

The VCP soil remediation goals are developed for residential and industrial/commercial populations, while groundwater remediation goals are developed for residents only. Consistent with the soil remediation goals, the vapor intrusion goals are developed for both residential and industrial/commercial populations. Current U.S. EPA (2004) guidance acknowledges the potential inconsistency between U.S. EPA and Occupational Safety and Health Administration (OSHA) goals for worker exposure. However, workers in an office setting are not covered by OSHA and these values would be appropriate.

2.0 VAPOR INTRUSION MODEL INPUT PARAMETERS

Volatilization of contaminants located in soil and groundwater, and the subsequent mass transport of these vapors into indoor spaces, constitute a potential inhalation exposure pathway evaluated through risk assessment. Johnson and Ettinger (1991) introduced a screening-level model that incorporates both convective and diffusive mechanisms for estimating the transport of contaminant vapors emanating from soil and groundwater into indoor spaces located directly above or in close proximity to the source of contamination. In their article, Johnson and Ettinger reported that the results of the model agreed qualitatively with published experimental case histories and agreed qualitatively and quantitatively with

detailed, three-dimensional numerical modeling of radon transport into houses (Loureiro and others 1990). Both U.S. EPA guidance documents contain extensive discussions concerning the verification of the model via comparison of its predicted results with measured results (U.S. EPA 2002, 2004); those discussions will not be repeated here.

The vapor intrusion model provides an estimated attenuation coefficient that relates the vapor concentration in the indoor space to the vapor concentration at the source of contamination. The model for soil gas and groundwater is constructed as a steady-state solution to vapor transport (infinite or nondiminishing source). Air emissions and transport of volatile COPCs from soil gas or groundwater to indoor air, and thus inputs to the model, are based on chemical properties of the contaminant, saturated and unsaturated zone soil properties, structural properties of the building, and appropriate exposure assumptions for those receptors under evaluation (U.S. EPA 2002). The model also incorporates default fate and transport chemical parameters such as vapor pressure, Henry's Law constants, and others. Additionally, the model incorporates inhalation toxicity factors selected based on U.S. EPA hierarchy (see Section 6.2 of the RG Protocol above). The remediation goals are calculated using the standard target risks and hazards (residential—1E-06 and 0.25, and commercial/industrial—1 E-05 and 1). If site conditions are not represented by the default assumptions, a Tier 3 risk assessment may be conducted to assess the potential risks using site-specific information.

Proposed input parameters are discussed in the following subsections and are listed in Table 2-1.

2.1 SOIL AND GROUNDWATER PROPERTIES

Because remediation goals are to be developed for the entire State, the most health-protective assumptions should be used. The model contains information on a wide variety of soil types from sand to clays, as the types of soils vary throughout the State. In order to address this variability, remediation goals are calculated using two soil types—sand or silt. The model also assumes homogeneous soil stratigraphy from the soil surface to the top of contamination for modeling indoor air concentrations. Although depth to groundwater varies widely across the State of Nebraska, for the development of statewide RGs, a conservative depth of 180 centimeters (cm) (approximately 6 feet) is used as the distance from the base of the structure to the top of the groundwater table. Table 2-1 presents the input parameters for modeling the vapor intrusion pathway.

2.2 SOIL, SOIL GAS, AND GROUNDWATER CHARACTERISTICS

Migration of chemicals through soil depends on the ability of chemicals to diffuse from the source into the vapor space and through the soil. Vapor space is a function of the total porosity of soil and the

volume of water displacing air within the pore volume. Research has shown that the vapor space immediately above free product and dissolved-phase hydrocarbon contamination is typically low due to the capillary fringe effect. The total soil porosity, water-filled soil porosity, and air-filled soil porosity used in the model are based on default parameters for "sand" and "silt" (U.S. EPA 2004). The average soil gas and groundwater temperature (13.9 degrees Celsius [°C]) used in the model is based on the information provided on Figure 8 of "User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings" (U.S. EPA 2004). A depth of 180 cm is also used for the depth of the soil gas sample. Soil gas sampled at a shallow depth (less than 4 feet below ground surface [bgs]), may not represent actual soil gas concentrations because of possible dilution from above ground air. Table 2-1 presents the input parameters for modeling the vapor intrusion pathway.

2.3 BUILDING PARAMETERS

In this assessment, buildings, whether residential or commercial/industrial, may be of slab-on-grade construction or constructed with a basement, and are assumed to have a foundation that is 10 cm (4 inches) thick. The building size for the hypothetical residence (see Table 2-1) derives from the most conservative and protective default for residential structures (U.S. EPA 2002). The model assumes that the contaminant source is infinite and vapor infiltration is through cracks in the foundation and basement floor, if any (U.S. EPA 2002). The area of cracks through which vapors can pass is calculated by assuming a 0.1-cm-wide crack for all the building scenarios.

The vapor intrusion model also assumes the ventilation rate for a residential building is 0.5 air changes per hour (ACH; 0.5 $hour^{-1}$), based on U.S. EPA (2004) guidance, and for a industrial building is 1.0 ACH, based on guidance from the California Department of Toxic Substance Control (California Environmental Protection Agency [Cal EPA] 2005).

Buildings can develop negative pressure relative to ambient pressure as a result of temperature gradients and wind effects. These pressure differences (dP) affect contaminant flux into buildings and are taken into account in the vapor intrusion model. Typical dP values are 10 to 100 grams per cm per second squared ($g/cm\text{-}s^2$). However, the recommended value from U.S. EPA (2002) of 40 $g/cm\text{-}s^2$ is used for dP in this evaluation because flux is directly proportional to dP.

The average vapor flow rate into the building (referred to as Q_{soil} in the model) is set to the model default of 5 liters per minute (L/m) for the hypothetical residence, as recommended by U.S. EPA (2002).

2.4 SUBSLAB SOIL GAS VALUES

Soil gas remediation goals calculated using the methods described above should not be compared to soil gas concentrations obtained from directly beneath a slab or basement floor. To those latter concentrations, an attenuation factor of 0.02 for residential exposure and 0.01 for commercial/industrial exposure should be applied, and the resulting values should be compared to the acceptable indoor air concentrations specified in the lookup tables.

3.0 SUMMARY AND CONCLUSIONS

This document outlines the approach for developing remediation goals for vapor intrusion into indoor air from underlying contaminated soils (in terms of soil gas) and groundwater. RGs are calculated for both residential and commercial/industrial buildings, and for two potential soil types (sand and silt). The groundwater depth and soil gas depth are both assumed to be approximately 6 feet bgs. These are generally considered conservative assumptions. The results for the calculation of the soil gas remediation goals are presented in Table 3-1 through 3-6; these include the identification of the toxicity factors, calculation of risk-based indoor air concentrations, calculation of soil gas values and the groundwater remediation goals for the protection of indoor air.

4.0 REFERENCES

California Environmental Protection Agency. 2005. Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air. Interim Final. Division of Toxic Substance Control. February 7.

Johnson, P.C. and R.A. Ettinger. 1991. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings." *Environ. Sci. Technol.* Volume 25. Pages 1,445 through 1,452.

Loureiro, C.O., L.M. Abriola, J.E. Martin, and R.G. Sextro. 1990. "Three-dimensional simulation of radon transport into houses with basements under constant negative pressure." *Environ. Sci. Technol.* Volume 24. Pages 1,338 through 1,348.

Nebraska Department of Environmental Quality (NDEQ). 2006. Nebraska Voluntary Cleanup Program Guidance. Remediation Section. Attachment 2-6 Lookup Tables.

U.S. Environmental Protection Agency (U.S. EPA). 2002. "Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Soils (Subsurface Vapor Intrusion Guidance)." Draft. *Federal Register*. Volume 67. Number 230. Pages 71,169 through 71,172. November 29. On-Line Address: http://www.epa.gov/correctiveaction/eis/vapor.htm

U.S. EPA. 2004. "User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings." Office of Emergency and Remedial Response. Washington D.C. December.

TABLES

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TABLE 2-1

SUMMARY OF INPUT PARAMETERS FOR VAPOR INTRUSION MODEL

Input Parameter	**Residential (slab on grade construction)**	**Commercial/Industrial (slab on grade construction)**
Depth Below Grade to Bottom of Enclosed Space Floor (basement or slab-on-grade) (cm)	15 (1)	15 (1)
Fraction Organic Carbon in Soil (unitless)	S and SI: 0.001 (2)	S and SI: 0.001 (2)
Water-Filled Porosity (cm^3/cm^3)	S: 0.054 and SI: 0.167 (2)	S: 0.054 and SI: 0.167 (2)
Soil Bulk Density (g/cm^3)	S: 1.66 and SI: 1.35 (2)	S: 1.66 and SI: 1.35 (2)
Soil Porosity = 1 - Bd/Ps (unitless)	S: 0.375 and SI: 0.489 (2)	S: 0.375 and SI: 0.489 (2)
Depth to Groundwater (cm)	180 (3)	180 (3)
Depth of Soil Gas Sample (cm)	180 (3)	180 (3)
Vadose Zone Soil Types (unitless)	S (0 ft bgs-GW) SI (0 ft bgs-GW) (4)	S (0 ft bgs-GW) SI (0 ft bgs-GW) (4)
Average Soil/GW Temperature (^oC)	13.9 (2)	13.9 (2)
Soil Stratum Directly Above Water Table and Soil Gas Sampling Depth (A, B, or C)	A	A
Enclosed Space Floor Thickness (cm)	10 (1)	10 (1)
Soil-Building Pressure Differential ($g/cm\text{-}s^2$)	40 (1)	40 (1)
Enclosed Space Floor Length (cm)	1,000 (1)	1,000 (1)
Enclosed Space Floor Width (cm)	1,000 (1)	1,000 (1)
Enclosed Space Height (cm)	244 (1)	305 (5)
Floor-Wall Seam Crack Width (cm)	0.1 (1)	0.1 (1)
Indoor Air Exchange Rate (hr^{-1})	0.5 (1)	1.0 (6)
Average Vapor Flow Rate into Building: Q_{soil} (L/m)	5 (1)	10 (6)
Attenuation Factor (unitless)	S – 0.00224 SI – 0.00173	S – 0.000514 SI – 0.000433

Notes:

(1) Default value from U.S. EPA 2002
(2) Default values from U.S. EPA 2004
(3) Assumed groundwater depth and soil gas sampling depth for a shallow sand aquifer typical of the Platte River Valley
(4) Assumed soil profile is sand or silt—for a shallow sand aquifer typical of the Platte River Valley
(5) Assumed typical commercial/industrial building will have a ceiling height of approximately 10 feet
(6) Default value from CalU.S. EPA 2005

Definitions:

A	One soil stratum
B	Two soil strata
C	Three soil strata
Bd	Bulk density
bgs	Below ground surface
cm	Centimeters
^{o}C	Celsius
U.S. EPA	U.S. Environmental Protection Agency
ft	Feet
g	Grams
g/cm^3	Grams per cubic centimeter
$g/cm\text{-}s^2$	Grams per centimeter per second squared
gw	Groundwater
hr	Hours
hr^{-1}	Reciprocal hours
L/m	Liters per minute
Ps	Soil porosity
S	Sand
SI	Silt

References:

California Environmental Protection Agency (CalU.S. EPA). 2005. Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air. Interim Final. Division of Toxic Substance Control. February 7.

U.S. Environmental Protection Agency (U.S. EPA). 2002. "Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)." Draft Federal Register. November 29. On-Line Address: http://www.epa.gov/correctiveaction/eis/vapor/complete.pdf

U.S. EPA 2004. "User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings." Office of Emergency and Remedial Response. February.

TABLE 3-1: INHALATION UNIT RISKS

Chemical	CAS Number	Inhalation Unit Risk		Chronic Inhalation Reference Concentration	
		Value $(\mu g/m^3)^{-1}$	Source	Value (mg/m^3)	Source
ACENAPHTHENE	83329	--	--	--	--
ACETALDEHYDE	75057	2.20E-06	IRIS	9.00E-03	IRIS
ACETONE	67641	--	--	3.10E+01	ATSDR
ACETONITRILE	75058	--	--	6.00E-02	IRIS
ACETOPHENONE	98862	--	--	--	--
ACROLEIN	107028	--	--	2.00E-05	IRIS
ACRYLONITRILE	107131	6.80E-05	IRIS	2.00E-02	IRIS
ALDRIN	309002	4.90E-03	IRIS	--	--
ALPHA-BHC	319846	1.80E-03	IRIS	--	--
AZOBENZENE	103333	3.10E-05	IRIS	--	--
BENZALDEHYDE	100527	--	--	--	--
BENZENE	71432	7.80E-06	IRIS	3.00E-02	IRIS
BENZO(B)FLUORANTHENE	205992	1.10E-04	OEHHA	--	--
BENZYLCHLORIDE	100447	4.50E-05	IRIS	1.00E-03	PPRTV
BETA-BHC	319857	5.30E-04	IRIS	--	--
BIPHENYL	92524	--	--	--	--
BIS(2-CHLOROETHYL)ETHER	111444	--	--	--	--
BROMODICHLOROMETHANE	75274	3.70E-05	OEHHA	--	--
BROMOFORM	75252	1.10E-06	IRIS	--	--
BROMOMETHANE	74839	--	--	5.00E-03	IRIS
BUTADIENE-1,3	106990	3.00E-05	IRIS	2.00E-03	IRIS
BUTANONE-2	78933	--	--	5.00E+00	IRIS
CARBON DISULFIDE	75150	--	--	7.00E-01	IRIS
CARBON TETRACHLORIDE	56235	6.00E-06	IRIS	1.00E-01	IRIS
CHLORDANE	12789036	1.00E-04	IRIS	7.00E-04	IRIS
CHLORO-2-BUTADIENE-1,3	126998	--	--	--	--
CHLOROBENZENE	108907	--	--	5.00E-02	PPRTV
CHLOROBUTANE-1	109693	--	--	--	--
CHLORODIFLUOROMETHANE	75456	--	--	5.00E+01	IRIS
CHLOROETHANE	75003	--	--	1.00E+01	IRIS
CHLOROFORM	67663	2.30E-05	IRIS	9.80E-02	ATSDR
CHLOROMETHANE	74873	--	--	9.00E-02	IRIS
CHLORONAPHTHALENE-2	91587	--	--	--	--
CHLOROPHENOL-2	95578	--	--	--	--
CHRYSENE	218019	1.10E-05	OEHHA	--	--
CIS-1,2-DICHLOROETHENE	156592	--	--	--	--
CROTONALDEHYDE	123739	--	--	--	--
CYCLOHEXANE	110827	--	--	6.00E+00	IRIS
DDE-4,4'	72559	9.70E-05	OEHHA	--	--
DIBENZOFURAN	132649	--	--	--	--
DIBROMOCHLOROMETHANE	124481	2.70E-05	OEHHA	--	--
DIBROMOETHANE-1,2	106934	6.00E-04	IRIS	9.00E-03	IRIS
DICHLOROBENZENE-1,2	95501	--	--	2.00E-01	HEAST
DICHLOROBENZENE-1,3	541731	--	--		
DICHLOROBENZENE-1,4	106467	1.10E-05	OEHHA	8.00E-01	IRIS
DICHLORODIFLUOROMETHANE	75718	--	--	2.00E-01	HEAST
DICHLOROETHANE-1,1	75343	1.60E-06	OEHHA	--	--
DICHLOROETHANE-1,2	107062	2.60E-05	IRIS	4.00E-01	OEHHA
DICHLOROETHENE (TOTAL)-1,2	540590	--	--	--	--
DICHLOROETHENE-1,1	75354	--	--	2.00E-01	IRIS
DICHLOROPROPANE-1,2	78875	1.00E-05	OEHHA	4.00E-03	IRIS

TABLE 3-1: INHALATION UNIT RISKS

Chemical	CAS Number	Inhalation Unit Risk		Chronic Inhalation Reference Concentration	
		Value $(\mu g/m^3)^{-1}$	Source	Value (mg/m^3)	Source
DICHLOROPROPENE-1,3	542756	4.00E-06	IRIS	2.00E-02	IRIS
DIELDRIN	60571	4.60E-03	IRIS	--	--
DIOXANE-1,4	123911	7.70E-06	OEHHA	3.00E+00	OEHHA
ENDOSULFAN	115297	--	--	--	--
ETHYL ETHER	60297	--	--	--	--
ETHYLACETATE	141786	--	--	--	--
ETHYLBENZENE	100414	2.50E-06	OEHHA	1.00E+00	IRIS
ETHYLENE OXIDE	75218	8.80E-05	OEHHA	3.00E-02	OEHHA
ETHYLMETHACRYLATE	97632	--	--	--	--
FLUORENE	86737	--	--	--	--
FURAN	110009	--	--	--	--
GAMMA-BHC (LINDANE)	58899	3.10E-04	OEHHA	--	--
HEPTACHLOR	76448	1.30E-03	IRIS	--	--
HEXACHLORO-1,3-BUTADIENE	87683	2.28E-05	IRIS	--	--
HEXACHLOROBENZENE	118741	4.60E-04	IRIS	--	--
HEXACHLOROCYCLOPENTADIENE	77474	--	--	2.00E-04	IRIS
HEXACHLOROETHANE	67721	4.00E-06	IRIS	--	--
HEXANE	110543	--	--	7.00E-01	IRIS
HEXANONE-2	591786	--	--	3.00E-02	IRIS
ISOBUTANOL	78831	--	--	--	--
ISOPROPYLBENZENE	98828	--	--	4.00E-01	IRIS
M,P-XYLENES	108383, 106423	--	--	7.00E-01	OEHHA
MERCURY	7439976	--	--	3.00E-04	IRIS
METHACRYLONITRILE	126987	--	--	7.00E-04	HEAST
METHOXYCHLOR	72435	--	--	--	--
METHYL ACETATE	79209	--	--	--	--
METHYL ACRYLATE	96333	--	--	--	--
METHYL TERT-BUTYL ETHER (MTBE)	1634044	2.60E-07	IRIS	3.00E+00	ATSDR
METHYL-4-PENTANONE-2	108101	--	--	3.00E+00	IRIS
METHYLCYCLOHEXANE	108872	--	--		
METHYLENE CHLORIDE	75092	4.70E-07	IRIS	1.00E+00	ATSDR
METHYLMETHACRYLATE	80626	--	--	7.00E-01	IRIS
METHYLNAPHTHALENE-1	90120	--	--	--	--
METHYLNAPHTHALENE-2	91576	--	--	--	--
NAPHTHALENE	91203	3.40E-05	OEHHA	3.00E-03	IRIS
N-BUTYLBENZENE	104518	--	--	--	--
NITROBENZENE	98953	4.00E-05	IRIS	9.00E-03	IRIS
NITROPROPANE-2	79469	2.70E-03	HEAST	2.00E-02	IRIS
O-NITROTOLUENE	88722	--	--	--	--
O-XYLENE	95476	--	--	7.00E-01	OEHHA
PROPYLBENZENE	103651	--	--	1.00E+00	PPRTV
PYRENE	129000	--	--	--	--
SEC-BUTYLBENZENE	135988	--	--		
STYRENE	100425	--	--	1.00E+00	IRIS
TERT-BUTYL METHYL ETHER	1634044	2.60E-07	OEHHA	3.00E+00	IRIS
TERT-BUTYLBENZENE	98066	--	--		
TETRACHLOROETHANE-1,1,1,2	630206	7.40E-05	IRIS	--	--
TETRACHLOROETHANE-1,1,2,2	79345	5.80E-05	IRIS	--	--
TETRACHLOROETHENE	127184	2.60E-07	IRIS	4.00E-02	IRIS
TOLUENE	108883	--	--	5.00E+00	IRIS
TRANS-1,2-DICHLOROETHENE	156605	--	--	6.00E-02	PPRTV

TABLE 3-1: INHALATION UNIT RISKS

Chemical	CAS Number	Inhalation Unit Risk		Chronic Inhalation Reference Concentration	
		Value $(\mu g/m^3)^{-1}$	Source	Value (mg/m^3)	Source
TRICHLORO-1,1,2-TRIFLUOROETHANE-1,2,2	76131	--	--	3.00E+01	HEAST
TRICHLOROBENZENE-1,2,3	87616	--	--	--	--
TRICHLOROBENZENE-1,2,4	120821	--	--	2.00E-03	PPRTV
TRICHLOROETHANE-1,1,1	71556	--	--	5.00E+00	IRIS
TRICHLOROETHANE-1,1,2	79005	1.60E-05	IRIS	--	--
TRICHLOROETHENE	79016	4.10E-06	IRIS	2.00E-03	IRIS
TRICHLOROFLUOROMETHANE	75694	--	--	7.00E-01	HEAST
TRICHLOROPROPANE-1,2,3	96184	--	--	3.00E-04	IRIS
TRIMETHYLBENZENE-1,2,4	95636	--	--	7.00E-03	PPRTV
TRIMETHYLBENZENE-1,3,5	108678	--	--	--	--
VINYL ACETATE	108054	--	--	2.00E-01	IRIS
VINYL CHLORIDE	75014	4.40E-06	IRIS	1.00E-01	IRIS
XYLENE (TOTAL)	1330207	--	--	1.00E-01	IRIS

Notes:

--	Not available; not applicable. Chemicals for which toxicity values are not provided due to EPA guidance indicating the current opinion that route-to-route extrapolation of toxicity data is not appropriate, and that those chemicals for which no values are provided have no viable toxicity data for the inhalation exposure route
µg/m3	Microgram per cubic meter
ATSDR	Agency for Toxic Substances and Disease Registry (ATSDR 2008)
BHC	Benzene hexachloride
CAS	Chemical Abstract Service
DDE	Dichlorodophenyldichloroethane
EPA	U.S. Environmental Protection Agency
HEAST	EPA Health Effects Assessment Summary Tables (EPA 1997)
IRIS	EPA Integrated Risk Information System (EPA 2009b)
OEHHA	California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Cancer Potency List (Cal/EPA 2009)
PPRTVs	EPA Provisional Peer-Reviewed Toxicity Values (EPA 2009a)

References:

Cal/EPA. 2009. Cancer Potency List. Office of Environmental Health Hazard Assessment. July 21. Available on-line at: http://www.oehha.ca.gov/risk/chemicalDB//index.asp

U.S. Environmental Protection Agency (EPA). 1997. "Health Effects Assessment Summary Tables (HEAST): Annual Update, FY 1997." EPA-540-R-97-036. National Center for Environmental Assessment, Office of Research and Development and Office of Emergency and Remedial Response. July.

EPA. 2009a. Risk-Based Concentration Table. Regional Screening Levels for Chemical Contaminants at Superfund Sites. December. Available on-line at: <http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm>.

EPA. 2009b. Integrated Risk Information System. On-line Database. Office of Research and Development, National Center for Environmental Assessment. Accessed 12/09/2009. Available on-line at: <http://cfpub.epa.gov/ncea/iris/index.cfm>

TABLE 3-2: RISK-BASED CONCENTRATIONS FOR INDOOR AIR

Chemical	CAS Number	Residential Indoor Air RBC		Industrial Indoor Air RBC	
		Target Cancer Risk Level = 1E-06 (µg/m^3)	Target Noncancer Hazard Index = 0.25 (µg/m^3)	Target Cancer Risk Level = 1E-05 (µg/m^3)	Target Noncancer Hazard Index = 1 (µg/m^3)
ACENAPHTHENE	83329	--	--	--	--
ACETALDEHYDE	75057	1.11E+00	2.01E-01	5.57E+01	3.94E+00
ACETONE	67641	--	6.93E+02	--	1.36E+04
ACETONITRILE	75058	--	1.34E+00	--	2.63E+01
ACETOPHENONE	98862	--	--	--	--
ACROLEIN	107028	--	5.00E-03	--	2.92E-02
ACRYLONITRILE	107131	3.58E-02	4.47E-01	1.80E+00	8.76E+00
ALDRIN	309002	4.97E-04	--	2.50E-02	--
ALPHA-BHC	319846	1.35E-03	--	6.81E-02	--
AZOBENZENE	103333	7.85E-02	--	3.96E+00	--
BENZALDEHYDE	100527	--	--	--	--
BENZENE	71432	3.12E-01	6.70E-01	1.57E+01	1.31E+01
BENZO(B)FLUORANTHENE	205992	2.21E-02	--	1.11E+00	--
BENZYLCHLORIDE	100447	5.41E-02	2.23E-02	2.73E+00	4.38E-01
BETA-BHC	319857	4.59E-03	--	2.31E-01	--
BIPHENYL	92524	--	--	--	--
BIS(2-CHLOROETHYL)ETHER	111444	--	--	--	--
BROMODICHLOROMETHANE	75274	6.58E-02	--	3.31E+00	--
BROMOFORM	75252	2.21E+00	--	1.11E+02	--
BROMOMETHANE	74839	--	1.12E-01	--	2.19E+00
BUTADIENE-1,3	106990	8.11E-02	4.47E-02	4.09E+00	8.76E-01
BUTANONE-2	78933	--	1.12E+02	--	2.19E+03
CARBON DISULFIDE	75150	--	1.56E+01	--	3.07E+02
CARBON TETRACHLORIDE	56235	4.10E-01	2.50E+01	2.00E+01	4.56E+02
CHLORDANE	12789036	2.43E-02	1.56E-02	1.23E+00	3.07E-01
CHLORO-2-BUTADIENE-1,3	126998	--	--	--	--
CHLOROBENZENE	108907	--	1.12E+00	--	2.19E+01
CHLOROBUTANE-1	109693	--	--	--	--
CHLORODIFLUOROMETHANE	75456	--	1.12E+03	--	2.19E+04
CHLOROETHANE	75003	--	2.23E+02	--	4.38E+03
CHLOROFORM	67663	1.06E-01	2.19E+00	5.33E+00	4.29E+01
CHLOROMETHANE	74873	--	2.01E+00	--	3.94E+01
CHLORONAPHTHALENE-2	91587	--	--	--	--
CHLOROPHENOL-2	95578	--	--	--	--

TABLE 3-2: RISK-BASED CONCENTRATIONS FOR INDOOR AIR

Chemical	CAS Number	Residential Indoor Air RBC		Industrial Indoor Air RBC	
		Target Cancer Risk Level = 1E-06 (µg/m^3)	Target Noncancer Hazard Index = 0.25 (µg/m^3)	Target Cancer Risk Level = 1E-05 (µg/m^3)	Target Noncancer Hazard Index = 1 (µg/m^3)
CHRYSENE	218019	2.21E-01	--	1.11E+01	--
CIS-1,2-DICHLOROETHENE	156592	--	--	--	--
CROTONALDEHYDE	123739	--	--	--	--
CYCLOHEXANE	110827	--	1.34E+02	--	2.63E+03
DDE-4,4'	72559	2.51E-02	--	1.26E+00	--
DIBENZOFURAN	132649	--	--	--	--
DIBROMOCHLOROMETHANE	124481	9.01E-02	--	4.54E+00	--
DIBROMOETHANE-1,2	106934	4.06E-03	2.01E-01	2.04E-01	3.94E+00
DICHLOROBENZENE-1,2	95501	--	4.47E+00	--	8.76E+01
DICHLOROBENZENE-1,3	541731	--	4.47E+00	--	8.76E+01
DICHLOROBENZENE-1,4	106467	2.21E-01	1.79E+01	1.11E+01	3.50E+02
DICHLORODIFLUOROMETHANE	75718	--	4.47E+00	--	8.76E+01
DICHLOROETHANE-1,1	75343	1.52E+00	--	7.67E+01	--
DICHLOROETHANE-1,2	107062	9.36E-02	8.94E+00	4.72E+00	1.75E+02
DICHLOROETHENE (TOTAL)-1,2	540590	--	--	--	--
DICHLOROETHENE-1,1	75354	--	4.47E+00	--	8.76E+01
DICHLOROPROPANE-1,2	78875	2.43E-01	8.94E-02	1.23E+01	1.75E+00
DICHLOROPROPENE-1,3	542756	6.08E-01	4.47E-01	3.07E+01	8.76E+00
DIELDRIN	60571	5.29E-04	--	2.67E-02	--
DIOXANE-1,4	123911	3.16E-01	6.70E+01	1.59E+01	1.31E+03
ENDOSULFAN	115297	--	--	--	--
ETHYL ETHER	60297	--	--	--	--
ETHYLACETATE	141786	--	--	--	--
ETHYLBENZENE	100414	9.73E-01	2.23E+01	4.91E+01	4.38E+02
ETHYLENE OXIDE	75218	2.77E-02	6.70E-01	1.39E+00	1.31E+01
ETHYLMETHACRYLATE	97632	--	--	--	--
FLUORENE	86737	--	--	--	--
FURAN	110009	--	--	--	--
GAMMA-BHC (LINDANE)	58899	7.85E-03	--	3.96E-01	--
HEPTACHLOR	76448	1.87E-03	--	9.43E-02	--
HEXACHLORO-1,3-BUTADIENE	87683	1.07E-01	--	5.38E+00	--
HEXACHLOROBENZENE	118741	5.29E-03	--	2.67E-01	--
HEXACHLOROCYCLOPENTADIENE	77474	--	4.47E-03	--	8.76E-02
HEXACHLOROETHANE	67721	6.08E-01	--	3.07E+01	--

TABLE 3-2: RISK-BASED CONCENTRATIONS FOR INDOOR AIR

Chemical	CAS Number	Residential Indoor Air RBC		Industrial Indoor Air RBC	
		Target Cancer Risk Level = 1E-06 (µg/m^3)	Target Noncancer Hazard Index = 0.25 (µg/m^3)	Target Cancer Risk Level = 1E-05 (µg/m^3)	Target Noncancer Hazard Index = 1 (µg/m^3)
HEXANE	110543	--	1.56E+01	--	3.07E+02
HEXANONE-2	591786	--	6.70E-01	--	1.31E+01
ISOBUTANOL	78831	--	--	--	--
ISOPROPYLBENZENE	98828	--	8.94E+00	--	1.75E+02
M,P-XYLENES	108383, 106423	--	1.56E+01	--	3.07E+02
MERCURY	7439976	--	6.70E-03	--	1.31E-01
METHACRYLONITRILE	126987	--	1.56E-02	--	3.07E-01
METHOXYCHLOR	72435	--	--	--	--
METHYL ACETATE	79209	--	--	--	--
METHYL ACRYLATE	96333	--	--	--	--
METHYL TERT-BUTYL ETHER (MTBE)	1634044	9.36E+00	6.70E+01	4.72E+02	1.31E+03
METHYL-4-PENTANONE-2	108101	--	6.70E+01	--	1.31E+03
METHYLCYCLOHEXANE	108872	--	1.34E+02	--	2.63E+03
METHYLENE CHLORIDE	75092	5.18E+00	2.23E+01	2.61E+02	4.38E+02
METHYLMETHACRYLATE	80626	--	1.56E+01	--	3.07E+02
METHYLNAPHTHALENE-1	90120	--	--	--	--
METHYLNAPHTHALENE-2	91576	--	--	--	--
NAPHTHALENE	91203	7.16E-02	6.70E-02	3.61E+00	1.31E+00
N-BUTYLBENZENE	104518	--	8.94E+00	--	1.75E+02
NITROBENZENE	98953	6.08E-02	2.01E-01	3.07E+00	3.94E+00
NITROPROPANE-2	79469	9.01E-04	4.47E-01	4.54E-02	8.76E+00
O-NITROTOLUENE	88722	--	--	--	--
O-XYLENE	95476	--	1.56E+01	--	3.07E+02
PROPYLBENZENE	103651	--	2.23E+01	--	4.38E+02
PYRENE	129000	--	--	--	--
SEC-BUTYLBENZENE	135988	--	8.94E+00	--	1.75E+02
STYRENE	100425	--	2.23E+01	--	4.38E+02
TERT-BUTYL METHYL ETHER	1634044	9.36E+00	6.70E+01	4.72E+02	1.31E+03
TERT-BUTYLBENZENE	98066	--	8.94E+00	--	1.75E+02
TETRACHLOROETHANE-1,1,1,2	630206	3.29E-02	--	1.66E+00	--
TETRACHLOROETHANE-1,1,2,2	79345	4.20E-02	--	2.11E+00	--
TETRACHLOROETHENE	127184	9.40E+00	1.05E+01	4.70E+02	1.75E+02
TOLUENE	108883	--	1.12E+02	--	2.19E+03
TRANS-1,2-DICHLOROETHENE	156605	--	1.34E+00	--	2.63E+01

TABLE 3-2: RISK-BASED CONCENTRATIONS FOR INDOOR AIR

Chemical	CAS Number	Residential Indoor Air RBC		Industrial Indoor Air RBC	
		Target Cancer Risk Level = 1E-06 (µg/m^3)	Target Noncancer Hazard Index = 0.25 (µg/m^3)	Target Cancer Risk Level = 1E-05 (µg/m^3)	Target Noncancer Hazard Index = 1 (µg/m^3)
TRICHLORO-1,1,2-TRIFLUOROETHANE-1,2,2	76131	--	6.70E+02	--	1.31E+04
TRICHLOROBENZENE-1,2,3	87616	--	--	--	--
TRICHLOROBENZENE-1,2,4	120821	--	4.47E-02	--	8.76E-01
TRICHLOROETHANE-1,1,1	71556	--	1.12E+02	--	2.19E+03
TRICHLOROETHANE-1,1,2	79005	1.52E-01	--	7.67E+00	--
TRICHLOROETHENE	79016	4.30E-01	5.00E-01	3.00E+01	8.80E+00
TRICHLOROFLUOROMETHANE	75694	--	1.56E+01	--	3.07E+02
TRICHLOROPROPANE-1,2,3	96184	--	6.70E-03	--	1.31E-01
TRIMETHYLBENZENE-1,2,4	95636	--	1.56E-01	--	3.07E+00
TRIMETHYLBENZENE-1,3,5	108678	--	--	--	--
VINYL ACETATE	108054	--	4.47E+00	--	8.76E+01
VINYL CHLORIDE	75014	5.53E-01	2.23E+00	2.79E+01	4.38E+01
XYLENE (TOTAL)	1330207	--	2.23E+00	--	4.38E+01

Notes:

All concentrations in microgram per cubic meter.

--	Not available; not applicable. Chemicals for which toxicity values are not provided due to EPA guidance indicating the current opinion that route-to-route extrapolation of toxicity data is not appropriate, and that those chemicals for which no values are provided have no viable toxicity data for the inhalation exposure route
µg/m^3	Microgram per cubic meter
BHC	Benzene hexachloride
CAS	Chemical Abstract Service
DDE	Dichlorodophenyldichloroethane
RBC	Risk-based concentration

TABLE 3-3: RISK-BASED CONCENTRATIONS FOR SOIL GAS - RESIDENTIAL & INDUSTRIAL EXPOSURES

Chemical	CAS Number	Residential Soil Gas RBC				Industrial Soil Gas RBC			
		Target Cancer Risk Level = 1E-06 ($\mu g/m^3$)		Target Noncancer Hazard Index = 0.25 ($\mu g/m^3$)		Target Cancer Risk Level = 1E-05 ($\mu g/m^3$)		Target Noncancer Hazard Index = 1 ($\mu g/m^3$)	
		Sandy Soil α_{sg} = 0.00224	Silty Soil α_{sg} = 0.00173	Sandy Soil α_{sg} = 0.00224	Silty Soil α_{sg} = 0.00173	Sandy Soil α_{sg} = 0.000514	Silty Soil α_{sg} = 0.000433	Sandy Soil α_{sg} = 0.000514	Silty Soil α_{sg} = 0.000433
ACENAPHTHENE	83329	--	--	--	--	--	--	--	--
ACETALDEHYDE	75057	4.94E+02	6.39E+02	8.98E+01	1.16E+02	1.08E+05	1.29E+05	7.67E+03	9.10E+03
ACETONE	67641	--	--	3.09E+05	4.00E+05	--	--	2.64E+07	3.14E+07
ACETONITRILE	75058	--	--	5.99E+02	7.75E+02	--	--	5.11E+04	6.07E+04
ACETOPHENONE	98862	--	--	--	--	--	--	--	--
ACROLEIN	107028	--	--	2.23E+00	2.89E+00	--	--	5.68E+01	6.74E+01
ACRYLONITRILE	107131	1.60E+01	2.07E+01	2.00E+02	2.58E+02	3.51E+03	4.17E+03	1.70E+04	2.02E+04
ALDRIN	309002	2.22E-01	2.87E-01	--	--	4.87E+01	5.78E+01	--	--
ALPHA-BHC	319846	6.04E-01	7.81E-01	--	--	1.33E+02	1.57E+02	--	--
AZOBENZENE	103333	3.50E+01	4.54E+01	--	--	7.70E+03	9.14E+03	--	--
BENZALDEHYDE	100527	--	--	--	--	--	--	--	--
BENZENE	71432	1.39E+02	1.80E+02	2.99E+02	3.88E+02	3.06E+04	3.63E+04	2.56E+04	3.03E+04
BENZO(B)FLUORANTHENE	205992	9.88E+00	1.28E+01	--	--	2.17E+03	2.57E+03	--	--
BENZYLCHLORIDE	100447	2.41E+01	3.13E+01	9.98E+00	1.29E+01	5.30E+03	6.29E+03	8.52E+02	1.01E+03
BETA-BHC	319857	2.05E+00	2.65E+00	--	--	4.50E+02	5.34E+02	--	--
BIPHENYL	92524	--	--	--	--	--	--	--	--
BIS(2-CHLOROETHYL)ETHER	111444	--	--	--	--	--	--	--	--
BROMODICHLOROMETHANE	75274	2.94E+01	3.80E+01	--	--	6.45E+03	7.65E+03	--	--
BROMOFORM	75252	9.88E+02	1.28E+03	--	--	2.17E+05	2.57E+05	--	--
BROMOMETHANE	74839	--	--	4.99E+01	6.46E+01	--	--	4.26E+03	5.06E+03
BUTADIENE-1,3	106990	3.62E+01	4.69E+01	2.00E+01	2.58E+01	7.95E+03	9.44E+03	1.70E+03	2.02E+03
BUTANONE-2	78933	--	--	4.99E+04	6.46E+04	--	--	4.26E+06	5.06E+06
CARBON DISULFIDE	75150	--	--	6.98E+03	9.04E+03	--	--	5.96E+05	7.08E+05
CARBON TETRACHLORIDE	56235	1.83E+02	2.37E+02	1.12E+04	1.45E+04	3.89E+04	4.62E+04	8.87E+05	1.05E+06
CHLORDANE	12789036	1.09E+01	1.41E+01	6.98E+00	9.04E+00	2.39E+03	2.83E+03	5.96E+02	7.08E+02
CHLORO-2-BUTADIENE-1,3	126998	--	--	--	--	--	--	--	--
CHLOROBENZENE	108907	--	--	4.99E+02	6.46E+02	--	--	4.26E+04	5.06E+04
CHLOROBUTANE-1	109693	--	--	--	--	--	--	--	--
CHLORODIFLUOROMETHANE	75456	--	--	4.99E+05	6.46E+05	--	--	4.26E+07	5.06E+07
CHLOROETHANE	75003	--	--	9.98E+04	1.29E+05	--	--	8.52E+06	1.01E+07
CHLOROFORM	67663	4.72E+01	6.12E+01	9.78E+02	1.27E+03	1.04E+04	1.23E+04	8.35E+04	9.91E+04
CHLOROMETHANE	74873	--	--	8.98E+02	1.16E+03	--	--	7.67E+04	9.10E+04
CHLORONAPHTHALENE-2	91587	--	--	--	--	--	--	--	--
CHLOROPHENOL-2	95578	--	--	--	--	--	--	--	--
CHRYSENE	218019	9.88E+01	1.28E+02	--	--	2.17E+04	2.57E+04	--	--

TABLE 3-3: RISK-BASED CONCENTRATIONS FOR SOIL GAS - RESIDENTIAL & INDUSTRIAL EXPOSURES

Chemical	CAS Number	Residential Soil Gas RBC				Industrial Soil Gas RBC			
		Target Cancer Risk Level = 1E-06 ($\mu g/m^3$)		Target Noncancer Hazard Index = 0.25 ($\mu g/m^3$)		Target Cancer Risk Level = 1E-05 ($\mu g/m^3$)		Target Noncancer Hazard Index = 1 ($\mu g/m^3$)	
		Sandy Soil α_{sg} = 0.00224	Silty Soil α_{sg} = 0.00173	Sandy Soil α_{sg} = 0.00224	Silty Soil α_{sg} = 0.00173	Sandy Soil α_{sg} = 0.000514	Silty Soil α_{sg} = 0.000433	Sandy Soil α_{sg} = 0.000514	Silty Soil α_{sg} = 0.000433
CIS-1,2-DICHLOROETHENE	156592	--	--	--	--	--	--	--	--
CROTONALDEHYDE	123739	--	--	--	--	--	--	--	--
CYCLOHEXANE	110827	--	--	5.99E+04	7.75E+04	--	--	5.11E+06	6.07E+06
DDE-4,4'	72559	1.12E+01	1.45E+01	--	--	2.46E+03	2.92E+03	--	--
DIBENZOFURAN	132649	--	--	--	--	--	--	--	--
DIBROMOCHLOROMETHANE	124481	4.02E+01	5.21E+01	--	--	8.84E+03	1.05E+04	--	--
DIBROMOETHANE-1,2	106934	1.81E+00	2.34E+00	8.98E+01	1.16E+02	3.98E+02	4.72E+02	7.67E+03	9.10E+03
DICHLOROBENZENE-1,2	95501	--	--	2.00E+03	2.58E+03	--	--	1.70E+05	2.02E+05
DICHLOROBENZENE-1,3	541731	--	--	2.00E+03	2.58E+03	--	--	1.70E+05	2.02E+05
DICHLOROBENZENE-1,4	106467	9.88E+01	1.28E+02	7.98E+03	1.03E+04	2.17E+04	2.57E+04	6.82E+05	8.09E+05
DICHLORODIFLUOROMETHANE	75718	--	--	2.00E+03	2.58E+03	--	--	1.70E+05	2.02E+05
DICHLOROETHANE-1,1	75343	6.79E+02	8.79E+02	--	--	1.49E+05	1.77E+05	--	--
DICHLOROETHANE-1,2	107062	4.18E+01	5.41E+01	3.99E+03	5.17E+03	9.18E+03	1.09E+04	3.41E+05	4.05E+05
DICHLOROETHENE (TOTAL)-1,2	540590	--	--	--	--	--	--	--	--
DICHLOROETHENE-1,1	75354	--	--	2.00E+03	2.58E+03	--	--	1.70E+05	2.02E+05
DICHLOROPROPANE-1,2	78875	1.09E+02	1.41E+02	3.99E+01	5.17E+01	2.39E+04	2.83E+04	3.41E+03	4.05E+03
DICHLOROPROPENE-1,3	542756	2.72E+02	3.52E+02	2.00E+02	2.58E+02	5.96E+04	7.08E+04	1.70E+04	2.02E+04
DIELDRIN	60571	2.36E-01	3.06E-01	--	--	5.19E+01	6.16E+01	--	--
DIOXANE-1,4	123911	1.41E+02	1.83E+02	2.99E+04	3.88E+04	3.10E+04	3.68E+04	2.56E+06	3.03E+06
ENDOSULFAN	115297	--	--	--	--	--	--	--	--
ETHYL ETHER	60297	--	--	--	--	--	--	--	--
ETHYLACETATE	141786	--	--	--	--	--	--	--	--
ETHYLBENZENE	100414	4.35E+02	5.63E+02	9.98E+03	1.29E+04	9.54E+04	1.13E+05	8.52E+05	1.01E+06
ETHYLENE OXIDE	75218	1.23E+01	1.60E+01	2.99E+02	3.88E+02	2.71E+03	3.22E+03	2.56E+04	3.03E+04
ETHYLMETHACRYLATE	97632	--	--	--	--	--	--	--	--
FLUORENE	86737	--	--	--	--	--	--	--	--
FURAN	110009	--	--	--	--	--	--	--	--
GAMMA-BHC (LINDANE)	58899	3.50E+00	4.54E+00	--	--	7.70E+02	9.14E+02	--	--
HEPTACHLOR	76448	8.36E-01	1.08E+00	--	--	1.84E+02	2.18E+02	--	--
HEXACHLORO-1,3-BUTADIENE	87683	4.76E+01	6.17E+01	--	--	1.05E+04	1.24E+04	--	--
HEXACHLOROBENZENE	118741	2.36E+00	3.06E+00	--	--	5.19E+02	6.16E+02	--	--
HEXACHLOROCYCLOPENTADIENE	77474	--	--	2.00E+00	2.58E+00	--	--	1.70E+02	2.02E+02
HEXACHLOROETHANE	67721	2.72E+02	3.52E+02	--	--	5.96E+04	7.08E+04	--	--
HEXANE	110543	--	--	6.98E+03	9.04E+03	--	--	5.96E+05	7.08E+05
HEXANONE-2	591786	--	--	2.99E+02	3.88E+02	--	--	2.56E+04	3.03E+04

TABLE 3-3: RISK-BASED CONCENTRATIONS FOR SOIL GAS - RESIDENTIAL & INDUSTRIAL EXPOSURES

Chemical	CAS Number	Residential Soil Gas RBC				Industrial Soil Gas RBC			
		Target Cancer Risk Level = 1E-06 ($\mu g/m^3$)		Target Noncancer Hazard Index = 0.25 ($\mu g/m^3$)		Target Cancer Risk Level = 1E-05 ($\mu g/m^3$)		Target Noncancer Hazard Index = 1 ($\mu g/m^3$)	
		Sandy Soil α_{sg} = 0.00224	Silty Soil α_{sg} = 0.00173	Sandy Soil α_{sg} = 0.00224	Silty Soil α_{sg} = 0.00173	Sandy Soil α_{sg} = 0.000514	Silty Soil α_{sg} = 0.000433	Sandy Soil α_{sg} = 0.000514	Silty Soil α_{sg} = 0.000433
ISOBUTANOL	78831	--	--	--	--	--	--	--	--
ISOPROPYLBENZENE	98828	--	--	3.99E+03	5.17E+03	--	--	3.41E+05	4.05E+05
M,P-XYLENES	108383, 106423	--	--	6.98E+03	9.04E+03	--	--	5.96E+05	7.08E+05
MERCURY	7439976	--	--	2.99E+00	3.88E+00	--	--	2.56E+02	3.03E+02
METHACRYLONITRILE	126987	--	--	6.98E+00	9.04E+00	--	--	5.96E+02	7.08E+02
METHOXYCHLOR	72435	--	--	--	--	--	--	--	--
METHYL ACETATE	79209	--	--	--	--	--	--	--	--
METHYL ACRYLATE	96333	--	--	--	--	--	--	--	--
METHYL TERT-BUTYL ETHER (MTBE)	1634044	4.18E+03	5.41E+03	2.99E+04	3.88E+04	9.18E+05	1.09E+06	2.56E+06	3.03E+06
METHYL-4-PENTANONE-2	108101	--	--	2.99E+04	3.88E+04	--	--	2.56E+06	3.03E+06
METHYLCYCLOHEXANE	108872	--	--	5.99E+04	7.75E+04	--	--	5.11E+06	6.07E+06
METHYLENE CHLORIDE	75092	2.31E+03	2.99E+03	9.98E+03	1.29E+04	5.08E+05	6.03E+05	8.52E+05	1.01E+06
METHYLMETHACRYLATE	80626	--	--	6.98E+03	9.04E+03	--	--	5.96E+05	7.08E+05
METHYLNAPHTHALENE-1	90120	--	--	--	--	--	--	--	--
METHYLNAPHTHALENE-2	91576	--	--	--	--	--	--	--	--
NAPHTHALENE	91203	3.20E+01	4.14E+01	2.99E+01	3.88E+01	7.02E+03	8.33E+03	2.56E+03	3.03E+03
N-BUTYLBENZENE	104518	--	--	3.99E+03	5.17E+03	--	--	3.41E+05	4.05E+05
NITROBENZENE	98953	2.72E+01	3.52E+01	8.98E+01	1.16E+02	5.96E+03	7.08E+03	7.67E+03	9.10E+03
NITROPROPANE-2	79469	4.02E-01	5.21E-01	2.00E+02	2.58E+02	8.84E+01	1.05E+02	1.70E+04	2.02E+04
O-NITROTOLUENE	88722	--	--	--	--	--	--	--	--
O-XYLENE	95476	--	--	6.98E+03	9.04E+03	--	--	5.96E+05	7.08E+05
PROPYLBENZENE	103651	--	--	9.98E+03	1.29E+04	--	--	8.52E+05	1.01E+06
PYRENE	129000	--	--	--	--	--	--	--	--
SEC-BUTYLBENZENE	135988	--	--	3.99E+03	5.17E+03	--	--	3.41E+05	4.05E+05
STYRENE	100425	--	--	9.98E+03	1.29E+04	--	--	8.52E+05	1.01E+06
TERT-BUTYL METHYL ETHER	1634044	4.18E+03	5.41E+03	2.99E+04	3.88E+04	9.18E+05	1.09E+06	2.56E+06	3.03E+06
TERT-BUTYLBENZENE	98066	--	--	3.99E+03	5.17E+03	--	--	3.41E+05	4.05E+05
TETRACHLOROETHANE-1,1,1,2	630206	1.47E+01	1.90E+01	--	--	3.22E+03	3.83E+03	--	--
TETRACHLOROETHANE-1,1,2,2	79345	1.87E+01	2.43E+01	--	--	4.11E+03	4.88E+03	--	--
TETRACHLOROETHENE	127184	4.20E+03	5.43E+03	4.69E+03	6.07E+03	9.14E+05	1.09E+06	3.40E+05	4.04E+05
TOLUENE	108883	--	--	4.99E+04	6.46E+04	--	--	4.26E+06	5.06E+06
TRANS-1,2-DICHLOROETHENE	156605	--	--	5.99E+02	7.75E+02	--	--	5.11E+04	6.07E+04
TRICHLORO-1,1,2-TRIFLUOROETHANE-1,2,2	76131	--	--	2.99E+05	3.88E+05	--	--	2.56E+07	3.03E+07
TRICHLOROBENZENE-1,2,3	87616	--	--	--	--	--	--	--	--
TRICHLOROBENZENE-1,2,4	120821	--	--	2.00E+01	2.58E+01	--	--	1.70E+03	2.02E+03

TABLE 3-3: RISK-BASED CONCENTRATIONS FOR SOIL GAS - RESIDENTIAL & INDUSTRIAL EXPOSURES

Chemical	CAS Number	Residential Soil Gas RBC				Industrial Soil Gas RBC			
		Target Cancer Risk Level = 1E-06 ($\mu g/m^3$)		Target Noncancer Hazard Index = 0.25 ($\mu g/m^3$)		Target Cancer Risk Level = 1E-05 ($\mu g/m^3$)		Target Noncancer Hazard Index = 1 ($\mu g/m^3$)	
		Sandy Soil α_{sg} = 0.00224	Silty Soil α_{sg} = 0.00173	Sandy Soil α_{sg} = 0.00224	Silty Soil α_{sg} = 0.00173	Sandy Soil α_{sg} = 0.000514	Silty Soil α_{sg} = 0.000433	Sandy Soil α_{sg} = 0.000514	Silty Soil α_{sg} = 0.000433
TRICHLOROETHANE-1,1,1	71556	--	--	4.99E+04	6.46E+04	--	--	4.26E+06	5.06E+06
TRICHLOROETHANE-1,1,2	79005	6.79E+01	8.79E+01	--	--	1.49E+04	1.77E+04	--	--
TRICHLOROETHENE	79016	1.92E+02	2.49E+02	2.23E+02	2.89E+02	5.84E+04	6.93E+04	1.71E+04	2.03E+04
TRICHLOROFLUOROMETHANE	75694	--	--	6.98E+03	9.04E+03	--	--	5.96E+05	7.08E+05
TRICHLOROPROPANE-1,2,3	96184	--	--	2.99E+00	3.88E+00	--	--	2.56E+02	3.03E+02
TRIMETHYLBENZENE-1,2,4	95636	--	--	6.98E+01	9.04E+01	--	--	5.96E+03	7.08E+03
TRIMETHYLBENZENE-1,3,5	108678	--	--	--	--	--	--	--	--
VINYL ACETATE	108054	--	--	2.00E+03	2.58E+03	--	--	1.70E+05	2.02E+05
VINYL CHLORIDE	75014	2.47E+02	3.20E+02	9.98E+02	1.29E+03	5.42E+04	6.44E+04	8.52E+04	1.01E+05
XYLENE (TOTAL)	1330207	--	--	9.98E+02	1.29E+03	--	--	8.52E+04	1.01E+05

Notes:
All concentrations are in microgram per cubic meter.

--	Not available; not applicable. Chemicals for which toxicity values are not provided due to EPA guidance indicating the current opinion that route-to-route extrapolation of toxicity data is not appropriate, and that those chemicals for which no values are provided have no viable toxicity data for the inhalation exposure route
$\mu g/m^3$	Microgram per cubic meter
α_{sg}	Soil gas-to-indoor air attenuation factor
BHC	Benzene hexachloride
CAS	Chemical Abstract Service
DDE	Dichlorodophenyldichloroethane
RBC	Risk-based concentration

TABLE 3-4: SOIL GAS REMEDIATION GOALS FOR THE VAPOR INTRUSION PATHWAY

Chemical	CAS Number	Soil Gas Remediation Goal[a]							
		Residential (µg/m^3)				Industrial (µg/m^3)			
		Sandy Soil α_{sg} = 0.000514		Silty Soil α_{sg} = 0.000173		Sandy Soil α_{sg} = 0.000514		Silty Soil α_{sg} = 0.000433	
ACENAPHTHENE	83329	--	--	--	--	--	--	--	--
ACETALDEHYDE	75057	8.98E+01	nc	1.16E+02	nc	7.67E+03	nc	9.10E+03	nc
ACETONE	67641	3.09E+05	nc	4.00E+05	nc	2.64E+07	nc	3.14E+07	nc
ACETONITRILE	75058	5.99E+02	nc	7.75E+02	nc	5.11E+04	nc	6.07E+04	nc
ACETOPHENONE	98862	--	--	--	--	--	--	--	--
ACROLEIN	107028	2.23E+00	nc	2.89E+00	nc	5.68E+01	nc	6.74E+01	nc
ACRYLONITRILE	107131	1.60E+01	ca	2.07E+01	ca	3.51E+03	ca	4.17E+03	ca
ALDRIN	309002	2.22E-01	ca	2.87E-01	ca	4.87E+01	ca	5.78E+01	ca
ALPHA-BHC	319846	6.04E-01	ca	7.81E-01	ca	1.33E+02	ca	1.57E+02	ca
AZOBENZENE	103333	3.50E+01	ca	4.54E+01	ca	7.70E+03	ca	9.14E+03	ca
BENZALDEHYDE	100527	--	--	--	--	--	--	--	--
BENZENE	71432	1.39E+02	ca	1.80E+02	ca	2.56E+04	nc	3.03E+04	nc
BENZO(B)FLUORANTHENE	205992	9.88E+00	ca	1.28E+01	ca	2.17E+03	ca	2.57E+03	ca
BENZYLCHLORIDE	100447	9.98E+00	nc	1.29E+01	nc	8.52E+02	nc	1.01E+03	nc
BETA-BHC	319857	2.05E+00	ca	2.65E+00	ca	4.50E+02	ca	5.34E+02	ca
BIPHENYL	92524	--	--	--	--	--	--	--	--
BIS(2-CHLOROETHYL)ETHER	111444	--	--	--	--	--	--	--	--
BROMODICHLOROMETHANE	75274	2.94E+01	ca	3.80E+01	ca	6.45E+03	ca	7.65E+03	ca
BROMOFORM	75252	9.88E+02	ca	1.28E+03	ca	2.17E+05	ca	2.57E+05	ca
BROMOMETHANE	74839	4.99E+01	nc	6.46E+01	nc	4.26E+03	nc	5.06E+03	nc
BUTADIENE-1,3	106990	2.00E+01	nc	2.58E+01	nc	1.70E+03	nc	2.02E+03	nc
BUTANONE-2	78933	4.99E+04	nc	6.46E+04	nc	4.26E+06	nc	5.06E+06	nc
CARBON DISULFIDE	75150	6.98E+03	nc	9.04E+03	nc	5.96E+05	nc	7.08E+05	nc
CARBON TETRACHLORIDE	56235	1.83E+02	ca	2.37E+02	ca	3.89E+04	ca	4.62E+04	ca
CHLORDANE	12789036	6.98E+00	nc	9.04E+00	nc	5.96E+02	nc	7.08E+02	nc
CHLORO-2-BUTADIENE-1,3	126998	--	--	--	--	--	--	--	--
CHLOROBENZENE	108907	4.99E+02	nc	6.46E+02	nc	4.26E+04	nc	5.06E+04	nc
CHLOROBUTANE-1	109693	--	--	--	--	--	--	--	--
CHLORODIFLUOROMETHANE	75456	4.99E+05	nc	6.46E+05	nc	4.26E+07	nc	5.06E+07	nc
CHLOROETHANE	75003	9.98E+04	nc	1.29E+05	nc	8.52E+06	nc	1.01E+07	nc
CHLOROFORM	67663	4.72E+01	ca	6.12E+01	ca	1.04E+04	ca	1.23E+04	ca
CHLOROMETHANE	74873	8.98E+02	nc	1.16E+03	nc	7.67E+04	nc	9.10E+04	nc
CHLORONAPHTHALENE-2	91587	--	--	--	--	--	--	--	--
CHLOROPHENOL-2	95578	--	--	--	--	--	--	--	--
CHRYSENE	218019	9.88E+01	ca	1.28E+02	ca	2.17E+04	ca	2.57E+04	ca

TABLE 3-4: SOIL GAS REMEDIATION GOALS FOR THE VAPOR INTRUSION PATHWAY

Chemical	CAS Number	Soil Gas Remediation Goal[a]							
		Residential (µg/m^3)				Industrial (µg/m^3)			
		Sandy Soil α_{sg} = 0.000514		Silty Soil α_{sg} = 0.000173		Sandy Soil α_{sg} = 0.000514		Silty Soil α_{sg} = 0.000433	
CIS-1,2-DICHLOROETHENE	156592	--	--	--	--	--	--	--	--
CROTONALDEHYDE	123739	--	--	--	--	--	--	--	--
CYCLOHEXANE	110827	5.99E+04	nc	7.75E+04	nc	5.11E+06	nc	6.07E+06	nc
DDE-4,4'	72559	1.12E+01	ca	1.45E+01	ca	2.46E+03	ca	2.92E+03	ca
DIBENZOFURAN	132649	--	--	--	--	--	--	--	--
DIBROMOCHLOROMETHANE	124481	4.02E+01	ca	5.21E+01	ca	8.84E+03	ca	1.05E+04	ca
DIBROMOETHANE-1,2	106934	1.81E+00	ca	2.34E+00	ca	3.98E+02	ca	4.72E+02	ca
DICHLOROBENZENE-1,2	95501	2.00E+03	nc	2.58E+03	nc	1.70E+05	nc	2.02E+05	nc
DICHLOROBENZENE-1,3	541731	2.00E+03	nc	2.58E+03	nc	1.70E+05	nc	2.02E+05	nc
DICHLOROBENZENE-1,4	106467	9.88E+01	ca	1.28E+02	ca	2.17E+04	ca	2.57E+04	ca
DICHLORODIFLUOROMETHANE	75718	2.00E+03	nc	2.58E+03	nc	1.70E+05	nc	2.02E+05	nc
DICHLOROETHANE-1,1	75343	6.79E+02	ca	8.79E+02	ca	1.49E+05	ca	1.77E+05	ca
DICHLOROETHANE-1,2	107062	4.18E+01	ca	5.41E+01	ca	9.18E+03	ca	1.09E+04	ca
DICHLOROETHENE (TOTAL)-1,2	540590	--	--	--	--	--	--	--	--
DICHLOROETHENE-1,1	75354	2.00E+03	nc	2.58E+03	nc	1.70E+05	nc	2.02E+05	nc
DICHLOROPROPANE-1,2	78875	3.99E+01	nc	5.17E+01	nc	3.41E+03	nc	4.05E+03	nc
DICHLOROPROPENE-1,3	542756	2.00E+02	nc	2.58E+02	nc	1.70E+04	nc	2.02E+04	nc
DIELDRIN	60571	2.36E-01	ca	3.06E-01	ca	5.19E+01	ca	6.16E+01	ca
DIOXANE-1,4	123911	1.41E+02	ca	1.83E+02	ca	3.10E+04	ca	3.68E+04	ca
ENDOSULFAN	115297	--	--	--	--	--	--	--	--
ETHYL ETHER	60297	--	--	--	--	--	--	--	--
ETHYLACETATE	141786	--	--	--	--	--	--	--	--
ETHYLBENZENE	100414	4.35E+02	ca	5.63E+02	ca	9.54E+04	ca	1.13E+05	ca
ETHYLENE OXIDE	75218	1.23E+01	ca	1.60E+01	ca	2.71E+03	ca	3.22E+03	ca
ETHYLMETHACRYLATE	97632	--	--	--	--	--	--	--	--
FLUORENE	86737	--	--	--	--	--	--	--	--
FURAN	110009	--	--	--	--	--	--	--	--
GAMMA-BHC (LINDANE)	58899	3.50E+00	ca	4.54E+00	ca	7.70E+02	ca	9.14E+02	ca
HEPTACHLOR	76448	8.36E-01	ca	1.08E+00	ca	1.84E+02	ca	2.18E+02	ca
HEXACHLORO-1,3-BUTADIENE	87683	4.76E+01	ca	6.17E+01	ca	1.05E+04	ca	1.24E+04	ca
HEXACHLOROBENZENE	118741	2.36E+00	ca	3.06E+00	ca	5.19E+02	ca	6.16E+02	ca
HEXACHLOROCYCLOPENTADIENE	77474	2.00E+00	nc	2.58E+00	nc	1.70E+02	nc	2.02E+02	nc
HEXACHLOROETHANE	67721	2.72E+02	ca	3.52E+02	ca	5.96E+04	ca	7.08E+04	ca
HEXANE	110543	6.98E+03	nc	9.04E+03	nc	5.96E+05	nc	7.08E+05	nc

TABLE 3-4: SOIL GAS REMEDIATION GOALS FOR THE VAPOR INTRUSION PATHWAY

Chemical	CAS Number	Soil Gas Remediation Goal[a]							
		Residential (µg/m^3)				Industrial (µg/m^3)			
		Sandy Soil α_{sg} = 0.000514		Silty Soil α_{sg} = 0.000173		Sandy Soil α_{sg} = 0.000514		Silty Soil α_{sg} = 0.000433	
HEXANONE-2	591786	2.99E+02	nc	3.88E+02	nc	2.56E+04	nc	3.03E+04	nc
ISOBUTANOL	78831	--	--	--	--	--	--	--	--
ISOPROPYLBENZENE	98828	3.99E+03	nc	5.17E+03	nc	3.41E+05	nc	4.05E+05	nc
M,P-XYLENES	108383, 106423	6.98E+03	nc	9.04E+03	nc	5.96E+05	nc	7.08E+05	nc
MERCURY	7439976	2.99E+00	nc	3.88E+00	nc	2.56E+02	nc	3.03E+02	nc
METHACRYLONITRILE	126987	6.98E+00	nc	9.04E+00	nc	5.96E+02	nc	7.08E+02	nc
METHOXYCHLOR	72435	--	--	--	--	--	--	--	--
METHYL ACETATE	79209	--	--	--	--	--	--	--	--
METHYL ACRYLATE	96333	--	--	--	--	--	--	--	--
METHYL TERT-BUTYL ETHER (MTBE)	1634044	4.18E+03	ca	5.41E+03	ca	9.18E+05	ca	1.09E+06	ca
METHYL-4-PENTANONE-2	108101	2.99E+04	nc	3.88E+04	nc	2.56E+06	nc	3.03E+06	nc
METHYLCYCLOHEXANE	108872	5.99E+04	nc	7.75E+04	nc	5.11E+06	nc	6.07E+06	nc
METHYLENE CHLORIDE	75092	2.31E+03	ca	2.99E+03	ca	5.08E+05	ca	6.03E+05	ca
METHYLMETHACRYLATE	80626	6.98E+03	nc	9.04E+03	nc	5.96E+05	nc	7.08E+05	nc
METHYLNAPHTHALENE-1	90120	--	--	--	--	--	--	--	--
METHYLNAPHTHALENE-2	91576	--	--	--	--	--	--	--	--
NAPHTHALENE	91203	2.99E+01	nc	3.88E+01	nc	2.56E+03	nc	3.03E+03	nc
N-BUTYLBENZENE	104518	3.99E+03	nc	5.17E+03	nc	3.41E+05	nc	4.05E+05	nc
NITROBENZENE	98953	2.72E+01	ca	3.52E+01	ca	5.96E+03	ca	7.08E+03	ca
NITROPROPANE-2	79469	4.02E-01	ca	5.21E-01	ca	8.84E+01	ca	1.05E+02	ca
O-NITROTOLUENE	88722	--	--	--	--	--	--	--	--
O-XYLENE	95476	6.98E+03	nc	9.04E+03	nc	5.96E+05	nc	7.08E+05	nc
PROPYLBENZENE	103651	9.98E+03	nc	1.29E+04	nc	8.52E+05	nc	1.01E+06	nc
PYRENE	129000	--	--	--	--	--	--	--	--
SEC-BUTYLBENZENE	135988	3.99E+03	nc	5.17E+03	nc	3.41E+05	nc	4.05E+05	nc
STYRENE	100425	9.98E+03	nc	1.29E+04	nc	8.52E+05	nc	1.01E+06	nc
TERT-BUTYL METHYL ETHER	1634044	4.18E+03	ca	5.41E+03	ca	9.18E+05	ca	1.09E+06	ca
TERT-BUTYLBENZENE	98066	3.99E+03	nc	5.17E+03	nc	3.41E+05	nc	4.05E+05	nc
TETRACHLOROETHANE-1,1,1,2	630206	1.47E+01	ca	1.90E+01	ca	3.22E+03	ca	3.83E+03	ca
TETRACHLOROETHANE-1,1,2,2	79345	1.87E+01	ca	2.43E+01	ca	4.11E+03	ca	4.88E+03	ca
TETRACHLOROETHENE	127184	4.20E+03	ca	5.43E+03	ca	3.40E+05	nc	4.04E+05	nc
TOLUENE	108883	4.99E+04	nc	6.46E+04	nc	4.26E+06	nc	5.06E+06	nc
TRANS-1,2-DICHLOROETHENE	156605	5.99E+02	nc	7.75E+02	nc	5.11E+04	nc	6.07E+04	nc
TRICHLORO-1,1,2-TRIFLUOROETHANE-1,2,2	76131	2.99E+05	nc	3.88E+05	nc	2.56E+07	nc	3.03E+07	nc

TABLE 3-4: SOIL GAS REMEDIATION GOALS FOR THE VAPOR INTRUSION PATHWAY

Chemical	CAS Number	Soil Gas Remediation Goal[a]							
		Residential (µg/m^3)				Industrial (µg/m^3)			
		Sandy Soil α_{sg} = 0.000514		Silty Soil α_{sg} = 0.000173		Sandy Soil α_{sg} = 0.000514		Silty Soil α_{sg} = 0.000433	
TRICHLOROBENZENE-1,2,3	87616	--	--	--	--	--	--	--	--
TRICHLOROBENZENE-1,2,4	120821	2.00E+01	nc	2.58E+01	nc	1.70E+03	nc	2.02E+03	nc
TRICHLOROETHANE-1,1,1	71556	4.99E+04	nc	6.46E+04	nc	4.26E+06	nc	5.06E+06	nc
TRICHLOROETHANE-1,1,2	79005	6.79E+01	ca	8.79E+01	ca	1.49E+04	ca	1.77E+04	ca
TRICHLOROETHENE	79016	1.92E+02	ca	2.49E+02	ca	1.71E+04	nc	2.03E+04	nc
TRICHLOROFLUOROMETHANE	75694	6.98E+03	nc	9.04E+03	nc	5.96E+05	nc	7.08E+05	nc
TRICHLOROPROPANE-1,2,3	96184	2.99E+00	nc	3.88E+00	nc	2.56E+02	nc	3.03E+02	nc
TRIMETHYLBENZENE-1,2,4	95636	6.98E+01	nc	9.04E+01	nc	5.96E+03	nc	7.08E+03	nc
TRIMETHYLBENZENE-1,3,5	108678	--	--	--	--	--	--	--	--
VINYL ACETATE	108054	2.00E+03	nc	2.58E+03	nc	1.70E+05	nc	2.02E+05	nc
VINYL CHLORIDE	75014	2.47E+02	ca	3.20E+02	ca	5.42E+04	ca	6.44E+04	ca
XYLENE (TOTAL)	1330207	9.98E+02	nc	1.29E+03	nc	8.52E+04	nc	1.01E+05	nc

Notes:

All concentrations are in microgram per cubic meter.

[a] The prelminary SGAL is based on the lowest concentration between the cancer- and noncancer-based soil gas RBC. If the laboratory RL is less than the soil gas RBC, then the laboratory RL is used as the SGAL

-- Not available; not applicable. Chemicals for which toxicity values are not provided due to EPA guidance indicating the current opinion that route-to-route extrapolation of toxicity data is not appropriate, and that those chemicals for which no values are provided have no viable toxicity data for the inhalation exposure route

µg/m^3 Microgram per cubic meter

α_{sg} Soil gas-to-indoor air attenuation factor

BHC Benzene hexachloride

ca Cancer risk-based

CAS Chemical Abstract Service

DDE Dichlorodophenyldichloroethane

nc Non-cancer risk-based

TABLE 3-5: GROUNDWATER REMEDIATION GOALS FOR THE VAPOR INTRUSION PATHWAY

Chemical	CAS	Groundwater Remediation Goal (µg/L)			
		Residential, Sandy Soil	Residential, Silty Soil	Industrial, Sandy Soil	Industrial, Silty Soil
Acenaphthene	83329	--	--	--	--
Acetaldehyde	75070	4.35E+02	1.74E+03	1.52E+03	6.07E+03
Acetone	67641	3.00E+06	8.61E+06	1.05E+07	3.01E+07
Acetonitrile	75058	6.01E+03	1.30E+04	2.10E+04	4.55E+04
Acetophenone	98862	--	--	--	--
Acrolein	107028	7.80E-01	3.96E+00	2.73E+00	1.38E+01
Acrylonitrile	107131	1.55E+01	6.69E+01	3.16E+02	1.36E+03
Aldrin	309002	1.14E+00	2.87E+00	NOC	NOC
alpha-BHC	319846	2.58E+01	5.68E+00	1.08E+03	2.39E+02
Benzaldehyde	100527	--	--	--	--
Benzene	71432	3.68E+00	5.17E+01	1.29E+02	1.82E+03
Benzo(b)fluoranthene	205992	NOC	NOC	NOC	NOC
Benzylchloride	100447	9.86E+00	9.04E+01	7.19E+01	6.59E+02
Biphenyl	92524	--	--	--	--
Bis(2-chloroethyl)ether	111444	2.33E+01	3.56E+01	9.81E+02	1.50E+03
Bromodichloromethane	75274	6.45E+00	7.41E+01	2.71E+02	3.11E+03
Bromoform	75252	9.84E+02	5.22E+03	4.13E+04	2.19E+05
Butadiene-1,3	106990	3.04E-02	3.21E-01	2.74E-01	2.89E+00
Carbon disulfide	75150	1.28E+02	1.79E+03	4.46E+02	6.28E+03
Carbon tetrachloride	56235	1.53E-01	1.98E+00	3.24E+01	3.85E+02
Chlordane	57749	NOC	NOC	NOC	NOC
Chloro-2-butadiene (chloroprene)-1,3	126998	4.23E+00	6.13E+01	1.48E+01	2.14E+02
Chlorobenzene	108907	1.18E+02	1.67E+03	4.14E+02	5.85E+03
Chlorobutane-1	109693	--	--	--	--
Chlorodibromomethane	124481	2.11E+01	1.67E+02	8.85E+02	7.01E+03
Chlorodifluoromethane	75456	NOC	NOC	NOC	NOC
Chloroethane (ethyl chloride)	75003	3.26E+03	3.30E+04	1.14E+04	1.15E+05
Chloroform	67663	1.60E+00	2.14E+01	6.74E+01	9.00E+02
Chlorophenol-2	95578	--	--	--	--
Chloropropane-2	75296	4.31E+01	6.24E+02	1.51E+02	2.18E+03
Chrysene	218019	NOC	NOC	NOC	NOC
cis-1,2-Dichloroethylene	156592	--	--	--	--
Crotonaldehyde (2-butenal)	123739	--	--	--	--
Cumene	98828	4.02E+00	6.31E+01	1.41E+01	2.21E+02
DDE-4,4'	72559	NOC	NOC	NOC	NOC
Dibenzofuran	132649	--	--	--	--
Dibromoethane (ethylene dibromide)-1,2	106934	1.08E+00	7.33E+00	4.55E+01	3.08E+02
Dichlorobenzene-1,2	95501	1.08E+03	1.42E+04	3.77E+03	4.96E+04
Dichlorobenzene-1,3	541731	3.37E+02	4.73E+03	1.18E+03	1.65E+04
Dichlorobenzene-1,4	106467	8.82E+00	1.20E+02	3.71E+02	5.05E+03
Dichlorodifluoromethane	75718	5.03E+00	7.86E+01	1.76E+01	2.75E+02
Dichloroethane-1,1	75343	1.93E+01	2.79E+02	8.10E+02	1.17E+04
Dichloroethane-1,2	107062	5.56E+00	6.37E+01	2.34E+02	2.68E+03
Dichloroethylene-1,1	75354	4.61E+01	6.71E+02	1.62E+02	2.35E+03

TABLE 3-5: GROUNDWATER REMEDIATION GOALS FOR THE VAPOR INTRUSION PATHWAY

Chemical	CAS	Groundwater Remediation Goal (µg/L)			
		Residential, Sandy Soil	Residential, Silty Soil	Industrial, Sandy Soil	Industrial, Silty Soil
Dichloropropane-1,2	78875	6.39E+00	8.81E+01	3.84E+01	5.29E+02
Dichloropropene-1,3	542756	3.14E+00	4.85E+01	3.76E+01	5.82E+02
Dieldrin	60571	1.01E+01	2.95E+00	NOC	1.24E+02
Endosulfan	115297	--	--	--	--
Ethyl ether	60297	--	--	--	--
Ethylacetate	141786	--	--	--	--
Ethylbenzene	100414	1.04E+01	1.54E+02	4.38E+02	6.46E+03
Ethylene oxide	75218	2.41E+00	2.26E+01	1.01E+02	9.51E+02
Ethylmethacrylate	97632	--	--	--	--
Fluorene	86737	--	--	--	--
Furan	110009	--	--	--	--
gamma-BCH (Lindane)	58899	1.15E+02	3.10E+01	1.61E+03	4.33E+02
Heptachlor	76448	9.98E-04	1.85E-02	4.19E-02	7.76E-01
Hexachloro-1,3-butadiene	87683	1.71E+00	2.64E+01	7.18E+01	1.11E+03
Hexachlorobenzene	118741	8.00E-01	NOC	NOC	NOC
Hexachlorocyclopentadiene	77474	3.28E-01	5.66E+00	1.15E+00	1.98E+01
Hexachloroethane	67721	2.69E+02	1.92E+03	1.13E+04	NOC
Hexane	110543	1.62E+00	1.86E+01	5.66E+00	6.51E+01
Hexanone-2	591786	1.53E+03	8.09E+03	5.36E+03	2.83E+04
Hydrogen cyanide	74908	7.42E+01	3.41E+02	2.60E+02	1.19E+03
Isobutanol	78831	--	--	--	--
Mercury (elemental)	7439976	7.30E-01	1.18E+01	2.55E+00	4.14E+01
Methacrylonitrile	126987	1.51E+01	1.02E+02	5.29E+01	3.56E+02
Methoxychlor	72435	--	--	--	--
Methyl acetate	79209	--	--	--	--
Methyl acrylate	96333	--	--	--	--
Methyl bromide	74839	5.38E+00	7.84E+01	1.88E+01	2.74E+02
Methyl chloride (chloromethane)	74873	4.33E+01	5.75E+02	1.52E+02	2.01E+03
Methylcyclohexane	108872	2.37E+02	3.62E+03	8.29E+02	1.27E+04
Methylene bromide	74953	5.58E+01	6.07E+02	1.95E+02	2.12E+03
Methylene chloride	75092	1.29E+02	1.65E+03	5.42E+03	6.92E+04
Methylethylketone (2-butanone)	78933	4.65E+05	1.52E+06	1.63E+06	5.32E+06
Methylisobutylketone (4-methyl-2-pentanone)	108101	1.56E+05	8.92E+05	5.48E+05	3.12E+06
Methylmethacrylate	80626	1.66E+04	1.37E+05	5.80E+04	4.79E+05
Methylnaphthalene-2	91576	--	--	--	--
MTBE	1634044	8.02E+02	8.37E+03	3.37E+04	3.52E+05
m-Xylene	108383	8.92E+02	1.33E+04	3.12E+03	4.64E+04
Naphthalene	91203	1.66E+01	1.48E+02	2.54E+02	2.26E+03
n-Butylbenzene	104518	1.31E+02	NOC	4.57E+02	NOC
Nitrobenzene	98953	1.42E+02	2.49E+02	5.97E+03	1.05E+04
Nitropropane-2	79469	4.27E-01	2.12E+00	1.80E+01	8.91E+01
n-Propylbenzene	103651	1.07E+03	1.64E+04	3.73E+03	5.73E+04
o-Nitrotoluene	88722	--	--	--	--
o-Xylene	95476	1.08E+03	1.50E+04	3.76E+03	5.24E+04
p-Xylene	106423	7.94E+02	1.16E+04	2.78E+03	4.06E+04

TABLE 3-5: GROUNDWATER REMEDIATION GOALS FOR THE VAPOR INTRUSION PATHWAY

Chemical	CAS	Groundwater Remediation Goal (µg/L)			
		Residential, Sandy Soil	Residential, Silty Soil	Industrial, Sandy Soil	Industrial, Silty Soil
Pyrene	129000	--	--	--	--
sec-Butylbenzene	135988	NOC	NOC	NOC	NOC
Styrene	100425	3.38E+03	4.69E+04	1.18E+04	1.64E+05
tert-Butylbenzene	98066	1.25E+02	1.95E+03	4.37E+02	6.82E+03
Tetrachloroethane-1,1,1,2	630206	1.29E+01	1.75E+02	5.41E+02	7.35E+03
Tetrachloroethane-1,1,2,2	79345	1.00E+01	8.48E+01	4.22E+02	3.56E+03
Tetrachloroethylene	127184	5.60E+00	7.24E+01	4.53E+02	5.38E+03
Toluene	108883	5.55E+03	7.90E+04	1.94E+04	2.77E+05
trans-1,2-Dichloroethylene	156605	4.85E+01	7.20E+02	1.70E+02	2.52E+03
Trichloro-1,1,2-trifluoroethane-1,2,2	76131	4.36E+02	6.61E+03	1.53E+03	2.31E+04
Trichlorobenzene-1,2,4	120821	3.05E+01	3.32E+02	1.07E+02	1.16E+03
Trichloroethane-1,1,1	71556	2.15E+03	3.21E+04	7.52E+03	1.12E+05
Trichloroethane-1,1,2	79005	1.27E+01	1.46E+02	5.35E+02	6.15E+03
Trichloroethylene	79016	4.57E-01	5.92E+00	4.07E+01	4.83E+02
Trichlorofluoromethane	75694	4.39E+01	6.48E+02	1.54E+02	2.27E+03
Trichloropropane-1,2,3	96184	6.62E+00	5.90E+01	2.32E+01	2.06E+02
Trimethylbenzene-1,2,4	95636	1.31E+01	1.95E+02	4.58E+01	6.84E+02
Trimethylbenzene-1,3,5	108678	--	--	--	--
Vinyl acetate	108054	2.71E+03	2.68E+04	9.50E+03	9.38E+04
Vinyl chloride (chloroethene)	75014	9.57E-01	1.34E+01	4.02E+01	5.62E+02

Notes

--	Not available; not applicable. Chemicals for which toxicity values are not provided due to EPA guidance indicating the current opinion that route-to-route extrapolation of toxicity data is not appropriate, and that those chemicals for which no values are provided have no viable toxicity data for the inhalation exposure route.
µg/m^3	Microgram per cubic meter
NOC	Concentration calculated above saturation limit