Table 2. Preliminary Screening of Remedial Technologies - Soil
Rolling Knolls Landfill Superfund Site
Chatham, New Jersey

General Response Action	Remedial Technology	Process Option	Description	Retained: Yes or No	Decision Rationale
No Action	No Action	No Action	No remedial action	Yes	Required by NCP and USEPA guidance as a baseline for comparison to other remedial alternatives.
Institutional Controls	Institutional Controls	Proprietary Controls, Enforcement Tools, Deed Restrictions, and Information Devices	Institutional controls are administrative actions that minimize the potential for human exposure to constituents by limiting land or resource use; institutional controls maintain the protectiveness of a remedial action by modifying or guiding human behavior	Yes	Institutional controls impose site use restrictions and discourage inappropriate land use.
Access Restrictions	Access Restrictions	Physical Barriers, Signage, and Security	Using signage, perimeter fencing, and security personnel to discourage entry into area	Yes	Access restrictions are generally used in conjunction with other technology types for remedial actions
Containment	Soil Capping	Asphalt Cover	Using an asphalt cover to prevent infiltration and direct contact with constituents in soil	Yes	The impermeable barrier prevents direct contact with constituents in surface soil and prevents infiltration
		Vegetative Cover	Prevents direct contact with constituents in surface soil	Yes	The vegetative cover prevents direct contact with constituents surface soil and stabilizes the soil to reduce transport of constituents via erosion.
		Impermeable Cover	Using an impermeable cover to prevent infiltration and direct contact with constituents in soil	Yes	The impermeable barrier prevents direct contact with constituents in surface soil and prevents infiltration.
In-Situ Treatment	Chemical	Solidification/Stabilization	Using Portland cement or equivalent to immobilize organic and inorganic compounds in wet or dry media	Yes	Stabilization/Solidification reduces the mobility of constituents in soil; therefore, reducing the concerns associated with direct contact and infiltration.
Removal	Excavation	Excavation	Removal of impacted soil via excavation	Yes	Conventional technology generally used in conjunction with disposal options.
Disposal	Disposal	Off-site Landfill	Off-site disposal of soil at an approved landfill	Yes	Conventional disposal option generally used in conjunction with removal of contaminated waste or media.
		Off-site Incineration	Off-site incineration of excavated soil or remediation process residuals in an approved incineration facility	No	Technology is applicable to site constituents, with the exception of inorganics. Presence of inorganics in soil following incineration would require off-site disposal. This degree of treatment is unnecessary as off-site disposal of excavated material is already satisfactory given the constituent levels present.
		On-site Consolidation	Redistribute impacted soil on site for long-term management	Yes	Conventional disposal option generally used in conjunction with other technologies (e.g., vegetative cover, capping, institutional controls).
		Backfilling Excavation	Backfilling with unimpacted soil	Yes	Conventional disposal option generally used in conjunction with other technologies (e.g., excavation, capping, institutional controls).
		Soil Reuse	Treated soils with low residual constituent levels may be reused off site as fill material or daily cover within a landfill	No	Excavation of soil would require off-site disposal, as ex-situ treatments necessary to generate soil for reuse are not appropriate for site.

General Notes:
Shaded process options eliminated from further evaluation.

Acronyms and Abbreviations:
NCP = National Contingency Plan
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
SVOCs = semi-volatile organic compounds
USEPA = United States Environmental Protection Agency
VOCs = volatile organic compounds

Table 3. Preliminary Screening of Remedial Technologies - Groundwater
Rolling Knolls Landfill Superfund Site
Chatham, New Jersey

General Response Action	Remedial Technology	Process Option	Description	Retained: Yes or No	Decision Rationale
No Action	No Action	No Action	No remedial action	Yes	Required by NCP and USEPA guidance as a baseline for comparison to other remedial alternatives.
Institutional Controls	Institutional Controls	Proprietary Controls, Enforcement Tools, Information Devices, Deed Restrictions, and Classification Exception Area	ICs are administrative actions that minimize the potential for human exposure to constituents by limiting land or resource use; ICs maintain the protectiveness of a remedial action by modifying or guiding human behavior	Yes	ICs impose site use restrictions and discourage inappropriate land use; a Classification Exception Area provides notification of constituents in groundwater.
Monitored Natural Attenuation	Monitored Natural Attenuation	Monitored Natural Attenuation	Perform routine water quality monitoring to periodically assess natural attenuation processes and nature and extent of impacted groundwater	Yes	Conventional technology for constituents in groundwater.
Containment	Infiltration Control	Soil Cap	Using an impermeable cover to prevent infiltration into impacted areas	Yes	Prevents continued leaching of constituents to groundwater.
	Barriers	Trenched Cut-off Wall	Using a bentonite slurry or other low permeability material placed in a trench to create a wall that prevents horizontal migration of impacted groundwater	Yes	Conventional technology for containment of constituents in groundwater.
		Sheet Piling	Using sheet piles to form a low permeability wall that prevents the horizontal migration of impacted groundwater	Yes	Conventional technology for containment of constituents in groundwater.
		Permeable Reactive Wall	A passive treatment wall is constructed across the flow path of the contaminant plume, allowing groundwater to be treated as it passes through the wall	Yes	Conventional technology for treatment of constituents in groundwater.
		Groundwater Extraction	Hydraulic containment through the extraction of groundwater	Yes	Conventional technology; groundwater extraction provides constituent mass removal.
		Groundwater Recovery Trenches	Trenches, drains, and piping used to passively collect groundwater	Yes	Conventional technology; passive collection of groundwater and subsequent pumping provide constituent mass removal.
In-Situ Treatment	Physical	Soil Vapor Extraction	Low to moderate vacuum (i.e., less than 10 mm Hg) is applied to a series of extraction wells to enhance volatilization of constituents (i.e., VOCs); vapor is recovered at the wellhead and treated	Yes	May be combined with other enhanced extraction/recovery technologies for collection and treatment of vapors in conjunction with air sparging.
		Air Sparging	In-sit stripping of constituents (i.e., VOCs) using air injection wells	Yes	Conventional technology, typically employed with other technologies such as soil vapor extraction for the treatment of vapors.
	Chemical	Ozone	Use of ozone to oxidize constituents in-situ	Yes	Conventional technology for constituents in groundwater.
		Fenton's Regent/Hydrogen Peroxide	Use of the hydroxyl radical through Fenton's reagent to oxidize constituents in-situ and/or increase dissolved oxygen	Yes	Conventional technology for constituents in groundwater.
		Persulfate	Use of persulfate to oxidize constituents in-situ	Yes	Conventional technology for constituents in groundwater.
		Permanganate	Use of potassium or sodium permanganate to oxidize constituents in-situ	Yes	Conventional technology for constituents in groundwater.
	Biological	Enhanced Reductive Dechlorination	Injection of a degradable substrate to facilitate biodegradation of chlorinated compounds by native microorganisms	Yes	Conventional technology for constituents in groundwater.
		Aerobic Bioremediation	The injection of an oxygen source to aerobically degrade contaminants or precipitate metals.	Yes	Conventional technology for constituents in groundwater.
Ex-Situ Treatment	Physical	Air Stripping	Contaminants are transferred from an aqueous phase to a vapor phase; off-gas may require additional treatment	Yes	These ex-situ physical treatment technologies have been used extensively to treat groundwater and vapor process streams and are routinely combined to provide adequate treatment (in conjunction with collection and discharge).
		Carbon Adsorption	Contaminants are removed from the aqueous phase or vapor phase onto activated carbon	Yes	
	Chemical	Ion-Exchange	Use of an engineered resin or media to preferentially sorb ionic species from an aqueous stream	Yes	Conventional technology that may be required for pre-treatment metals in conjunction with other technologies.
		Precipitation	Metals precipitation through the conversion of soluble heavy metals salts to insoluble salts that will precipitate	Yes	
Disposal/ Discharge	Disposal	Off-site Landfill	Off-site disposal of at an approved landfill	Yes	Although groundwater is not treated via disposal within a landfill, the spent treatment media (e.g., activated carbon) that are used as part of other treatment technologies will need disposal.
	Discharge	POTW	Off-site discharge to a POTW under applicable discharge permits	Yes	POTWs typically accept remediation system discharges (in conjunction with collection and ex-situ treatment); may require on-site pretreatment for certain chemical classes (i.e., metals and VOCs).
		Groundwater Discharge (Reinjection)	Reinject treated groundwater meeting NJDEP and USEPA discharge limits outside the areas of contamination	Yes	On-site discharge of treated groundwater is a common discharge technology, when done in conjunction with collection and ex-situ treatment.
		Surface-Water Discharge	Discharge treated groundwater meeting NPDES permit limits to the Delaware River	Yes	

General Notes:
Shaded process options eliminated from further evaluation.

Acronyms and Abbreviations:
CEA = Classification Exception Area
COCs = chemicals of concern
ICs = institutional controls
NCP = National Contingency Plan
NJDEP = New Jersey Department of Environmental Protection
NPDES = National Pollution Discharge Elimination Program
POTW = publicly owned treatment works
USEPA = United States Environmental Protection Agency
VOCs = volatile organic compounds

Table 4. Process Options Screening - Soil
Rolling Knolls Landfill Superfund Site
Chatham, New Jersey

General Response Action	Remedial Technology	Process Option	Effectiveness Evaluation		Implementability Evaluation		Relative Cost Evaluation		Retained?	
No Action	No Action	No Action	---		---		---		Yes	Required by NCP and USEPA guidance as a baseline for comparison to other process options
Institutional Controls	Institutional Controls	Proprietary Controls, Enforcement Tools, Deed Restrictions, and Information Devices	Moderate	Standard practice for protecting human health and the environment, effectiveness governed by maintenance of ICs	Moderate-High	Generally implementable but requires close coordination of regulatory authorities	Low	Low capital and O&M costs	Yes	Considered in conjunction with other technologies; standard practice for long-term management of landfills
Access Restrictions	Access Restrictions	Physical Barriers, Signage, and Security	Moderate	Standard practice for protecting human health and the environment, effectiveness governed by maintenance of access restrictions	High	Readily implementable	Low-Moderate	Low to moderate capital and O&M costs	Yes	Considered in conjunction with other technologies; standard practice for long-term management of landfills
Containment	Soil Capping	Asphalt Cover	Moderate	Effective in preventing direct contact with soils, long term effectiveness governed by maintenance of cover, may depend on future site use	Moderate	Readily implementable, uses standard equipment and materials, may depend on future site use	Moderate	Moderate capital costs, low to moderate O&M costs	No	Other containment options are likely to be more effective and maintain site use
		Vegetative Cover	Moderate	Effective in preventing direct contact with soils, long-term effectiveness governed by maintenance of cover, may depend on future site use	Moderate-High	Readily implementable, uses standard equipment and materials, may depend on future site use	Low-Moderate	Moderate capital costs, low O&M costs	Yes	Standard capping technology
		Impermeable Cover	Moderate	Effective in preventing direct contact with soils, long-term effectiveness governed by maintenance of cover, may depend on future site use	Moderate	Readily implementable, uses standard equipment and materials, may depend on future site use	Moderate	Moderate capital costs, low O&M costs	Yes	Standard capping technology
In-Situ Treatment	Chemical	Solidification/Stabilization	Moderate	Does not destroy constituents, but incorporates them into a dense, homogeneous, low-porosity structure that reduces their mobility	Low-Moderate	Solidification/Stabilization utilizes standard construction equipment and methods, site conditions may be limiting in certain areas of the site	Moderate	High capital costs	Yes	Stabilization/solidification is a proven technology.
Removal	Excavation	Excavation	High	Permanently reduces the mobility, toxicity, and volume of constituents by removing them from the site	Low-Moderate	Excavation utilizes standard construction equipment and methods, site conditions may be limiting in certain areas of the site	High	High capital costs	Yes	Excavation is a proven technology to be combined with disposal
Disposal/ Discharge	Disposal	Off-site Landfill	Moderate-High	Permanently reduces the mobility, toxicity, and volume of constituents by removing them from the site	Moderate-High	Landfilling is a proven and accepted technology, characterization required to find appropriate disposal facility	Moderate-High	Disposal costs are dictated by volume and whether soils are hazardous or non-hazardous	Yes	Off-site landfill is a proven and standard disposal method
		On-site Consolidation	Moderate	Effective at reducing the overall area of long-term management by combining impacted areas to a single location, may be combined with other technologies to treat or contain the soils	Moderate-High	Consolidation utilizes standard construction equipment and methods, site conditions may be limiting in certain areas of the site	Moderate	Moderate costs associated with soil sampling, stockpiling, and placement	Yes	On-site consolidation is a proven technology to be combined with containment method
		Backfilling Excavation	Moderate	Effective disposal option, may be combined with other technologies to treat or contain the soils	Low-Moderate	May not be administratively feasible	Moderate	Moderate costs associated with soil sampling, stockpiling, and placement	No	Other disposal options are likely to be more implementable

General Notes:
Shaded process options eliminated from further evaluation.

Acronyms and Abbreviations:
IC - institutional control
NCP - National Contingency Plan
O&M - operation and maintenance
USEPA - United States Environmental Protection Agency
VOCs - volatile organic compounds

Table 5. Process Options Screening - Groundwater
Rolling Knolls Landfill Superfund Site
Chatham, New Jersey

General Response Action	Remedial Technology	Process Option	Effectiveness Evaluation		Implementability Evaluation		Relative Cost Evaluation		Retained?	
No Action	No Action	No Action	---		---		---		Yes	Required by NCP and USEPA guidance as a baseline for comparison to other process options
Institutional Controls	Institutional Controls	Proprietary Controls, Enforcement Tools, Information Devices, Deed Restrictions, and Classification Exception Area	Moderate	Standard practice for protecting human health and the environment, effectiveness governed by maintenance of ICs	Moderate-High	Generally implementable but requires close coordination of regulatory authorities	Low	Low capital and O&M costs	Yes	Considered in conjunction with other technologies; standard practice for long-term management of former industrial sites
Monitored Natural Attenuation	Monitored Natural Attenuation	Monitored Natural Attenuation	Moderate	Effective for preventing exposure pathways and some constituents are susceptible to natural attenuation processes	High	Readily implementable	Low	Low capital and O&M costs, existing infrastructure can be used for groundwater monitoring	Yes	Conventional technology; can be used in conjunction with other technologies
Containment	Infiltration Control	Soil Cap	Low-Moderate	Effectiveness at reducing leaching to groundwater is likely limited	Moderate	Readily implementable, uses standard equipment and materials	Moderate	Moderate capital and low to moderate O&M costs	Yes	Standard capping technology; can be used in conjunction with other technologies
	Barriers	Trenched Cut-off Wall	Moderate	Generally effective at controlling contaminant migration	Moderate	Conventional technology, implementability only limited by geology	High	High capital costs given depth and nature of groundwater contamination		Less effective than other remedial technologies
		Sheet Piling	Low-Moderate	Limited effectiveness given site conditions	Moderate	Conventional technology, implementability only limited by geology	Moderate-High	Moderate to high capital costs	No	Less effective than other remedial technologies
		Permeable Reactive Wall	Moderate	Generally effective at controlling contaminant migration	Moderate	Conventional technology, implementability only limited by geology	High	High capital costs	Yes	Conventional technology; can be used in conjunction with other technologies
		Groundwater Extraction	Moderate	Generally effective in controlling contaminant migration, reduces the mobility and volume of constituents within groundwater	Moderate	Conventional technology, implementability only limited by geology	Low-Moderate	Low to moderate capital and O&M costs	No	Less effective than other remedial technologies
		Groundwater Recovery Trenches	Moderate	Generally effective at controlling contaminant migration	Moderate	Conventional technology, implementability only limited by geology	High	High capital costs given depth and nature of groundwater contamination	No	Less effective than other remedial technologies
In-Situ Treatment	Physical	Soil Vapor Extraction	Moderate-High	Removes VOCs from the subsurface for ex-situ treatment, effectiveness depends on the geology	Moderate-High	Standard technology and equipment, as with effectiveness, implementability depends on the geology	Moderate	Moderate capital cost associated with well install and equipment; low to moderate O&M	Yes	Conventional technology; can be used in conjunction with other technologies
		Air Sparging	Moderate-High	Removes VOCs from the subsurface for ex-situ treatment, effectiveness depends on the geology	Moderate-High	Standard technology and equipment, as with effectiveness, implementability depends on the geology	Moderate	Moderate capital cost associated with well install and equipment; low to moderate O&M	Yes	Conventional technology; can be used in conjunction with other technologies
	Chemical	Ozone	Moderate	Generally effective technology for destruction or susceptible constituents	Low	Ozone distribution is likely to be difficult in the subsurface	High	High capital and O&M costs	No	Difficult to implement and does not offer significant benefit over other technologies
		Fenton's Regent/Hydrogen Peroxide	Moderate	Generally effective technology for destruction or susceptible constituents	Low	Site conditions and depth of groundwater make implementation difficult, significant health and safety concerns during operation	High	High capital and O&M costs	No	Difficult to implement and does not offer significant benefit over other technologies
		Persulfate	Moderate-High	Effective for treatment of susceptible constituents (i.e. VOCs), proven technology for this application	Moderate	Generally implementable using standard equipment and materials	Moderate-High	Moderate-high capital and O&M costs	Yes	Conventional technology; can be used in conjunction with other technologies
		Permanganate	Moderate-High	Effective for treatment of susceptible constituents (i.e. VOCs), proven technology for this application	Moderate	Generally implementable using standard equipment and materials	Moderate-High	Moderate-high capital and O&M costs	Yes	Conventional technology; can be used in conjunction with other technologies
	Biological	Enhanced Reductive Dechlorination	Moderate-High	Effective for treatment of susceptible constituents (i.e. CVOCs), proven technology for this application	Moderate	Generally implementable using standard equipment and materials	Moderate	Moderate capital and O&M costs	Yes	Conventional technology; can be used in conjunction with other technologies
		Aerobic Bioremediation	Moderate-High	Effective for treatment of susceptible constituents (i.e. VOCs), proven technology for this application	Moderate	Generally implementable using standard equipment and materials	Moderate	Moderate capital and O&M costs	Yes	Conventional technology; can be used in conjunction with other technologies
Ex-Situ Treatment	Physical	Air Stripping	Moderate-High	Effective for removal of VOCs from aqueous waste stream, requires air treatment/discharge	High	Conventional water treatment technology	Moderate	Moderate capital and O&M costs	Yes	Standard and effective treatment for relatively high concentrations of VOCs
		Carbon Adsorption	Moderate-High	Effective for removal of VOCs from aqueous or vapor waste stream, not as effective for some VOCs (i.e., vinyl chloride)	High	Conventional water treatment technology	Low-Moderate	Low to moderate capital and O&M costs	Yes	Standard and effective treatment for VOCs
	Chemical	Ion-Exchange	High	Highly effective for ex-situ treatment of metals	High	Conventional Technology	Moderate	Moderate capital costs; moderate O&M costs	Yes	Effective and proven when used in conjunction with other technologies
		Precipitation	Low-Moderate	Presence of multiple metals species may be difficult to treat	Low-Moderate	Sampling and disposal of sediment will be required	High	High capital costs; high O&M cost	Yes	Effective and proven when used in conjunction with other technologies
Disposal/ Discharge	Disposal	Off-Site Landfill	High	Effective disposal method for treatment media associated with ex-situ groundwater treatment	Moderate-High	Landfilling is a proven and accepted technology, characterization required to find appropriate disposal facility	Moderate-High	Disposal costs are dictated by volume and whether materials are hazardous or non-hazardous	Yes	Off-site landfill is a proven and standard disposal method
	Discharge	POTW	High	Effective and proven technology for the disposal of aqueous waste stream	Moderate	May require permitting and pretreatment of groundwater before discharge into POTW	Low-Moderate	Low to moderate capital and O&M costs	Yes	Considered in conjunction with other technologies
		Reinjection	Moderate	Effective disposal method for treated groundwater	Low	May require permitting and testing prior to reinjection, likely not acceptable to regulatory authorities if other disposal methods available, geology may not accept required flowrate	Moderate	Moderate capital and O&M costs	Yes	Considered in conjunction with other technologies
		Surface-Water Discharge	High	Standard method for disposal of treated water with appropriate permit	Moderate	May require permitting and testing prior to discharge	Low-Moderate	Low to moderate capital and O&M costs	Yes	Considered in conjunction with other technologies

General Notes:
Shaded process options eliminated from further evaluation.

Acronyms and Abbreviations:
IC = institutional control
NCP = National Contingency Plan
O&M = operation and maintenance
POTW = publicly owned treatment works
USEPA = United States Environmental Protection Agency
VOCs = volatile organic constituents