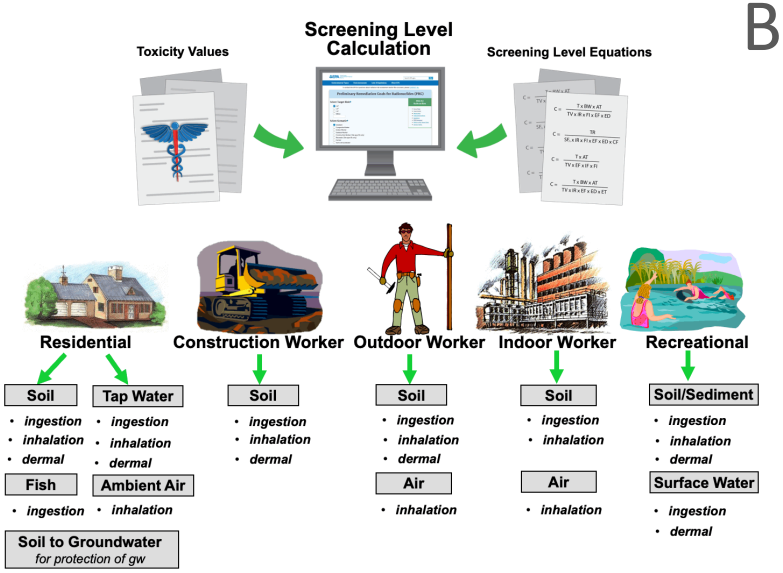
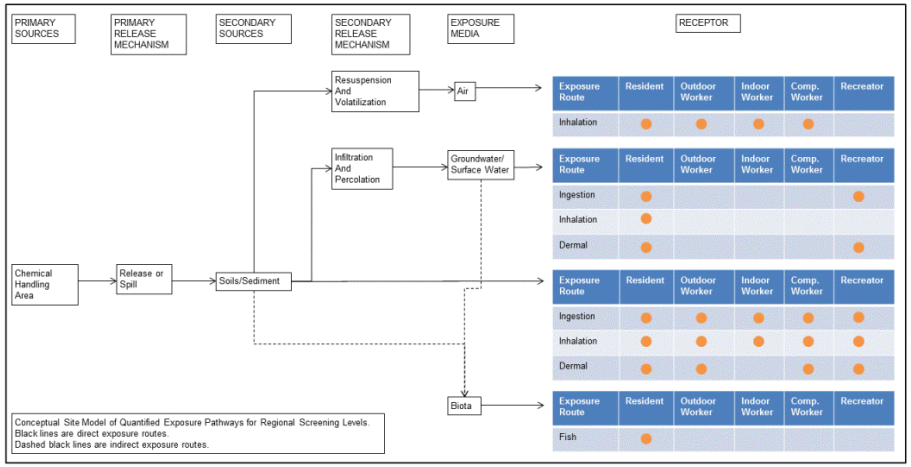
US EPA Regional Screening Level and Vapor Intrusion Screening Level Calculator Training

October 22&23, 2025

Boise, ID





https://www.epa.gov/risk/regional-screening-levels-rsls

https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Contact Information

- Fred Dolislager dolislagerf1@ornl.gov
- Debra Stewart stewartdj@ornl.gov
- Karessa Manning manningkl@ornl.gov
- Katie Noto boluska@ornl.gov

Schedule

- 8:00 a.m. Meet and Greet
- 8:30 a.m. Welcome and Introductory Remarks
- 8:45 a.m. Risk Assessment Basics
- 9:15 a.m. RSL Background and Supporting Material
- 10:00 a.m. Break
- 10:15 a.m. Regional Screening Levels Calculator
- 12:00 p.m. Lunch
- 1:00 p.m. Resume Regional Screening Levels Calculator
- 2:30 p.m. Break
- 2:45 p.m. Resume Regional Screening Levels Calculator
- 3:30 p.m. Vapor Intrusion Screening Levels Calculator
- 4:00 p.m. Practice Exercises for RSL and VISL
- 5:00 p.m. Dismiss

Outline

- Risk Assessment Basics
- Historical Perspective of RSLs
- Understanding Changes Over time (What's New)
- Getting Support (FAQ, Contact Information)
- User Guide Special Cases
  - Mutagens
  - Trichloroethylene
  - Vinyl Chloride
  - Arsenic
- RSL Calculator
  - Resident, Worker, Construction, Recreator, Migration to Groundwater
  - Water, Soil, Air, Fish
- Historical Perspective of VISLs
- Understanding Changes over time (What's New)
- VISL Calculator
  - Focus on Resident and Worker
  - Water, Soil, Air
- RSL and VISL Practice Sessions

Risk Assessment Basics

- Risk really means…
  - Cancer
  - Noncancer
- Forward vs. Backward Risk Assessment
- Totaling risk and SLs
- The Four Steps
- VF & C_{sat}
- PEF
- K
- Toxicity Values
- Dermal

Risk Assessment Basics

- Risk is product of: impact of severity (consequence) and impact of likelihood (probability).
- For carcinogenic effects, risk is estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen.
- For noncarcinogenic (systemic or hazardous) effects, risk is not expressed as a probability but rather is evaluated by comparing an exposure level over a period of time to a reference dose derived for a similar exposure period.

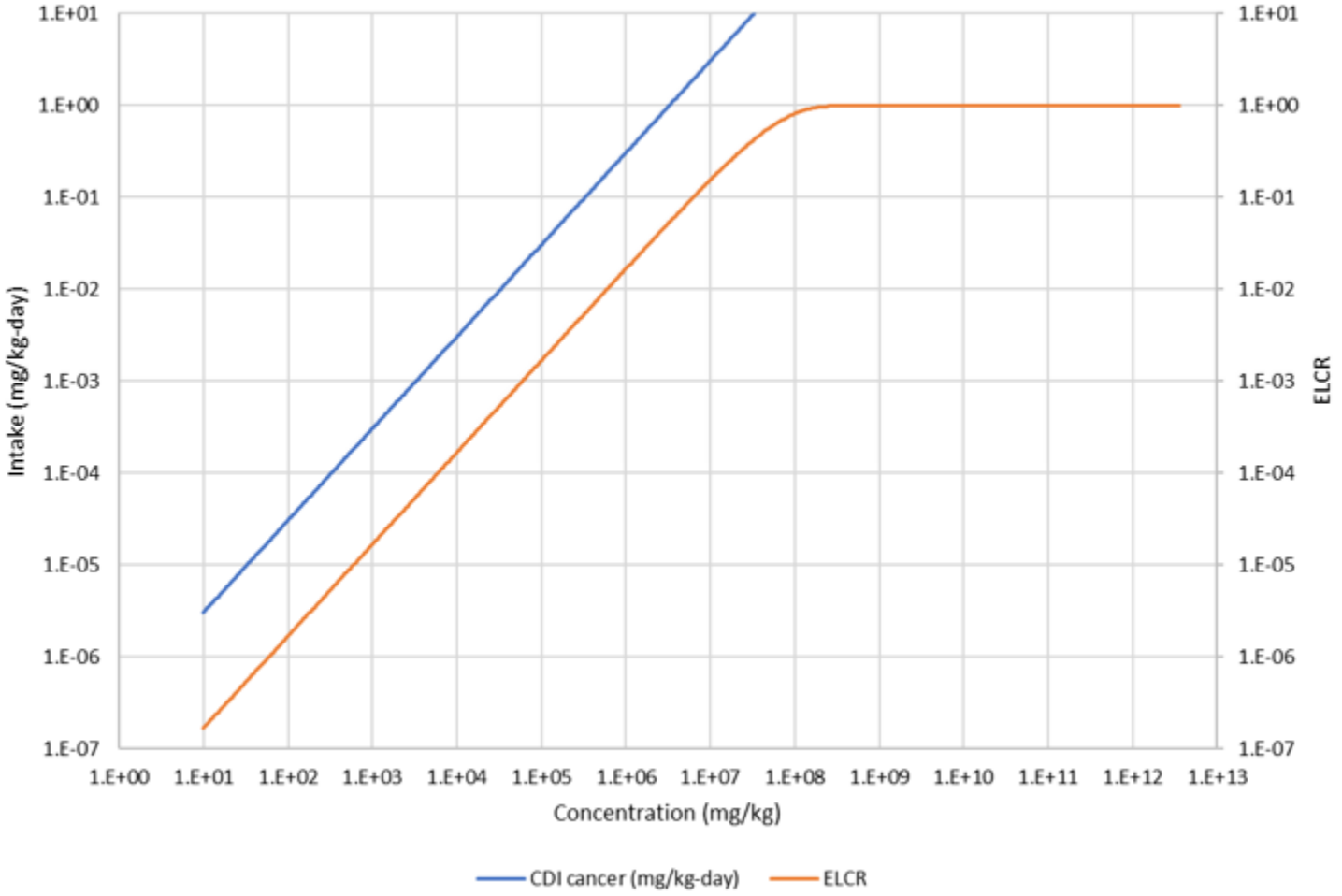
Risk Assessment Basics

- Oral Cancer Risk = Intake × SF = Probability.

$$CDI_{ind\text{-}wat\text{-}ingc}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times IRW_{ind}\left(\frac{1.25\ L}{day}\right)}{AT_{ind}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right) \times BW_{ind}(80\ kg)}$$

- Oral HQ = Intake/RfD.
- Quotient = a result obtained by dividing one quantity by another.
- When intake exceeds RfD (>1), you have a problem.
- HI = sum of HQs.
- HI and HQ are often used interchangeably.

Risk Assessment Basics

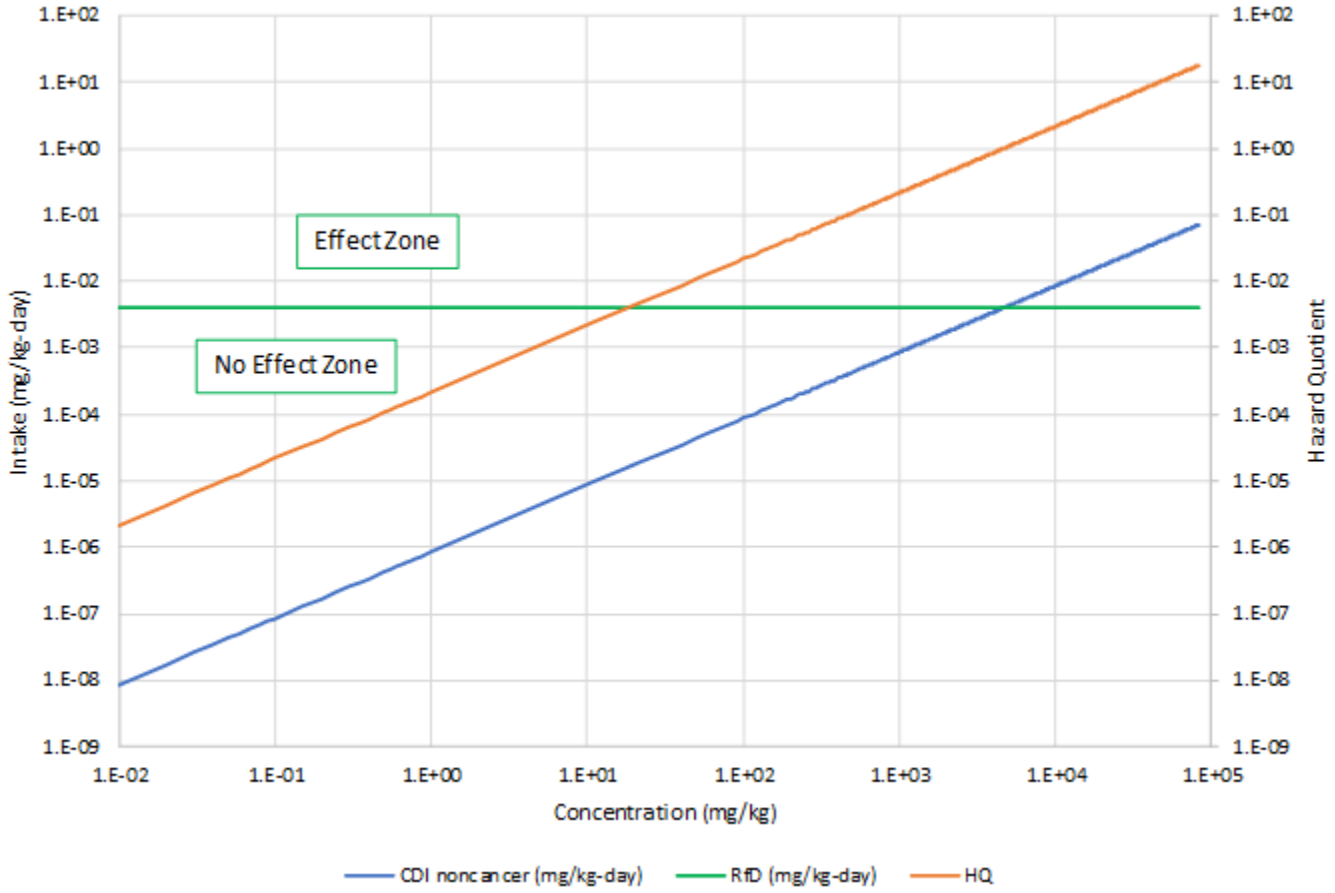


https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Risk Assessment Basics

- Risk = 1 – exp(-CDI x SF)
- When risk is 1E-03, the one hit risk is 1E-03.
- When risk is 1E-02, the one hit risk is 9.95E-03.
- Risk from a single exposure route for a single chemical.
- Summation of single chemical risk (without one-hit rule applied to single radionuclide results) for multiple exposure routes (right of each row).
- Summation of risk (without one-hit rule applied to single chemical results) from a single exposure route for multiple chemicals (bottom of each column).
- Summation of total risk (without one-hit rule applied to single chemical results or summations listed above) from multiple chemicals across multiple exposure routes (bottom right hand cell).

Risk Assessment Basics



https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Risk Assessment Basics

- Forward – calculate a risk or HQ
  - Oral Risk = Intake × SF = Probability
  - Oral HQ = Intake/RfD. HQ > 1 = Problem

$$CDI_{ind\text{-}wat\text{-}ingc}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times IRW_{ind}\left(\frac{1.25\ L}{day}\right)}{AT_{ind}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right) \times BW_{ind}(80\ kg)}$$

- Backward – calculate a media concentration

$$PRG_{ind\text{-}wat\text{-}ingc}\left(\frac{\mu g}{L}\right) = \frac{TR \times AT_{ind}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right) \times BW_{ind}(80\ kg)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times IRW_{ind}\left(\frac{1.25\ L}{day}\right)}$$

$$PRG_{ind\text{-}wat\text{-}ingn}\left(\frac{\mu g}{L}\right) = \frac{THQ \times AT_{ind\text{-}a}\left(\frac{365\ days}{yr} \times ED_{ind}(25\ yr)\right) \times BW_{ind}(80\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times IRW_{ind}\left(\frac{1.25\ L}{day}\right)}$$

https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Risk Assessment Basics

- All About the media and concentrations
- Forward
  - Determine media concentrations
  - Cancer sum risk by media
  - Combine multiple media
  - Total risk across all chemicals and all media
  - Identify COCs
- Backward
  - Determine protective media concentrations
  - Compare against the screening levels for that media
    - Air data vs. air screening levels
    - Soil data vs. soil screening levels
    - Water data vs. water screening levels
    - Identify COPCs for forward risk assessment

Risk Assessment Basics

- Totals for forward risk

Chemical	Ingestion HQ	Dermal HQ	Inhalation HQ	Total HI	Ingestion Risk	Dermal Risk	Inhalation Risk	Total Risk
Arsenic, Inorganic	3.57E+00	3.98E-02	-	3.61E+00	5.73E-04	6.40E-06	-	5.80E-04
Benzene	1.34E-01	4.01E-02	1.90E-01	3.64E-01	1.05E-05	3.15E-06	1.59E-05	2.96E-05
Trichloroethylene	5.35E-01	1.72E-01	1.43E+00	2.13E+00	4.40E-06	1.41E-06	4.18E-06	9.99E-06
Vinyl Chloride	4.46E-02	6.90E-03	1.43E-02	6.58E-02	3.44E-05	5.33E-06	2.24E-06	4.20E-05
*Total Risk/HI	4.28E+00	2.59E-01	1.63E+00	6.17E+00	6.23E-04	1.63E-05	2.23E-05	6.61E-04

- Totals for backward risk (screening levels)

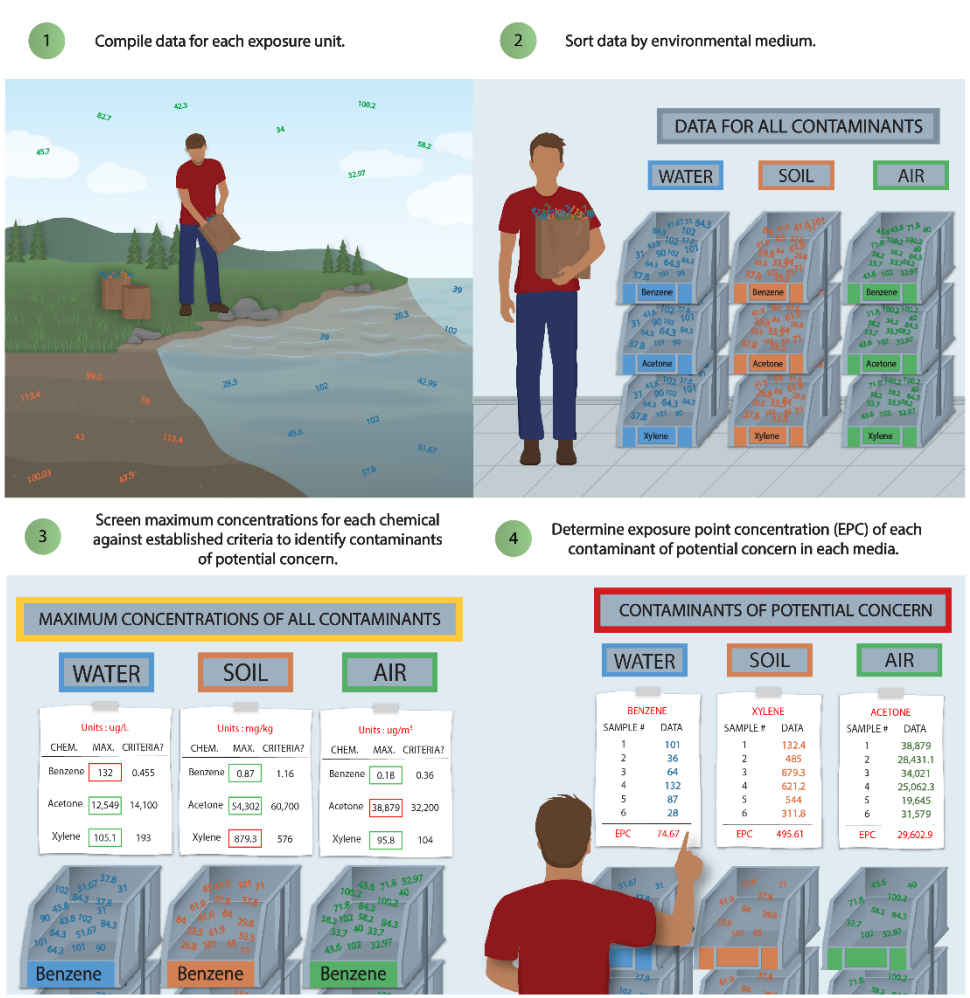
$$PRG_{ind\text{-}wat\text{-}totc}\left(\frac{\mu g}{L}\right) = \frac{1}{\frac{1}{PRG_{ind\text{-}wat\text{-}ingc}} + \frac{1}{PRG_{ind\text{-}wat\text{-}inhc}} + \frac{1}{PRG_{ind\text{-}wat\text{-}derc}}}$$

https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Risk Assessment Basics

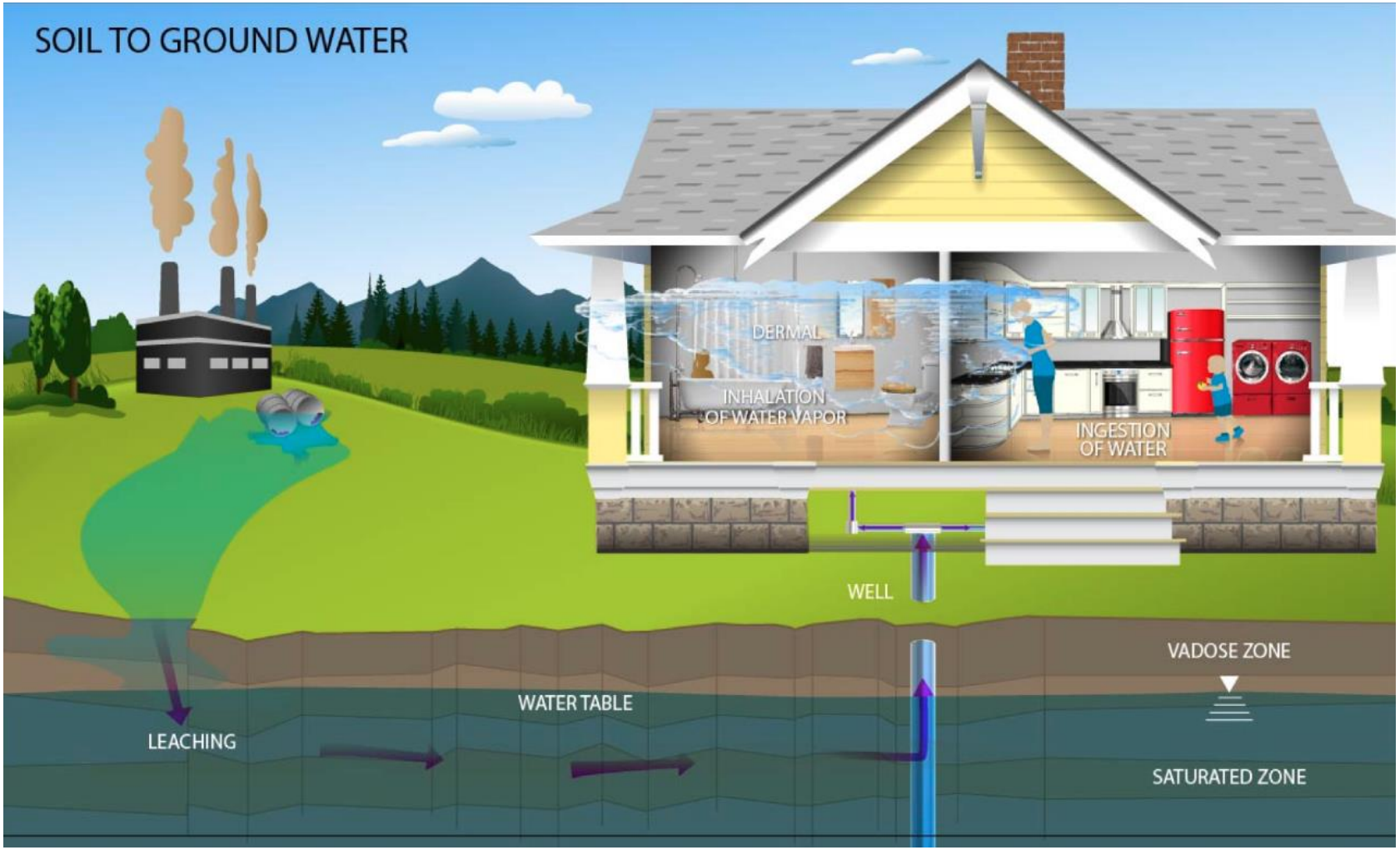
- The four steps (plus one)
  - Data Assessment
    - Screening steps of COPCs to get COCs
  - Exposure Assessment
    - Determine intakes
  - Toxicity Assessment
  - Risk Characterization
    - ELCR and HI
  - Uncertainty Assessment
    - What if? Repeat, changing one parameter at a time.

Data Assessment



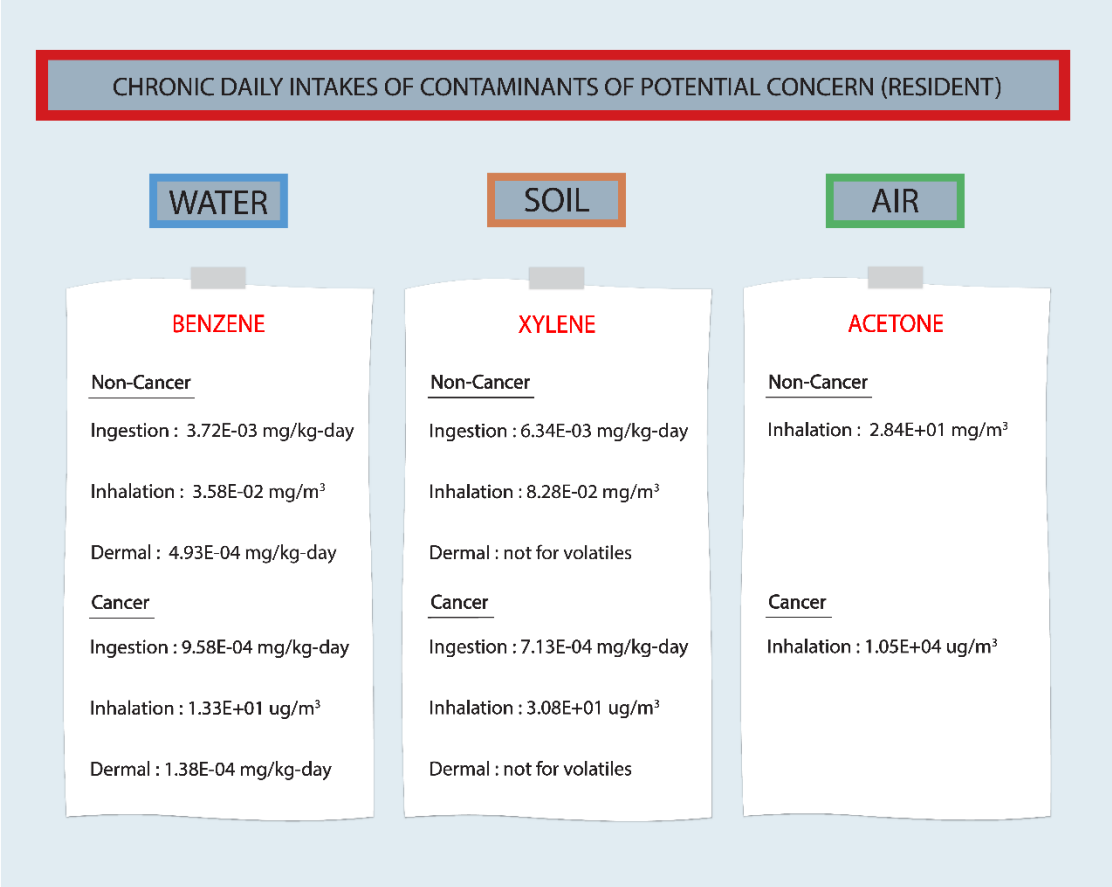
https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Exposure Assessment



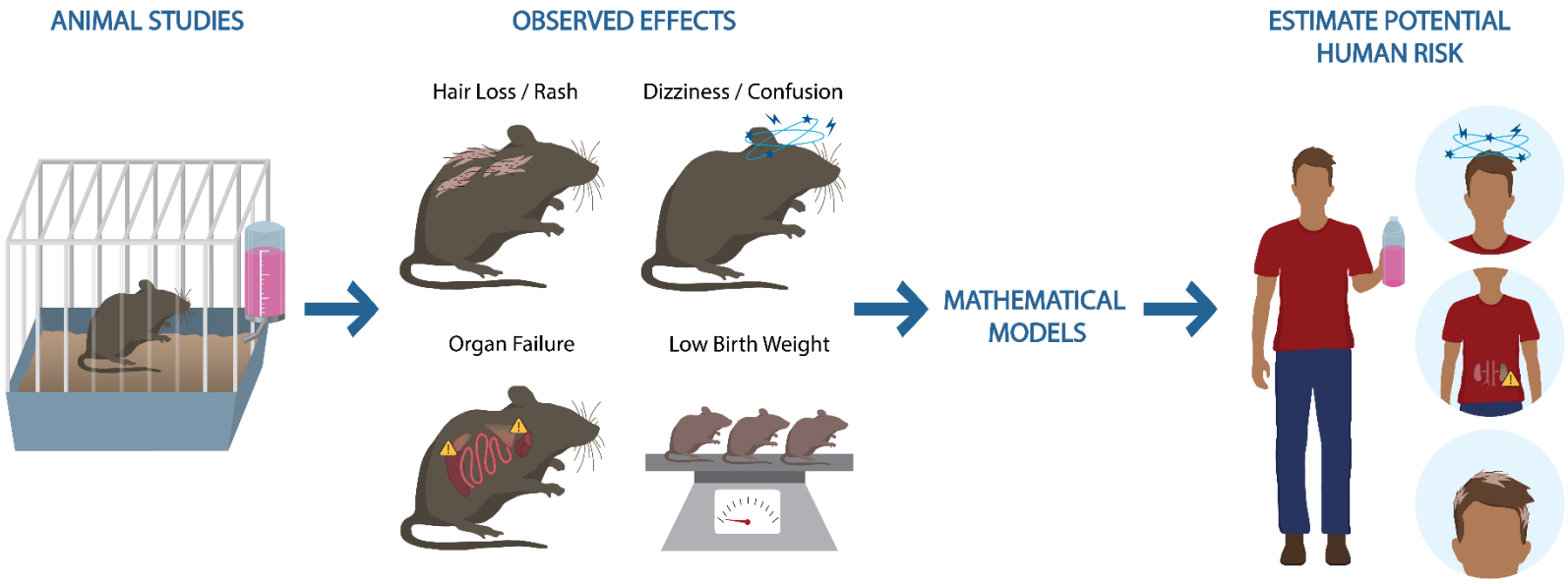
https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Quantify Exposure



https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Toxicity Assessment



https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Noncancer Toxicity Assessment



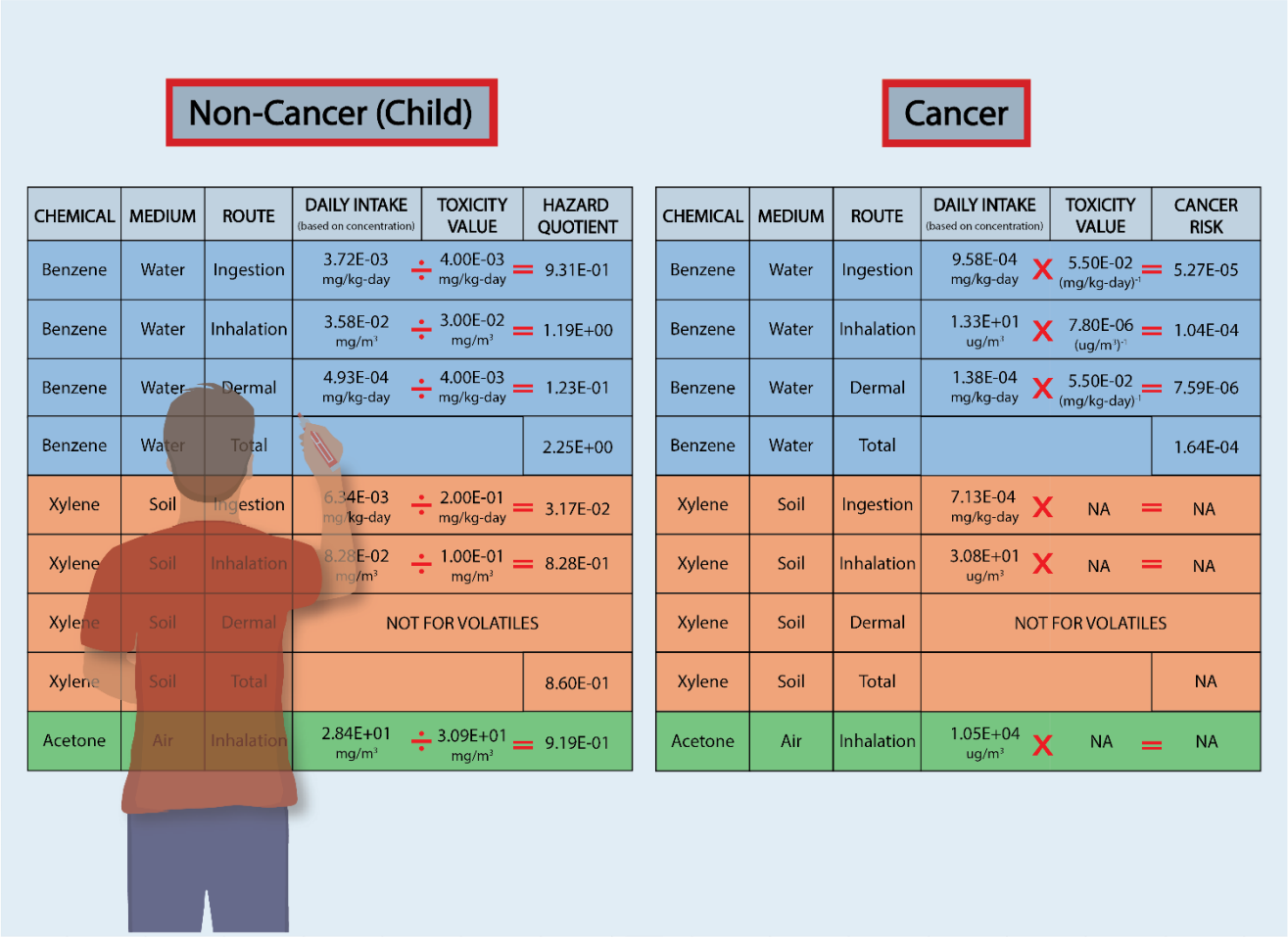
https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Cancer Toxicity Assessment



https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Risk Characterization



Non-Cancer (Child)

CHEMICAL	MEDIUM	ROUTE	DAILY INTAKE (based on concentration)		TOXICITY VALUE		HAZARD QUOTIENT
Benzene	Water	Ingestion	3.72E-03 mg/kg-day	÷	4.00E-03 mg/kg-day	=	9.31E-01
Benzene	Water	Inhalation	3.58E-02 mg/m³	÷	3.00E-02 mg/m³	=	1.19E+00
Benzene	Water	Dermal	4.93E-04 mg/kg-day	÷	4.00E-03 mg/kg-day	=	1.23E-01
Benzene	Water	Total					2.25E+00
Xylene	Soil	Ingestion	6.34E-03 mg/kg-day	÷	2.00E-01 mg/kg-day	=	3.17E-02
Xylene	Soil	Inhalation	8.28E-02 mg/m³	÷	1.00E-01 mg/m³	=	8.28E-01
Xylene	Soil	Dermal	NOT FOR VOLATILES				
Xylene	Soil	Total					8.60E-01
Acetone	Air	Inhalation	2.84E+01 mg/m³	÷	3.09E+01 mg/m³	=	9.19E-01

Cancer

CHEMICAL	MEDIUM	ROUTE	DAILY INTAKE (based on concentration)		TOXICITY VALUE		CANCER RISK
Benzene	Water	Ingestion	9.58E-04 mg/kg-day	X	5.50E-02 (mg/kg-day)⁻¹	=	5.27E-05
Benzene	Water	Inhalation	1.33E+01 ug/m³	X	7.80E-06 (ug/m³)⁻¹	=	1.04E-04
Benzene	Water	Dermal	1.38E-04 mg/kg-day	X	5.50E-02 (mg/kg-day)⁻¹	=	7.59E-06
Benzene	Water	Total					1.64E-04
Xylene	Soil	Ingestion	7.13E-04 mg/kg-day	X	NA	=	NA
Xylene	Soil	Inhalation	3.08E+01 ug/m³	X	NA	=	NA
Xylene	Soil	Dermal	NOT FOR VOLATILES				
Xylene	Soil	Total					NA
Acetone	Air	Inhalation	1.05E+04 ug/m³	X	NA	=	NA

https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Risk Assessment Basics

- VF & C_{sat}
  - Air to hold a kg of soil
  - Q/C = flux in center of square
  - 3-phase model
  - If inhalation SL is >C_{sat}, use C_{sat}
  - Above the C_{sat}, NAPL is formed
  - Chemical-specific

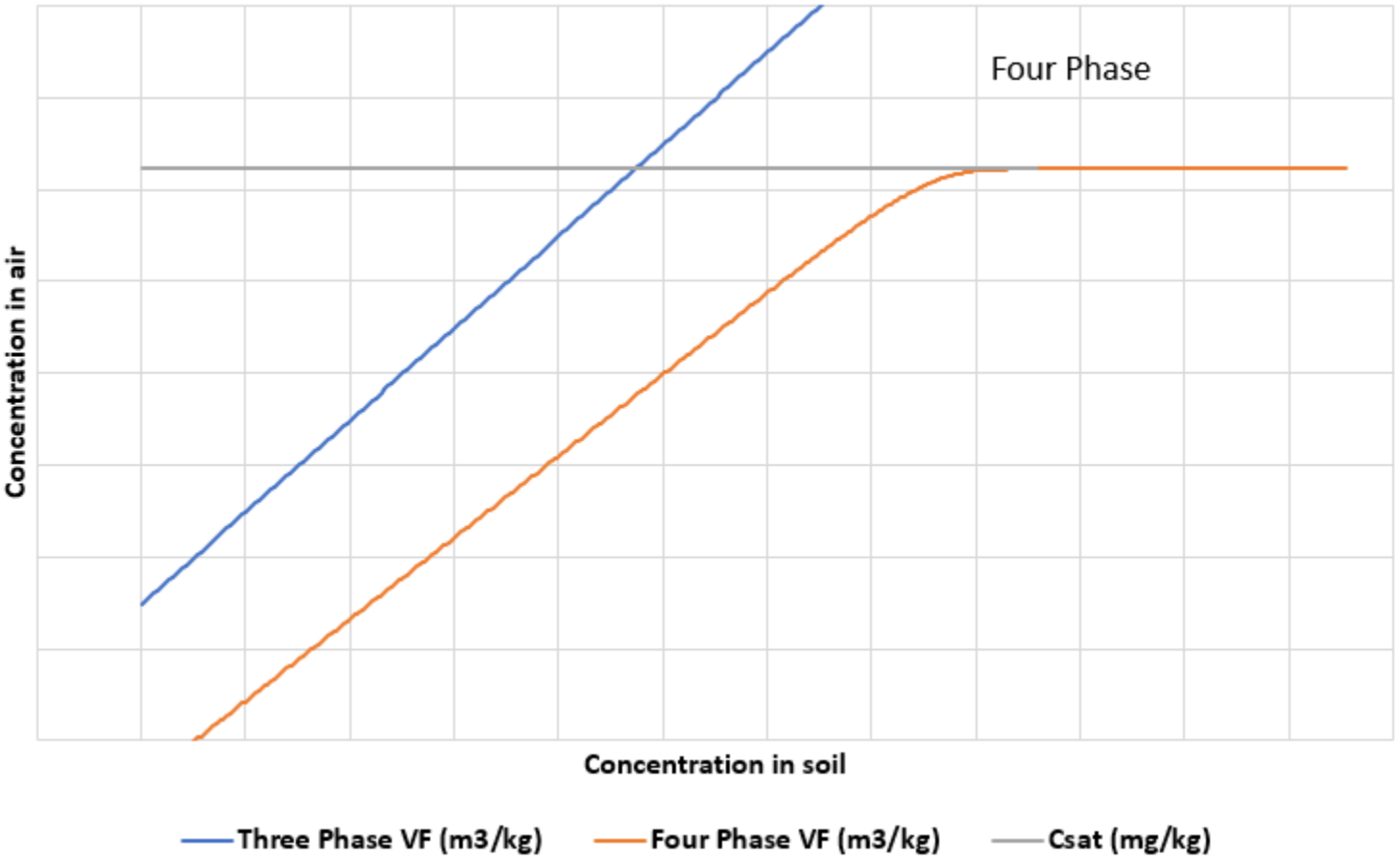
$$VF_S\left(\frac{m^3_{air}}{kg_{soil}}\right) = \frac{\frac{Q}{C_{vol}}\left(\frac{\left(\frac{g}{m^2-s}\right)}{\left(\frac{kg}{m^3}\right)}\right) \times \left(3.14 \times D_A\left(\frac{cm^2}{s}\right) \times T(s)\right)^{1/2} \times \left(\frac{10^{-4}\ m^2}{cm^2}\right)}{2 \times \rho_b\left(\frac{1.5\ g}{cm^3}\right) \times D_A\left(\frac{cm^2}{s}\right)}$$

$$D_A\left(\frac{cm^2}{s}\right) = \frac{\left(\theta_a\left(\frac{0.28\ L_{air}}{L_{soil}}\right)^{10/3} \times D_{ia}\left(\frac{cm^2}{s}\right) \times H' + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) \times D_{iw}\left(\frac{cm^2}{s}\right)\right) \Big/ n^2\left(\frac{0.43\ L_{pore}}{L_{soil}}\right)}{\rho_b\left(\frac{1.5\ g}{cm^3}\right) \times K_d\left(\frac{cm^2}{g}\right) + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) + \theta_a\left(\frac{0.28\ L_{air}}{L_{soil}}\right) \times H'}$$

$$C_{sat}\left(\frac{mg}{kg}\right) = \frac{S\left(\frac{mg}{L}\right)}{\rho_b\left(\frac{1.5\ g}{cm^3}\right)} \times \left(K_d\left(\frac{L}{kg}\right) \times \rho_b\left(\frac{1.5\ g}{cm^3}\right) + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) + H' \times \theta_a\left(\frac{0.28\ L_{air}}{L_{soil}}\right)\right)$$

https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Risk Assessment Basics

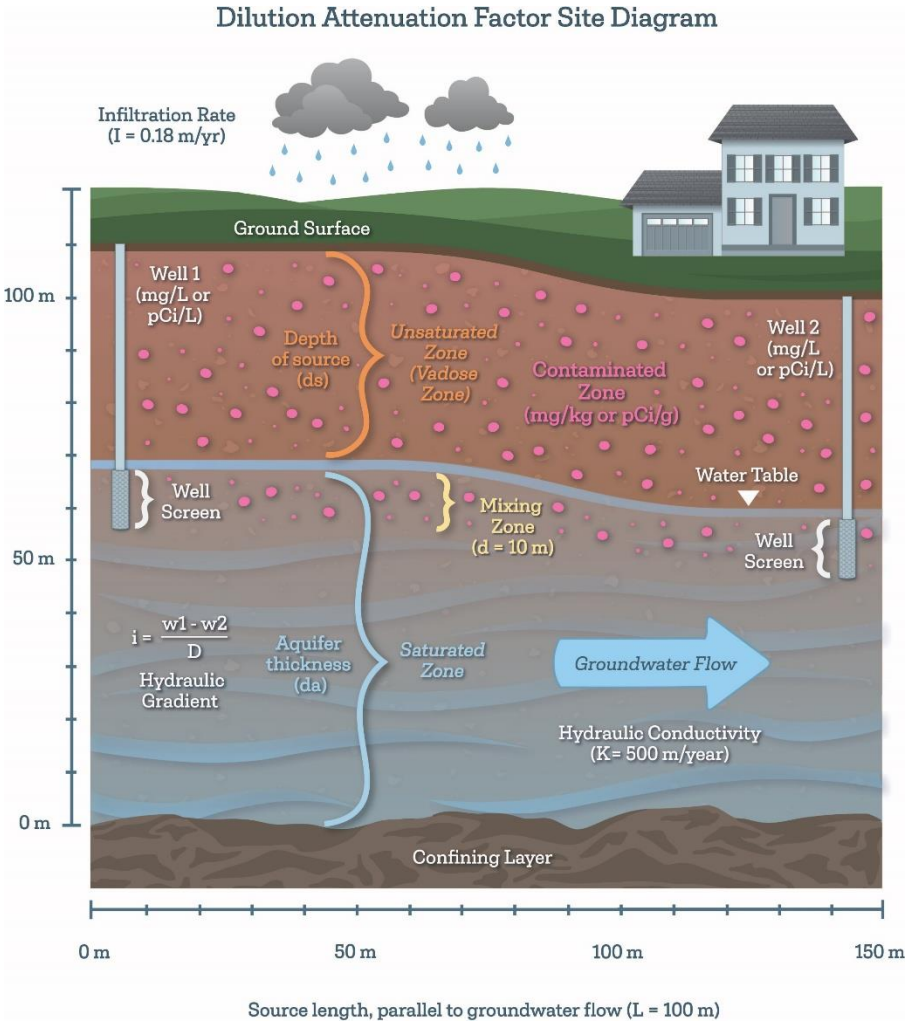


https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Risk Assessment Basics (VF and SSL)

- Infinite source can violate the mass-limit, especially for small sources.
- These equations can be used only when the volume (i.e., area and depth) is known.
- Use when the contaminated soil source volume is known or can be estimated with confidence.
- The calculator, in site-specific mode for the mass-limit volatilization factor (VF) option, now returns the higher value of the mass-limit and the standard VF calculation method.

Risk Assessment Basics



$$\text{Dilution Attenuation Factor (DAF)} = 1 + \frac{K\left(\frac{m}{yr}\right) \times i\left(\frac{m}{m}\right) \times d(m)}{I\left(\frac{0.18\ m}{yr}\right) \times L(m)}$$

where:

$$d(m) = \left(0.0112 \times L^2(m)\right)^{0.5} + d_a(m) \times \left[1 - \exp\left(\frac{-L(m) \times I\left(\frac{0.18\ m}{yr}\right)}{K\left(\frac{m}{yr}\right) \times i\left(\frac{m}{m}\right) \times d_a(m)}\right)\right]$$

https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Risk Assessment Basics

- Particulate emission factor (PEF)
  - Air to hold a kg of soil
  - Q/C = flux in center of square site
  - Land use specific

$$PEF\left(\frac{m^3_{air}}{kg_{soil}}\right) = \frac{\frac{Q}{C_{wind}}\left(\frac{\left(\frac{g}{m^2-s}\right)}{\left(\frac{kg}{m^3}\right)}\right)\times\left(\frac{3{,}600\ s}{hr}\right)}{0.036\times(1-V)\times\left(\frac{U_m\left(\frac{m}{s}\right)}{U_t\left(\frac{m}{s}\right)}\right)^3\times F(x)}$$

$$\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)$$

Risk Assessment Basics

- Andelman's Volatilization Factor (K)
  - Volatiles only
  - relationship between the concentration in water and the volatilized contaminant in air
  - 0.0005 x 1000 L/m3
  - Not chemical specific
  - Showering, laundering, dish washing, etc.

$$PRG_{res\text{-}wat\text{-}inhnc}\left(\frac{\mu g}{L}\right) = \frac{THQ \times AT_{res\text{-}c}\left(\frac{365\ days}{yr} \times ED_{res\text{-}c}(6\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}c}(6\ yr) \times ET_{res\text{-}c}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times K\left(\frac{0.5\ L}{m^3}\right)}$$

https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Risk Assessment Basics

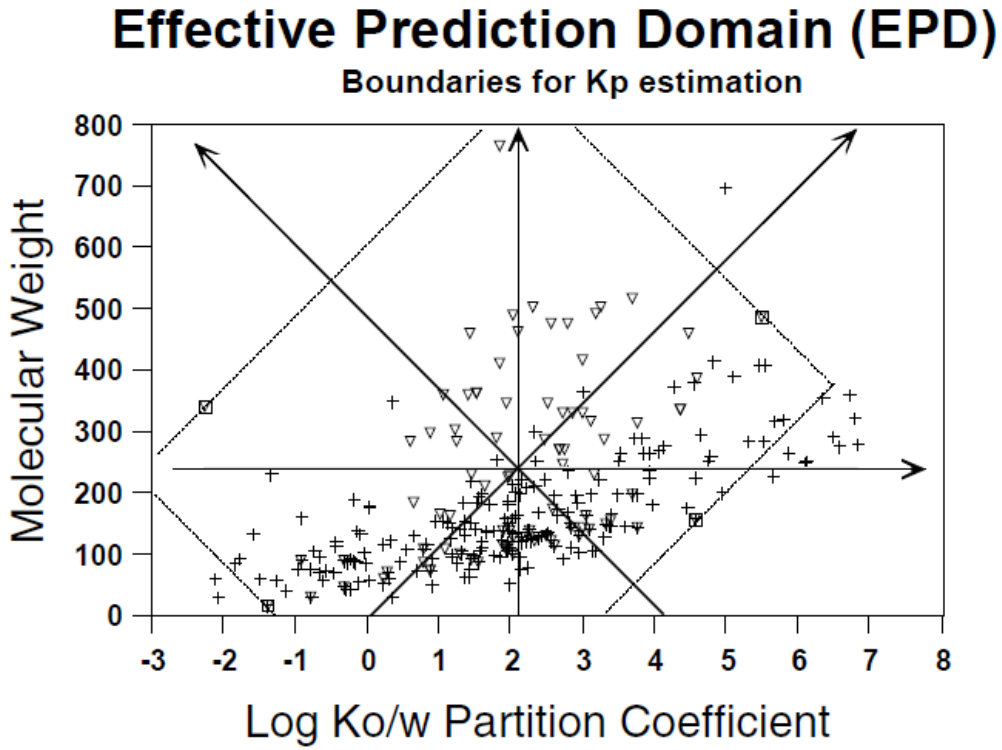
- Uncertainty factors are typically used in deriving reference doses. Uncertainty adjustments may be made to account for
  - interspecies variability in response when extrapolating from animal studies to humans
  - response variability in humans
  - uncertainty in estimating a no-effect level from a dose where effects were observed
  - extrapolation from shorter duration studies to a full life-time exposure
  - data deficiencies
- The use of uncertainty factors in deriving reference doses is thought to help protect sensitive human subpopulations.

Risk Assessment Basics

- For soil default, dermal is only calculated for SVOC.
  - ABS default is null for VOC and inorganics
  - ABS is 0.1 for SVOC
  - RAGS Part E has unique ABS for a small set of chemicals
  - Indoor worker does not get dermal
- Tox values for dermal
  - CSF_o/GIABS
  - RfD_o x GIABS
  - Default GIABS is 1.0 for VOC, SVOC, and inorganics
  - If GIABS >50% then it is set to 100% for the calculation of dermal toxicity values. RAGS Part E has unique values.

Risk Assessment Basics

- For organics in **<u>water,</u>** K_p is only calculated if chemical is in the EPD.
- For inorganics, K_p is from a list in RAGS Part E.



https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Risk Assessment Basics

- K_p comes from EPI first or RAGS Part E equation.

$$K_p = 10^{\log K_p}$$

where:

$$\log K_p = -2.805063 + r^2 \times \log K_{ow} - 0.0056118 \times MW$$

where:

$\log K_p$ = log dermal permeability coefficient of compound in water $\left(\frac{cm}{hr}\right)$;

$r^2 = 0.6645865$

Risk Assessment Basics

- Fraction absorbed water (FA) is required.
  - The FA term should be applied to account for the loss of chemical due to the desquamation of the outer skin layer and a corresponding reduction in the absorbed dermal dose.
- The dimensionless value (B) is the ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (ve).
- t* = Time to reach steady-state
- τ_{event} = Lag time per event

Idaho's RSL Chemicals

Chemical	Mutagen?	VOC?	EPD?	VISL?
Benzene	N	Y	Y	Yes
Toluene	N	Y	Y	Yes
Ethyl benzene	N	Y	Y	Yes
Xylenes (mixed)	N	Y	Y	Yes
1,2 Dibromoethane (EDB)	N	Y	Y	Yes
1,2 Dichloroethane (EDC)	N	Y	Y	Yes
Methyl Tert-Butyl Ether (MTBE)	N	Y	Y	Yes
Acenaphthene	N	Y	Y	No Tox
Anthracene	N	Y	Y	No Tox
Benzo(a)pyrene	Y	N	N	No
Benzo(b)fluoranthene	Y	N	N	No
Benzo(k)fluoranthene	Y	N	N	No
Benz(a)anthracene	Y	Y	N	Yes
Chrysene	Y	N	N	No
Fluorene	N	Y	Y	No Tox
Fluoranthene	N	N	N	No Tox
Naphthalene	N	Y	Y	Yes
Pyrene	N	Y	Y	No Tox

https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

RSL History

- RSL = Regional Screening Levels
- Individual tables for Regions 3, 6, and 9 with constant maintenance and differences.
- Last published regional tables: Region 3 - 2004, Region 6 - 2007, Region 3 - 2006.
- Combined Headquarters (OSRTI) table in 2008.
- Website on an ORNL-UT server for the first year.
- Subsequently moved to R3 server to maintain static pages; ORNL-UT still operates the calculator page.
- 2008 to present: What's New page provides pertinent history of the changes.
- Unified tables are shared on Region 3, 6, and 9 websites as well as other Regional websites.

What RSLs Are and Are Not

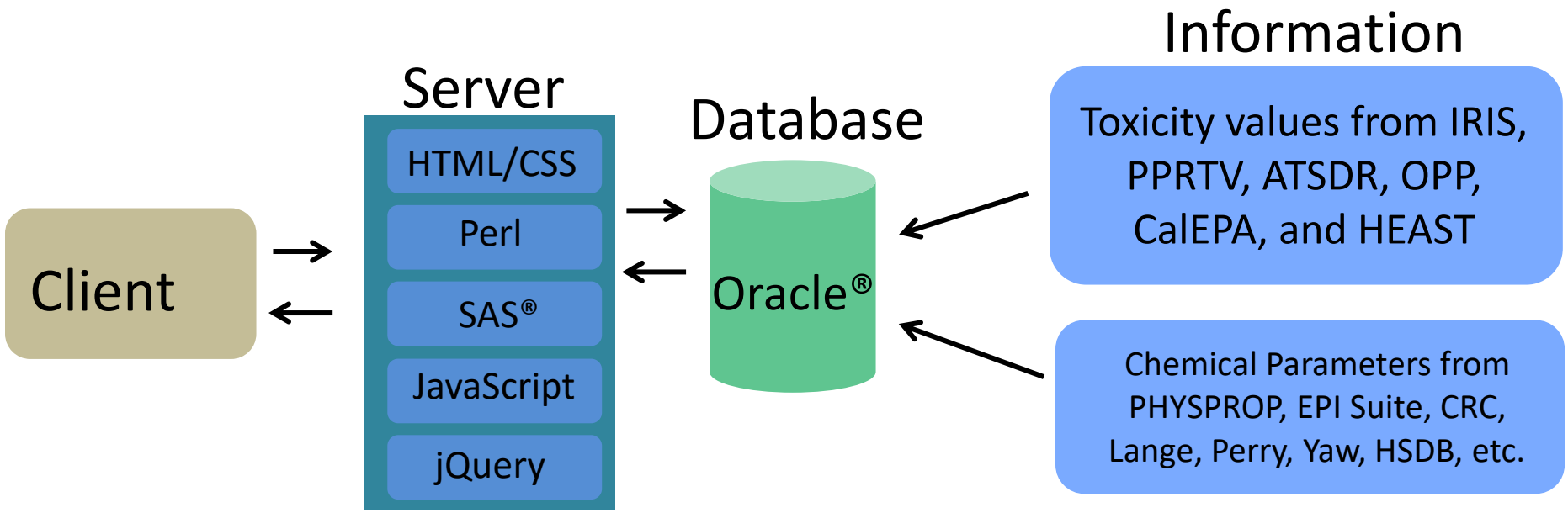
- Default Screening levels – yes
- De facto Remediation levels – maybe, only if your PRG equations are same as RGOs
- Site-specific screening levels – yes. Simply use the calculator to derive appropriate numbers.
- Site-specific remediation levels – yes. Simply use the calculator to derive appropriate numbers.

RSL Regulatory Basis

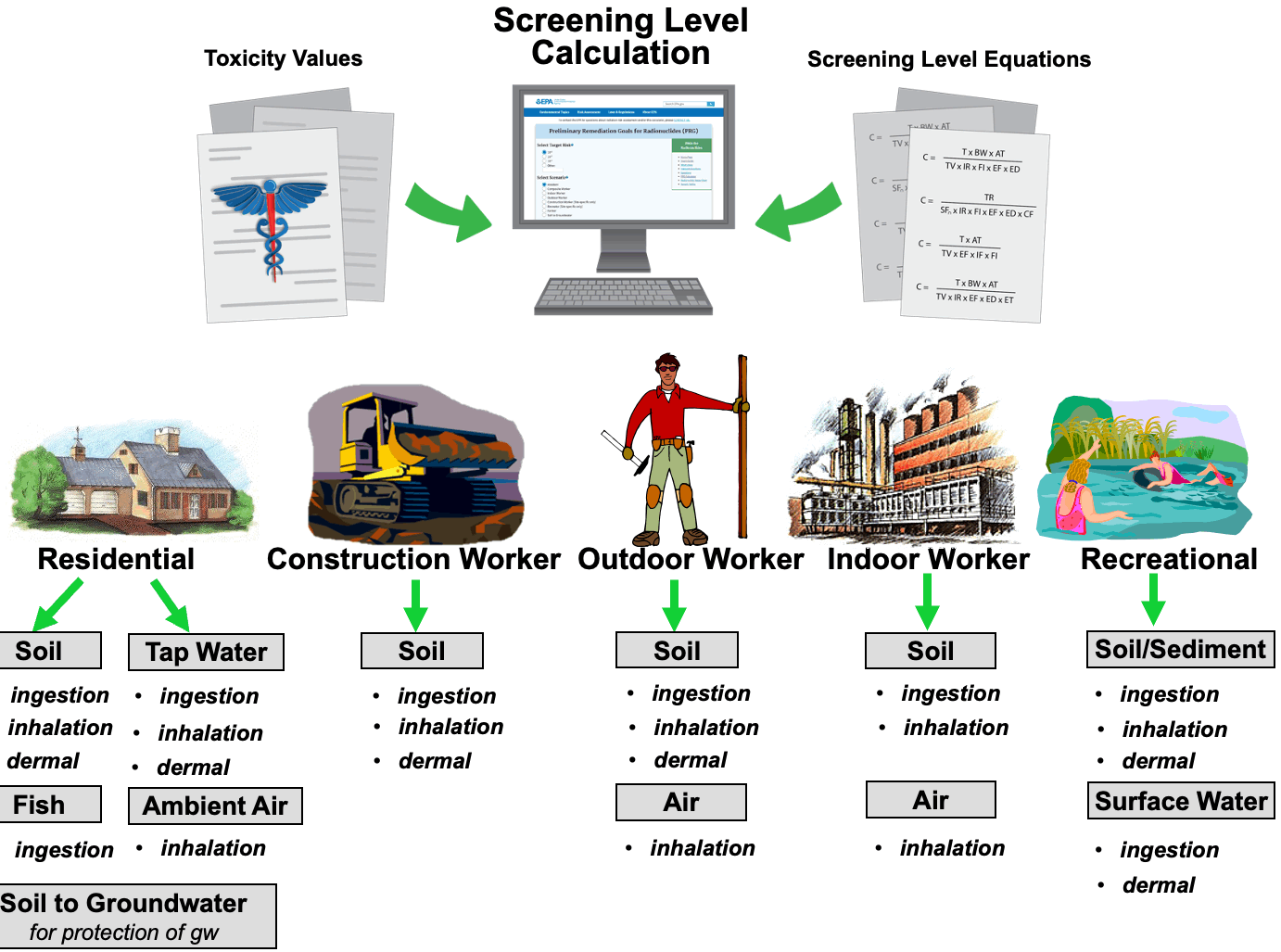
- RAGS Part A-F
- Supplemental Soil Screening Guidance and Technical Background Document
- Guidelines for Carcinogen Risk Assessment
- Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (mutagen information)

How Does it Work?

- ORACLE
- SAS
- Java script, PHP, Perl, etc.
- General hierarchy for toxicity and chemical parameters (see Sections 2.3 and 2.4 of RSL User Guide for details)



How Does it Work cont.



https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

What is the Update Process?

- Dynamic Agenda of issues
- Conference Calls
- Toxicity Updates
- Chemical-parameter Updates
- MCL Updates
- Text updates (FAQ, What's New)
- Freeze database
- QA check of calculations
- QA tables (by hand and with computer program)
- The RSL Checklist (around 52 steps)
- Go Live

RSL Update Checklist

- **RSL Toxicity Database Check**
  - IRIS, PPRTV, CalEPA, OPP, and ATSDR databases are checked for updates; changes are made to database and verified.
  - HEAST updates are automatically read into database, as ORNL is hosting this database.
  - Tier 3 toxicity values selected by the RSL Workgroup are hardcoded into database.
  - Confirm that all contaminants identified as carcinogenic by a mutagenic mode of action in the OSWER cancer handbook have an M in the table and use the ADAFs. Confirm that only contaminants in the handbook (and those approved by the RSL workgroup) have an M in the tables and use the ADAFs.
  - Exceptions are hardcoded (e.g., omission of lead RfD, some dioxins, furans, and TCE).
  - Make sure GIABS, ABS, VOC status, and mutagenic status are added for new chemicals.
  - Run database search of all missing values (e.g., EPD, FA, DIA, DIW, C_{sat}) that need to be calculated and search for new values.
  - Look for C_{sat} of 0 and missing C_{sat} if VOC=1. Make sure the AMBIENT STATE variable is updated.
  - Investigate the HLC, MW, and VP of new chemicals to make sure that VOC status is assigned appropriately.
  - The toxicity database is “frozen” from further updates.
  - Add banner to the calculator stating that a new database in in place.
  - Run a tox compare routine, which is posted in the What's New, and verify each change, subtraction, and addition of toxicity values.
  - Run the parameters compare for group to review.
  - Run the summary table compare.

RSL Update Checklist cont.

- **Chemical-Specific Parameters Check**
  - Chemical-specific parameters are added when a new chemical is added to the toxicity database.
  - Check the parameters table for chemicals without any values at all.
  - Added parameters are reviewed.

RSL Update Checklist cont.

- **RSL Review**
  - The RSLs for each chemical in the Excel QA sheet are reviewed by land use and exposure route.
  - The soil to groundwater, Diffusivity in air and water, C_{sat}, volatilization factor, and particulate emission factor calculations are reviewed.
  - Hardcoded exceptions are reviewed for chemicals that are not listed in the QA sheet. These include all of the contaminants specifically discussed in the User's Guide (lead, manganese, vanadium, uranium, chromium, aminodinitrotoluenes, PCBs, and xylenes) as well as copper(RfD), TCE, and lead residential and industrial soil levels.
  - MCL footnotes for perchlorates and trihalomethanes are verified.
  - Make sure lead footnotes and non-RSL values are in place.
  - Make sure TCE is handled appropriately in the resident soil, air, and tapwater tables.
  - If any discrepancy is found and new tables are generated, the QA process begins from the top.
  - Do all the toxicity values have a source code for one of the 6 sources described in the user's guide or the special cases noted in the legend of the generic tables?
  - Do the supporting tables present oral, inhalation, and dermal-based screening levels (when we have the data) for both cancer and non-cancer?
  - Are the initial cancer and non-cancer RSLs no lower than the individual oral, inhalation, and dermal screening levels?
  - Is the lower of the cancer and non-cancer RSLs for each exposure media (e.g., residential soil, industrial air) carried forward into the summary table?
  - Are the RSLs in the supporting and summary tables coded with "c" for cancer and "nc" for non-cancer?

RSL Update Checklist cont.

- Are the other codes (G to see user's guide and m for exceeding ceiling limit) used when appropriate?
- Are all the units in the tables correct?
- Make sure the header row texts are all visible.
- Make sure the parameters table is condensed as much as possible.
- Are there missing pages in any of the individual tables?
- Correct tables if necessary.
- Are all the pages in all the tables contained in the Composite Table?
- Tables are released to EPA for comment.
- Tables and test site are released to RSL workgroup.
- Changes are made on EPA's Drupal server.
- Review Drupal test site.
- Activate the Drupal site to go live.
- Quick review of Drupal live site.
- Tell the world.

RSL Update Checklist cont.

- Miscellaneous
  - Incorporate fish table from Region 3
  - EQUIS output
  - SADA tables
  - Archive the html and pdf web pages – Drupal does this now
  - Archive the previous download tables – SEMSPUB does this now
- Nightly automated QA

Example Agenda Items

- Old Issues
  - Use HgCl RfD for Hg.
  - Look at states like Minnesota for more tox values.
  - Vanadium MW adjustment is not done for subchronic.
- New Issues
  - Update adult fish equation to also do child and age-adjust for cancer.
  - Adopt 2022 WHO TEFs for dioxins.
  - Should the reference for PFAS salts be IRIS or IRIS SURROGATE .
  - Consider adding chromium salt MW adjusted RfDs to RSL.
  - Add EQuIS tables for the VISL.

Toxicity Sources

1. EPA Integrated Risk Information System (IRIS)
2. EPA Provisional Peer Reviewed Toxicity Values (PPRTV)
3. EPA Office of Pesticide Programs (OPP) Human Health Benchmarks for Pesticides (HHBPs)
4. Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs)
5. The EPA Office of Water (OW)
6. California Environmental Protection Agency (CalEPA) Office of Environmental Health Hazard Assessment (OEHHA)
7. EPA's Health and Environmental Risk Assessment (HERA) final Office of Research and Development (ORD) values
8. The 11th Cycle of Groundwater Standards Proposals from the State of Wisconsin Department of Health Services
9. EPA PPRTV Appendix Screening Values
10. EPA Health Effects Assessment Summary Table (HEAST)

(https://semspub.epa.gov/work/03/2218797.pdf)

https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Chemical-specific Parameter Sources

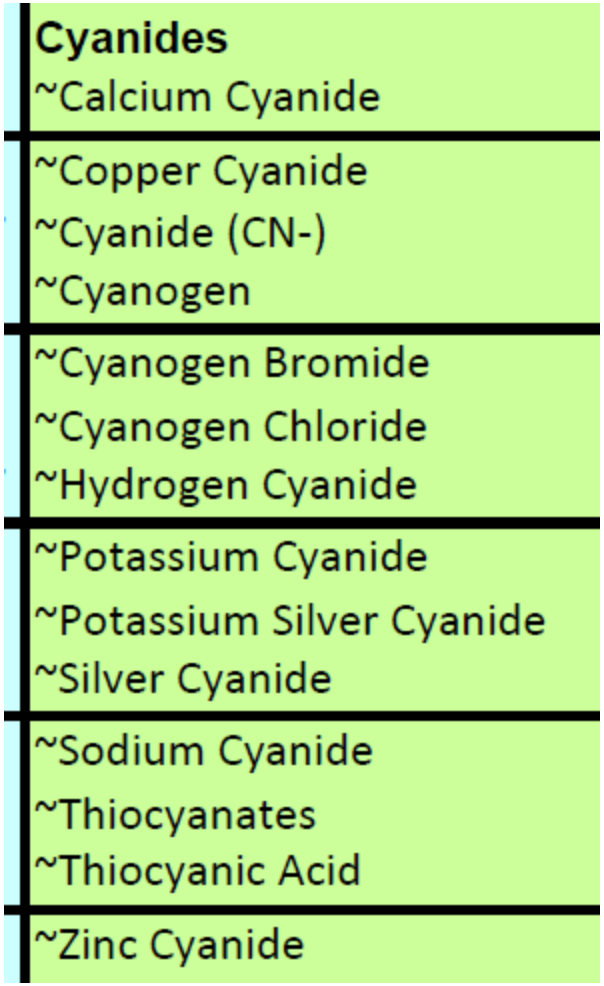
- PHYSPROP
- EPI SuiteTM
- EPA Soil Screening Level (SSL)
- WATER9
- CHEMFATE
- Yaws' Handbook of Thermodynamic and Physical Properties of Chemical Compounds
- Baes, C.F (SCDM)
- NIOSH Pocket Guide to Chemical Hazards (NPG)
- CRC Handbook of Chemistry and Physics
- Perry's Chemical Engineers' Handbook
- Lange's Handbook of Chemistry
- RAGS Part E, Supplemental Guidance for Dermal Risk Assessment
- ARS Pesticide Properties Database
- OTHER

Chemical-specific Parameters

- Organic Carbon Partition Coefficient (Koc)
- Dermal Permeability Coefficient (Kp)
- Effective Predictive Domain (EPD)
- Fraction Absorbed (FA)
- Molecular Weight (MW)
- Water Solubility (S)
- Unitless Henry's Law Constant (H')
- Henry's Law Constant
- Diffusivity in Air (Dia)
- Diffusivity in Water (Diw)
- Fish Bioconcentration Factor (BCF)
- Soil-Water Partition Coefficient (Kd)
- Density
- Melting Point (MP)
- log Octanol-Water Partition Coefficient (logKow)
- Vapor Pressure (VP)
- Critical Temperature (Tc)
- Enthalpy of vaporization at the normal boiling point
- ABS
- GIABS

Generic Tables

- Landuses
- Resident – child
- Why 3 workers?
- SSL (soil2gw)
- Media (Fish and Region 3 are exception)
- Targets (TR, THQ)
- C_{sat}, max
- Key symbols (e.g., I = IRIS; P = PPRTV; G = See User's Guide; M = mutagen; c = cancer; n = noncancer; s = concentration may exceed C_{sat})
- What's New
  - Tox compare
  - Params compare
- Chemical Groups



Generic Tables cont.

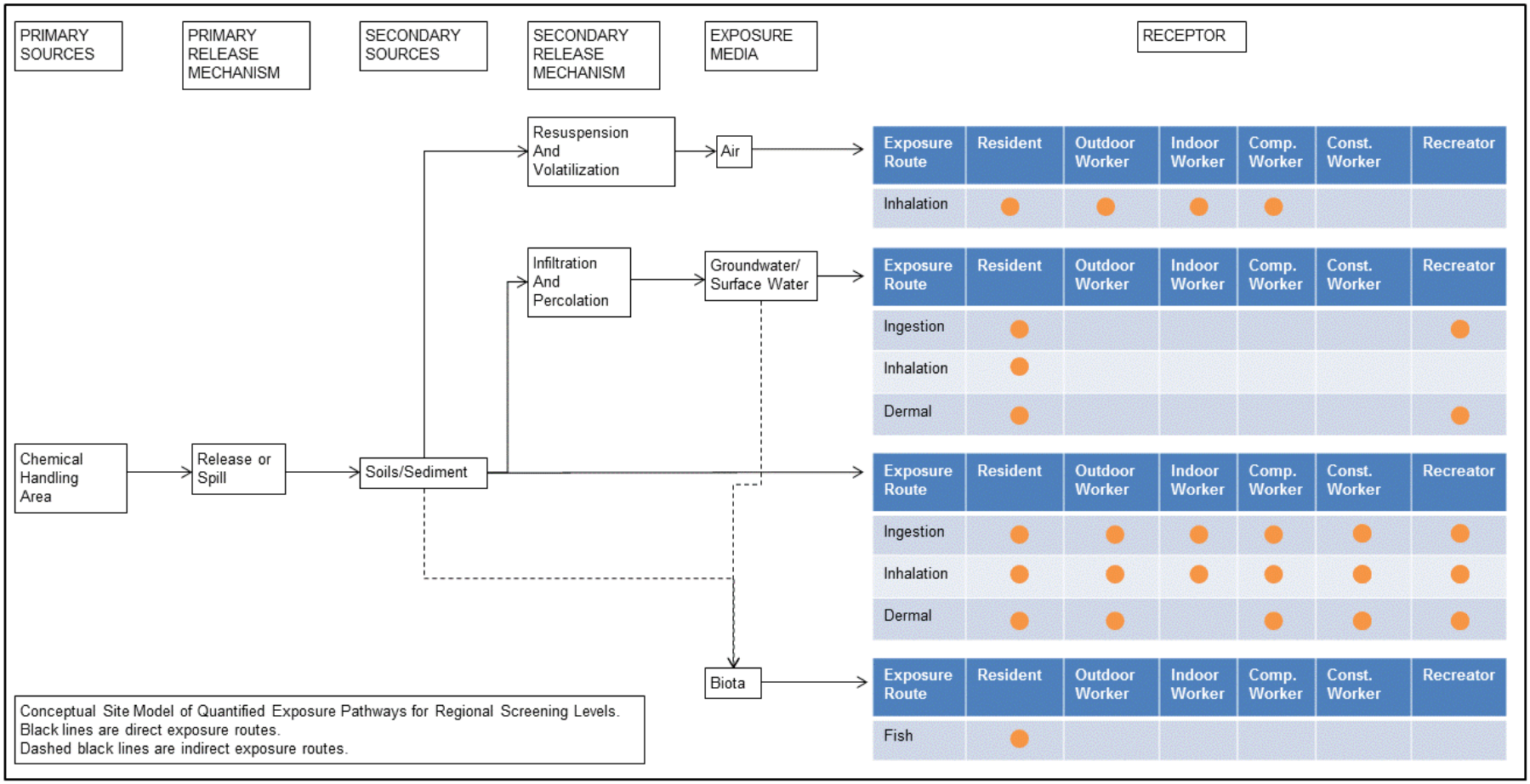
Toxicity and Chemical-specific Information												
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)
1.8E-02	C	5.1E-06	C	1.5E-01	I					1	0.1	
8.7E-03	I			4.0E-03	I					1	0.1	
		2.2E-06	I			9.0E-03	I	V		1		1.1E+05
				2.0E-02	I					1	0.1	
				9.0E-01	I	3.1E+01	A	V		1		1.1E+05
						2.0E-03	X	V		1		1.1E+05

Screening Levels									
Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key
2.7E+01	c	9.6E+01	c	4.8E-01	c	2.4E+00	c	3.7E+00	c
5.6E+01	c**	2.0E+02	c*					7.7E+00	c**
1.0E+01	c**	5.2E+01	c**	1.1E+00	c**	5.6E+00	c**	2.2E+00	c**
1.2E+03	n	1.2E+04	n					2.7E+02	n
6.1E+04	n	6.3E+05	nms	3.2E+04	n	1.4E+05	n	1.2E+04	n
5.3E+01	n	2.2E+02	n	2.1E+00	n	8.8E+00	n	4.2E+00	n
8.7E+02	n	3.7E+03	n	6.3E+01	n	2.6E+02	n	1.3E+02	n
7.8E+03	ns	1.0E+05	nms					1.5E+03	n
1.3E-01	c	4.5E-01	c	1.9E-03	c	9.4E-03	c	1.3E-02	c

EPA

https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Landuses



https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

Calculator

- What's not in the table
  - Recreator
    - Sediment
    - Surface water
  - Indoor worker
  - Outdoor worker
  - Construction worker
  - Fish

Calculator cont.

- Site-specific
  - Exposure parameters
  - Toxicity and chem-specific parameters
  - Age cohorts
  - New Chemical
- Chronic vs. Subchronic
- Apply C_{sat} and max substitutions

Calculator cont.

- Metadata
- EQuIS format
- Changing target risk or HQ
- Changing the groundwater/soil system temperature
- VF changes
- PEF changes
- SSL changes

Confusing Chemicals

- **Lead** - why not use the Cal EPA tox values?
- **Benzene** - Slope factors for benzene are actually ranges, yet the SL table shows a single number. The upper end of the range was chosen, because the SL Table is a screening tool. The consequences of screening out a chemical that could pose a significant risk are more serious than carrying the chemical through the risk assessment process.
- **Cadmium and Manganese** - Cadmium (water) and Manganese (non-diet) are used for tap water and surface water; Cadmium (diet) and Manganese (non-diet) are used for soil and sediment; Cadmium (diet) and Manganese (diet) are used for fish (biota). Cadmium RfDs on IRIS are based on the same study. The diet RfD incorporates a 2.5% absorption adjustment, while the water RfD incorporates a 5% absorption adjustment. For another medium (e.g., soil), choose the value with an absorption factor that most closely matches the expected site conditions. In most cases, the expected absorption is unknown, and the RfD for food should be used. Manganese IRIS RfD is used for all sources, including diet. IRIS recommends a modifying factor of 3 when calculating risks associated with non-food sources. IRIS also recommends subtracting dietary exposure (default assumption in this case is 5 mg). Thus, the IRIS RfD has been lowered by a factor of 2 x 3, or 6. The table now reflects manganese for "non-diet" sources.

Confusing Chemicals cont.

- **Copper** - Currently, the RfD is 0.04 mg/kg-day with a reference of HEAST. Actually, HEAST presents a drinking water screening level of 1.3 mg/L. In order to use the value to assess oral exposures to other media, we "back out" the adult exposure assumptions (e.g., body weight of 70 kg, ingestion rate of 2 L/day) that go into the calculation of a drinking water screening level. **This will be replaced by the intermediate ATSDR MRL for the Spring 2025 update.**
- **Chromium** - It is recommended that valence-specific data for chromium be collected when chromium is likely to be an important contaminant at a site and when hexavalent chromium (Cr (VI)) may be present. The 2024 IRIS toxicity profile identifies Cr(VI) as carcinogenic via a mutagenic mode of action. Therefore, the RSLs will be applying Age-Dependent Adjustment Factors (ADAFs) to the cancer toxicity values provided in the assessment. The 2024 IRIS assessment is based solely on Cr(VI); therefore, the adjustment to modify total chromium exposure to Cr(VI) using a 6:1 ratio of Cr(III):Cr(VI) is no longer necessary. The Maximum Contaminant Level (MCL) of 100 µg/L for "Chromium (total)" from the EPA's MCL listing is applied to the "Chromium, Total" analyte on this website.
- **Mercury** - Where is the oral RfD from Cal EPA? The EPA RSL group removed it. Not standard practice to pick apart the individual tox values.

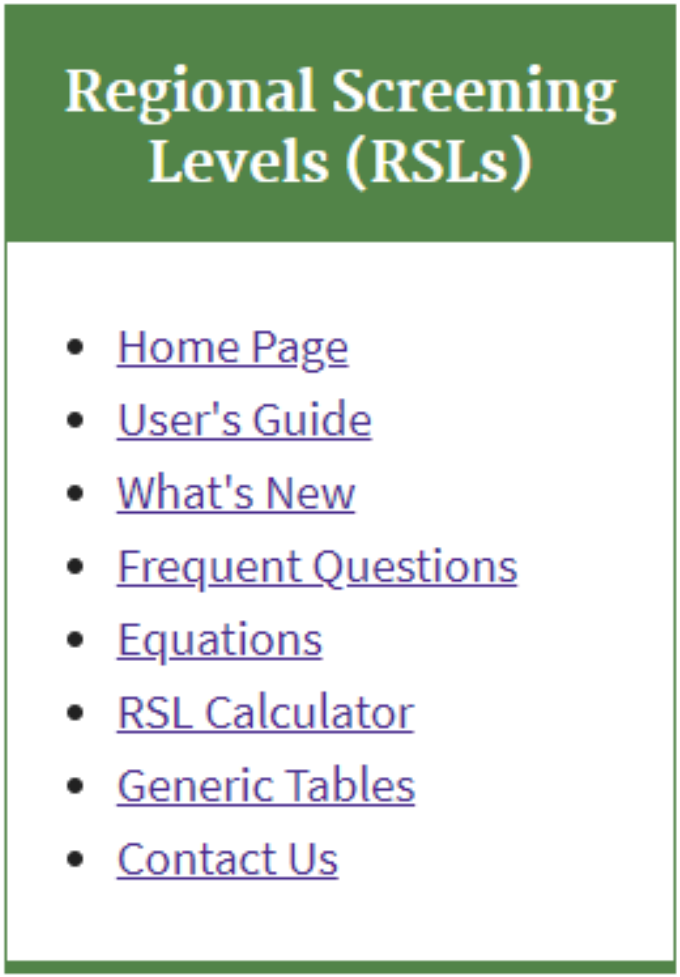
Confusing Chemicals cont.

- **Vinyl chloride** - unique set of equations that combine the prorated cancer with non-prorated child
- **Dioxins and Furans** - TEFs; however, if IRIS has a value, we present the RSL based on that value
- **PAHs** and RPFs based on BaP
- **TCE** - Uses a CAF and MAF so one tox value can be used
- **TPHs** - Noncancer only

Confusing Chemicals cont.

5. Special Considerations
5.1 Cadmium
5.2 Lead
5.3 Manganese
5.4 Vanadium Compounds
5.5 Uranium
5.6 Chromium (VI)
5.7 Aminodinitrotoluenes
5.8 PCBs and Aroclors
5.9 Xylenes
5.10 Arsenic
5.11 Total Petroleum Hydrocarbons (TPHs)
5.12 Soil Saturation Limit (C_{sat})
5.13 SL Theoretical Ceiling Limit
5.14 Target Risk
5.15 Screening Sites with Multiple Contaminants
5.16 Deriving Soil Gas SLs
5.17 Mutagens
5.18 Trichloroethylene (TCE)
5.19 Mercuric Chloride (and other Mercury salts)
5.20 Cyanide (CN-)
5.21 Thallic Oxide and Thallium Selenite
5.22 Polycyclic Aromatic Hydrocarbon
5.23 Refractory Ceramic Fibers (units in fibers)
5.24 Lanthanum Salts
5.25 MCLs for Trihalomethanes and Haloacetic Acids
5.26 Perchlorate
5.27 Styrene-acrylonitrile trimer (SAN Trimer)
5.28 *cis*- and *trans*-Chlordane Surrogate
5.29 Asbestos

RSL Website Pages



https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

RSL Homepage and What's New Notes

1) Homepage

2) What's New
   - Tox Compare
   - Table Compare

RSL Frequent Questions and Equations Notes

1) Frequent Questions

2) Equations

RSL Tables and User's Guide Notes

1) Download Tables

2) User's Guide

RSL Calculator in Default Mode

- Chronic
- Subchronic
- Metadata
- Site-specific options
- Selecting landuses
- Output data
  - View
  - Cut and paste
  - XLS
  - PDF

Master the Pick List

- Clicking
- Typing
- Select All
- Add New Chemical

Site-specific Mode

- Exposure parameters
- Cohorts (pink and blue cells) for resident and recreator
- Toxicity values
- Chemical-specific parameters
- PEF and VF
- SSL protective of groundwater

Lessons Learned

- Calculate default RSLs for all land uses
- Calculate site-specific RSLs for all land uses
- Change toxicity and chemical-specific parameters
- Calculate ELCR and HI
- Add a new chemical
- Include C_{sat} substitution
- Include Max substitution
- Access metadata
- Activate subchronic toxicity values

Questions?

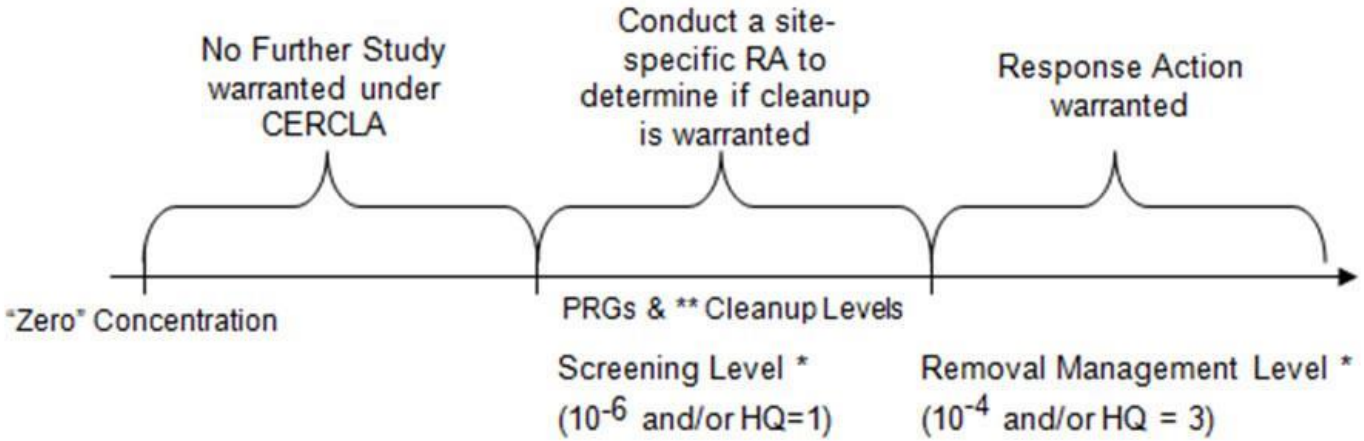


RML History

- RML = Regional Removal Management Level
- Assist On Scene Coordinators (OSCs) and others involved in decision-making concerning Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) removal actions
- Used to support the decision for EPA to undertake a removal action. They are not necessarily health protective concentrations for chronic exposure, and exceedance of an RML by itself does not imply that adverse health effects will occur.
- 1998 was the latest release prior to our website.
- 2008 to present: What's New page portrays change history
- Unified tables are shared on Region 3, 6, and 9 websites and other Regional websites.
- Formerly called RALs.

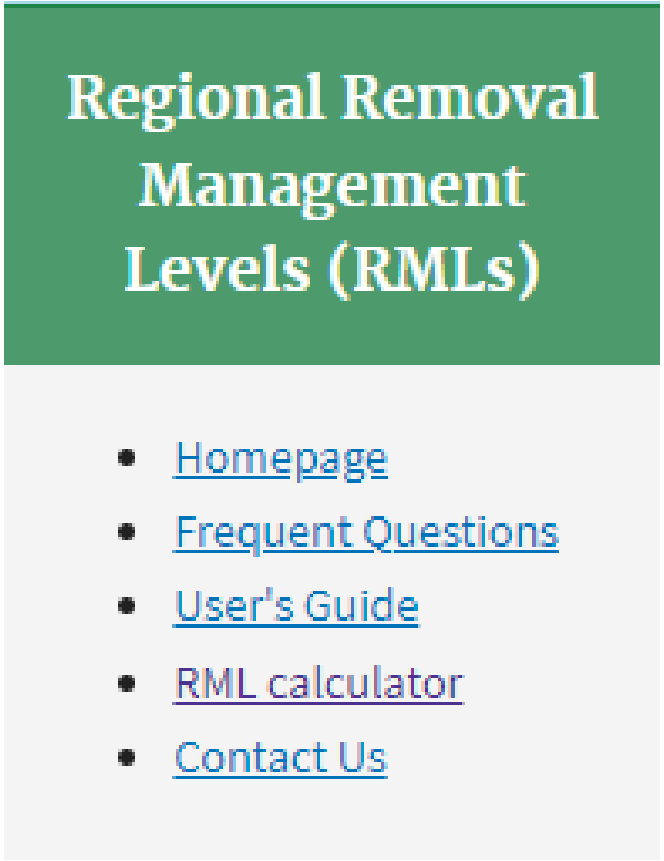
What RMLs Are and Are Not

- Not protective for long term exposures
- Site-specific screening levels – yes
- Site-specific remediation levels – no



* - Screening Levels and RMLs are for individual chemicals
** - Cleanup levels take into account exposure to multiple chemicals

RML Website Pages



https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

RML Webpage Notes

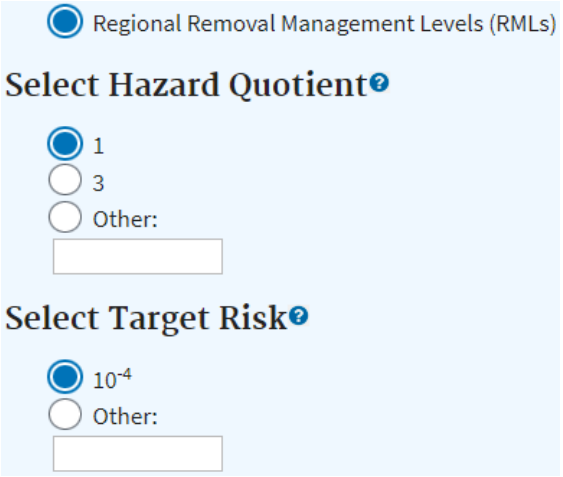
1) Homepage

2) Frequent Questions

3) User's Guide

RML Calculator Notes

1) Calculator



Lessons Learned

- Calculate default RMLs for all land uses
- Calculate site-specific RMLs for all land uses
- Change toxicity and chemical-specific parameters
- Calculate ELCR and HI
- Add a new chemical
- Include C_{sat} substitution
- Include Max substitution
- Access metadata
- Activate subchronic toxicity values

Questions?

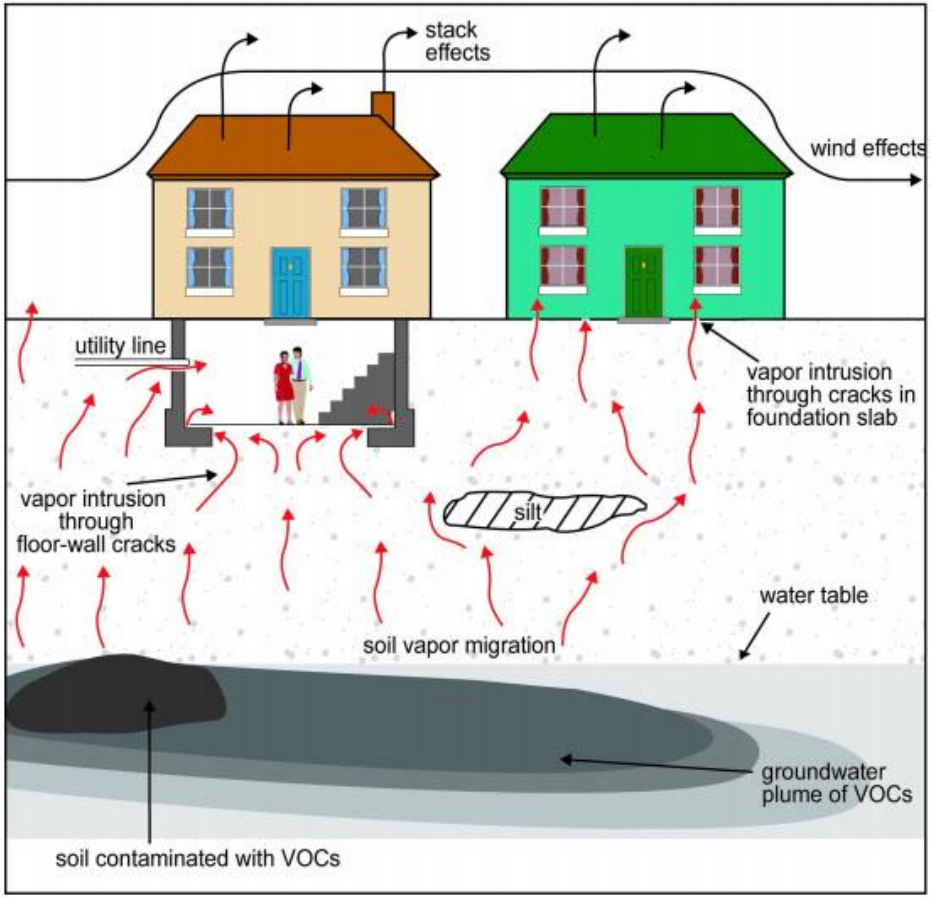


VISL Outline

- Historical Perspective of VISL
- Understanding Changes Over time (What's New)
- Getting Support (FAQ, Contact Information)
- VISL User Guide Special Cases
  - Mutagens
  - Trichloroethylene
  - Vinyl Chloride
  - Arsenic
- VISL Calculator
  - Resident, Worker
  - Water, Soil, Air
- VISL and RSL Practice Sessions

VISL History

- 2002: OSWER released DRAFT guidance
- 2013: DRAFT available for public comment
- 2015: Technical guide released, spreadsheet provided
- Spring 2018: VISL calculator made public



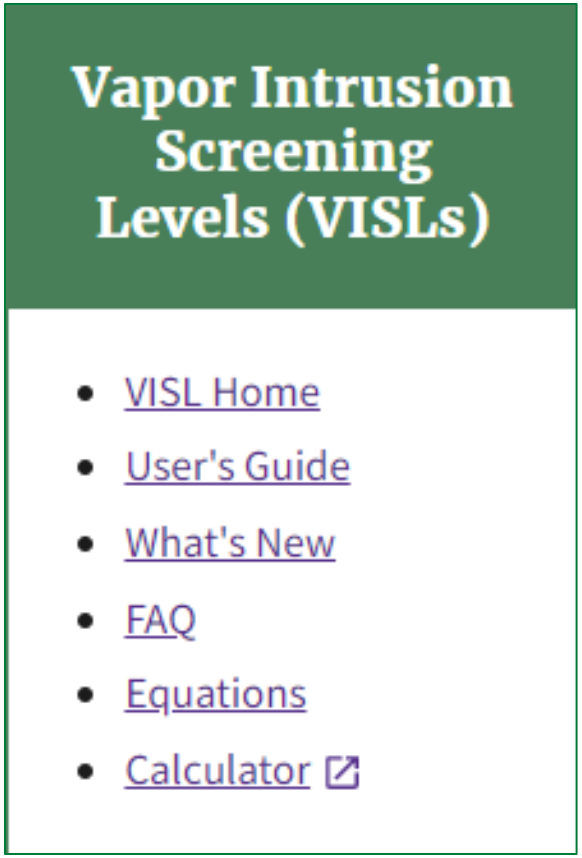
What VISLs Are and Are Not

- VISLs are screening level concentrations for groundwater, soil gas (target sub-slab and near-source), and indoor air.
- VISLs assist Agency staff with making a vapor intrusion determination based on limited, initial data.
- VISLs are NOT cleanup levels.

VISL Rules

- Must be a volatile (VP > 1 mmHg or HLC > 1E-05 atm * m^3/mol).
- Pure phase vapor concentration in soil gas must be greater than air VISL.
- Groundwater vapor concentration must be greater than the air VISL.
- Must have IUR or RfC.

VISL Website Pages



https://www.epa.gov/risk/regional-screening-levels-rsls
https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator

VISL/RSL AIR EQUATIONS

$$SL_{res\text{-}air\text{-}inhn}\left(\frac{\mu g}{m^3}\right) = \frac{THQ \times AT_{res\text{-}a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

$$C_{res\text{-}ia\text{-}nc}\left(\frac{\mu g}{m^3}\right) = \frac{THQ \times AT_{res\text{-}a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

VISL Equations

Groundwater Screening Level

$$C_{gw,Target}\left(\frac{\mu g}{L}\right) = \frac{C_{i,a,Target}\left(\frac{\mu g}{m^3}\right)}{AF_{gw} \times \left(\frac{1000\ L}{m^3}\right) \times H'T_{gw}}$$

Soil Gas Screening Level

$$C_{sg,Target}\left(\frac{\mu g}{m^3}\right) = \frac{C_{i,a,Target}\left(\frac{\mu g}{m^3}\right)}{AF_{ss}}$$

VISL Risk Equations

Indoor Air Concentration Derived from Soil Gas Concentration

- Calculated Indoor Air Concentration from Soil Gas

$$C_{i,a}\left(\frac{\mu g}{m^3}\right) = C_{sg}\left(\frac{\mu g}{m^3}\right) \times AF_{ss}$$

Indoor Air Concentration Derived from Groundwater Concentration

- Calculated Indoor Air Concentration from Groundwater

$$C_{i,a}\left(\frac{\mu g}{m^3}\right) = C_{gw}\left(\frac{\mu g}{L}\right) \times AF_{gw} \times \left(\frac{1000\ L}{m^3}\right) \times H'T_{gw}$$

VISL Homepage and What's New Notes

1) Homepage

2) What's New

VISL Frequent Questions and Equations Notes

1) Frequent Questions

2) Equations

VISL Tables and User's Guide Notes

1) Download Tables???

2) User's Guide

VISL Calculator in Default Mode

- Metadata
- Site-specific options
- Selecting landuses
- Output data
  - View
  - Cut and paste
  - XLS
  - PDF

Master the Pick List

- Clicking
- Typing
- Select All
- Add New Chemical

Site-specific Mode

- Exposure parameters
- Toxicity values
- Chemical-specific parameters

Lessons Learned

- Calculate default VISLs for all land uses
- Calculate site-specific VISLs for all land uses
- Change toxicity and chemical-specific parameters
- Calculate ELCR and HI
- Add a new chemical
- Access metadata

Questions?



RSL/VISL Practice Sessions