Data Evaluation & Background Contamination

Key topics

- Data Quality Review
- Sampling & data quality
- Data comparison
- Background contamination & potential sources
- Indoor air data evaluation

Afternoon

Petroleum VI Screening

↓

Investigative Approach

↓

Data Evaluation

↓

Vapor Control and Site Management

↓

General Remediation

Data Evaluation

- Main areas:
  - Data quality review
  - Data comparison to screening levels
  - Background sources of contamination
  - Other lines of evidence (CSM check)

Data Quality Review

- Program design
  - Well justified scope of work based on CSM
- Field methods
  - Samples representative and reproducible
- Laboratory methods

  - Analysis precise and accurate, reporting limits < targets
- Quality assurance / quality control
  - Duplicates, replicates, equipment blanks, container certification, outdoor air samples, building survey, etc.
- Assess consistency with CSM after each phase
  - Compare data to expectations

Sampling Methods
Field Methodology

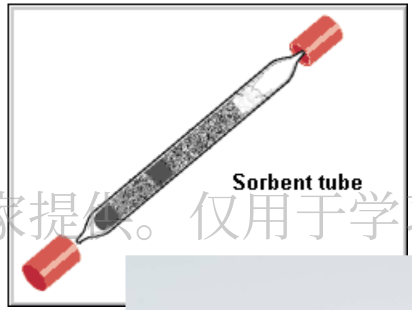
- Was the appropriate sampling methodology employed?
  - Apply what you learned

Power Auger

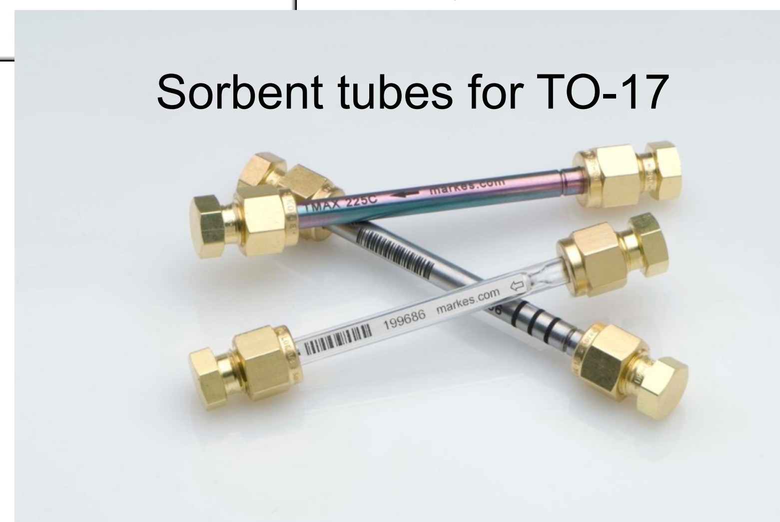
Sub-slab Soil Gas Sampling

Sampling Methods
Lab Methodology

- Was the appropriate lab methodology utilized?
  - Apply what you learned



SUMMA® canister for TO-15



Sorbent tubes for TO-17

Source: Hartman Environmental Geoscience

Data Quality Assessment

- Two-step process
  1. **Data Quality**: Assessment of the laboratory quality control data, the laboratory report, laboratory narrative, chain of custody
  2. **Data Usability**: Based on the results of the data quality evaluates the analytical data and the intended use of the data

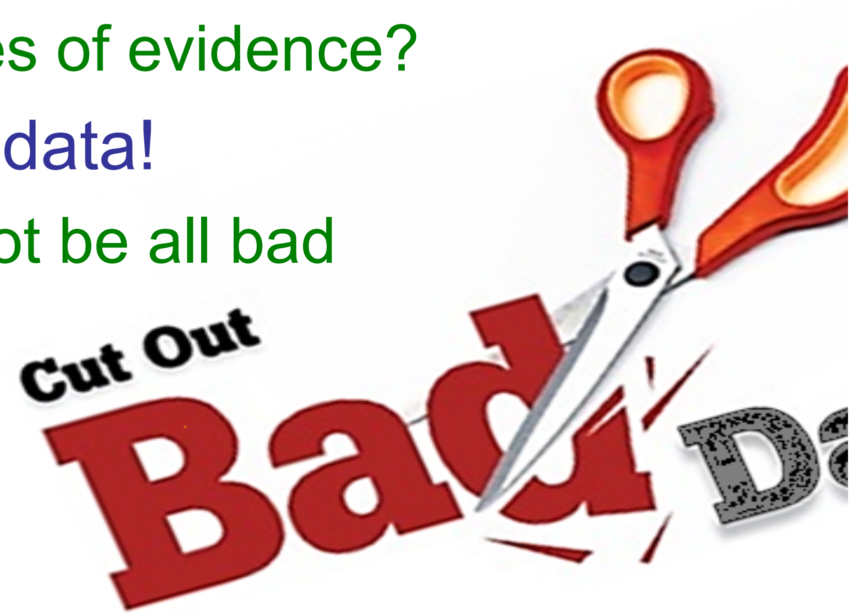
KEY POINT: **The investigator, not the laboratory, is responsible for the usability of data.**

Data Quality Assessment
Step 1: Data Quality

- Regulatory agency requirements?
- **MUST** be performed *prior* to using the data
  - Lab QC requires a number of samples spiked and/or analyzed in duplicate
  - Absence of QC, exceedances of holding time, low recoveries of spikes and/or surrogates, other procedure issues
- Not unusual for laboratory reports to contain “nonconformances”
  - Many won’t affect the usability of the data for the intended purpose
  - Bias low or high? True values lower or higher?

Data Quality Assessment
Step 2: Data Usability

- How does it impact the conclusions?
  - Is it valid or do you need to resample?
  - Understand the uncertainty
- How does it impact the conclusions?
  - Can it meet the goals of the project
  - Does it align with other lines of evidence?
- No data is better than BAD data!
  - BUT Imperfect data may not be all bad



Common Data Quality Issues

- Positive bias
  - Equipment blank samples may show VOCs
  - May also find compounds unrelated to the site
- Negative bias
  - Adsorptive losses in sample train
  - Leaks (soil gas and sub-slab)
  - Volatilization losses (groundwater, soil)
- Variability
  - Spatial, temporal, operator

Exacerbated because target levels are so low

Data Evaluation

- Main areas:
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  - Background sources of contamination
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Data Comparison

- Wide range of options
  - Look-up tables
  - Site-specific attenuation factors
  - Site-specific modeling
- Many regulatory agencies start with something conservative
  - Apply to a wide range of sites and site conditions
  - Regions/states/districts likely to vary
- Some allow for some type of modification

Data Comparison
Look-Up Tables

- Easiest to utilize and apply
  - Based on an attenuation factor . . .

    . . . which may be based on a model!
- Typically conservative
  - “One-size” fits all
  - Typically applies to a wide range of sites
  - May be really conservative for your site
- If you exceed, can you evaluate further?

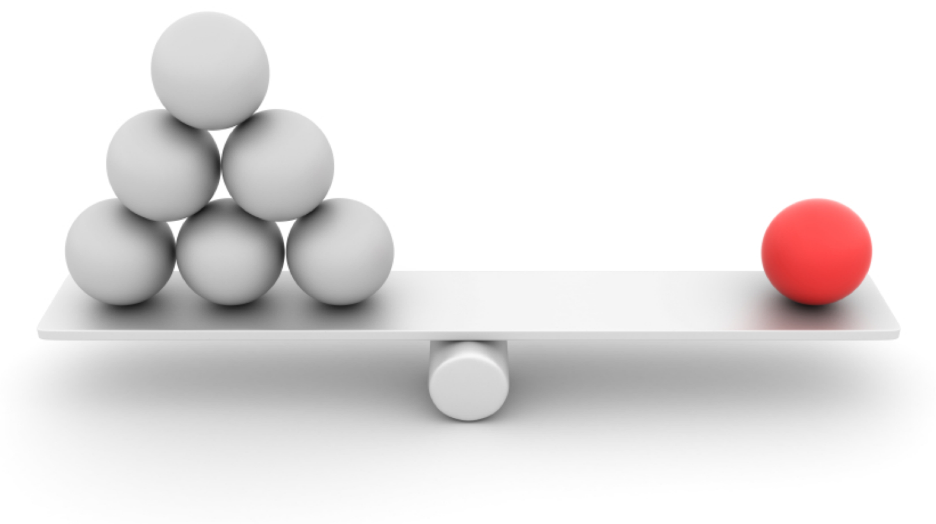
Reviewing Attenuation Factors

- Concentration (C) allowed = C_{indoor} / alpha
- Alpha varies with depth and soil type
  - Sub-slab
  - Soil gas
  - Groundwater
- Three general sources for alpha values
  - Empirical (EPA database)
  - From models (e.g. J&E Model)
  - Measured with tracers (radon, 1,1-DCE, etc.)

Important Considerations
Are the units utilized right?

- A quick check is all it takes!
- Remember:
  - ppbv is NOT equivalent to a µg/L or µg/m³
  - ppmv is NOT equivalent to mg/L

≠!



Biodegradation and Oxygen

- O_2 in soil and water will promote biodegradation
- Biodegradation will occur rapidly over a short distance in the presence of >2% O_2 in soil gas.
- Lack of O_2 (<2%) significantly decreases rate of biodegradation

Source:
ITRC PVI Table 2-1. General differences between PHCs and CVOCs (USEPA 2012g)

How much Oxygen is Enough?

- Atmospheric O_2 (20.95%) is usually sufficient to continually support biodegradation
  - Not a bright line - where it starts and stops are levels of grey
- > concentration, >O_2 demand
- Most states generally concur >2% is a good sign that it can occur (may be up to 5%)

Data Evaluation

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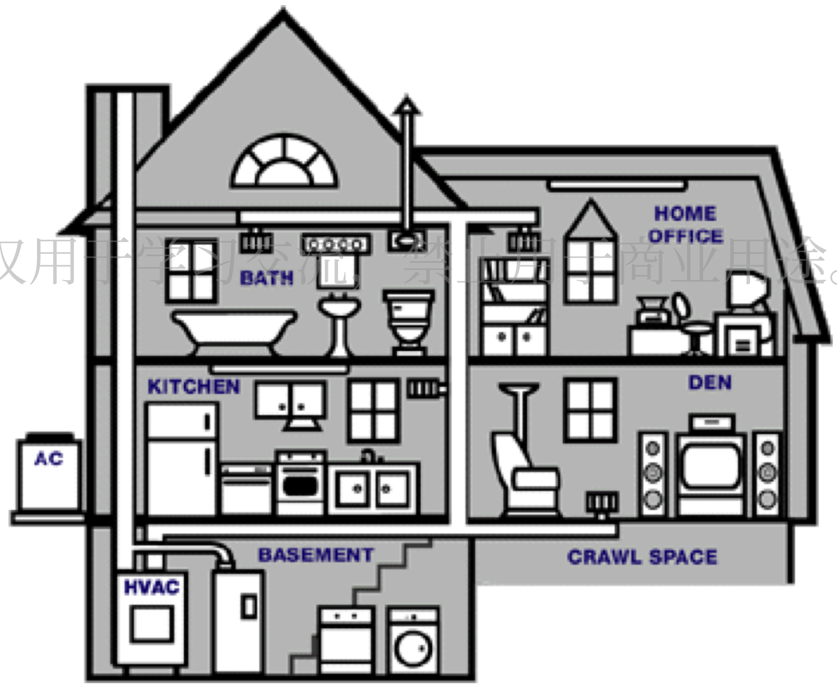
Indoor Sources

- Specific sources of indoor air contamination
  - Consumer activities
  - Household products
  - Building materials and furnishings
  - Ambient (outdoor) air



Some Examples of Background Sources

- PCE > 95% by weight
- Can also include:
  - TCE
  - Toluene
  - Acetone

- Can include:
  - Toluene
  - Xylene
  - Ethylbenzene
  - Petroleum distillates

- Can include:
  - TCE
  - Toluene
  - Acetone

- Cigarette smoke can include:
  - Benzene
  - Naphthalene
  - Vinyl chloride
  - Formaldehyde

Source (in part) :
H&P Analytical

Indoor Air Quality

- Cleaning Your Dishes?

DRAFT: Soap Head Space (E012073-01) Vapor Sampled: 10-Dec-10 Received: 13-Dec-10

2,2,4-Trimethylpentane	54	10	ug/m3	1	EL01310	13-Dec-10	13-Dec-1
n-Heptane	230	5.0	·	·	·	·	·
Trichloroethene	ND	5.0	·	·	·	·	·
1,2-Dichloropropane	ND	[illegible]	·	·	·	·	·
1,4-Dioxane	2100	[illegible]	·	·	·	·	·
Bromodichloromethane	ND	[illegible]	·	·	·	·	·
cis-1,3-Dichloropropene	ND	5.0	·	·	·	·	·
4-Methyl-2-pentanone	[illegible]	[illegible]					·
trans-1,3-Dichloropropene	[illegible]	[illegible]					·
1,3-Dichloropropane	[illegible]	[illegible]					·
Toluene	120	5.0	·	·	·	·	·
1,1,2-Trichloroethane	ND	5.0	·	·	·	·	·
2-Hexanone (MBK)	ND	10	·	·	·	·	·
Dibromochloromethane	ND	5.0	·	·	·	·	·
Tetrachloroethene	ND	5.0	·	·	·	·	·
1,2-Dibromoethane (EDB)	ND	5.0	·	·	·	·	·
1,1,1,2-Tetrachloroethane	ND	5.0	·	·	·	·	·
Chlorobenzene	ND	5.0	·	·	·	·	·
Ethylbenzene	25	5.0	·	·	·	·	·
m,p-Xylene	27	5.0	·	·	·	·	·
Styrene	ND	5.0	·	·	·	·	·
o-Xylene	16	5.0	·	·	·	·	·
Bromoform	ND	20	·	·	·	·	·
1,1,2,2-Tetrachloroethane	ND	5.0	·	·	·	·	·
4-Ethyltoluene	13	5.0	·	·	·	·	·
1,2,3-Trichloropropane	ND	10	·	·	·	·	·
Isopropylbenzene (Cumene)	[illegible]	[illegible]					·
Bromobenzene	[illegible]	[illegible]					·
2-Chlorotoluene	[illegible]	[illegible]					·
n-Propylbenzene	ND	10	·	·	·	·	·
p-Isopropyltoluene	1200	10	ug/m3	1	EL01310	13-Dec-10	13-Dec-1
1,2-Dichlorobenzene	ND	10	·	·	·	·	·
n-Butylbenzene	ND	10	·	·	·	·	·
1,2-Dibromo-3-chloropropane	ND	20	·	·	·	·	·
Naphthalene	31	10	·	·	·	·	·

1,4-Dioxane 2100 ug/m3

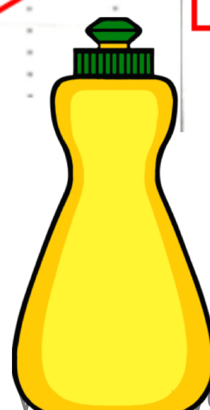
Naphthalene 31 ug/m3

DRAFT: Soap Head Space (E012073-01) Vapor Sampled: 10-Dec-10 Received: 13-Dec-10

Propene	190	10	ug/m3	1	EL01310	13-Dec-10	13-Dec-10
Dichlorodifluoromethane (F12)	ND	10	·	·	·	·	·
Chloromethane	190	5.0	·	·	·	·	·
Dichlorotetrafluoroethane (F114)	ND	10	·	·	·	·	·
Vinyl chloride	ND	5.0	·	·	·	·	·
1,3-Butadiene	7.2	5.0	·	·	·	·	·
Bromomethane	ND	5.0	·	·	·	·	·
Chloroethane	ND	5.0	·	·	·	·	·
Ethanol	6000000	10	·	·	·	·	·
Trichlorofluoromethane (F11)	ND	5.0	·	·	·	·	·
Acetone	[illegible]	[illegible]					·
Isopropyl alcohol	[illegible]	[illegible]					·
1,1-Dichloroethene	[illegible]	[illegible]					·
Tertiary-butyl alcohol	[illegible]	[illegible]					·
1,1,2-Trichlorotrifluoroethane (F113)	ND	10	·	·	·	·	·
Methylene chloride (Dichloromethane)	ND	10	·	·	·	·	·
Carbon disulfide	ND	5.0	·	·	·	·	·
trans-1,2-Dichloroethene	ND	5.0	·	·	·	·	·
Methyl tertiary butyl ether (MTBE)	ND	5.0	·	·	·	·	·
Vinyl acetate	ND	10	·	·	·	·	·
1,1-Dichloroethane	ND	5.0	·	·	·	·	·
2-Butanone (MEK)	100	5.0	·	·	·	·	·
n-Hexane	110	5.0	·	·	·	·	·
cis-1,2-Dichloroethene	ND	5.0	·	·	·	·	·
Diisopropyl ether (DIPE)	ND	5.0	·	·	·	·	·
Ethyl acetate	ND	5.0	·	·	·	·	·
Chloroform	130	5.0	·	·	·	·	·
2,2-Dichloropropane	[illegible]	[illegible]					·
Tetrahydrofuran	[illegible]	[illegible]					·
Ethyl tert-butyl ether (ETBE)	[illegible]	[illegible]					·
1,1,1-Trichloroethane	[illegible]	[illegible]					·
1,2-Dichloroethane (EDC)	ND	5.0	·	·	·	·	·
1,1-Dichloropropene	ND	10	·	·	·	·	·
Benzene	19	5.0	·	·	·	·	·
Carbon tetrachloride	ND	5.0	·	·	·	·	·
Dibromomethane	ND	10	·	·	·	·	·
Cyclohexane	ND	10	·	·	·	·	·
Tertiary-amyl methyl ether (TAME)	ND	5.0	·	·	·	·	·

Ethanol 600000 ug/m3

Benzene 19 ug/m3



Source: Blayne Hartman, H&P Analytical

It Doesn't Take Much: One Drop of Gasoline in a Room

$$(0.05\ mL * 0.8\ \frac{g}{ml} * 1000\ \frac{mg}{g} * 1000\ \frac{\mu g}{mg})/300\ m^3 =$$

$$133\ \mu g/m^3$$

Source: Richard Rago, Haley & Aldrich

Some Background Sources not Obvious

Analyte	BBQ	Garage	Patio	Closet
methane	40%	90%	100%	nd (0.1%)
n-hexane	1700	2000	10000	nd (15)
n-heptane	460	710	3100	nd (50)
benzene	270	340	1900	7.9

Benzene found in Natural Gas

Indoor Sources

Household Products Searchable Database

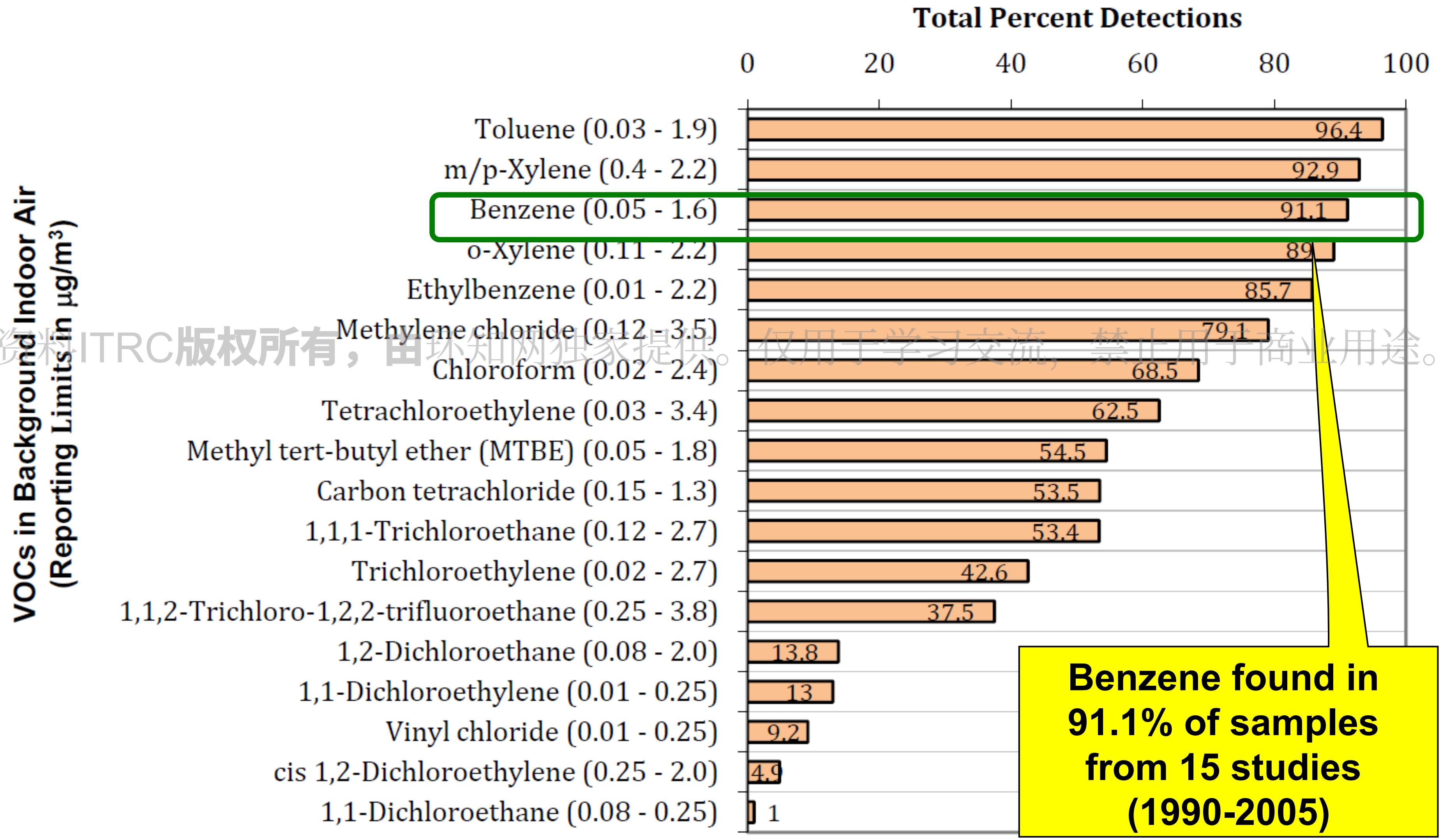
http://householdproducts.nlm.nih.gov/

- Chemical ingredients in specific brands
- Which products contain specific chemical ingredients
- Who manufactures a specific brand
- Health effects

Caution on the Use of Indoor Air Data

- US EPA, Background Indoor Air Concentrations of Volatile Organic Compounds in North American Residences (1990–2005): A Compilation of Statistics for Assessing Vapor Intrusion, EPA 530-R-10-001
  - Measured background in thousands of North American residences between 1990 and 2005
  - Assumed to NOT be associated with vapor intrusion
- VOCs most commonly detected in indoor air due to background sources included
  - Benzene
  - Toluene
  - Ethylbenzene
  - Xylenes

Common VOCs in Background Indoor Air



USEPA, 2011. Background Indoor Air Conc. of VOCs in North American Residences (EPA 530-R-10-001), Figure 4.

United States Clean Air Act of 1970

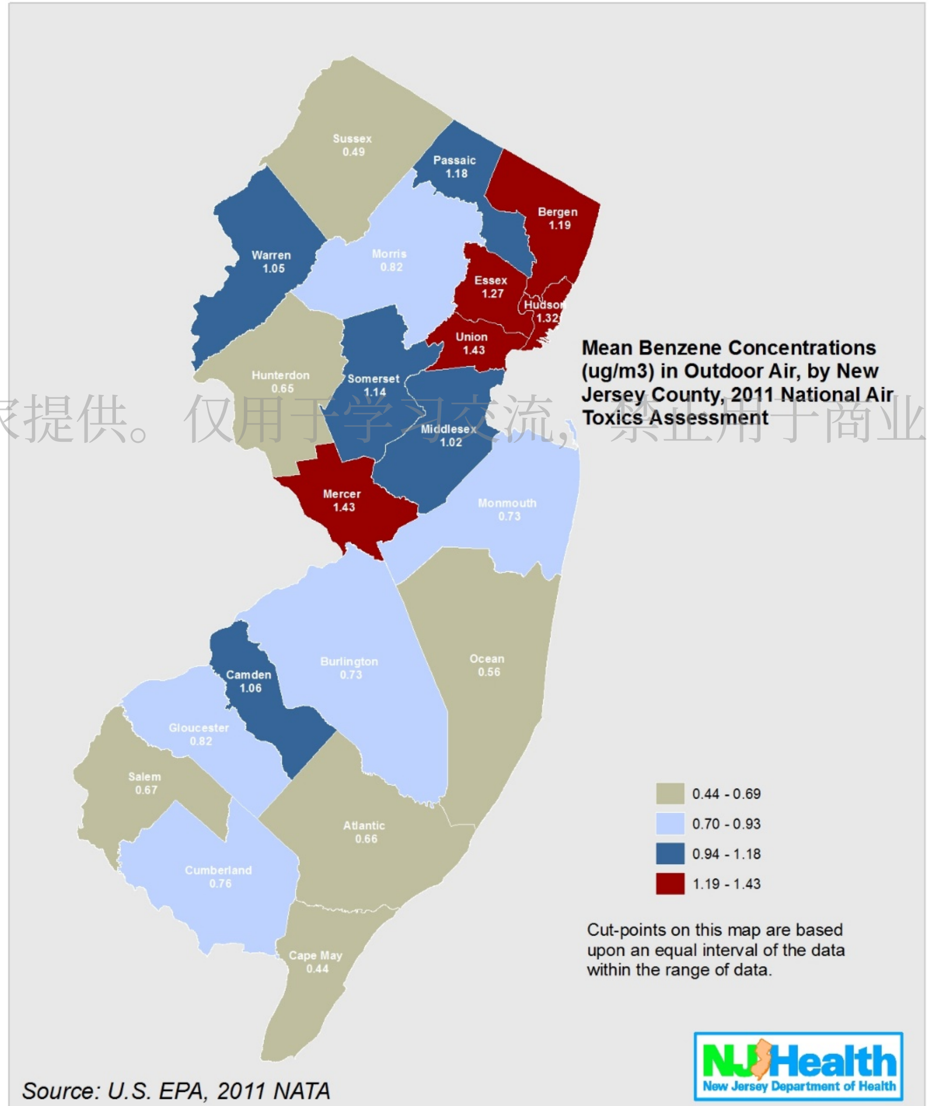
Ambient (outdoor) air quality impacts indoor air quality

New York City

Benzene in New Jersey Outdoor Air

Mean outdoor (ambient) benzene concentration in the State of New Jersey by counties

- New Jersey residential indoor air screening level (IASL) for benzene is 2 μg/m^3



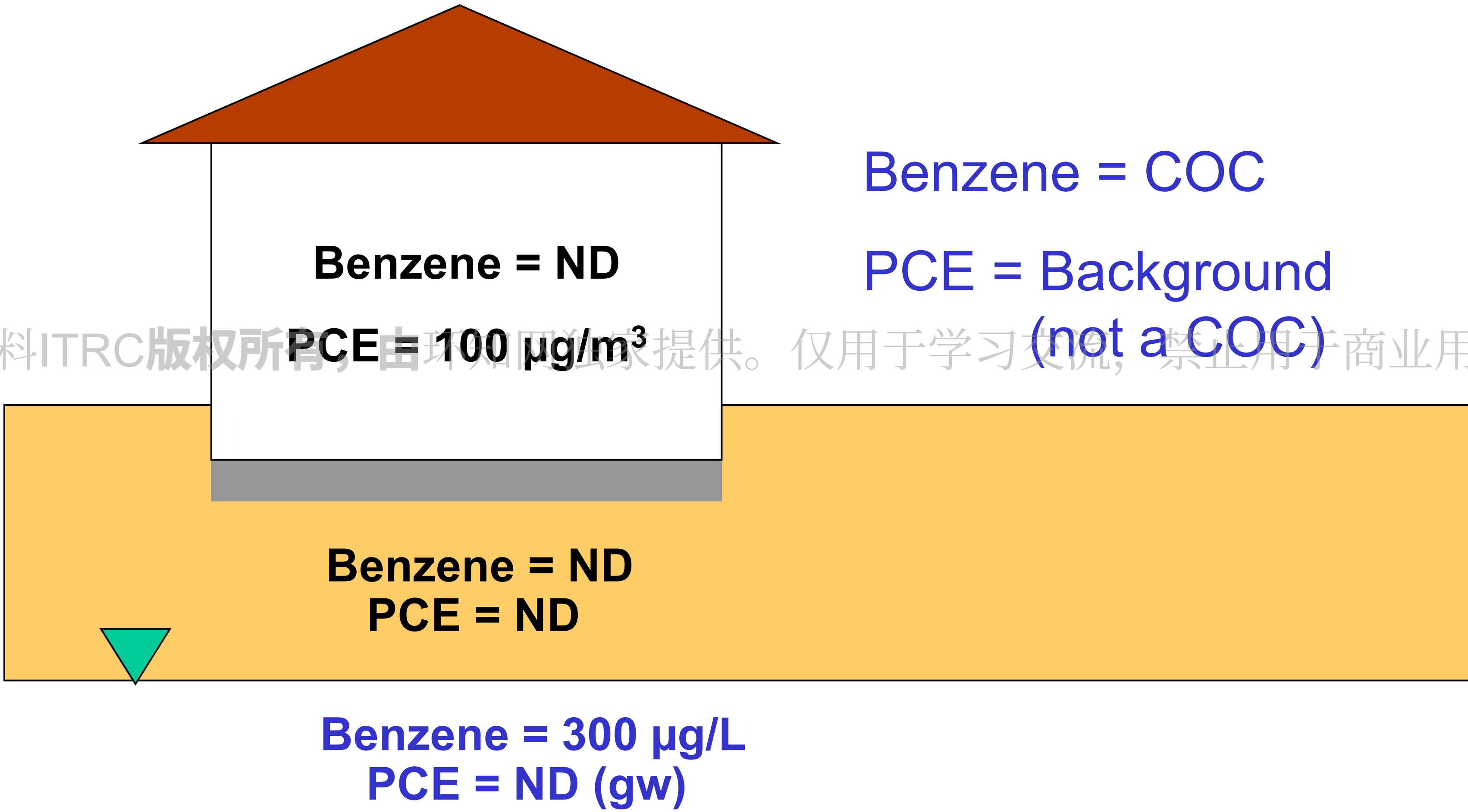
Data Evaluation

- Main areas:
  - Data quality review
  - Data comparison to screening levels
  - Background sources of contamination
  - Other lines of evidence (CSM check)

COCs = Multiple Lines of Evidence

- Site-specific Contaminants of Concern (COCs)
  - COCs not present in soil or groundwater are likely due to background sources
  - Media must be well characterized
  - Degradation products must be considered
  - Review Building Survey – are consumer products present that contain the compounds detected that are not COCs?

Site-specific Chemicals of Concern

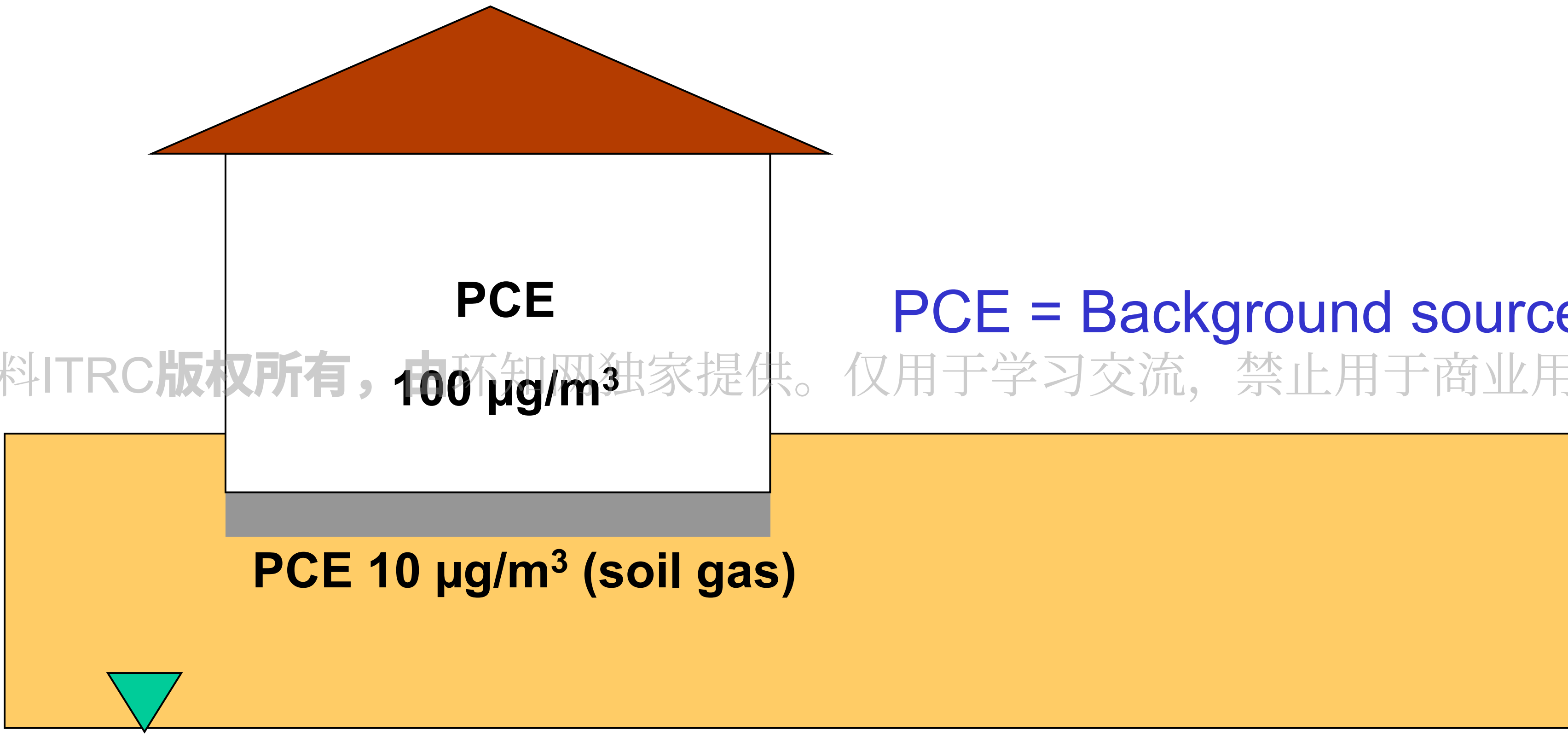


Benzene = COC

PCE = Background (not a COC)

VI Guideline p. 38

Breathing Buildings

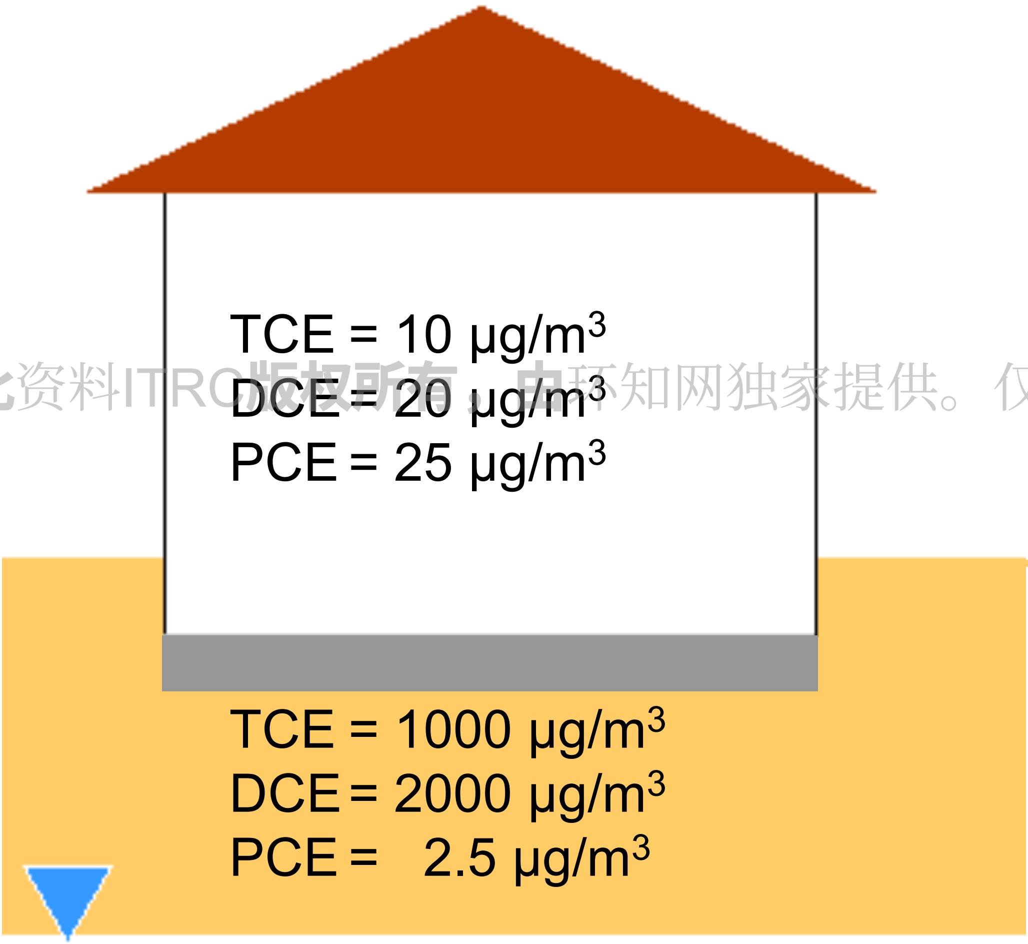


PCE = Background source

PCE Not detected (gw)

Is this vapor extrusion?

Constituent Ratio Example



Compare sub-slab soil gas and indoor air

TCE and DCE attributable to vapor intrusion

TCE = 0.5x DCE

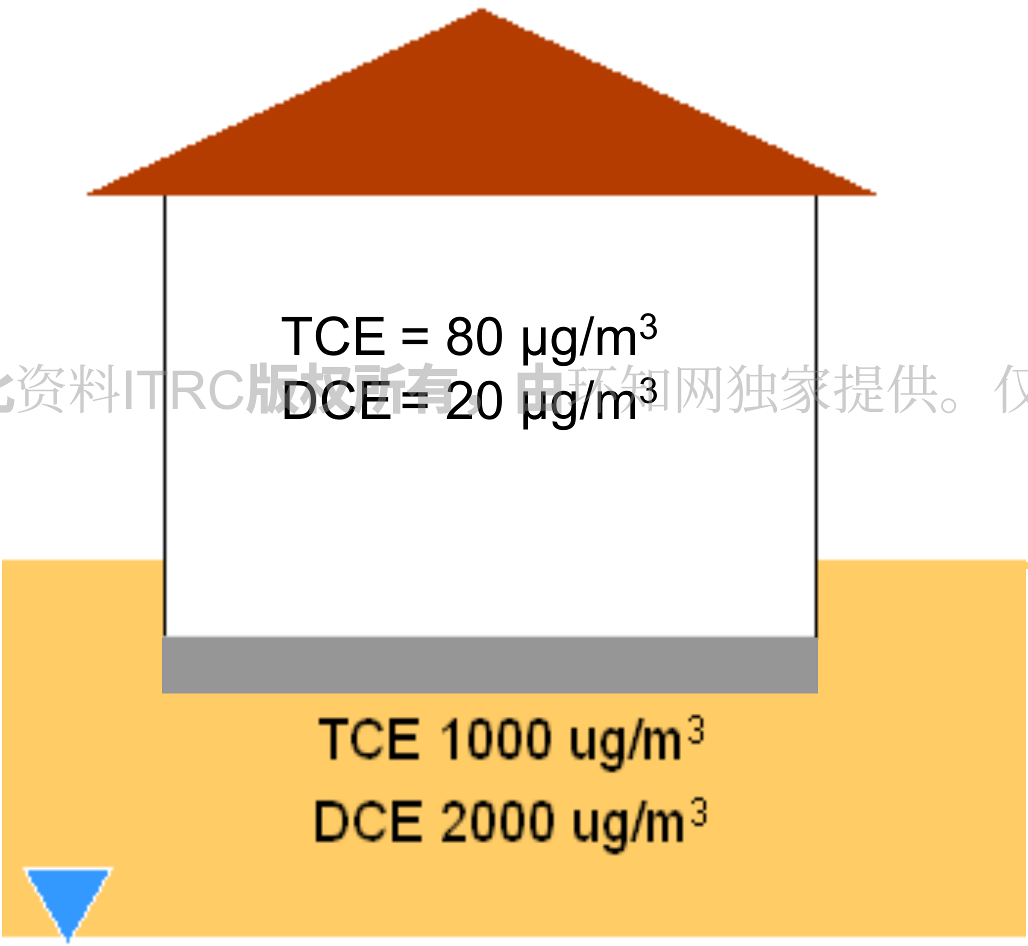
PCE = 2.5x TCE

TCE = 0.5x DCE

PCE << TCE

PCE likely from indoor background source

Constituent Ratio Example #2



Constituent ratio for indoor air does NOT match the ratio for sub-slab soil gas

TCE = 4x DCE

TCE = 0.5x DCE

Most TCE in indoor air likely from a background source, but the rest (~10 $\mu g/m^3$) may still be unacceptable

Data Comparison
Next Steps

- Should I further develop detailed site specific clean-up values?
  - Generally "Yes":
    - Petroleum - especially if bio can be considered!
    - Site differs from the assumptions utilized

  - Probably not:
    - Site matches assumptions
    - Source is close and/or in contact
    - Large exceedances for CVI
- Can you use it as a line of evidence?

Data Comparison
Site Specific Value Development

- Typically a model . . .

  . . . maybe an attenuation factor
  - Use J&E model or BIOVAPOR
  - Can you develop a site-specific attenuation factor?
- Less conservative . . .

  . . . though still may be!
  - Using actual site inputs

Data Evaluation Summary

- Data Quality Review
  - Both sampling approach and lab quality
- Background contamination
  - Indoor sources and ambient air quality impact
- Data review & comparison
  - COCs
  - Constituent ratios
- CSM and sanity check

Be THIS:

Not this: