

Design, Effectiveness, and Reliability of Sub-Slab Depressurization Systems

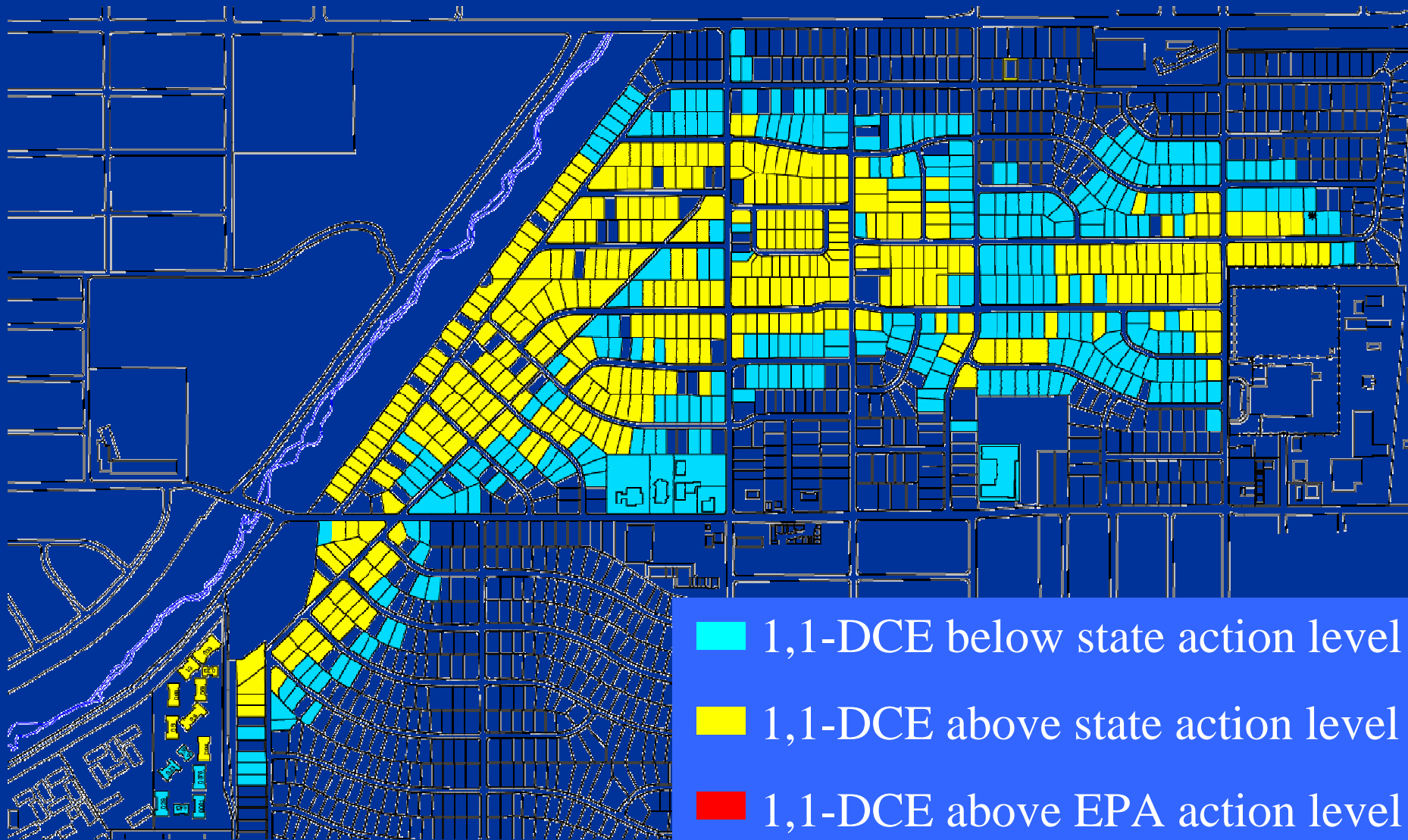
**EPA Seminar on Indoor Air Vapor Intrusion
San Francisco, December 3-4, 2002**

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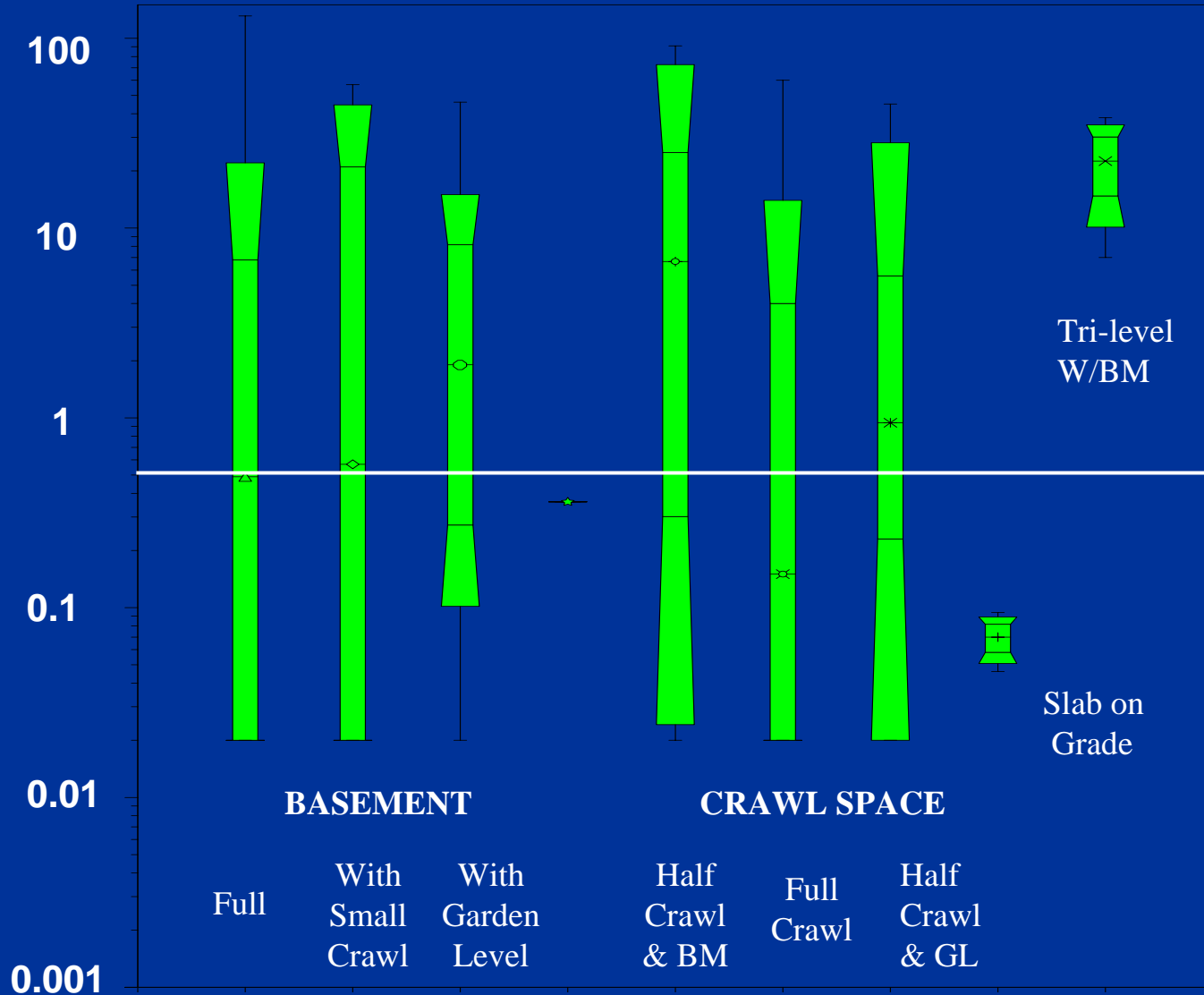
Redfield Site

- Driver is 1,1-DCE with Interim Colorado action level of 0.49 ug/m³ (10⁻⁵ risk)
- Over 700 homes tested
- Over 360 mitigation systems installed
- Over 4.5 years of performance data

Redfield Site, Denver CO



Pre-Mitigation 1,1-DCE (ug/m³)



Initial Questions

- Can standard radon systems meet performance required for VOCs?
- What modifications will improve performance?
- When are modifications required?
- What are the limits of performance?

Required Performance

- **Radon**

- Radon less than 40 pCi/L in 99% Colorado homes
- EPA recommends mitigation above 4 pCi/L
- Less than 90% reduction typically required

- **1,1-DCE**

- 1,1-DCE levels up to 131 ug/m³ at Redfield
- Colorado interim (10-5) action level is 0.49 ug/m³
- Up to 99.6% reduction required

Approach to Design

- **Iterative Approach**
 - Install standard system
 - Performance test
 - Modify system as necessary
 - Performance test final system

Standard System Design

- Slab-on-Grade
 - One suction point (approx. 1-3 cubic foot void)
 - Seal visible cracks/joints
 - 90 watt fan
 - 3 or 4 inch PVC

Standard System Design

- **Crawl Spaces**
 - 0.1 mm cross-laminated polyethylene membrane
 - Seal membrane to foundation walls
 - Suction point options:
 - Elbow or tee below liner
 - Corrugated drain pipe extension below liner
 - Non-woven geotextile below liner
 - 90 watt fan

Design Modifications

- Additional suction pits
- Larger suction pits
- Larger (150 W) fan
- Outside combustion air
- Additional sealing (liners/cracks)
- Extending perforated pipe under liner

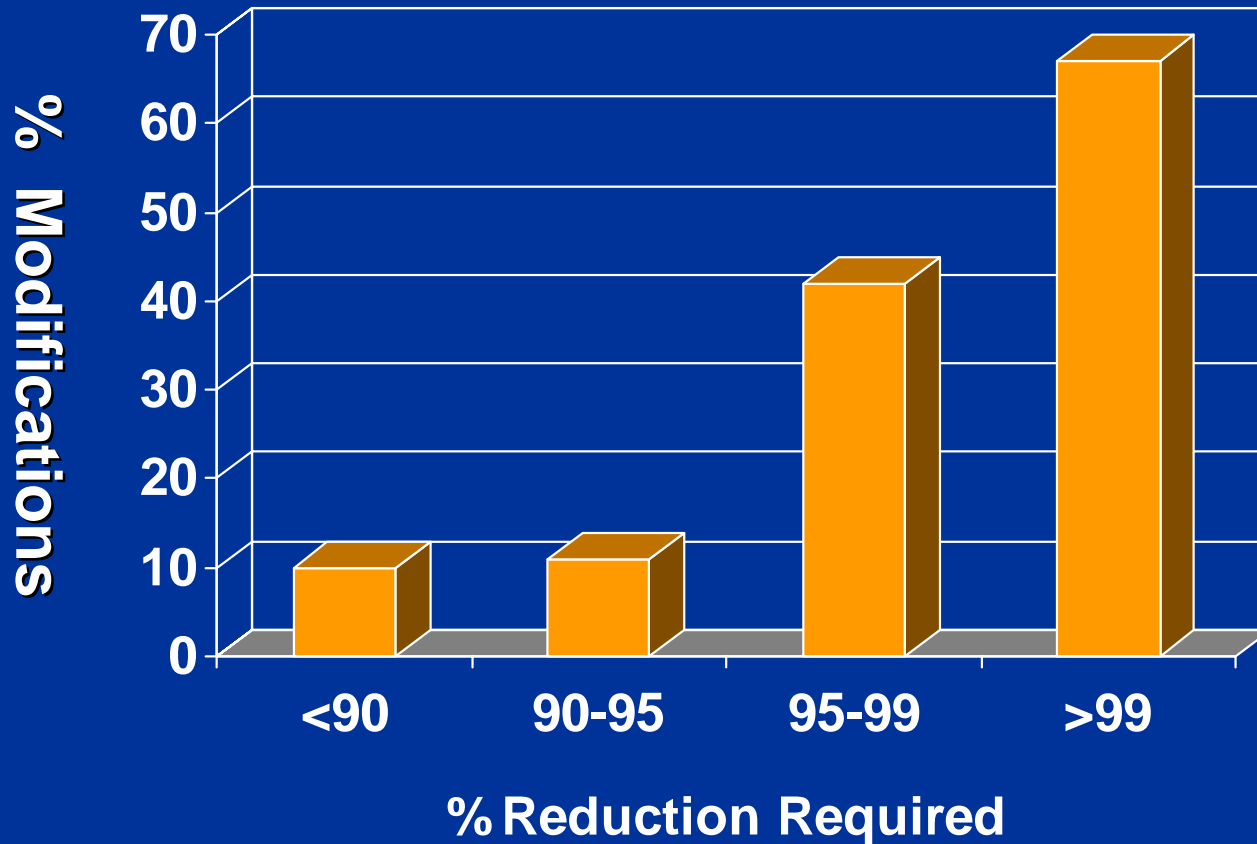
Modification Frequency

Modifications	SSDs	SMDs	Combined
None	75%	68%	70%
One	16%	27%	21%
Two or more	9%	5%	9%
Total	100%	100%	100%

Observations

- 99.6%+ reductions can be achieved
- Modifications (added suction points, larger fans, more sealing) may be required
- Modifications more common at higher DCE concentrations

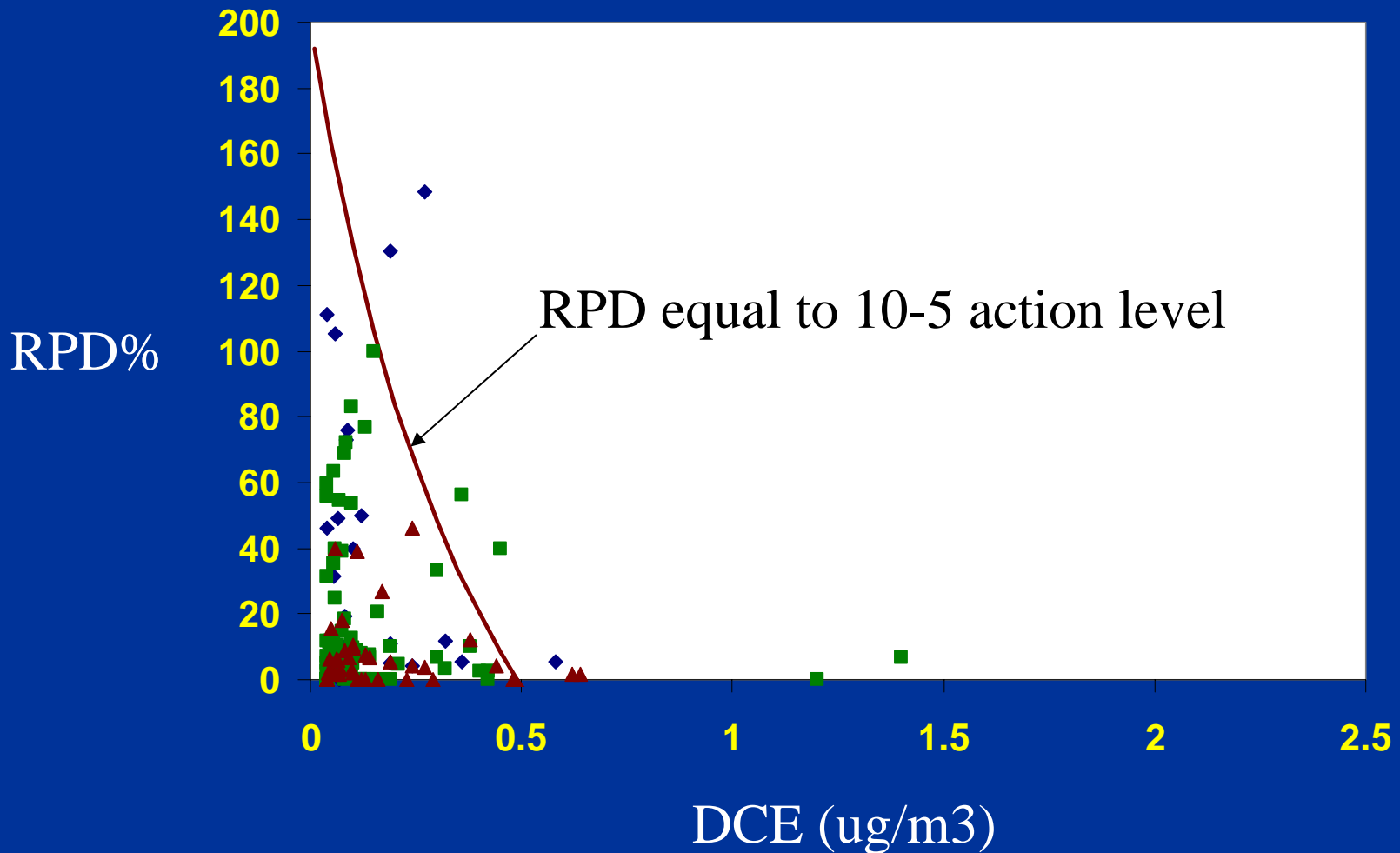
Effect of Concentration on Need for Modifications



Limits to Performance

- Detection limits and test precision
- Background sources
- 99.99% reductions possible?

Analytical Limitations

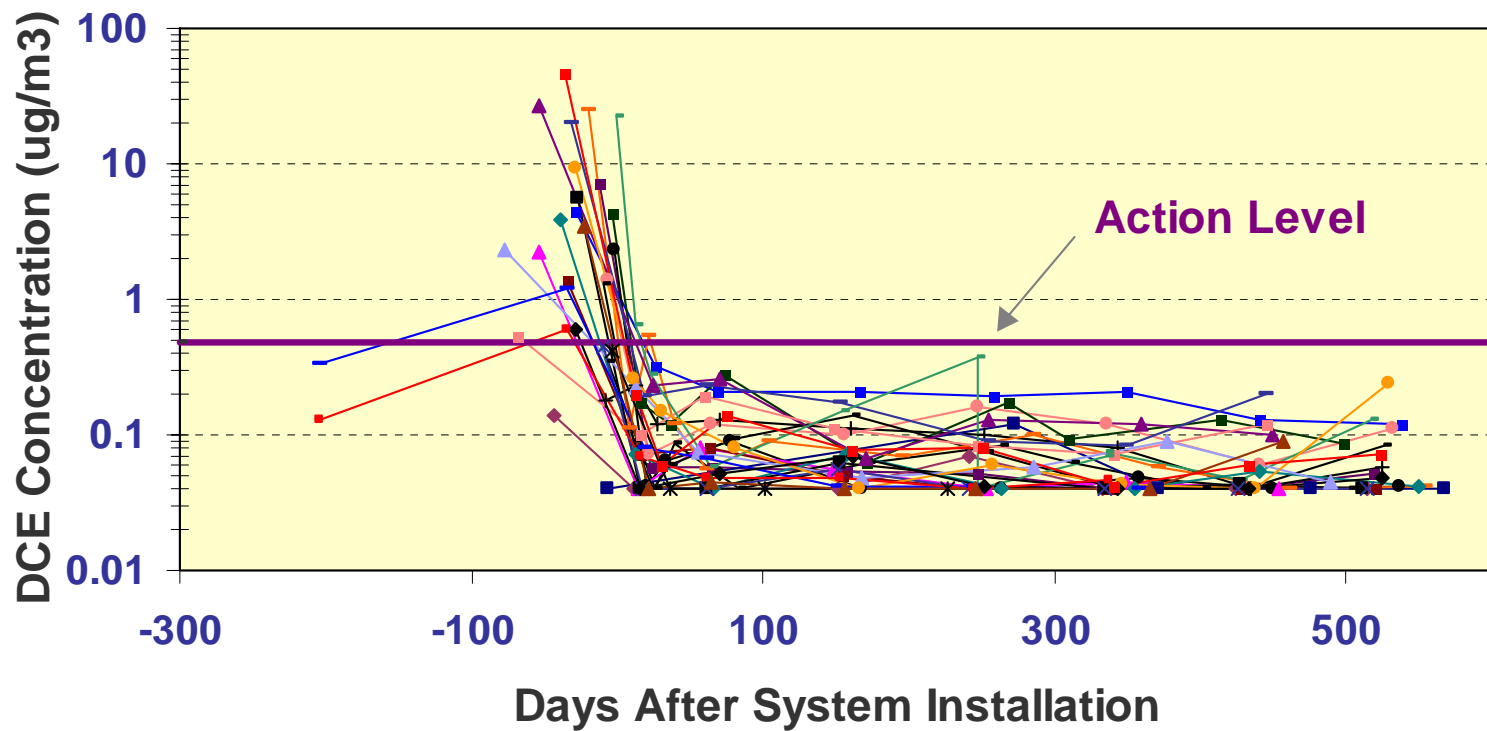


Long-Term Effectiveness

- Consistent performance over 4.5 years
- Concentrations fluctuate over time but within consistent range beyond 1 year
- Seasonal influence?

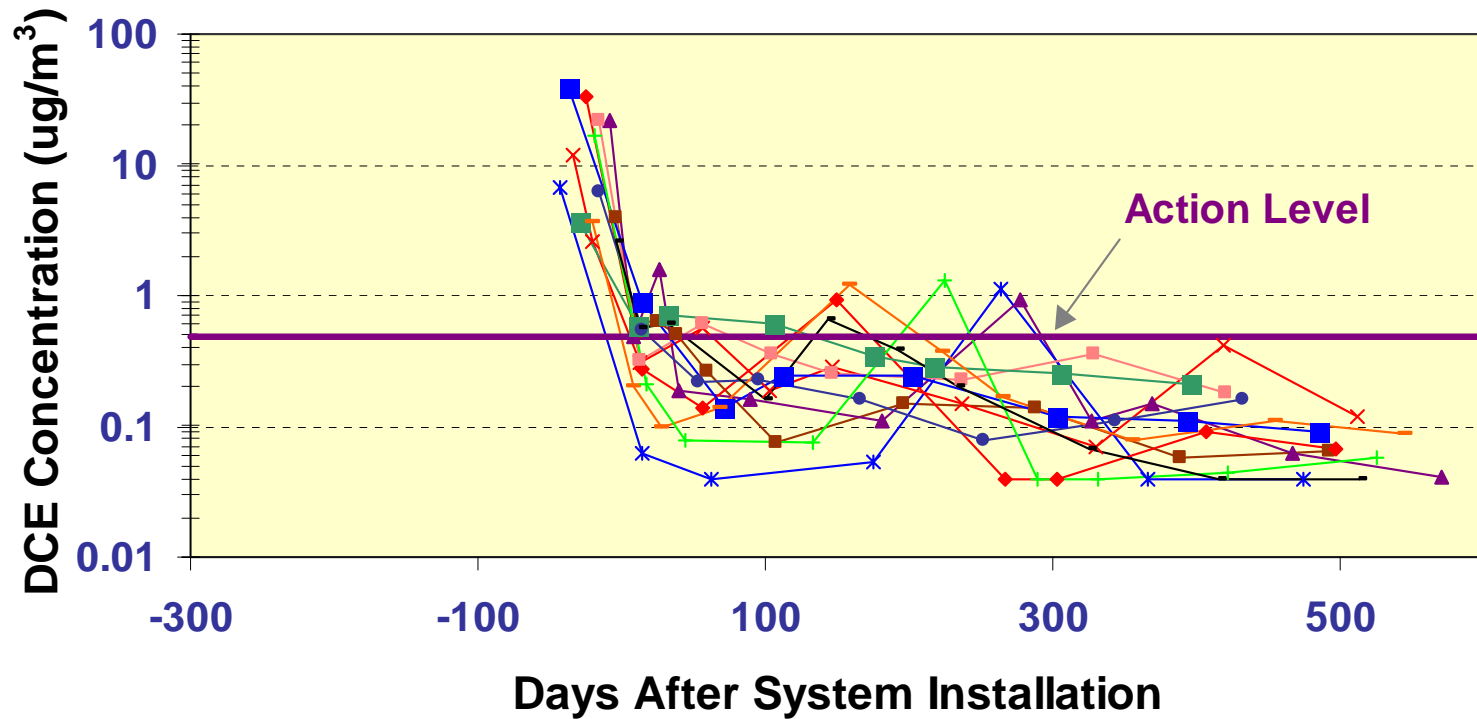
Sub-Slab System Performance

NO MODIFICATIONS REQUIRED



Sub-Slab System Performance

MODIFICATIONS REQUIRED



Summary

- 99.6% reductions achievable
- Reductions > 95% often require more aggressive systems
- Analytical capabilities limit achieving very low action levels
- Systems effective over time

Information on Future Research

- **www.envirogroup.com**
 - Vapor Intrusion Newsletter signup
 - Download technical papers
- **dfolkes@envirogroup.com**
 - Hard copies of PowerPoint slides
 - Questions