Thermal Remediation Combinations with Other Technologies

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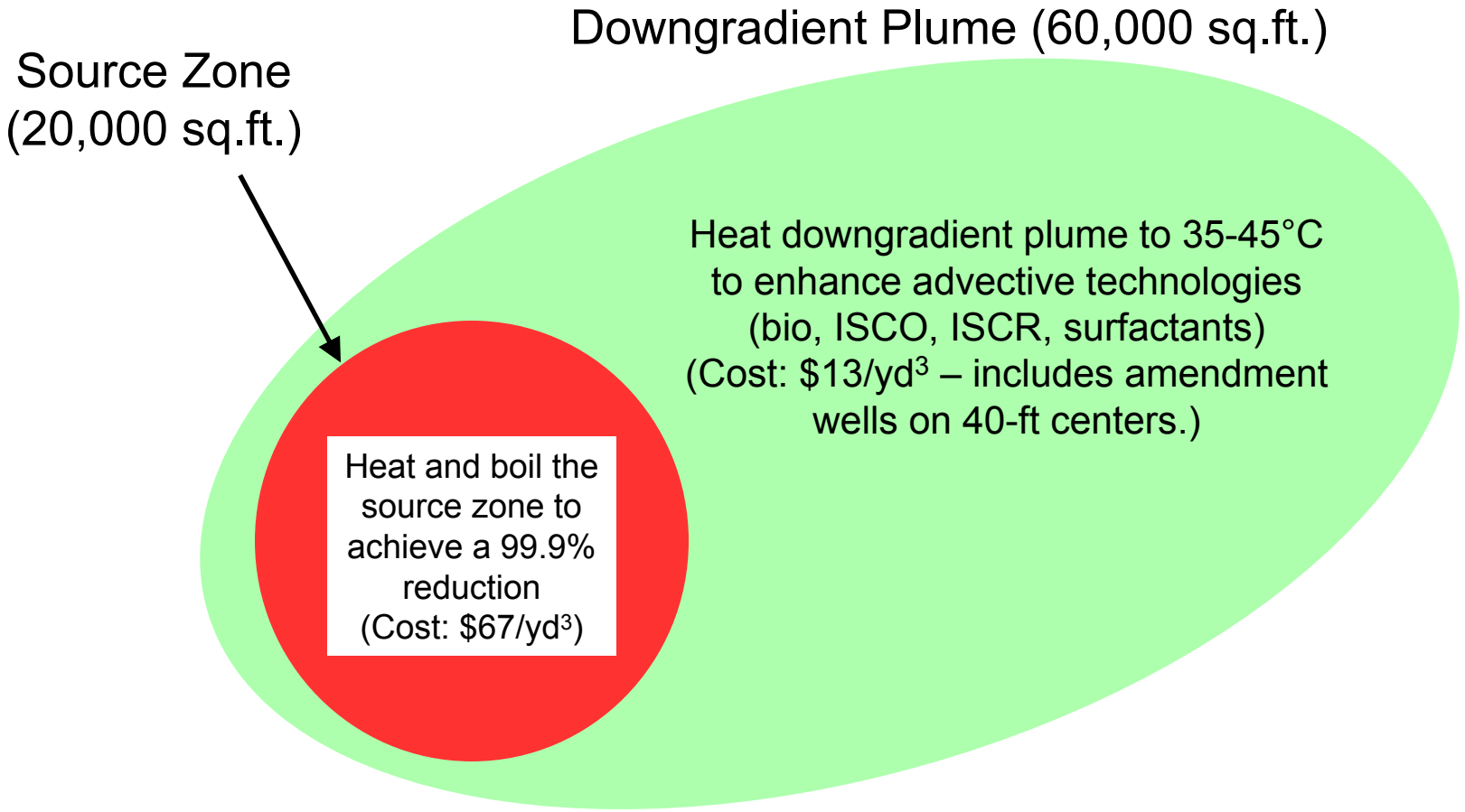
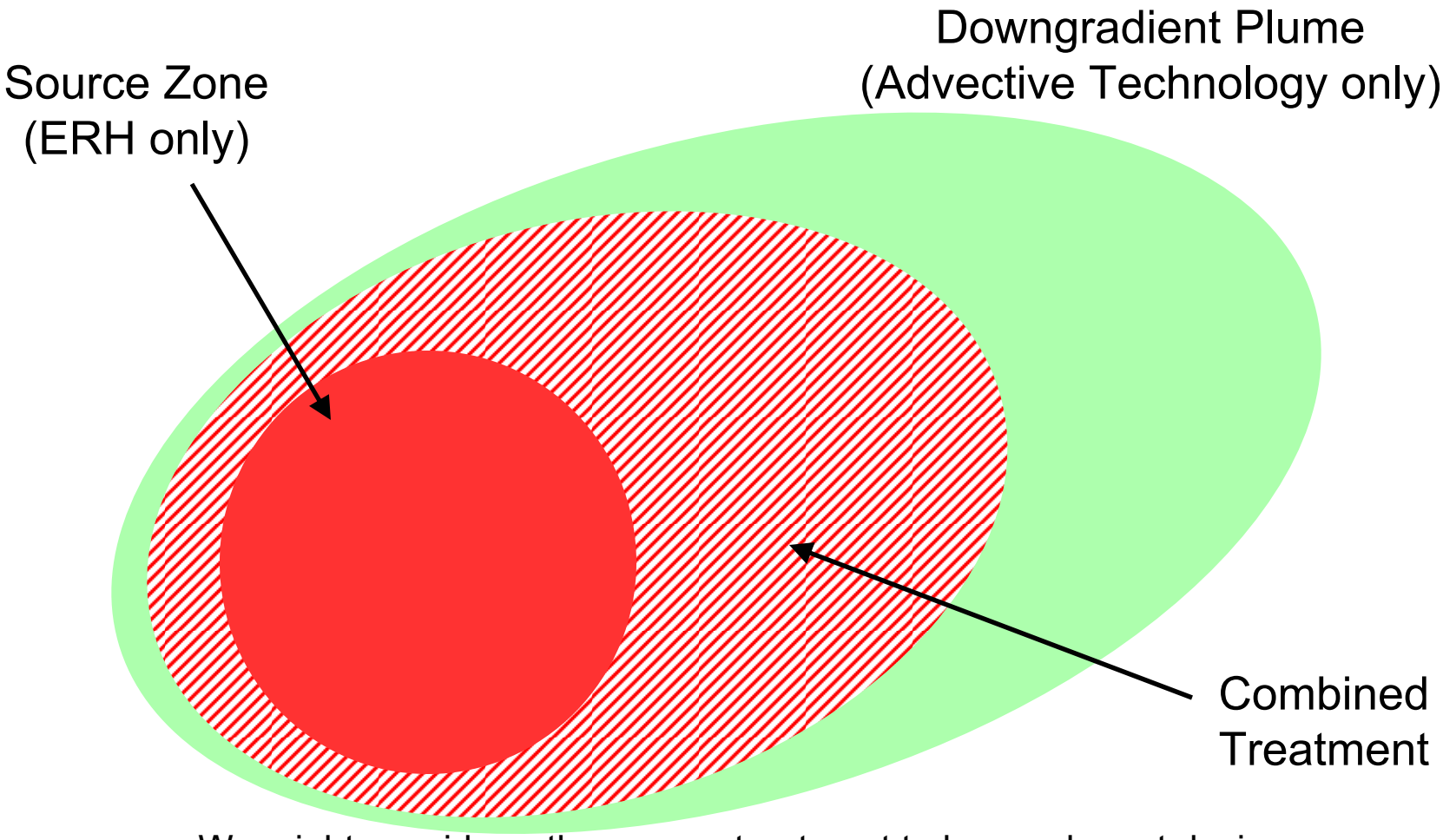
Thermal Combined Remedies
TCE Example
(treatment from 10-35 feet below grade)



Question: Does heating provide a value to the advective technology that exceeds $13/yd^3?

Three-zone Combined Remedies

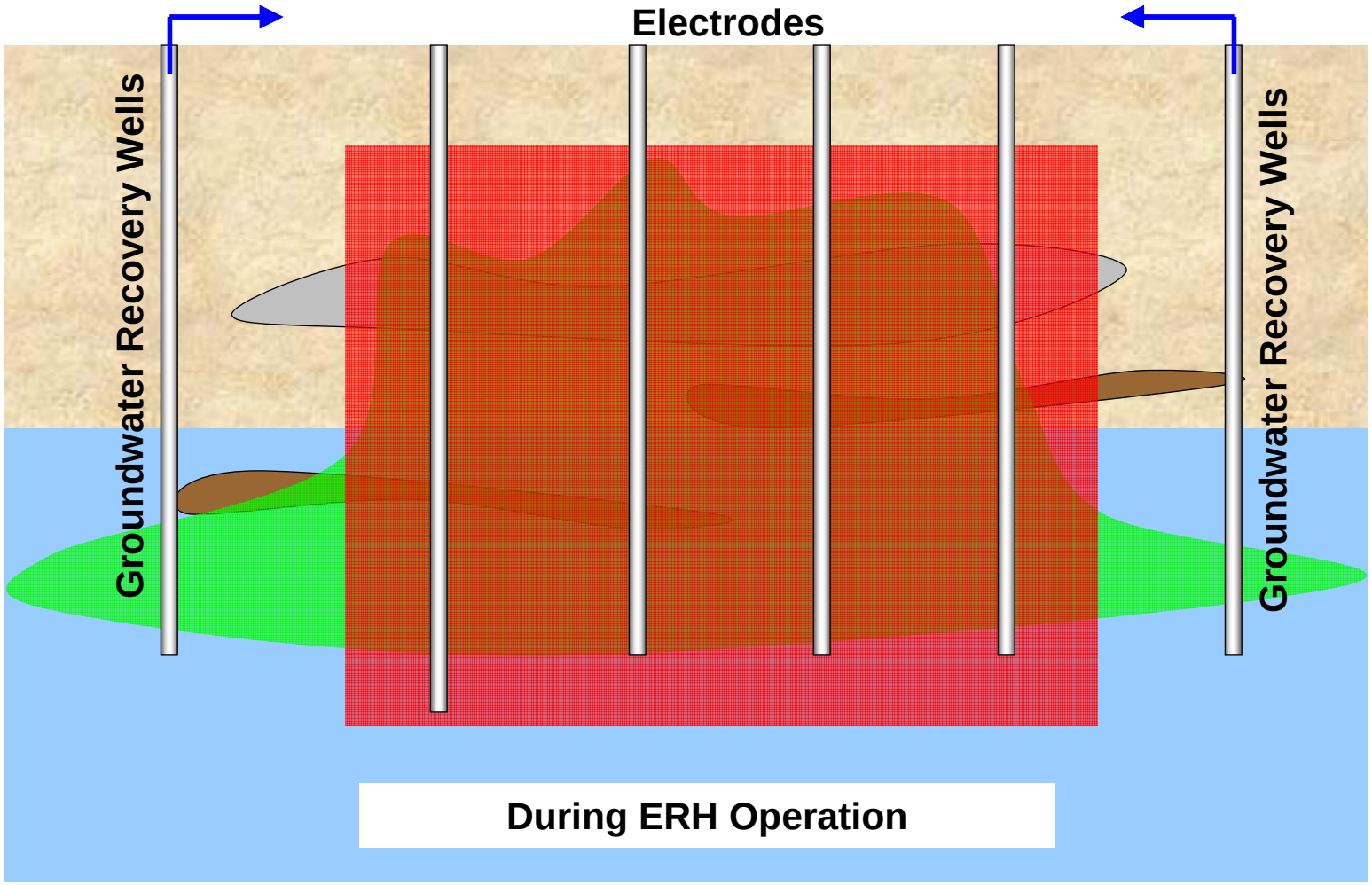


We might consider a three-zone treatment to be an elegant design;
however, some clients will believe that three zones triples the risk of failure.

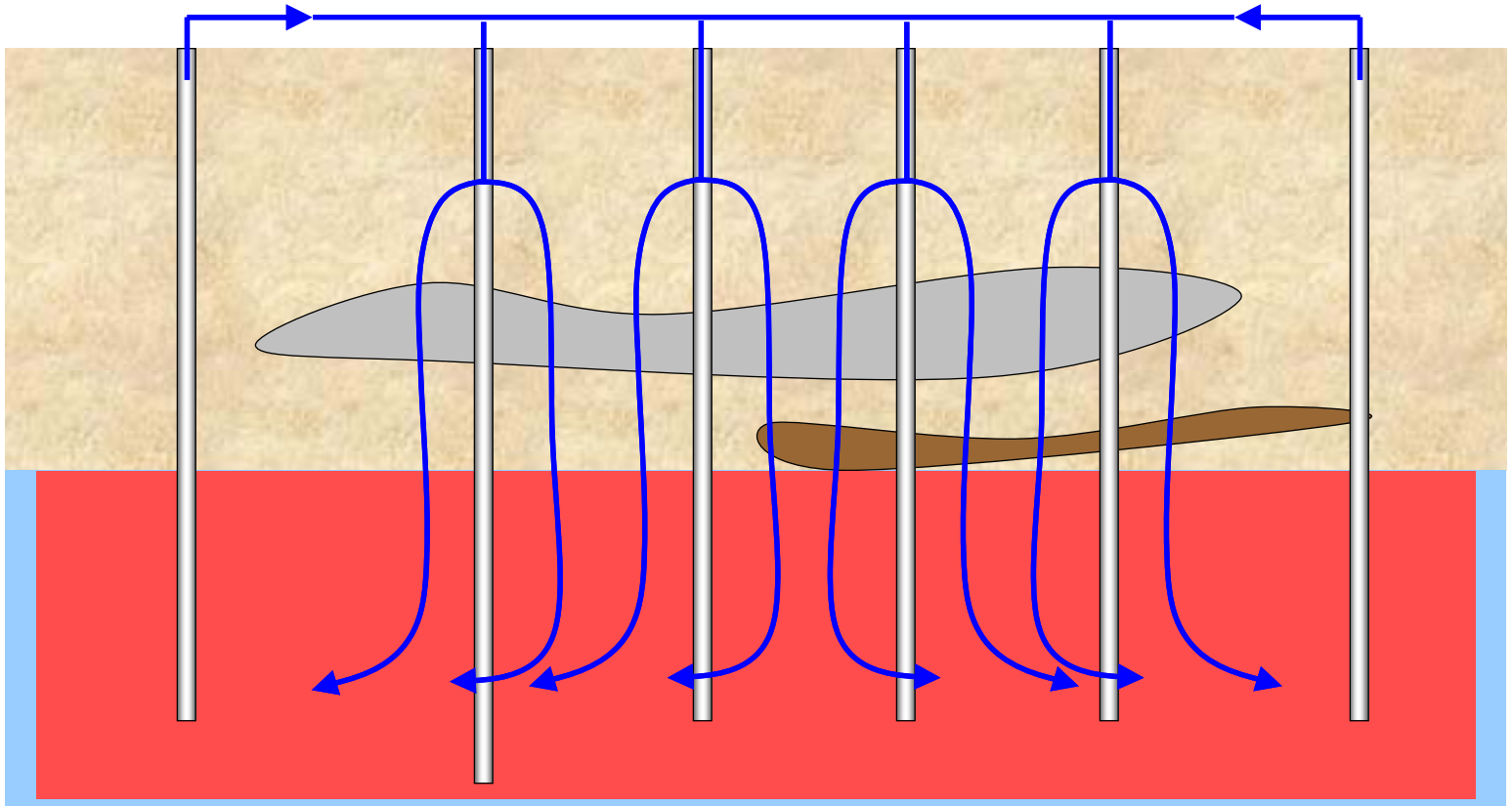
Thermal Combined Remedies Candidate Sites

- As a general rule, once employed, thermal remediation can reduce concentrations by an order of magnitude (99%→99.9% reduction) for about 15% additional cost. These reductions can be guaranteed. Therefore, a combined remedies “polish” is hard to justify unless it includes regions outside the principal thermal zone.
- Thermal treatment of the source zone is almost required for cost-effective treatment (spatial division of treatment areas).
- To show a cost benefit for combined remedies, large sites are better candidates.
- Exception to the above: low volatility compounds that thermally degrade to become amenable to bio/oxidation/reduction (examples: tetrachloroethane, tribromopropane?)

Combined Remedies Example - Slide 1
(Pemaco Superfund Site)



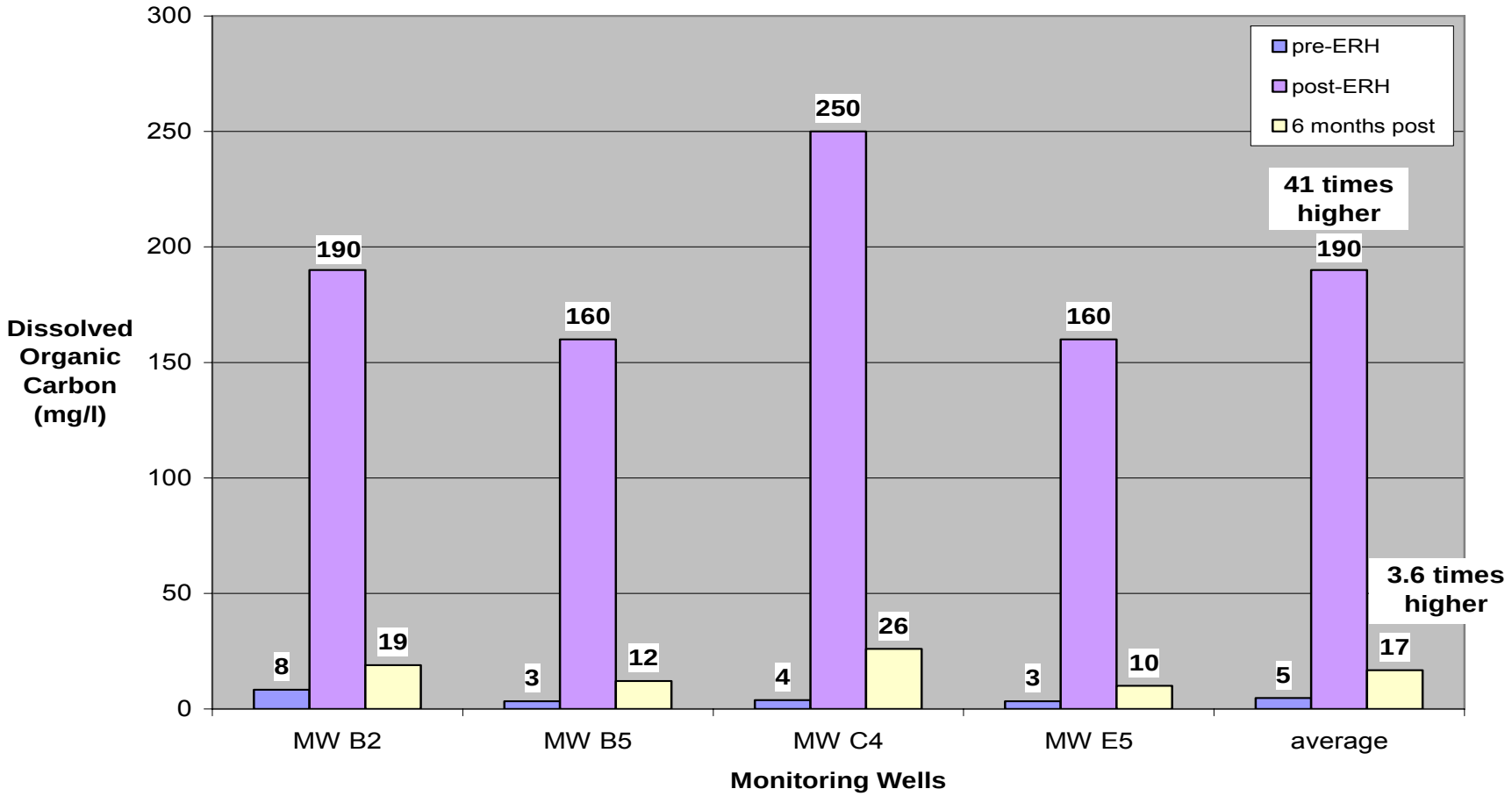
Combined Remedies Post-ERH Example
(Pemaco Superfund Site)



After ERH operation, groundwater is infiltrated though the ERH region to spread the heat to the surrounding saturated zone (cost: less than 1% of the total project cost)

Natural Organic Carbon (Humic Material)

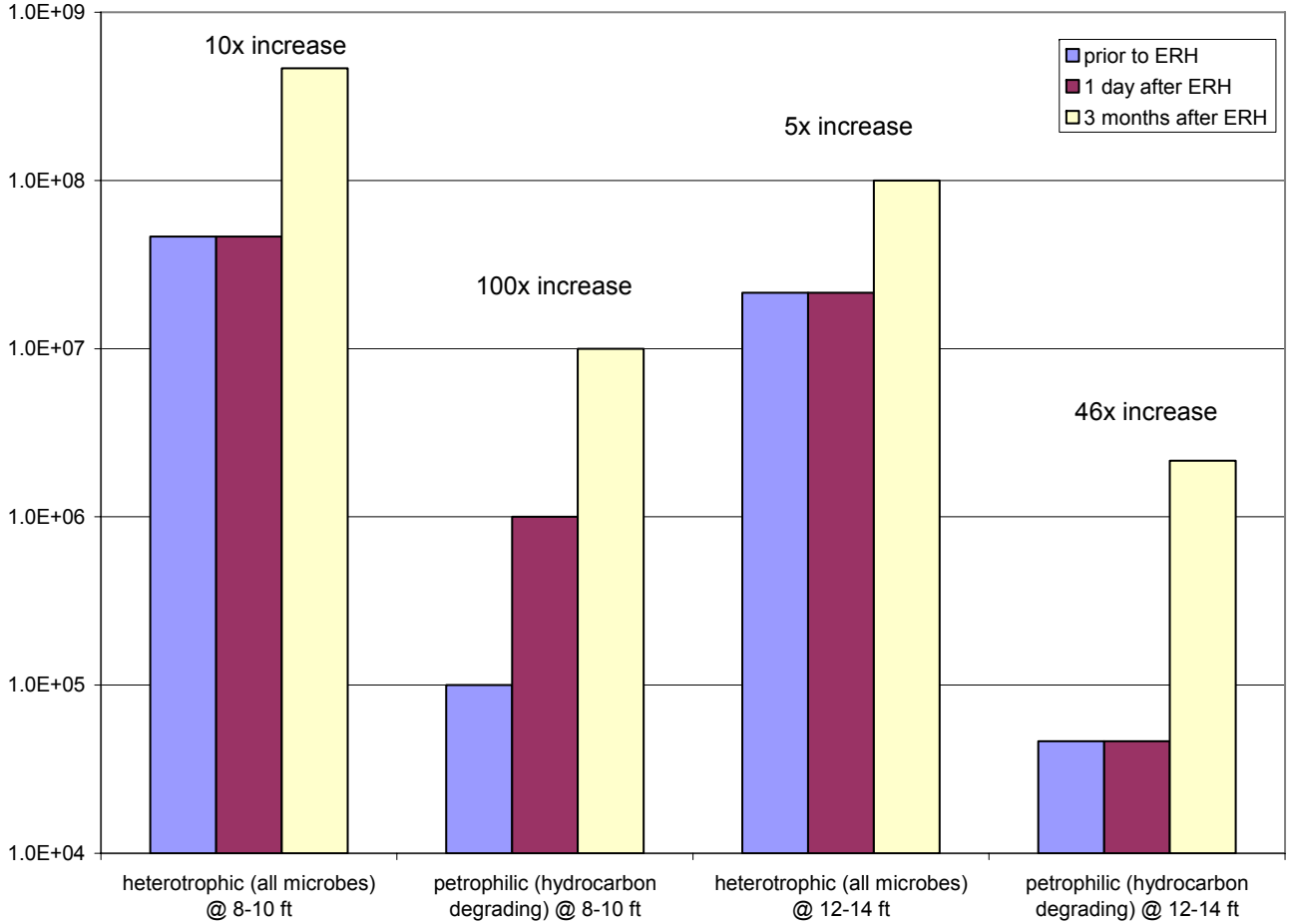
Effect of ERH on Groundwater Dissolved Organic Carbon



Heating makes the naturally occurring humic material more water-soluble and therefore more bio-available. *In situ* bio amendment without injection.

Microbe Counts at a Fuel Site

Average of Three Wells



At fuel sites, heating does not damage the microbial population; it appears to help it. At chlorinated solvent sites, microbial populations rebound immediately upon cooling, and may be enhanced by higher levels of dissolved organic carbon.