Active Soil-Gas Sampling for Vapor Intrusion: Your Biggest Problem

Presented to the Hawai'i Department of Health

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March 11, 2015

Cox-Colvin & Associates, Inc.

DEVICES - Direct Push

Post-Run Tubing

Deep Soil-Gas Implants

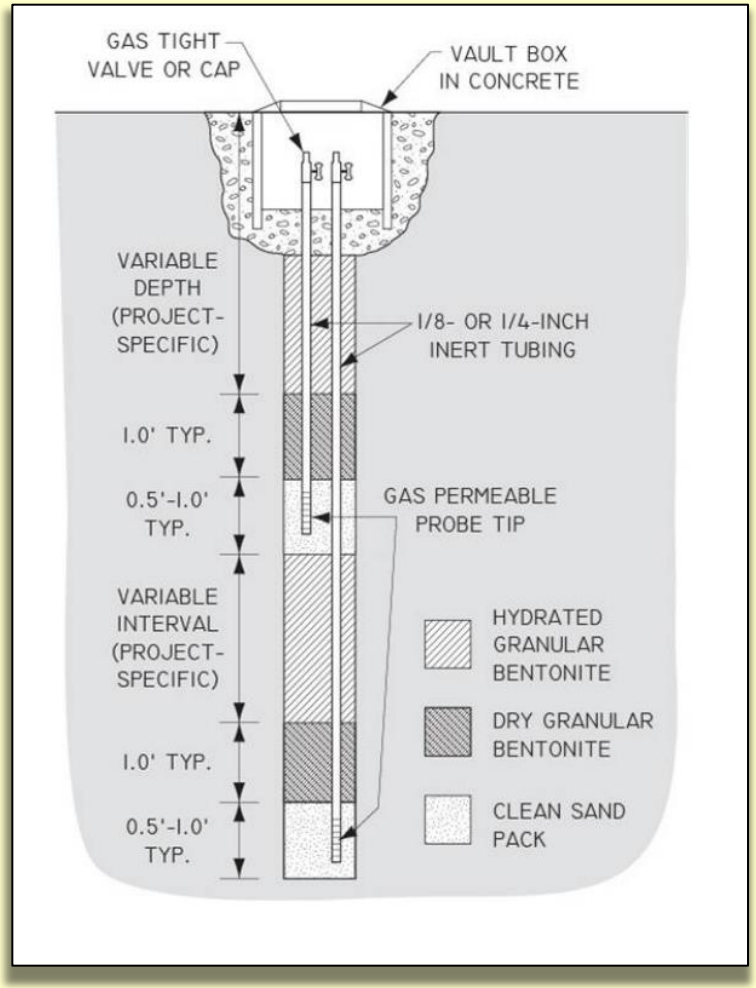


Figure from Hawai`i HEER TGM 2014

Sub-Slab Soil-Gas Implants

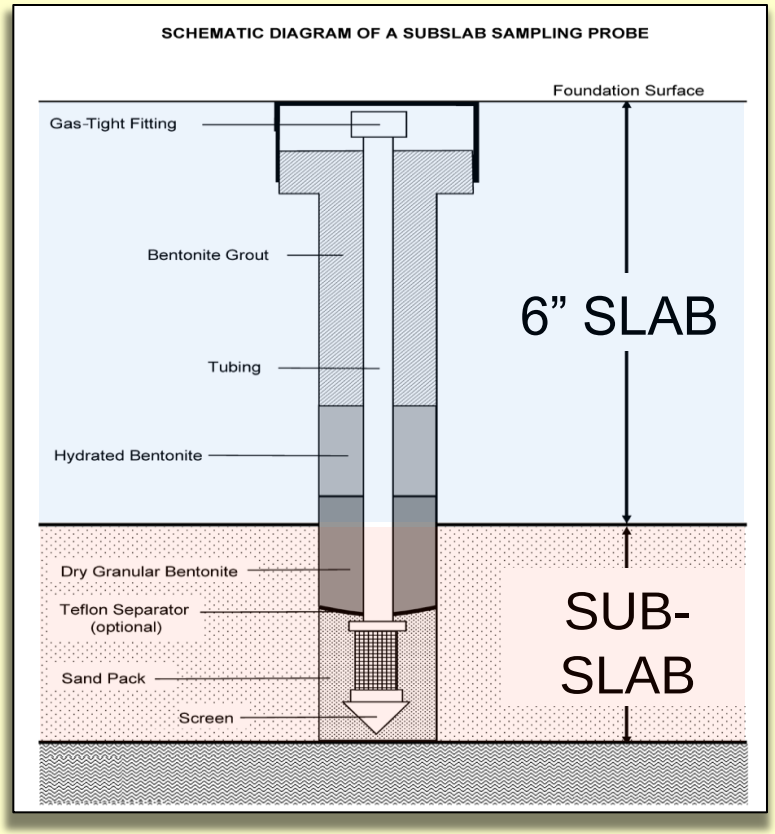
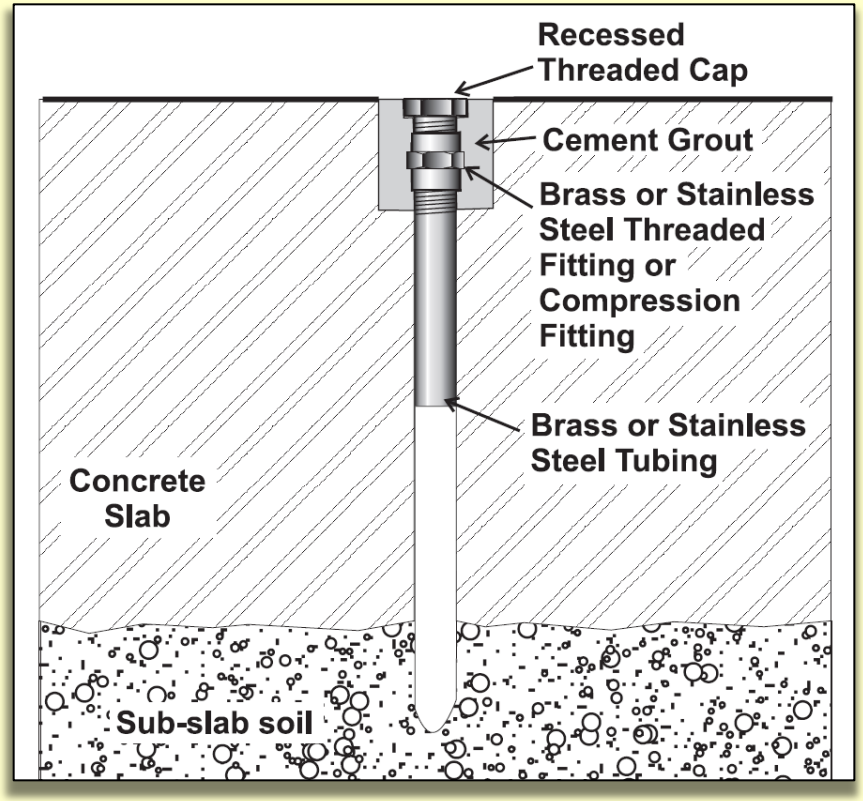


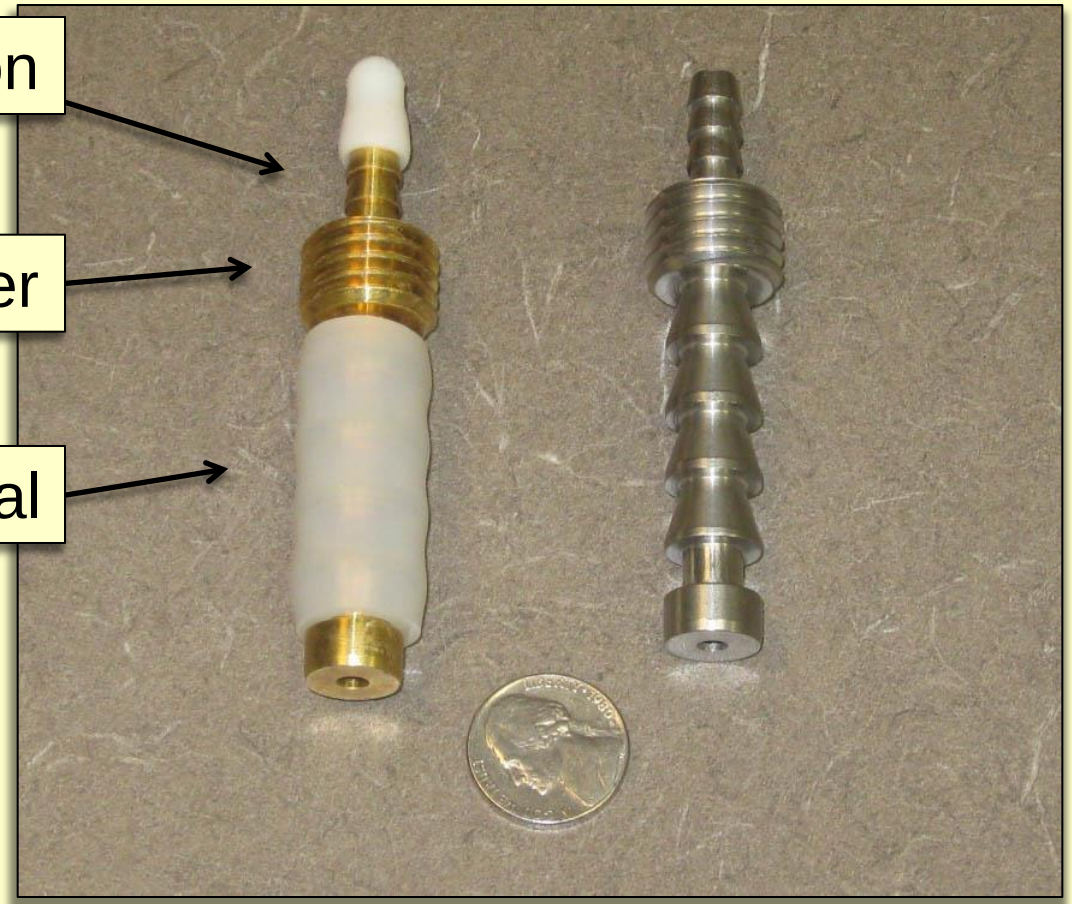
Figure from CA VI Guidance, 2011

Conventional Sub-Slab Sample Point

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



Vapor Pin™



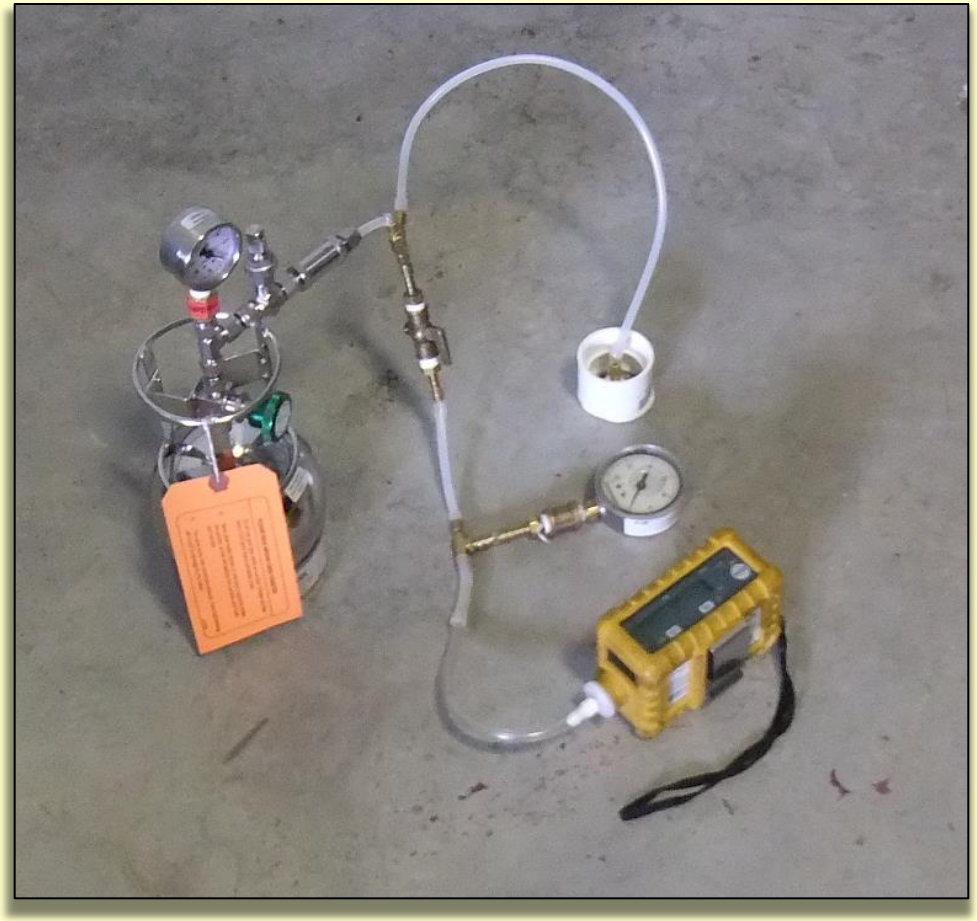
Drilling Through Slab

Installing Point

Stick-Up

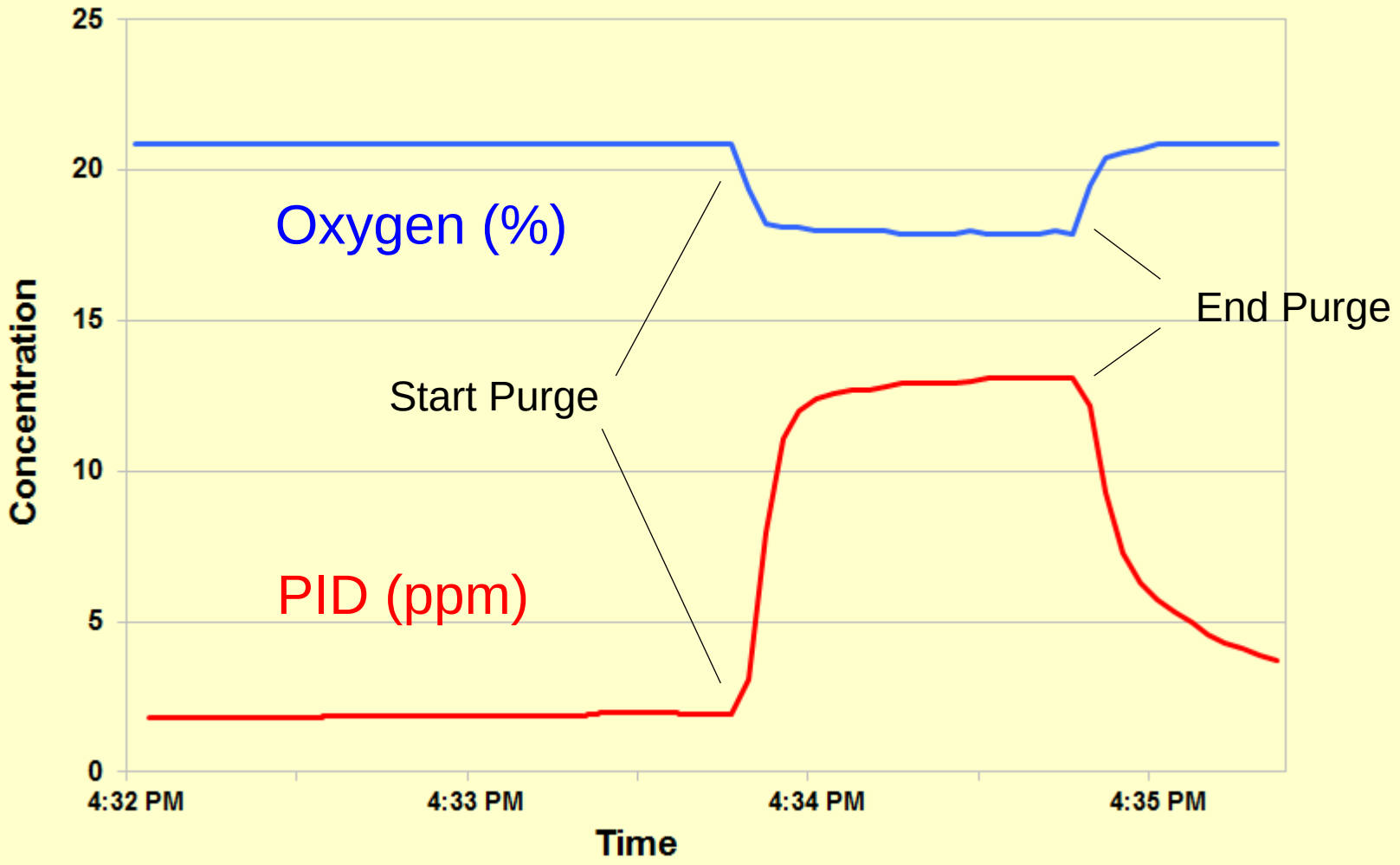
Flush Mount

VAPOR PURGING - Pump



- Equipment
  - Syringe
  - Peristaltic
  - PID
- Monitor Meter Readings
  - PID
  - O_2
  - LEL
  - CO_2
  - Vacuum
- Various Volumes

Purge Volume Based on Levels



CONTAINERS - Glass Vials

Compact,
Disposable,
Inexpensive

Reporting Levels
Typically 10 ppb

Tedlar Bags

Limited Holding Times

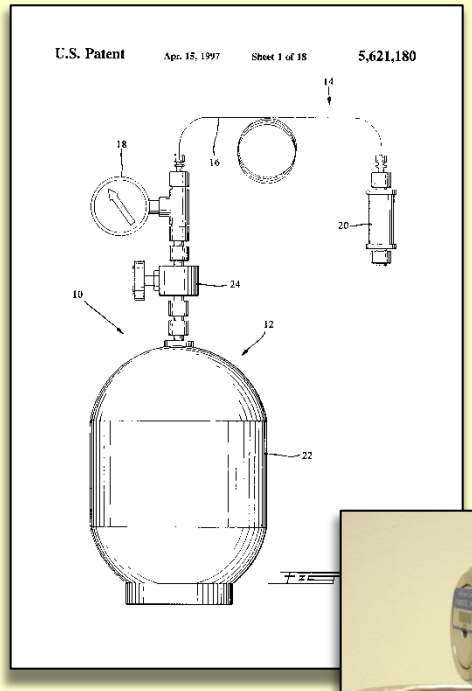
Potential Interferences

Sampling Into Bottle-Vacs

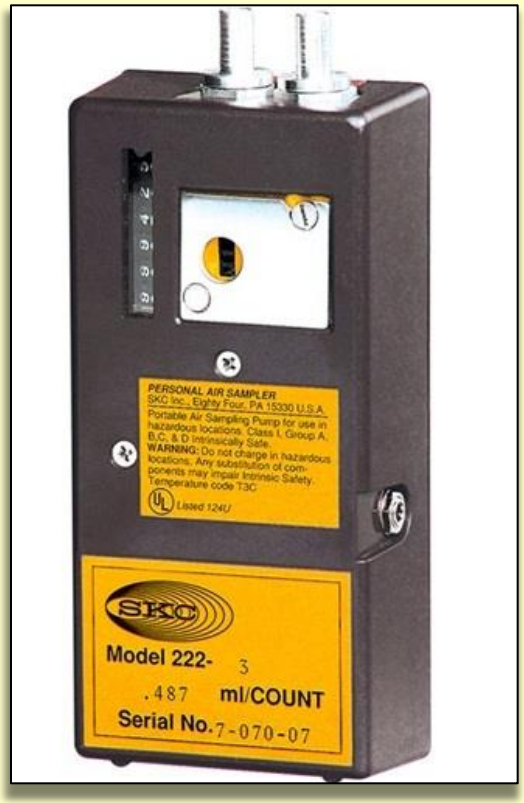
1 Liter

125 ml

Stainless Steel Canisters

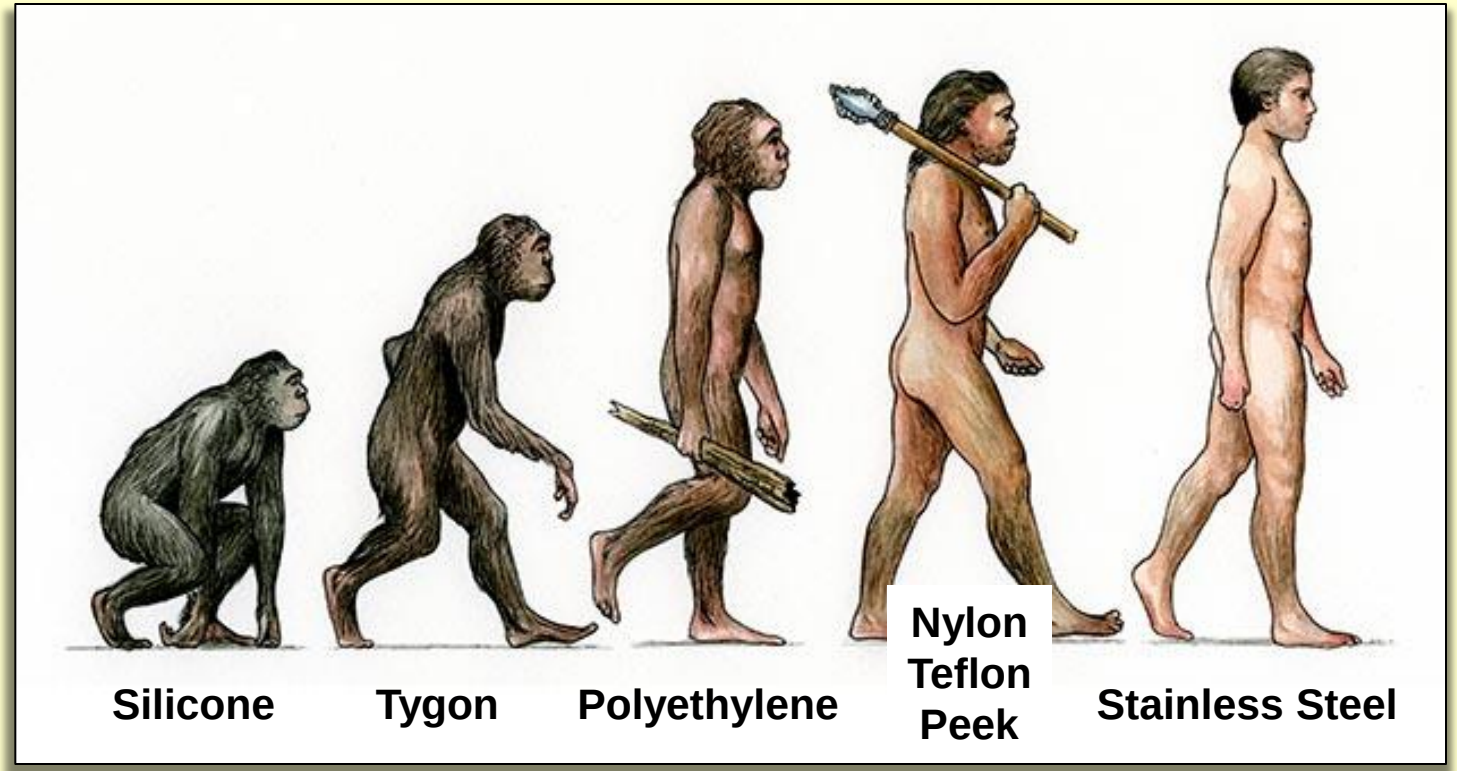


Active Sorbents

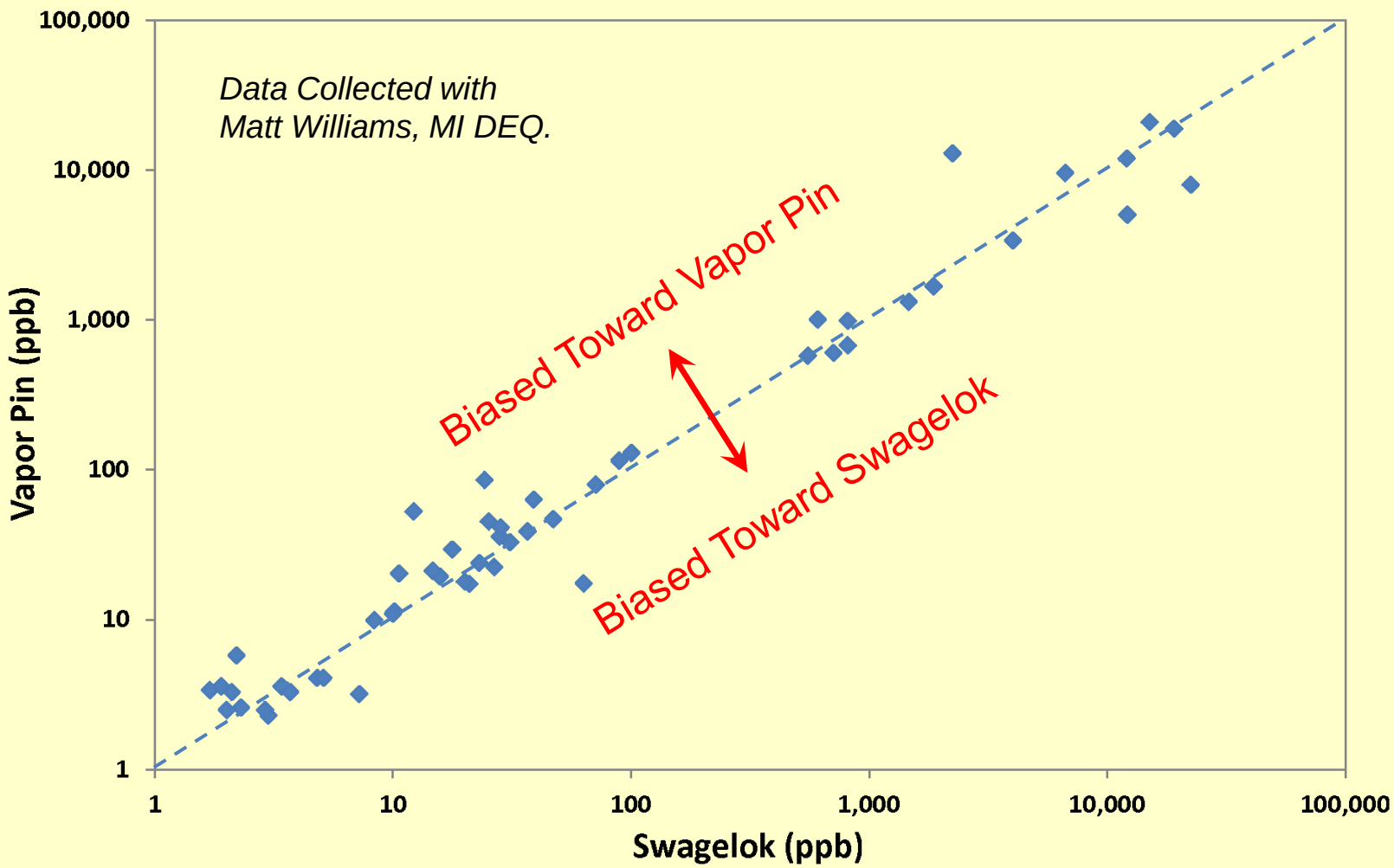


- Compact
- Good for broad range of compounds & concentrations
- Sample quantity, sample rate, and sorbent type are critical

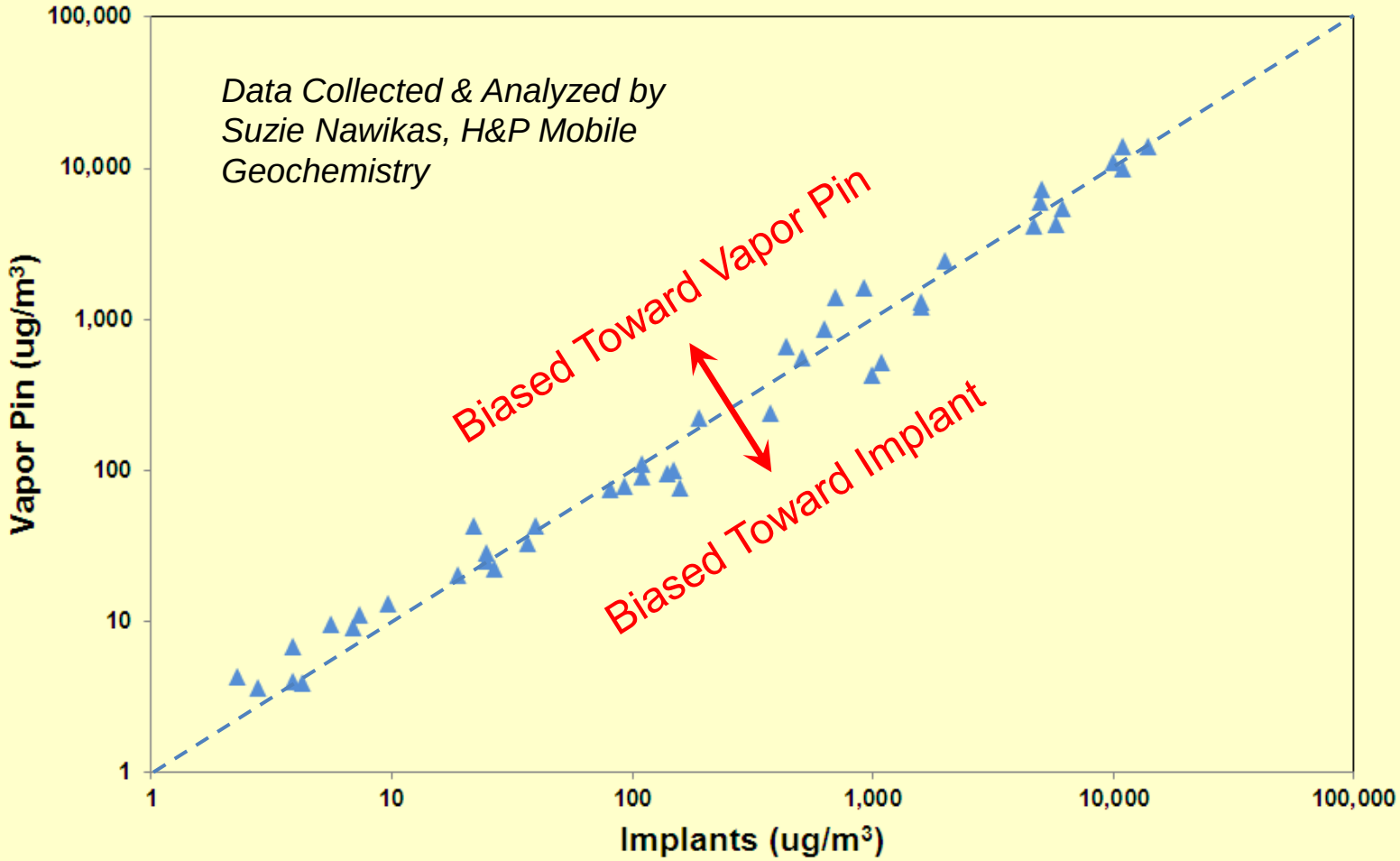
TUBING - Interference



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



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



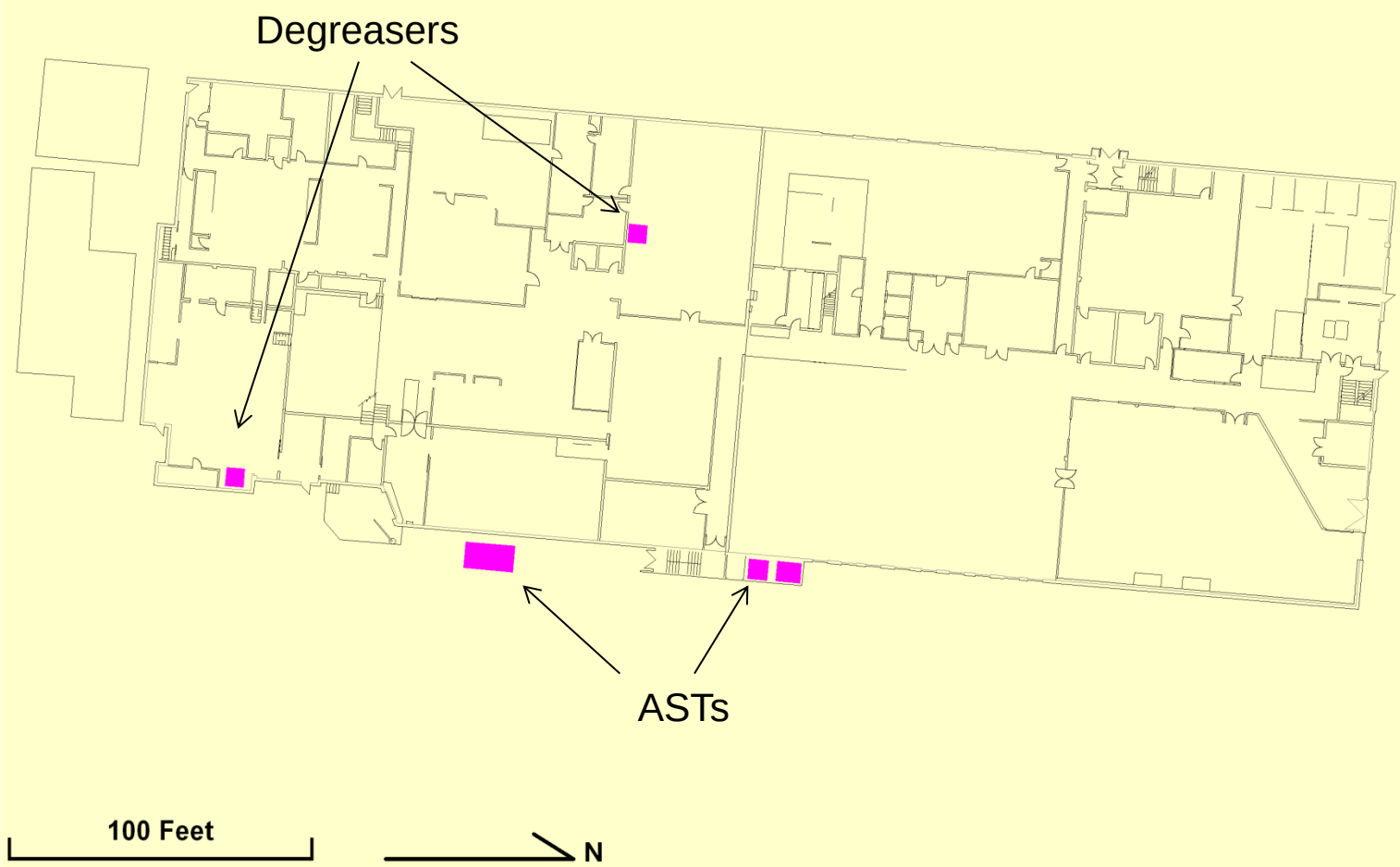
LEAK DETECTION - Helium

DiGiulio 2007

Vacuum Test & Water Dam

"Shut In Test" Most effective way to identify and prevent surface leaks. Nawikas & Balkenbush. AEHS March 20, 2013.

CASE STUDY
Locating PCE Source Using Soil Gas, Western Ohio

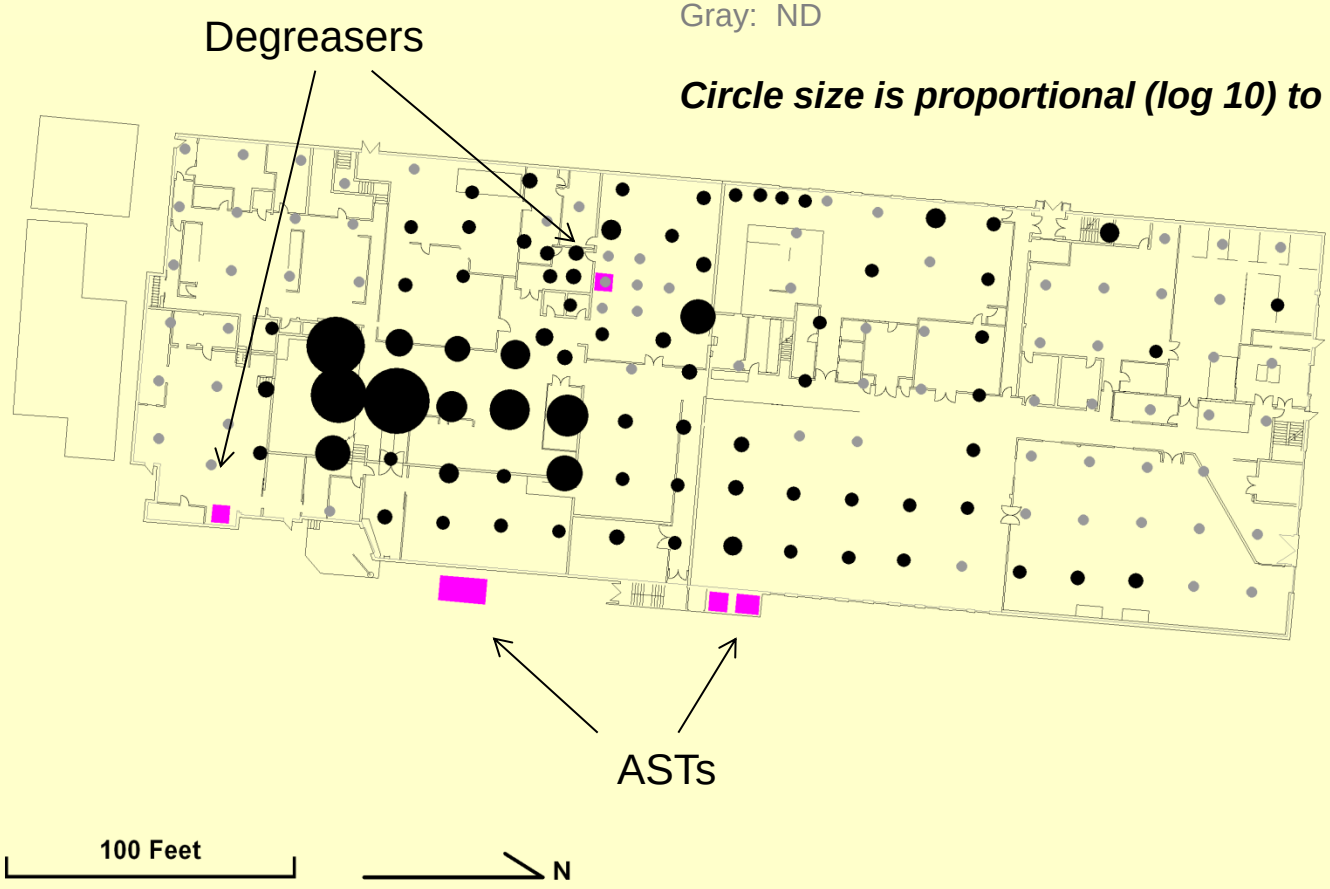


Field Soil-Gas (PID) Results

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

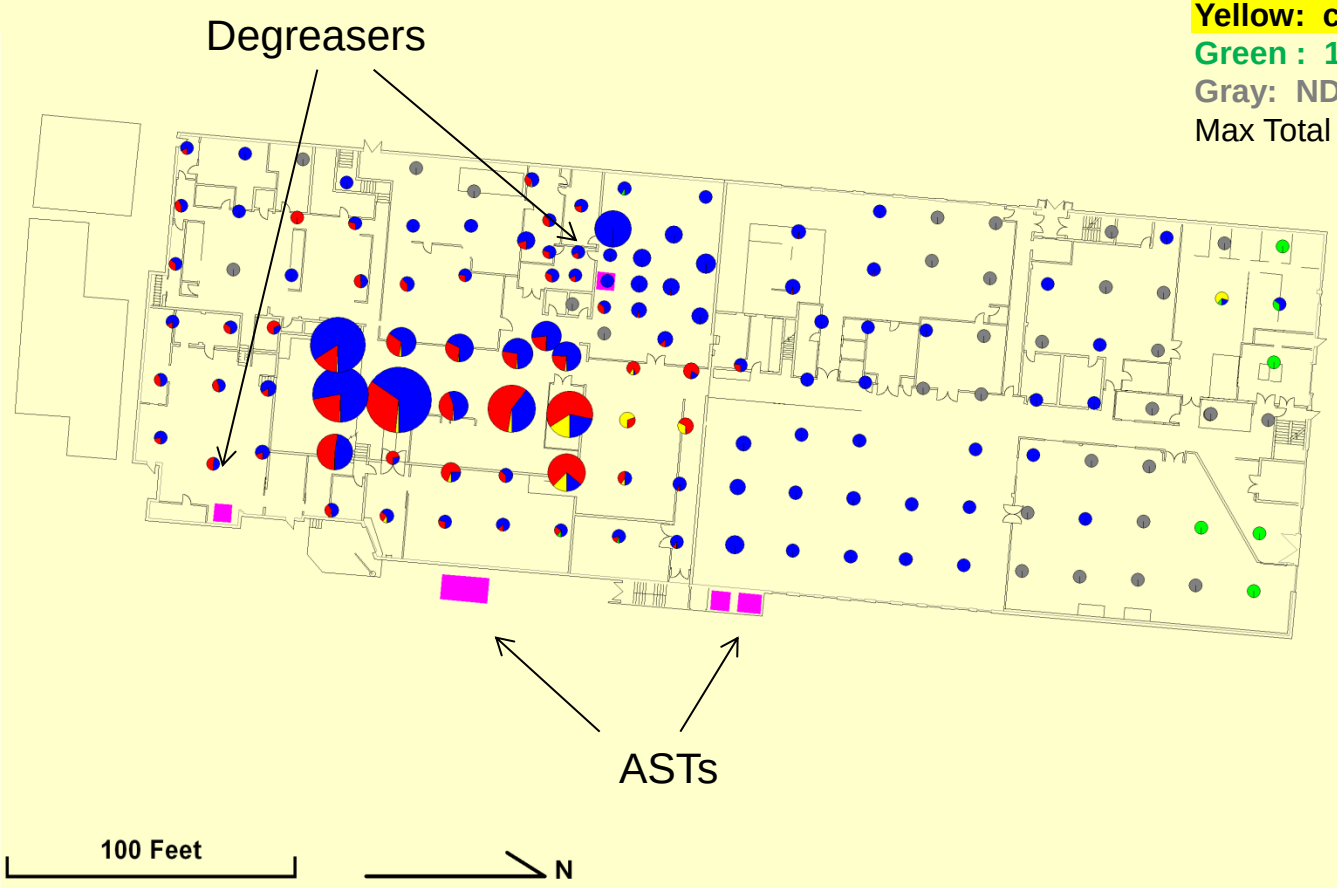
Gray: ND

Circle size is proportional (log 10) to concentration



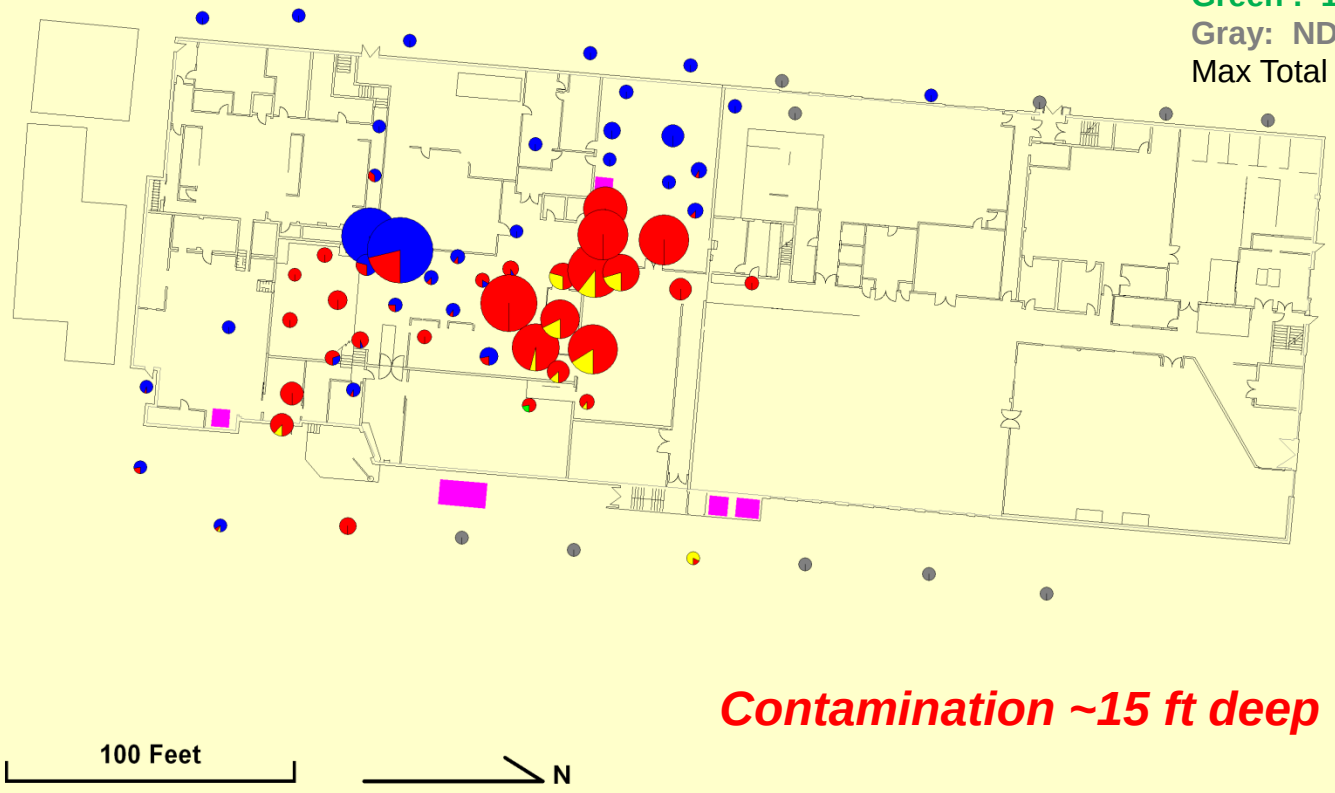
Lab Soil-Gas Results

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



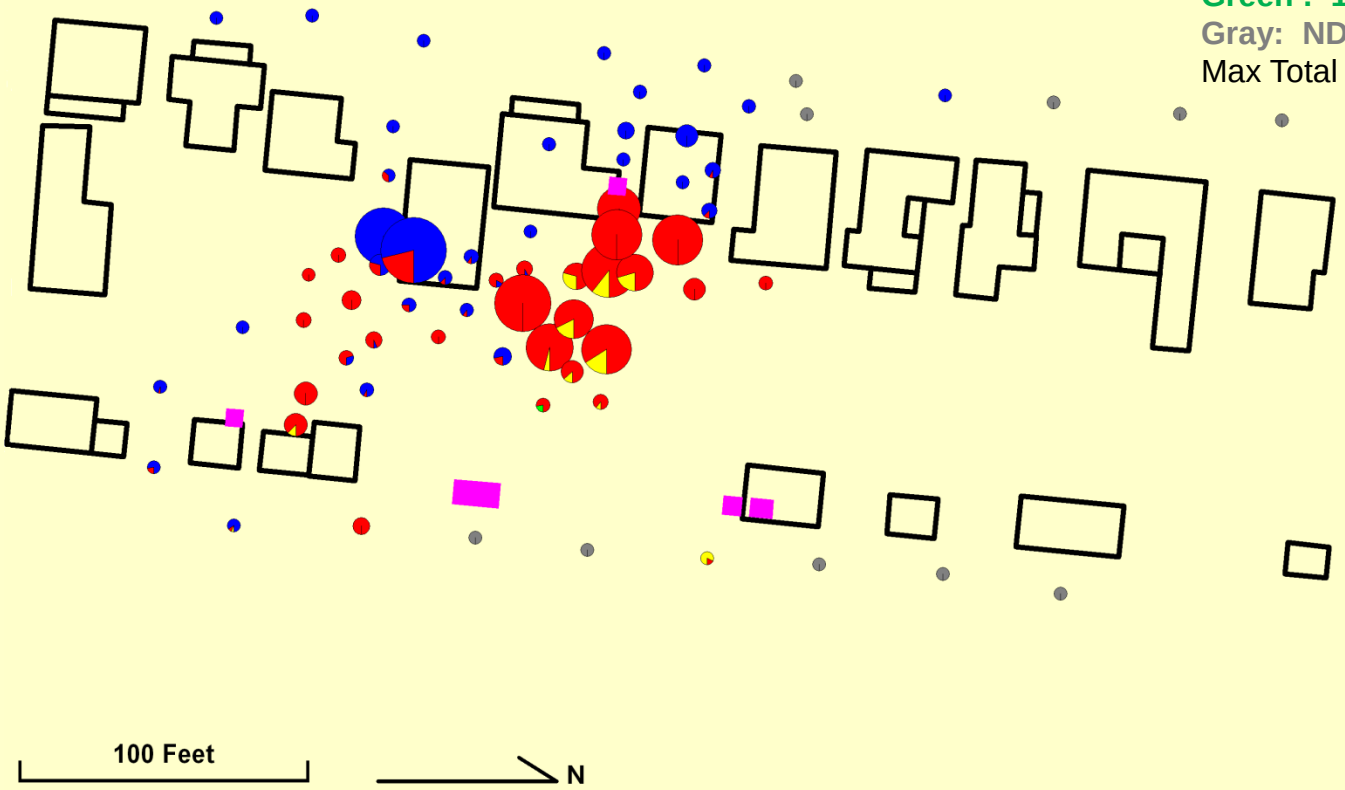
Lab Soil Results

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



Contamination ~15 ft deep

Building Configuration 1924

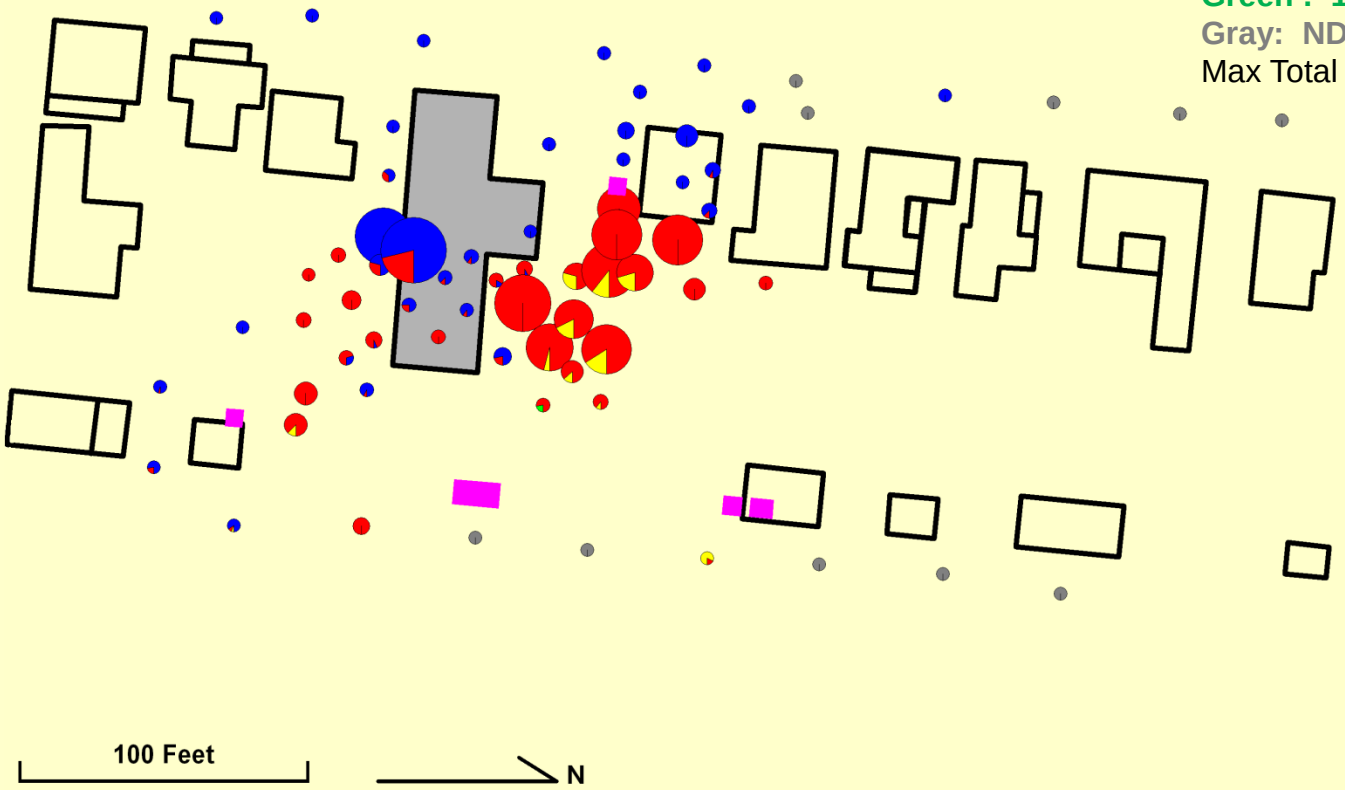


SOIL
Blue: PCE
Red: TCE
Yellow: cis-1,2-DCE
Green : 111-TCA
Gray: ND
Max Total 241,000 ug/kg

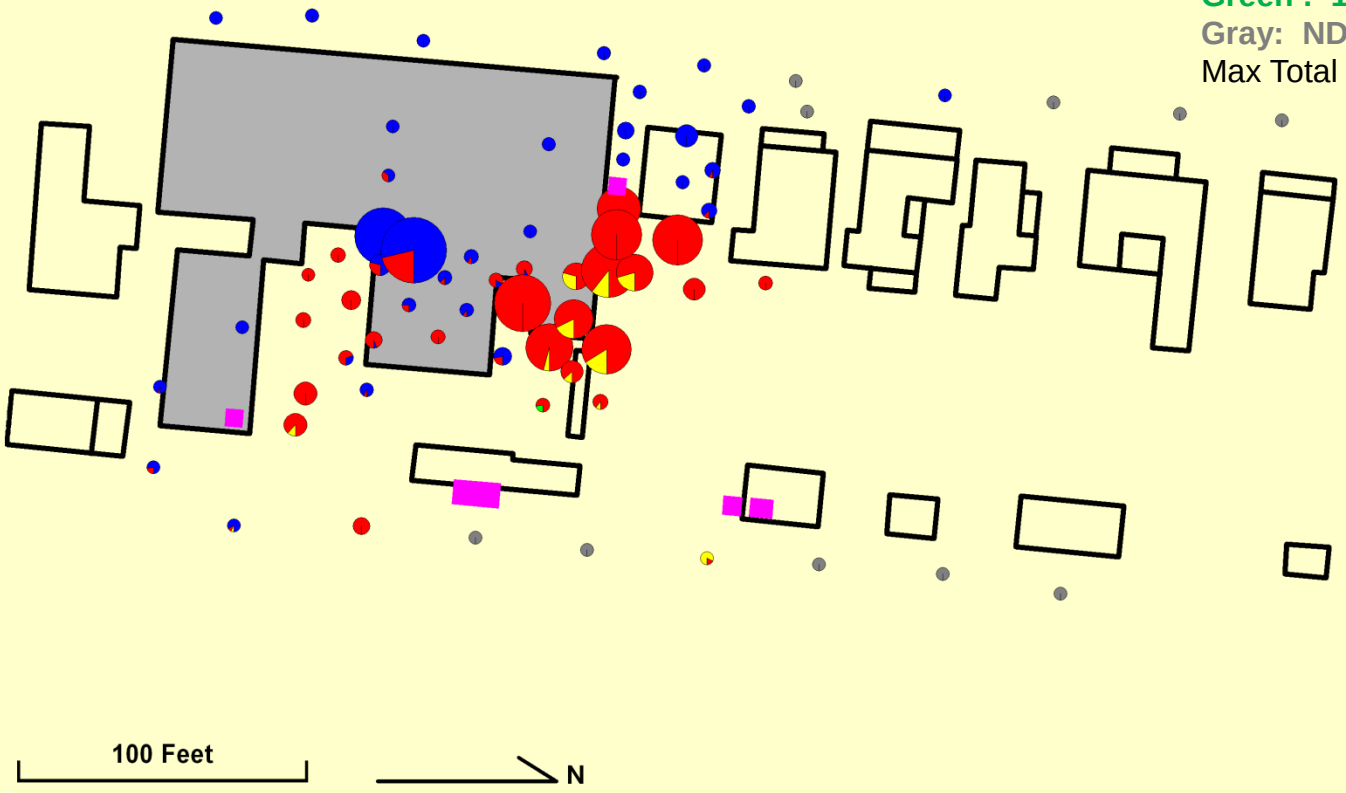
Building Configuration 1938

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

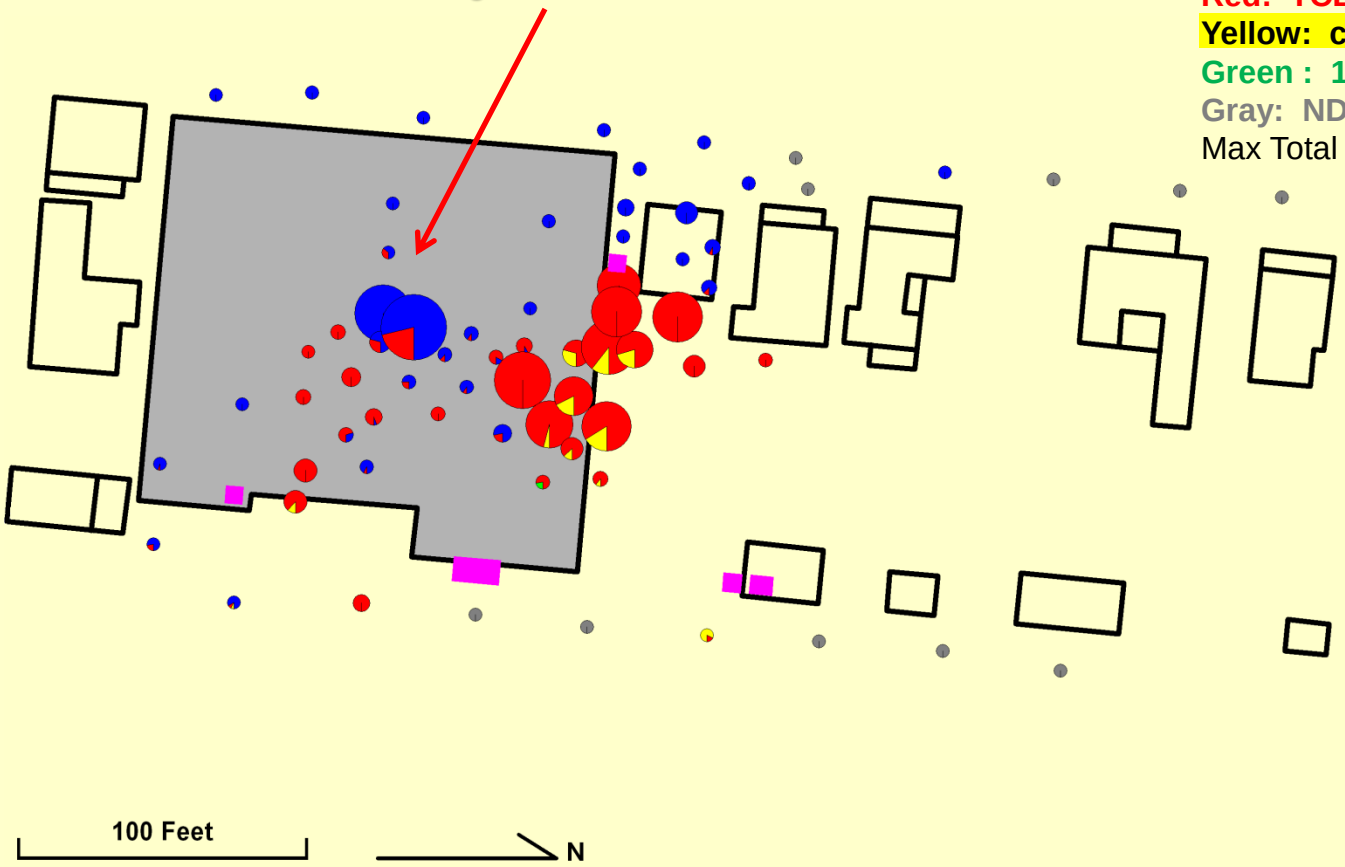


SOIL
Blue: PCE
Red: TCE
Yellow: cis-1,2-DCE
Green : 111-TCA
Gray: ND
Max Total 241,000 ug/kg

Building Configuration 1952

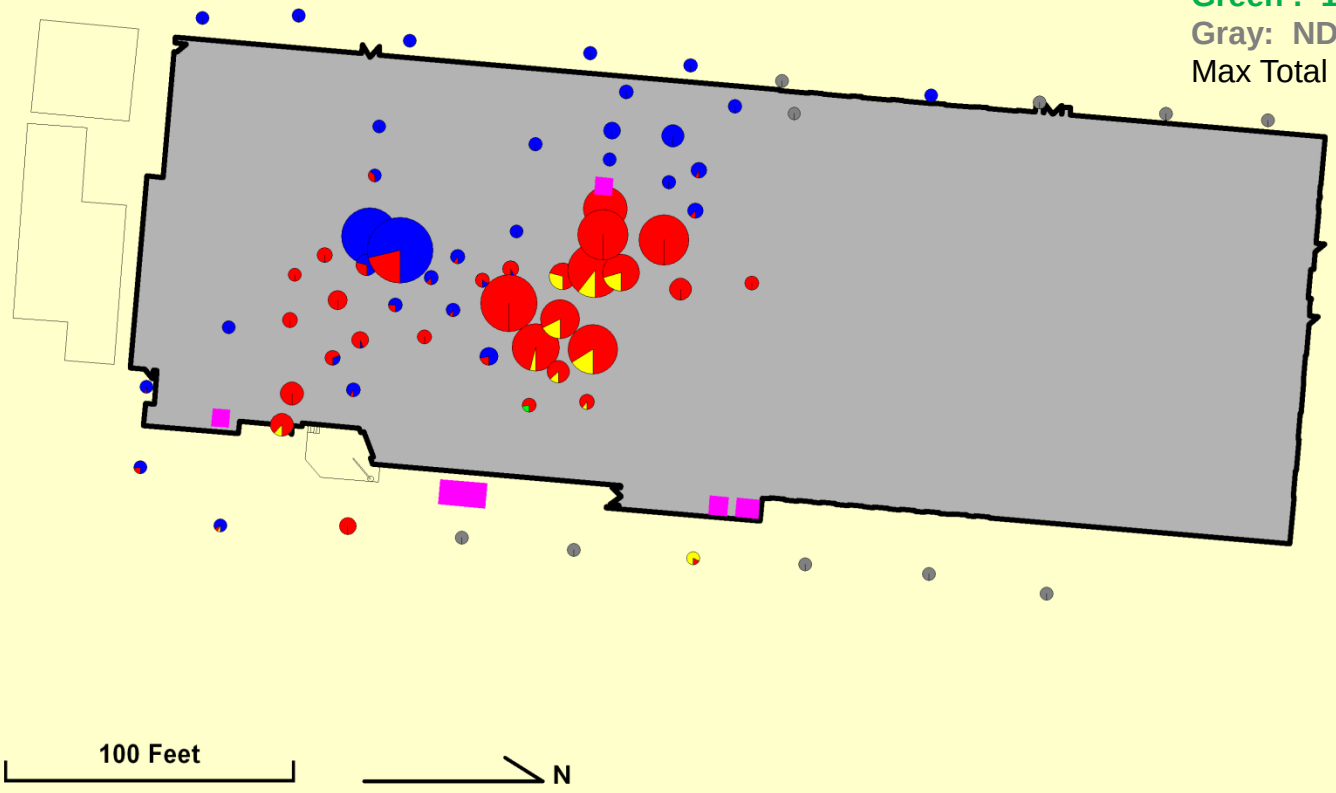
Contamination Probably Between 1933 and 1952

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



Current Building Configuration

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



Sub-Slab, Soil-Gas, & Groundwater AF

US EPA's Attenuation Factor Database

Range of Empirical (Measured) Attenuation Factors

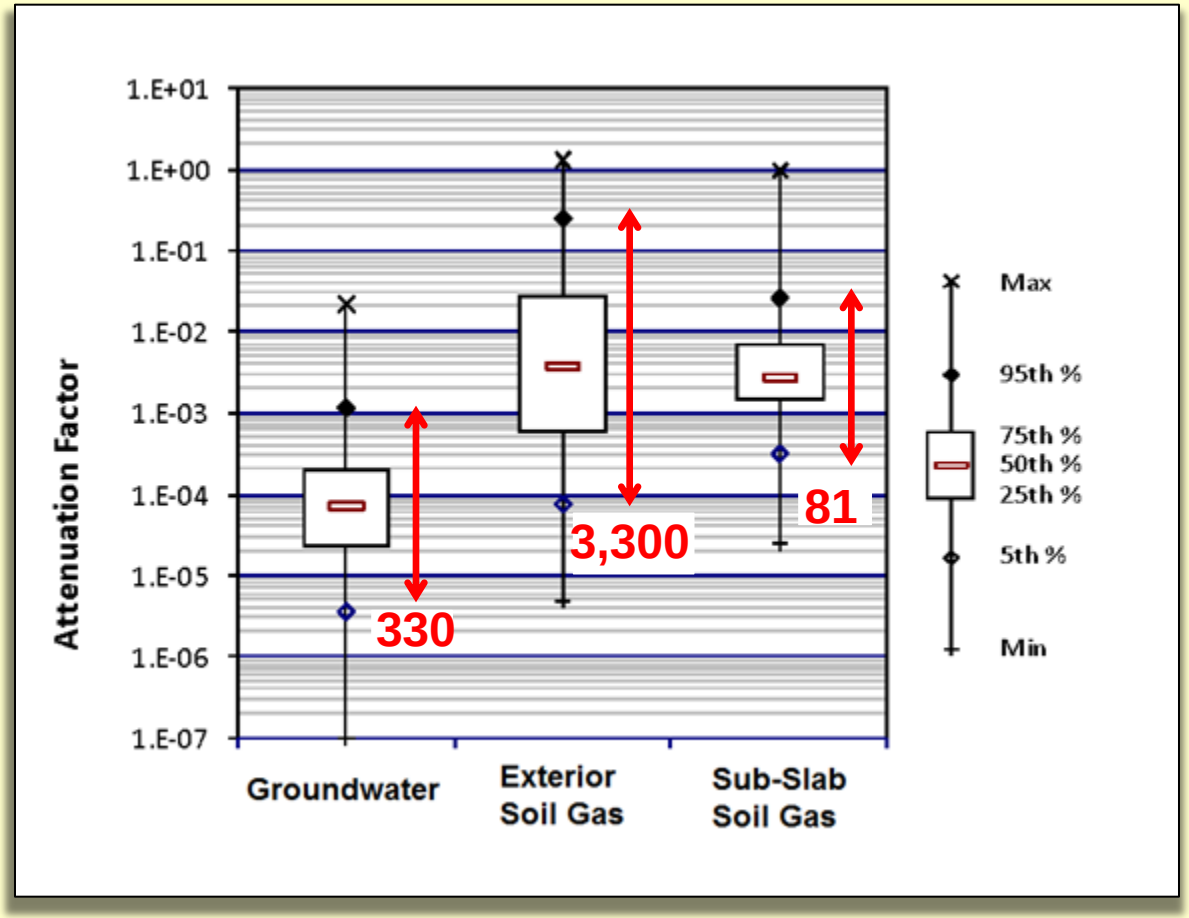
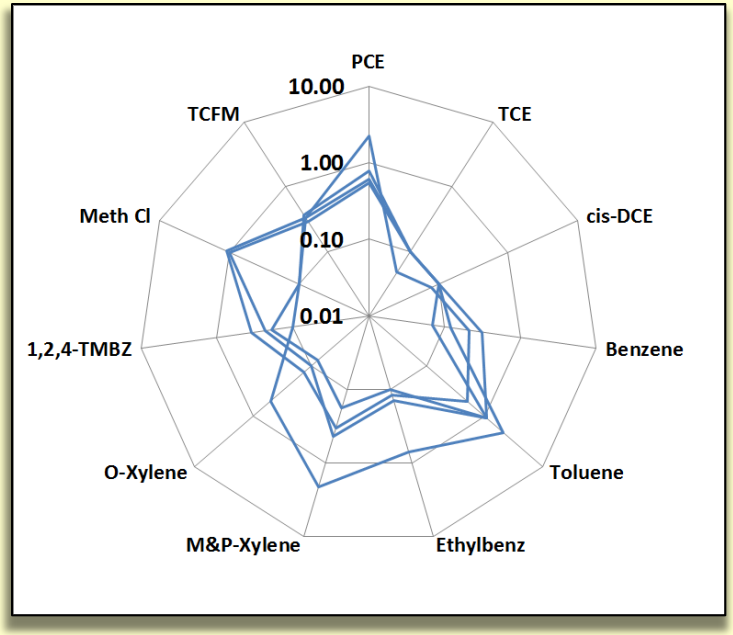


Figure after EPA's Vapor Intrusion Database, EPA 530-R-10-002, 2012

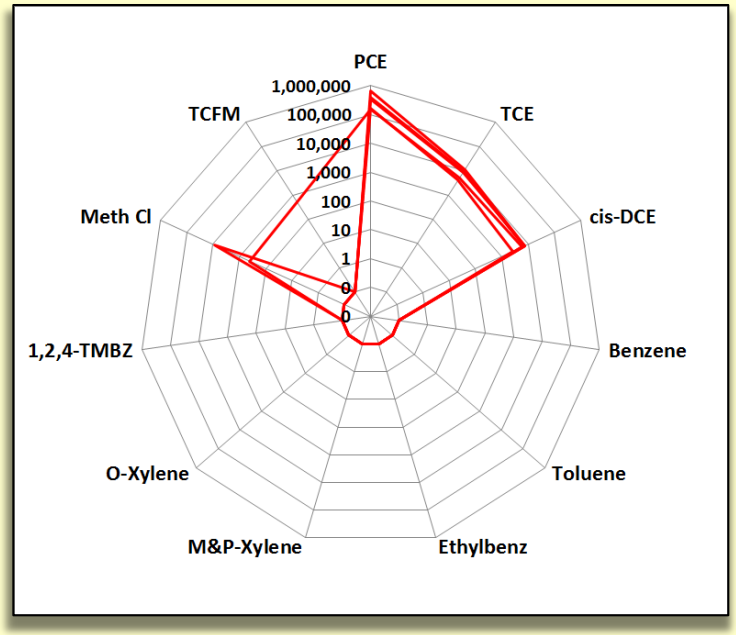
Temporal Variability

One Location, Multiple Dates

Indoor Air



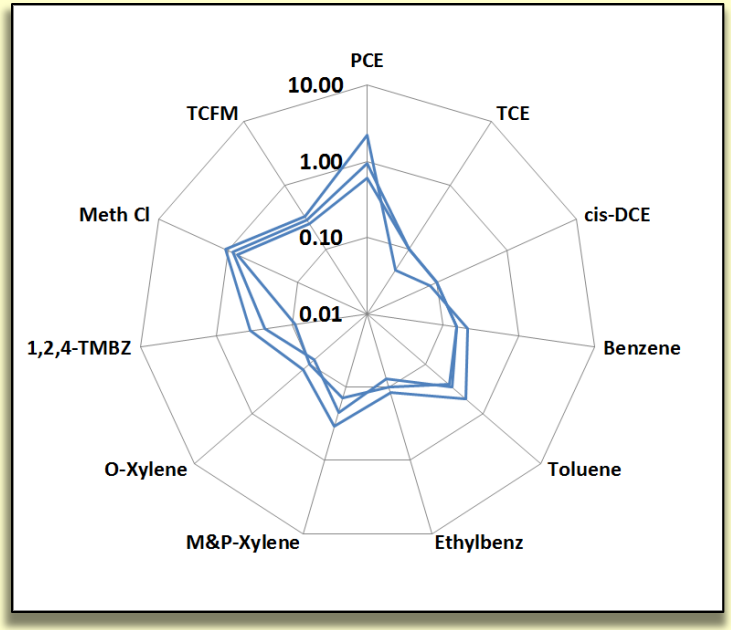
Sub-Slab Soil Gas



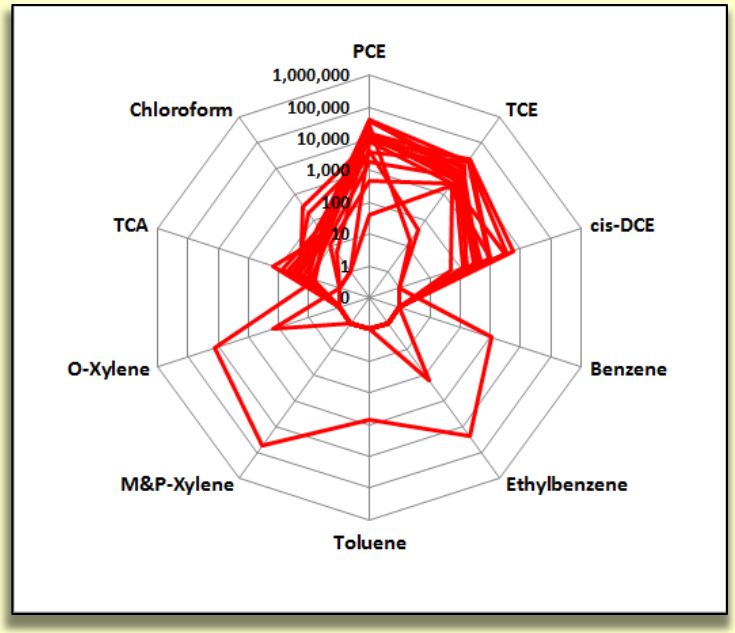
Spatial Variability

Multiple Locations, One Date

Indoor Air



Sub-Slab Soil Gas



The Biggest Problem?

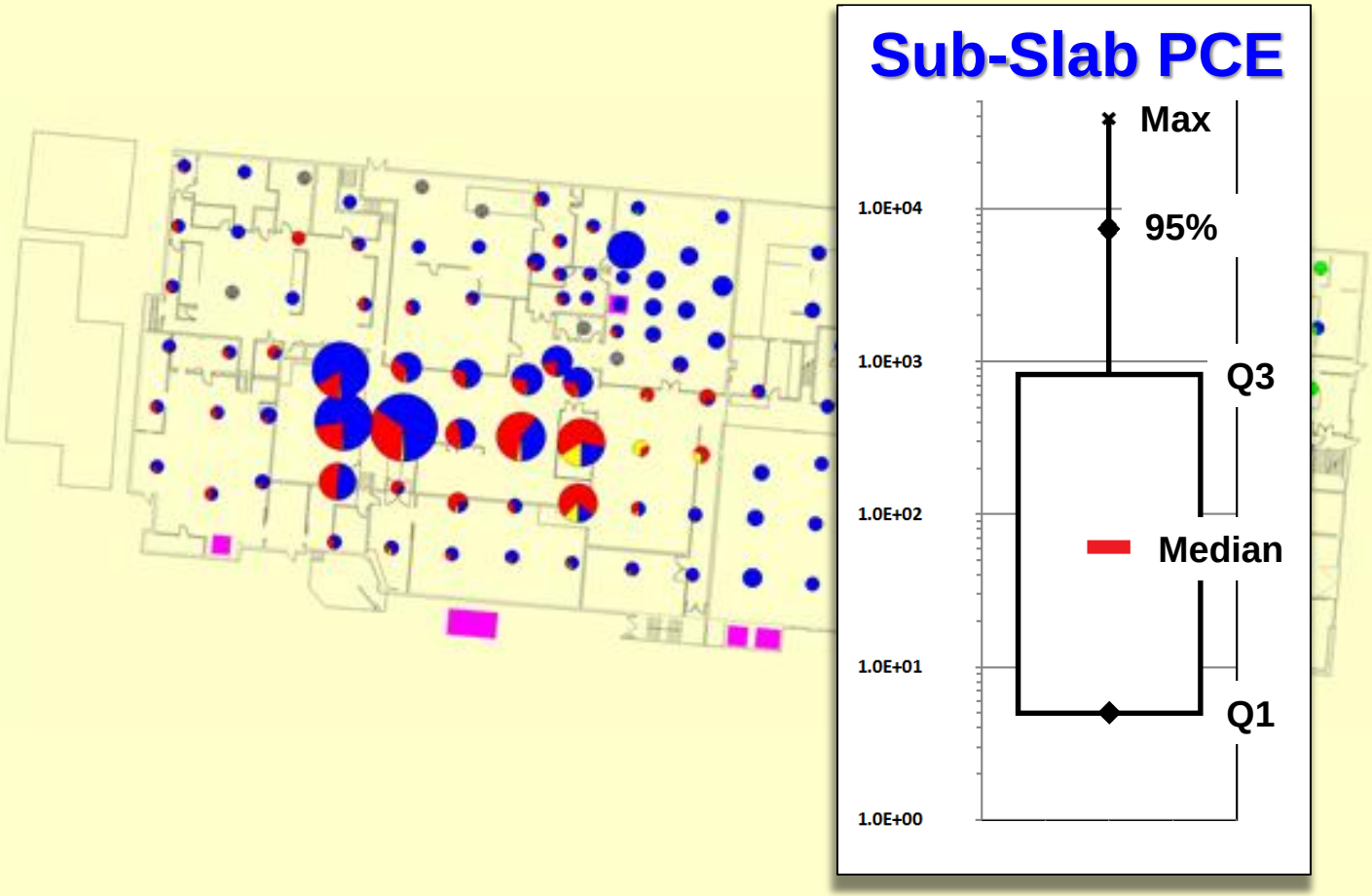
A. Tubing Type

B. Purge Volume & Rate

C. Sample Type & Container

D. Leak-Detection Method

Spatial Heterogeneity!!!



QUESTIONS?

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