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Building Crack Ratio (n)		0.00038	[unitless]
Building Foundation Slab Thick	(ness (Lorack)	0.100	(m)
Exposure Parameters			
Exposure Duration for Carcino	gens (EDc)	30	(years)
Exposure Frequency for Carcin	nogens (EFc)	350	(days/year)
Averaging Time for Carcinoger	ns (ATc)	70	(years)
Exposure Duration for Non-Car	cinogens (EDnc)	30	[years]
Exposure Frequency for Non-C	arcinogens (EFnc)	365	[days/year]
Averaging Time for Non-Carcin	ogens (ATnc)	30	[years]
	CALCULATE RESU	TS]	

RESULTS

Unsaturated Zone Effective Diffusion Coefficient (Deff)
Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT

0.004532 [cm²/s] 0.0008963 [cm²/s]

off)

"A" Parameter
"B" Parameter

8.010e-5 Based on parameter analysis: Advection is

based on parameter analysis. Advection is the dominant mechanism across foundation. Diffusion through soil is the overall ratelimiting process for the subsurface to indoor-air pathway.

"C" Parameter 0.004918

7.882e-

		Johnson & Ettinge	r Attenu	ation Fac	tor (a)					
	INDOOR	AIR RESULTS FOR	GROUN	D WATE	R SA	MPLE DA	TA			
	Low Pred	liction ¹		Best Esti	mate	***************************************		High Pre	diction2	
Indoor Air	2.799	[µg/m3] 0.4129	[ppbv]	4.994	[µg/m³]	0.7367	(ppbv)	5.714	[µg/m³] 0.8430	[ppbv]
Concentration				<u> </u>						
Cancer Risk		3.450e-6			6.156e	-6			7.045e-6	
Hazard Quotient		0.			O.				0.	

1 "Low Prediction" concentration produced with HIGHEST

moisture content and DEEPEST

456.5

depth to

contamination.

2 "High Prediction" concentration produced with LOWEST contamination.

moisture content and SHALLOWEST

depth to

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What do these results mean?

Comments or suggestions

<u> 10p ^</u>

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http://www.epa.gov/athens/leam2model/part-two/onsite/JnE_lite_forward.html

Last updated on Thursday, April 07, 2011



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Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

Background

Migration of volatile chemicals from the subsurface into overlying buildings is called vapor intrusion (VI). Volatile organic chemicals in contaminated soils or groundwater can emit vapors, which may migrate through subsurface soils and may enter the indoor air of overlying buildings. Building depressurization may cause these vapors to enter the home through cracks in the foundation. Depressurization can be caused by a combination of wind effects and stack effects, which are the result of heating within the building and/or mechanical ventilation. In extreme cases, the vapors may accumulate in dwellings to levels that may pose near-term safety hazards, such as explosion. Typically, however, vapor concentrations are present at low levels, to which long-term exposure may pose increased risk for chronic health effects.

This on-line calculator implements the Johnson and Ettinger (J&E) (Johnson and Ettinger, 1991) simplified model to evaluate the vapor intrusion pathway into buildings. This J&E model replicates the implementation that the US EPA Office of Solid Waste and Emergency Response (OSWER) used in developing its <u>draft vapor intrusion guidance</u>, but includes a number of enhancements that are facilitated by web implementation; temperature dependence of Henry's Law Constants and gaseous diffusivities, automatic sensitivity analysis of certain parameters, and others described on the background page.

The results you obtain from this OnSite implementation of the Johnson and Etlinger model may differ from other versions of the Johnson & Etlinger Model. In addition to the OSWER implementation that was used for the draft vapor intrusion guidance, EPA Office of Emergency Response and Remediation (OERR) distributes a set of spreadsheet implementations of the model. The differences among these implementations is described in detail on the results page. Beyond these differences the on-line version includes a simplified uncertainty analysis the other implementations lack.

		Click For an Exam	ple				
Enter Site Na	me (optional):		adult	esident - Phase) []		
Enter sample	concentration, units and media type		33.7	μg/L	*	Ground V	Vater
	epth of the soil gas sample or ground wat contamination)?(LT)	er table (for		7		m	eters ·
· ·	n change by +/-			1		m	eters :
What is your co	ontaminant of concern (COC)?		1,2,4-T	richlorobenzene	,		
What type of b	uliding are you investigating at your site?				s	lab-on-Grade	
What type of so	oil is beneath the building?					Loam	
What is the ave	erage soil/ground water temperature?					55	Farenheit
Chemical Properties	•					•	
	CAS Number		120	821			
	Molecular Weight (MW)		181	.45 (g/mole	9}		
	Henry's Law Constant at ground water	temperature (H)	0.0	329789 (unitle:	ss]		
	Free-Air Diffusion Coefficient (Da)		3.00	00e-2 [cm ² /s	l		
	Diffusivity in Water (Dw)		8.23	30e-6 [cm²/s)		
	Unit Risk Factor (URF)		0.	((µg/m	3)-1}		
	Reference Concentration (RfC)		0.20)0 (mg/m	3]		
Soil Properties					,		
	Total Porosity (n)		0.39	9 (unitles	ss)		
	Unsaturated Zone Moisture Content	Low 0.0610	Dest Est	mate High	0.240	[unitless]	
	(θw)		0.148				
	Capillary Zone Moisture Content at Air-	Entry Pressure	0.33	2 [unitles	s)		
	(O w,cap)						
	Height of Capillary Zone (CZh)		0.37				
	Soil-gas Flow Rate Into the Building (Q:	soil)	5.00	(L/min)			
Building Properties							
	Air Exchange Rate (EB)		0.25				
	Building Mixing Height (HB)		2.44				
	Building Footprint Area (FB)		100				
	Subsurface Foundation Area (AB)		106	.0 [m²]			

	Building Crack Ratio (η)	0.00038	[unitless]
	Building Foundation Slab Thickness (Lorack)	0.100	(m)
Exposure Paramete	ers		
	Exposure Duration for Carcinogens (EDc)	30	[years]
	Exposure Frequency for Carcinogens (EFc)	350	[days/year]
	Averaging Time for Carcinogens (ATc)	70	[years]
	Exposure Duration for Non-Carcinogens (EDnc)	30	(years)
	Exposure Frequency for Non-Carcinogens (EFnc)	365	[days/year]
	Averaging Time for Non-Carcinogens (ATnc)	30	[years]
	CALCULATE RESULTS		
RESULTS	***************************************		
	Unsaturated Zone Effective Diffusion Coefficient (Deff)	0.001892	[cm²/s]

Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.0008528 [cm²/s]

"A" Parameter "B" Parameter "C" Parameter 7.621e-5 Based on parameter analysis: Advection is the dominant mechanism across foundation. Diffusion through soil is the overall rate-limiting process for the subsurface to indoor-air pathway.

Johnson & Ettinger Attenuation Factor (a)

7.505e-5

	NDOOR A	OOR AIR RESULTS FOR GROUND WATER SAMPLE DATA										
	Low Predi-	Low Prediction1			Best Estimate			High Prediction2			***************************************	
Indoor Air	0,02185	[µg/m³]	0.002946	[ppbv]	0.05892	[µg/m³]	0.007945	[ppbv	0.08268	[µg/m3]	0.01115	[ppbv]
Concentration												
Cancer Risk	ŀ	0.				0.			l	0,		
Hazard Quotient		1.092e	-4			2.946e	-4			4.134e	-4	

^{1 &}quot;Low Prediction" concentration produced with HIGHEST

moisture content and DEEPEST

depth to

moisture content and SHALLOWEST

depth to

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http://www.epa.gov/athens/learn2model/part-two/onsite/JnE_lite_forward.html

^{2 &}quot;High Prediction" concentration produced with LOWEST



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Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

Background

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Click For an Example

Enter Site Na	me (optional):		Resident - Phase II		
Enter sample	concentration, units and media type	159	μg/L	Ground V	Vater
	epth of the soil gas sample or ground water table (for contamination)?(LT)		7	m	eters
This value car	change by +/-		1	m	eters
What is your co	ntaminant of concern (COC)?	Trichlor	cethylene		
What type of bu	ilding are you investigating at your site?			Slab-on-Grade	
What type of so	Il is beneath the building?			Loam	
What is the aye	rage spil/ground water temperature?			55	Farenheit
Chemical Proporties			-		
	CAS Number	790			
	Molecular Weight (MW)	131.			
	Henry's Law Constant at ground water temperature (H)		67947 (unitless)		
	Free-Air Diffusion Coefficient (Da)		0e-2 [cm ² /s]		
	Diffusivity in Water (Dw)		0e-6 (cm²/s)		
	Unit Risk Factor (URF)	4.10			
	Reference Concentration (RfC)	2e-0	3 [mg/m³]		
Soil Properties	T. (5. 11.1)				
	Total Porosity (n)	0.39	- • • • • • •		
	Unsaturated Zone Moisture Content I ow 0.0610	8est Estir	nate High 0.240	[unitiess]	
	(θw) Capillary Zone Moislure Content at Air-Entry Pressure	0.148 0.33	o fueltions		
	(8w,cap)	0.33	2 (unitless)		
	Height of Capillary Zone (CZh)	0.37	5 [m]		
	Soil-gas Flow Rate Into the Building (Qsoil)	5.00			
Building Properties	See that the way are many	0.00	(coming		
Daniella Lichardo	Air Exchange Rate (EB)	0.25	0 [hr·1]		
	Building Mixing Height (HB)	2.44	• •		
	Building Footprint Area (FB)	100.			
	Subsurface Foundation Area (AB)	106.	• • • •		
	V	100.	- ()		

	Building Crack Ra	tio (ŋ)					0.0	00038	(unitless)			
	Building Foundation	on Siab Thickr	ness (Lc	rack)			0.1	100	[m]			
Exposure Parameter	s											
·	Exposure Duration	for Carcinog	ens (ED	c)			30		[years]			
	Exposure Frequer	cy for Carcino	ogens (E	Fc)			35	0	[days/year]			
	Averaging Time fo	r Carcinogens	5 (ATc)				70		(years)			
	Exposure Duration	for Non-Card	cinogens	(EDnc)			30		[years]			
	Exposure Frequer	cy for Non-Ca	arcinoge	ns (EFnc))		36	5	(days/year)			
	Averaging Time fo	r Non-Carcino	ogens (A	(Tnc)			30		(years)			
			1	CALC	ULATE	RESULTS)					
RESULTS			£									
WEGGE 10	Unsamrateri Zone	Edective Offic	usion Co	eńicent (Deff)		0.0	04973	[cm ² /s]			
	Unsaturated + Car	allay Zong Et	ffective f	Sittision (Coatticie	nt (D Υ	0.0	01014	[cm ² /s]			
	eff)					•			•			
	"A" Paramet	êг				9.061e-5			rameter a			
	"B" Paramet	ar				416.0			t mechani hrough so			
						0.004918	limit	ing pr	ocess for			
	"Ç" Paramet					0.004916	indoo	r-air	pathway.			
	Johnson	a & Ettinger /	Attenuat	tion Fact	<u>or (</u> a)							8.897e-5
	INDOOR AIR RES	ULTS FOR G	ROUND	WATER	: S.	AMPLE DA	TA					
	Low Prediction1		E	Best Estin	nate			High Pro	ediction2			
Indoor Air	1.855 [µg/m	3] 0.3454	[ppbv]	3,350	[µg/m	0.6238	(ppbv)	3.849	[µg/m³]	0.7168	(ppbv)	
Concentration				·								

1 "Low Prediction" concentration produced with HIGHEST

3.125e-6

0.9274

moisture content and DEEPEST

depth to

6.486e-6

1.925

Cancer Risk Hazard Quotient

moisture content and SHALLOWEST

5.644e-6

1.675

depth to

2 "High Prediction" concentration produced with LOWEST

contamination.

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Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

Background

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		Click For an Exan	rbie				
Enter Site Na	me (optional):			adult resident	t - Phase II		
Enter sample	concentration, units and media type		1.68		μg/L	Ground V	Vater ·
	epth of the soil gas sample or ground water	rtable (for			7	m	eters ·
•	contamination)?(LT)						
inis value car	1 change by +/-				1	m	eters ·
What is your co	ntaminant of concern (COC)?		V	finyl chioride ((chloroethene)		
What type of bu	ilding are you investigating at your site?					Slab-on-Grade	٠.
What type of so	if is beneath the building?					Loam	v ·
What is the ave	rage soil/ground water temperature?					55	Farenheit
Chemical Properties							
	CAS Number			75014			
	Molecular Weight (MW)			62.5	[g/mole]		
	Henry's Law Constant at ground water to	mporature (H)		0.8021316	[unitless]		
	Free-Air Diffusion Coefficient (Da)			0.1060	[cm ² /s]		
	Diffusivity in Water (Dw)			1.230e-5	[cm²/s]		
	Unit Risk Factor (URF)			8.80e-6	[(µg/m ³)-1}		
	Reference Concentration (RfC)			0.100	[mg/m³]		
Soil Properties							
	Total Porosity (n)			0.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610		st Estimato	High 0.240	[ecettinu]	
	(θw)		0.	148			
	Capillary Zone Moisture Content at Air-Ei	ntry Pressure		0.332	[unitless]		
	(θw,cap)						
	Height of Capillary Zone (CZh)			0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qso	a)		5.00	(L/min)		
Building Properties							
	Air Exchange Rate (EB)			0.250	[hr1]		
	Building Mixing Height (HB)			2.44	[m]		
	Building Footprint Area (FB)			100.0	[m ²]		
	Subsurface Foundation Area (AB)			106.0	[m ²]		

	Building Crack Ratio (η)		0.00038	[unitiess]	
	Building Foundation Slab Thickness (L.	crack)	0.100	[m]	
Exposure Parameters	Exposure Duration for Carcinogens (EE)-)	30	[years]	
	•		350	[days/year]	
	Exposure Frequency for Carcinogens (I	EFC)			
	Averaging Time for Carcinogens (ATc)		70	[years]	
	Exposure Duration for Non-Carcinogen		30	(years)	
	Exposure Frequency for Non-Carcinoge	ens (EFnc)	365	[days/year]	
	Averaging Time for Non-Carcinogens (A	ATnc}	30	[years]	
		CALCULATE RESULT	s)		
RESULTS	· • • • • • • • • • • • • • • • • • • •				
	Unsaturated Zone Effective Diffusion C	oefficient (Deff)	0.006672	[cm ² /s]	
	Unsaturated + Capillary Zone Effective	Olifusion Coefficient (DT	0.001289	[cm2/s]	
	eff)				
	"A" Parameter	1.152e-4		arameter analysis: Ad	
	"B" Parameter	310.1	Diffusion	nt mechanism across fo through soil is the ov	erall rate-
	"C" Parameter	0.004918	indoor-air	rocess for the subsurf pathway.	ace to
	Johnson & Ettinger Attenua	tion Factor (a)			1.126e-4
	INDOOR AIR RESULTS FOR GROUN	D WATER SAMPLE C	ATA		7
	Low Prediction [‡]	Best Estimate	High P	rediction2	7
Indoor Air Concentration	0.08613 [µg/m ³] 0.03372 [ppbv]	0.1517 [µg/m³] 0.0593	9 [ppbv] 0.1729	9 [µg/m³] 0.06767 [pp	DVI
Cancer Risk	3.115e-7	5,486e-7		6.251e-7	
Hazard Quotient	8,613e-4	0.001517		0.001729	

1 "Low Prediction" concentration produced with HIGHEST

moisture content and DEEPEST

depth to

contamination.

2 "High Prediction" concentration produced with LOWEST contamination.

moisture content and SHALLOWEST

depth to

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	, ,,,,	Click For an Examp	,				
Enter Site Na	me (optional):		a	dult residen	t - Phase II		
Enter sample	concentration, units and media type		.101		µg/L	Ground	Water ·
	epth of the soil gas sample or ground water ta	bie (for			7	п	neters
•	contamination)?(LT)				4		otom
i nis value car	change by +/-				1	n	reters
What is your co	ntaminant of concem (COC)?		alş	oha-HCH (al	pha-BHC)		.1
What type of bu	ilding are you investigating at your site?					Slab-on-Grade	21
What type of so	il is beneath the building?					f nam	
What is the ave	rage soil/ground water temperature?					55	Farenheit
Chemical Proporties							
	CAS Number			319846			
	Molecular Weight (MW)			290.83	(g/mole)		
	it lenny's Law Constant at ground water temp	perature (H)		0.0000988	6 (unillass)		
	Free-Air Diffusion Coefficient (Da)			1.420e-2	[cm²/s]		
	Diffusivity in Water (Dw)			7.340e-6	[cm ² /s]		
	Unit Risk Factor (URF)			1.80e-3	[(µg/m³)-1]		
	Reference Concentration (RfC)			0.	[mg/m³]		
Soil Properties							
	Total Porosity (n)			0.399	(unitiess)		
	Unsaturated Zone Moisture Content	Low 0.0610		t Estimate	High 0.240	[unitless]	
	(0w)		0.1	48			
	Capillary Zone Moisture Content of Air-Entry	у Ргеззиге		0.332	[unitless]		
	(θw,cap)						
	Height of Capillary Zone (CZh)			0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoii)			5.00	(Umin)		
Building Properties	At Monte on But 45-3				D - 43		
	Air Exchange Rate (Es)			0.250	[hr-1]		
	Building Mixing Height (HB)			2.44	[m]		
	Building Footprint Area (FB)			100.0	[m²]		
	Subsurface Foundation Area (AB)			106.0	[m ²]		

	Building Crack Ratio (η)	0.00038	(unitiess)
	Building Foundation Slab Thickness (Lerack)	0.100	[m]
Exposure Paran	neters		
	Exposure Duration for Carcinogens (EDs)	30	[years]
	Exposure Frequency for Carcinogens (EFc)	350	(days/year)
	Averaging Time for Carcinogens (ATc)	70	(years)
	Exposure Duration for Non-Carcinogens (EDnc)	30	[years]
	Exposure Frequency for Non-Carcinogens (EFnc)	365	[days/year]
	Averaging Time for Non-Carcinogens (ATnc)	30	[years]
	CALCULATE RES	ULTS]	
RESULTS	\		

Unpaturated Zone Effective Diffusion Coefficient (Daff) 0.001699 [cm²/s] Unsaturated + Capitlary Zone Effective Diffusion Coefficient (DT 0.001780 [cm²/s]

"A" Parameter *B* Parameter "C" Parameter 1.591e-4

Based on parameter analysis: Advection is the dominant mechanism across foundation. Diffusion through soil is the overall rate-limiting process for the subsurface to indoor-air pathway.

0.004918

Johnson & Ettinger Attenuation Factor (a)

1.541e-4

	INDOOR A	NDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA									
	Low Prediction1			Best Estimate			High Prediction2				
Indoor Air	1.344e-6	[µg/m³] 1.131e-7	[ppbv]	1.539e-6	[μg/m³]	1.295e-7	[ppbv	4.188e-6	[µg/m³]	3.523e-7	[ppbv]
Concentration											
Cancer Risk		9.942e-10			1.138e	-9			3,0986	-9	
Hazard Quotient		0.			0.				0.		

^{1 &}quot;Low Prediction" concentration produced with BEST ESTIMATE

moisture content and DEEPEST

depth to

2 "High Prediction" concentration produced with HIGHEST

moisture content and SHALLOWEST

depth to

CLEAR ALL

contamination.

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	Building Crack Ratio (n)	0.00038	[unitless]
	Building Foundation Slab Thickness (Lcrack)	0.100	(m)
Exposure Parameter	s		
	Exposure Duration for Carcinogens (EDc)	30	[years]
	Exposure Frequency for Carcinogens (EFc)	350	[days/year]
	Averaging Time for Carcinogens (ATc)	70	[years]
	Exposure Duration for Non-Carcinogens (EDnc)	30	[years]
	Exposure Frequency for Non-Carcinogens (EFnc)	365	[days/year]
	Averaging Time for Non-Carcinogens (ATnc)	30	[years]
	CALCULATE RESUL	TS I	

RESULTS

0.001699 [cm²/s] Unsaturated Zone Effective Diffusion Coefficient (Deff) Unsaturated + Capitlary Zone Effective Diffusion Coefficient (DY 0.001780 [cm²/s]

eff)

"A" Parameter "8" Parameter "C" Parameter

1.591e-4 1218. 0.004918

Based on parameter analysis: Advection is the dominant mechanism across foundation. Diffusion through soil is the overall rate-limiting process for the subsurface to indoor-air pathway.

Johnson & Ettinger Attenuation Factor (a)

1.541e-4

	NDOOR A	VR RESU	ILTS FOR	GROUN	O WATER	SA	MPLE DAT	Ά				
	Low Predic	tion1			Best Estim	ate			High Predi	ction2		
Indoor Air	1.344e-6	[µg/m³]	1.131e-7	[ppbv]	1,539e-6	(µg/m³	1.295e-7	(ppbv)	4.188e-6	[µg/m³]	3.523e-7	[ppbv]
Concentration												
Cancer Risk		9,942e	-10			1.138e	-9			3.098e	-9	
Hazard Quotient	1	٥.				0,				0.		

^{1 &}quot;Low Prediction" concentration produced with BEST ESTIMATE

moisture content and DEEPEST

depth to

contamination.

2 "High Prediction" concentration produced with HIGHEST contamination.

moisture content and SHALLOWEST

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Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

Background

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Click For an Example

Enter Site Na	me (optional):	Olick Fol all Example	adult resider	it - Phase II				
Enter sample	concentration, units and media type		.291	μg/L	Ground V	/ater ·		
	epth of the soil gas sample or ground water ta	ble (for	7			eters		
=	n change by +/-		1 n			eters ·		
What is your co	What is your contaminant of concern (COC)?			aipha-HCH (alpha-BHC)				
What type of bi	uilding are you investigating at your site?			:	Siab-on-Grade			
What type of so	oll is beneath the building?				Loam			
What is the ave	rage soil/ground water temperature?				55	Farenheit		
Chemical Properties								
	CAS Number	•	319846					
	Molecular Weight (MW)		290.83	(g/mole)				
	Henry's Law Constant at ground water temp	perature (H))6 (unidees)				
	Free-Air Diffusion Coefficient (Da)		1.420e-2	[cm ² /s]				
	Diffusivity in Water (Dw)		7.340e-6	[cm ² /s]				
	Unit Risk Factor (URF)		1.80e-3	{(µg/m³)-1]				
	Reference Concentration (RfC)		0.	[mg/m³]				
Soil Properties								
	Total Porosity (n)		0.399	[unitiess]				
	Unsaturated Zone Moisture Content	Low 0.0610	Bost Estimate	fligh 0.240	(unitloss)			
	(9 w)		0.148					
	Capillary Zone Moisture Content at Air-Entry	y Pressure	0.332	[unitiess]				
	(O w,cap)							
	Height of Capillary Zone (CZh)		0.375	[m]				
	Soil-gas Flow Rate Into the Building (Qsoll)		5.00	(L/min)				
Building Properties	A billion to the control of the cont							
	Air Exchange Rate (EB)		0.250	(hr-1)				
	Building Mixing Height (HB)		2.44	[m]				
	Building Footprint Area (Fa)		100.0	[m²]				
	Subsurface Foundation Area (AB)		106.0	[m²]				

	Building Crack Ratio (n)		0.00038	[unitless]		
	Building Foundation Slab Thickness (Lerack)		0.100	[m]		
Exposure Paramete	rs					
	Exposure Duration for Carcinogens (EDc)		30	[years]		
	Exposure Frequency for Carcinogens (EFc)	350	(days/year)			
	Averaging Time for Carcinogens (ATc)	70	(years)			
	Exposure Duration for Non-Carcinogens (EDnc)	30	(years)			
	Exposure Frequency for Non-Carcinogens (EFnc)		365	[days/year]		
	Averaging Time for Non-Carcinogens (ATnc)		30	[years]		
	CALCULA	TE RESULTS				
RESULTS	***************************************	*************************				
	Unsaturated Zone Effective Diffusion Coefficient (Dett)		0.001699	[cm ² /s]		
	Unsaturated + Capillary Zone Effective Diffusion Coeff	clent (DT	0.001780	[cm ² /s]		
	eff)					
	"A" Parameter	1.591e-4		rameter analysis: Advection is		
	"B" Parameter	1218.		t mechanism across foundation. Through soil is the overall rate-		
	"C" Parameter	0.004918		ocess for the subsurface to		

Johnson & Ettinger Attenuation Factor (a)

1.541e-4

	INDOOR A	IR RESU	LTS FOR	GROUN	D WATER	ŞA	MPLE DAT	Ä				
	Low Predic	ction1			Best Estim	ate			High Predi	ction2		
Indoor Air Concentration	3.872e-6	[µg/m³]	3.257e-7	[ppbv]	4.434e-6	[µg/m³]	3.730e-7	[ppbv]	1.207e-5	[µg/m3]	1.015e-6	[ppbv
Cancer Risk		2.864e	-9			3.280e	-9			8.926e	-9	
Hazard Quotient		0.				Q.				0.		

^{1 &}quot;Low Prediction" concentration produced with BEST ESTIMATE

moisture content and DEEPEST

depth to

2 "High Prediction" concentration produced with HIGHEST contamination.

moisture content and SHALLOWEST

depth to

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Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

Background

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Click For an Evamola

		Click For an Examp	ole .				
Enter Site Na	me (optional):		adul	t resident	- Phase !!		
Enter sample	concentration, units and media type		.296		hB\r	Ground 1	Water ·
	epth of the soil gas sample or ground water contamination)?(LT)	table (for			7	n	neters ·
This value car	n change by +/-			1			eters ·
What is your co	ntaminant of concern (COC)?		alpha	-HCH (alp	ha-BHC)		
What type of bu	rilding are you investigating at your site?					Slab-on-Grade	•
What type of so	il is beneath the building?					Loam	-
What is the ave	rage soil/ground water temperature?					55	Farenheit
Chemical Properties							
	CAS Number		31	19846			
	Molecular Weight (MW)		29	88.09	[g/mole]		
	Henry's Law Constant at ground water te	mperature (H)	0,1	00009886	[unitless]		
	Free-Air Diffusion Coefficient (Da)		1.4	420e-2	[cm2/s]		
	Diffusivity in Water (Dw)		7.3	340e-6	[cm ² /s]		
	Unit Risk Factor (URF)		1.4	80e-3	[(µg/m³)-1]		
	Reference Concentration (RfC)		0.		[mg/m ³]		
Soil Properties					•		
·	Total Porosity (n)		0.3	399	(unitless)		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Es	stimate	Hìgh 0.240	(unitiess)	
	(0 w)		0.148		•		
	Capillary Zone Moisture Content at Air-Ea	ntry Pressure	0.3	332	[unitless]		
	(θw,cap)						
	Height of Capillary Zone (CZh)		0.3	375	(m)		
	Soil-gas Flow Rate Into the Building (Qso	il}	5.6	00	[L/min]		
Building Properties							
	Air Exchange Rate (EB)		0.2	250	[hr-1]		
	Building Mixing Height (HB)		2.4	44	{m]		
	Building Footprint Area (FB)		10	0.0	[m ²]		
	Subsurface Foundation Area (AB)		10	6.0	[m ²]		

	Building Crack Ratio (ŋ)			0.00038	[unitless]		
	Building Foundation Slab Thickr	less (Lorack)		0.100	[m]		
xposure Paramete	's						
	Exposure Duration for Carcinogo	ens (EDc)		30	[years]		
	Exposure Frequency for Carcino	gens (EFc)		350	[days/year]		
	Averaging Time for Carcinogens	i (ATc)		70	[years]		
	Exposure Duration for Non-Card	30	[years]				
	Exposure Frequency for Non-Ca	365	[days/year]				
	Averaging Time for Non-Carcino	gens (ATnc)		30	(years)		
		CALCUI	ATE RESULTS	1			
RESULTS		<u> </u>					
	Unsaturated Zone Effective Diffi-	ssion Coerlicient (De	K)	0.001699	[cm ² /s]		
	insaturated + Capitlary Zone Effective Diffusion Coefficient (DT			0.001780	(cm ² /s)		
	eff)						
	"A" Parameter		1.591e-4	Based on pa			
	"B" Parameter		1218.	the dominan			
	"C" Parameter		0.004918	Diffusion through soil is the ov limiting process for the subsurf			
				indoor-air	pathway.		
	Johnson & Ettinger A		(α)				1.5
				r 4			
	INDOOR AIR RESULTS FOR G		SAMPLE DAT				
	Low Prediction1	Best Estimati	В	High Pr	ediction2		
Indoor Air	Low Prediction1	Best Estimati				.033e-6	[ppbv]
Concentration	Low Prediction ¹ 3.939e-6 [µg/m ³]3.313e-7	Best Estimato [ppbv] 4.510e-6	в [µg/m³] 3.794e-7	High Pr	-5 [µg/m³] 1		[ppbv]
	Low Prediction1	Best Estimato [ppbv] 4.510e-6	В	High Pr			[ppbv]

moisture content and SHALLOWEST

CLEAR ALL

contamination.

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2 "High Prediction" concentration produced with HIGHEST

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depth to



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Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

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Click Say on Everente

	Į	Click For an Exam	ple			
Enter Site Na	me (optional):		adult residen	t - Phase II		
Enter sample	concentration, units and media type		.835	µg/L	Ground W	ater ·
	epth of the soil gas sample or ground water to contamination)?(LT)	table (for	7			ters ·
•	n change by +/-		1 meters			ters ·
What is your co	What is your contaminant of concern (COC)?			gamma-HCH (Lindane)		
What type of bu	vilding are you investigating at your site?				Slab-on-Grade	
What type of so	it is beneath the building?				Loam -	
What is the <u>ave</u>	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		58899			
	Molecular Weight (MW)		290.83	[g/mole]		
	Henry's Law Constant at ground water ten	nperature (H)		/ [unitioss]		
	Free-Air Diffusion Coefficient (Da)		1.420e-2	[cm ² /s]		
	Diffusivity in Water (Dw)		7.340e-6	[cm ² /s]		
	Unit Risk Factor (URF)		3.71e-4	[(µg/m³)-1]		
	Reference Concentration (RfC)		1.05e-3	[mg/m³]		
Soil Properties						
	Total Porosity (n)		0.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	[unitloss]	
	(0 w)		0.148			
	Capillary Zone Moisture Content at Air-En (θw,cap)	try Pressure	0.332	(unitiess)		
	Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoil	3)	5.00	(L/min)		
Building Properties	, and	•	0.00	[2]		
mantanta i reperties	Air Exchange Rate (Es)		0.250	[hr-1]		
	Building Mixing Height (Ha)		2.44	[m]		
	Building Footprint Area (FB)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m ²]		

	Building Crack Ratio (η)		0.00038	[unitless]
	Building Foundation Slab Thickness (Lerack)		0.100	[m]
Exposure Parameters	5			
	Exposure Duration for Carcinogens (EDc)		30	(years)
	Exposure Frequency for Carcinogens (EFc)		350	[days/year]
	Averaging Time for Carcinogens (ATc)		70	[years]
	Exposure Duration for Non-Carcinogens (EDnc)		30	[years]
	Exposure Frequency for Non-Cardinogens (EFnc)		365	[days/year]
	Averaging Time for Non-Carcinogens (ATnc)		30	[years]
	CALCULATI	E RESULTS		
RESULTS	(4)			
	Unsaturated Zone Effective Diffusion Coefficient (Deff)		0.001503	[cm ² /s]
	Unsaturated + Capillary Zone Effective Diffusion Coeffic	ent (DT	0.001573	[cm ² /s]
	eff)			
	<u>"A" Parameter</u>	1.406a-4		rameter analysis: Advection is
	"B" Parameter	1376.	Diffusion t	t mechanism across foundation. hrough soil is the overall rate-
	"C" Parameter	0.004918	limiting pr indoor-air	ocess for the subsurface to pathway.

Johnson & Ettinger Attenuation Factor (a)

1,367e-4

	NDOOR A	VR RESULTS FOR	GROU!	ID WATER	SAMPLE	DATA			
	Low Predic	tion1		Best Estim	ate		High Predi	ction2	
Indoor Air	1.301e-5	[µg/m³] 1.095e-6	[ppbv	1.490e-5	[µg/m³] 1.25	4e-6 (ppbv)	3.584e-5	[µg/m3] 3.015e-6	[ppb
Concentration									
Cancer Risk		1.984e-9			2.272e-9			5,464e-9	
Hazard Quotient		1.239e-5			1.419e-5			3.413e-5	

^{1 &}quot;Low Prediction" concentration produced with BEST ESTIMATE

moisture content and DEEPEST

depth to

moisture content and SHALLOWEST

depth to

.....

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² "High Prediction" concentration produced with HIGHEST



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Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

Forward Calculation of Indoor Air Concentration

Beckward Calculation full uncertainty analysis

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Enter Site No	me (optional):	Click For an Exam	pie adult residen	t. Dhasa II		
Ellier Ske iva	ше (ориола).		acuit resideri	(- mase II		
Enter sample	concentration, units and media type		.00436	μg/L	Ground V	Vater
	epth of the soil gas sample or ground water	table (for	7 me			eters ·
• • • • • • • • • • • • • • • • • • • •	contamination)?(LT)					
This value ca	n change by +/-		1 meter			eters ·
What is your co	ntaminant of concern (COC)?		Heptachlor			
What type of bu	allding are you investigating at your site?			Slab-on-Grade	F	
What type of so	il Is beneath the building?				Loam	
What is the ave	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		76448			
	Molecular Weight (MW)		373.32	[g/mole]		
	Henry's Law Constant at ground water to	mperature (H)	16.77690	įunilleas		
	Free-Air Diffusion Coefficient (Da)		1.120e-2	[cm ² /s]		
	Diffusivity in Water (Dw)		5.690e-6	[cm²/s]		
	Unit Risk Factor (URF)		1.30e-3	[(µg/m³)-1]		
	Reference Concentration (RfC)		1.75e-3	[mg/m³]		
Soil Properties						
	Total Porosity (n)		0.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	[esoltinu]	
	(0 w)		0.148			
	Capillary Zone Moisture Content at Air-Er	try Pressure	0.332	[unitless]		
	(θw,cap)					
	Height of Capillary Zone (CZh)		0.375	[tt]		
	Soil-gas Flow Rate Into the Building (Qsoil	ii)	5.00	(∟/min)		
Building Properties						
	Air Exchange Rate (EB)		0.250	(hr-1)		
	Building Mixing Height (HB)		2.44	[m]		
	Building Footprint Area (FB)		100.0	[m²]		
	Subsurface Foundation Area (As)		106.0	[m²]		

	Building Crack Ratio (n)	0.00038	[unitiess]
	Building Foundation Slab Thickness (Lcrack)	0.100	[m]
Exposure Parameter	r s		
	Exposure Duration for Carcinogens (EDc)	30	[years]
	Exposure Frequency for Carcinogens (EFc)	350	[days/year]
	Averaging Time for Carcinogens (ATc)	70	[years]
	Exposure Duration for Non-Carcinogens (EDnc)	30	[years]
	Exposure Frequency for Non-Carcinogens (EFnc)	365	[days/year]
	Averaging Time for Non-Carcinogens (ATnc)	30	[years]
	(CALCULATE RESUL	.TS	

RESULTS

Unsaturated Zone Effective Diffusion Coefficient (Detr) Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT

0.0007050 [cm²/s] 0.0001337 [cm2/s]

"A" Parameter "B" Parameter

1.194e-5 2935. 0.004918 Based on parameter analysis: Advection is the dominant mechanism across foundation. Diffusion through soil is the overall rate-limiting process for the subsurface to indoor-air pathway.

"C" Parameter

Johnson & Ettinger Attenuation Factor (a)

1.192e-5

	INDOOR A	IR RESU	GROUN	ID WATER	SA	MPLE DAT	Ά					
	Low Prediction1 E			Best Estimate			High Prediction2					
Indoor Air Concentration	4.943e-4	[µg/m³]	3,240e-5	[ppbv]	8.716e-4	[µg/m³]	5.712e-5	(ppbv)	9.9346-4	[µg/m³]	6.510e-5	[ppbv]
Cancer Risk		2.641e	-7			4.656e	-7			5.307e	-7	
Hazard Quotient	2.825e-4			4.981e-4			5.676e-4					

^{1 &}quot;Low Prediction" concentration produced with HIGHEST

moisture content and DEEPEST

depth to

moisture content and SHALLOWEST

depth to

2 "High Prediction" concentration produced with LOWEST contamination.

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http://www.epa.gov/athens/team2model/part-two/onsite/JnE_lite_forward.html

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Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

Background

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Click Eas an Evamala

Enter Site Name (optional): Enter sample concentration, units and media type 111	
What is the depth of the soil gas sample or ground water table (for 7 meters ground water contamination)?(LT)	
ground water contamination)?(LT)	
This value can change by +/- 1 meters	•
What is your contaminant of concern (COC)? Dieldrin	
What type of building are you investigating at your site? Slab-on-Grade	
What type of soil is beneath the building?	
What is the average soil/ground water temperature? 55 Fa	renheit -
Chemical Properties	
CAS Number 60571	
Molecular Weight (MW) 380.91 [g/mole]	
Henry's Law Constant at ground water temperature (H) 0.00010989 [unitless]	
Free-Air Diffusion Coefficient (D₄) 1.250e-2 [cm²/s]	
Diffusivity in Water (Dw) 4.740e-6 [cm²/s]	
Unit Risk Factor (URF) 4.60e-3 [(µg/m³)·1]	
Reference Concentration (RfC) 1.75e-4 [mg/m³]	
Soil Properties	
Total Porosity (n) 0.399 [unitless]	
Unsaturated Zone Moisture Content Low 0.0610 Best Estimate High 0.240 [unilless]	
(0 w) 0.148	
Capillary Zone Moisture Content at Air-Entry Pressure 0.332 [unitiess]	
(O w,cap)	
Height of Capillary Zone (CZh) 0.375 [m]	
Soil-gas Flow Rate Into the Building (Qsoil) 5.00 [L/min]	
Building Properties	
Air Exchange Rate (Es) 0.250 [h⁻⁴]	
Building Mixing Height (Ha) 2.44 [m]	
Bullding Footprint Area (Fg) 100.0 [m²]	
Subsurface Foundation Area (AB) 106.0 [m²]	

ure Duration Slab Thickness (Le ure Duration for Carcinogens (ED ure Frequency for Carcinogens (ATc) ging Time for Carcinogens (ATc) ure Duration for Non-Carcinogen ure Frequency for Non-Carcinogen ging Time for Non-Carcinogens (A	ic) (EDnc) (EDnc) (ITnc) CALCULATE RE:	SULTS (30	[m] [years] [years] [years] [days/year] [years]		
ure Frequency for Carcinogens (I ping Time for Carcinogens (ATc) ure Duration for Non-Carcinogens ure Frequency for Non-Carcinogens ping Time for Non-Carcinogens (A	EFC) (EDnc) Ins (EFnc) Vinc) CALCULATE RES	SULTS	350 70 30 365 30	[days/year] [years] [years] {days/year] {years}		
ure Frequency for Carcinogens (I ping Time for Carcinogens (ATc) ure Duration for Non-Carcinogens ure Frequency for Non-Carcinogens ping Time for Non-Carcinogens (A	EFC) (EDnc) Ins (EFnc) Vinc) CALCULATE RES	SULTS	350 70 30 365 30	[days/year] [years] [years] {days/year] {years}		
ping Time for Cardinogens (ATc) ure Duration for Non-Cardinogens ure Frequency for Non-Cardinogens ping Time for Non-Cardinogens (A	s (EDnc) POS (EFnc) VTnc) CALCULATE RES	SULTS	70 30 365 30	[years] [years] {days/year] [years]		
ure Duration for Non-Carcinogen: ure Frequency for Non-Carcinogen jing Time for Non-Carcinogens (A	ens (EFnc) Tnc) CALCULATE RE	SULTS	30 365 30	[years] {days/year} (years}		
ure Frequency for Non-Carcinoges (A plant Time for Non-Carcinogens (A plan	ens (EFnc) Tnc) CALCULATE RE	SULTS (365 30	[days/year] [years]		
ging Time for Non-Carcinogens (A	CALCULATE RE	SULTS (30	(years)		
rated Zone Effective Diffusion Ca	CALCULATE RE	SULTS (
	efficient (Deff)	(3.001254	(am2/e)		
			3.001254	(am2(e)		
			3.001254	(om2(e)		
rated + Capillary Zone Effective	Diffusion Coefficient (I			(cn-is)		
		DT (0.001312	[cm ² /s]		
A" Parameter	1.17			ameter analysis:		
the dominant mechanism across for B"Parameter 1649. Diffusion through soil is the ov						
C" Parameter	0.0		limiting process for the subsurfa indoor-air pathway.			
Johnson & Ettinger Attenua	tion Factor (a)		_	-	1.14	
R AIR RESULTS FOR GROUNI	WATER SAM	PLE DATA				
ediction1	Best Estimate		High Pre	diction2		
-6 [µg/m³] 7.829e-8 [ppbv]	1.397e-6 [µg/m³] 8.	.972e-8 (ppb	3,151e-6	[µg/m³] 2.024e-7	(ppbv)	
2.304e-9	2.641e-9			5.956e-9		
6.965e-6	7.982e-6		1	1,800a-5		
	Parameter Johnson & Ettinger Attenua R AIR RESULTS FOR GROUNE ediction ¹ -6 [µg/m ³] 7.829e-8 [ppbv] 2.304e-9 6.965e-6	Parameter 0.00	1649. Diff	1649. Diffusion the Diffusion the 1649. Diffusion the Diff	1649. Diffusion through soil is the limiting process for the substance	

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Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

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Background

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Click For an Evample

		Click For an Exam	ple					
Enter Site Na	me (optional):		indu	strial Wor	ker - Phase II			
Enter sample	concentration, units and media type		1.68		µg/L	s. (Ground Wa	ater
	epth of the soil gas sample or ground water	table (for			7		mei	ters
•	contamination)?(LT)							
This value car	n change by +/-				1		me	lers -
What is your co	ntaminant of concern (COC)?		Vînyl	chloride (chloroethene)		,	
What type of bu	ulldling are you investigating at your site?					Slab-on-	-Grade	
What type of so	il is beneath the building?					Loam		
What is the ave	rage soil/ground water temperature?					5	5	Farenheit
Chemical Properties								
	CAS Number			5014				
	Molecular Weight (MW)		-	2.5	[elom\g]			
	Henry's Law Constant at ground water te	mperature (H)	Ω	8021316	[unitless]			
	Free-Air Diffusion Coefficient (Da)		0	.1060	(cm ² /s)			
	Diffusivity in Water (Dw)		1	.230e-5	[cm ² /s]			
	Unit Risk Factor (URF)		8	80e-6	{(µg/m³}-1)			
	Reference Concentration (RfC)		0	.100	[mg/m3]			
Soll Properties								
	Total Porosity (n)		0.	399	[นกใช้ขรร]			
	Unsaturated Zone Moisture Content	Low 0.0610	Best E	stimate	Hìgh 0,240	[u	nitless]	
	(0 w)		0.148		-			
	Capillary Zone Moisture Content at Air-Ei	ntry Pressure	0.	332	[unitless]			
	(O w,cap)							
	Height of Capillary Zone (CZh)		0.	.375	(m)			
	Soil-gas Flow Rate Into the Building (Qso	an)	5	.00	[L/min]			
Building Properties								
	Air Exchange Rate (Es)		0	.250	(hr-1)			
	Building Mixing Height (He)		2	.44	(m)			
	Building Footprint Area (FB)		1	0.00	(m²)			
	Subsurface Foundation Area (As)		1	06.0	(m²)			

	Building Crack R	atio (η)				0.0	00038	[unitiess]			
	Building Foundat	tion Slab Thic	kness (L	crack)		0.1	100	[m]			
cposure Parameter	6										
	Exposure Duration	on for Carcino	gens (El	Dc)		25		[years]			
	Exposure Freque	ency for Carci	nogens (EFc)		25	-	[days/year]			
	Averaging Time	for Carcinoge	ns (ATc)			70		[years]			
	Exposure Duration		-			25		(years)			
	Exposure Freque	-				25	0	[days/year]			
	Averaging Time t	for Non-Carci	nogens (ATnc)		25		[years]			
			1	CALC	ULATE RESULTS	1					
ESULTS			***	***************************************							
	Unsaturated Zon	e Effective Di	ffusion C	oefficlent (Deff)	0.0	06672	[cm ² /s]			
	Unsaturated + Ca	apillary Zone	Effective	Diffusion (Coefficient (DT	0.0	01289	[cm2/s]			
	eff)										
	"A" Parame	ater			1.152e-4			rameter an t mechanis			
	"B" Parame	<u>eter</u>			310.1	Diffu	sion th	hrough so	l is th	e overal	ll rate-
	"C" Parame	eter			0.004918			ocess for pathway.	the sub	surface	to
	Johns	on & Ettinge	r Attenu	ation Fact	or (a)	21,000	,	,			1.126e
·····	NDOOR AIR RE					т.					
	Low Predictions	SOL13 FOR	***************************************	Best Estin		10	High Pre	diction2			
Indoor Air		m3) 0.03372		0.1517	[µg/m3] 0.05939	lonbyl	0.1729	[µg/m³]	0.06767	[vdqq]	
	υ.υσυ το (μφη	11310,00012	[bbp.e]	,,,,,,	[pg/m/o] o.cocco	{pp2+1		[pg/m·]	0.00101	Ope V	
Concentration	1.85	L 54e-7			3.266e-7			3.721e-	7		
Concentration Cancer Risk					0.001039			0.00118	4	\neg	
Concentration Cancer Risk Hazard Quotient	5.89	99e-4		1							

² "High Prediction" concentration produced with LOWEST contamination.

moisture content and SHALLOWEST

depth to

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What do these results mean?

Comments or suggestions

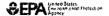
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Click For an Example

Enter Site Nar	me (optional):	Click For an Examp		rker - phase II		
Enter sample	concentration, units and media type		1.01e-1	h6\r	Ground V	Vater ·
	opth of the soil gas sample or ground water	rtable (for		7	m	eters ·
•	contamination)?(LT) n change by +/-			1	m	eters ·
What is your co	ntaminant of concern (COC)?		alpha-HCH (al	pha-8HC)		
What type of bu	ilding are you investigating at your site?				Slab-on-Grade	
What type of so	il is beneath the building?				Loam	
What is the ave	rage spil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		319846			
	Molecular Weight (MW)		290.83	[g/mole]		
	Henry's Law Constant at ground water to	emperature (H)	8890000.0			
	Free-Air Diffusion Coefficient (Da)		1.420e-2	[cm ² /s]		
	Diffusivity in Water (Dw)		7.340e-6	[cm ² /s]		
	Unit Risk Factor (URF)		1.80e-3	[(µg/m³)-1]		
	Reference Concentration (RfC)		0.	[mg/m³]		
Soil Properties						
	Total Porosity (n)		0.399	(unitiess)		
	Unsaturated Zone Moisture Content	Low 0.0510	Best Estimate	High 0.240	[unitless]	
	(8 _W)		0.148			
	Capillary Zone Moisture Content at Air-E (θw,cap)	intry Pressure	0.332	(unitless)		
	Height of Capillary Zone (CZh)		0.376	[m]		
	Soil-gas Flow Rate Into the Building (Qs	oil)	5.00	[L/min]		
Building Properties		•				
- manig v v - poviner	Air Exchange Rate (EB)		0.250	[hr-1]		
	Suilding Mixing Height (He)		2.44	[m]		
	Building Footprint Area (Fs)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m ²]		

	Building Co	ack Ratio) (ŋ)					0	.00038	[unitless]			
	Building Fo	เยกdation	Slab Thick	iness (L	crack)			0	.100	[m]			
Exposure Parameters	3												
	Exposure C	Juration f	or Carcinor	jens (El	Oc)			2	5	[years]			
	Exposure F	requency	y for Carcin	iogens (EFc)			2	50	(days/year	3		
	Averaging 3	Time for (Carcinoger	is (ATc)				74		[years]			
	Exposure D	Juration f	or Non-Car	cinogen	is (EDnc)			2	-	[years]			
	Exposure F		•	-		l .			50	(days/year	ì		
	Averaging 1	Time for I	Non-Carcin	ogens (ATnc)			2	5	[years]			
				۲	CALC	ULATE R	ESULTS						
ESULTS				****	***************************************	***************************************	Wall whomas						
	Unsaturated	d Zone E	ffective Dif	fusion C	oefficient (Deff)		0.	.001699	[cm ² /s]			
	Unsaturated	d + Capill	ary Zone E	ffective	Diffusion (20efficient	(DT	0.	001780	[cm2/s]			
	off)												
	"A" P	arameter				1.	.591e-4				nalysis: .sm acros		
	B P	arameter				12	218.	Diff	usion th	rough so	il is th	e overal	l rate-
	"C" P:	arameter				0	.004918		ting pro or-air p		the sub	surface	to
			& Ettinger	Attenu	ation Fact	or (a)		11100	or-air b	aciiway.			1.541e-4
	INDOOR A						MPLE DAT	ΓΑ					
	Low Predict		10.01	0110011	Best Estin		illi CC DAI	-	High Pre	diction2			
Indpor Air	1.344e-6		1.131e-7	foobyl	1.539e-6	[µg/m³]	1 2050-7	(a a b a			3.523e-7		
	1,0776.0	[hBussal	1.1010-7	[hbn4]	1	[ԻԹուսո			/\4.188e-6	i lun/m3		fnnbyl	
Concentration							1.2000-7	lbbov	4.188e-6) [hā\w ₃	0.02001	[vđqq]	
		5,918e <i>-</i>	10			6.776e		[ppn/	/ 4.188e-6	μg/m³ 1.844e	<u> </u>	[ppbv]	
Concentration		5,918e- 0.	10					, addi	/) 4.168e-6		<u> </u>	(ppbv)	
Concentration Cancer Risk Hazard Quotient "Low Prediction" concentration.		0. oduced w	ith BEST E			6.776e 0. moisture c		DEEP	EST	1.844e 0.	<u> </u>	(ppbv)	
Concentration Cancer Risk		0. oduced w	ith BEST E			6.776e 0. moisture c	-10 content and	DEEP	EST	1.844e 0.	-9 epth to	(ppbv)	
Concentration Cancer Risk Hazard Quotient "Low Prediction" contentiontamination. "High Prediction" con		0. oduced w	ith BEST E			6.776e 0. moisture c	-10 content and	DEEP	EST	1.844e 0.	-9 epth to	[ppbv]	
Concentration Cancer Risk Hazard Quotient "Low Prediction" concontamination. "High Prediction" concontamination.	centration pro	0. oduced w	ith BEST E			6.776e 0. moisture c	-10 content and	DEEP	EST	1.844e 0.	-9 epth to	[ppbv]	

What do these results mean?

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		Click For an Exampl	e)			
Enter Site Na	me (optional):		Industrial W	/orker - phase II		
Enter sample	concentration, units and media type		.835	μg/L	Ground	Water ·
	epth of the soil gas sample or ground water tal	oie (for		7	ı	neters ·
•	contamination)?(LT)				_	
This value ca	n change by +/-			1	n	neters
What is your co	ontaminant of concern (COC)?		gamma-HCl-	ł (Lindane)		•
What type of b	uilding are you investigating at your site?				Slab-on-Grade	v
What type of s	oil is beneath the building?				Loam	*
What is the ave	erage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		58899			
	Motecular Weight (MW)		290.83	[g/mote]		
	Henry's Law Constant at ground water temp	ereture (H)	0.000130)57 (unitless)		
	Free-Air Diffusion Coefficient (Da)		1.420e-2	[cm2/s]		
	Diffusivity in Water (Dw)		7,340e-6	[cm²/s]		
	Unit Risk Factor (URF)		3.71e-4	{(µg/m³)-1]		
	Reference Concentration (RfC)		1.05e-3	[mg/m ³]		
Soil Properties						
	Total Porosity (n)		0,399	(unitloos)		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	[unitiess]	
	(θw)		0.148			
	Capillary Zone Moisture Content at Air-Entry	/ Pressure	0,332	(unitless)		
	(0 w,cap)					
	Height of Capillary Zone (CZn)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoil)		5.00	[L/min]		
Bullding Properties						
	Air Exchange Rate (Es)		0.250	(hr·1)		
	Building Mixing Height (Hs)		2.44	(m)		
	Building Footprint Area (FB)		100,0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m²]		

	Building C:	rack Datis	\ (n)					0.0	00038	(unitless)			
	Building Co			nace (I				0.1		[m]			
P		Bridation	OIGD TRICE	11000 (L	Crack)			0.1	V 0	11.11			
Exposure Parameter	s Exposure (Auration 1	or Carcino	ans /Fi	201			25		[years]			
	Exposure f							25		[days/year]	1		
	Averaging	•						70	_	[years]			
	Exposure I							25		[vears]			
•	Exposure F			_				25		[days/year]	1		
	Averaging		•	-				25	_	[years]	•		
	Averaging	CHEST TOP	WOIF-CO:WI	ogono ([302.0]			
				L	CALC	ULATE F	RESULTS						
RESULTS													
		Unsaturated Zone Effective Diffusion Coefficient (Den)						•		[cm2/s]			
	Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT						(DT	0.0	01573	[cm ² /s]			
	off)												
	<u>"A" P</u>	arameter				1	.406e-4			ameter a: mechani			
	"B" P	arameter				1	376.	Diffu	sion th	rough so	il is th	e overa	ll rate-
	<u>*C* P</u>	arameter				C	.004918			cess for athway	the sub	surface	to
	ř	ohnson	& Ettinger	<u>Attenu</u>	ation Facto	<u>er (</u> α)							1.367e-4
	INDOOR A	JR RESU	LTS FOR	GROUN	D WATER	SA	MPLE DAT	ſΑ					
	Low Predic	tion !			Best Estim	ate			High Pre	diction2			
Indoor Air Concentration	1.301e-5	[µg/m³]	1.095e-6	(ppbv)	1.490e-5	[µg/m³	1.254e-6	[ppbv]	3.584 e -5	5 [µg/m³]	3,015e-6	[ppbv]	
Cancer Risk		1.181e	9			1.3536	1-9			3.252e	-9		
Hazard Quotient	8,488e-6				9.7228-6			2.338e-5					

1 "Low Prediction" concentration produced with BEST ESTIMATE

moisture content and DEEPEST

depth to

contamination.

² "High Prediction" concentration produced with HIGHEST

moisture content and SHALLOWEST

depth to

contamination.

CLEAR ALL

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WCMS

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http://www.epa.gov/athens/leam2model/part-two/onsite/JnE_lite_forward.html



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Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

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Click For an Example

Enter Site Na	ne (optional):	Calca For an Example		rker - phase II		
Enter sample	concentration, units and media type		4.36e-3	h&√r	Ground W	later -
	opth of the soil gas sample or ground water ta	ble (for	7			eters
•	contamination)?(LT) s change by +/-			1	me	eters ·
What is your co	ntaminant of concern (COC)?		Heptachlor			
What type of bu	ilding are you investigating at your site?				Slab-on-Grade	
What type of so	il is beneath the building?				Loam	
What is the ave	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		76448			
	Molecular Weight (MW)		373.32	[g/mole]		
	Henry's Law Constant at ground water temp	perature (H)	16 77690	(unitiess)		
	Free-Air Diffusion Coefficient (Da)		1.120e-2	[cm ² /s]		
	Diffusivity in Water (Dw)		5,690e-6	[cm ² /s]		
	Unit Risk Factor (URF)		1.30e-3	[(µg/m³)-1]		
	Reference Concentration (RfC)		1.75e-3	[mg/m³]		
Soil Properties						
	Total Porosity (n)		0.399	(unilless)		
	Unsaturated Zone Moisture Content (0w)	Low 0.8610	Best Estimate 0.148	High 0.240	[unitless]	
	Capillary Zone Moisture Content at Air-Entr	v Droceuro	0.140	(unitless)		
	(Ow,cap)	À Lipaphip	V.332	ไทเหนออา		
	Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoil)		5.00	[L/min]		
Building Properties	Con gas i lon tials illia allo serioni (acon)		0.00	(
Daniality i Topolites	Air Exchange Rate (Es)		0.250	[hr-1]		
	Building Mixing Height (HB)		2.44	[m]		
	Building Footprint Area (Fe)		100.0	(m²)		
	Subsurface Foundation Area (AB)		106.0	[m ²]		
	Captainess (outlander)) and (vib)		10010	p 7		

B Exposure Parameters E: A E: E:	uilding Crack Ratio (n) uilding Foundation Slab Thickness xposure Duration for Carcinogens xposure Frequency for Carcinogers veraging Time for Carcinogens (A' xposure Duration for Non-Carcino xposure Frequency for Non-Carcino xposure Frequency for Non-Carcinoger veraging Time for Non-Carcinoger (negaturated Zone Effective Diffusion (negaturated + Capillary Zone Effect	(EDc) is (EFc) fe) gens (EDnc) ogens (EFnc) s (ATnc)	JLATE RESULTS	0.100 25 260 70 25 250 25	[years] [days/year] [days/year] [years]			
E. A S. E:	xposure Frequency for Carcinoger veraging Time for Carcinogens (A' xposure Duration for Non-Carcinogens Frequency for Non-Carcinoger veraging Time for Non-Carcinoger Insaturated Zone Effective Diffusion	is (EFc) (Fc) gens (EDnc) ogens (EFnc) is (ATnc) [CALCL	JLATE RESULTS	250 70 25 250	[days/year] [years] [days/year]			
E: A: E: E:	xposure Frequency for Carcinoger veraging Time for Carcinogens (A' xposure Duration for Non-Carcinogens Frequency for Non-Carcinoger veraging Time for Non-Carcinoger Insaturated Zone Effective Diffusion	is (EFc) (Fc) gens (EDnc) ogens (EFnc) is (ATnc) [CALCL	JLATE RESULTS	250 70 25 250	[days/year] [years] [days/year]			
A: E: E:	veraging Time for Carcinogens (A xposure Duration for Non-Carcino xposure Frequency for Non-Carcino veraging Time for Non-Carcinoger (Non-Carcinoger (Non-Carcinoger)	fe) gens (EDnc) ogens (EFnc) s (ATnc)	JLATE RESULTS	70 25 250	[years] [years] [days/year]			
£:	xposure Duration for Non-Carcino, xposure Frequency for Non-Carcino, veraging Time for Non-Carcinoger (neaturated Zone Effective Diffusion)	gens (ED _{RC}) ogens (EF _{RC}) s (AT _{RC}) CALCL	ILATE RESULTS	25 250	[years] [days/year]			
E:	xposure Frequency for Non-Carcin veraging Time for Non-Carcinoger manual time for Non-Carcinoger serving Time for Non-Carcinoger	ogens (EFnc) s (ATnc) CALCU	ILATE RESULTS	250	[days/year]			
	veraging Time for Non-Carcinoger	S (ATnc)	ILATE RESULTS					
А	insaturated Zone Effective Diffusion	CALCL	ILATE RESULTS	25 ₁	[years]			
		*	ILATE RESULTS	_i				
		n Coefficient (D						
RESULTS		1 Coefficient (D						
	nsaturated + Capillary Zone Effect		•		0 [cm²/s]			
<u>U</u> efi	4)	ve Diffusion Co	pefficient (DT	0.000133	7 [cm ² /s]			
	"A" Parameter		1.194e-5		arameter analysis:			
	B Parameter		2935.	Diffusion	int mechanism across	e overa	ll rate-	
	"C" Parameter		0.004918	indoor-air	rocess for the sub- pathway.	Burrace	CO	
	Johnson & Ettinger Atte	nuation Factor	r_(a)				1.192e-5	
lV.	DOOR AIR RESULTS FOR GRO	UND WATER	SAMPLE DAT	Ά				
Lo	ow Prediction1	Best Estima	ite	High I	Prediction2			
Indoor Air 4.	.943e-4 [µg/m³] 3.240в-5 [pp	bv) 8.716e-4	(µg/m3) 5.712e-5	(pobv) 9.934	e-4 [µg/m3] 6.510e-5	[ppbv]		
Concentration								
Cancer Risk	1.572e-7		2.772e-7		3.159ө-7			
Hazard Quotient	1.935e-4		3.411e-4		3.888e-4			
contamination.	ntration produced with HIGHEST		oisture content and		depth to			
CLEAR ALL FORMAT REPOR	RT FOR PRINTER							
What do these results m	ean?							
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Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

Forward Calculation of Indoor Air Concentration

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		Click For an Exam	elqr			
Enter Site N	łame (optional);		Industrial Wo	rker - phase II		
Enter samp	ie concentration, units and media type		2.91e-1	µg/L .	Ground W	/ater ·
	depth of the soil gas sample or ground water	table (for		7	me	eters
-	er contamination)?(LT)					
This value of	can change by +/-			1	me	eters
What is your	contaminant of concern (COC)?		alpha-HCH (a	lpha-8HC)		
What type of	building are you investigating at your site?			\$	Slab-on-Grade	
What type of	soll is beneath the building?				Loam	
What is the <u>a</u>	verage soll/ground water temperature?				55	Farenheit
Chemical Propertie	96					
	CAS Number		319846			
	Molecular Weight (MW)		290.83	[g/mole]		
	Henry's Law Constant at ground water te	emperature (H)		36 (unitiess)		
	Free-Air Diffusion Coefficient (Da)		1.420e-2	[cm ² /s]		
	Diffusivity in Water (Dw)		7.340a-6	[cm ² /s]		
	Unit Risk Factor (URF)		1.80e-3	[(µg/m³)-1}		
	Reference Concentration (RfC)		0.	[mg/m³]	•	
Soil Properties						
	Total Porosity (n)		0.300	(unitions)		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	(unitless)	
	(0 w)		0.148			
	Capillary Zone Moisture Content at Air-E	ntry Pressure	0.332	[unitless]		
	(θw,cap)					
	Height of Capillary Zone (CZh)		0,375	[m]		
	Soil-gas Flow Rate Into the Building (Qso	oll)	5.00	[L/min]		
Building Propertie				70 44		
	Air Exchange Rate (EB)		0.250	[hr-1]		
	Bullding Mixing Height (HB)		2.44	[m]		
	Building Footprint Area (FB)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m2]		

	Building Crack Ratio	o (ŋ)				0.000	38 (uni	itless]			
	Building Foundation	Siab Thickness (L	crack)			0.100	[m]				
Exposure Parameter	S .										
	Exposure Duration f	for Carcinogens (El	Dc)			25	(yea	ars]			
	Exposure Frequenc	y for Carcinogens (EFc)			250	(da	ys/year)	1		
	Averaging Time for Carcinogens (ATc)					70	70 [years]				
	Exposure Duration for Non-Carcinogens (EDnc)					25	(yea	ars]			
	Exposure Frequency	y for Non-Carcinog	ens (EFnc)			250	Įda;	ys/year)			
	Averaging Time for	Non-Carcinogens (ATnc)			25	[ye:	ars]			
		ſ	CALCI	BATER	ESULTS						
RESULTS		<u></u>		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,							
RESULIS	Unsaturated Zone E	ffective Diffusion C	oefficient (E	latt'i		0.001	nol PP8	2/s}			
			•	•	· /DT		0.001780 [cm ² /s]				
	Unsaturated + Capil	Biy Zone Enective	Daidsion Ci	Dallice	; (D)	0.007780 [GIII-73]					
	eff)				.591e-4	Based on parameter analysis: Advection					tion is
	"A" Perameter			,	.9818 -4				em acrosi		
	<u>"B" Parameter</u>	•		1.	218.				il is the		
	"C" Parameter	:		0	.004918	limiting			the subs	urface	to
	<u>Johnson</u>	& Ettinger Attenu	ation Facto	<u>r (a)</u>							1.541e-4
1	INDOOR AIR RESU	ITS FOR GROUN	D WATER	SA	MPLE DA1	ľA]	
	Low Prediction1		Best Estima	ite		Hic	h Predicti	on2		$\neg \neg$	
Indoor Air		3.257e-7 [ppbv]	4.434e-6	fug/m31	3.730e-7	[ppbv] 1.2	207e-5	lua/m3)	1.015e-6	[ppbv]	
Concentration	o.orze-o [µg/mə]	O,EO, 6-1 [PPDV]		[եԹյուհ]	017 000-7	۰۰۰ (۲۵۵۹)		[h8/III.		(hlan a)	
Cancer Risk	1.705e	-9		1.952e	.9	5.313e-9					

0.

1 "Low Prediction" concentration produced with BEST ESTIMATE

0.

moisture content and DEEPEST

depth to

0.

2 "High Prediction" concentration produced with HIGHEST

moisture content and SHALLOWEST

depth to

CLEAR ALL

contamination.

Cancer Risk Hazard Quotient

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 $http://www.eps.gov/athens/learn2model/part-two/onsite/JnE_lite_forward.html$



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Forward Calculation of Indoor Air Concentration

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Click For an Example

Enter Site Na	Enter Site Name (optional):			Industrial Worker - phase II						
Enter sample	concentration, units and media type		2.96e-1	μg/L	Ground V	later -				
	What is the depth of the soil gas sample or ground water table (for			7 meters						
•	ground water contamination)?(LT) This value can change by +/-			1	me	eters -				
What is your co	ontaminant of concern (COC)?		alpha-HCH (a	ipha-BHC)						
·	uilding are you investigating at your site?		, ,		Sab-on-Grade					
•										
What type of so	oil is beneath the building?				Loam	•				
What is the ave	grage soil/ground water temperature?			-	55	Farenheit				
Chemical Properties										
	CAS Number		319846							
	Molecular Weight (MW)		290.83	[g/moie]						
	Henry's Law Constant at ground water ter	mperature (H)	0.0009886 [unitless]							
	Free-Air Diffusion Coefficient (Da)		1.420e-2	[cm ² /s]						
	Diffusivity in Water (Ow)		7.340e-6	[cm²/s]						
	Unit Risk Factor (URF)		1,80 s -3	[(µg/m³)-1]						
	Reference Concentration (RfC)		0.	[mg/m³}						
Soil Properties	•									
	Total Porosity (n)		0.399	(unitiess)						
	Unsaturated Zone Moisture Content (0 w)	Low 0.0610	Best Estimate 0.148	High 0.240	(unitless)					
	Capillary Zone Moisture Content at Air-Er	ntou Droceuro	0.332	[unitless]						
		iay riessule	0.332	(unitess)						
	(θw,cap) Height of Capitlary Zone (CZh)		0.375	[m]						
	Soil-gas Flow Rate Into the Building (Qso	e)	5.00	[L/min]						
Bullding Properties	Con gue i lett i late into dio Bananig (410	117	0.00	(mining)						
PRINTING 1 (Phairies	Air Exchange Rate (Eg)		0.250	[hr-1]						
	Building Mixing Reight (Ha)		2.44	[m]						
	Building Foolprint Area (Fe)		100.0	[m²]						
	Subsurface Foundation Area (AB)		106.0	[m²]						
				V 1						

	Building Crack Rati	io (n)			0.0	00038	[unitiess]		
	Building Foundation		Lorack)			100	[m]		
Exposure Parameter	=								
,	Exposure Duration	for Carcinogens (£	Dc)		25		[years]		
	Exposure Frequenc	y for Carcinogens	(EFc)		25	0	[days/year]		
	Averaging Time for	Carcinogens (ATa)		70		(years]		
	Exposure Duration i	for Non-Carcinoge	ns (EDnc)		25		[years]		
	Exposure Frequency for Non-Carcinogens (EFnc)					0	[days/year]		
	Averaging Time for Non-Carcinogens (ATnc)						(years)		
		1	CALCULATE	DESILITS					
RESULTS		ŧ	OALOODARE	- INCOUCTO					
KESOLIS	Unsaturated Zone E	Effective Diffusion	Coefficient (Detr)		0.0	01699	[cm ² /s]		
	Unsaturated + Capil			ent (DT		01780	[cm²/s]		
	off)			1	0.0		[om-rej		
	"A" Parameter	τ		1.591e-4	Based	on pa	rameter analys:	s: Adve	ction is
	"B" Parameter	r		1218.			t mechanism ac: hrough soil is		
							ocess for the s		
	"C" Parameter			0.004918			pathway.		9
	Johnson	& Ettinger Attenu	ation Factor (a)						1.541e-4
	INDOOR AIR RESU	ILTS FOR GROUP	ND WATER 8	SAMPLE DAT	ГА				
	Low Predictions		Best Estimate			High Pre	ediction2		
Indoor Air Concentration	3.939e-6 [µg/m3]	3.313e-7 [ppbv]4.510e-6 [µg/n	n3) 3.794e-7	[ppbv]	1.227e-	5 [µg/m³] 1.033e	-6 (ppbv)	
Cancer Risk	1.734e	-9	1.98	6e-9			5.405e-9		
Hazard Quotient	0.		0.				0.		
	<u> </u>								
1 "Low Prediction" cond	entration produced w	vith BEST ESTIMA	TE moisture	e content and	DEEPE	ST	depth to		
contamination.		LUCUSOT				ALE 07			
2 "High Prediction" con-	centration produced v	Mith MIGHESI	moistur	e content an	SHALL	OWEST	depth to		
contamination.									
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	Click For an Exam;	ole]					
Enter Site Name (optional):		Industrial Worker - phase II					
Enter sample concentration, units and media	уре	1.11e-1	µg/L	Ground Water			
What is the depth of the soil gas sample or ground water contamination)?(LT)	bund water table (for		7	meters			
This value can change by +/-			1	meters			
What is your contaminant of concern (COC)?		Dieldrin		•			
What type of building are you invostigating at yo	our site?			Slab on Grade			
What type of soil is beneath the building?				Loam			
What is the average soil/ground water temperat	ure?			55 Farenheit			
Chemical Properties							
CAS Number		60571					
Molecular Weight (MW)		380.91	[g/mole]				
Henry's Law Constant at ground			9 [unitless]				
Free-Air Diffusion Coefficient	(Da)	1.250e-2	[cm ² /s]				
Diffusivity in Water (Dw)		4.740e-6	[cm²/s]				
Unit Risk Factor (URF)		4.60e-3	[(µg/m³)-1]				
Reference Concentration (RfC	*)	1.75e-4	[mg/m ³]				
Soil Properties							
Total Porosity (n)		0.399	[unitioas]				
Unsaturated Zone Moisture Co	ontent Low 0.0610	Best Estimate	High 0.240	[unitiess]			
(0 w)		0.148					
Capillary Zone Moisture Conte	int at Air-Entry Pressure	0.332	[unitless]				
(8w,cap)		0.275	(ma)				
Height of Capillary Zone (CZh		0.375	[m]				
Soil-gas Flow Rate Into the Bu	isony (Cson)	5.00	(L/min)				
Building Properties		0.250	[hr-1]				
Air Exchange Rate (EB)		0.250 2.44	[tit]				
Building Mixing Height (HB)		∠. 44 100.0	[ff] [ft]				
Building Footprint Area (FB)	Ant						
Subsurface Foundation Area (ABJ	106.0	[m²]				

	Building Crack Ratio (η)	0.00038	[unitless]
	Building Foundation Slab Thickness (Lcrack)	0.100	[m]
Exposure Parameter	s		
	Exposure Duration for Carcinogens (EDc)	25	(years)
	Exposure Frequency for Carcinogens (EFc)	250	(days/year)
	Averaging Time for Carcinogens (ATc)	70	[years]
	Exposure Duration for Non-Carcinogens (EDnc)	25	[years]
	Exposure Frequency for Non-Carcinogens (EFnc)	250	[days/year]
	Averaging Time for Non-Carcinogens (ATnc)	25	[years]
	CALCULATE RESI	ULTS)	

Unsaturated Zone Effective Diffusion Coefficient (Derr) 0.001254 [cm²/s] Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001312 [cm²/s]

"A" Parameter "B" Parameter

Based on parameter analysis: Advection is the dominant mechanism across foundation. Diffusion through soil is the overall rate-limiting process for the subsurface to indoor-air pathway.

"C" Parameter 0.004918 Johnson & Ettinger Attenuation Factor (a)

	INDOOR A	INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA								
	Low Predic	ction!		Best Estim	ate		High Predi	ction2		
Indoor Air	1.219e-6	[µg/m³] 7.829e-8	(ppbv	1.397e-6	[µg/m3] 8.972e-8	(ppbv)	3.151e-6	[µg/m³]	2.024e-7	[ppbv]
Concentration					<u></u>					
Cancer Risk		1.372e-9			1.572e-9			3.545e-	9	
Hazard Quotient	4.771e-6		5.467e-6			1.233e-5				

1 "Low Prediction" concentration produced with BEST ESTIMATE

moisture content and DEEPEST

1.172e-4

1649.

depth to

2 "High Prediction" concentration produced with HIGHEST

moisture content and SHALLOWEST

depth to

contamination.

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		Click For an Exam	ple				
Enter Site Nan	ne (optional):		adu	ilt resident	- Phase II		
Enter sample of	Enter sample concentration, units and media type				μg/L	nd Water	
	What is the depth of the soil gas sample or ground water table (for			7 me			meters
•	contamination)?(LT)						
This value can	change by +/-				1		meters ·
What is your cor	ntaminant of concern (COC)?		Bena	zene			
What type of bui	lding are you investigating at your site?					Slab-on-Grad	de ·
What type of sol	is beneath the building?					Loam	
What is the aver	age soil/ground water temperature?					55	Farenheit
Chemical Properties							
	CAS Number			1432			
	Molecular Weight (MW)		7	8.11	[g/mole]		
	Henry's Law Constant at ground water to	emperature (H)	0	3,1316031	(unitless)		
	Free-Air Diffusion Coefficient (Da)		8	3.800e-2	[cm2/s]		
	Diffusivity in Water (Dw)		g).800e-6	[cm2/s]		
	Unit Risk Factor (URF)		7	'.80e-6	[(µg/m³)•1]		
	Reference Concentration (RfC)		0).	[mg/m³]		
Soll Properties							
	Total Porosity (n)		Ù	.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best E	sumate	High 0.240	(unities	is)
	(0 w)		0.148	3			
	Capillary Zone Moisture Content at Air-E	ntry Pressure	0	.332	[unitless]		
	(O w,cap)						
	Height of Capillary Zone (CZh)			.375	[m]		
	Soil-gas Flow Rate into the Building (Qs.	oll)	5	.00	(L/min)		
Building Properties							
	Air Exchange Rate (EB)			,250	[hr-1]		
	Building Mixing Height (HB)			.44	(m)		
	Building Footprint Area (FB)			0.00	[m²]		
	Subsurface Foundation Area (As)		1	0.00	[m ²]		

	Building Crack Rat	io (η)					0.	88000	[unitless]			
	Building Foundatio	n Slab Thickne	ss (Lcra	ack)			0.	100	[m]			
Exposure Parameter	rs											
	Exposure Duration	for Carcinogen	s (EDc))			30	}	[years]			
	Exposure Frequen	cy for Carcinog	ans (EF	Fc)			35	50	(days/year	1		
	Averaging Time for	Carcinogens (ATc)				70	70 [years]				
	Exposure Duration	for Non-Cardin	ogens ((EDnc)			30)	[years]			
	Exposure Frequen	cy for Non-Card	nogen	s (EFnc)			36	5	[days/year	1		
	Averaging Time for	Non-Carcinoge	ens (AT	lnc)			30	1	[years]			
				CALCIII	LATE RE	STILLS						
RESULTS			ļ		W716 116	JOLIO						
ALGOLIG	Hosaterated Zone	Effective Diffest	on Can	office of ID a	·#)		0.0	005540	[cm2/s]			
		Unsaturated + Capillary Zone Effective Diffusion Co				יחד		001190	[cm2/s]			
	off)	Hillian & Allegan Location	V 1 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3		A3000111		0.0	001100	[GITH/3]			
	"A" Paramete	ır			1.0	648-4	Based	on pa	rameter a	nalysis;	Adve	ction is
	"B" Paramete	r			373	2 A			mechani			
	-	_							hrough so ocess for			
	"C" Paramete	Ţ			0.0	04918			pathway.	*****		
	Johnson	& Ettinger Att	<u>enuatio</u>	on Factor	<u>(α)</u>							1.041e-4
	INDOOR AIR RESI	JLTS FOR GR	DUND	WATER	ŞAM	PLE DAT	A					
	Low Prediction1		Ве	st Estimate	e			High Pre	diction2			
Indoor Air	0.01188 (µg/m³	0.003721 [p	obv) 0.i	02192	[µg/m3] 0	0.006866	[ppbv]	0.02538	[µg/m³]	0.007950	(vdqq)	
Concentration		1]			ĺ			" 1	
Cancer Risk	3,8086	ı-B			7.027e-8	3			8,136e	-8		
Hazard Quotient	0.				0.				0.			

moisture content and DEEPEST

depth to

2 "High Prediction" concentration produced with LOWEST

moisture content and SHALLOWEST

depth to

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Click Ear on Evannia

	Į.	Click For an Exam	ple			
Enter Site Name (option	nei):		adult residen	t - Phase II		
Enter sample concentra	ition, units and media type		.316	μg/L	Ground W	/ater
What is the depth of the ground water contamina	soil gas sample or ground water: ation)?(LT)	table (for		7	me	eters ·
This value can change I	by +/-			1	me	ters
What is your contaminant	of concern (COC)?		1,4-Dichlorob	enzene		
What type of building are	you investigating at your site?			;	Slab-on-Grade	
What type of soil is benea	ith the building?				Loam	
What is the average soll/o	round water temperature?				55	Farenheit
Chemical Properties						
CAS Nu			106467			
	ar Weight (MW)		147	(g/mole)		
Henry's	Law Constant at ground water ter	nperature (H)	0.0454356	iO (unitless)		
Free-Air	Diffusion Coefficient (Da)		6.900e-2	[cm ² /s]		
Diffusivi	ty in Water (Dw)		7.900 a -6	[cm ² /s]		
Unit Ris	k Factor (URF)		O.	[(µg/m³)-1]		
Referen	ce Concentration (RfC)		0.800	[mg/m³]		
Soil Properties						
Total Po	nosity (n)		0.399	[unliless]		
Unsatur	ated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	[unitless]	
(θw)			0.148			
Capillary	y Zone Moisture Content at Air-En	try Pressure	0.332	[unitless]		
(8 w,cap)						
Height o	f Capillary Zone (CZh)		0.375	[m]		
Soil-gas	Flow Rate into the Building (Qsoi	i)	5.00	(L/min)		
Building Properties						
Air Exch	lange Rate (EB)		0.250	[hr-1]		
Building	Mixing Height (HB)		2.44	(m)		
Building	Footprint Area (FB)		100.0	{m²]		
Subsurfa	ace Foundation Area (AB)		106.0	[m ²]		

	Building C	rack Ratio	(ŋ)					0.0	0038	[unitiess]			
	Building Fo	oundation	Slab Thic	kness (L	crack)			0.1	00	[m]			
Exposure Parameter	5												
	Exposure 8	Duration f	or Carcino	gens (El	Oc}			30		[years]			
	Exposure f	Frequenc	y for Carci	nogens (EFc)			35	0	[days/year]	l		
	Averaging	Time for	Carcinoge	ns (ATc)				70		[years]			
	Exposure (Duration f	or Non-Ca	rcinogen	s (EDnc)			30		[years]			
	Exposure l	requency	y for Non-(Carcinog	ens (EFnc)			36	5	[days/year]	i		
	Averaging	Time for I	Non-Carci	nogens (,	ATnc)			30		[years]			
				ſ	CALC	ULATE	RESULTS						
RESULTS				***	*****		.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,						
	Unsaturate	d Zone E	lfactive Di	ffusion.C	oefficient (Daff)		0.0	04345	[cm ² /s]			
	Unsaturate	d.+.Gapil	lary Zone l	Effective	Diffusion (oefficie	ent (DY	0.0	01140	(cm²/\$)			
	off)												
	"A" P	'arameter					1.018e-4			rameter a: : mechani:			
	<u>"B" P</u>	arameter					476.1	Diffu	sion th	rough so	il is th	overa	ll rate-
	"C" P	arameter					0.004918			cess for cathway.	the sub	surface	to
		lohnson	& Ettinger	r Attenua	tion Fact	or (a)							9.977e-
	INDOOR A	IR RESU	LTS FOR	GROUN	D WATER	S	AMPLE DAT	ΓA					
	Low Predic	tion1			Best Estin	ate			Hìgh Pre	diction2			
Indoor Air Concentration	7.075e-4	[µg/m³]	1.1776-4	[ppbv]	0.001432	[µg/m	3 2.3840-4	(ppbv)	0.00171	9 [µg/m³]	2.860e-4	[vdqq]	
Cancer Risk	+	0.			77	0.				0.			
Hazard Quotient	†	8.843e-	7			1.79	le-6			2.148e-	-6		
1 "Low Prediction" con	centration pr	oduced w	ith HIGHE	ST	1	noisture	content and	DEEPE	ST	de	pih to		

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What do these results mean?

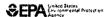
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		Click For an Exam	ple				
Enter Site Na	me (optional):		a	dult resident	- Phase II		
Enter sample	concentration, units and media type		2.91		μg/L	Grou	ınd Water
	epth of the soil gas sample or ground water	er table (for			7		meters
•	contamination)?(LT)						
This value car	n change by +/-				1		meters
What is your co	ntaminant of concern (COC)?		1,1	1-Dichloroetl	narte		
What type of bu	illding are you investigating at your site?					Slab-on-Gra	de ·
What type of so	Il is beneath the building?					Loam	
What is the ave	rage soil/ground water temperature?					55	Farenheit -
Chemical Properties							
	CAS Number			75343			
	Molecular Weight (MW)			98.96	[g/mole]		
	Henry's Law Constant at ground water to	emperature (H)		0.1399030	[unitless]		
	Free-Air Diffusion Coefficient (Da)			7.420e-2	(cm ² /s)		
	Diffusivity in Water (Dw)			1.050e-5	[cm²/s]		
	Unit Risk Factor (URF)			0.	[{µg/m³}-1]		
	Reference Concentration (RfC)			0.500	$[mg/m^3]$		
Soil Properties							
	Total Porosity (n)			0.300	[unitlace]		
	Unsaturated Zone Moisture Content	Low 0.0610	Bes	t Estimate	High 0.240	(unitle	ss]
	(0 w)		0.1	48			
	Capillary Zone Moisture Content at Air-E	intry Pressure		0.332	[unitless]		
	(Өм,сар)						
	Height of Capillary Zone (CZh)			0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qs	oil)		5,00	[L/min]		
Building Properties							
	Air Exchange Rate (Es)			0,250	[hr-1]		
	Building Mixing Height (HB)			2.44	[m]		
	Building Footprint Area (Fa)			100.0	[m²]		
	Subsurface Foundation Area (As)			106.0	[m²]		

	Building C	rack Rati	ο (η)					0.	00038	[unitless]			
	Building Fo	oundation	Slab Thick	cness (L	crack)			0.	100	[m]			
Exposure Parameters													
	Exposure l	Duration t	or Carcino	gens (El	De)			30)	[years]			
	Exposure I	requenc	y for Carcir	ogens (EFc)			35	60	[days/year	1		
	Averaging	Time for	Carcinoger	s (ATc)				70	70 [years]				
	Exposure i	Duration t	or Non-Ca	rcinoger	is (EDnc)			30	[years]				
	Exposure R	requenc	y for Non-C	Carcinog	ens (EFnc)			36	5 [days/year]				
	Averaging Time for Non-Carcinogens (ATnc)							30)	[years]			
	CALCULATE RESULTS												
RESULTS				ι			LUGEIU						
1000010	Unsalmale	d Zone B	Hective Dif	foslon C	oefficient (D	eff)		8.6	004671	[cm²/s]			
					Dilitusion Co		: (DT		301027	[cm2/s]			
	eff)						. 1-			•			
	•	arameter				9	.175e-5			rameter a			
	"81 P	arameter				4	42.9			t mechani hrough so			lation. all rate-
	"C" P	arameter				0	.004918	limit	ing pr	ocess for pathway.			
	لِ	ohnson	& Ettinger	Attenu	ation Factor	(a)			,				9.006e-5
	INDOOR A	R RESU	LTS FOR	GROUN	D WATER	SA	MPLE DAT	`A					
	Low Predic	tion1			Best Estima	te			High Pre	ediction2			
Indoor Air	0.01964	(ug/m3)	0.004857	(ppbv)	0.03667	(ua/m3)	0.009065	lopby	0.04263	luo/m3	0.01054	[ppbv]	
Concentration		r-4		., , ,		47-0-111	1	,, _F =-,]	11"0"	1	" (- ``]	
Cancer Risk		0.	***************************************			Q.			1	0.	•		
Hazard Quotient		3.929e	-5			7.333e	-5			8.525e	-5		

moisture content and DEEPEST

depth to

2 "High Prediction" concentration produced with LOWEST contamination.

moisture content and SHALLOWEST

depth to

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Phase II Data



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Click For so Evample

		Click For an Examp	***************************************	(-Jb II		
Enter Site Na	me (optional):		industnal V	orker - phase II		
Enter sample	concentration, units and media type		1.6	μg/L	Ground	Water ·
	opth of the soil gas sample or ground wate contamination)?(LT)	r table (for		7	r	meters ·
•	change by +/-			1	r	neters
What is your co	ntaminant of concern (COC)?		Benzene			
What type of bu	ilding are you investigating at your site?				Słab-on-Grade	
What type of so	il is beneath the building?				Loam	
What is the aye	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		71432 78.11	(a/mala)		
	Molecular Weight (MW)	emperature (III)	0.131603	[g/mole] If [unitless]		
	Herrry's Law Constant at ground water to	emberatore (ur)	8,800e-2			
	Free-Air Diffusion Coefficient (Da)			. ,		
	Diffusivity in Water (Dw)		9.800e-6 7.80e-6			
	Unit Risk Factor (URF)			[(µg/m3)-1]		
6 11 6	Reference Concentration (RfC)		0.	[mg/m ³]		
Soil Properties	Total Porosity (n)		0.399	[unitiess]		
	Unsaturated Zone Moisture Content	Low 0 0610	Best Estimate		[unitless]	
	(0 w)	FOM A GOLD	0.148	HIGH GUARG	[GENNUSS]	
	Capillary Zone Moisture Content at Air-E	ntry Pressure	0.332	[unitless]		
	(θw,cap)	and y a resource	0.002	[amaooo]		
	Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate into the Building (Qs	oil)	5.00	(L/min)		
Building Properties		,		•		
aumming respectives	Air Exchange Rate (EB)		0.250	(hr-1)		
	Building Mixing Height (HB)		2.44	[m]		
	Building Footprint Area (Fa)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m²]		
	, ,			- •		

	Building Crack Ratio (ŋ)			0.00038	(unitless)			
	Building Foundation Slab Thi	ckness (Lorack)		0.100	[m]			
Exposure Paramete	rs							
·	Exposure Duration for Carcin	ogens (EDc)		25	(years)			
	Exposure Frequency for Care	dnogens (EFc)		250	[days/year]			
	Averaging Time for Carcinog	ens (ATc)		70	[years]			
	Exposure Duration for Non-C	arcinogens (ED _{RC})		25	(years)			
	Exposure Frequency for Non	-Carcinogens (EFnc)		250	[days/year]			
	Averaging Time for Non-Care	inogens (ATnc)		25	(years)			
		CALCUL	ATE RESULTS					
prem re		(CALCOD	OTTOGRAPH TEN					
RESULTS	Unsaturated Zone Effective C	Siffusion Coefficient (D. #	3	0.005540	(cm2/s)			
		•	•					
	Unsaturated + Capillary Zone	Effective Diffusion Coe	ilidetit (Di	0.001190	[cm ² /s]			
	eff)							
	"A" Parameter		1.064e-4	Based on pa	rameter ana t mechanism			
	"B" Parameter		373.4	Diffusion t				
	"C" Parameter		0.004918	limiting pr indoor-air	ocess for t pathway.	he subs	urface	to:
	Johnson & Ettinge	or Attenuation Factor (1)					1.041e-4
	INDOOR AIR RESULTS FOR	GROUND WATER	SAMPLE DAT	-A			\neg	
	Low Prediction1	Best Estimate		· · · · · · · · · · · · · · · · · · ·	ediction2			
)					•	002050	, ·	
Indoor Air	0.01188 [µg/m³] 0.00372	[ppbv] 0.02192 [j	ig/m3 0.006866	[ppbv] 0.0253	3 [µg/m3] 0.	00/950	[ppbv]	
Concentration	1	1	1	1			- 1	

2.267e-8

moisture content and DEEPEST

4.183e-8

0.

depth to

4.843e-8

0.

2 "High Prediction" concentration produced with LOWEST

moisture content and SHALLOWEST

depth to

contamination.

CLEAR ALL

Cancer Risk

Hazard Quotient

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http://www.epa.gov/athens/leam2model/part-two/onsite/JnE_lite_forward.html



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Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

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Click For an Example

Enter Site Nan	ne (optional):	Click For an Examp		lorker - phase II		
Enter sample	concentration, units and media type		.316	μg/L ·	Ground W	/ater
	pth of the soil gas sample or ground water contamination)?(LT)	table (for		7	me	eters ·
•	change by +/-			1	me	eters
What is your cor	ntaminant of concern (COC)?		1,4-Dichlorol	benzene		
What type of but	Iding are you investigating at your site?			;	Slab-on-Grade	:
What type of soi	l is beneath the building?				Loam	
What is the aver	age soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		106467			
	Molecular Weight (MW)		147	[g/mole]		
	Henry's Law Constant at ground water to	mporoture (H)		600 (unitless)		
	Free-Air Diffusion Coefficient (Da)		6.900e-2			
	Diffusivity in Water (Dw)		7.900e-6			
	Unit Risk Factor (URF)		O.	[(µg/m³)-1]		
	Reference Concentration (RfC)		0.800	[mg/m³]		
Soil Properties						
	Total Porosity (n)		0.399	(unitless)		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	[unitless]	
	(0 w)		0.148			
	Capillary Zone Moisture Content at Air-E	ntry Pressure	0.332	[unitless]		
	(θw,cap)		0.076	[mu]		
	Height of Capillary Zone (CZh)	1	0.375	[m]		
B. M. O B	Soil-gas Flow Rate Into the Building (Qso	ii)	5.00	(L/min)		
Building Properties	Air Sychongo Poto (Ep)		0.050	[hed]		
	Air Exchange Rate (EB)		0.250	[hr-1]		
	Building Mixing Height (Hs)		2.44	[m]		
	Building Footprint Area (FB)		100.0	(m²)		
	Subsurface Foundation Area (AB)		106.0	[m²]		

	Building Crack Ratio (ŋ)			0.00038	[unitless]	
	Building Foundation Stab Thickness (La	crack)		0.100	[m]	
Exposure Paramete	rs					
•	Exposure Duration for Carcinogens (EL)s)		25	(years)	
	Exposure Frequency for Carcinogens (I	Efc)		250	[days/year]	
	Averaging Time for Carcinogens (ATc)			70	[years]	
	Exposure Duration for Non-Carcinogen	s (EDnc)		25	[years]	
	Exposure Frequency for Non-Carcinoge	ens (EFnc)		250	(days/year)	
	Averaging Time for Non-Carcinogens (A	ATnc)		25	(years)	
	Γ	CALCULATI	E RESULTS			
RESULTS	***************************************					
	Unsaturated Zone Effective Diffusion Co	oefficient (Deff)		0.004345	[cm ² /s]	
	Unsaturated + Capillary Zone Effective	Diffusion Coeffic	ient (DT	0.001140	[cm ² /s]	
	eff)					
	"A" Parameter				rameter analysis: Adve	
	"B" Parameter		476.1	Diffusion t	t mechanism across four hrough soil is the over	all rate-
	"C" Parameter			limiting pr indoor-air	ocess for the subsurface pathway.	e to
	Johnson & Ettinger Attenua	tion Factor (0)				9.977e-5
	NDOOR AIR RESULTS FOR GROUN	D WATER	SAMPLE DATA			1
	Low Prediction1	Best Estimate		High Pr	ediction2] ·
				~~~		7

	POUL LIGHT					***		(		
Indoor Air	7.075e-4		1.177e-4	(ppbv)	0.001432	[µg/m³] 2.384e-4	[ppbv]	0.001719	[µg/m³] 2.860e-4	(ppbv
Concentration										
Cancer Risk		0.				0.			0.	
Hazard Quotient		6.057e	-7			1.22 <del>6e</del> -6			1.471e-6	

^{1 &}quot;Low Prediction" concentration produced with HIGHEST

moisture content and DEEPEST

depth to

2 "High Prediction" concentration produced with LOWEST

moisture content and SHALLOWEST

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Enter Site Name (optional);			Click For an	Example				
What is the depth of the soil gas sample or ground water table (for ground water contamination)?(±T)         7         moters           This value can change by */-         1,1-Dichlorosthart         1         meters           What is your contaminant of concern (COC)?         1,1-Dichlorosthart         \$lab-on-Grade         -           What type of building are you investigating et your aito?         \$lab-on-Grade         -           What type of soil is beneath the building?         \$loon         Loon         -           What is the average soil/ground water temperature?         \$55         Farenheit           Chemical Properties           CAS Number         75343           Free-Air Diffusion Coefficient (MW)         98.96           g/mole]           Free-Air Diffusion Coefficient (Da)         7.420e-2           [moles]           Free-Air Diffusion Coefficient (Da)         7.420e-2           [moles]           Free-Air Diffusion Coefficient (Da)         1.050e-5           [moles]           Free-Air Diffusion Coefficient (Da)           Free-Air Diffusion Coefficient (Da)		Enter Site Nar	ne (optional):		Industrial Wo	rker - phase II		
### State		Enter sample	concentration, units and media type	2.91	l	μg/L	Ground V	/ater
This value can change by +/-         1         males           What is your contaminant of concern (COC)?         1,1-Dichloreethane           What type of building are you investigating at your aito?         Slab-on-Grade           What type of soil is beneath the building?         Loam           What is the average soil/ground water temperature?         55         Farenheit           Chemical Properties           CAS Number         7,5343         1,554         Farenheit           CAS Number         7,5343         1,550						7	me	eters
What is your conterminant of concern (COC)?         1,1-Dichloroethus         Slab-on-Grade         Common to specify the properties of building are you investigating at your sito?         I.oam         Slab-on-Grade         Slab-on-Grade         I.oam           What type of soil is beneath the building?         I.oam         55         Farenheit           Chemical Properties         CAS Number         75343         55         Farenheit           Chemical Properties         CAS Number         75343         [g/mole]		•						
What type of building are you investigating at your site?         Slab-on-Grade           What type of soil is beneath the building?         Loam           What is the average soil/ground water temperature?         550         Farenheit           Chemical Properties         CAS Number         75343         [gmole]         Farenheit           CAS Number         75343         [gmole]		This value can	change by +/-			3	me	iters ·
What type of soil is beneath the building?         Loam           What is the average soil/ground water temperature?         55         Farenheit           Chemical Properties         CAS Number         75343           G/mole)		What is your con	ntaminant of concern (COC)?		1,1-Dichloroeth	nane		:
Mail is the average soli/ground water temperature2   55   Farenheit		What type of bu	ilding are you investigating at your site?				Siab-on-Grade	
Chemical Properties		What type of so	il is beneath the building?				Loam	
CAS Number		What is the aver	rage spil/ground water temperature?				55	Farenheit -
Molecular Weight (MW)   98.96   [g/mole]   Henry's Law Constant at ground water temperature (H)   0.13980.30   [unitless]   Free-Air Diffusion Coefficient (Da)   7.420e-2   [cm²/s]   [cm²/s]   Unit Risk Factor (URF)   0.   [(µg/m³)-1)   Reference Concentration (RfC)   0.500   [mg/m³]   Unitless]	Çher	nical Properties						
Henry's Law Constant at ground water temperature (H)			•					
Free-Air Diffusion Coefficient (Da)   7.420e-2   cm²/s								
Diffusivity in Water (Dw)					0 1399030	[unitless]		
Unit Risk Factor (URF)   0.0   ((µg/n/3)-1)     Reference Concentration (RfC)   0.500   (mg/m³)     Soli Properties			Free-Air Diffusion Coefficient (Da)		7.420e-2	[cm²/s]		
Reference Concentration (RfC)   0.500   [mg/m³]			Diffusivity in Water (Dw)		1.050e-5	[cm ² /s]		
Tutal Purusity (n)   0.399   [unitless]     Unsaturated Zone Moisture Content   1.0w 0.0610   8est Estimate   High 0.240   [unitless]     (θw)   0.148   (θw,cap)   Height of Capillary Zone Moisture Content at Air-Entry Pressure   0.332   [unitless]     (θw,cap)   Height of Capillary Zone (CZh)   0.375   [m]     Soil-gas Flow Rate Into the Building (Qsoil)   5.00   [L/min]     Building Properties   Air Exchange Rate (EB)   0.250   [hr-1]     Building Mixing Height (HB)   2.44   [m]     Building Footprint Area (FB)   100.0   [m²]			Unit Risk Factor (URF)		0.	[(µg/m³)-1)		
Tutal Purusity (n)   0.399   [unitless]     Unsaturated Zone Moisture Content   1.0w 0.0610   Best Estimate   High 0.240   [unitless]     (θw)   0.148       Capillary Zone Moisture Content at Air-Entry Pressure   0.332   [unitless]     (θw,cap)   Height of Capillary Zone (CZh)   0.375   [m]     Soil-gas Flow Rate Into the Building (Qsoil)   5.00   [L/min]     Building Properties     0.250   [hr-1]     Building Mixing Height (HB)   2.44   [m]     Building Footprint Area (FB)   100.0   [m²]			Reference Concentration (RfC)		0.500	[mg/m³]		
Unsaturated Zone Moisture Content Low 0.0610   Best Estimate   High 0.240   [unitless]	Soli	Properties						
(6w) 0.148 Capillary Zone Moisture Content at Air-Entry Pressure 0.332 [unitless] (6w,cap) Height of Capillary Zone (CZh) 0.375 [m] Soit-gas Flow Rate Into the Building (Qsoil) 5.00 [L/min]  Building Properties Air Exchange Rate (EB) 0.250 [hr-1] Suitding Mixing Height (HB) 2.44 [m] Building Footprint Area (FB) 100.0 [m²]			Total Porosity (n)		0.399	[unilless]		
Capillary Zone Moisture Content at Air-Entry Pressure			Unsaturated Zone Moisture Content Low 0.0616	8	est Estimate	High 0.240	[unitless]	
(6w,cap)   Height of Capillary Zone (CZh)   0.375   [m]   Soit-gas Flow Rate Into the Building (Qsoil)   5.00   [L/min]   Building Properties   Air Exchange Rate (EB)   0.250   [hr-1]   Building Mixing Height (HB)   2.44   [m]   Building Footprint Area (FB)   100.0   [m²]			( <del>0</del> w)	(	0.148			
Height of Capillary Zone (CZh) 0.375 [m] Soli-gas Flow Rate Into the Building (Qsoll) 5.00 [L/min]  Building Properties Air Exchange Rate (EB) 0.250 [hr-1] Suilding Mixing Height (HB) 2.44 [m] Building Footprint Area (FB) 100.0 [m²]			Capillary Zone Moisture Content at Air-Entry Pressure		0.332	[unitless]		
Soil-gas Flow Rate Into the Building (Qsoil) 5.00 [L/min]  Building Properties  Air Exchange Rate (EB) 0.250 [hr-1]  Building Mixing Height (HB) 2.44 [m]  Building Footprint Area (FB) 100.0 [m²]								
Building Properties       Air Exchange Rate (EB)       0.250 [hr-1]         Building Mixing Height (HB)       2.44 [m]         Building Footprint Area (FB)       100.0 [m²]			*		0.375	[m]		
Air Exchange Rate (EB) 0.250 [hr·1] Suilding Mixing Height (HB) 2.44 [m] Building Footprint Area (FB) 100.0 [m²]			Soil-gas Flow Rate Into the Building (Qsoll)		5.00	[L/min]		
Suilding Mixing Height (HB) 2.44 [m] Building Footprint Area (FB) 100.0 [m²]	Bullo	ilng Properties						
Building Footprint Area (FB) 100.0 [m²]			• , ,			[hr-1]		
- ,			Suliding Mixing Height (HB)		2.44	[m]		
Subsurface Foundation Area (AB) 106.0 [m²]			Building Footprint Area (FB)		100.0	[m ² ]		
			Subsurface Foundation Area (AB)		106,0	[m ² ]		

	Building Crack Ratio (n)			0.00038	[unitless]	
	Building Foundation Slab Thickness (L	.crack)		0.100	[m]	
Exposure Parameter	8					
	Exposure Duration for Carcinogens (E	Đc)		25	[years]	
	Exposure Frequency for Carcinogens	(EFc)		250	[days/year]	
	Averaging Time for Carcinogens (ATc)	1		70	[years]	
	Exposure Duration for Non-Carcinoger	ns (EDne)		25	[years]	
	Exposure Frequency for Non-Carcinog	iens (EFnc)		250	[days/year]	
	Averaging Time for Non-Carcinogens (	(AYnc)		25	[years]	
	ľ	CALCULA1	E RESULTS			
RESULTS	~					
	Unsaturated Zone Effective Diffusion C	Coefficient (Deff)		0.004671	[cm ² /s]	
	Unsaturated + Capillary Zone Effective	0.001027	[cm ² /s]			
	eff)					
	"A" Parameter		9.175e-5		rameter analysis: Advec	
	"B" Parameter		442.9	Diffusion t	t mechanism across found hrough soil is the overs	all rate-
	*C* Parameter		0.004918	limiting pr indoor-air	ocess for the subsurface pathway.	e to
	Johnson & Ettinger Attenu	ation Factor (a)				9.006e-5
	INDOOR AIR RESULTS FOR GROUN	D WATER	SAMPLE DATA	4		
	Low Prediction1	Best Estimate		High Pr	ediction2	

	Low Predic	ction1		Best Estim	nate		High Predi	ction2	
Indoor Air	0.01964	[µg/m³] 0.00485	[ppbv	0.03667	[µg/m3] 0.009065	(ppbv)	0.04263	[µg/m³] 0.01054	[ppbv
Concentration							ļ		
Cancer Risk		0.			0.			0.	
Hazard Quotient		2.691e-5			5.023e-5			5.839e-5	

^{1 &}quot;Low Prediction" concentration produced with HIGHEST

moisture content and DEEPEST

depth to

2 "High Prediction" concentration produced with LOWEST

moisture content and SHALLOWEST

depth to

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Click For an Example

Enter Site Na	ime (optional):	CHCK PUI AN EXAM	MACANITA MACANITA	rker - Phase II				
Enter sample	concentration, units and media type		83.5	μ <b>g/</b> L.	Ground V	Vater ·		
	epth of the soit gas sample or ground water contamination)?(LT)	table (for		7	m	eters ·		
This value ca	n change by +/-			1	m	eters ·		
What is your co	entaminant of concern (COC)?		cis-1,2-Dichloroethylene					
What type of b	allding are you investigating at your site?				Slab-on-Grade			
What type of so	oll is beneath the building?				Loam			
What is the ave	orage soil/ground water temperature?				55	Farenheit		
Chemical Properties								
	CAS Number		156592					
	Molecular Weight (MW)		96,94	[g/mole]				
	Henry's Law Constant at ground water ter	nperature (H)		1 (unitless)				
	Free-Air Diffusion Coefficient (Da)		7.360e-2	[cm ² /s]				
	Diffusivity in Water (Dw)		1.130a-5	[cm ² /s]				
	Unit Risk Factor (URF)		0.	{(µg/m³)-1}				
	Reference Concentration (RfC)		3,50e-2	[mg/m³]				
Soil Properties								
	I otal Porosity (n)		0.399	[unitless]				
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0,240	(unitless)			
	( <del>0</del> w)	I D	0.148					
	Capillary Zone Moisture Content at Air-En (6w,cap)	try Pressure	0.332	[unitless]				
	Height of Capillary Zone (CZh)		0.375	(m)				
	Soil-gas Flow Rate Into the Building (Qsoi	ī)	5.00	[Umin]				
<b>Building Properties</b>								
	Air Exchange Rate (Es)		0.250	{hr-1}				
	Building Mixing Height (HB)		2.44	(m)				
	Building Footprint Area (Fs)		100.0	[m²]				
	Subsurface Foundation Area (AB)		106.0	[m²]				

	Building Crack Ratio (η)					0.0	10038	[unitiess]			
	Building Foundation Slab Thi	ckness (L	creck)			0.	100	[m]			
Exposure Parameters	5										
	Exposure Duration for Carcin	ogens (Ei	Oc)			25		[years]			
	Exposure Frequency for Card	inogens (	EFc)			25	0	[days/year	1		
	Averaging Time for Carcinog	ens (ATc)				70		[years]			
	Exposure Duration for Non-C	arcinogen	s (EDnc)			25		[years]			
	Exposure Frequency for Non-	Carcinog	ens (EFnc)			25	0	(days/year	1		
	Averaging Time for Non-Card	inogens (	ATne)			25		(years)			
	• •	CALCULATE RESULTS						•			
		L,	CALCUL	AICK	ESULIS						
RESULTS		aturated Zone Effective Diffusion Coefficient (Derr)						f 0 ()			
				•			04634	[cm ² /s]			
	Unsaturated + Capillary Zone	j:flective	Official Coe	ificient	(DT	0.001090 [cm ² /s]					
	eff)										
	"A" Parameter			9.	743e-5	Based on parameter analysis: Advection in the dominant mechanism across foundation.					
	"8" Parameter			44	16.4	Diffusion through soil is the overall rate-					
	"C" Parameter			0.	004918			ocess for pathway.	the sul	surface	to
	Johnson & Ettinge	r Attenua	tion Factor (	α)							9.553e-5
	INDOOR AIR RESULTS FOR	GROUN	D WATER	SAM	VIPLE DAT	'A					
	Low Prediction1		Best Estimate	,			High Pro	ediction2			
indoor Air	0.4124 [µg/m ³ ] 0.1041	[ppbv]	0.7936	µg/m³]	0.2003	(ppbv)	0.9331	{µg/m³]	0.2355	[ppbv]	
Concentration	, ,								[		
Cancer Risk	0.		(	).				0.			
Hazard Quotient	0.008071		(	0.01553	3			0.0182	6		

moisture content and DEEPEST

depth to

contamination.

² "High Prediction" concentration produced with LOWEST contamination.

moisture content and SHALLOWEST

depth to

CLEAR ALL

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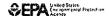
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2.572 4,,,010.1000 410 .	Annual (1990)	Click For an Examp	ile ]			
Enter Site Nan	ne (optional);		Industrial Wor	rker - phase If		
Enter sample (	concentration, units and media type		.377	µg/L	· Ground W	/ater
ground water o	pth of the soil gas sample or ground water tal contamination)?(LT)	ble (for		7	me	eters ·
This value can	change by +/-			1	me	eters
What is your cor	ntaminant of concern (COC)?		Ethylbenzene			e.
What type of bu	liding are you investigating at your site?		i.		Słab-on-Grade	
What type of so	l is beneath the building?				Loam	, ·
What is the aver	age soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		100414			
	Molecular Weight (MW)		106.17	(g/mole)		
	Henry's Law Constant at ground water temp	perature (H)	0.1613978	[unitless]		
	Free-Air Diffusion Coefficient (Da)		7.500e-2	[cm ² /s]		
	Diffusivity in Water (Dw)		7.800e-6	[cm ² /s]		
	Unit Risk Factor (URF)		1.10e-6	[(µg/m³)-1]		
	Reference Concentration (RfC)		1.00	[mg/m ³ ]		
Soil Properties						•
	Total Porosity (n)		0.399	(unitless)		
	Unsaturated Zone Moisture Content (6w)	Low 0.0610	Best Estimate 0,148	High 0.240	[unitiess]	
	Capitlary Zone Moisture Content at Air-Entry	/ Pressure	0.332	[unitless]		
	(Ow,cap)					
	Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate (nto the Building (Qsoil)		5.00	[L/min]		
<b>Building Properties</b>						
- •	Air Exchange Rate (Es)		0,250	[hr-1]		
	Building Mixing Height (Hs)		2.44	[m]		
	Building Footprint Area (FB)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m²]		

	Building Crack Ratio (n)	0.00038	[unitiess]
	Building Foundation Slab Thickness (Lerack)	0.100	(m)
Exposure Parameter	rs		
	Exposure Duration for Carcinogens (EDs)	25	[years]
	Exposure Frequency for Carcinogens (EFc)	250	[days/year]
	Averaging Time for Carcinogens (ATa)	70	[years]
	Exposure Duration for Non-Carcinogens (EDnc)	25	[years]
	Exposure Frequency for Non-Carcinogens (EFnc)	250	[days/year]
	Averaging Time for Non-Carcinogens (ATnc)	25	[years]
	CALCULATE RESU	LTS	

RESULTS

Unsaturated Zone Effective Diffusion Coefficient (Deff) 0.004721 [cm²/s] Unsaturated + Capillary Zone Effective Diffusion Coefficient (D7 0.0009855 (cm²/s)

"A" Parameter "B" Parameter "C" Parameter 8.807e-5 438.2

Based on parameter analysis: Advection is the dominant mechanism across foundation. Diffusion through soil is the overall rate-limiting process for the subsurface to indoor-air pathway.

Johnson & Ettinger Attenuation Factor (q)

	INDOOR A	IR RESU	LTS FOR	GROUN	D WATER	SAMPLE DAT	Α				
	Low Predic	tion1			Best Estim	ate		High Predi	ction2		
indoor Air	0.002885	[µg/m³]	6.647e-4	vdqq]	0.005265	[µg/m³] 0.001213	[ppbv]	0.006071	(µg/m³)	0.001399	(ppbv
Concentration						<u></u>					
Cancer Risk		7.762e	-10			1.417e-9			1.634e	-9	
Hazard Quotient		1.976e	-6			3.606e-6			4.158e	-6	

1 "Low Prediction" concentration produced with HIGHEST

moisture content and DEEPEST

depth to

² "High Prediction" concentration produced with LOWEST contamination.

moisture content and SHALLOWEST

depth to

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## **EPA On-line Tools for Site Assessment Calculation**

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# Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

# Forward Calculation of Indoor Air Concentration

Backward Calcolation full uncertainty analysis

Background

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	0	Click For an Exampl	e			
Enter Site Na	me (optional):		Industrial W	orker - phase II		
Enter sample	concentration, units and media type		7	µg/L	· Ground \	Vater ·
	epth of the soil gas sample or ground water	table (for		7	m	eters -
•	contamination)?(LT)					
This value ca	n change by +/-			1	m	eters
What is your co	ntaminant of concern (COC)?		Naphthalene			•
What type of bu	uilding are you investigating at your site?				Slab-on-Grade	4.
What type of so	it is beneath the building?				Loam	
What is the ave	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		91203			
	Molecular Weight (MW)		128.18	(g/mole)		
	Henry's Law Constant at ground water ten	nperature (H)	0.008106	28 (unitless)		
	Free-Air Diffusion Coefficient (Da)		5.900e-2	[cm ² /s]		
	Diffusivity in Water (Dw)		7,500e-6	[cm ² /s]		
	Unit Risk Factor (URF)		0.	{(µg/m³)-1}		
	Reference Concentration (RfC)		3.00e-3	[mg/m³]		
Soil Properties						
	Total Porosity (n)		0.309	(unitioes)		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	[unitiess]	
	(8w)		0.148			
	Capillary Zone Moisture Content at Air-En	try Pressure	0.332	(unitless)		
	(θw,cap)					
	Height of Capillary Zone (CZn)		0.375	[m]		
	Soil-gas Flow Rate into the Building (Qsoil	i)	5.00	[Umin]		
Building Properties						
	Air Exchange Rate (EB)		0.250	[hr-1]		
	Building Mixing Height (Ha)		2.44	[m]		
	Building Footprint Area (FB)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m ² ]		

	Building Crack Ratio (n)		0.00038	[unitless]	
	Building Foundation Slab Thickness (Lcrack)		0.100	[m]	
Exposure Parameter	rs				
	Exposure Duration for Carcinogens (EDs)		25	[years]	
	Exposure Frequency for Carcinogens (EFc)		250	[days/year]	
	Averaging Time for Carcinogens (ATc)		70	[years]	
	Exposure Duration for Non-Carcinogens (EDnc)		25	(years)	
	Exposure Frequency for Non-Carcinogens (EFnc)		250	[days/year]	
	Averaging Time for Non-Carcinogens (ATnc)		25	[years]	
	CALCULAT	E RESULTS			
RESULTS	***************************************	***************************************			
	Unsaturated Zone Effective Diffusion Coefficient (Deff)		0.003724	[cm ² /s]	
	Unsaturated + Capitlary Zone Effective Diffusion Coeffice	ient (DT	0.001883	[cm ² /s]	
	eff)				
	"A" Parameter	1.683e-4		rameter analysis: Adve	
	<u>"B" Parameter</u>	555.6	Diffusion t	hrough soil is the over	all rate-
	"C" Parameter	0.004918	limiting pr indoor-air	ocess for the subsurfac pathway.	e to
	Johnson & Ettinger Attenuation Factor (a)			-	1,627e-4
	INDOOR AIR RESULTS FOR GROUND WATER	SAMPLE DAT	Ά		]

	Low Predic	ction1		Best Estim	ale		High Predi	ction2	
Indoor Air	0,003254	[µg/m3] 6.211e-4	vdqq]	0.009234	[µg/m³] 0.001762	[ppbv]	0.01351	[µg/m³] 0.002579	(ppb)
Concentration		Ī							
Cancer Risk		0.			0.			0.	
Hazard Quotient	1	7.429e-4			0.002108			0.003084	

moisture content and DEEPEST

depth to

contamination. 2 "High Prediction" concentration produced with LOWEST

moisture content and SHALLOWEST

depth to

CLEAR ALL

contamination.

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### **EPA On-line Tools for Site Assessment Calculation**

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# Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

Background

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		Click For an Exam	ole			
Enter Sile Na	ne (optional):		Industrial We	orker - phase II		
Enter sample	concentration, units and media type		161	µg/L	Ground V	Vater ·
	ppth of the soil gas sample or ground water contamination)?(LT)	table (for		7	m	eters ·
This value car	change by +/-			1	m	eters
What is your co	staminant of concern (COC)?		Tetrachloroet	hylene		٠.
What type of bu	ilding are you investigating at your site?	-			Slab-on-Grade	
What type of so	Il is beneath the building?				Loam	
What is the ave	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		127184			
	Molecular Weight (MW)		165.83	[g/mole]		
	Henry's Law Constant at ground water to	emperature (H)		7 [unitless]		
	Free-Air Diffusion Coefficient (Da)		7.200e-2	[cm²/s]		
	Diffusivity in Water (Dw)		8.200e-6	[cm²/s]		
	Unit Risk Factor (URF)		3,00e-G	[(µg/m³)-1]		
	Reference Concentration (RfC)		0.	[mg/m³]		
Soil Properties						
	Total Porosily (n)		0.399	(unitless)		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	[unitless]	
	( <del>0</del> w)	_	0.148			
	Capillary Zone Moisture Content at Air-E (#w,cap)	ntry Pressure	0.332	(unitless)		
	Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qso	oit)	5.00	[L/min]		
<b>Bullding Properties</b>						
	Air Exchange Rate (Es)		0.250	{hr-1}		
	Building Mixing Height (Hs)		2.44	[m]		
	Building Footprint Area (FB)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m²]		

	Building Crack F	atio (ŋ)					0,0	00038	[unitless]			
	Building Founda	tion Slab Thi	ckness (Lo	crack)			0.1	00	[m]			
Exposure Parameter	s											
•	Exposure Durati	on for Carcin	ogens (EE	)c)			25		(years)			
	Exposure Frequ	ency for Caro	inogens (I	EFc)			25	0	(days/year	1		
	Averaging Time	for Carcinog	ens (ATc)				70		[years]			
	Exposure Duration	on for Non-C	arcinogen	s (EDnc)			25		[years]			
	Exposure Freque	ncy for Non-	Carcinoge	ens (EFn	c)		25	0	{days/year	]		
	Averaging Time	for Non-Card	inogens (A	ATnc)			25		[years]			
			ſ	CAL	CULATE	RESULTS						
RESULTS			ι		***************************************							
	Unsaturated Zon	saturated Zone Effective Diffusion Coefficient (Deff)						04532	[cm ² /s]			
	Unsaturated + C	apillary Zone	Effective	Diffusion	Coefficie	ot (DT	0.0	008963	[cm2/s]			
	eff)											
	"A" Parame	eter				8.010e-5	Based on parameter analysis: Advect the dominant mechanism across founds					
	<u>"8" Parame</u>	eter				456.5	the dominant mechanism across foundation. Diffusion through soil is the overall rate					
	"C" Parame	eter				0.004918			ocess for pathway.	the sul	surface	to
	Johns	on & Ettinge	r Attenua	tion Fac	<u>tor (</u> a)							7.882e-5
	NDOOR AIR RE	SULTS FOR	GROUN	O WATE	R S	AMPLE DA	TA					
	Low Prediction1	**		Best Esti	mate			High Pr	ediction2			
Indoor Air Concentration	2.799 [µg/i	m3] 0.4129	(vdqq)	4.994	{µg/m	3) 0.7367	(vdqq]	5.714	[h8\w ₃ ]	0.8430	[ppbv]	
Cancer Risk	2.05	2.054e-6 3.665e-6							4.193e	-6		
Hazard Quotient	0.				0.				0.			

moisture content and DEEPEST

depth to

contamination. 2 "High Prediction" concentration produced with LOWEST

moisture content and SHALLOWEST

depth to

contamination.

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#### **EPA On-line Tools for Site Assessment Calculation**

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# Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

# Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

Background

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	{	Click For an Exam	ple			
Enter Site Na	me (optional):		Industrial Wo	orker - phase II		
Enter sample	concentration, units and media type		33.7	μg/L	Ground V	Vater -
	apth of the soil gas sample or ground water l contamination)?(!T)	table (for		7	m	eters ·
This value car	n change by +/-			1	m	elers
What is your co	ntaminant of concern (COC)?		1,2,4-Trichtoro	pbenzene		
What type of bu	ilding are you investigating at your site?				Siab-on-Grade	
What type of so	il is beneath the building?				Loam	•
What is the ave	rage soii/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		120821			
	Molecular Weight (MW)		181.45	(g/mole)		
	Henry's Law Constant at ground water ten	nperature (H)	0.0232978	19 (unitless)		
	Free-Air Diffusion Coefficient (Da)		3.000e-2	[cm2/s]		
	Diffusivity in Water (Dw)		8.230e-6	[cm ² /s]		
	Unit Risk Factor (URF)		0.	[(µg/m³)·1}		
	Reference Concentration (RfC)		0.200	[mg/m³]		
Soil Properties						
	Total Porosity (n)		0,399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	[unitless]	
	( <del>0</del> w)		0.148			
	Capillary Zone Moisture Content at Air-En (θw,cap)	try Pressure	0.332	(unitiess)		
	Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoil	)	5.00	[L/min]		
<b>Building Properties</b>						
	Air Exchange Rate (Es)		0.250	{hr-1}		
	Building Mixing Height (HB)		2.44	(m)		
	Building Footprint Area (Fs)		100.0	[m²]		
	Subsurface Foundation Area (As)		106.0	[m²]		

	Building Crack Ratio	o (n)				0.	00038	[unitless]			
	Building Foundation	Slab Thickness	(Lcrack)			0.	100	[m]			
Exposure Parameter	· · · · · · · · · · · · · · · · · · ·		•					•			
	Exposure Duration	for Carcinogens	EDc)			25	5	[years]			
	Exposure Frequenc	y for Carcinogen	s (EFc)			25	50	[days/year	1		
	Averaging Time for	Carcinogens (A)	c}			70	)	[years]			
	Exposure Duration	for Non-Carcinog	ens (EDac)			25	i	(years)			
	Exposure Frequenc	y for Non-Cardn	gens (EFnc)			25	0	(days/year	1		
	Averaging Time for	Non-Carcinogen	(ATnc)			25	i	(years)			
			CALC	ULATE F	RESULTS						
RESULTS											
11200210	Unsaturated Zone E	ffective Diffusion	Coefficient (	Deff}		0,0	001892	[cm ² /s]			
	Unsaturated + Capil	lary Zone Effecti	e Diffusion C	Coefficien	ı (DT	0.0	0008528	[cm2/s]			
	eff)				•		,	•			
	"A" Parameter			7	7.621e-5				nalysis:		
	"B" Parameter			1	093.				sm acros il is th		
	"C" Parameter			0	.004918		ing production		the sub	surface	to
•	Johnson	& Ettinger Atter	uation Facto	<u>or (</u> a)							7.505e-5
	INDOOR AIR RESU	LTS FOR GROU	ND WATER	SA	MPLE DAT	ſΑ					
	Low Prediction1		Best Estim	ate			High Pred	liction2			
Indoor Air Concentration	0.02185 [µg/m³]	0.002946  ppl	v) 0.05892	[µg/m³	0.007945	[ppbv]	0.08268	(µg/m³)	0.01115	[ppbv]	
Cancer Risk	0.			0.				0.			
Hazard Quotient	7.481e	-5		2.018e	1-4			2.832e	-4		

moisture content and DEEPEST

depth to

contamination.

2 "High Prediction" concentration produced with LOWEST

moisture content and SHALLOWEST

depth to

-----

contamination.

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What do these results mean?

Comments or suggestions

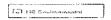
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	Click	For an Example				
Enter Site Nar	ne (optional):	24 25 14 4 2 4 14 4 4 4 4 5 4 4 4 4 4 4 4 4 4 4 4 4	Industrial Wor	ker - Phase II		
Enter sample	concentration, units and media type	159		h <del>0</del> /L	Ground W	ater ·
	pth of the soil gas sample or ground water table (for contamination)?(LT)			7	me	eters
This value can	change by +/-			1	me	ters
What is your co	ntaminant of concern (COC)?		Frichtoroethyle	ne		
What type of bu	ilding are you investigating at your site?			:	Slab-on-Grade	
What type of so	il is beneath the building?				Loam	
What is the aver	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		79016			
	Molecular Weight (MW)		131.39	(g/mole)		
	Henry's I aw Constant at ground water temperature	₹ (H)	0.2367947			
	Free-Air Diffusion Coefficient (Da)		7.900 <del>e</del> -2	[cm²/s]		
	Diffusivity in Water (Dw)		9.100e-6	[cm²/s]		
	Unit Risk Factor (URF)		4.10e-6	{(µg/m³)-1}		
	Reference Concentration (RfC)		2e-03	[mg/m ³ ]		
Soil Properties						
	Total Porosity (n)		0.399	[unitless]		
	Unsaturated Zone Moisture Content Lov (6w)	•	st Estimate .148	High 0.240	[unitless]	
	Capillary Zone Moisture Content at Air-Entry Press		0.332	[unitless]		
	(θw,cap)			•		
	Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoil)		5.00	[L/min]		
<b>Building Properties</b>				•		
- ,	Air Exchange Rate (Es)		0.250	(hr-1)		
	Building Mixing Height (Ha)		2.44	{m]		
	Building Footprint Area (FB)		100.0	[m ² ]		
	Subsurface Foundation Area (AB)		106.0	[m ² ]		

"B" Parameter 418.0 biffusion through soil is the over indoor air pathway.  "C" Parameter 0.004918 indoor air pathway.  Johnson & Ettinger Attenuation Factor (a)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction Best Estimate the dominant mechanism across for biffusion through soil is the over indoor air pathway.  Limit of the dominant mechanism across for biffusion through soil is the over indoor air pathway.  Limit of the dominant mechanism across for biffusion through soil is the over indoor air pathway.  Limit of the dominant mechanism across for biffusion through soil is the over indoor air pathway.  Limit of the dominant mechanism across for biffusion through soil is the over indoor air pathway.  Limit of the subsurfusion for the subs	Building Foundation Stab Thickness (Lcrack)  Exposure Parameters  Exposure Duration for Carcinogens (EDa)  Exposure Frequency for Carcinogens (EEc)  Exposure Frequency for Carcinogens (EEc)  Exposure Duration for Non-Carcinogens (EDnc)  Exposure Frequency for Non-Carcinogens (EDnc)  Exposure Frequency for Non-Carcinogens (EDnc)  Exposure Frequency for Non-Carcinogens (EEnc)  Exposure Frequency for	Building Foundation Stab Thickness (Lerack)  Exposure Parameters  Exposure Puration for Carcinogens (EDc)  Exposure Frequency for Carcinogens (EFc)  Averaging Time for Carcinogens (EFc)  Exposure Duration for Non-Carcinogens (EDnc)  Exposure Frequency for Non-Carcinogens (EFnc)  Averaging Time for Non-Carcinogens (EFnc)  Averaging Time for Non-Carcinogens (EFnc)  CALCULATE RESULTS  SULTS  Unsaturated * Capillary Zone Effective Diffusion Coefficient (Darr)  Unsaturated * Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm²/s]  eff)  "A" Parameter  "B" Parameter  "C" Parameter  "C" Parameter  "C" Parameter  "On04918 limiting process for the subsurface indoor-air pathway.  Johnson & Ettinger Attenuation Factor (o)  NDDOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1  Best Estimate  Indoor Air  Low Prediction1  Best Estimate  Indoor Air  1.855 [µg/m³] 0.3454 [ppbv] 3.350 [µg/m³] 0.6238 [ppbv] 3.849 [µg/m³] 0.7168 [ppbv] Concentration  Cancer Risk  1.860e-6  3.360e-6  3.861e-6  Hazard Quotient  0.6352  1.147  1.318   CLEAR ALL  FORMAT REPORT FOR PRINTER												
Exposure Parameters  Exposure Duration for Carcinogens (EDc) 25 [years]  Exposure Frequency for Carcinogens (EFc) 250 [days/year]  Averaging Time for Carcinogens (ATc) 70 [years]  Exposure Duration for Non-Carcinogens (EDnc) 25 [years]  Exposure Frequency for Non-Carcinogens (EEnc) 250 [days/year]  Averaging Time for Non-Carcinogens (EFnc) 250 [days/year]  Averaging Time for Non-Carcinogens (ATnc) 25 [years]  CALCULATE RESULTS  RESULTS  Unsaturated Zone Effective Diffusion Coefficient (Deff) 0.004973 [cm2/s]  Unsaturated Zone Effective Diffusion Coefficient (DT 0.001014 [cm2/s]  eff) 9.0616-5 Based on parameter analysis: Act the dominant mechanism across for the dominant mechanism across for 11 [Best Parameter] 11 [B	Exposure Duration for Carcinogens (EDc) 25 [years] Exposure Frequency for Carcinogens (EFc) 250 [days/year] Averaging Time for Carcinogens (EDnc) 70 [years] Exposure Duration for Non-Carcinogens (EDnc) 25 [years] Exposure Frequency for Non-Carcinogens (EDnc) 25 [years] Exposure Frequency for Non-Carcinogens (EFnc) 250 [days/year] Averaging Time for Non-Carcinogens (ATnc) 25 [years]  CALCULATE RESULTS  SULTS  Uquaturated Zone Effective Officiation Coefficient (Detr) 0.004973 [cm2/s] Unsaturated + Capillary Zone Effective Officiation Coefficient (DT 0.001014 [cm2/s] eff)  "A" Parameter 9.061e-5 Based on parameter analysis: Adverted dominant mechanism across four by the dominant mechanism across four by the dominant mechanism across four by the dominant mechanism across four by Parameter 1.004918 indoor-air pathway.  Johnson & Ettinger Attenuation Factor (o)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1 Best Estimate High Prediction2  Indoor Air 1.855 [µg/m³] 0.3454 [ppbv] 3.350 [µg/m³] 0.6238 [ppbv] 3.849 [µg/m³] 0.7168 [ppbv] Concentration  Cancer Risk 1.860e-6 3.360e-6 3.861e-6  Hazard Quotient 0.6352 1.147 1.318  Low Prediction" concentration produced with HIGHEST moisture content and DEEPEST depth to tamination.  High Prediction" concentration produced with LOWEST moisture content and SHALLOWEST depth to	Exposure Parameters  Exposure Frequency for Carcinogens (EDa)  Exposure Frequency for Carcinogens (EFc)  Exposure Duration for Non-Carcinogens (EDa)  Exposure Prequency for Non-Carcinogens (EDa)  Exposure Prequency for Non-Carcinogens (EDa)  Exposure Frequency for Non-Carcinogens (EDa)  Exposure F		Bullding Cra	ck Ratio	(n)				0.	00038	[unitless]		
Exposure Duration for Carcinogens (EDc) 25 [years]  Exposure Frequency for Carcinogens (EFc) 250 [days/year]  Averaging Time for Carcinogens (ATc) 70 [years]  Exposure Duration for Non-Carcinogens (EDnc) 25 [years]  Exposure Frequency for Non-Carcinogens (EEnc) 250 [days/year]  Averaging Time for Non-Carcinogens (ATnc) 25 [years]  Averaging Time for Non-Carcinogens (ATnc) 25 [years]  CALCULATE RESULTS  ESSULTS  Unsaturated Zone Effective Officsion Coefficient (Deff) 0.004973 [cm²/s]  Unsaturated + Capillary Zone Effective Officsion Coefficient (DT 0.001014 [cm²/s] eff)  "A" Parameter 9.061e-5 Based on parameter analysis: Ad the dominant mechanism across for the dominant mechanism across for the dominant mechanism across for "B" Parameter 416.0 Diffusion through soil is the on limiting process for the subsurf indoor-air pathway.  Johnson & Ettinger Attenuation Factor (0)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1 Best Estimate High Prediction2  Indoor Air 1.855 [µg/m³] 0.3454 [ppbv] 3.350 [µg/m³] 0.6238 [ppbv] 3.849 [µg/m³] 0.7168 [ppc] 250 [ppc] 2	Exposure Duration for Carcinogens (EDc) 25 [years] Exposure Frequency for Carcinogens (EFc) 250 [days/year] Averaging Time for Carcinogens (ATc) 70 [years] Exposure Duration for Non-Carcinogens (EDnc) 25 [years] Exposure Frequency for Non-Carcinogens (EDnc) 25 [years] Exposure Frequency for Non-Carcinogens (EFnc) 250 [days/year] Averaging Time for Non-Carcinogens (ATnc) 25 [years]  CALCULATE RESULTS  SULTS  Unsaturated 2 One Effective Officiation Coefficient (Derr) 0.004973 [cm2/s] Unsaturated + Capillary Zone Effective Officiation Coefficient (DT 0.001014 [cm2/s] err)  "A" Parameter 9.061e-5 Based on parameter analysis: Adverted dominant mechanism across four the dominant mechanism across four Diffusion through soil is the over indoor-air pathway.  "O" Parameter 0.004918 indoor-air pathway.  Johnson & Ettinger Attenuation Factor (o)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1 Best Estimate High Prediction2  Indoor Air 1.855 [µg/m³] 0.3454 [ppbv] 3.350 [µg/m³] 0.6238 [ppbv] 3.849 [µg/m³] 0.7168 [ppbv] Concentration  Cancer Risk 1.860e-6 3.360e-6 3.861e-6  Hazard Quotient 0.6352 1.147 1.318  Low Prediction" concentration produced with HIGHEST moisture content and DEEPEST depth to Itamination.  High Prediction" concentration produced with LOWEST moisture content and SHALLOWEST depth to	Exposure Duration for Carcinogens (EPc) 25 (years) Exposure Frequency for Carcinogens (EFc) 70 (years) Exposure Frequency for Non-Carcinogens (EFc) 70 (years) Exposure Duration for Non-Carcinogens (EFnc) 25 (years) Exposure Frequency for Non-Carcinogens (EFnc) 25 (days/year) Averaging Time for Non-Carcinogens (EFnc) 25 (years)    CALCULATE RESULTS		Building Fou	undation S	Slab Thickness	(Lorack)			0.	100	[m]		
Exposure Frequency for Carcinogens (EFc) 250 (days/year) Averaging Time for Carcinogens (ATc) 70 (years) Exposure Duration for Non-Carcinogens (EDnc) 25 (years) Exposure Frequency for Non-Carcinogens (EFnc) 250 (days/year) Averaging Time for Non-Carcinogens (ATnc) 25 (years)  CALCULATE RESULTS    CALCULATE RESULTS	Exposure Frequency for Carcinogens (EFc) 250 [days/year] Averaging Time for Carcinogens (ATc) 70 [years] Exposure Duration for Non-Carcinogens (EFnc) 25 [years] Exposure Frequency for Non-Carcinogens (EFnc) 250 [days/year] Averaging Time for Non-Carcinogens (ATnc) 25 [years]  CALCULATE RESULTS  SULTS    CALCULATE RESULTS	Exposure Frequency for Carcinogens (EFc) 250 (days/year) Averaging Time for Carcinogens (ATc) 70 (years) Exposure Duration for Non-Carcinogens (EDne) 25 (years) Exposure Frequency for Non-Carcinogens (EFne) 250 (days/year) Averaging Time for Non-Carcinogens (EFne) 250 (days/year) Averaging Time for Non-Carcinogens (ATne) 25 (years)  CALCULATE RESULTS  SULTS  Unsaturated Zone Effective Diffusion Coefficient (Derr) 0.004973 [cm²/s] Unsaturated 2 one Effective Diffusion Coefficient (DT 0.001014 [cm²/s] etr)  "A" Parameter 9,081e-5 Based on parameter analysis: Advective Offusion Coefficient (DT 0.001014 [cm²/s] etr)  "A" Parameter 418.0 piffusion the charles across found the owner of the dominant mechanism across found provided indoor-air pathway.  Johnson & Ettinger Attenuation Factor_(o)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1 Best Estimate High Prediction2  Indoor Air 1.855 [ug/m3] 0.3454 [ppby] 3.350 [µg/m3] 0.6238 [ppbv] 3.849 [µg/m3] 0.7168 [ppby]  Concentration 1.855 [ug/m3] 0.3454 [ppby] 3.350 [µg/m3] 0.6238 [ppbv] 3.849 [µg/m3] 0.7168 [ppby]  Concentration 0.6352 1.1.147 1.318  Low Prediction* concentration produced with HIGHEST moisture content and DEEPEST depth to Itamination.  Idiph Prediction* concentration produced with LOWEST moisture content and SHALLOWEST depth to Itamination.  CLEAR ALL  FORMAT REPORT FOR PRINTER  at do these results mean?	posure Parameters	3										
Averaging Time for Carcinogens (ATc) 70 [years] Exposure Duration for Non-Carcinogens (EDnc) 25 [years] Exposure Frequency for Non-Carcinogens (EFnc) 250 [days/year] Averaging Time for Non-Carcinogens (ATnc) 25 [years]  CALCULATE RESULTS    CALCULATE RESULTS	Averaging Time for Carcinogens (ATc) 70 [years] Exposure Duration for Non-Carcinogens (EDnc) 25 [years] Exposure Frequency for Non-Carcinogens (EFnc) 250 [days/year] Averaging Time for Non-Carcinogens (ATnc) 25 [years]    CALCULATE RESULTS	Averaging Time for Carcinogens (ATc)  Exposure Duration for Non-Carcinogens (EDnc)  Exposure Frequency for Non-Carcinogens (EFnc)  Exposure Frequency for Non-Carcinogens (EFnc)  Averaging Time for Non-Carcinogens (ATnc)  CALCULATE RESULTS  SULTS  Unsaturated Zone Effective Diffusion Coefficient (Deff)  Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT  O.001014 [cm2/s]  eff)  "A" Parameter  "B" Parameter  "B" Parameter  "C" Parameter  Johnson & Ettinger Attenuation Factor (0)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1  Best Estimate  Indoor Air  Concentration  Cancer Risk  1.885e-6  3.360e-6  3.360e-6  3.360e-6  3.360e-6  3.360e-6  3.360e-6  3.360e-6  3.361e-6  Hazard Quotient  Ower Prediction* concentration produced with HIGHEST moisture content and DEEPEST depth to Itamination.  CLEAR ALL  FORMAT REPORT FOR PRINTER  at do these results mean?	•		uration fo	or Carcinogens	(EDc)			25	5	[years]		
Exposure Duration for Non-Carcinogens (EDne)  Exposure Frequency for Non-Carcinogens (EFne)  Averaging Time for Non-Carcinogens (ATnc)  CALCULATE RESULTS   CALCULATE RESULTS   CALCULATE RESULTS   CALCULATE RESULTS  SULTS  Uquaturated Zone Effective Diffusion Coefficient (Dett)  Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm2/s]  etf)  "A" Parameter 9.061e-5 Based on parameter analysis: Ad the dominant mechanism across for the dominant mechanism across for "B" Parameter 416.0 Diffusion through soil is the own of the comparameter indoor-air pathway.  Johnson & Ettinger Attenuation Factor (0)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction Best Estimate High Prediction (pp/m3) 0.7168 [pp. Concentration]  Indoor Air 1.855 [µg/m3] 0.3454 [ppby) 3.350 [µg/m3] 0.6238 [ppby] 3.849 [µg/m3] 0.7168 [pp. Concentration]	Exposure Duration for Non-Carcinogens (EDnc) 25 [years] Exposure Frequency for Non-Carcinogens (EEnc) 250 [days/year] Averaging Time for Non-Carcinogens (ATnc) 25 [years]  CALCULATE RESULTS  SULTS  CALCULATE RESULTS  Unsaturated Zone Effective Diffusion Coefficient (Derr) 0.004973 [cm²/s] Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm²/s]  err)  "A" Parameter 9.061e-5 Based on parameter analysis: Adverthe dominant mechanism across four the dominant mechanism across four Diffusion through soil is the over indoor-air pathway.  "C" Parameter 0.004918 limiting process for the subsurface indoor-air pathway.  Johnson & Ettinger Attenuation Factor (0)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1 Best Estimate High Prediction2  Indoor Air 1.855 [µg/m³] 0.3454 [ppbv] 3.350 [µg/m³] 0.6236 [ppbv] 3.849 [µg/m³] 0.7168 [ppbv] Concentration  Cancer Risk 1.860e-6 3.360e-6 3.861e-6  Hazard Quotient 0.6352 1.147 1.318  OW Prediction" concentration produced with HIGHEST moisture content and DEEPEST depth to Itamination.  High Prediction" concentration produced with LOWEST moisture content and SHALLOWEST depth to	Exposure Duration for Non-Carcinogens (EDnc) 25 [years]  Exposure Frequency for Non-Carcinogens (EFnc) 250 [days/year]  Averaging Time for Non-Carcinogens (ATnc) 25 [years]  CALCULATE RESULTS  SULTS  Unsaturated Zone Effective Diffusion Coefficient (Dett) 0.004973 [cm²/s]  Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm²/s] eff)  "A" Parameter 9.061e-5 Based on parameter analysis: Advective dominant mechanism across found biffusion though soft if is the overal limiting process for the subsurface indoor-air pathway.  Johnson & Ettinger Attenuation Factor (o)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1 Best Estimate High Prediction2  Indoor Air 1.855 [µg/m³] 0.3454 [ppbv] 3.350 [µg/m³] 0.9238 [ppbv] 3.849 [µg/m³] 0.7168 [ppbv] Concentration Concentration Produced with HiGHEST moisture content and DEEPEST depth to Itamination.  Cancer Risk 1.880e-6 3.360e-6 3.861e-6  Hazard Quotient 0.6352 1.147 1.318  COW Prediction* concentration produced with LOWEST moisture content and SHALLOWEST depth to Itamination.  CIEAR ALL  FORMAT REPORT FOR PRINTER  at do these results mean?		Exposure Fr	requency	for Carcinoger	s (EFc)			25	50	[days/year	)	
Exposure Frequency for Non-Carcinogens (EFnc) 250 [days/year] Averaging Time for Non-Carcinogens (ATnc) 25 [years]  CALCULATE RESULTS    CALCULATE RESULTS	Exposure Frequency for Non-Carcinogens (EFnc) 250 [days/year] Averaging Time for Non-Carcinogens (ATnc) 25 [years]  CALCULATE RESULTS    CALCULATE RESULTS	Exposure Frequency for Non-Cardinogens (EFne)  Averaging Time for Non-Cardinogens (ATne)  CALCULATE RESULTS  SULTS  Unsaturated Zone Effective Diffusion Coefficient (Deff)  Unsaturated + Capillary Zone Effective Diffusion Coefficient (Deff)  "A" Parameter  "B" Parameter  "B" Parameter  "C" Parameter  Johnson & Ettinger Attenuation Factor (o)  INDOOR AIR RESULTS FOR GROUND WATER  Low Prediction1  Best Estimate  High Prediction2  Low Prediction1  Low Prediction1  Best Estimate  High Prediction2  Cancer Risk  1.880e-6  3.360e-6  3.861e-6  Hazard Quotient  O.6352  1.147  DEEPEST  depth to Itamination.  High Prediction concentration produced with HIGHEST  moisture content and DEEPEST  depth to Itamination.  CLEAR ALL  FORMAT REPORT FOR PRINTER  at do these results mean?		Averaging T	ime for C	Carcinogens (A	Γε)			70	)	[years]		
Averaging Time for Non-Carcinogens (ATnc)  CALCULATE RESULTS  CALCULATE RESULTS  Unsaturated Zona Effective Diffusion Coefficient (Dert)  Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm²/s]  eff)  "A" Parameter  "A" Parameter  "B" Parameter  "C" Parameter  Johnson & Ettinger Attenuation Factor (0)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1  Best Estimate  Indoor Air  1.855 [µg/m³] 0.3454 [ppbv] 3.350 [µg/m³] 0.6238 [ppbv] 3.849 [µg/m³] 0.7168 [ppc]	Averaging Time for Non-Carcinogens (ATnc)  CALCULATE RESULTS  SULTS  Upsaturated Zone Effective Offusion Coefficient (Deff) Unsaturated + Capillary Zone Effective Offusion Coefficient (DT 0.001014 [cm2/s]  eff)  "A" Parameter "B" Paremeter "C" Parameter Johnson & Ettinger Attenuation Factor (a)  INDOOR AIR RESULTS FOR GROUND WATER Low Prediction1 Best Estimate Indoor Air 1.855 [µg/m3] 0.3454 [ppbv] 3.350 [µg/m3] 0.6238 [ppbv] 3.849 [µg/m3] 0.7168 [ppbv] Concentration Cancer Risk 1.860e-6 3.360e-6 3.861e-6 Hazard Quotient ONE Prediction produced with HIGHEST moisture content and DEEPEST depth to itemination.  High Prediction concentration produced with LOWEST moisture content and SHALLOWEST depth to	Averaging Time for Non-Carcinogens (ATnc)  CALCULATE RESULTS  Upsaturated Zone Effective Diffusion Coefficient (Deft) Upsaturated + Capillary Zone Effective Diffusion Coefficient (DT  -eff)  -A" Parameter		Exposure D	uration fo	r Non-Carcino	ens (EDnc)			25	i	(years)		
CALCULATE RESULTS  Unsaturated Zone Effective Diffusion Coefficient (Dett)  Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm²/s]  eff)  "A" Parameter 9.061e-5 Based on parameter analysis: Ad the dominant mechanism across for purifusion through soil is the own limiting process for the subsurfundor-air pathway.  "C" Parameter Johnson & Ettinger Attenuation Factor (0)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1 Best Estimate High Prediction2  Indoor Air 1.855 [µg/m³] 0.3454 [ppbv] 3.350 [µg/m³] 0.6238 [ppbv] 3.849 [µg/m³] 0.7168 [ppc]	SULTS  Uqsaturated Zone Effective Offician Coefficient (Deft) 0.004973 [cm2/s] Unsaturated + Capillary Zone Effective Offician Coefficient (DT 0.001014 [cm2/s] eff)  "A" Parameter 9.061e-5 Based on parameter analysis: Advertise dominant mechanism across four the dominant mechanism across four Diffusion through soil 1 is the over 1 limiting process for the subsurfacting process for the subsurfa	CALCULATE RESULTS  Unsaturated Zone Effective Diffusion Coefficient (Derr)  Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm2/s] err)		Exposure Fr	requency	for Non-Carcin	ogens (EFn	ic)		25	60	(days/year	Ĭ	
Unsaturated Zone Effective Diffusion Coefficient (Det)  Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm2/s]  eff)  "A" Parameter 9.061e-5 Based on parameter analysis: Ad the dominant mechanism across for the dominant mechanism across for "B" Parameter 416.0 Diffusion through soil is the own indoor air pathway.  Johnson & Ettinger Attenuation Factor (0)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1 Best Estimate High Prediction2  Indoor Air 1.855 [µg/m³] 0.3454 [ppbv] 3.350 [µg/m³] 0.6238 [ppbv] 3.849 [µg/m³] 0.7168 [ppc]	Upsaturated 2 one Effective Diffusion Coefficient (Derf) 0.004973 [cm2/s]  Upsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm2/s]  eff)  "A" Parameter 9.061e-5 Based on parameter analysis: Adv. the dominant mechanism across four the d	Unsaturated Zone Effective Diffusion Coefficient (Deff) Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT  "A" Parameter "B" Parameter "B" Parameter "C" Parameter  Johnson & Ettinger Attenuation Factor (o)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1 Best Estimate High Prediction2  Indoor Air 1.855 (µg/m³) 0.3454 (ppbv) 3.350 (µg/m³) 0.6238 (ppbv) 3.849 (µg/m³) 0.7168 (ppbv) Concentration  Cancer Risk 1.880e-6 3.360e-6 3.851e-6  Hazard Quotient 0.6352 1.147 1.318  Low Prediction* concentration produced with HIGHEST moisture content and DEEPEST depth to Itamination.  CLEAR ALL  FORMAT REPORT FOR PRINTER  at do these results mean?		Averaging T	ime for N	lon-Carcinogen	s (ATnc)			25	<b>,</b>	[years]		
Unsaturated Zone Effective Diffusion Coefficient (Derr)  Unsaturated Zone Effective Diffusion Coefficient (DT  Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT  "A" Parameter  "A" Parameter  "B" Parameter  "C" Parameter  Johnson & Ettinger Attenuation Factor (0)  INDOOR AIR RESULTS FOR GROUND WATER  Low Prediction1  Best Estimate  Indoor Air  Concentration  Unsaturated Zone Effective Diffusion Coefficient (DT  0.004973 [cm2/s]  0.004973 [cm2/s]  Based on parameter analysis: Attended the dominant mechanism across for the dominant mechanism across for the subsurfination indoor-air pathway.  Johnson & Ettinger Attenuation Factor (0)  INDOOR AIR RESULTS FOR GROUND WATER  SAMPLE DATA  Low Prediction1  Best Estimate  High Prediction2  Indoor Air  Concentration	Upsaturated 2 one Effective Diffusion Coefficient (Derf) 0.004973 [cm2/s]  Upsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm2/s]  eff)  "A" Parameter 9.061e-5 Based on parameter analysis: Adv. the dominant mechanism across four the d	Unsaturated Zone Effective Diffusion Coefficient (Deff) Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT  "A" Parameter "A" Parameter "B' Parameter "B' Parameter "C" Parameter "Johnson & Ettinger Attenuation Factor (o)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA Low Prediction1 Best Estimate High Prediction2  Low Prediction1 Best Estimate High Prediction2  Concentration Cancer Risk 1.880e-6 3.360e-6 3.851e-6 Hazard Quotient 0.6352 1.147 1.318  Low Prediction* concentration produced with HIGHEST moisture content and DEEPEST depth to Itamination.  CLEAR ALL  FORMAT REPORT FOR PRINTER  at do these results mean?					CAL	CULATER	ESULTS	1				
Unsaturated Zone Effective Diffusion Coefficient (Derf)   0.004973   (cm2/s]	Uqsaturated Zone Effective Diffusion Coefficient (DT 0.001973 [cm2/s]  Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm2/s]  eff)  "A" Parameter 9.061e-5 Based on parameter analysis: Adv. the dominant mechanism across four piffusion through soil is the over 1.000 piffusion process for the subsurfaction piffusion through soil is the over 1.000 piffusion through soil is the ov	Unsaturated Zone Effective Diffusion Coefficient (Dert)  Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm2/s]  eff)  "A" Parameter 9.061e-5 the dominant mechanism across found Diffusion through soil 1 is the overs 1 industry process for the subsurface indoor-air pathway.  Johnson & Ettinger Attenuation Factor (o)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction 1 Best Estimate High Prediction2  Indoor Air 1.855 [µg/m3] 0.3454 [ppbv] 3.350 [µg/m3] 0.6238 [ppbv] 3.849 [µg/m3] 0.7168 [ppbv] Concentration  Cancer Risk 1.860e-6 3.360e-6 3.861e-6  Hazard Quotient 0.6352 1.147 1.318  Ow Prediction" concentration produced with HIGHEST moisture content and DEEPEST depth to Itamination.  Gight Prediction" concentration produced with LOWEST moisture content and SHALLOWEST depth to Itamination.  CLEAR ALL  FORMAT REPORT FOR PRINTER  at do these results mean?	CIII TC				L		LOOLIO					
Unsawrated + Capitlary Zone Effective Diffusion Coefficient (DT 0.001814 [cm2/s]  •ff)  "A" Parameter 9.061e-5 Based on parameter analysis: Ad the dominant mechanism across for the dominant mechanism across for Diffusion through soil is the own limiting process for the subsurfundor-air pathway.  Johnson & Ettinger Attenuation Factor (0)  INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1 Best Estimate High Prediction2  Indoor Air 1.855 [µg/m3] 0.3454 [ppbv] 3.350 [µg/m3] 0.6238 [ppbv] 3.849 [µg/m3] 0.7168 [ppc]	Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm2/s] eff)  "A" Parameter 9.051e-5 the dominant mechanism across four Diffusion through soil 1 is the over 1 the dominant mechanism across four Diffusion through soil 1 is the over 1 the dominant mechanism across four Diffusion through soil 1 is the over 1 the dominant mechanism across four Diffusion through soil 1 is the over 1 the dominant mechanism across four Diffusion through soil 1 is the over 1 the dominant mechanism across four Diffusion through soil 1 is the over 1 the dominant mechanism across four Diffusion through soil 1 is the over 1 the dominant mechanism across four Diffusion through soil 1 is the over 1 imiting process for the subsurfaction of 1 indoor Air SAMPLE DATA  NOW Prediction 1 the Prediction 2 this production 2 the poly 3.350 [µg/m3] 0.6238 [ppbv] 3.849 [µg/m3] 0.7168 [ppbv] [ppbv] 3.849 [µg/m	Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT 0.001014 [cm2/s] eff)  "A" Parameter 9.061e-5 the dominant mechanism across found across found across found across found the dominant mechanism across found across full flower across full flower across full flower across full flower across f	-30L13	Ucsatuoned	i Zone Eif	fective Diffusion	i Coefficien	(Dett)		0.1	004973	(cm²/s)		
eff)  "A" Parameter  "B" Parameter  "C" Parameter  Johnson & Ettinger Attenuation Factor (a)  INDOOR AIR RESULTS FOR GROUND WATER  Low Prediction1  Best Estimate  Indoor Air  Concentration  1.855 [µg/m³] 0.3454 [ppbv) 3.350 [µg/m³] 0.6238 [ppbv] 3.849 [µg/m³] 0.7168 [ppc]	#A" Parameter 9.061e-5 Based on parameter analysis: Advertised the dominant mechanism across four Diffusion through soil is the over 15°P Parameter 416.0 Diffusion through soil is the over 15°P Parameter 10.004918 Diffusion through soil is the over 15°P Parameter 10.004918 Diffusion through soil is the over 15°P Parameter 15°P Parame	"A" Parameter "A" Parameter "B" Parameter "B							(DT					
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### 1.855   μg/m³   0.3454   ppbv   3.350   μg/m³   0.6238   ppbv   3.849   μg/m³   0.7168   ppcc   pppc   ppcc	Corporation   Concentration produced with HIGHEST   Concentration   Concent	Johnson & Ettinger Attenuation Factor (a)    INDOOR AIR RESULTS FOR GROUND WATER   SAMPLE DATA		"B" Pa	remeter			4	16.0					
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INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA   Low Prediction1   Best Estimate   High Prediction2	INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1 Best Estimate High Prediction2  Indoor Air 1.855 [µg/m³] 0.3454 [ppbv] 3.350 [µg/m³] 0.6238 [ppbv] 3.849 [µg/m³] 0.7168 [ppbv] Concentration  Cancer Risk 1.860e-6 3.861e-6  Hazard Quotient 0.6352 1.147 1.318  Low Prediction" concentration produced with HIGHEST moisture content and DEEPEST depth to alternination.  High Prediction" concentration produced with LOWEST moisture content and SHALLOWEST depth to	INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA  Low Prediction1 Best Estimate High Prediction2  Indoor Air 1.855 [µg/m³] 0.3454 [ppbv] 3.350 [µg/m³] 0.6238 [ppbv] 3.849 [µg/m³] 0.7168 [ppbv]  Concentration  Cancer Risk 1.860e-6 3.360e-6 3.861e-6  Hazard Quotient 0.6352 1.147 1.318  Low Prediction" concentration produced with HIGHEST moisture content and DEEPEST depth to attamination.  Idigh Prediction" concentration produced with LOWEST moisture content and SHALLOWEST depth to attamination.  CLEAR ALL  FORMAT REPORT FOR PRINTER  at do these results mean?					=	_	.004910	indoc	r-air	pathway.		
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Concentration	Concentration  Cancer Risk 1.860e-6 3.360e-6 3.861e-6  Hazard Quotient 0.6352 1.147 1.318  .ow Prediction" concentration produced with HIGHEST intermination.  High Prediction" concentration produced with LOWEST moisture content and SHALLOWEST depth to	Cancer Risk 1.860e-6 3.360e-6 3.861e-6 Hazard Quotient 0.6352 1.147 1.318  Ow Prediction" concentration produced with HIGHEST intermination. High Prediction" concentration produced with LOWEST intermination.  CLEAR ALL  FORMAT REPORT FOR PRINTER  at do these results mean?									<del></del>			
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Hazard Quotient 0.6352 1.147 1.318	amination. igh Prediction" concentration produced with LOWEST moisture content and SHALLOWEST depth to	amination.  igh Prediction" concentration produced with LOWEST moisture content and SHALLOWEST depth to amination.  CLEAR ALL  FORMAT REPORT FOR PRINTER  It do these results mean?	Hazard Quotient	<u> </u>	0.6352			1.147			<u></u>	1.318		
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Last updated on Tuesday, September 20, 2011

http://www.epa.gov/AthensR/learn2model/part-two/onsite/JnE_tite_forward.html



### **EPA On-line Tools for Site Assessment Calculation**

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## Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

#### Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

#### Background

Migration of volatile chemicals from the subsurface into overlying buildings is called vapor intrusion (VI). Volatile organic chemicals in contaminated solls or groundwater can emit vapors, which may migrate through subsurface soils and may enter the indoor air of overlying buildings. Building depressurization may cause these vapors to enter the home through cracks in the foundation. Depressurization can be caused by a combination of wind effects and stack effects, which are the result of heating within the building and/or mechanical ventilation. In extreme cases, the vapors may accumulate in dwellings to levels that may pose near-term safety hazards, such as explosion. Typically, however, vapor concentrations are present at low levels, to which long-term exposure may pose increased risk for chronic health effects.

This on-line calculator implements the Johnson and Ettinger (J&E) (Johnson and Ettinger, 1991) simplified model to evaluate the vapor intrusion pathway into buildings. This J&E model replicates the implementation that the US EPA Office of Solid Waste and Emergency Response (OSWER) used in developing its draft vapor intrusion guidance, but includes a number of enhancements that are facilitated by web implementation; temperature dependence of Henry's Law Constants and gaseous diffusivities, automatic sensitivity analysis of certain parameters, and others described on the background page.

The results you obtain from this OnSite implementation of the Johnson and Ettinger model may differ from other versions of the Johnson & Ettinger Model. In addition to the OSWER implementation that was used for the draft vapor intrusion guidance, EPA Office of Emergency Response and Remediation (OERR) distributes a set of spreadsheet implementations of the model. The differences among these implementations is described in detail on the results page. Beyond these differences the on-line version includes a simplified uncertainty analysis the other implementations lack.

Click For an Example

Enter Site Na	me (optional):	Circk For an Examp	Adult Resider	nt - Phase ilB		
Enter sample	concentration, units and media type		54,6	μ <b>g/</b> L.	Ground W	/ater
	epth of the soil gas sample or ground water contamination)?(LT)	table (for		7	me	eters
This value car	n change by +/-			1	me	eters
What is your co	ntaminant of concern (COC)?		Tetrachloroeth	ylene	,	
What type of bu	ulding are you investigating at your site?				Słab-on-Grade	
What type of so	il is beneath the building?				Loam	•
What is the ave	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		127184			
	Molecular Weight (MW)	. 40	165,83	(g/mole)		
	Henry's Law Constant at ground water te	mperature (H)	0.3934997			
	Free-Air Diffusion Coefficient (Da)		7.200e-2	(cm2/s)		
	Diffusivity in Water (Dw)		8.200e-6	[cm ² /s]		
	Unit Risk Factor (URF)		3,00a-6	{(µg/m³)-1]		
	Reference Concentration (RfC)		0.	[mg/m³]		
Soil Properties	Label (In address that		44 (411)	[contract]		
	Total Porosity (n) Unsaturated Zone Moisture Content	Low 0.0610	ບ,399 Best Eslimate	[unitiess]	[unitless]	
		FOM 0.0010	0.148	High 0.240	ប្រធេបមនេះ	
	(θw) Capillary Zone Moisture Content at Air-Ei	ntov Draecura	0.332	[unitless]		
	(6w,cap)	inay Freesaule	0.332	[critice > *]		
	Height of Capillary Zone (CZn)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qso	ou)	5.00	[L/min]		
Building Properties		,		,		
	Air Exchange Rate (EB)		0.250	(hr-1)		
	Building Mixing Height (HB)		2.44	[m]		
	Building Footprint Area (Fs)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m ² ]		

	Building Crack Ratio	> (η)		0.	00038	(unitless)		
	Building Foundation	Slab Thickness (L	-crack)	0.	100 (	[m]		
Exposure Parameten	s							
	Exposure Duration f	or Carcinogens (E	Dc)	30	) (	[years]		
	Exposure Frequency	y for Carcinogens (	(EFc)	38	50 [	[days/year]		
	Averaging Time for	Carcinogens (ATc)	)	70	] (	[years]		
	Exposure Duration f	or Non-Carcinoger	ns (EDnc)	30	) (	[years]		
	Exposure Frequency	y for Non-Carcinog	jens (EFnc)	36	35 (	(days/year)		
	Averaging Time for	Non-Carcinogens (	(ATnc)	30	) [	[years]		
		ſ	CALCULATE R	RESULTS				
RESULTS		_						
	Unsaturated Zone E	(fective Olffusion C	Coefficient (Derr)	0.	004532 [	(cm ² /s)		
			Diffusion Coefficien	t (DT 0.	0008963 [	[cm ² /s]		
	eff)							
	*A" Parameter		8			ameter analysis:		
	"B" Parameter		4	56,5 Diffu	ision thr	mechanism acros	e over	all rate-
	"C" Parameter		0		or-air pa	cess for the sub athway.	BULLAC	3 60
	Johnson	& Ettinger Attenu	ation Factor (a)			_		7.882e-5
	NDOOR AIR RESU	LTS FOR GROUN	ID WATER SA	MPLE DATA				
****	Low Prediction1		Best Estimate		High Pred	liction2		
Indoor Air	0.9491 (µg/m³)	0.1400 [ppbv	1.693 [µg/m³]	0.2498 [ppbv	1.938	[µg/m³] 0.2859	[ppbv]	
Concentration				<u> </u>	ļ			
Cancer Risk	1.170e-	-6	2,088e	s-6		2.389e-6		
Hazard Quotient	0.		0.			0,		
		. INCHEST		Deco	COT			
"Low Prediction" con-	centration produced w	III HIGHEST	moisture c	content and DEEP	E91	depth to		
contamination. Prediction" con	controlled produced :-	ons LOWEST	moletura	content and SHAL	LOWEST	depth to		
r "High Prediction" con contamination.	centration produced v	Aut COTTEO	monsule:	William and or the	,,	ochii io		
omanii aavii.								
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FORMAT REF	PORT FOR PRINTER							
What do these results	mean?							
Comments or suggesting	<u>ons</u>							

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http://www.epa.gov/athens/learn2model/part-two/onsite/JnE_lite_forward.html



### **EPA On-line Tools for Site Assessment Calculation**

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## Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

#### Forward Calculation of Indoor Air Concentration

Escaward Calculation full uncertainty analysis

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Fator Sito I	Nome (antianal):	Click For an Exam	nple Adult Residen	st Dhaca IID		
	Name (optional):			,		
Enter samp	ole concentration, units and media type		41.4	μg/L	Ground V	Vater
	depth of the soil gas sample or ground water	table (for		7	m	eters
	er contamination)?(LT) can change by +/-			1	m	eters
	· ·					01010
What is your	contaminant of concern (COC)?		Trichloroethyle	ne		•
What type of	building are you investigating at your site?				Slab-on-Grade	
What type of	soil is beneath the building?				Loam	
What is the g	verage soil/ground water temperature?				55	Farenheit
Chemical Properti	08					
	CAS Number		79016			
	Molecular Weight (MW)		131,39	[g/mole]		
	Henry's Law Constant at ground water ter	mperature (H)	0.2367947	[unitless)		
	Free-Air Diffusion Coefficient (Da)		7.900e-2	[cm ² /s]		
	Diffusivity in Water (Dw)		9.100e-6	[cm ² /s]		
	Unit Risk Factor (URF)		4.10e-6	(µg/m³)-1)		
	Reference Concentration (RfC)		2e-03	[mg/m³]		
Soil Properties						
	Total Porosity (n)		0.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	[unitless]	
	(θw) Capillary Zone Moisture Content at Air-En	day Branques	0.148 0.332	[unitless]		
	(θw.cap)	iny riessule	0.332	[umuess]		
	Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoi	11	5.00	(L/min)		
Building Propertie	•	••	0.00	(m-111117)		
	Air Exchange Rate (EB)		0.250	(hr-1)		
	Building Mixing Height (HB)		2.44	(m)		
	Building Footprint Area (Fs)		100.0	[m²]		
	Subsurface Foundation Area (As)		106.0	[m ² ]		

	Building C	Crack Ratio	o (ŋ)					0.0	00038	[unitiess]			
	Building F	oundation	Slab Thic	kness (L	.crack)			0.1	100	[m]			
Exposure Parameters	3												
	Exposure	Duration t	for Carcino	gens (E	Dc)			30		(years)			
	Exposure	Frequenc	y for Carcii	nogens	(EFc)			35	0	[days/year]			
	Averaging	Time for	Carcinoge	ns (ATc)	}			70		(years)			
	Exposure	Duration f	for Non-Ca	rcinoger	ns (EDnc)			30		(years)			
	Exposure	Frequenc	y for Non-C	Carcinog	jens (EF _{no}	:)		36	5	[days/year]			
	Averaging	Time for I	Non-Carcir	ogens (	(ATnc)			30		[years]			
				Ĺ	CAL	CULATE F	RESULTS	)					
RESULTS													
			fluctive Oil						04973	[cm ² /s]			
		edit Çapil	lary Zone f	Hiective	Diffusion	Coefficien	: (DT	0.0	01014	[cm ² /s]			
	eff)					_							
	"A" F	Parameter				9	.061e-5			rameter am t mechanis			
	<u>"B" f</u>	Parameter				4	16.0	Diffu	sion t	hrough soi	il is th	ne overa	all rate-
	"C" I	Parameter	:			0	.004918			ocess for pathway.	the sub	osurface	to to
	:	Johnson	& Ettinger	Attenu	ation Fac	tor (a)		2	- 1111	endered.			8,897e-5
	INDOOR A	AIR RESU	LTS FOR	GROUN	ID WATER	R SA	MPLE DA	TA					
	Low Predic	ction1			Best Estir	nate			High Pr	ediction2			
Indoor Air	0.4829	{µg/m³}	0.08993	[ppbv	0.8722	[hð/w ₃	0.1624	(ppbv)	1.002	[µg/m³]	0.1866	(ppbv)	
Concentration		" 1				., -	]					- 1	
Cancer Risk		8.137e	-7			1.470e	-6			1.689e-	6		
Hazard Quotient		0.2415		***************************************		0,4361			***************************************	0.5011			
l "Low Prediction" conc contamination. t "High Prediction" cond contamination.	,						content and			_	pth to		
CLEAR ALL													
FORMAT REP	ORT FOR	PRINTER											
What do these results	mean?												
Comments or suggestio	ns												
Iop.^ ∃ome   Glossary   Notal	lion I Links	l Referenc	es I Calcul	lators									
				_									

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Last updated on Tuesday, September 20, 2011



#### **EPA On-line Tools for Site Assessment Calculation**

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# Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

## Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

#### Background

Migration of volatile chemicals from the subsurface into overlying buildings is called vapor intrusion (VI). Volatile organic chemicals in contaminated soils or groundwater can emit vapors, which may migrate through subsurface soils and may enter the indoor air of overlying buildings. Building depressurization may cause these vapors to enter the home through cracks in the foundation. Depressurization can be caused by a combination of wind effects and stack effects, which are the result of heating within the building and/or mechanical ventilation. In extreme cases, the vapors may accumulate in dwellings to levels that may pose near-term safety hazards, such as explosion. Typically, however, vapor concentrations are present at low levels, to which long-term exposure may pose increased risk for chronic health effects.

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		Cłick For an Exam	ole )			
Enter Site Na	me (optional):		Adult F	Resident - Phase IIB		
Enter sample	concentration, units and media type		11	μg/L	Ground	Water ·
	epth of the soil gas sample or ground water ta	ible (for		7	г	neters ·
-	contamination)?(LT)					
This value ca	n change by +/-			1	n	neters
What is your co	ontaminant of concern (COC)?		Vinyl ch	loride (chloroethene)		÷
What type of bi	illding are you investigating at your site?				Slab-on-Grade	
What type of so	oil is beneath the building?				Loam	
What is the ave	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		750			
	Melecular Weight (MW)		62.5	,		
	Henry's Law Constant at ground water temp	perature (H)		21316 [unitiess]		
	Free-Air Diffusion Coefficient (Da)		0.10	•		
	Diffusivity in Water (Dw)		1.23	0e-5 [cm²/s]		
	Unit Risk Factor (URF)		8.80	e-6 [(µg/m³)-1]		
	Reference Concentration (RfC)		0.10	0 (mg/m³)		
Soil Properties						
	Total Porosity (n)		0.39			
	Unsaturated Zone Moisture Content	Low 0.0610	Best Esti	mate High 0.240	) [unitless]	
	( <del>0</del> w)	_	0.148			
	Capillary Zone Moisture Content at Air-Entr	y Pressure	0.33	2 [unitless]		
	(θw,cap)		2 27	e [		
	Height of Capillary Zone (CZh)		0.37			
B 4 F B	Soil-gas Flow Rate Into the Building (Qsoil)		5.00	(L/min)		
Building Properties	Air Evolunes Bato (En)		0.25	0 {hr-1]		
	Air Exchange Rate (EB)		2.44	- • •		
	Building Mixing Height (HB)		2.44 100.			
	Building Footprint Area (FB)		•	- • •		
	Subsurface Foundation Area (AB)		106.	0 [m²]		

	Building C	rack Ratio	o (ŋ)					0.0	00038	[unitiess]					
	Building Fo	oundation	Slab Th	ickness (L	crack)			0.1	00	[m]					
Exposure Parameter	s														
	Exposure	Duration t	for Carcin	iogens (£l	Dc)			30		(years)					
	Exposure	Frequenc	y for Car	cinogens (	EFc)			35	0	(days/year	1				
	Averaging	Time for	Carcinog	ens (ATc)				70		[years]					
	Exposure	Duration 1	for Non-C	arcinoger	s (EDnc)			30		(years)					
	Exposure	Frequenc	y for Non	-Carcinog	ens (EFn	c)		36	5	(days/year	J				
	Averaging	Time for	Non-Care	inogens (	ATnc)			30		(years)					
				ſ	CAL	CULATE R	ESULTS								
RESULTS				٤,			COOLIO								
KESULIS	Unsaturate	art Zema E	Bortius f	liffersing (	natúciant	(Datt)		0.0	06672	[cm ² /s]					
	Unsaturate						· (DT		01289	[cm ² /s]					
	eff)	adi' . Onkili	ingi y a com	. 251100011130	Victoria extracts	2000-Million Contractor	, , , ,	0.0	01200	form-tol					
	•	arameter				1	.152e-4	Based	on pa	rameter a	nalysis:	Advec	tion is		
								the d	ominan	t mechani	sm acros	s found	lation.		
	<u>"B" J"</u>	Parameter	:			3	10.1			hrough so ocess for				:-	
	"C" E	^a arameter	Ī			0	.004918			pathway.	VIIC DUD	Dur Luce			
	,	Johnson	& Etting	er Attenu	ation Fac	tor (a)							1,126	6e-4	
	INDOOR A	UR RESU	LTS FOR	GROUN	D WATE	R SA	MPLE DA	ГА			~~~~				
	Low Predic		210.01	,	Best Esti			***************************************	High Pr	ediction2					
Indoor Air	0.5639	[µg/m³]	0 2208	[nohy]	0.9933		0.3888	[ppbv]			0.4430	(ppbv)			
Concentration	0,5000	[եֆոււո		[bbp4		(bButte)	0.0000	(bbs v)		[hB ₁₁₁ ,		,,,,,,,			
Cancer Risk		2.039e	-6		·	3.592e	-6			4.093e	-6				
Hazard Quotient		0.0056			f	0.0020				0.0113					
Hazard Quotient		0.0000			l	0.0000			L	0.0110					
1 "Low Prediction" con-	aanteetlan or	roduced v	as HIGH	FST		moisture o	content and	DEFPE	ST	de	pth to				
contamination.	cennanon pi	roduced w	MM) 111-92			molecule	Joine III ain	,		•	, par to				
2 "High Prediction" con	centration a	induced s	with LOW	ÆST.		moisture e	content an	n SHALL	.OWE\$1	Га	epth to				
contamination.	içonu dubir p		viui – -			***************************************		_		•					
CLEAR ALL															
FORMAT RE	PORT FOR	PRINTER													
What do these results	s mean?														
Comments or suggesting	<u>ons</u>														
Ton A															
Top ^ Home   Glossary   Nota	ation ( Linke !	! Dafaranı	nas I Cair	ulatore											
HATTE   ZINSSBIX   HATTE	Short ( Pings )	170101011	853   2580	CHILIPIO											
WCMS									he	n:/hunu one	nov/athone/	aam2m^r	ial/na/t-tu-^	inneita/Ine	_lite_forward.
Last updated on Thursda	v. Seplember	r 15. 2011							in	римичи. ора.	Anstan (21)	Junamuc	ion hai (-two	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	me_iviwaiu.i
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## **EPA On-line Tools for Site Assessment Calculation**

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# Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

# Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

Background

Migration of volatile chemicals from the subsurface into overlying buildings is called vapor intrusion (VI). Volatile organic chemicals in contaminated soils or groundwater can emit vapors, which may migrate through subsurface soils and may enter the indoor air of overlying buildings. Building depressurization may cause these vapors to enter the home through cracks in the foundation. Depressurization can be caused by a combination of wind effects and stack effects, which are the result of heating within the building and/or mechanical ventilation. In extreme cases, the vapors may accumulate in dwellings to levels that may pose near-term safety hazards, such as explosion. Typically, however, vapor concentrations are present at low levels, to which long-term exposure may pose increased risk for chronic health effects.

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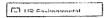
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		Click For an Examp	ple			
Enter Site Nar	me (optional):		Adult Reside	nt - Phase IIB		
Enter sample	concentration, units and madia type		.0375	µg/L	Ground V	/ater
	epth of the soil gas sample or ground water to contamination)?(LT)	able (for		7	m	eters ·
This value car	n change by +/-			1	m	eters
What is your co	ntaminant of concern (COC)?		aipha-HCH (a	pha-BHC)		
What type of bu	ilding are you investigating at your site?			,	Slab-on-Grade	•
What type of so	il is beneath the building?				Loam	
What is the ave	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		319846			
	Molecular Weight (MW)		290.83	[g/mole]		
	Honry's Law Constant at ground water tem	perature (H)		(unitless)		
	Free-Air Diffusion Coefficient (Da)		1.420e-2	(cm ² /s)		
	Diffusivity in Water (Dw)		7.340e-6	[cm ² /s]		
	Unit Risk Factor (URF)		1.80e-3	[(µg/m³)-1]		
	Reference Concentration (RfC)		C.	[mg/m³]		
Soil Properties			J. J. N.	formal transit		
	Total Porosity (n)		0.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	[unitiess]	
	(Ow)	o d Oseanouse	0.148 0.332	(unitless)		
	Capitary Zone Moisture Content at Air-Entr	y Pressule	0.332	frundassi		
	( <del>0</del> w,cap) Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoil)		5.00	[⊔min]		
Building Properties	CONTROL TOTAL CALL OF THE PARTY		0.00	[]		
Danuing 1 Topolities	Air Exchange Rate (EB)		0.250	[hr-1]		
	Building Mixing Height (Hs)		2.44	[m]		
	Building Footprint Area (Fa)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m²]		

	Building Crack Ratio (r	n)			0.00	0038	[unitless]			
	Building Foundation SI		crack)		0.10		[m]			
Exposure Parameter	18									
	Exposure Duration for	Carcinogens (EI	Oc)		30		[years]			
	Exposure Frequency fo	or Carcinogens (	EFc)		350	ı	[days/year]			
	Averaging Time for Car	rcinogens (ATc)			70		[years]			
	Exposure Duration for	Non-Carcinogen	s (EDnc)		30		years]			
	Exposure Frequency fo	or Non-Carcinogo	ens (EFnc)		365		[days/year]			
	Averaging Time for No	ก-Carcinogens (ม	ATne)		30		[years]			
		(	CALCULATE R	ESULTS	_				٠	
RESULTS		****								
	Unsaturated Zone Effe				0.00	1699	[cm ² /s]			
	Unsaturated + Capitian	y Zane Effective	Diffusion Coefficient	(DT	0.00	1780	[cm²/s]			
	eff)								_	
	*A" Parameter						ameter ar mechanis			
	"B" Parameter		12	218. ı	Diffus	ion th	rough soi	ll is the	overa	ll rate-
	"C" Parameter		0.0				cess for athway.	the subs	urrace	: to
	Johnson & E	Ettinger Attenua	tion Factor (a)			•	-			1.541e-4
	INDOOR AIR RESULT	S FOR GROUN	D WATER SAM	MPLE DATA						
	Low Prediction1		Best Estimate		ŀ	tigh Pred	diction2			
Indoor Air	4.990e-7 [µg/m³] 4.1	198e-8 [ppbv]	5.714e-7 [µg/m³]	4.807e-8	[ppbv]	1.555e-6	[µg/m³]	1.308e-7	(ppbv)	
Concentration										
Cancer Risk	3.691e-10	)	4.227e-	10			1.150e-	9		
Hazard Quotient	0.		0.		1	-	0.			
ontamination.	centration produced with			ontent and ^C content and ^c			,	pth to		
CLEAR ALL )	·									
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hat do these results	s illeau i									
omments or suggesti	ons									
op ^										
	ation   Links   References	Calculators								
										allowed to refer all of Lag. Ste. See

http://www.epa.gov/alhens/learn2model/part-two/onsite/JnE_lite_forward.html

Last updated on Thursday, September 15, 2011



## **EPA On-line Tools for Site Assessment Calculation**

48 of 67

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		Click For an Exam	ple			
Enter Site Name	e (optional):		Adult Resid	ent - Phase IIB		
Enter sample co	oncentration, units and media type		.136	μg/L	Ground	Water ·
ground water co	th of the soil gas sample or ground water ta ontamination)?(LT)	ble (for		7	r	neters -
This value can o	change by +/-			1	n	nelers
What is your cont	aminant of concern (COC)?		alpha-HCH (	alpha-BHC)		
What type of build	ling are you investigating at your site?				Slab-on-Grade	
What type of soil i	is beneath the building?				Loam	
What is the <u>average</u>	ge soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		319846			
	Molecular Weight (MW)		290,83	[g/mole]		
	Henry's Law Constant at ground water temp	setarne (H)		86 (unitless)		
	Free-Air Diffusion Coefficient (Da)		1.420e-2	•		
	Diffusivity In Water (Dw)		7.340e-6			
	Unit Rick Factor (URF)		1.80e-3	[(µg/m³)-1]		
	Reference Concentration (RfC)		٥.	(mg/m³)		
Soll Properties			•			
	Total Porosity (n)		0.300	(unitioca)	-	
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	(unitiess)	
	(θw)		0.148			
	Capillary Zone Moisture Content at Air-Entry	/ Pressure	0,332	[unitless]		
	( <del>0</del> w,cap)					
	Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoil)		5.00	[⊔min]		
<b>Building Properties</b>						
	Air Exchange Rate (Es)		0.250	[hr-1]		
	Suilding Mixing Height (HB)		2.44	[m]		
	Building Footprint Area (FB)		100.0	[m²]		
	Subsurface Foundation Area (As)		106.0	[m²]		

		•			
	Building Crack Ratio (n)		0.00038	[unitiess]	
	Building Foundation Slab Thickness	(Lcrack)	0.100	[m]	
xposure Parameter	s				
	Exposure Duration for Carcinogens	30	(years)		
	Exposure Frequency for Carcinoger	350	[days/year]		
	Averaging Time for Carcinogens (A*	70	[years]		
	Exposure Duration for Non-Carcino	30	[years]		
	Exposure Frequency for Non-Carcin	365	[days/year]		
	Averaging Time for Non-Carcinogen	s (ATnc)	30	[years]	•
		CALCULATE RESULTS			
SULTS					
	Unsaturated Zone Effective Diffusion	Coefficient (Deff)	0.001699	[cm ² /s]	
	Unsaturated + Capillary Zone Effecti	ys Diffusion Coefficient (DT	0.001780	[cm ² /s]	
	eff)				
•	"A" Parameter	1.591e-4		rameter analysis: t mechanism acros	
	"B" Parameter	1218.	Diffusion th	hrough soil is th	e overall rate
	*C* Parameter	0.004918	indoor-air	ocess for the sub pathway.	surface to
	Johnson & Ettinger Atter	nuation Factor (c)			1.541
	INDOOR AIR RESULTS FOR GRO	JND WATER SAMPLE DA	TA		
	Low Prediction1	Best Estimate	High Pre	ediction2	
indoor Air Concentration	1.810e-6 (µg/m³) 1.522e-7 [pp	ov] 2.072e-6 [µg/m³] 1.743e-7	(ppbv) 5.640e-	6 {µg/m3 4.744e-7	[ppbv]
Cancer Risk	1.339e-9	1.5336-9		4.172e-9	
Hazard Quotient	0.	0.		0.	
ntemination.	centration produced with BEST ESTIN	MATE moisture content an		depth to	
CLEAR ALL FORMAT RE	PORT FOR PRINTER				
hat do these result	s mean?				
omments or suggesti	ons				
THE PERSON NAMED OF THE PE	3.4.I.				
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http://www.epa.gov/athens/learn2model/part-two/onsite/JnE_lite_forward.html



### **EPA On-line Tools for Site Assessment Calculation**

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	(	Çlick For an Exam	ple			
Enter Site Name (optional):			Adult Resi	dent - Phase IIB		
Enter sample concentration, units and media type			.0204	ha\r	· Ground \	Vater ·
What is the depth of the soil gas sample or ground water table (for				7	m	elers
ground water contamination)?(LT)						
i nis value cai	n change by +/-			1	111	eters
What is your contaminant of concern (COC)?			Dieldrin	Dieldrin		
What type of building are you investigating at your site?					Slab-on-Grade	
What type of soil is beneath the building?					Loam	
What is the ave	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		60571			
	Molecular Weight (MW)		380.91	[g/mole]		
	Henry's Law Constant at ground water temperature (H)			989 [unitless]		
	Free-Air Diffusion Coefficient (Da)		1.250e-			
	Diffusivity in Water (Dw)		4.740e-	6 [cm²/s]		
	Unit Risk Factor (URF)		4.60e-3	[(µg/m³)-1]		
	Reference Concentration (RfC)		1.75e-4	[mg/m³]		
Soil Properties						
	Total Porosity (a)		0.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	e High 0.240	[unitless]	
	(Bw)		0.148			
	Capillary Zone Moisture Content at Air-Entry Pressure		0.332	(unitess)		
	( <del>O</del> w,cap)					
	Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoil)	)	5.00	[L/min]		
Building Properties						
	Air Exchange Rate (Es)		0.250	[hr-1]		
	Building Mixing Height (HB)		2.44	[m]		
	Building Footprint Area (FB)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m2]		

	Building Crack Ratio (n)		0.00038 [unitless]			
	Building Foundation Slab Thickness	(Leack)	0.100 [m]			
Exposure Parameter		· Implement	\$.140			
Exposure r diamotor	Exposure Duration for Carcinogens	(EDc)	30 (years)	(years)		
	Exposure Frequency for Carcinoger	ns (EFc)	350 [days/year]	[days/year]		
	Averaging Time for Carcinogens (A	Tc)	70 [years]	• • • •		
	Exposure Duration for Non-Carcino	· ·	30 [years]			
	Exposure Frequency for Non-Carcin	, ,	365 [days/year]	•		
	Averaging Time for Non-Carcinoger	• ' '	30 [years]			
		CALCULATE RESULTS				
RESULTS	and the state of the state of	. A. officient <b>(B)</b>	0.004054 [2/-]			
	Unsaturated Zone Effectiva Diffusio		0.001254 [cm ² /s]			
	Unsaturated + Capillary Zone Effect	ive Diffusion Coefficient (DT	0.001312 [cm ² /s]			
	eff)					
	"A" Parameter	1.172e-4	Based on parameter analysis: Advecti the dominant mechanism across foundat			
	"B" Parameter	1649.	Diffusion through soil is the overall	rate-		
	"C" Parameter	0.004918	limiting process for the subsurface t indoor-air pathway.	٥		
	Johnson & Ettinger Atte	nuation Factor (c)		1.145e-4		
	INDOOR AIR RESULTS FOR GRO	UND WATER SAMPLE DA	NTA			
	Low Prediction1	Best Estimate	High Prediction2			
Indoor Air	2.240e-7 [µg/m3] 1.439e-8 [pp	bv) 2.567e-7 [µg/m3] 1.649e-8	[ppbv] 5.790e-7 [µg/m3] 3.719e-8 [ppbv]			
Concentration	1 1					
Cancer Risk	4.235e-10	4.853e-10	1.095e-9			
Hazard Quotient	1,280e-6	1.467e-6	3,309e-6			

1 "Low Prediction" concentration produced with BEST ESTIMATE

moisture content and DEEPEST

depth to

2 "High Prediction" concentration produced with HIGHEST contamination.

moisture content and SHALLOWEST

depth to

CLEAR ALL

FORMAT REPORT FOR PRINTER

What do these results mean?

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http://www.eps.gov/athens/leam2model/part-two/onsite/JnE_file_forward.html



### **EPA On-line Tools for Site Assessment Calculation**

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## Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

#### Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

Background

Migration of volatile chemicals from the subsurface into overlying buildings is called vapor intrusion (VI). Volatile organic chemicals in contaminated soils or groundwater can emit vapors, which may migrate through subsurface soils and may enter the indoor air of overlying buildings. Building depressurization may cause these vapors to enter the home through cracks in the foundation. Depressurization can be caused by a combination of wind effects and stack effects, which are the result of heating within the building and/or mechanical ventilation. In extreme cases, the vapors may accumulate in dwellings to levels that may pose near-term safety hazards, such as explosion. Typically, however, vapor concentrations are present at low levels, to which long-term exposure may pose increased risk for chronic health effects.

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		Click For an Exam	ple			
Enter Site Nan	ne (optional):		Industrial Wo	rker- Phase IIB		
Enter sample o	concentration, units and media type		0.136	μg/L	Ground V	Vater ·
	pth of the soil gas sample or ground water tab contamination)?(ET)	ile (for		7	m	eters ·
This value can	change by +/-			1	m	eters ·
What is your con	ntaminant of concern (COC)?		elpha-HCH (al	pha-BHC)		
What type of buil	lding are you investigating at your site?			s	lab-on-Grade	
What type of soil	is beneath the building?				Loam	
What is the aver-	age soil/ground water temperature?				55	Farenheit
Chemical Proparties						
	CAS Number		319846	(g/mole)		
	Molecular Weight (MW)	aratura (U)	290.83			
	Henry's Law Constant at ground water temper	ыявив (п)		6 (unitless) (cm2/s)		
	Free-Air Diffusion Coefficient (Da)		1.420e-2 7.340e-6	•		
	Diffusivity in Water (Dw)			(cm²/s)		
	Unit Risk Factor (URF)		1,80e-3	[(µg/m³)-1]		
0.11.0	Reference Concentration (RfC)		0.	[mg/m ³ ]		
Soil Properties	Total Porosity (n)		0.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	(unitiess)	
	( <del>0</del> w)	204 0.0010	0.148	Tilgit 0:240	farmacool	
	Capillary Zone Moisture Content at Air-Entry	Pressure	0.332	(unitless)		
	(Bw,cap)		*****	•		
	Height of Capillary Zone (CZn)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoil)		5.00	[L/min]		
<b>Building Properties</b>	-					
	Air Exchange Rate (EB)		0.250	{hr-1}		
	Building Mixing Height (HB)		2.44 .	[m]		
	Building Footprint Area (FB)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m²]		

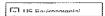
	Building Crack Ratio (η)			0.0	00038	[unitless]		
	Building Foundation Slab Thic	kness (Lcrack)		0.1	00	[m]		
Exposure Parameters	;							
	Exposure Duration for Carcino	gens (EDc)		25		[years]		
	Exposure Frequency for Carci			25		[days/year]		
	Averaging Time for Carcinoge			70		[years]		
	Exposure Duration for Non-Ca			25		[years]		
	Exposure Frequency for Non-	= -	inc)	25	-	[days/year]		
	Averaging Time for Non-Card			25		(years)		
		C/	ALCULATE RESULTS					
RESULTS	11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	vi /: /:	(D. 11)	0.0	10.4.CDA	(om2(a)		
	Unsaturated Zone Effective Di Unsaturated + Capillary Zone				01699 01780	[cm ² /s] [cm ² /s]		
	ott)	Cueriisa ismaan	Mr (Situationar In)	0.0	01700	form-val		
	"A" Parameter		1.591e-4			rameter analysis:		
	"B" Parameter		1218.			t mechanism acros: hrough soil is the		
	"C" Parameter		0.004918	limit	ing pro	ocess for the sub		
	<del></del>	. A4		indoo	r-air p	pathway.		1.541e-4
	Johnson & Ettinger						·····	1.5416-4
	INDOOR AIR RESULTS FOR				Wah Dro	ordination 2		
Santana Ala	Low Predictions	Best E: [ppbv] 2.072e			High Pre 5.640e-		[ppbv]	
Indoor Air Concentration	1.810e-6 [µg/m³] 1.522e-7	[pobv][2.0726	en [ħā/Wai 171436-1	[bhno]	3.0408-	6 [μg/m ³ ] 4.744e-7	[bbp4]	
Cancer Risk	7.968e-10		9,124e-10			2.483e-9		
Hazard Quotient	0.		0.			0.		
M Paradiations	PEST	ESTIMATE	moisture content and	DEEDE	sr	depth to		
s "Low Prediction" cond contamination.	centration produced with BEST	LOTIMETTE	moisture content and			dopul to		
	centration produced with HIGH	EST	moisture content an	SHALL	OWEST	depth to		
ontamination.	,							
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Comments or suggestion	ons							
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### **EPA On-line Tools for Site Assessment Calculation**

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# Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

# Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

#### Background

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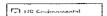
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		Click For an Example	8			
Enter Site Na	ame (optional):		Industrial Wo	orker- Phase IIB		
Enter sample	concentration, units and media type		.0204	μg/L	· Ground \	Water ·
	lepth of the soil gas sample or ground water tab	le (for		7	m	eters
•	contamination)?(LT)					
This value ca	n change by +/-			1	m	eters
What is your co	ontaminant of concern (COC)?		Dieldrin			
What type of b	uilding are you investigating at your site?				Slab-on-Grade	•
What type of so	oil is beneath the huilding?				Loam	
What is the ave	erage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		60571			
	Molecular Weight (MW)		380.91	[g/mole]		
	Henry's Law Constant at ground water temper	erature (H)	0.0001096	19 (unitless)		
	Free-Air Diffusion Coefficient (Da)		1.250e-2	[cm ² /s]		
	Diffusivity in Water (Dw)		4.740e-6	[cm ² /s]		
	Unit Risk Factor (URF)		4.60e-3	[(µg/m³)-1]		
	Reference Concentration (RfC)		1.75e-4	[mg/m³]		
Soli Properties						
	Total Porosity (n)		0.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	<b>Best Estimate</b>	High 0.240	[unitless]	
	( <del>0</del> w)		0.148			
	Capillary Zone Moisture Content at Air-Entry	Pressure	0.332	[unitless]		
	(θw,cap)					
	Height of Capillary Zone (CZh)		0.375	(m)		
	Soil-gas Flow Rate Into the Building (Qsoit)		5.00	(L/min)		
<b>Building Properties</b>						
	Air Exchange Rate (Es)		0.250	[hr-1]		
	Building Mixing Height (Hs)		2.44	[m]		
	Building Footprint Area (Fs)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m²]		

	Building Crack Ratio (η) Building Foundation Slab Thickness (ξ	_crack)	0.000 0.100				
Exposure Parameter	В						
	Exposure Duration for Carcinogens (E	Dc)	25	(years)			
	Exposure Frequency for Carcinogens	(EFc)	250	[days/yea	ar]		
	Averaging Time for Carcinogens (ATc	)	70	[years]			
	Exposure Duration for Non-Carcinoger		25	(years)			
	Exposure Frequency for Non-Carcinog	• •	250	(days/yea	ar)		
	Averaging Time for Non-Carcinogens	(ATnc)	25	[years]			
RESULTS	C	CALCULATE RESULTS					
1111111	Unsaturated Zone Effective Officion (	Coefficient (Datr)	0.001	254 [cm²/s]			
	Unsaturated + Capillary Zone Effective	· ·	0.001				
	off)		5.551	012 (MII-70]			
	"A" Parameter	1,172e-4	Based or	n parameter	analysis:	Advection is	
	"B" Parameter	1649.	Diffusio	on through s	oil is the	s foundation. e overall rate	<del>-</del>
	"C" Parameter	0.004918		g process fo air pathway.	r the sub	surface to	
	Johnson & Ettinger Attenu	ation Factor (α)	1110001-6	arr pachway.		1,145	\$a_4
	INDOOR AIR RESULTS FOR GROUN		Δ	~~~			704
	Low Prediction1	Best Estimate		h Prediction2			
Indoor Air		2.567e-7 [µg/m³] 1.649e-8	[ppbv] 5.7		3,719e-8	[nohu]	
Concentration	Elizade (pg/maj 1.4000 b (pppb)	Liberton (http://orginal.org	[bbnslie.)	1 SOC-1 [µg/m	7  -0.7  36-0 	[ppbv]	
Cancer Risk	2,521e-10	2.889e-10		8.516	-L		
Hazard Quotient	8.768e-7	1.005e-6		2,266			
		J					
	entration produced with BEST ESTIMA	TE moisture content and	DEEPEST	ď	epth to		
contamination.	HIGHEST		CHALLON	MEGT			
2 "High Prediction" con- contamination.	centration produced with HIGHEST	moisture content and	SHALLOV	AE21 (	iepth to		
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## **EPA On-line Tools for Site Assessment Calculation**

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Click Ear on Evennie

		Click For an Exam	<u></u>			
Enter Site Na	me (optional):		Adult Reside	nt - Phase IIB		
Enter sample	concentration, units and media type		2.94	µg/L	- Ground W	/ater -
	epth of the soil gas sample or ground water ta contamination)?(LT)	ible (for		7	me	eters
This value ca	n change by +/-			1	me	ters
What is your co	entaminant of concern (COC)?		Benzene			
What type of bu	uilding are you investigating at your site?				Slab-on-Grade	
What type of so	oil is beneath the building?				Loam	
What is the <u>ave</u>	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		71432	e		
	Molecular Weight (MW)		78.11	[g/mole]		
	Henry's Law Constant at ground water tens	peratore (M)	0.1316031			
	Free-Air Diffusion Coefficient (Da)		8.800e-2	[cm ² /s]		
	Diffusivity in Water (Dw)		9.800e-6	[cm ² /s]		
	Unit Risk Factor (URF)		7.80e-6	{(µg/m³)-1}		
	Reference Concentration (RfC)		0.	[mg/m ³ ]		
Soil Properties						
	Total Porosity (n)		0.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	[unitless]	
	( <del>0</del> w)	_	0.148			
	Capitlary Zone Moisture Content at Air-Entr	y Pressure	0.332	[unitless]		
	(θw.cap)		0.075	F1		
	Height of Capillary Zone (CZh)		0.375	[m]		
Building Booksales	Soil-gas Flow Rate Into the Building (Qsoit)		5.00	(L/min)		
Building Properties	Air Evenanas Poto /En)		0.050	the C		
	Air Exchange Rate (Es)		0.250	[hr-1]		
	Building Mixing Height (Hs)		2.44	[m]		
	Building Footprint Area (FB)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m²]		

	Building C	rack Rati	ο (η)					0.0	00038	[unitless]			
	•		n Slab Thick	ness (L	crack)			0.	100	[m]			
Exposure Parameters	3												
•	Exposure I	Duration	for Carcinog	gens (E	D _G }			30		[years]			
	Exposure f	requen	y for Carcin	ogens	(EFc)			35	0	[days/year	1		
	Averaging	Time for	Carcinogen	s (ATc)	ļ			70		[years]			
	Exposure (	Duration	for Non-Car	cinoger	is (EDnc)			30		[years]			
	Exposure F	requenc	y for Non-C	ardnog	ens (Efnc)			36	5	days/year	)		
	Averaging	Time for	Non-Carcin	ogens (	ATnc)			30		[years]			
				ľ	CALCU	JLATE F	RESULTS	1					
RESULTS				`	·····								
	Unsaturate	d Zone (	Mestive Diff	iusion,C	cetticient (D	eff)		0.0	05540	[cm ² /s]			
	Unsaturato	d.+ Capi	ilary Zone E	Ifective	Diffusion C	oefficien	t (DT	0.0	01190	[cm ² /s]			
	eff)												
	"A" P	aramete	t.			1	.064e-4			rameter a			
	<u>"B" P</u>	aramete	ŗ			3	73.4			t mechani hrough so			
	"C" P	aramete	ſ			0	.004918			ocess for	the sub	surface	to to
			-	Attonu	ation Facto	r (a)		111000	r-air	pathway.			1.041e-4
f	_												1.0410-4
			JLTS FOR	SKOON	·		MPLE DAT		Clink De				
	Low Predic		Ja 000000		Best Estima		10.04.000	***************************************		ediction2	0.04404		
Indoor Air Concentration	0.02183	(hâ\w ₃	8.58900.0	[bbpv]	0.04028	[hð/m³]	0.01262	ppov	0.04664	i (µg/m³)	0.01461	(ppbv)	
Cancer Risk		6.997e				1,291e				1,495e	L		
Hazard Quotient		0.				0.	·-•			0.	-r		
mazard Gdollent	<u> </u>					···							
1 "Low Prediction" cond	antralian ne	مطييحمط يا	in HIGHES	ST	m	nietura r	content and	DEEDE	ST	de	pth to		
contamination.	ossiation pr	JUGUQU	1(1)		(	mater c	South the talk			- C	perto		
2 "High Prediction" con	centration or	oduced v	with LOWES	\$T	п	noisture «	content and	SHALL	.OWEST	. de	epth to		
contamination.					•								
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What do these results mean?

Comments or suggestions

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http://www.epa.gov/athens/learn2model/part-two/onsite/JnE__tite_forward.html



### **EPA On-line Tools for Site Assessment Calculation**

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Click For an Evampio

	(	Click For an Exam	pie					
Enter Site Na	me (optional):			Adult Resider	nt - Phase IIB			
Enter sample	concentration, units and media type		3.43		μg/L	Gr	ound \	Nater
	epth of the soil gas sample or ground water t contamination)?(LT)	able (for			7		m	neters
	n change by +/-				1		m	eters
THIS FAIRE CA	Total Book 1				'		- 11	10(013
What is your co	ntaminant of concern (COC)?		1	,1-Dichloroeth	nane			·
What type of bu	uilding are you investigating at your site?					Slab-on-G	rade	
What type of so	il is beneath the building?					Loam		4.
What is the <u>ave</u>	race soil/ground water temperature?					55		Farenheit
Chemical Properties								
	CAS Number			75343				
	Molecular Weight (MW)			98.96	[g/mole]			
	Henry's Law Constant at ground water tem	porature (H)		0.1099030	[unitiess]			
	Free-Air Diffusion Coefficient (Da)			7.420e-2	(cm ² /6)			
	Diffusivity in Water (Dw)			1.050e-5	[cm²/s]			
	Unit Risk Factor (URF)			0.	[(µg/m³)·1]			
	Reference Concentration (RfC)			0.500	[mg/m³]			
Soil Properties								
	Total Porosity (n)			0.399	[unitless]			
	Unsaturated Zone Moisture Content	Low 0.0610	Se:	st Estimate	High 0.240	{unit	[336]	
	(θw)		0.	148				
	Capillary Zone Moisture Content at Air-Ent	ry Pressure		0.332	[unitless]			
	(θw _i cap)							
	Height of Capillary Zone (CZh)			0.375	[m]			
	Solf-gas Flow Rate Into the Suilding (Qsolf)	•		5.00	[L/min]			
Building Properties								
	Air Exchange Rate (EB)			0.250	[hr·1]			
	Building Mixing Height (HB)			2.44	[m]			
	Building Footprint Area (FB)			100.0	(m²)			
	Subsurface Foundation Area (AB)			106.0	[m²]			

			(ባ)					0.0	00038	[unitiess]				
	<b>Building Fou</b>	indation	Slab Thick	mess (L	crack)			0.1	00	[m]				
xposure Parameters	•													
	Exposure Di	មration f	or Carcino	gens (£l	Dc)			30	(	years]				
	Exposure Fr	equenc	for Carcin	rogens (	EFc)			35	0 [	days/year	1			
	Averaging T	ime for (	Carcinoger	ıs (ATc)				70	1	years)				
	Exposure Di	uration f	or Non-Car	rcinoger	is (EDnc)			30	[	[years]				
	Exposure Fr	equenc	/ for Non-C	arcinog	ens (EFnc)	-		36	5 [	days/year	1			
	Averaging T	ime for l	don-Carcin	iogens (	ATnc)			30	1	years]				
				ſ	CALC	ULATE F	RESULTS							
ESULTS				1,										
	Unsaurated	Zone E	Ifective Oif	lusion ()	pefficient (	Deff)		0.0	04671 [	cm2/s]				
	Unsaturated	+ Capil	ary Zone E	ffective	Diffusion C	oetficer	it (DY	0.0	01027 [	cm²/s]				
	eff)													
	"A" Pa	rameter				\$	9.175e-5				nalysis:			
	"8" Pa	rameter				4	142,9				sm acros		ation. .ll rate-	
	"C" Pa	rameter				(	0.004918	limit	ing proc	ess for	the sub			
					-41 64-			indoo	r-air pa	ithway.			9.006e	
					ation Facto								9,0066	
	INDOOR AIF		LTS FOR		·		MPLE DAT							
	Low Prediction				Best Estim				High Pred	·····	1			
Indoor Air	0.02315	(µg/m³)	0.005725	[vdqq]	0.04322	(µg/m³	0.01069	[ppbv]	0.05024	[µg/m³]	0.01242	[ppbv]		
Concentration	ļ						<u></u>				1			
Cancer Risk		0.				0.				0.				
Hazard Quotlent		4.631e-	5	~		8.544	3-5			1.005e	-4			
"Low Prediction" conc		ورد استعمارات	SE HIGHE	<b>ST</b>		noietuse	content and	DEEDE	ST	d,	apth to			
ntamination.	ena anon prov	ancen M	101 - 110-110	~.	11	Holaturo	contont and			-	ppu, to			
'High Prediction" cond	entration oro	duced w	ith LOWE	ST	г	moisture	content and	SHALL	OWEST	d	epth to			
	A . to a divi i bi o									-	-F-4, 14			

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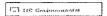
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## **EPA On-line Tools for Site Assessment Calculation**

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# Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

# Forward Calculation of Indoor Air

Backward Calculation full uncertainty analysis

#### Background

Migration of volatile chemicals from the subsurface into overlying buildings is called vapor intrusion (VI). Volatile organic chemicals in contaminated soils or groundwater can emit vapors, which may migrate through subsurface soils and may enter the indoor air of overlying buildings. Building depressurization may cause these vapors to enter the home through cracks in the foundation. Depressurization can be caused by a combination of wind effects and stack effects, which are the result of heating within the building and/or mechanical ventifation. In extreme cases, the vapors may accumulate in dwellings to levels that may pose near-term safety hazards, such as explosion. Typically, however, vapor concentrations are present at low levels, to which long-term exposure may pose increased risk for chronic health effects.

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		Click For an Examp	ole			
Enter Site Na	me (optional):		Adult Resid	ent - Phase IIB		
Enter sample	concentration, units and media type		300	μg/L	Ground V	Vater ··
	epth of the soil gas sample or ground wate contamination)?(LT)	r table (for		7	m	eters
•	n change by +/-			1	m	elers
What is your co	ntaminant of concern (COC)?		cis-1,2-Dichfo	oroethylene		
What type of bu	silding are you investigating at your site?				Slab-on-Grade	
What type of so	il is beneath the building?				) nam	
What is the ave	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		156592			
	Molecular Weight (MW)		96.94	(g/mole)		
	Henry's Law Constant at ground water to	omperaturo (H)	0.099467	'21 (unitiosa)		
	Free-Air Diffusion Coefficient (Da)		7,360e-2	[cm²/s]		
	Diffusivity in Water (Dw)		1.130e-5	[cm²/s]		
	Unit Risk Factor (URF)		٥.	{(µg/m³}-1]		
	Reference Concentration (RfC)		3.50e-2	[mg/m³]		
Soil Properties						
	Total Porosity (n)		0.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0,240	[unitless]	
	(8w)		0.148			
	Capillary Zone Moisture Content at Air-E	intry Pressure	0.332	[unitless]		
	( <del>0</del> w,cap) Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate into the Building (Qse	-11	5.00	[L/min]		
Building Properties	Souther Lion Late title file printing lets.	on)	3.00	(Cital)		
conomy Properties	Air Exchange Rate (EB)		0.250	{hr-1]		
	Building Mixing Height (Hs)		2.44	[m]		
	Building Footprint Area (F8)		100.0	[111] [m²]		
	• • • • •					
	Subsurface Foundation Area (AB)		106,0	[m²]		

	Building Crack Ra	atio (ŋ)					0.0	00038	[unitless]			
	Building Foundati	on Slab Thic	kness (L	crack)			0.	100	[m]			
Exposure Parameter	6											
	Exposure Duratio	n for Carcino	gens (E	Dc)			30		[years]			
	Exposure Freque	ncy for Carcl	nogens (	EFc)			35	0	[days/year	1		
	Averaging Time for	or Carcinoge	ns (ATc)				70		(years)			
	Exposure Duretio	n for Non-Ca	rcinoger	is (EDnc)			30		(years)			
	Exposure Freque	ncy for Non-0	Carcinog	ens (EFnc)			36	5	(days/year	]		
	Averaging Time for	or Non-Carci	nogens (	ATnc)			30		[years]			
			ſ	CALC	IR ATE E	RESULTS	1					
RESULTS			١		001101	LOOCIO.						
NEOOFIO	Unsaturated Zone	Filteriliye Di	Yasion C	netikient (	Deff)		0.0	04634	[cm ² /s]			
	Unsaturated + Ca			•	•	: /DT		01090	[cm ² /s]			
	eff)	Secretal Secretary	,			. (-	0.0		Lann (e)			
	"A" Parame	er			g	.743e-5	Based	on pa	rameter a	nalysis	Advec	tion is
						46.4			t mechani			
	"B" Parame								hrough so ocess for			
	"C" Parame	er			0	.004918			pathway.	-110 041		
	<u>Johnso</u>	n & Ettinger	Attenu	ation Facto	<u>or (</u> α)							9.553e-5
	INDOOR AIR RES	SULTS FOR	GROUN	D WATER	SA	MPLE DA	FA					
	Low Prediction1			Best Estim	ate			High Pre	ediction2			
Indoor Air	1.482 [uo/m	3 0.3740	[ppbv]	2.851	[µg/m³	0.7196	(vdqq)	3.353	(µg/m³)	0.8461	[ppbv]	
Concentration	1,-4	1				1	., ,				1	
Cancer Risk	0.	·			0.	•			0.			
Hazard Quotient	0.042	34			0.0814	7			0.0957	9		

1 "Low Prediction" concentration produced with HIGHEST contamination,

moisture content and DEEPEST

depth to

2 "High Prediction" concentration produced with LOWEST

moisture content and SHALLOWEST

depth to

CLEAR ALL

contamination.

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What do these results mean?

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## **EPA On-line Tools for Site Assessment Calculation**

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# Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

# Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

#### Background

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		Click For an Exam;	ole				
Enter Site Na	me (optional):		Adu	ft Resider	nt - Phase IIB		
Enter sample	concentration, units and media type		7		μg/L	Ground '	Water ·
	epth of the soil gas sample or ground water to contamination)?(LT)	able (for			7	n	neters
•					1		
Inis value cai	n change by +/-				,	rı	neters ·
What is your co	ntaminant of concern (COC)?		Napi	athalene	•		-
What type of bu	ulding are you investigating at your site?					Slab-on-Grade	
What type of so	il is beneath the building?					i nam	
What is the ave	rage soil/ground water temperature?					55	Farenheit
Chemical Properties							
	CAS Number		9	1203			
	Molecular Weight (MW)		1:	28.18	[g/mole]		
	Honry's Law Constant at ground water ten	perature (H)	0	.0081062	8 [unitless]		
	Free-Air Diffusion Coefficient (Da)		5	.900e-2	[cm2/s]		
	Diffusivity in Water (Dw)		7.	.500e-6	[cm ² /s]		
	Unit Risk Factor (URF)		Ð.		[(µg/m³)-1]		
	Reference Concentration (RfC)		3	.00a-3	[mg/m³]		
Soil Properties							
	Total Porosity (n)		0.	.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best E	stimate	High 0.240	[unitless]	
	( <del>0</del> w)		0.148	1			
	Capillary Zone Moisture Content at Air-Ent	ry Pressure	0	.332	(unitiess)		
	(θw,cap)						
	Height of Capillary Zone (CZh)		0.	375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoil)	)	5.	.00	{L/min}		
<b>Building Properties</b>							
	Air Exchange Rate (Es)		0.	.250	[hr-1]		
	Building Mixing Height (Ha)		2.	.44	[m]		
	Building Footprint Area (FB)		14	0,00	{m ² }		
	Subsurface Foundation Area (As)		16	06.0	[m ² ]		

	Building Cr	ack Rati	io (ŋ)					0.0	30038	[unitless]			
	Building Fo	undatio	n Siab Thic	kness (L	.crack)			0.1	100	[m]			
Exposure Parameters													
	Exposure D							30		[years]			
	Exposure F	•	•	-				35	•	[days/year	r]		
	Averaging 1							70		[years]			
	Exposure D							30		[years]			
	Exposure F		•					36	-	(days/year	r]		
	Averaging 1	fime for	Non-Carcin	ogens (	(ATnc)			30		[years]			
				ĺ	CALC	ULATE I	RESULTS						
RESULTS													
	Unsaimated	i Zone £	Effectiva (N	lusion (	oefficiont (	Daff)		0.0	003724	[cm²/s]			
	Unsaturated	≨ + Capi	llary Zone I	Effective	Diffusion (	oolligier	it (DT	0.0	01883	[crn2/s]			
	eff)												
	"A" Pa	eramete	C .				1.683e-4				unalysis: sm acros:		
	"B" Pa	aramete	£.				555,6	Diffu	sion th	hrough so	oil is the	e overa	11 rate-
	<u>"C" Pa</u>	aramete	ť.			(	0.004918			ocess for pathway.	the sub	surface	to
	ولو	ohnson	& Ettinger	Attenu	ation Facto	or (a)				-			1.627e-4
	INDOOR AL	R RESU	JLTS FOR	GROUN	D WATER	SA	MPLE DAT	A			***************************************		
	Low Predict	ion1			Sest Estim	ate	,		High Pre	ediction2			
Indoor Air	0.003254	[µg/m³]	6.211e-4	[ppbv]	0.009234	[hß/w ₃	0.001762	[ppbv]	0.01351	(µg/m³	0.002579	(ppbv)	
Concentration			L				<u> </u>				<u> </u>		
Cancer Risk		0.			ļ	0.				0.			
Hazard Quotient		0.0010	85		<u> </u>	0.0030	078		L	0.0045	503		
"Low Prediction" conc contamination.	entration pro	duced v	vith HIGHE	ST	r	noisture	content and	DEEPE	ST	dı	epth to		
2 "High Prediction" con-	centration pro	oduced v	with LOWE	ST	I	moisture	content and	SHALL	.QWEST	d	epth to		
							•						
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## **EPA On-line Tools for Site Assessment Calculation**

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# Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

# Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

Background

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	Click For an Exam	ible i			
Enter Site Name (optional):		Adult Resid	ent - Phase IIB		
Enter sample concentration, units and media type		54.6	μg/L	Ground	Water
What is the depth of the soil gas sample or ground water	table (for		7	n	neters
ground water contamination)?(LT)					_
This value can change by +/-			1	n	neters
What is your contaminant of concern (COC)?		Tetrachloroe	thylene		*
What type of building are you investigating at your site?				Slab-on-Grade	(1)
What type of soil is beneath the building?				Loam	
What is the average soli/ground water temperature?				55	Farenheit
Chemical Properties					
CAS Number		127184			
Molecular Weight (MW)		165.83	[g/mole]		
Henry's Law Constant at ground water te	mperature (H)	0.393499	7 [unitless]		
Free-Air Diffusion Coefficient (Da)		7.200e-2	(cm²/s)		
Diffusivity in Water (Dw)		8.200e-6	[cm ² /s]		
Unit Risk Factor (URF)		3.00 <b>#-6</b>	[(µg/m³)-1]		
Reference Concentration (RfC)		0.	[mg/m³]		
Soil Properties					
Total Porosity (ii)		0.399	[unitless]		
Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	(unitless)	
( <del>0</del> w)		0.148			
Capillary Zone Moisture Content at Air-Er	ntry Pressure	0.332	[unitless]		
( <del>0</del> w,cap)					
Height of Capillary Zone (CZh)		0.375	(m)		
Soil-gas Flow Rate Into the Building (Qso	il)	5.00	[L/min]		
Building Properties					
Air Exchange Rate (EB)		0.250	[hr-1]		
Building Mixing Height (HB)		2.44	[m]		
Building Footprint Area (FB)		100.0	[m²]		
Subsurface Foundation Area (AB)		106.0	[m²]		

Phase IIB Data



### **EPA On-line Tools for Site Assessment Calculation**

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# Forward Calculation of Indoor Air Concentration

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	0	Click For an Exam	ple				
Enter Site Na	me (optional):		įį	ndustrial Wor	ker- Phase IIB		
Enter sample	concentration, units and media type		2.94		µg/L	Ground 1	Water
	epth of the soil gas sample or ground water t	able (for			7	m	neters ·
<u> </u>	contamination)?(LT)				1	_	
inis value car	n change by +/-				1	13	eters -
What is your co	ntaminant of concern (COC)?		86	enzene			
What type of bu	ilding are you investigating at your site?					Slab-on-Grade	**
What type of so	il is beneath the building?					Loam	
What is the ave	rage soil/ground water temperature?					55	Farenheit
Chemical Properties							
	CAS Number			71432			
	Motecular Weight (MW)			78.11	[g/mole]		
	Henry's Law Constant at ground water ten	nperature (H)		0.1316031	- •		
	Free-Air Dittusion Cosfficient (Da)			8.800e-2	[cm²/s]		
	Diffusivity in Water (Dw)			9.800e-6	[cm²/s]		
	Unit Risk Factor (URF)			7.80e-6	[(µg/m³)-1]		
	Reference Concentration (RfC)			0.	[mg/m ³ ]		
Soil Properties							
	Total Porosity (n)			0.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Bes	t Estimate	High 0.240	[unitless]	
	(0w)		0.1	48			
	Capillary Zone Moisture Content at Air-Ent	try Pressure		0.332	[unitless]		
	(θw,cap)						
	Height of Capillary Zone (CZh)			0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoil	}		5.00	(L/min)		
Building Properties							
	Air Exchange Rate (EB)			0.250	[hr-1]		
	Building Mixing Height (HB)			2.44	[m]		
	Building Footprint Area (FB)			100.0	[m²]		
	Subsurface Foundation Area (AB)			106.0	[m²]		

	Building C	ilding Crack Ratio (η)							0,00038 [unitless]				
	Building F	oundation	Slab Thick	kness (L	.crack)			0.	100	[m]			
Exposure Parameter	8												
•	Exposure	Duration:	for Carcino	gens (E	Dc)			25	i	[years]			
	Exposure	Frequenc	y for Carcir	nogens i	(EFc)			25	60	(days/year	]		
	Averaging	Time for	Carcinoger	ns (ATc)				70	)	(years)			
	Exposure	Exposure Duration for Non-Cardnogens (EDnc)							;	(years)			
	Exposure	Exposure Frequency for Non-Carcinogens (EFnc)							0	(days/year	1		
	Averaging	Averaging Time for Non-Carcinogens (ATnc)							i	[years]			
				r	CALCI	በ ለፕሮ በ	RESULTS						
000111 70				L	CALCO	LAIE	KEQUL10						
RESULTS	Usastinat	and "Zaliana E"	Maridian Pile	instant e	oefficient (D	. 41		0.0	005540	[om2/e]			
	V				•		/DY	0.005540 [cm²/s] 0.001190 [cm²/s]					
		эд + Сарл	mily voing c	cukcaivo	Diffusion Co	ienesei	R (D)	0.0	301190	[CITH-78]			
	eff)	Parameter					1.064e-4	Dasad	00 00	rameter a	nalveie	hdvar	tion is
										mechani			
	<u>"B" J</u>	erameter				:	373.4			nrough so			
	<u>"C" i</u>	Parameter				(	0.004918			ocess for pathway.	the sub	surface	to to
	,	Johnson	& Ettinger	Attenu	ation Factor	<u>(</u> (a)							1.041e-4
	INDOOR A	IR RESU	LTS FOR	GROUN	D WATER	SA	AMPLE DA	TΑ					
	Low Predic	ction1			Best Estima	te			High Pre	diction2			
Indoor Air Concentration	0.02183	[hB\w ₃ ]	0.006838	[ppbv]	0.04028	(µg/m³	0.01262	[ppbv]	0.04664	[µg/m³]	0.01461	[ppbv]	
Cancer Risk	4.165e-8 7.686e-8					e-8	8.899e-8						
Hazard Quotient	1	0. 0.						0.					

1 "Low Prediction" concentration produced with HIGHEST contamination.

moisture content and DEEPEST

depth to

2 "High Prediction" concentration produced with LOWEST contamination.

moisture content and SHALLOWEST

depth to

CLEAR ALL

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What do these results mean?

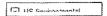
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## **EPA On-line Tools for Site Assessment Calculation**

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Backward Calculation full uncertainty analysis

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	. (	Click For an Exam	ple			
Enter Site Na	me (optional):		Industrial Wor	ker- Phase IIB		
Enter sample	concentration, units and media type		3.43	ρg/L	Ground \	Vater -
ground water	epth of the soil gas sample or ground water t contamination)?(Lt)	able (for		7	m	eters
This yelue ca	n change by +/-			1	m	eters ·
What is your co	interminant of concern (COC)?		1,1-Dichloroeth	ane		
What type of bu	uilding are you investigating at your site?			:	Slab-on-Grade	
What type of so	il is beneath the building?				Loam	•
What is the ave	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		75343			
	Molecular Weight (MW)		98.96	[g/mole]		
	Henry's Law Constant at ground water ten	perature (H)	0.1399030	-		
	Free-Air Diffusion Coefficient (Da)		7.420e-2	[cm²/s]		
	Diffusivity in Water (Dw)		1.050e-5	[cm²/s]		
	Unit Risk Factor (URF)		٥,	[(µg/m³)-1]		
	Reference Concentration (RfC)		0.500	[mg/m³]		
Soil Properties						
	Total Porosity (n)		0.399	[unitiess]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	[unitless]	
	(Ow)	D	0.148	E . a lela a a X		
	Capillary Zone Moisture Content at Air-Ent	ry Pressure	0.332	[unitless]		
	( <del>0</del> w,cap) Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoil	1	5.00	(L/min)		
Building Properties	Odil-See Light valo 1990 the popularial federal	,	3.00	[Danial]		
Countill Clobalties	Air Exchange Rate (Es)		0.250	{hr-1}		
	Building Mixing Height (HB)		2.44	[m]		
	Building Footprint Area (FB)		100.0	[m2]		
	Subsurface Foundation Area (A8)		106.0	[m²]		
	Canada i deligioni, ven (10)		100.0	FJ		

								_					
	Building (								00038	[unitless]			
	-	oundation	Stab Thick	kness (L	.crack)			Q.	100	[m]			
Exposure Parameter													
	,		for Carcino	- ,	,			30	)	[years]			
	Exposure	Frequenc	y for Carcii	nogens	(EFc)			35	i0	(days/year	1		
	Averaging	veraging Time for Carcinogens (ATc)							70 (years)				
	Exposure	xposure Duration for Non-Cardinogens (EDnc)							30 (years)				
	Exposure	xposure Frequency for Non-Carcinogens (EFnc)							5	(days/year	7		
	Averaging	Averaging Time for Non-Carcinogens (ATnc)						30	)	[years]			
		CALCULATE R						1					
RESULTS							***************************************						
	Unsalmat	od Zone E	ffactive Oif	lusion (	Coefficient (D	Paff)		0.0	004671	[cm ² /s]			
	Unsatural	ed + Capil	Jary Zone 8	Hective	Diffusion C	oelficien	t (DY	0,0	001027	[cm ² /s]			
	off)												
	"A" I	arameter				9	.175a-5			rameter a			
	"B" I	arameter				4	42.9	Diffu	sion th	t mechani nrough sc	il is th	ne overa	all rate-
	<u>"C" 1</u>	arameter				0	.004918			ocess for oathway.	the sub	osurface	to to
		Johnson .	& Ettinger	Attenu	ation Facto	<u>r</u> (a)			·				9.006e-5
	INDOOR /	NR RESU	LTS FOR	GROUN	D WATER	SA	MPLE DAT	ſA				]	
	Low Predic	ction1			Best Estima	ele			High Pre	diction2		·	
Indoor Air	0.02315	[µg/m³]	0.005725	[ppbv]	0.04322	[µg/m3]	0.01069	[vdqq]	0.05024	[µg/m³]	0.01242	(ppbv)	
Concentration	İ											- 1	
Cancer Risk		0.				G.				0.			
Hazard Quotient		4.631e-	5			8.644e	-5			1.005e	-4		

1 "Low Prediction" concentration produced with HIGHEST contamination.

moisture content and DEEPEST

depth to

2 "High Prediction" concentration produced with LOWEST

moisture content and SHALLOWEST

contamination.

depth to

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# Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

# Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

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	Clie	ck For an Example				
Enter Site Name (optional):			Industrial Wo	orker- Phase I/B		
Enter sample concentration, un	its and media type	300		μg/L ·	Ground V	/ater ·
What is the depth of the soil ga ground water contamination)?(I	s sample or ground water table (fo .T)	or		7	me	eters
This value can change by +/-				1	me	eters ·
What is your contaminant of cond	em (COC)?		cis-1,2-Dichlor	roethylene		
What type of building are you inve	estigating at your site?			;	Slab-on-Grade	
What type of soil is beneath the b	uilding?				Loam	
What is the average soil/ground v	vater temperature?				55	Farenheit
Chemical Properties						
CAS Number			150592			
Molecular Weig	ht (MW)		96.94	[g/mole]		
Henry's Law Co	nstant at ground water temperatu	re (H)	0.0994872	1 [unitless]		
Free-Air Diffusio	nı Coefficient (Da)		7.300a-2	[cm ² /s]		
Diffusivity in Wa	ter (Dw)		1.130e-5	[cm ² /\$]		
Unit Risk Factor	(URF)		0.	[(µg/m³)-1]		
Reference Cond	entration (RfC)		3,50e-2	[mg/m ³ ]		
Soil Properties				[4]		
Total Porosity (n	1)		0.399	[unitiess]		
Unsaturated Zor	ne Moisture Content Lo	w 0.0610 Be	st Estimate	High 0.240	[unitless]	
( <del>0</del> w)		0	.148	1.11.2.1.1.1.1.1	[amassa]	
Capillary Zone A	foisture Content at Air-Entry Pres	sure	0.332	[unitless]		
(0w,cap)				•		
Height of Capilla	ry Zone (CZh)		0.375	[m]		
Soil-gas Flow Re	ate Into the Building (Qsolf)		5.00	[Umin]		
Building Properties						
Air Exchange Ra	ile (EB)		0.250	(hr-1)		
Building Mixing I	feight (HB)		2.44	(m)		
Building Footprin	nt Area (Fs)		100.0	[m ² ]		
Subsurface Four	ndation Area (AB)		106.0	[m²]		

	Building (	Crack Ratio	) (ŋ)					0.4	00038	(unitless)			
	Bullding F	oundation	Slab Thick	kness (L	crack)			0.1	100	(m)			
Exposure Parameters	3												
	Exposure	Duration 1	or Carcino	gens (El	Dc)			30	ŀ	[years]			
	Exposure	Frequenc	y for Carcin	nogens (	EFc)			35	0	(days/year	)		
	Averaging	Time for	Carcinoger	ns (ATc)				70	ı	(years)			
	Exposure	φosure Duration for Non-Carcinogens (EDnc)								(years)			
	Exposure	cosure Frequency for Non-Carcinogens (EFnc)								(days/year	1		
	Averaging	veraging Time for Non-Carcinogens (ATnc)								[years]			
			•	ſ"	ČΑί	CULATE	RESULTS						
RESULTS				١		000111	ILCOULIO						
RESULIS	iineaturat	od Zono E	ficelive Dif	ársion C	nefficient	(De#)		0.0	004634	[cm2/s]			
			lary Zone E			. ,	ni (DT			[cm²/s]			
	eff)	area i sassitan	my rainer	-Hebitae	677.764.57647	(Annihi titan)	(D	0.001090 [cm ² /s]					
		Parameter					9.743e-5	Based on parameter analysis: Advec					tion is
							446.4			t mechani			
		<u>Parameter</u>								hrough so ocess for			
	<u>"C"</u>	Parameter					0.004918			pathway.			
		Johnson	8. Ettinger	Attenua	ation Fac	tor (a)							9.553e-5
	INDOOR	AIR RESU	LTS FOR	GROUN	D WATE	R S	AMPLE DA	TA		*			
	Low Predi	iction1			Best Esti	mate			High Pr	ediction2			
Indoor Air	1.482	[µg/m³]	0.3740	[vdqq]	2.851	Jua/m	3 0.7196	(vdqq)	3.353	(ua/m³	0.8461	[ydqq]	
Concentration		(1-6 )				11-9	1		]	11-0		- 1	
Cancer Risk		0.				0.	***************************************			0.	·		
Hazard Quotient	0.04234 0.08147					47	0.09579						

1 "Low Prediction" concentration produced with HIGHEST contamination.

moisture content and DEEPEST

depth to

2 "High Prediction" concentration produced with LOWEST

moisture content and SHALLOWEST

depth to

CLEAR ALL

contamination.

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	Į	Click For an Exam	ple			
Enter Site Na	me (optional):		Industrial W	orker- Phase II8		
Enter sample	concentration, units and media type		7	μg/L	Ground V	Vater -
	apth of the soil gas sample or ground water to contamination)?(LT)	table (for		7	me	eters ·
-	containing by +/-			1	mr	eters -
What is your co	ntaminant of concern (COC)?		Naphthalene			
What type of bu	aiding are you investigating at your site?				Slab-on-Grade	-
What type of so	il is beneath the building?				Loam	
••						
What is the ave	rage soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		91203			
	Molecular Weight (MW)		128.18	[g/mole]		
	Henry's Law Constant at ground water ten	nperature (H)	0.008106	28 (unitless)		
	Free-Air Diffusion Coefficient (Da)		5.900e-2	[cm ² /s]		
	Diffusivity in Water (Dw)		7,500e-6	[cm ² /s]		
	Unit Risk Factor (URF)		0.	[(µg/m³)-1]		
	Reference Concentration (RfC)		3.00e-3	[mg/m ³ ]		
Soil Properties						
•	Total Porosity (n)		0.399	[unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estimate	High 0.240	[unitless]	
	(0w)		0.148			
	Capillary Zone Moisture Content at Air-En	try Pressure	0.332	[unitless]		
	(θw,cap)					
	Height of Capillary Zone (CZh)		0.375	[m]		
	Soil-gas Flow Rate Into the Building (Qsoil	1)	5.00	(L/min)		
<b>Building Properties</b>						
	Air Exchange Rate (Ep)		0.250	[hr-1]		
	Building Mixing Height (HB)		2.44	[m]		
	Building Footprint Area (FB)		100.0	[m²]		
	Subsurface Foundation Area (As)		106.0	[m ² ]		

	Building Cn	ack Ratio	(η)				0.	00038	[unitless]		
	Building Fo	undation	Slab Thick	iness (L	crack)		0.	100	[m]		
Exposure Parameters											
	Exposure D	uration f	or Carcino	gens (Ei	Dc)		25	i	[years]		
	Exposure F	requenc	for Carcin	ogens (	Efc)		25	iO	{days/year}	•	
	Averaging 1	veraging Time for Carcinogens (ATc)						)	(years)		
	Exposure D	exposure Duration for Non-Carcinogens (EDnc)						;			
	Exposure F	exposure Frequency for Non-Carcinogens (EFnc)						0	[days/year]		
	Averaging 1	Time for	von-Carcin	iogens (	ATnc)		25		[years]		
				ſ	CALC	JLATE RESULTS					
RESULTS				L.							
RESOLIO	Unsalurated	1 Zone E	Bactive Dit	fusion G	oefficient (E	Deff)	0.0	003724	[cm²/s]		
						oefficient (DT		001883	(cm ² /s)		
	ett.)	a - , cee;geit	eni() (0.01) (0.1)	***********			-		ţ		
	•	arameter				1.683e~4			rameter analy		
	*B* P;	rameter				555.6			t mechanism a hrough soil i		
									ocess for the		
	<u>"C" P</u> E	arameter				0.004918	indoo	r-air p	pathway.		
	<u>J</u> e	ohnson .	<u> Ettinger</u>	Attenua	tion Facto	<u>r.</u> (a)					1.627e-4
	INDOOR AL	R RESU	LTS FOR	GROUN	D WATER	SAMPLE DA	λTA				
	Low Predict	ion1			Best Estima	ale		High Pre	ediction2		
Indoor Air	0.003254	[µg/m³]	6.211e-4	(ppbv)	0.009234	[µg/m3] 0.00176	2 [ppbv]	0.01351	(00.0 [£m\qu]	2579 [ppbv]	
Concentration											
Cancer Risk		0.				0.			0.		
Hazard Quotient	<u> </u>	7.429e-	4		l	0,002108			0.003084		

moisture content and DEEPEST

moisture content and SHALLOWEST

CLEAR ALL

contemination.

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1 "Low Prediction" concentration produced with HIGHEST

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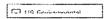
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depth to

depth to



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		Click For an Exam	ple			
Enter Site Nar	ne (optional):		Industria	l Worker- Phase IIB		
Enter sample	concentration, units and media type		54.6	μg/ί.	Ground \	Water ·
	pth of the soil gas sample or ground water	er table (for		7	n	neters
-	contamination)?(LT)					
inis value can	change by +/-			1	m	elers
What is your con	ntaminant of concern (COC)?		Tetrachio	roethylene		
What type of bu	liding are you investigating at your site?				Slab-on-Grade	
What type of soi	I is beneath the building?				Loam	-
What is the aver	age soil/ground water temperature?				55	Farenheit
Chemical Properties						
	CAS Number		12718	4		
	Molecular Weight (MW)		165.83	3 [g/mole]		
	Henry's Law Constant at ground water t	emperature (H)	0.3934	1997 [unitiess]		
	Free-Air Diffusion Coefficient (Da)		7.200€	3-2 [cm ² /8]		
	Diffusivity In Water (Dw)		8.200€	-6 (cm²/s)		
	Unit Risk Factor (URF)		3.00e-	6 [{µg/m³}·1]		
	Reference Concentration (RfC)		0.	[mg/m³]		
Soll Properties						
	Total Porosity (n)		0.389	{unitless]		
	Unsaturated Zone Moisture Content	Low 0.0610	Best Estima	ite High 0.240	[unitless]	
	( <del>0</del> w)		0.148			
	Capillary Zone Moisture Content at Air-8 (0w,cap)	Entry Pressure	0.332	[unitless]		
	Height of Capillary Zone (CZh)		0.375	[m}		
	Soil-gas Flow Rate Into the Building (Qs	oil)	5.00	(L/min)		
Building Properties		,	0.00	terming.		
	Air Exchange Rate (Ep)		0.250	(hr-1]		
	Building Mixing Height (Ha)		2,44	[m]		
	Building Footprint Area (Fa)		100.0	[m²]		
	Subsurface Foundation Area (AB)		106.0	[m²}		
	· -•			F 1		

	Building C	rack Rati	o (ŋ)					0.0	00038	[unitless]			
	Building F	oundation	Siab Thic	kness (L	crack)			0.1	100	[m]			
Exposure Parameter	'S												
	Exposure	Duration:	for Carcin	ogens (El	)c)			25		[years]			
	Exposure	xposure Frequency for Carcinogens (EFc)						25	0	(days/year	1		
	Averaging	veraging Time for Carcinogens (ATc)						70		[years]			
	Exposure	Duration :	or Non-C	arcinoger	s (EDnc)			25		(years)			
	Exposure	Frequenc	y for Non-	Carcinog	ens (EFn	c)		25	0	[days/year	ì		
	Averaging	Time for	Non-Card	inogens (	ATnc)			25		[years]			
				ſ	CAL	CULATE R	ESULTS						
RESULTS				1									
(LOULIO	Unsaturate	ed Zone E	ffective D	iffusion C	aetticlent	(Deff)		0.0	04532	[cm ² /s]			
	** ,*********						(DT		008963				
	Unsaturated + Capillary Zone Effective Diffusion Coefficient (DT												
	atf)		ALLE MARKET				<b>,</b> –						
	off) "A" f	arameter					.010e-5	Based		rameter a			
	<u>"A" f</u>	arameter	:			8.		Based the d	ominant	: mechani	sm acro	ss found	ation.
	"A" F		:			8. 45	.010e-5	Based the d Diffu limit	ominant sion th ing pro		sm acro	ss found he overa	ation. 11 rate-
	"A" f "B" f "C" f	Parameter Parameter Parameter	:		ition Fac	8. 48 0.	.010e-5 56.5	Based the d Diffu limit	ominant sion th ing pro	mechani rough so ocess for	sm acro	ss found he overa	ation. 11 rate- to
	"A" f "B" f "C" f	Parameter Parameter Parameter	& Ettinge	r Attenu		8. 48 0. <u>tor (</u> a)	.010e-5 56.5	Based the d Diffu limit indoo	ominant sion th ing pro	mechani rough so ocess for	sm acro	ss found he overa	ation. 11 rate-
	"A" F "B" F "C" F	Parameter Parameter Parameter Johnson NR RESU	& Ettinge	r Attenui GROUN		8. 49 0. <u>stor (</u> a) R SAI	010e-5 56.5 004918	Based the d Diffu limit indoo	ominant sion th ing pro	mechani nrough so ocess for pathway.	sm acro	ss found he overa	ation. 11 rate- to
indoor Air	"A" F "B" F "C" F	Parameter Parameter Parameter Johnson NR RESU	& Ettinge	r Attenui GROUN	D WATE Best Esti	8. 49 0. <u>stor (</u> a) R SAI	.010e-5 56.5 .004918 MPLE DA	Based the d Diffu limit indoo	ominant sion th ing pro r-air p	mechani nrough so ocess for pathway.	sm acrosil is the sub	ss found he overa	ation. 11 rate- to
indoor Air Concentration	"A" F "B" F "C" F INDOOR A Low Predic	Parameter Parameter Parameter Johnson NR RESU	& Ettinge	r Attenui GROUN	D WATE Best Esti	8. 48 0. tor (α) R SAI mate	.010e-5 56.5 .004918 MPLE DA	Based the d Diffu limit indoo	ominant sion th ing pro r-air p	mechani nrough so ocess for pathway.	sm acro	ss found he overa bsurface	ation. 11 rate- to
	"A" F "B" F "C" F INDOOR A Low Predic	Parameter Parameter Parameter Johnson NR RESU	& Ettinge LTS FOR	r Attenui GROUN	D WATE Best Esti	8. 48 0. tor (α) R SAI mate	010e-5 56.5 004918 MPLE DA	Based the d Diffu limit indoo	ominant sion th ing pro r-air p	mechani nrough so ocess for pathway.	sm acro- il is to the sul	ss found he overa bsurface	ation. 11 rate- to

moisture content and SHALLOWEST

CLEAR ALL

contamination.

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2 "High Prediction" concentration produced with LOWEST

What do these results mean?

Comments or suggestions

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Last updated on Thursday, September 15, 2011

http://www.epa.gov/athens/leam2model/part-two/onsite/JnE_lite_forward.html

depth to



### **EPA On-line Tools for Site Assessment Calculation**

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#### Forward Calculation of Indoor Air Concentration

Backward Calculation full uncertainty analysis

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	Click For an Exe	mple				
Enter Site Name (optional):	The of the selection of the first transfer of the selection of the selecti	Industrial Wo	rker - Phase IIB			
Enter sample concentration, units and r	media type	41.4	µg/L	Ground V	Vater -	
What is the depth of the soil gas sample ground water contamination)?(LT)	e or ground water table (for		7	m	eters	
This value can change by +/-			m	meters		
What is your contaminant of concern (CO	C)?	Trichloroethyle				
What type of building are you investigatin	g at your site?			Slab-on-Grade		
What type of soil is beneath the building?				Loam		
What is the average soll/ground water ten	nperature?			55	Farenheit	
Chemical Properties						
CAS Number		79016				
Molecular Weight (MW)		131,39	[g/mole]			
Henry's Law Constant a	t ground water temperature (H)	0.2367947	[unitiess]			
Free-Air Diffusion Coeffi	icient (Da)	7.900e-2	[cm2/s]			
Diffusivity in Water (Dw)		9.100e-6	[cm ² /s]			
Unit Risk Factor (URF)		4.10e-8	[(µg/m³)-1]			
Reference Concentration	n (RfC)	2e-03	[mg/m³]			
Soil Properties						
Total Porosity (ii)		0.399	(unitless)			
Unsaturated Zone Moisl	ure Content Low 0.0610	Best Estimate	High 0.240	[unitless]		
(6w)		0.148				
Capillary Zone Moisture	Content at Air-Entry Pressure	0.332	[unitiess]			
(θw,cap)						
Height of Capillary Zone	· ·	0.375	[tts]			
Soil-gas Flow Rate Into	the Building (Qsoll)	5.00	(L/min)			
Building Properties						
Air Exchange Rate (EB)		0.250	[hr-1]			
Building Mixing Height (I	•	2.44	[m]			
Building Footprint Area (	•	100.0	[m²]			
Subsurface Foundation	Area (AB)	106.0	[m ² ]			

Exposure Parameters Ex Ex Av Ex Ex Av RESULTS Un Gn en)	"A" Parameter "B" Parameter "C" Parameter Johnson & DOOR AIR RESUL W Prediction1	or Carcinogo for Carcino Carcinogens or Non-Carc for Non-Ca don-Carcino fective Uiffu any Zone Eff	ens (ED ogens (E s (ATc) sinogens arcinoge ogens (A	e) EFc) s (EDnc) ons (EFnc) kTnc) CALCU		25 25 70 25 25 25 25	0	[m] [years] [days/year] [years] [years] [days/year] [years] [cm2/s]		
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Av Ex Ex Av RESULTS Un Un eff)	veraging Time for C  xposure Duration for  xposure Frequency veraging Time for N  nsaturated Zono Et  saturated + Capilia  "A" Parameter  "B" Parameter  "C" Parameter  Johnson &  DOOR AIR RESUL  w Prediction1	Carcinogens or Non-Carc for Non-Ca for-Carcino feetive Cliffs feetive Cliffs	s (ATc) sinogens arcinoge ogens (A	s (EDne) ins (EFne) iTne) CALCU	reff) verficerat (DT	70 25 25 25 0.0 0.0	0	[years] [years] [days/year] [years] [cm2/s]		
EX EX AV  RESULTS  Un Un en)  Indoor Air Lov  Concentration	xposure Duration for xposure Frequency veraging Time for N insaturated Zono Et isaturated + Capilio)  "A" Parameter "B" Parameter "C" Parameter Johnson & DOOR AIR RESUL w Prediction1	or Non-Carc for Non-Ca don-Carcino fective Cliffs ary Zone ISf	cinogens arcinoge ogens (A	ns (EFnc) (Tnc) CALCL	reff) verficerat (DT	25 25( 25 25 0.0 0.0	0	(years) [days/year] (years] [cm2/s]		
EX AV  RESULTS  Un Un en)  INC Lov Indoor Air Concentration	posure Frequency veraging Time for N  nsaturated Zono Et isaturated + Capilio ) "A" Parameter "B" Parameter "C" Parameter Johnson &  DOOR AIR RESUL w Prediction1	for Non-Ca Non-Carcino fective Cliffu ary Zone 136	arcinoge ogens (A  usion Co	ns (EFnc) (Tnc) CALCL	reff) verficerat (DT	256 25 0.0 0.0	0	[days/year] (years) [cm²/s]		
RESULTS Un Un en  (NE Lov Indoor Air Concentration	veraging Time for N  nsaturated Zono Et  nsaturated + Capilio )  "A" Parameter "B" Parameter "C" Parameter Johnson &  DOOR AIR RESUL w Prediction1	<b>don-Carcino</b> fective Cliffo ary Zone Ef	ogens (A	CALCL	reff) verficerat (DT	0.0 0.0	04973	(years) [cm²/s]		
RESULTS  Un Un err)  INC Lov Indoor Air Concentration	nsaturated Zono Et isaturated + Capilio ) "A" Paremeter "B" Parameter "C" Parameter Johnson & DOOR AIR RESUL w Prediction1	factive Criffo ary Zone Ef	E ssion Co	CALCL	reff) verficerat (DT	0.0 0.0	04973	[cm ² /s]		
Un U	isaturated * Capilis )  "A" Paremeter "B" Parameter "C" Parameter Johnson &  DOOR AIR RESUL w Prediction1	ary Zone Ef		iofficient <b>(D</b>	reff) verficerat (DT	0.0				
Un U	isaturated * Capilis )  "A" Paremeter "B" Parameter "C" Parameter Johnson &  DOOR AIR RESUL w Prediction1	ary Zone Ef		iofficient <b>(D</b>	reff) verficerat (DT	0.0				
Un U	isaturated * Capilis )  "A" Paremeter "B" Parameter "C" Parameter Johnson &  DOOR AIR RESUL w Prediction1	ary Zone Ef			uefficient (DT	0.0				
Indoor Air 0.4 Concentration	isaturated * Capilis )  "A" Paremeter "B" Parameter "C" Parameter Johnson &  DOOR AIR RESUL w Prediction1	ary Zone Ef			uefficient (DT	0.0				
Indoor Air 0.4 Concentration	"A" Parameter "B" Parameter "C" Parameter Johnson & DOOR AIR RESUL W Prediction1				•		01014	[		
Indoor Air 0.4 Concentration	"A" Parameter "B" Parameter "C" Parameter Johnson & DOOR AIR RESUL W Prediction1	. Ettinger A			9.061e-5	Bacca				
Lov Indoor Air 0.4 Concentration	"B" Parameter "C" Parameter Johnson & DOOR AIR RESUL w Prediction1	Ettinger A				baseu	on pa	rameter analysis:	Advec	ction is
Lov Indoor Air 0.4 Concentration	"C" Parameter Johnson & DOOR AIR RESUL w Prediction1	Ettinger A			446.0	the d	ominan	t mechanism acros	s found	dation.
Lov Indoor Air 0.4 Concentration	Johnson & DOOR AIR RESUL w Prediction1	Ettinger A			416.0			hrough soil is th ocess for the sub		
Lov Indoor Air 0.4 Concentration	DOOR AIR RESUL w Prediction1	Ettinger A			0.004918			pathway.	surrace	5 10
Lov Indoor Air 0.4 Concentration	w Prediction1		Attenua	tion Factor	<u>r_(</u> a)					8.897e-5
Lov Indoor Air 0.4 Concentration	w Prediction1	TS FOR G	ROUNE	WATER	SAMPLE DA	TΑ	*******	· · · · · · · · ·		
Concentration	····			Best Estima	ite		High Pre	ediction2		
Concentration	4829 (µg/m³) 0	0.08993	[ppbv] (	0.8722	[µg/m³] 0.1624	[ppbv]	-	(µg/m³) 0.1866	[ppbv]	
Cancer Risk	1.00		" 1			"' 1		1.00	0.77	
	4.844e-7	7			8.748e-7			1.005e-6		
Hazard Quotient	0.1654				0.2987			0.3432		
"Low Prediction" concentrentation. "High Prediction" concente contamination.	,				oisture content and			depth to		
CLEAR ALL FORMAT REPOR	IT FOR PRINTER									
Vhat do these results me	ean?									
Sammania as summerito = -										
comments or suggestions										
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Last updated on Tuesday, September 20, 2011



## **EPA On-line Tools for Site Assessment Calculation**

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## Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with two variable/uncertain parameters (source depth, moisture content)

# Forward Calculation of Indoor Air

Backward Galculation full uncertainty analysis

Background

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Click For an Evample

Enter Site Name (op	tional):	Click For an Example		ndustriał Wo	rker- Phase IIB		
.,	ntration, units and media type		11		uaŭ	Central	Minton
Eliter sample concer	ination, thats and media type		11		μg/L Ground Wa		
What is the depth of ground water contain	ole (for			7	neters ·		
This value can chang				1	reters ·		
What is your contamin		Vi	nyi chioride (	chloride (chloroethene)			
What type of building a	are you investigating at your site?				Siab-on-Grade		
What type of soil is her	neath the building?					Loam	
What is the average so	pil/ground water temperature?					65	Farenheit
Chemical Properties							
	Number			75014			
Mole	cular Weight (MW)			62.5	[g/mole]		
Henry	y's Law Constant at ground water temp	oroturo (H)		0.8021316	[anitiess]		
Free-	Air Diffusion Coefficient (Da)			0.1060	[cm²/s]		
Diffus	sivity in Water (Dw)			1.230e-5	[cm ² /s]		
Unit I	Risk Factor (URF)			8.80e-6	[(µg/m³)-1]		
Refer	rence Concentration (RfC)			0.100	[mg/m³]		
Soil Properties							
Total	Porosity (n)			0.399	[unitiess]		
Unsa	turated Zone Moisture Content	i.ow 0.0610	Bes	t Estimate	High 0.240	[unitless]	
$(\theta_W)$			0.1	48			
Capil	lary Zone Moisture Content at Air-Entry	Prosaure		0.332	[unitiess]		
(⊕w,c∈	• •						
•	nt of Capillary Zone (CZh)			0.375	[m]		
-	gas Flow Rate Into the Building (Qsoil)			5.00	[L/min]		
Building Properties							
	xchange Rate (Ep)			0.250	{hr-1}		
	ing Mixing Height (HB)			2.44	[m]		
	ing Footprint Area (FB)			100.0	[m²]		
Subs	urface Foundation Area (AB)			106.0	[m²]		

	Building Crack Ratio (η)	0.00038					
	Building Foundation Slab Thickness (Lcrack)	0.100	[m]				
Exposure Parame	ters						
	Exposure Duration for Carcinogens (EDc)	25	[years]				
	Exposure Frequency for Carcinogens (EFc)	250	[days/year]				
	Averaging Time for Carcinogens (ATc)	70	[years]				
	Exposure Duration for Non-Carcinogens (EDnc)	• • • •					
	Exposure Frequency for Non-Carcinogens (EFnc)		250	[days/year]			
	Averaging Time for Non-Carcinogens (ATnc)	25	[years]				
	CALCULA	TE RESULTS					
RESULTS	**************************************		and the same of th				
	Unsaturated Zone Effective Diffusion Coefficient (Deff)	0.006672	[cm ² /s]	-			
	Unsaturated + Capillary Zone Effective Diffusion Coeff	0.001289	(cm ² /s)				
	eff)						
	"A" Parameter	1.152e-4	Based on parameter analysis: Advection is				
	"B" Parameter		e dominant mechanism across foundation fusion through soil is the overall ra				
	*C" Parameter	<u>arameter</u> 0.004918			ace to		
	Johnson & Ettinger Attenuation Factor (c	ı	indoor-air		1.126e-4		
	INDOOR AIR RESULTS FOR GROUND WATER	SAMPLE DAT	`A				
			1.4.		<b>─</b> i		

	INDOOR AIR RESULTS FOR GROUND WATER SAMPLE DATA								
	Low Prediction1			Best Estimate			High Prediction2		
Indoor Air	0.5639	(µg/m³) 0.2208	(ppbv)	0.9933	[µg/m³] 0.3888	(ppbv)	1.132	[µg/m³] 0.4430	[ppbv]
Concentration									1
Cancer Risk	1.214e-6		2.138e-6			2.436e-6			
Hazard Quotient	0.003863			0.006804			0.007752		

1 "Low Prediction" concentration produced with HIGHEST

moisture content and DEEPEST

depth to

contamination.

2 "High Prediction" concentration produced with LOWEST

moisture content and SHALLOWEST

depth to

CLEAR ALL

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What do these results mean?

Comments or suggestions

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http://www.epa.gov/athens/leam2model/part-two/onsite/JnE_life_forward.html



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	(	Click For an Exam	ple					
Enter Site Na	Enter Site Name (optional):			Industrial Worker- Phase IIB				
Enter sample	concentration, units and media type	0.0375	μg/L ·	Ground Water				
	epth of the soil gas sample or ground water t contamination)?(LT)		7	meters				
This value ca	This value can change by +/-			1	meters ~			
What is your contaminant of concern (COC)?			alpha-НСН (а	lpha-BHC)	•			
What type of be	What type of building are you investigating at your site?			Slab-on-Grade				
What type of so	oil is beneath the building?		Loam					
What is the ave	rage soil/ground water temperature?				55	Farenheit		
Chemical Properties								
	CAS Number		319846					
	Molecular Weight (MW)		290,83	[g/mole]				
	Henry's I,aw Constant at ground water ten	nperature (H)		i6 (unitless)				
	Free-Air Diffusion Coefficient (Da)		1.420e-2	[cm ² /s]				
	Diffusivity in Water (Dw)		7.340e-6	[cm ² /s]				
	Unit Risk Factor (URF)		1.80e-3	[{µg/m³)-1]				
	Reference Concentration (RfC)		0.	[mg/m³]				
Soil Properties								
	Total Porosity (n)		0.399	[unitless]				
	Unsaturated Zone Moisture Content (6w)	Low 0.0610	Best Estimate 0.148	High 0.240	[unitless]			
	Capillary Zone Moisture Content at Air-Ent	ry Pressure	0.332	[unitless]				
	( <del>0</del> w,cap)							
	Height of Capillary Zone (CZn)		0.375	[m]				
	Soil-gas Flow Rate Into the Building (Qsoil)	)	5.00	(L/min)				
<b>Building Properties</b>								
	Air Exchange Rate (EB)		0.250	[hr-1]				
	Building Mixing Height (Ha)		2.44	[m]				
	Building Footprint Area (FB)		100.0	[m ² ]				
	Subsurface Foundation Area (AB)		106.0	[m ² ]				