Guidance Document for the Remediation of Contaminated Soils

State of New Jersey
Christine Todd Whitman, Governor

Department of Environmental Protection
Robert C. Shinn, Jr., Commissioner

Prepared By:
Site Remediation Program
Richard Gimello, Assistant Commissioner
January, 1998

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The 1998 Revised *Guidance Document for the Remediation of Contaminated Soils* was prepared by staff in the NJDEP Site Remediation Program under the administration of Richard Gimello, Assistant Commissioner; Anthony J. Farro, Director, Division of Publicly Funded Site Remediation; and Susan Boyle, Director, Division of Responsible Party Site Remediation, with assistance from staff of the Division of Solid and Hazardous Waste.

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<th>Description</th>
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<td>AA</td>
<td>Atomic Adsorption Spectroscopy (inorganics anal.)</td>
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<td>A-280</td>
<td>Amendments to SDWA which establish MCLs</td>
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<td>ACGH</td>
<td>American Conf. of Governmental Industrial Hygienists</td>
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<td>ACL</td>
<td>Alternate Cleanup Levels</td>
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<tr>
<td>ACM</td>
<td>Asbestos Containing Material</td>
</tr>
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<td>ACO</td>
<td>Administrative Consent Order</td>
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<tr>
<td>ADI</td>
<td>Acceptable Daily Intake</td>
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<tr>
<td>AE</td>
<td>Acid Extractable Compounds (AE+10) Part of BN/AE</td>
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<tr>
<td>A/E</td>
<td>Architectural/Engineering</td>
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<tr>
<td>AHERA</td>
<td>Federal Asbestos Hazard Emergency Abatement Act</td>
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<tr>
<td>AHPA</td>
<td>Archaeological Resources Protection Act of 1979</td>
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<tr>
<td>AIC</td>
<td>Acceptable Intake for Chronic Exposure</td>
</tr>
<tr>
<td>AIS</td>
<td>Acceptable Intake for Subchronic Exposure</td>
</tr>
<tr>
<td>AOC</td>
<td>Area of concern (or contamination)</td>
</tr>
<tr>
<td>APF</td>
<td>Assigned Protection Factor</td>
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<tr>
<td>ARARS</td>
<td>Applicable or Relevant and Appropriate Requirements Include Federal or State standards, requirements criteria, or limitations.</td>
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<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
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<td>ASTSWMO</td>
<td>Association of State and Territorial Solid Waste Management Officials</td>
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<tr>
<td>ATSDR</td>
<td>Agency for Toxic Substances and Disease Registry (CDC)</td>
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<tr>
<td>ATTIC</td>
<td>Alternative Treatment Technology Information Center</td>
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<tr>
<td>AWQC</td>
<td>Ambient Water Quality Criteria</td>
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<tr>
<td>BA</td>
<td>Biological Assessment</td>
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<tr>
<td>BCF</td>
<td>Bioconcentration Factor</td>
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<tr>
<td>BDAT</td>
<td>Best Demonstrated Available Technology</td>
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<td>BEI</td>
<td>Biological Exposure Indices</td>
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<td>BOD</td>
<td>Biological Oxygen Demand</td>
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<tr>
<td>BN</td>
<td>Base Neutral Compounds (BN+10, BNE) Part of BN/AE</td>
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<td>BN/AE</td>
<td>Base Neutral/Acid Extractable Compounds, semivolatile</td>
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<td>BTAG</td>
<td>Biological Technical Assistance Group</td>
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<td>BTEX</td>
<td>Benzene, Toluene, Ethyl benzene, xylenes (also BTX)</td>
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<td>BTU</td>
<td>British Thermal Units (heat unit)</td>
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<td>CA</td>
<td>Cooperative Agreement</td>
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<td>CAA</td>
<td>Clean Air Act (Federal)</td>
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<td>CAFRA</td>
<td>Coastal Area Facility Review Act (DEP)</td>
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<td>CAG</td>
<td>Carcinogen Assessment Group (EPA)</td>
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<td>CAMU</td>
<td>Corrective Action Management Unit (RCRA)</td>
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<td>CaPAH</td>
<td>Carcinogen Polycyclic Aromatic Hydrocarbons</td>
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<td>CBI</td>
<td>Confidential Business Information</td>
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<td>CC</td>
<td>Calibration Compound</td>
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<td>CDC</td>
<td>Center for Disease Control</td>
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<tr>
<td>CDDs</td>
<td>Chlorinated Dibenzo-p-dioxins</td>
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<td>CDFs</td>
<td>Chlorinated Dibenzofurans</td>
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<td>CDI</td>
<td>Chronic Daily Intake</td>
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<td>CEAM</td>
<td>Center for Exposure Assessment Modeling</td>
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<td>CEC</td>
<td>Cation Exchange Capacity</td>
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<td>CEPP</td>
<td>Chemical Emergency Preparedness Program</td>
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<td>CERCLA</td>
<td>Comprehensive Environmental Response, Compensation and Liability Act</td>
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<td>Acronyms/Abbreviations (continued)</td>
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<td>CERCLIS</td>
<td>CERCLA Information System</td>
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<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>CGA</td>
<td>Combustible Gas Analyzer</td>
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<tr>
<td>Ci</td>
<td>Curie (radiation unit)</td>
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<td>CIR</td>
<td>Color Infrared</td>
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<tr>
<td>CLP</td>
<td>Contract Laboratory Program</td>
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<tr>
<td>CM</td>
<td>Corrective Measures</td>
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<tr>
<td>CO</td>
<td>Contracting Officer</td>
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<tr>
<td>COD</td>
<td>Chemical Oxygen Demand</td>
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<tr>
<td>CPM</td>
<td>Critical Path Method</td>
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<tr>
<td>CRP</td>
<td>Community Relations Plan</td>
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<tr>
<td>CRDL</td>
<td>Contract Required Detection Limit</td>
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<td>CRQL</td>
<td>Contract Required Quantitation Limit under the CLP</td>
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<tr>
<td>CRS</td>
<td>Cultural Resources Survey</td>
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<tr>
<td>CRRL</td>
<td>Chronic Toxicity Reference Level</td>
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<tr>
<td>CV</td>
<td>Coefficient of Variation</td>
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<td>CVAA</td>
<td>Cold Vapor Atomic Adsorption Spectroscopy</td>
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<tr>
<td>CWE</td>
<td>Clean Water Act</td>
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<td>CZMA</td>
<td>Coastal Zone Management Act of 1972</td>
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<tr>
<td>D</td>
<td>Absorbed Dose (radiation)</td>
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<td>DCF</td>
<td>Dose Conversion Factor</td>
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<td>DL</td>
<td>Detection Limit</td>
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<tr>
<td>DNAPL</td>
<td>Dense Non-Aqueous Phase Liquid</td>
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<td>DNPH</td>
<td>Dinitrophenyl Hydrazine</td>
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<tr>
<td>DO</td>
<td>Dissolved Oxygen</td>
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<td>DOC</td>
<td>Department of Commerce (Federal)</td>
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<td>DoD</td>
<td>Department of Defense</td>
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<tr>
<td>DOI</td>
<td>Department of the Interior (Federal)</td>
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<td>DOT</td>
<td>Department of Transportation</td>
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<td>DPCC/DCR</td>
<td>Discharge Prevention, Containment and Countermeasure Plan/Discharge Cleanup and Removal Plan</td>
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<tr>
<td>DQO</td>
<td>Data Quality Objectives</td>
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<tr>
<td>DRE</td>
<td>Destruction and Removal Efficiency</td>
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<tr>
<td>DTW</td>
<td>Domestic Treatment Works</td>
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<tr>
<td>EA</td>
<td>Endangerment Assessment (also Environ. Assess.)</td>
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<td>EC50</td>
<td>Median effective concentration during a bioassay</td>
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<td>ECD</td>
<td>Electron Capture Detector</td>
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<td>ECRA</td>
<td>Environmental Cleanup Responsibility Act (New Jersey)</td>
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<td>EDD</td>
<td>Enforcement Decision Document</td>
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<td>EE/CA</td>
<td>Engineering Evaluation/Cost Analysis</td>
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<td>EEM</td>
<td>Environmental Evaluation Manual (EPA)</td>
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<td>EHS</td>
<td>Extremely Hazardous Substance</td>
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<td>EIS</td>
<td>Environmental Impact Statement</td>
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<tr>
<td>EO</td>
<td>Executive Order</td>
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<tr>
<td>EM</td>
<td>Electromagnetic (usually refers to a type of geophysics survey)</td>
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<td>EMSL</td>
<td>Environmental Monitoring Support Laboratory, Las Vegas</td>
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<td>EPA</td>
<td>Environmental Protection Agency (Federal-USEPA)</td>
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<tr>
<td>EP</td>
<td>Extraction Procedure</td>
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<td>EPCRA</td>
<td>Emergency Planning and Community Right-to-Know Act</td>
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<td>EPIC</td>
<td>Environmental Photographic Interpretation Center</td>
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EPTox  Extraction Procedure Toxicity Test (leachability Test)
ERA  Expedited Response Action
ERRIS  Emergency and Remedial Response Information System
ERT  Environmental Response Team
ESA  Endangered Species Act of 1973 (Federal)
ESD  Document which Explains Significant Differences to ROD
ESI  Expanded site investigation
FCC  Fiscal Control Center
FEMA  Federal Emergency Management Agency
FID  Flame Ionization Detector
FFS  Focused Feasibility Study
FIT  Field Investigation Team
FIFRA  Federal Insecticide, Fungicide and Rodenticide Act
FMS  Financial Management System
foc  Fraction Organic Carbon in Soil
FPXRF  Field Portable X-Ray Fluorescence (inorganics)
FS  Feasibility Study (See RAA also)
FSP  Field Sampling Plan
FTS  Federal Telephone System
FWPCA  Federal Water Pollution Control Act
FWS  U.S. Fish and Wildlife Service
FY  Fiscal Year
GAC  Granular Activated Carbon
GAO  General Accounting Office
GC  Gas Chromatography
GC/MS  Gas Chromatography/Mass Spectroscopy
GFAA  Graphite Furnace Atomic Absorption Spectroscopy
GIS  Geographic Information System
also General Information Submission (ECRA)
GPC  Gel Permeation Chromatography
GPR  Ground Penetrating Radar
HAP  Hazardous Air Pollutants
HEA  Health and Environmental Assessment
HEAST  Health Effects Assessment Summary Tables
HEEP  Health and Environmental Effects Profile
HHEM  Human Health Evaluation Manual (EPA replaces SPHEM)
HI  Hazard Index (for noncarcinogens)
HMR  Hazardous Materials Regulations
HMTA  Hazardous Materials Transportation Act (Federal)
HOC  Halogenated Organic Compounds
HPLC  High Pressure Liquid Chromatography
HSL  Hazardous Substance List
HSO  Health and Safety Officer
HSWA  Hazardous and Solid Waste Amendments (to SARA)
HQ  EPA Headquarters
HRS  Hazard Ranking System
HRSD  Hazardous Response Support Division
HWS  Hazardous waste sites
IA  Innovative Alternatives
IAG  Inter-Agency Agreement
ICP  Inductively Coupled Plasma Atomic Emission Spectrophotometry
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<td>ID</td>
<td>Infrared Detector</td>
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<tr>
<td>IDL</td>
<td>Instrument Detection Limit</td>
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<tr>
<td>IDLH</td>
<td>Immediately Dangerous to Life or Health</td>
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<td>IEMP</td>
<td>Interim Environmental Monitoring Plan (during design)</td>
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<tr>
<td>IEUBK</td>
<td>Integrated Exposure Uptake Biokinetic Model - EPA model used to develop residential direct contact lead soil cleanup criteria</td>
</tr>
<tr>
<td>IFB</td>
<td>Invitation for bids</td>
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<tr>
<td>IG</td>
<td>Inspector General</td>
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<td>IRIS</td>
<td>Integrated Risk Information System</td>
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<td>IRL</td>
<td>Interagency review letter</td>
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<td>IRM</td>
<td>Interim or Initial Remedial Measure</td>
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<td>ISAL</td>
<td>Interim Soil Action Level(s)</td>
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<td>ISRA</td>
<td>Industrial Site Recovery Act (1070)</td>
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<td>ISV</td>
<td>In Situ Vitrification</td>
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<td>Kd</td>
<td>Soil/Water Partition Coefficient</td>
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<td>Koc</td>
<td>Organic Carbon Absorption Coefficient</td>
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<td>Octanol/Water Partition Coefficient</td>
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<td>KPEG</td>
<td>Potassium Hydroxide/Polyethylene glycol</td>
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<tr>
<td>kV</td>
<td>Kilovolts</td>
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<td>LAER</td>
<td>Lowest Achievable Emission Rate</td>
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<td>LC50</td>
<td>Median lethal concentration in a bioassay</td>
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<tr>
<td>LD50</td>
<td>Dose causing 50% mortality in bioassay</td>
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<td>LDR</td>
<td>Land Disposal Restrictions</td>
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<tr>
<td>LEL</td>
<td>Lower Explosive Limit</td>
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<td>LOAEL</td>
<td>Lowest Observable Adverse Effect Level</td>
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<td>LOD</td>
<td>Limit of Detection</td>
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<td>Level of Effort</td>
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<td>Limit of Linearity</td>
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<td>Limit of Quantitation</td>
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<td>Large Quantity Generator (NJDEP-RCRA)</td>
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<td>MAC</td>
<td>Maximum Achievable Control Technology</td>
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<tr>
<td>MA7CD10</td>
<td>Minimum average 7 consecutive day flow with a statistical recurrence interval of 10 years</td>
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<td>MBE</td>
<td>Minority Business Enterprise</td>
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<td>MCL</td>
<td>Maximum Contaminant Level (for drinking water)</td>
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<tr>
<td>MCLG</td>
<td>Maximum Contaminant Level Goals (for drinking water)</td>
</tr>
<tr>
<td>MDL</td>
<td>Method Detection Limit</td>
</tr>
<tr>
<td>MEK</td>
<td>Methyl Ethyl Ketone (2-Butanone)</td>
</tr>
<tr>
<td>MeV</td>
<td>Million electron volts</td>
</tr>
<tr>
<td>MGD</td>
<td>Million Gallons per Day</td>
</tr>
<tr>
<td>MOA</td>
<td>Memorandum or Agreement</td>
</tr>
<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
</tr>
<tr>
<td>MPRSA</td>
<td>Marine Protection Research and Sanctuaries Act</td>
</tr>
<tr>
<td>MRATS</td>
<td>Major Remedial Action Tracking System (NJDEP)</td>
</tr>
<tr>
<td>MS</td>
<td>Mass Spectrometer</td>
</tr>
<tr>
<td>MS/MSD</td>
<td>Method Spike/Method Spike Duplicate (QA/QC term)</td>
</tr>
<tr>
<td>MSCA</td>
<td>Multi-Site Cooperative Agreement</td>
</tr>
<tr>
<td>MSHA</td>
<td>Mine Safety and Health Administration</td>
</tr>
<tr>
<td>MSDS</td>
<td>Material Safety Data Sheet</td>
</tr>
<tr>
<td>MSP</td>
<td>Medical Surveillance Plan</td>
</tr>
<tr>
<td>MTBE</td>
<td>Methyl Tertiary Butyl Ether</td>
</tr>
<tr>
<td>MUL</td>
<td>Maximum Use Limit (respiratory protection)</td>
</tr>
</tbody>
</table>
### Acronyms/Abbreviations (continued)

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>NAAQS</td>
<td>National Ambient Air Quality Standards</td>
</tr>
<tr>
<td>NAPL</td>
<td>Non-Aqueous Phase Liquid</td>
</tr>
<tr>
<td>NBS</td>
<td>National Bureau of Standards</td>
</tr>
<tr>
<td>NCP</td>
<td>National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 300)</td>
</tr>
<tr>
<td>NEIC</td>
<td>National Enforcement Information Center</td>
</tr>
<tr>
<td>NEPA</td>
<td>National Environmental Policy Act</td>
</tr>
<tr>
<td>NESHAP</td>
<td>National Emission Standards for Hazardous Air Poll.</td>
</tr>
<tr>
<td>NFIP</td>
<td>National Flood Insurance Program</td>
</tr>
<tr>
<td>NHPA</td>
<td>National Historic Preservation Act of 1966</td>
</tr>
<tr>
<td>NIOSH</td>
<td>National Institute for Occupational Safety and Health</td>
</tr>
<tr>
<td>NJAC</td>
<td>New Jersey Administrative Code</td>
</tr>
<tr>
<td>NJDEP</td>
<td>New Jersey Department of Environmental Protection</td>
</tr>
<tr>
<td>NJR</td>
<td>New Jersey Register</td>
</tr>
<tr>
<td>NJSA</td>
<td>New Jersey Statutes Annotated</td>
</tr>
<tr>
<td>NJAPCA</td>
<td>New Jersey Air Pollution Control Act</td>
</tr>
<tr>
<td>NJPCA</td>
<td>New Jersey Pesticide Control Act</td>
</tr>
<tr>
<td>NJPDES</td>
<td>New Jersey Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>NJWPCA</td>
<td>New Jersey Water Pollution Control Act</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanographic and Atmospheric Administration</td>
</tr>
<tr>
<td>NOAEC</td>
<td>No-observable-adverse-effect-level</td>
</tr>
<tr>
<td>NOEC</td>
<td>No-observable-effect-concentration</td>
</tr>
<tr>
<td>NOAEL</td>
<td>No-observed-adverse-effect-level</td>
</tr>
<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>NPL</td>
<td>National Priorities List</td>
</tr>
<tr>
<td>NPS</td>
<td>National Park Service</td>
</tr>
<tr>
<td>NRC</td>
<td>Nuclear Regulatory Commission</td>
</tr>
<tr>
<td>NRHP</td>
<td>National Register of Historic Places</td>
</tr>
<tr>
<td>NTGS</td>
<td>National Technical Guidance Studies</td>
</tr>
<tr>
<td>NTIS</td>
<td>National Technical Information Service</td>
</tr>
<tr>
<td>NVLAP</td>
<td>National Voluntary Laboratory Approval Program</td>
</tr>
<tr>
<td>NWI</td>
<td>National Wetlands Inventory</td>
</tr>
<tr>
<td>OERR</td>
<td>Office of Emergency and Remedial Response</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>Operation and Maintenance</td>
</tr>
<tr>
<td>OMB</td>
<td>Office of Management and Budget</td>
</tr>
<tr>
<td>ORD</td>
<td>Office of Research and Development (EPA - Cinn., Ohio)</td>
</tr>
<tr>
<td>OCHN</td>
<td>Office of Research and Development (EPA - Cinn., Ohio)</td>
</tr>
<tr>
<td>OSC</td>
<td>On-Scene Coordinator</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration, U.S. Department of Labor</td>
</tr>
<tr>
<td>OSWER</td>
<td>Office of Solid Waste and Emergency Response</td>
</tr>
<tr>
<td>OU</td>
<td>Operable Unit</td>
</tr>
<tr>
<td>OVA</td>
<td>Organic Vapor Analyzer</td>
</tr>
<tr>
<td>OWPE</td>
<td>Office of Waste Programs Enforcement</td>
</tr>
<tr>
<td>PA</td>
<td>Preliminary Assessment</td>
</tr>
<tr>
<td>PAC</td>
<td>Project Activity Code</td>
</tr>
<tr>
<td>PAH</td>
<td>Polycyclic (Polynuclear) Aromatic Hydrocarbon</td>
</tr>
<tr>
<td>PA/SI</td>
<td>Preliminary Assessment/Site Investigation</td>
</tr>
<tr>
<td>PCB</td>
<td>Polychlorinated Biphenyls. Syn. - Aroclors</td>
</tr>
<tr>
<td>PCE</td>
<td>Tetrachloroethylene, Syn. - Perchloroethylene, Perc</td>
</tr>
<tr>
<td>pCi</td>
<td>Picocurie (equiv. 10^{-12} Curie radiation)</td>
</tr>
<tr>
<td>PCDD</td>
<td>Polychlorinated Dibenzo-p-dioxins</td>
</tr>
<tr>
<td>PCDF</td>
<td>Polychlorinated Dibenzo-furans</td>
</tr>
<tr>
<td>Acronyms/Abbreviations (continued)</td>
<td></td>
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<tr>
<td>-----------------------------------</td>
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</tr>
<tr>
<td><strong>PEG</strong> Polyethylene Glycol (KPEG - hydrodechlorination)</td>
<td></td>
</tr>
<tr>
<td><strong>PEL</strong> Permissible Exposure Limit</td>
<td></td>
</tr>
<tr>
<td><strong>PF</strong> Protection Factor</td>
<td></td>
</tr>
<tr>
<td><strong>PHA</strong> Public Health Assessment</td>
<td></td>
</tr>
<tr>
<td><strong>PHC</strong> Petroleum Hydrocarbons (see TPH)</td>
<td></td>
</tr>
<tr>
<td><strong>PID</strong> Photoionization Detector</td>
<td></td>
</tr>
<tr>
<td><strong>pKa</strong> Acid Dissociation Constant</td>
<td></td>
</tr>
<tr>
<td><strong>PO</strong> Project Officer</td>
<td></td>
</tr>
<tr>
<td><strong>POETS</strong> Point of entry treatment system (for potable water)</td>
<td></td>
</tr>
<tr>
<td><strong>POHC</strong> Principal Organic Hazardous Constituent (emissions)</td>
<td></td>
</tr>
<tr>
<td><strong>POP</strong> Project Operations Plan</td>
<td></td>
</tr>
<tr>
<td><strong>POTW</strong> Publicly Owned Treatment Works</td>
<td></td>
</tr>
<tr>
<td><strong>PP</strong> Proposed Plan (Equiv. to PRAP)</td>
<td></td>
</tr>
<tr>
<td><strong>PP</strong> Priority Pollutant List, PP+40 - with 40 Tentatively Identified Compounds</td>
<td></td>
</tr>
<tr>
<td><strong>ppb</strong> Parts per billion (ug/Kg, ng/g)</td>
<td></td>
</tr>
<tr>
<td><strong>PPE</strong> Personal Protective Equipment</td>
<td></td>
</tr>
<tr>
<td><strong>ppm</strong> Parts per million (mg/Kg, ug/g)</td>
<td></td>
</tr>
<tr>
<td><strong>ppt</strong> Parts per trillion (ng/Kg, pg/g)</td>
<td></td>
</tr>
<tr>
<td><strong>PRAP</strong> Proposed Remedial Action Plan (Equiv. to PP)</td>
<td></td>
</tr>
<tr>
<td><strong>PRM</strong> Project Response Matrix</td>
<td></td>
</tr>
<tr>
<td><strong>PRP</strong> Potentially Responsible Party</td>
<td></td>
</tr>
<tr>
<td><strong>PSI</strong> Pounds per square inch</td>
<td></td>
</tr>
<tr>
<td><strong>PTFE</strong> Polytetrafluoroethylene (Teflon - trademark)</td>
<td></td>
</tr>
<tr>
<td><strong>PUF</strong> Polyurethane foam sampling media (air sampling media)</td>
<td></td>
</tr>
<tr>
<td><strong>PVC</strong> Polyvinyl Chloride</td>
<td></td>
</tr>
<tr>
<td><strong>q1</strong> Cancer Potency Factor, risk mg/kg body Wt. per day</td>
<td></td>
</tr>
<tr>
<td><strong>QA/QC</strong> Quality Assurance/Quality Control</td>
<td></td>
</tr>
<tr>
<td><strong>QAPP</strong> Quality Assurance Project Plan (also QAPjP)</td>
<td></td>
</tr>
<tr>
<td><strong>QAPMP</strong> Quality Assurance Project Management Plan</td>
<td></td>
</tr>
<tr>
<td><strong>RA</strong> Regional Administrator (EPA)</td>
<td></td>
</tr>
<tr>
<td><strong>RAA</strong> Remedial Alternative Analysis from Section 5 of 7:26E (Equiv. to FS)</td>
<td></td>
</tr>
<tr>
<td><strong>RAGS</strong> Risk Assessment Guidance for Superfund</td>
<td></td>
</tr>
<tr>
<td><strong>RAS</strong> Routine Analytical Services</td>
<td></td>
</tr>
<tr>
<td><strong>RAWP</strong> Remedial Action Workplan, required as per 7:26E-6.2</td>
<td></td>
</tr>
<tr>
<td><strong>RBE</strong> Relative Biological Effectiveness</td>
<td></td>
</tr>
<tr>
<td><strong>RCRA</strong> Resource Conservation and Recovery Act</td>
<td></td>
</tr>
<tr>
<td><strong>RD</strong> Remedial Design</td>
<td></td>
</tr>
<tr>
<td><strong>RD/RA</strong> Remedial Design/Remedial Action</td>
<td></td>
</tr>
<tr>
<td><strong>REL</strong> Recommended Exposure Limit</td>
<td></td>
</tr>
<tr>
<td><strong>REM</strong> Remedial Planning Contractor (for EPA)</td>
<td></td>
</tr>
<tr>
<td><strong>RFA</strong> RCRA Facility Assessment</td>
<td></td>
</tr>
<tr>
<td><strong>RFl</strong> RCRA Facility Investigation</td>
<td></td>
</tr>
<tr>
<td><strong>RfD</strong> Reference Dose, toxicity value for noncarcinogens</td>
<td></td>
</tr>
<tr>
<td><strong>RfD_{dt}</strong> Developmental Reference Dose</td>
<td></td>
</tr>
<tr>
<td><strong>RfD_{s}</strong> Subchronic Reference Dose</td>
<td></td>
</tr>
<tr>
<td><strong>RFP</strong> Request for Proposals</td>
<td></td>
</tr>
<tr>
<td><strong>RFQ</strong> Request for Qualifications</td>
<td></td>
</tr>
<tr>
<td><strong>RI</strong> Remedial Investigation</td>
<td></td>
</tr>
<tr>
<td><strong>RI/FS</strong> Remedial Investigation/Feasibility Study</td>
<td></td>
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</tbody>
</table>
Acronyms/Abbreviations (continued)

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>RIWP</td>
<td>Remedial Investigation Work Plan</td>
</tr>
<tr>
<td>RMCL</td>
<td>Recommended Maximum Contaminant Level</td>
</tr>
<tr>
<td>RMP</td>
<td>Risk Management Plan</td>
</tr>
<tr>
<td>RME</td>
<td>Reasonable Maximum Exposure</td>
</tr>
<tr>
<td>ROD</td>
<td>Record of Decision</td>
</tr>
<tr>
<td>RPD</td>
<td>Relative Percent Difference, $% \text{RPD} = 100 \times \frac{X_1 - X_2}{X_1 + X_2}$</td>
</tr>
<tr>
<td>RPM</td>
<td>Remedial Project Manager (EPA)</td>
</tr>
<tr>
<td>RQ</td>
<td>Reportable Quantity</td>
</tr>
<tr>
<td>RSCRC</td>
<td>Regional Superfund Community Relations Coordinator</td>
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<tr>
<td>RSD</td>
<td>Risk Specific Dose</td>
</tr>
<tr>
<td>also</td>
<td>Relative Standard Deviation (%)</td>
</tr>
<tr>
<td>RTK</td>
<td>Right To Know (Act)</td>
</tr>
<tr>
<td>SAP</td>
<td>Sampling and Analysis Plan</td>
</tr>
<tr>
<td>SAS</td>
<td>Special Analytical Services</td>
</tr>
<tr>
<td>SASS</td>
<td>Source Assessment Sampling System</td>
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<tr>
<td>SARA</td>
<td>Superfund Amendments and Reauthorization Act</td>
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<tr>
<td>SCBA</td>
<td>Self Contained Breathing Apparatus</td>
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<tr>
<td>SCS</td>
<td>Soil Conservation Service</td>
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<tr>
<td>SDWA</td>
<td>Safe Drinking Water Act</td>
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<tr>
<td>SEAM</td>
<td>Superfund Exposure Assessment Manual (EPA)</td>
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<tr>
<td>SES</td>
<td>Site Evaluation Submission (ECRA)</td>
</tr>
<tr>
<td>SF</td>
<td>Slope Factor</td>
</tr>
<tr>
<td>SI</td>
<td>Site Investigation or Inspection</td>
</tr>
<tr>
<td>SIA</td>
<td>Standard Intake Assumption</td>
</tr>
<tr>
<td>SIC</td>
<td>Standard Industrial Classification</td>
</tr>
<tr>
<td>SITE</td>
<td>Superfund Innovative Technology Evaluation Program</td>
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<tr>
<td>SLCP</td>
<td>Secondary Landfill Conventional Parameters</td>
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<tr>
<td>SMP</td>
<td>Site Management Plan</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
</tr>
<tr>
<td>SOW</td>
<td>Scope of Work or Statement of Work</td>
</tr>
<tr>
<td>SPHEM</td>
<td>Superfund Public Health Evaluation Manual (HHEM - new)</td>
</tr>
<tr>
<td>SPOC</td>
<td>Single Point of Contact</td>
</tr>
<tr>
<td>SQC</td>
<td>Sediment Quality Criteria</td>
</tr>
<tr>
<td>SQG</td>
<td>Small Quantity Generator (NJDEPE-RCRA)</td>
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<tr>
<td>SQL</td>
<td>Sample Quantitation Limit</td>
</tr>
<tr>
<td>SSC</td>
<td>Superfund State Contract</td>
</tr>
<tr>
<td>STEL</td>
<td>Short Term Exposure Limit</td>
</tr>
<tr>
<td>SVE</td>
<td>Soil Vacuum (Vapor) Extraction</td>
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<tr>
<td>SVOC</td>
<td>Semivolatile Organic Compounds (same as BN/AE)</td>
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<tr>
<td>SW-846</td>
<td>EPA Test Methods for Evaluating Solid Wastes</td>
</tr>
<tr>
<td>SWDA</td>
<td>Solid Waste Disposal Act</td>
</tr>
<tr>
<td>SWMU</td>
<td>Solid Waste Management Unit (RCRA)</td>
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<tr>
<td>TAL</td>
<td>Target Analyte List (Inorganics)</td>
</tr>
<tr>
<td>TAT</td>
<td>Technical Assistance Team</td>
</tr>
<tr>
<td>TBA</td>
<td>Tertiary (Tert) Butyl Alcohol</td>
</tr>
<tr>
<td>TBC</td>
<td>To be Considered (refers to ARARs)</td>
</tr>
<tr>
<td>TC</td>
<td>Toxicity Characteristic</td>
</tr>
<tr>
<td>TCDD</td>
<td>Tetrachlorodibenzo-p-dioxin, usually 2,3,7,8-TCDD</td>
</tr>
<tr>
<td>TCDF</td>
<td>Tetrachlorodibenzofuran</td>
</tr>
<tr>
<td>TCA</td>
<td>1,1,1-Trichloroethane</td>
</tr>
<tr>
<td>TCE</td>
<td>Trichloroethylene, Syn. - Trichloroethene</td>
</tr>
<tr>
<td>TCL</td>
<td>Target Compound List (TCL+30)</td>
</tr>
</tbody>
</table>
Acronyms/Acronyms (continued)

TCLP  Toxicity Characteristic Leaching Procedure
TCPA  Toxic Catastrophe Prevention Act (New Jersey)
TEF   Toxic Equivalency Factor (risk compared to TCDD)
also Total Ion Chromatogram
TLV   Threshold Limit Value (respiratory protection)
TMDL  Total Maximum Daily Load
TOC   Total Organic Carbon
TSCA  Toxic Substances Control Act
TOX   Total Organic Halogen analysis
TPH   Total Petroleum Hydrocarbons (see PHC)
TRIS  Toxic Release Inventory System
TWA   Time Weighted Average
UCL   Upper Confidence Limit (usually 95%)
UCS   Unconfined Compressive Strength
UEL   Upper Explosive Limit
UGST  Underground Storage Tank (also UST)
USACE U.S. Army Corps of Engineers (also COE)
USATHAMA U.S. Army Toxic and Hazardous Materials Agency
USEPA United States Environmental Protection Agency
USGS  U.S. Geological Survey
UV    Ultraviolet
VO    Volatile Organics (VOC, VOA, VO+10)
VOC   Volatile Organic Compounds
VOST  Volatile Organic Sampling Train (air sampling)
VSP   Vertical Seismic Profiling
VTSR  Verified Time of Sample Receipt
WA    Wilderness Act
also Work Assignment
WBE   Women’s Business Enterprise
WHO   World Health Organization
WP    Work Plan
WPCA  Water Pollution Control Act
WQC   Water Quality Criteria
WSRA  Wild and Scenic Rivers Act
XRF   X-Ray Fluorescence, Syn. (FPXRF) - Field Portable XRF
I. What is in This Guidance Document

Although this Guidance Document for the Remediation of Contaminated Soils provides assistance in choosing an appropriate action at a specific site, the reader is reminded that the Technical Requirements N.J.A.C. 7:26E is the complete and final technical authority for the remediation process. It includes an extensive, although not comprehensive, list of remedial actions that have proven track records or have been stated as being effective by USEPA for remediating soil impacted by particular contaminants. Non-inclusion of a specific type of remedial action in this guidance document does not preclude its use or indicate that it will not be effective for a particular contaminant or situation. It will, however, require justification on a technical basis. Natural attenuation will be considered on a case-by-case basis.

This guidance document describes four types of remedial actions: excavation, treatment, reuse, and capping. Each type is described in its own section but is not intended to provide extensive information on sampling or investigative procedures at a site. Refer to the Technical Requirements (see next section) and the NJDEP Field Sampling Procedures Manual (may be requested by calling 609/777-1038) for extensive information. NJDEP plans to revise this guidance document as needed to reflect changes in technology.

Background

On June 16, 1993, P.L. 1993, c. 139 became effective. This law did the following:

1) amended the Environmental Cleanup Responsibility Act by, among other things, changing its name to the Industrial Site Recovery Act;

2) amended the Spill Compensation and Control Act (P.L. 1976, c. 141) by adding an innocent purchaser defense; and

3) created a new statute which is codified as N.J.S.A. 58:10B-1 et seq.

For all sites, the law intends to accelerate cleanups through streamlining the regulatory process by reducing or eliminating New Jersey Department of Environmental Protection (NJDEP) oversight of remediation activities in certain situations. For Industrial Site Recovery Act sites, the law provides a process to assure that work plans and funds will be in place before an industrial establishment is sold or transferred to remEDIATE any contamination on the facility’s property. The law streamlines the regulatory process through expedited reviews.

Mandate

To assist small businesses in carrying out its provisions, the law requires NJDEP to write regulations and guidance documents. The Guidance Document for the Remediation of Contaminated Soils is one such document and is mandated by Section 38 of P.L. 1993, c. 139 which states:

...The guidance document shall include a description of remedial actions the department determines are effective in remediating soil contamination to the residential or nonresidential use soil remediation standards and that should be considered by a person performing a soil remediation...

Purpose

This guidance document is intended to assist persons (e.g., responsible parties, consultants, businesses, municipalities) conducting remediations in choosing remedial actions which have been determined by NJDEP to be effective or potentially effective in remediating a site for certain contaminants or situations. It should aid in expediting remediations by reducing the time to prepare remedial action workplans and subsequent NJDEP review. It also is expected to be especially useful when a person elects to proceed with a remedial action without NJDEP oversight. However, following this guidance document does not guarantee that every document submitted to NJDEP will be unconditionally approved.
Pertinent Regulatory Changes

On January 6, 1988, Governor Whitman signed into law P.L. 1997, c.278, known as the “Brownfield and Contaminated Site Act” (the “Act”), which amends the Hazardous Site Discharge Contamination Act, N.J.S.A. 58:10B-1 et seq., the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11 et seq., and the Industrial Site Remediation Act, N.J.S.A. 13:1K-1 et seq. The Act provides a more flexible regulatory system to facilitate the remediation of brownfields, those large areas in New Jersey formerly used for commercial and industrial purposes. The Act provides incentives to innocent parties to facilitate the remediation of these sites so that they may be put to productive use.

Due to the enactment of the Brownfield and Contaminated Site Remediation Act on January 6, 1998, it is likely that changes will be made to the rules and regulations which guide the remediation of hazardous sites; in particular, the Technical Requirements for Site Remediation (N.J.A.C. 7:26E), the Department Oversight of the Remediation of Contaminated Sites (N.J.A.C. 7:26C), the Industrial Site Recovery Act (N.J.A.C. 7:26B) and the Regulations Implementing the New Jersey Underground Storage of Hazardous Substance Act (N.J.A.C. 7:14B).

In addition, the Department’s Historic Pesticide Task Force is studying the issue of soils containing arsenic and pesticides and is expected to publish a policy statement during 1998. Any changes that need to be made to this document as a result of that statement will be made accordingly.

Since we anticipate changes to this document throughout the year, please be sure to check with your case manager, refer to the New Jersey Register, or visit the SRP Web Page (http://www.state.nj.us/dep/srp/ List “Regulations and Guidance”) to ensure you are furnished with the most updated information regarding soil remediation.
II. Responsibility and Disclaimer

Responsibility

It is the responsibility of the owner/operator to properly manage and characterize/classify soils and to determine if soils are contaminated. Testing of soils from areas where contamination is unlikely (i.e., residential areas, etc.) is at the discretion of the generator. The possibility that contamination exists is greater in, but is not limited to, soils originating from industrial sites, discharge areas, potentially contaminated fill, and tank areas. Therefore, the NJDEP recommends that owner/operators considering these soils for reuse first perform analytical testing and retain copies of the results.

Disclaimer

The NJDEP has the authority to perform testing and analysis of contaminated soil and to require others to perform this work. (See N.J.S.A. 58:10-23.11 and N.J.S.A. 58:10B.)

Any person who excavates soil which is used/reused remains responsible for any remediation should the soil, and any other media impacted by the soil, be considered unsuitable by the NJDEP. Use or reuse of soil consistent with this document shall not relieve any person from obtaining any and all permits that are required from any federal, state, county or local agency. This document does not grant permission to fill or alter floodplain areas, riparian lands, freshwater wetlands or surface water runoff conditions.
III. The Technical Requirements and Their Role in Site Remediation

The Technical Requirements for Site Remediation (referred to as the Technical Requirements) establishes the minimum regulatory requirements for remediation of contaminated sites in New Jersey. The Technical Requirements became effective on July 1, 1993, and were readopted with amendments on February 18, 1997. These regulations are part of the New Jersey Administrative Code (N.J.A.C. Section 7:26E).

Most libraries have the New Jersey Administrative Code. If you wish to purchase a copy of the Technical Requirements for Site Remediation (7:26E), it can be obtained from West Publishing (800) 808-WEST, or you can download it from the Site Remediation Program BBS by phoning (609) 292-2006 or the SRP Web Page at http://www.state.nj.us/dep/srp (Select the Regulations & Guidance topic).

The Guidance Document for the Remediation of Contaminated Soils is a supplement to, and should not be used in place of, the Technical Requirements. Please refer to the Guidance Document for the Remediation of Contaminated Soils when reading those parts of the Technical Requirements that refer to soil remediation to obtain more information on soil remediation technologies.

Electronic Data Submittals for Investigation of Contaminated Sites

In response to a departmental effort to allow internal and external data sharing, SRP has recently initiated a process for the electronic submission and collection of environmental data. Requirements for electronic data submissions and Geographic Information System (GIS)-compatibility are included in the Technical Requirements. They require that results from the analysis of environmental samples must be provided in an electronic format, and that every sample point must be provided with its coordinate location in either State Plane Feet or Latitude and Longitude.

To facilitate the regulated community’s implementation of the new requirements, several resources and guidance documents have been developed and are available on the DEP Bulletin Board at (609) 292-2006 and on the DEP Home Page at http://www.state.nj.us/dep/srp under the “Regulations and Guidance” topic. Acceptable formats for submitting electronic samples can be found on the Home Page and include: HAZSITE4; .wk1 or .dbf (detailed in the SRP-EDI Manual); ASCII; and EQWIN. The Home Page also includes a routine for an administrative and completeness check of submitted data (EDSA), and guidance on development of GIS-compatible maps and on determining coordinates for sample points (TECHGIS). The SRP has set up a help desk for questions and comments. The regulated community may email hazsites@dep.state.nj.us at any time for assistance. SRP staff will provide direct assistance over the phone at (609) 292-9418.

Electronic data submittal will allow the SRP to manage volumes of analytical data in a form that SRP representatives can easily retrieve, and automate a large portion of the review steps now performed manually. On a larger scale, the new requirements will allow use of GIS for evaluation of SRP data, enabling the generation of contaminant contour site maps or verification of ones provided. As these sites are linked to GIS, other DEP programs will be able to quickly identify the presence of contaminated sites and additional important data to be used in the many ongoing projects that are taking a whole-system approach to environmental management. Access for the public will be developed in the future through the application of Internet technology and the preparation of CDs that contain the relevant information. The electronic system will allow for automated development of environmental indicators, the measures chosen to evaluate the actual environmental progress achieved at sites. Examples of indicators under development by SRP include areal extent of soil and ground water contamination and change over time. Development of these and other indicators will be facilitated by electronic data submission.

Natural Remediation

The Department does, on a case-by-case basis, consider natural remediation as a remedial option for soils that require remediation. However, this document provides only limited guidance on “enhanced” bioremediation technologies (See Section VI. B.). It should be noted that current Department policy is to require treatment or removal of any continuing sources of contamination, whenever practicable, prior to approval of any type of natural remediation efforts.
Institutional and Engineering Controls

An institutional control is a mechanism used to limit human activities at or near a contaminated site, or to ensure the effectiveness of the remedial action over time, when contaminants remain at a site at levels above the applicable remediation standard which would allow for the unrestricted use of the property. Institutional controls include, without limitation, structure, land and natural resource use restrictions, well restriction areas, classification exception areas, deed notices and declarations of environmental restrictions.

An engineering control means any physical mechanism to contain or stabilize contamination or ensure the effectiveness of a remedial action. Engineering controls include, without limitation, caps, covers, dikes, trenches, leachate collection systems, signs, fences and access controls.

Historic Fill

N.J.A.C. 7:26E (Technical Requirements for Site Remediation) established a procedure through which a person can identify historic fill material. N.J.A.C. 7:26E-1.8 defines historic fill. Identification of historic fill should be done in the beginning of the remediation process.

For historic fill assumed to be contaminated, sampling and analysis requirements are provided at N.J.A.C. 7:26E-4.6(b). Proving historic fill is not contaminated is done on a case-by-case basis. N.J.A.C. 7:26E-4.6 provides an option during the remedial investigation to utilize the Department’s historic fill database (Table 4-2) when evaluating historic fill material at a site.

The Department will require a ground water investigation at N.J.A.C. 7:26E-3.12(c) and at N.J.A.C. 7:26E-4.6(b)6 if the historic fill site is in an area such as a potable water use area.

N.J.A.C. 7:26E-6.2(c) provides, as a presumptive remedy, that institutional and engineering controls may be proposed to remediate historic fill at a site.

Remedial Action Types

There are four types of remedial actions for contaminated soils discussed herein—excavation, treatment, reuse and containment and exposure controls—which, along with the off-site disposal option, may be used separately or in some combination. This section illustrates their general relationship. When soil is determined to be contaminated as defined in the Technical Requirements, there are several remediation options. Contaminated soils may be: Treated through a chemical, physical or biological process in situ (in place) or ex situ (in an above ground process unit either on or off-site); Excavated—dug up (for onsite or offsite handling); or Contained—covered or encapsulated. If the soil is Excavated, it may be: Treated, Reused, Disposed of, or Contained. Sometimes an Interim Remedial Measure (temporary), such as a capping system or free product removal system, will be utilized on a site to contain or stabilize the contamination until further evaluation is completed. After Treatment, the treated soil may be returned to the site or reused off-site. See the specific technical sections for a detailed discussion of four of the remedial action types: Excavation, Treatment, Reuse, and Containment. The following diagram illustrates the general relationships among the five remedial action types:
Compliance with Other Laws

Any selected remedial action for soil contamination must be consistent with other applicable or relevant federal, state or local laws or regulations. If a remedial action does not comply with other applicable laws, then the remedy is not implementable and would not be approved by the Department. The person responsible for conducting the remediation must identify all applicable and/or relevant laws and regulations and may seek assistance with this effort from the Department.

The Remediation Process

This section is a general description of the remediation process of a contaminated area.

The typical remediation process includes the following sequence of steps:

1. **Preliminary Assessment (PA):** Preliminary Assessment means the first phase in the process of identifying areas of concern pursuant to N.J.A.C. 7:26E-3. Background information is collected to determine whether or not further investigation is required. The Preliminary Assessment determines if there are probable areas of contamination, and whether hazardous substances were used/handled onsite or have been discharged in the past. See Technical Requirements N.J.A.C. 7:26E-3.1 and 3.2.

2. **Site Investigation (SI):** Site Investigation means the collection and evaluation of data necessary to determine whether or not contaminants exist at the site which fail to satisfy the applicable remediation standard. The requirements of a site investigation are set forth at N.J.A.C. 7:26E-3. The site is visually inspected and soil and/or ground water samples are obtained and analyzed.

3. **Remedial Investigation (RI):** Remedial investigation means actions to investigate contamination and the problems presented by a discharge. The requirements of a remedial investigation are set forth at N.J.A.C. 7:26E-4. The Remedial Investigation is an extensive analytical study of the site and may include additional soil, ground water, surface water, sediment, biota and/or waste samples. The Remedial Investigation is used to make the final determination of the nature and extent of contamination and to determine if the contaminants are migrating. The Remedial Investigation identifies current or potential problems caused by the contamination and potential receptors. The data collected in the Remedial Investigation assists in the evaluation and selection of the appropriate remedial action. For less
complicated sites, it may be possible to meet the Preliminary Assessment and Site Investigation requirements within the Remedial Investigation, thereby completing the Preliminary Assessment, Site Investigation, and Remedial Investigation in a single phase. See Technical Requirements N.J.A.C.7:26E-4.

4. **Remedial Action Selection:** Remedial Action Selection means the process of selecting the most appropriate remedy for a site or area of concern that will ensure protection of the public health, safety, and the environment, based upon careful consideration of a variety of factors, including without limitation, future site use, surrounding land uses, remediation goals and objectives, cost, implementability, reliability and effectiveness. The requirements for remedial action selection are provided at N.J.A.C. 7:26E-5. The process is an analysis of the possible methods (i.e., remedial actions) to clean up the contaminated soil. It is in this step that one or more technologies listed in this guidance document could be selected. Also, the analysis may conclude that a “no action” remedy be selected if the contamination does not represent a threat to human health, safety or the environment.

5. **Remedial Action (RA):** Remedial action means those actions taken at a contaminated site as may be required by the Department, including, without limitation, removal, treatment, containment, transportation, securing, or other engineering or institutional controls, whether of a permanent nature or otherwise, designed to ensure that any discharged contaminant is remediated in compliance with the applicable remediation standards. The requirements for remedial actions are provided at N.J.A.C. 7:26E-6. A Remedial Action Workplan (RAW) should be prepared to describe in detail how the remedial action will be implemented. See Technical Requirements N.J.A.C. 7:26E-6.

6. **Operation, Maintenance and Monitoring (O&M):** This includes any remedial action that leaves contaminated media onsite, and will require some level of long term maintenance and monitoring of any engineering and/or institutional controls. Pursuant to the provisions at N.J.A.C. 7:26E-6.1(b)5, for limited restricted or restricted remedial actions for soil contamination, the property owner must reevaluate the action at least every 5 years (or at a frequency determined by the Department) to ensure that any engineering and/or institutional controls are still protective of human health and the environment. Such reevaluation must be reported to the Department.

In many situations, the person responsible for conducting the remediation may proceed with steps 1 through 4 above, without prior NJDEP approval or with approval later in the remediation process. (See the following sections of P.L. 1993, c 139:4f, 4h, 4I, 9, 15, 16, 17, 18 and 43.) However, pursuant to N.J.A.C. 7:26E-1.12, sites (1) with “immediate environmental concern” conditions and, (2) suspected or known to be contaminated with radionuclide material must be investigated and remediated with Department oversight in accordance with N.J.A.C. 7:26C. All persons conducting remediation activities must notify the Department Action Line at 609/292-7172 and the appropriate Municipal Clerk(s) pursuant to the provisions at N.J.A.C. 7:26E-1.4(a).

It is the responsibility of the persons conducting the remediation to perform the necessary studies and investigations and provide sufficient information on which to base a remedial action selection. Certain remedial actions are highly site-specific and may require treatability studies (pilot or bench scale) to evaluate the effectiveness of a technology at a particular site.

Various steps within the site remediation program process may be combined for efficiency, cost savings or other site specific conditions. Pursuant to the provisions at N.J.A.C. 7:26E-1.6, the Department provides flexibility in complying with the Technical Requirements and allows for variation from specified provisions throughout the regulation. Also, all the required information for the Preliminary Assessment, Site Investigation, Remedial Investigation, and Remedial Action Selection and Remedial Action can be combined into a single report which documents the completion of the remedial action in accordance with the Technical Requirements.

**Soil Cleanup Criteria and Other Contaminated Media**

NJDEP has established Soil Cleanup Criteria (current copy provided in Appendix A) to provide guidance in establishing site-specific cleanup levels. Changes to the Soil Cleanup Criteria will be found in the Site
Other criteria, such as environmental impacts, site-specific conditions and background levels, may also be considered, which could result in a site-specific cleanup level that differs from the Soil Cleanup Criteria levels found in Appendix A. Therefore, the Soil Cleanup Criteria levels should not be assumed to represent approval by NJDEP of any remedial action conducted to these levels or to represent NJDEP’s opinion that a site requires remediation. The Soil Cleanup Criteria are to be used as indicators that a cleanup might be required. All proposed site-specific cleanup levels that exceed the Soil Cleanup Criteria must be approved by NJDEP. Questions concerning the derivation of a particular soil cleanup criteria should be directed to the Environmental Toxicology and Risk Assessment Unit, Bureau of Environmental Evaluation and Risk Assessment in the Site Remediation Program, at 609/633-1348.

At a site with contaminated soil, other media (e.g., ground water, air, surface water, and sediments) could be impacted. Ecological impacts to wetlands and other sensitive ecosystems may occur also. These other impacts will be determined during the Preliminary Assessment, Site Investigation, and/or Remedial Investigation steps of the remediation process.

For state regulations on ground water quality standards, please refer to N.J.A.C. 7:9-6.1 et seq. For state regulations on surface water quality standards, please refer to N.J.A.C. 7:9B.

**NJDEP Oversight**

The *Department Oversight of the Remediation of Contaminated Sites* regulations are located in N.J.A.C. 7:26C.

To obtain NJDEP oversight of remediation activities at industrial establishments not subject to the Industrial Site Recovery Act (Public Law 1993, chapter 139) or the Underground Storage of Hazardous Substances Act N.J.S.A. 58:A-21, a person may enter into a Memorandum of Agreement with NJDEP under the Voluntary Cleanup Program. Information regarding the Voluntary Cleanup Program can be obtained by calling the Case Assignment Section of the Division of Responsible Party Site Remediation at 609/292-2943. A Memorandum of Agreement requires the person conducting the remediation to pay all NJDEP oversight costs incurred with the remediation. A person conducting a remediation may select comprehensive NJDEP oversight throughout all stages of the remediation or may choose to have NJDEP review periodic outputs, as specified in the Memorandum of Agreement.

To obtain NJDEP advice on how to proceed using a selected remedial action at a site where NJDEP has oversight responsibility, to speak with the case manager assigned to a site, to obtain information on the Voluntary Cleanup Program, or for other program information, please call the Division of Responsible Party Site Remediation at 609/633-1408.
IVA. General Technical Considerations

Information in the four sections that follow — Community Relations, Ground Water, Restoration, and Health & Safety Considerations — is applicable to the four types of remedial actions discussed in this document: Excavation, Treatment, Reuse, and Capping.

Community Relations

NJDEP recognizes the importance of early coordination and communication with local communities regarding sites undergoing remedial investigations or cleanup actions. Local governing bodies can facilitate remedial efforts since they are familiar with present and planned land uses as well as local policies and concerns. NJDEP advises that persons remediating a site that they are required to notify the municipal clerk in writing prior to the implementation of the remedial action, allowing for early coordination with local officials. Please refer to the Technical Requirements (N.J.A.C. 7:26E-1.4) for further guidance.

Additionally, NJDEP advises the person conducting a remedial action to use their judgment as to whether further notification is appropriate. The person may want to notify the local government health agency in order to prepare the official for any human/ecological health related questions. In situations where a person is bringing in heavy equipment or will have workers in protective gear, the person may want to alert residents in close proximity beforehand in order to avoid undue alarm. These actions often help avoid additional problems and delays.

Ground Water

At sites with contaminated soil, ground water may be impacted also. Therefore, ground water may need to be evaluated for possible contamination. This section familiarizes the person with some aspects of ground water evaluation and treatment.

For regulatory information on when ground water evaluations are required and the requirements for performing them, please refer to Technical Requirements N.J.A.C. 7:26E-1.7, 7:26E-3.7 and 7:26E-4.4.

The extent of a ground water investigation depends on site conditions. It may be a very simple process, consisting of one ground water sample taken near a contaminated soil area. If the ground water sample is below the contaminant levels indicated in the Ground Water Quality Standards (N.J.A.C.7:9-6), the ground water investigation is usually complete. For more complicated sites, a ground water evaluation may be appropriate to determine depth to ground water, local and regional ground water flow directions, flow gradients, recharge areas, discharge areas, and aquifers used by private and public water supply wells. This information can be obtained from monitor wells, United States Geological Survey reports, New Jersey Geological Survey reports, state well databases, and logs of public water supply companies. Also, ground water samples may need to be taken to determine the extent and type of contamination. A geotechnical evaluation may be needed to determine the physical properties of the subsurface soil.

Well pairs are used to determine the vertical direction of flow between the water table and a lower aquifer and may be required. Samples from the deep well of the well pair can be analyzed to determine if contamination detected by the shallow well has entered the lower aquifer. Wells penetrating shallow aquifers must be constructed using procedures to prevent them from becoming conduits for contamination to deeper aquifers.

Restoration

Investigating and remediating a site might alter site conditions and the site may have to be restored to its pre-remediation conditions. This section familiarizes the person conducting a remediation with some aspects of restoration.

The extent of restoration depends on site-specific conditions and the remedial action chosen. Permits may be required.
It is suggested that persons conducting remediations consult with the case manager assigned to the site.

1. **Technical Requirements**

   According to the Technical Requirements, N.J.A.C. 7:26E-6.4(b), “All areas subject to remediation shall be restored, to the extent practicable, to pre-remediation conditions with respect to topography, hydrology and vegetation, unless alternate restoration is approved by the Department.” Please refer to this section of the Technical Requirements for the regulatory information about restoration.

2. **As-Built Measurements**

   If applicable, as-built measurements should be taken for use in preparation of drawings of the post-construction remediated area. As-built measurements are measurements generally in the form of a survey plan, cross section, or other scale drawing of the completed excavation and/or restoration.

3. **Backfilling**

   Usually, backfilling should occur after the cleanup objectives have been met. In general, the following information should be submitted to NJDEP: proof that the backfill is clean (7:26E-1 et seq.); the name of the person providing the clean endorsement; that person’s relationship to the source providing the backfill; and the bill of lading documenting the source. Backfill should, to the extent practicable, have physical properties similar to the material which was removed unless specified by NJDEP. Sites located in or adjacent to “wetlands” or “critical habitat areas” may have to meet requirements of N.J.A.C. 7:7E (Coastal Zone Management Regulations) or N.J.A.C. 7:7A (Fresh Water Wetlands Act Regulations).

4. **Areas for Development**

   In areas that might be developed, field inspection, and in situ testing of portions of the backfilled and compacted material should be performed. ASTM Method D-2216 (Sand Cone Method) or ASTM D-3017 (various nuclear methods) are available that will give quantitative measurements relative to construction performance. Equipment such as vibratory rollers, or ancillary attachments such as plate tampers and compactor rollers, are available for trackhoes and backhoes as bucket replacements.

5. **Impermeable Layers**

   In areas where impermeable geologic layers are encountered and breached, backfill of similar hydraulic characteristics should be placed.

6. **Vegetation and Grading**

   Restoration of the vegetative soil layer should be performed to the extent practicable. This includes applying seed and mulch in prepared areas at recommended rates. New Jersey Department of Agriculture’s “Standards for Soil Erosion and Sediment Control in New Jersey” details methods and acceptable practices for restoration of turned areas. Trees and other vegetation which were removed should be restored to the extent possible with nursery grown trees of the same species. The site should be graded to reflect pre-existing conditions using information gathered during the preconstruction topographic survey.

7. **References**

   NJDEP has formulated checklists to aid in preparation of Remedial Action Plans which may be useful in developing a course of action at a site. (See “E. References” under Section III, “Remedial Action I — Excavation.”)

**Health and Safety Considerations**

Consideration for soliciting candidate contractors for hazardous waste removal might include reviewing the following:
1. The presence of a written corporate internal health and safety program as mandated by the federal Occupational Safety and Health Administration, U.S. Department of Labor, 29 C.F.R. 1910.120, which must address, at a minimum, the contractor’s individual:
   a. Organizational Structure: Establishes a specific chain of command and specifies the overall responsibilities of supervisors and employees;
   b. Comprehensive Workplan: Addresses the tasks and objectives of the site operations and the logistics and resources required to reach the identified tasks and objectives;
   c. Safety and Health Training Program: Outlines the basic training regimen(s) required for specific tasks and objectives performed by the company;
   d. Medical Surveillance Program (MSP): Establishes medical monitoring contents and criteria for company personnel who potentially are exposed to hazardous substances in the field and who wear respiratory devices 30 or more days in a year;
   e. Site-Specific Health and Safety Plan (HASP): Addresses site-specific health and safety concerns and requirements dependent upon the site’s characteristics and operations as well as period and duration of operation. Included in the Health and Safety Plan are explicit requirements relative to the site such as, but not limited to: employee training; personal protective equipment projected for the site; medical surveillance particular to potential site exposure: frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques; site control measures to repress personnel exposure to hazardous substances by zonation of the site operations according to areas of contamination and procedures for site emergencies; safe work practices and identification of medical assistance; decontamination procedures to minimize personnel contact with hazardous substances and equipment thereof; emergency response plan necessary to effectively handle anticipated emergencies prior to an actual emergency, (e.g., lines of authority, evacuation, critique, and emergency equipment) confined space entry procedures; and spill containment procedures should transfer, transport or disposal of hazardous material be necessary;
   f. Standard Operating Procedures for Health and Safety:
      Example: Drilling Procedures, Safe Backhoe Operation Procedures, and Excavating Procedures;
   g. How subcontractors will be informed of emergency response procedures and any potential fire, explosion, health, safety, or other hazards present at any site at which they are hired to perform work.

2. The frequency and circumstances of the company’s record of contacting the NJDEP Hotline because of a hazardous substance spill or other release to the environment. This information may be indicative of the company’s application of lawful operating procedures.

3. The frequency and number of occupationally related injuries and illnesses. This information is also indicative of the company’s application of safe operating procedures.

4. The number of Occupational Safety and Health Administration violations received as a result of inadequate site operations. This information may be verified by contacting the Occupational Safety and Health Administration via phone and, as needed, more extensively through a mail-in request. Requests should state explicitly that the inquiry is being made under the Freedom of Information Act and should detail as much information as possible regarding the company’s location, activity, and suspected violation. The Occupational Safety and Health Administration offices are located throughout New Jersey and requests should be made to the local office serving the particular area where the company is located, as follows:
OSHA Avenel Office 732/750-3270
Serves Hunterdon, Middlesex, Somerset, Union and Warren Counties.

OSHA Hasbrouck Heights Office 201/288-1700
Serves Bergen and Passaic Counties.

OSHA Parsippany Office 973/263-1003
Serves Essex, Hudson, Morris and Sussex Counties.

OSHA Marlton Office 609/757-5181
Serves Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Monmouth, Ocean and Salem Counties.

Example: Information on XYZ Co. located in Camden, New Jersey, may be obtained by contacting the Occupational Safety and Health Administration office located in Marlton, which services southern New Jersey.
V. Remedial Action 1 — Excavation

A. Introduction

Excavation is probably one of the most common activities of remediation. Excavation, in general, involves the removal of material from the ground for disposal, reuse, or treatment.

Excavation can generally be used in all phases of a remediation — from assessment of conditions at a site, to construction and, ultimately, closure. Practically all contaminated soil remediation technologies require some form of materials handling or excavation, with the exception of some of the in situ treatment technologies including soil venting, bioremediation, stabilization and bioattenuation. Also, many non-remedial activities involve excavation such as the performance of test pits and the installation of slurry walls and collection systems.

Excavation often is used at sites where site conditions preclude on-site treatment, stabilization, or capping. Also, excavation and off-site treatment or disposal often is used at sites where persons conducting remediation do not want to have on-site contamination and the associated liability connected with their property. However, if the material is removed from the site and disposed of without treatment, there still may be long-term liability for management of the material at a treatment, storage, or disposal location. If landfilling or other off-site disposal is the chosen remedial action, care should be taken to ensure that the receiving facility is properly permitted to accept the type of material being disposed of and is in compliance with all permit conditions.

The following factors are some of the reasons why excavation is used more often as part of a remedy, rather than as the remedy at contaminated sites:

• Excavation has many hidden costs. Transportation, treatment, tipping fees, liability, and regulatory restrictions may become part of the cost of excavation;
• Advances in remedial technologies which make it possible to stabilize or decontaminate soils on-site are helping to allow the use of more cost effective remedies that take land use into consideration;
• The capacity of permitted land disposal facilities is limited; and,
• Public awareness of environmental contamination and regulatory disposal restrictions have reduced the number of locations at which persons can legally dispose of contaminated materials without pre-treatment.

The decision whether or not to excavate contaminated materials can depend on many factors, particularly when the contaminants consist of toxic, pyrophoric, pressurized, radioactive, reactive, explosive, or ignitable materials. Other specialized methods, which may or may not include excavation, require careful consideration.

The variability of site conditions and contaminant types requires site-specific combinations of remedial actions to be developed for each site.

B. Planning

1. Conditions Affecting Use of Excavation

Special equipment considerations (for use in hazardous environments):

a. Volume to be Handled

The volume of contaminated soils to be handled affects the size of the equipment needed to perform the removal efficiently and subsequent transport, storage, and disposal options. Material density and the percentage that the material “swells” when disturbed affect the volume after the material is excavated. Generally, soil material in its natural state has fewer pockets or voids than it does post excavation. Some materials, such as clays, may swell up to 40 percent of their original volume, with 10 to 15 percent being the average for sands and gravels.
b. Location

The location of the area to be excavated affects the type, size, operating cost, and efficiency of the equipment. The location also affects the nature of the operations at the site with regard to safety and regulatory concerns (wetlands, special use areas, flood elevation considerations, and air monitoring requirements). Excavation to great depths or in complex hydrogeologic environments also can impact the use of excavation as a remedy and, in some instances, can make excavation technically impractical.

c. Type of Soils and Contamination to be Handled

The type of soil and contamination to be handled not only affects the choice of equipment and other factors mentioned above but also dictates the choice of personal protective equipment necessary for worker protection, the type of monitoring required, and the need for special adaptations to excavation equipment. Toothed buckets, drum grapplers, pressurized cabs, splash shields, supplied air to operators, and other special adaptations may be necessary in areas where material being excavated is toxic, explosive, reactive, or otherwise dangerous to handle. These factors also need to be considered when determining the type of decontamination procedures, material staging, or storage requirements.

d. Pre-treatment Requirements

Pre-treatment requirements are: (1) remedial action dependent and (2) site-specific. Segregation, debris removal, sizing, and moisture content of the material to be disposed of or treated will play a role in the choice of equipment and methods to excavate or remove the contaminated soil. Some of the pre-treatment requirements for each remedial action type are described in Section VI, “Remedial Action 2 — Soil Treatment Technologies for Contaminated Soils,” of this document. For example, excavation processes or methods which require the addition of water to soils being excavated, such as for dust suppression, might interfere with or add cost to treatments which require dry materials. Also, contaminated soils excavated or dredged from below the water table can require dewatering procedures and associated ancillary equipment and increase the cost of the project.

e. Standard Engineering Practices

Standard engineering practices should be followed when performing excavation at contaminated sites.

During excavation, there are multiple situations which will require methods to prevent the walls of the excavation from slumping into the hole. The following situations are examples of when and why shoring of an excavation may be necessary:

1. Worker protection;
2. Protection for adjacent structures;
3. Segregation of clean material which would otherwise cave into or mix with contaminated material; and,
4. Prevention of ground water infiltration to areas being excavated at or below the water table.

When mechanical shoring or trench boxes are used, pre-engineered devices are placed into the excavation which are rigid and strong enough to hold back potential cave-ins. There are many types, most of which are made up of large plates separated by adjustable brackets or hydraulic pistons that can be extended outward to apply pressure against the sides of the excavation to prevent caving.
Sheeting pile or coffer dams consist of interlocking, corrugated steel sheets that are driven in by conventional pile installation techniques. These devices may be used to impede the infiltration of water into the excavation from the side walls of the excavation.

An innovative method known as freeze wall technology is available. Wells are installed in a line along the desired area to be stabilized, usually several feet apart depending on site conditions. Once in place, piping is installed which conveys refrigerated brine from trailer-mounted refrigeration units to each of the wells. Water contained in the soils and sediments, or in voids in bedrock, is cooled below freezing, creating a wall of ice that cements the soil together. This technology can be applied to depths as great as 250 feet. It provides structural integrity as well as an effective barrier against contaminant migration and ground water infiltration.

Water infiltrating an excavation can create many problems during a remediation. The water itself may be contaminated with pollutants which present a contact or other hazard. The infiltration of the water itself can suspend soil or sediment undermining the base or “toe” of slopes, causing the failure of that wall and slumping into the excavation. Dewatering of excavations requires the procurement of a construction dewatering permit, which may require monitoring and treatment of effluent resultant from the dewatering prior to disposal.

2. Regulatory Concerns
   a. Health and Safety

As per regulations set forth in 1926 C.F.R., Subpart P, 1926.651 and .652, any time personnel will be required to enter an excavation, methods must be employed to prevent the sidewalls of the trench or excavation from collapsing onto the workers within the area. These methods may include:

   (1) Sloping the excavation at a minimum 1½:1 ratio (horizontal to vertical, if soil compaction or characterization has not been determined by a competent person);

   (2) Mechanical shoring or trench boxes;

   (3) Specialized shielding system design;

   (4) Dewatering; and

   (5) Freeze wall technology.

Health and safety are of utmost importance in the performance of any task. Given the nature and diversity of problems one can encounter at a contaminated site, the health and safety concerns may be compounded.

The removal of contaminated soil can involve underground installations such as a tank, piping, or vault which may necessitate entry. In particular, OSHA 29 C.F.R. 1910.146 (confined space entry) describes definitions, entry permitting systems, training, and emergency services.

Training, preparation, and planning are not only key, they are mandated by Occupational Safety and Health Administration 29 C.F.R. Parts 1910 and 1926, in particular 29 C.F.R. 1910.120. Health and safety issues specific to excavation activities are noted below.

Proper planning with regard to the requirements for the job can reduce the cost of remediating a contaminated site. Proper assessment of the site itself is critical for cost effectiveness and, just as importantly, for safety. To illustrate this point, the following is a list of factors to be considered prior to excavating contaminated soil:

   (1) Air monitoring (Will excavation cause volatile or particulate contaminant emissions or toxins to become airborne from disturbed or exposed soils?)
(2) Site hygiene (decontamination procedures):

- Dust monitoring and suppression;
- Vapor monitoring and suppression;
- Protection of “clean areas” through site control including defined work zones and traffic control; and
- Appropriate personnel and equipment decontamination.

(3) Physical hazards:

- Protection against public access (fencing, barriers);
- Underground utilities;
- Overhead utilities;
- Engineering considerations with regard to nearby structures;
- Cave-in or mass movements, slumping; and
- Dewatering (may cause undermining and caving considerations, runoff).

It is the responsibility of a contractor to be aware of and comply with all federal, state, and local health and safety regulations at its sites. The information in this section is intended only to provide guidance with regard to site work or development of site health and safety plans. NJDEP is responsible only for NJDEP personnel who are providing oversight of work at those locations. See Appendix J.

b. Pre-construction Survey

Prior to beginning construction, a pre-construction survey should be performed. The pre-construction survey should delineate the meets, bounds, and topography of affected properties, locate structures and other important physical features on the site, and spatially locate the areal extent of contamination that has been delineated on-site both vertically and horizontally. This location survey may be used to provide estimates of contaminated material and allow for proper restoration of the site. Photographs of the site are often useful to document pre-remediation conditions at a site. Note: any physical hazard should be identified at this point, to ensure that proper safety precautions are taken.

Survey monuments, markers, and other control points should be located during the pre-construction survey. This will allow for their preservation and, if necessary, restoration at the site. A topographic survey of the site showing existing contours should be completed prior to excavation with lines and grades of the contaminated area to be excavated included in the survey.

c. Soil Conservation Plans

Prior to the start of excavation or soil disturbance at a site, the person conducting the remediation must secure certification of a plan for soil erosion and sediment control, pursuant to N.J.S.A. 4:24-39 et seq. This requirement applies to any project where there is a disturbance of more than 5,000 square feet of land surface. County or regional soil conservation districts can provide applications or specific guidance with regard to the requirements for a plan.

In general the plan must include the following components:

(1) Soil Erosion and Sediment Control Title;
(2) Signature and certification by a N.J. licensed professional engineer;
(3) A map with existing and proposed topographic contours at two foot intervals;
(4) A line delineating the extent of disturbance;
(5) Delineation of wetlands areas;
(6) District notes;
(7) Stabilized construction entrance with design detail;
(8) Sediment barriers with installation detail;
(9) Inlet protection with installation detail;
(10) Dust control countermeasures;
(11) Temporary and permanent seeding specifications (to include the type and rate of application of lime, fertilizer, seed, mulch, or sod);
(12) Site-specific construction sequence;
(13) Key map with north arrow;
(14) Soil information;
(15) Location of all streams and other natural features within the project area;
(16) Location of present and proposed drains and culverts with their discharge capacities and velocities and supporting calculations. Conditions below outlets should be detailed also;
(17) Location and supporting documentation for all structural soil erosion methods, including site-specific cross sections and profiles of each structure. Supporting documentation must be in a format specific with the standards;
(18) Delineation of any areas adversely impacted by a 100-year storm event;
(19) One copy of complete subdivision or site plan as submitted to the municipality;
(20) Appropriate fees;
(21) Additional items as required by the district; and,
(22) All hydrologic and hydraulic data - specifically HEC1, HEC2, WSP2, TR20 electric input files, if used, of existing and proposed conditions, and a completed copy of the Hydraulic and Hydrologic Data Base Summary Form SSC 251 HDF 1.

C. Management of Excavated Soils

This guidance document explains when excavated soil is a concern to the NJDEP and presents guidance for the handling, characterization and management of excavated soils suspected or known to be contaminated. For this purpose, soil can be characterized according to the type and amount of contamination present in the soil: (1) soil that contains hazardous waste, (2) soil that contains non-hazardous waste (ID 27 when disposed of), and (3) any other soil.

1. Soil Handling
   a. Hazardous Soil

   Excavated soils are considered hazardous when the following criteria are met:

2) Is a listed waste as per 40 CFR Part 261 Subpart D (261.31-261.33).

3) Is a mixture of a solid waste (non-hazardous) and one or more hazardous wastes listed in 40 CFR Part 261 Subpart D (261.31-261.33).

Items 1, 2, and 3 are federal rules which were incorporated by reference by New Jersey on October 21, 1996 at N.J.A.C. 7:26G-5.1.

All excavated soils designated as a hazardous waste (soils with contamination above the non-hazardous waste levels) must be properly staged and removed from the excavation site within 90 days of their placement out of the unit. (They cannot simply be placed back into the unit.) Hazardous waste piles may be permitted pursuant to N.J.A.C.7:26G-8.

When excavated soils are determined to contain a hazardous waste, they should be staged during the remaining 90-day period in a sealed rolloff container or sealed drums.

If on-site treatment is the chosen remediation option, a hazardous waste treatment, storage or disposal permit will not be necessary in order to implement on-site remedial actions for contaminated soil if there is appropriate NJDEP oversight as per N.J.A.C. 7:26E-7:1 (a) 31, and the contaminated soil is no longer subject to the same timeframes as for the storage of hazardous waste. A new timeframe, in accordance with the chosen remedial action, will now apply, but all applicable permits must be obtained.

The remedial action options for hazardous waste in soil include on-site remediation, off-site management as a hazardous waste, and, in some instances, it may be recycled. If a hazardous soil is to be treated or remediated on-site, all applicable permits must be obtained as per N.J.A.C. 7:26E-7.1(a) et seq. Hazardous waste in soil going off-site for management shall be properly manifested, transported by a licensed, insured hauler and go to a facility authorized to accept same.

b. Non-hazardous Soil

Contaminated soil is considered to be non-hazardous when there is only one criterion following. It would be classified as an ID 27 solid waste if treatment, storage or disposal is the selected option.

Excavated soils are considered to be non-hazardous when the following criteria are met:

1) Soil contaminants exceed the NJDEP’s soil cleanup criteria, or,

2) exceed the site specific cleanup criteria, and

3) are not a hazardous waste as defined in (a) above.

Final remedy/reuse decisions should be made prior to soil excavation so that on-site handling and storage time are minimized. Contaminated soils that are designated as non-hazardous solid waste may not be stockpiled for more than six months pursuant to the Solid Waste Regulations, N.J.A.C.7:26-1.1;1.4. Security and public access must be considered when selecting a location for stockpiling of any potentially contaminated soils. Excavation and staging of any potentially contaminated soil must be performed using methods that minimize the disturbance of the soil. Upon or before excavation, the generator determines whether the soil is hazardous. For assistance by NJDEP in hazardous waste classification, contact the Bureau of Resource Recovery and Technical Programs in the Environmental Regulation Program (609/292-8341).

At a minimum, all potentially contaminated soils must be staged on an impervious surface and covered with a waterproof material (i.e., tarpaulin or 10 mil plastic sheeting). The containment must be maintained for the duration of the staging period to prevent contaminant volatilization, runoff, leaching, or fugitive dust emissions.

Non-hazardous soils should, when possible, be segregated when excavated based on the known or suspected levels and locations of the contamination. Proper segregation of soils at the time
of excavation is a critical procedure required for effective soils management. Segregation can facilitate soil reuse and may minimize the need for treatment or off-site disposal of minimally contaminated soils. The mixing of soils from different sources of contaminant levels is not an acceptable treatment option and often complicates accurate soil characterization and remedy selection. Mixing of soils during a reuse application should be avoided. Mixing of soils should be performed only if the selected remedy will mitigate all contamination present. For example, mixing of soils contaminated with metals and volatile organic compounds may necessitate the need for costly pretreatment of the soils for the volatile organic contamination prior to off-site disposal of a now larger volume of metal contaminated soil.

2. Soil Characterization
   a. Recommended Testing Protocol

   NJDEP recommends that characterization sampling and final remedy selection be performed prior to soil excavation to minimize the number of unnecessary and potentially costly remedial actions. Excavation should occur only if off-site disposal or ex situ treatment is the selected remedy. For those owners/operators who believe that their soil pile may be contaminated or who are excavating soil to comply with NJDEP’s requirements, NJDEP recommends the following minimum sampling and testing protocol:

   (1) Hazardous Waste Classification

   Detailed sampling guidance for determining if soils generated contain a hazardous waste may be obtained from the Bureau of Resource Recovery and Technical Programs. This provides the directions for a waste classification request and the minimum sampling requirements that must be met if NJDEP is requested to issue a written opinion of waste classification. NJDEP’s assistance is not required for waste classification unless it has been requested by a disposal facility or NJDEP Site Remediation Program personnel.

   It is the generator’s responsibility to determine if a waste is a hazardous waste pursuant to N.J.A.C. 7:26G-5.2(b) and if soil contains a hazardous waste. Waste classification is required only for soils that contain a waste and/or are going to be treated as a waste. For more information, call 609/292-8341.

   (2) Testing

   When the owner/operator and/or NJDEP has determined the need for testing to determine if contaminant levels are above appropriate cleanup guidelines, analyses should be selected as per the latest version of the Technical Requirements. If sampling is going to be conducted for hazardous waste classification and NJDEP’s opinion is required, contact the Bureau of Resource Recovery and Technical Programs for the parameters and requirements. Waste classification is required only for soils that contain a waste and/or are going to be treated as a waste. If recycling or disposal is the selected option for this soil, contact the selected facility to determine if any additional testing is required for their approval.

   If soils are determined to be non-hazardous and are to be recycled out-of-state, please refer to VII.C., 4.

   (3) Soil Reuse/Characterization

   The purpose of an investigation/reuse sampling is to determine if a soil contains contaminants above appropriate cleanup levels and, if contaminated, to determine the nature and extent of the contamination. Then the data can be used to determine appropriate reuse or remedial options. All sampling procedures and analytical methods must conform to the most recent guidance in the Technical Requirements and the NJDEP Field Sampling Procedures Manual. N.J.A.C. 7:26E-6.2(b) and 6.4(d) set forth requirements for soil reuse. Soil reuse
requirements are applicable to any known or suspected contaminated soil for site-specific applications.

(4) Waste Piles

In circumstances where excavated soil has not been characterized prior to excavation, **discrete** soil pile sampling is required for the contaminants of concern. The sampling strategy used must consider site history, the source of the soil and all available data and field observations. To minimize laboratory analysis requirements, field analytical methods presented in the Technical Requirements may be used to bias sample locations. Piles should be divided into an imaginary grid of 20-yard lots. A minimum of two borings must be field screened throughout the pile depth, at 2 foot intervals, in each 20-yard lot for the suspected contaminants. (See the preceding section, “(2) Testing,” for analysis selection.) At a minimum, two samples for the first 100 cubic yards and one sample for each additional 100 cubic yards must be lab analyzed. Samples must be biased to the location of highest suspected contaminant concentrations based on field screening results.

When field analytical methods are not available, biased samples based on field observation (visual/olfactory) must be collected and lab analyzed at a frequency of one sample per 20 cubic yards for the first 100 yards of soil and one sample for each additional 100 cubic yards thereafter. A minimum of two borings must be screened throughout the pile depth in each 20-yard lot. When biasing sample locations is not possible because contamination is not detectable by observation, samples for analysis must be collected at the pile mid-depth.

Additional sampling may be required based on the results of the initial data collected if further contaminant delineation is necessary. A higher frequency of sampling, screening, and analysis may be required to characterize the soils when “hotspots” of contamination are known or suspected to exist in a pile. For very large quantities of soil, a lower frequency may be appropriate subject to NJDEP review based on site-specific data. It is recommended that NJDEP review sampling plans that vary from the above-referenced approach prior to sampling.

If contamination is detected using field analysis methods, the contamination should be delineated in the field to approximate the extent of the contamination. This field analysis information is relatively easy to obtain while mobilized in the field and can prove to be invaluable in remedial or reuse decisions.

3. **Loading and Transporting Waste Material**

If the material being transported is classified as non-hazardous, it is legally considered a solid waste, (ID 27), and, as such, the transporter hauling the waste must be a New Jersey registered solid waste transporter in accordance with N.J.A.C. 7:26-1 et seq. In addition, all vehicles used must have valid Solid Waste decals affixed to both sides, have valid registration cards in all vehicles, execute proper O & D forms at the disposal facility, and comply with all specific transporter requirements under 7:26-3. In addition, a proposal to send non-hazardous waste out-of-state for reuse or recycling needs an approval from the Bureau of Resource Recovery and Technical Programs pursuant to N.J.A.C. 7:26-1.1(a)1, and 1.7(g) for beneficial uses.

If waste material is classified as hazardous or is solid waste over-classed as hazardous at the direction of the generator for disposal at an RCRA facility, the transporter must be New Jersey registered to haul hazardous waste. All hazardous waste must be shipped in accordance with the U.S. Department of Transportation guidelines as stated in 49 C.F.R. 171-179, N.J.A.C. 7:26-3.0 et seq., and contaminated soils material must be shipped in accordance with N.J. Solid Waste Regulations, applicable radioactive and medical waste regulations, and applicable local regulations. Hazardous waste shipments must be properly containerized, labeled, and manifested prior to leaving the site.
The manifest should be completed as specified in N.J.A.C. 7:26G-6.1. The hauler should accept the material for transport, signing and dating the manifest, only if all relevant information is included on the manifest.

Whether hauling a solid waste or hazardous waste, trucks should be lined with plastic and covered with a tarp prior to leaving the site to prevent spreading of fugitive material.

A running inventory of all excavated material should be kept. Areas excavated should be tested as specified in a predetermined pattern as stated in the Technical Requirements and the NJDEP Field Sampling Procedures Manual.

For post excavation sampling requirements, refer to appropriate sections in the Technical Requirements and NJDEP’s Field Sampling Procedures Manual.

The NJDEP Hazardous Waste Technical Assistance Program issues bulletins in the Hazardous Waste Information Series. They may be obtained by calling (609/292-8341).

D. Equipment Considerations and Handling

Excavation usually involves the use of earthmoving heavy equipment common to construction projects. In many instances, specialized modifications to standard construction or earthmoving equipment are made for a specific remedial task. Where water or other materials saturate sediments, removal and transportation technology selection may be driven by treatment and/or disposal requirements.

Performance of a particular piece of equipment is measured in the unit cost of material moved from point to point. Some of the factors that affect operating costs and productivity for various pieces of equipment are weight-to-horsepower ratio, capacity, transmission type, speeds, and maintenance.

Access to a site is a factor in the selection of equipment. It may be difficult or impractical to use large pieces of equipment in areas where there are buildings, overhead structures, utilities, or vegetation. Weight may be a factor in determining whether or not the equipment can be used to access a site. Special tracks, tires, long reach booms on excavation equipment, and other modifications are available.

Computer programs exist that assist in equipment selection.

The cost of earth moving and hauling is compounded by the costs of operating under adverse conditions where operators and support personnel may be wearing personal protective equipment, where equipment needs to be decontaminated or lined with plastic, or where contaminated soil requires special handling such as stabilization prior to load-out. Special conditions not typically encountered at non-contaminated construction sites require additional measures that increase the operating cost. Techniques must be applied to prevent contaminated materials from being spread or tracked to “clean” areas of the site. Working from within a contaminated area radially outward and downward toward uncontaminated areas aids in preventing spread of contamination. Also, ground coverings, liners, or mats are employed to prevent “cross contamination.” At sites where sediment removal involves the use of dredging or wet excavation, the introduction of contamination to previously uncontaminated areas can result from suspension of sediments in a stream or other water body after they are disturbed. The types of equipment used will determine the types of countermeasures which must be taken to minimize impacts to localities outside the area of concern. The U.S. Army Corps of Engineers, in cooperation with USEPA, has published a guidance document entitled Evaluating Environmental Effects of Dredged Material Management Alternatives — A Technical Framework. The document provides an overview of various dredging techniques, regulatory concerns, and dredged material management.

At sites where contamination is being excavated, post-extraction sampling and confirmatory analysis usually are performed to determine whether cleanup standards have been met. Sampling locations, frequency, and methods are described in detail in NJDEP’s Field Sampling Procedures Manual and the Technical Requirements. Sampling and analysis may extend the time necessary for equipment to be kept at the site.
Additional costs may be incurred for remobilization of equipment to the site after post-excavation sampling analysis is complete or after subsequent phases of remedial work are finished in the excavated areas prior to backfilling and restoration. This should be a consideration in selecting equipment for remediation.

E. Engineering and Geotechnical Aspects

1. Dewatering — Excavation

During the course of excavation activities, ground water may be encountered. This often presents two problems. First, ground water which is in contact with the contaminated soils may itself be contaminated. This presents problems to workers being exposed to fugitive emissions from the contaminated water or with product flowing into the excavation area. Second, in unconsolidated sediments, ground water moving into an excavation area can undermine the side walls causing a slump hazard or cave-in that might undermine buildings or structures adjacent to the excavation.

Prior to dewatering an excavation, the person conducting the remediation may be required to apply for a construction dewatering permit using the consolidated permit application form CP#1 “Construction and Discharge Related Permits.” This package allows for the submission of applications for various permits as well as a pre-application conference with NJDEP staff to discuss project concepts. In order to facilitate the investigation and remediation of sites under department oversight, lead programs in the department are able to issue permit-by-rule discharge authorizations under N.J.A.C. 7:14A-2.15 to allow certain discharges related to homeowner site remediations, pilot treatment plants, aquifer tests, or remedial design tests back to ground waters of the state.

NJDEP staff will inform the applicant of current statutes, rules, regulations, application procedures, and the permit programs’ policies and procedures. It is the applicant’s responsibility to obtain all federal, state, and local permits required by law. Please refer to “Appendix E — Permit Identification” and “Appendix F — Cover Letter and Permit Identification Form” near the end of this document.

2. Stormwater Diversion

During the course of remedial activities at a hazardous waste site, weather, in particular, precipitation, becomes a problem. Water which collects on-site and comes in contact with contaminated materials can become contaminated and require disposal. Also, water may wet soils or pond in open excavations, increasing the weight of material being shipped for disposal. This may require stabilization or drying of the excavated waste prior to transport. Poly sheeting or other waterproof materials are used in excavated areas to capture or contain precipitation and isolate it from contamination below. Then the water can be pumped off without treatment and disposed of in other non-contaminated areas of the property.

Often excavation of ditches, streams, or creeks needs to be performed. Ditches, streams, creeks, and other channels are areas of concern that often become contaminated due to uncontrolled run-off, spills, poor air pollution control practices, and other discharges. At these locations, it is not uncommon to divert the flow of water, whether intermittent or constant. Excavation of these contaminated areas necessitates isolation of activities from water currents which would carry distributed or disturbed sediments downstream to be deposited in “clean” areas. Restoration of these areas should take into account peak flow and potential for erosion. The nature of the transverse cross section of a stream should be studied.

Methods for diversion may include temporary pipes, channels, or canals circumventing contaminated areas. Also, damming and diverting water by use of pumps and hoses is an option in low flow volume areas.
F. References


15. NIOSH. *A Recommended Standard for Occupational Exposure to Hot Environments*. HSM No. 72-10269.


VI. Remedial Action 2 — Soil Treatment Technologies For Contaminated Soils

A. Introduction

This section includes the soil treatment technologies that NJDEP considers to be effective or potentially effective in treating various categories of contaminants. These have been chosen based on USEPA documents and commercial availability. Effectiveness ratings, however, are based upon actual NJDEP case studies. Effectiveness is defined in the following manner:

1. Demonstrated Effectiveness — successful treatability test at some scale completed.
2. Potential Effectiveness — expert opinion that technology will work.

This section is intended to be used as a guide and is in no way meant to discourage the use of soil treatment technologies not included here. On any given site, site-specific conditions may result in other technologies being effective in remediating the contaminants. The person conducting the remediation is encouraged to pursue such technologies, especially if site-specific treatability studies indicate reasonable likelihood of success.

Every treatment technology discussed here may, in any given situation, be the sole treatment used on a site or it may be part of a treatment train using different technologies for different contaminants. Technologies which are not in situ (to be referred to as ex situ) will involve excavation at the very minimum. In situ technologies do not involve excavation but may still be part of a treatment train with one or more other technologies. There are three basic means of addressing contaminants: the first is to address the toxicity of a contaminant; the second is to reduce the volume of the contaminant; and, the third is to alter the mobility of the contaminant. The purpose of the latter can be to either increase the mobility of the contaminant or to decrease it. In soil flushing, for example, flushing increases the mobility of the contaminant by transporting the contaminant in a water matrix from which it is more easily recovered than from a soil matrix. In stabilization, on the other hand, the mobility of the contaminant is reduced and the threat of the contaminant leaching into the ground water is correspondingly reduced.

The treatability groups, along with the specific chemical contaminants they contain, are listed in Appendix B. For instance, if the contaminant under consideration is 1, 1, 1 trichloroethane, technologies that apply to halogenated volatiles (the contaminant group this belongs to) should be considered.

Throughout Section VI, a note such as “reference 1” means the first reference in Section E. References are at the end of this section.

Checklists for five technologies have been included in Appendix H. These checklists are helpful in evaluating the completeness of the corrective action plan (CAP) and in identifying areas that require closer scrutiny (reference 34).

B. Categories

1. Bioremediation
   a. Slurry Biodegradation
      
      Process Description:

      Soil to be treated is mixed in a reactor with water, creating a slurry which maximizes contact between the contaminants and the microorganisms capable of degrading those contaminants. Usually, the treatment is aerobic, and is implemented in batches. Nutrients are added. Neutralizing agents also are added to adjust the pH to an acceptable range – 4.5 to 8.8. Temperature is maintained between 15 and 35 degrees Centigrade. Finally, bioactive microorganisms are added. After treatment is completed, the slurry is dewatered and the soil
may be redeposited on site. The residence time in the bioreactor is dependent on the soil/slugge matrix and the type of contaminant.

Flow Diagram of Slurry Biodegradation Process (reference 4):

**Slurry Biodegradation Process**

**Soil Preparation:**
This includes excavation of the soil to be treated as well as screening to remove debris, rubble, and other large objects. Water is added; pH and temperature also are adjusted. The soil is mixed with water to create a slurry.

**Waste Streams Generated:**
1. The treated solids — if these do not meet target goals, they may be reprocessed;
2. Process water; and
3. Possible air emissions.

**Treatability Group:**
The treatment is demonstrated effective for fuel hydrocarbons.

It is potentially effective for halogenated volatiles, halogenated semivolatiles, non-halogenated volatiles, non-halogenated semivolatiles, and pesticides. However, the treatment may only be effective for some compounds within these categories. (reference 3).

**Advantages and Ideal Conditions; Disadvantages and Limitations:**
Advantages and Ideal Conditions —
1. Potential exists for contaminants to be completely destroyed, hence addresses the toxicity of contaminants;
2. Reduces volume of contaminated soil;
3. Available as a full scale technology; and
4. Treated soil may be redeposited on-site.

Disadvantages and Limitations –

1. Soil must first be excavated;
2. An acceptable method for disposal of wastes (water and air emissions discharges) must be present;
3. The treated soils need to be disposed of after treatment — however, they can possibly be redeposited on-site;
4. Presence of chlorides or inorganics, such as heavy metals, as well as some pesticides and herbicides, may reduce the effectiveness of the process by inhibiting microbial action;
5. Contaminants with low water solubility are harder to biodegrade; and
6. Non-uniform particle size can reduce effectiveness by inhibiting microbial contact.

**Treatability Matrix For Slurry Biodegradation:**

<table>
<thead>
<tr>
<th>Contaminant Group</th>
<th>Slurry Biodegradation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Demonstrated Effectiveness</td>
</tr>
<tr>
<td>Halogenated Volatiles</td>
<td></td>
</tr>
<tr>
<td>Halogenated Semi Volatiles</td>
<td></td>
</tr>
<tr>
<td>Non Halogenated Volatiles</td>
<td></td>
</tr>
<tr>
<td>Non Halogenated Semi Volatiles</td>
<td></td>
</tr>
<tr>
<td>Fuel Hydrocarbons</td>
<td></td>
</tr>
<tr>
<td>Pesticides</td>
<td></td>
</tr>
<tr>
<td>Inorganics</td>
<td></td>
</tr>
</tbody>
</table>
b. Ex Situ Bioremediation and Landfarming

Process Description:

The process basically involves periodically turning over or tilling the soils to aerate the waste. For landfarming, no special nutrients or microbes are added. In ex situ bioremediation, prepared biotreatment cells or beds are used. Moisture, heat, nutrients, oxygen, and pH may be controlled. For composting, wood chips may be added.

Schematic of ex situ bioremediation and composting (reference 23):

Soil Preparation:

In most cases, excavation of the existing soils is needed; surface contaminated soils may be treated in place without excavation. Screening for debris and rocks must take place.

Waste Streams Generated:

1. Leachate from the treatment process; and
2. Possible air emissions.
Treatability Group:
This has been demonstrated effective in treating fuel hydrocarbons.
The treatment is potentially effective for halogenated volatiles, halogenated semivolatiles, non-halogenated volatiles, non-halogenated semivolatiles, and pesticides. However, it may only be effective for some compounds within these groups (reference 3).

Advantages and Ideal Conditions; Disadvantages and Limitations:
Advantages and Ideal Conditions –
1. Contaminant toxicity is reduced or eliminated completely;
2. System maintenance is at a minimum; and
3. This is a full scale technology which is generally accepted without difficulty by the public.
Disadvantages and Limitations –
1. Contaminated soil must be excavated unless it is surficial contamination, in which case it may be landfarmed in place; and,
2. There is no control of volatile emissions during landfarming.

Treatability Matrix For Landfarming and Composting:

<table>
<thead>
<tr>
<th>Contaminant Group</th>
<th>Landfarming &amp; Composting</th>
<th>Demonstrated Effectiveness</th>
<th>Potential Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halogenated Volatiles</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Halogenated Semi Volatiles</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Non Halogenated Volatiles</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Non Halogenated Semi Volatiles</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Fuel Hydrocarbons</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Pesticides</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Inorganics</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
c. In Situ Biological Treatment

Process Description:

In this process, the activities of naturally-occurring microbes are enhanced by circulating either (a) nutrient and oxygen enriched nutrient water-based solutions or (b) forced air movement which provides oxygen. The latter also is called bioventing. (references 3, 6, and 7). The air flow rate is much lower than in vapor extraction since the object is to deliver oxygen while minimizing volatilization and release of contaminants to the atmosphere.

Conceptual diagram of bioventing (reference 16):

Soil Preparation:

Minimal, since the process is in situ.

Waste Streams Generated:

1. Possible air emissions; and
2. Process water.
Treatability Group:
This is demonstrated effective for non-halogenated volatiles and fuel hydrocarbons.

Potentially effective for halogenated volatiles, halogenated semivolatiles, non-halogenated semivolatiles, and pesticides (reference 3).

Advantages and Ideal Conditions; Disadvantages and Limitations:

Advantages and Ideal Conditions –
1. Contaminant toxicity is reduced or even eliminated;
2. Soil preparation is minimal; and
3. This is a full scale technology with good community acceptability.

Disadvantages and Limitations –
1. As with most in situ systems, detailed site characteristics and treatability studies are needed prior to designing and implementing the system; and
2. Applicability in certain soil types, such as those with low permeabilities, may be limited.

Treatability Matrix for In Situ Biological Treatment:

<table>
<thead>
<tr>
<th>Contaminant Group</th>
<th>In Situ Biological Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Demonstrated Effectiveness</td>
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<td>Halogenated Volatiles</td>
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<td>Halogenated Semi Volatiles</td>
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<td>Non Halogenated Volatiles</td>
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<td>Non Halogenated Semi Volatiles</td>
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<td>Fuel Hydrocarbons</td>
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<td>Pesticides</td>
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<tr>
<td>Inorganics</td>
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</tr>
</tbody>
</table>
2. Liquid Extraction Technologies
   a. Soil Washing

   **Process Description:**

   Contaminants which have adsorbed onto soil particles are separated by washing with a leaching agent, and surfactant, chelating agents, or pH adjustment.

   Soil is mixed with washwater in order to remove contaminants adsorbed onto soil particles. Sometimes, extraction agents may be added to enhance this process. Soil (now contaminant free or with reduced contaminants) and washwater are then separated. Suspended fines and sludges are recovered using either gravitational methods or flocculation. These may need to be further treated since they contain a higher concentration of contaminant than the original soil. The waste water can be treated and recycled into the process.

   Flow diagram of soil washing (reference 11):

   **Aqueous Soil Washing Process**

   Soil Preparation: Contaminated soil must be excavated and taken to the processor. It is then screened to remove debris, stones, and other large objects.

   **Waste Streams Generated:**
   1. Wastewater – this can be kept to a minimum by treating and recycling the wastewater;
   2. Air emissions – in some cases;
   3. Contaminated clays, fines and sludges resulting from the process; and
4. Spent carbon and spent ion exchange resin used to treat the wastewater (reference 11).

**Treatability Group:**

This is demonstrated effective for halogenated semivolatiles, fuel hydrocarbons, and inorganics. It is potentially effective for some halogenated volatiles, some non-halogenated volatiles, non-halogenated semivolatiles, and pesticides (reference 3).

**Advantages and Ideal Conditions; Disadvantages and Limitations:**

Advantages and Ideal Conditions –

1. Reduces the volume of contaminant, so that further treatment or disposal is less problematic; and
2. Commercially available.

Disadvantages and Limitations –

1. Contaminant toxicity is unchanged, although volume is reduced;
2. Less effective when soil contains a high percentage of silt and clay-sized particles or a high organic content; and
3. Costs associated with the disposal of the subsequent waste streams must be considered.

**Treatability Matrix for Soil Washing:**

<table>
<thead>
<tr>
<th>Contaminant Group</th>
<th>Soil Washing</th>
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<tr>
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<td>Demonstrated</td>
<td>Potential</td>
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<td>Halogenated Volatiles</td>
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<td>Inorganics</td>
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</tbody>
</table>
b. Soil Flushing

Process Description:

A water-based solution, or water, is applied to the soil in order to enhance the solubility of the contaminant in question. The fluid is applied by injection wells, shallow infiltration galleries, or above-ground sprayers. The contaminants are mobilized by solubilization or through the chemical reactions with the liquid. This mixture leaches into the ground water and must be recaptured. In the diagram below, ground water is recaptured and pumped to the surface using standard ground water extraction wells. Appropriate wastewater treatment systems treat the contaminated ground water (reference 15).

Schematic of Soil Flushing (reference 15):

Soil Preparation:

None or minimal, as this is an in situ treatment.

Waste Streams Generated:

1. The contaminated ground water which, after undergoing the process, contains contaminants and flushing agents. The water may be treated and recycled into the process; and
2. Residuals from treating the contaminated ground water.

Treatability Group:

This treatment is demonstrated effective for non-halogenated volatile organics.
It is potentially effective for halogenated volatiles, halogenated semivolatiles, non-halogenated semivolatiles, fuel hydrocarbons, pesticides, and inorganics. However, it may be effective only for some compounds in these categories.

Advantages and Ideal Conditions; Disadvantages and Limitations:

Advantages and Ideal Conditions –
1. Contaminant volume is reduced and the resulting matrix, water, is easier to treat.

Disadvantages and Limitations –
1. Great care must be exercised to ensure that the contaminated ground water is recaptured and treated and not allowed to migrate off-site;
2. Contaminant toxicity is not reduced;
3. Soils with low permeability or with particles that strongly adsorb contaminants, such as clays, are less amenable to this treatment;
4. Treatment times are often lengthy; and,
5. If more than one contaminant is present in the soil, formulation of a single flushing fluid is complicated.

Treatability Matrix for Soil Flushing:

<table>
<thead>
<tr>
<th>Contaminant Group</th>
<th>Soil Flushing</th>
<th>Demonstrated Effectiveness</th>
<th>Potential Effectiveness</th>
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</thead>
<tbody>
<tr>
<td>Halogenated Volatiles</td>
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<td>Halogenated Semi Volatiles</td>
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<td>Non Halogenated Semi Volatiles</td>
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<td>Fuel Hydrocarbons</td>
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<td>Pesticides</td>
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<td>Inorganics</td>
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</tbody>
</table>
c. Solvent Chemical Extraction

**Process Description:**

Contaminated soil is mixed with a solvent. This results in the organic contaminant dissolving into the solvent, which is then separated from the soil. The separation is caused by temperature and pressure changes. The solvent is recycled and fed back to the extractor. Dewatering of the treated soil also may take place.

Flow diagram of solvent extraction (reference 12):

**Soil Preparation:**

Contaminated soil must be excavated and taken to the processor. It is then screened to remove debris, stones and other large objects.

**Waste Streams Generated:**

1. The concentrated contaminants;
2. The treated soil; and
3. Water generated after dewatering.

**Treatability Group:**

The treatment is demonstrated effective for halogenated semivolatiles and pesticides.

The technology is potentially effective for halogenated volatiles, non-halogenated volatiles, non-halogenated semivolatiles and fuel hydrocarbons. It may only be effective for some compounds in this group (reference 3).
Advantages and Ideal Conditions; Disadvantages and Limitations:

Advantages and Ideal Conditions –
1. Contaminant volume is reduced.

Disadvantages and Limitations –
1. Does not reduce contaminant toxicity; only volume;
2. Organically bound metals can co-extract with targeted organics, leading to their presence in the waste stream. This complicates disposal of the wastes; and
3. In general, solvent extraction is least effective on very high molecular weight organics and very hydrophilic substances.

Treatability Matrix for Solvent Extraction:

<table>
<thead>
<tr>
<th>Contaminant Group</th>
<th>Solvent Extraction</th>
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<tr>
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<td>Halogenated Volatiles</td>
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<td>Fuel Hydrocarbons</td>
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<td>Pesticides</td>
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<td>Inorganics</td>
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</table>
3. Stabilization and Solidification Treatments

a. Stabilization

Process Description:

**In Situ Treatment:** The soil to be treated is mixed with binding/stabilizing materials (such as cement; fine-grained siliceous, or pozzolanic, materials; lime; thermoplastic binders), sorbents (such as activated carbon, clays, zeolites and silicates) and water in appropriate ratios. Surface area mixing is typically accomplished with standard construction equipment. For depths of up to approximately 100 feet, other techniques, including the injection system, auger/cassion system, and auger system, are necessary. Key operating parameters are fixative to waste ratio, length of time for setting and curing, required structural integrity, and minimized potential for leaching. Depending upon the particular process, the final product ranges from a loose, soil-like material to concrete-like molded solids.

**Ex Situ Treatment:** The process is similar to the in situ method described above with the exception that contaminated soil is excavated and mixed via on-site cement-mixing and handling equipment.

Flow Diagram of stabilization and solidification (reference 20):
Soil Preparation:

Any cyanide and hexavalent chromium must be removed/pretreated prior to solidification. High concentrations of organics, sulfates or chlorides may interfere with the curing of the solidified product. Pretreatment also is required for wastes high in oil and grease, surfactants, or chelating agents. Ex situ processing requires removal of oversize debris.

Waste Streams Generated:

1. The treated solids; and
2. Air emissions of volatile compounds and fugitive dusts that may occur during procedures.

Treatability Group:

Solidification/stabilization is demonstrated effective for soils, sludges, or slurries contaminated with inorganics.

Modified clays and other binders are being studied for application with other organic contaminants.

Advantages and Ideal Conditions; Disadvantages and Limitations:

Advantages and Ideal Conditions –

1. In situ and ex situ solidification/stabilization is available as a full-scale technology for non-volatile heavy metals;
2. The technology is relatively simple, uses readily available equipment and has high throughput rates; and
3. Contaminant mobility is reduced.

Disadvantages and Limitations –

1. The volume of treated material will increase with the addition of reagents (up to double the original volume);
2. Organics are usually not effectively treated using standard binding/stabilizing agents. If organics are of concern, special proprietary binding agents may be necessary;
3. A high content of water, clay or organics can interfere with the mixing process; the clay surface may adsorb key reactants, interrupting the polymerization chemistry of the solidification/stabilization agents;
4. Delivering reagents to the subsurface and achieving uniform mixing and treatment in situ may be difficult;
5. Environmental conditions may affect the long-term immobilization of contaminants;
6. Treatability studies may be required; and
7. Contaminant toxicity is not reduced.
### Treatability Matrix For Stabilization and Solidification:

<table>
<thead>
<tr>
<th>Contaminant Group</th>
<th>Stabilization and Solidification</th>
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<td>Potential Effectiveness</td>
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<td>Pesticides</td>
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<td>Inorganics</td>
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</table>
b. **Vitrification – Electric Process Heating (Joule Heating)**

**Process Description:**

**In Situ Treatment:** Large graphite electrodes are inserted into the soil to be treated. The electrodes are typically arranged in 30-foot squares. Graphite on the soil surface connects the electrodes. A high current of electricity passes through the electrodes and graphite. The heat causes a melt that gradually works downward through the soil. As the molten, or vitrified, zone grows, it incorporates inorganic contaminants into the melt and pyrolyzes organic components. After the process is terminated and the ground has cooled, the fused waste material will be dispersed in a chemically inert, stable, glass-like product with very low leaching characteristics.

**Ex Situ Treatment:** The theory is similar to the in situ method described above, with the exception that the soil is excavated and introduced into a joule-heated ceramic melter for processing.

Schematic of Vitrification (reference 21):

**Soil Preparation:**

For in situ treatment, a conductive mixture of flaked graphite and glass frit is placed on the soil surface between the pairs of electrodes as a starter path.

The process requires homogeneity of the media. The presence of large inclusions (e.g., highly concentrated contaminant layers, void volumes, containers, metal scrap, general refuse and debris, or other heterogeneous materials within the treatment area) can limit the use of the in situ process.
For ex situ treatment, the soil to be treated must be excavated.

Waste Streams Generated:
1. The inert, impermeable vitrified mass; and
2. Off gases, including volatilized organics and some inorganics.

Treatability Group:
Vitrification is potentially effective for halogenated volatiles, halogenated semivolatiles, non-halogenated volatiles, non-halogenated semivolatiles, fuel hydrocarbons, pesticides, and inorganics.

Advantages and Ideal Conditions; Disadvantages and Limitations:
Advantages and Ideal Conditions –
1. Ex situ vitrification is a full-scale technology; and
2. Contaminant mobility is reduced/eliminated; the vitrified mass resists leaching for geologic time periods. Organic contaminant toxicity is reduced/eliminated; inorganic contaminant toxicity is unchanged although availability is reduced/eliminated.

Disadvantages and Limitations –
1. The process is energy intensive, often requiring temperatures up to approximately 3000 degrees Fahrenheit for fusion and melting of the waste/silicate matrix;
2. Off-gases must be collected and treated before release;
3. Special equipment and trained personnel are required;
4. Water in soils affects operational time and increases the total cost of the process;
5. During in situ treatment, contaminants may volatilize and migrate to outside the boundaries of the treatment area instead of to the surface for collection;
6. In situ treatment is limited to the vadose zone, and only effective to a depth of approximately 30 feet; and
7. In situ vitrification is in pilot-scale development.

Treatability Matrix for Vitrification:

<table>
<thead>
<tr>
<th>Contaminant Group</th>
<th>Vitrification Effectiveness</th>
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<td>Halogenated Volatiles</td>
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<td>Halogenated Semi Volatiles</td>
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<td>Non Halogenated Volatiles</td>
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<td>Non Halogenated Semi Volatiles</td>
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<td>Fuel Hydrocarbons</td>
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<td>Pesticides</td>
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<td>Inorganics</td>
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4. Thermal Desorption

Low and High Temperature Thermal Desorption

Process Description:

This process heats wastes during a desorption process such that water and organic contaminants are volatilized. The contaminated soils are usually passed through zones of increasing temperature. The volatilized contaminants are then sent to a gas treatment system. This is therefore a physical separation system, and does not result in destruction of the contaminants. When the contaminated soils contain up to 10 percent organics only, thermal desorption can be the sole treatment.

Figure below is from reference 14.

Schematic Diagram of Thermal Desorption

Soil Preparation:

The contaminated soil must be excavated and screened to remove debris, stones and other large pieces. Dewatering of the soil may be needed (reference 3).

Waste Streams Generated:

1. Gaseous volatiles (collected on activated carbon, condensed, or burned in an afterburner);
2. Spent carbon; and
3. Condensed water with contaminants.

Treatability Group:

Halogenated volatiles and fuel hydrocarbons are effectively treated (demonstrated) with low temperature thermal desorption (200 - 600 degrees Fahrenheit or 93 - 315 degrees Centigrade).

Pesticides can be effectively treated (demonstrated) with high temperature thermal desorption (600 -1000 degrees Fahrenheit or 315 - 538 degrees Centigrade).

Low temperature thermal desorption is potentially effective for halogenated semivolatile, non-halogenated volatile, non-halogenated semivolatiles and pesticides (reference 3).
Similarly, high temperature thermal desorption is potentially effective for halogenated volatiles, halogenated semivolatile, non-halogenated volatiles, non-halogenated semivolatile, and fuel hydrocarbons.

**Advantages and Ideal Conditions; Disadvantages and Limitations:**

Advantages and Ideal Conditions –

1. Volume reduction of wastes

Disadvantages and Limitations –

1. Contaminant toxicity is not addressed by this treatment, although volume is reduced;
2. High moisture content increases heating costs; and
3. Less effective in tightly aggregated soils or those containing rock fragments or particles greater than an inch and a half.

**Treatability Matrix for Low Temperature Thermal Desorption:**

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<tr>
<th>Contaminant Group</th>
<th>Low Temperature Thermal Desorption</th>
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<td>Demonstrated Effectiveness</td>
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<td>Halogenated Semi Volatiles</td>
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<td>Pesticides</td>
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**Treatability Matrix for High Temperature Thermal Desorption:**

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<th>Contaminant Group</th>
<th>High Temperature Thermal Desorption</th>
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<td>Pesticides</td>
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5. Thermal Destruction

Incineration

Process Description:

Organic constituents in contaminated media are destroyed in the presence of oxygen at temperatures of 1600 - 2200 degrees Fahrenheit or 871-1204 degrees Centigrade. The incinerators may be either mobile or stationary. Different incinerator designs use different mechanisms to attain the high temperatures involved. Three common types of incinerator systems are rotary kilns, circulating fluidized bed, and infrared.

Prepared waste is fed into the incinerator and incinerated. Flue gases generated are handled by various air pollution control equipment, and residue solid (ash) needs are to be disposed of in accordance with appropriate regulations.

Flow diagram of incineration (reference 13):

Soil Preparation:

Contaminated soil must be excavated and taken to the incinerator site. Specific feed sizes are needed, hence screening and blending may be needed.

Waste Streams Generated:

1. Air emissions. The flue gases are treated using various air pollution control equipment such as venturi scrubbers or electrostatic precipitators (reference 13);

2. Ash and treated soil. These may contain residual metals; and,

3. Liquid wastes from the air pollution control operations.
Treatability Group:

This process is potentially effective for halogenated volatiles, halogenated semivolatiles, non-halogenated volatiles, non-halogenated semivolatiles, fuel hydrocarbons, and pesticides (reference 3).

Advantages and Ideal Conditions; Disadvantages and Limitations:

Advantages and Ideal Conditions –
1. Contaminant toxicity, as well as volume, are addressed by this technology. This is especially true for organic contaminants; and,
2. Widely used and available commercially.

Disadvantages and Limitations –
1. Metals (e.g., arsenic, mercury, lead, cadmium and chromium) are not destroyed, and end up in the flue gases or the ash;
2. Community resistance to incineration is often present;
3. The water content of the wastes can create the need to co-incinerate these materials with auxiliary fuels. Dewatering may be needed; and
4. Certain types of soils, such as clay soils or soil containing rocks, may need screening.

Treatability Matrix for Incineration:

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<tr>
<th>Contaminant Group</th>
<th>Incineration</th>
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<td>Demonstrated Effectiveness</td>
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<td>Halogenated Volatiles</td>
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<td>Halogenated Semi Volatiles</td>
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<td>Non Halogenated Volatiles</td>
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6. Vapor Extraction and Air Sparging

a. Soil-Vapor Extraction

**Process Description:**

The treatment is generally used to remove volatiles from the vadose zone. The vadose zone includes the soil from the ground surface to the top of the water table.

Air flow through extraction wells creates a vacuum which in turn creates a pressure gradient inducing volatiles to diffuse through the soil to extraction wells. The volatiles are collected as gases. A system must be installed to collect and treat these gases. If the physical dimensions of a site are such that the depth to which the contamination extends is quite shallow, but the contaminated area is large, horizontal piping systems or trenches are used.

Flow diagram of soil vapor extraction (reference 10):

**Process Schematic of the In Situ Soil Vapor Extraction System**

Soil Preparation:

Minimal or no preparation is needed as the system is in situ.

**Waste Streams Generated:**

1. Volatile emissions; and,

2. Liquid treatment residuals (e.g., spent granular activated carbon [GAC]).
Treatability Group:

This process is demonstrated effective for halogenated volatiles and fuel hydrocarbons. It is potentially effective for non-halogenated volatiles (references 3 and 10).

Advantages and Ideal Conditions; Disadvantages and Limitations:

Advantages and Ideal Conditions –
1. Cost effective when large volumes of soil are involved; and
2. Since treatment takes place on-site, risks and costs associated with transport of large volumes of contaminated soils are eliminated.

Disadvantages and Limitations –
1. Less effective in soils with low air permeability. Soils with high carbon content are less amenable to this treatment;
2. Low soil temperatures reduce the effectiveness of the process;
3. Contaminants are reduced in volume, but toxicity is not reduced; and
4. Prior to the design and cleanup, extensive site characterization studies are needed.

Treatability Matrix for Soil Vapor Extraction:

<table>
<thead>
<tr>
<th>Contaminant Group</th>
<th>Soil Vapor Extraction</th>
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<td>Pesticides</td>
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b. **Air Sparging**

**Process Description:**

Air sparging (AS) is an in situ remedial technology that reduces concentrations of volatile constituents that are adsorbed to soils as well as dissolved in ground water. This technology, which is also known as “in situ air stripping” and “in situ volatilization,” involves the injection of contaminant-free air into the subsurface saturated zone, enabling a phase transfer of hydrocarbons from a dissolved phase to a vapor phase. The air is then vented through the unsaturated zone. Air sparging is most often used together with soil vapor extraction (SVE), but it can also be used with other remedial technologies. When air sparging is combined with SVE, the SVE system creates a negative pressure in the unsaturated zone through a series of extraction wells to control the vapor plume migration. This combined system is called AS/SVE (references 34 and 35).

Schematic of Air Sparging System with SVE (reference 34):

**Soil Preparation:**

Minimal, as the system is in situ.

**Waste Streams Generated (as AS/SVE):**

1. Volatile emissions; and,
2. Liquid treatment residuals (e.g., spent granular activated carbon [GAC])
Treatability Group:
This process is demonstrated effective for halogenated volatiles and fuel hydrocarbons. It is potentially effective for non-halogenated volatiles.

Advantages and Ideal Conditions; Disadvantages and Limitations:
Advantages and Ideal Conditions –
1. Readily available equipment; easy installation.
2. Implemented with minimal disturbance to site operations.
3. Short treatment times; usually less than 1 to 3 years under optimal conditions.
4. In general, air sparging is less costly than aboveground systems.
5. Can enhance removal by SVE.

Disadvantages and Limitations –
1. Free product, if present, must be removed prior to air sparging.
2. Stratified soils may cause air sparging to be ineffective.
3. Potential for inducing migration of constituents.
4. Requires detailed pilot testing and monitoring to ensure vapor control and limit migration.

Treatability Matrix for Air Sparging:

<table>
<thead>
<tr>
<th>Contaminant Group</th>
<th>Air Sparging</th>
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<tr>
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<td>Demonstrated Effectiveness</td>
</tr>
<tr>
<td>Halogenated Volatiles</td>
<td>X</td>
</tr>
<tr>
<td>Halogenated Semi Volatiles</td>
<td></td>
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<tr>
<td>Non Halogenated Volatiles</td>
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<td>Non Halogenated Semi Volatiles</td>
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<tr>
<td>Fuel Hydrocarbons</td>
<td>X</td>
</tr>
<tr>
<td>Pesticides</td>
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<tr>
<td>Inorganics</td>
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</table>
C. Treatability Matrix — Treatment Technologies by Contaminant Groups

### Treatability Matrix

<table>
<thead>
<tr>
<th>Contaminant Group</th>
<th>Treatment Technology</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Slurry Biodegradation</td>
</tr>
<tr>
<td>Halogenated Volatiles</td>
<td>○</td>
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<tr>
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<tr>
<td>Fuel Hydrocarbons</td>
<td>●</td>
</tr>
<tr>
<td>Pesticides</td>
<td>○</td>
</tr>
<tr>
<td>Inorganics (Metals)</td>
<td>●</td>
</tr>
</tbody>
</table>

- ● = Demonstrated Effectiveness
- ○ = Potential Effectiveness

* Checklist Available — See Appendix
D. Interstate Technology Regulatory Cooperation (ITRC)

The legal and regulatory uncertainties surrounding the cleanup of waste sites discourages the testing and use of innovative technologies and innovative applications of accepted technologies. Technology developers have difficulty gaining regulatory approval for the use of new technologies. Their difficulties are compounded by the requirement for developers to demonstrate a technology’s performance in each state targeted for technology deployment.

In response to this concern, the Interstate Technology and Regulatory Cooperation (ITRC) Working Group was formed. The ITRC is made up of representatives of approximately twenty-five state environmental agencies and includes federal, industry, tribal and public stakeholders as well. The ITRC is exploring and developing mechanisms to more effectively deploy innovative environmental technologies for the cleanup of contaminated sites throughout the country. One of the mechanisms under review is the development of baseline regulatory requirements and standardized protocols for verifying a technology’s cost and performance.

The ITRC has established several areas of technical focus and teams have been formed to establish reporting and demonstration protocols for specific technologies. Technical and regulatory guidelines have been developed for several technologies applicable for soil remediation, including: 1) Soil Washing, 2) Low Temperature Thermal Desorption and 3) In-Situ Bioremediation. Fact sheets for each are included in Appendix I. The ITRC has developed several informational reports applicable to such emerging technologies as phytoremediation, electrokinetics and in situ stabilization. Additional ITRC information is available on the ITRC Web Page (http://www.westgov.org/ITRC).

E. References


9. Environmental Protection Agency. ROD Database.


24. *VISIIT Database*.


VII. Remedial Action 3 — Soil Reuse

A. Introduction

Soil reuse is defined as using soil that has contamination at levels above site-specific cleanup criteria for purposes such as landfill cover or recycling. The first step in determining whether soil can be reused is to characterize the nature of contamination. Please note: Soil reuse/characterization is discussed in section V.C.2. All sampling procedures and analytical methods used to characterize contamination must conform to the Technical Requirements N.J.A.C. 7:26E and the NJDEP’s Field Sampling Procedures Manual. All efforts should be made to accurately delineate the contamination in soils prior to excavation. Once soil is adequately characterized, no further sampling should be necessary to make a remedial or reuse decision. However, it should be noted that additional testing may be required by a disposal or recycling facility to meet its permit requirements or site-specific acceptance requirements. If a recycling or disposal facility has been selected, contact the facility to determine its acceptance criteria.

B. Soil Categories

Soils are categorized according to the type and amount of contaminants present as follows:

- Soils that contain hazardous waste;
- Non-hazardous (ID 27 waste); or
- Soils that contain contaminants below regulatory concern, i.e., below cleanup criteria.

1. Hazardous

Soils that contain hazardous waste must be managed as such when contamination is above the non-hazardous waste limits (Appendix C) or is otherwise classified a hazardous waste. These soils must be managed as a hazardous waste in accordance with N.J.A.C. 7:26-G et seq. The only options for soils that contain a hazardous waste are on-site remediation or off-site management as a hazardous waste.

2. Non-hazardous

Contaminated soil is non-hazardous when both of the following criteria are met:

a. The contaminant levels are above the most stringent soil cleanup criteria established by NJDEP. Appendix A is a listing of the NJDEP Soil Cleanup Criteria dated July 11, 1996 which can be used as guidance; however, site specific cleanup levels must be discussed with the case manager assigned to your site. Refer to section “III. Soil Cleanup Criteria and Other Contaminated Media,” pg. 6 at the beginning of this document for a discussion of the Soil Cleanup Criteria.

b. The waste is not classified as a hazardous waste (see Appendix C - Hazardous Waste Levels).

3. Soils That Contain Contaminants Below Regulatory Concern

Soils that contain contaminants at levels that are below the most stringent site cleanup levels established by NJDEP for a specific site are not of regulatory concern with the exception of sites in the Pinelands Area (see section C.2.a. below). Please refer to section C below for additional reuse considerations.

C. Options For Reuse of Soils

1. Non-hazardous Soils

The most common reuse applications for minimally contaminated soils are roadway sub-base material, landfill cover, and recycling facilities. Soils with levels of contamination exceeding the
most stringent site-specific cleanup levels established by NJDEP cannot be reused without prior NJDEP approval. In all cases, the reuse of soils also must be protective of ground water and surface water bodies and subsurface structures, such as basements and indoor areas, as well as all other potential human and ecological receptors.

2. Site-specific Soil Reuse Proposals

If NJDEP guidance is required for reuse on a site-specific basis (i.e., reuse at a location without a recycling permit to reuse soil), submit a Soil Reuse Proposal to the Site Remediation Program. Prior to NJDEP approval of a Soil Reuse Proposal, the generator of the soil must submit its determination of waste classification along with the rationale used for characterization of the soil. For cases that are under review by the Site Remediation Program, contact the assigned case manager to get approval of a Soil Reuse Proposal. The Bureau of Field Operations, Case Assignment Section, should be contacted for cases that do not have an assigned case manager in the Site Remediation Program. Any party that elects to perform work with NJDEP oversight, including the review of sampling results and plans related to soil use/reuse, will be required to enter into a Memorandum of Agreement with NJDEP for that task unless already under a control document such as a Memorandum of Agreement or Administrative Consent Order or the regulatory requirements of the Industrial Site Recovery Act Program, the Underground Storage Tank Program, or other NJDEP programs.

All soil use/reuse applications must meet the following criteria:

a. Pinelands Area

Soils generated outside or within the Pinelands Area that contain contaminants at or below the most stringent cleanup levels established by NJDEP shall not be moved from the site of generation into or within the Pinelands Area unless the soils are at or below the receiving site’s background levels. Soils generated in the Pinelands Area that exceed background levels may not remain in the Pinelands Area but may be used elsewhere with written permission from NJDEP. Written approval from the New Jersey Pinelands Commission must be obtained before any land disturbance or moving of soil at any level of contamination within the Pinelands Area.

b. Objectionable Odors or Appearance

Soils having objectionable odors, including petroleum or synthetic chemical odors, shall not be used in residential areas or other locations where the public would be exposed or where such odors or appearance would render a site or its improvements unusable for their reasonably intended purpose. Specifically, the soils to be used must not violate the air pollution rules, N.J.A.C. 7:28-1 et seq., or local nuisance codes.

c. Regulatory Compliance

The soils must be used in accordance with all applicable federal, state, and local requirements.

d. Allowable Storage Time

Non-hazardous soils must not be stockpiled at the site of generation or elsewhere for more than six months from the date of excavation pursuant to the Solid Waste Regulations, N.J.A.C. 7:26-1.1:1.4. Therefore, soil reuse considerations and subsequent actions should be acted upon as soon as possible. Refer to section V.B.2 (Excavation — Regulatory Concerns) for staging/storage considerations.
3. Approved Contaminated Soil Recycling Centers in New Jersey

Soil that is accepted at an NJDEP permitted recycling center, which is authorized to accept contaminated soils by its permit, does not require a Solid Waste Regulation exemption or a prior site-specific reuse approval. Contact the Bureau of Landfill and Recycling Management, Division of Solid and Hazardous Waste, for further information (609/984-6650).

4. Out-of-state Recycling

For recycling soils out-of-state, a written determination from NJDEP is required as to the non-applicability of the solid waste management regulations set forth in N.J.A.C. 7:26-1 et seq. For sites without a Site Remediation Program lead (i.e., Industrial Site Recovery Act, Bureau of Underground Storage Tanks, Bureau of Field Operations) and for the recycling of soil as a solid process waste, contact the Bureau of Resource Recovery and Technical Programs (609/984-6985). Sites with a Site Remediation Program lead must send this information in lieu of a Soil Reuse Proposal to the assigned case manager for an approval. The following are the standard requirements pursuant to N.J.A.C. 7:26-1.1(a)1, and 1.7(g) for approval to send soils out-of-state:

a. A letter, sent to the Bureau of Resource Recovery and Technical Programs from the generator of soil, certifying that the soil in question has been analyzed or is known in accordance with N.J.A.C. 7:26G-5.1 not to contain a hazardous waste. This also must include any necessary test results documenting that the soil contains constituents and hazardous waste characteristics below their regulatory levels. (See Appendix C – Hazardous Waste Levels.)

b. A letter sent to the Division of Solid and Hazardous Waste from the receiving facility stating they agree to accept the specified amount of soil, indicating intention and method to beneficially use or reuse the soil and the time frame for such activity from the date of receipt at the facility. In addition, a copy of this information must be sent directly to the solid waste coordinator of the county of the soil’s origin.

c. A letter sent to the Division of Solid and Hazardous Waste from the appropriate regulatory agency of the receiving state or a copy of a current facility permit verifying that facility is operating in accordance with applicable rules and regulations and can accept the soils for the declared use/reuse.

d. Once the soil is delivered to the identified use/reuse facility, a letter from the facility or a bill of lading stating the date and amount of soil received must be sent to the Division of Solid and Hazardous Waste and the solid waste coordinator of the county of the soil’s origin.

5. Operational Landfill Cover

Operating landfills that are permitted to accept ID 27 waste may use non-hazardous soil for daily landfill cover with approval from the Bureau of Landfill and Recycling Management. Fine grained soils which may create erosion problems or are easily windblown are prohibited for use as daily cover. The following information should be submitted for approval:

a. A letter from the landfill owner/operator indicating acceptance of the soil. The landfill owner/operator shall state that he/she has reviewed all technical data pertaining to the contaminated soil.

b. A copy of the soil test results.

c. A letter from the Bureau of Resource Recovery and Technical Programs denoting the waste classification of the soil.

The completed application should be mailed to:
6. **Soils That Contain Contaminants Below Regulatory Concern**

Soils that contain contaminants at levels below the most stringent site cleanup levels established by NJDEP for a specific site are not of regulatory concern with the exception of sites in the Pinelands Area. Soils with contaminant levels below site-specific standards set by NJDEP are suitable for on-site reuse without treatment or prior approval. Off-site reuse of suspected or known contaminated soils is permissible only if written NJDEP approval is obtained or if the soil is recycled at an approved recycling center. In addition, the minimum criteria for all use/reuse applications, as noted in Section VII.C.2, “Site-specific Soil Reuse Proposals,” also apply to soils below regulatory concern.

Soils that contain contaminants below regulatory concern and are not petroleum contaminated may be mixed with source separated concrete, brick and block generated on-site and may be recycled on-site as clean fill. Such operations are exempted from the requirement to obtain approval from the department in accordance with the Recycling Regulations at N.J.A.C. 7:26A-1.4(a)2. To qualify for this exemption, any necessary county and municipal approvals for the activity must be obtained. General requirements applicable to the recycling activity are located at N.J.A.C. 7:26A-1.4(b)1-5. The department, the host county and the host municipality must be provided with written notification of the recycling activity pursuant to N.J.A.C. 7:26A-1.4(b)5. The department’s notification should be mailed to:

NJDEP, Office of Permitting and Technical Programs  
Bureau of Resource Recovery and Technical Programs  
Division of Solid and Hazardous Waste  
P.O. Box 414  
Trenton, NJ 08625-0414

The case manager must be copied on all related correspondence if the case is a Site Remediation lead site. For further information, contact the Bureau of Landfill and Recycling Management (609/984-6650).
VIII. Remedial Action 4 — Containment and Exposure Controls

A. Introduction

Containment and exposure control remedies include a variety of engineered systems that are implemented for the purpose of encapsulation or covering of contaminated soils that will be left untreated within an “area of concern” (AOC) or site. Such engineered systems include cap systems, liner systems, barrier walls and containment vaults. The primary purposes of such systems are to eliminate direct contact exposure with contaminated soils and/or to eliminate migration of contaminants from the soil to ground water, air or other clean soil areas. Contingent upon the types, quantities and characteristics of the contaminants present in the soils, there may be a need to include leachate collection systems, groundwater remediation systems and/or monitoring systems or gas collection and/or treatment systems in conjunction with the engineered containment system selected for the site or AOC. In all cases, containment and exposure control remedies will require establishment of Institutional Controls as part of implementation of the remedy, since future use of the site/AOC will be restricted due to contaminants left untreated. Any future use of the site must be compatible with the selected containment system. Use of containment and exposure controls is the “presumptive remedy” for any “historic fill” AOC’s/sites.

Pursuant to the provisions of the N.J.A.C. 7:26E-5.1(d)3, the use of engineering and/or institutional controls must be commensurate with the degree of risk associated with the contaminants left on-site and must be reviewed and approved by the Department. For example, stricter engineering controls may be required based upon the future use of the site, residential versus non-residential. In evaluating the appropriateness and the long-term and short-term effectiveness of engineering and/or institutional controls, the Department will consider contaminant characteristics (i.e., toxicity, mobility, volume, etc.), future site use and surrounding site uses, and the presence of free/residual products, off-spec or discarded product or by-product from a manufacturing or industrial process. Whenever practicable, the Department will require the treatment or removal of free/residual product or non-soil hazardous material such as off-spec or discarded product or by-product materials, prior to implementation of remedial actions that rely on engineering and/or institutional controls. The person responsible for conducting the remediation must demonstrate to the Department that any contaminated soils left on-site can be reliably contained by the proposed controls and that the remedy is protective of human health and the environment. In addition, any contaminated ground water below or adjacent to an area of contaminated soil must be addressed by the person responsible for conducting the remediation as a separate remedial action or in conjunction with the selected containment and exposure control remedy.

Long-term operation, maintenance and monitoring of any engineered containment system is critical for any site or AOC where contaminated soils will be left on-site. The provisions at N.J.A.C. 7:26E-6.1(b)5 require the person responsible for conducting the remediation to report back to the Department on a regular basis regarding the continued adequacy of any engineering and/or institutional controls. Accordingly, preparation of a site-specific maintenance and monitoring plan and provision of adequate resources to support implementation of the plan are key elements of a containment and exposure control remedy.

Design and construction of containment and exposure control remedies will vary greatly from site to site, contingent upon the nature and extent of contamination being left on-site and the intended future use of the site and surrounding properties. The key factors to consider in selecting and implementing such remedies include: (1) Cap/Wall/Liner construction (i.e., permeable, impermeable, thickness, materials, slope stability, settlement, etc.); (2) Surface water controls and erosion controls; (3) Generated gas controls (i.e., migration, collection, treatment); (4) Leachate controls (i.e., migration, collection, treatment); and, (5) Long-term Operation, Maintenance and Monitoring Programs. These key factors also need to be addressed in the Remedial Action Work Plan. Each of these key factors is discussed below in greater detail.
Finally, the selection of a remedial action for soil contamination that utilizes containment and exposure controls must comply with other applicable federal, state and/or local laws or regulations. In addition to the provisions of N.J.A.C. 7:26E-1 et.seq., other primary laws/regulations one must consider and evaluate include:

- RCRA/HSWA
- CERCLA/SARA
- NCP
- Local municipal solid waste plans/codes
- Floodplain/wetland regulations/controls
- Stream encroachment regulations
- Toxic Substance Control Act

B. Gas Control Systems

1. Gas Generation

The contaminated material present at the site may generate large volumes of methane gas or other toxic gases. If this generated gas is allowed to accumulate, there may be potential for gas explosion and/or cap “blow-out.” It also provides stress to vegetation by lowering the oxygen content available at the roots, severely affecting the ability of the cover to support vegetation. In the absence of adequate paths or channels for the gas to escape, gas pressures can increase sufficiently to physically disrupt the cover system. Other problems include odor, toxic vapors, and uncontrolled gas migration, which may impact nearby properties.

2. Gas Migration

Final cover design and incorporation of gas migration control measures affect gas migration. Low hydraulic conductivity soil layers and geomembranes are very effective barriers to gas migration. Properly designed granular fill soil or geosynthetic drainage materials can provide effective corridors for channeling gas migration. Other channels affecting migration are cracks that may develop due to differential settlement and subsidence.

3. Gas Control Systems

Two gas control systems, passive and active, are available and should be evaluated at every site suspected of gas generation. Passive systems provide corridors to intercept lateral gas migration and channel the gas to a collection point or vent. These systems use a composite liner and vent in the cover system. The liner prevents uncontrolled vertical migration while the gas collection layer under the liner intercepts all vertical migration and directs it to the vent. Active systems generate a zone of negative pressure to increase the pressure gradient and make the gas flow toward the vents. This can be accomplished by installing gas extraction wells and using exhaust blowers. The extraction well system must be designed properly to prevent the well from drawing air from the surface which may result in destroying suction capacity needed to draw gas to the well. Collection and treatment of gas condensate must also be addressed in design and implementation of such systems.

C. Leachate Control System

The function of a leachate collection system is to minimize or eliminate the migration of leachate away from the contaminated soil area. Leachate collection systems commonly used are trench drains and vertical wells. Trench drains consist of underground trenches filled with coarse aggregate soil and generally equipped with perforated pipe for greater hydraulic efficiency. They are used to intercept and channel leachate to a sump, wet well, or appropriate surface discharge. Vertical extraction wells are wells drilled in the plume and screened in a highly permeable water bearing zone. The intent is to collect highly contaminated leachate or leachate/ground water mix.
Some implementation and operation and maintenance considerations concerning leachate collection include the following:

- A properly designed leachate collection system should provide a reduction in the potential for migration of leachate to surface water and ground water;
- Extraction systems will require ongoing maintenance to maintain effectiveness;
- Drilling conditions must be considered;
- Leachate collection is typically cost effective compared to recovering dispersed contaminants;
- A leachate collection system may result in an increase in soil settlement as a result of leachate extraction; and
- An effective collection system generally will require a thorough characterization of hydrogeology of the site before design or installation of the system.

The primary data needed for designing a leachate collection system include the following:

- Topographic characteristics of the site that may impact the leachate collection system;
- Site soil characteristics (e.g., permeability, grain size distribution);
- Hydrogeologic characteristics (e.g., depth to ground water, flow direction and velocity); and
- Waste characteristics (e.g., composition, moisture content, age).

Either on-site or off-site treatment of leachate may be a feasible option. Leachate quality varies from site-to-site and also will vary over time. Once the constituents and associated concentrations of the leachate are known, an appropriate remedial action can be selected. Generally, leachate is treated by conventional means such as chemical, biological, and physical treatment.

**Off-Site Treatment:**

Discharge to a publicly owned treatment works either by pipeline or by truck may be appropriate for leachate streams containing concentrations of contaminants that are amenable to treatment provided by the publicly owned treatment works. More often, pretreatment may be required before discharge to the publicly owned treatment works. Major considerations include the constituents of the leachate and their concentrations, the type of treatment used by the publicly owned treatment works, the remaining treatment capacity of the publicly owned treatment works, the volume of leachate to be disposed of, and the expected duration of the discharge. NJDEP considers discharge to a publicly owned treatment works as the least preferred option.

**D. Containment System Design and Construction**

A cap provides a physical separation between the contaminants and humans, animals, and plant roots. Cover systems placed over regulated hazardous waste landfill units must comply with the New Jersey Hazardous Waste Landfill Closure Requirements found in N.J.A.C. 7:26-10.8(i). Another objective of using a cap is to promote more effective surface drainage and to maximize runoff, thus reducing infiltration of water into the underlying media and minimizing impacts to the ground water. A cap’s impermeable layer (usually clay or a synthetic liner) must be covered by an adequately thick layer of soil to avoid damage from freeze/thaw action. Also, the material under the impermeable cap must be well compacted to minimize damage from differential settlement. The different types of capping technologies typically used include native soil cover, single barrier (e.g., geomembrane, asphalt/concrete, clay), and composite barrier (e.g., clay plus geomembranes). When implementation of the engineering controls are determined appropriate, then the recommended engineering control may include a single barrier cap for the insoluble contaminant(s) and composite caps for the more soluble contaminants (e.g., hexavalent chromium).
1. **Native Soil Cover**

The use of native soil as cover for containment of hazardous materials may be appropriate where surface water infiltration and subsequent leachate generation are not controlling factors. Soil caps are used to control erosion and direct contact. Soil covers also may be used as an interim remedy (interim cap) to reduce contact hazards prior to design and construction of an impermeable cap. Soil covers are generally low in initial cost and the construction materials are readily available from local sources. Soil covers must be vegetated to minimize erosion. Soil covers can be used only if reduced infiltration is not a design goal. Native soil may not be stable on steep slopes; therefore, the slope may be limited to 33 percent. A typical soil cover that provides the above limited functions is 18 to 24 inches thick with six inches of topsoil for vegetation purposes. With adequate vegetation and proper maintenance soil cover thicknesses may be reduced if engineering evaluation and justification can be provided by a New Jersey Licensed Professional Engineer.

2. **Single Barrier (Synthetic, Asphalt/Concrete, and Clay Cap)**

The main functions of a single barrier cap are to reduce surface infiltration, prevent direct contact, limit gas emissions, and control erosion. The most commonly used barrier layers are synthetic liners (geomembranes), asphalt or concrete, and clay soils. These layers serve as low permeability layers that reduce surface water infiltration into the underlying waste material. The low permeability layer, except asphalt or concrete, is usually overlain by a drainage layer and a vegetative protective layer.

Any synthetic liner should be located below the maximum depth of frost penetration, and the type of liner material is recommended to be a minimum of 40 mils in thickness. The liner should be protected by an overlying drainage layer that is free of rock, fractured stone, debris, cobbles, rubbish and roots. Sudden changes in grade that may impair the liner should be avoided. The liner should be installed on a granular protective layer of soil overlying the waste material. It should be installed on a smooth soil surface. It should be noted that extreme care must be taken to prevent the liner from being punctured by sharp objects.

In commercial areas, an asphalt or concrete barrier layer is generally preferred so that the areas may still be used as roads or parking areas. The asphalt or concrete layer must be adequately designed, complying with the local/county requirements (approximately 4” to 8” thick), to withstand the expected vehicular traffic on the surface. The soil layer under the cap must be well compacted to avoid cracks in the cap which will allow infiltration of surface water. The cap surface should be properly graded and have a good drainage system to avoid ponding on the finished surface.

Clay layers must also be located below the maximum depth of frost penetration. The clay materials can achieve very low permeabilities (e.g., 1x10^-7 cm/sec) if they are well compacted and if their moisture content is controlled. A drainage layer with soil material above the clay layer, as specified above for synthetic liners, should be provided. The clay layer should have a thickness of 12 inches.

A typical cross section of a single barrier cap consists of the following layers (from visible top to top of contaminated materials):

- Vegetative and protective layer, 18” to 24” soil including 6” top soil;
- Geotextile filter fabric (to prevent migration of fines to the drainage layer below);
- Drainage layer with 6” of granular soil or geosynthetic drainage material;
- Barrier layer, either 12” of clay or 40 mil thick synthetic liner or geosynthetic liner or geosynthetic clay liners; and,
- Protective layer, 12” of compacted soil subgrade (placed on top of waste). Site specific factors can prompt variances to this typical design.
3. Composite Caps

A composite cap provides an additional impermeable layer which acts as a backup in case of leakage through the first impermeable layer. A composite cap consists of a compacted clay layer overlain by a synthetic liner. The composite cap is also overlain by the drainage layer and vegetative/protective layer. A composite cap reduces infiltration to a minimum. The protective layer (subgrade) under the lower barrier, if required, can act as a gas collection layer. A composite cap can be used when the waste material is characterized as similar to a hazardous waste. A slurry wall may be constructed along the perimeter of the cap to contain the ground water plume, if required.

A typical cross section of a composite barrier cap consists of the following (from visible to top of contaminated materials):

- Vegetative and protective layer, 18” to 24” soil including 6” top soil;
- Geosynthetic drainage layer;
- Geotextile fabric (to prevent migration of fines to the drainage layer below);
- 6” of soil/sand (drainage layer);
- Geomembrane liner (40 mil minimum);
- 24” of clay or geosynthetic clay liner;
- Geosynthetic drainage layer; and,
- Protective layer, 12” of compacted soil subgrade (placed on top of contaminated materials).

Site specific factors can prompt variances to this typical design.

4. Containment

Vertical walls or barriers may be a viable technology for soil and/or ground water containment at the contaminated sites where the soil is leaching contaminants to underlying groundwater. Their use warrants some consideration since they may improve the overall effectiveness of a containment system. Extraction wells are often used to increase the effectiveness of the vertical barrier by creating an inward groundwater gradient. The impermeable vertical barriers may be constructed out of bentonite slurry, a grout curtain with cement or chemical grouts, or sheet piling cutoff walls using wood, precast concrete or steel.

An ideal barrier will completely encircle the contaminated site, will be keyed into a lower aquitard (impervious layer), and will include a low permeability cap and a groundwater collection system to maintain an inward hydraulic gradient across the barrier. Such a barrier is generally more effective in controlling movement of ground water and pollutants than an up gradient or down gradient barrier or a partially-penetrating barrier (that is, one that is not keyed in to an impervious layer).

a. Slurry Walls:

In general, slurry trenching involves excavating a trench through or under a slurry of bentonite clay and water, and then backfilling this trench with the original soil with or without slurry mixed in. Most commonly, the trench is excavated down to, often into, an impervious layer in order to shut off the ground water flow. The width of the trench can vary, but it is typically from 2 to 5 feet. The slurry used in this practice is essentially a 4 to 7 percent by weight suspension of bentonite in water. Bentonite is a clay of the montmorillonite group 2:1 expanding lattice clays, mined in the western United States, principally in Wyoming, and is often called Wyoming bentonite. The use of slurry walls is generally limited to relatively flat and unconfined sites. A distance of 50 to 75 feet of open area adjacent to the trench is required for mixing bentonite with backfill materials.
b. Grout Curtains:

Grout curtain installation is another method of ground water control. Grouting is, in general, the pressure injection of one of a variety of special fluids into a rock or soil body to seal and strengthen it. Once in place, these fluids set or gel into the rock or soil voids, greatly reducing the permeability of and imparting mechanical strength to the grouted mass. When carried out in the proper pattern and sequence, this process can result in a curtain or wall that can be a very effective ground water barrier. The cost of installing a grout curtain can be three times as costly as a slurry wall. It is rarely used when ground water has to be controlled in soil or loose overburden. The major use of curtain grouting is to seal voids in porous or fractured rock where other methods of ground water control are impractical.

The pressure injection of grout involves drilling holes to the desired depth and injecting grout by the use of special equipment. In curtain grouting, a line of holes is drilled in single, double or triple staggered rows (depending on site characteristics) and grouting is accomplished in descending stages with increasing pressure. The spacing of the injection holes is also site specific and is determined by the penetration radius of the grout out from the holes. Ideally, the grout injected in adjacent holes should touch between them. If this process is done properly, a continuous, impervious barrier (curtain) will be formed.

The equipment used in pressure grouting is, for the most part, sophisticated special machinery. This machinery includes pumps and specialty drills for the boring of injection holes. Often the pumps are connected to a manifold to allow grouting of several holes at once. In nearly all cases, the pumps are equipped with gages and meters to monitor grout pressures and volumes.

c. Sheet Piling Cut-off Walls:

Sheet piling can be used to form a continuous containment wall or barrier. Sheet piles can be made of wood, precast concrete, or steel. Wood is an ineffective barrier. Concrete is used primarily where great strength is required. Steel is the most effective in terms of ground water cut-off and cost. Steel sheet piling cut-off walls involve driving interlocking piles into the ground with a pneumatic or steam-driven pile driver. Lengths of the piles are commonly available from 4 to 40 feet, although longer lengths are available by special order.

For construction of a sheet piling cut-off, the pilings are assembled at their edge interlocks before they are driven into the ground. The piles are then driven a few feet at a time over the entire length of the wall. This process is repeated until the piles are all driven to the desired depth.

The performance life of a sheet piling can be between 7 and 40 years, depending on the condition of the soil in which the wall is installed. Sheet piling walls can be installed in various types of soils ranging from well-drained sand to impervious clay, with soil resistivities ranging from 300-ohm cm to 50,000 ohm cm, and with soil pH ranging from 2.3 to 8.6. Additional protection of the sheet piling wall against corrosion can be achieved by using hot-dip galvanized or polymer-coated sheet. Steel sheet piles should not be considered for use in very rocky soil.

5. Construction Quality Assurance

Construction quality assurance is critical for producing engineered cover systems that will perform satisfactorily. The critical construction quality assurance issues for cover systems are (1) control of subgrade preparation; (2) soil placement/compaction; (3) drainage layers, and (4) deployment of the geomembrane and geomembrane field seams. The drawings and specifications prepared for construction of a cap system must be signed and sealed by a New Jersey Licensed Professional Engineer. The specifications should include the most important and useful quality control tests for soil materials used in cover systems, which are: grain size, moisture content, proctor moisture density, Atterberg’s limits, permeability, and shear strength. The construction quality assurance
plan must also include the longevity for the expected life of the cap. The construction contractor and inspector are responsible for the construction of the cap system in accordance with the drawings and specifications.

a. Control of Subgrade Preparation

Prior to the placement of random fill material (protective layer directly on top of the contaminated material), the surface of the contaminated soil area should be cleared of vegetative cover and compacted to stabilize the contaminated material. Unstable areas can be undercut and backfilled with random fill. In certain circumstances, limited excavation and reshaping of the contaminated area can minimize the volume of random fill material required, which could result in substantial cost savings. Materials which are unsuitable for use as random fill include debris, roots, brush, sod, and organic and frozen materials. The random fill is placed in lift thicknesses of 8 to 12 inches. The random fill layer should have a minimum thickness of 12 inches to provide a firm foundation for the overlying layers of the cap.

b. Soil Placement/Compaction

Construction issues are critical when placing the select fill (granular soil) on synthetic liners. The select fill material should be placed starting at the toe of the cover working up the slope and parallel to the toe. The first layer of select fill should be placed in a thick loose lift of 15 to 18 inches in depth. Equipment should not be driven or pulled directly on any underlying synthetic liner. Equipment is allowed on areas underlain by the liner only after the first layer of select fill has been placed. The select fill should not be dropped or dumped onto liners from a height greater than 12 inches. The select fill should be placed onto the synthetic liner by dropping (not pushing) the fill from a small front end loader.

The thickness of a lift should not exceed the specified value, especially for materials having low hydraulic conductivity. Otherwise, the lower portion of the lift may be inadequately compacted, the bonding of lifts is likely to be poor, and the hydraulic conductivity could be larger than desired. Control of lift thickness is critical for low hydraulic conductivity compacted soil liners.

Fill elevations are usually controlled with grade stakes. Care must be taken to remove grade stakes and repair the resulting holes. The Construction Quality Assurance inspector should make sure that grade stakes are not buried in the cover system. To accomplish this, an inventory system is recommended in which all grade stakes are numbered and accounted for each day. One advantage of ferrous metal grade stakes is that, if inadvertently buried in the cover system, they can be found with a metal detector. The holes left by grade stakes should be packed with soil liner material or bentonite tamped into the hold in layers with a rod.

To protect the synthetic liners, achieve a stable structure, and to enhance the soil’s ability to support the vegetative cover, the fill material at the top (vegetative and protective layer) should be minimally compacted. Generally, traffic compaction using placement equipment is sufficient.

c. Drainage Layer

The primary functions of the drainage layer are to intercept water that infiltrates the selected fill and then to convey the water out from beneath the cover. The drainage layer should be designed to minimize the amount and residence time of water being in contact with the low permeability layer. The drainage layer must slope to an exit drain and discharge away from the toe of the cover. The drainage layer generally consists of either a geonet or 6 to 12 inches of granular material. Geonet drainage materials should identify the following characteristics:

- hydraulic transmissivity (the rate at which liquid can be removed);
• compressibility (the ability to maintain open pore space, and thus transmissivity, under expected overburden);
• deformation characteristics (the ability to conform to changes in shape of the surrounding materials);
• mechanical compatibility with the synthetic liner (the tendency for the drainage material and the liner to deform each other);
• useful life of the system; and,
• ability to resist physical, chemical and biological clogging.

As for drainage layers with granular material, normal compaction is usually adequate. One potential problem to avoid is bulking of wet or damp sands; compaction in lifts will overcome such problems. Of greater importance than the degree of compaction is protecting drainage materials from contamination by fines. Over-compaction of the drainage materials can grind up soil and increase the amount of fines. The specifications should not permit use of nondurable materials that are easily broken down.

d. Deployment of the Geomembrane and Geomembrane Field Seams

The subgrade (the material beneath the liner) must be prepared to be free of sharp objects of any kind that can damage the geomembranes. Ruts caused by the compaction equipment or by the geomembrane placement equipment must be leveled by hand. Ruts are particularly troublesome if they freeze in their uneven profile. They must be leveled before the geomembrane is placed by waiting until the ground thaws or by breaking the uneven surfaces. Geomembranes should never be placed in ponded water. Seaming can never be accomplished under such conditions. In addition, the synthetic liner must be properly anchored to prevent it from slipping.

The geomembranes should be placed in accordance with a predetermined roll or panel layout. Layout is a site-specific consideration, but plans are generally supplied by the geomembrane manufacturer, fabricator, or installation firm. Usually, the rolls or panels are ordered in a particular direction. After a roll or panel is initially positioned, it usually must be shifted for exact positioning. The entire roll or panel must then be inspected for blemishes, scratches, and imperfections. Finally, the roll or panel is weighted down with sandbags to prevent movement by wind or any other disturbance. If complete rolls or panels have been captured by gusts of wind, they can be damaged and may need replacement.

Quality control of the geomembrane field seams is very important. The individual panels of liner material must be sufficiently overlapped for field seaming. There are many types of geomembrane seams that can be used in the field. The method of field seaming used should be appropriate to the type of geomembrane and in accordance with the procedures recommended by the manufacturer of the material. The common types of seams are solvent seams, thermal seams and extrusion seams. A quality control technician should inspect each seam. Any area showing defects should be marked and repaired. Non-destructive tests should be employed to check all seams. In addition, some samples should be sent to a laboratory for destructive seam tests for failure in sheer or peel modes to evaluate the quality of the field performance.

E. Long-Term Operation, Maintenance and Monitoring

The time required for post-closure monitoring of hazardous waste units or solid waste landfills is generally 30 years after closure activities have been completed. However, under current state law, monitoring is required until unrestricted use criteria or standards are achieved. Key monitoring parameters include ground water, air quality, gas migration, subsidence (settlement), and surface erosion. It is necessary to incorporate the proper instrumentation into the cover design and construction in order
to monitor these parameters of concern. Baseline conditions must be measured either prior to or immediately after construction, depending upon the parameter of concern. Consistent and accurate record keeping during the post capping period is essential. In addition, properties where caps are constructed as a long-term remedy must be subject to certain use restrictions or other institutional controls. Capped sites not in use are normally fenced to prevent trespassing. Institutional controls and deed notices are used to prevent any activities that could harm the constructed remedy. Throughout the period of operation, maintenance and monitoring, a site access/easement must be available to the site.

1. **Ground Water**

   If ground water has been impacted, continued monitoring may be necessary. Ground water monitor wells are normally placed both up and down gradient from the final cover. Baseline ground water analyses for index parameters are taken prior to construction of the final cover. The ground water is sampled and monitored during the post-capping period. It may be necessary to abandon or raise existing monitor wells where fill material will cover the wells during cap construction.

2. **Air Quality**

   In cases where the contaminated material may generate gases, gas concentrations released from the contaminated material should be monitored for both the underground lateral movement of gas and for air quality at the vent outlet locations. Gas monitoring stations should be located around the perimeter of the cap between any developments or areas of concern. The lower explosive limit of gas is the primary parameter of concern. The monitoring stations should be in place prior to placement of the low permeability layers. Air quality should be monitored on the final cover surface for toxic gases emitted from the vent system. For passive systems, internal gas pressures may be a concern and can be measured using pressure cells.

3. **Subsidence**

   Subsidence is a critical parameter to monitor because of the damage that can be caused by differential settlements to the clay barrier, synthetic liner, penetration connections, drainage provisions and gas collection systems. The level of differential settlements during post-closure monitoring may be quite large. Evidence of settlement can commonly be found by walking the cover after a rain storm and looking for ponding. Subsidence depressions also can be found through an annual survey of the cover using either conventional or aerial survey methods. Subsidence depressions must be remediated below the level of the barrier system. Remediation requires removing the cover system in the region of subsidence and backfilling the depression with lightweight fills. This fill may either be more contaminated material, waste, or commercial lightweight aggregates. The full cover profile must then be rebuilt over the new fill.

4. **Surface Erosion**

   All cover systems will erode and require long term maintenance. Cover systems with moderate slopes and a vegetative cover will typically require annual maintenance of 0.5 percent of their surface area. This percentage increases with slope. Thus, all covers that use vegetative covers require an annual inspection and repair program. Such repair may include cleaning out surface water swales, replacing cover soil, and re-establishing vegetation. The annual inspection should verify that the vegetative cover is being mowed at least annually to prevent the growth of trees. Also, maintenance logs need to be maintained which document the inspection condition(s), repair(s), etc. of the cap.

**F. References**


Soil Cleanup Criteria (mg/kg)  
(Last Revised — 7/11/96)

This listing represents the combination of Tables 3-1 and 7-1 from the Department of Environmental Protection’s February 3, 1992, proposed rule entitled Cleanup Standards for Contaminated Sites, N.J.A.C. 7:26D. It includes noted corrections based upon errors identified by the department during or subsequent to the comment period as well as new toxicological information obtained since the rule proposal. Please refer to the respective footnotes for more detail. Notwithstanding, where the following criteria are based on human health impacts, the Department shall still consider environmental impacts when establishing site specific cleanup criteria. This, along with other site specific factors including background conditions, may result in site-specific cleanup criteria which differ from the criteria listed below. Therefore, this list shall not be assumed to represent approval by the Department of any remedial action or to represent the department’s opinion that a site requires remediation.

Note: Material bracketed [thus] is deleted and material underlined thus is added.

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>CASRN</th>
<th>Residential Direct Contact Soil Cleanup Criteria(a)(b)</th>
<th>Non Residential Direct Contact Soil Cleanup Criteria(a)(b)</th>
<th>Impact to Ground water Soil Cleanup Criteria(b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acenaphthene</td>
<td>83-32-9</td>
<td>3400</td>
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<tr>
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<td>500</td>
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<td>Arsenic</td>
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<td>20 (e)</td>
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<td>3,4-Benzofluoranthene (Benzo(b)fluoranthene)</td>
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<td>Bis(2-chloroethyl) ether</td>
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<td>Bis(2-chloroisopropyl) ether</td>
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<td>Bis(2-ethylhexyl) phthalate</td>
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<td>Bromomethane</td>
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<td>Cadmium</td>
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<td>Carbon tetrachloride</td>
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<tr>
<td>4-Chloroaniline</td>
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<tr>
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<td>Chrysene</td>
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<tr>
<td>Copper</td>
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<td>600 (m)</td>
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<tr>
<td>Cyanide</td>
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<td>4,4'-DDD (p,p'-TDE)</td>
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<td>4,4'-DDT</td>
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<td>Residential Direct Contact Soil Cleanup Criteria(a)(b)</td>
<td>Non Residential Direct Contact Soil Cleanup Criteria(a)(b)</td>
<td>Impact to Ground water Soil Cleanup Criteria(b)</td>
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<tr>
<td>Dibenz(a,h)anthracene</td>
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<td>0.66 (f)</td>
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<td>Dibromochloromethane</td>
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<td>43</td>
<td>(r)</td>
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<td>5 (k)</td>
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<td>2100</td>
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<tr>
<td>Dinitrotoluene (2,4- / 2,6- mixture)</td>
<td>25321-14-6</td>
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<td>4 (l)</td>
<td>[10] 10 (l)</td>
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<td>Endosulfan</td>
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<td>Endrin</td>
<td>72-20-8</td>
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<td>Ethylbenzene</td>
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<td>1000 (d)</td>
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<tr>
<td>Fluorantherne</td>
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<tr>
<td>Fluorene</td>
<td>86-73-7</td>
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<td>10000 (c)</td>
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<td>Heptachlor</td>
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<td>7300</td>
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<td>Indeno(1,2,3-cd)pyrene</td>
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<td>Lead</td>
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<td>600 (q)</td>
<td>(h)</td>
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<td>Lindane</td>
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<td>(r)</td>
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<td>Mercury</td>
<td>7439-97-6</td>
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<td>270</td>
<td>(h)</td>
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<td>4-Methyl-2-pentanone(MIBK)</td>
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<td>1000 (d)</td>
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<tr>
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<td>49</td>
<td>210</td>
<td>[10] 1 (j)</td>
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<tr>
<td>Naphthalene</td>
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<td>4200</td>
<td>100</td>
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<tr>
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<td>250</td>
<td>2400 (k)</td>
<td>(h)</td>
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<tr>
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<td>98-95-3</td>
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<td>520</td>
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<tr>
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<td>86-30-6</td>
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<td>600</td>
<td>100</td>
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<tr>
<td>N-Nitrosodi-n-propylamine</td>
<td>621-64-7</td>
<td>0.66 (f)</td>
<td>0.66 (f)</td>
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<tr>
<td>PCBs (Polychlorinated biphenyls)</td>
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<td>0.49</td>
<td>2</td>
<td>[100] 50 (i)</td>
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<td>87-86-5</td>
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<td>10000 (c)</td>
<td>10000 (c)</td>
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<tr>
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<td>129-00-0</td>
<td>1700</td>
<td>10000 (c)</td>
<td>[500] 100 (j)</td>
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<tr>
<td>Selenium</td>
<td>7782-49-2</td>
<td>63</td>
<td>3100 (n)</td>
<td>(h)</td>
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<td>Contaminant</td>
<td>CASRN</td>
<td>Residential Direct Contact Soil Cleanup Criteria(a)(b)</td>
<td>Non Residential Direct Contact Soil Cleanup Criteria(a)(b)</td>
<td>Impact to Ground water Soil Cleanup Criteria(b)</td>
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<td>-----------------------------------------------------------</td>
<td>-----------------------------------------------</td>
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<tr>
<td>Silver</td>
<td>7440-22-4</td>
<td>110</td>
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<td>(h)</td>
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<td>Styrene</td>
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<td>97</td>
<td>100</td>
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<td>630-20-6</td>
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<td>2 (f)</td>
<td>(h)</td>
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<td>1000 (d)</td>
<td>500</td>
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<td>0.2 (k)</td>
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<td>Xylenes (Total)</td>
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<td>1500 (m)</td>
<td>(h)</td>
</tr>
</tbody>
</table>

Footnotes

(a) criteria are health based using an incidental ingestion exposure pathway except where noted below
(b) criteria are subject to change based on site specific factors (e.g., aquifer classification, soil type, natural background, environmental impacts, etc.)
(c) health based criterion exceeds the 10000 mg/kg maximum for total organic contaminants
(d) health based criterion exceeds the 1000 mg/kg maximum for total volatile organic contaminants
(e) cleanup standard proposal was based on natural background
(f) health based criterion is lower than analytical limits; cleanup criterion based on practical quantitation level
(g) criterion has been recalculated based on new toxicological data
(h) the impact to ground water values for inorganics will be developed based upon site specific chemical and physical parameters
(i) original criterion was incorrectly calculated and has been recalculated
(j) typographical error
(k) criterion based on inhalation exposure pathway which yielded a more stringent criterion than the incidental ingestion exposure pathway
(l) new criterion derived using methodology in the basis and background document
(m) criterion based on ecological (phytotoxicity) effects
(n) level of the human health based criterion is such that evaluation for potential environmental impacts on a site by site basis is recommended
(o) level of the criterion is such that evaluation for potential acute exposure hazard is recommended
(p) criterion based on the USEPA Integrated Exposure Uptake Biokinetic (IEUBK) model utilizing the default parameters. The concentration is considered to protect 95% of target population (children) at a blood lead level of 10 ug/dl.
(q) criteria was derived from a model developed by the Society for Environmental Geochemistry and Health (SEGH) and was designed to be protective for adults in the workplace
(r) Insufficient information available to calculate impact to ground water criteria
Appendix B
Contaminants
A. Contaminant Groups


Major contaminant groups used in the Matrix are:

(1) Halogenated volatiles
(2) Halogenated semivolatiles
(3) Non-halogenated volatiles
(4) Non-halogenated semivolatiles
(5) Fuel Hydrocarbons
(6) Pesticides
(7) Inorganics

These major groups include the contaminants listed below. These are not comprehensive lists, but they contain examples of contaminants encountered at many sites.

(1) **Halogenated Volatiles**

- Bromodichloromethane
- Bromoform
- Bromomethane
- Carbon tetrachloride
- Chlorodibromomethane
- Chloroethane
- Chloroform
- Chloromethane
- Chloropropane
- Cis- 1,2-dichloroethylene
- Cis- 1,3-dichloropropene
- Dibromomethane
- 1,1-Dichloroethane
- 1,2-Dichloethane
- 1,2-Dichloroethene
- 1,1-Dichloroethylnle
- Dichloromethane
- 1,2-Dichloropropene
- Ethylene dibromide
- Fluorotrichloromethane (Freon 11)
- Hexachloroethane
- Monochlorobenzene
- 1,1,2,2-Tetrachloroethane
- Tetrachloroethylene (Perchloroethylene)
- 1,2-Trans-dichloroethylene
- Trans-1,3-dichloropropene
- 1,1,1-Trichloroethane

(2) **Halogenated Semivolatiles**

- 1,1,2-Trichloroethane (Freon 11/3)
- Vinyl chloride
- 1,1,2-Trichloro- 1,2,2-trifluoroethane (Freon 113)
- 1,2-Bis(2-chloroethoxy)ether
- 1,2-Bis(2-chloroethoxy)ethane
- Bis(2-chloroethoxy)methane
- Bis(2-chloroethoxy)phthalate
- Bis(2-chloroethyl)ether
- Bis(2-chloroisopropyl)ether
- 4-Bromophenyl phenyl ether
- 4-Chloroaniline
- p-Chloro-m-cresol
- 2-Chloronaphthalene
- 2-Chlorophenol
- 4-Chlorophenyl phenylether
- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 3,3-Dichlorobenzidine
### Halogenated Semivolatiles (Continued)

- 2,4-Dichlorophenol
- Hexachlorobenzene
- Hexachlorobutadiene
- Hexachlorocyclopentadiene
- Pentachlorophenol
- Polychlorinated biphenyls (PCBs)
- Tetrachlorophenol
- 1,2,4-Trichlorobenzene
- 2,4,5-Trichlorophenol
- 2,4,6-Trichlorophenol

### (3) Non-Halogenated Volatiles

- Acetone
- Acrolein
- Acrylonitrile
- n-Butyl alcohol
- Carbon disulfide
- Cyclohexanone
- Ethyl acetate
- Ethyl ether
- 2-Hexanone
- Isobutanol
- Methanol
- Methyl ethyl ketone
- Methyl isobutyl ketone
- 4-Methyl-2-pentanone
- Styrene
- Tetrahydrofuran
- Vinyl acetate

### (4) Non-Halogenated Semivolatiles

- Benzidine
- Benzoic acid
- Benzyl alcohol
- Bis(2-ethylhexyl)phthalate
- Bis phthalate
- Butyl benzyl phthalate
- Dibenzofuran
- Di-n-butyl phthalate
- Diethyl phthalate

### Dimethyl phthalate
- 4,6-Dinitro-2-methylphenol
- 2,4-Dinitrophenol
- 2,4-Dinitrotoluene
- 2,6-Dinitrotoluene
- Di-n-octyl phthalate
- 1,2-Diphenylhydrazine
- Isophorone
- 2-Nitroaniline
- 3-Nitroaniline
- 4-Nitroaniline
- 2-Nitrophenol
- 4-Nitrophenol
- n-Nitrosodimethylamine
- n-Nitrosodiphenylamine
- n-Nitrosodi-n-propylamine
- Phenyl napthalene

### (5) Fuel Hydrocarbons

- Acenaphthene
- Anthracene
- Benz(a)anthracene
- Benzene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Benzo(ghi)perylene
- Benzo(a)pyrene
- Chrysene
- Cis-2-butene
- Cresols
- Cyclohexane
- Cyclopentane
- Dibenz(a,h)anthracene
- 2,3-Dimethylbutane
- 3,3-Dimethyl-1-butene
- Dimethyllethylbenzene
- 2,2-Dimethylheptane
- 2,2-Dimethylhexane
- 2,2-Dimethylpentane
- 2,3-Dimethylpentane
- 2,4-Dimethylphenol
- Ethylbenzene
- 3-Ethylpentane
- Fluoranthene
- Fluorene
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<th>Compound</th>
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<td>Isobutane</td>
<td>1,2,4-Trimethyl-5-ethylbenzene</td>
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<td>2,2,4-Trimethylheptane</td>
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<td>2-Methyl-1,3-butadiene</td>
<td>2,3,4-Trimethylheptane</td>
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<tr>
<td>3-Methyl-1,2-butadiene</td>
<td>3,3,5-Trimethylheptane</td>
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<td>2-Methyl-butene</td>
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<td>3-Methyl-1-butene</td>
<td>2,2,4-Trimethylpentane</td>
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<tr>
<td>Methyl/propylbenzene</td>
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<tr>
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<tr>
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<td>(6) Pesticides</td>
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<td>Pyridine</td>
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<td>1,2,3,4-Tetramethylbenzene</td>
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Bismuth
Cadmium
Calcium
Chromium
Cobalt
Copper
Cyanide
Fluorine
Iron
Lead
Magnesium
Manganese
Mercury
Metallic cyanides
Nickel
Potassium
Selenium
Sodium
Tin
Vanadium
Zinc
B. Alphabetical Listing of Contaminants


Acenaphthene (see Fuel Hydrocarbons)
Acetone (see Non-Halogenated Volatiles)
Acrolein (see Non-Halogenated Volatiles)
Acrylonitrile (see Non-Halogenated Volatiles)
Aldrin (see Pesticides)
Aluminum (see Inorganics)
Anthracene (see Fuel Hydrocarbons)
Antimony (see Inorganics)
Arsenic (see Inorganics)
Asbestos (see Inorganics)
Barium (see Inorganics)
Benz(a)anthracene (see Fuel Hydrocarbons)
Benzene (see Fuel Hydrocarbons)
Benzidine (see Non-Halogenated Semivolatiles)
Benzo(a)pyrene (see Fuel Hydrocarbons)
Benzo(b)fluoranthene (see Fuel Hydrocarbons)
Benzo(ghi)perylene (see Fuel Hydrocarbons)
Benzo(k)fluoranthene (see Fuel Hydrocarbons)
Benzoic acid (see Non-Halogenated Semivolatiles)
Benzyl alcohol (see Non-Halogenated Semivolatiles)
Beryllium (see Inorganics)
Bhc-alpha (see Pesticides)
Bhc-beta (see Pesticides)
Bhc-delta (see Pesticides)
Bhc-gamma (see Pesticides)
Bis phthalate (see Non-Halogenated Semivolatiles)
1,2-Bis(2-chloroethoxy)ethane (see Halogenated Semivolatiles)
Bis(2-chloroethoxy)ether (see Halogenated Semivolatiles)
Bis(2-chloroethoxy)methane (see Halogenated Semivolatiles)
Bis(2-chloroethoxy)phthalate (see Halogenated Semivolatiles)
Bis(2-chloroethyl)ether (see Halogenated Semivolatiles)
Bis(2-chloroisopropyl)ether (see Halogenated Semivolatiles)
Bis(2-ethylhexyl)phthalate (see Non-Halogenated Semivolatiles)
Bismuth (see Inorganics)
Bromodichlommethane (see Halogenated Volatiles)
Bromoform (see Halogenated Volatiles)
Bromomethane (see Halogenated Volatiles)
4-Bromophenyl phenyl ether (see Halogenated Semivolatiles)
Butyl benzyl phthalate (see Non-Halogenated Semivolatiles)
Cadmium (see Inorganics)
Calcium (see Inorganics)
Carbon disulfide (see Non-Halogenated Volatiles)
Carbon tetrachloride (see Halogenated Volatiles)
Chlordane (see Pesticides)
4-Chloroaniline (see Halogenated Semivolatiles)
Chlorodibromomethane (see Halogenated Volatiles)
Chloroethane (see Halogenated Volatiles)
Alphabetical Listing of Contaminants (continued)

Chloroform (see Halogenated Volatiles)
Chloromethane (see Halogenated Volatiles)
2-Chloronaphthalene (see Halogenated Semivolatiles)
2-Chlorophenol (see Halogenated Semivolatiles)
4-Chlorophenyl phenylether (see Halogenated Semivolatiles)
Chloropropane (see Halogenated Volatiles)
Chromium (see Inorganics)
Chrysene (see Fuel Hydrocarbons)
Cis-1,2-dichloroethylen (see Halogenated Volatiles)
Cis-1,3-dichloropropene (see Halogenated Volatiles)
Cis-2-butene (see Fuel Hydrocarbons)
Cobalt (see Inorganics)
Copper (see Inorganics)
Cresols (see Fuel Hydrocarbons)
Cyanide (see Inorganics)
Cyclohexane (see Fuel Hydrocarbons)
Cyclohexanone (see Non-Halogenated Volatiles)
Cyclopentane (see Fuel Hydrocarbons)
4,4'-DDD (see Pesticides)
4,4'-DDE (see Pesticides)
4,4'-DDT (see Pesticides)
Di-n-butyl phthalate (see Non-Halogenated Semivolatiles)
Di-n-octyl phthalate (see Non-Halogenated Semivolatiles)
Dibenzo(a,h)anthracene (see Fuel Hydrocarbons)
Dibenzofuran (see Non-Halogenated Semivolatiles)
Dibromomethane (see Halogenated Volatiles)
1,2-Dichlorobenzene (see Halogenated Semivolatiles)
1,3-Dichlorobenzene (see Halogenated Semivolatiles)
1,4-Dichlorobenzene (see Halogenated Semivolatiles)
3,3-Dichlorobenzidine (see Halogenated Semivolatiles)
1,1-Dichloroethane (see Halogenated Volatiles)
1,2-Dichloroethane (see Halogenated Volatiles)
1,2-Dichloroethene (see Halogenated Volatiles)
1,1-Dichloroethylene (see Halogenated Volatiles)
Dichloromethane (see Halogenated Volatiles)
2,4-Dichlorophenol (see Halogenated Semivolatiles)
1,2-Dichloropropane (see Halogenated Volatiles)
Dieldrin (see Pesticides)
Diethyl phthalate (see Non-Halogenated Semivolatiles)
Dimethyl phthalate (see Non-Halogenated Semivolatiles)
3,3-Dimethyl-1-butene (see Fuel Hydrocarbons)
2,3-Dimethylbutane (see Fuel Hydrocarbons)
Dimethylethylbenzene (see Fuel Hydrocarbons)
2,2-Dimethylheptane (see Fuel Hydrocarbons)
2,2-Dimethylhexane (see Fuel Hydrocarbons)
2,2-Dimethylpentane (see Fuel Hydrocarbons)
2,3-Dimethylpentane (see Fuel Hydrocarbons)
2,4-Dimethylphenol (see Fuel Hydrocarbons)
4,6-Dinitro-2-methylphenol (see Non-Halogenated Semivolatiles)
2,4-Dinitrophenol (see Non-Halogenated Semivolatiles)
Alphabetical Listing of Contaminants (continued)

2,4-Dinitrotoluene (see Non-Halogenated Semivolatile)
2,6-Dinitrotoluene (see Non-Halogenated Semivolatile)
1,2-Diphenylhydrazine (see Non-Halogenated Semivolatile)
Endosulfan sulfate (see Pesticides)
Endosulfan I (see Pesticides)
Endosulfan II (see Pesticides)
Endrin (see Pesticides)
Endrin aldehyde (see Pesticides)
Ethion (see Pesticides)
Ethyl acetate (see Non-Halogenated Volatiles)
Ethyl ether (see Non-Halogenated Volatiles)
Ethyl parathion (see Pesticides)
Ethylbenzene (see Fuel Hydrocarbons)
Ethylene dibromide (see Halogenated Volatiles)
3-Ethylpentane (see Fuel Hydrocarbons)
Fluoranthen (see Fuel Hydrocarbons)
Fluorene (see Fuel Hydrocarbons)
Fluorine (see Inorganics)
Fluorotrichloromethane (Freon 11) (see Halogenated Volatiles)
Fuel Hydrocarbons
Halogenated Semivolatile
Halogenated Volatile
Heptachlor (see Pesticides)
Heptachlor epoxide (see Pesticides)
Hexachlorobenzene (see Halogenated Semivolatile)
Hexachlorobutadiene (see Halogenated Semivolatile)
Hexachlorocyclopentadiene (see Halogenated Semivolatile)
Hexachloroethane (see Halogenated Volatile)
2-Hexanone (see Non-Halogenated Volatiles)
Indeno(1,2,3-c,d)pyrene (see Fuel Hydrocarbons)
Inorganics
Iron (see Inorganics)
Isobutane (see Fuel Hydrocarbons)
Isobutanol (see Non-Halogenated Volatiles)
Isopentane (see Fuel Hydrocarbons)
Isophorone (see Non-Halogenated Semivolatile)
Lead (see Inorganics)
M-Xylene (see Fuel Hydrocarbons)
Magnesium (see Inorganics)
Malathion (see Pesticides)
Manganese (see Inorganics)
Mercury (see Inorganics)
Metallic cyanides (see Inorganics)
Methanol (see Non-Halogenated Volatiles)
Methyl isobutyl ketone (see Non-Halogenated Volatiles)
Methyl ethyl ketone (see Non-Halogenated Volatiles)
2-Methyl-1,3-butadiene (see Fuel Hydrocarbons)
3-Methyl-1,2-butadiene (see Fuel Hydrocarbons)
2-Methyl-2-butene (see Fuel Hydrocarbons)
4-Methyl-2-pentanone (see Non-Halogenated Volatiles)
Alphabetical Listing of Contaminants (continued)

2-Methyl-butene (see Fuel Hydrocarbons)
3-Methyl-l-butene (see Fuel Hydrocarbons)
3-Methyl-l-pentene (see Fuel Hydrocarbons)
Methylcyclohexane (see Fuel Hydrocarbons)
Methylcyclopentane (see Fuel Hydrocarbons)
2-Methylheptane (see Fuel Hydrocarbons)
3-Methylheptane (see Fuel Hydrocarbons)
3-Methylhexane (see Fuel Hydrocarbons)
Methylnaphthalene (see Fuel Hydrocarbons)
2-Methylnaphthalene (see Fuel Hydrocarbons)
Methylparathion (see Pesticides)
2-Methylpentane (see Fuel Hydrocarbons)
3-Methylpentane (see Fuel Hydrocarbons)
2-Methylphenol (see Fuel Hydrocarbons)
4-Methylphenol (see Fuel Hydrocarbons)
Methylpropylbenzene (see Fuel Hydrocarbons)
Monochlorobenzene (see Halogenated Volatiles)
N-Butane (see Fuel Hydrocarbons)
n-Butyl alcohol (see Non-Halogenated Volatiles)
N-Decane (see Fuel Hydrocarbons)
N-Dodecane (see Fuel Hydrocarbons)
N-Heptane (see Fuel Hydrocarbons)
N-Hexane (see Fuel Hydrocarbons)
N-Hexylbenzene (see Fuel Hydrocarbons)
n-Nitrosodi-n-propylamine (see Non-Halogenated Semivolatiles)
n-Nitrosodimethylamine (see Non-Halogenated Semivolatiles)
n-Nitrosodiphenylamine (see Non-Halogenated Semivolatiles)
n-Nitrosodiphenylamine (see Non-Halogenated Semivolatiles)
N-Nonane (see Fuel Hydrocarbons)
N-Octane (see Fuel Hydrocarbons)
N-Pentane (see Fuel Hydrocarbons)
N-Propylbenzene (see Fuel Hydrocarbons)
N-Undecane (see Fuel Hydrocarbons)
Naphthalene (see Fuel Hydrocarbons)
Nickel (see Inorganics)
2-Nitroaniline (see Non-Halogenated Semivolatiles)
3-Nitroaniline (see Non-Halogenated Semivolatiles)
4-Nitroaniline (see Non-Halogenated Semivolatiles)
Nitrobenzene (see Fuel Hydrocarbons)
2-Nitrophenol (see Non-Halogenated Semivolatiles)
4-Nitrophenol (see Non-Halogenated Semivolatiles)
Non-Halogenated Semivolatiles
Non-Halogenated Volatiles
O-Xylene (see Fuel Hydrocarbons)
p-Chloro-m-cresol (see Halogenated Semivolatiles)
P-Xylene (see Fuel Hydrocarbons)
Parathion (see Pesticides)
Pentachlorophenol (see Halogenated Semivolatiles)
1-Pentene (see Fuel Hydrocarbons)
Pesticides
Phenanthrene (see Fuel Hydrocarbons)
Alphabetical Listing of Contaminants (continued)

Phenol (see Fuel Hydrocarbons)
Phenyl naphthalene (see Non-Halogenated Semivolatiles)
Polychlorinated biphenyls (PCBS) (see Halogenated Semivolatiles)
Potassium (see Inorganics)
Propane (see Fuel Hydrocarbons)
Pyrene (see Fuel Hydrocarbons)
Pyridine (see Fuel Hydrocarbons)
Selenium (see Inorganics)
Sodium (see Inorganics)
Styrene (see Non-Halogenated Volatiles)
1,1,2,2-Tetrachloroethane (see Halogenated Volatiles)
Tetrachloroethylene (Perchloroethylene) (see Halogenated Volatiles)
Tetrachlorophenol (see Halogenated Semivolatiles)
Tetrahydrofuran (see Non-Halogenated Volatiles)
1,2,3,4-Tetramethylbenzene (see Fuel Hydrocarbons)
1,2,4,5-Tetramethylbenzene (see Fuel Hydrocarbons)
Tin (see Inorganics)
Toluene (see Fuel Hydrocarbons)
Toxaphene (see Pesticides)
Trans-1,3-dichloropropene (see Halogenated Volatiles)
Trans-2-butene (see Fuel Hydrocarbons)
Trans-2-pentene (see Fuel Hydrocarbons)
1,2-Trans-dichloroethylene (see Halogenated Volatiles)
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon I 13) (see Halogenated Volatiles)
1,2,4-Trichlorobenzene (see Halogenated Semivolatiles)
1,1,1-Trichloroethane (see Halogenated Volatiles)
1,1,2-Trichloroethane (see Halogenated Volatiles)
Trichloroethylene (see Halogenated Volatiles)
2,4,5-Trichlorophenol (see Halogenated Semivolatiles)
2,4,6-Trichlorophenol (see Halogenated Semivolatiles)
1,2,4-Trimethyl-5-ethylbenzene (see Fuel Hydrocarbons)
1,2,4-Trimethylbenzene (see Fuel Hydrocarbons)
1,3,5-Trimethylbenzene (see Fuel Hydrocarbons)
2,2,4-Trimethylheptane (see Fuel Hydrocarbons)
2,3,4-Trimethylheptane (see Fuel Hydrocarbons)
3,3,5-Trimethylheptane (see Fuel Hydrocarbons)
2,4,4-Trimethylhexane (see Fuel Hydrocarbons)
3,3,4-Trimethylhexane (see Fuel Hydrocarbons)
2,2,4-Trimethylpentane (see Fuel Hydrocarbons)
2,3,4-Trimethylpentane (see Fuel Hydrocarbons)
Vanadium (see Inorganics)
Vinyl chloride (see Halogenated Volatiles)
Vinyl acetate (see Non-Halogenated Volatiles)
Zinc (see Inorganics)
Appendix C
Hazardous Waste Levels
Hazardous Waste Levels

Below are the analytical parameters and their regulatory levels for waste classification purposes. The different testing parameters do not apply to all waste types. Parameters represented by EPA waste numbers D004 through D043 are determined by TCLP methods. Please contact our unit at the above telephone number for hazardous waste classification information.

<table>
<thead>
<tr>
<th>EPA Waste Number</th>
<th>Parameters/Contaminant</th>
<th>Hazardous Level</th>
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</thead>
<tbody>
<tr>
<td>D001</td>
<td>Ignitibility</td>
<td>≤140° F</td>
</tr>
<tr>
<td>D002</td>
<td>Corrosivity</td>
<td>≤2 and ≥12.5 pH</td>
</tr>
<tr>
<td>D003</td>
<td>Reactive Sulfide</td>
<td>500 mg/kg</td>
</tr>
<tr>
<td>D003</td>
<td>Reactive Cyanide</td>
<td>250 mg/kg</td>
</tr>
<tr>
<td>D004</td>
<td>Arsenic</td>
<td>5.0 mg/l</td>
</tr>
<tr>
<td>D005</td>
<td>Barium</td>
<td>100.0 mg/l</td>
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<tr>
<td>D006</td>
<td>Cadmium</td>
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<tr>
<td>D007</td>
<td>Chromium</td>
<td>5.0 mg/l</td>
</tr>
<tr>
<td>D008</td>
<td>Lead</td>
<td>5.0 mg/l</td>
</tr>
<tr>
<td>D009</td>
<td>Mercury</td>
<td>0.2 mg/l</td>
</tr>
<tr>
<td>D010</td>
<td>Selenium</td>
<td>1.0 mg/l</td>
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<tr>
<td>D011</td>
<td>Silver</td>
<td>5.0 mg/l</td>
</tr>
<tr>
<td>D012</td>
<td>Endrin</td>
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<td>D013</td>
<td>Lindane</td>
<td>0.4 mg/l</td>
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<tr>
<td>D014</td>
<td>Methoxychlor</td>
<td>10.0 mg/l</td>
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<tr>
<td>D015</td>
<td>Toxaphene</td>
<td>0.5 mg/l</td>
</tr>
<tr>
<td>D016</td>
<td>2,4-D</td>
<td>10.0 mg/l</td>
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<tr>
<td>D017</td>
<td>2,4,5-TP Silvex</td>
<td>1.0 mg/l</td>
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<tr>
<td>D018</td>
<td>Benzene</td>
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</tr>
<tr>
<td>D019</td>
<td>Carbon tetrachloride</td>
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<tr>
<td>D020</td>
<td>Chlordane</td>
<td>0.03 mg/l</td>
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<td>D022</td>
<td>Chloroform</td>
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<td>o-Cresol</td>
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<td>m-Cresol</td>
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<td>D026</td>
<td>Cresol</td>
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<td>D027</td>
<td>1,4-Dichlorobenzene</td>
<td>7.5 mg/l</td>
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<td>D028</td>
<td>1,2-Dichloroethane</td>
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<td>D029</td>
<td>1,1-Dichloroethylene</td>
<td>0.7 mg/l</td>
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<td>D030</td>
<td>2,4-Dinitrotoluene</td>
<td>0.13 mg/l</td>
</tr>
<tr>
<td>D031</td>
<td>Heptachlor</td>
<td>0.008 mg/l</td>
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<tr>
<td>D032</td>
<td>Hexachlorobenzene</td>
<td>0.13 mg/l</td>
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<tr>
<td>D033</td>
<td>Hexachlorobutadiene</td>
<td>0.5 mg/l</td>
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<tr>
<td>D034</td>
<td>Hexachloroethane</td>
<td>3.0 mg/l</td>
</tr>
<tr>
<td>D035</td>
<td>Methyl ethyl ketone</td>
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<tr>
<td>D036</td>
<td>Nitrobenzene</td>
<td>2.0 mg/l</td>
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<tr>
<td>D037</td>
<td>Pentachlorophenol</td>
<td>100.0 mg/l</td>
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<tr>
<td>D038</td>
<td>Pyridine</td>
<td>5.0 mg/l</td>
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<tr>
<td>D039</td>
<td>Tetrachloroethylene</td>
<td>0.7 mg/l</td>
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<tr>
<td>D040</td>
<td>Trichloroethylene</td>
<td>0.5 mg/l</td>
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<tr>
<td>D041</td>
<td>2,4,5-Trichlorophenol</td>
<td>400.0 mg/l</td>
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<tr>
<td>D042</td>
<td>2,4,6-Trichlorophenol</td>
<td>2.0 mg/l</td>
</tr>
<tr>
<td>D043</td>
<td>Vinyl chloride</td>
<td>0.2 mg/l</td>
</tr>
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Appendix D
District Solid Waste Management Officials
# District Solid Waste Management Officials – February 1998

<table>
<thead>
<tr>
<th>State</th>
<th>Coordinator</th>
<th>District</th>
<th>Address</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlantic</td>
<td>Mr. Brian Lefke</td>
<td>Solid Waste Coordinator</td>
<td>Atlantic County Utilities Authority</td>
<td>609/646-5500 Fax 272-6941</td>
</tr>
<tr>
<td>H.M.D.C.</td>
<td>Mr. Thomas Marturano</td>
<td>Director of Solid Waste</td>
<td>Hackensack Meadowlands Development Commission</td>
<td>PO Box 640 Lyndhurst, NJ 07071 201/460-1700 Fax 460-1722</td>
</tr>
<tr>
<td>Ocean</td>
<td>Mr. Alan Avery</td>
<td>Director</td>
<td>Ocean County Solid Waste Dept.</td>
<td>129 Hooper Avenue Box 2191 Toms River, NJ 08754-2191 732/506-5047 Fax 244-8396</td>
</tr>
<tr>
<td>Bergen</td>
<td>Mr. Richard Wierer</td>
<td>Director</td>
<td>Bergen County Utilities Authority</td>
<td>609/695-1200 Fax 695-1452</td>
</tr>
<tr>
<td>Hudson</td>
<td>Mr. Thomas Calvanico</td>
<td>Director</td>
<td>Hudson County Improvement Authority</td>
<td>201/795-4555 Fax 795-0240</td>
</tr>
<tr>
<td>Passaic</td>
<td>Mr. James Rogers</td>
<td>Planning Director</td>
<td>Passaic County Planning Department</td>
<td>201/881-4490 Fax 881-4484</td>
</tr>
<tr>
<td>Burlington</td>
<td>Mr. Robert Simkins</td>
<td>Solid Waste Coordinator</td>
<td>Burlington County Waste Management</td>
<td>609/499-1001 Fax 499-5212</td>
</tr>
<tr>
<td>Hunterdon</td>
<td>Mr. Alan Johnson</td>
<td>Director</td>
<td>Hunterdon County Utilities Authority</td>
<td>908/788-1110 Fax 788-1662</td>
</tr>
<tr>
<td>Salem</td>
<td>Mr. Peter Dewilde</td>
<td>Director</td>
<td>Salem County Utilities Authority</td>
<td>609/935-7900 Fax 935-7331</td>
</tr>
<tr>
<td>Camden</td>
<td>Mr. Jack Sworaski</td>
<td>Director</td>
<td>Camden County Solid Waste Mgmt.</td>
<td>609/216-2146</td>
</tr>
<tr>
<td>Mercer</td>
<td>Mr. Al Collins</td>
<td>Solid Waste Supervisor</td>
<td>Mercer County Improvement Authority</td>
<td>609/695-1200 Fax 695-1452</td>
</tr>
<tr>
<td>Somerset</td>
<td>Ms. Diana Vigilante</td>
<td>Manager</td>
<td>Somerset County Utilities Authority</td>
<td>908/231-7031 Fax 707-1749</td>
</tr>
<tr>
<td>Cape May</td>
<td>Mr. Thomas Hroncich</td>
<td>Solid Waste Manager</td>
<td>Cape May Co. Municipal Util. Authority</td>
<td>609/825-3700 Fax 825-8121</td>
</tr>
<tr>
<td>Middlesex</td>
<td>Mr. Richard Hills</td>
<td>Director</td>
<td>Middlesex County Department of Solid Waste Management</td>
<td>732/745-4100 Fax 745-3010</td>
</tr>
<tr>
<td>Sussex</td>
<td>Mr. Fred Suljic</td>
<td>Administrator</td>
<td>Sussex County Dept. of Planning</td>
<td>973/579-0500 Fax 579-0513</td>
</tr>
<tr>
<td>Cumberland</td>
<td>Mr. Steven Wymbus</td>
<td>Director</td>
<td>Cumberland County Improvement Auth.</td>
<td>973/857-2350 Fax 857-9361</td>
</tr>
<tr>
<td>Monmouth</td>
<td>Mr. Lawrence Zaayenga</td>
<td>Solid Waste Coordinator</td>
<td>Monmouth County Planning Board Hall of Records Annex</td>
<td>609/822-8155 Freehold, NJ 07728-1255 732/431-7460 Fax 431-7795</td>
</tr>
<tr>
<td>Union</td>
<td>Mr. Joe Spatola</td>
<td>Director</td>
<td>Union County Utilities Authority</td>
<td>973/832-9400 Fax 832-5862</td>
</tr>
<tr>
<td>Gloucester</td>
<td>Mr. David Shields</td>
<td>Director</td>
<td>Gloucester County Improvement Auth.</td>
<td>609/848-4002 Fax 384-1262</td>
</tr>
<tr>
<td>Morris</td>
<td>Mr. Larry Gindoff</td>
<td>Solid Waste Coordinator</td>
<td>Morris County Municipal Util. Authority</td>
<td>973/285-8390 Fax 285-8397</td>
</tr>
</tbody>
</table>
Appendix E

Permit Identification
Permit Identification

A. Introduction

The information contained in this section is designed to provide a Responsible Party or its agent with guidance regarding the permits that may be required to implement a specific remedial action. However, this section should not be viewed as a final identification of all permits required to implement a site-specific remedial action work plan. In order to fully identify the permits required for a site-specific project, the Responsible Party or its agent should utilize the Permit Identification Form (see Appendix H) and the services of the Office of Permit Information and Assistance (609/292-3600).

Upon completion of the Permit Identification Form, the Responsible Party will initiate a process wherein it will receive assistance in identifying all applicable permits and reviews required by NJDEP. In addition, the Office of Permit Information and Assistance will schedule a preapplication meeting with all of the pertinent NJDEP review entities and continue to assist the Responsible Party when necessary throughout the permit/review process.

B. Potential Permits and Reviews

The attached Permit Identification Chart has been assembled to indicate the “Probably Needed” and “Possibly Needed” permits for each of the Soil Treatment Technologies described in Section IV of the Guidance Document for the Remediation of Contaminated Soils. If a particular permit is listed as “Probably Needed,” it is almost certain that this permit will be required to implement this remedial action. If a particular permit is listed as “Possibly Needed,” this permit may be required in certain situations and the Responsible Party will need to contact the permit program for a final determination. Listed below are descriptions of the permit categories on the attached chart.

1. NJPDES: When this category has been marked on the chart, it indicates that a New Jersey Pollution Discharge Elimination System (NJPDES) permit may be required, based upon the description of that particular process. However, given the varied types of NJPDES permits, the specific type will not be indicated, as this will depend on the method of discharge chosen. For example, if you have chosen to discharge to ground water, a NJPDES Discharge to Ground Water (DGW) permit would be required. However, if you are going to an existing publicly owned treatment works or you are going to pretreat the discharge prior to going to a publicly owned treatment works, then you may only be required to get an NJPDES SIU (Significant Industrial User) permit.

   If you are choosing to build and operate your own treatment facility which will discharge to a surface water body, you will need to obtain a NJPDES Discharge to Surface Water (DSW) permit. Given the various types of NJPDES permits, if the remedial action you have chosen indicates that you probably need a permit, you should contact the appropriate bureau within the Wastewater Facilities Program to determine the exact permit you will need.

2. TWA (Treatment Works Approval): This category, when marked on the chart, indicates that a Treatment Works Approval (TWA) may be required, based on the description of the particular process. A TWA may be issued for a variety of reasons such as: a newly approved or substantially modified treatment facility; newly approved or substantially modified pretreatment equipment; or, the construction of a new lateral, main or pump station. In fact, whenever a process involves the treatment or disposal of wastewater, the applicant should contact the Bureau of Construction and Connection for a formal determination on whether or not a TWA will be required.

3. Air Quality Regulation Permits: This category, when marked on the chart, indicates that some type of Air permit may be required, based upon the description of that particular process. Air permits are extremely varied. For example, the Air Quality regulations require a permit to construct new equipment, as well as a separate permit to operate newly installed equipment. Also, the permits are divided into five different levels, based on the type of pollution control a particular piece of equipment is supposed
to provide. Whenever the process you have chosen involves an air pollution control device or a basic air filtration system, you should contact the Bureau of New Source Review for a formal determination on which type of permit is required.

4. **Land Use Regulation Program (LURP), Wetlands Permits**: When this category is marked on the chart, it indicates some type of wetlands permit may be required. In fact, on the chart a wetlands permit is always marked in the “Possibly Needed” category, as a wetlands permit would be required only if wetlands are present on the specific location where a remedial action is to be taken. Absent specific site locations, each of the remedial action sections indicates a possible need for a wetlands permit. The category “wetlands permit” actually refers to the following permit or review categories:

1) Letters of Exemption (LOE)  
2) Letters of Interpretation (LOI)  
3) Statewide General Permits (SGP)  
4) Open Water Fill Permits  
5) Individual Permits  
6) Transition Area Waivers

5. **Land Use Regulation Program (LURP), Stream Encroachment**: A Stream Encroachment permit is always marked in the “Possibly Needed” category, as a Stream Encroachment permit would be required if any construction or installation activities were to occur along, in, or across a channel or the floodplain of a stream. Also, a Stream Encroachment permit would be required for any alteration of the floodplain or the stream. If there are questions regarding a specific project or site location, contact the Land Use Regulation Program for a formal determination on whether a permit will be required.

6. **Well Drilling Permits**: When this category is marked on the chart, it indicates that a well drilling permit may be required. This permit is obtained by the well driller, whether for a potable well or a monitoring well. Should you need a well installed, contact a New Jersey licensed well driller.

7. **Bureau of Water Allocation Permits**: When this category is marked on the chart, it indicates that a Water Supply Allocation permit may be required. A water supply allocation permit is required only when you will be diverting 100,000 gallons of water per day (70 gpm) or more from surface or ground waters for non-agricultural purposes. If your activity qualifies under this criteria, or you wish an applicability determination, contact the Bureau of Water Allocation.

It is suggested that you contact the specific bureau or office should you have questions regarding the applicability of a particular permit. However, should your project require two or more permits, you are encouraged to contact the Office of Permit Information and Assistance by completing and mailing the attached Permit Identification Form or by calling 609/292-3600. The Office of Permit Information and Assistance will schedule a preapplication meeting with all of the pertinent NJDEP review entities and continue to assist the Responsible Party when necessary throughout the permit/review process. The Permit Identification Form is meant only to inform applicants of the potential permits which may be needed, but is not meant to provide the actual permits required to proceed with your project.

In addition to the Permit Identification Form, Appendix I is a list of the technical manuals that are available through the DEP’s Office of Maps and Publications. These technical manuals are produced by the permit programs, and offer technical and policy guidance to applicants to prepare submissions for permits. You may reach this office by mail at:

Map Sales and Publications Office  
PO Box 438  
Trenton, NJ 08625-0438

or by calling 609/777-1038.
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Appendix F
Cover Letter and Permit Identification Form
Appendix G
List of Publications
Technical Manuals Relevant To
Division of Solid and Hazardous Waste Management

**Bureau of Landfill Engineering Landfill Permits:** includes new permits, major modifications, minor modifications, closure plans, permit renewals, transfer of ownership, minor technical reviews, annual topographic surveys, disruptions, Preliminary Environmental Health and Impact Statement, cover material requests, on-site disposal requests, ID-27 soil requests, miscellaneous technical reviews, methane venting systems. $7.50

**Bureau of Resource Recovery Incinerator Permits:** includes new incinerator and Thermal Destruction Units, small scale incinerators, permit renewals, continuation of expiring permits and transfers of ownership, major modifications, minor and miscellaneous technical reviews, Preliminary Environmental Health and Impact Statement, vegetative waste composting facilities. $5.50

**Bureau of Small Facility Review: Material Recovery Facility and Transfer Station Approvals:** includes transfer stations, materials recovery facilities, new permits, capacity expansion of existing facilities, major modifications, minor modifications, permit renewals, transfers of ownership, minor technical reviews, temporary certifications of authority to operate. $6.50

**Bureau of Small Facility Review: Class B Recycling Center Approvals:** includes modifications, renewals, transfers of ownership $5.00

**Hazardous Waste Facility (Part B) Permit or Permit Modification** $7.50

**Hazardous Waste Facility Closure Plan Approval** $3.00

To purchase a Technical Manual please write to:

Map Sales and Publications Office
PO Box 438
Trenton, New Jersey 08625-0438
(609) 777-1038

Please make check payable to Treasurer, State of New Jersey
All manuals will be sent via U.S. Postal Service, 1st class mail
Appendix H
Checklists
A. Checklist: Can Landfarming Be Used At This Site?


This checklist can help you to evaluate the completeness of the CAP and to identify areas that require closer scrutiny. As you go through the CAP, answer the following questions. If the answer to several questions is no and biotreatability studies demonstrate marginal to ineffective results, request additional information to determine if landfarming will accomplish cleanup goals at the site.

1. **Soil Characteristics That Contribute To Landfarming Effectiveness**
   - Yes  No
     - Is the total heterotrophic bacteria count > 1,000 CFU/gram dry soil?
     - Is the soil pH between 6 and 8?
     - Is the soil moisture between 40% and 85%?
     - Is the soil temperature between 10°C and 45°C?
     - Is the carbon:nitrogen:phosphorous ratio between 100:10:1 and 100:1:0.5?
     - Does the soil divide easily and tend not to clump together?

2. **Constituent Characteristics That Contribute To Landfarming Effectiveness**
   - Yes  No
     - Are products to be treated primarily kerosene or heavier (i.e., not gasoline), or will air emissions be monitored and, if necessary, controlled?
     - Are most of the constituents readily degradable?
     - Are total petroleum constituents ≤ 50,000 ppm and total heavy metals ≤ 2,500 ppm?

3. **Climatic Conditions That Contribute To Landfarming Effectiveness**
   - Yes  No
     - Is the rainfall less than 30 inches during the landfarming season?
     - Are high winds unlikely?

4. **Biotreatability Evaluation**
   - Yes  No
     - Has a biotreatability study been conducted?
     - Were biodegradation demonstrated, nutrient application and formulation defined, and potential inhibitors or toxic conditions checked?

5. **Evaluation of Landfarm Design**
   - Yes  No
     - Is sufficient land available considering the landfarm depth and additional space for berms and access?
5. Evaluation of Landfarm Design (continued)

☐ Are run-on and runoff controlled?
☐ Are erosion control measures specified?
☐ Are the frequency of application and composition of nutrients and pH adjustment materials specified?
☐ Is moisture addition needed?
☐ Are other sub-optimal natural site conditions addressed in the landfarm design?
☐ Is the site secured?
☐ Are air emissions estimated and will air emissions monitoring be conducted?
☐ Are provisions included for air emissions controls, if needed?

6. Operation And Monitoring Plans

Yes No

☐ Is monitoring for stormwater discharge or air quality permits (if applicable) proposed?
☐ Does the operation plan include the anticipated frequency of aeration, nutrient addition, and moisture addition?
☐ Does the monitoring plan propose measuring constituent reduction and biodegradation conditions in the landfarm soils?
☐ Are air, soil, and surface runoff water sampling (if applicable) proposed to ensure compliance with appropriate permits?
☐ Are the proposed numbers of samples to be collected, sampling locations, and collected methods in accordance with state regulations?
☐ Is quarterly (or more frequent) monitoring for soil pH, moisture content, bacterial population, nutrient content, and constituent concentrations proposed?
B. Checklist: Can Bioventing Be Used At This Site?


This checklist can help you evaluate the completeness of the CAP and to identify areas that require closer scrutiny. As you go through the CAP, answer the following questions. If the answer to several questions is no, you should request additional information to determine if bioventing will accomplish cleanup goals at the site.

1. Site Characteristics

   Yes  No
   □ □ Is the soil intrinsic permeability greater than $10^{10}$ cm²?
   □ □ Is the soil free of impermeable layers or other conditions that would disrupt air flow?
   □ □ Is the total heterotrophic bacteria count $> 1,000$ CFU/gram dry soil?
   □ □ Is soil pH between 6 and 8?
   □ □ Is the moisture content of soil in the contaminated area between 40% to 85% of saturation?
   □ □ Is soil temperature between 10°C and 45°C during the proposed treatment season?
   □ □ Is the carbon:nitrogen:phosphorus ratio between 100:10:5 and 100:1:0.5?
   □ □ Is the depth to groundwater $> 3$ feet?

2. Constituent Characteristics

   Yes  No
   □ □ Are constituents all sufficiently biodegradable?
   □ □ Is the concentration of Total Petroleum Hydrocarbon $\leq 25,000$ ppm and heavy metals $\leq 2,500$ ppm?
   □ □ If there are constituents with vapor pressures greater than 0.5 mm Hg, boiling ranges above 300°C, or Henry’s law constants greater than 100 atm/mole fraction, has the CAP addressed the potential environmental impact of the volatilized constituents?

3. Evaluation of The Bioventing System Design

   Yes  No
   □ □ Will the induced air flow rates achieve cleanup in the time allotted for remediation in the CAP?
   □ □ Does the radius of influence (ROI) for the proposed extraction or injection wells fall in the range of 5 to 100 feet?

---

1 This parameter alone may not negate the use of bioventing. However, provisions for the construction of horizontal wells or trenches or for lowering the water table should be incorporated into the CAP.
3. Evaluation of The Bioventing System Design (continued)

- Has the ROI been calculated for each soil type at the site?
- Is the type of well proposed (horizontal or vertical) appropriate for the site conditions present?
- Is the proposed well density appropriate, given the total area to be cleaned up and the radius of influence of each well?
- Do the proposed well screen intervals match soil conditions at the site?
- Are air injection wells proposed?
- Is the proposed air injection well design appropriate for this site?
- Is the selected blower appropriate for the desired vacuum conditions?

4. Optional Bioventing Components

   Yes  No

- If nutrient delivery systems will be needed, are designs for those systems provided?
- Are surface seals proposed?
- Are the proposed sealing materials appropriate for this site?
- Will groundwater depression be necessary?
- If groundwater depression is necessary, are the pumping wells correctly spaced?
- Is a vapor treatment system required?
- If a vapor treatment system is required, is the proposed system appropriate for the contaminant concentration at the site?

5. Operation And Monitoring Plans

   Yes  No

- Is monitoring of offgas vapors for VOC and carbon dioxide concentration proposed?
- Is subsurface soil sampling proposed for tracking constituent reduction and biodegradation conditions?
- Are manifold valving adjustments proposed for the start-up phase?
- Is nutrient addition (if necessary) proposed to be controlled on a periodic rather than continuous basis?
C. Checklist: Can Low Temperature Thermal Desorption (LTTD) Be Used At This Site?


This checklist can help you to evaluate the completeness of the corrective action plan (CAP) and to identify areas that require closer evaluation. As you go through the CAP, answer the following questions.

1. **Evaluation LTTD Effectiveness**

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- Do soils have high plasticity?
- Do soils contain large rocks or debris?
- Is moisture content > 35%?
- Is the TPH concentration > 2% by weight?
- Are hydrocarbons highly volatile?

If the answer to any of the above questions is yes, then the soils require pretreatment.

- Do the soils have a high concentration of humic material?
- Do the soils have a high concentration of heavy metals?
- Are contaminant $K_{ow}$s relatively high?
- Are dioxin precursors present in the soils?

If the answer to any of the above questions is yes, then a pilot test or “test burn” should be conducted to demonstrate that LTTD is an applicable remedial technology.

- Do the results of the pilot test indicate that LTTD is applicable?

2. **Evaluation of The Practicality of Using LTTD**

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- Is the depth of contaminated soil 25 feet or less below land surface?
- Is contaminated soil contained within site boundaries?
- Is there no contamination beneath buildings or near building foundations?

If the answer to any of the above questions is no, then excavation of the soil is not practical; therefore, LTTD is not practical. Consider an *in situ* remedial technology instead.

- Is sufficient land area available for operation of equipment and temporary storage (staging) of contaminated soil and treated soil?
- Is the distance to an off-site facility prohibitively far?
- Will surrounding land use permit operation of an onsite system in the neighborhood?
If the answer to any of the above questions is no, then excavated soils must be transported to an off-site facility for treatment.

3. **Evaluation of The Effectiveness of Using LTTD**

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If the answer to any of the above questions is no, then additional information is necessary to evaluate whether LTTD is likely to be an effective remedial technology.
D. Checklist: Can Soil Vapor Extraction (SVE) Be Used At This Site?

This checklist can help you to evaluate the completeness of the CAP and to identify areas that require closer scrutiny. As you go through the CAP, answer the following questions. If the answer to several questions is no, you will want to request additional information to determine if SVE will accomplish the cleanup goals at the site.

1. Factors That Contribute To Permeability Of Soil
   - Yes No
     - ☐ Is the intrinsic permeability greater than $10^{-9}$ cm$^2$?
     - ☐ Is the depth to groundwater greater than 3 feet?
     - ☐ Are site soils generally dry?

2. Facts That Contribute To Constituent Volatility
   - Yes No
     - ☐ Is the contaminant vapor pressure greater than 0.5 mm Hg?
     - ☐ If the contaminant vapor pressure is not greater than 0.5 mm Hg, is some type of enhancement (e.g., heated air injection) proposed to increase volatility?
     - ☐ Are the boiling points of the contaminant constituents less than 300°C?
     - ☐ Is the Henry’s law constant for the contaminant greater than 100 atm?

3. Evaluation of The SVE System Design
   - Yes No
     - ☐ Does the radius of influence (ROI) for the proposed extraction wells fall in the range 5 to 100 feet?
     - ☐ Has the ROI been calculated for each soil type at the site?
     - ☐ Examine the extraction flow rate. Will these flow rates achieve cleanup in the time allotted for remediation in the CAP?
     - ☐ Is the type of well proposed (horizontal or vertical) appropriate for the site conditions present?
     - ☐ Is the proposed well density appropriate, given the total area to be cleaned up and the radius of influence of each well?
     - ☐ Do the proposed well screen intervals match soil conditions at the site?
     - ☐ Is the blower selected appropriate for the desired vacuum conditions?

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If no, this parameter alone may not negate the use of SVE. However, provisions for use of a surface seal, construction of horizontal wells, or for lowering the water table should be incorporated into the CAP.
4. Optional SVE Components

Yes  No

☐  ☐ Are air injection or passive inlet wells proposed?

☐  ☐ Is the proposed air injection/inlet well design appropriate for this site?

☐  ☐ Are surface seals proposed?

☐  ☐ Are the sealing materials proposed appropriate for this site?

☐  ☐ Will groundwater depression be necessary?

☐  ☐ If groundwater depression is necessary, are the pumping wells correctly spaced?

☐  ☐ Is a vapor treatment system required?

☐  ☐ If a vapor treatment system is required, is the proposed system appropriate for the contaminant concentration at the site?

5. Operation And Monitoring Plans

Yes  No

☐  ☐ Does the CAP propose daily monitoring for the first 7 to 10 days of flow measurements, vacuum readings, and vapor concentrations from each extraction vent, the manifold, and the effluent stack?

☐  ☐ Does the CAP propose biweekly to monthly monitoring of flow measurements, vacuum readings, and vapor concentrations from each extraction vent, the manifold, and the effluent stack?
E. Checklist: Can Air Sparging Be Used At This Site?


This checklist can help you to evaluate the completeness of the CAP and to identify areas that require closer scrutiny. As you go through the CAP, answer the following questions. If the answer to several questions is no, you will want to request additional information to determine if air sparging will accomplish the cleanup goals at the site.

1. Factors That Contribute To The Vapor/Dissolved Phase Partitioning of The Constituents

   Yes  No
   ☐ ☐ Is the Henry’s law constant for the contaminant greater than 100 atm?
   ☐ ☐ Are the boiling points of the contaminant constituents less than 300°C?
   ☐ ☐ Is the contaminant vapor pressure greater than 0.5 mm Hg?

2. Factors That Contribute To Permeability Of Soil

   Yes  No
   ☐ ☐ Is the intrinsic permeability greater than $10^{-9}$ cm²?
   ☐ ☐ Is the soil free of impermeable layers or other conditions that would disrupt air flow?
   ☐ ☐ Is the dissolved iron concentration at the site < 10 mg/L?

3. Evaluation of The Air Sparging System Design

   Yes  No
   ☐ ☐ Does the radius of influence (ROI) for the proposed air sparging wells fall in the range 5 to 100 feet?
   ☐ ☐ Has the ROI been calculated for each soil type at the site?
   ☐ ☐ Examine the sparging air flow rate. Will these flow rates provide sufficient vapor/dissolved phase partitioning of constituents to achieve cleanup in the time allotted for remediation in the CAP?
   ☐ ☐ Examine the sparging air pressure. Will the proposed pressure be sufficient to overcome the hydraulic head and capillary forces?
   ☐ ☐ Is the number and placement of wells appropriate, given the total area to be cleaned up and the radius of influence of each well?
   ☐ ☐ Do the proposed well screen intervals account for contaminant plume location at the site?
   ☐ ☐ Is the proposed well configuration appropriate for the site conditions present?
   ☐ ☐ Is the air compressor selected appropriate for the desired sparge pressure?
4. Operation And Monitoring Plans

Yes  No

☐  ☐ Does the CAP propose starting up the SVE system prior to starting the air sparging system?

☐  ☐ Are manifold valving adjustments proposed during the first 7 to 10 days of operation?

☐  ☐ Is monitoring for sparge pressure and flows, vacuum readings (for SVE), groundwater depth, vapor concentrations, dissolved oxygen levels, carbon dioxide levels, and pH proposed for the first 7 to 10 days of operation?

☐  ☐ Is weekly to biweekly monitoring of groundwater pH and levels of contaminants, carbon dioxide, and dissolved oxygen proposed following startup?

☐  ☐ Is weekly to biweekly monitoring of the effluent stack for levels of contaminants, oxygen, and carbon dioxide proposed following startup?
Appendix I
ITRC Information
Products
“Technical and Regulatory Guidelines for Soil Washing”
“Fixed Facilities for Soil Washing”

Description of Products
“Technical and Regulatory Guidelines for Soil Washing”:
• Contains general information on the ITRC process
• Presents technical and regulatory guidelines applicable to the removal of metals and organic contaminants from soil using soil washing technologies which have been successfully demonstrated full scale
• Identifies a model demonstration for soil washing, the King of Prussia Landfill site in NJ, which can be used as a basis for development of a workplan for soil washing technologies that have not been demonstrated full scale
• Recommends a format for cost and performance reporting for full scale applications of soil washing

“Fixed Facilities for Soil Washing”
• Explores the status of the use of fixed facilities for soil washing operations in the US
• Identifies several models that show promise for the deployment of fixed facilities in the US
• Examines regulatory and market factors that led to the successful deployment of many fixed facilities in Europe

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Application of Technology

- Soil washing is considered feasible for the treatment of a wide range of inorganic and organic contaminants including heavy metals, radionuclides, cyanides, polynuclear aromatic compounds, pesticides and PCBs.
- Soil washing is most appropriate when soils consist of at least 50 to 70 percent sands. Soil washing will generally not be cost effective for soils with fines (silt/clay) content in excess of 30 to 50 percent (Section 3 has more details on matrix factors).
- Typically, onsite treatment of soils using soil washing will not be cost effective unless the site contains at least 5000 tons of contaminated soil.
- Space requirements can be very variable based on the design of the soil washing system, system throughput rate, and site logistics. A 20 ton per hour unit can be sited on approximately one half acre, including staging for untreated and treated soils, however, some systems may require additional space, depending on system design.

Target Audience

“Technical and Regulatory Guidelines for Soil Washing” will be useful to state case managers, vendors, technology developers, public stakeholders, consultants, field contractors and the regulated community.

“Fixed Facilities for Soil Washing” will be useful to state and federal agency program managers, commerce agency managers, vendors, technology developers, public stakeholders, consultants, and the regulated community. It may be of interest, but may provide limited benefit to state case managers.

Relevance within Regulatory Framework

Each of these documents provides background information on the current state of soil washing technology. The technical document will be useful in enabling case managers in remediation departments to more effectively review soil washing projects. The scenarios outlined in the implementation guide provide examples of situations where the document can be used. The fixed facility document provides policy makers with alternative ideas which may facilitate the remediation of soils contaminated with metals.

Contacts

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Dan Sogorka, Coleman Research Corporation, (301) 903-1531
Products
Emerging Technologies for the Removal of Metals from Soils
- Phytoremediation
- Electrokinetics
- In-situ Stabilization

Description of Products
The Emerging Technologies document presents developing technologies that show potential for the remediation of metals in soils. The document consists of three stand alone sections noted above. Each section outlines an overview of the technology, general approaches to implementation, future research and development needs, regulatory issues, costs, and public and stakeholder acceptance and concerns.

Contents of Documents
Each document contains the following sections:
- Introduction
- Approaches to Technology Implementation
- Research & Development-Future Needs
- Case Studies
- Regulatory Issues
- Cost
- Public and Stakeholder Concerns
- Conclusions

Application of Technology
Each of the technologies outlined in the Emerging Technologies document may be applicable to sites with varying degrees of metal-contaminated soils. Phytoremediation is the use of plants to remediate soils. The technology is most applicable at sites with low to moderate metals concentrations, relatively shallow depths of contamination, and soil media favorable to plant growth. Phytoremediation may be used as a low cost follow-up technique once contaminant concentrations have been reduced to relatively low levels. Electrokinetics is the use of low level electric current to mobilize contaminants within a given soil matrix. The technology is most applicable at metal contaminated sites with homogeneous, fine-grained soils exhibiting both high permeability and moisture content. Electrokinetics can treat both organic and inorganic contaminants. The technology may be most beneficial when applied to soils inaccessible for conventional technologies. In-situ stabilization involves the chemical and/or physical manipulation of soil properties to reduce the mobility and availability of contaminants. The technology may be applicable at any site where conventional remediation methods could be used. The use of plants and soil amendments will depend upon soil characteristics at a particular site.
**Target Audience**
These documents will be useful to state regulatory case managers in need of information on developing technologies. They provide regulatory concerns and insight into site and project applicability. The documents will also be helpful to vendors, technology developers, public stakeholders, consultants, contractors and the regulated community.

**Relevance within Regulatory Framework**
Each of these documents will be useful in providing background information on each emerging technology to state regulators. Because the technologies are in the development stage, little completed project work is available. As such, these documents provide potential regulatory concerns and operational issues that will help assess potential remedial work plans. In addition, the documents provide points of contact in state agencies knowledgeable with the technologies and pertinent issues facing state case managers. These particular technologies may be used at CERCLA, RCRA, Superfund, voluntary cleanup or Brownfield sites with metal-contaminated soils.

**Potential / Intended uses of the Product**
The Emerging Technologies documents are intended as educational references on developing technologies that lack completed project information. They provide guidance on site applicability, the current state of the technology, regulatory and stakeholder concerns, and preliminary cost. The information should provide state regulators with a starting point for the assessment of an emerging technology at a particular site. Furthermore, the documents may provide regulators with additional options at metal-contaminated sites where conventional technologies are not applicable.

**Contacts**
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Dan Sogorka, Coleman Research Corporation, (301) 903-1531
**Description of Product**
Document that specifies minimum technical requirements for on-site thermal treatment of soil contaminated with petroleum, coal tar, or manufactured gas plant waste that is not regulated as hazardous waste. The requirements are provided in a format beginning with soil characterization and going through treatment, addressing operating parameters, performance testing and continuous monitoring. The document also suggests a format for reporting of Cost and Performance Data.

**Intended Target Audience**
The primary target audience is state and federal project managers who are responsible for specifying the requirements at a site for the thermal treatment of soil contaminated with chlorinated compounds. Technology vendors will also benefit from this document by knowing in advance what the requirements will be in states which have accepted (concurred with) this document.

**Relevance within the Regulatory Framework**
This document is not intended to address regulatory issues, (e.g., whether low temperature thermal desorbers are considered incinerators). Rather this document is intended to specify minimum technical requirements (which the concurring states agreed to) irrespective of how this type of technology is considered from a regulatory perspective.

**Potential/Intended Use of the Product**
This document is intended to be used by the target audience in determining what technical requirements must be achieved for acceptable use of this technology.

**Product Contents/Organization**
- Process Findings
- Performance Test and Air Monitoring
- Introduction
- Water Discharge Requirements
- Need for Public Involvement
- Operations Record Keeping
- Pretreatment Sampling
- General QA/QC
- Feed Soil Limitations
- Health and Safety
- Treatment Verification Sampling
- Cost and Performance Format

**Points of Contact**
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Ted Dragovich, Illinois (217-524-3306)
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Tom Douglas, Florida (904-488-3935)
Chris Renda, Environmental Services Network., Technical Support (303-777-1189)

**Status:** Document is final (March 12, 1996). Thirteen states have concurred.
ITRC LTDT TEAM FACT SHEET
Technical Requirements for On-Site Thermal Desorption of Hazardous Solid Media Contaminated With Chlorinated Organics

Description of Product
Document that specifies minimum technical requirements for on-site thermal treatment of soil regulated as hazardous waste and contaminated with chlorinated compounds. The document does not address regulatory issues beyond the fact that the medium being treated is regulated as hazardous waste. The requirements are provided in a format beginning with soil characterization and going through treatment, addressing operating parameters, performance testing and continuous monitoring. The document also suggests a format for reporting of Cost and Performance Data.

Intended Target Audience
The primary target audience is state and federal project managers who are responsible for specifying the requirements at a site for the thermal treatment of soil contaminated with chlorinated compounds. Technology vendors will also benefit from this document by knowing in advance what the requirements will be in states which have accepted (concurred with) this document.

Relevance within the Regulatory Framework
This document is not intended to address regulatory issues, (e.g., whether low temperature thermal desorbers are considered incinerators). Rather this document is intended to specify minimum technical requirements (which the concurring states agreed to) irrespective of how this type of technology is considered from a regulatory perspective.

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Chris Renda, Environmental Services Network., Technical Support (303-777-1189)

Status: Document is final (October, 1997). Currently undergoing concurrence process.
**Description of Product**

Document that specifies minimum technical requirements for thermal treatment of solid media and mixed waste contaminated with mercury and/or hazardous chlorinated compounds. The document does not address regulatory issues beyond the fact that the medium being treated is regulated as hazardous waste. The requirements are provided in a format beginning with soil characterization and going through treatment, addressing operating parameters, performance testing and continuous monitoring. The document also suggests a format for reporting of Cost and Performance Data.

**Intended Target Audience**

The primary target audience is state and federal project managers who are responsible for specifying the requirements at a site for the thermal treatment of soil contaminated with chlorinated compounds. Technology vendors will also benefit from this document by knowing in advance what the requirements will be in states which have accepted (concurred with) this document.

**Relevance within the Regulatory Framework**

This document is not intended to address regulatory issues, (e.g., whether low temperature thermal desorbers are considered incinerators). Rather this document is intended to specify minimum technical requirements (which the concurring states agreed to) irrespective of how this type of technology is considered from a regulatory perspective.

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**Status:** Document is draft (October, 1997). Currently undergoing review and comment.
Bioremediation of Petroleum Hydrocarbons

Overview

In situ Bioremediation technologies rely on the capabilities of indigenous or introduced microorganisms to degrade, destroy or reduce the toxicity of objectionable chemicals in soils or ground water. The In Situ Bioremediation Technology Task Group of the ITRC recognized that given appropriate conditions, ISB can remediate contaminants more cost effectively than conventional technologies.

Description of the Protocol

Use of this document is intended to offer the proponent of the demonstration multi-state acceptance of the data generated during the demonstration project. It also offers an early opportunity for tribal and community stakeholders to understand the intent of the demonstration and discuss their concerns and sensitivities with the proponent before the demonstration is in its final design. The document emphasizes the establishment of objectives, criteria and measures so that work plans can be designed consistent with those measures, and results can be verified.

This protocol presents an outline containing the essential elements the proponent of an in situ demonstration must address when initiating a demonstration. The outline represents a compilation of concerns gathered by the ITRC states.

Table 1 of the protocol identifies the parties responsible for verifying demonstration results and transferring those results to other states for acceptance.

In addition, as a guide to the proponent, ITRC has included examples of recommended technology-specific protocols which have been developed by industry and tested in field applications. These Technology-Specific Protocols have been evaluated by members of the ISB Group. Use of these protocols will increase the likelihood that the essential information required by the states has been included in the design of the demonstration and test plan.

Description of Class of Technologies

In Situ Bioremediation uses aerobic or anaerobic micro-organisms to degrade organic contamination by the addition of nutrients or oxygen. In situ Bioremediation includes: Bioventing (increasing the flow of air through the unsaturated zone to stimulate indigenous aerobic micro-organisms) and ground water recirculation (extraction and treatment of contaminated ground water followed by addition of nutrients, oxygen and sometimes cultured bacterial strains and re-injection). Most current applications utilize indigenous micro-organisms.

Intended User

State and Federal Regulators, consultants, PRPs and community Stakeholders

Potential and Intended Uses of this Product

The General Outline contained in this Protocol provides guidance to the proponent during
development of the initial proposal for a demonstration. The proposal should contain enough detail so that the other parties can identify the applicable regulatory requirements for the project, the innovative nature and scope of the project, the advantage this technology might have over conventional technologies and the sensitivities the participants might have with this technology. These participants include host states, participating states, proponents, tribes and community/public Stakeholders.

**Potential Barriers**

- Cleanup levels, and the approaches used by various jurisdictions to derive those numerical criteria, vary among state and federal agencies. Although a single set of concentration based cleanup levels cannot be developed to apply to all jurisdictions, it is recommended that a work group be established to formulate policy recommendations for changes that encourage consistency in approach, if not numerical criteria.

- Factors beyond the jurisdiction of the state regulatory agencies often dictate the type of remedial technology that is deployed. These factors include addressing the concerns of participants in real estate transactions and the financial institutions lending on such transactions, and the public’s opposition and fear of a technology. These pressures often discourage the deployment of cost-effective techniques and technologies, particularly natural attenuation and bioventing, and thus reduce the potential market for affordable remedial measures.

- Natural attenuation for petroleum hydrocarbons, particularly benzene, toluene, ethyl benzene and xylene, is well demonstrated as a remedial option for ground water. For all sites where remediation is deemed necessary, particularly fuel tank sites, the appropriate agencies should evaluate natural attenuation as a remedy, referencing their agencies to consider the ITRC work-product concerning this topic and the various technical guidance documents and references now available in the literature.

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Appendix J

Health, Safety and Emergency Response
Minimum Requirements
Health, Safety and Emergency Response
Minimum Requirements

Index
1.0 General
2.0 Requirements

1.0 General

1.1 Description of Scope

A. Hazardous Waste Site

If the site is a hazardous waste site as defined within the meaning of 29 CFR 1910.120, the Contractor shall submit a Health and Safety Plan (HASP) to the New Jersey Department of Environmental Protection (NJDEP). The HASP must receive NJDEP approval before a notice to proceed with the site work will be granted.

B. Minimum Requirements

This document describes the minimum safety, health, and emergency response requirements for remedial activities at the site. The responsibility for development, implementation, and enforcement of the HASP lies with the Contractor and its health and safety personnel. The HASP developed by the Contractor shall include programs for accident prevention, personnel protection, medical surveillance, training, special and permit operations, excavation and trenching, spill containment, emergency responses and contingency planning, and air monitoring.

C. Compliance and Termination

Safety and health requirements shall conform to 29 CFR 1910.120, and other federal and state codes and statutes as identified by the text of this document. Controls and procedures specified herein and by the HASP may be terminated only when a Certified Industrial Hygienist determines that hazards have been eliminated. Such termination shall be effective only if approved in writing by the NJDEP.

1.2 Site Description

A. Specific Location

The site’s description includes: Lot #, Block # and all other locations where work is to be conducted for this contract.

B. Supplements and Additions

The site may be described in supplementary sections. Additional details provided should be referenced and presented in listed subsections.

C. Site History

A short history of the site prior to the contracted operations should be presented, indicating industrial/hazardous activities.

1.3 Submittals

A. Contractor Submissions to State Department of Environmental Protection

1. The Contractor shall submit three (3) copies of a HASP to the NJDEP and one (1) copy to the specified lead representative of the department for this contract.
2. The Contractor shall submit to the department four (4) copies of analytical results from any area or personnel samples that are specified in the subsections.

3. The Contractor shall submit to the department, on a weekly schedule, four (4) copies of the daily air monitoring log as specified by the NJDEP Office of Site Safety and Health (OSSH).

B. Health and Safety Plan (HASP) Approval

1. Review and approval of the HASP shall be the responsibility of the OSSH.

2. The OSSH shall provide back to the Contractor, through the NJDEP site/construction manager, a written evaluation of the submitted HASP. Evaluation of the HASP shall be performed by comparison to the minimum requirements presented in this document and applicable state and federal statutes.

2.0 Minimum Requirements

2.1 Organizational Responsibilities

A. Key Personnel and Organizational Chart.

The Contractor must provide, at a minimum, an organizational chart and resumes of key personnel involved in all phases of the operations on site. Also, the contractor must submit the names of other personnel needed for hazardous waste site operations and emergency response, indicating their functions and responsibilities. This chart must include Senior-Level Management, Project Manager, Health and Safety Officer (HSO), Field Supervisor, and on-site Foreman Personnel; at a minimum.

B. Site Health and Safety Officer (HSO).

The Contractor must utilize a qualified individual (e.g., an industrial hygienist, safety engineer, etc.) to function as the Site HSO for the project. That individual must be responsible to the Contractor and have the authority and knowledge necessary to implement the site HASP and verify compliance with applicable safety and health requirements.

1. At a minimum, the HSO shall have the following responsibilities and authority to perform the following functions:
   a. Be present at all times during site operations.
   b. Have the authority to enforce the HASP and stop operations if safety and health of personnel may be jeopardized.
   c. Effect evacuation of the site or work area if necessary.
   d. Evaluate monitoring data to make field decisions regarding safety and health.

C. The HSO must meet the following minimum educational and experience qualifications in matters of health and safety:

1. Possess a sound working knowledge of State and Federal occupational safety and health regulations.

2. Have formal professional development training in occupational safety and health. Initial 40 Hour (or 24 hour) HAZWOPER or any other basic training necessary for general work eligibility will not satisfy this requirement.

3. Have a minimum of four (4) years experience in the environmental and health and safety services field, chemical industry, or chemical waste disposal industry, more than 50% of which must be in the area of industrial hygiene and/or environmental safety related to the site operations.
4. Have a bachelor of science degree in biology, chemistry, engineering, industrial hygiene or other related natural or physical science.

NOTE: Each graduate degree in occupational safety and health can be substituted for one (1) year of experience.

2.2 Risk or Hazard Analysis

A. Health and Safety Evaluation.

The Contractor shall perform and provide a hazard assessment for each location and the tasks to be performed.

B. Best Information Available

The assessment shall be based upon the best information available regarding the contaminants and conditions present at the site as well as the practices, tools and other equipment to be applied in the operation and shall include but not be limited to the following:

1. A preliminary evaluation of the site’s characteristics performed prior to the initial site survey
2. An evaluation of the known or suspected contaminants and conditions that may pose inhalation, skin absorption/contact, exposure or ingestion hazards.
3. Material Safety Data Sheets (MSDS) provided on site for any chemicals known to be present which workers may be exposed to during site normal operations or in a foreseeable emergency.
4. An evaluation of known or potential safety hazards associated with each task
5. An overview of the following information:
   a. Size and location of the site
   b. Description of the operation and tasks to be performed
   c. Approximate duration of each operation and task
   d. Site topography, accessibility and special features (e.g., structures, tanks)
   e. Known or suspected pathways of contaminant dispersion pertinent to the operations and tasks performed
   f. Safety and health hazards expected on the site
   g. Status and capabilities of emergency response teams that shall provide assistance during site emergencies, including those providing medical treatment and transport of any contaminated injured persons.

2.3 Employee Training

A. Training Requirements for On-Site Personnel

1. Pursuant to 29 CFR 1910.120, et al, all Contractor and subcontractor employees for on-site activities must have met one of the following requirements prior to the start of operations at the site:
   a. General site workers (such as equipment operators, general laborers, and supervisory personnel) engaged in hazardous substance removal or other activities that expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three (3) days actual field experience under the direct supervision of a trained, experienced supervisor.
b. Workers on site only occasionally for a specific limited task (such as, but not limited to, groundwater monitoring, land surveying, or geophysical surveying) and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and a minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

c. Workers regularly on site, who work in areas that have been monitored and are fully characterized indicating that exposures are under permissible exposure limits and published exposure limits where respirators are not necessary, and the characterization indicates that there are no health hazards or the possibility of an emergency developing, shall receive a minimum of 24 hours of instruction off the site and a minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

d. Workers with 24 hours of training who are covered by paragraphs b. and c. of this section, and who become general site workers or who are required to wear respirators, shall have the additional 16 hours and two (2) days of training necessary to total the training specified in paragraph a.

e. In addition, an annual eight (8) hour minimum refresher course after the initial training shall be provided to all field (site) personnel in order to continue on-site employment eligibility.

2. On-site management and supervisors directly responsible for or who supervise employees engaged in site operations, including the on-site HSO, shall have also received eight (8) hours additional training in managing such site operations prior to the start of site activities as stipulated in 29 CFR 1910.120.

3. Employees who have been designated as responsible for responding to on-site emergencies shall have received additional training in how to respond to such expected emergencies prior to the start of site activities as stipulated in 29 CFR 1910.120.

4. Employees who have not received the required training prior to the start of site operations are not to engage in site operations until such training has been completed.

B. Employee Training Program

The Contractor shall include in the HASP a summary of the hazardous materials safety and health training program and a list of elements and topics covered.

C. Program Certification

The Contractor shall provide a written certification statement of completed training and/or acquired experience for all employees designated to engage in on-site activities. Such certification shall be endorsed by a member of top-level management, a corporate officer, or the health and safety program manager and shall be incorporated into the HASP.

D. Site Specific Training and Pre-entry Briefings

The Contractor shall provide site specific training and perform daily safety briefings that will provide an awareness of planned operations, the site-specific HASP, the form and warning properties of potential hazards, work zones, locations of emergency/safety equipment, local emergency response procedures and any changes in site characteristics, levels of protection, communications, decontamination procedures, emergency facilities and signals, and evacuation procedures.
2.4 Personnel Protection

A. Engineering and Work Practice Controls.

The Contractor must consider the need to apply engineering and/or work practice controls as a means of protecting personnel in the performance of site-specific tasks. When practicable, engineering controls shall be implemented to reduce and maintain employee exposures to or below safe levels for those tasks demonstrating known or suspected hazards. Work practice controls shall next be applied when engineering controls are impractical and shall be incorporated as site-specific standard operating procedures (SOPS) for personnel precautions and routine operations.

B. Personnel Protective Equipment (PPE) and Levels of Protection

1. The Contractor shall use personnel protective equipment (PPE) only when engineering and/or work practice controls have been deemed impractical or insufficient to protect employees during site operations.

2. The Contractor shall select PPE based on an evaluation of performance characteristics, site-specific tasks, and known or suspected hazards and shall assemble the PPE into Levels of Protection (LOP) or ensembles appropriate for the site.

3. The Contractor shall include in the HASP a list of components for each protective ensemble, the LOP selected for each task, the rationale for each task-specific selection, and any contaminant action levels to be followed in LOP decision making. This information can be presented in a block-type chart with specific references to fabric, Level of Protection, permeation, etc., in a text.

These specific tasks requiring identification of protective clothing ensembles shall include but not be limited to:

a. Existing Debris and Waste Removal
b. Recovery, Injection, and Monitoring Well Construction
c. Excavation
d. Contaminated Soil Removal
e. Sampling and Monitoring
f. Dewatering
g. Erosion and Sediment Control
h. Operating specialized equipment, containers
i. Confined Space and Hazardous Area Entry

4. If the Contractor’s HASP provides for respiratory protection, the Contractor shall include a description of the respiratory protection program and the method of respirator fit testing employed.

5. The Contractor shall use only NIOSH/MSHA approved respiratory protective equipment. Any other PPE selected shall be in conformance with appropriate ANSI standards for that equipment.

6. The Contractor shall establish a PPE program addressing the following elements:

a. Site hazards
b. PPE selection
c. PPE use and limitations
d. Duration of site operations  

e. PPE maintenance and storage  

f. PPE decontamination and NJDEP approved disposal  

g. PPE training and proper fit  

h. Donning and doffing procedures  

i. PPE inspection prior to, during and after use  

j. Evaluation of program effectiveness  

k. Heat stress and temperature limitations  

2.5 Medical Surveillance  

A. Medical Surveillance Program  

1. The Contractor shall have an established and implemented medical surveillance program (MSP) for employees engaged in on-site operations, if any of the following 29 CFR 1910.120(b) criteria are met:  

a. All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits, or if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year  

b. All employees who wear a respirator for 30 days or more a year or as required by 29 CFR 1910.134  

c. All employees who are injured due to overexposure from an emergency incident involving hazardous substances or health hazards  

d. Members of HAZMAT teams  

2. The MSP program shall include physical examinations administered or supervised by a board-certified physician knowledgeable in internal or occupational medicine. The Contractor shall include the name and business address of the administering physician in the HASP.  

3. The Contractor shall include a written description of the components of both the MSP program and the physical examination in the HASP and whether the examination is administered or supervised by the physician.  

4. The Contractor shall address the need for personnel exposure monitoring and post-exposure medical screening in the HASP and include a description of those provisions.  

B. Medical Records Retention  

The Contractor shall retain all medical records and personnel exposure monitoring data for 30 years as described in Subpart C of 29 CFR 1910.20.  

C. Fitness Certification  

The Contractor shall provide written certification of the medical fitness for work of all employees designated to engage in on-site operations prior to the start of those operations. Such certification shall be endorsed by a member of senior level management, a corporate officer, or the health and safety program manager and shall be incorporated into the site HASP.
D. Heat and Cold Stress Monitoring

As dictated by seasonal conditions, the Contractor shall implement an employee heat and/or cold stress monitoring program during site operations and shall incorporate the program into the site HASP. The program shall include employee awareness of the signs and symptoms of heat and/or cold stress, preventive measures, and employee and/or environmental parameters that will be measured. The Contractor shall maintain a daily heat and/or cold stress log on all employees wearing protective ensembles on-site and shall describe the log in the site HASP.

2.6 Air Surveillance

A. Site Specific Monitoring

The Contractor shall establish and implement a site-specific air monitoring program to identify areas of elevated airborne contaminant concentrations and to determine the level of the concentrations relative to background. The Contractor shall provide the personnel, instruments, and materials necessary to perform such air monitoring and identify the individual responsible for administering the program. The program shall be included in the HASP.

1. The Contractor must incorporate the following information into the air monitoring program:
   a. Type, make, and model of instrument(s) selected for use
   b. All instrument settings for each instrument used
   c. Method of instrument calibration, including calibrant and sample calibration data sheet
   d. Manner and frequency of pre and post (or greater) field calibration checks

   The Contractor must present the frequency of air measurements and the tasks or locations to be monitored.

B. Area and Personnel Air Sampling

1. The Contractor shall examine and report to the NJDEP’s satisfaction the need, or lack thereof, to develop and implement an area and personnel air sampling program during the project, based upon adequate initial Area and Personnel Air Sampling episodes, and shall include any resultant air sampling program in the site HASP.

2. Special considerations shall be given to intrusive or high-risk tasks and the potential for exposure to those performing such tasks.

3. The Contractor shall provide all necessary sampling devices, pumps, collection media, and support equipment to perform the sampling per the program. The sampling devices and pumps must bear all approvals necessary for use in combustible or flammable atmospheres.

4. The sampling devices, pumps, collection media, and any necessary support equipment shall be appropriately assembled into a sampling train, and each resultant sampling train shall be flow calibrated as a complete system before and after each day’s use against a primary standard.

5. The Contractor shall maintain a daily sampling record as part of the air sampling program. The record must include, as a minimum, the following:
   a. Collection date
   b. Sample identification number
   c. Location and/or task monitored
   d. Wind speed and direction during each sample collection period
e. Duration of each sample collected, including the start and stop times of each sample
f. Ambient temperature and humidity of sampling period
g. Pre- and post sampling train flow rate checks
h. Instrument readings and calibration checks
i. Any pertinent comments

6. The laboratory selected for sample analysis must be accredited by the AIHA for the analysis required. Sampling and analytical methods of first NIOSH, then OSHA, must be used preferentially when such methods are available for the samples collected and all appropriate QA and QC provisions regarding sample collection, transport, and holding times must be followed. Sampling and health and safety protocols are presented in the NJDEP’s most current Field Sampling Procedures Manual, (May 1992).

C. Records Retention and Data Reporting

1. The Contractor shall retain all personnel exposure sampling results and monitoring data in accordance with the requirements set forth in OSHA, Subpart C of 29 CFR 1910.20. The Contractor shall follow all other pertinent provisions of that regulation.

2. The Contractor shall submit, in writing, the analytical results from any area and personnel samples collected within 30 working days of the collection of each sample. Sample flow rates in liters per minute (lpm) and sampling periods in minutes for each sample collected must be reported with the analytical results. Sample locations or tasks and identification numbers shall also be reported.

3. The Contractor shall maintain a daily air monitoring log and include, as a minimum, the following information:
   a. Monitoring date
   b. Location and/or task monitored
   c. Wind speed, direction, ambient temperature, and humidity
   d. Instruments used including make and model and all instrument settings
   e. Instrument readings
   f. Pertinent comments or information
   g. Results of instrument calibration checks, including date and time of each check, the calibration agent used, and its concentration, for each instrument employed.

4. The Contractor shall report verbally all data resulting from daily air monitoring to the NJDEP representative, at a minimum, at the end of the work period. If at any time the instrumentation indicates an adverse change in conditions, the HSO must notify the NJDEP representative immediately and follow up this reporting in writing by the close of business on that day.

5. The Contractor shall furnish copies of the daily air monitoring log to the NJDEP representative at a minimum, weekly, unless otherwise noted or arranged.

2.7 Site Control

A. Routine Requirements

   For ongoing operations, the Contractor and/or its designee will be required to meet with the on-site NJDEP representative, when present, prior to the start of the day’s activities to prepare all the
necessary paperwork and outline the day’s activities. The Contractor shall also meet with the NJDEP representative at the completion of the day’s activities to discuss the work performed.

B. Control of Work Zones

1. The Contractor shall be responsible for conducting operations at the site in such a controlled fashion as to reduce the possibility of contact with any contaminants present and to prevent the removal of contaminants by personnel or equipment leaving the site. The Contractor shall delineate work zones in which specific operations or tasks will occur and shall institute specific site entry and decontamination procedures at designated control points.

2. Three (3) work zones shall be established to perform this work: an exclusion (contaminated) zone, a contamination reduction zone and a support (clean) zone. A map or diagram showing the specific work zones and a description of the site control plan shall be included in the HASP. The work zone boundaries shall be revised as the work of removing hazardous materials proceeds, so as to reflect the reduced area containing hazardous materials. The revised map or diagram shall be inserted in the HASP and provided to the NJDEP representative upon adoption of each revision. The Contractor shall include any SOPs pertaining to site control in the HASP and shall incorporate plans for routine and emergency communications appropriate for the site and project.

3. The Contractor shall keep a daily site control log. The log shall include:
   a. Personnel visiting the site
   b. Affiliation
   c. Date
   d. Arrival time
   e. Departure time
   f. Purpose of visit and locations visited

4. The Contractor shall provide the NJDEP lead representative with a list of all Contractor and subcontractor personnel who are authorized to enter the site prior to the start of operations, updating the list as necessary. Authorized NJDEP personnel shall have unlimited access to the site. The Contractor shall be responsible to exclude all unauthorized entrants from the site.

2.8 Decontamination

A. Personnel and Equipment Requirements

All contaminated personnel and equipment exiting the exclusion zone must be decontaminated prior to entering the support zone. This decontamination must be performed in order to prevent contamination from being transferred into clean areas and contaminating or exposing unprotected personnel.

1. The Contractor shall develop and implement personnel and equipment decontamination procedures appropriate for the site and shall include those procedures in the site HASP. The procedures shall include the necessary equipment and number of steps to achieve the objective, provisions for any personnel protection, and a diagram outlining the steps or stations in the procedures.

2. The procedures must ensure adequate containment and removal of any decontamination solutions and spent disposable protective apparel.
3. Provisions shall be made to facilitate personal hygiene at breaks and following daily operations. Where decontamination procedures indicate shower usage and change rooms away from the exclusion zone, they shall meet the requirements of 29 CFR 1910.141 and 1926.51.

2.9 Site Standard Operating Procedures

The Contractor shall be responsible for developing and implementing all necessary SOPs for safe and healthful site operations. Such SOPs shall be incorporated into the site HASP. A copy of these SOPs and the HASP are to be on site at all times.

2.10 Contingency Planning

A. Emergency Response Plan (ERP)

Prior to the start of site operations, the Contractor shall develop and implement an Emergency Response Plan (ERP) to handle anticipated on-site emergencies.

B. Plan Updates

The ERP shall be incorporated into the site HASP as a separate section of that document and shall be periodically reviewed and, as necessary, amended to keep it current with new or changing site conditions or information.

1. The ERP shall address, as a minimum, the following:
   a. Preplanning of site operations to prevent emergencies
   b. Personnel roles and lines of authority
   c. Key personnel at the site authorized and responsible for implementing the plan
   d. Emergency recognition and control measures
   e. Evacuation routes and procedures, and the frequency of emergency drills
   f. Safe distances and places of refuge
   g. Emergency security and site control measures
   h. Decontamination measures not previously listed in the HASP and specific for all anticipated emergencies.
   i. Emergency medical treatment and first aid
   j. Emergency alerting and response procedures
   k. Site communications
   l. Site diagrams showing general layout, work zones, and prevailing weather conditions
   m. Procedures for reporting incidents to pertinent local, state, and Federal agencies
   n. A list of emergency telephone contacts including the name, location, telephone number, written directions and a route map to the nearest medical facility that will provide emergency medical services.
   o. Measures to review and follow up on site responses
   p. Emergency and personal protective equipment kept at the site for emergencies, with an equipment list and a drawing indicating their on site location.

2. Prior to start up of site operations, the contractor shall attend any and all meetings necessary with local officials and/or those responsible for local emergency management and public safety
for the purpose of coordinating the site specific ERP with any emergency response efforts that would be performed by such agencies. These agencies include but are not limited to:

a. Fire,
b. Ambulance,
c. Police,
d. Local/County health officials

C. Special First Aid/CPR Training

The Contractor shall ensure that at least one person holding up-to-date certifications (American Red Cross or equivalent) in basic first aid and CPR is present at the site during all site operations. A photocopy of the current certifications must be included in the HASP.

D. Verification of Medical Facility Preparedness

The contractor shall contact the local medical facility selected for inclusion into the ERP to ensure that said facility is willing and is capable of providing that medical support necessary to satisfy those anticipated hazards and emergencies detailed in the ERP. Material Safety Data Sheets (MSDS), product information or any technical information on hazard, exposure and treatment of anticipated/known hazards should be provided by the Contractor to the medical facility. Written verification of such contact and agreement of medical services must be detailed in the ERP, including the name and title of individual contacted, and shall be provided to the NJDEP prior to start of site operations.

E. Accident and Exposure Reports

1. The Contractor shall notify the NJDEP representative of all on-site accidents at the time of occurrence and follow up in writing within 24 hours. This notification shall include, but not be limited to, the date, time and identity of individual(s) involved in the accident, the nature of the accident, the actions taken to treat the victim(s), and the steps taken to prevent recurrence.

2. The Contractor shall notify the NJDEP representative of all person(s) exposed at the time of occurrence and follow up in writing within 24 hours. This notification shall include, but not be limited to, the date, time, and identity of individual(s) involved in the exposure, the nature of the exposure episode, what the individual(s) were exposed to, the personnel protective equipment worn during the exposure, and the steps taken to prevent recurrence.

3. The Contractor shall notify the NJDEP immediately of any incident/accident that results in death or severe injury to personnel, or of any fire or explosion or any incident that results in public disruption, media attention or closure of a roadway. After hours notification of such events shall be addressed to the NJDEP’s 24 hour Action Line (609) 292-7171.

2.11 Confined Space Operations

If no confined space entry is to be made, then a statement indicating such is sufficient for this section, however, all confined spaces must be identified in the HASP.

A. Standard Operating Procedures for Confined Spaces

    Should site operations include activities within confined spaces, the Contractor shall develop and implement a confined space entry program and SOPs and shall incorporate them into the HASP pursuant to 29 CFR 1910.146. If the confined space entry meets the OSHA definition of a Permit Required Confined Space Entry, then a section addressing such entries shall be included in the HASP.
B. Entry Permit System
   1. The contractor shall develop and implement an Entry Permit System to ensure that the following are addressed and complied with:
      a. Identification of all confined spaces to all employees
      b. Identification of hazards in the confined space
      c. Training program
      d. A system of monitoring for atmospheric hazards
      e. A system of calibration of monitoring equipment
      f. A system of barricades, to prevent unauthorized entry
      g. A system of identifying authorized entrants, attendants, rescuers and those authorized to sign the entry permit
      h. A procedure for emergency evacuation
      i. Emergency rescue procedures
      j. Procedures to test the program to ensure effectiveness
   2. Pre-entry briefings shall be held prior to initiating any confined space entries and at other times as necessary to ensure that employees are aware of the HASP provisions governing such activities and that they are being followed. The completed permit shall be made available at the time of entry to all authorized entrants, by posting it at the point of entry or by any other equally effective means, for assurance that the pre-entry preparations have been completed.

C. Inspection and Effectiveness of SOP verification
   Inspections shall be conducted by the HSO or, in the absence of that individual, another qualified individual acting on behalf of the HSO as necessary to determine the effectiveness of the confined space SOP with regard to those confined spaces identified on site. Any deficiencies in effectiveness shall be corrected by the Contractor.

D. Atmospheric Monitoring for Safe Entry
   The Contractor shall ensure that the HSO or, in the absence of that individual, another qualified individual acting on behalf of the HSO, shall test the atmosphere of the confined space prior to entry and during entry to ensure that all measures necessary to protect the health and safety of employees entering have been taken. Monitoring shall be appropriate for the contaminant(s) that are known or suspected of being present in the space.

E. Emergency Equipment and Rescue Services
   The Contractor shall provide appropriate protective and entry equipment for all entrant personnel necessary for the Permit Required entry. On site rescue personnel must be present or off site rescue must be able to respond to the site within 3 minutes of notification. Equipment necessary for a rescue must be identified and present at the point of entry.

F. Training of Entrants, Attendants and Rescuers
   The Contractor shall comply with the Federal OSHA training requirements for all personnel involved in confined space entry. A training program must be administered to all personnel involved in confined space entry before entrance can be initiated. Rescue teams shall practice at least annually at the confined space or at representative openings having the same size, configuration and
accessibility as the confined space from which an actual rescue would be performed. A record of training and authorized personnel shall be kept on-site and listed in the HASP.

2.12 Spill Containment

A. Containment Program

1. The contractor shall establish and implement a written spill containment program to handle the possibility of a spill or leakage of drummed or containerized hazardous materials involving any of the following activities:
   a. Transfer
   b. Transport
   c. Disposal
   d. Excavation

2. The contractor shall identify the following on site and off site personnel and equipment or services necessary to isolate, contain and mitigate the spill:
   a. Clean up contractor or personnel
   b. Estimate of response time of off site contractors
   c. Spill containment procedures (Diking, Overpack, etc.)
   d. Special safety precautions (fire, corrosive, radioactivity, etc.)
   e. Equipment and supplies on hand at site or readily available to respond to contain and clean up the spill

2.13 Special and Permit Operations

A. Excavations and Trenching

1. If no trenching or excavation is to be performed on site during site operations, then a statement indicating such is sufficient for this section.

2. All excavation work shall comply with 29 CFR 1926, Subpart P and other state and federal regulations governing excavations and trenching. The need to perform any excavations or trenching as part of the site operations must be described in the HASP.

3. The methods of preparing the trench or excavation must be detailed to include descriptions of sloping, shoring and guarding.

4. Proper spacing of equipment, use of barriers, means of exit, and placing of machinery and spoils must be observed.

5. Personnel working around and in trenches and excavations must be trained in such operations to assure knowledge of hazards, safe operations and procedures to be followed in the event of an emergency.

6. Avoidance of overhead electric lines, underground utilities and storage structures, and service passageways must be addressed by including drawings, measurements and descriptions in the HASP. All pertinent sections of 29 CFR 1910, Subpart S and 29 CFR 1926, Subpart K must be complied with and identified in the HASP.

7. Notifications of utilities prior to excavation and trenching per New Jersey requirements must be detailed and listed in the HASP (1-800-272-1000).
B. Hot Work

1. If no hot work is to be performed on site, then a statement indicating such is sufficient for this section.

2. The performance of Hot Work such as welding, cutting, etc. during site operations must be addressed in the HASP. A Hot Work “Permit” procedure must be included in the HASP if hot work is performed and must comply with the sections of OSHA 1910.119(k), OSHA 1910.146 and OSHA 1926.64 (k) et al as they apply to these operations.

3. All hot work procedures should be outlined and shall comply with both state and local fire codes as well as with OSHA regulations.

4. All electrical supply wiring and distribution shall comply with the local and National Electric Codes as well as any state codes and OSHA 1926.400 Subpart K, governing such installations.

5. Proper utilization and storage of flammable cutting gases and other compressed gases shall comply with the requirements of OSHA 1926.350 et al. All gas cylinders shall be secured from falling or being damaged.
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Citations from NJ State codes/regulations, 29 CFR 1910.120 and other federal regulations as well as OSSH requirements

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