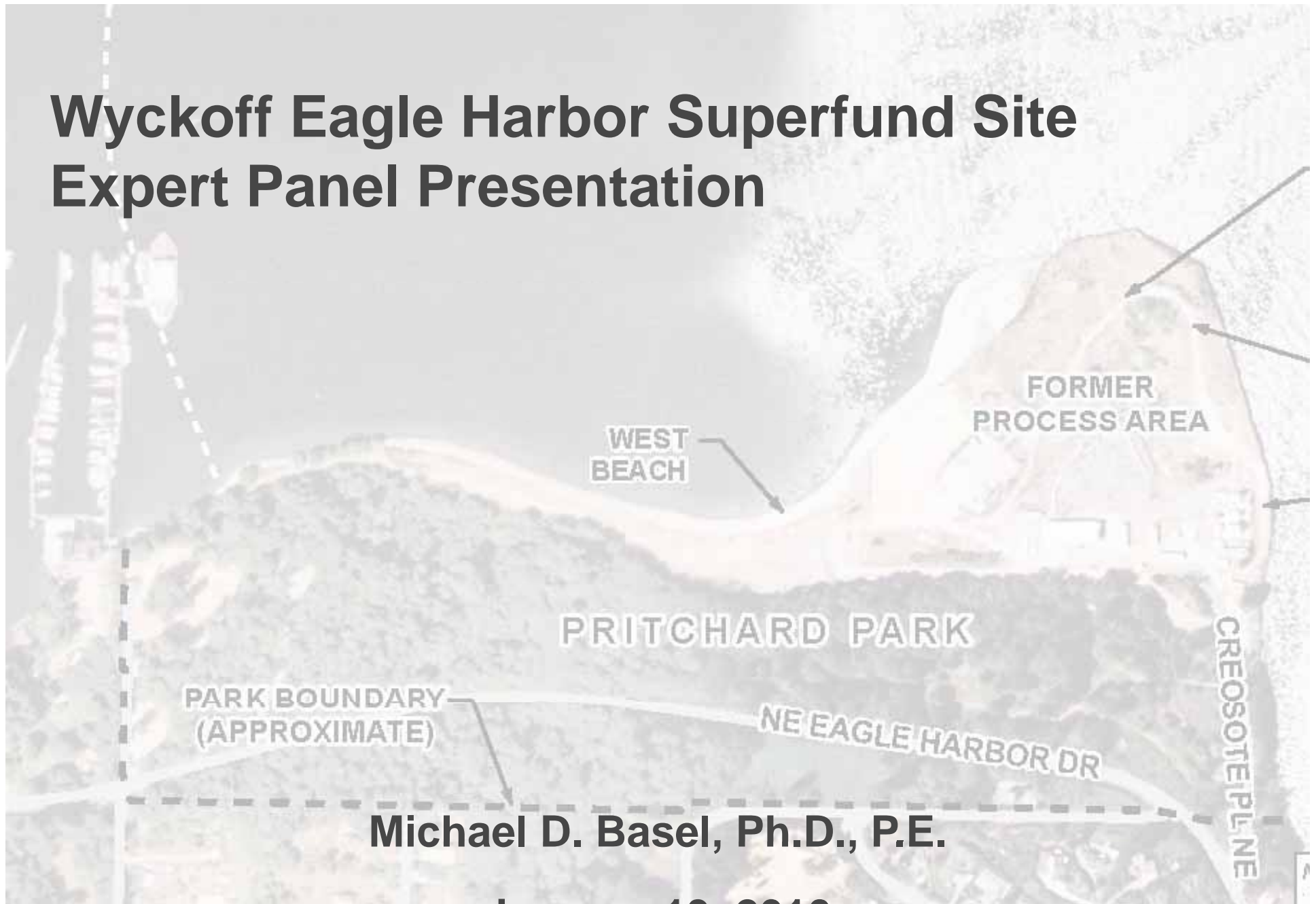


# Wyckoff Eagle Harbor Superfund Site Expert Panel Presentation



**Michael D. Basel, Ph.D., P.E.**

**January 13, 2010**

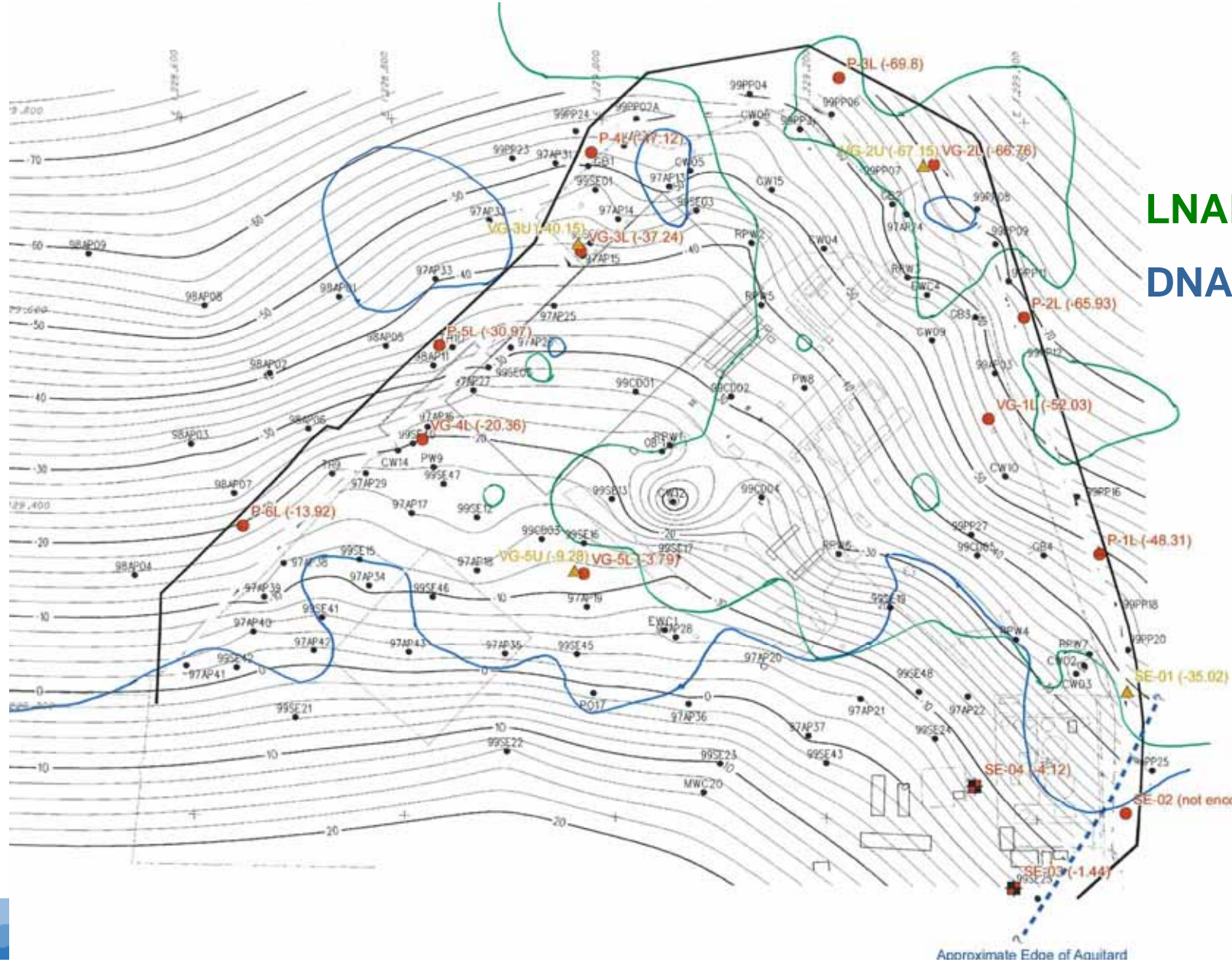
# Presentation Overview

- Challenges for Wyckoff Site
- Site-Specific Insight Based on Thermal Database Review
- Perspective Regarding Wyckoff Remediation

# Site Specific Conditions Create Some Challenging Challenges

- Presence of LNAPL and DNAPL
- Varying depth of target treatment zone (varying depth of ground surface, varying depth of bottom surface)
- Presence of low permeability layers affecting flow characteristics and injection capabilities
- Contaminant characteristics limit options available for source area remediation
- Distribution from historical release would require containment for long timeframe without source area removal or reduction of mobility

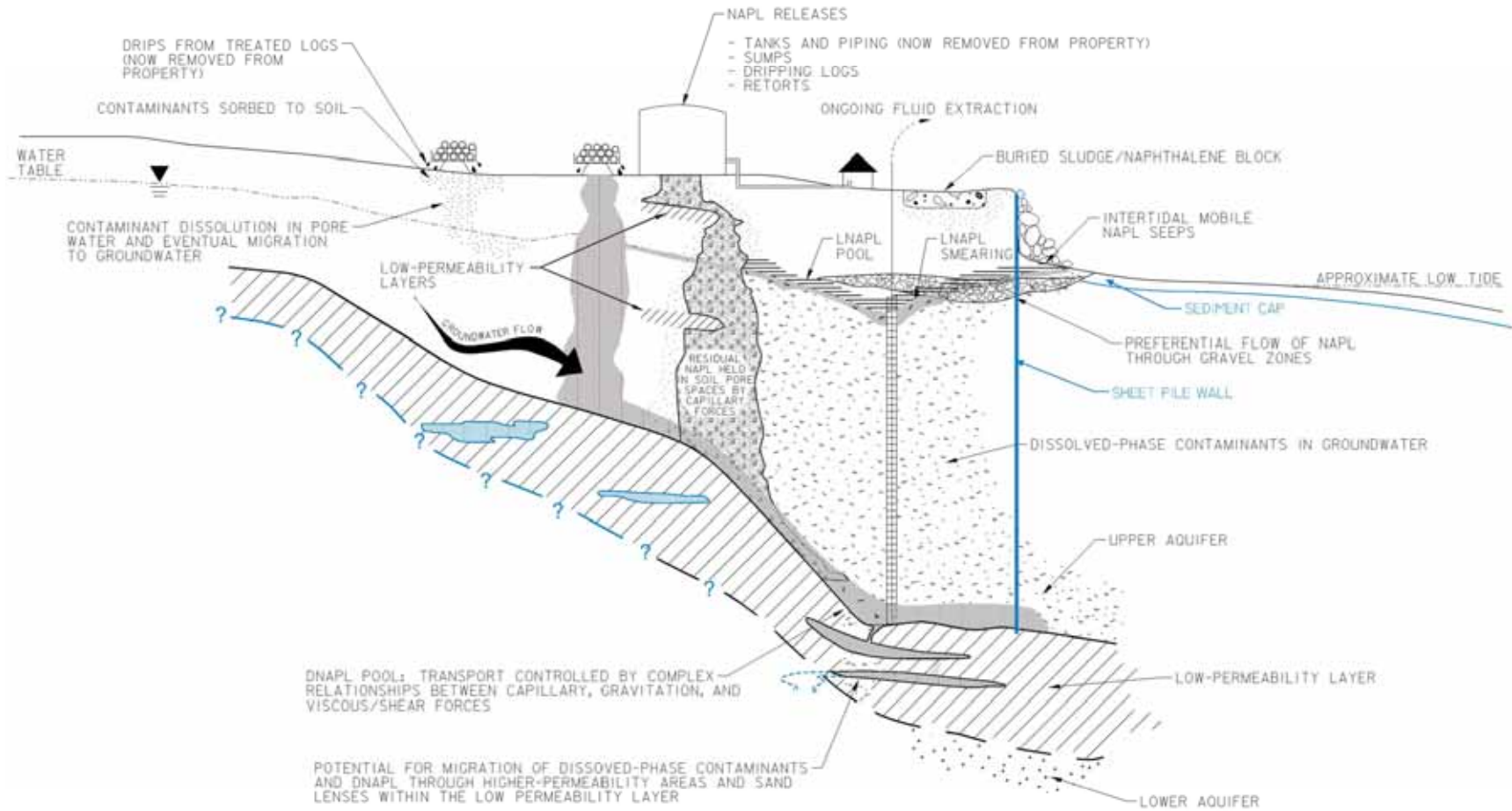
# LNAPL and DNAPL



LNAPL > 1 ft  
DNAPL > 1 ft



# Bottom Surface Drops Sharply



# Perspective on Remediation

- Source area technology options exist that could reduce cost and enhance certainty compared to solely containment approach
- It's a challenging question - there is no perfect technology without challenges.
- The best option may be a combination of approaches

# Thermal Database Review

- ESTCP Project ER-0314. Review of In Situ Thermal Treatment Technologies. (Dr. Jennifer Kingston, et al)
- 182 applications were reviewed for applications between 1988 and 2007
- Approximately 90% of the 182 applications were implemented after 1995 and about half since 2000

Technology	Number of Applications	Number Since Year 2000
Steam-Based	46	15
Electrical Resistance Heating	87	48
Conduction	26	17
Other/Radio-Frequency	23	4
<b>Total</b>	<b>182</b>	<b>84</b>

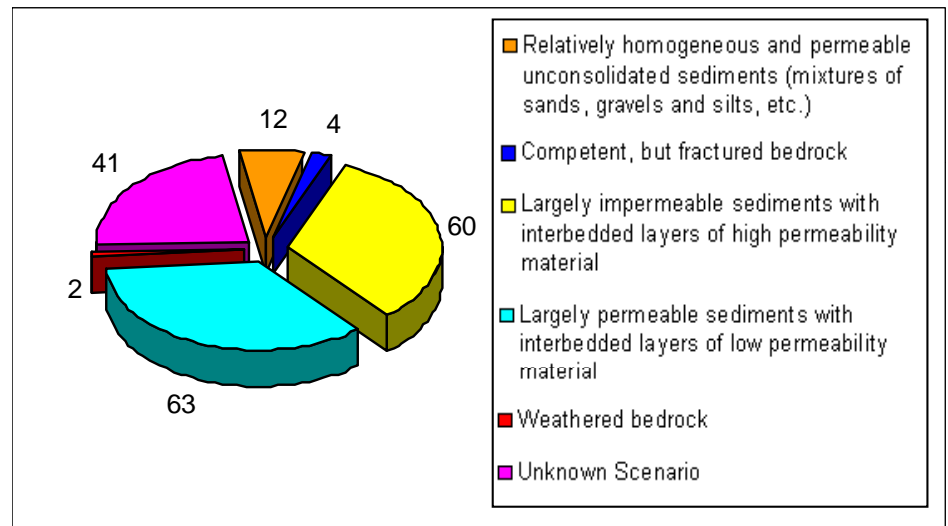
# Treatment Zone Size Summary

Technology	Number of Sites With Target Treatment Zones With Sizes In This Range [ft <sup>2</sup> ]			
	<10 <sup>4</sup>	10 <sup>4</sup> – 4x10 <sup>4</sup>	>4x10 <sup>4</sup>	Unknown
Steam-Based Heating	16	6	4	20
Resistance Heating	36	24	0	27
Conductive Heating	19	6	0	1
Other (including Mixing/Heating)	8	2	0	13

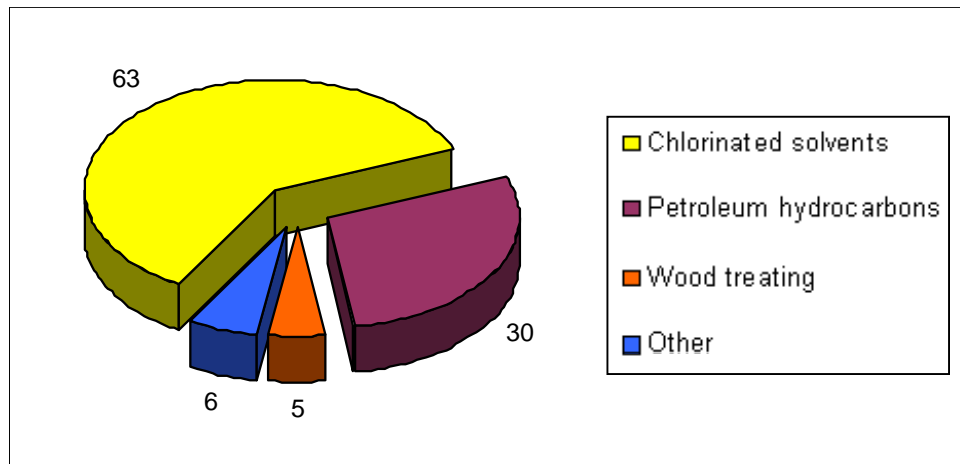
- 117 of 121 applications for which data were available involved treating areas <math> < 4 \times 10^4 \text{ ft}^2 </math>
- Roughly 2/3 of those involved treatment zones smaller than 10<sup>4</sup> ft<sup>2</sup>
- Wyckoff would be in the >4 x 10<sup>4</sup> ft<sup>2</sup>
  - Only 4 applications were greater than 40,000 ft<sup>2</sup> by the end of the 2007
  - Other applications since 2007 have been larger than 40,000 ft<sup>2</sup> (LNAPL ET-DSP site in North Carolina)

# Generalized Scenario Summary

- 141 of 182 applications for which data were available have known geologic settings
- Approximately 45% (63 of 141) have geologic scenarios (Largely permeable sediments with interbedded layers of low permeability material) similar to Wyckoff



# Chemical Treatment Summary



**Note:**

- 1) Some sites might be treating multiple chemical groups.
- 2) Figure contains data for sites since 2000 only.

- 8 of the 172 applications with known chemicals treated were wood-treating chemicals.
- 6 of the 84 applications since 2000 have treated wood-treating chemicals.

# Conclusions from Database Review

- In Situ Thermal Treatment is a proven technology, with growing number of applications in past 5 to 10 years.
- Issues encountered with thermal can often be attributed to inexperience of teams (repeating lessons learned)
- Wyckoff Site is:
  - Large but other sites of this size have been addressed
  - Wyckoff constituents have been successfully addressed elsewhere
  - Very common type of lithology

# Perspective Regarding Wyckoff Remediation

## Technologies With Merit Include:

- Thermal approaches
- Chemical Oxidation/Stabilization
- Large Diameter Drilling in conjunction with other techniques

# In Situ Thermal

- Past pilot test demonstrated capability for thermal to remove contaminants
- Combined technologies
- Varying approaches for LNAPL or DNAPL areas
- Significant benefit can be provided (mass removal/stabilization) without necessarily removing every molecule

# In Situ Chemical Oxidation

- Activated Persulfates could address NAPL constituents (permanganate would be limited with acetone and methylene chloride)
- Full oxidation of all NAPL would require unreasonable oxidant quantity
- Goal might be to stabilize (particularly DNAPLs) rather than complete removal
  - Demonstrated on bench and pilot scale
  - Significant reduction in mobility and dissolution
  - Distribution where intended could be a challenge
  - Incomplete data regarding longevity of stabilization effect

# Large Diameter Augers Could Be Combined with Other Technologies

- Have been used with oxidants, reductants, steam
- Provide opportunity for surgical applications (but requires surface access)
- Could also be used to reduce mobility via solid stabilizing column

# Large Diameter Auger

- Excavation
- Steam
- ISCO
- Reduction
- Stabilization



From Tom Sale

# Large Diameter Auger



From Tom Sale

Haley & Aldrich, Inc.

# Large Diameter Auger



From Tom Sale



From [www.feccorporation.com](http://www.feccorporation.com)