Table A-8.A. Cosolvent flushing

Technology	Cosolvent flushing	Cosolvent flushing involves the injection and subsequent extraction of a cosolvent (e.g., an alcohol) to solubilize LNAPL.	
Remediation process	Physical mass recovery	Yes	Cosolvents enhance LNAPL removal by reducing the LNAPL/water interfacial tension.
	Phase change	No	Cosolvents allow LNAPL to be solubilized above its aqueous solubility limit, thereby enhancing removal.
	In situ destruction	No	N/A
	Stabilization/binding	No	N/A
Objective applicability	LNAPL saturation	Yes	LNAPL saturation decreases due to direct recovery and enhanced solubilization.
		Example performance metrics	Reduced LNAPL transmissivity; reduction, or elimination of measurable LNAPL in wells.
	LNAPL composition	Yes	Abate accumulation of unacceptable constituent concentrations in soil vapor and/or dissolved phase from an LNAPL source.
		Example performance metrics	LNAPL composition change; soil and groundwater VOC concentrations to below regulatory standard.
Applicable LNAPL type	Assuming the primary mechanism is solubilization, cosolvents are most effective with lighter- molecular-weight LNAPLs (ITRC 2003) and become less effective as the molecular weight of the LNAPL increases.		
Geologic factors	Unsaturated zone	When unsaturated zone LNAPL is near the water table, the water table can be raised (via mounding effect) to flood the zone with cosolvent. When unsaturated zone LNAPL is far above water table, infiltration techniques may be used to flush the zone with cosolvent but are not as effective as saturated zone treatment. More homogeneity and moderate permeability results in more effective treatment through even distribution of cosolvent. See saturated zone geologic factors.	
	Saturated zone	Permeability	The overall cosolvent delivery and LNAPL recovery are more rapid in higher-permeability soils, but cosolvent can be delivered to lower-permeability soils; however, the time to complete the flushing process is longer with lower permeability.
		Grain size	The overall LNAPL mass recovery is effective in coarser-grain soils (sands) and finer-grain soils (e.g. silt and clay); however, the time to complete the flushing process is longer in the finer-grain soils.
		Heterogeneity	In highly heterogeneous soils, separate flow network may be required (e.g., one to treat the more permeable zone and another to treat the less permeable zone) if LNAPL is distributed in both zones. In some cases, short-circuiting of flushing is unavoidable. Higher heterogeneity can also reduce cosolvent delivery efficiency, which increases the required number of pore volumes.
		Consolidation	High consolidation may reduce pore sizes, permeability, and injection feasibility. Unconsolidated/loosely consolidated soil may allow larger grids on flow network (i.e., tend to be more favorable for recovery).