



Mitigation of Petroleum Vapor Intrusion with Horizontal Remediation Wells

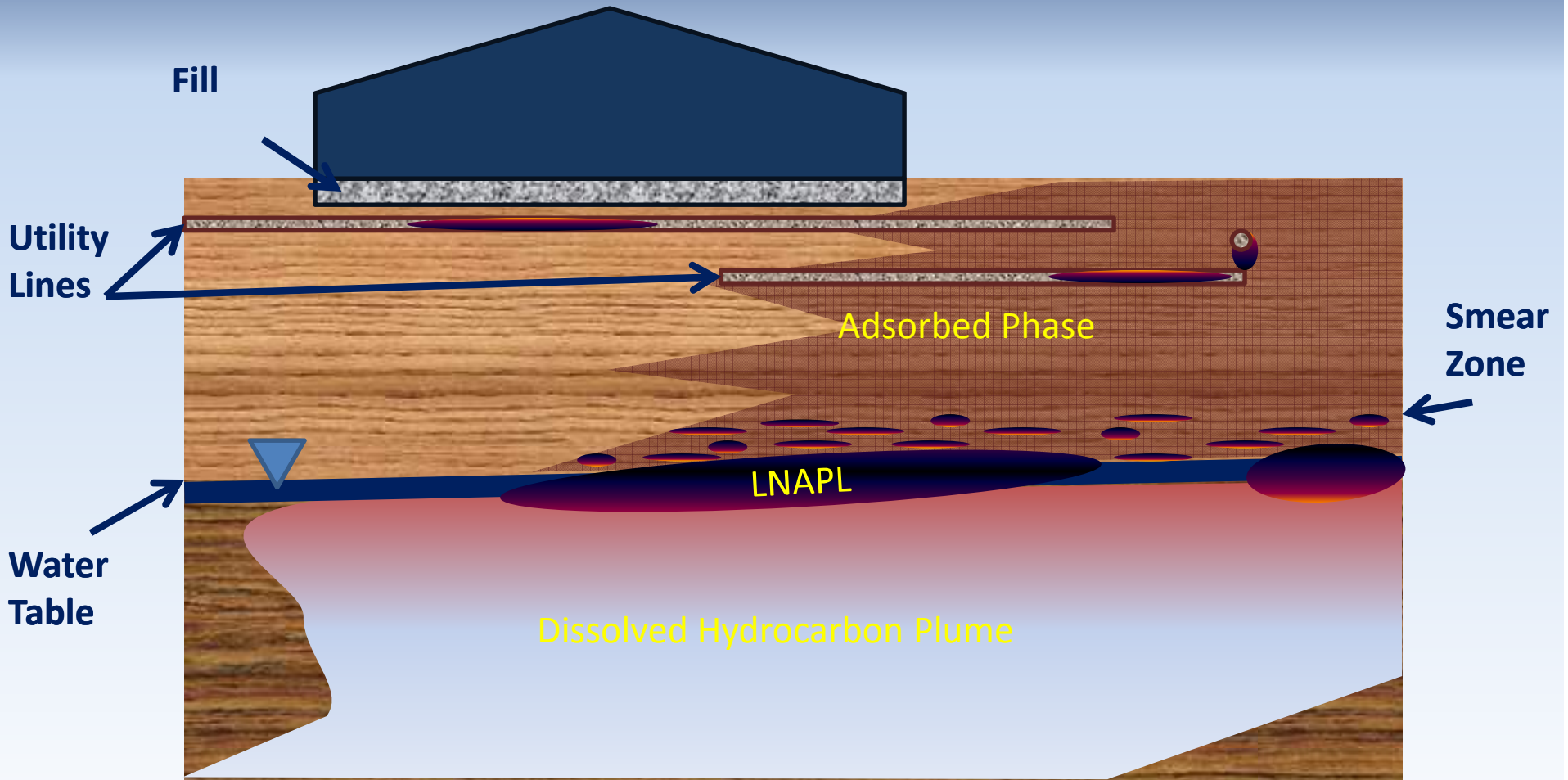
IPEC Conference

San Antonio, TX

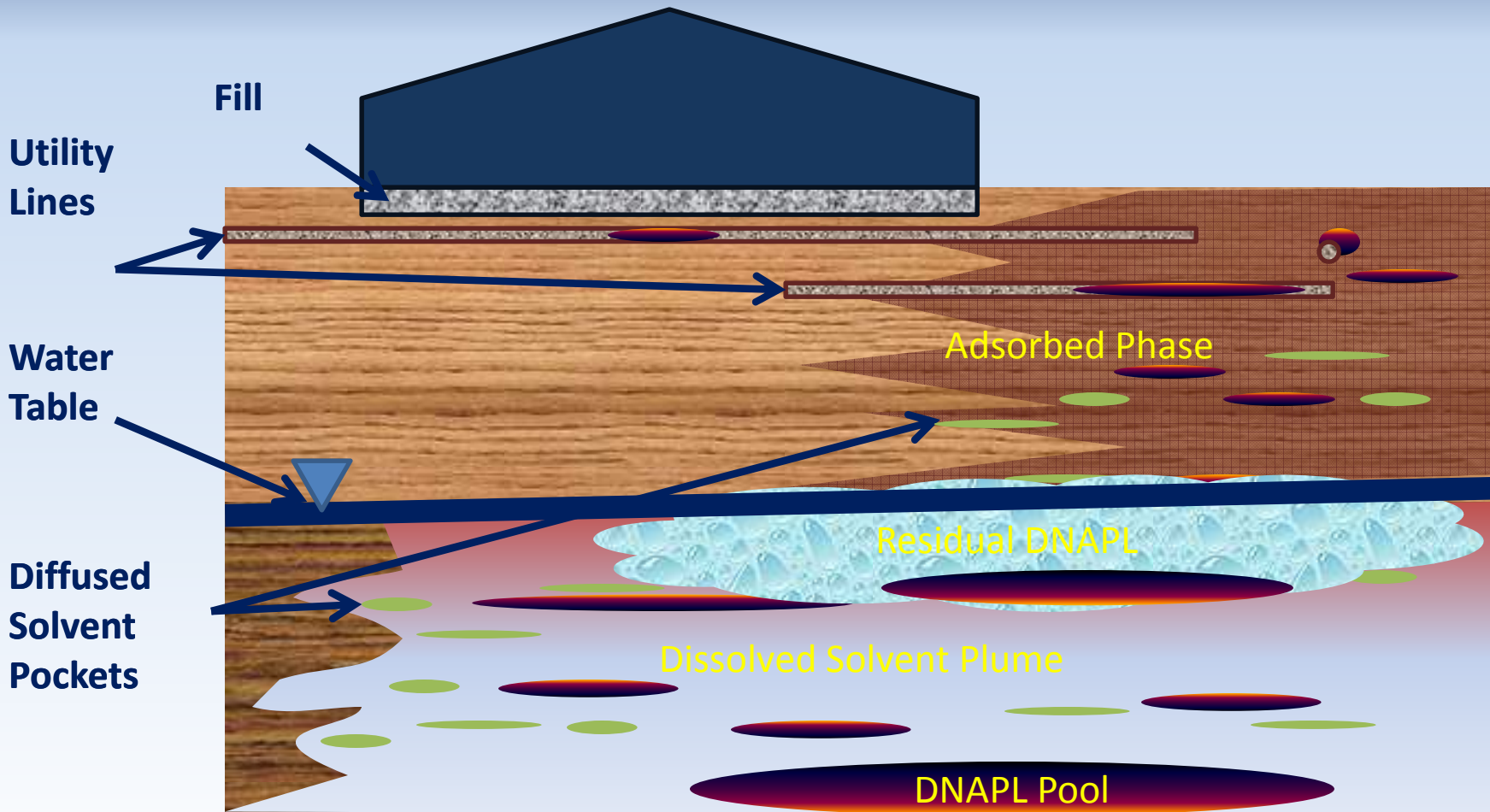
November 13, 2013

Glenn Nicholas Iosue

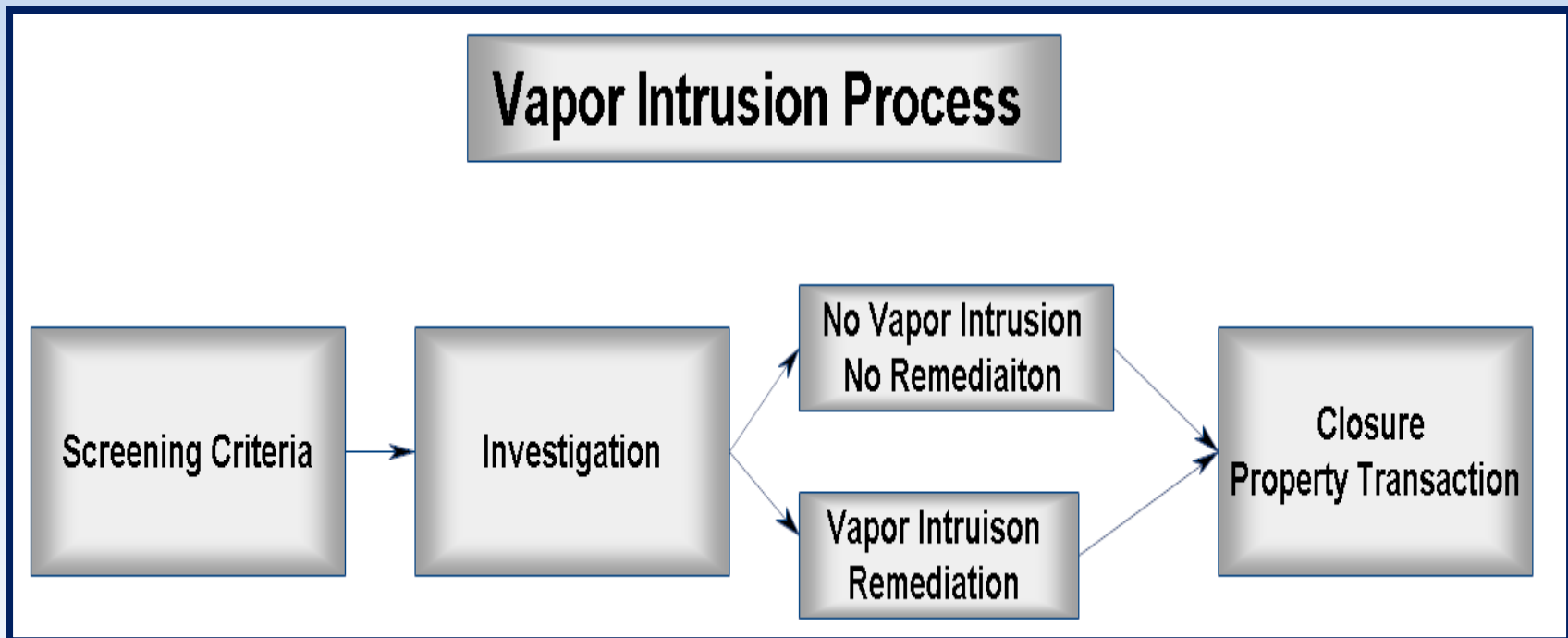
Distribution of Source Material at LNAPL Site



Distribution of Source Material at DNAPL Site



VI Puts Emphasis on Source Reduction and Shallow Plume Remediation



Horizontal Wells Solve VI Problem



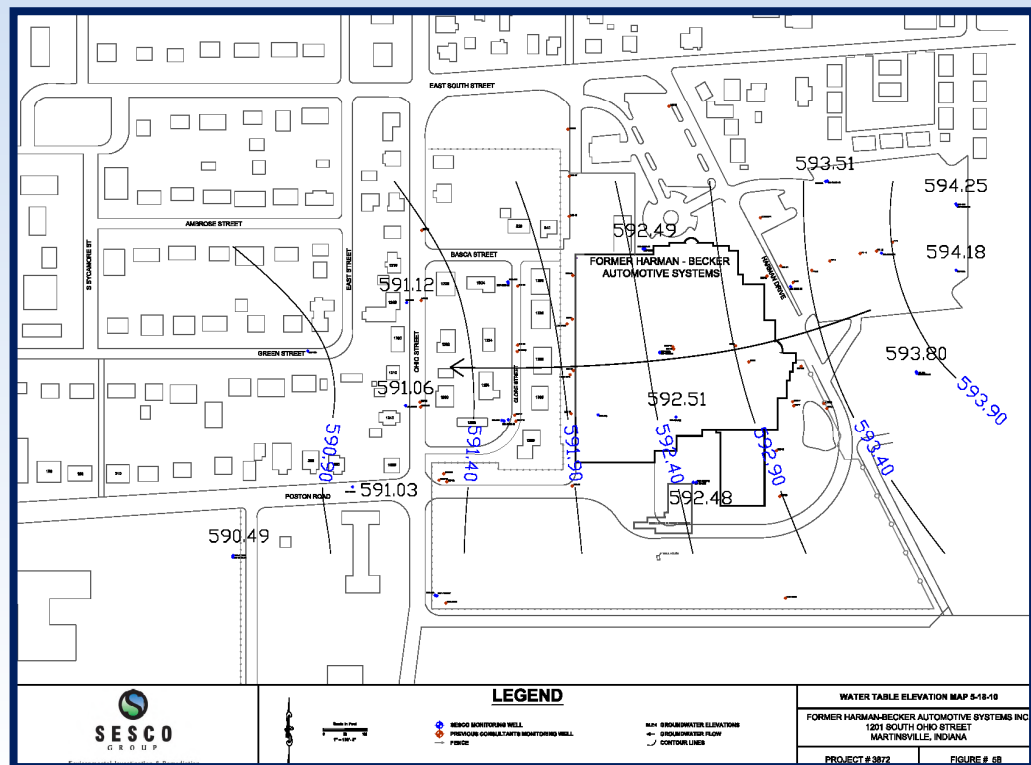
- Subslab vapor represents completed pathway
- Even below subslab screening levels, variability of subslab vapor must be considered
 - Horizontal screens address subslab variability
- Future changes in structure or HVAC configuration
 - Horizontal mitigation systems allow HVAC flexibility

Subslab Alternatives



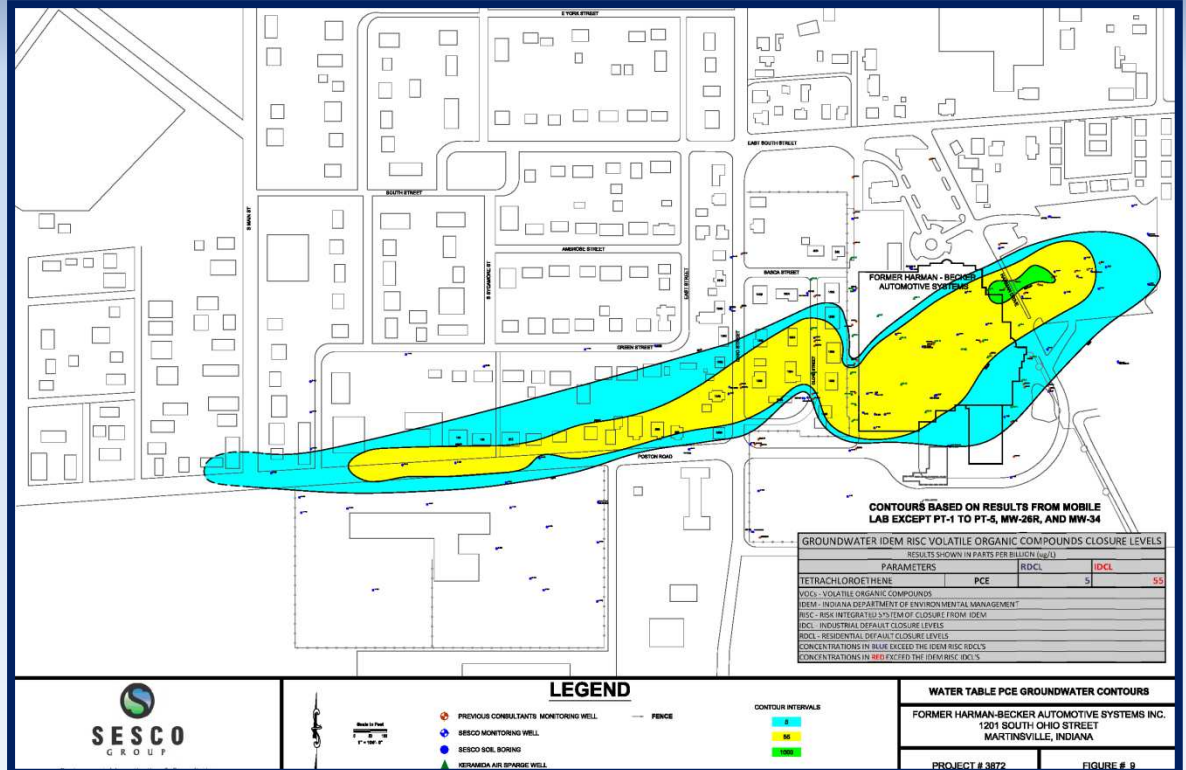
Mass Distribution and Well Efficacy

- Source areas under building and east (right) of building
- Hydraulic gradient distributes VOCs under building and under residential neighborhood down-gradient of building
- Seasonal, diurnal and barometric water table fluctuations
- Placement restrictions limit vertical well efficacy



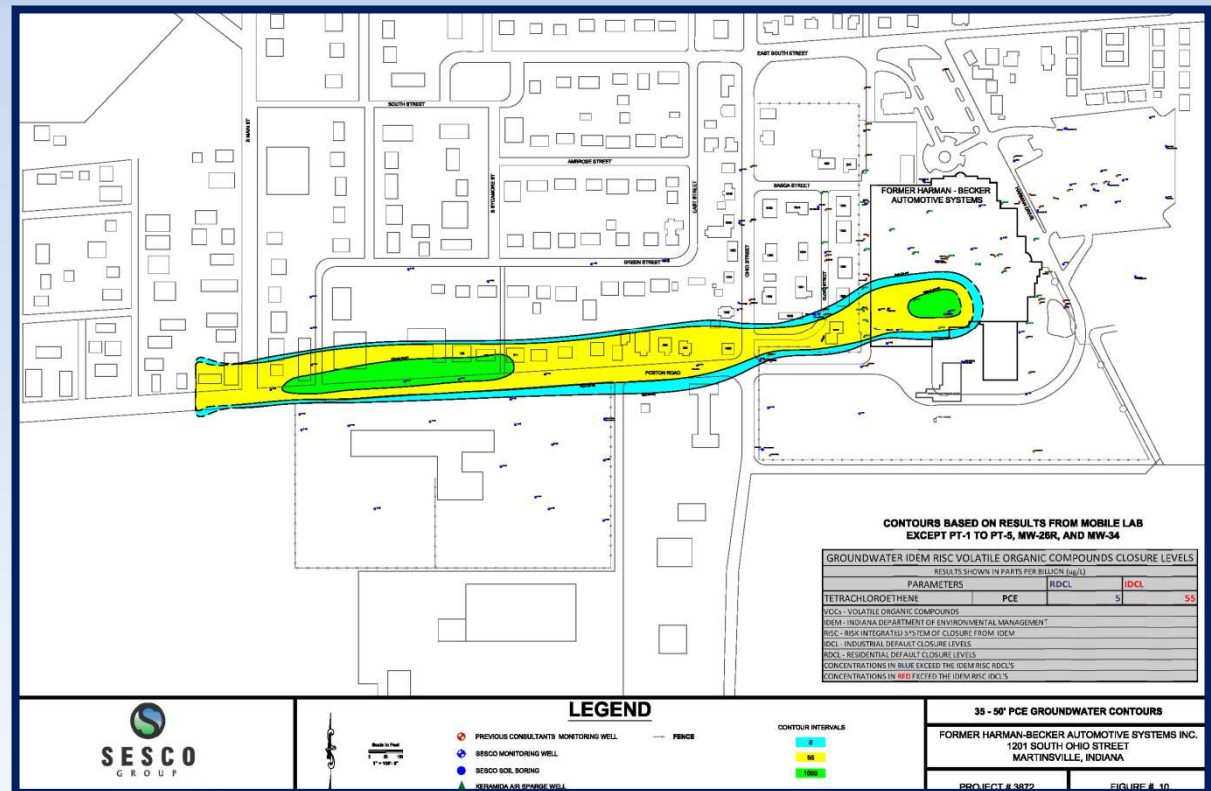
Hydrogeology

- Stratified formations with alternating sand, silt or gravel produce plumes with distinct horizons and layering of constituents



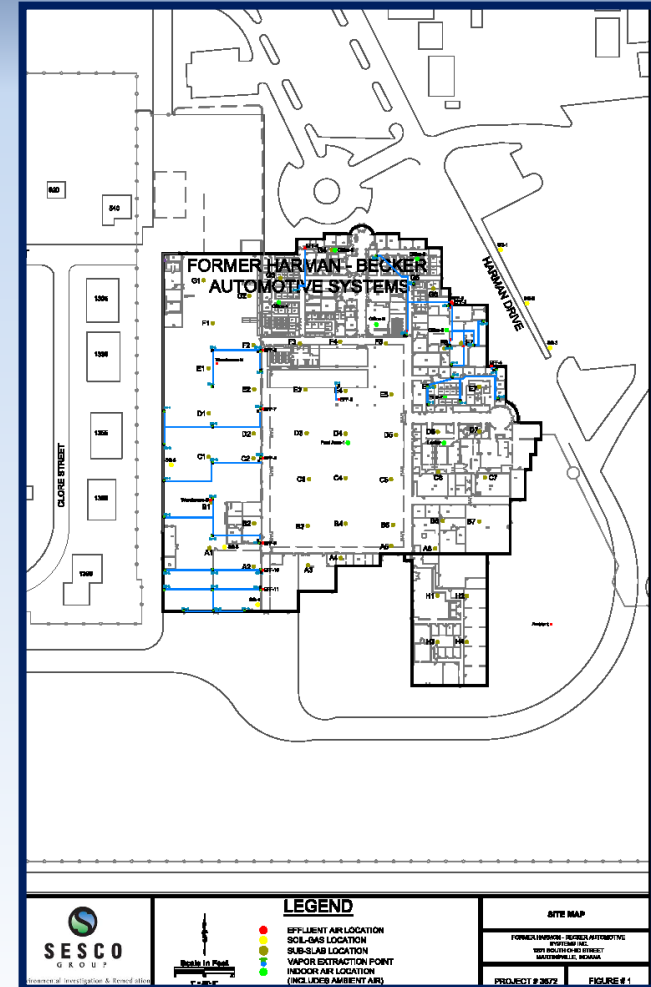
Hydrogeology

- Only the top layer at the water table directly affects vapor



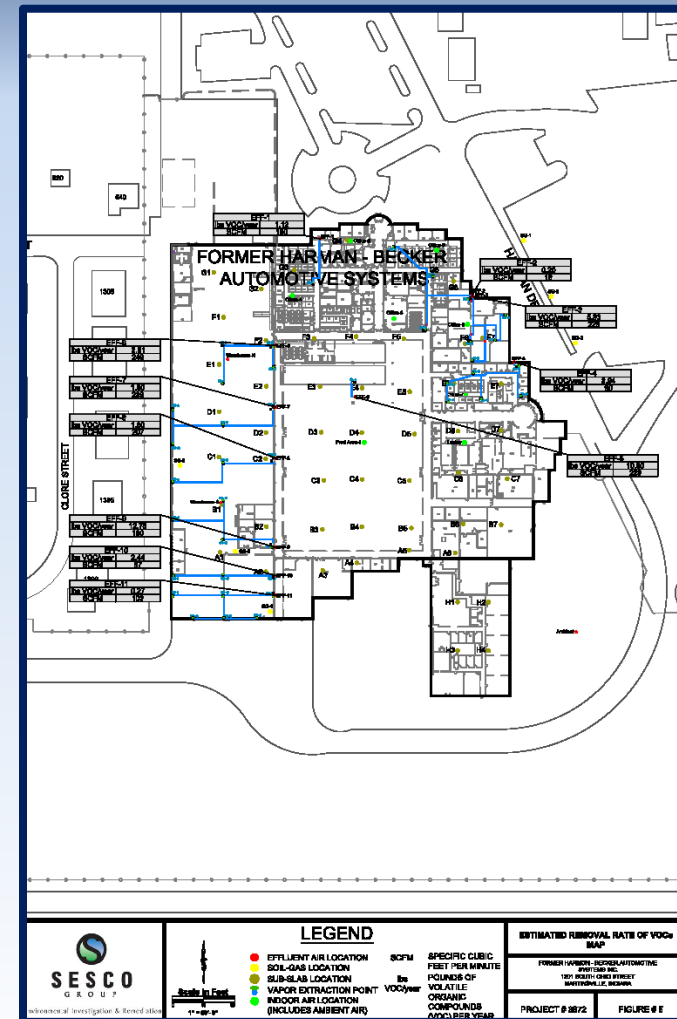
Conventional Mitigation System

- Subslab gas samples taken on grid
- Soil gas samples taken near suspected soil source
- Vapor extraction points target areas of indoor air exceedence
- Indoor air sample locations based on interior walls, HVAC system
- Conventional mitigation system needs many ports in slab and is sensitive to changes in interior wall and HVAC configuration



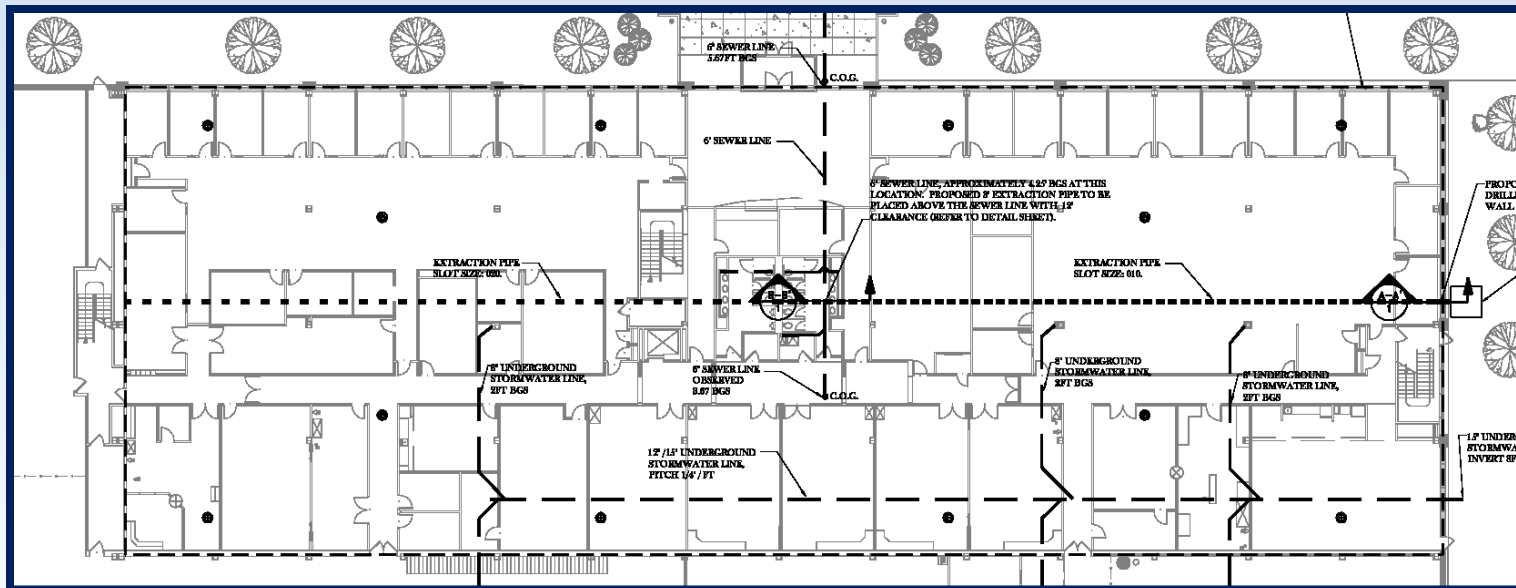
Variable Removal Rates

- Vapor extraction points show wide range of flow rates (SCFM), reflecting changing subsurface conditions
- Mass removal rate (lbs VOC/yr) reflects pore volume exchange over limited zone of influence of point sinks
- In context of tabular target zone created by sedimentary deposition or man made construction, the vertical wells are point sinks



Subslab SVE and Depressurization

- One horizontal screen influences 100 x 300 ft commercial building
- 3-inch PVC screen is installed in a blind wellbore, with no exit point
- Line sink zone of influence blankets entire footprint



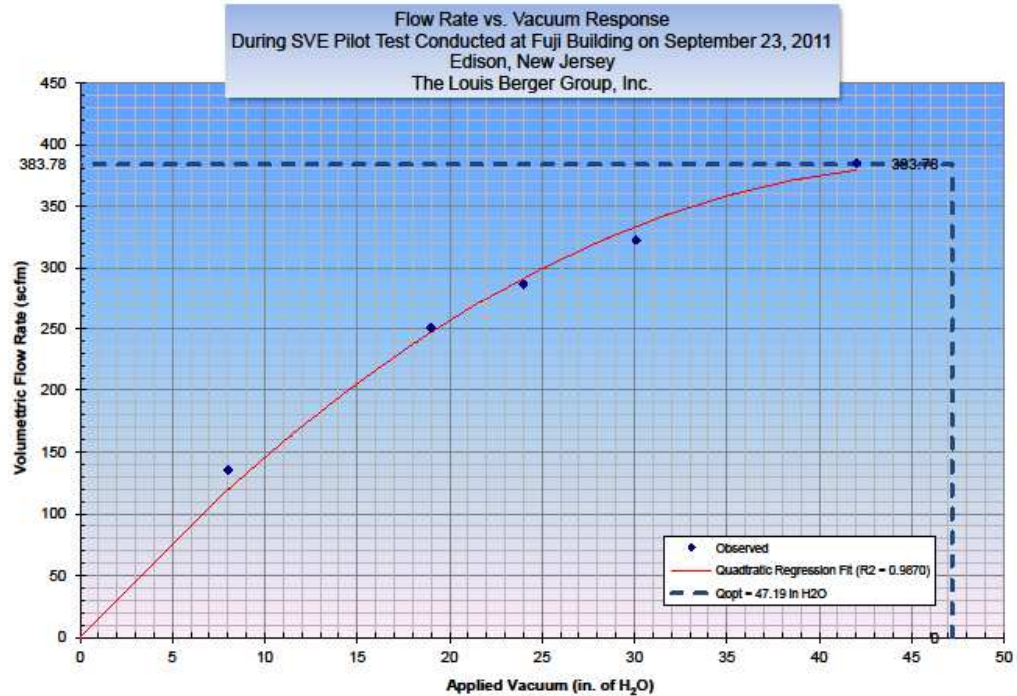
Technical Approach

- Horizontal subsurface sampling and characterization
- Pilot Test
- Horizontal Remediation Well chosen as preferred remedy
- Human health risk mitigated



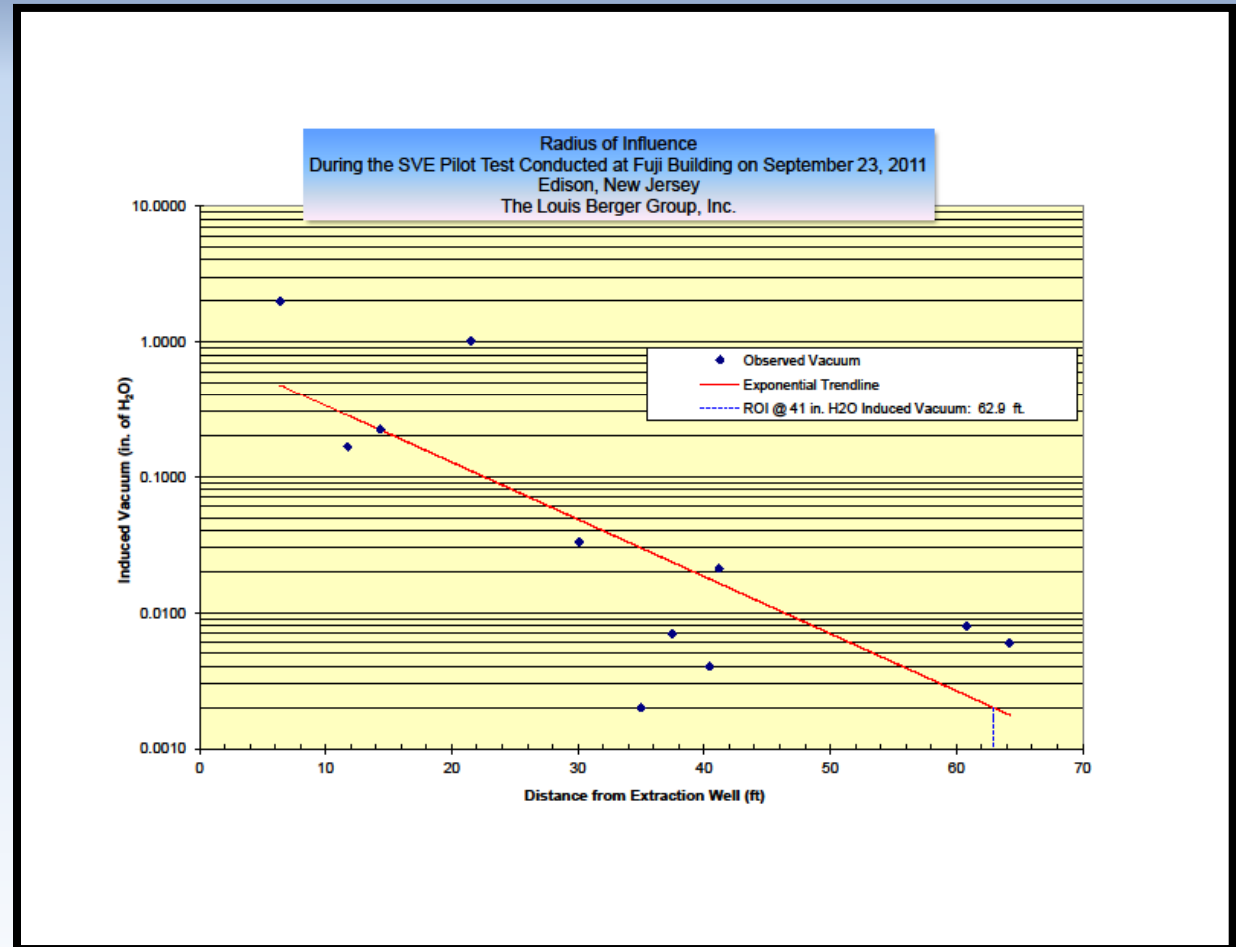
Flow Rate and Vacuum

Near-linear increase,
300 scfm at 30 inches
of water

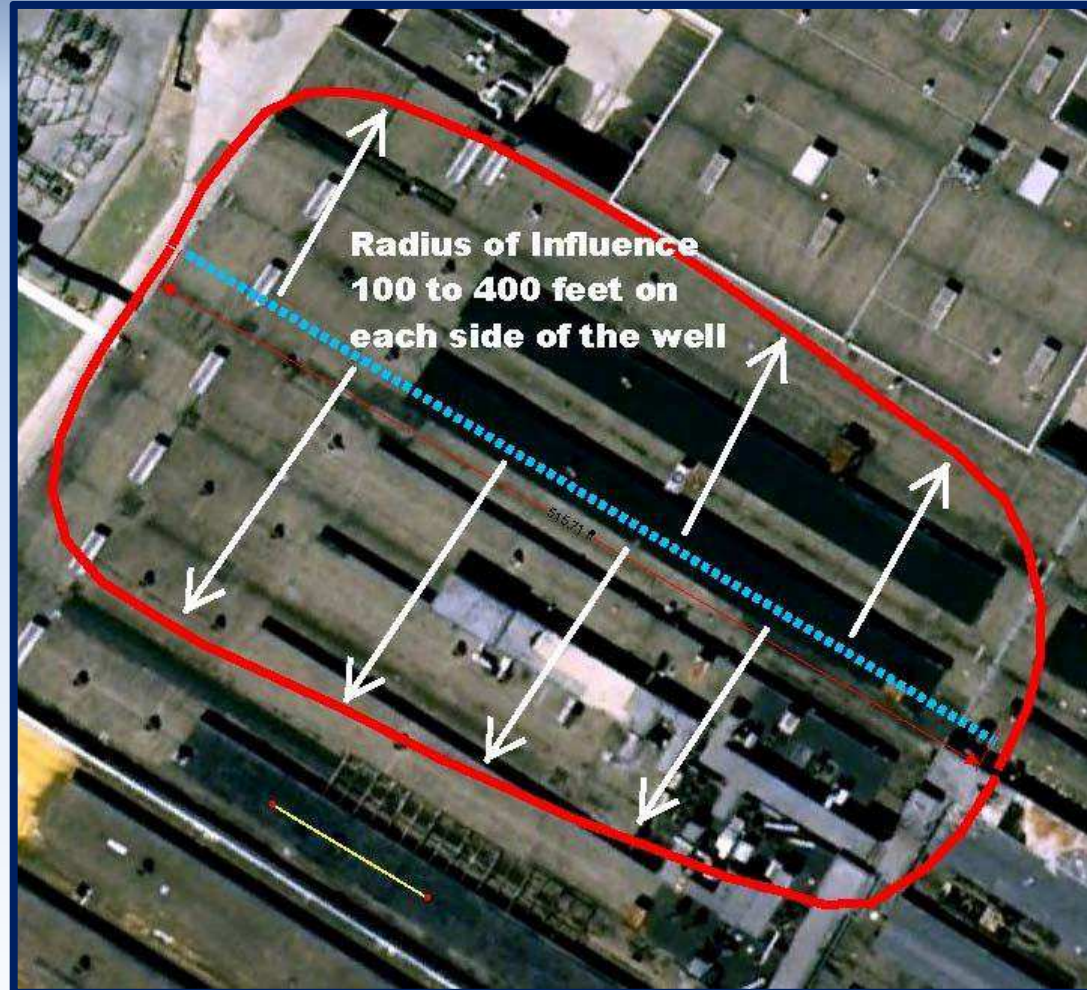


Zone of Influence

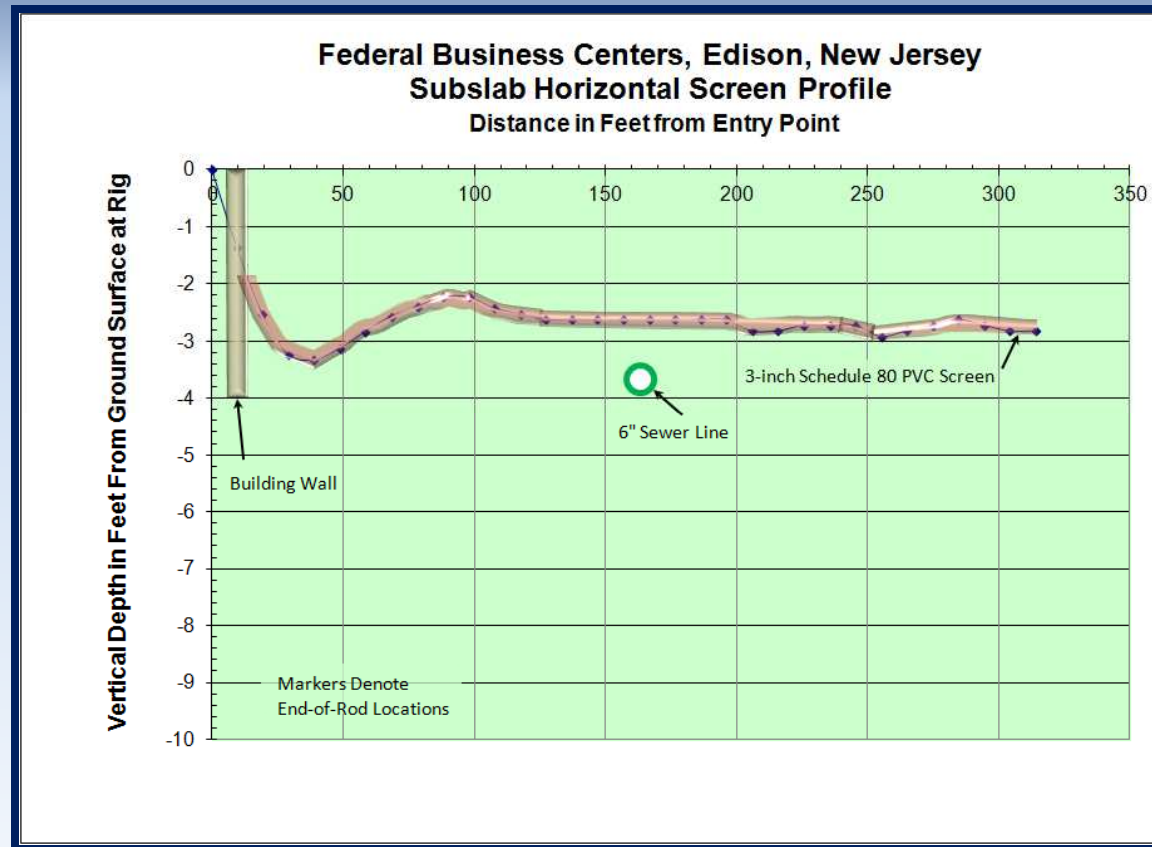
Zone of influence is 60 ft, with 40 inches of water



Zone of Influence

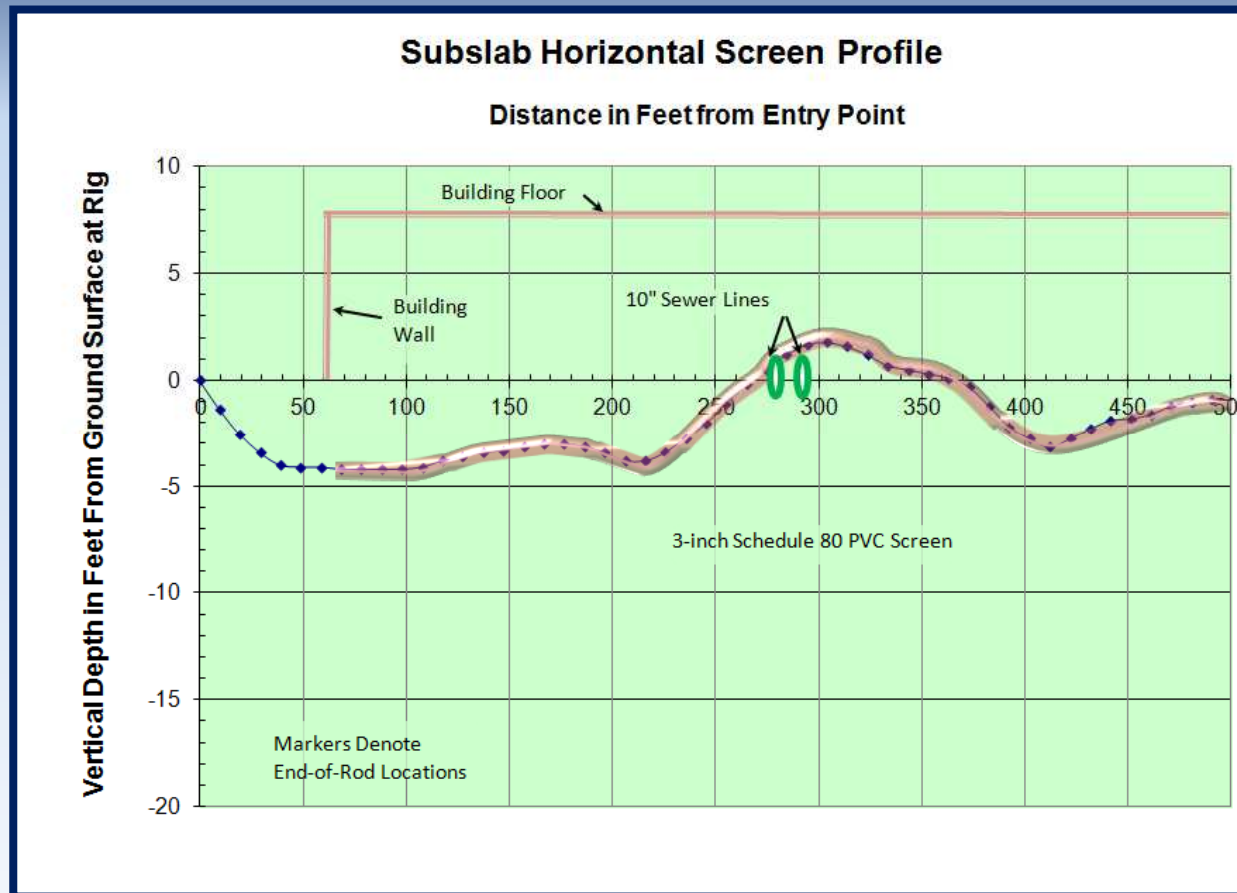


Horizontal Subslab Screen Profile



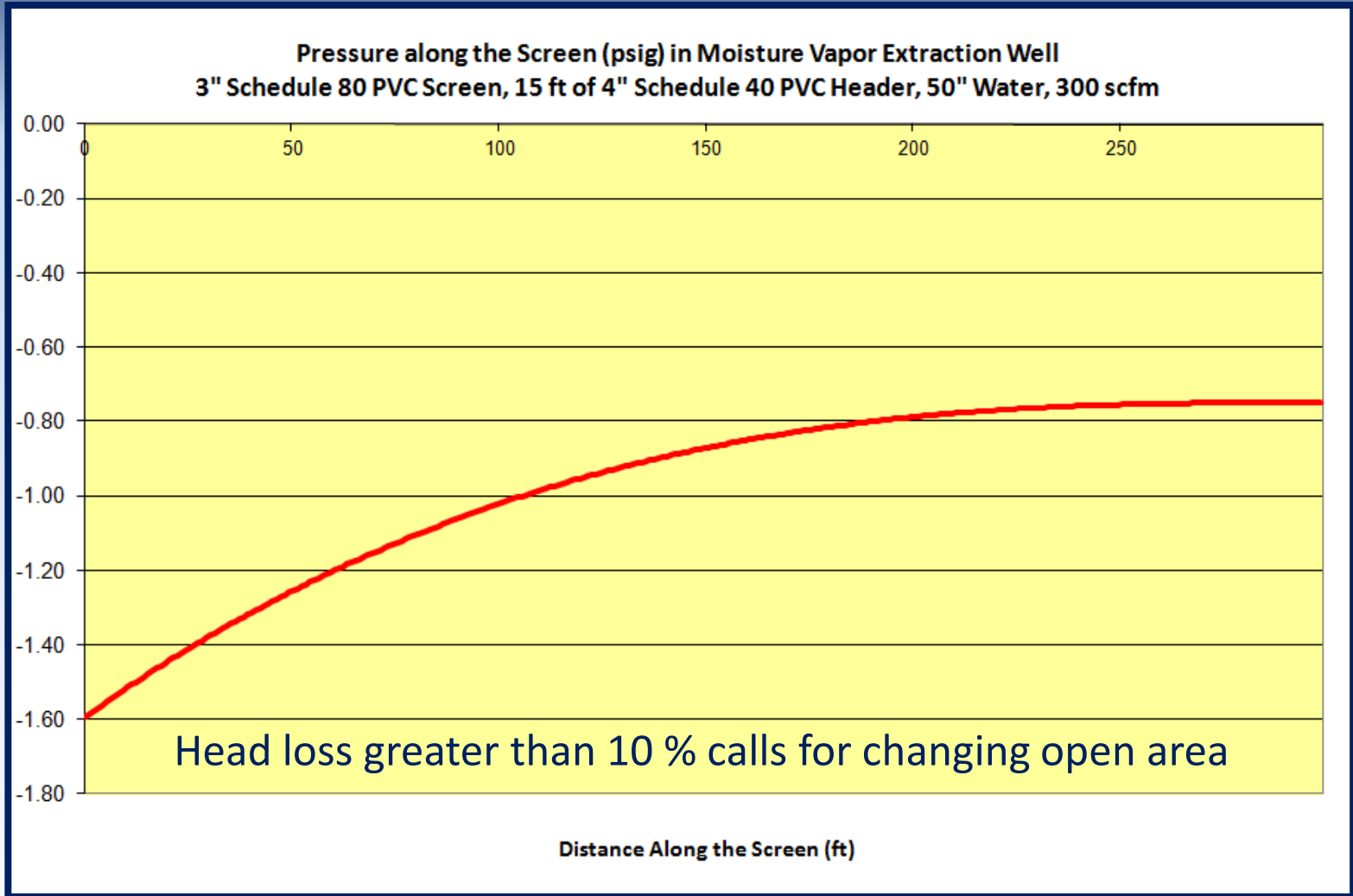
Steering capability allows well to be drilled under foundation,
then back to required depth under slab

Horizontal Subslab Screen Profile

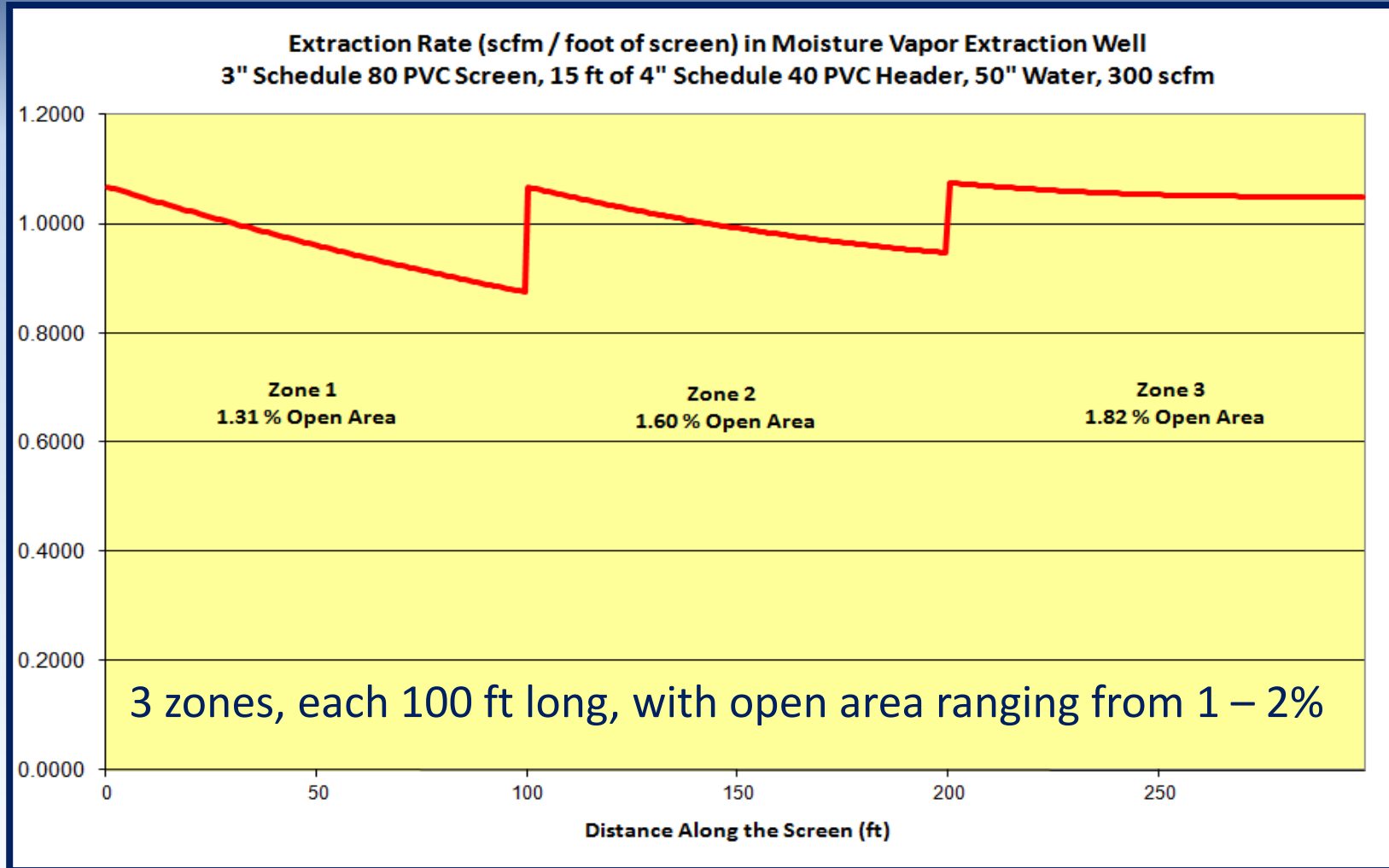


Longer screen avoids utility lines and changes elevation

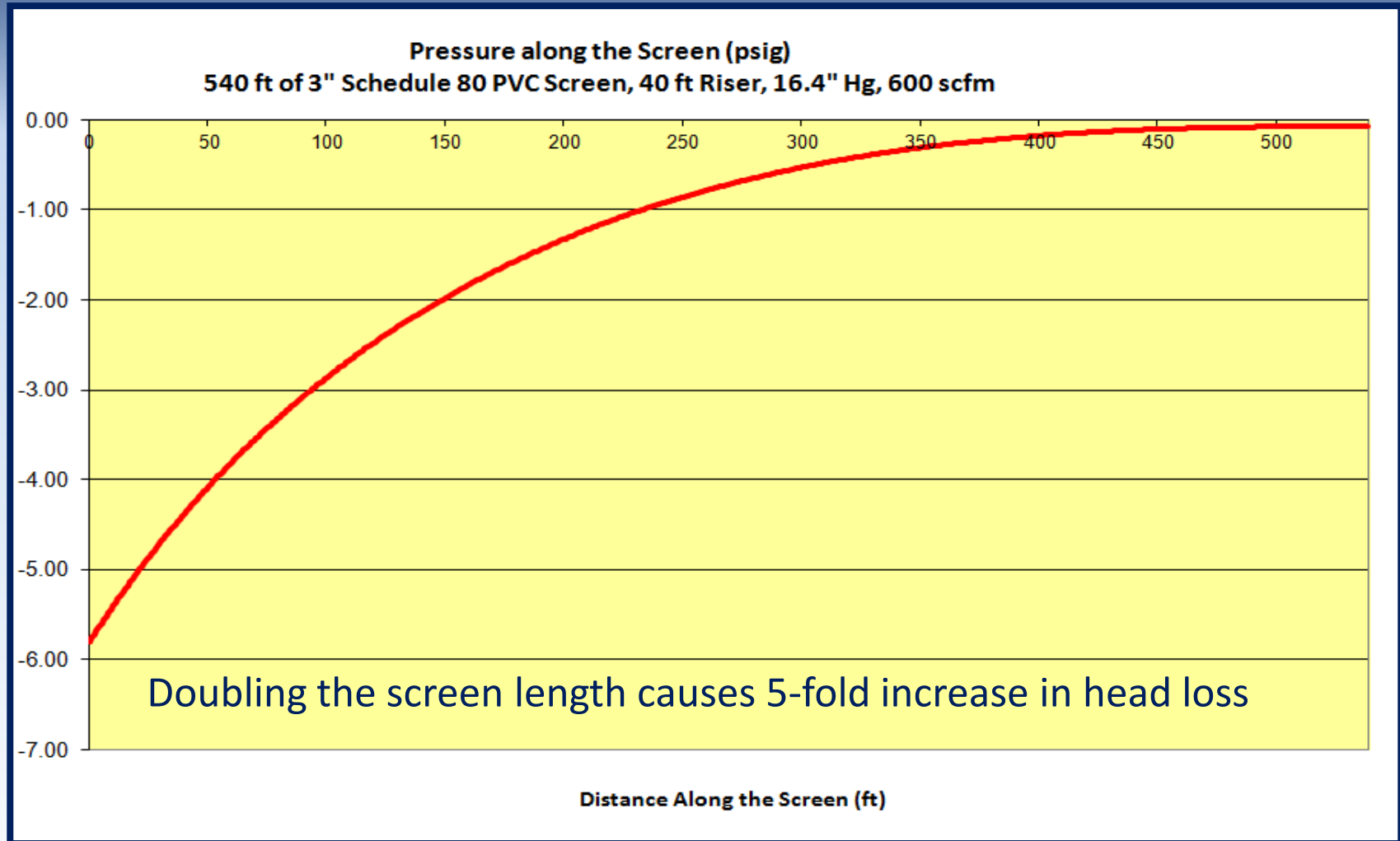
Pressure Drop



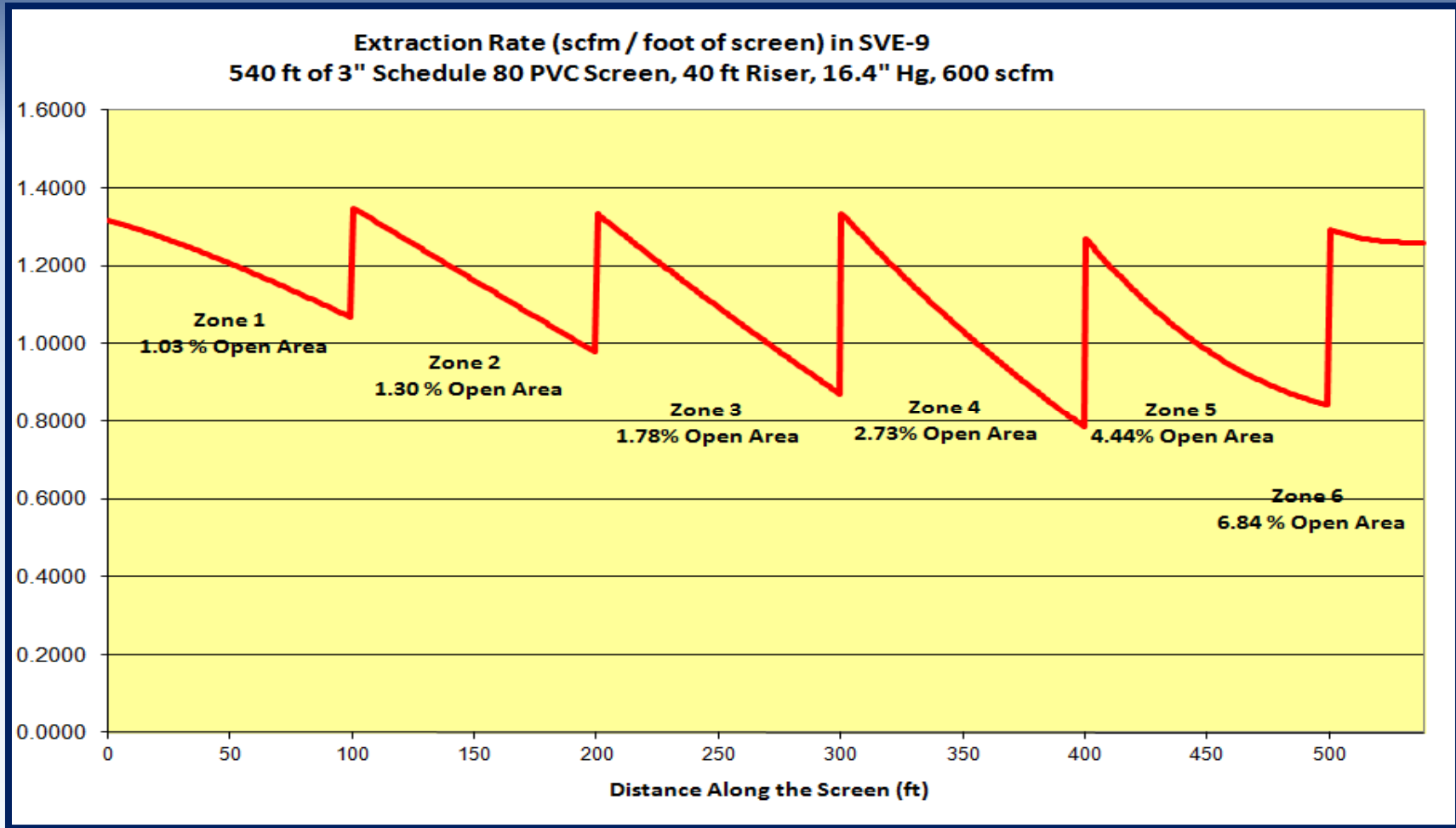
Flow Rate



Larger Pressure Drop in Longer Screen

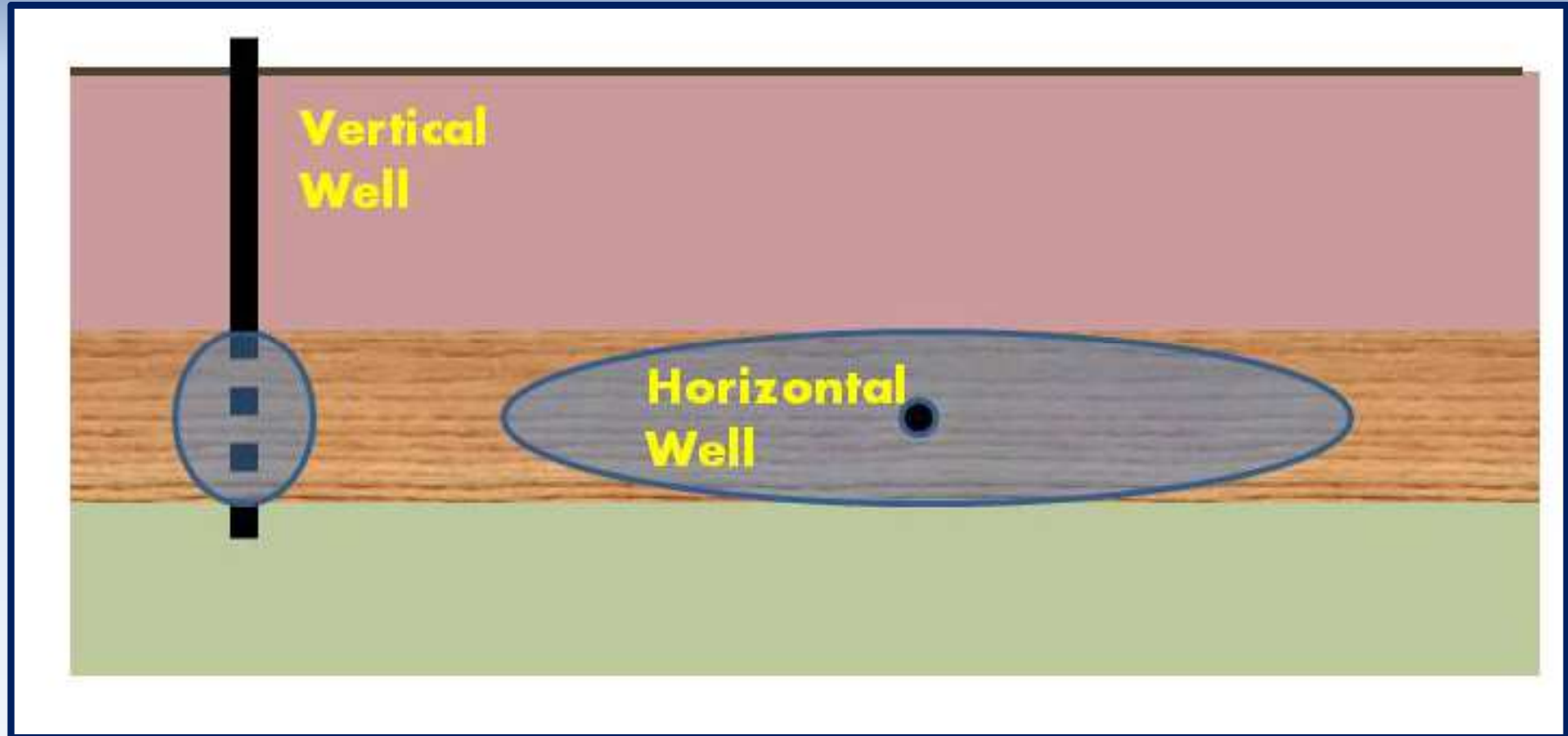


Flow Rate and Zones in Longer Well



Twice the screen length requires double the number of zones

Horizontal vs. Vertical



Horizontal vs. Vertical

Map View



Conclusions



- HRWs have substantially greater screen length and contact area than vertical wells
- Significantly greater zone-of-influence (ZOI) compared with vertical wells [i.e., HRWs = larger capture zone]
- HRWs are superior option for cost-effective vapor mitigation
- HRWS installed outside building footprint involve little to no business disruption

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Questions?

Founded in 1992, Directional Technologies, Inc. has installed over 1,000 horizontal remediation wells thru out the world.

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www.directionaltech.com | giosue@directionaltech.com