Remediation of Chlorinated-solvent Contaminated Groundwater

Motorola 52nd St. Superfund Site

Community Information Group Meeting

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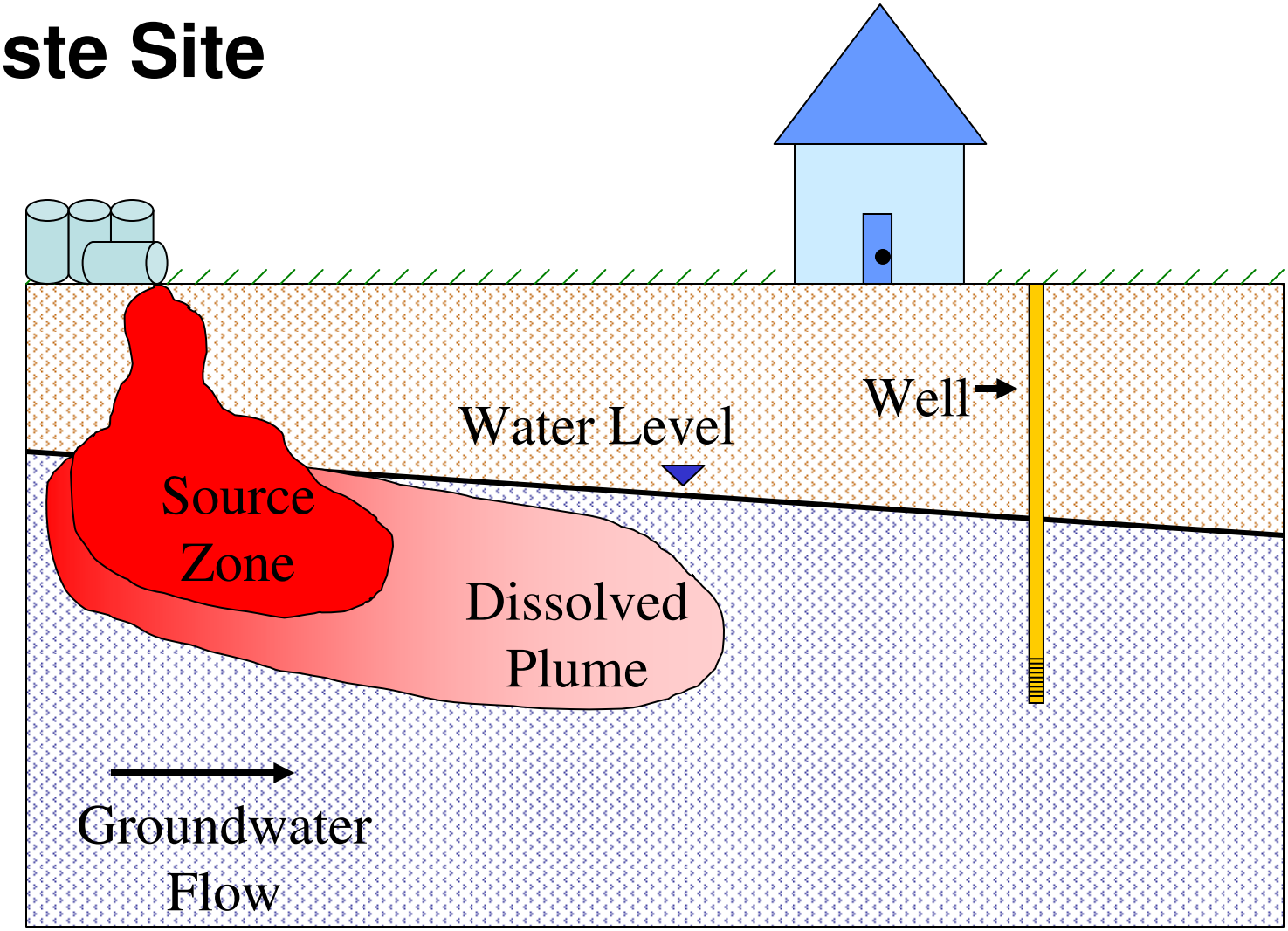
Subsurface Contamination at a Hazardous Waste Site

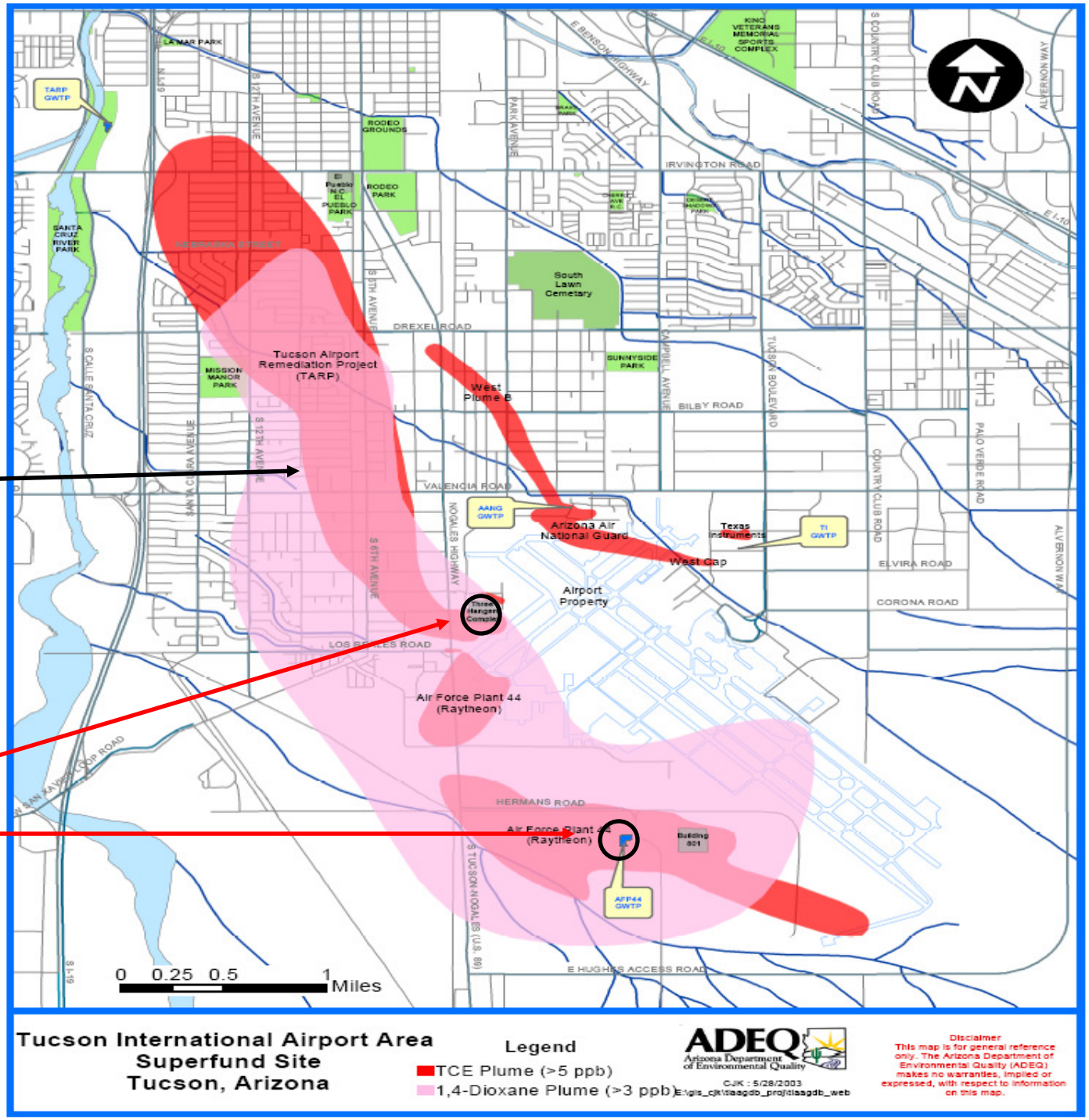


S-Z Scale = 10's – 100's meters

Plume Scale = 100's - 1000's meters

Plume

Source Zones

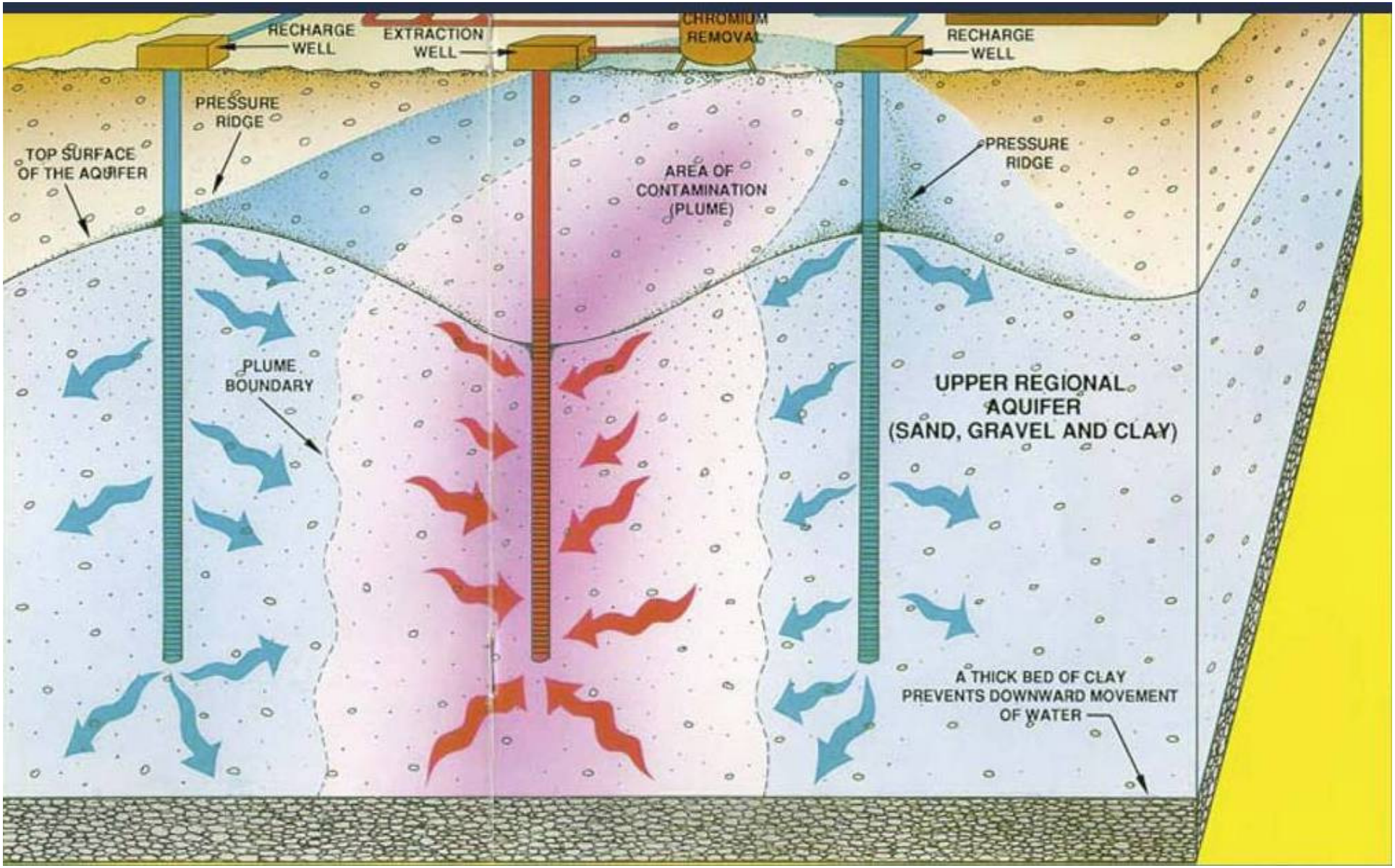


Remediation Technologies

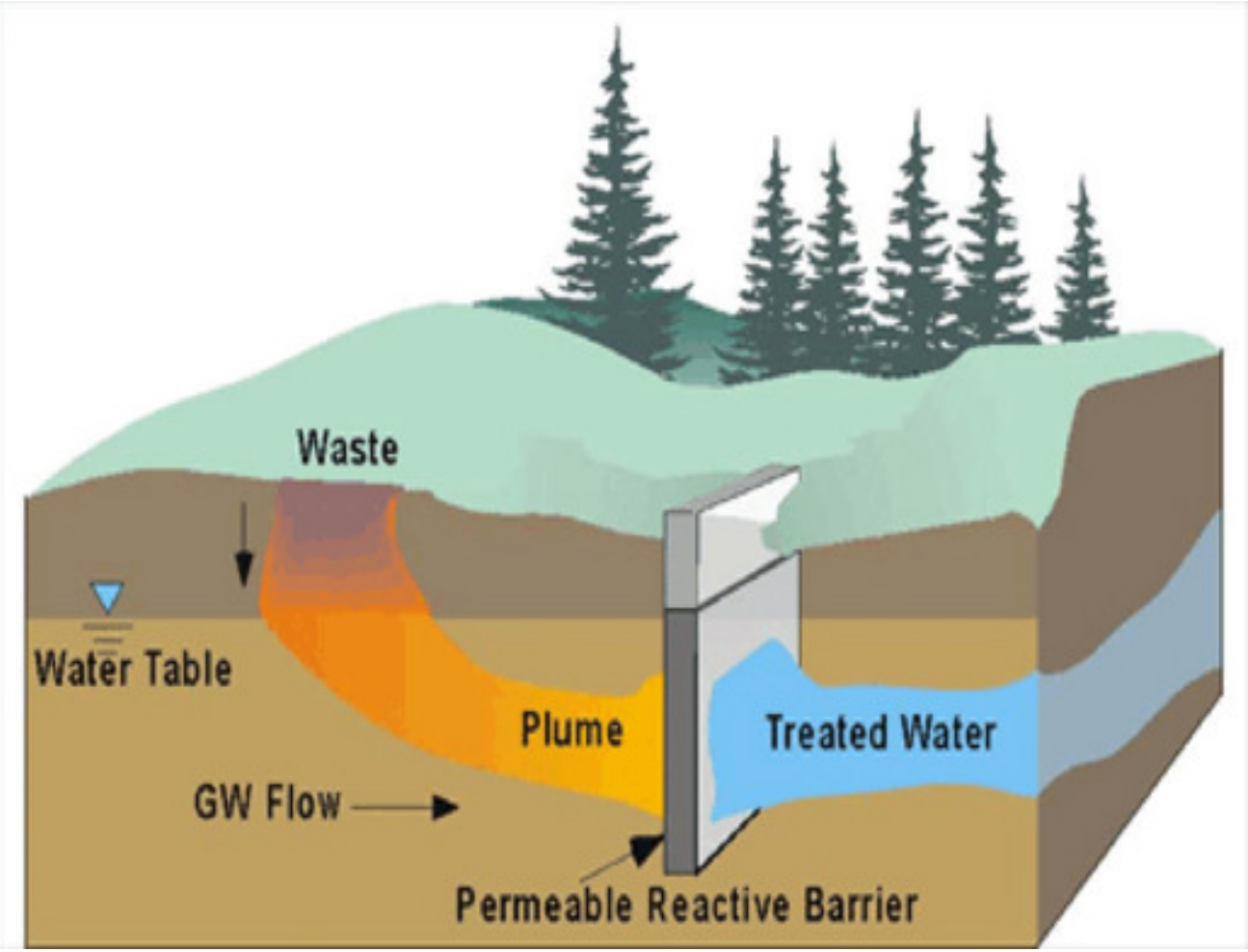
Potentially Applicable for Chlorinated-solvent Contamination in Fractured Systems

- Groundwater Plume
  - Pump and Treat
  - Permeable Reactive Barriers
- Source Zone
  - Hydraulic Containment (local pump and treat)
  - In-situ Chemical Oxidation
  - Colloidal Zero-valent Iron
  - Enhanced Bioremediation
  - Thermal- Direct Heating

Pump and Treat



Permeable Reactive Barriers

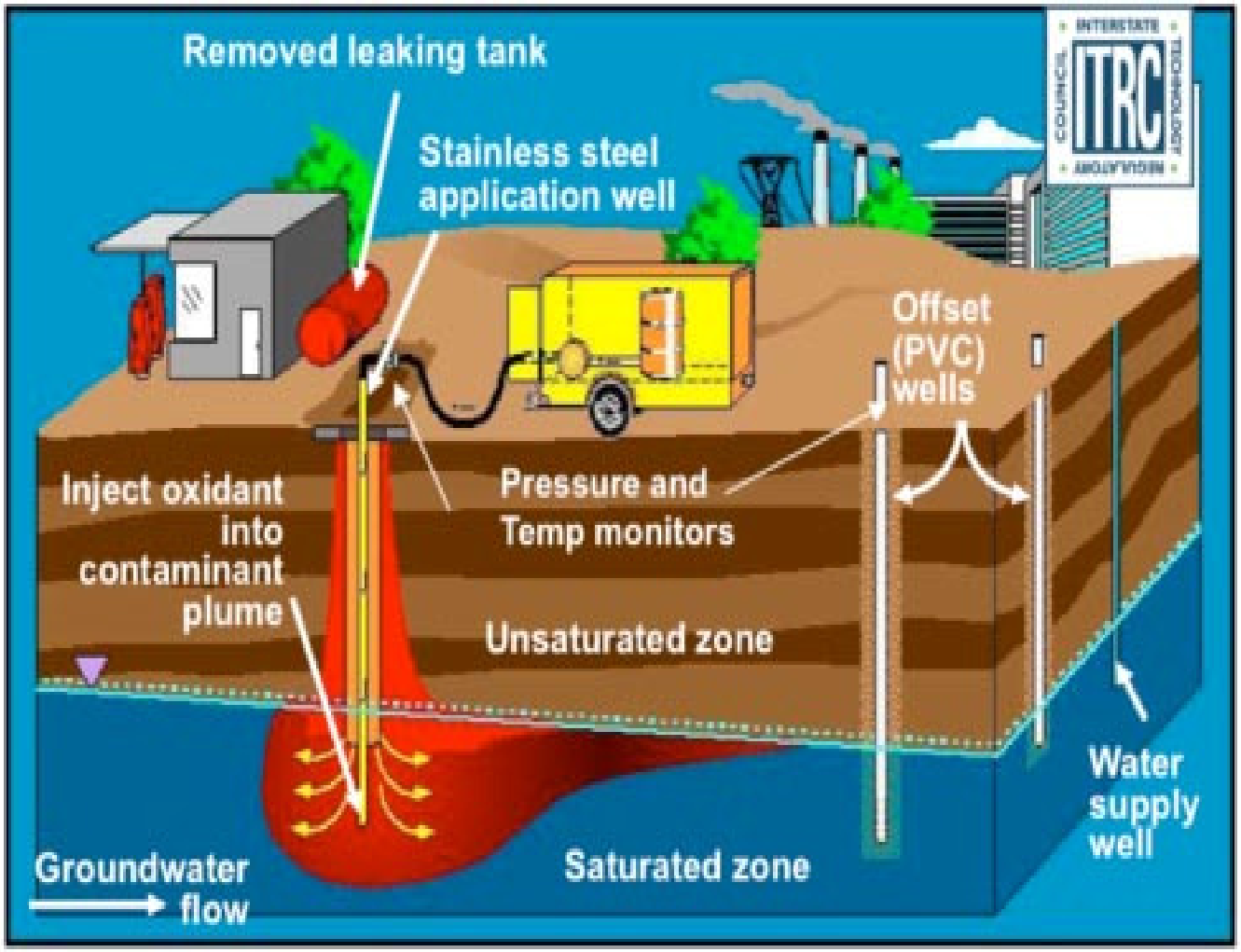


Reactive Barrier Types

for chlorinated solvents

- **Abiotic transformation barriers** facilitate reactions that break down contaminants in the plume
  - Iron filings
- **Biotransformation barriers** promote biodegradation of contaminants
  - Compost, wood chips, molasses, nutrients
- **Mass-transfer barriers** adsorb or volatilize contaminants
  - Activated carbon
  - Aeration curtain
- Requires special methods for deeper systems
  - Boreholes rather than trench

In-situ Chemical Oxidation

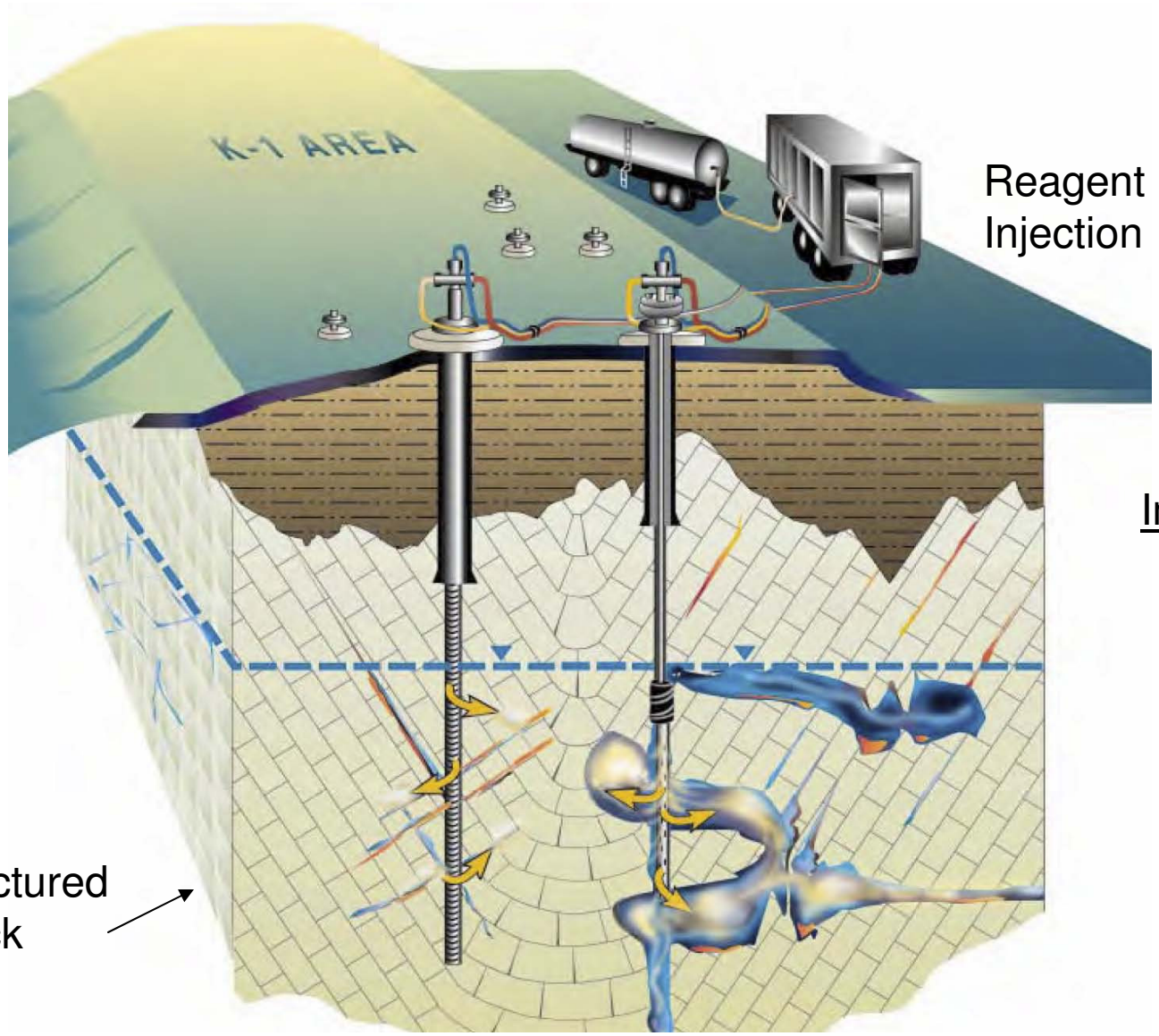


<u>Common oxidants</u>:

- permanganate (MnO_4^-)
- hydrogen peroxide (H_2O_2)
- persulfate ($S_2O_8^{2-}$)
- ozone (O_3)

Some are enhanced through activation (Fenton's reagent, activated persulfate)

Preferential Flow and Diffusion

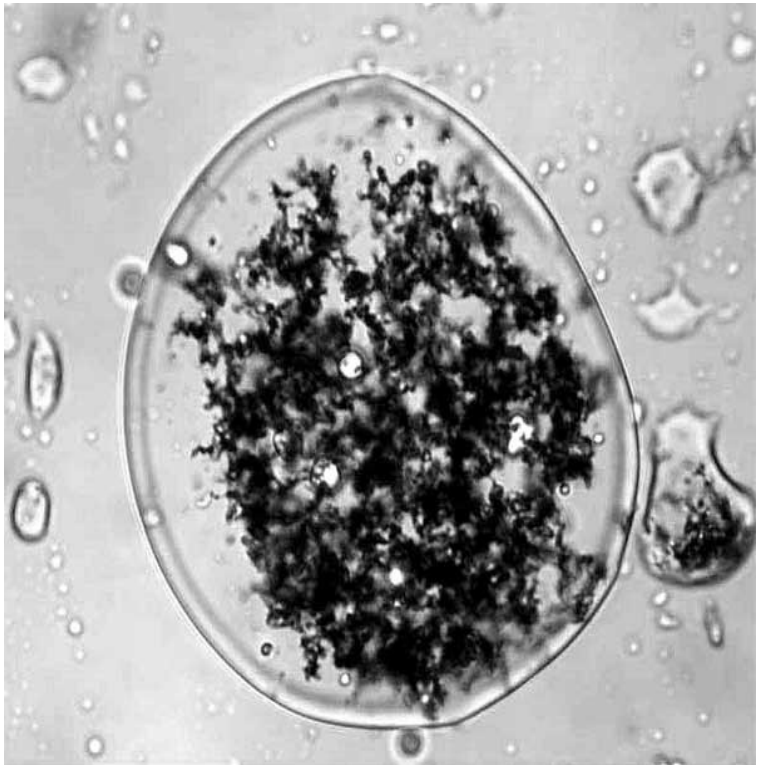


Important factors:

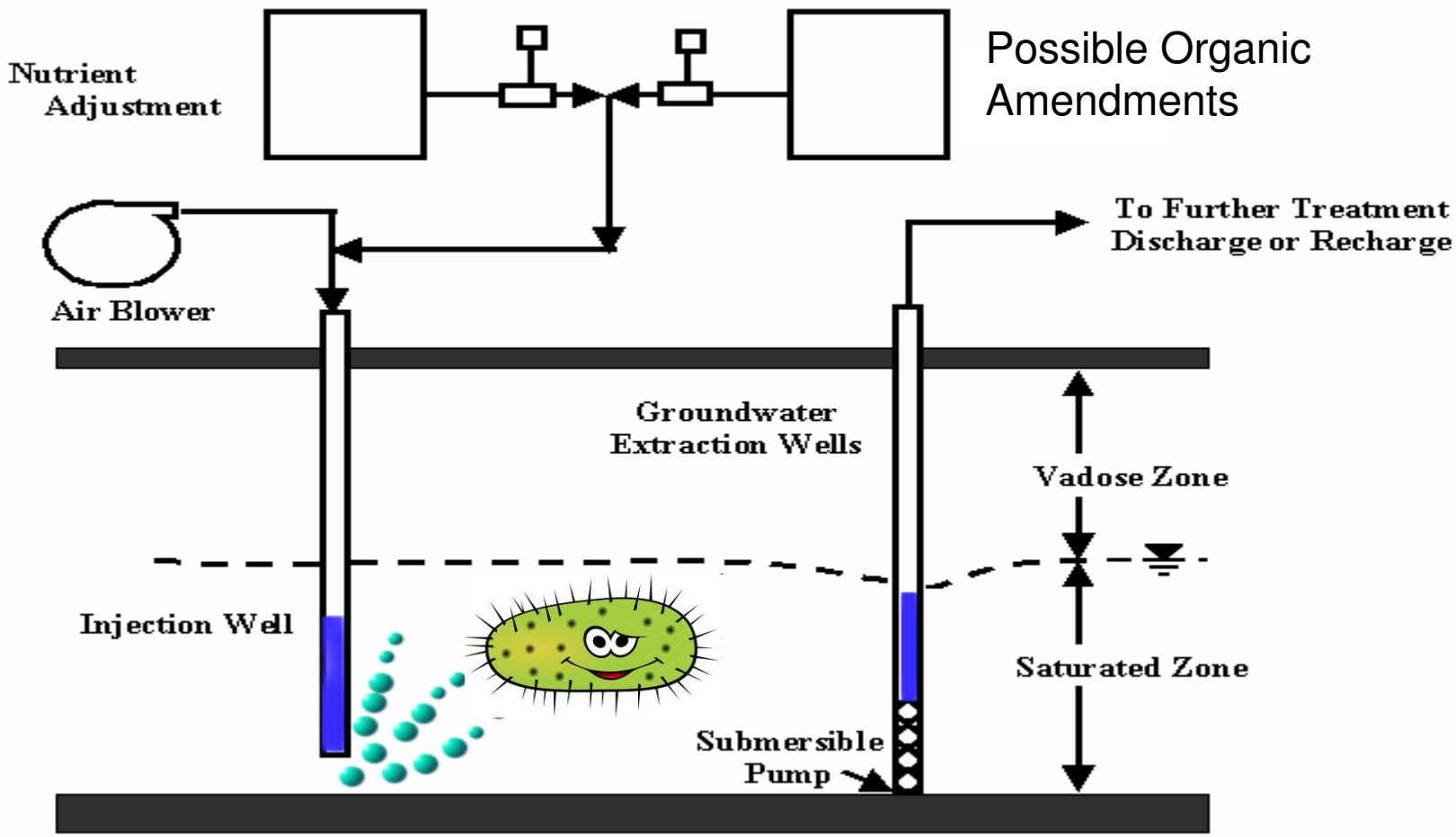
- Contact with contaminant
- Persistence of oxidant

Colloidal Zero-valent Iron

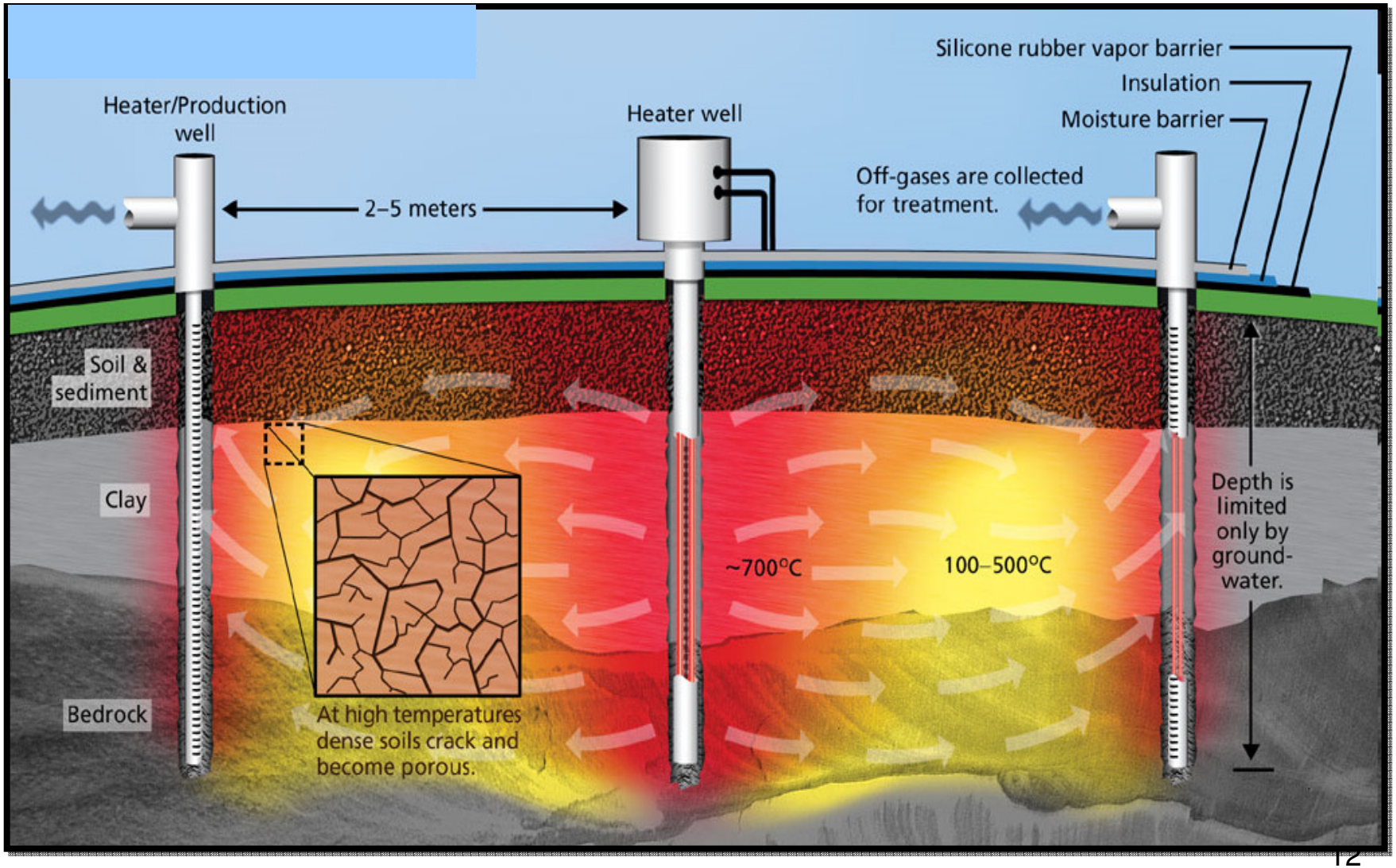
- Inject suspension of colloidal ZVI
  - Emulsified in oil
  - Surface modification
- Reductive abiotic transformation of contaminants
- Longer persistence, lesser transport compared to ISCO



Enhanced Bioremediation



Thermal- Direct Heating

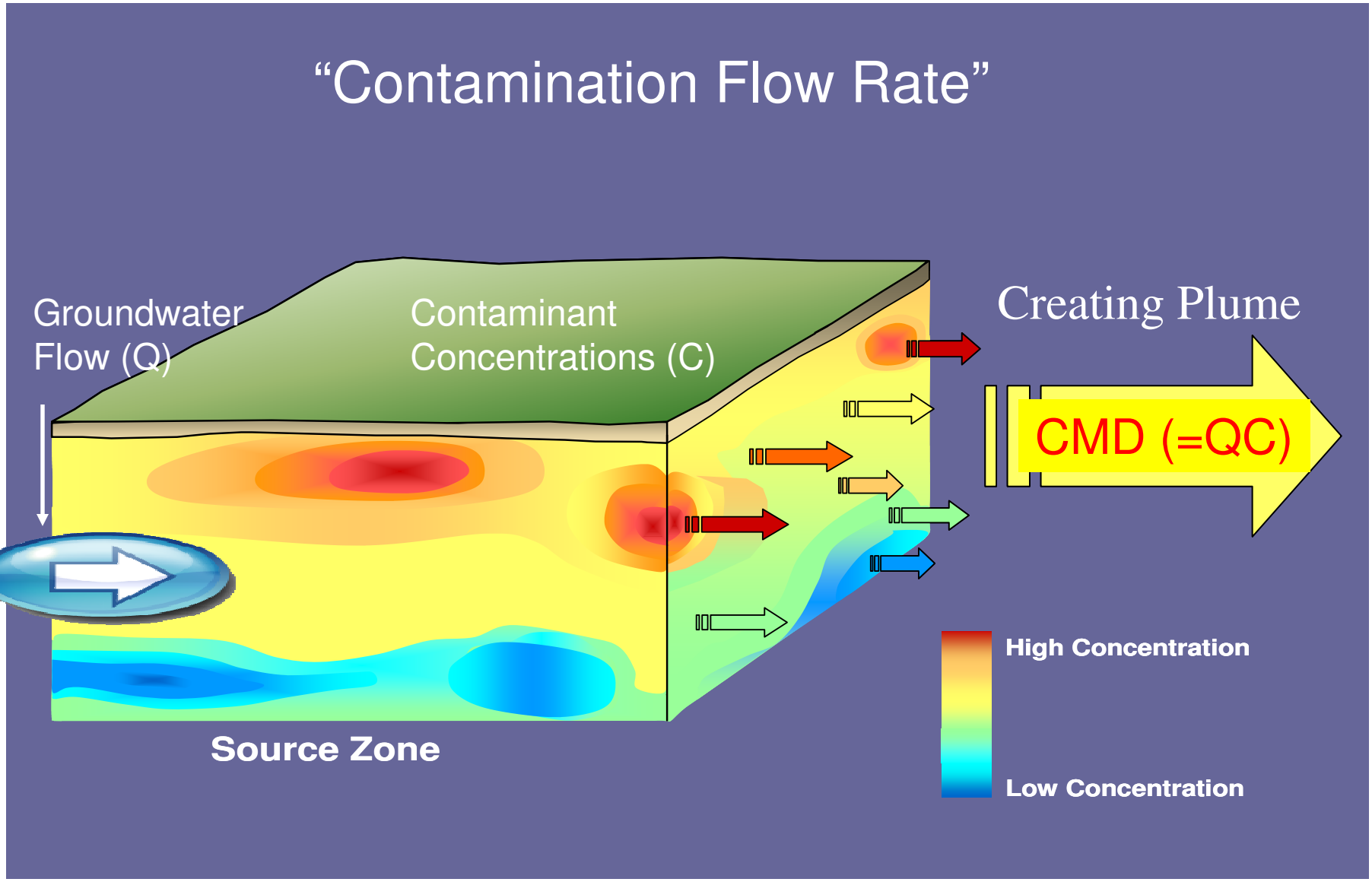


Assessing Performance

- Need robust metrics to evaluate performance

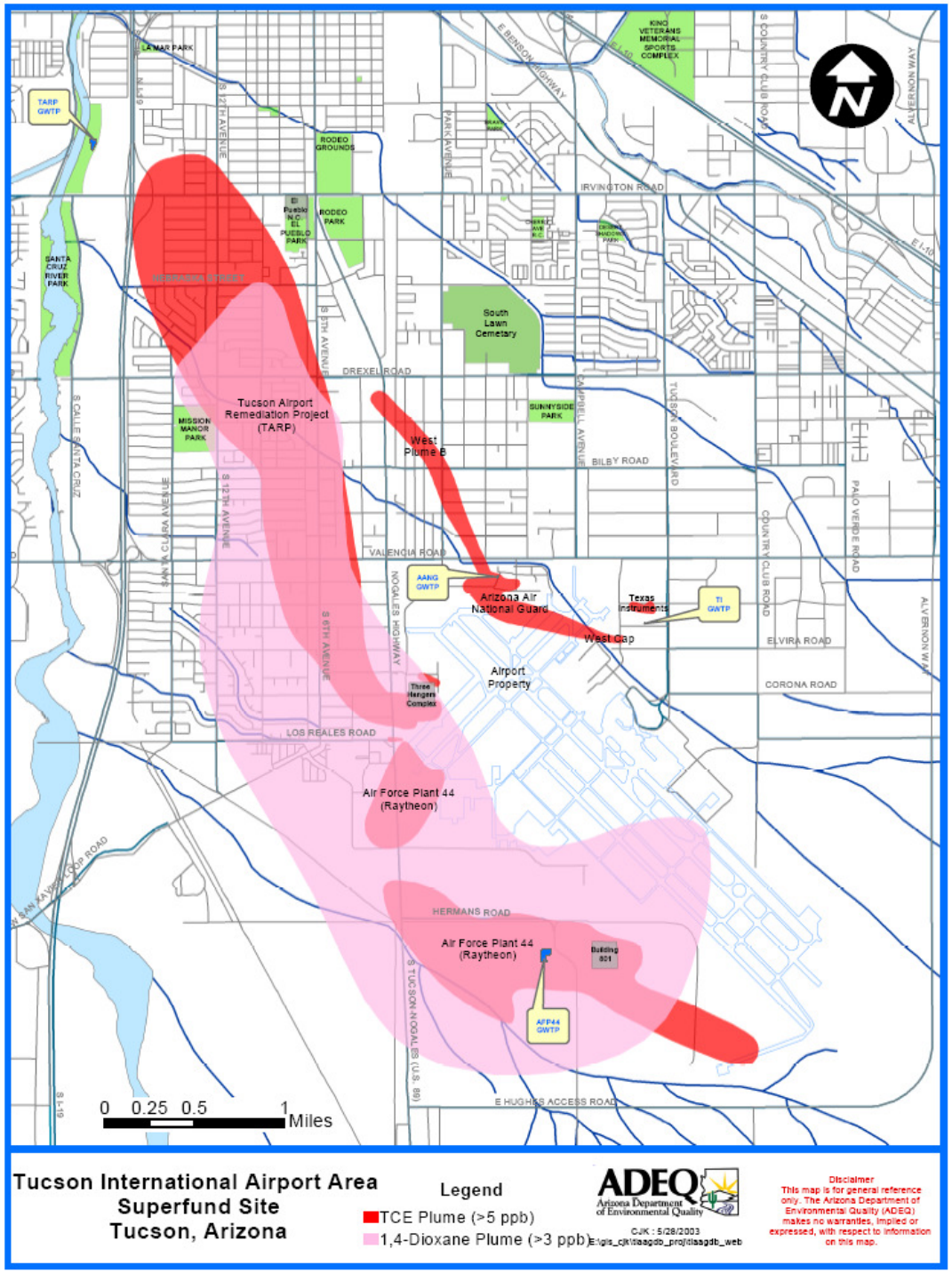
- Useful Metric:
  - Quantitative (objective)
  - Readily measureable
  - Incorporates impact of operations on contaminant transport behavior

Contaminant Mass Discharge



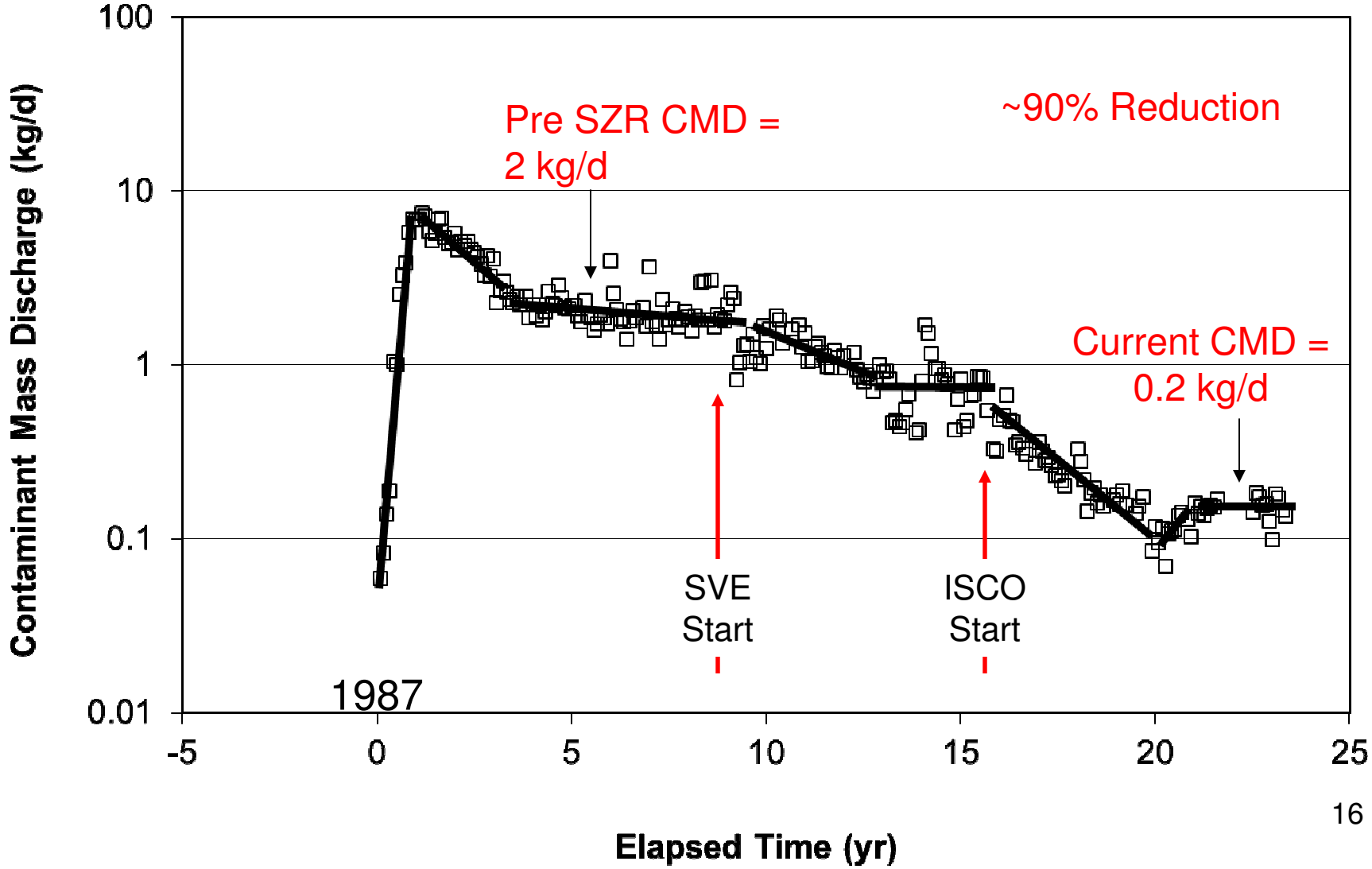
Tucson International Airport Authority Superfund Site

- TCE/DCE Contamination Identified in 1981
- Site Placed on Superfund NPL in 1983
- Pump and Treat started in 1987
- Source-zone Remediation efforts [SVE, ISCO]
- UA Collaboration since 1993

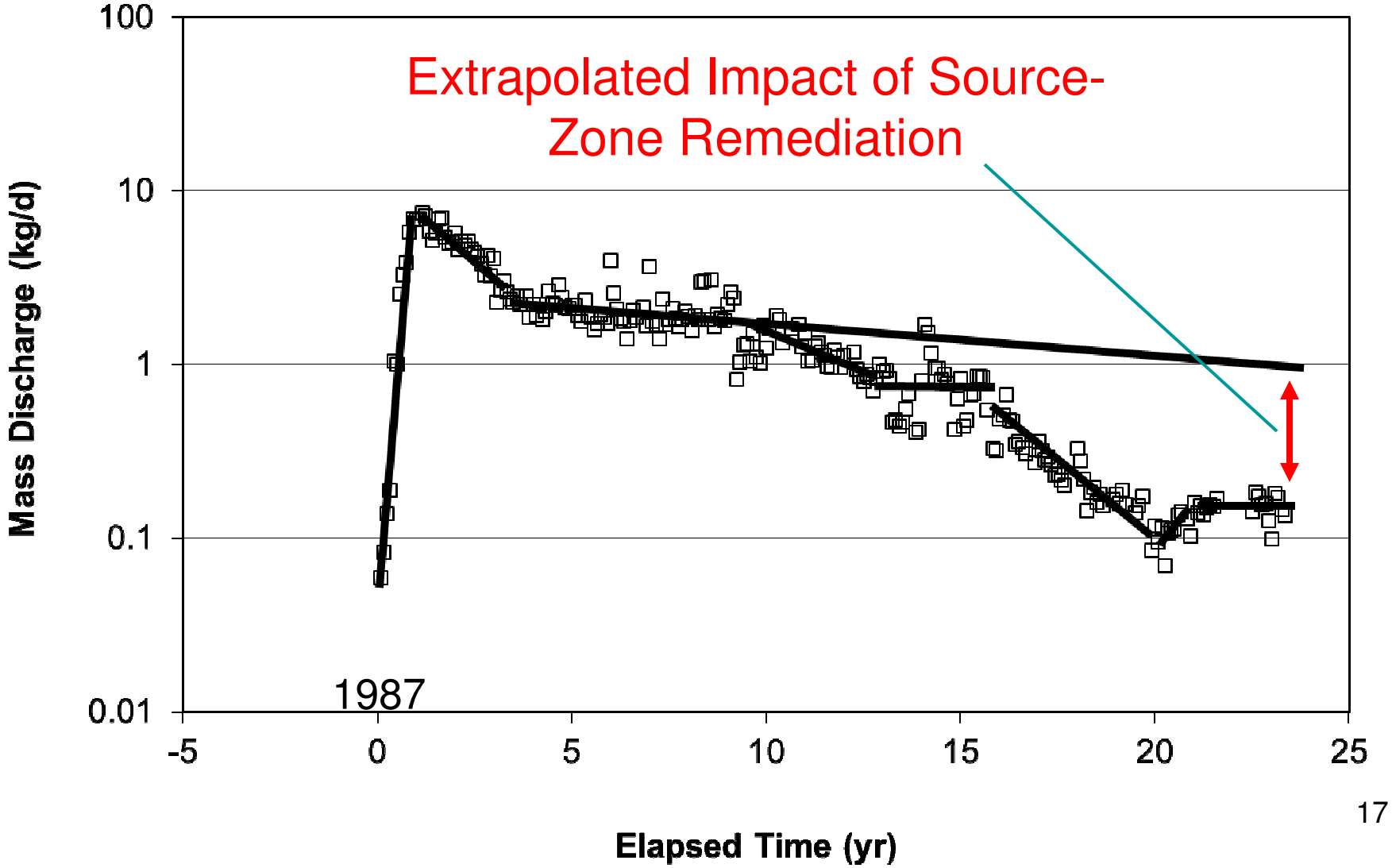


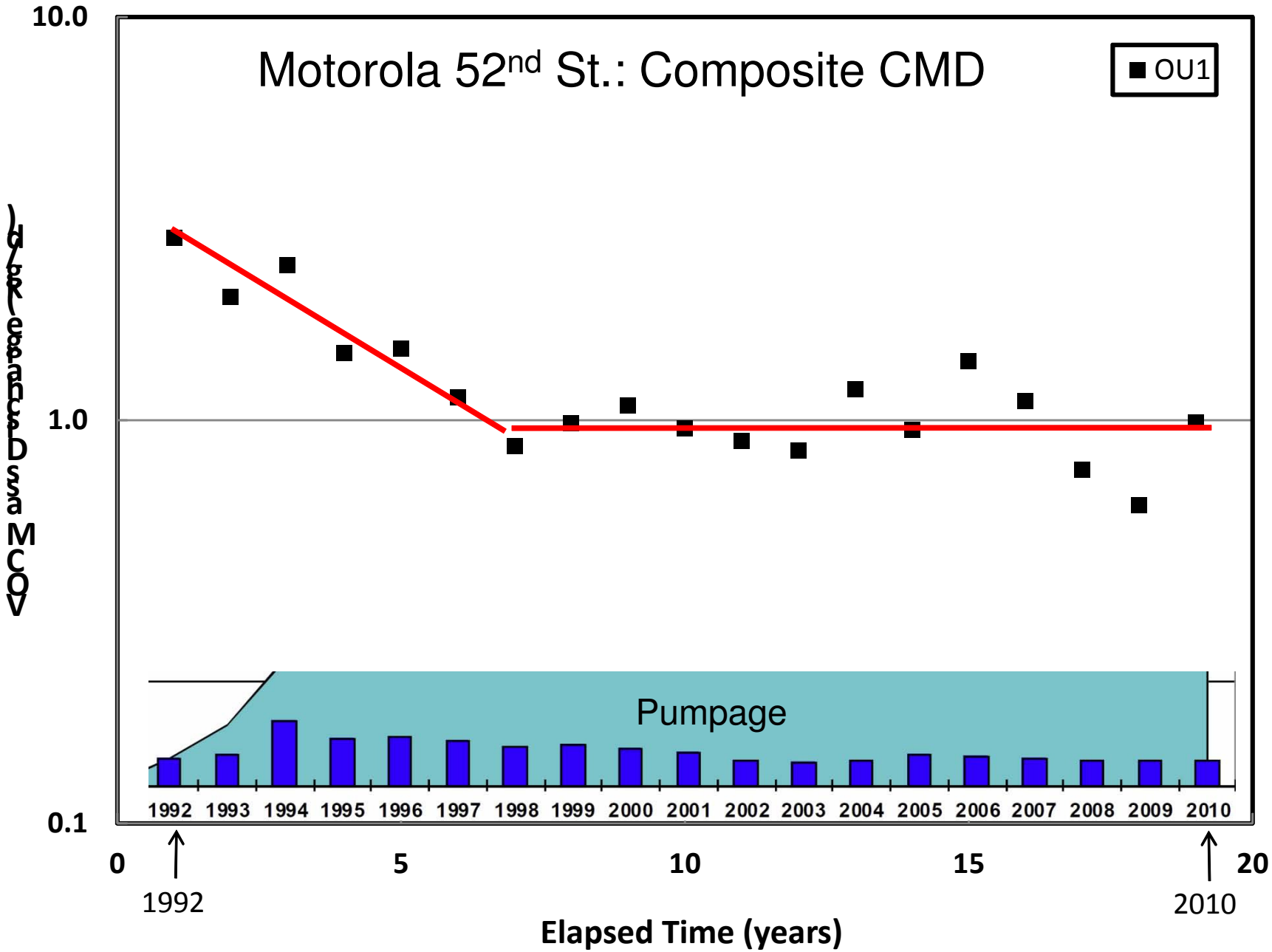
Composite CMD- Historical

Observed impacts from SZ Remediation efforts



Composite CMD- Historical




Motorola 52nd St.: Composite CMD
OU1
10.0
1.0
0.1
Pumpage
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
0
5
10
15
20
1992
2010
Elapsed Time (years)

Summary

- Source zones- incomplete removal of contamination, continuing source
- Plumes- difficult to remove
- Difficult to achieve site closure in timely manner
- Long-term Site Management
  - Optimize and reduce costs while maintaining effective attainment of objectives