ATTACHMENT 4:
Pre-ISCO Coupling Processes

ISCO is often coupled with other remediation technologies as part of the overall treatment approach. Considerations for enhancing the coupling approach and/or cautions to consider in ISCO design and implementation are provided in the following table.

Table A4-1. Conditions Resulting from Pre-ISCO Mass Reduction Processes that May Be Applied Within the ISCO Target Treatment Zone

Pre-ISCO Technology	Advantages	Disadvantages
Excavation	+ Rapid implementation + Easy to apply oxidant at the infiltrative surface + Soil mixing approaches may be more easily implemented	- Hotspots may remain - Preferential flow may occur through backfill - Contaminated or highly organic backfill may cause excessive oxidant demand - Oxidant treatment of clean backfill represents inefficient oxidant use
Enhanced product recovery / Multiphase extraction	+ Removal of pooled or high NAPL saturation zones improves advective oxidant transport and likelihood of ISCO's success	- Smear zone thicknesses may be increased - Residual NAPL will likely remain
Surfactant enhanced aquifer remediation (SEAR)	+ Surfactants may improve the reactivity of some oxidants + Enhanced solubilization and desorption may occur improving oxidation efficiency in the aqueous phase	- Incompatible surfactants may cause excessive oxidant decomposition - Gas evolution may cause foaming and permeability loss - Some NAPL mass is likely to remain after SEAR - Potential lack of control of mobilized contaminants
Soil vapor extraction / Air sparging	+ Infrastructure may already be in place for in situ ozonation + Contaminated vapors may be captured when using oxidants that evolve significant amounts of gas + May oxidize some reduced minerals, lowering the soil's natural oxidant demand for ISCO	- Desaturated groundwater zones may have lower relative permeability, challenging uniform delivery of aqueous oxidants
Thermal remediation	+ Elevated temperature may effectively activate some oxidants + For some oxidants and resistant contaminants, kinetic rates of degradation may be tremendously improved at elevated temperature	- Elevated temperatures may pose health and safety concerns for some oxidants and contaminants with exothermic reactions - Solidification of silt and clay materials may occur challenging subsequent oxidant delivery - At elevated temperature, excessive oxidant decomposition may challenge effective delivery
Intrinsic or enhanced bioremediation	+ Biological degradation processes (if any) may be anticipated to return to baseline (e.g., unamended natural levels) after ISCO, and these may be used as a polishing step	- Reducing conditions associated with anaerobic conditions may require excessive oxidant dosing - Elevated biomass and/or organic substrate concentrations in the treatment zone may cause excessive competition for oxidant and lead to poor treatment efficiencies