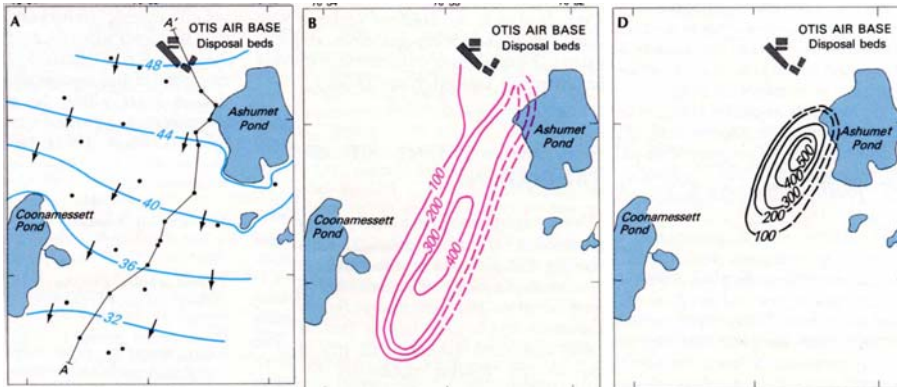


Ground Water Transport Processes



**Ground Water
Flow Direction**

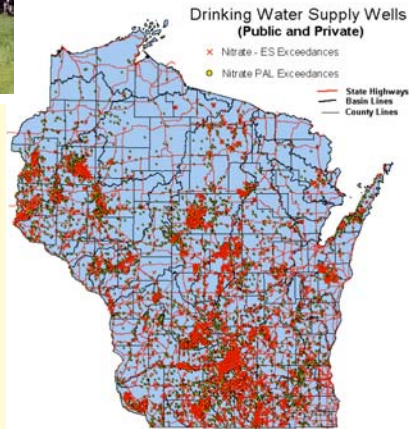
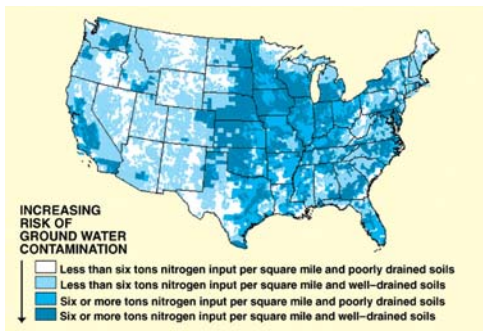
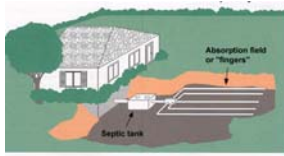
**Plume Migration in
Flow Direction**

**Retardation of
Contaminants that
Sorb to Aquifer
Solids**



Ground Water Pollutants

Non-point Human, Animal and Agricultural Sources of Nitrate



Ground Water Pollutants

Agricultural Chemicals

A national ranking of **HERBICIDES** in ground water

Herbicide detection frequency—Each circle represents a ground-water study

- Highest 25 percent
- Middle 50 percent
- Lowest 25 percent

Drinking-water standards or guidelines

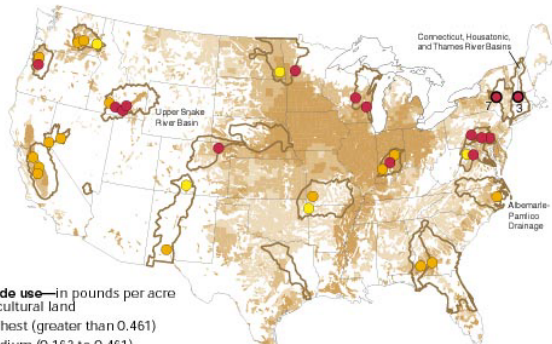
○² Bold outline indicates exceedance by one or more herbicides. Number is percentage of wells that exceeded a standard or guideline

Shallow ground water in agricultural areas

The highest detection frequencies occurred where use is moderate to high and where soil and geologic conditions promote rapid infiltration.

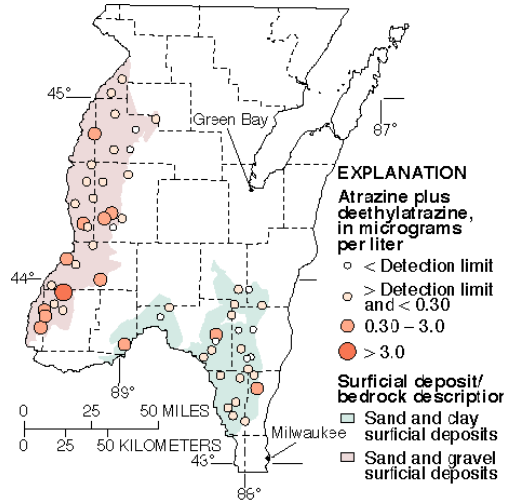
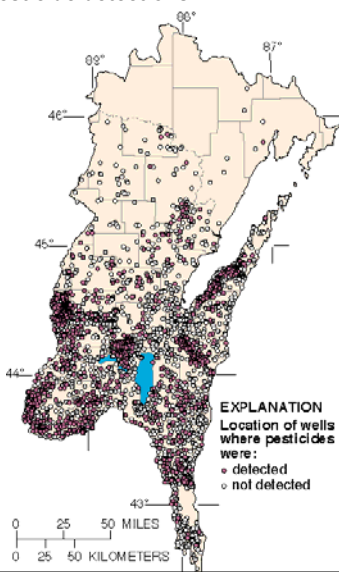
Herbicide use—in pounds per acre of agricultural land

- Highest (greater than 0.461)
- Medium (0.162 to 0.461)
- Lowest (less than 0.162)
- No reported use



Ground Water Pollutants Agricultural Chemicals

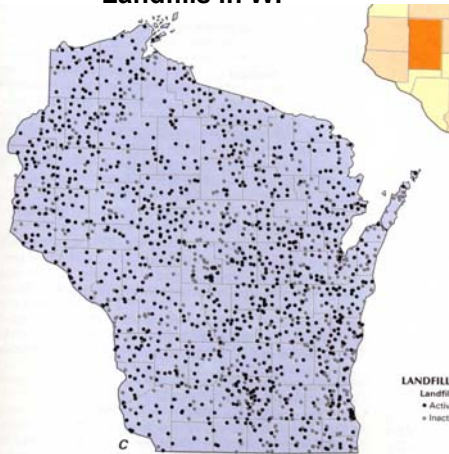
Pesticide detections



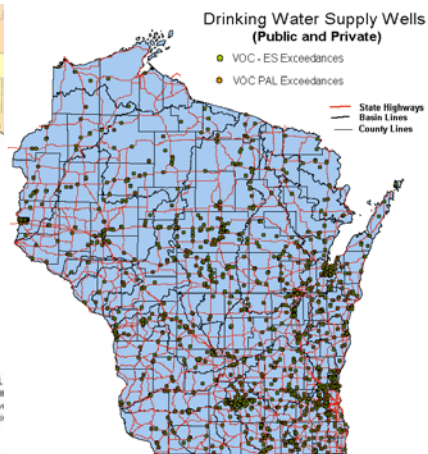
Atrazine in WI groundwater

Ground Water Pollutants Landfill Leachate

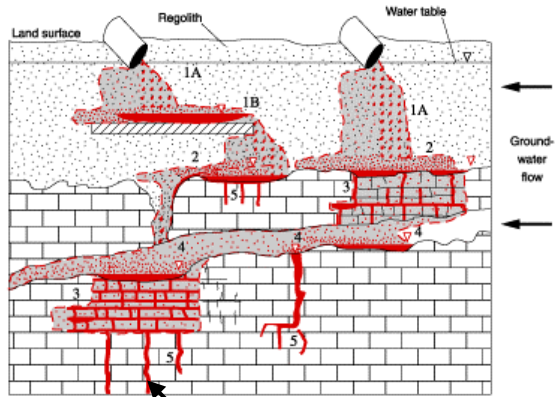
Active and Closed Landfills in WI



Volatile Organic Contaminants

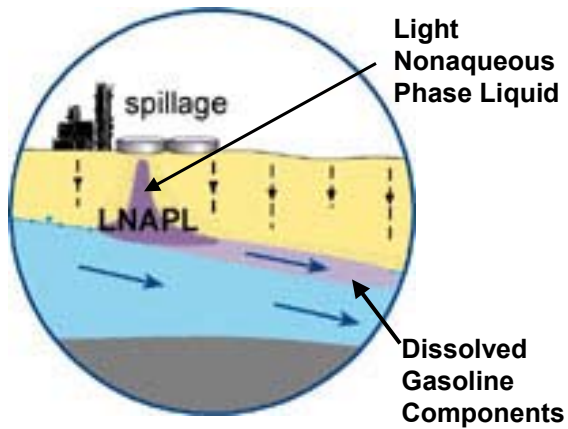


Ground Water Pollution Industrial Point Sources



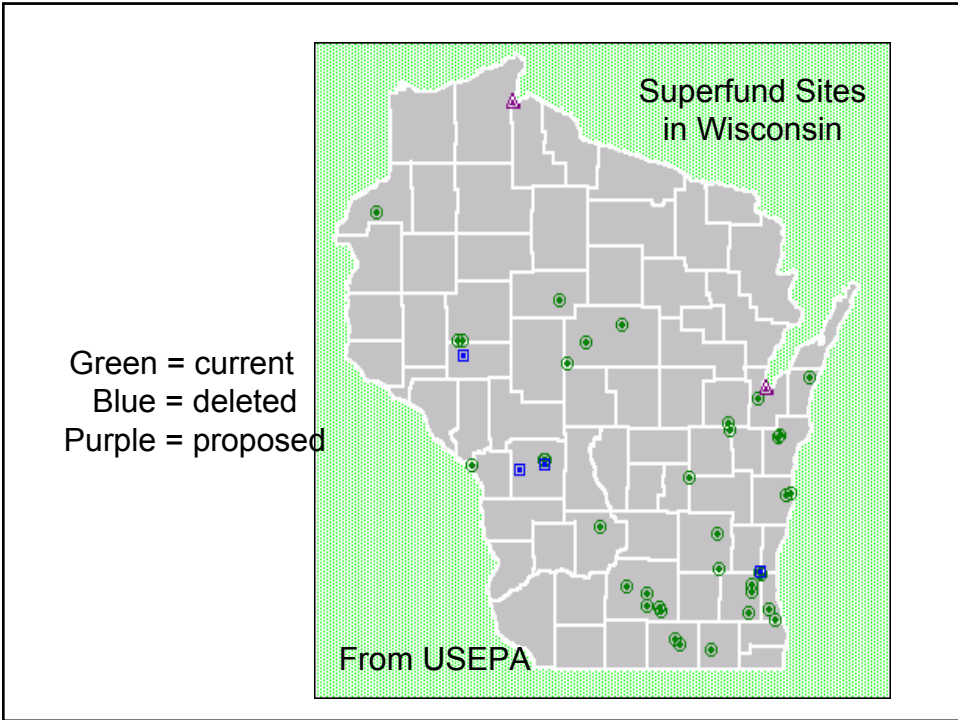
Dense Nonaqueous Phase Liquid
DNAPL

Ground Water Pollutants Fuel Spills and Leaks



Light
Nonaqueous
Phase Liquid

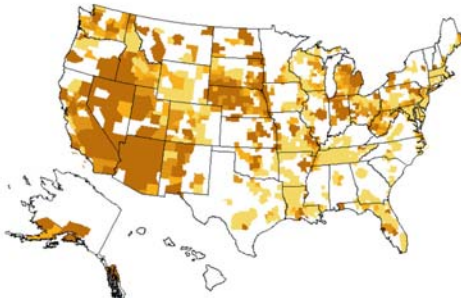
Dissolved
Gasoline
Components



Ground Water Pollutants Naturally occurring contaminants

Arsenic

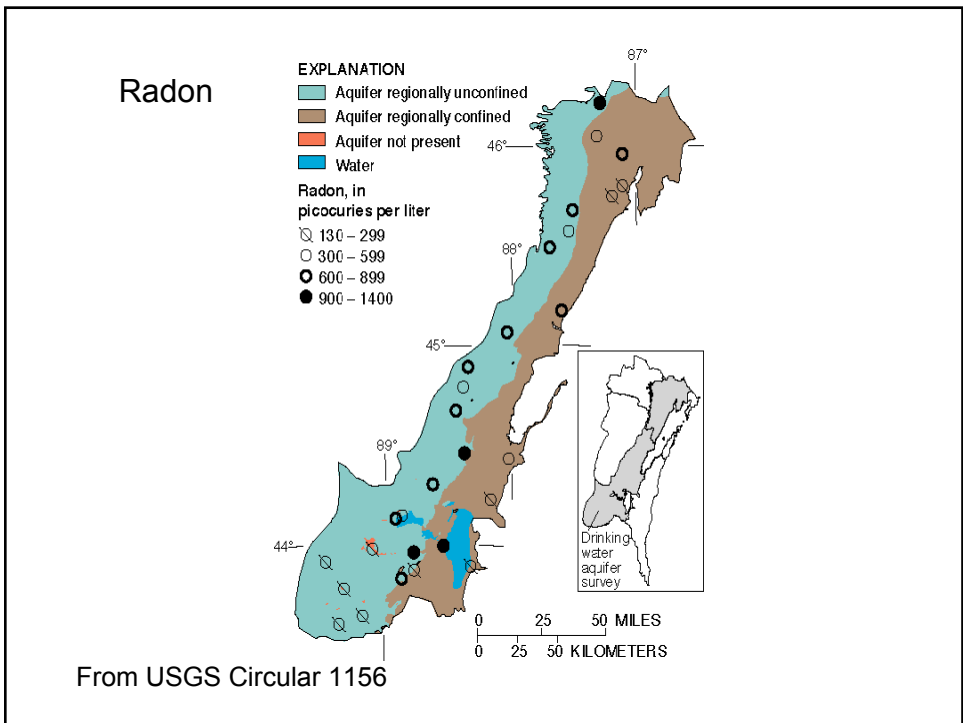
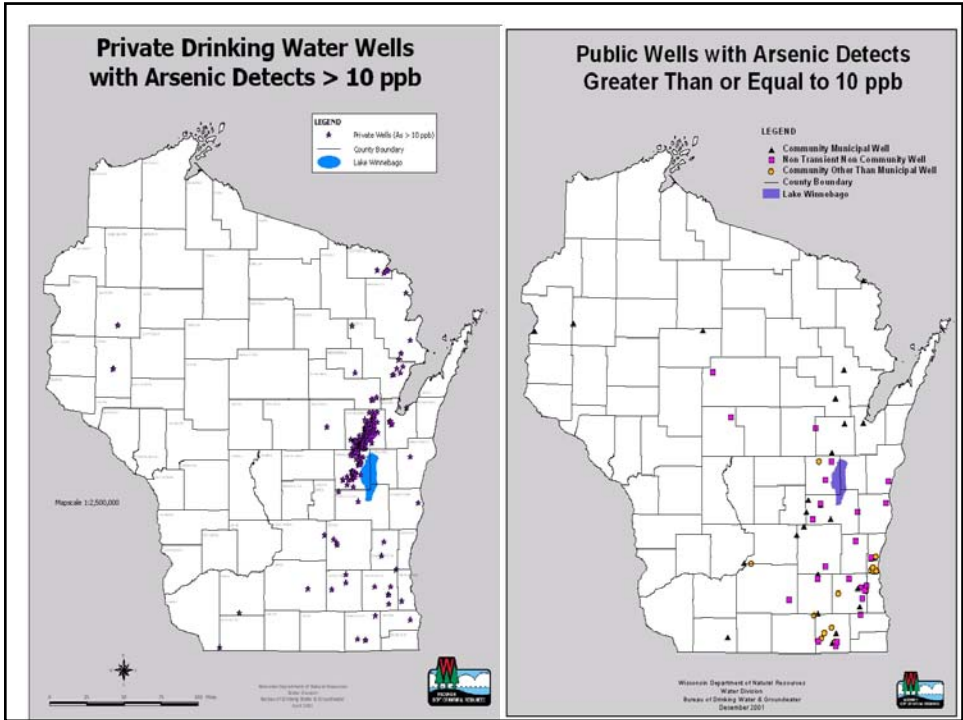
- Counties with arsenic concentrations exceeding 10 µg/L in 10% or more of samples.
- Counties with arsenic concentrations exceeding 5 µg/L in 10% or more of samples.
- Counties with arsenic concentrations exceeding 3 µg/L in 10% or more of samples.
- Counties with fewer than 10% of samples exceeding 3 µg/L, representing areas of lowest concentration.
- Counties with insufficient data in the USGS database to make estimates.



Radionuclides

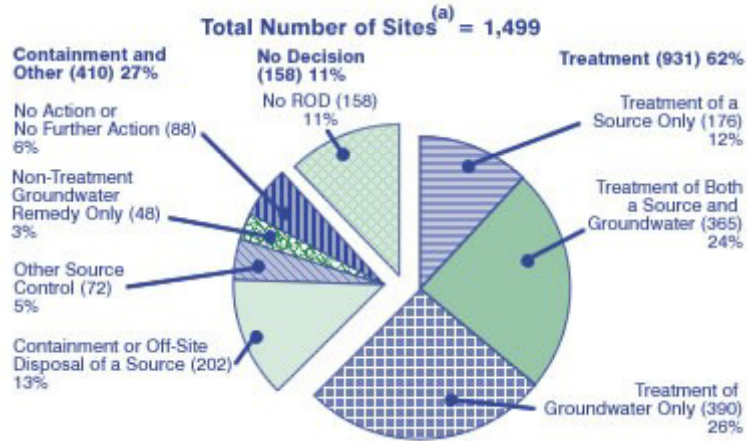


- EXPLANATION**
- Dominant radionuclide—
 Generalized area (boundaries are approximate) where naturally occurring radionuclide exceeds indicated concentration
- Radon—10,000 pCi/L (equivalent to about 1 pCi/L in air)
 - Radium—5 pCi/L
 - Uranium—10 pCi/L

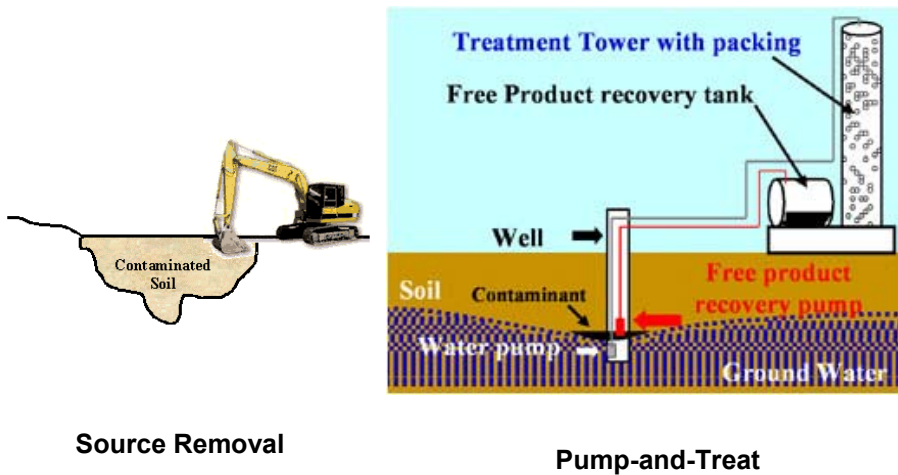


Ground Water Remediation Superfund Remedial Actions

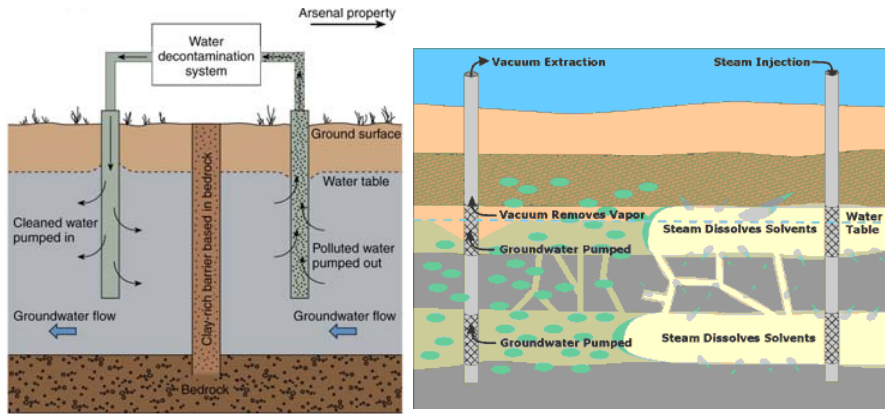
Figure 1: Superfund Remedial Actions: Actual Remedy Types at Sites on the National Priorities List (NPL) (FY 1982 - 2002)*



Ground Water Remediation Common Strategies



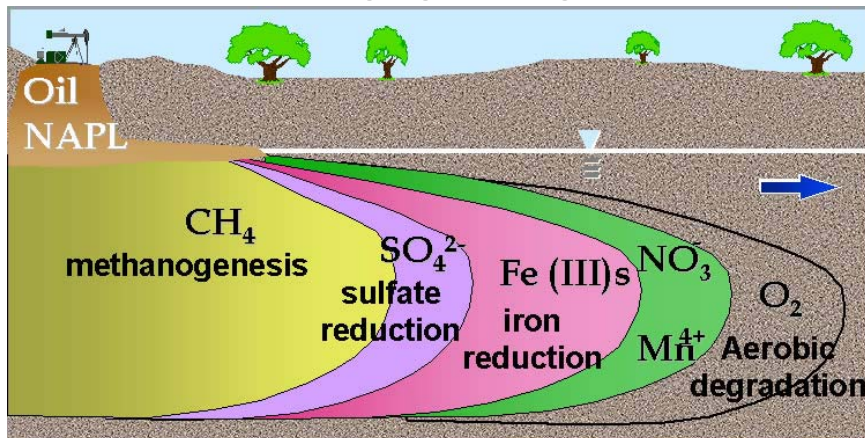
Ground Water Remediation Advanced Strategies



Pump-and-Treat with Barrier

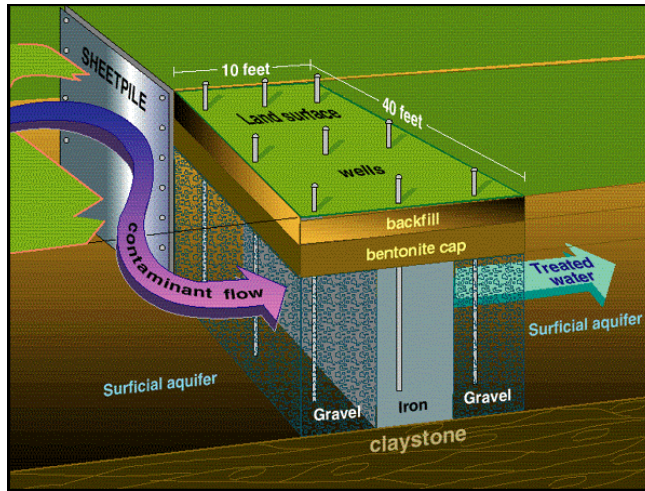
Steam Injection, Vacuum Extraction

Ground Water Remediation Emerging Strategies



Natural Attenuation by Biodegradation

Ground Water Remediation Emerging Strategies



Permeable Reactive Barriers