

Brave New World

Emerging Tools for NAPL Remediation

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Policy Framework

- Current policy envisions active attention to the source term
 - Technical Impracticability (TI) waiver guidance
 - MNA Policy
 - Corrective Action Groundwater Policy

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Technical Impracticability Waiver Guidance

“...Sources should be located and treated or removed where feasible and where significant risk reduction will result, regardless of whether EPA has determined that groundwater restoration is technically impracticable...”

Directive 9234.2-25

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Monitored Natural Attenuation Policy

“...EPA expects that MNA will be **most appropriate when used in conjunction with other remediation measures** (e.g., **source control**, groundwater extraction), or **as a follow up to active remediation measures** that have already been implemented...”

Directive 9200.4-17P

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Handbook of Groundwater Policies for RCRA Corrective Action (2002)

“Source control, where necessary, will be a critical component of a facility’s cleanup strategy aimed at returning contaminated groundwater to its maximum beneficial use in a reasonable timeframe.”

“As conveyed in the 1996 Advance Notice of Proposed Rulemaking (ANPR), EPA expects facilities to control or eliminate surface and subsurface sources of groundwater contamination.”

“The exact balance between treating, removing, and containing the source is best determined on a case-by-case basis during remedy evaluation and selection, and may depend on whether the facility is trying to achieve short-term, intermediate, or final cleanup goals.”

“Facilities should, therefore, avoid basing their technical impracticability justification solely on the presence of NAPL or the apparent inability of any one technology (e.g., pump-and-treat).”

EPA530-F-01-021

<http://www.epa.gov/correctiveaction/resource/guidance/gw/gwhandbk/gwhndbk.htm>

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Elements for Effective Management of Operating Pump and Treat Systems (2002)

“...The goals of the P&T systems should be appropriate relative to the site-specific conceptual model; otherwise, they may not be achieved. For example, a P&T system will not likely restore groundwater to cleanup levels in a reasonable time frame if there are continuing sources of contamination, such as non-aqueous phase liquids or soil contamination.” (pg. 2)

OSWER 9355.4-27FS

<http://www.epa.gov/correctiveaction/resource/guidance/gw/gwhandbk/gwhndbk.htm>

Del Amo ROD Excerpt

“...When NAPL is recovered from the ground, its mass and saturation are reduced. In principle, this can (1) **reduce the amount of time** that the containment zone must be maintained, (2) **reduce the potential for NAPL to move** naturally either vertically or laterally, and (3) **increase the long-term certainty** that the remedial action will be protective of human health and remain effective.

NAPL Remediation Status Quo Ante

- **DNAPL Ignorance/ DNAPL Denial**
- **Empty Tool Box**
- **Pump and Treat since we didn't know what else to do**

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Types of Sites Likely to Have Significant NAPL

- Chlorinated Solvents
- Wood Treaters
- Former Manufactured Gas Plants (MGP)
- Petroleum Refineries
- Dry Cleaners

What's New

- **Potential to address vadose zone SVOC contamination not amenable to SVE**
- **Potential to address contamination in the saturated zone below the water table**
- **Ability to address contamination at depths below those amenable to excavation**

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Technological Approaches

- In Situ Thermal
 - Steam Enhanced Extraction
 - Electrical Resistive Heating
 - Thermal Conductive Heating
- In Situ Chemical Oxidation
 - Fenton's/H₂O₂/Permanganate/Ozone
- Surfactant Co-Solvent Flushing

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The “\$64,000 Question”

- **Can you remove enough mass to allow meaningful risk reduction and meaningful reduction in Pump and Treat/MNA timeframes**
- **At ‘many’ sites - Yes**
- **At ‘most’ sites - ?**

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Bottom Line

- **Promising New Tools to Achieve Environmental Remediation/Facility Restoration Objectives**
- **“Brave New World”: Link Aggressive Source Term Remedies with Cost Effective Polishing Approaches for Residual Plume**
 - e.g., potential to reduce mass flux to allow credible, reasonable timeframe MNA

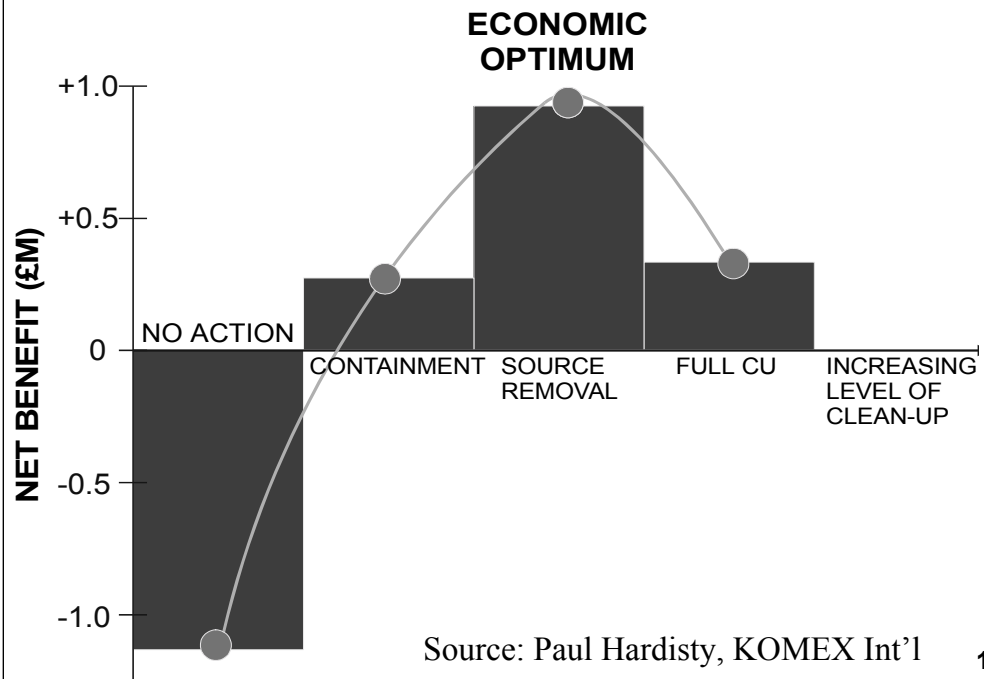
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Next Steps ...

- **Develop Regulatory Framework which rewards good behavior and provides certainty**
 - **Worst fear: Turn on expensive remedy, won't be able to turn it off**
 - **Second worst fear : Protracted pump and treat even after source term remedy**
- **Implement remedial packages which restore resource in a reasonable timeframe**

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BENEFITS ASSESSMENT FOR REMEDIAL GOAL SETTING



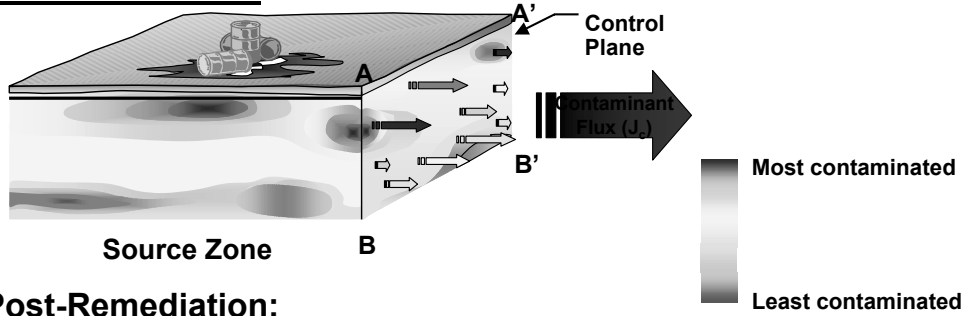
Desired End State/Least Cost Solutions

- **Adequate Use of Robust Source Term Removal Technologies**
- **Timely transition to cost-effective 'polishing' step(s)**
- **Reduce/Eliminate Need for Pump and Treat**
- **Appropriate Reliance on MNA**

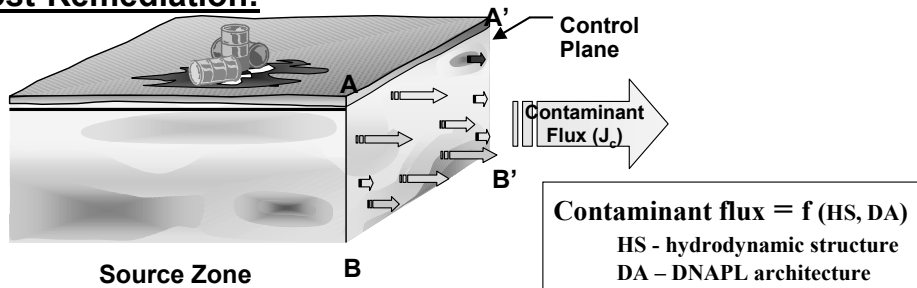
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Mass Reduction vs Mass Flux

Pre-Remediation:



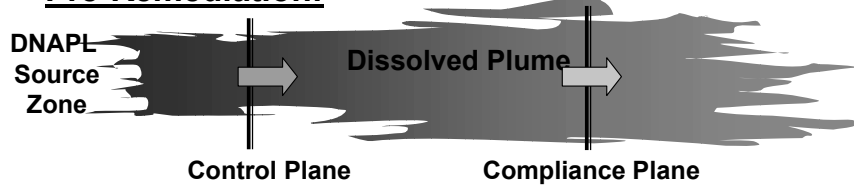
Post-Remediation:



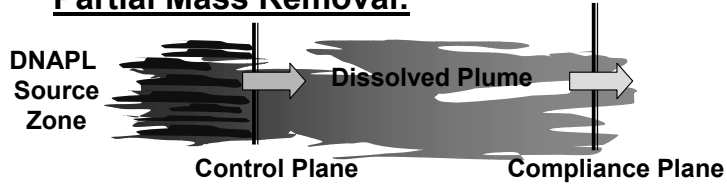
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PLUME RESPONSE

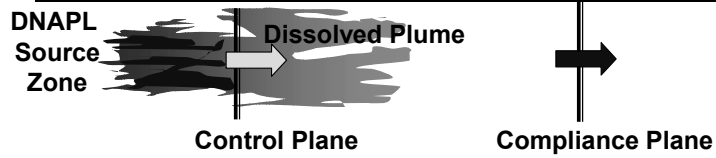
Pre-Remediation:



Partial Mass Removal:



Partial Mass Removal + Enhanced Natural Attenuation:



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