

# NJDEP VAPOR INTRUSION GUIDANCE

## Ground Water Screening Levels: Default Values and Site-Specific Evaluation



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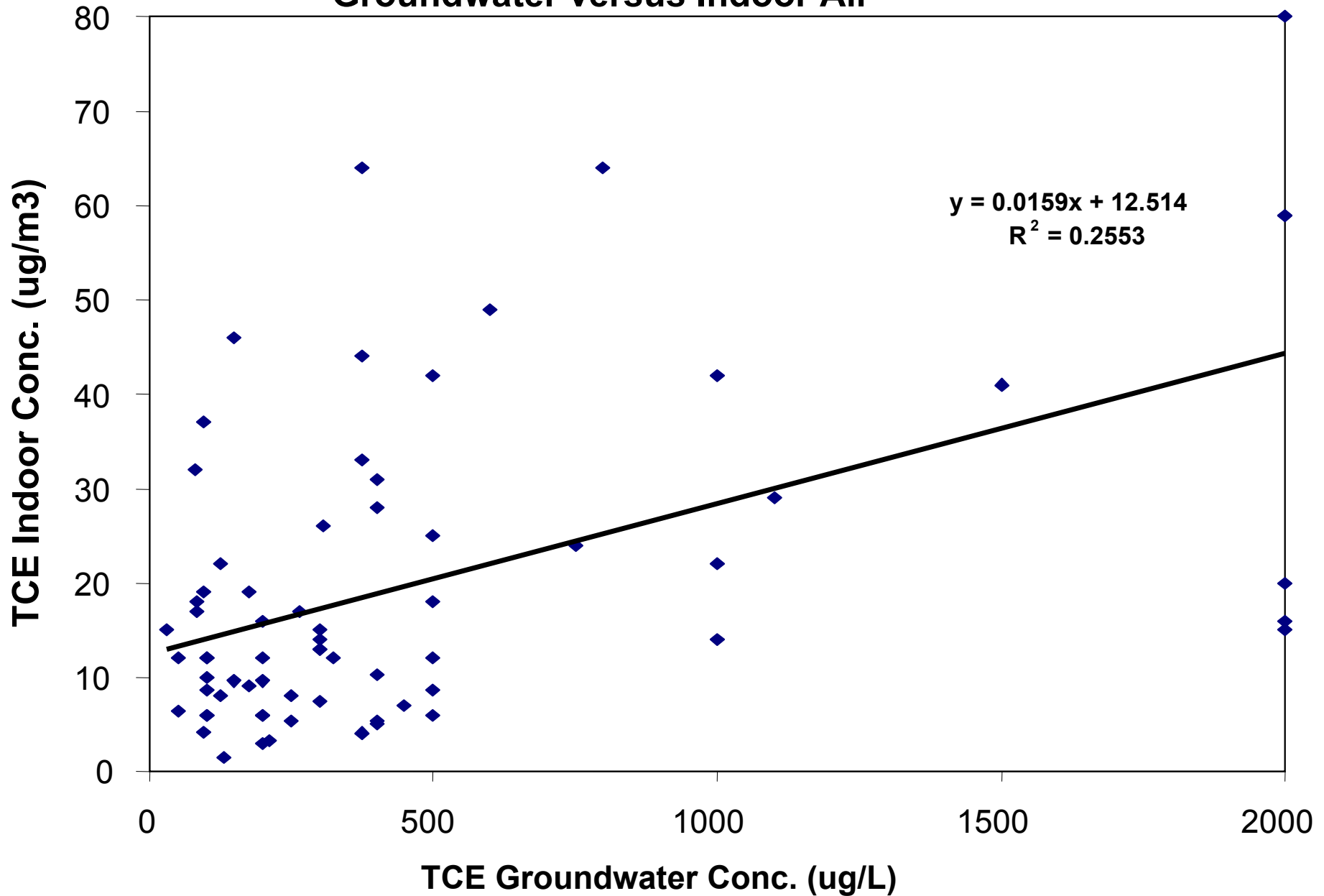
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# Why are the Ground Water Screening Levels Low?

- $10^{-6}$  risk level for carcinogens
- Higher groundwater concentrations most often the problem, but:
- Need to protect all homes to this level

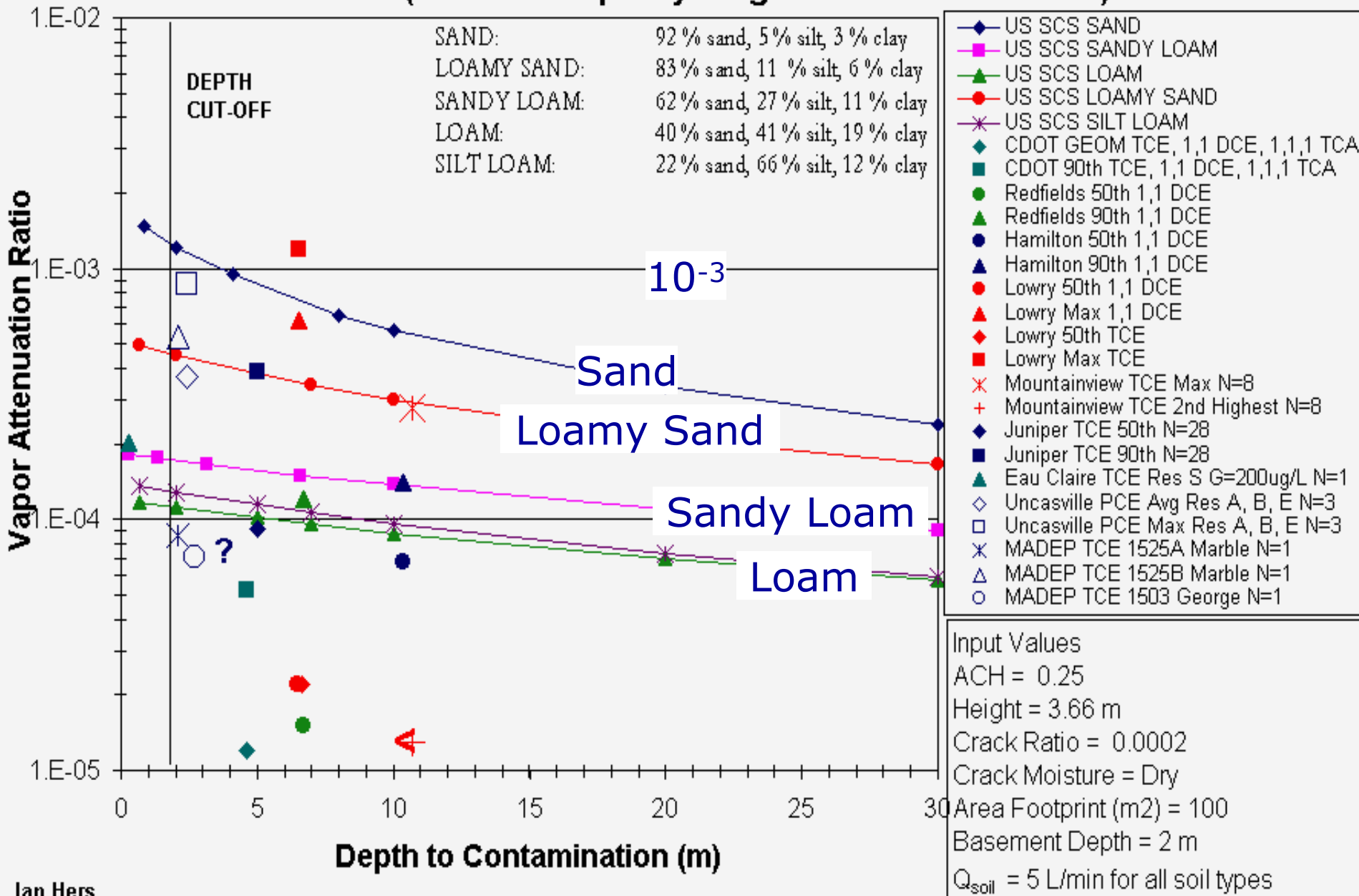
# Groundwater versus Indoor Air



# USEPA Indoor Air Guidance screening numbers were developed by considering both model predictions and field data

- Modeling: Johnson & Ettinger model used to calculate Attenuation Factors between the groundwater and indoor air
- Field data: Attenuation Factors calculated from actual site measurements of groundwater and indoor air concentrations

# ALPHA'S CHLORINATED SOLVENTS - GROUNDWATER TO INDOOR AIR PATHWAY (Diffusion capillary fringe & unsaturated zone)



# NJDEP used modeling approach to develop Ground Water Screening Levels

- Allows for use of individual chemical properties
- Allows for adjustment of GW temperature
- Allows for easy calculation of GWSL using alternate soil textures

# Generic Ground Water Screening Levels (GWSL)

- GWSL (Table 1) calculated using the Johnson & Ettinger (J&E) Model with NJ specific parameters
- Model parameters include:
  - sand soil
  - depth interval of 5 feet between building foundation and groundwater
  - ground water temperature of 13<sup>0</sup>C
- J&E results for carcinogens multiplied by child adjustment factor (0.74)
- Defer to the NJ GWQS when the calculated health-based ground water screening levels fall below the NJ GWQS

Degradation of BTEX compounds often results in an additional dilution factor that is highly uncertain at this time

- EPA Guidance (*November, 2002*): 3X-10X
- Fitzpatrick/Fitzgerald (*Soil & Sediment Contamination, 2002*): 100X-1000X
- Ririe/Sweeney/Daugherty (*Soil & Sediment Contamination, 2002*): 500X - 35,000X



# Petroleum Hydrocarbons & Biodegradation

- The Department recognizes biodegradation of hydrocarbons occurs
- GWSLs include a multiplier (10X) for benzene, ethylbenzene, toluene and total xylenes to address biodegradation
- NJDEP will track future developments regarding this issue

# Default GWSL for Vapor Intrusion

	<i>Health-Based GW to Indoor Air Value (<math>\mu\text{g/L}</math>)</i>	<i>NJDEP GWQS (<math>\mu\text{g/L}</math>)</i>	<i><b>NJDEP GWSL (<math>\mu\text{g/L}</math>)</b></i>
Benzene	15	1	<b>15</b>
PCE	0.8	1	<b>1</b>
TCE	0.06	1	<b>1</b>
1,1-DCE	250	1	<b>250</b>
1,1,1-TCA	5,100	30	<b>5,100</b>
$\text{CCl}_4$	0.2	1	<b>1</b>
MTBE	78	70	<b>78</b>

Default GWSL are adequately protective of most conditions.

## Exceptions:

- Groundwater is less than 2 feet below building foundation
- Groundwater reaches fill material below building foundation
- Capillary zone reaches building foundation (Table 4-1 in guidance)
- Building foundation in direct contact with fractured bedrock

# Site-Specific Options to the Generic GWSL

## Option 1:

GWSL for Alternate Soil Textures (Table 3) have been developed for:

*loamy sand*

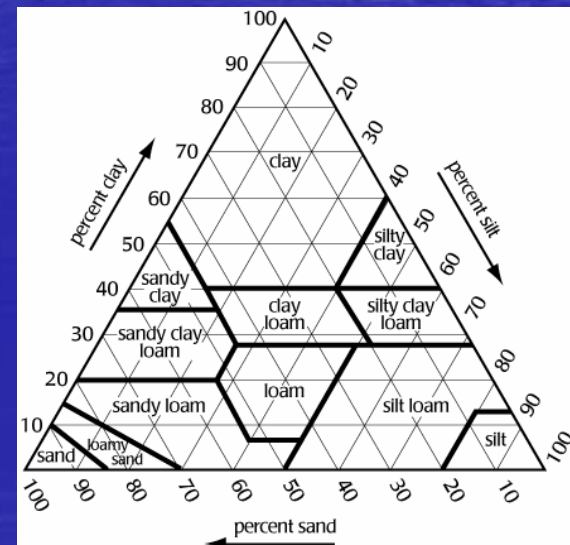
*sandy loam*

*loam*

Applicability based on lab soil grain size analysis with at least 75% of the soil profile as fine as above

# Determining soil texture

- Collect soil core(s)
- Soil samples submitted to laboratory for texture analysis
- Textures assigned using USDA soil triangle
- At least 75% of soil vertical profile must be as fine as selected alternate texture



# Sensitivity of Groundwater Screening Level ( $\mu\text{g/L}$ ) to Soil Texture

<i>Soil Texture</i>	<i>Benzene</i>	<i>PCE</i>	<i>TCE</i>
Sand	15	1*	1*
Loamy sand	33	2	1*
Sandy loam	81	5	1*
Loam	120	7	1*

\*PQL

# Site-Specific Options to the Generic GWSL

## Option 2: Site-specific use of the J&E model:

- Model available from  
[http://www.epa.gov/oswer/riskassessment/airmodel/johnson\\_ettinger.htm](http://www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm)
- Soil texture layers<sup>#</sup>
- Depth to ground water and building foundation below grade
- Building air exchange rate, perimeter and first floor height<sup>\*#</sup>
- Exposure duration and frequency (worker scenario)<sup>\*</sup>
- Toxicity factors

*\*Requires institutional control and/or monitoring to address changes in future use*

*#Requires use of advanced J&E spreadsheet*

# Site-specific soil texture layers

- Layers must be continuous across the site and may not be fractured, as demonstrated by soil borings
- Enter depth range of each soil layer in advanced version of J&E spreadsheet. Select built-in soil properties for each layer.
- For carcinogens, result must be multiplied by 0.74 (child adjustment factor)
- May have large effect on results if a continuous fine soil layer exists (e.g. silty clay)



# Depth to Groundwater/Depth of Foundation

- The depth interval between the building foundation and water table is the controlling parameter
- For a given groundwater depth, the depth interval is greater for slab construction than for basement construction
- Enter depth of foundation and depth of water table on either the screening or advanced J&E spreadsheet
- For carcinogens, results must be multiplied by 0.74 (child adjustment factor)

# Sensitivity of Groundwater Screening Level ( $\mu\text{g/L}$ ) to GW Depth (sand soil)

<i>Depth to GW (feet)</i>	<i>Benzene</i>	<i>PCE</i>	<i>TCE</i>
11	15	1*	1*
20	19	1.0	1*
30	25	1.3	1*

\*PQL

# Adjustment of Building Air Exchange Rate

- Enter air exchange rate ( $\text{hr}^{-1}$ ) in J&E advanced spreadsheet

## Adjustment of Building Perimeter

- $Q_{\text{soil}} = 5\text{L/min} \times \text{Perimeter (cm)} / 4000 \text{ cm}$
- Enter  $Q_{\text{soil}}$  and Perimeter in J&E advanced spreadsheet
- Height of lowest floor of the building may also be adjusted

Don't forget: child adjustment factor (0.74) for carcinogens!

# Sensitivity of Groundwater Screening Level ( $\mu\text{g/L}$ ) to Building Air Exchange Rate (sand soil)

<i>Air Exchange Rate (<math>\text{hr}^{-1}</math>)</i>	<i>Benzene</i>	<i>PCE</i>	<i>TCE</i>
0.25	15	1*	1*
0.5	30	1.5	1*
1.0	60	3	1*

\*PQL

# Sensitivity of Groundwater Screening Level ( $\mu\text{g/L}$ ) to Building Perimeter (sand soil)

<i>Building Perimeter (m)</i>	<i>Benzene</i>	<i>PCE</i>	<i>TCE</i>
10	15	1*	1*
20	23	1.1	1*
30	36	1.2	1*

\*PQL

# Toxicity Factors and Exposure Assumptions

- Toxicity factors: New IRIS or USEPA Region III factors may be used. Must modify J&E spreadsheet chemical properties database.
- Worker scenario allows for the following changes:
  - Elimination of child adjustment factor (0.74)
  - Exposure duration of 25 years
  - Exposure frequency of 250 days/year