

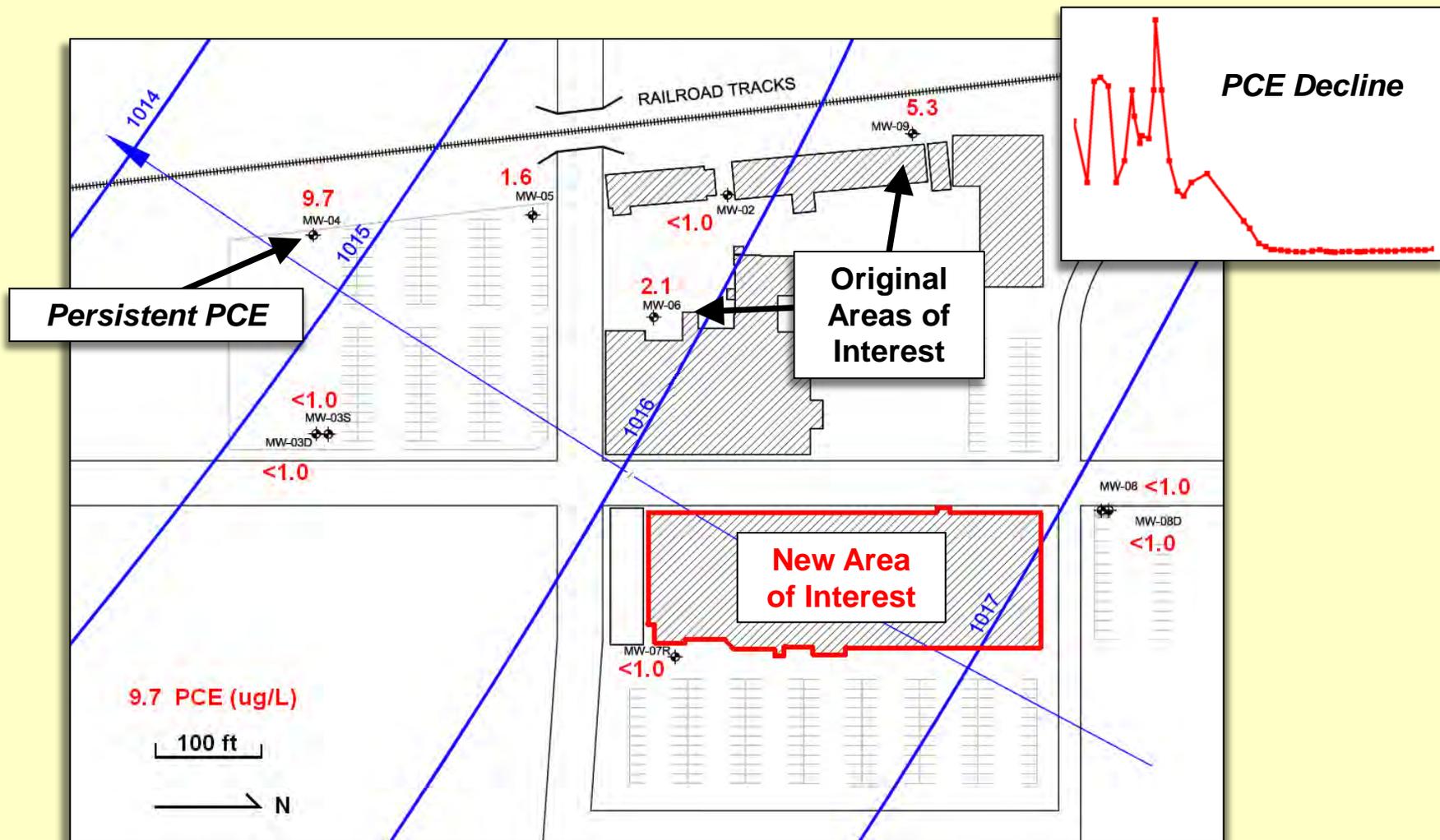


**Rapid Sub-Slab Soil Gas Sampling
for Finding Sources and
Assessing Vapor Intrusion**

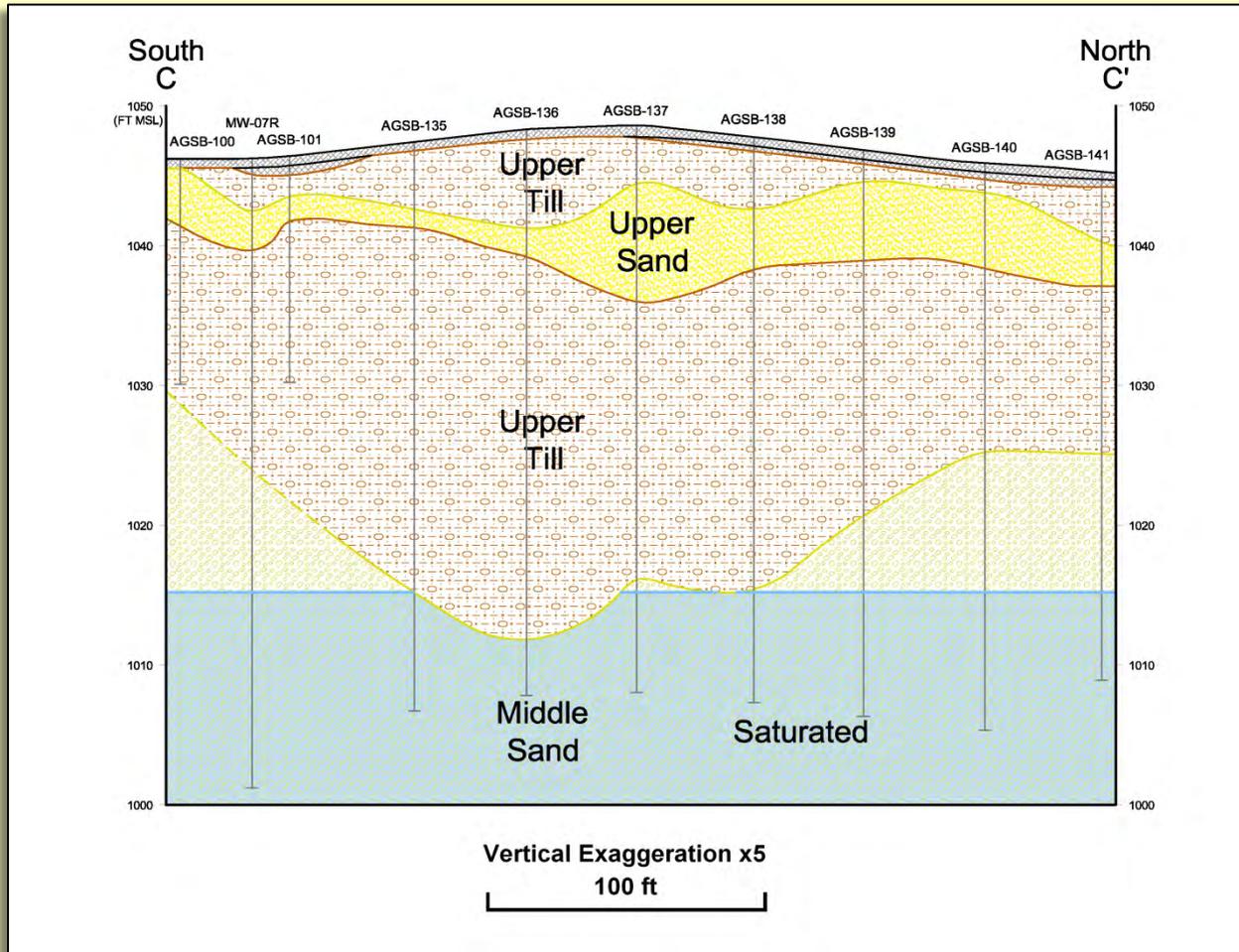
Martin (Mort) Schmidt, CPG-08432

Ohio Brownfield Conference, May 24, 2012

Manufacturing Facility in Ohio w/ Tetrachloroethene (PCE) Contamination in Groundwater



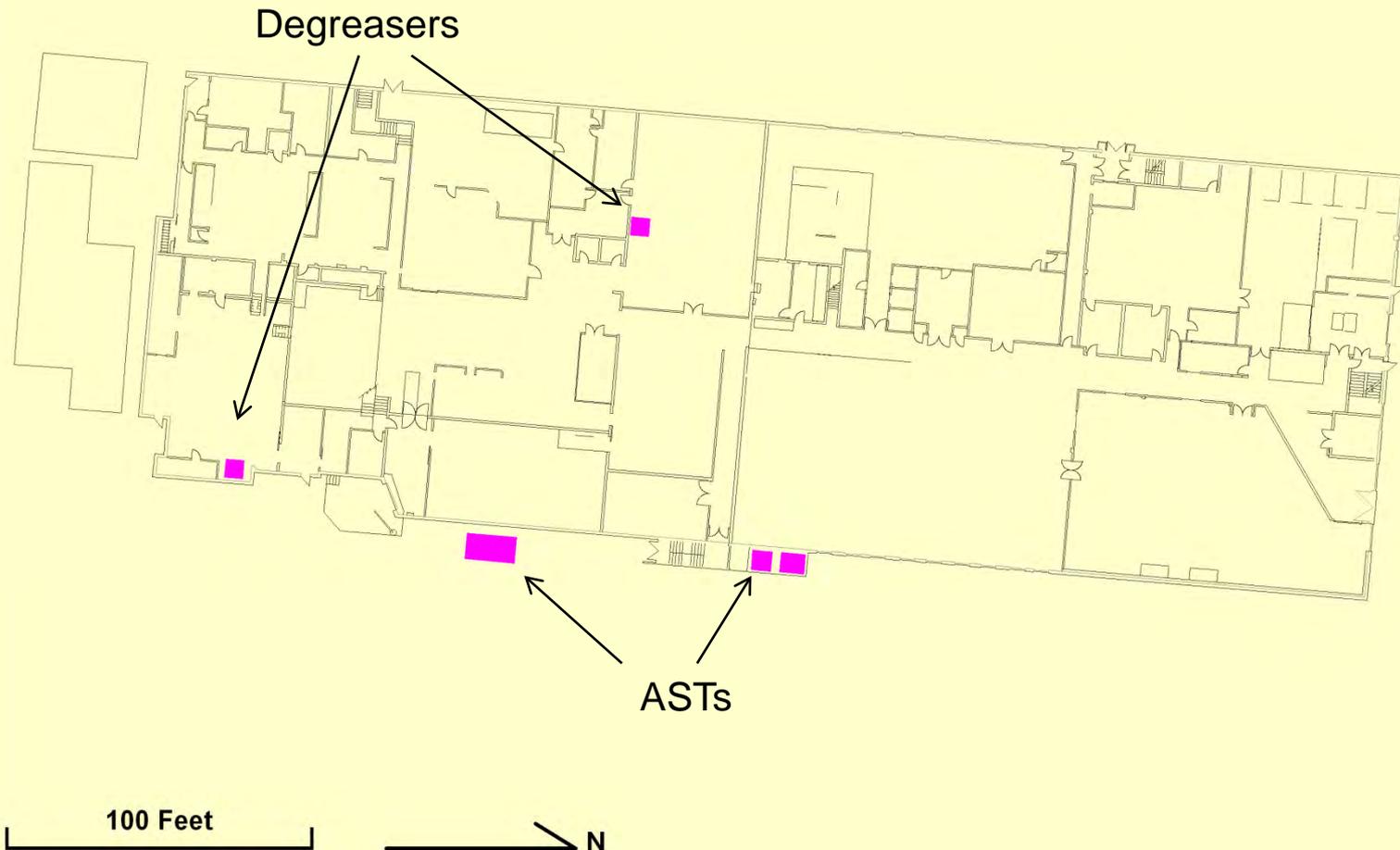
Geologic Cross Section



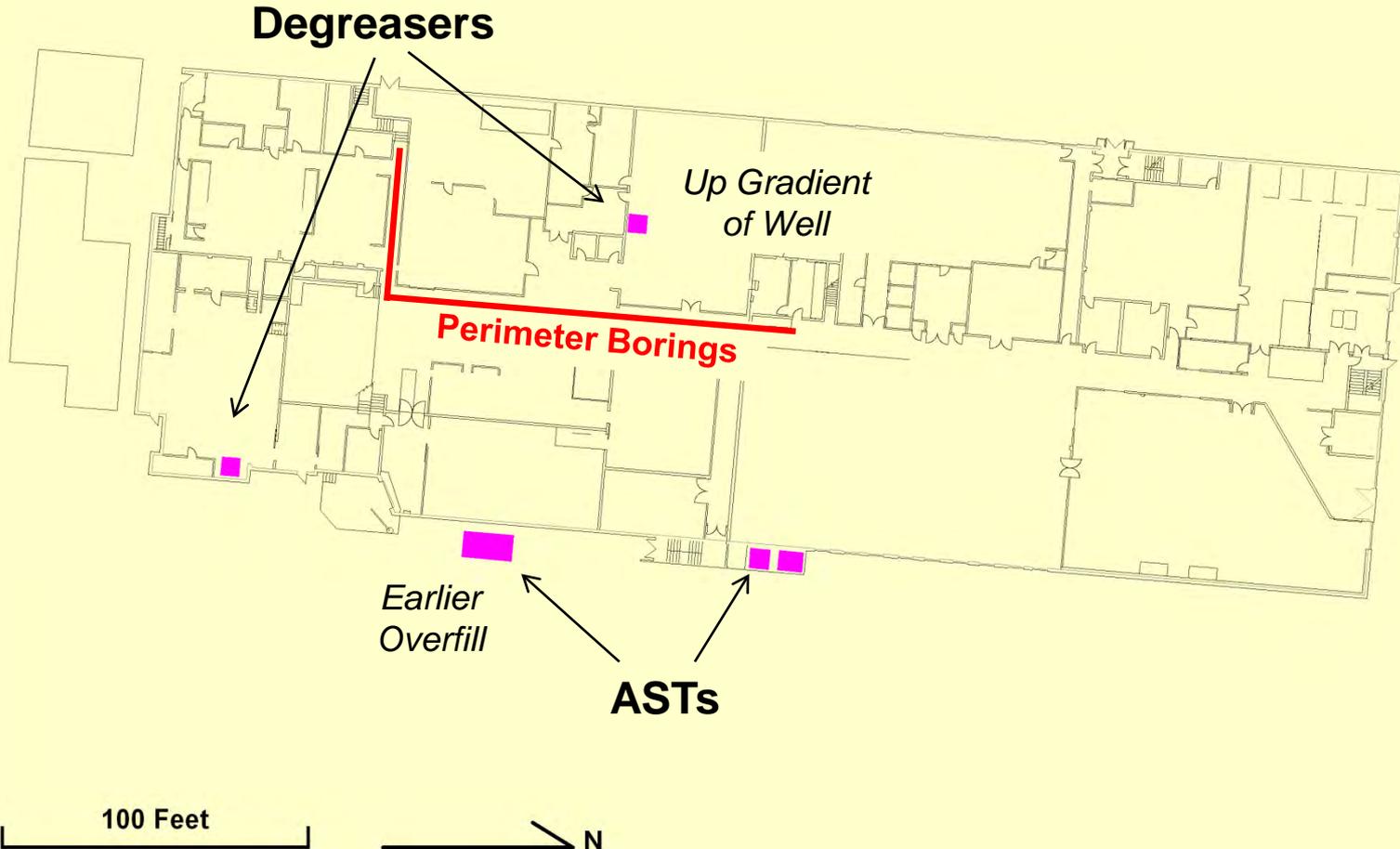
Chlorinated Solvent Contamination

- Tetrachloroethene (PCE) above MCL of 5 ug/L
- Breakdown products, TCE & DCE in groundwater.
- Source of contamination assumed to be former PCE degreasers or ASTs.

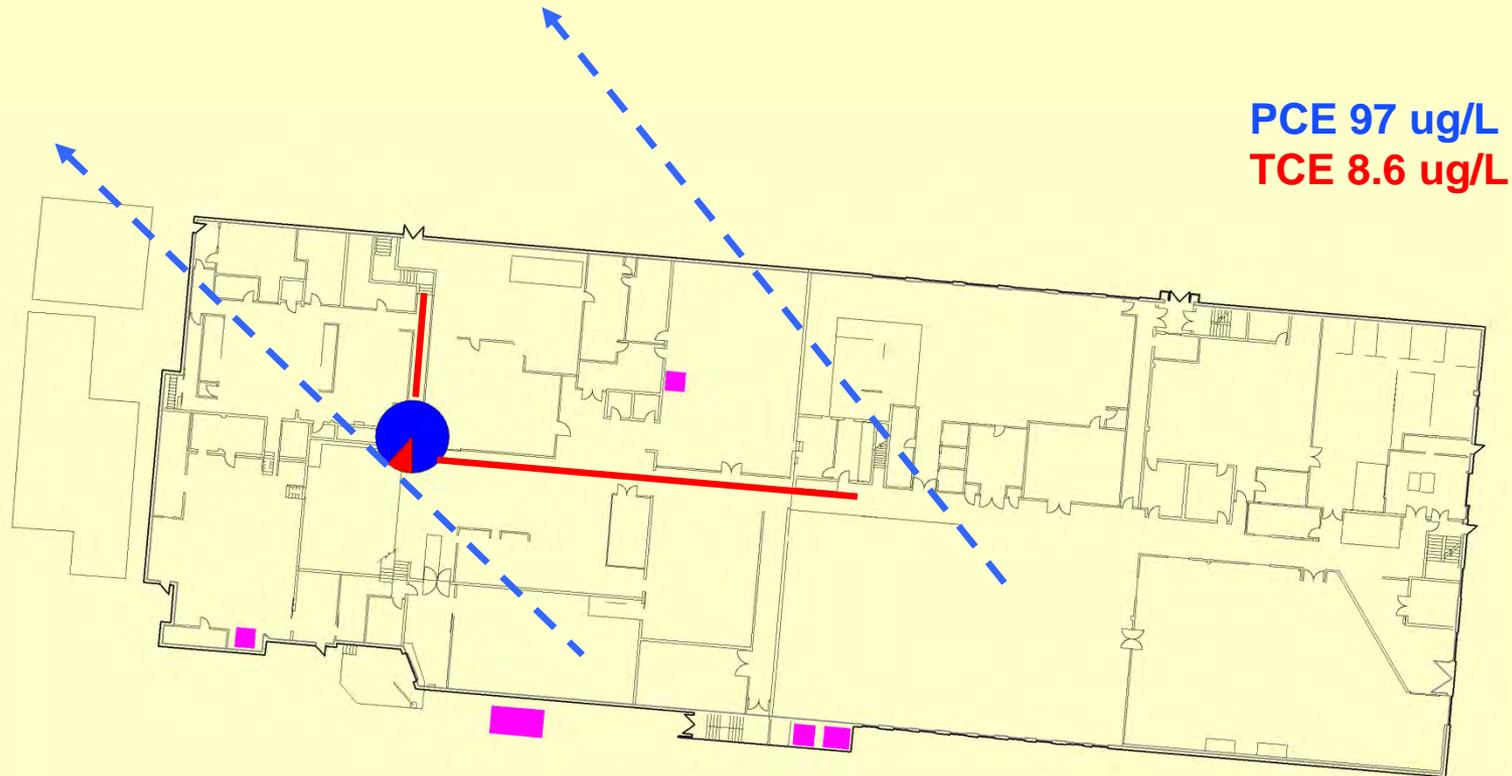
Former PCE Use & Storage



Former PCE Use & Storage



Unexpected Groundwater Contamination



100 Feet

N

Source Investigation

- Earlier sampling inconclusive
- Recent sampling revealed unknown source location
- Needed to locate all possible sources

Proposed to locate source with grid of subslab soil gas

Typical Vapor Intrusion CSM

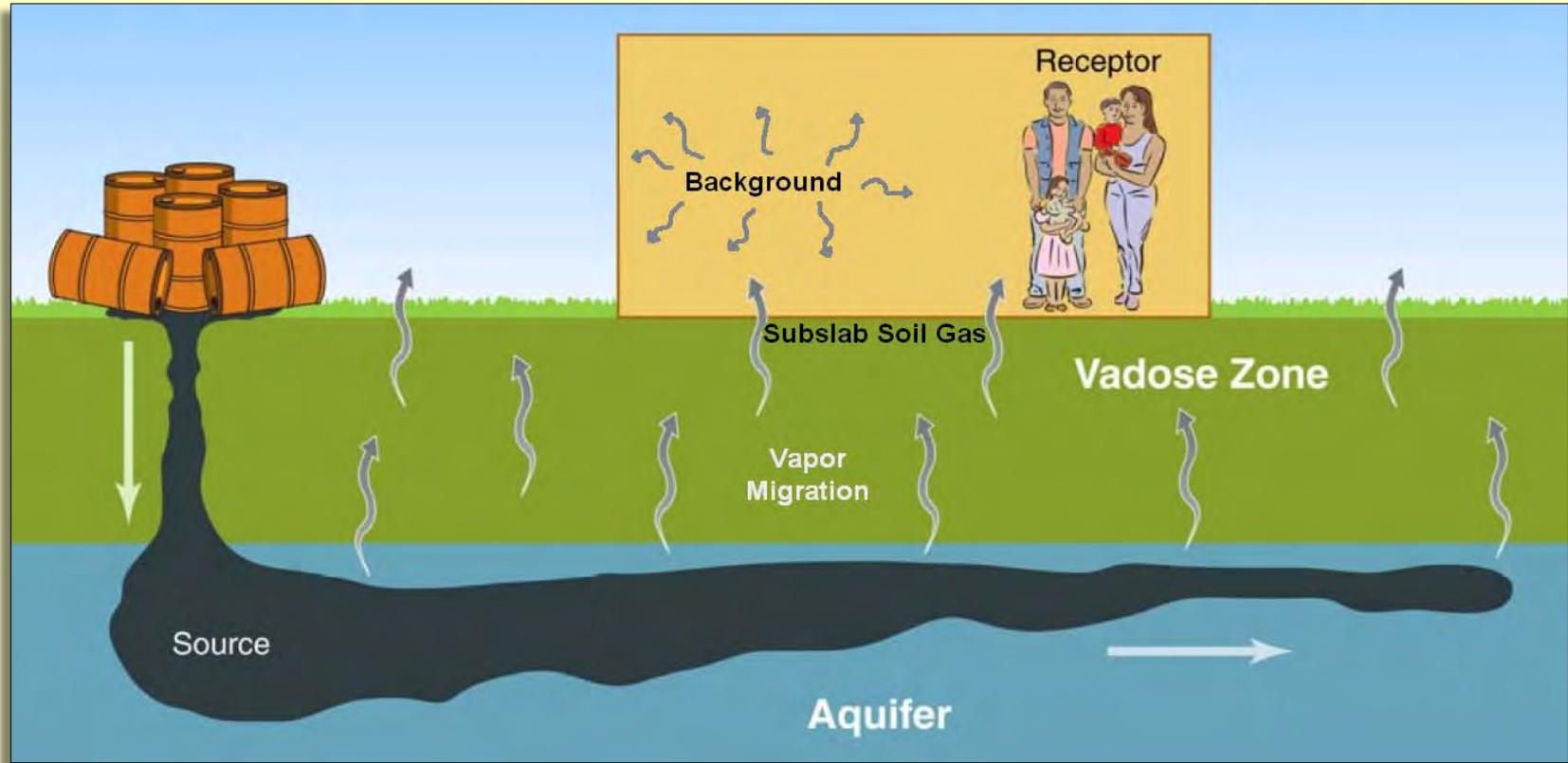
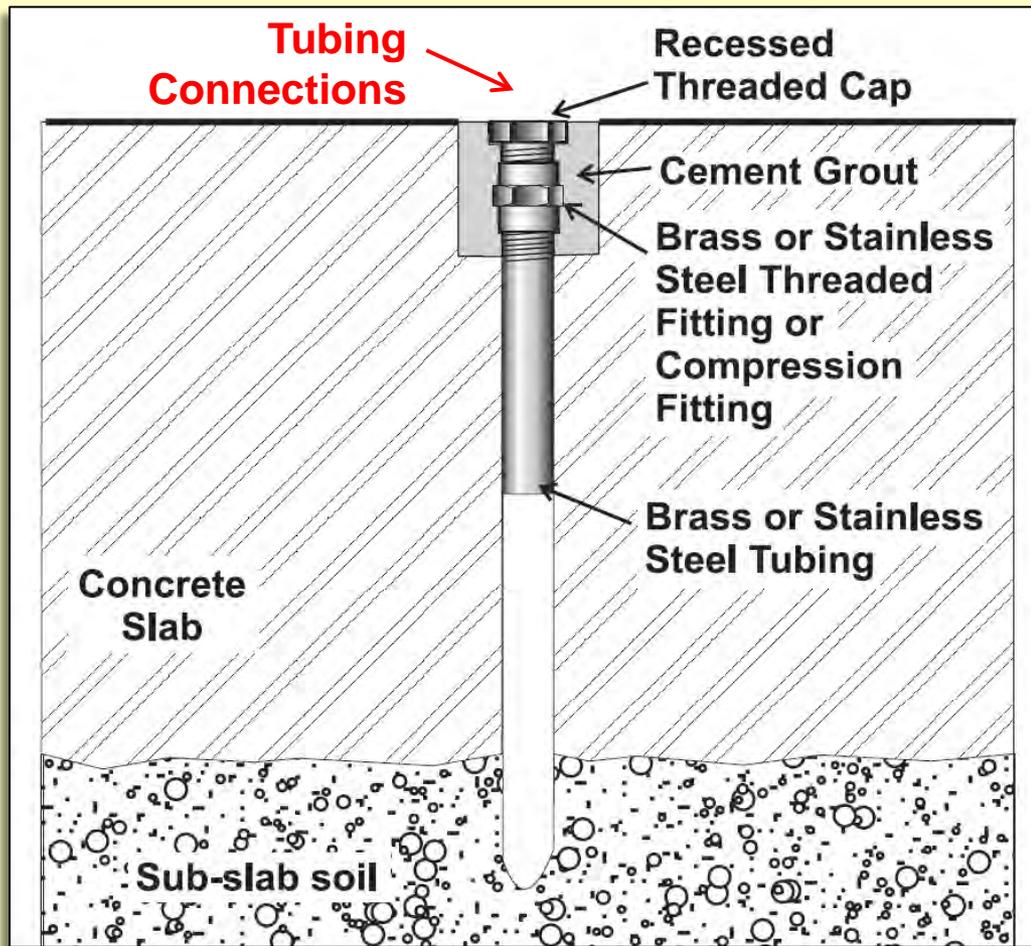


Figure Modified After ITRC, 2007

Conventional Subslab Sample Point



LIMITATIONS

Seal is Prone to Leak When Connecting Tubing

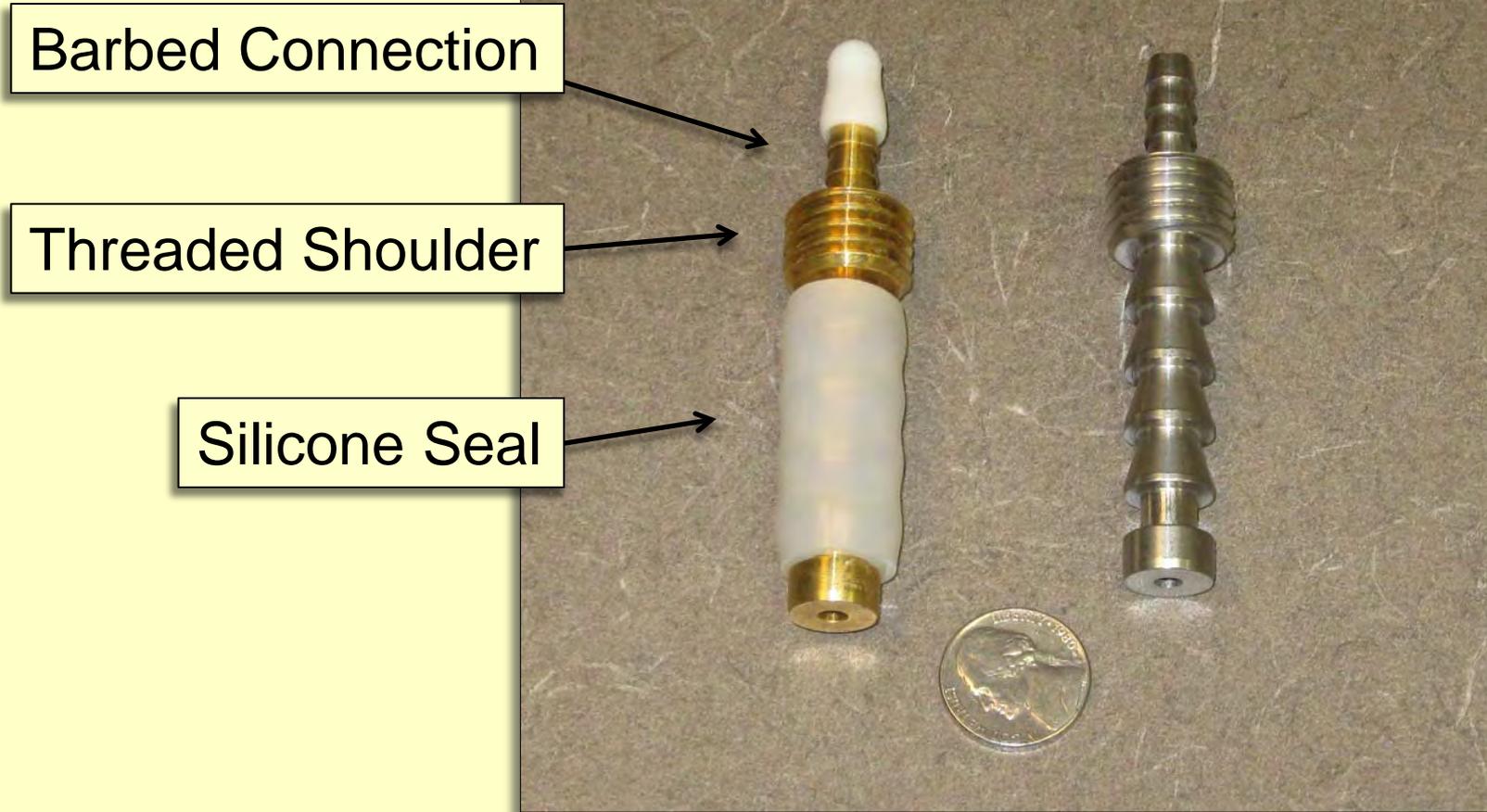
Difficult Working Space

Cement Set Up Time

Extended Open Time

Figure from DiGiulio et al., 2006, Raymark Investigation, EPA/600/R-05/147

Vapor Pin™



Drilling Through Slab



Installing Point



Flush Mount



Stick-Up

Purging and Sampling



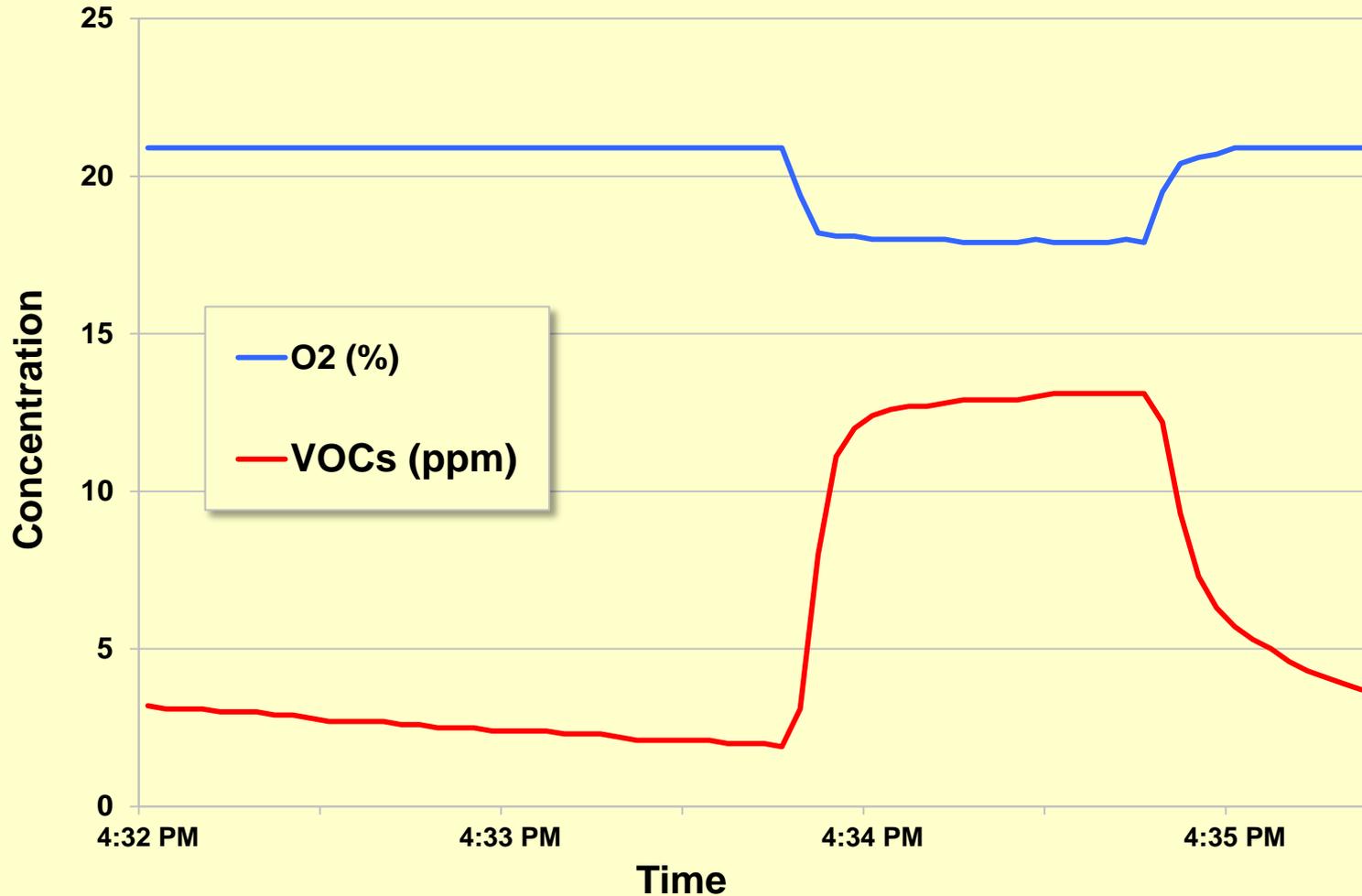
Equilibration

*Monitor O₂ &
VOCs While
Purging*

*Withdraw Soil
Gas*

*Inject Into
Evacuated
Glass Vials*

Example Purge Data



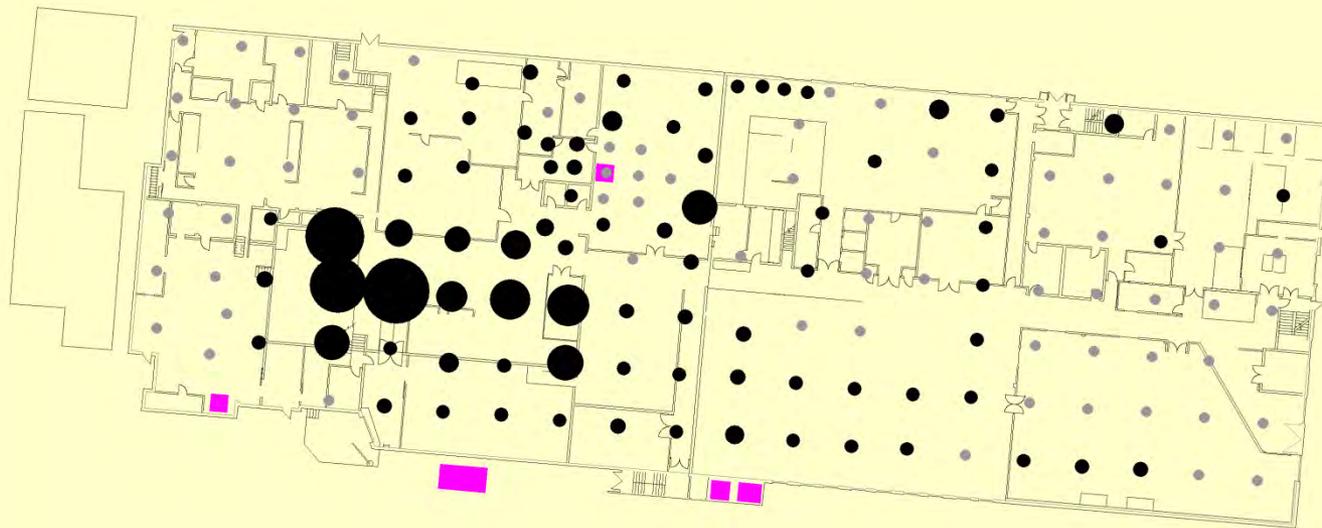
Soil Sampling vs Soil-Gas Prospecting

- Less Obtrusive than Soil Sampling
- Real-Time Data Reduces Delays and Cost
- Soil Gas Detects Nearby Sources

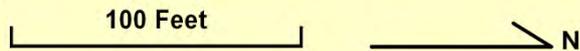
Field Soil-Gas (PID) Results

Black: 100-100,000 ppb, Calibrated for Isobutylene
(57-57,000 ppb, when corrected for PCE)

Gray: ND

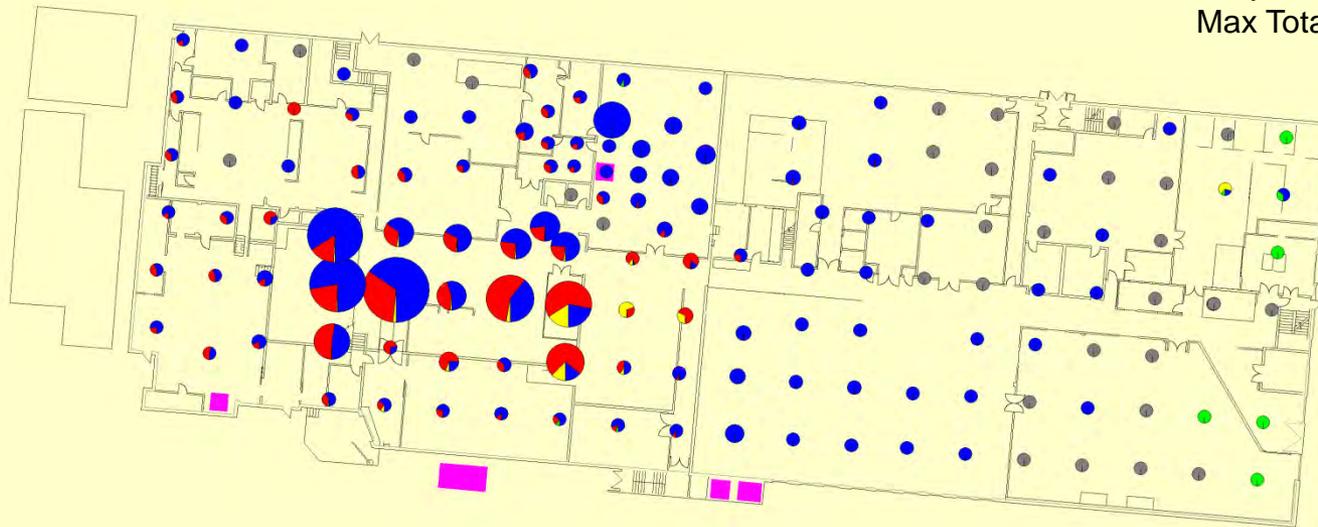


Don't Blame the Usual Suspects!

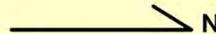


Lab Soil-Gas Results

Blue: PCE
Red: TCE
Yellow: cis-1,2-DCE
Green : 111-TCA
Gray: ND
Max Total 58,000 ppb

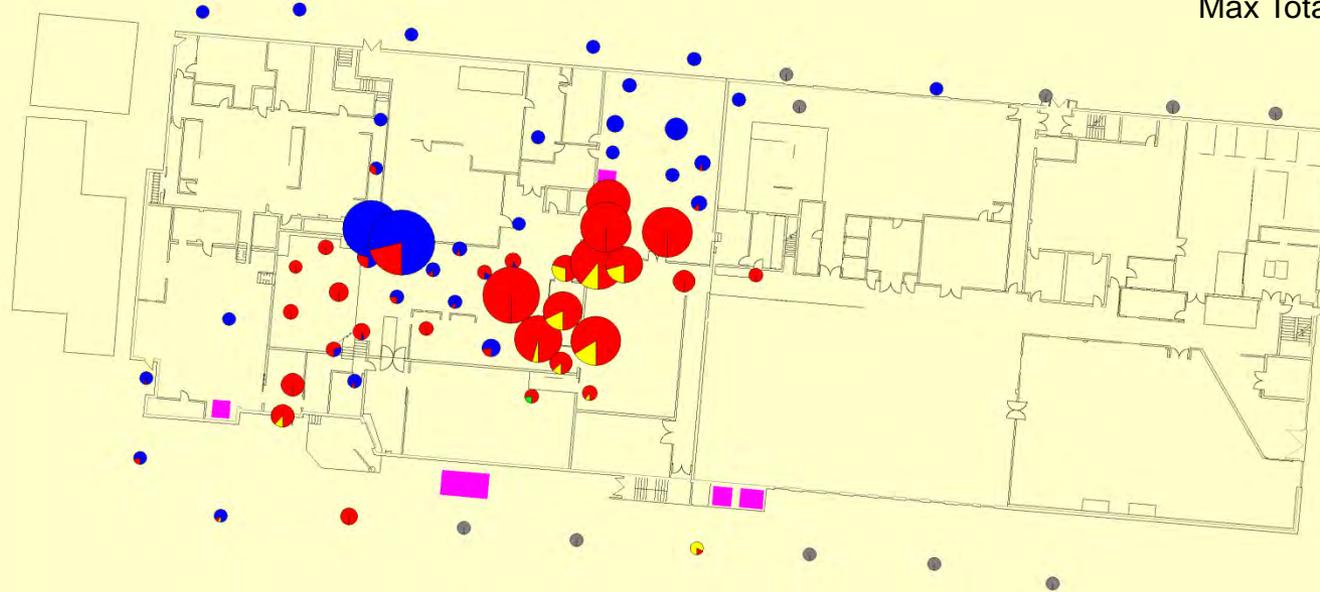


100 Feet



Lab Soil Results

Blue: PCE
Red: TCE
Yellow: cis-1,2-DCE
Green : 111-TCA
Gray: ND
Max Total 241,000 ug/kg

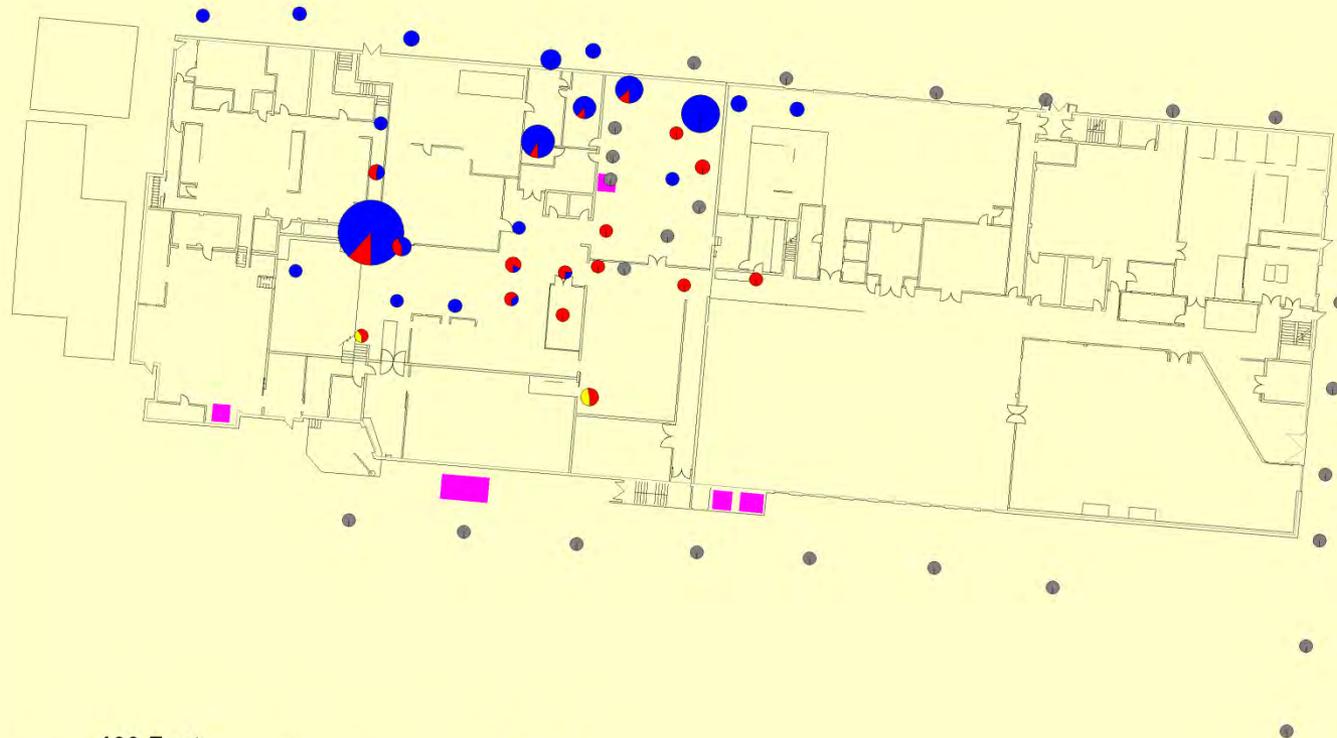


- *Soil Data Used for Remediation*
- **Contamination ~15 ft deep**
- *Avoided Sampling North Half of Bldg*

100 Feet 

Groundwater Data

Blue: PCE
Red: TCE
Yellow: cis-1,2-DCE
Gray: ND
Max Total 272 ug/L

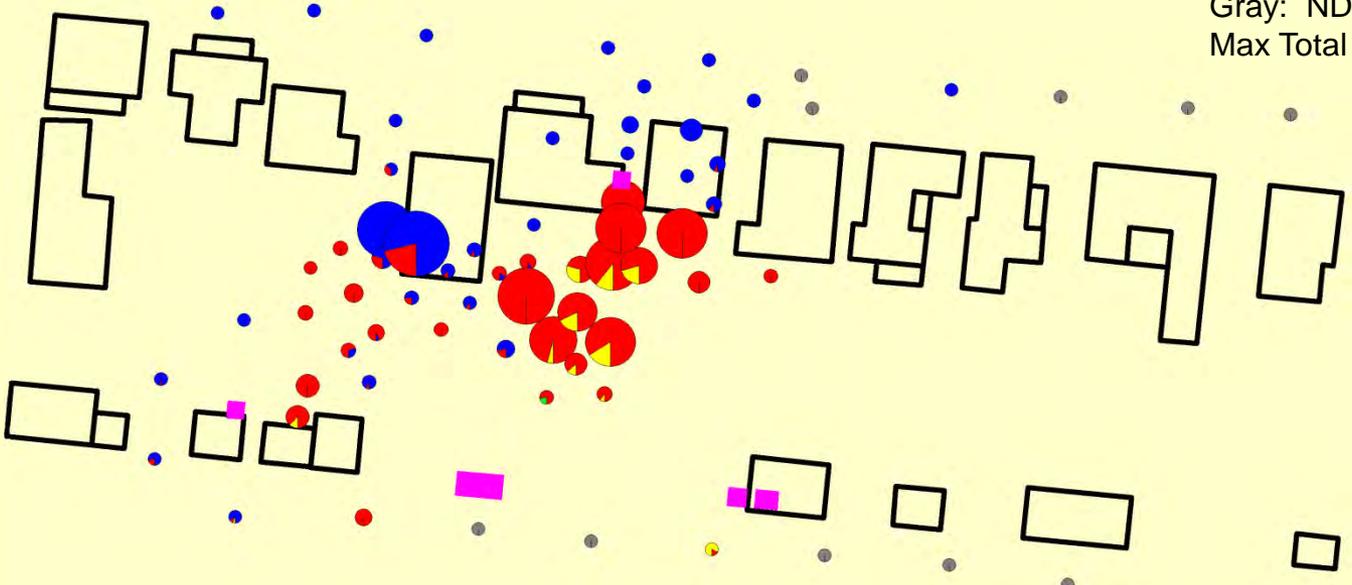


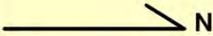
100 Feet

N

Building Configuration 1924

SOIL
Blue: PCE
Red: TCE
Yellow: cis-1,2-DCE
Green : 111-TCA
Gray: ND
Max Total 241,000 ug/kg



100 Feet 

Building Configuration 1938

Manufacturing
Started in 1933

SOIL

Blue: PCE

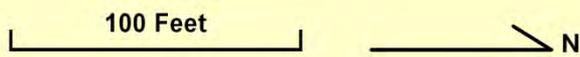
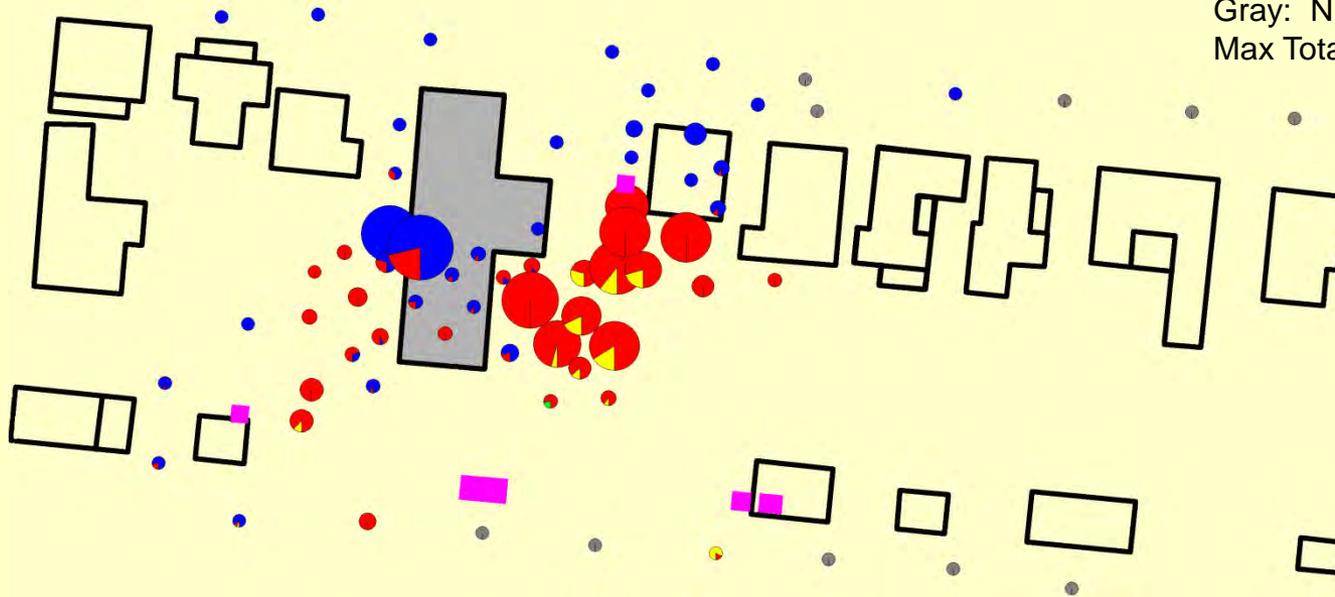
Red: TCE

Yellow: cis-1,2-DCE

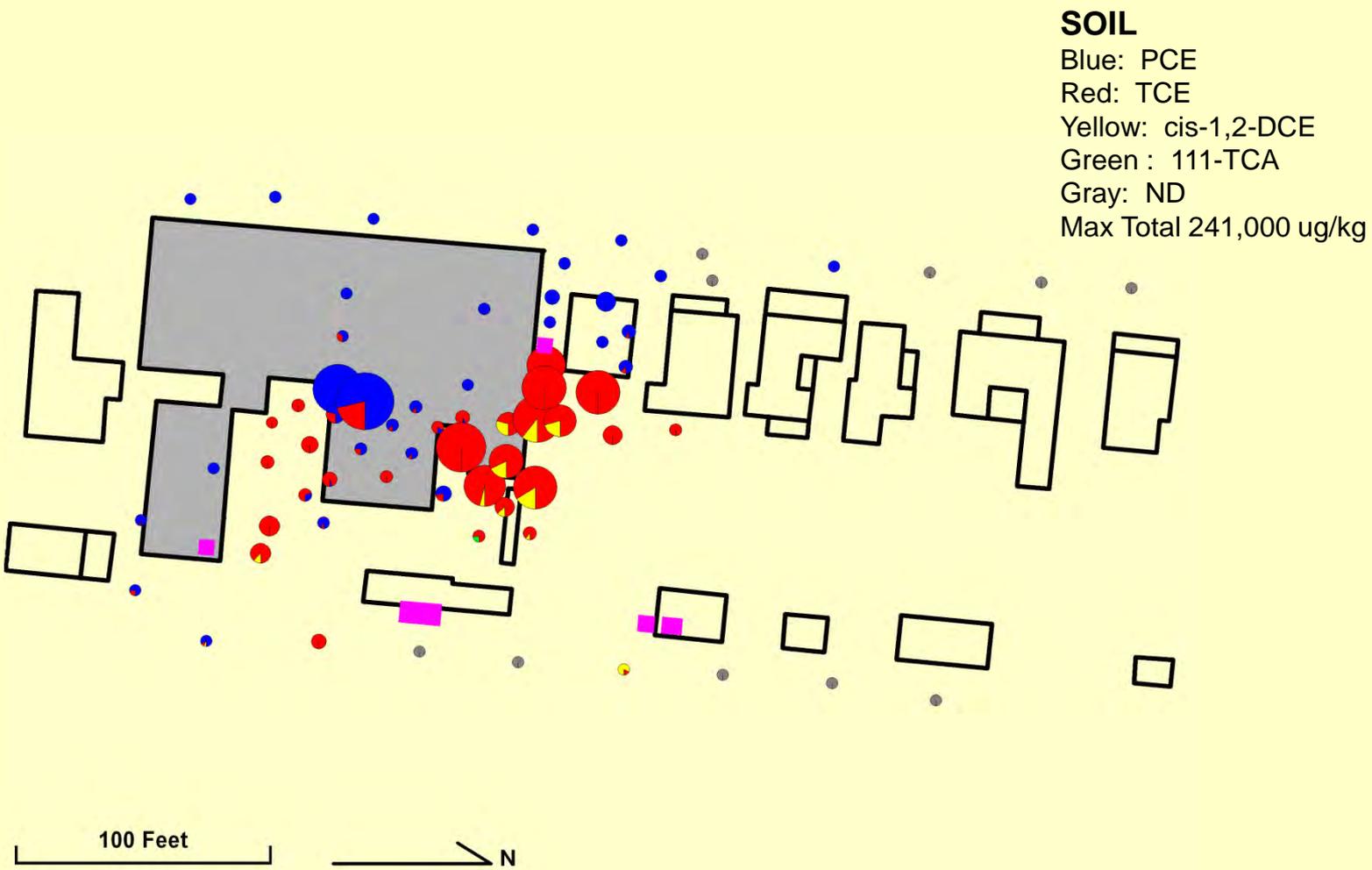
Green : 111-TCA

Gray: ND

Max Total 241,000 ug/kg



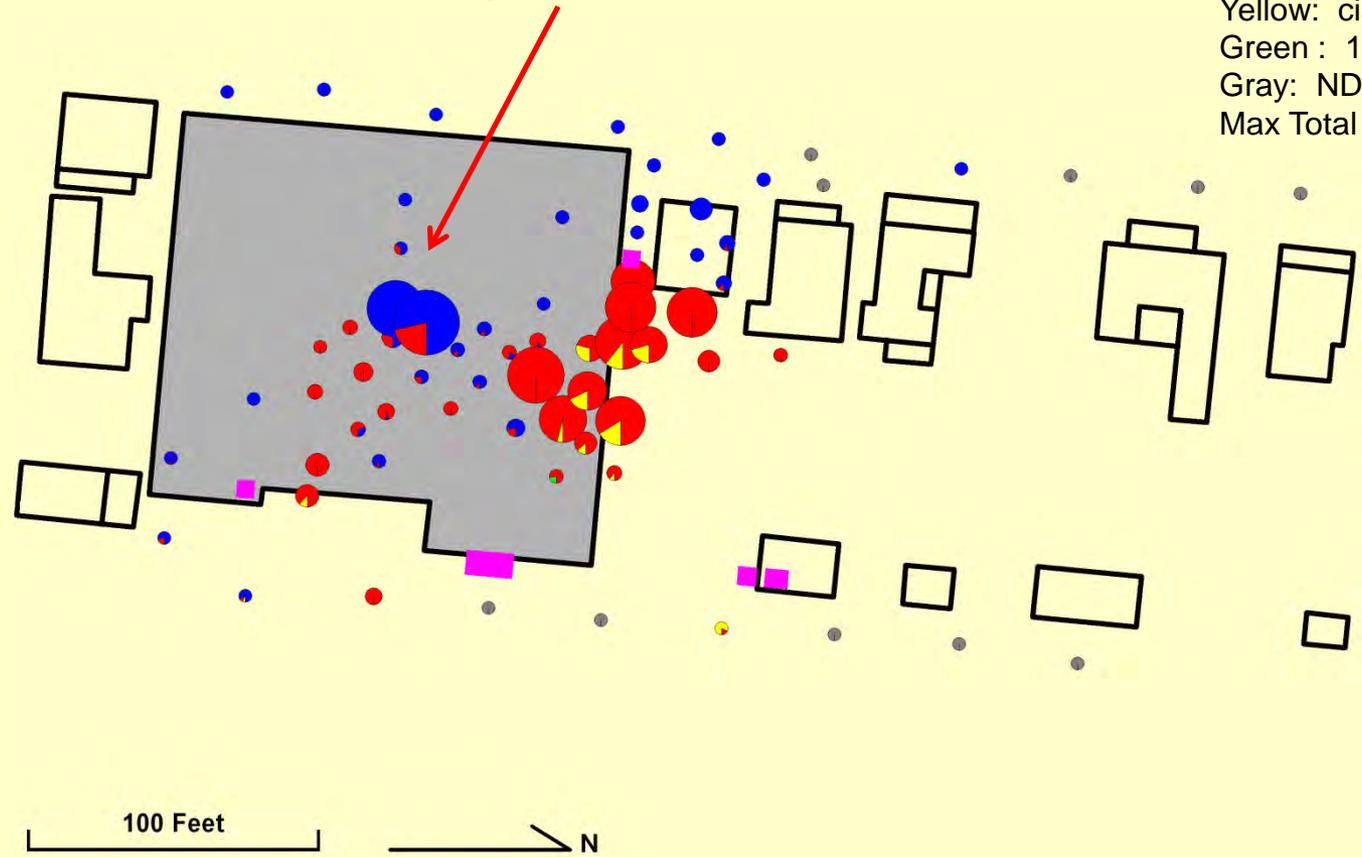
Building Configuration 1950



Building Configuration 1952

Contamination Probably Between 1933 and 1952

SOIL
Blue: PCE
Red: TCE
Yellow: cis-1,2-DCE
Green : 111-TCA
Gray: ND
Max Total 241,000 ug/kg



Building Configuration 2012

SOIL

Blue: PCE

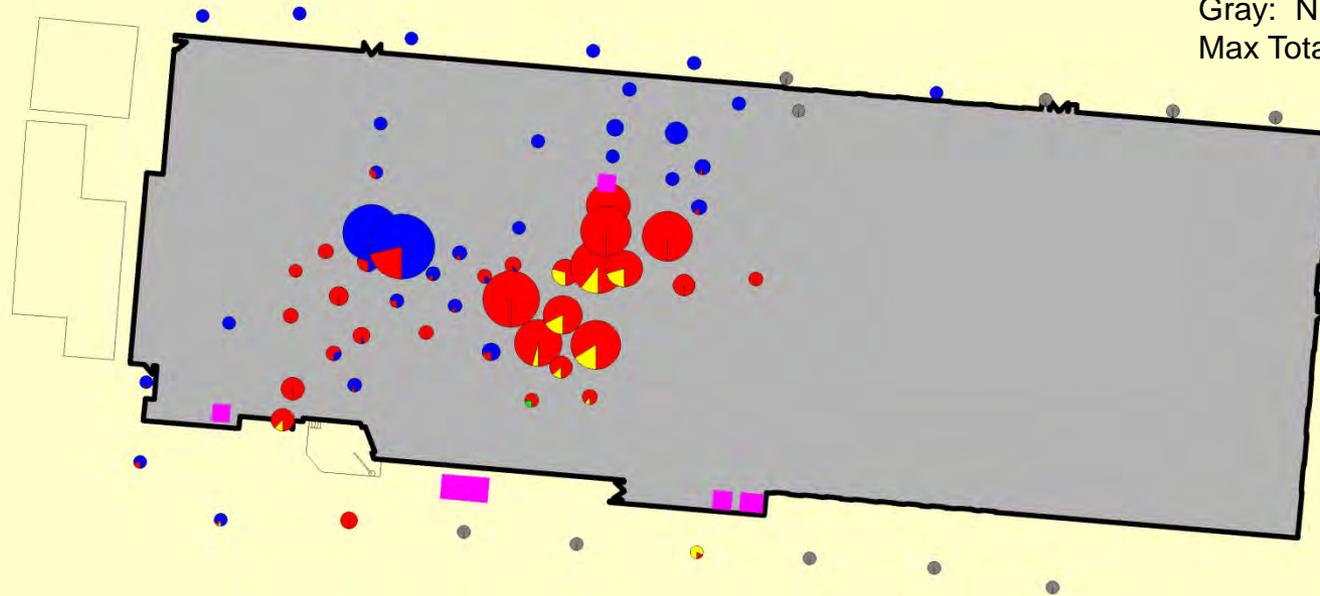
Red: TCE

Yellow: cis-1,2-DCE

Green : 111-TCA

Gray: ND

Max Total 241,000 ug/kg



100 Feet

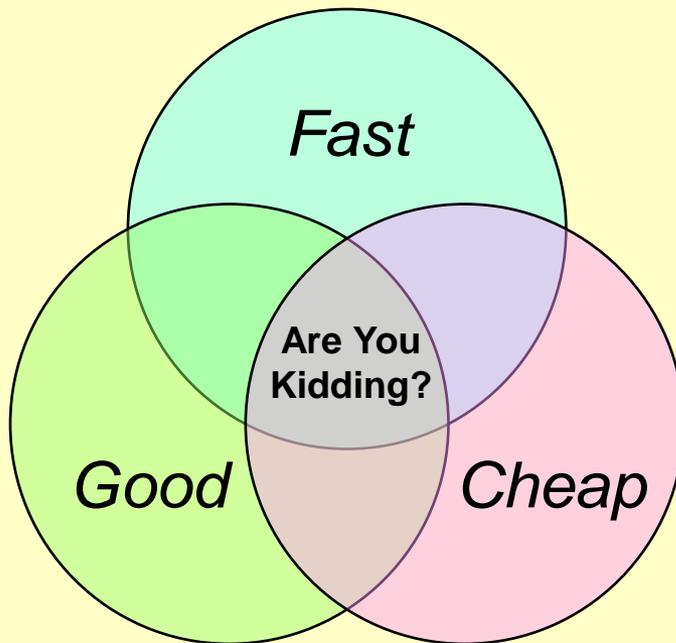
N

Benefits

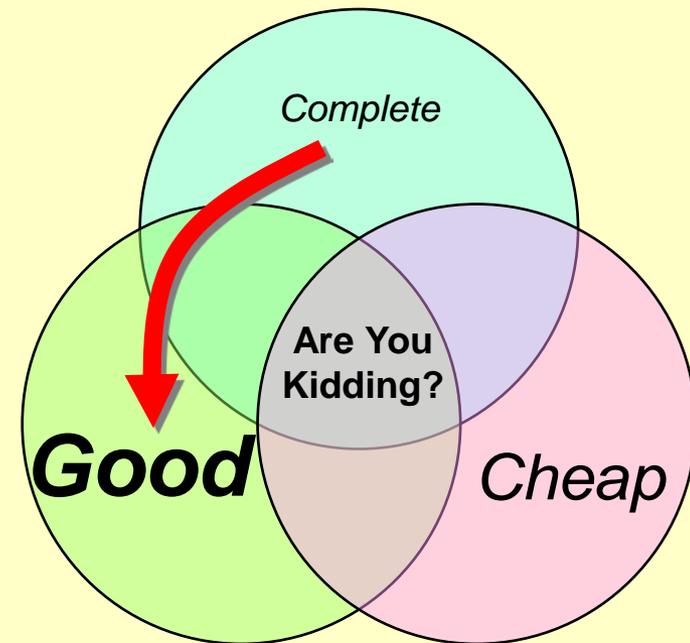
- Low Costs Enable Dense Sampling Grid
- Low Risk of Missing Sources
- No Interruption to Plant Operations
- Reduced Time Before Remediation
- Faster, More Quantitative than Passive Sorbents
- Sample Points Reusable
- Applicable to Vapor Intrusion – Draft SOP by MI DEQ
- (Vapor Pins™ are Commercially Available)

Pick Two!

MOST STUFF

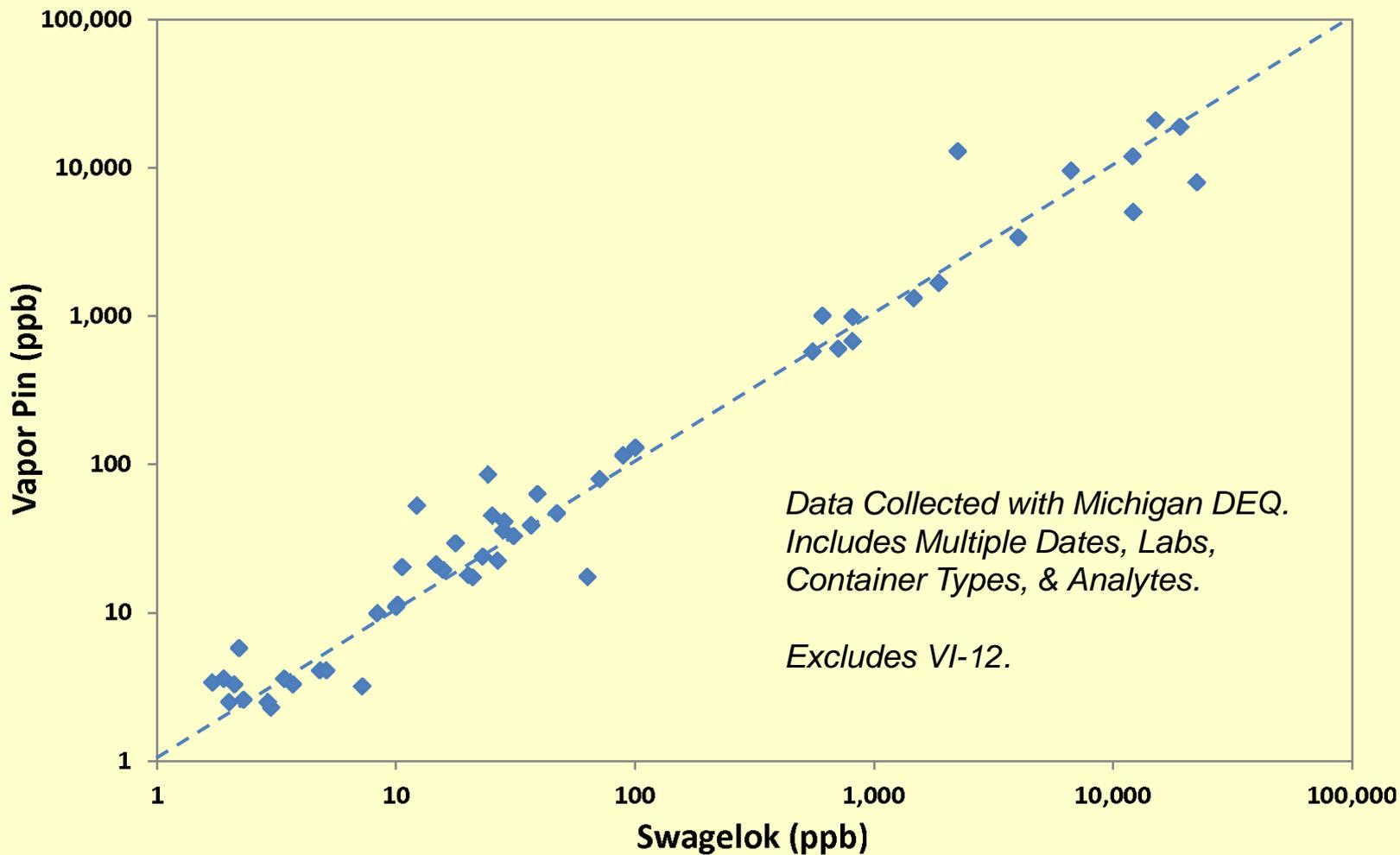


VAPOR INTRUSION

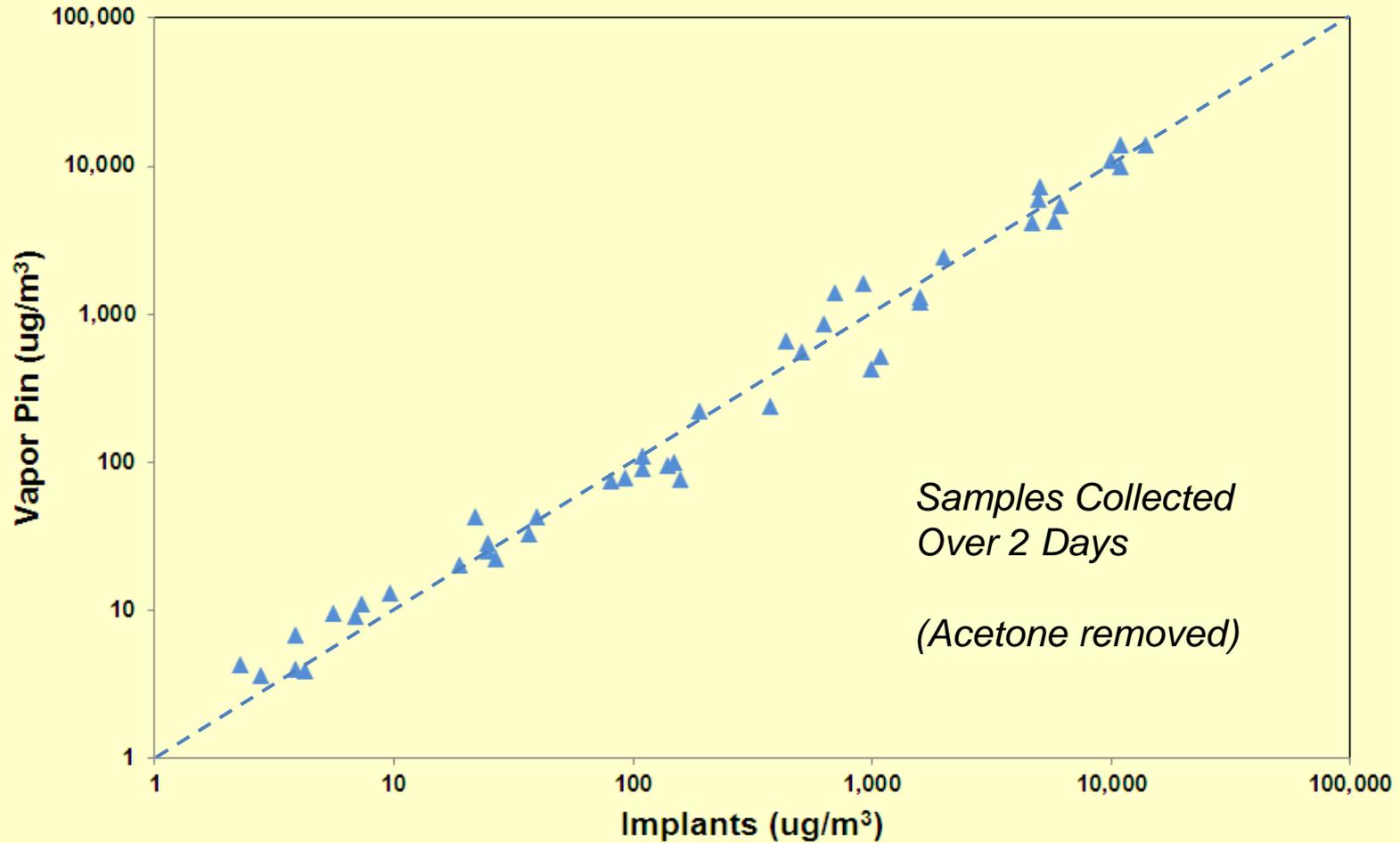


We Obsess on Good at the Expense of Complete

Comparison of Results from Vapor Pins™ & Swagelok™ Fittings, Michigan DEQ



Comparison of Results from Vapor Pins™ to Permanent Implants, H&P Labs, California



Innovative Soil-Gas Sampling

QUESTIONS?

O₂ Concentrations Don't Suggest Leakage

Gray: Sample Point
Black: Least O₂ Depletion

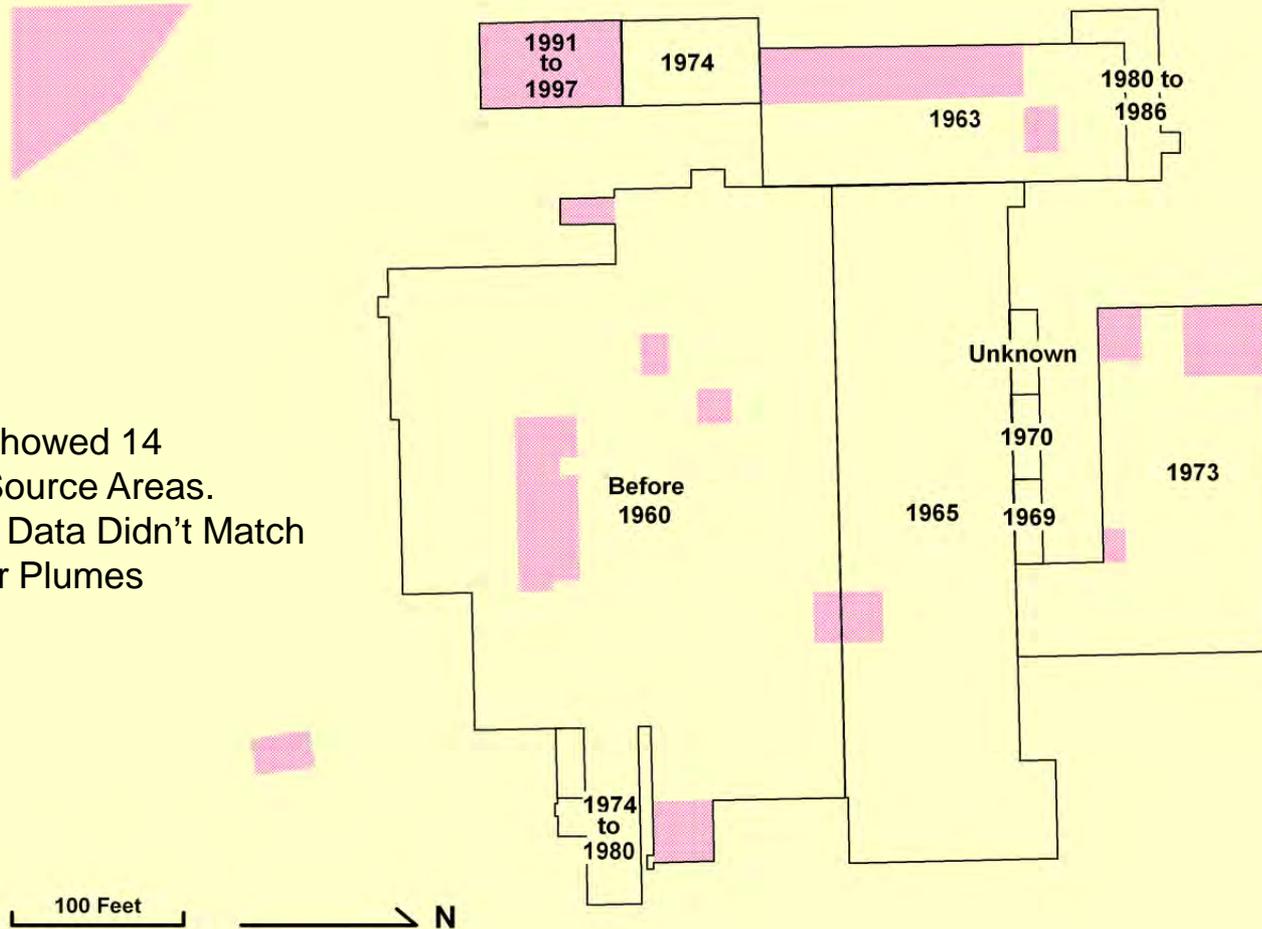


100 Feet

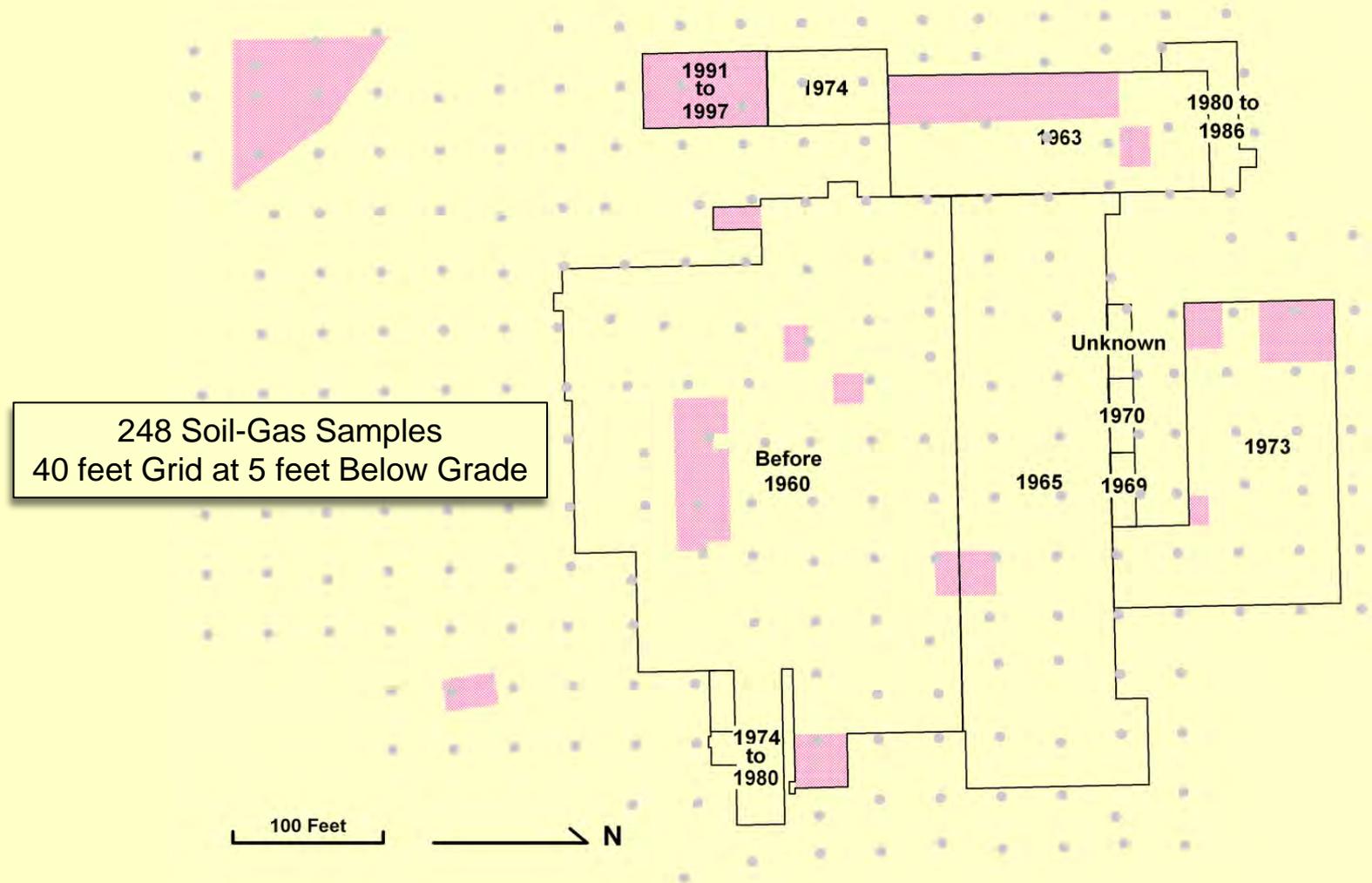


Manufacturing Facility in Northern Ohio

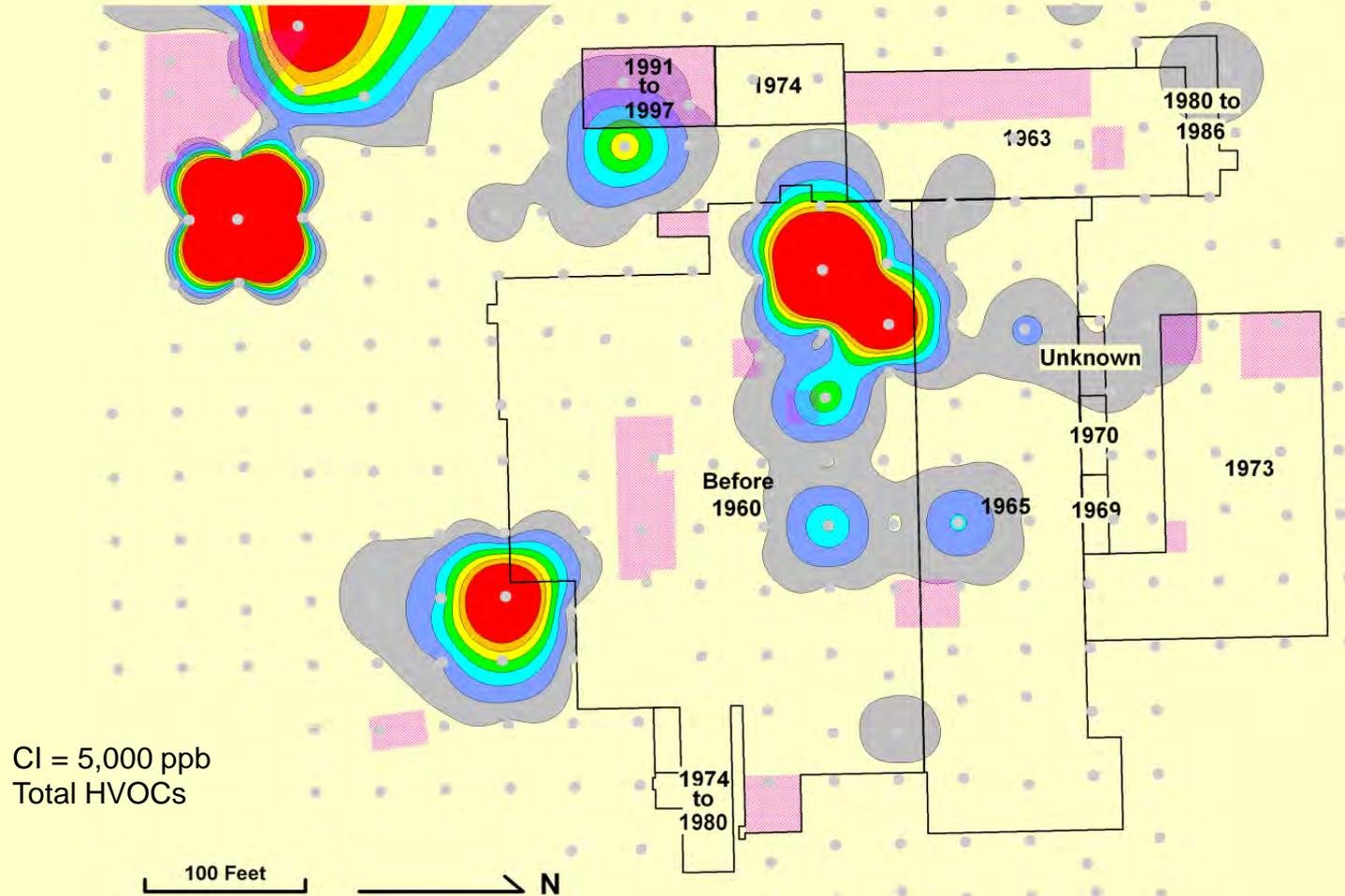
Work Plan Showed 14 Suspected Source Areas. Existing Soil Data Didn't Match Groundwater Plumes



Soil Gas via Geoprobe™ & Vials



Once Again, Not the Usual Suspects



Problems with Conventional Subslab Points

- ***“Compression fittings should be avoided for all connections except at the Summa canister...”*** Soil Gas Sampling Protocol, Missouri Risk-Based Corrective Action Technical Guidance, 2006.
- ***“Some leakage may occur despite the investigator’s best efforts to seal the gap between the sampling probe and the slab hole...”*** Guidance for Evaluating Soil VI in WA State, Investigation and Remedial Action, Draft, October 2009.
- ***“7.3.1 If the probe assembly breaks loose from the anchoring compound while removing or installing the hex socket plug...”*** Vapor Intrusion Guidance, Ohio EPA, May, 2010.
- ***“Only two probes were sampled using EPA Method TO-15 because one probe P[B], became loose during sampling...”*** DiGiulio et al., 2006, EPA Raymark Investigation.

Background VOCs

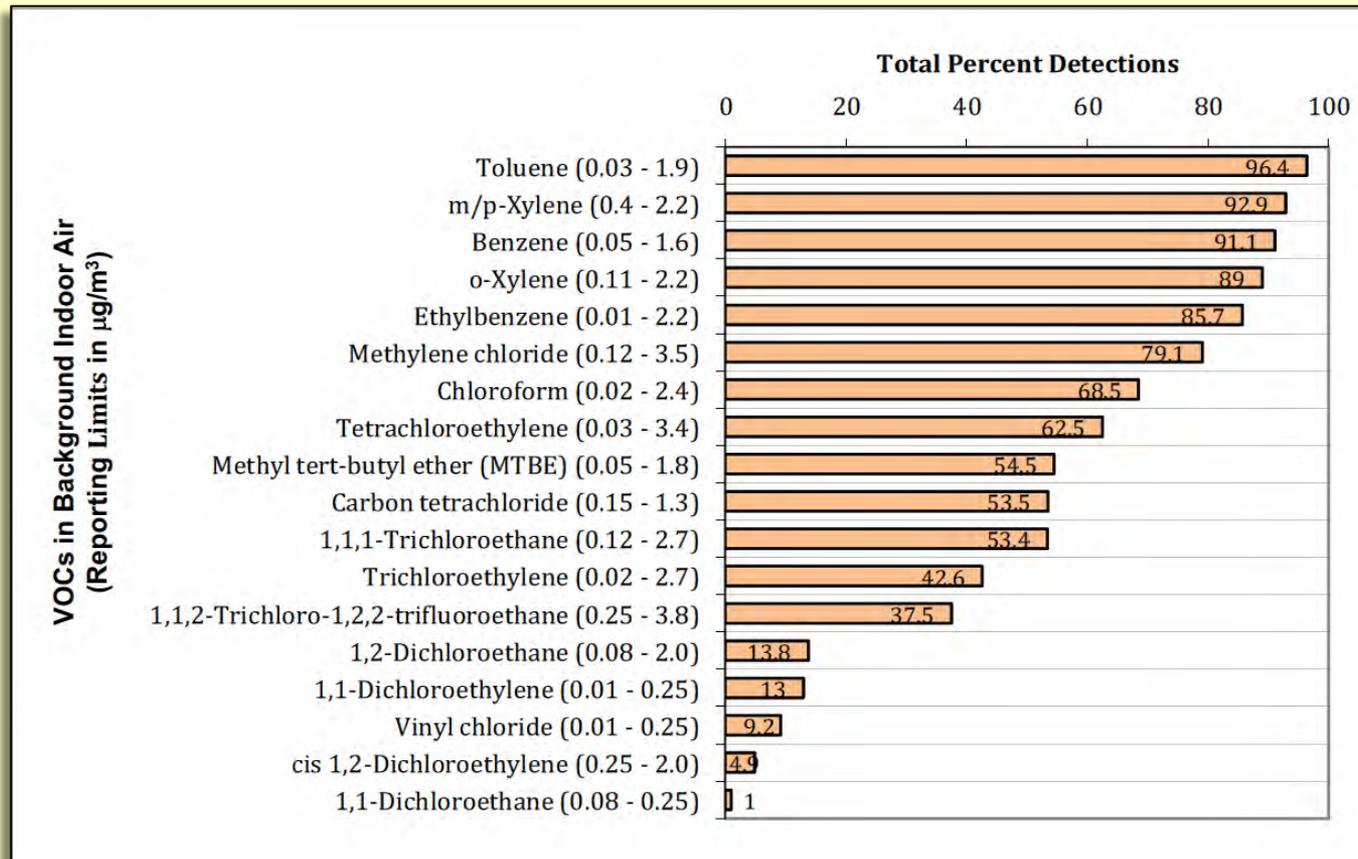


Figure from USEPA 2011, Background Indoor Air Concentrations, EPA /530/R-10/001