

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.

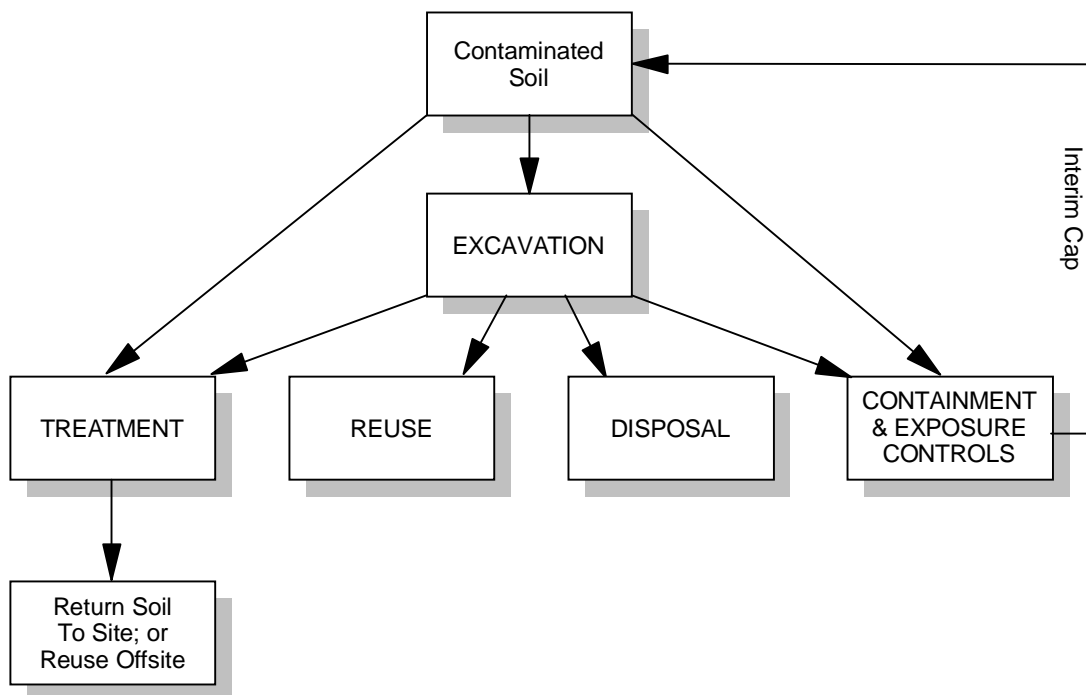
For historic fill assumed to be contaminated, sampling and analysis requirements are provided at N.J.A.C. 7:26E-4.6(b). Proving historic fill is not contaminated is done on a case-by-case basis. N.J.A.C. 7:26E-4.6 provides an option during the remedial investigation to utilize the Department's historic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

Remediation News—the Site Remediation Program’s newsletter which may be obtained by contacting NJDEP, Program Support Element, P.O. Box 413, Trenton, NJ 08625-0413 or phoning (609/633-1373). It also can be downloaded from the SRP Web Page at <http://www.state.nj.us/dep/srp/news>.

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.

IV. 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 1 — 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:

- 1) The soils test positive for characteristics of a hazardous waste defined at Title 40 Code of Federal Regulations (CFR) Part 261 Subpart C (261.21-261.24).

- 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-classified 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-excavation 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.

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