



## Sources of Ground Water Contamination and NAPL

April 10, 2012

Presenter: Jeffrey Farrell – PS&S


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## General Intent

- This section of the guidance addresses:
  - Saturated Zone contamination/sources;
  - Unsaturated Zone contamination/sources; &
  - Free Phase Non-Aqueous Phase Liquid (NAPL) or Residual NAPL when Present in either the saturated or unsaturated zones.


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## Triggers for Ground Water Investigations

- N.J.A.C. 7:26E – 4.4(a) identifies 4-triggers:
  1. GW w/contaminant above GW Remediation Standard;
  2. Soil w/in 2-feet of GW/Bedrock w/contaminant above applicable Soil Remediation Standard (SRS);
  3. Soil w/in the AOC w/contaminant above SRS and no plans to remediate or remove; and
  4. Contaminant w/water solubility > 100mg/L @ 20° -25° C
    - Soils (between contaminant(s) and saturated zone) are <15% silt and/or clay; OR
    - Any part of AOC w/in 2,000 feet of public supply well.


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### If NAPL Identified

- Reminder- N.J.A.C.7:26E 1-12(a) & (b)
  - (a) As a first priority ...
    1. Identify ... any interim remedial measures (IRM) necessary to
      - remove, contain, or stabilize a source of contamination to prevent contaminant migration and exposure to receptors; and
  - (b) ... follow the Department's LNAPL Free Product Interim Remedial Measures guidance (Regulatory/Mandatory Time Frames Apply)


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### Delineation Process and Source Identification

- Assess known Hydrogeologic Framework;
- Create/Update Conceptual Site Model;
- Delineate Contaminant Extent:
  - Soil Impacts,
  - Dissolved Constituents,
  - Address NAPL.


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### Source Identification

- Unsaturated Zone Sources
  - Soil constituents leaching into GW
  - Assess/Develop Site Specific IGW SRS
    - Default Values (very conservative!)
    - Soil Water Partition Equation
    - SPLP (with spreadsheet)
    - Seasonal Soil Compartment Model (SESOIL)
    - SESOIL/AT123D





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## Source Identification

- Saturated Zone Sources
  - Constituents leaching into GW
  - NAPL or Residual NAPL
  - Source Zone "non-NAPL" layers




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## Source Detection Methods

- Method Success Depends On:
  - Geology/Lithology;
  - Degree of Consolidation;
  - Depth to Groundwater; and
  - NAPL Composition




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## Source Detection Methods

- Soil Gas Surveys Screen For:
  - LNAPL Plumes,
  - DNAPL Release Location,
  - Dissolved constituent source areas
- Constraints for Soil Gas Surveys:
  - Low Permeability soils,
  - Saturated Soils




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**Soil Gas Constraints**

(a) unsaturated zone (b) saturated zone

Modified from: UK Environment Agency "Illustrated handbook of DNAPL transport and fate in the subsurface" (2003)  
[http://www.clu-in.org/conf/itrc/dnaplpa/dnapl\\_handbook\\_final.pdf](http://www.clu-in.org/conf/itrc/dnaplpa/dnapl_handbook_final.pdf)

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**Source Detection Methods**

- Direct Push Techniques
  - Membrane Interface Probes (MIPs - both)
  - Cone Penetrometer (both NAPL types)
    - Laser induced Fluorescence - LNAPL

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**Source Detection Methods**

- Geophysical Techniques
  - Acoustic
  - Electrical Resistance
  - Electromagnetic
- Geophysical Constraints:
  - Very Specialized/Expensive
  - Provides Indirect Evidence
  - Requires Confirmatory Techniques

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**NAPL Primer - LNAPL**

From: ITRC - Evaluating LNAPL Remedial Technologies for Achieving Project Goals (December 2009)

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**NAPL Primer - DNAPL**

From: EPA - Assessment and Delineation of DNAPL Source Zones at Hazardous Waste Sites (2009)

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**NAPL Primer - DNAPL**

From: ITRC - An Introduction to Characterizing Sites Contaminated with DNAPLs (September 2003)

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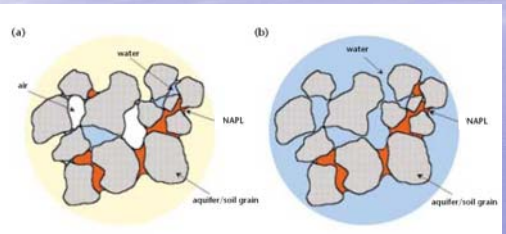
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**NAPL Source Comparison**

(a) unsaturated zone (b) saturated zone

Modified from: UK Environment Agency "Illustrated handbook of DNAPL transport and fate in the subsurface" (2003)  
[http://www.clu-in.org/conf/itrc/dnaplpa/dnapl\\_handbook\\_final.pdf](http://www.clu-in.org/conf/itrc/dnaplpa/dnapl_handbook_final.pdf)

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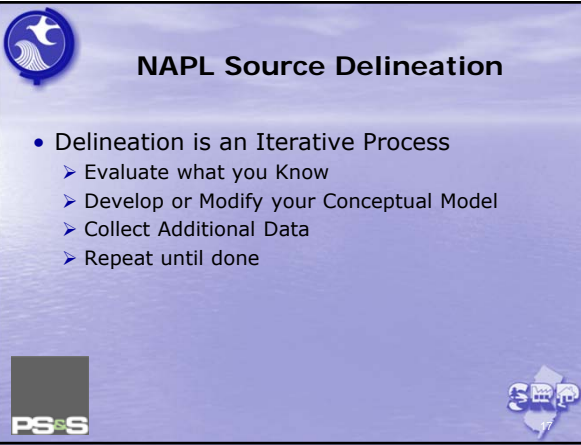
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**NAPL Source Delineation**

- Delineation is an Iterative Process
  - Evaluate what you Know
  - Develop or Modify your Conceptual Model
  - Collect Additional Data
  - Repeat until done

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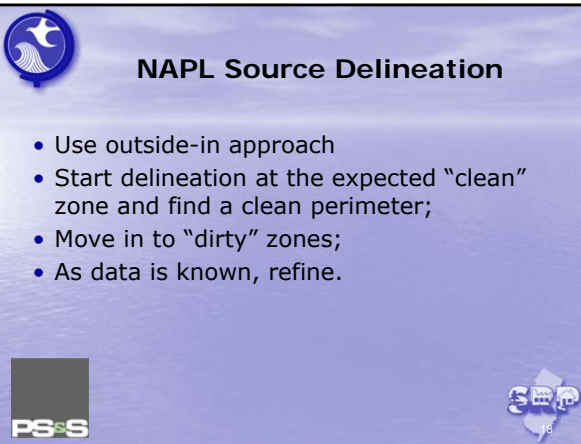
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**NAPL Source Delineation**

- Use outside-in approach
- Start delineation at the expected "clean" zone and find a clean perimeter;
- Move in to "dirty" zones;
- As data is known, refine.

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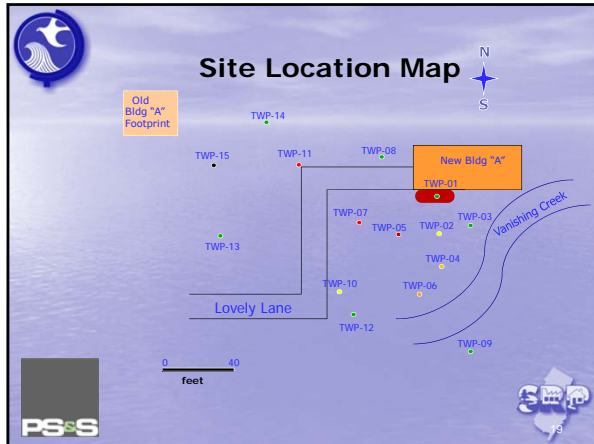
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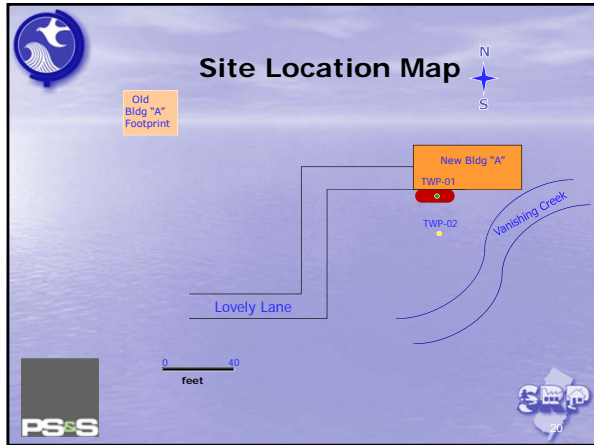
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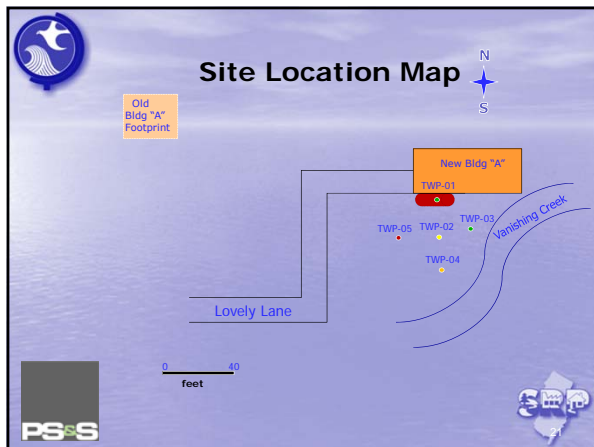
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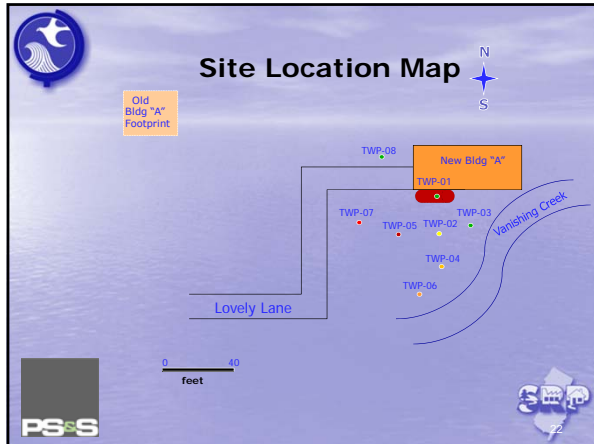
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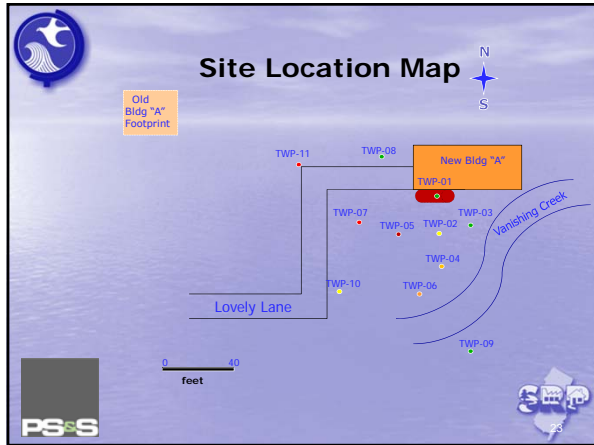
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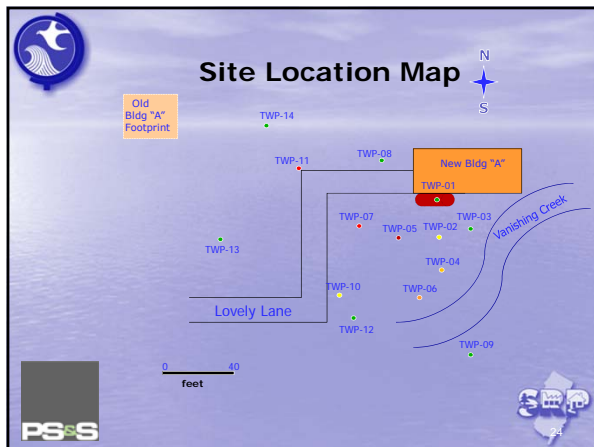
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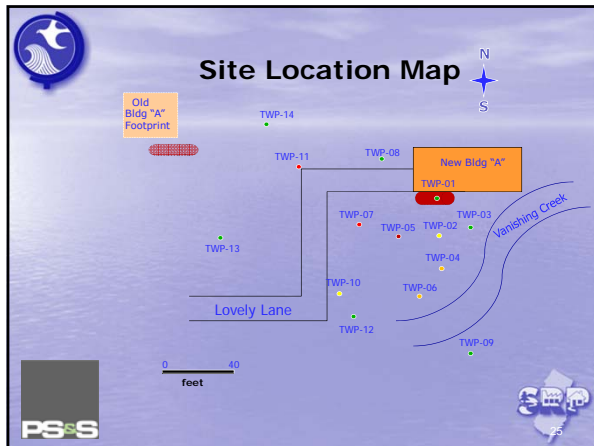


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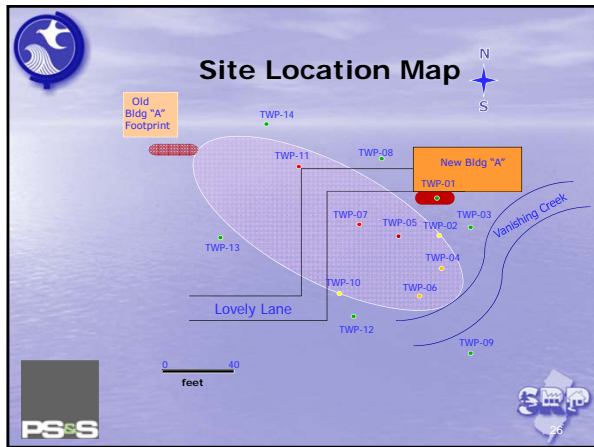
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**NAPL Detection**

So you have completed GW delineation of the dissolved phase. What questions should you ask?

- Does my data indicate that a NAPL source exists?

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## NAPL Detection

- Review Field Data (N.J.A.C. 7:26E 3.6(a); 7:26E 4.4(g))
  - Soil Screening Results during Well Installation:
    - Visual Observations;
    - FID/PID;
    - Hydrophobic Dyes;
    - Ultraviolet Fluorescence


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## NAPL Detection

- Review GW Data:
  - 1 % rule for DNAPL
  - Threshold DNAPL Saturation Calculation
  - Soil Saturation Limit (LNAPL/DNAPL)


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## 1% Solubility Rule

- Tetrachloroethylene (PCE) has an approximate pure phase solubility of 150 mg/L and an effective solubility of approximately 133 mg/L.
- 1% of the effective solubility = 1.33 mg/L or 1,330 ug/L (1,330 ppb).
- GW concentration of PCE  $\geq$  1,330 ppb infers that DNAPL may be present.


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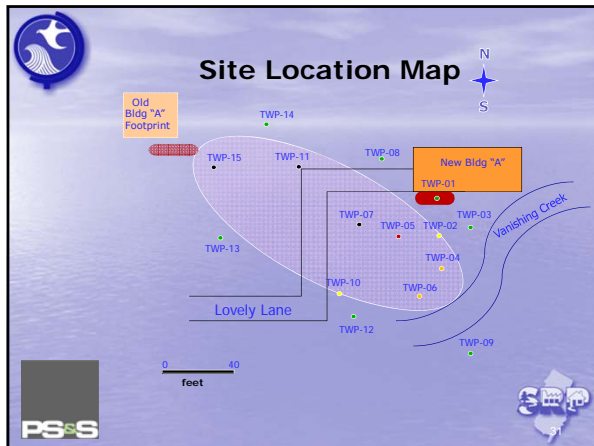
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**Conclusion**

- There are many tools available to identify source and delineate impacts
- Understanding the tools and picking the right one will save time/\$\$
- References, including the Guidance Documents, are resources to help you - use them!

Logos for 'PS&S' and a group of people are visible in the bottom corners.

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