The Use of Empirical Data to Evaluate

The Impact of Biodegradation on Petroleum Hydrocarbon Vapor Intrusion

Database Development and Preliminary Results

Thomas E. McHugh and Silvia Maberti, Groundwater Services, Inc., Houston, Texas
Lynn Spence, Spence Environmental Engineering, California
Greg Johnson, Colorado Department of Labor and Employment, Denver, Colorado
Robin Davis, Utah Department of Environmental Quality, Salt Lake City, Utah
Harley Hopkins, American Petroleum Institute, Washington DC

Vapor Intrusion: The Next Great Environmental Challenge -- An Update
Los Angeles, California, September 13-15, 2006

Groundwater Services, Inc., Houston, Texas. www.gsi-net.com

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Pretty Good

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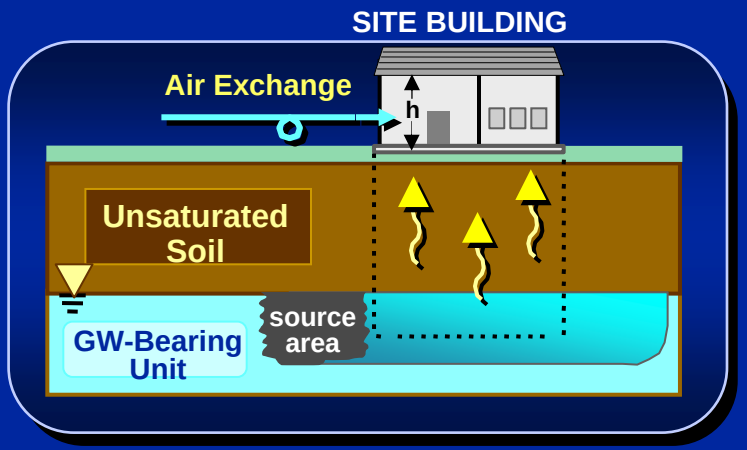
Petroleum Vapor Intrusion Database

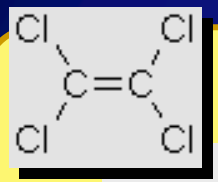
- Overview of Database
- Preliminary Data Analysis
- Future Plans

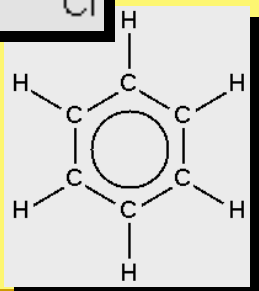


Project Overview

Petroleum Vapor Intrusion Database

What	■ Database of petroleum VOC conc. in GW, soil gas, soil, and air.
Why	■ Existing USEPA VI database mostly chlorinated VOCs. Does not reflect petroleum VOC attenuation.
How	■ Obtain available data sets from multiple sources. ■ Combine in flexible database format.





KEY POINT: **Database and documentation will be made publicly-available for peer-review and independent analysis.**

Database Overview

Sources of Petroleum VI Data

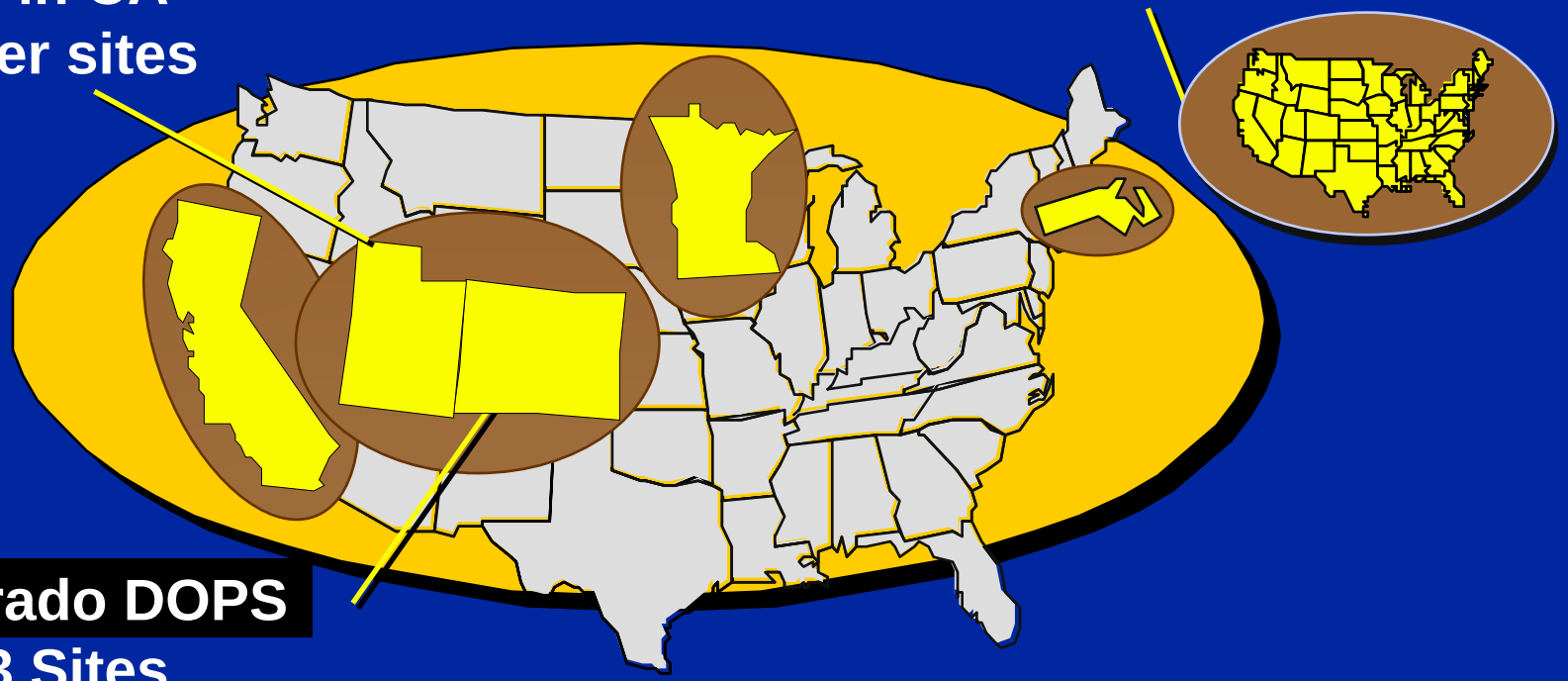
Colorado DOPS	■ Data from UST sites regulated by the Division of Oil and Public Safety.
Robin Davis, UDEQ	■ Data compiled from published literature plus data from sites regulated by UDEQ.
USEPA	■ Petroleum VOC data submitted to USEPA for inclusion in their VI database.
Petroleum Industry	■ Unpublished data from petroleum corrective action sites.

Database Overview

Corrective Action Sites: Where?

Robin Davis, UDEQ
- 20 Sites in MN
- 8 Sites in UT
- 7 Sites in CA
- 13 Other sites

USEPA VI Database
- 5 Sites in MA
- 8 Other sites



Colorado DOPS
- 113 Sites

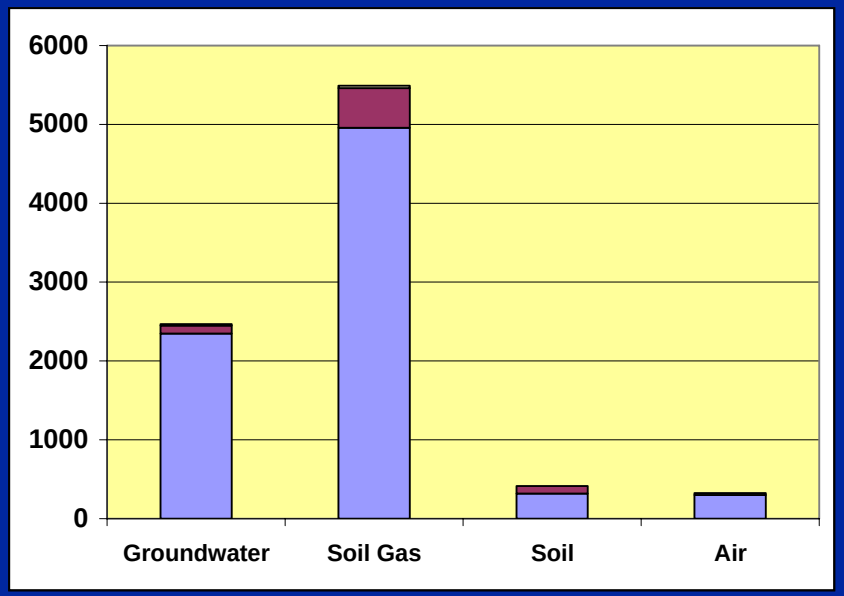
Database Overview

How Much Data?

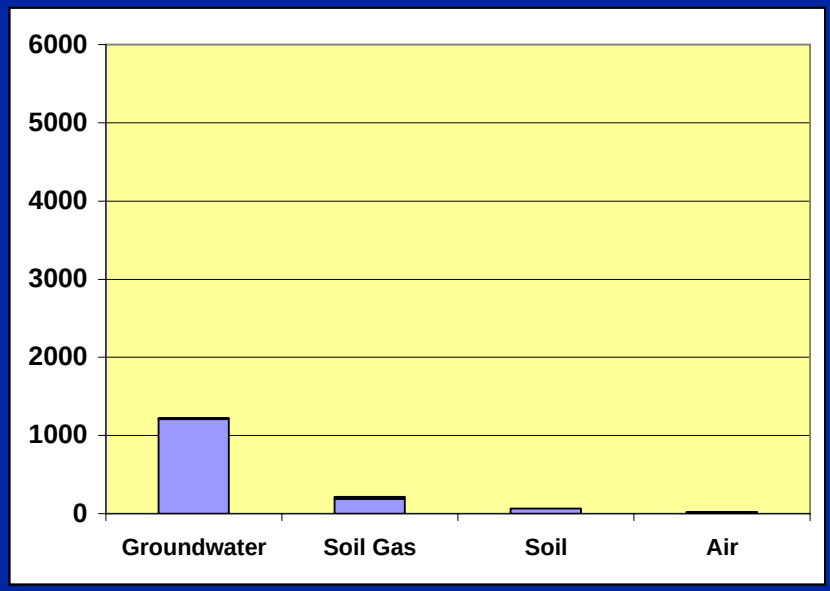
Legend

- Colorado
- Robin Davis
- USEPA

Benzene



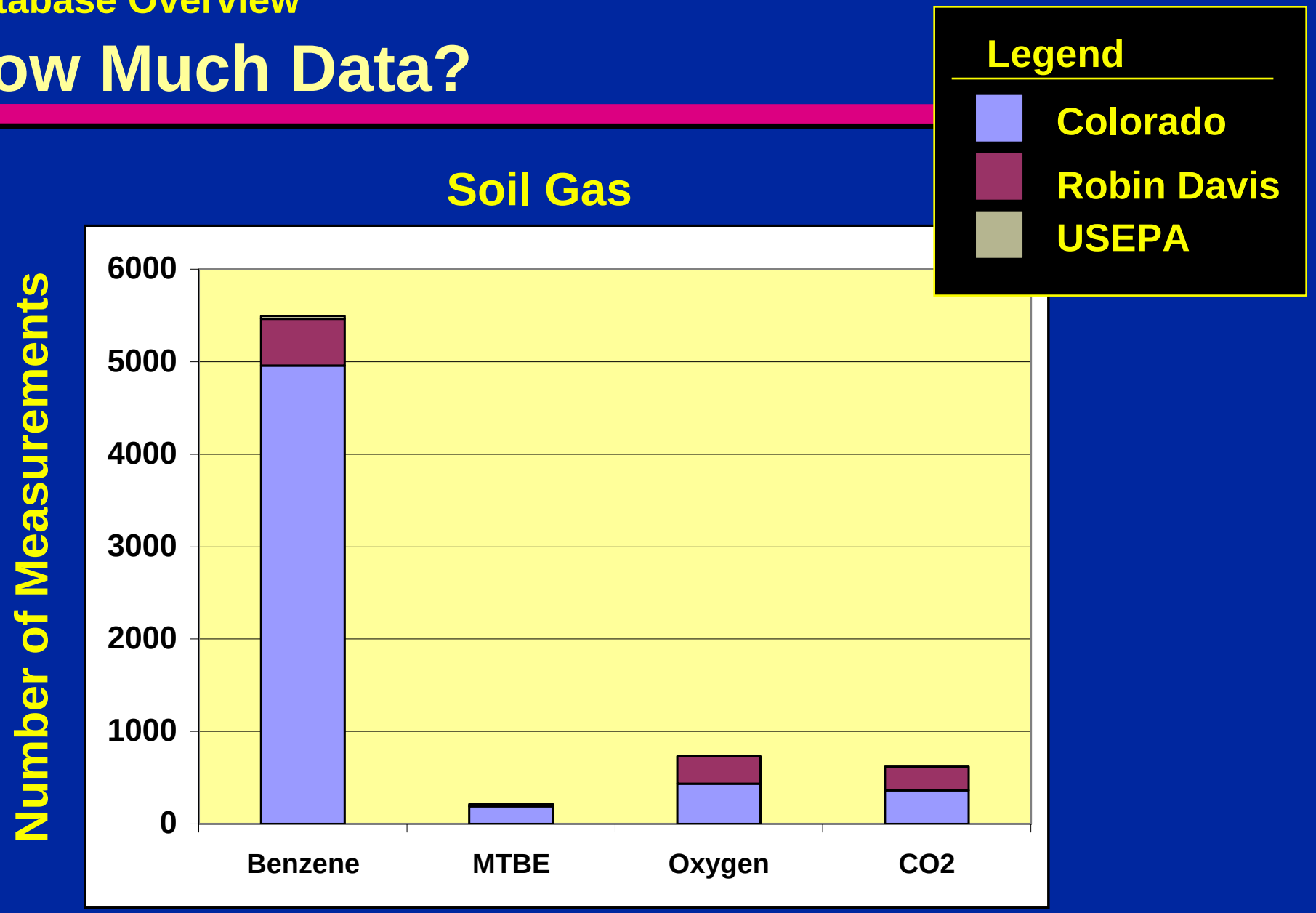
MTBE



KEY POINT: **> 40,000 individual chemical concentration measurements.**

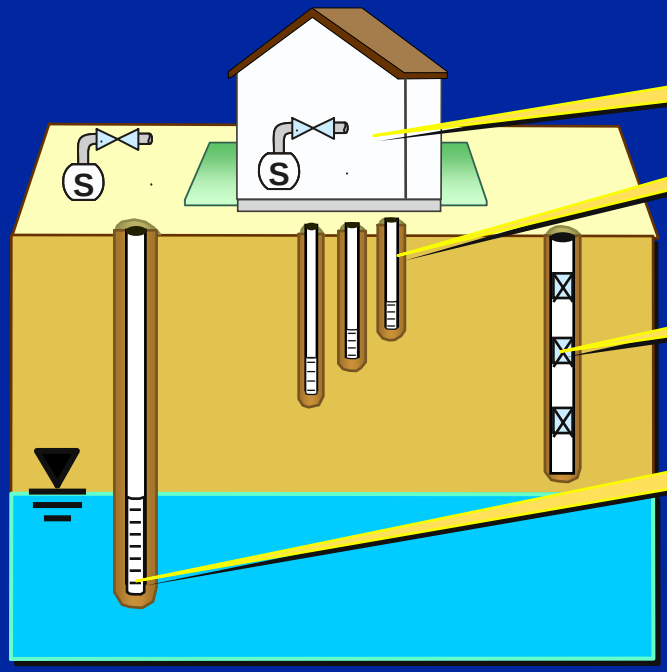
Database Overview

How Much Data?



Overview of Database

Structure: Relational Database

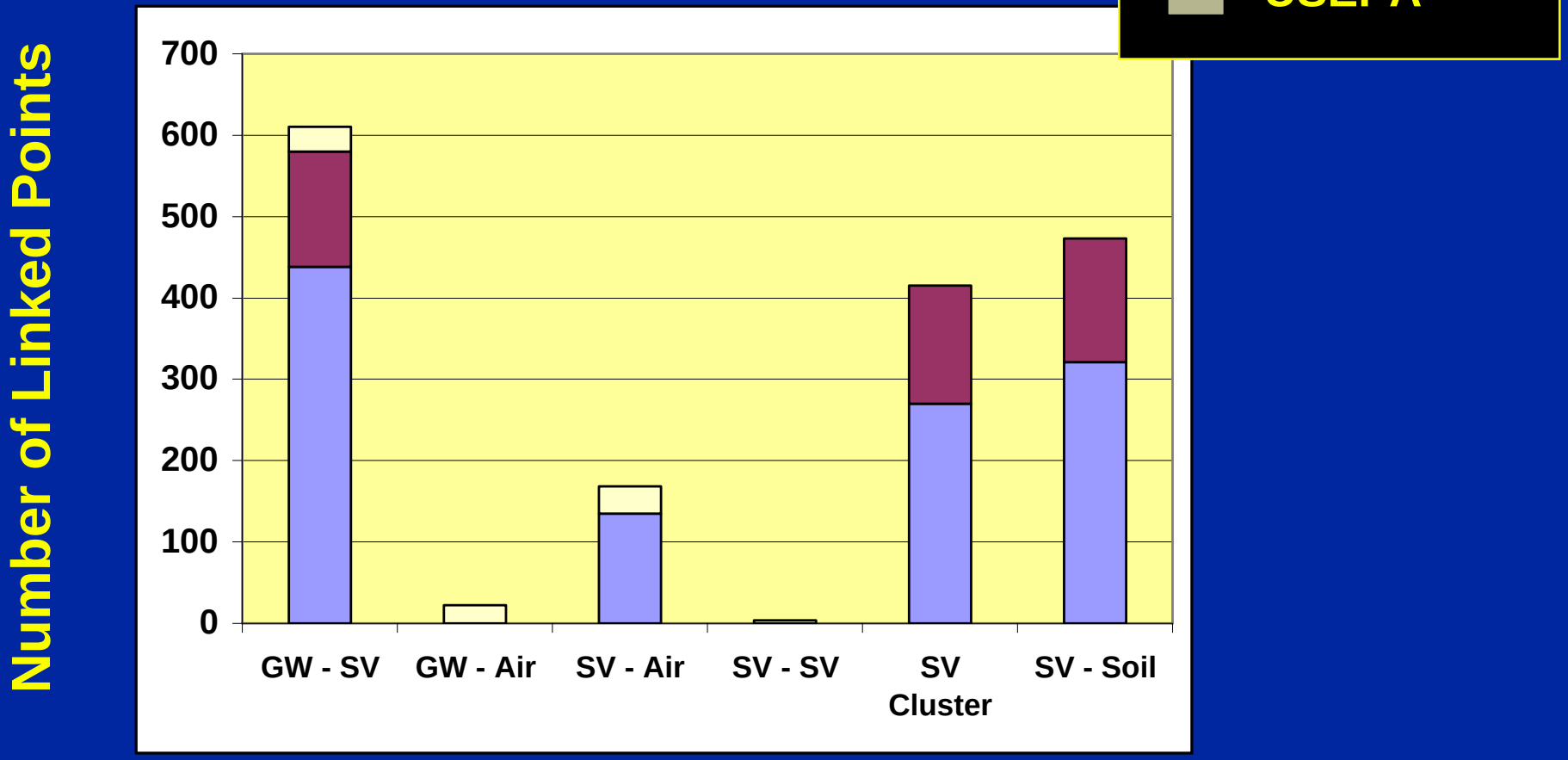


Sites	Sample Clusters	Sample Points	Analytical Data
	Building	Air Point Flux Chamber	Date VOC Conc. MDL Etc.
	SV Cluster	SV Point	
	Soil Boring	Soil Sample	
	Well Cluster	GW Well	

Sample Point Linking	
SV - Air	SV - Flux
SV - SV	GW - Air
Soil - SV	GW - SV

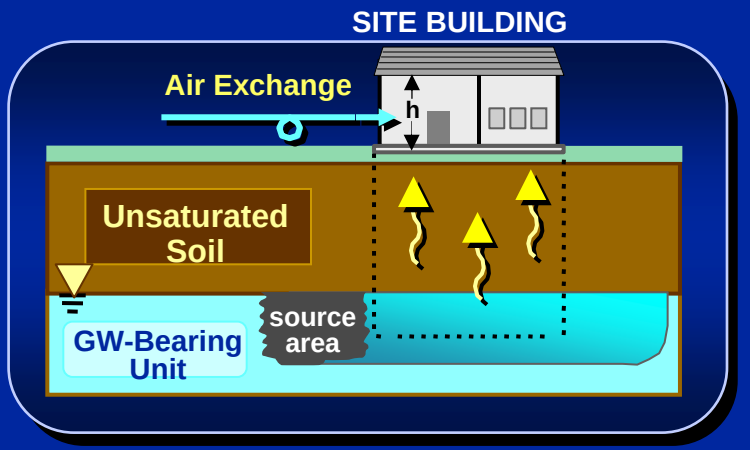
Database Overview

Linked Sample Points



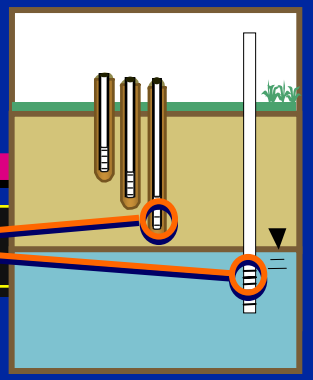
Petroleum Vapor Intrusion Database

- Overview of Database
- ***Preliminary Data Analysis***
- Future Plans



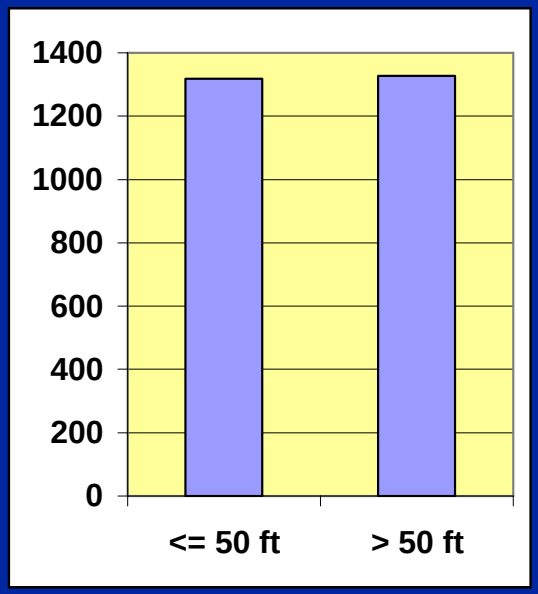
Preliminary Data Analysis

Distance Criteria

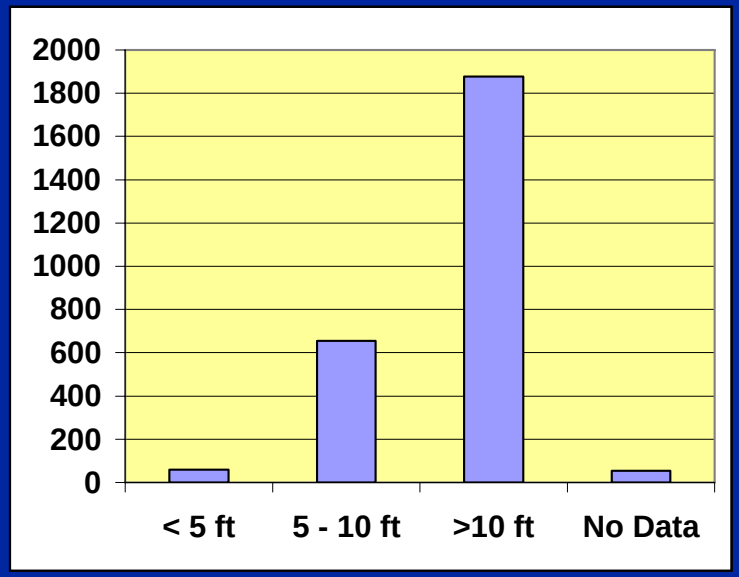


PAIRED GW AND DEEP SOIL GAS: BENZENE (1645 PAIRS)

Distance from Source



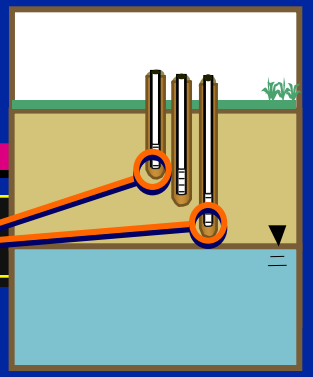
Depth to Groundwater



EXPECTED FINDING: **Deeper samples farther from source will provide better understanding of GW to soil gas attenuation**

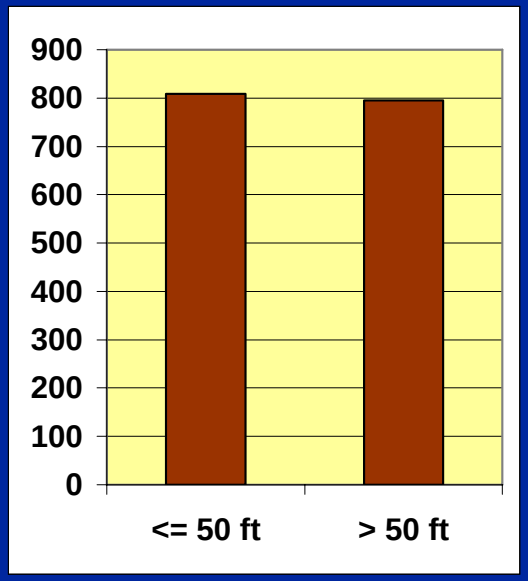
Preliminary Data Analysis

Distance Criteria

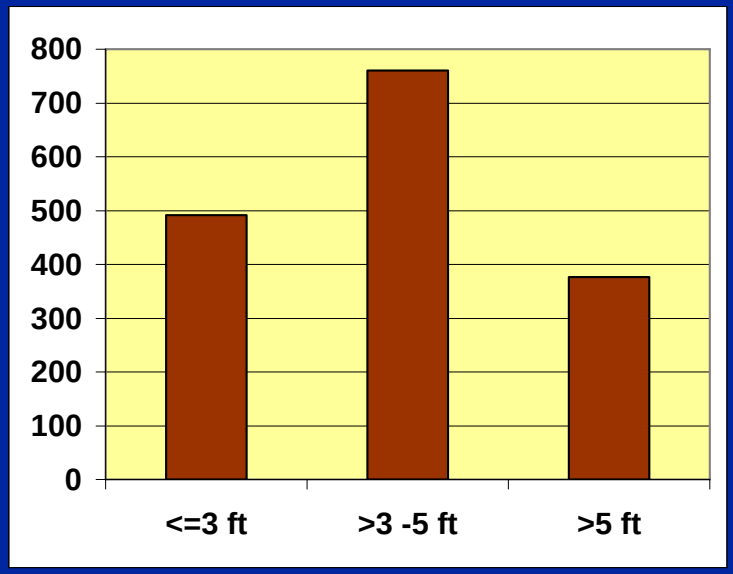


PAIRED DEEP AND SHALLOW SOIL GAS: BENZENE (1629 PAIRS)

Distance from Source



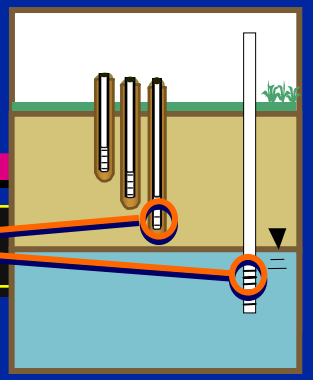
Depth to Shallow SG Point



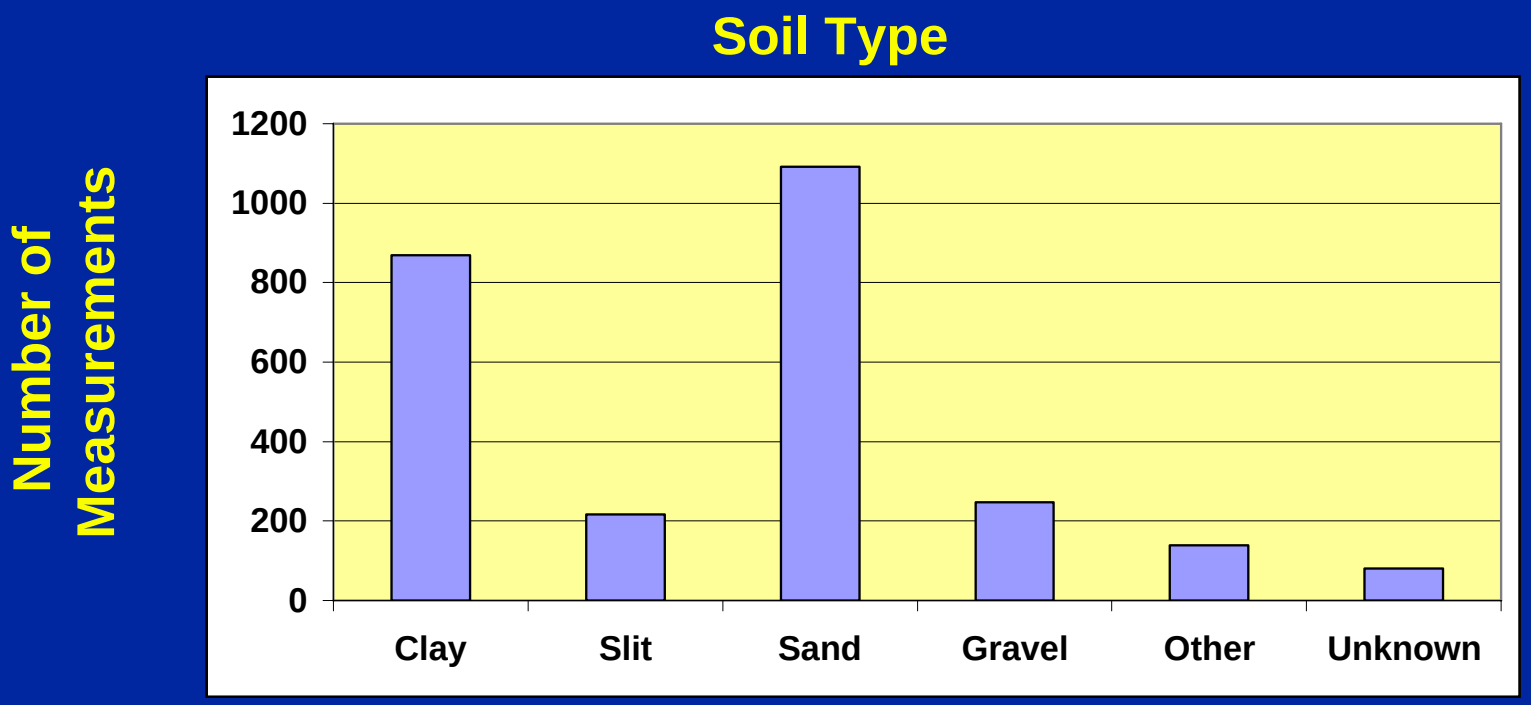
EXPECTED FINDING: **Samples farther from source will provide better understanding of soil gas attenuation**

Preliminary Data Analysis

Soil Type



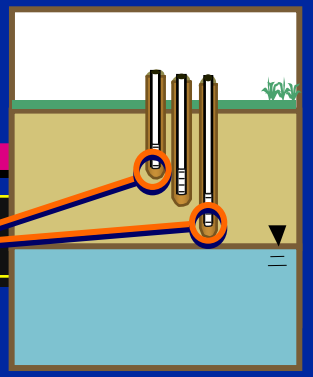
PAIRED GW AND DEEP SOIL GAS: BENZENE (1645 PAIRS)



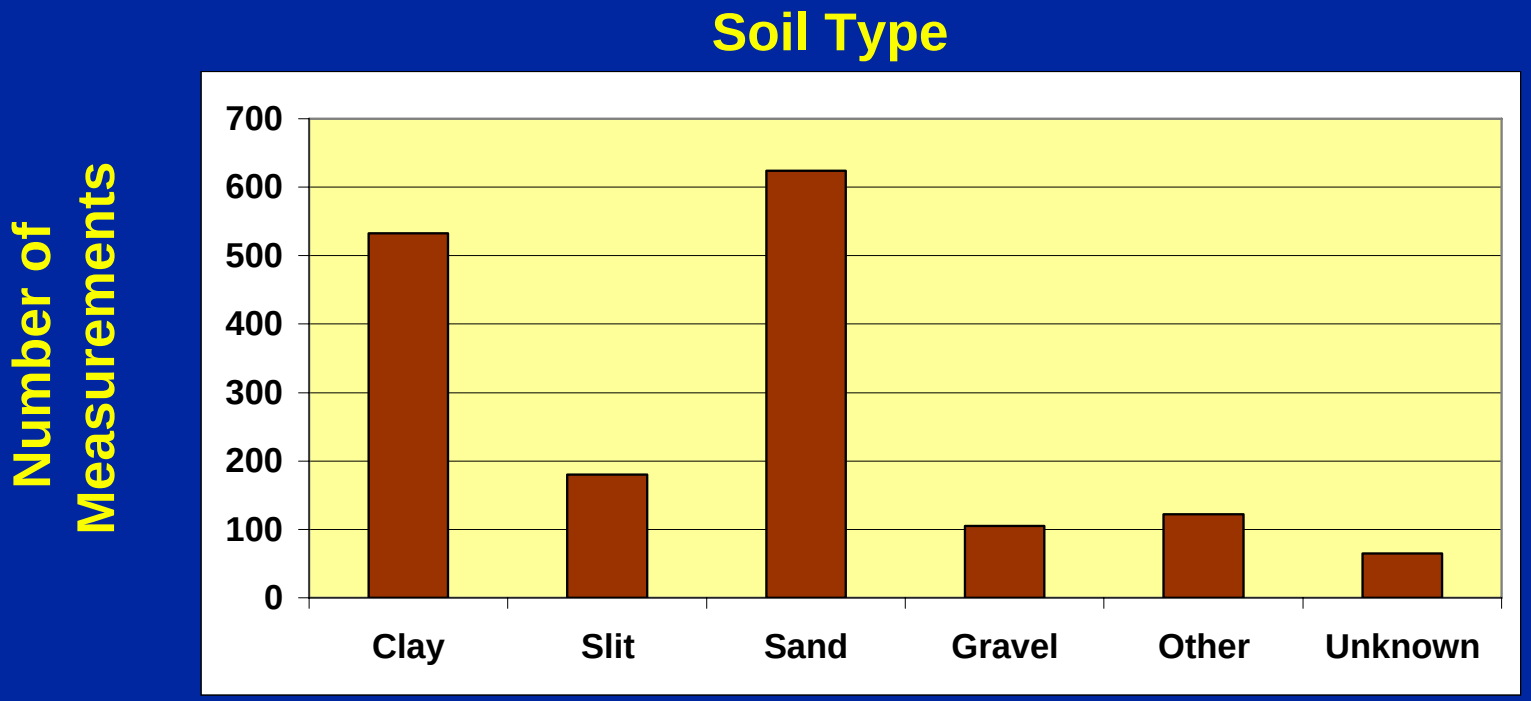
ANALYSIS: **Effect of soil type on petroleum attenuation**

Preliminary Data Analysis

Soil Type



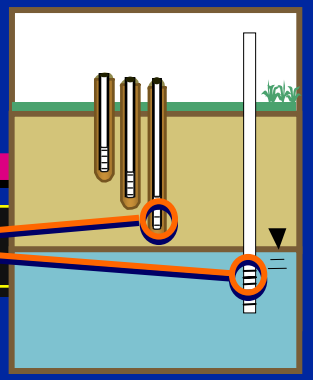
PAIRED DEEP AND SHALLOW SOIL GAS: BENZENE (1629 PAIRS)



ANALYSIS: **Effect of soil type on petroleum attenuation**

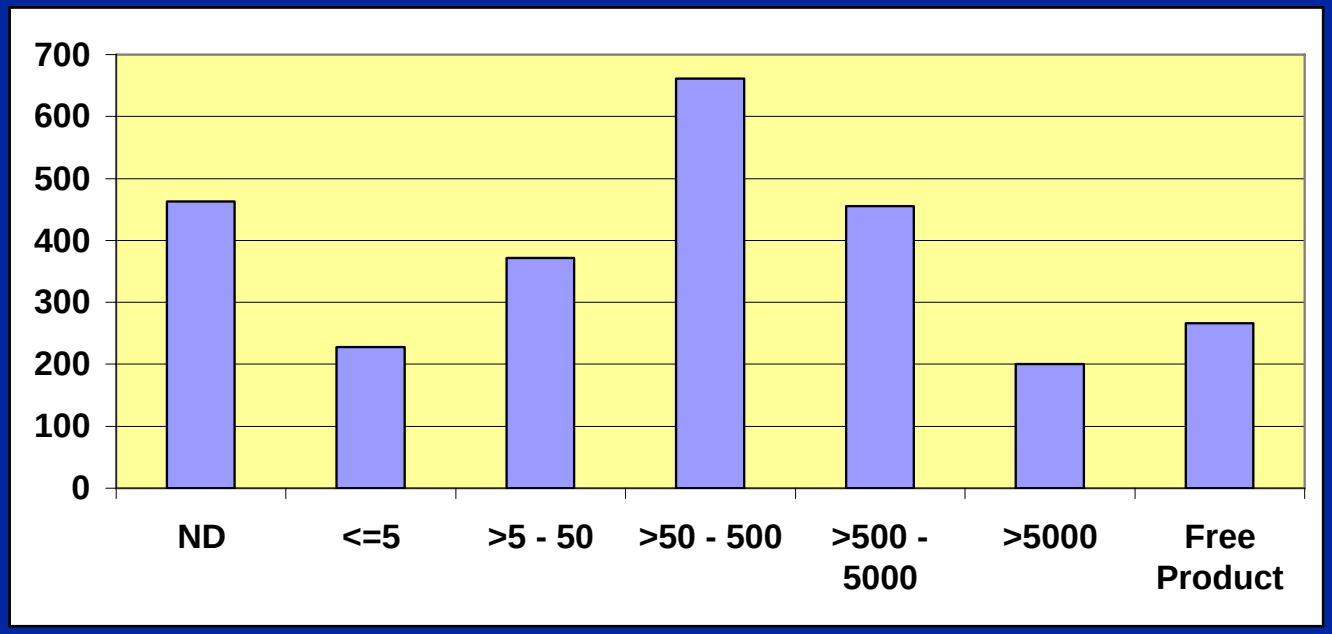
Preliminary Data Analysis

Source Strength



PAIRED GW AND DEEP SOIL GAS: BENZENE (1645 PAIRS)

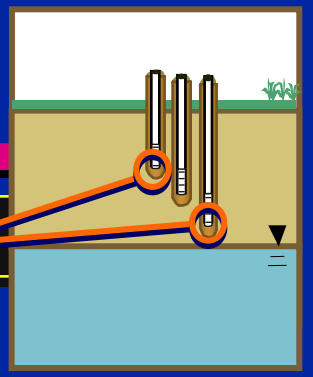
Concentration of Benzene in GW (ug/L)



ANALYSIS: **Effect of source strength on biodegradation / attenuation.**

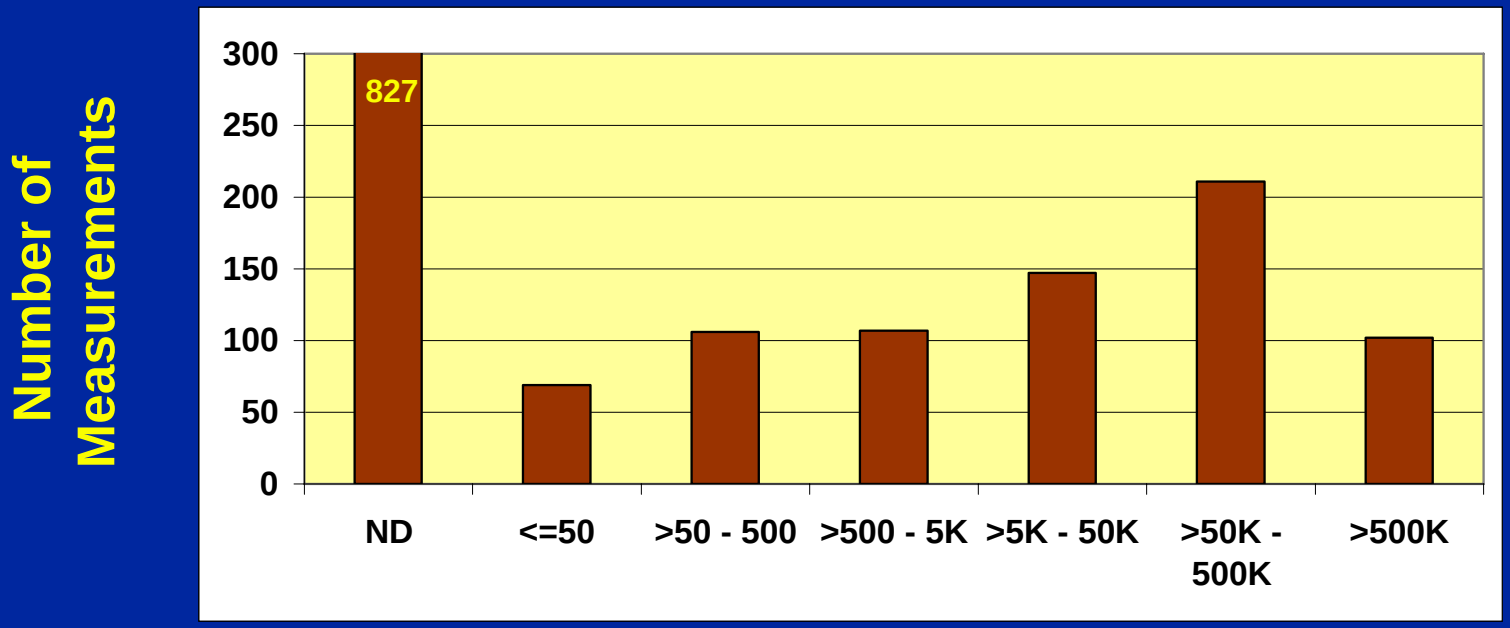
Preliminary Data Analysis

Source Strength



PAIRED DEEP AND SHALLOW SOIL GAS: BENZENE (1629 PAIRS)

Concentration of Benzene in Deep SG (ug/m3)

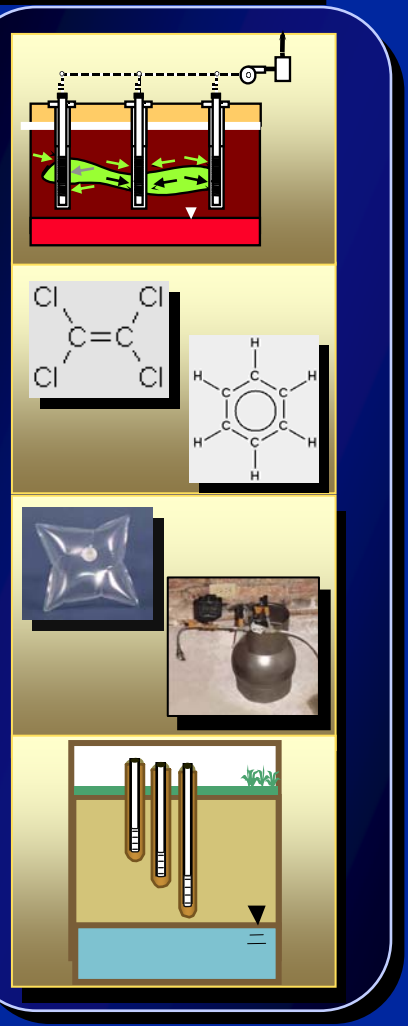


ANALYSIS: **Effect of source strength on biodegradation / attenuation.**

Preliminary Data Analysis

Other Useful Database Analyses

Remediation System	■ Effect of SVE or other remedy on soil vapor concentrations
Constituent	■ Differences in attenuation: Benzene, TEX, TVPH, MTBE
Sample Collection/ Analysis	■ Summa vs. Tedlar ■ TO 14/15 vs. 8260/8021
Sample Point Construction	■ Nested PVC, direct push, hand auger.



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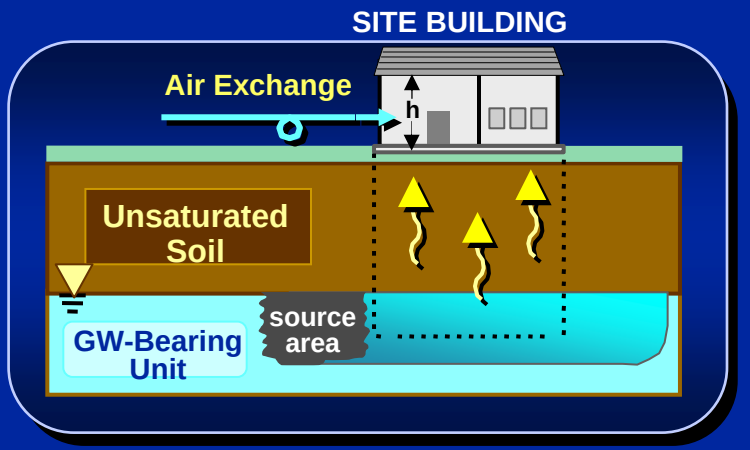
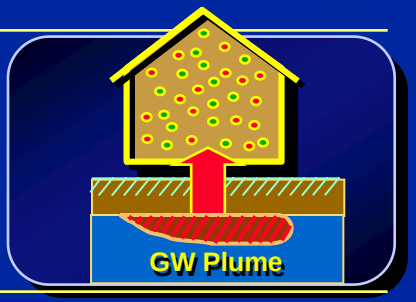


Future Plans

Project Deliverables: *Database Analysis*

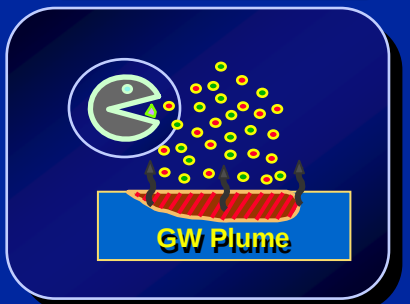
Attenuation Factors

- Upper-bound attenuation factors for petroleum hydrocarbons



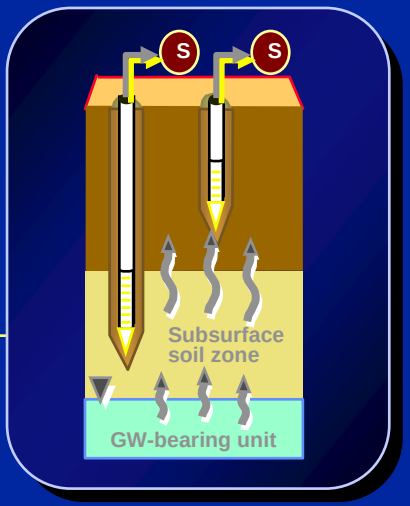
Impact of Biodegradation

- Impact of biodeg. on petroleum VI
- Influence of source strength, soil type, etc.



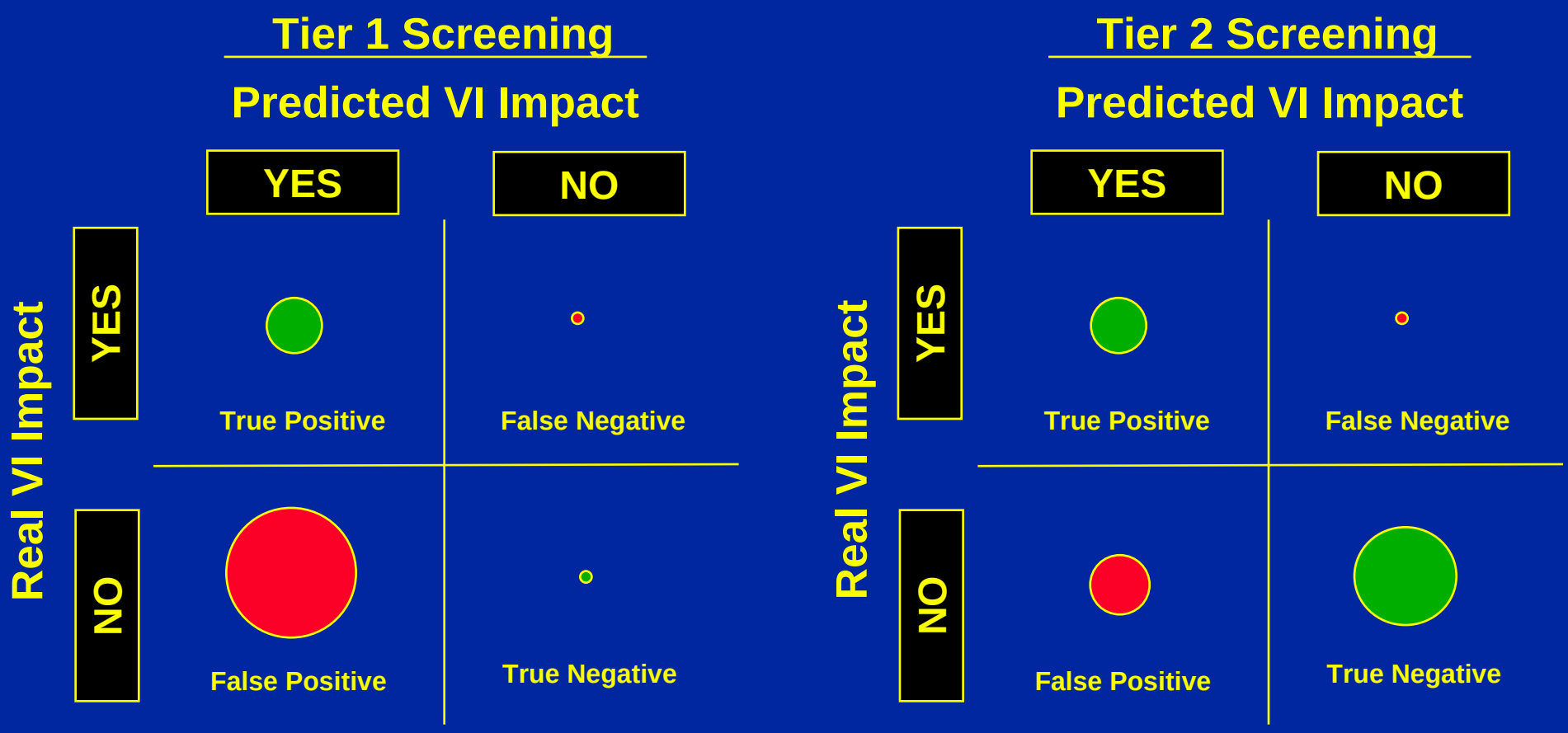
Other Analyses

- Impact of surface cover
- Evaluation of sampling & analysis methods



Future Plans

Project Deliverables: *Improved Screening*

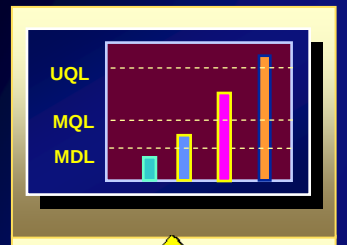


Key Point: **Improved screening yields more truth without increasing the false positive rate.**

Future Plans

Project Deliverables: *Data Wish List*

QA/QC	■ Sample collection leak tracer results (e.g., helium, SF_6 ,isopropyl alcohol, 1,2-DFA, etc.)
Fixed Gases	■ Oxygen, nitrogen, CO_2 - Direct evidence of aerobic biodeg.
Tracers	■ MTBE, Chlorinated VOCs, radon - Biodeg. vs. other attenuation



GOAL: **Identify data most valuable for improved understanding of petroleum vapor intrusion.**

Future Plans

Project Deliverables: *Shared Database*

Publicly Available Database

- Microsoft Access
- Documentation
- Example Queries

KEY POINT: **For copy of database (when available), contact Harley Hopkins, Hopkins@api.org.**

Thanks

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Lynn Spence	Spence Environmental Engineering, California
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Robin Davis	Utah Department of Environmental Quality, Salt Lake City, Utah
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Members	API Soil and Groundwater Task Force