

**GUIDELINES FOR EX SITU PETROLEUM
CONTAMINATED SOIL REMEDIATION**

UST Section

North Carolina

Department of Environment and Natural Resources

Division of Waste Management

August 23, 2012 Version

Change 1, Effective December 1, 2013

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Definitions

Action Level: the concentration of a contaminant that if exceeded may require further regulatory action such as cleanup or monitoring.

Aquifer: a permeable body of rock or sediment that stores and transmits groundwater in sufficient quantity to supply wells or springs.

Bedrock: any consolidated rock which is encountered in the place in which it was formed or deposited and which cannot be readily excavated without the use of explosives or heavy rock cutting equipment. Bedrock generally underlies soil or other unconsolidated, superficial material.

Cleanup Level: the concentration of a contaminant at which no further cleanup actions are required based on the risk of harm posed by the contaminant.

Closure: activities conducted during the permanent removal (or abandonment) of underground storage tank systems and not inclusive of corrective actions/remediation.

Confining Layer: a layer having very low hydraulic conductivity, in relationship to adjacent stratigraphic units, that restricts the movement of water into and out of an aquifer (e.g., dense, unfractured clay).

Confirmed Release: a release for which an analytical result for sampled media shows any contaminant level above the Method Detection Limit.

De minimus Concentration: amount of a regulated substance which does not exceed one percent of the capacity of the tank, excluding piping and vent lines.

Department: the North Carolina Department of Environment and Natural Resources.

Discharge: a release (See also Release).

Division: the Division of Waste Management.

Ex Situ Soil: soil that has been excavated.

Free Product: any accumulation of a substance of greater than or equal to 1/8 inch (0.010417 foot) in contact with groundwater or perched on the water table, with a density less than or greater than water, and existing as a non-aqueous phase liquid (i.e., not dissolved in water).

Gross Contamination Levels: levels of groundwater contamination for any contaminant (except ethylene dibromide, benzene and the aliphatic and aromatic carbon fraction classes) that exceed 50 percent of the solubility of the contaminant at 25 degrees Celsius or 1,000 times the groundwater quality standard or interim groundwater quality standard established in 15A NCAC 2L .0202, whichever is lower; and levels of groundwater contamination for ethylene dibromide and benzene that exceed 1,000 times the federal drinking water standard set out in 40 CFR 141.

Groundwater: those waters occurring in the subsurface under saturated conditions.

Hazardous Substance: a hazardous substance defined in Section 101 (14) of the Comprehensive Environmental Response Compensation and Liability (CERCLA) Act of 1980 (but not including any substances regulated as a hazardous waste under Subtitle C or any mixture of such substances and petroleum).

Hazardous Waste: discarded material which, due to its quantity, concentration, or physical or chemical characteristics, may cause or significantly contribute to an increase in mortality, irreversible or incapacitating reversible illness, or pose a substantial threat or potential hazard to human health or the environment when improperly treated, stored, transported, disposed or otherwise managed (Federal regulations define a waste as a hazardous waste if it exhibits a characteristic of a hazardous waste (40 CFR 261.20 through 261.24); has been listed as hazardous (40 CFR 261.31 through 261.33); or is a mixture containing a listed hazardous waste and a non-hazardous solid waste (unless the mixture is specifically excluded or no longer exhibits any of the characteristics of a hazardous waste).)

In Situ Soil: soil or fill material that is in the ground and has not been disturbed.

Land Application: the process of remediating contaminated soil by spreading soil over land. Land application may include remediating soil by natural biological methods, enhanced biological methods, or volatilization.

Maximum Soil Contaminant Concentration: the concentration of a soil contaminant at which no further cleanup actions are required based upon the risk of harm posed by the contaminant.

Method Detection Limit: the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR 136 Appendix B).

Minimum Reporting Limit: the minimum reporting limit that must be achieved by laboratories for target analyte results submitted to the UST Section; it is a reporting limit established by the UST Section for the target analytes required for each approved analytical method as an alternative to the detection limit indicated in the method description and is listed for each analyte in the *Guidelines for Sampling*.

Petroleum or Petroleum Product: crude oil or any fraction thereof which is liquid at standard conditions of temperature (60 degrees Fahrenheit) and pressure (14.7 pounds per square inch absolute), but excluding substances defined as a hazardous substance in Section 101 (14) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980.

Petroleum Contaminated Soil or Soil Containing Petroleum Products: any soil that has been exposed to petroleum products because of any emission, spillage, leakage, pumping, pouring, emptying, or dumping of petroleum products onto or beneath the land surface and that exhibits characteristics or concentrations of typical petroleum product constituents in sufficient quantities as to be detectable by approved analytical procedures.

Receptor: any human, plant or animal, structure or surface water body that is or has the potential to be adversely effected by the release or migration of contaminants.

Release: any spilling, leaking, emitting, discharging, escaping, leaching or disposing into groundwater, surface water or subsurface soils. (Refer to statutes and regulations relevant to UST releases or to AST and surface releases.)

Responsible Party: a UST owner, UST operator, and/or landowner seeking reimbursement from the State Trust Fund, or any person who is responsible for a discharge or release of petroleum or a hazardous substance. (Refer to statutes and regulations relevant to UST releases or to AST releases and spills.)

Surface Water: all waters of the state as defined in G.S. 143-215.77 Article 21A, except for underground waters, such that "waters" shall mean any stream, river, creek, brook, run, canal, swamp, lake, sound, tidal estuary, bay, reservoir, waterway, wetlands or any other body or accumulation of water, surface or underground, public or private, natural or artificial, which is contained within, flows through, or borders upon this State, or any portion thereof, including those portions of the Atlantic Ocean over which this State has jurisdiction.

Soil or Regolith: a general term for the fragmental and unconsolidated geological material of highly varied character that nearly everywhere forms the surface of the land and overlies or covers bedrock. It includes rock debris of all kinds, volcanic ash, glacial till, alluvium, loess and eolian deposits, and vegetal accumulations.

Soil Scientist: an individual who is a Certified Professional in Soils through the NCRCP (N.C. Registry of Certified Professionals in Soils) or a Certified Professional Soil Scientist or Soil Specialist by ARCPACS (American Registry of Certified Professionals in Agronomy, Crops and Soils) or a Registered Professional Soil Scientist by NSCSS (the National Society of Consulting Soil Scientist) or can provide documentation that he/she meets the minimum education and experience requirements for certification or registration by one or more of the organizations named in this Subparagraph or upon approval by the Director, an individual with a demonstrated knowledge of soil science.

Source Area: point of release or discharge.

Total Petroleum Hydrocarbons (TPH): the concentration of petroleum fuel contamination present.

Transmissivity: the ability of geologic material to transmit water.

Underground Storage Tank (UST): any one or combination of tanks (including underground pipes connected thereto) that is used to contain an accumulation of regulated substances, and the volume of which (including the volume of underground pipes connected thereto) is 10 percent or more beneath the surface of the ground (Refer to full definition in 15A NCAC 2N .0203.).

UST System: an underground storage tank, connected underground piping, underground ancillary equipment, and containment system, if any.

Waste Oil: any used nonhazardous petroleum product other than crankcase oil. Crankcase oil mixed with other used nonhazardous petroleum products shall be considered as waste oil.

Water Table: the surface of the saturated zone below which all interconnected voids are filled with water and at which the pressure is atmospheric.

Acronyms

<u>AFVR</u>	Aggressive Fluid - Vapor Recovery
<u>AST</u>	Aboveground Storage Tank
<u>ASTM</u>	American Society for Testing and Materials
<u>CAP</u>	Corrective Action Plan
<u>CAS</u>	Chemical Abstracts Service Number
<u>CERCLA</u>	Comprehensive Environmental Response, Compensation and Liability Act
<u>CFR</u>	Code of Federal Regulations
<u>CSA</u>	Comprehensive Site Assessment
<u>DENR</u>	Department of Environment and Natural Resources
<u>DWR</u>	Division of Water Resources
<u>DWM</u>	Division of Waste Management
<u>EDB</u>	Ethylene Dibromide (1,2 Dibromoethane)
<u>EPA</u>	The Environmental Protection Agency
<u>FID</u>	Flame Ionization Detector
<u>GCL</u>	Gross Contamination Level
<u>HCl</u>	Hydrochloric Acid
<u>HNO₃</u>	Nitric Acid
<u>IAA</u>	Initial Abatement Action
<u>IAR</u>	Initial Site Assessment Report
<u>IATA</u>	International Air Transport Association
<u>L.G.</u>	Licensed Geologist
<u>LSA</u>	Limited Site Assessment
<u>MADEP</u>	Massachusetts Department of Environmental Protection
<u>MDL</u>	Method Detection Limit
<u>MMPE</u>	Mobile Multi-phase Extraction
<u>MRL</u>	Minimum Reporting Limit
<u>MSCC</u>	Maximum Soil Contaminant Concentration
<u>NC</u>	North Carolina
<u>NCAC</u>	North Carolina Administrative Code
<u>NCDA&CS</u>	North Carolina Department of Agriculture & Consumer Services
<u>NCGS</u>	North Carolina General Statutes

<u>NCS</u>	Notice of Contaminated Site
<u>NFA</u>	No Further Action
<u>NORR</u>	Notice of Regulatory Requirements
<u>NOV</u>	Notice of Violation
<u>NPDES</u>	National Pollutant Discharge Elimination System
<u>NRP</u>	Notice of Residual Petroleum
<u>OPHSCA</u>	Oil Pollution and Hazardous Substances Control Act of 1978
<u>PAH</u>	Polycyclic Aromatic Hydrocarbon
<u>PCB</u>	Polychlorinated Biphenyl
<u>P.E.</u>	Professional Engineer
<u>PID</u>	Photo Ionization Detector
<u>POTW</u>	Publicly Owned Treatment Works
<u>QA/QC</u>	Quality Assurance/Quality Control
<u>SAR</u>	Soil Assessment Report
<u>SCR/SCR</u>	Soil Cleanup Report/Site Closure Request
<u>SM</u>	Standard Method
<u>STF</u>	State Trust Fund
<u>SVE</u>	Soil Vapor Extraction
<u>SVOC</u>	Semi-volatile Organic Compounds
<u>SW</u>	Solid Waste
<u>TCLP</u>	Toxicity Characteristic Leaching Procedure (EPA Method SW-846 1311)
<u>TOC</u>	Total Organic Carbon
<u>TPH</u>	Total Petroleum Hydrocarbons
<u>TPH-DRO</u>	Total Petroleum Hydrocarbons - Diesel Range Organics
<u>TPH-GRO</u>	Total Petroleum Hydrocarbons - Gasoline Range Organics
<u>UST</u>	Underground Storage Tank
<u>UVF</u>	Ultraviolet Fluorescence
<u>USGS</u>	United States Geological Survey
<u>VOA</u>	Volatile Organic Analysis
<u>VOC</u>	Volatile Organic Compounds

1.0 Regulatory Background

NC General Statute 143-215.1(a) requires that the treatment of contaminated soil be permitted by the Department of Environment and Natural Resources. The design criteria and minimum requirements for all soil treatment and containment systems are described at 15A NCAC 2T and 15A NCAC 2L. Copies of these rules can be obtained from the central office, the regional offices (see Figure 1 for office locations) and on the Office of Administrative Hearings Web page at <http://ncrules.state.nc.us/ncadministrativ /default.htm> .

The purpose of this document is to provide guidance on the permitting process for the treatment of *ex situ* petroleum contaminated soil. Questions concerning the information presented in this document should be directed to the UST Section Central Office at 919-707-8171. Questions concerning a specific site should be directed to the UST Section Regional Office that is responsible for the county in which the site is located. The address, telephone number and jurisdiction of each regional office are presented in Figure 1.

2.0 *Ex Situ* Petroleum Contaminated Soil Remediation

Ex situ petroleum contaminated soil must be remediated in accordance with 15A NCAC 2T and 15A NCAC 2L. Table 1 summarizes the general permitting requirements for the storage and treatment of petroleum contaminated soil. This section also presents other general permitting requirements.

Considerations When Selecting *Ex Situ* Remediation Technologies For Soil

When selecting an alternative method of remediation, consider the nature and extent of the soil contamination, the physical limitations of the contaminated site and the limitations of any other site selected for remediation. The treatment goals for soil remediation are defined as concentrations that are less than the reportable concentrations as presented in Table 3. The reportable concentrations are defined as concentrations of typical petroleum product constituents in sufficient quantities as to be detectable by compatible laboratory analytical procedures.

Exclusions - Soil contaminated with the following is excluded from coverage under these guidelines:

- Chlorinated solvents, organic acids or other hazardous waste;
- Heavy oils
- Petroleum refinery sludge;
- Spray irrigation from municipal or industrial wastewater treatment systems;
- Tars and asphalt;
- Industrial sludge, fly ash or other unapproved non-petroleum substances.

The main types of *Ex Situ* Soil Management Methods used are:

- Temporary Storage of Petroleum Contaminated Soil or Land Application of Petroleum Contaminated Soil Less Than or Equal To 50 Cubic Yards or for the Land Application of Up

To 100 Cubic Yards if the Application Is At Minimum Rate – These methods require Certificates of Approval. (See Section 2.1 of these guidelines for further details.)

- Conventional Land Application of Soil Containing Petroleum Contamination with a Soil Volume Greater than 50 Cubic Yards of Contaminated Soil or Minimum Rate Land Application of Soil Containing Petroleum Contamination with a Soil Volume Greater than 100 Cubic Yards of Contaminated Soil – These methods require non-discharge permits. (See Sections 2.2 and 2.3.A for further details.) Contaminated soil may be land applied utilizing two thickness rates (minimum and conventional).
- Containment and Treatment of Soil Containing Petroleum Contamination – These methods require non-discharge permits. (See Sections 2.2 and 2.3.B for further details.)

Dedicated contaminated soil facilities require non-discharge permits and are designed to receive contaminated soil on a repeated basis. These facilities may use conventional rate land application, minimum rate land application, production facility storage, or containment and treatment methodologies. Dedicated facilities may receive shipments of contaminated soil from many sources. Each shipment must be individually tracked. Permits for these sites require soil, groundwater and possibly surface water and air monitoring to ensure protection of human health and the environment. These permits are issued for up to five years.

If a facility has previously been approved for a one-time use (including under a Certificate of Approval), any subsequent use of that facility will require the facility to be re-permitted as a dedicated facility and the soil be amended to suitable conditions for a dedicated site, subject to the guideline and rule requirements, unless it can be demonstrated by soil testing that fuel hydrocarbons or other contaminants from previous applications have been remediated below reportable concentration treatment goals.

2.1 Certificate of Approval for the Temporary Storage of Contaminated Soil or Land Application of Petroleum Contaminated Soil Less than 50 Cubic Yards or for the Land Application of Up To 100 Cubic Yards if the Application Is At Minimum Rate

Temporary Storage Petroleum Contaminated Soil

On-site temporary storage is approved for 45 days or less and must be in accordance with Figure 2. Unauthorized storage of soil or storage in excess of 45 days may be considered a violation of GS 143-215.1. Authorization for off-site temporary storage requires the approval of the appropriate regional office. The issuance of a "Certificate of Approval" (UST-71) for off-site temporary storage will not be given by the Department, unless:

- there is a health-based emergency, or
- the responsible party has an approved treatment permit in hand prior to excavating the soil. Unauthorized storage of soil or storage in excess of 45 days may be considered a violation of GS 143-215.1.

Temporary storage of contaminated soil shall be on 10-mil thick plastic and bermed to prevent runoff (Figure 2). A plastic cover of at least 10-mil shall be used to eliminate the generation of leachate. See Appendix A for Certificate of Approval (UST-71).

Land Application of Petroleum Contaminated Soil Less Than 50 or 100 Cubic Yards

Land application sites for petroleum contaminated soils with volumes of soil from each source of less than or equal to 50 cubic yards or for the application of up to 100 cubic yards if the application is at minimum rate are deemed permitted pursuant to 15A NCAC 2T .0113, if setbacks required in 15A NCAC 2T .1506 are maintained, and approval of the activity has been received from the appropriate regional supervisor or his designee through issuance of a Certificate of Approval (UST-71, Appendix A).

Soil approved for application and treatment by a Certificate of Approval must be land-applied in accordance with regional office specifications and incorporated into the receiver site soil. Soil amendments may be required depending on the type of contaminated soil. A cover crop must be established to prevent soil erosion. At a minimum, regional office specification requirements include Soil Quarantine (Section 2.2.1), Land Use Agreement (Section 2.2.2), Performance Standards (Section 2.2.7) and Setback Requirements (Section 2.2.12).

2.2 Non-Discharge Permit Requirements and General Performance Standards for the Treatment of Petroleum Contaminated Soil

Permits are effective only with respect to the nature and volume of wastes described in the permit application and other supporting information. A permittee may only accept clays, silts, sands, soil, natural minerals or soil contaminated with petroleum products as defined by G.S. 143-215.94A(10). No contaminants other than petroleum are covered under these permits. No soil containing non-petroleum non-hazardous products, unless approved in writing by the regional office supervisor, may be placed on a treatment site.

These guidelines are applicable to excavated soil (under the provision of NCGS 143-215.1) that is contaminated with one or more of the following petroleum fuel products:

Low Boiling Point Fuels

Gasoline, aviation gasoline, gasohol, etc.

Medium/High Boiling Point Fuels

Jet fuels, kerosene, diesel fuel, varsol, mineral spirits, naphtha, fuel oils (#1 - #6); motor oils (new or used). The following criteria and exclusions apply to this guidance.

1. Soil Quarantine - Any soil originating from areas quarantined by the N.C. Department of Agriculture & Consumer Services must be certified by the NCDA&CS for treatment at any facility. This certificate must be received prior to any transport of the petroleum-contaminated soil to the facility. Requests for certification should be directed to local NCDA&CS field representatives. (See Appendix B for further information.)

2. Agreement for Land Application or Containment and Treatment of Soil Containing Petroleum Products on Private Lands - Permit applicant must secure written permission from the landowner prior to application (See Appendix A – “Agreement for Land Application or Containment and Treatment of Soil Containing Petroleum Products on Private Lands,” UST-72). The agreement is not required when the permit applicant is the sole landowner.
3. Change of Ownership - A permit is not transferable. In the event there is a desire to change ownership, or there is a name change of the permittee, a formal permit request must be submitted. Submit requests to the appropriate regional office, UST Section, accompanied by the appropriate application fee, documentation from the parties involved, and other supporting materials as appropriate. The approval of this request will be considered on its merits; it may or may not be approved. A set of approved documents for the subject project must be retained by the applicant for the life of the project.
4. Land Transfer - In any future transfer of this land, a notice shall be given to the new owner that gives full details of the materials applied or incorporated at this site.
5. Erosion Control Plan - If one or more acres of land are affected during application, approval of an erosion control plan must be obtained from the Land Quality Section's regional engineer.
6. Air Permits - The Division of Air Quality policy (October 1, 1995) does not require permitting or registration of soil treatment procedures unless thermal treatment of soil is utilized. However, thermal treatment may be able to take advantage of the "insignificant activity exemption" provided in 15A NCAC 2Q .0102, provided the potential emissions of any regulated pollutant are below five tons per year. Mobile source remediation units are generally permitted one time for use at multiple sites pursuant to 15A NCAC 2Q .0311. This air quality policy applies to all areas of North Carolina, including non-attainment areas. Please contact the Division of Air Quality for guidance pertaining to air quality permitting requirements at (919) 707-8400. Local county officials should also be contacted to check for any county air quality requirements.
7. Performance Standards - The issuance of a permit does not relieve a permittee of the responsibility for damages to surface waters or groundwaters resulting from the operation of a facility in accordance with 15A NCAC 2T .0113(b). A permit may be modified or revoked if a facility fails to perform satisfactorily, including the creation of nuisance conditions. A permittee must take immediate corrective action to correct any operational problems or to alleviate any violation of environmental standards. These corrective actions may include actions required by the N.C. Department of Environment and Natural Resources; such as but not limited to, the operation of additional/replacement treatment or disposal facilities in accordance with 15A NCAC 2T .0110(l) and .1505 (c).
8. Chemical Analysis - A complete chemical analysis of the typical petroleum contaminated soil must be submitted. The analysis must include total petroleum hydrocarbons, semivolatile and volatile hydrocarbons, pH, a determination of hazardous waste constituents and heavy metals. See Section 3 of these guidelines for sampling and analysis information.

9. Land Application Notice - An applicant for a permit to dispose of petroleum contaminated soil by land application shall give written notice, as required by statute, that he intends to apply for such a permit to each city and county government having jurisdiction over any part of the land on which disposal is proposed to occur. A copy of the notice and evidence that the notice was sent to each such government by certified mail, return receipt requested must accompany the permit application. The Department may consider, in determining whether to issue the permit, the comments submitted by local governments.

10. Treatment Initiation - To allow for a site inspection, contaminated soil application/treatment shall be initiated during normal working hours (unless another time has been arranged with the appropriate regional office).

11. Foreign Debris - All foreign debris (i.e., pipes, tires, plastic, concrete, asphalt, wood, metal, etc.) greater than (2) inches in diameter must be removed, and foreign debris shall not be included with the petroleum-contaminated soil in or on soil remediation sites. Foreign debris removed from the petroleum-contaminated soil shall be removed from the site within 48 hours after removal, unless specific approval has been granted by the regional office only to accommodate emergencies or extenuating circumstances. This foreign debris must be disposed of in a manner consistent with all statutes, rules, regulations, or ordinances that may be imposed by local, state, and federal government agencies that have jurisdiction.

12. Setback Requirements - Remediation systems shall adhere to the following setbacks addressed in NCAC 15A 2T .1506 and greater where necessary to comply with minimum horizontal distance requirements (in feet) set by the Division pursuant to 15A NCAC 2L .0107 and this guidance:

- a) Any habitable residence or place of public assembly under separate ownership or not to be maintained as part of the project site 100
- b) Any well with the exception of a Division approved groundwater monitoring well 100
- c) Surface waters (streams – intermittent and perennial, perennial water bodies, and wetlands) 100
- d) Surface water diversions (ephemeral streams, waterways, ditches) 25
- e) Groundwater lowering ditches (where the bottom of the ditch intersects the seasonal high water table) 25
- f) Subsurface groundwater lowering drainage systems 25
- g) Any building foundation except treatment facilities 15
- h) Any basement 15
- i) Any property line 50
- j) Any water line 10
- k) Any swimming pool 100
- l) Rock outcrops 25
- m) Public right-of-way 50
- n) 10 feet of area shall be maintained around the application area with a permanent vegetative cover to be included within any of the existing buffers where applicable.

NOTE: *In addition, the Compliance boundary requirements are specified by regulations in 15A NCAC 2L, Groundwater Classifications and Standards.*

13. Plans And Specifications: (15A NCAC 2T .0105). Four sets of complete plans and specifications for the entire system, including facilities and equipment for treatment, storage and preparation for final disposal of the soil, must be submitted to and approved by the regional office before implementation. The use of public funds may require environmental documentation pursuant to the North Carolina Environmental Policy Act. A set of approved documents for the subject project must be retained by the applicant for the life of the project.

Plans and specifications must be signed and sealed by a Professional Engineer. The only exceptions from the Professional Engineer requirement are projects proposing the land application of contaminated soils, when no storage units are being proposed and no treatment of the material is being proposed other than that provided by the soil and exposure to the atmosphere, with or without the addition of nutrients or the mechanical tilling of the soil,

At a minimum, the plans and specifications must include the following items as well as any necessary information to insure proper design and operation and maintenance of the facility. (15A NCAC 2T .1504)

- a) For all applications:
 1. a general location map, showing orientation of the facility with reference to at least two geographic references (numbered roads, named streams/rivers, etc.);
 2. a scaled map of the site, with a horizontal scale of one inch equals 100 feet or less and topographic contour intervals not exceeding 10 feet or 25 percent of total site relief, whichever is less and showing:
 - (I) all property boundaries and all structures within the treatment, storage and land application areas,
 - (II) the location of all wells, springs, lakes, ponds, or other surface drainage features within 500 feet of the waste disposal site; and
 - (III) any residences or place of public assembly under separate ownership within 400 feet of the waste disposal site.
 3. confirmation that an erosion control plan has been submitted to the Division of Land Quality or its designee, for disposal sites encompassing more than one (new law) acre,
 4. the volume of petroleum contaminated soil to be remediated,
- b) For soil remediation at minimum rates, this includes, but may not be limited to:
 1. a calculation of the area required for landfarming using the maximum application thickness of one inch;
 2. an indication of cover crop(s);
 3. proof of written notification in the form of certified mail return receipts to each city and county government having jurisdiction over any part of the land over which disposal is to occur.
- c) For soil remediation at conventional rates (dedicated or non-dedicated sites), this includes, but is not limited to:

1. a soils evaluation report of the disposal area to evaluate the soil to a depth of five feet. If required by G.S. 89F, a soil scientist shall prepare this evaluation. The report shall include:

[Note: The North Carolina Board for Licensing of Soil Scientists has determined, via letter dated December 1, 2005, that preparation of soils reports pursuant to this Paragraph constitutes practicing soil science under G.S. 89F.]

- A. field descriptions of texture, color, and structure;
 - B. depth and thickness of soil horizons;
 - C. presence of any restrictive horizons;
 - D. depth to seasonal high water table;
 - E. soil pH and cation exchange capacity; and
 - F. estimates of liming and fertilization requirements;
2. the calculation of the size of the disposal area and thickness of application;
 3. a description of the proposed cover crop;
 4. a site maintenance plan;
 5. proposed groundwater quality monitor well network (dedicated sites only); and
 6. proof of written notification in the form of certified mail return receipts to each city and county government having jurisdiction over any part of the land over which disposal is to occur.

d) For containment and treatment this includes, but is not limited to:

1. a soils evaluation report of the containment area to evaluate the soil to a depth of five feet. If required by G.S. 89F, a soil scientist shall prepare this evaluation. The report shall include:

[Note: The North Carolina Board for Licensing of Soil Scientists has determined, via letter dated December 1, 2005, that preparation of soils reports pursuant to this Paragraph constitutes practicing soil science under G.S. 89F.]

- A. field descriptions of texture, color, and structure;
 - B. depth and thickness of soil horizons;
 - C. presence of any restrictive horizons; and
 - D. depth to seasonal high water table;
2. the plans and specifications of the soil containment vessel and any associated leachate collection system, including the operating thickness of the soil to be contained and treated; and
 3. a description of the chemical or biological additives used in treating the contaminated soil.

e) For containment and utilization at brick, asphalt or other production facilities, a site management plan, consisting of a complete description of all operational procedures related to the handling of soils at the proposed facility shall be submitted to the permitting agency by the applicant, including but not limited to:

1. a description of the staging area(s) designated for initial receipts of the contaminated soils;
2. the method of emplacement of the soils in the containment area(s);
3. the average residence time of the soils in the containment area;
4. the method of incorporation of the soils into the production facilities product materials; and

5. the method of containment and disposal of any leachate or runoff resulting from the containment and storage of contaminated soils.

- f) For mobile or portable self-contained facilities this includes, but is not limited to:
1. a description of the treatment system to include procedures for controlling any vapors, liquid or solid by-products of the treatment process;
 2. the method by which any by-products will be disposed;
 3. the predicted average concentration of petroleum contaminants in the untreated soil;
 4. the sampling procedures and analytical methods by which the concentration(s) and type(s) of contaminants in the treated soil will be determined;
 5. the method of disposal of the treated soil; and,
 6. for applications proposing to stage soils, a description of the method proposed to prevent contact of contaminated soil with the environment.

2.3 Non-Discharge Permit Design, Operation and Maintenance Requirements for Specific Petroleum Contaminated Soil Remediation Technologies

All facilities requiring a permit shall be designed following good engineering practice. Waste, including treated waste, shall not be placed directly into, or in contact with, GA classified groundwater unless such placement will not result in a contravention of GA groundwater standards, as demonstrated by predictive calculations or modeling methods acceptable to the Director. Waste shall not be applied or discharged onto or below the land surface when the vertical separation between the waste and the seasonal high water table is less than one foot. If the area is to be utilized for industrial waste and has a separation of less than three feet, and in other areas as designated by the Director, a demonstration must be made using predictive calculations or modeling methods, acceptable to the Director, that such placement will not result in contravention of classified groundwater standards. The distance between water supply wells and waste facilities shall be in accordance with 15A NCAC 2C .0107(a).

A. Treatment by Land Application for Non-Hazardous Petroleum-Contaminated Soil

1. Non-discharge permits are required for these activities. An Erosion Control Plan (ECP) is required if more than one acre is affected. Guidance to prepare an ECP can be found in the Division of Land Resources' "Erosion and Sediment Control Planning and Design Manual." Copies of the manual can be obtained from the regional office. The ECP must be attached to the permit application and a separate copy of the ECP should be sent to the Division of Land Resources for evaluation and approval. Contaminated soil may be land applied utilizing varying rates:

Minimum Rates - Contaminated soil is applied at a thickness not to exceed one inch and mixed with the native soil. Petroleum contaminated soils shall be incorporated into the native soils of the receiver site immediately upon application. Liming, fertilization, and aeration of the soils mixture shall be optional, unless otherwise required by the Division. The permits are issued for one year. The texture of the contaminated soil under consideration must be such that a one inch application is achievable (i.e., granular). Food chain crops for human

consumption shall not be grown on the permitted land until 12 months after the permit expires.

One Time Conventional Rate - For best results, soil should be applied at a thickness not to exceed four inches and mixed with the native soil. Soil amendments, such as lime and fertilizer, must also be incorporated to provide adequate nutrients for bioremediation. These systems will require periodic aeration of the soil and the establishment of a cover crop. Operation of the landfarming program shall not result in contravention of classified groundwater or surface water quality standards. These permits are issued for up to 18 months and may be renewed if permit completion monitoring shows remediation is not complete. The permit may require periodic soil analysis to monitor treatment progress and to verify permit completion. Food chain crops for human consumption shall not be grown until 12 months after the permit expires.

Dedicated Conventional Rate - For best results, soil should be applied at a thickness appropriate to design requirements (for best results, soil should be applied at a thickness not to exceed four inches) and mixed with the native soil. Soil amendments must be incorporated to provide adequate nutrients for bioremediation. These systems will require groundwater monitoring, soil monitoring, periodic soil aeration and the establishment of a cover crop. Operation of the landfarming program shall not result in contravention of classified groundwater or surface water quality standards. The cover crop is required to be established within 30 days of application or last aeration. These permits are issued for up to five years and may be renewed. Food chain crops for human consumption shall not be grown until 12 months after the permit expires.

2. Land application can be completed by either conventional or minimum rates as previously described. Land application at any non-dedicated site shall not reoccur unless soil tests demonstrate that fuel hydrocarbons or other contaminants from previous applications have been remediated below the treatment goals in accordance with 15A NCAC 2T .1505 and that soil conditions are suitable (pH, etc.). Sampling and analysis should be in accordance with this document. Subsequent use will require the system to be reclassified as a "dedicated site." The review of applications and/or issuance of permits address the following points.
3. Criteria for Site Selection, Site Preparation, Application Rates, Post-Application Maintenance, and Monitoring
 - a) Site Selection - Sites to be considered for land application should meet the following standards on a site-specific basis:
 1. The depth to seasonal high water table should be at least 2.5 feet below the waste zone (three feet below land surface).
 2. The slope of the site should not exceed 5 percent. Sites with slopes of greater than 5 percent will require additional sedimentation and erosion control measures.
 3. Sites with organic-rich topsoil (black-dark gray color) are preferable because of the greater abundance and variety of microorganisms available for biodegradation.
 4. Soil textures should range from sandy clay loam to sandy loam. Sandy or clayey soils should be avoided. Very sandy soils have fewer microorganisms for biodegradation, a reduced ability to absorb metals or organics, and higher vertical percolation rates. Clayey

soils deter thorough mixing with the contaminated soil and may contribute to surface runoff of contaminants due to low permeability. Compacted clays exhibiting massive soil structures retard infiltration and chemical exchange.

Soil Texture Classification Chart			
Texture Class	% Sand	% Silt	% Clay
Sands	> 85	<15	0
Loamy Sands	70 - 85	< 30 (silt + clay)	< 30 (silt + clay)
Sandy Loams	50 - 70	< 50	< 20
Loam	<52	28-50	7 - 27
Silt Loam	Trace	50 - 80	12 - 27
Silt	Trace	> 80	<12
Sandy Clay Loams	45 - 72	< 28	20 - 35
Clay Loams	20 - 45	15 - 40	27 - 40
Silty Clay Loams	< 20	60 - 73	27 - 40
Sandy Clays	45-65	0	35 - 55
Silt Clays	0	40 - 60	40 - 60
Clays	<15	< 40	> 40

NOTE: County soil reports, USDA Soil Taxonomy sheets (blue pages) and local, state or federal agencies (Natural Resource Conservation Service, NC Agricultural Extension Service, etc.) can provide assistance in defining the seasonal high water table, land slopes and textures and other characteristics of regional soil. However, the actual site soil conditions must be identified specifically by persons who are duly licensed by the appropriate North Carolina licensing board to provide such services, as defined in 15A NCAC 2T .0103 Rule (38) "Soil Scientist".

- b) Site Preparation - Soil in North Carolina is generally acidic, and the introduction of petroleum-fuel wastes results in a lower pH of the contaminated-native soil mixture. The biodegradation of the contaminants is dependent upon pH. The rate of degradation decreases significantly at lower pH. To maintain higher rates of biodegradation, lime, in the form of agricultural limestone or dolomite, must be applied to the native soil to attain a higher soil pH and increase the availability of nutrients in the uppermost six inches of soil, as follows:
1. For soil contaminated with Low Boiling Point Fuels: Raise pH of application site soil to a minimum of 6.0.
 2. For soil contaminated with Medium/High Boiling Point Fuels: Raise pH of application site soil to a minimum of 6.5.
 3. Where both Low boiling point fuels and Medium/high boiling point fuels are in the contaminated soil: Raise pH of application site soil to a minimum of 6.5.

NOTE: It is preferable to have the pH of the native soil tested by an agronomist or soil scientist, who can then specify the amount of lime needed. Local agents (Natural Resource Conservation Service, N.C. Agricultural Extension Service) may be sufficiently knowledgeable of soil characteristics and land management activities to provide reliable estimates of the liming required. The permit application must contain information specifying the amount of lime to be added and how that determination was made. Agronomic rates incorporating pH may also aid in selection of the most effective cover crop.

- c) Application Rates

1. Application rates are dependent upon the petroleum-fuel product involved, depth to seasonal high water table and application site vegetation and may be determined by either of the following methods:
 - A. Weight/Weight basis: A percentage based on a ratio between the weight of the fuel in the contaminated soil and the average weight of the application site soils to a depth of six inches. See Tables 7 and 9, Example 1.
 - B. Volume per Area basis: A rough approximation of the more accurate weight/weight basis. This procedure may be applied when the amount of fuel in the contaminated soil cannot be reasonably estimated. Because of the uncertainty involved, application rates utilizing this method will be the more conservative of the two methods. Application rates are based on the same criteria as c)(1)(a) above and specify the maximum thickness of contaminated soil that may be applied. See Tables 8 and 9, Example 2.
2. Because of their sensitivity, no petroleum fuel contaminated soil should be permitted on sites where:
 - A) Crop seedlings have just been planted or are expected to be planted within 30 days, or
 - B) A food-chain crop is growing. Once a permit has been issued, food chain crops for human consumption may not be grown on the permitted fields until 12 months after the permit expires.
3. No soil contaminated with heavy fuel oils (#4, #5 or #6), new, or used motor oils, shall be applied to sites where food-chain crops will be grown.

NOTE: *Research to determine the effects that petroleum products have on plants in general, including food-chain crops, have produced mixed conclusions. Despite the fact that aromatic compounds are lost rapidly via evaporation, they have shown a high degree of contact toxicity to seeds and the tender portions of plants. Metals and various toxic organics (ex: benzene, toluene and naphthalene) can be absorbed into the plant structure. Additionally, since hydrocarbons are decomposed by oxidative pathways, oxygen and nutrients available to the root systems of plants are significantly reduced during biodegradation, possibly resulting in inhibited plant growth. The result may be lower crop yields and, for any food crop that develops below ground (such as potatoes, peanuts, onions, etc.), the potential absorption of high levels of metals and/or organics. Because of the potential (but by no means certain) impacts, those involved in application projects, where food-chain crops are involved, should be informed of potential adverse effects on crop yields.*

d) Post Application Maintenance

1. The contaminated soil and lime should be thoroughly incorporated into the top six to eight inches of the native soil by tilling or discing. Since tilling is more efficient than discing, a single pass of the tiller should be sufficient, whereas two to three passes of a disc harrow will normally be required. Inadequate mixing precludes interaction between the native soil microbes and the waste and reduces the amount of incorporated oxygen available for biodegradation.
2. Nutrients, in the form of nitrogen and phosphorus fertilizers, must be sprayed or spread over the application area and fully incorporated into the mixed contaminated and native soil

layer. To provide maximum benefits, fertilization should occur between 15 days before and 30 days after application.

3. The rate of fertilizer application should be the lesser of the following:
 - A) For nitrogen, the tolerance level of the vegetative crop, as determined by a knowledgeable party, or 75-100 pounds per acre of plant available nitrogen; or
 - B) For phosphorus, the tolerance level of the vegetative crop, as determined by a knowledgeable party, or 50-75 pounds per acre P₂O₅ (phosphate or equivalent).
4. To provide extra oxygen for waste biodegradation to proceed, the site should be re-tilled every six months following application. Straw or other bulking agents may be added to the native soil to encourage aeration and biological activity.

NOTE: *Organic matter and bulking agents incorporated into the soil may contribute to TPH values.*

B. Containment and Treatment of Non-Hazardous Petroleum-Contaminated Soil

Containment and treatment facilities are those where petroleum-contaminated soil is accepted and placed on or in a type of contaminant containment structure. The soil is treated according to the specified treatment method. A non-discharge permit is required for these facilities. An Erosion Control Plan (ECP) is required if more than one acre is affected. The ECP must be attached to the permit application, and a separate copy of the ECP should be sent to the Division of Land Resources at the appropriate regional office for approval.

1. There are two different methods of containment of the contaminated soil:
 - a) Inside an Enclosed Structure - An “enclosed structure,” for the purposes of these guidelines, shall mean a rigid building that contains a roof, four complete sidewalls, and a floor with a hydraulic conductivity of 1×10^{-7} cm/sec (15A NCAC 2T .1505) at minimum. These buildings must be designed to keep surface run-off (i.e., rainwater) from contacting the contaminated soil and producing a leachate or surface water runoff. Because leachate generation is virtually impossible in such a building, no leachate collection or disposal system is required. However, any soil additives that have the potential to generate leachate may require appropriate leachate collection and disposal facilities. If storage of contaminated soil takes place prior to or after treatment, appropriate measures for storage as specified in these guidelines shall also apply. **(There should be no storage of contaminated soil outside the enclosed structure.)** Because enclosed structures tend to concentrate organic vapors; emissions from these facilities may be regulated in accordance with conditions in air quality permit(s).
 - b) Impermeable Surfaces Open to the Environment - This category consists of all containment and treatment units other than an enclosed building that will be subject to the elements. Such exposure could result in production of leachate or runoff. These facilities include bioremediation on plastic, bioremediation under a shed that has no sidewalls, composting operations involving windrows that are either covered with plastic or uncovered, or other facilities subject to weather as determined by the N.C. Department of Environment and Natural Resources.

These processes usually involve the use of soil amendments (lime, fertilizer, microorganisms, bulking agents, etc.) to enhance and accelerate the bioremediation process. Soil amendments can also prevent leaching of contaminant hydrocarbon products at low pH conditions.

The required permit stipulates construction standards, leachate control and final placement of the treated soil. Final placement of the treated soil may require additional N.C. Department of Environment and Natural Resources approval.

2. There are several different treatment methods for contaminated soil. Required permits address facility construction standards, soil handling procedures, and monitoring (both surface and groundwater) as necessary.

NOTE: *If reimbursement from the STF is expected, all methods must be carefully considered before selecting a technology. The most cost-effective technology must be selected.*

a) Thermal Treatment by a Mobile or Stationary Facility - Soil contaminants may be thermally treated or destroyed by the use of mobile incinerators or other like technologies. This method of treatment uses extreme heat to volatilize contaminants. In both stationary and mobile units, an air quality permit may be required.

Measures taken to store and inventory contaminated soil shall be regulated by the conditions of the permit. In the instance where a mobile unit is used at various locations, the issued permit is valid for the counties within the jurisdiction of the issuing regional office. The permit may stipulate that groundwater monitoring is necessary, depending upon the nature and volume of contaminated soil and groundwater use in the area.

b) Containment and Use of Petroleum Fuel Contaminated Soil in Brick, Asphalt or Other Production Facilities - Another treatment method for *ex situ* soil is thermal incineration, which allows the soil to be consumed and/or encapsulated into an end product (usually brick or asphalt). Storage of contaminated soil must take place in a controlled area that is lined with either a synthetic liner having a hydraulic conductivity less than 1×10^{-7} cm/sec, or a one foot thick natural material liner compacted to 95 percent Proctor Standard Clay Density with a hydraulic conductivity of 1×10^{-7} cm/sec (15A NCAC 2T .1505).

Surface water runoff and/or leachate from the contaminated soil storage area must be collected and properly disposed to prevent leachate migration. Operators of soil storage facilities with leachate collection systems and treatment facilities must also obtain a non-discharge permit for the leachate collection and treatment facilities. This permit addresses facility construction standards, soil handling procedures, and monitoring (both surface and groundwater).

1. General Design Condition - All soil containing petroleum products shall be placed within a containment area that is underlain by one of the following:

- A) A synthetic liner that is chemically compatible with the petroleum products being contained and treated. The liner must have a hydraulic conductivity no greater than 1×10^{-7} cm/sec and be comprised of a single layer of no less than 30 mil in thickness, or be a 20 mil Permalon liner;

- B) A liner of uncontaminated natural materials (i.e., clays, etc.) at least one foot in thickness at all locations. The liner must have a hydraulic conductivity no greater than 1×10^{-6} cm/sec (unless being placed four feet or less above bedrock, then 1×10^{-7} cm/sec is required) upon being compacted to 95 percent Proctor standard dry density; or
 - C) Other liner materials (asphalt, concrete, etc.) approved by the appropriate regional office.
2. Site Management Plan - A site management plan is a complete description of all operational procedures for handling petroleum-contaminated soil at the proposed facility. Plans include:
- A) A description of the staging area(s) designated for initial receipt of petroleum-contaminated soil,
 - B) Method(s) of emplacement of contaminated soil into the containment area(s),
 - C) Average residence time of contaminated soil within the containment area(s), and
 - D) Method of incorporation of the contaminated soil with the brick or asphalt materials prior to incorporation into the respective production processes.
- c) Bioremediation and Volatilization of Non-Hazardous Petroleum Contaminated Soil
- This treatment category involves bioremediation and volatilization of the petroleum-contaminated soil until such time as the petroleum contamination is less than the treatment goals. These processes usually involve the use of soil amendments (lime, fertilizer, microorganisms, bulking agents, etc.) to enhance and accelerate the bioremediation process. The need for leachate control is dictated by the type of containment used (enclosed structure or impermeable surface open to the environment).
1. Design conditions (P.E. certification required)
 - A) The site must be secured to prevent unauthorized access.
 - B) The soil shall be placed within a contained area on:
 - i) a synthetic liner which has a hydraulic conductivity less than 1×10^{-7} cm/sec and is at least 30 mil in thickness, a 20 mil Permalon liner; or
 - ii) a minimum of one foot thickness of compacted clayey soil which has a hydraulic conductivity no greater than 1×10^{-7} cm/sec, and has been compacted to 95 percent standard proctor.
 - C) The containment vessel must be able to withstand the processes used during remediation without failure of the impermeable layer.
 - D) A leachate collection system may be required in order to prevent run-off from the contaminated soil. Preferably, steps should be taken to avoid accumulation of water within the contained area.
 - E) Provisions to dispose of leachate in an approved manner in accordance with applicable local, state or federal regulations must be made.
 - F) Slope of the treatment surface must be less than 5 percent.
 - G) Complete plans and specifications for the entire system, including facilities and equipment for treatment, storage, and preparation for final disposal of the soil, must be submitted to and approved by the regional office before implementation.
 2. Soil Preparation

Soil in North Carolina is generally acidic and the introduction of petroleum-fuel wastes results in a lower pH of the contaminated-native soil mixture. Biodegradation of contaminants is dependent upon pH and the rate of degradation decreases significantly at

lower pH. To maintain higher rates of biodegradation, lime, in the form of agricultural limestone or dolomite, must be applied to the contaminated soil to attain a higher soil pH and increase the availability of nutrients, as follows:

- A) For Low Boiling Point fuels contaminated soil: Raise pH of contaminated soil to a minimum of 6.0.
- B) For Medium/High Boiling Point contaminated soil: Raise pH of contaminated soil to a minimum of 6.5.
- C) Where both Low Boiling Point and Medium/High Boiling Point fuels are in the contaminated soil: Raise pH of contaminated soil to a minimum of 6.5.

NOTE: *It is preferable to have the pH of the contaminated soil tested by an agronomist or soil scientist, who can then specify the amount of lime needed. Local agents (Natural Resource Conservation Service, N.C. Agricultural Extension Service) may be sufficiently knowledgeable of soil characteristics and land management activities to provide reliable estimates of the liming required. The permit application must contain information specifying the amount of lime to be added and how that determination was made.*

3. Soil Maintenance

- A) Nutrients, in the form of nitrogen and phosphorus fertilizers, must be fully incorporated into the contaminated soil.
- B) Fertilization rate: The optimum quantity of nitrogen and phosphorus required for microbial degradation is related to the organic carbon content of the soil-waste mixture. The optimum organic carbon/nitrogen/phosphorus for waste degradation is 60/1/0.075 (Bartha and Bossert, 1981).
- C) Extra oxygen for waste biodegradation and volatilization should be provided using the most appropriate method (i.e., soil mixing, air injection).

C. Dedicated Sites

Dedicated contaminated soil facilities are designed to receive contaminated soil on a repeated basis. These facilities may use conventional rate land application, production facility storage, or containment and treatment methodologies. Dedicated facilities may receive shipments of contaminated soil from many sources. Each shipment must be individually tracked. The facility permit may require additional conditions outside the minimum design requirements associated with one-time use methodologies. Permits for these sites require soil, groundwater and possibly surface water and air monitoring to ensure protection of human health and the environment. These permits are issued for up to five years and require the payment of annual administrative fees.

If a application facility has previously been approved for a one-time use (including under a Certificate of Approval), any subsequent use of that facility will require the facility to be re-permitted as a dedicated facility, unless it can be demonstrated by soil testing that fuel hydrocarbons or other contaminants from previous applications have been remediated below treatment goals and that soil conditions are suitable, subject to the guidelines and rules for dedicated facilities.

2.4 Inspections

Adequate inspection and maintenance of the subject facility shall be provided by the permittee to insure compliance with applicable state, federal or local laws and regulations in accordance with 15A NCAC 2T .0110(1).

Any duly authorized officer, employee or representative of the division may, upon presentation of credentials, enter and inspect any property, premises or place on or related to the application site and facility for the purpose of determining compliance with this permit. They may also inspect or copy any records that must be kept under the terms and conditions of this permit and/or may obtain samples of soil, groundwater, surface water or leachate in accordance with 15A NCAC 2T .0110(3).

2.5 Monitoring

In accordance with NCAC 2L .0110, the director of DWM may require any monitoring deemed necessary to ensure surface water and groundwater protection. An acceptable sampling, analysis and reporting schedule shall be followed.

A systematic sampling approach must be used to assure that sample collection activities provide usable data. Sampling must begin with an evaluation of background information, historical data and site conditions. The three purposes of soil sampling activities required for soil remediation permitting are: initial characterization, routine monitoring and permit completion. The necessity for groundwater monitoring will be determined by the regional office, based on potential environmental impacts for one-time application sites. **For a dedicated site, a minimum of four monitoring wells will be required. One well should represent background, and the others should be located in a downgradient direction of the application area.**

Sampling requirements are specific to the analytical method required for the contamination source material, the type of soil remediation technology and the purpose of sampling. Possible contaminants are listed, with approved analytical methods, in Table 3 for soil samples and Table 5 for groundwater samples. Samples must be collected and preserved in appropriate sample containers, as listed in Table 4 for soil samples and Table 6 for groundwater samples. Soil and groundwater samples must be collected with appropriate, clean tools. Soil sampling must follow the general procedures outlined in Section 3.1 (Soil Sampling and Analysis). Sampling of groundwater must follow the procedures outlined in Section 3.2 (Groundwater Sampling and Analysis). Detailed information is included in the *Guidelines for Sampling* (current edition).

NOTE: *Special procedures are necessary for collecting and preserving composite soil samples requiring volatiles analysis (i.e. the current versions of SW-846 Method 8015 TPH Gasoline & of Method 8260). Several collection and preservation options are provided in the Guidelines for Sampling (current edition). All volatiles soil samples must be grab samples and may **not** be composited in the field before submission to a DWR Certified Laboratory.*

2.6 Permit Completion Requirements

Soil remediation permits may be closed-out based upon a determination by the Department that any involved facilities and equipment have been decontaminated and that the contaminated soil has been remediated to below the treatment goals. The treatment goals for soil remediation are defined as concentrations that are less than the reportable concentrations as presented in Table 3. The reportable concentrations are defined as concentrations of typical petroleum product constituents in sufficient quantities as to be detectable by compatible laboratory analytical procedures in accordance with 15A NCAC 2T .1507. A reason for closure of the facility must be provided. A demonstration must also be made that any groundwater or surface waters are not impacted in excess of their appropriate standards.

If the owner/operator or their agent learns that the permit conditions for completion will not be met when the permit expires, a permit renewal request must be submitted to the regional office as soon as possible. The permit renewal request must include Form UST-70, the appropriate fees and site drawings.

3.0 Sampling, Analysis and Reporting

A systematic sampling approach must be used to assure that sample collection activities provide usable data. Sampling must begin with an evaluation of background information, historical data and site conditions. Three types of soil sampling activities are required for soil remediation permitting: initial characterization, routine monitoring and permit completion. The only type of groundwater sampling associated with soil remediation is routine monitoring, which is used to determine if contaminants are escaping from the remediation zone. Each sampling activity has specific analytical requirements. Sampling requirements are specific to both the analytical method and the type of soil remediation technology. Specific procedures are outlined for soil and groundwater sampling in the *Guidelines for Sampling* (current edition).

The first step in the soil remediation sampling process is initial characterization. It begins by identifying the former contents of the UST system(s) or source of petroleum contamination. This is often based on historical information from the UST registration database. There may also be existing analytical results from assessment and corrective action procedures at the source site for the contaminated soil. Any existing analytical data should be evaluated before methods of analysis and associated sample collection and preservation procedures are selected. Field screening results should be used to segregate soils at the time of excavation, based on apparent levels of contamination, to help monitor potential exposures and for health and safety monitoring. If instruments or other observations indicate contamination, soil should be separated into stockpiles based on apparent degrees of contamination. At a minimum, soil suspected of contamination must be segregated from soil observed to be free of contamination. However, field screening can not take the place of the laboratory samples required for initial characterization of contaminated soils for treatment. Analysis of the stockpiled soil is necessary to determine whether treatment of the soil is needed, to assist with selection of treatment methods, and to establish baseline data for use in evaluating the effectiveness of treatment. To determine if untreated stockpiled soils can be considered not contaminated, stockpiled soils must be characterized by formal initial characterization sampling and laboratory analysis. The initial characterization of soil to be remediated must include a complete chemical analysis as required by 15A NCAC 2T .1504.

Next, to monitor the progress of treatment and to determine if soil has been adequately treated, routine monitoring and permit completion samples must be collected. If groundwater monitoring is necessary, sufficient monitoring and observation wells must be properly installed to be able to determine the presence, degree or extent of groundwater contamination, in accordance with 15A NCAC 2L requirements. Routine soil monitoring must include chemical analyses as required by the permit to prevent the contravention of any environmental standards as required by 15A NCAC 2T .1505 and 15A NCAC 2L .0110 (c). Soil samples for permit completion must include chemical analyses which document that petroleum contaminant levels are remediated to below analytical detection level as required by 15A NCAC 2T .1507. Possible contaminants are listed, with approved analytical methods, in Table 3 for soil samples and Table 5 for groundwater samples. Samples must be collected and preserved in appropriate sample containers, as listed in Table 4 for soil samples and Table 6 for groundwater samples.

The N.C. Division of Water Resources Laboratory Certification Program generates a list of certified commercial laboratories. The list includes laboratory contact information and the

analytical methods they are certified to perform. The list is available from the N.C. Division of Water Resources Chemistry Laboratory at 4405 Reedy Creek Road, Raleigh, NC 27607; requested by phone at (919) 733-3908; or online at <http://portal.ncdenr.org/web/wq/lab/cert/certlablists> .

Sampling kits for sample collection and transport may be purchased from some commercial laboratories. Kits include all the items needed (sample containers, shipping cartons, etc.) for collection and shipment of samples. If you use these services, carefully follow the instructions provided and do not discard any preservative that may have been added to the containers. If you do not choose to use a customized kit provided by your laboratory, use only new containers of the appropriate type for the contaminants for which you are sampling. Refer to Table 4 and check with the laboratory that will be running the analysis about appropriate sample containers and preservation requirements for each method. **If proper sampling and QA/QC protocols are not followed, the N.C. Department of Environment and Natural Resources may consider your results invalid.**

3.1 Soil Sampling and Analysis

A. Sampling

Composite sampling will be used for soil samples collected for soil remediation permitting. Samples will be composited as a means of reducing sample handling and analytical costs. Each composite sample for soil remediation will be composed of six primary samples. The six primary samples, comprising each composite sample, shall be mixed together by the laboratory, with a representative portion of this mixture to be analyzed. Composite samples are prepared differently depending on the analysis required and the relative tendency of the contaminant analyzed to vaporize.

Samples collected for volatile organic analysis cannot be dried, ground or mixed if they are to reflect the concentrations found in the soil. Since methanol preserved samples lend themselves to composite sampling techniques, the methanol preservation technique is required for primary samples to be composited and analyzed for volatiles analysis (i.e. the current versions of SW-846 Method 8015 TPH Gasoline or Method 8260). The six primary samples collected for volatiles analysis shall be methanol preserved in **separate** VOA vials. The primary samples must be extracted, and representative portions of the methanol extracts must be composited by the analytical laboratory using methods that minimize volatile organic loss.

NOTE: *Collection and preservation options for composite soil samples requiring volatiles analysis are provided in the Guidelines for Sampling (current edition). Unless otherwise approved by the UST Section, all volatiles soil samples for soil remediation must be methanol preserved grab samples collected as primary samples in **separate** containers and may **not** be composited in the field before submission to a DWR Certified Laboratory.*

The six primary samples collected for metals analysis may be added to a single sample container, clearly marked as composite, for the laboratory to dry, sieve, mix and sub-sample for analysis of a representative portion.

The six primary samples collected for semi-volatiles analysis (i.e. the current versions of SW-846 Method 8015 TPH Diesel or Method 8270) may be added to a single sample container, clearly marked as composite, for the laboratory to mix and sub-sample for analysis of a representative portion.

B. Soil Analytical Methods

The three types of soil sampling and analysis activities relating to soil remediation permitting are listed below with required analytical methods and in Table 3. These activities should be consistent with the type of decision to be made.

1. Analytical Methods for Initial Characterization Soil Sampling

For initial characterization, results of one composite sample collected (per 200 cubic yards or per source) for initial characterization of petroleum contaminated soil are required prior to acceptance on site. Analysis must be in accordance with methods to provide:

- a) A complete chemical analysis of the typical petroleum contaminated soil to be remediated, including but not limited to, TPH, semivolatile and volatile hydrocarbons (per SW-846 Methods 8260 and 8270, current versions), pH, and heavy metals.

1. Low Boiling Point Fuels: gasoline, aviation gasoline, gasohol, etc. by methanol preserved EPA 8260B with IPE & MTBE, EPA 8270D. Preparation: Total Metals (Chromium and Lead)/EPA 1311; methanol preserved EPA 8015C GRO, **and** EPA 9045D.

2. Medium/High Boiling Point Fuels: jet fuels, kerosene, diesel, varsol, mineral spirits, naphtha, fuel oil #2, etc. by methanol preserved EPA 8260B with IPE & MTBE; EPA 8270D. Preparation: Total Metals (Chromium and Lead)/ EPA 1311; methanol preserved EPA 8015C GRO and EPA 8015C DRO; **and** EPA 9045D.

3. Heavy Fuels: #4, #5 and #6 fuel oils; motor oil; hydraulic fluid; etc. by EPA 8270D;. Preparation: Total Metals (Chromium and Lead)/ EPA 1311; EPA 8015C DRO; **and** EPA 9045D.

4. Used / Waste Oil: by methanol preserved EPA 8260B with IPE & MTBE, EPA 8270D. Preparation: Total Metals (Chromium and Lead) / EPA 1311; 9071B; **and** EPA 9045D.

- b) A determination of hazardous waste constituents using the Toxicity Characteristic Leaching Procedure described in 40 CFR 261.24 (EPA SW-846/Method 1311 (TCLP) metals). Any substance shall be considered a hazardous waste if the results of the TCLP analysis indicate concentrations of constituents greater than the federal regulatory level, unless documentation is provided stating that the petroleum contaminated soil is not a hazardous waste regulated under Subtitles C or D of RCRA. A TCLP analysis will be required for all permit applications to contain or treat petroleum contaminated soil in accordance with the following criteria:

1. If the source of the soil contamination is a virgin (unused) petroleum product, from an underground storage tank regulated under Subtitle I of RCRA, the contaminated soil shall not be considered a hazardous waste and no TCLP analysis is required. In lieu of the

TCLP analysis, certification of soil contamination from a virgin petroleum product will be required;

2. If an analysis of the source of petroleum product is submitted showing concentrations less than the regulatory level associated with the constituents of the TCLP analysis, the contaminated soil shall not be considered a hazardous waste and no TCLP analysis will be required;

3. For soils contaminated with used motor oil, the soils will be considered hazardous until proven otherwise by a TCLP analysis for metals only (EPA Hazardous Waste Nos. D004-D011);

4. For soils contaminated by waste oil, a TCLP analysis, with the exception of pesticides and herbicides, shall be required;

5. For soils contaminated with petroleum products not regulated under Subtitle I of RCRA (excluding used motor and waste oils), the soils will be considered hazardous until proven otherwise by procedures specified by the Department.

Total analysis of the TCLP constituents (as found in EPA SW-846) may be used instead of the TCLP analysis if the individual analytes are not present in the waste or if they are present at levels which could not possibly exceed TCLP regulatory levels (EPA SW-846/Method 1311, Section 1.2). Levels which could not possibly exceed TCLP regulatory levels are defined as those which do not exceed the Maximum Theoretical Leachate Concentration. The Maximum Theoretical Leachate Concentration is the specific total analyte concentration divided by twenty.

For any soil in which one or more constituents do exceed the regulatory level, a written clearance is required from this Department's Division of Waste Management Hazardous Waste Section stating that the soil is not subject to regulation by programs administered under their authority.

2. Analytical Methods for Routine Monitoring Soil Sampling

Routine monitoring sampling for containment and treatment requires one composite sample collected for each 200 cubic yards of soil, per source, contained or treated. For land application treatment, routine monitoring sampling requires two composite soil samples from each acre, or the land application area if it is less than one acre. Samples shall be collected at the treatment site as scheduled by the permit until the permittee can demonstrate that the soil has been remediated to below the method detection limit. Demonstrations must use the analytical method for the source material as listed below and in Table 3:

- a) Low Boiling Point Fuels: gasoline, aviation gasoline, gasohol, etc. by methanol preserved EPA 8015C GRO.
- b) Medium/High Boiling Point Fuels: jet fuels, kerosene, diesel, varsol, mineral spirits, naphtha, fuel oil #2, etc. by methanol preserved EPA 8015C GRO **and** EPA 8015C DRO.
- c) Heavy Fuels: #4, #5 and #6 fuel oils; motor oil; hydraulic fluid; etc. by EPA8015C DRO.
- d) Used/Waste Oil: by EPA 9071B.

3. Analytical Methods for Permit Completion Soil Sampling

Permit completion sampling for containment and treatment requires analytical results for one composite sample collected per each 200 cubic yards of soil, per source, contained or treated. For

land application treatment, permit completion sampling requires two composite soil samples from each acre, or the land application area if it is less than one acre. Permits may be closed-out if the Division determines that the contaminated soil has been remediated to below the method detection limit by the analytical methods for the source material as listed below and in Table 3, in accordance with 15A NCAC 2T .1507:

- a) Low Boiling Point Fuels: gasoline, aviation gasoline, gasohol, etc. by methanol preserved EPA 8260B with IPE & MTBE, EPA 8270D **and** methanol preserved EPA 8015C GRO.
- b) Medium/High Boiling Point Fuels: jet fuels, kerosene, diesel, varsol, mineral spirits, naphtha, fuel oil #2, etc. by methanol preserved 8260B with IPE & MTBE; EPA 8270D; methanol preserved EPA 8015C GRO; **and** EPA 8015C DRO.
- c) Heavy Fuels: #4, #5 and #6 fuel oils; motor oil; hydraulic fluid; etc. by EPA 8270D **and** EPA 8015C DRO.
- d) Used / Waste Oil: by methanol preserved EPA 8260B with IPE & MTBE; EPA 8270D; **and** EPA 9071B.

3.2 Groundwater Sampling and Analysis

Routine groundwater monitoring sampling may be required by some permits. Groundwater samples are collected to identify, investigate, assess, and monitor the concentration of dissolved contaminant constituents. To properly assess the groundwater contamination, first install sampling points (monitoring wells, etc.), then collect groundwater samples and perform specific laboratory analyses. All monitoring wells should be constructed in accordance with 15A NCAC 2C .0100 and sampled as outlined in the *Guidelines for Sampling* (current edition).

Monitor wells shall be sampled after construction but before contaminated soil treatment operations. Additional samples shall be taken as required by permit for the following parameters:

- Water level
- pH (6.5 - 8.5 standard units)
- Nitrate (NO₃-N)
- Total Ammonia (as N)
- Total Dissolved Solids
- Metals (Lead and Chromium)
- Volatile Organic Compounds (by methods 1 **or** 2 below):

Method 1: MADEP VPH: Aliphatics/Aromatics **AND** SM 6200B with IPE & MTBE. EDB by EPA Method 504.1.

OR

Method 2: MADEP VPH: Aliphatics/Aromatics **AND** EPA Methods 601 and 602 with IPE, MTBE, & Xylenes. EDB by EPA Method 504.1.

NOTE: If any volatile organic compounds are detected by Permit Methods 1 or 2, EPA Method 625 (plus the 10 largest non-target peaks) **AND** MADEP EPH Aliphatics/Aromatics must be run to detect other organic compounds which may be present. The results of all analyses specified in the monitoring requirements, including EPA Method 625 and MADEP EPH, must be submitted simultaneously.

Allowable concentrations in groundwater are set by the state's Groundwater Quality Standards, established in accordance with the provisions set forth in General Statute (G.S.) 143-214.1. These standards are located in Title 15A, North Carolina Administrative Code, Subchapter 2L (15A NCAC 2L), Groundwater Classifications and Standards, Rule .0202.

The results of the sampling and analysis shall be sent to the UST Section at the appropriate regional office on Form UST-59 (Compliance Monitoring Report Form) within 30 days of sampling. All compounds analyzed using a certified method must be reported. The laboratory report must include the items outlined in the *Guidelines for Sampling* (current edition) and in Attachment A of soil remediation permits.

When selecting analytical methods to determine groundwater contamination for the purposes of soil remediation permit activities, please refer to Table 5 (Approved Methods for Groundwater Analysis).

3.3 Laboratory Reports

All compounds analyzed using a certified method must be reported. See the *Guidelines for Sampling* (current edition) for detailed information to be communicated to the NC DWR Certified Laboratory chosen to analyze your samples. This information is also included as an attachment in soil remediation permits. Please provide a copy of the referenced attachment to the laboratory to ensure that reporting requirements can be met by the laboratory you have selected.

4.0 References

Alaska Department of Environmental Conservation “Underground Storage Tanks Procedures Manual”. November 7, 2002. Available on the Internet at <http://dec.alaska.gov/spar/guidance.htm#ust> .

Bartha, R. and Bossert, I.1981. “The Treatment and Disposal of Petroleum Wastes,” *Petroleum Microbiology*. McMillan Publishing Co., NY.

State of California Leaking Underground Fuel Tank Task Force “Leaking Underground Fuel Tank Field Manual: Guidelines for Site Assessment, Cleanup, and Underground Storage Tank Closure.” October 1989.

US EPA, “Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.” *Publication 9240.1-05-01, PB 94-963502*, February 1994. EPA540/R-94/013.

US EPA, “Contract Laboratory Program National Functional Guidelines for Organic Data Review.” *Publication 9240.1-05, PB 94-963501*, February 1994. EPA540/R-94/012.

U.S. EPA, “Preparation of Soil Sampling Protocols: Sampling Techniques and Strategies.” Preissue copy, July 1992. EPA/600/R-92/128.

U.S. EPA. “Soil Sampling Quality Assurance User’s Guide.” Second Edition, March 1989. EPA/6008-89/046.

**Figure 1
Regional Office Locations and Map**

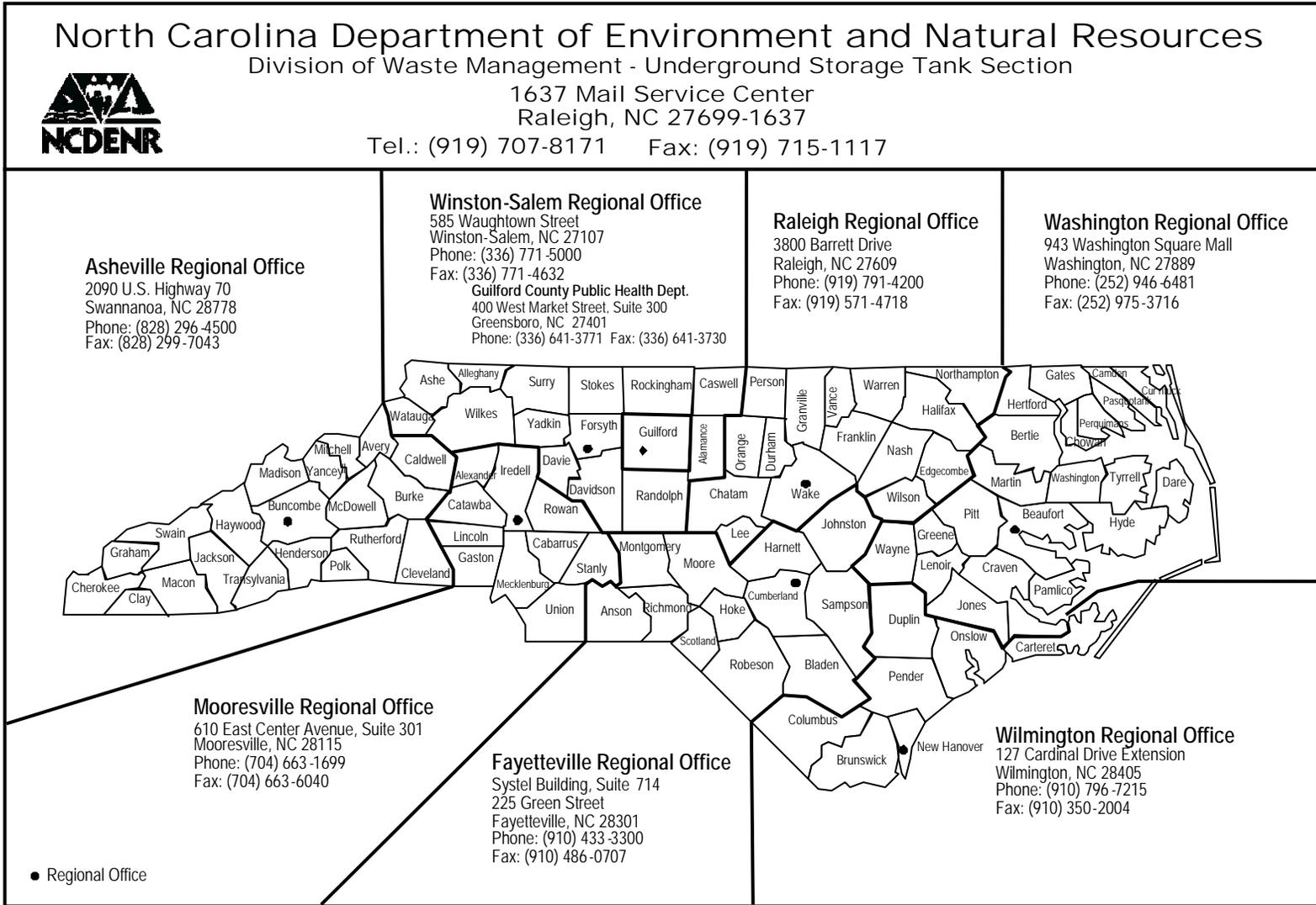
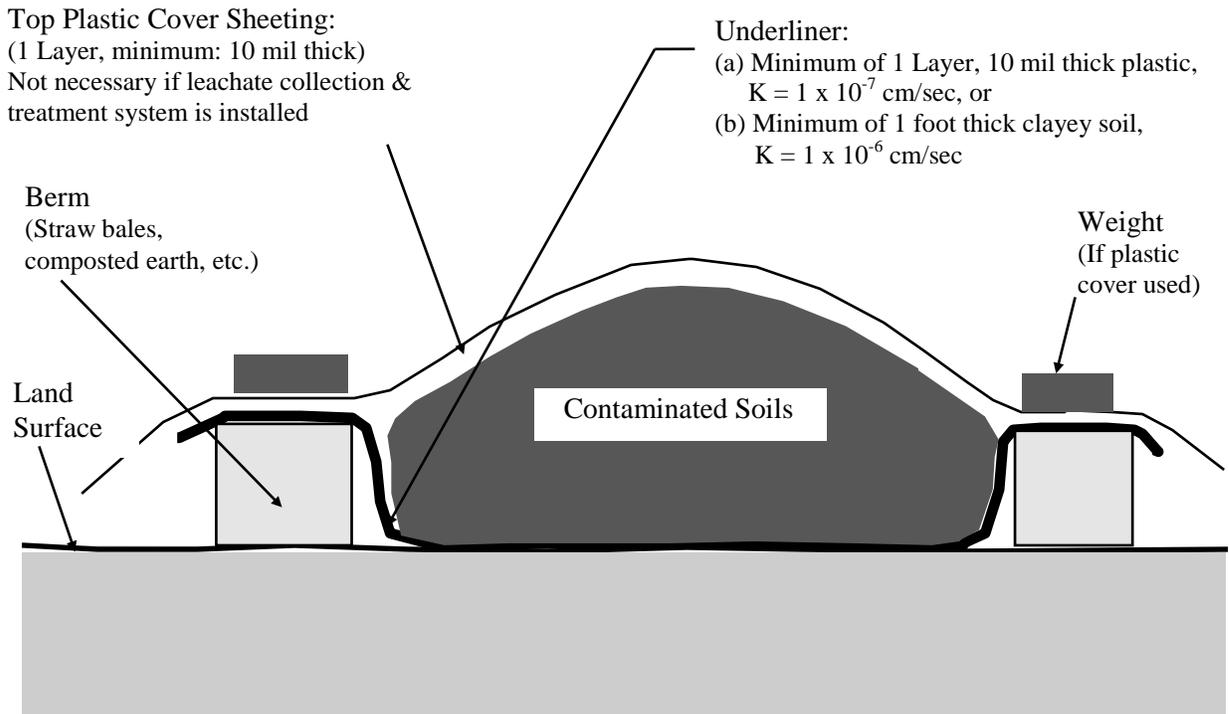
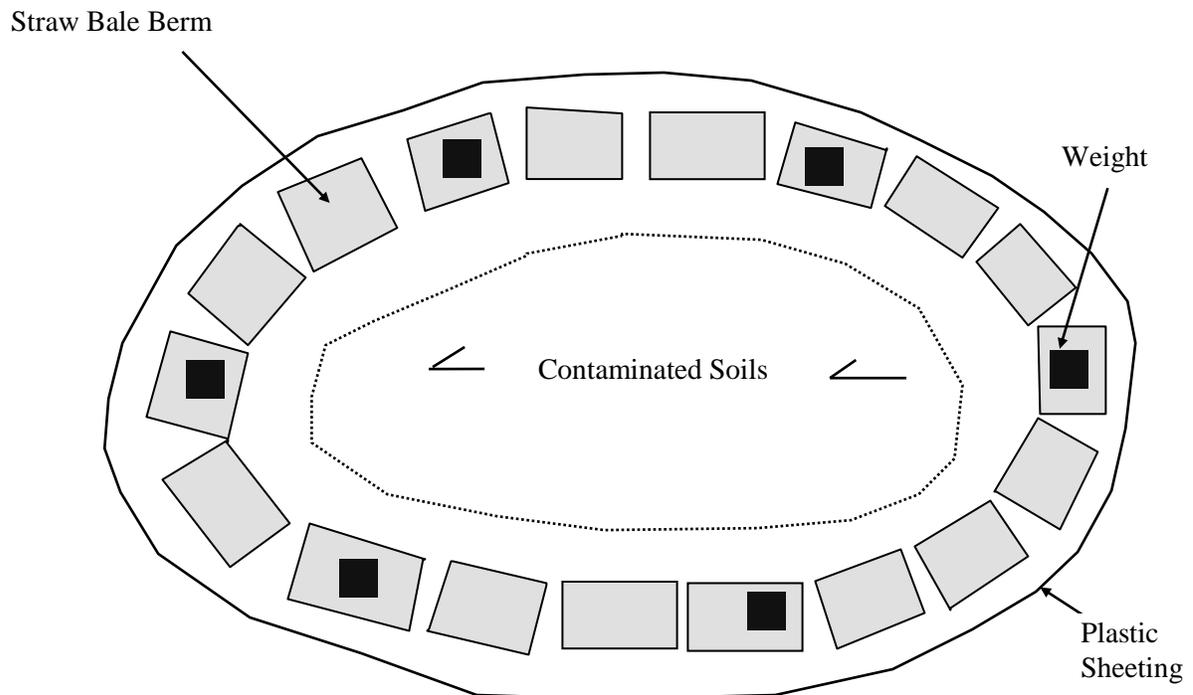


Figure 2
Diagram for Temporary Containment and Treatment of
Petroleum-Contaminated Soil

Cross-Section View

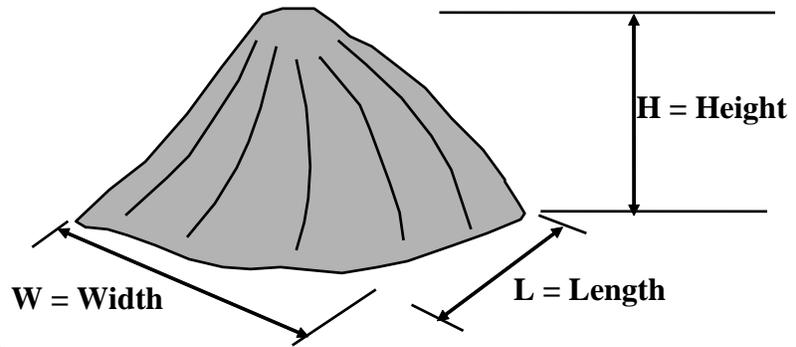


Map View

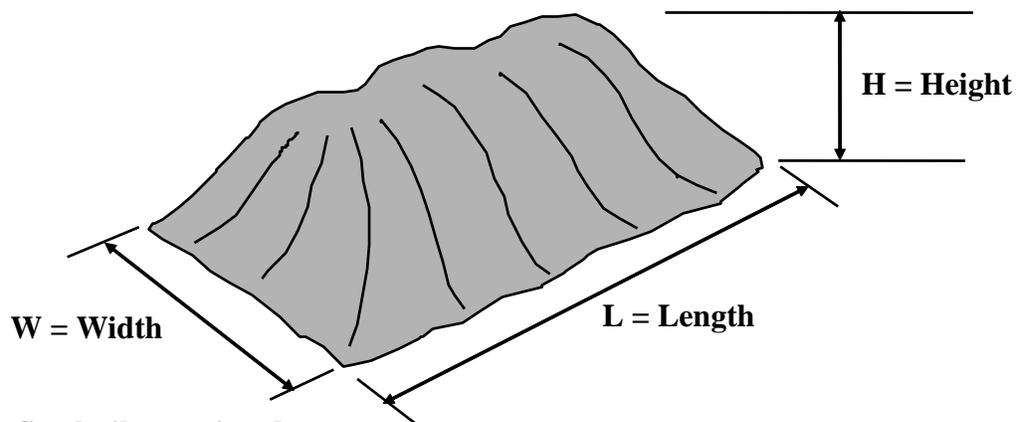


**Figure 3 (copy)
Volumes of Stockpiles**

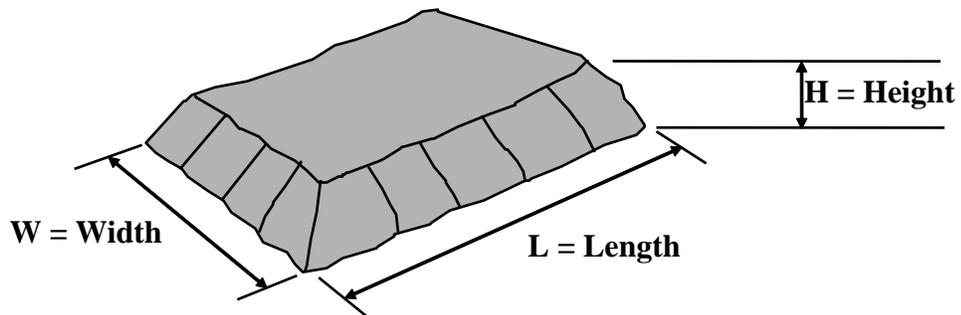
$L > W > H$



Conical Stockpiles
Volume = $1/3 \times H \times L \times W$



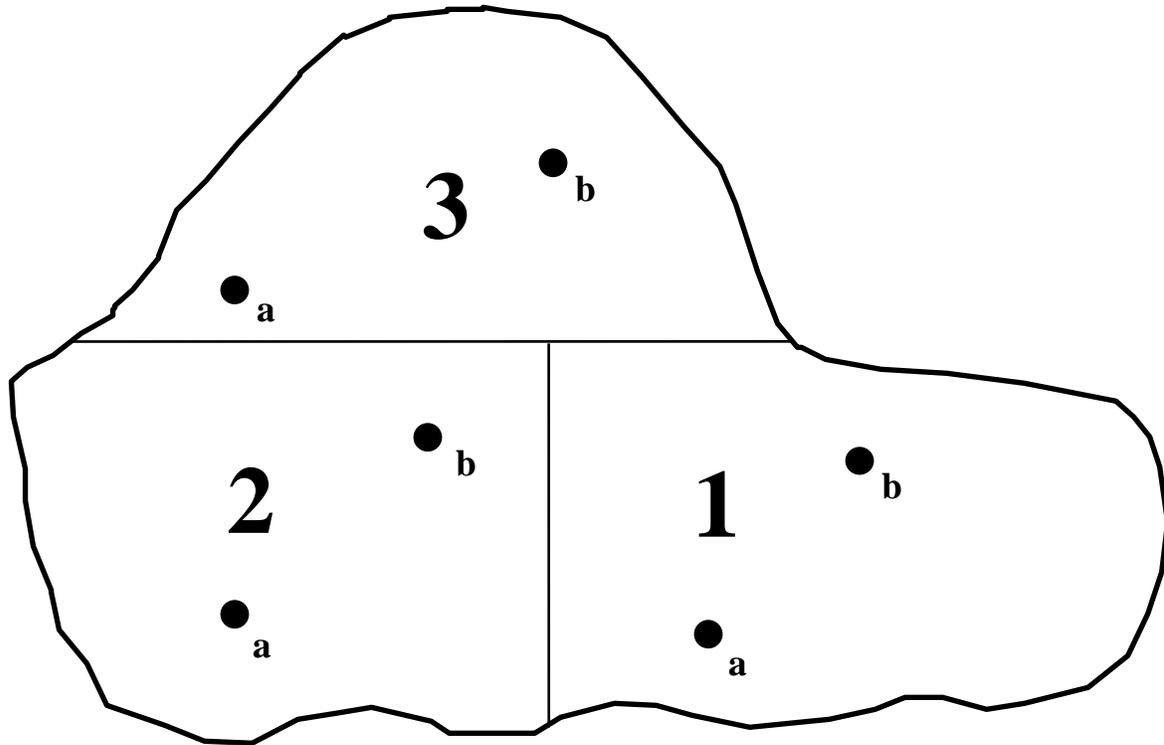
Rectangular Stockpiles - pointed crest
Volume = $1/2 \times H \times L \times W$



Rectangular Stockpiles - flat topped
Volume = $H \times [(L \times W) - (2 \times H \times W)]$

Note: These equations have been simplified for ease of calculation.

**Figure 4 (copy)
Soil Stockpile Sampling Map (Example)**



Stockpile Type: Rectangle, Flat Topped

Volume = $4 \times [(21 \times 11) - (2 \times 4 \times 11)] = 572$ cubic yards

where:

Height (maximum)	=	12 feet	=	4 yards
Length (maximum)	=	63 feet	=	21 yards
Width (maximum)	=	33 feet	=	11 yards

<u>Composite Samples</u>	<u>3 Primary Samples per core</u>	<u>Sample Depths</u>
1	core 1a	1', 4', 7'
	core 1b	1', 5', 8'
2	core 2a	2', 6', 10'
	core 2b	1', 4', 7'
3	core 3a	1', 3', 5'
	core 3b	2', 5', 8'

NOTE: Each composite sample contains six primary samples, three from core "a" and three from core "b."