

# Guidance: Wisconsin Vapor Quick Look-Up Table 1, 2, 3 Indoor Air Vapor Action Levels and Vapor Risk Screening Levels

(Based on May 2021 U.S. EPA Regional Screening Levels)



## Remediation and Redevelopment Program September 2021

CHEMICAL	RESIDENTIAL				SMALL COMMERCIAL				LARGE COMMERCIAL/INDUSTRIAL				MOLECULAR WEIGHT	U.S. EPA RSL BASIS
	AF = 0.03								AF = 0.01					
	INDOOR AIR VAL		SUB-SLAB VAPOR VRSL		INDOOR AIR VAL		SUB-SLAB VAPOR VRSL		INDOOR AIR VAL		SUB-SLAB VAPOR VRSL			
	µg/m <sup>3</sup>	ppbV	µg/m <sup>3</sup>	ppbV	µg/m <sup>3</sup>	ppbV	µg/m <sup>3</sup>	ppbV	µg/m <sup>3</sup>	ppbV	µg/m <sup>3</sup>	ppbV	g/mole	
Benzene	3.6	1.1	120	37	16	4.9	<b>520</b>	160	16	4.9	1,600	490	78.11	c
Carbon Tetrachloride	4.7	0.73	160	<b>25</b>	20	3.1	<b>680</b>	<b>110</b>	20	3.1	2,000	310	153.82	c
Chloroform	1.2	0.24	<b>41</b>	<b>8.3</b>	5.3	1.1	180	<b>36</b>	5.3	1.1	530	110	119.38	c
Chloromethane	94	45	3,100	1,500	390	190	13,000	<b>6,200</b>	390	190	39,000	19,000	50.49	n
Dichlorodifluoromethane	100	20	<b>3,500</b>	<b>700</b>	440	88	15,000	<b>3,000</b>	440	88	44,000	8,800	120.91	n
1,1-Dichloroethane (1,1-DCA)	18	4.4	<b>590</b>	<b>140</b>	77	19	2,600	630	77	19	7,700	1,900	98.96	c
1,2-Dichloroethane (1,2-DCA)	1.1	0.27	<b>36</b>	<b>8.7</b>	4.7	1.1	160	<b>39</b>	4.7	1.1	470	110	98.96	c
1,1-Dichloroethylene (1,1-DCE)	210	52	7,000	1,700	880	220	29,000	<b>7,200</b>	880	220	88,000	22,000	96.94	n
Dichloroethylene, cis-1,2-	--	--	--	--	--	--	--	--	--	--	--	--	96.94	--
Dichloroethylene, trans-1,2-	42	10	1,400	350	180	45	5,800	1,400	180	45	18,000	4,500	96.94	n
Ethylbenzene	11	2.5	370	<b>84</b>	49	11	1,600	<b>360</b>	49	11	4,900	1,100	106.17	c
Methyl Tert-Butyl Ether (MTBE)	110	30	<b>3,600</b>	<b>980</b>	470	130	16,000	<b>4,400</b>	470	130	47,000	13,000	88.15	c
Methylene Chloride	630	180	21,000	<b>5,900</b>	2,600	740	<b>88,000</b>	25,000	2,600	740	260,000	74,000	84.93	n
Naphthalene	0.83	0.16	28	5.3	3.6	0.68	120	23	3.6	0.68	360	68	128.18	c
Tetrachloroethylene (PCE)	42	<b>6.1</b>	1,400	<b>200</b>	180	<b>26</b>	<b>5,800</b>	<b>840</b>	180	<b>26</b>	18,000	<b>2,600</b>	165.83	n
Toluene	5,200	1,400	170,000	<b>44,000</b>	22,000	5,700	730,000	190,000	22,000	5,700	2,200,000	570,000	92.14	n
1,1,1-Trichloroethane (1,1,1-TCA)	5,200	940	170,000	31,000	22,000	4,000	730,000	130,000	22,000	4,000	2,200,000	400,000	133.41	n
Trichloroethylene (TCE)	2.1	<b>0.38</b>	70	13	8.8	1.6	290	53	8.8	1.6	880	160	131.39	n
Trichlorofluoromethane	--	--	--	--	--	--	--	--	--	--	--	--	137.37	--
1,2,4-Trimethylbenzene	63	13	2,100	<b>420</b>	260	52	<b>8,800</b>	<b>1,800</b>	260	52	26,000	5,200	120.20	n
1,3,5-Trimethylbenzene	63	13	2,100	<b>420</b>	260	52	<b>8,800</b>	<b>1,800</b>	260	52	26,000	5,200	120.20	n
Vinyl Chloride	1.7	0.65	<b>56</b>	22	28	11	930	<b>360</b>	28	11	2,800	1,100	62.50	c
Xylene (mix)	100	23	3,500	<b>790</b>	440	100	15,000	<b>3,400</b>	440	100	44,000	10,000	106.17	n
Xylene (m,o,p- separately)	100	23	3,500	<b>790</b>	440	100	15,000	<b>3,400</b>	440	100	44,000	10,000	106.17	n

**Notes**  
 All values in µg/m<sup>3</sup> obtained from U.S. EPA Vapor Intrusion Screening Level (VISL) calculator (three significant figures) & rounded to two significant figures. VISL linked to U.S. EPA RSL database of toxicity and chemical parameters.  
 All values in ppbV calculated from VALs & VRSLs reported above in µg/m<sup>3</sup>.  
 AF = Attenuation Factor      VAL = Vapor Action Level      VRSL = Vapor Risk Screening Level      U.S. EPA RSL = Regional Screening Level      -- = Inhalation toxicity values not available from U.S. EPA  
 Bolded values are updated from previous version of WI Vapor Quick Look-Up Table.      n = noncarcinogenic; c = carcinogenic

**Immediate Action Criteria:** carcinogens (c) = 10 x VAL or VRSL; non-carcinogens (n) = 3 x VAL or VRSL; TCE in indoor air at certain concentrations

- Footnotes**
- Quick Look-up Table only includes common contaminants. To determine the VAL and VRSL for other contaminants, refer to the steps on the next page.
  - Concentrations reported in ppbV and µg/m<sup>3</sup> are not equivalent for air. If comparing datasets with both units, refer to the instructions on page 3 for how to convert between ppbV and µg/m<sup>3</sup>.
  - Note indoor air and sub-slab vapor concentrations are variable when making decisions on protecting public health from vapor intrusion under Wis. Admin. Code s. NR 708

### **STEP 1: Check if the contaminant is sufficiently volatile and toxic to pose a vapor risk:**

- Open the current “U.S. EPA Vapor Intrusion Screening Levels (VISL) Calculator” home page at [www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator](http://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator).
- Select the “Calculator” from the Contents list.
- Set Hazard Quotient (for Non-Carcinogens) to 1 and Target Risk (for Carcinogens) to  $10^{-5}$ .
- Select Exposure Scenario. *[Example: Resident]*
  - Select “Resident” for settings (i.e., land use) meeting the definition of “residential setting” in Wis. Admin. Code § NR 700.03(49g).
  - Select “Commercial” for settings meeting definition of “non-residential setting” (i.e., commercial or industrial) in Wis. Admin. Code § NR 700.03(39m).
- Select Screening Level Type “Default” which will provide an attenuation factor of 0.03. See step 2 to select a different attenuation factor.
- Select Individual Chemical(s). *[Example: Trichloroethylene (TCE)]*
- Click on “Retrieve (new window).”
- Scroll down to “(Resident or Commercial) VISL” *[Example: Resident VISL]* and scroll over to columns 5 and 6 to determine if the chemical is sufficiently volatile and toxic to pose an inhalation risk via vapor intrusion from soil or groundwater source. *[Example: Yes (Soil Source) and Yes (Groundwater Source) for TCE]*
  - If no, this means the chemical does not pose an inhalation risk, and the vapor intrusion assessment may be complete for that chemical.
  - If yes, move to Step 2.

### **STEP 2: Determine the indoor air Vapor Action Level (VAL)**

- For the Exposure Scenario selected in Step 1 *[Example: Resident]*, scroll over to column 7 for “Target Indoor Air Concentration” (now reported on VISL to three significant figures). *[Example: 2.09E+00 for Resident Target Indoor Air Concentration for TCE]*
- Target Indoor Air Concentration rounded to two significant figures = **VAL** for selected Exposure Scenario. *[Example: 2.09E+00 rounded to 2.1  $\mu\text{g}/\text{m}^3$  for Residential VAL for TCE]*
- For additional Exposure Scenarios, return to the VISL Calculator page and select applicable Exposure Scenario as described in Step 1 above. *[Example Commercial]* Note “Commercial” = all non-residential settings.
- Click on “Retrieve (new window).”
- Scroll down to “(Resident or Commercial) VISL” *[Example Commercial VISL]* and over to column 7 for “Target Indoor Air Concentration” as described above for the VAL for selected Exposure Scenario. *[Example 8.76E+00 for Commercial Target Indoor Air Concentration for TCE rounded to 8.8  $\mu\text{g}/\text{m}^3$  for Commercial VAL for TCE]*

### **STEP 3: Calculate the Vapor Risk Screening Levels (VRSLs)**

- Select the appropriate attenuation factor from the table on page 3:
  - Attenuation factor is based on the building type and the location where the sample was collected.
  - It is expected that the *sub-slab vapor attenuation factor* will be the default (0.03) for most sampling scenarios.
- On the retrieval windows specific for each exposure scenario, scroll over to “Target Sub-Slab and Near-source Soil Gas Concentration” and round to two significant figures. *[Example 6.95E+01 for Residential Target Sub-slab and Near-source Soil Gas Concentration rounded to 70  $\mu\text{g}/\text{m}^3$  for Residential sub-slab VRSL for TCE and 2.92E+02 for Commercial Target Sub-slab and Near-source Soil Gas Concentration rounded to 290  $\mu\text{g}/\text{m}^3$  for Commercial sub-slab VRSL for TCE]*
- For additional Screening Levels (i.e., attenuation factor other than 0.03), choose option A or B:
  - A. Return to the VISL Calculator page. **Note:** If utilizing the VISL Calculator page to calculate VRSLs with attenuation factors other than the default 0.03, always select “Output to PDF” and include the PDF in a submittal to the DNR as support for calculations.
    - Select Screening Level Type “Site Specific.”
    - Select source for chemical physical properties and toxicity values “User-provided.”
    - Click on “Retrieve (new window).”
    - Scroll down to “Groundwater and Soil Gas Equation and Parameters” and update the applicable AF. *[Example 0.01 for  $AF_{ss}$  for sub-slab large commercial or industrial]*
    - Click on “Retrieve,” scroll to appropriate column as described above for the VRSLs and round to two significant figures as described above.
  - B. Divide each VAL by the selected attenuation factor.  $\text{VAL}/\text{attenuation factor} = \text{VRSL}$  rounded to two significant figures.

**\* Groundwater VRSLs:**

- Do not use the VISL Calculator or the formula below for calculating the groundwater VRSL for PCE and TCE. If PCE or TCE are in groundwater, use the respective Wis. Admin. Code ch. NR 140 Enforcement Standards as the vapor screening criteria for plumes at the water table.
- Do not use the VISL Calculator or the formula below for calculating the groundwater VRSL for any contaminant where the groundwater plume is in contact with a building foundation, including PCE and TCE. If groundwater is in contact with the building foundation, use the Wis. Admin. Code ch. NR 140 Preventive Action Limit as the vapor screening criteria.
- Use the VISL Calculator for the default 0.001 attenuation factor for the appropriate exposure scenario and chemical.
- On the retrieval windows specific for each exposure scenario, scroll over to “Target Groundwater Concentration” and round to two significant figures. *[Example 4.59E+01 for Residential Target Groundwater Concentration rounded to 460 µg/m³ for Residential groundwater VRSL for naphthalene]*
- For additional Screening Levels (i.e., attenuation factor other than 0.001), choose option A or B:
  - A. Return to the VISL Calculator page. Note if utilizing the VISL Calculator page to calculate groundwater VRSLs with attenuation factors other than the default 0.001, always select “Output to PDF” and include the PDF in a submittal to the DNR as support for calculations.
    - Select Screening Level Type “Site Specific”
    - Select source for chemical physical properties and toxicity values “User-provided”
    - Click on “Retrieve (new window)”
    - Scroll down to “Groundwater and Soil Gas Equation and Parameters” and update the applicable AF. *[Example 0.0001 for AF<sub>gw</sub> for groundwater large commercial or industrial]*
    - Click on “Retrieve,” scroll to appropriate column as described above for the groundwater VRSLs and round to two significant figures as described above.
  - B. Use the following formula to calculate the groundwater concentrations that could cause a VAL exceedance in indoor air for a compound.

MEDIA	ATTENUATION FACTOR	
	RESIDENTIAL OR SMALL COMMERCIAL BUILDING	INDUSTRIAL OR LARGE COMMERCIAL BUILDING
Crawl space	1	1
<b>Sub-slab vapor</b>	<b>0.03</b>	<b>0.01</b>
Deep soil gas	0.01	0.001
Groundwater*	0.001	0.0001
Sanitary sewer gas (from main)**	0.03	0.03

$$C_{gw} = \frac{VAL}{H \times AF \times 1000 \frac{L}{m^3}}$$

Where: C<sub>gw</sub> = Groundwater Concentration (µg/L)  
 VAL = Vapor Action Level (µg/m³)  
 AF = attenuation factor (dimensionless or unitless)

- Use groundwater attenuation factor in most cases, or
  - Use the sub-slab attenuation factor if groundwater is near, or in contact with the building foundation.
- H = Henry’s Law constant (dimensionless)
- On the VISL spreadsheet, go to worksheet titled “Parameters Summary” and look up the Henry’s law constant for the chemical.
  - Or go to [www3.epa.gov/ceampubl/learn2model/part-two/onsite/esthenry.html](http://www3.epa.gov/ceampubl/learn2model/part-two/onsite/esthenry.html) Input the temperature and chemical name to get Henry’ law constant.

**\*\*Sanitary Sewer Gas Screening Levels:**

- See RR-649, *Guidance for Documenting the Investigation of Human-made Preferential Pathways Including Utility Corridors*. Go to [dnr.wi.gov](http://dnr.wi.gov), search “RR-649.”

**Convert data from ppbV to µg/m³ (if needed):**

- If a vapor dataset has multiple units (ppbV and µg/m³), convert the data to a common unit of measure prior to evaluating trends or comparing values in the data.
- To convert between µg/m³ and ppbV, go to [www3.epa.gov/ceampubl/learn2model/part-two/onsite/ia\\_unit\\_conversion.html](http://www3.epa.gov/ceampubl/learn2model/part-two/onsite/ia_unit_conversion.html), or use following formula:

$$\mu\text{g}/\text{m}^3 = \frac{\text{ppbV} * \text{MW}}{24.05}$$

Where: MW = molecular weight (g/mole)  
 24.05 = conversion factor based on temperature = 20°C and pressure = 1 atm

For additional assistance, contact a DNR vapor intrusion specialist listed on the “Vapor Intrusion Resources for Environmental Professionals” web page under the “Contacts” tab; visit [dnr.wisconsin.gov/topic/Brownfields/Vapor.html](http://dnr.wisconsin.gov/topic/Brownfields/Vapor.html).