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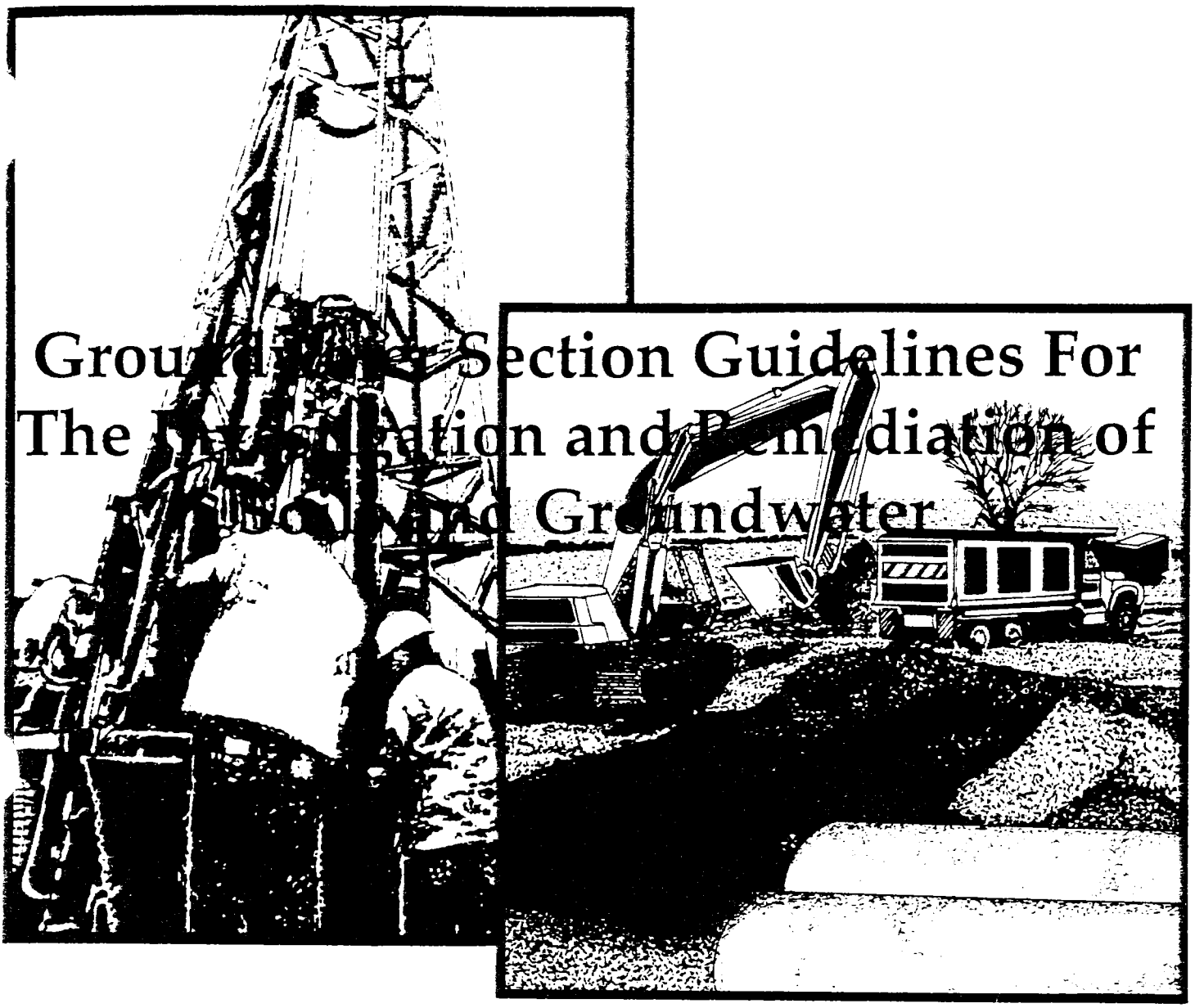
GROUNDWATER SECTION GUIDELINES FOR THE INVESTIGATION AND REMEDIATION OF SOIL AND GROUNDWATER MCAS CHERRY POINT NC

STATE OF NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH, AND NATURAL RESOURCES



Groundwater Section Guidelines For The Investigation and Remediation of Soil and Groundwater

North Carolina
Department of Environment, Health, and Natural Resources
Division of Environmental Management

Groundwater Section

March 1993
(with June 1993 Revisions incorporated)

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1.0 PURPOSE AND APPLICATION OF THE GUIDELINES

This document provides instructions for an individual involved in non-hazardous waste contaminated soil and/or groundwater investigation and remediation activities in North Carolina. These guidelines include information on the statutes and rules governing groundwater investigations, along with the actual step-by-step process required to comply with the state's requirements for the remediation of contaminated soil and groundwater. Alternative methods of soil and groundwater remediation will be considered if it can be demonstrated that the proposed methods achieve comparable results. This document is intended to provide guidance and in no way supersedes federal, state or local regulations.

These guidelines include methods for collecting soil and groundwater samples, determining the source, degree and extent of contamination, and implementing remediation. This document contains information on underground storage tank investigations, petroleum contaminated soil and/or groundwater cleanups, above ground leaks and spills, and other potential sources of contamination which could affect the quality of groundwater in the state of North Carolina.

If there are any questions concerning information in this document or requirements for project review, site investigation, or site closure, the Groundwater Section, Division of Environmental Management of the Department of Environment, Health, and Natural Resources should be contacted. Figure 1 shows the counties in North Carolina which fall under the jurisdiction of each regional office, and the telephone number of the regional offices. Questions concerning a specific site should be directed to the regional office responsible for the county in which the site is located.

Fig. 1

North Carolina - Department of Environment, Health, & Natural Resources
Division of Environmental Management

Groundwater Section
512 N. Salisbury Street
P.O. Box 29535
Raleigh, NC 27626-0535
(919)733-3221

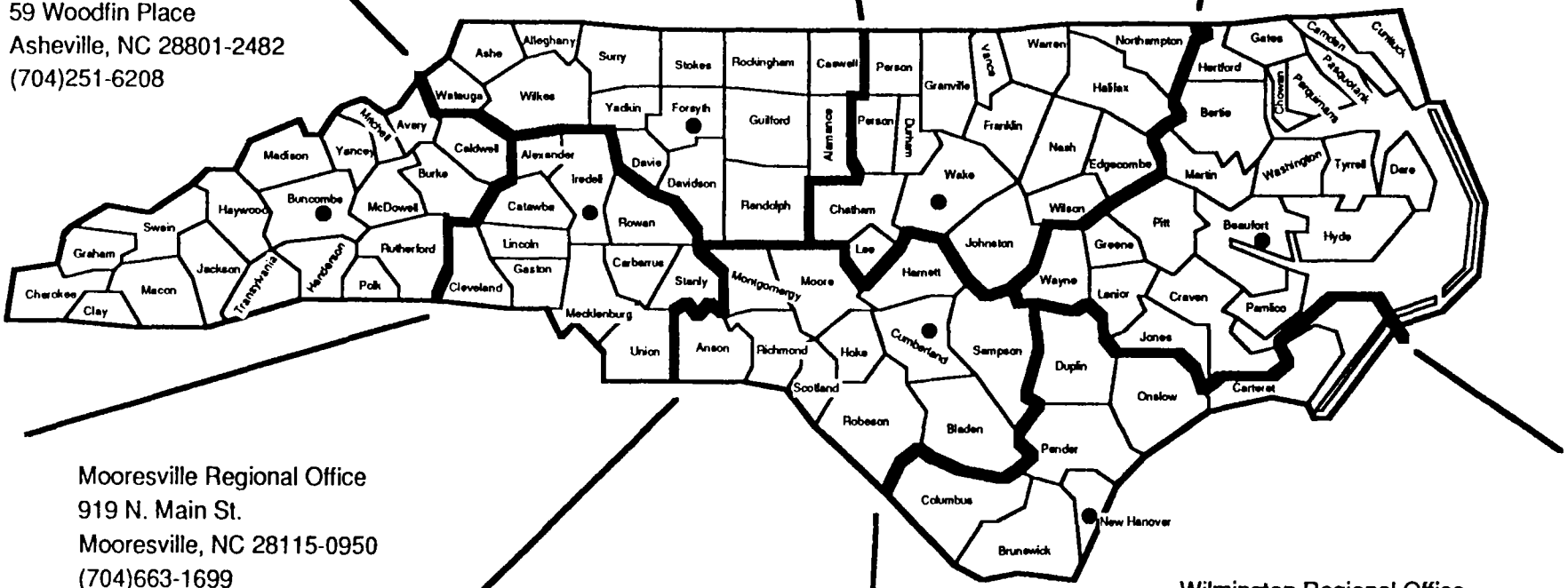
Pollution Control Branch
441 N. Harrington Street
P.O. Box 29535
Raleigh, NC 27626-0535
(919)733-8486

Winston-Salem Regional Office
8025 North Point Blvd.
Winston-Salem, NC 27106-3256
(919)896-7007

Raleigh Regional Office
3800 Barrett Dr.
Raleigh, NC 27609
(919)571-4700

Washington Regional Office
1424 Carolina Ave.
Washington, NC 27889-3314
(919)946-6481

Asheville Regional Office
59 Woodfin Place
Asheville, NC 28801-2482
(704)251-6208



Mooresville Regional Office
919 N. Main St.
Mooresville, NC 28115-0950
(704)663-1699

Fayetteville Regional Office
Wachovia Bldg. Suite 714
Fayetteville, NC 28301-5094
(919)486-1541

Wilmington Regional Office
127 Cardinal Dr. Extension
Wilmington, NC 28405-3845
(919)395-3900

● Denotes Regional Office Location

2.0 DEFINITIONS AS USED IN THESE GUIDELINES

A. Bedrock A general term for geologic material that underlies soil or other unconsolidated, superficial material. Bedrock cannot readily be excavated without the use of explosives or power equipment.

B. Confining Layer means a layer having very low hydraulic conductivity, in relationship to adjoining material, that restricts the movement of water into and out of an aquifer.

C. Department means the North Carolina Department of Environment, Health, and Natural Resources.

D. Division refers to the Division of Environmental Management

E. Hazardous Waste is discarded material which, because of 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 or disposed of, or otherwise managed. For the purpose of determining if you have a hazardous waste, the regulatory definition is defined as it appears in 15A NCAC 13A .0006, Identification and Listing of Hazardous Wastes - Part 261.3

F. Land Application is defined as the process of bioremediating contaminated soils by incorporating them into native, uncontaminated soils in such a way as to enhance the biological activity and chemical breakdown of the contaminants.

G. Petroleum or Petroleum Product means 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.

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

I. Relict Structures and Relict Textures mean those original sedimentary, igneous and metamorphic rock structures and textures, which because of the textural immaturity of the saprolite, have been preserved. Although none of the original minerals may have survived in the saprolite, their original outlines, or the outlines of characteristic mineral aggregates depicting various textures and structures, may be discernible.

J. Rock Structures refers to the three dimensional features of a geologic mass such as a bedding, jointing, banding, cleavage, faulting or brecciation. The term may also apply to the sum of these features.

K. Rock Texture means the geometric arrangement of the rock's components and crystals, such as crystallinity, grain size, grain shape; and the external and internal arrangement of the rock constituents.

L. Saprolite is a term for soil derived from weathered bedrock. It is often clayey material that exhibits certain characteristics of the bedrock from which it was derived.

M. Sedimentary Structure describes a geologic structure in a sedimentary formation, formed at the time of deposition or by sedimentary processes subsequent to deposition.

N. Total Petroleum Fuel Hydrocarbons (TPFH) means the concentration of petroleum fuel contamination present in soil as measured by the California Gas Chromatograph method.

O. Transmissivity describes the ability of geologic material to transmit water.

P. Waste Oil is any used petroleum product including used motor oil. All used petroleum products are deemed hazardous until proven otherwise by chemical analyses.

Q. Zone of Contamination refers to the volume of soil or groundwater having contaminant concentrations in excess of regulatory levels, and which may pose a threat to the environment or human health.

3.0 ACRONYMS

AST	Above ground Storage Tank
CAP	Corrective Action Plan
CFR	Code of Federal Regulations
CSA	Comprehensive Site Assessment
DEHNR	Department of Environment, Health, and Natural Resources
DEM	Division of Environmental Management
DSWM	Division of Solid Waste Management
EDB	Ethylene Dibromide
EPA	The Environmental Protection Agency
GC	Gas Chromatography
MTBE	Methyl Tertiary Butyl Ether
NCAC	North Carolina Administrative Code
NCDA	North Carolina Department of Agriculture
NCGS	North Carolina General Statutes
NOV	Notice of Violation
NRR	Notice of Regulatory Requirements
SCS	Soil Conservation Service
SHWT	Seasonal High Water Table
SSE	Site Sensitivity Evaluation
TCLP	Toxicity Characteristic Leaching Procedure, EPA method SW-846 1311
TOC	Total Organic Carbon

TPFH	Total Petroleum Fuel Hydrocarbons as determined by the California GC-FID method (used interchangeably with TPH)
TPH	Total Petroleum Hydrocarbons (used interchangeably with TPFH)
UST	Underground Storage Tank System
USDA	United States Department of Agriculture
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compounds
>	Greater Than
<	Less Than
≥	Greater Than or Equal to
≤	Less Than or Equal to

4.0 REGULATORY REQUIREMENTS

Article 21, Section 143-215.1 of the North Carolina General Statutes requires that a permit be obtained from the Department (authorized permitting agency) for any activity which "causes or permits any waste, directly or indirectly, to be discharged to or in any manner intermixed with the waters (including underground waters) of the State in violation of the water quality standards...". Therefore, an unpermitted release of a contaminant onto the surface or into the subsurface in a manner which may result in violation of water quality standards is considered a violation of NCGS 143-215.1(a)(6). Groundwater quality standards are listed in Section .0200 of the North Carolina Administrative Code (NCAC), Title 15A, Subchapter 2L. Surface water quality standards are listed in Section .0200 of the North Carolina Administrative Code, Title 15A, Subchapter 2B.

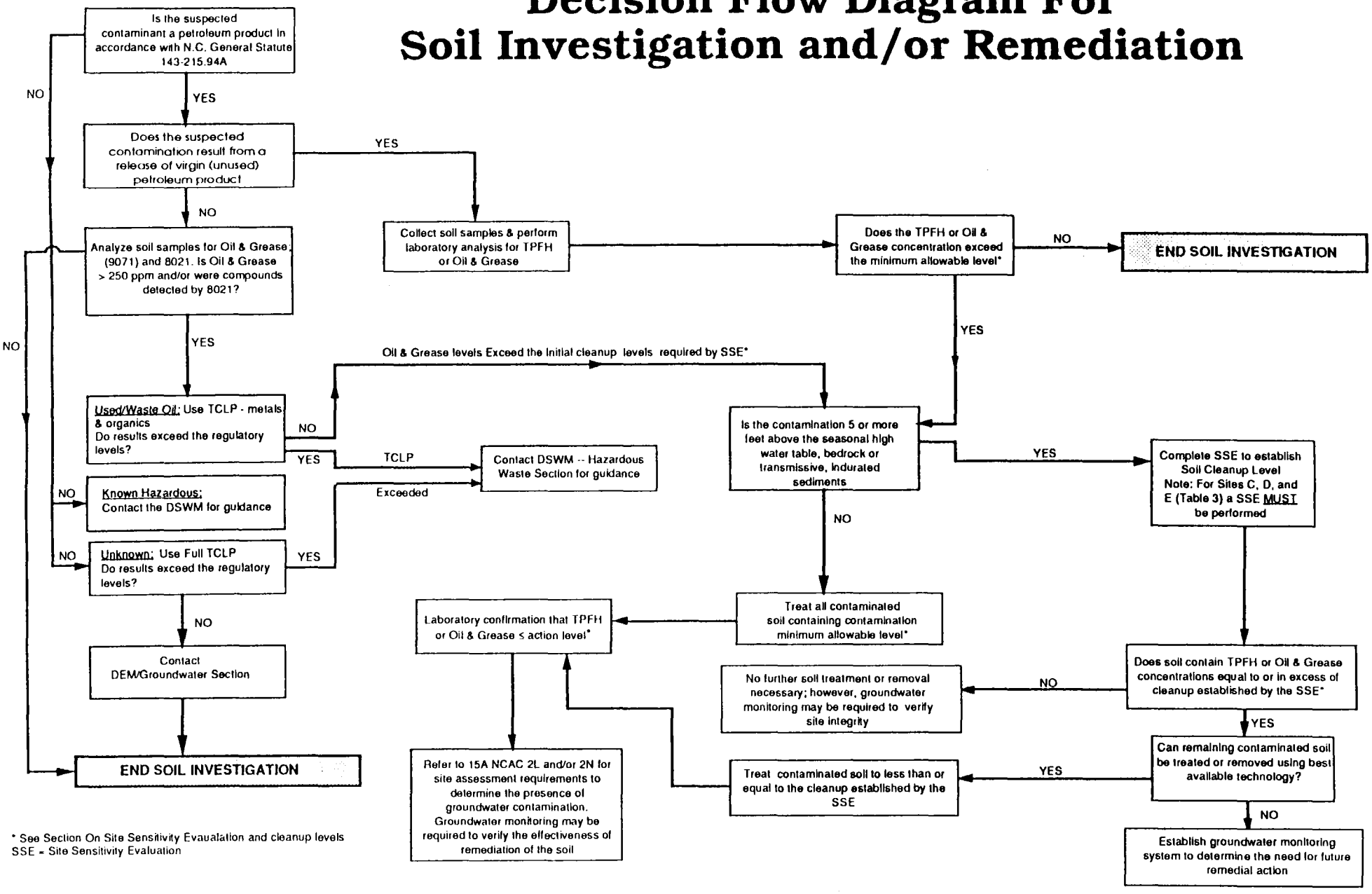
The Oil Pollution and Hazardous Substances Control Act of 1978 (Oil Spill Act), NCGS 143-215.75 et seq., requires that any person having control over oil, or other hazardous substances, discharged in violation of Article 21A shall immediately notify the North Carolina Department of Environment, Health, and Natural Resources (Department) of the discharge and immediately to collect and remove the discharge and to restore the area affected by the discharge as nearly as may be to the condition existing prior to the discharge. The Act further states that if it is not feasible to collect and remove the discharge, the person responsible shall take all practicable actions to contain, treat and disperse the discharge.

The regulations at 15A NCAC 2N, Criteria and Standards Applicable to Underground Storage Tanks, require the owner or operator of an underground storage tank (UST) which is found to be leaking to immediately take action to prevent any further release to the environment and to mitigate any fire, explosion or vapor hazards. These regulations are applicable to underground storage tanks containing petroleum products or hazardous substances. The UST owner or operator is also required to conduct a comprehensive site assessment (CSA) to determine the extent of contamination, to develop a plan for cleanup of the release, and to implement the corrective action plan (CAP) in accordance with a schedule approved by the Department. Corrective action plans must ensure that proposed cleanup activities will adequately protect human health, safety, and the environment. Remediation in accordance with these regulations will satisfy all federal corrective action requirements or rules with regard to soil contaminated with petroleum.

The North Carolina General Assembly ruled that in order to protect public health and the environment, groundwater contamination should be cleaned up in the most efficient and cost-effective manner possible. In 1992, the General Assembly enacted legislation to allow closed-loop groundwater remediation systems (NCGS 143-215.1A). The use of closed-loop groundwater remediation systems are allowed and encouraged where these systems are the most efficient and cost-effective remediation systems, and if the system does not degrade groundwater quality.

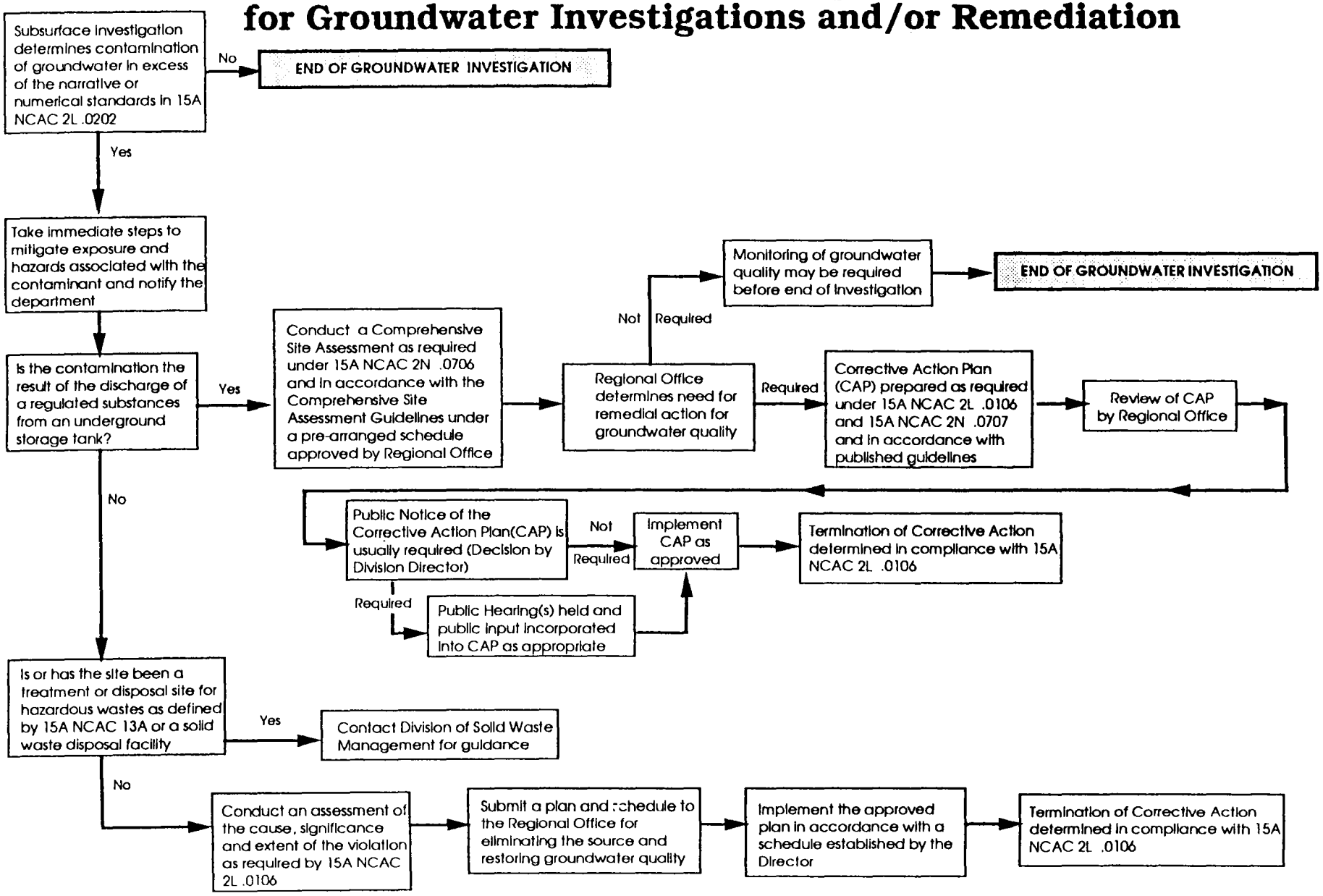
In keeping with the foregoing regulatory requirements, soil and groundwater remediation shall be conducted to eliminate potential threats to human health and welfare resulting from exposure to contaminated materials. Remediation procedures shall be designed to prevent further environmental degradation as a result of contaminants leaching into the groundwater or contaminants spreading into surrounding uncontaminated water. Therefore, soil and groundwater remediation should be performed in accordance with steps outlined in Figures 2 and 3: Decision Flow Diagrams.

Fig. 2
Decision Flow Diagram For Soil Investigation and/or Remediation



* See Section On Site Sensitivity Evaualation and cleanup levels
SSE = Site Sensitivity Evaluation

Fig. 3
Decision Flow Diagram for Groundwater Investigations and/or Remediation



5.0 ADDITIONAL REQUIREMENTS

5.1 HAZARDOUS WASTE

In the instance where the release of a known hazardous waste has occurred or if the presence of hazardous waste constituents is suspected, the Hazardous Waste Section - Division of Solid Waste Management (DSWM) - Department of Environment, Health and Natural Resources (DEHNR) must be informed.

Hazardous Waste Section
Division of Solid Waste Management
Department of Environment, Health and Natural Resources
P.O. Box 27687
Raleigh, North Carolina 27611-7687
(919) 733-2178

A listing of hazardous wastes may be found in 15A NCAC 13A .0006, Hazardous Waste Management Rules.

For reporting requirements of Superfund (CERCLA) and inactive waste site regulations, contact the DSWM at the above listed number.

5.2 SOLID WASTE

Discharge associated with storage tanks or residue from areas subjected to multiple discharges will be assumed to be unacceptable for landfilling until laboratory analysis indicates otherwise. The DSWM Solid Waste Section may be contacted for guidance at (919) 733 - 0692.

5.3 PESTICIDE CONTAMINATION

In instances of suspected or known pesticide contamination of soil or groundwater at any concentration, the North Carolina Department of Agriculture (NCDA) must be notified as well as the appropriate DEHNR Regional Groundwater office. NCAC Title 15A Subchapter 2L Section .0106, discusses DEM's responsibilities regarding pesticides and agricultural operations.

If soil or groundwater contamination is suspected, but it is unknown whether it is a pesticide, the responsibility for enforcing assessment lies with DEM until the cause and identity of the contamination is determined. In this case, the soil or groundwater must be tested using analytical methods capable of detecting the pesticides which could be present. Guidance for correct sampling and analytical methods should be obtained from the NCDA or DEM laboratory.

The NCDA Pesticide Section may be contacted at:

Address: North Carolina Department of Agriculture
Pesticide Section
P.O. Box 27647
Raleigh, North Carolina 27611-7647

Phone: (919) 733-3556

6.0 SITE SENSITIVITY EVALUATION FOR PETROLEUM CONTAMINATED SOIL

The purpose of the Site Sensitivity Evaluation (SSE) is to evaluate the sensitivity of groundwater to contamination by the release of petroleum related substances from the unsaturated zone. The "in-situ" soil cleanup levels, based on total petroleum fuel hydrocarbons (TPFH) and/or oil and grease (O&G), is determined by the SSE score; i.e., a higher SSE score requires a lower TPFH or O&G soil cleanup level. The SSE is only applicable for petroleum contaminated sites. (For cleanup procedures for soil contaminated by non-petroleum products, see Section 7).

If groundwater levels at the site are generally known or can be determined from field observations, one boring may be sufficient to obtain information necessary to complete the SSE. Also, if a release is discovered during a tank excavation, field investigations such as test pits, soil borings, or deeper excavation into the tank pit may provide pertinent information.

An SSE must be performed on **all** sites that meet the following criteria and must be conducted by a "qualified person" as described on the next page:

1. For sites in categories A and B (Table 3), where contaminated soils are located 5 feet or greater from the water table, top of bedrock or transmissive indurated sediments (shell limestone, fractured shale or sandstone, etc.). For sites in categories C, D, and E, (Table 3) an SSE must be performed in all cases, and

2. Contaminated soil does not create a human exposure pathway via ingestion, absorption, or inhalation.

NOTE: ***For sites where the criteria in 1 and 2 above are not met,*** *the cleanup levels will be 10 ppm TPFH (EPA Method 5030), 40 ppm TPFH (EPA Method 3550), or 250 ppm O&G (EPA Method 9071) (unless DEM specifies otherwise). The references to EPA methods 5030 and 3550 throughout this document include the use of the California GC-FID method for TPFH and are referred to only as 5030 and 3550 for brevity.*

The Site Sensitivity Evaluation will determine the soil cleanup levels that must be achieved for each site. Depending on the SSE scores, the final cleanup level for site soils may range between 10 to 300 ppm TPFH (for EPA Method 5030), 40 to 1200 ppm TPFH (for EPA Method 3550), and 250 to 3000 ppm O&G (for EPA Method 9071). Soils exhibiting contamination levels **greater than** (>) 300 ppm TPFH (for EPA Method 5030) or > 1200 ppm TPFH (for EPA Method 3550) , or > 3000 ppm O&G (for EPA Method 9071) **must** be remediated (unless otherwise directed by DEM).

"Contaminated soil" in this document refers to soils containing greater than 10 ppm TPFH, as detected by EPA method 5030, greater than 40 ppm TPFH, as detected by EPA method 3550,

and greater than 250 ppm oil & grease, as detected by EPA method 9071. Remedial activities will generally **not** be required on soil exhibiting TPFH levels of less than or equal to (≤) 10 ppm TPFH (EPA Method 5030), levels of ≤ 40 ppm TPFH (EPA method 3550), or O&G levels of ≤ 250 ppm (EPA Method 9071). However, in cases where groundwater has been contaminated or other special site conditions exist, a lower cleanup level and/or additional investigation may be required by the DEM.

In any case, whenever soil remediation is necessary, the treatment/disposal technologies that are used should be cost effective and provide adequate protection of human health and the environment.

6.1 SITE SENSITIVITY EVALUATION (SSE)

STEP 1: Site Characteristics Evaluation (See Table 1)

The sensitivity of groundwater to contamination from petroleum contaminated soils is evaluated by assessing five specific site characteristics. These characteristics are rated in accordance with their potential for contributing to the contamination of groundwater; the greater the potential contribution, the higher the score. The overall sensitivity of a site is determined by a numerical value representing the sum of values for each site characteristic.

Complete the SSE score sheet (Table 1) and proceed to step 2.

EXPLANATION OF SITE CHARACTERISTICS

Grain Size - The main objective of this analysis is to estimate soil permeability, potential for contaminant attenuation, and the presence of zones which restrict contaminant migration.

> Sample Collection and Location: The sample collected for determination of grain size should be **representative** of the **predominant** soil type found in the area of the deepest contaminated soils located beneath the source, or in proximity to the source (in the apparent downgradient direction). Retaining this soil sample for future reference is advisable.
>
> Sample Classification: The soil sample collected as described above should be classified according to the Unified Soil Classification System (ASTM designation D-2487) or the U.S. Department of Agriculture's method of soil classification. (A visual and textural field inspection will suffice.)

NOTE: *SSE's and sample collection and classification should be performed by a qualified person, who through a combination of training and experience is competent to evaluate the conditions existing at the contamination site, including the physical and chemical conditions of the subsurface. A geologist, soil scientist, or engineer experienced and active in the environmental field will be considered qualified.*

Relict structures, sedimentary structures, and/or textures present in the zone of contamination and underlying "soils"- These include structures in soils that may significantly increase the permeability such as quartz veins, fractures, or textures with coarse grained sandy beds in clays and silts, weathered coarse grained igneous intrusions, etc.

Distance from location of deepest contaminated soil to seasonal high water table - The determination may be based upon water levels in shallow water table wells in the immediate vicinity, mottling of the soil, an auger hole in the area of contamination or immediate vicinity, or specific knowledge of an area. If an auger hole penetrating the water table is made, it shall immediately be grouted with neat cement. Compaction of soil located on the ground surface is acceptable for borings that do not penetrate the water table as long as the compaction of the borehole soils has the same (or lower) permeability as the original soil.

Location of the water table relative to bedrock or transmissive indurated sediments - Is the top of bedrock or top of transmissive indurated sediments (shell limestone, fractured shale or sandstone, etc.) located closer to the surface than the water table?

Artificial conduits present within the zone of contamination - Are there water lines, sewer lines, telephone cables, product dispensing piping, etc., in the area of contamination?

STEP 2: Initial Cleanup Level (See Table 2)

Once the SSE score has been obtained, select the corresponding initial cleanup level based on the test method(s) (i.e. 5030, 3550 or 9071) for determining the type of fuel product (low or high boiling point, or heavy fuels) released on site. Proceed to step 3.

STEP 3: Final Cleanup Level (See Table 2, Table 3 [SSE Site Category Descriptions])

Determine and document the site category (A, B, C, D, or E) based on field evaluations. Use Tables 2 and 3 (SSE Site Category Descriptions), to select the final cleanup level. Based on the final cleanup level, determine the quantity of soil that requires remediation. Evaluate several treatment/disposal technologies and their associated costs.*

Submit data and other evidence used in the determination of the final cleanup level to the appropriate regional office. They will verify the site's final cleanup level upon review of the information provided. However, the responsible party should begin soil remediation without waiting for regional office verification. Upon completion of the SSE, the responsible party should immediately begin remediation of soils containing TPFH or O&G concentrations in excess of the final proposed cleanup level, utilizing cost effective treatment/disposal technologies that will provide protection of human health and the environment. **The responsible party should maintain accurate records of the remediation process and be prepared to justify all remediation activities and costs.**

*NOTE:*See Section 8 "Limiting Quantities and Costs of Soil Treatment/Disposal."*

Table 1

Site Sensitivity Evaluation (SSE)

Site Characteristics Evaluation (Step 1)

Characteristic	Condition	Rating	
Grain Size*	Gravel Sand Silt Clay	150 100 50 0	
Are relict structures, sedimentary structures, and/or textures present in the zone of contamination and underlying "soils"?	Present and intersecting the water table. Present but not intersecting the water table. None present.	10 5 0	
Distance from location of deepest contaminated soil** to water table.	0 -5 feet (C, D & E sites only) 5 - 10 feet >10 - 40 feet > 40 feet	20 20 10 0	
Is the top of bedrock or transmissive indurated sediments located above the water table?	Yes No	20 0	
Artificial conduits present within the zone of contamination.	Present and intersecting the water table. Present but not intersecting the water table. Not present.	10 5 0	

Total Site Characteristics Score:

* **Predominant** grain size based on Unified Soil Classification System or U.S. Dept. of Agriculture's Soil Classification Method.

** (>10 ppm TPFH by Method 5030; >40 ppm TPFH by Method 3550; >250 ppm O&G by Method 9071)

Table 2

Site Sensitivity Evaluation (SSE)

Initial Cleanup Level (Step 2) | Final Cleanup Level (Step 3)

EPA Method 5030 for Low Boiling Point Hydrocarbons such as Gasoline, Aviation Fuels, Gasohol

Total Site Characteristics Score	**Initial** Cleanup Level TPFH (ppm)
>150	≤10
121-150	20
91-120	40
61-90	60
31-60	80
0-30	100

Select Site Category* →

		Final Cleanup Level
Category A & B (Multiply initial cleanup level by 1)	1 x ____ =	____ ppm
Category C & D (Multiply initial cleanup level by 2)	2 x ____ =	____ ppm
Category E (Multiply initial cleanup level by 3)	3 x ____ =	____ ppm

EPA Method 3550 for High Boiling Point Hydrocarbons such as Kerosene, Diesel, Varsol, Mineral Spirits, Naphtha

Total Site Characteristics Score	**Initial** Cleanup Level TPFH (ppm)
>150	≤40
121-150	80
91-120	160
61-90	240
31-60	320
0-30	400

Select Site Category* →

		Final Cleanup Level
Category A & B (Multiply initial cleanup level by 1)	1 x ____ =	____ ppm
Category C & D (Multiply initial cleanup level by 2)	2 x ____ =	____ ppm
Category E (Multiply initial cleanup level by 3)	3 x ____ =	____ ppm

EPA Method 9071 for Heavy Fuels - Oil & Grease (O&G) such as Fuel Oil #4, #5, #6, Motor Oil, Hydraulic Fluid

Total Site Characteristics Score	**Initial** Cleanup Level O&G (ppm)
>150	≤250
121-150	400
91-120	550
61-90	700
31-60	850
0-30	1000

Select Site Category* →

		Final Cleanup Level
Category A & B (Multiply initial cleanup level by 1)	1 x ____ =	____ ppm
Category C & D (Multiply initial cleanup level by 2)	2 x ____ =	____ ppm
Category E (Multiply initial cleanup level by 3)	3 x ____ =	____ ppm

* See Site Category Descriptions, Table 3

TABLE 3

SSE SITE CATEGORY DESCRIPTIONS

CATEGORY A (*Site meets any one of the criteria*)

1. Water supply well(s) contaminated and not served by accessible public water supply.

2. Vapors present in confined areas at explosive or health concern levels.

3. Treated surface water supply in violation of the safe drinking water standards.

CATEGORY B (*Site meets any one of the criteria*)

1. Water supply well(s) contaminated, but served by accessible public water supply.

2. Water supply well(s) within 1500 feet of site, but not contaminated and not served by accessible public water supply.

3. Vapors present in confined areas but not at explosive or health concern levels.

CATEGORY C (*Site meets both of the criteria*)

1. No known water supply well(s) contaminated.

2. Water supply well(s) greater than 1500 feet from site but not served by accessible public water supply.

CATEGORY D (*Site meets both of the criteria*)

1. No known water supply well(s) contaminated.

2. Water supply well(s) within 1500 feet of site but served by accessible public water supply.

CATEGORY E (*Site meets both of the criteria*)

1. No known water supply well(s) contaminated or within 1500 feet of site.

2. Area served by accessible public water supply.

7.0 CLEANUP REQUIREMENTS FOR SOIL CONTAMINATED BY NON-PETROLEUM PRODUCTS

The goal of soil restoration is to ensure that groundwater contamination does not occur or continue to occur. Cleanup levels for soil contaminated by non-petroleum products are site specific. **The regulatory status of all contaminated medium by hazardous waste constituents must be determined by DSWM - Hazardous Waste Section.** Soil cleanup is required to be either to background levels, a level based on the groundwater standards, or a health based number, unless it can be demonstrated that the concentration of the contaminant in the soil will not result in a violation of the groundwater standard.

For soil contaminated with a hazardous waste, all applicable NC Hazardous Waste Management Rules shall be adhered to. These rules include specific requirements for the treatment and removal of hazardous waste. General requirements for the NC hazardous Waste Section are listed in section 7.1 of this document.

Table 4 gives an example of how these no-action concentrations might be determined. Cleanup levels in soil at the water table have been calculated for bis (2-ethylhexyl) phthalate (DHEP) and tetrachloroethylene (PCE) using an organic leachate model (OLM). Higher cleanup levels may be permissible depending upon site specific factors which include, but are not limited to:

1. depth of contamination;
2. depth to the water table;
3. depth to bedrock; and
4. soil characteristics.

Use of a contaminant transport model would likely be required to justify higher cleanup levels. **Please note that the cleanup levels calculated in Table 4 may vary for PCE and DHEP depending on the source, site and situation. In certain instances these contaminants could be considered hazardous waste and would be subject to cleanup level requirements stipulated by DSWM - Hazardous Waste Section (see 7.1 NC Hazardous Waste Section Requirements).** Prior to using a model, the model user must be certain that the model is valid for the type of contamination and the site conditions which are present. There is a growing body of literature on contaminant transport and leachability in soil. The appropriate regional office will consider all reasonable proposals for cleanup levels provided the documentation of the methods used to determine the level is supplied. The documentation should include information on the strengths and limitations of the method, technical articles pertaining to the method, and case studies where the method has been used, if available.

Table 4

EXAMPLE OF A DETERMINATION OF SOIL CLEANUP LEVELS FOR NON-PETROLEUM SUBSTANCES

Demonstration Purposes Only

Organic Leachate Model[1] $C_s = \left(\frac{C_L}{.0021(s)^{.373}}\right)^{1.47}$

C_s = Concentration of VOC in soil mg/kg
C_L = Concentration of VOC in leachate in mg/kg
S = Solubility of VOC in water mg/l

	DHEP	DHEP*	PCE
2L Standard (mg/l)	< .001	.003	.0007
Calculated Soil Cleanup (mg/kg)	.66	3.34	.013
Solubility of VOC in Water[2]	2.85×10^{-1}	2.85×10^{-1}	1.5×10^{2}

*Newly proposed groundwater standard

If soil has been contaminated by a pesticide, contact the North Carolina Department of Agriculture, and the appropriate regional Groundwater office for guidance on cleanup.

7.1 NC HAZARDOUS WASTE SECTION REQUIREMENTS

If the soil has been contaminated by a hazardous waste or hazardous waste constituents, contact the Division of Solid Waste Management, Hazardous Waste Section (919) 733-2178 to determine the regulatory status of the contaminated area. The type of remediation activities initiated or proposed may determine whether or not the contaminated soil is considered a hazardous waste.

Provide the DSWM with the following information at this time:

1. potential or probable contaminant type (e.g. plating waste, waste solvents, etc.) if known;

2. unit type (i.e. tank, spill, pond);

3. highest contaminant concentrations of organics and inorganics in the soil.

NOTE: *Sites with known releases of hazardous substances which do not have responsible parties conducting remedial action with the direction of the Groundwater Section are required to notify the Superfund Section of the release, pursuant to NCGS 130A-310.1 and NCAC 15A 13C .0100 (b).*

REFERENCES

1. The EPA Site Program: Federal Register Vol. 51, No. 145, Tuesday July 29, 1986, pp. 27062 and Federal Register Vol. 51, No. 219, Thursday, Nov. 13, 1986 pp. 41088.

2. "Using the Properties of Organic Compounds to Help Design a Treatment System", Ground Water Monitoring Report, Fall 1991: 81-86.

3. 15A NCAC 13A North Carolina Hazardous Waste Management Rules.

8.0 LIMITING QUANTITIES AND COSTS OF SOIL TREATMENT/DISPOSAL:

The following are recommended procedures regarding non-hazardous waste contaminated soil excavation, assessment and the selection of cost effective remedial alternatives.

A. For sites where a release is discovered during the excavation of an underground storage tank, it is recommended that soil excavation, assessment, and remediation proceed as follows:

1. Once the release is discovered, notify DEM, and when applicable, perform a Site Sensitivity Evaluation (SSE) to determine the site's soil cleanup level.

   NOTE: *A SSE must be performed on all sites that meet the following criteria:*

   1. For sites in categories A and B, where contaminated soils are located 5 feet or greater from the water table, top of bedrock or transmissive indurated sediments. For sites in categories C, D, and E, a SSE must be performed in all cases, and

   2. Contaminated soil does not create a human exposure pathway via ingestion, absorption, or inhalation.

2. Limit the quantity of soil excavated from a tank pit during tank removal:

   NOTE: *Separate clean soil (soil that would most likely exhibit TPFH levels* ***below*** *the SSE based cleanup level) from contaminated soil during the stockpiling operation. (Document field screening method(s), including field calibration of instruments utilized to separate soils; laboratory confirmation will be required to document that a release has occurred. (See sections 9 and 10 on soil sampling for location, methods and frequency)).*

   If the soils that are contaminated **above** the SSE cleanup level can be removed within the spatial boundaries specified below, proceed with the excavation of these contaminated soils.

   If contaminated soils exist outside the spatial boundary described below, cease excavation of contaminated soils and proceed with step 3 below.

   SPATIAL BOUNDARIES FOR TANK EXCAVATIONS
   a. Vertical extent - cease excavation within 5 feet below the bottom of the tank or prior to this depth upon contact with either clean soils, groundwater or bedrock (unless free product is entrapped in the soils below the water table; then those soils should be removed, where possible, and the free product pumped out). *Periodic samples should also be collected for lab analysis to compare to field screening results.*

b. Lateral extent - the toe of the excavation should extend laterally no further than 5 feet on any side of the tank. The excavation walls should be sloped and/or constructed according to OSHA standards.

NOTE: *For release discovered during removal of pump islands, proceed in a similar manner; for piping releases, initially excavate the contaminated soil immediately surrounding the leaking piping.*

3. Determine the extent (horizontal and vertical) of soil contamination (based on SSE cleanup levels, when applicable, or as defined otherwise by the regional office).

   NOTE: *Field investigations (such as test pits, soil borings, borings into the sidewalls of the excavation) conducted simultaneously with the tank excavation (during the initial remedial action phase) can be used to help determine the extent of soil contamination. If the soil plume can be delineated from field investigations performed at the time of tank removal, and if it is decided to continue soil excavation at that time, the responsible party must be able to justify the selection of this remedial alternative as the best cost-effective method. Otherwise, if the extent of soil contamination appears to be widespread or undetermined at the time of the tank removal, stop excavation and proceed with the Comprehensive Site Assessment immediately.*

4. Estimate the volume of soil to be remediated.

5. Evaluate the effectiveness, advantages/disadvantages, feasibility, and associated costs of several soil treatment/disposal options (obtain several cost estimates for each option).

6. **Choose cost effective cleanup measures that provide adequate protection of human health and the environment.**

7. If soil excavation is selected as the best remedial alternative, after evaluating several options and costs, excavate the quantity of contaminated soils that is deemed necessary.

8. Submit evaluations, cost estimates, and recommendation to appropriate regional office for approval as part of the Corrective Action Plan (CAP), if a CAP is required. These procedures are outlined in NCAC 2N .0707 (d).

   NOTE: *If a Corrective Action Plan is not required, this documentation will still be necessary for State Trust Fund Reimbursement. Failure to submit adequate documentation may affect reimbursement.*

B. For sites where a release is known to have occurred from an underground storage tank prior to excavation of the tank (or for all other sites where soil contamination exists due to other sources), the recommended procedures are as follows:

1. Perform a Site Sensitivity Evaluation (SSE) to determine the site's soil cleanup level.

2. If tank(s) exist, remove the tank's contents immediately. If any free product exists in the subsurface, remove it immediately.

3. Perform the Comprehensive Site Assessment to determine the extent of contamination before excavating the tank and/or any contaminated soils (unless, of course, an emergency situation exists, and immediate excavation is necessary).

4. Proceed with steps A(4) through A(8) above.

NOTE: *The responsible party must immediately proceed with the remediation of soils without waiting for regional office verification of the final cleanup level. The regional office will verify final cleanup level upon review of submitted documentation.*

9.0 SOIL SAMPLING GUIDELINES FOR NON-HAZARDOUS WASTE

Generally samples should be collected from suspected worst-case locations, including areas exhibiting visible contamination (stains, etc.) and elevated levels of volatile organics. The location and number of sampling points should be sufficient to delineate horizontally and vertically the area of soil containing contamination.

The numbers and locations of samples specified in the following methods are only intended as the minimum number of samples required to provide a statistically accurate result where the degree or extent of contamination is unknown. Additional samples should be taken as appropriate whenever contamination is known or suspected at a specific location.

Portable organic vapor analyzers (Flame Ionization Detectors [FIDs] and Photoionization Detectors [PIDs]) are useful tools in on-site sample screening and selection. However, samples for site assessment and closure are required to be performed by approved laboratory methods.

Sample collection for laboratory analysis should be performed in a manner that reduces the loss of the critical contaminants - this is especially important when dealing with volatile constituents such as those in gasoline.

9.1 UNDERGROUND STORAGE TANK (UST) SYSTEM

AROUND THE TANK

For an in-place UST, soil samples should be collected from beneath the mid-line of the tank, or as close as possible to the mid-line. The minimum number of samples required depends on the length (longest dimension) of the tank:

less than 6 feet	1
less than 20 feet	2
20 to 30 feet	3 samples
30 to 40 feet	4 samples
40 to 50 feet	5 samples
greater than 50 feet	1 sample per 10 ft of tank length

These samples should be distributed at evenly spaced intervals along the length of the tank.

If the tank is still in place, the samples should be taken between 1 and 5 feet beneath the base of the tank. This may be accomplished by either angled borings or, if appropriate (i.e. tank empty and being closed in place), by boring through the tank bottom.

Please note that the angle borings require specialized equipment and that boring through tank bottoms is dangerous and should be avoided if possible. Close adherence to OSHA requirements for confined space entry should be followed before entering a tank.

Also, samples should be collected from around each fill pipe to document overfills/spills. This fill pipe data provides additional information for determining if there has been a release.

If the tank has been removed, the samples should be taken between 1 and 2 feet into the native soil at the base of the excavation. **Remember, samples should be taken beneath the location of the tank, and any other appropriate places where significant contamination has been identified.**

LINES AND DISPENSERS

Samples collected along underground product lines should be taken wherever contamination is suspected (i.e. at joints, or where stained soil is encountered), with not less than 1 sample per 20 linear feet, or a portion thereof. Samples should be collected at evenly spaced intervals along the length of the piping, and should be from between 1 and 2 feet into the native soil directly beneath the lines. If an excavation has been made, the samples should be taken between 1 and 2 feet into the native soil at the base of the excavation.

Samples collected beneath dispensers or dispenser islands should be from the area nearest the suspected contamination source. Samples should be collected at ten foot intervals (i.e., 1 sample for 0 - 10 ft, 2 samples for 0 - 20 ft, etc.). Sample points should be at evenly distributed intervals along the length of the island, and should be from between 1 and 2 feet into the native soil directly beneath the dispensers or midline of an island. If there has been an excavation, the samples should be taken from native soil between 1 and 2 feet below the base of the excavation. Samples should also be taken from beneath coupling joints.

9.2 OTHER LEAKS AND SPILLS

ABOVEGROUND SPILLS

Samples should be taken after the initial excavation or other emergency response action has been initiated. At least one sample should be taken beneath the point of the release. If the release occurred on essentially unbroken pavement, the sample(s) should be taken where the product first encountered soils. Additional samples should be taken as appropriate following an initial assessment of the movement or distribution of the product. The samples should be taken between 1 and 2 feet beneath the base of excavation (at the ground surface if no excavation has been made).

UNDERGROUND LINES AND GROUND-SITTING DISPENSERS

See section in 9.1, Lines and Dispensers.

NON-POINT DISCHARGES

A non-point discharge is a discharge resulting from an indirect source such as spills on the side of the road, irrigation spray run-off, road construction site run-off, etc.
Upon discovery of a non-point discharge, the appropriate regional office of the Division of Environmental Management, Groundwater Section, should be contacted. If the release falls under DEM authority, the number and distribution of any samples will be determined by that office following a review of the site conditions. If the release is a pesticide, the NCDA Pesticide Section must be contacted at (919) 733-3556 for guidance.

9.3 SAMPLE COLLECTION AND HANDLING

Soil samples should be collected in a manner that does not unnecessarily disturb the internal structure of the soil and reduces the exposure to sunlight and open air. Likewise, care should be taken to keep the samples from being contaminated by other material at the site or from contaminating other samples taken from the site (i.e. the sample container should be clean and the outside should be kept uncontaminated).

When taking samples of potentially contaminated soil, care should be taken to reduce contact with skin or other parts of the body. Disposable gloves should be worn by the sample taker, and the gloves should be changed between samples. At a minimum, a clean stainless steel spoon should be used to collect each sample and properly cleaned between sampling events.

Ideally, samples would be collected from cores of the soil. For practical reasons, however, it may often be necessary to collect samples from a backhoe bucket, augers, or even a hand-shovel. As long as an effort is made to reduce the loss of contaminants from the sample, any of these methods may be used as necessary.

Immediately upon extraction from the ground, each sample must be placed in a vapor and fluid tight container. Ideally this container should be a sealed sampling tube (thin-walled stainless steel or brass cylinder at least 3 inches long) or equivalent, but a clean glass or other non-reactive jar is acceptable.

A minimum of about 1 cup (1 lb; 400-500 g) of soil is needed for the sample. The sample should fill the entire volume of the container, leaving no head-space. As soon as the sample is collected, the container should be immediately capped and sealed (also with a chemically inert material) in an air-tight manner.

The samples should be stored at approximately 4° C (40° F) following collection. Place in an ice chest or similar container and add ice and water, as necessary. Immediately transport under chain-of-custody to the laboratory certified in the required analyses. Avoid unnecessary handling of sample containers, exposure to heat, direct sunlight, or freezing of the sample containers. Reduce the time between sampling and delivery to a laboratory.

9.4 EXCAVATED SOILS - STOCKPILES

It is important to segregate clean soil from contaminated soil during excavation to reduce the amount of contaminated soil requiring disposal. The sampling of stockpiles of contaminated soil is primarily intended for the determination of risk to human health and for the development of acceptable disposal alternatives. The following sampling protocol is designed to determine the average contamination level in the stockpile, as well as whether there are any large quantities of highly contaminated soil that might pose a health threat or an environmental risk.

Sampling of the stockpile should be done immediately prior to applying for a permit or to disposing of the soil. Samples collected during excavation may be substituted, if the analytical results represent current levels of contamination in the stockpile. Samples should be taken and stored in accordance with the Sampling Methodology described in a following subsection. The analytical methods for soil analysis are specified in Table 5.

NUMBER OF SAMPLES

The number of samples required is based on the volume of the stockpiled soils. A composite sample must be taken and analyzed for each 200 cubic yards of the stockpile. The volume of the stockpile can be either determined by analyzing the specific geometry of the pile and/or the excavation, or approximated using the general geometry of the pile as specified in figure 4. If using figure 4, use the maximum dimensions as indicated by the sketches for the different shapes of stockpiles.

Once the volume is determined, lay out a grid that divides the pile into square blocks with equal surface area. The minimum number of grid blocks is equal to the required number of composite samples for analysis. Each grid block must be represented by at least one composite sample. Each composite sample must consist of at least six randomly chosen primary samples (see "Sampling Methodology" below).

NOTE: ***If soils are excavated in association with a UST closure or change-in-service, and reimbursement for disposal costs is expected, samples of the waste soils must be analyzed and documentation submitted to the appropriate regional office. Failure to do so may affect reimbursement.***

SIZE OF SAMPLES

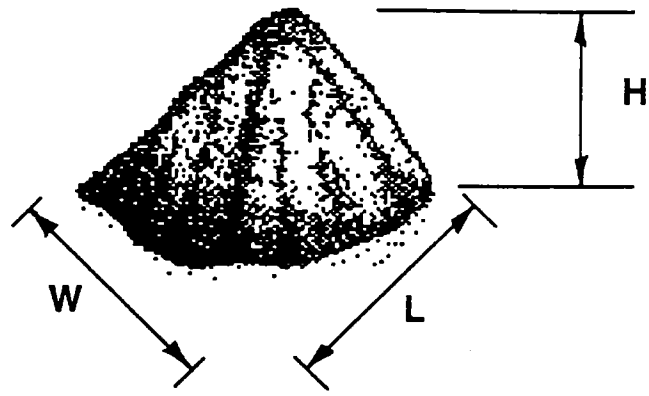
Composite samples:

> 400 - 500 g. (approximately 1 cup)
> Samples for analysis should be obtained from a mixture of at least 6 primary samples of equal size.

Fig. 4

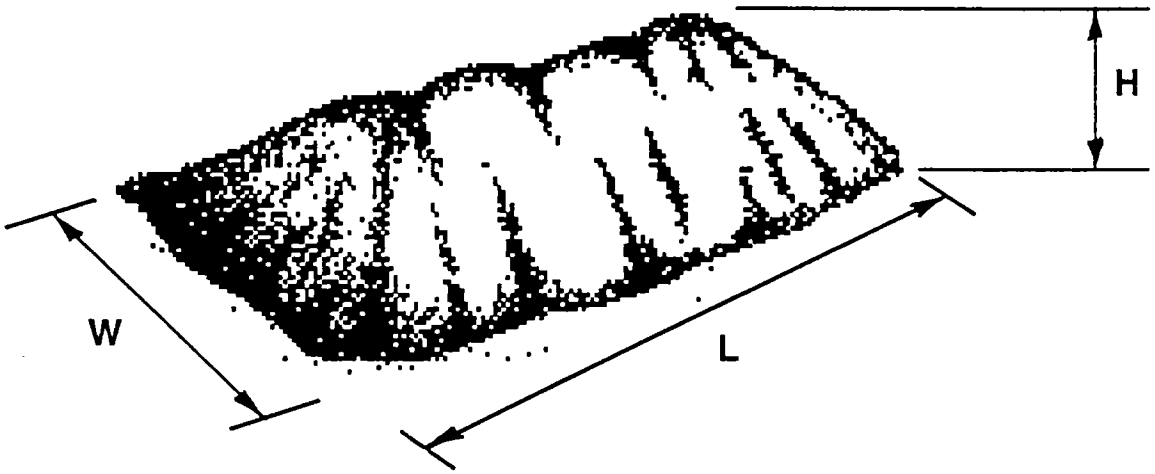
Volumes of Stockpiles

H = height
L = length
W = width
L>W>H



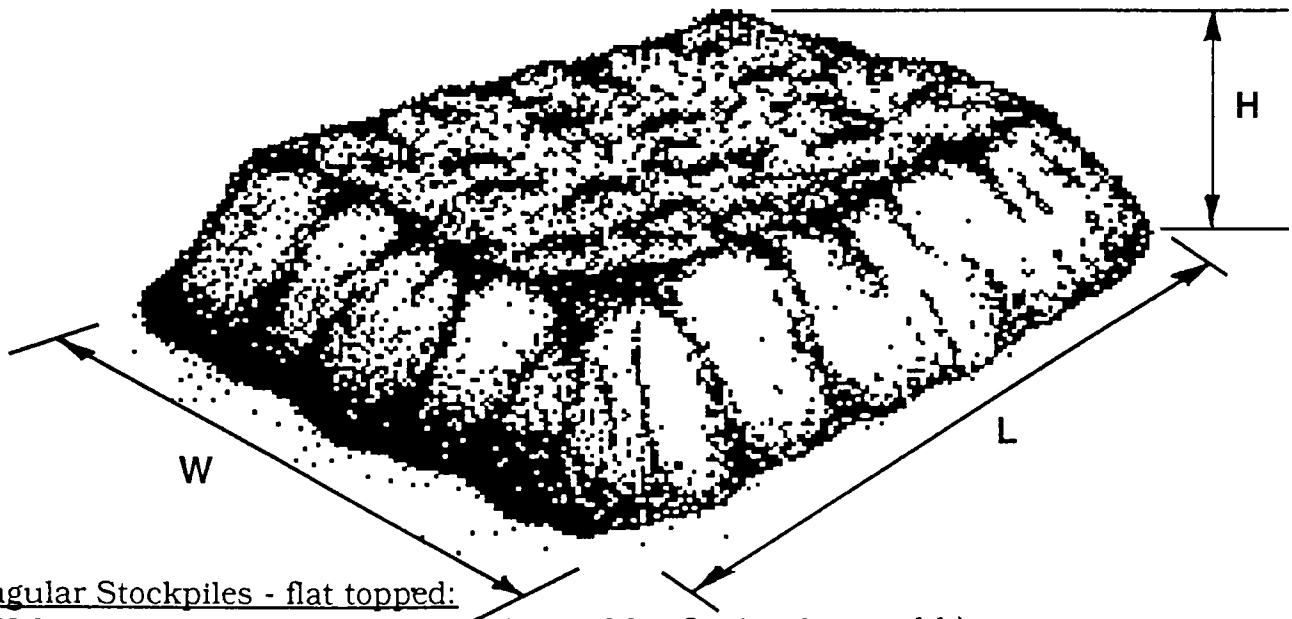
Conical Stockpiles:

Volume = $\frac{1}{3}$ x height x length x width



Rectangular Stockpiles - pointed crest:

Volume = $\frac{1}{2}$ x height x length x width

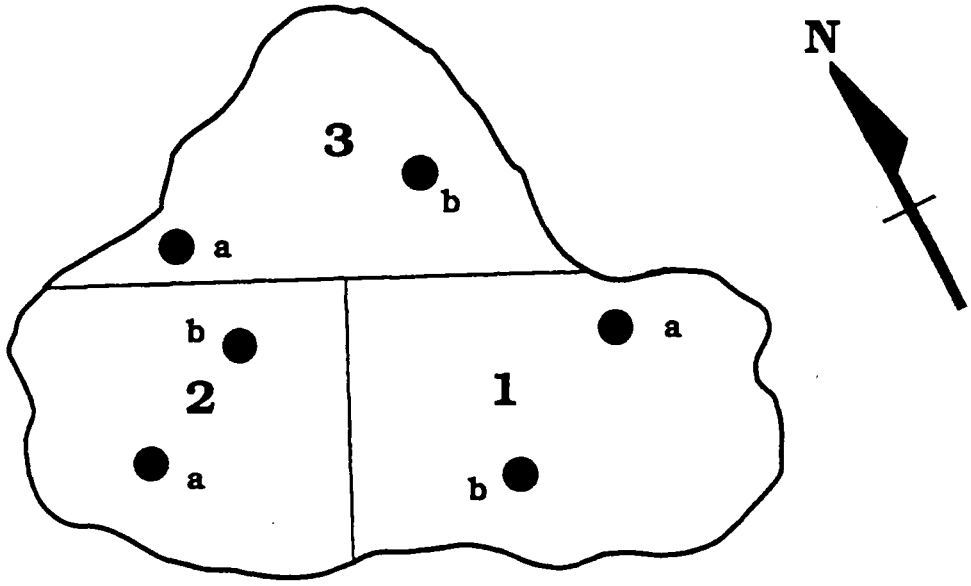


Rectangular Stockpiles - flat topped:

Volume = height x (length x width - 2 x height x width)

These equations have been simplied for ease of calculation.

Fig. 5
Example
Soil Stockpile Sampling Map



Stockpile Type: Rectangle, Flat topped

Volume = 4 x (21 x 11 - 2 x 4 x 11) = 572 cu. yds.
Height (maximum) = 12 ft. = 4 yds.
Length (maximum) = 63 ft. = 21 yds.
Width (maximum) = 33 ft. = 11 yds.

Composite Samples	Primary Samples
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'

LOCATION OF SAMPLES

Primary Samples:

Take primary samples from 6 randomly selected borings per block of the stockpile. A sample should be collected from the top, middle, and bottom of each boring (Figure 5).

SAMPLING METHODOLOGY

Primary samples:
Primary samples are to be disturbed internally as little as possible during acquisition; probe sampling (i.e. auger, core, etc.) is preferred to excavation.

Immediately upon extraction from the stockpile, each primary sample must be placed in a vapor and fluid-tight container. This container should be a sealed sampling tube or equivalent, but a clean glass or other non-reactive jar is acceptable. No headspace should be present in the container.

Samples should not be exposed to sunlight and should be placed in the coolest place available. If there is a delay of more than 10 minutes between sample acquisition and compositing, primary samples should be maintained in an area or container with a temperature of no more than 50°F until composited. If the primary samples are to be transported off-site prior to compositing, they are to be handled in accordance with **Section 9.3 Sample Collection and Handling**.

Samples for Analysis:

Samples should be mixed in the laboratory under controlled conditions. If the responsible party is mixing their samples, they must strictly adhere to the following protocol. *If the appropriate regional office feels that the mixing was done improperly, they may not accept the data. It is preferred that the mixing be done by qualified laboratory technicians.* Samples for analysis are composite samples made by mixing together at least 6 primary samples. Mixing should be accomplished quickly, but in a manner that effectively combines the primary samples so that all portions of the mixture can be reasonably considered to contain nearly equal portions of all of the component primary samples. Because homogenization will, by its very nature, allow some loss of the most volatile petroleum constituents, care should be taken to perform the mixing under the best available environmental conditions to minimize the loss; this means performing the mixing where there is no wind, the temperature is under 80°F (including the surface or container on or in which the mixing is performed), and out of direct sunlight.

The composite sample is to be placed in a vapor and liquid tight container immediately upon completion of the homogenization process. The sample should then be handled in accordance with standard sample handling procedure Section 9.3.

10.0 ANALYTICAL METHODS FOR DETERMINING SOIL CONTAMINATION FROM NON-HAZARDOUS WASTE

10.1 SCREENING METHODS

There are a number of field screening methods currently available for the detection of volatile organic compounds. Portable flame ionization detectors (FIDs) and photo ionization detectors (PIDs) have been widely used to indicate soils that have been contaminated by petroleum fuel hydrocarbons. Wet chemical reaction tests and soil gas tests with various color-based indicators are also available. Recent applications of biomedical immunoassay technology to the environmental industry provide field tests for the presence of TPFH and other contaminants.

Each of the field screening methods has one or more features that commend its use. These positive features include rapidly obtained results to assist in the on-site decision making process, a wide range of detectable compounds, ease of operation, cost savings as compared with laboratory analysis, and cost savings by reducing the amount of uncontaminated soil remediated or removed. Furthermore, competent application of field screening methods may allow the early detection of an immediate on-site health risk. It also could help reduce public safety hazards associated with open holes by providing reasonably reliable information regarding contamination prior to receiving confirmatory data. However, because of the lack of specificity, accuracy, precision, reproducibility, etc., inherent in some of these methods, they are not permitted as the final confirmation of soil contamination.

Regardless which screening method is used, the final determination of contamination must be made by the recommended laboratory analytical methods as presented in the following table (Table 5), or as indicated by appropriate regional office personnel. Periodically, soil samples should be collected and analyzed at a laboratory to confirm field screening results.

EPA has recently approved an immunoassay procedure, method 4030 (SW-846), which is solely for the purpose of screening samples for petroleum hydrocarbons onsite. This method has been shown to be more reproducible and predictable then previous methods. It provides useful information in defining the extent of contamination at a site, along with determining which samples are the most contaminated and should be submitted for laboratory analyses.

10.2 LABORATORY ANALYTICAL METHODS

The suggested analytical methods for soils suspected to be contaminated are listed in Table 5, and the reference for the EPA methods follows the table. A summary of the California GC-FID Method for TPFH in soil is in 10.3 of this document.

Discharges of virgin gasoline and of fuel oil (e.g. kerosene, diesel, etc.) which are not blended from used oil will be assumed to be free of metals, or at least less than the allowable limits.

Table 5

Suggested Analytical Methods For Soil Analyses

Contaminant Testing For:	Method*	Reportable Concentrations
1) Low Boiling Point Fuels: Gasoline, Aviation Fuels, Gasohol, etc.	5030 Sample preparation with a Modified 8015 (California GC-FID Method) See page 34	10 ppm
2) High Boiling Point Fuels: Kerosene, Diesel, Varsol, Mineral Spirits, Naphtha, Fuel Oil #2, etc.	5030 and 3550 sample preparation with a Modified 8015(California GC-FID Method) See page 34	For 5030 10 ppm and For 3550 40 ppm
3) Heavy Fuels- #4, #5, #6 Fuel Oil, Motor Oil, Hydraulic Fluid, etc.	9071 - (Oil & Grease)	250 ppm
4) Used/Waste Oil	1. 9071 and 8021; if 9071 > 250 ppm or if compounds detected by 8021, then analyze using method #2 (1311)	MDL For 8021
	2. 1311 (TCLP) Toxicity Characteristic Leaching Procedure - Total organics (volatile/semivolatile) and metals	MDL For 1311
5) Metals	TCLP (1311) for Metals	MDL For 1311
6) Halogenated Solvents	8021	MDL For 8021
Non-Halogenated Solvents	8240	MDL For 8240
7) Non-Petroleum - Unknown	1311 (TCLP) Toxicity Characteristic Leaching Procedure - Total organics (volatile/semi-volatile) and metals	MDL For 1311
8) Pesticides	Contact N.C. Department of Agriculture and regional Groundwater Section staff of the N.C. Department of Environment, Health, and Natural Resources	N/A
9) For Substances Not Covered in 1 - 7	Contact central Office Groundwater Section staff of the N.C. Department of Environment, Health, and Natural Resources.	N/A

MDL = Method Detective Limit

* Or other EPA Approved Comparable Method which also has similar costs and detection limits.

Discharges of used/waste oil, or fuel oil blended from used oil (both motor oil and industrial oil) will be assumed to be in excess of all limits for hazardous waste unless laboratory analysis indicates otherwise.

10.3 CALIFORNIA METHOD FOR TPFH

The following analytical procedures and analyses are for the detection and quantification of petroleum hydrocarbons and fuel constituents. These techniques are to be followed when analysis is required for evaluation of either a suspected or confirmed release or confirmation of other petroleum contaminated soil, as presented in these guidelines. These analytical techniques cover the full range of petroleum fuel hydrocarbons from gasoline (C_4-C_{12}), to jet fuel (C_{10}-C_{16}), to diesel (C_9-C_{22}) in the soil matrix. Detection of complex hydrocarbon mixtures are best achieved using a Gas Chromatograph with a Flame Ionization Detector (GC/FID).

LOW BOILING POINT FUELS

This includes the full range of gasolines. This technique may also be appropriate for military grade jet fuels.

A. Soil Sample Preparation

Use EPA method 5030 Purge and Trap, (EPA manual SW-846, November 1990). Polyethylene glycol (PEG) or Methanol can be used as an extracting solvent. However, hexane is not acceptable. Extractions are applicable for the analyses of both fresh or aged fuels.

B. Analysis

1. Chromatographic operations for detection of total petroleum fuel hydrocarbons without BTEX distinction.

Detector: Flame Ionization
Column: 10 Percent SP-2100 on 80/100 Supelcoport
(8 ft. x 1/8" glass column). Capillary columns
may also be used as a substitute to improve separation.

Typical Operating Conditions

Carrier Gas: Nitrogen or Helium at 30 ml/min.
Injector Temperature: 250°C
Detector Temperature: 300°C
Column Temperature: 40°C hold for 3 minutes.
10°C/min ramp rate to 300°C or until at least 95% of all components are eluted.

HIGH BOILING POINT FUELS

This analysis includes the range of kerosene, diesel motor fuels, commercial grade jet fuels, varsol, and mineral spirits.

A. Soil Sample Preparation

Use EPA method 3550, Sonication Extraction, (EPA manual SW-846, November 1990). Acetone extraction with sample partitioning in hexane has been found to be an acceptable sample preparation, however other appropriate solvents may be used.

B. Analysis

Chromatographic operations for detection of total petroleum fuel hydrocarbons.
Detector: Flame Ionization
Column: 10 Percent SP-2100 on 80.100 8 ft. x 1/8" glass supelcoport. Capillary columns may also be used as a substitute to improve separation.

Typical Operating Conditions

Carrier Gas: Nitrogen or Helium at 30 ml/min.
Injector Temperature: 250°C
Detector Temperature: 300°C
Column Temperature: 40°C hold for 3 minutes.
10°C/min ramp rate to 300°C or until at least 95% of all components are eluted.

QUANTIFICATION FOR EITHER LOW OR HIGH BOILING POINT FUELS USING THE CALIFORNIA METHOD

Quantify Total Petroleum Fuel hydrocarbons (TPFH) by integrating all major peaks within the time period in which at least 95% of the recoverable hydrocarbons are eluted. Calibration shall be based upon an appropriate fuel standard representative of the suspect fuel.

If an appropriate sample for calibration does not exist, as in the case of an aged fuel, calibration shall be done using a "non-aged" representative fuel standard.

Calibration should be established within the estimated range of contaminant levels within the sample, based on odor or sheen or on prescreening measurement (i.e., combustible gas meter, or I.R. method). Where "non-detectable concentrations" are reported, the level of detection shall not exceed 10 ppm for low boiling point fuels and 40 ppm for high boiling point fuels in soil.

REFERENCES FOR TPFH ANALYSIS

1. US EPA 1990,"Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods", US EPA SW-846, Third Edition, November, 1990.

2. US EPA 1984, Federal Register, "October 26, 1984, 40 CFR part 136".

3. Eisenberg, D.M., and Others, 1985, "Guidelines for Addressing Fuel Leaks", California Regional Quality Control Board San Francisco Bay Region, 43 pp.

11.0 SOIL ASSESSMENT AND REMEDIATION AT NON-HAZARDOUS WASTE CONTAMINATED SITES

This section applies to releases from underground storage tank (UST) systems as well as all other sources. The assessment and remediation of a site with **only** soil contamination should be accomplished in accordance with these guidelines:

-Preparation and submittal of a Comprehensive Site Assessment (CSA)
-Preparation and submittal of a Corrective Action Plan (CAP)
-Preparation and submittal of Site Closure documentation

For soils contaminated by a UST system, the requirements for assessment and remediation are outlined in NCAC Title 15A, Subchapter 2N, Section .0700. Initial response and initial remedial actions are outlined in Sections .0702 through .0705. Investigation for soil cleanup (CSA) requirements are outlined in Section .0706 and the Corrective Action Plan (CAP) requirements in Section .0707.

Comprehensive Site Assessments (CSAs) and Corrective Action Plans (CAPs) may **not** be required for USTs, if contaminated soils with TPFH levels **greater** than the final cleanup level as determined by the Site Sensitivity Evaluation (SSE) can be removed within the spatial boundaries specified in Section 8.0 "Limiting Quantities and Costs for Soil Treatment/Disposal".

11.1 COMPREHENSIVE SITE ASSESSMENT (CSA)

The Comprehensive Site Assessment (CSA) should characterize the cause, significance and extent of soil contamination such that a Corrective Action Plan can be developed.

A CSA for soil contamination is required if either of the following conditions apply:

-a request from the Division of Environmental Management or other regulatory agencies

-where in-situ petroleum contaminated soils, exceeding the final cleanup level (as determined by the SSE), exist outside the spatial boundaries described in Section 8, "Limiting Quantities and Costs of Soil Treatment/Disposal"

Submit a CSA report to the appropriate regional Groundwater office. Guidelines for preparation of a CSA report appear in Section 15, **Groundwater Assessment and Remediation**. Since the CSA report format addresses **both** soil and groundwater contamination, CSA subsections 7, 10 (J, K, L, M) and 11 (D) do **not** need to be completed for sites with **only** soil contamination. All other subsections **must** be addressed. Do **not** submit separate CSA reports for incidents having both soil and groundwater contamination, include both in the same CSA.

11.2 CORRECTIVE ACTION PLAN

The Corrective Action Plan (CAP) details the proposed remedial actions at a site. CAPs are required when the CSA indicates additional remedial action is necessary.

Submit the CAP to the regional office for approval. Approval of the CAP is conditional upon approval of any required permits. Responsible parties, and owners/operators may, in the interest of reducing environmental contamination and promoting more effective cleanup, initiate soil and groundwater remediation before CAP approval. However, they must notify the appropriate regional office of their intentions to begin remediation, comply with any conditions imposed by the Department, and incorporate the self-initiated remedial measures into the CAP. Public notice of the CAP may be required for incidents resulting from releases of substances from underground storage tanks (UST) regulated by 15A NCAC 2N.

Guidelines for preparation of a CAP appear in Section 15.0, **Groundwater Assessment and Remediation.** The CAP format includes sections on both soil and groundwater contamination. In situations involving **only** soil contamination, address the sections only applicable to soil contamination. Do **not** submit separate reports for incidents having both soil and groundwater contamination.

11.3 SITE CLOSURE

Site closure may be approved when remediation has been achieved to the cleanup levels or standards specified by the Department, or as described in 15A NCAC 2L .0106.

REGULATED UNDERGROUND STORAGE TANK SITES

For site closure when regulated UST's are closed or have a change-in-service, the following information must be submitted to the appropriate regional office within 30 days following tank closure per 15A NCAC 2N .0800:

1. Completed and signed GW/UST-2 Form

2. Base map (include scale, name of U.S.G.S. quadrangle map, and north arrow) showing all relevant physical features, including roads, buildings, and underground utilities. Identify roads with state highway numbers when possible.

3. Detailed scale map of UST excavation area including:
   - orientation of UST, pumps, and product lines
   - length, diameter and volume of UST
   - type of material(s) stored (currently and previously)
   - sample locations in UST and product line excavations identified by letter or number
   - North arrow
   - Buildings or road boundaries

4. Description of soil sampling points and procedures utilized in sampling:
   - Show location of samples in excavation
   - Indicate depth (below land surface) at which sample was taken
   - Indicate if sample was taken from side of floor or an excavation
   - Indicate depth of tank burial (from land surface to top of tank)
   - Identify each sample by letter or number

   Note: *See Section 9.1 "Underground Storage Tank (UST) System."*

5. Description of quality control measures:
   - Describe how sample was collected (i.e. shovel, auger, etc.)
   - Describe how sample was preserved and transported
   - Describe decontamination procedures used
   - Describe time and date sample was collected and date submitted to laboratory

   Note: *See Section 9.3 "Sample Collection and Handing"*

6. Sample results including:
   - Copy of all laboratory results
   - Method of analysis used
   - Copy of completed chain-of-custody
   - Reference to sampling points shown on map

   Note: *See Section 10.0 "Analytical Methods for Determining Soil Contamination from Non-hazardous Waste"*

7. Confirmation of final disposition of any contaminated soil

8. Final destination of tank and contents

The appropriate regional office may determine that a site has been properly closed in accordance with 15A NCAC, Subchapter 2N and require no further action if the information submitted is adequate (including proper sampling methodology) and indicates that no contamination remains in place above the following levels:

1. the appropriate SSE action level for petroleum, or

2. background or detection level for other regulated substances

A comprehensive site assessment may be required for UST sites with widespread contamination where petroleum contaminated soils remain in excess of the SSE level, or where other regulated substances remain in excess of the detection level.

OTHER SITES (NON-REGULATED UST'S, SPILLS, etc.)

Close-out of other sites may be approved by the appropriate regional office when documentation is provided that indicates no contaminated soils remain in excess of the appropriate cleanup level (i.e. SSE) or other regulated substance in excess of the detection level. Additional information, such as confirmation that groundwater has not been affected, may also be required prior to final disposition of any contaminated soils.

For sites where contamination exists at the soil/bedrock, soil/groundwater interface (i.e. in proximity to groundwater as defined by 15A NCAC 2L .0106 and 2N .0706) at levels in excess of the cleanup levels, groundwater monitoring wells (a minimum of one) should be installed to monitor groundwater quality and to determine the groundwater flow direction (minimum of three). If no contamination is detected in the initial sampling, a quarterly or semi-annual monitoring program must be initiated hydraulically downgradient of the source. If no contamination is found in four consecutive quarters of sampling (or other time frame as specified by the regional office), a request by the responsible party for no further action will be evaluated.

12.0 PERMIT REQUIREMENTS FOR THE REMEDIATION OF NON-HAZARDOUS WASTE CONTAMINATED SOILS

N.C. General Statute 143-215.1(d) requires that the disposal and/or treatment of contaminated soil be permitted by the Department of Environment, Health, and Natural Resources. The design criteria and minimum requirements for all soil treatment and disposal systems is described at 15A NCAC 2H .0200 and 15A NCAC 2L. Also, N.C. General Statute 143-215.108 states that the operation of any device which may result in the emission of air contaminants will also require an air quality permit. This section is designed to provide guidance to the regulated community regarding the permitting process for contaminated soil storage, treatment, or disposal facilities.

Table 6 summarizes the general permitting requirements for the storage, treatment and disposal of contaminated soils. Pages 58-64 contain copies of the general land application permit (Figures 9-10) and other general permitting papers that are mentioned throughout this section. The following is a brief discussion of the permitting requirements for contaminated soil.

12.1 TYPES OF REMEDIATION METHODS

TEMPORARY STORAGE OF CONTAMINATED SOIL

On-site temporary storage for less than 45 days must be in accordance with Figure 7. Authorization for off-site temporary storage requires the approval of the appropriate regional office and the issuance of a "Certificate of Approval for Disposal" (Figure 6) and will not **be given by the Division, unless**

1. there is a health-based emergency, or

2. the responsible party has an approved permitted treatment/disposal document 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 ml thick plastic and bermed to prevent runoff (figure 7). A cover of at least 10 ml thickness shall be used to eliminate the generation of leachate.

THERMAL TREATMENT METHODS

Soil contaminants may be treated or thermally destroyed by the use of incinerators or other thermal units. These units may be designed to combust petroleum contaminants in an incineration process or they may be designed to volatilize petroleum contaminants to the atmosphere. In both stationary and mobile units, an air quality permit may be required to regulate the emissions or contaminants as well as the operation of these units. All thermal

Table 6

Required Permits Associated With Various Alternatives For Storage, Treatment, and Disposal of Non-Hazardous Contaminated Soils

	Nondischarge Permit	Erosion Control Plans	Certificate of Approval	Air Quality Permit or Registration
Temporary Storage (<45 days) onsite			(3)	
Temporary Storage (<45 days) offsite			✓(4)	
Thermal Treatment by a Stationary Facility	✓(1)			✓
Thermal Treatment by a Mobile Facility	✓(5)			
Storage at a Production Facility (Brick, Asphalt, etc.)	✓(1)	(7)		✓(6)
Containment/Treatment on an impermeable surface open to the environment	✓(1)	(7)		✓(2)
Containment/Treatment inside an Enclosed Structure (8)	✓(1)			✓(2)
Land Application for volumes <50 yd^3 or for soils with less than required cleanup level stipulated by Regional Office or Site Sensitivity Evaluation (See Section 6.0)		(7)	✓	
Land Application at Minimum Rates	✓(1)	(7)		
Land Application at Conventional Rates	✓(1)	(7)		

Legend for Table 6

(1) - These methods of remediation may be used as dedicated systems, which may require additional design/operation criteria.

(2) - Air Quality Permits may be required for these remediation methods. Determination will be made on a site specific basis.

(3) - Approval is automatic when designed in accordance with Figure 7.

(4) - Off site temporary storage will only be approved in emergency situations (i.e. when there is a direct and immediate threat to human health or environmental resources).

(5) - A general nondischarge permit will be issued for the remediation process. Procedures for disposal of the treated soils at various sites will be stipulated in the permit..

(6) - This method may also require amendment to the facility's air quality permit.

(7) - Erosion Control Plans are required in cases where more than one acre will be disturbed.

(8) - 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^{-6} cm/sec (or 1×10^{-7} cm/sec if the liner is to be placed four feet or less above bedrock [NCAC 15A 2H .0219 (g)]).

Fig. 6

CERTIFICATE #_____

North Carolina - Division of Environmental Management

CERTIFICATE OF APPROVAL FOR

DISPOSAL OF SOILS CONTAINING PETROLEUM PRODUCTS

☐ of 50 Cubic Yards or Less

☐ with Average Total Petroleum Hydrocarbon Concentration of ≤Cleanup Level of 10 TPFH (Method 5030), 40 TPFH (Method 3550), 250 Oil & Grease (Method 9071)

☐ Temporary Storage

☐ Other (explain below)

Approval Is Hereby Granted To:

Name: _____

Address: _____

_____

for the storage/disposal of approximately_____ cubic yards of contaminated soil as specified below:

Type of Contaminants: _____

Location of Source of Contaminant(s) (include business/owner name): _____

_____

Address of Source of Contaminants: _____

_____

County: _____

_____

Method of Disposal: _____

_____

_____

Location(s) where contaminated soils will be stored or disposed of (map must be provided):

_____

_____

This approval is based upon information provided to the Regional Supervisor, _____ Regional Office, by the responsible party, who hereby agrees to conduct the approved soil disposal activities in accordance with applicable state, local or federal requirements and additionally agrees to abide by any special conditions or limitations specified below. **(Note: Contaminated Soils shall not be disposed of, without written permission from the Division of Solid Waste Management, if the soil is Regulated under Subtitles C or D of RCRA)**

Special Conditions, Limitations or Comments: _____

_____

_____

_____

Certificate of Approval issued this the _____ day of _____, 199___.

_____ _____

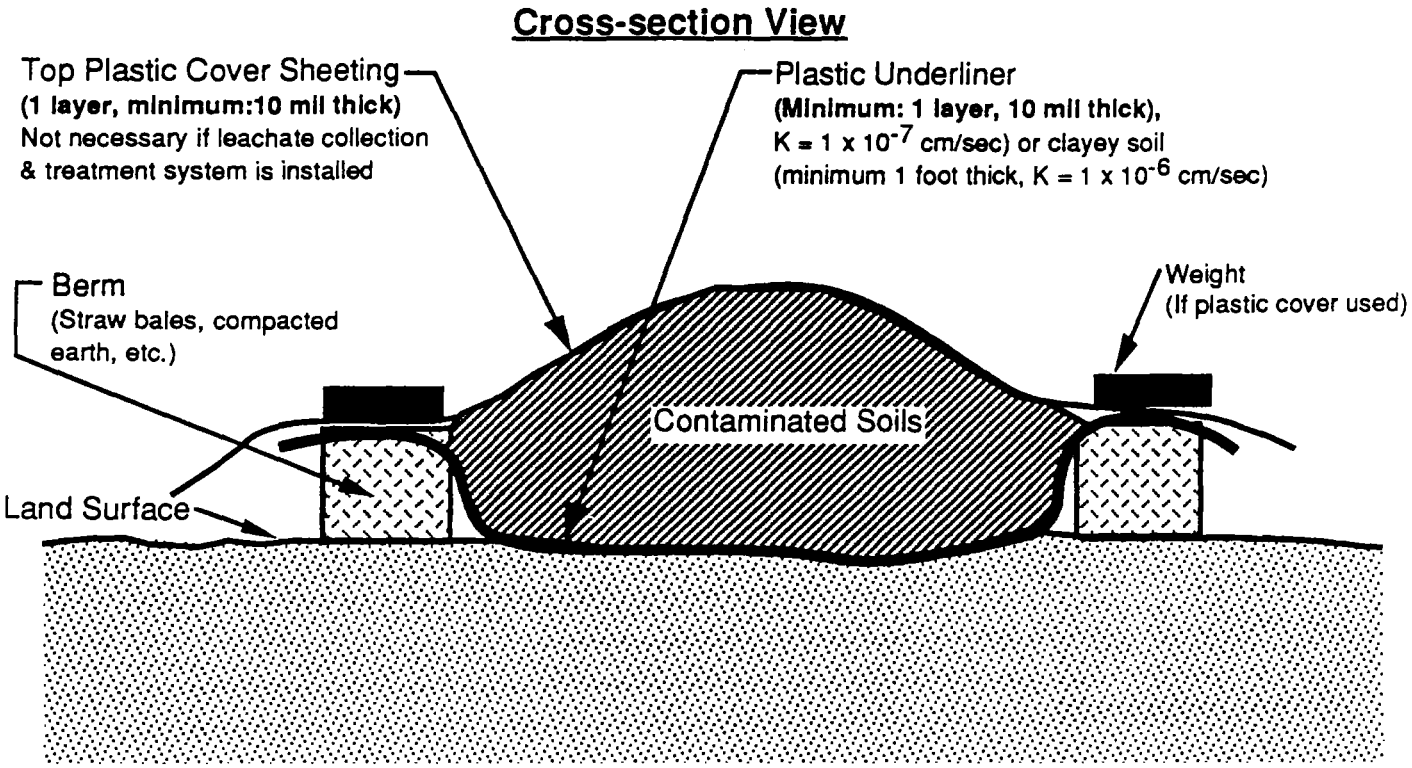
Signature of D.E.M. Representative Signature of Responsible Party

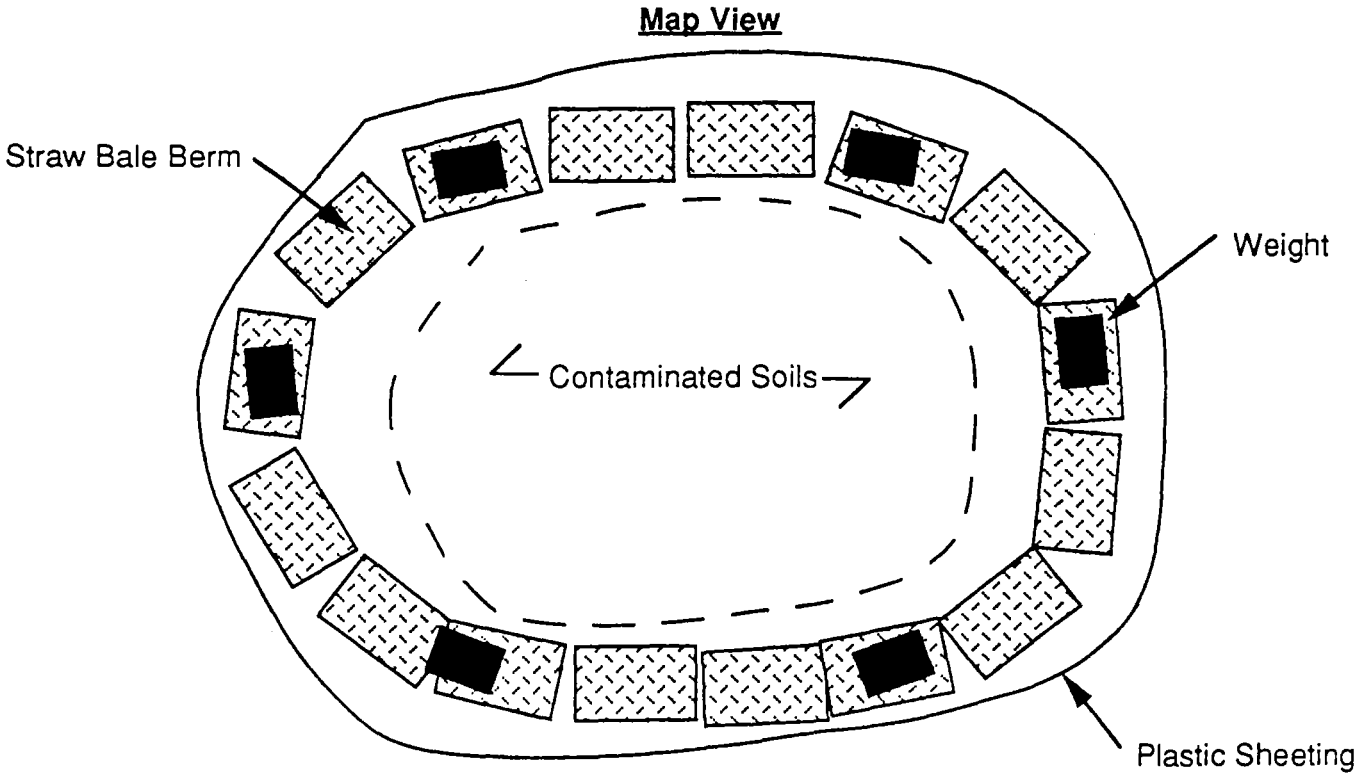
_____ Regional Office

GW-71(2/3/92)
3/10/93

Fig. 7

Diagram for Temporary Containment and Treatment of Petroleum Contaminated Soil





destruction or combustion units shall be designed to comply with North Carolina air quality standards regardless of location.

Measures taken to store treated soil and measures associated with the tracking of contaminated soil shall be regulated by the conditions of a nondischarge permit. In the instance where a mobile unit is used at various locations, a general nondischarge permit may be required and will regulate these same measures. A nondischarge permit may stipulate that groundwater monitoring is necessary, depending upon the nature and volume of contaminated soil. Permits will not be issued where groundwater may be affected.

12.2 CONTAINMENT AND TREATMENT

BRICK, ASPHALT, OR OTHER PRODUCTION FACILITIES

Thermal treatment of contaminated soil allows the soil to be degraded, consumed and/or encapsulated in the end product. The end product is a marketable product free of contamination. 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^{-9} cm/sec, or a one foot thick natural material liner compacted to 95% Proctor Standard Clay Density with a hydraulic conductivity of 1×10^{-6} cm/sec (or 1×10^{-7} cm/sec if the liner is to be placed four feet or less above bedrock [NCAC 15A 2H .0219 (g)]).

Surface water runoff must be collected and properly disposed to prevent leachate formation. Operators of soil storage facilities with leachate collection systems and treatment facilities must obtain a nondischarge permit. The permit addresses facility construction standards, soil handling procedures and monitoring (both surface and groundwater). An erosion control plan will also be required if more than one acre is disturbed.

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^{-6} cm/sec (or 1×10^{-7} cm/sec if the liner is to be placed four feet or less above bedrock [NCAC 15A 2H .0219 (g)]). These buildings must be designed to keep water from rainfall 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 unit is required; however, any soil additives that have the potential for leachate generation may require appropriate leachate 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). A

nondischarge permit will be required for the construction and operation of these facilities and the tracking of the contaminated soil.

12.3 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 weather and could result in production of leachate or runoff due to precipitation or other adverse weather events. These facilities include bioremediation on plastic, bioremediation under a shed that has no sidewalls, composting operations involving wind rows that are either covered with plastic or uncovered, or other facilities subject to weather as determined by the Division of Environmental Management (DEM).

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

A nondischarge permit is required for the construction and operation of these facilities. The permit stipulates construction standards, leachate control and final disposal (with approval) or the ultimate fate of the contaminated soils. An erosion control plan is required if more than one acre is disturbed.

12.4 LAND APPLICATION

LESS THAN 50 YD^3 OR $\leq$ THE SSE CLEANUP LEVEL

Land application of this type of contaminated soil may be approved by the Division through issuance of a "Certificate of Approval for Disposal". Soils approved for disposal by a Certificate of Approval (Figure 6) must be land-applied in accordance with regional office specifications and incorporated into the receiver site soils. No soil amendments may be required, depending on the type of contaminated soil. A cover crop must be established to prevent erosion of the soils.

MINIMUM RATES

Soils must be applied at a thickness no greater than one inch and incorporated into the native soils. A nondischarge permit is required for this activity and is valid for one year. The texture of the contaminated soil under consideration must be such that a one inch application is achievable (i.e. granular). No subsequent sampling of soil or groundwater is required.

CONVENTIONAL RATES

Soils may be applied at thicknesses not to exceed four inches and incorporated into the native soils. 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 soils and the establishment of a cover crop. These permits are issued for 18 months and may be renewed if remediation is not complete. The permit also requires periodic soil analysis to determine remediation. An erosion control plan is required if more than one acre is disturbed. No food chain crops for human consumption may be grown within 12 months following the application of contaminated soil.

12.5 IN-SITU REMEDIATION

No permits are generally required for in-situ activities; however, these processes will be reviewed during the review of the site corrective action plan. An air quality permit or registration with the appropriate Air Quality regional office may be required for certain remedial activities such as vapor extraction. The Division may also require the issuance of other permits for the in-situ remediation, upon review of the Corrective Action Plan.

12.6 DEDICATED FACILITIES

Dedicated contaminated soil facilities are designed to receive contaminated soil on a repeated basis. This may include conventional rate land application, production facility storage, or containment and treatment methodologies. Dedicated systems may receive multiple sources contaminated soil that must be individually tracked. They may require additional conditions outside the minimum design requirements associated with one-time use methodologies. Permits for these sites require significant soil, groundwater, and possibly surface water monitoring to ensure protection of human health and the environment. These permits are issued for 5 years and require the payment of annual administrative fees.

If a disposal facility has previously been approved for a one-time use, any subsequent use of that facility will cause the facility to be repermitted as a dedicated facility, subject to the guidelines and rules for dedicated facilities.

CRITERIA FOR LAND DISPOSAL OF PETROLEUM FUEL CONTAMINATED SOILS

These guidelines are applicable to disposal, under the provision of N.C.G.S. 143-215.1 of soil exceeding fifty cubic yards (50 yd^3) in volume, which are contaminated with one or more of the following petroleum fuel products:

Class I Products: (Low Boiling Point Fuels)	Motor Gasoline, Aviation Gasoline, Gasohol, Some Military Jet Fuels (JP-4, Jet-A)
Class II Products: (High Boiling Point Fuels)	All Other Jet Fuels, Kerosene, Diesel Fuel, Fuel Oils (#1 - #6); Motor Oils (New or Used)

EXCLUSIONS

Soils contaminated with the following are generally excluded from coverage under these guidelines:

1. Chlorinated solvents, organic acids or other hazardous waste. For applicable transport and disposal recommendations or requirements, contact the Hazardous Waste Section, Division of Solid Waste Management.

2. Tars and asphalt. High viscosity makes the land disposal of soil containing these products impractical.

3. Petroleum refinery sludge. High but variable concentrations of toxic metals and organic compounds require complex preliminary environmental risk assessments and intensive oversight of disposal operations.

4. Petroleum fuel contaminated soils of less than fifty (50) yd^3 total volume to be disposed of from any one site. The disposal is deemed permitted with the issuance of a "Certificate of Approval for Disposal", but the appropriate Regional Supervisor may require the issuance of a nondischarge permit.

12.7 GENERAL PERMIT CONDITIONS

OPTIONS FOR DISPOSAL BY LAND APPLICATION

Land application can be done by either conventional or minimum rates as described on page 46.

Land Disposal of Contaminated Soils will be in accordance with the applicable provisions of NCAC 15A 2H .0200 (Waste Not Discharged to Surface Waters) for land application of waste at "non-dedicated" sites. The review of applications and/or issuance of permits addresses the following:

1. The use of public funds may require environmental documentation pursuant to the North Carolina Environmental Policy Act.

2. If one or more acres of land are disturbed during disposal, approval of an erosion control plan must be obtained from the Land Quality section's regional engineer.

3. Compliance with the buffer requirements in NCAC 15A 2H.0219(j).

4. Disposal at any given site should not reoccur unless it can be demonstrated by soil testing that fuel hydrocarbons from previous applications have been remediated below cleanup levels and that soil conditions are suitable (pH, etc.). Sampling and analysis should be in accordance with this document. Subsequent use will cause the system to be reclassified as a "dedicated site."

5. Permit applicant must secure written permission from the land owner prior to disposal (Figure 10).

Following are the criteria that should be applied to site selection, site preparation, application rates, post-disposal maintenance and monitoring.

SITE SELECTION

Sites to be considered for disposal should meet the following standards on a site specific basis:

1. The depth to seasonal high water table should be at least one (1) foot below the waste zone (1.5 feet below land surface).

2. The average overall slope of the site should not exceed 5%, with approximately 8% slopes the maximum permissible. Sites with slopes of greater than 5% may 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 loams to sandy loams. Sandy or clayey soils should be avoided. Very sandy soils contain fewer microorganisms for biodegradation, reduced ability to absorb metals or organics, and have higher vertical percolation rates. Very clayey soils deter thorough mixing with the contaminated soils and may contribute to surface runoff of contaminants due to low permeability. Compacted clays exhibiting massive soil structures retard infiltration and chemical exchange.

NOTE: *County soils reports, U.S.D.A. Soil Taxonomy sheets (blue pages) and local, state or federal agencies (Soil Conservation Services, N.C. Agricultural Extension Service, etc.) can provide assistance in defining the seasonal high water table, land slopes and textures and other characteristics of regional soils.*

SITE PREPARATION

Soils in North Carolina are 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 soils to attain a higher soil pH and increase the availability of nutrients in the uppermost six inches of soil, as follows:

1. For Class I contaminated soils: Raise pH of disposal site soils to a minimum of 6.0.

2. For Class II contaminated soils: Raise pH of disposal site soils to a minimum of 6.5.

3. Where both Class I and II are in the contaminated soil, refer to (2) above.

NOTE: *It is preferable to have the pH of the native soils tested by an agronomist or soil scientist, who can then specify the amount of lime needed. Local agents (Soil Conservation Survey, N.C. 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.*

APPLICATION RATES:

1. Application rates are dependent upon the class of petroleum-fuel product involved, depth to seasonal high water table and disposal site vegetation and may be determined by the volume per area basis (Figure 8).

2. Because of their sensitivity, no petroleum fuel contaminated soils should be permitted on sites where:

   a) Crop seedlings have just been planted or can be expected to be planted within thirty (30) days; or

   b) Where any food-chain crop is growing (However, a food chain crop may be grown 12 months after a soil application, if the soil is remediated).

3. No soils 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.

Fig. 8

Application Rates of Petroleum Fuel - Contaminated Soils, (in Average Thickness) On A Volume/Area Basis

		Disposal Site Vegation			
		Group A		Group B	
		Coastal Bermuda grass Perrennial Grasses Red Clover Rye Grass		Lawn Grasses Others Not Specified Elsewhere	
Depth To Seasonal High Water Table (In Feet) From Land Surface [Assumes Contaminated Soils Incorporated To A depth Of 6 Inches]	**1.5' - 3.5'**	3"	2"	2"	1"
	>3.5'	4"	3"	3"	2"
Fuel Class		I	II	I	II

WEIGHT OF PETROLEUM

Gasoline (1 gal.) = 6.0 lbs.

Kerosene, Diesel Jet Fuel, #2 Fuel Oil (1 gal.) = ~6.75 lbs.

Motor Oil, #4 Fuel Oil (1 gal.) = 7.5 lbs.

#6 Fuel Oil (1 gal.) = ~8.5 lbs.

WEIGHTS OF AVERAGE NATIVE SOIL

1 ft.^{2} (6" deep) = ~ 88 lbs.
1 acre (6" deep) = ~ 3,840,000 lbs.
1 yd^3 = ~ 4,762 lbs.
= 324 ft.^{2} x 1" deep
= 162 ft.^{2} x 2" deep
= 108 ft.^{2} x 3" deep
= 81 ft.^{2} x 4" deep

Example 1

There are 30 yd.^{3} of soils contaminated with an unknown amount of gasoline (Class I), to be disposed of on a site where rye grass (Vegetative Group A) will be grown and where the depth to seasonal high water table is 4.0 feet. Determine the amount of land necessary for disposal, using 6" of native soil.

applicable data

Application rate (Volume/Area Basis) = 4" average thickness of application (Fig. 7)
1 yd. = coverage of 81 ft.^{2} at a thickness of 4"
Area needed = (Volume of Contaminated Soils in yd.^{3}) x (Area of coverage at a Specific Depth)

30 x 81 = 2,430 ft.^{2} = 0.05 Acres

Fig. 8

Application Rates of Petroleum Fuel - Contaminated Soils, (in Average Thickness) On A Volume/Area Basis

		Disposal Site Vegation			
		Group A		Group B	
		Coastal Bermuda grass Perrennial Grasses Red Clover Rye Grass		Lawn Grasses Others Not Specified Elsewhere	
Depth To Seasonal High Water Table (In Feet) From Land Surface [Assumes Contaminated Soils Incorporated To A depth Of 6 Inches]	**1.5' - 3.5'**	3"	2"	2"	1"
	>3.5'	4"	3"	3"	2"
Fuel Class		I	II	I	II

WEIGHT OF PETROLEUM

Gasoline (1 gal.) = 6.0 lbs.

Kerosene, Diesel (1 gal.) = ~6.75 lbs.
Jet Fuel, #2 Fuel Oil

Motor Oil, (1 gal.) = 7.5 lbs.
#4 Fuel Oil

#6 Fuel Oil (1 gal.) = ~8.5 lbs.

WEIGHTS OF AVERAGE NATIVE SOIL

1 ft.^{2} (6" deep) = ~ 88 lbs.
1 acre (6" deep) = ~ 3,840,000 lbs.
1 yd^3 = ~ 4,762 lbs.
= 324 ft.^{2} x 1" deep
= 162 ft.^{2} x 2" deep
= 108 ft.^{2} x 3" deep
= 81 ft.^{2} x 4" deep

Example 1

There are 30 yd.^{3} of soils contaminated with an unknown amount of gasoline (Class I), to be disposed of on a site where rye grass (Vegetative Group A) will be grown and where the depth to seasonal high water table is 4.0 feet. Determine the amount of land necessary for disposal, using 6" of native soil.

applicable data

Application rate (Volume/Area Basis) = 4" average thickness of application (Fig. 7)
1 yd. = coverage of 81 ft.^{2} at a thickness of 4"
Area needed = (Volume of Contaminated Soils in yd.^{3}) x (Area of coverage at a Specific Depth)

30 x 81 = 2,430 ft.^{2} = 0.05 Acres

POST DISPOSAL MAINTENANCE

1. The contaminated soil and lime should be thoroughly incorporated into the top six (6) to eight (8) inches of the native soils by rototilling or disking. Since rototilling is more efficient than disking, a single pass of the rototiller should be sufficient, whereas two (2) to three (3) passes of a disk 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 disposal area and fully incorporated into the mixed contaminated and native soil layer. To provide maximum benefits, fertilization should occur no sooner than 15 days nor later than 30 days subsequent to disposal.

3. 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 (PAN).

   b) For phosphorus, the tolerance level of the vegetative crop, as determined by a knowledgeable party, or 50-75 pounds per acre P_20_5 (phosphate, or equivalent).

4. To provide the extra oxygen for waste biodegradation to proceed, the site should be retilled at periods of 1 month, 2 months and 6 months following disposal.

MONITORING

1. Soil Sampling:

   a) Two soil samples will be collected from each acre, or each application area if it is less than one acre, at intervals of 6 months and 12 months following disposal.

   b) Each sample will be composed of the vertical column of soil, extending from land surface to the maximum depth of waste incorporation, and collected using a soil auger, Shelby tube or split-spoon sampler.

   c) Each individual sample shall be mixed and a representative portion analyzed (by methods specified by the Division) to determine the concentration of Total Petroleum Fuel Hydrocarbons (Section 10.3). If the soils disposed of originally contained contamination other than petroleum or petroleum related

substances, the permittee shall also determine concentrations of both volatile and semivolatile organic compounds present by EPA SW-846 methods 8240, 8270 and/or other methods as deemed necessary by the Division.

d) A copy of the laboratory results of the soil analysis will be submitted to the appropriate regional office, to the attention of the regional groundwater supervisor, within thirty (30) days of sample collection, or in compliance with the permit. A copy of each analysis shall be forwarded to the Groundwater Section Permits and Compliance Group.

2. Groundwater Monitoring:

The necessity for groundwater monitoring will be determined by the regional groundwater supervisor, based on potential environmental impacts.

12.8 GUIDELINES FOR BIO-REMEDIATION AND VOLATILIZATION OF PETROLEUM FUEL CONTAMINATED SOILS CONTAINED ON IMPERMEABLE SURFACES OPEN TO THE ENVIRONMENT

This section is applicable to the disposal, under the provisions of N.C.G.S. 143-215.1, of those soils which are contaminated with one or more petroleum fuel product(s) as described in section 12.6 of this document.

EXCLUSIONS

Soils contaminated with the following are not covered under these guidelines:

1. Chlorinated solvents, organic acids or other hazardous substances. For applicable transport and disposal recommendation or requirements, contact the Hazardous Waste Section, Division of Solid Waste Management.

2. Petroleum refinery sludge and waste oil. High but variable concentrations of toxic metals and organic compounds require complex preliminary environmental risk assessments and intensive oversight of disposal operations. However petroleum refinery sludge or waste oils may be treated if synthetic liners are used that have a hydraulic conductivity of $< 1 \times 10^{-9}$ cm/sec and, are compatible with the contaminant being treated and have a thickness of $\geq$ 30 mils, under this guideline.

DESIGN CONDITIONS

1. The site must be secured to prevent unauthorized access.

2. The soils shall be placed within a contained area on

   a) a synthetic liner which has a hydraulic conductivity less than 1×10^{-9} cm/sec and is at least 30 mm in thickness, a 20 mm Permalon liner,

   or

   b) a minimum of 1 ft. thickness of compacted clayey soil which has a hydraulic conductivity no greater than 1×10^{-6} cm/sec (or 1×10^{-7} if being placed less than 4 feet from bedrock), and has been compacted to 95% proctor and P.E. (P.E. certification required).

3. The containment vessel must be able to withstand the processes used during remediation without failure of the impermeable layer.

4. A leachate collection system may be required in order to prevent run-off from the contaminated soils or preferably, steps should be taken to avoid accumulation of water within the contained area.

5. Provisions to dispose of leachate in an approved manner in accordance with applicable local, state, or federal regulations must be made.

6. The design must comply with the buffer requirements addressed in NCAC 15A 2H .0219(j).

7. Slope of the treatment surface must be less than 5%.

8. Complete plans and specifications for the entire system, including facilities and equipment for treatment, storage, and preparation for final disposal of the soils, must be submitted to and approved by the Groundwater Section before implementation.

SITE PREPARATION

See section 12.7 (p. 50)

SITE MAINTENANCE

1. Nutrients, in the form of nitrogen and phosphorus fertilizers, must be sprayed (or spread) over the disposal area and fully incorporated into the mixed contaminated soil. To provide maximum benefits, nutrients should be applied no sooner than 15 days nor later than 30 days subsequent to disposal.

2. 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).

3. Extra oxygen for waste biodegradation and volatilization should be provided using the most appropriate method (i.e. tilling, air injection).

MONITORING

1. Soil Sampling:

a) Two composite samples, per acre shall be collected at the disposal site, at a minimum of 6 month intervals.

b) Each sample will be composed of the vertical column of soil, extending through the waste pile, and collected using a soil auger, Shelby tube or split-spoon sampler.

c) Each individual Sample will be analyzed to determine the concentration of Total Petroleum Fuel Hydrocarbons (TPFH) as described in Section 10.3.

d) A copy of the laboratory results of the soil analysis will be submitted to the appropriate regional groundwater office, to the attention of the groundwater regional supervisor, within thirty (30) days of sample collection.

e) When laboratory results indicate the concentrations of total petroleum fuel hydrocarbons are below the SSE action level, the soil will be considered remediated and acceptable for final disposal at a location approved by the appropriate regional office.

GROUNDWATER MONITORING

The necessity for groundwater monitoring will be determined by the Regional Groundwater Supervisor, based on potential environmental impacts.

PERMIT REQUIREMENTS

1. Non-Discharge Permit for Land Application of Petroleum Contaminated Soil is required for the disposal of all contaminated soil not covered under a "Certificate of Disposal."

a) Contact the Groundwater Supervisor in the appropriate regional office concerning permit requirements.

2. Air Quality (if applicable):

a) Contact the Air Quality Supervisor in the appropriate regional office Concerning permit requirements.

CLOSURE

Prior to close-out of the soil remediation site, analyses of soil samples from beneath the treatment area may be required to verify that the integrity of the impermeable barrier has been maintained.

12.9 GUIDELINES FOR CONTAINMENT AND USE OF PETROLEUM FUEL CONTAMINATED SOILS IN BRICK AND ASPHALT PRODUCTION FACILITIES

As described in the preceding section, except for the following amendments:

GENERAL DESIGN CONDITION

All soils containing petroleum products shall be placed within a containment area which is underlain by one of the following:

a) synthetic liner that is chemically compatible with the petroleum products being contained and treated, having a hydraulic conductivity no greater than 1×10^{-9} centimeters per second (cm/sec), and that is comprised of a single layer of no less than 30 mils in thickness, or a 20 mm Permalon liner or

b) a liner of uncontaminated natural materials (i.e. clays, etc.) at least one foot in thickness at all locations and having a hydraulic conductivity no greater than 1×10^{-6} cm/sec (unless being placed four feet or less above bedrock, then 1×10^{-7} is required) upon being compacted to 95% Proctor standard dry density.

c) other liner materials (asphalt, concrete, etc.) approved by the appropriate regional office.

SITE MANAGEMENT PLAN

A site management plan is a complete description of all operational procedures for handling petroleum contaminated soils at the proposed facility, including:

(1) a description of staging area(s) designated for initial receipt of petroleum contaminated soils,

(2) method(s) of emplacement of contaminated soils into the containment area(s),

(3) average residence time of contaminated soils within the containment area(s), and

(4) method of incorporation of the contaminated soils with the brick or asphalt materials prior to incorporation into the respective production processes.

Fig. 9

North Carolina Department of Environment, Health, and Natural Resources
Environmental Management Commission

DEM USE ONLY
PERMIT NO: SR

Permit Application For The Land Application or Containment and Treatment of Soils Containing Petroleum Fuel Products

Note: Processing of this application will not begin until three (3) copies of this application form and three (3) copies of all of the following information and documents, and the $400.00 non-refundable permit application processing fee **(Make checks/M.O. Payable to: N.C. Dept. EHNR)**, have been submitted. If any of the required items have been excluded from the package, please explain.

SUBMIT COMPLETED APPLICATION TO: _____ REGIONAL OFFICE,
ATTN. REGIONAL SUPERVISOR
(For Appropriate Regional Office, See Map on Reverse of Pink Copy)

Applicant (Name of corporation, company, individual or other): _____

Applicant Mailing Address: _____
Zip Code

_____
Contact Person Telephone No.

Section A: GENERAL INFORMATION

1. LOCATION of source of contaminated soil: _____
_____ County: _____
2. PRODUCT RELEASED: Indicate Specific Type (see below): _____
   Class I Products: Motor gasoline, Aviation Gasoline, Gasohol, Some Military Jet Fuels (JP-4, Jet-A).
   Class II Products: All other Jet Fuels, Kerosene, Diesel Fuel, Fuel Oils (Nos. 1-6), Motor Oils (new or used).
3. SOURCE(S) OF PETROLEUM RELEASED (Check all that apply)
   - ☐ Underground Storage Tank **(Indicate Tank Facility I.D. # (if known): _____)**
   - ☐ Aboveground Storage Tank
   - ☐ Spill From Tanker Truck or Other Carrier
   - ☐ Other (specify) _____
4. If source(s) of petroleum released includes Underground Storage Tank, provide tank owner's name, mailing address and telephone number.
   ☐ **Check here, if same as applicant**

Name: _____

Address: _____

Telephone Number: _____

5. Provide the name, mailing address and telephone number of the owner of the property on which the petroleum release occurred.
   ☐ **Check here, if same as applicant**

Name: _____

Address: _____

Telephone Number: _____

Physical Address of Where The Contaminated Soil is Proposed to be Land Applied, Treated or Utilized:

_____

6. Volume of product released (if known): _____ gallons.
7. Volume of contaminated soil (estimate): _____ cubic yards.
8. Date soil was excavated: _____

Section B: DESIGN INFORMATION (Check Only One)

1- ☐ Land Application - (Minimum Rate: One Time Application)
2- ☐ Land Application - (Conventional Rate: One Time Application)
3- ☐ Containment and Treatment or Treatment/Utilization at a Production Facility
4- ☐ Land Application (Dedicated Site)

_____
Signature of Applicant

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Fig. 9 (cont.)

REQUIREMENTS FOR THE COMPLETION OF PERMIT APPLICATION FOR THE LAND APPLICATION OR CONTAINMENT AND TREATMENT OF SOILS CONTAINING PETROLEUM FUEL PRODUCTS.

Part I : Guidance On Completing Section B: Design Information

the following description in filling out Section B of the Permit Application.

1- Land Application - (Minimum Rate - One Time Application): the contaminated soils will be spread to a thickness NO GREATER THAN one (1) inch and throughly incorporated (within 24 hours) into the upper 6 to 8 inches of native soil, at the location specified in this application **(Provide the information specified in Part II AND Part III below.)** *

2- Land Application - (Conventional Rate - One Time Application): the petroleum contami nated soil will be disposed of by land application at the approved conventional rate as specified in Attachment II, "Criteria for Land Disposal of Petroleum Fuel Contaminated Soils" (Available on request) **(Provide the information specified in Part II AND Part IV below.)** *

3- Containment and Treatment: the petroleum contaminated soil will be contained on a bermed liner of plastic (or other approved material) as specified in Attachment III,for the purpose of reducing contaminant levels. **(Provide the information specified in Part II AND Part V below.)** *

*** The disposal of contaminated soils in watersheds classified WS-1 is prohibited. If you do not know the watershed classification of the proposed application area, contact the appropriate Regional Office.**

Part II : Information For Hazardous Waste (RCRA) Requirements

Does the petroleum product(s) released exhibit any toxicity characteristic(s) as defined, under RCRA, by the Toxicity Characteristic Leaching Procedure (TCLP)? **(See Federal Register, Vol. 55, No. 61, and below)**

ANALYTICAL REQUIREMENTS:

(a) If the source of the soil contamination is a virgin (unused) petroleum product from an underground storage tank regulated under Subtitle I of RCRA, no TCLP analysis is required. If you are unsure if this exemption applies to your situation, see Note #3 at end of this attachment.

(b) IF AN ANALYSIS OF THE SOURCE PETROLEUM PRODUCT IS SUBMITTED, SHOWING NO CONCENTRATIONS HIGHER THAN THE REGULATORY LEVEL ASSOCIATED WITH THE CONTAMINANTS LISTED IN TABLE I (see last page of this Attachment), SOIL IS AUTOMATICALLY NON-HAZARDOUS AND NO TCLP ANALYSIS IS REQUIRED AND NO DOCUMENTATION, AS SPECIFIED IN THE NOTE #1: BELOW, IS REQUIRED;

(c) For soils contaminated by "waste oil" (i.e. used petroleum products including used motor oil, crankcase oil); a TCLP analysis of both volatiles, semi-volatiles and metals is required.

(d) For soils contaminated with other petroleum products not regulated under Subtitle I, (excluding used oil or "waste oil"), a TCLP analysis of volatiles and semi-volatile components only (EPA Hazardous Waste Nos. DO18-DO43, See Table 1 of this Figure), is required.

NOTE #1: **IF THE RESULTS OF ANY TCLP ANALYSIS REQUIRED BY THIS SECTION INDICATE A CONCENTRATION AT OR ABOVE THE FEDERAL REGULATORY LEVEL, YOU MUST SUBMIT DOCUMENTATION FROM THE HAZARDOUS WASTE SECTION, N.C. DIVISION OF SOLID WASTE MANAGEMENT (P.O. BOX 27687, RALEIGH, N.C. 27611, TELEPHONE (919) 733-2178) THAT THE CONTAMINATED SOIL IS NOT A HAZARDOUS WASTE REGULATED UNDER SUBTITLES "C" OR "D" OF RCRA.**

Part III : LAND APPLICATION AT MINIMUM RATES : ONE TIME APPLICATION

Provide the following:

1. Scaled site map of the landfarm area showing the following:

   a. property boundaries

   b. any habitable residence on, or within 400 feet of, the disposal area

(Continued on next page)

Part III : LAND APPLICATION AT MINIMUM RATES (CONT.)

c. any public or private well on, or within 500 feet of, the disposal area

d. any surface water (streams, rivers, ponds, etc.) or natural drainageway on, or within 100 feet of, the disposal area

2. Calculation of the area needed for land application and an indication of the cover crop to used (For calculating this area, 1 cubic yard (yd^3) of soil, spread to a thickness of one inch (1"), will cover an area of approx. 325 square feet (ft^2), i.e. 134 yd of contaminated soil per acre).

3. Erosion control plan (if area needed for land application is more than one (1) acre).

4. Landowner's agreement (for permission to use the properties for the purpose of land Application of petroleum contaminated soils; not required if the applicant is the sole landowner).

Part IV : LAND APPLICATION AT CONVENTIONAL RATES : ONE TIME APPLICATION

Provide the following:

1. Scaled site map of the land application area showing the following:

   a. property boundaries

   b. any habitable residence on, or within 400 feet of, the disposal area

   c. any public or private well on, or within 500 feet of, the disposal area

   d. any surface water (streams, rivers, ponds, etc.) or natural drainageway on, or within 100 feet of, the disposal area

2. Soils report of the disposal area which includes the following:

   a. field descriptions of textures, color, and structure

   b. depth and thickness of soil horizons

   c. presence of any restrictive soil horizons or layers

   d. depth to seasonal high water table

   e. slope of site

   f. estimate of liming required based on soil pH

   g. amount of nitrogen and phosphorus fertilizers to be added

NOTE #2: **(i) Verification of on-site soil series by Soil Conservation Service or Agricultural Extension personnel is acceptable,**
(ii) The soils report should include soils information to a depth of 5 feet below land surface.

3. calculation of the area needed for land application and an indication of the cover crop to be used.
4. proposed thickness of application.

5. erosion control plan (if area needed for land application is more than one (1) acre).

6. site maintenance plan, indicating the number and location of samples to be collected.

7. soil sampling plan.

8. landowner's agreement (for permission to use the properties for the purpose of land application of contaminated soils; not required if the applicant is the sole landowner).

Part V: SOIL CONTAINMENT AND TREATMENT

A. For biomediation and volitalization on impermeable surfaces.
Provide the following (see APPENDIX B for guidance)

1. site map of area where soils will be contained and treated showing the information specified in Part IV,1. (a) - (d).

2. diagram of the soil containment vessel(s) and any associated leachate containment structures, including the operating thickness of the soil to be contained and treated.

3. soils report, for the portion of the property underlying the containment structure, as specified in Part IV, 2. (a) - (e).

4. description of the chemical, physical and biological method(s) to be used in treating the contaminated soil, including precautions that will be taken to preserve the integrity of the liner and any leachate collection system.

5. erosion control plan (if area needed for containment is more than one (1) acre).

6. proposed soil sampling plan.

7. landowner's agreement (for permission to use the properties for the purpose of containment and treatment contaminated soils; not required if the applicant is the sole land owner). **(Fig. 9)**

B. For containment and utilization at production facilities (i.e brick, asphalt, etc.).
Provide the following:

1. Information specified in Part V, A., 1-6 above.

2. A site management plan.

NOTE #3: INFORMATION FOR THE DETERMINATION OF UNDERGROUND STORAGE TANKS AND REGULATED SUBSTANCES COVERED UNDER SUBTITLE I OF RCRA.

What Tanks Are Included? An underground storage tank is defined as any one or combination of tanks that (1) is used to contain an accumulation of "regulated substances," and (2) whose volume (including connected underground piping) is 10% or more beneath the ground. Some examples are underground tanks storing gasoline, used crankcase oil, diesel fuel, industrial solvents, pesticides, herbicides or fumigants.

What Tanks Are Excluded? Tanks removed from the ground are excluded. Other tanks excluded are:

1. farm or residential tanks of 1,100 gallons or less capacity used for storing motor fuel for noncommercial purposes;
2. tanks used for storing heating oil for consumptive use on the premises where stored
3. septic tanks;
4. pipeline facilities (including gathering lines) regulated under the Natural Gas Pipeline safety Act of 1968, or the Hazardous Liquid Pipeline Safety Act of 1979, or which is an intrastate pipeline facility regulated under State laws;
5. surface impoundments, pits, ponds or lagoons;
6. storm water or waste water collection systems;
7. flow-through process tanks;
8. liquid traps or associated gathering lines directly related to oil or gas production and gathering operations;
9. storage tanks situated in an underground area (such as a basement, cellar, mineworking, drift, shaft, or tunnel) if the storage tank is situated upon or above the surface of the floor;
any UST system holding hazardous wastes listed or identified under Subtitle C of the Solid Waste Disposal Act, or a mixture of such hazardous waste and other regulated substances;
11. any wastewater treatment tank system that is part of a wastewater treatment facility regulated under Section 402 or 307(b) of the Clean Water Act, including wasterwater treatment tanks;

NOTE #3 (Continued)

12. equipment or machinery that contains regulated substances for operational purposes such as hydraulic lift tanks and electrical equipment tanks;
13. any UST system whose capacity is 110 gallons or less;
14. any UST system that contains a "de minimis" concentration of regulated substances;
15. any emergency spill or overflow containment UST system that is expeditiously emptied after use;
16. tanks containing "waste oil" (used petroleum products, including used crankcase oil).

What Substances Are Covered? Subtitle I of RCRA applies to underground storage tanks, not excluded above, that contain regulated substances. This includes any petroleum product i.e., crude oil or any fraction therefore which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute).

Table I - Maximum Concentration of Contaminants for Toxicity Characteristic

EPA hazardous waste number [1]	Contaminant	CAS No [2]	Regulatory Level (mg/l)
Metals			
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D006	Cadmium	7440-43-9	1.0
D020	Chlordane	57-74-9	0.03
D007	Chromium	7440-47-3	5.0
D012	Endrin	72-20-8	0.02
D031	Heptachlor (and its hydroxide)	76-44-8	0.008
D008	Lead	7439-92-1	5.0
D009	Mercury	7439-97-6	0.2
D014	Methoxychlor	72-43-5	10.0
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D017	2, 4, 5- TP Silvex	93-72-1	1.0
Organics			
D018	Benzene	71-43 2	0.5
D019	Carbon Tetrachloride	56-23-5	0.5
D021	Chlorobenzene	108-90-7	100.0
D022	Choroform	67-66-3	6.0
D023	o-Cresol	95-48-7	[4] 200.00
D024	m-Cresol	108-39-4	[4] 200.00
D025	p-Cresol	106-44-5	[4] 200.00
D026	Cresol	----------	[4] 200.00
D027	1,4- Dichlorobenzene	106-46-7	7.5
D028	1,2- Dichloroethane	107-06-2	0.5
D029	1,1- Dichloroethylene	75-35-4	0.7
D030	2, 4- Dinitrotoluene	121-14-2	[3] 0.13
D032	Hexachlorobenzene	118-74-1	[3] 0.13
D033	Hexachlorobutadiene	87-68-3	0.5
D034	Hexachloroethane	67-72-1	3.0
D035	Methyl ethyl ketone	78-93-3	200.0
D036	Nitrobenzene	98-95-3	2.0
D037	Pentrachlorophenol	87-86-5	100.0
D039	Tetrachloroethylene	127-18-4	0.7
D040	Trichloroethylene	79-01-6	0.5
D041	2, 4, 5- Trichlorophenol	95-95-4	400.0
D042	2, 4, 6- Trichlorophenol	88-06-2	2.0
D043	Vinyl chloride	75-01-4	0.2
Pesticides			
D016	2,4- D	94-75-7	10.0
D012	Endrin	72-20-8	0.02
D031	Heptachlor (and its hydroxide)	76-44-8	0.008
D013	Lindane	58-89-9	0.4
D038	Pyridine	110-86-1	[3] 5.0
D010	Selenium	8001-35-2	0.5
D015	Toxaphene	93-72-1	1.0
D017	2, 4, 5- TP Silvex		

[1] Hazardous waste number.
[2] Chemical abstracts service number.
[3] Quantitation limit is greater than the calculated regulatory level. The quantition limit therefore becomes the regulatory level.
[4] If o-, *m*-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/l.

Fig. 10

North Carolina - Division of Environmental Management

AGREEMENT FOR LAND APPLICATION OR CONTAINMENT AND TREATMENT OF SOILS CONTAINING PETROLEUM PRODUCTS ON PRIVATE LANDS

General Information

Permit Applicant: _____

Contact Person (if different than Applicant): _____

Address of Applicant: _____

_____ Telephone #: _____

Name and Address of Source of Soils Containing Petroleum Products (Hereinafter "Soils")to be applied to these lands: _____

_____

Amount of Land Available Under This Agreement: _____ acres

Quantity of Soils to be applied to these lands: _____ cubic yards

PERMITTED ACTIVITY (check appropriate box)

☐ LAND APPLICATION OF SOILS ☐ CONTAINMENT AND TREATMENT OF SOILS ☐ OTHER (SPECIFY: _____ _____)

Location of Land(s) where the contaminated soils will be placed (include map for each site): _____

_____

Owner of Property where the contaminated soils will be placed:

Name: _____

Address: _____

_____ Telephone #: _____

Lessee of property (if appropriate):

Name: _____

Address: _____

_____ Telephone #: _____

Land use or cropping patterns (FOR LAND APPLICATION ONLY): _____

Intended use or disposition of crops (FOR LAND APPLICATION ONLY): _____

Land Owner

The undersigned landowner or his representative hereby authorizes _____, hereinafter referred to as the Applicant, to allow the placement of the listed soils upon the land at the location(s) shown as described herein, in accordance with the stipulations as specified on the reverse of this page. This agreement shall remain in effect for the length of the permit issued by the Division of Environmental Management (Division). The landowner or his representative and the permit applicant agree to abide by these stipulations for the duration of the permitted activity unless prior written approval for modification or cancellation has been obtained from the Division.

I, _____ have read this land owner's agreement and do hereby grant permission to the Permittee to conduct the permitted activity on my property as specified herein.

_____

Land Owner Date

Notary Public

NOTARY PUBLIC CERTIFICATION: State of _____, County, _____

I, the undersigned Notary Public, do hereby certify that _____ personally appeared before me and acknowledged the due execution of the forgoing instrument.

WITNESS my hand and official seal this _____ day of _____, 19____. (Notary Public Seal)

Signature of Notary _____ My commission Expires _____

Lessee

I, _____ have read this land owner's agreement and do herby agree by the stipulations and restrictions as specified herein.

_____

Lessee Date

Applicant

I, _____ have read this land owner's agreement and do herby agree by the stipulations and restrictions as specified herein.

_____

Permitt Applicant Date

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Fig. 10 (cont.)

STIPULATIONS:

1. The landowner or his representative hereby authorizes the Permittee, county and state officials or their representatives to inspect and, if necessary, take soil, surface and groundwater samples at each parcel of property prior to, during, and after the permitted activity.

2. If a permit is issued to the Applicant (thus making him or her the Permittee), the landowner or his representative will inform the Permittee of any applicable revisions or modifications to the intended use and cropping patterns referenced in this document, prior to each planting seasoning, to enable the Permittee to amend this Agreement so as to schedule permit-related activities at appropriate periods.

3. No crops for direct human consumption shall be raised on this site for a period of 12 months following land application of the soils containing petroleum products.

4. The landowner or his representatives or successors shall adhere to the provisions of this Agreement for a period of eighteen (18) months from the date of the most recent soils application.

5. Should the landowner or his representative lease or otherwise permit the use of the land by a third party, the landowner shall be responsible to insure that the third party agrees and complies with the terms and conditions of this Agreement.

6. Animals should not be grazed on soil disposal lands within a one hundred eighty (180) day period following the soils application. Application sites that are to be used for grazing should have fencing, or other equally effective barriers, that will be used to prevent access during this period after application.

REFERENCE

1. Bartha, R. and Bossert, I. 1981. "The Treatment and Disposal of Petroleum Wastes." In: Petroleum Microbiology. McMillan Publishing Co., N.Y.

GROUNDWATER REMEDIATION SECTIONS

The following sections are applicable to non-hazardous waste groundwater investigations. Regulatory requirements of the State of North Carolina are listed at Title 15A NCAC, Subchapter 2L "Classifications and Water Quality Standards Applicable To The Groundwaters of North Carolina". The Decision Flow Diagram for Groundwater can be found on page 10, Figure 3. The following sections will provide information concerning procedures for groundwater sampling, investigations, assessments, remediation and closure.

13.0 GROUNDWATER SAMPLING GUIDELINES

13.1 PLANNING

NUMBER AND LOCATION OF SAMPLES

The number and location of samples will depend on specific site conditions and the goals of the investigation. The Groundwater Section strongly encourages the use of field screening techniques prior to the installation of monitor wells.

WATER SUPPLY WELLS

If contamination of groundwater supplies is suspected, samples should be collected from nearby water supply wells. The number of samples needed will depend on the number and distribution of the wells, the type of contaminant, and the specific knowledge about the site. It is important to note that a shallow aquifer may be contaminated and the supply wells which are in a deeper aquifer may not show the contamination, or in some instances the opposite may be true.

NOTE: ***Water supply wells may not be considered for monitoring purposes other than to provide information relative to exposure through consumption of water.***

UNDERGROUND STORAGE TANK EXCAVATION

When groundwater is encountered in an excavation, a sample taken from the groundwater seepage in the pit may be sufficient for a preliminary assessment. Keep in mind, however, that this sample may not truly represent actual groundwater conditions because of the possibility of contamination from excavating equipment, etc.

DIRECTION OF GROUNDWATER MOVEMENT

In most cases, a minimum of three monitoring wells will be needed to determine the direction of groundwater flow and the hydraulic gradient. Specific site conditions will determine if additional wells are needed.

SAMPLE CONTAINERS

The type of sample containers which should be used depends on the type of analyses that will be performed. First, determine the type(s) of contaminants expected to be found and the proper analytical method(s) to use from Section 14, Groundwater Analytical Methods for Determining Contamination.

Select a laboratory *certified to perform the specific groundwater analyses required.* After consultation with that laboratory, decide whether to do your own sampling or to negotiate a contract for sampling and analysis. A list of laboratories which are certified for different analyses, and is updated periodically, may be obtained from:

N.C. Division of Environmental Management
Chemistry Laboratory
4405 Reedy Creek Road
Raleigh, North Carolina 27607
(919) 733-3908

If you decide to do your own sampling, consult with the selected laboratory about sample containers, volumes, and other requirements. If you do not follow the proper sampling and QA/QC protocols, the Department may not consider your results valid.

Sampling kits for sample collection and transport may be purchased from some commercial laboratories and 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 preservatives which may have been added to the containers.

If not using a customized kit provided by your laboratory, use only new containers of the appropriate type for the contaminants for which you are sampling.

Label sample containers prior to sample collection and record type and amount of preservative (if any) on each sample label.

SAMPLING EQUIPMENT

All sampling equipment (bailers, tubing, containers, etc.) must be selected based on the source being sampled (e.g., water supply well, tank pit, monitoring well) and the contaminants potentially present. All sampling equipment should be thoroughly cleaned (see section 13.4 General Cleaning Procedures) and transported in a manner that does not allow it to become contaminated. Arrangements should be made ahead of time for decontamination of any sampling or measuring equipment that will be used when taking more than one sample. Field decontamination of sampling equipment will be necessary between individual sample

collection.

Prepare the storage and transport containers (ice chest, etc.) prior to taking any samples so that each collected sample can be placed in a chilled environment immediately after collection

13.2 GROUNDWATER SAMPLING PROCEDURES

WATER SUPPLY WELLS

In sampling a water supply well, you are attempting to determine the condition of the water which is being delivered to the house or business. Since placing a sampler (sample pump or bailer) into a well could further contaminate the well, the sample should be taken using the existing pump system. All bailers and sampling equipment used should be decontaminated.

In order to get a representative sample, the sample should be taken as close to the pump system as possible without breaking the lines. This means that the first spigot/faucet on the line from the pump should be used to get the sample. In some cases, this may mean sampling from a sink inside the house or building, but many systems have spigots at points much closer to the well. Well construction regulations require a spigot (hose Bib) at the well head, which can be used for sample collection.

Before taking the sample, the static water in the system needs to be purged. For a system which is actively in use, this may be done by running the water at maximum flow rate for at least one minute. If sampling for volatile contaminants, run water for at least 5 minutes. For a system which is not actively in use, the water should be run at maximum flow rate for at least 10 minutes. Longer times may be appropriate if the well is very large diameter or the flow rate from the spigot is low.

Always leave as little airspace as possible in the sample container. If collecting a volatile sample, fill the VOA vial to the upper meniscus, such that the top of the water in the vial reaches above the top of the vial in a convex form. A gentle tap on the side of the vial may be necessary to loosen any little bubbles. When you put the cap on, make sure that no bubbles are left in the vial. Air in the vial will affect the lab results and may not be considered acceptable by the regional offices.

Try to obtain as much information as possible about the well to make a rough estimate of the depth from which the water came, and if possible what the well volume may be. Useful information would be the well depth, casing diameter, static water level, depth of casing and screened intervals where applicable.

WATER IN OPEN EXCAVATIONS

When sampling water from an open excavation, attempt to collect as clear a sample as possible since turbidity may reduce the accuracy of the analysis. Also, always leave as little

airspace as possible in the sample container. Try to avoid bubbles and foam on the surface.

If collecting a volatile sample, fill a VOA vial to the upper meniscus. A gentle tap on the side of the vial may be necessary to loosen any little bubbles. When you put the cap on, make sure that no bubbles are left in the vial.

The sample should be taken so that it represents a "worst case" possibility. Therefore, if you are sampling for petroleum, sample at the surface of the pit water. If sampling for solvents, sample from the bottom.

MONITORING WELLS

1) Measure the Water level

From an established reference point at the top of the well casing, lower a cleaned, weighted steel tape or electric sounder into the well. Use the same reference point each time a water level measurement is made at the well. Measure the static water level.

Note: *When using a steel tape, record the holding mark and the wet level mark from the tape. Subtract the wet level mark from the holding mark to determine the static water level.*

Subtract the water level measurement from the total depth of the well to obtain the height of the water column in feet.

Note: *When using an electric sounder which emits an audible and/or visible alarm upon contacting the water, the holding mark is equivalent to the static water level.*

Thoroughly clean the steel tape or electric sounder before using in another well to avoid cross contamination. If the relative contamination of wells is known in advance, start at the least contaminated well first, and work toward the most contaminated.

2) Purge the Well

The well must be adequately purged prior to sample collection to remove stagnant water and allow water from the surrounding soil or rock, which more accurately reflects the true conditions of groundwater, to flow into the well. The purged water must be disposed of in an environmentally sound manner, so as not to negatively affect the environment.

Determine the volume of water in the well. This can be done precisely, or can be approximated by multiplying the height of the water column (in feet) by the following conversion factors:

2" diameter casing = 0.16 gallon per foot
3" diameter casing = 0.37 gallon per foot
4" diameter casing = 0.65 gallons per foot
6" diameter casing = 1.5 gallons per foot
8" diameter casing = 2.6 gallons per foot
10" diameter casing = 4.1 gallons per foot
12" diameter casing = 5.9 gallons per foot

Remove the static water

To remove the static water, pump or bail three well volumes of water from the well. If you are using a bailer of known volume, bail the necessary volume of water from the well. Otherwise, collect purged water in a graduated bucket so that the volume of water removed from the well can be measured.

A well that is pumped/bailed dry is considered to be adequately purged. Samples may be collected following recovery of the well, within 24 hours of the purging process.

Dispose of the water in an environmentally sound matter that does not negatively affect on the environment.

3) Take the Sample

To prevent accidental contamination during sampling, spread clean plastic sheeting around the well to protect sampling equipment from the ground surface and wear a new pair of disposable gloves, or cleaned reusable gloves, for each well sampled.

After wells are purged, collect samples using a positive-displacement bladder pump or bailer (if using a bailer made of material other than stainless steel, teflon, or glass, do not use any bailer in more than one well - cross-contamination could result). Do not use peristaltic or vacuum systems to collect samples for volatile contaminants (e.g., petroleum or solvents).

Pumps: When pumps of any type are used for sampling, the flow rate must be adjusted low enough to fill the sampling jar effectively. This is especially important when sampling for volatile contaminants. A flow rate of less than about 100 ml/min (½ cup/min) is required to fill a VOA vial without aerating the sample.

Bailers: When sampling with a bailer, lower the bailer slowly into the well to avoid unnecessarily aerating the water sample or agitating sediment on the bottom of the well. Retract the bailer slowly and gently empty the sample into the appropriate

container until the correct volume has been collected. Always leave as little air-space as possible in the sample container. If collecting a volatile sample, fill VOA vial to the upper meniscus. A gentle tap on the side of the vial may be necessary to loosen any little bubbles. When you put the cap on, make sure that no bubbles are present.

13.3 SAMPLE STORAGE AND TRANSPORT

Add prescribed preservatives,before filling the sample containers if necessary. After filling the containers, seal firmly to prevent leakage and store samples for transport in a manner that will prevent breakage. The samples should be kept at a temperature of approximately 4°C (40°F) following collection. Add ice, if necessary, and transport to the certified laboratory of your choice as soon as possible. Avoid unnecessary handling of sample containers. Small samples which require cooling (VOA's, etc.) should be placed in ziploc@ bags prior to being submerged in ice. **The samples should preferably be collected in a glass container prior to being put in the plastic bag.** Avoid either heating (room temperature or above, including exposure to sunlight) or freezing of the sample containers. Reduce the time between sample collection and delivery to a laboratory. Be sure that the sample containers are labeled with the location and/or appropriate well number, the date of collection, the sample type and any other pertinent information.

13.4 GENERAL CLEANING PROCEDURES

Cleaning procedures should be based on the composition (type) of sampling equipment being used, and the type(s) of suspected or known contaminants.

All equipment used in the field must be thoroughly cleaned (decontaminated) between wells to prevent cross-contamination.

Following is a summary of minimum cleaning techniques for bailers and pumps used in sampling petroleum and other noncorrosive contaminants. These same methods are applicable to other equipment of the same composition.

Steps for Cleaning & Decontaminating Sampling Equipment

Stainless Steel Bailers/Equipment

1. Phosphate-free soap and hot tap-water wash
2. Hot tap-water rinse
3. Deionized (or distilled) water rinse
4. Isopropyl alcohol rinse
5. Deionized (or distilled) water rinse
6. Air Dry
7. Wrap bailer (or other sampling equipment) with aluminum foil or other material to prevent contamination before next use. Consider target contaminants when selecting wrapping materials.

NOTE: *If hot tap water is not available, deionized or distilled water may be substituted.*

Teflon or Glass Bailers/Equipment

1. Phosphate-free soap and hot tap-water wash
2. Hot tap-water rinse
3. 10% nitric acid rinse
4. Deionized (or distilled) water rinse
5. Isopropyl alcohol rinse
6. Deionized (or distilled) water rinse
7. Air dry
8. Wrap sampling equipment with aluminum foil or other material to prevent contamination before use (Consider target contaminants when selecting wrapping materials).

NOTE: *If hot tap water is not available, deionized or distilled water may be substituted.*

Bailer lines

Braided nylon or cotton cord should not be reused, even if cleaned, in order to minimize the possibility of cross-contamination.

Teflon coated wire, single strand stainless wire, or other monofilament line can be reused if thoroughly cleaned between use.

Pumps

Pumps and reusable hoses/lines must be cleaned inside and out between use. Be sure that hoses, lines, and exposed gaskets are either made out of non-reactive materials or are replaced between use.

14.0 ANALYTICAL METHODS FOR DETERMINING GROUNDWATER CONTAMINATION FROM NON-HAZARDOUS SUBSTANCES

14.1 FIELD SCREENING METHODS

Several methods are commercially available for screening groundwater samples in the field for contamination. These methods and test kits have features such as speed of detection, ease of operation, cost savings as compared with laboratory analyses, etc. which commend their use. Competent application of field screening techniques can allow the rapid detection of on-site health hazards associated with high concentrations of contaminants. However, because of the lack of specificity, accuracy, precision, reproducibility, etc., associated with field screening methods, they are not approved for the final assessment of the extent of groundwater contamination. The final determination must be made by one of the recommended laboratory analytical methods listed in the following table (Table 8).

14.2 LABORATORY ANALYTICAL METHODS

The recommended laboratory analyses for potentially impacted groundwater are listed in Table 7 and method references follow the table. Due to the complex chemical composition of most petroleum and other groundwater contaminants, these recommendations apply to preliminary screening of groundwater for a variety of potential contaminants. **It is important to note that once actual contaminant compounds have been identified, there may be less expensive analyses available for investigative and monitoring purposes**. Questions regarding analytical methods for site monitoring should be directed to the appropriate regional office.

Results of analyses must be submitted on the appropriate form (GW-59; supplied by the Department) to the attention of the Regional Groundwater Supervisor at the appropriate Regional office, within thirty (30) days of sample collection, if doing compliance monitoring .

NOTE: *For used and waste motor oils, the analyses must include arsenic, cadmium, chromium, lead and mercury.*

FILTRATION: Sample filtration in the field is not permitted for any analyses, and the analytical results of the field filtered samples will not be accepted by any Groundwater Section. For metals analysis, the Standard Method 3030C, Preliminary Treatment for Acid-Extractable Metals will be the only accepted method for metals analysis. This method does include laboratory filtration, which should only be performed by qualified laboratory personnel. The sample must be acidified in the field with 5 ml of concentrated nitric acid per liter of sample and analyzed within 72 hours of collection. A 0.45 micron filter must be used for laboratory filtration following the acid extraction. Please do not submit metals analyses any other way.

Table 7

Suggested Analytical Methods For Groundwater Analyses

Contaminant Testing For:	Method*	Reportable Concentrations
1) Low Boiling Point Fuels: Gasoline, Aviation Fuel, Gasohol, etc.	1. 601 and 602 or 502.2** or 524.2** Also Xylenes, MTBE, EDB, Isopropyl Ether and 2. Std. Methods 3030C*** (Lead)	MDL
2) High Boiling Point Fuels: Diesel, Varsol, Mineral Spirits, Naphtha, Kerosene, etc.	1. 602 (Include Xylenes) or 502.2** and 2. 625 plus 10 largest peaks and 3. Std. Methods 3030C*** (Lead)	MDL
3) Heavy Fuels: #4, #5, #6 Fuel Oil, Motor Oil, Hydraulic Fluid, etc.	625 with 10 largest peaks identified	MDL
4) Used/Waste Oil	1. 502.2 ** and 2. 625 with 10 largest peaks identified and 3. Std. Methods 3030C*** (Metals): Lead, Barium, Arsenic, Cadium, Chromium, Silver, Mercury, Selenium	MDL
5) Metals	1. Standard Methods 3030C ***	MDL
6) Solvents: Halogenated Non-Halogenated Ethylene Glycol Formaldehyde	 502.2 ** or 601 and 602 502.2** GC-FID Chromatropic Acid Method	 MDL MDL MDL MDL
7) Non-Petroleum - Unknown	1. 624 or 524.2** and 2. 625 with 10 largest peaks identified 3. Std. Methods 3030C*** (Metals): Barium, Selenium, Silver, Lead, Arsenic, Cadmium, Chromium, Mercury	MDL MDL MDL
8) Pesticides	Contact N.C. Department of Agriculture and N.C. Department of Environment, Health, and Natural Resources Groundwater Regional Office	N/A
9) For Substances Not Covered 1 - 7	Contact N.C. Department of Environment, Health, and Natural Resources, Groundwater Regional Office	N/A

MDL = Method Detection Limit

* Or other EPA Approved Comparable Method, which also has similar costs and detection limits.

** Standard Methods 6230D and 6210D are accepted by EPA as equivalent to 502.2 and 524.2 respectively.

*** Conditions: 1) Total holding time 72 hours after collection. 2) Use 0.45 micron filter.

NOTE: Once contaminants have been initially identified by GC/MS methods (i.e., 625), other more economical compound specific GC Methods may be used.

REFERENCES

1. EPA 500 Series - "Methods for the Determination of Organic Compounds in Drinking Water", US EPA - 600/4-88/039.

2. EPA 600 Series -Federal Register, October 26, 1984, 40 CFR Part 136.

3. Std Methods 6000 Series -"Standard Methods for the Examination of Water and Wastewater," American Public Health Association, American Water Works Association, and Water Pollution Control Federation, 17th Edition, 1989.

15.0 GROUNDWATER ASSESSMENT AND REMEDIATION AT NON-HAZARDOUS WASTE SITES

The assessment and remediation of a site with groundwater **and** soil contamination should be accomplished by following the guidelines presented below.

1. Prepare and submit a Comprehensive Site Assessment (CSA)

2. Prepare and submit a Corrective Action Plan (CAP)

3. Prepare and submit Site Closure documentation

This section applies to all releases from underground storage tank (UST) systems and other non-UST sources.

For UST systems, the requirements for assessment and remediation are outlined in Title 15A, NCAC, Subchapter 2N, Section .0700. Initial response and initial remedial actions are outlined in Sections .0702 through .0705. Investigation for soil and groundwater cleanup (CSA) requirements are outlined in Section .0706, and the CAP requirements are in Section .0707. For other release sources the requirement for site assessment and corrective action is authorized at 15A NCAC 2L .0106.

15.1 COMPREHENSIVE SITE ASSESSMENT (CSA)

The CSA sufficiently characterizes the cause, significance and extent of groundwater and soil contamination such that a Corrective Action Plan (CAP) can be developed.

A CSA for groundwater and soil contamination is required if any of the following requirements apply:

1. Contaminant concentrations in groundwater exceed the 15A NCAC 2L groundwater standards

2. Free product is present on the water table

3. Contaminated soil is in contact with groundwater or in proximity to groundwater

4. The Division of Environmental Management or other regulatory agency requests it

5. For petroleum contaminated sites, in-situ soils exceeding the final cleanup level determined by the SSE exist outside the spatial boundaries described in Section 8 "Limiting Quantities and Costs of Soil Treatment/Disposal".

Submit a CSA report to the appropriate regional office. Guidelines for preparing a CSA report appear below. As the CSA report format addresses **both** soil and groundwater contamination, submit only **one** report for a site. All sections **must** be addressed for groundwater contamination; however, for incidents where only soil contamination exists, subsections 7, 10 (J, K, L, M) and 11 (D) may be omitted from the CSA report. Do **not** submit separate CSA reports for an incident with both soil and groundwater contamination.

15.2 COMPREHENSIVE SITE ASSESSMENT (CSA) FORMAT

Minimum Elements of CSA Reports:

1. **Title Page**

   a. Relevant site information
      - Site name, incident identification No. # (if applicable) and location
      - Date report submitted
      - Responsible party and author of report.

2. **Executive Summary**

   a. Source information
      - Type of source (gasoline, diesel etc.)
      - Container (tank, line, drum)
      - Amount of release (gallons, estimated or know)

   b. Initial abatement/emergency response information
      - Tank Closure?
      - Soil removal, quantity and disposition
      - Amount of free product recovered and remaining (gallons, estimated)
      - Alternative water supply availability and location

   c. Damage/extent of release information including potentially affected receptors
      - Potentially affected receptors (e.g. water supply wells, surface waters, drinking water supplies)
      - Subsurface structures (basements, vaults, etc.)
      - Populations (residences, schools, parks, etc.)
      - Maximum contaminant concentrations in soil and groundwater (lab data only)
      - Groundwater estimated flow rate (ft/yr) and direction

   d. Conclusions/recommended corrective action

NOTE: *The Executive Summary should provide a brief overview of the pertinent site information, i.e., it should provide sufficient information to acquaint the reader with the who, what, when, where, why and how of site activities to date.*

3. Table of Contents

a. First page number for each section listed
b. List of Figures (all placed in a single section following contents text)
c. List of Tables (all placed in a single section following contents text)
d List of Appendices

4. Site History and Source Characterization

a. Give a history of property ownership and use. Discuss chronology with references, lists and tables indicating owners/operators, dates of ownership (immediately prior to 1/1/74 through the present), uses of site and potential sources, which may include UST's, aboveground storage tanks (AST's), chemicals used and stored onsite, hazardous substances, etc.

b. Summarize release incidents and environmental investigations of known contamination. Discuss current and previous releases including but not limited to dates, sources, extent, inventory discrepancies, system tightness test, odors, stained soils, observed product, samples taken, previous enforcement orders, civil penalty assessments, etc. Reference any previous reports

c. Summarize corrective actions to date (reference any reports), emergency response/initial abatement, free product recovery and primary and secondary source removal

5. Potential Receptors and Migration Pathways

This section should include identification and location of water supplies within 1500 feet of the contamination; surface water intakes for public water supplies with 0.5 mile; identification of adjacent property owners; identification of subsurface utilities; availability of municipal water lines and identification and discussion of the potential impacts that different pathways may have on contaminant migration (e.g., septic leach fields, utility lines and the effects of fluid mounding, etc.).

Reference the required figures and tables in subsections 10 and 11 below.

6. Soils Investigation

Briefly discuss the site's soils and geology. Soil gas surveys results should be included if performed. Discuss how soil and geological characteristics may affect the migration and attenuation of contaminants. Reference the required figures and tables in Sections 10 and 11.

NOTE: *Full reimbursement for soil treatment may not be approved without adequate evaluation of the most cost-effective treatment options.*

7. Groundwater Investigation

a. Discuss the number, location and construction of monitor wells, in terms of the nature of contaminants (i.e., floaters vs. sinkers, placement of screened interval, etc.) and the aquifer contamination in both the vertical and horizontal extent (i.e., contaminated groundwater in saprolite vs. bedrock, upgradient vs. downgradient wells, etc.).

b. Discuss the plume's physical and chemical characteristics and significant features or mechanisms that could affect local groundwater flow patterns and plume migration.

c. Discuss the hydrogeologic conditions unique to the site such as vertical permeability of the unsaturated zone, hydraulic conductivity of the saturated zone, aquifer characteristics, confining beds, and depth to the seasonal high water table.

d. Discuss justification for all well locations and screening intervals.

Reference the required figures and tables in Sections 10 and 11.

NOTE: *If large volumes of contaminated water are to be generated during aquifer testing, use slug tests to gather interim data for developing CSA while awaiting discharge permit for contaminated water.*

8. Recommendations

Discuss the proposed preliminary corrective actions for developing a CAP and provide a rationale.

9. References

a. Interview summaries, including dates, contacts, etc.
b. File reviews for onsite/offsite sources
c. Resource materials cited

10. Figures (All figures should include scale, north arrow, and site location in addition to the information listed below)

a. 7 1/2 minute USGS topographical quadrangle map (photocopied portion)
   - indicate water supplies within 1500 feet
   - quadrangle name
   - north arrow
   - scale

b. County road map

   - include primary/secondary road numbers

c. Site base map/plan

   - North arrow

   - Surface features including property boundaries, roads/easements/rights of way, existing and previous building/structure, pavements, product or chemical storage areas, surface water bodies, drainage ways, wetlands, etc.

   - Subsurface features including underground storage tank systems (former/existing), basements, utilities, wells of all types, septic tanks, etc.

NOTE: *All reports submitted to DEM should make use of graphical methods of data presentation to the greatest extent possible. An appropriate number of useful and topical maps, figures and tables should be provided so that rapid and comprehensive reviews of site data are possible. Furthermore, the text of reports should provide a concise synthesis of this graphical information so as to clearly communicate the preparer's own interpretations of the data.*

If possible, a single base map should be used to prepare site plans, potentiometric maps, isocontour maps, etc. using a map scale of 1 inch = 100 feet. Maps and figures submitted to DEM should include conventional symbols,

notations, labelling, legends and north arrows and conform to generally accepted practices of map presentation such as those enumerated in the U.S.G.S. Geological Survey pamphlet, "Topographic Maps".

d. Receptor well map showing location of all downgradient water supplies within 1,500 feet of contamination including surface water intakes for public water supply, all water supply wells, and irrigation wells. Provide a table listing well owner and pertinent construction details keyed to the figure. The map scale should be 1 inch = 400 feet.

   If no water supplies exist within 1500 feet, state this with references in report and on the map.

e. Local monitoring well map showing location of all monitoring wells for off-site sources within 1,000 feet of the site.

f. Designation of subsurface utilities, lines, conduits, basements and other structures potentially at risk from free product and/or vapors (note whether they intercept the water table)

g. Soil sample (grabs, boring, etc.) locations superimposed on base map

h. Cross-sections through the contaminated soil

   - Show at least at least two profiles crossing at or near right angles
   - Indicate sample location results noted adjacently
   - Delineate vertical extent of contamination (preferably in cross section)
   - Indicate subsurface profiles, illustrated fill, bedrock and outcrops, intersecting conduits, structures (if applicable)
   - Show SSE contour (if applicable)

i. Isoconcentration contour map(s) of soil contamination

   - Show horizontal and vertical contaminant extent in unsaturated zone
   - Delineate concentrations above the action level established for soil remediation with a bold contour
   - Delineate the Site Sensitivity Evaluation (SSE) cleanup level with a bold contour
   - Include SSE form (if applicable)

j. Potentiometric/groundwater elevation contour map

- Superimpose on a base map
- Show and label source location(s), monitor wells and recovery wells
- Note water level elevations at wells
- Note footnote pumping conditions
- Identify and locate datum (arbitrary 100', USGS, NGVD) or benchmark
- Use appropriate contour interval
- Show direction of groundwater flow and average gradient

NOTE: *A separate map (modified base map) or acetate overlays may be used for all potentiometric contour maps.*

k. Free product thickness map

- Superimpose on a base map with all wells labelled and thickness noted at wells
- Use appropriate contour interval (0.01 foot minimum)
- Note date and method of measurement

NOTE: *Acceptable methods of free product measurement include interface probes, tape/paste, or other DEM pre-approved methods only.*

l. Contaminant isoconcentration contour map(s)

- Superimpose on a base map with all wells labeled
- Label wells with contaminant, concentration and footnote date of sampling
- Plot total volatile (if applicable) and most widespread contaminant, most concentrated contaminant, (if warranted)

NOTE: *For all applicable plots, a 15A NCAC 2L standard contour must be shown in bold. A series of wells with contaminant levels near or below the 2L standard will be required to demonstrate this condition.*

m. Contaminant isoconcentration contour crossections

- Use at least two orthogonal sections that transect the contaminated zone
- Label wells with contaminant concentrations and footnote date of sampling
- Use vertical and horizontal scales
- Depict surface topography and stratigraphy
- Depict screened intervals of wells and water levels
- Note potentiometric elevations for each well and soil boring
- Footnote horizontal and vertical gradient

NOTE: *Data from at least one upgradient and one well or well cluster (i.e., nested or proximal shallow and deep wells) are required to accurately construct these sections. At least deep well or well cluster must demonstrate contaminant levels at or below the appropriate 2L standard.*

11. Tables

a. Table of water supply well construction details keyed to the appropriate figure(s)

Include well numbers that correspond to map, owner's name, address, well use and construction information.

b. Table of adjacent property owners

Include names, addresses and telephone numbers and show adjacent properties on the site base map

c. Table of field screening and laboratory data for soil

Reference sample identification numbers, sample type, (grab, split spoon, auger etc.), sample depth, total depth of boring, analytical method, units and dates of sampling and analysis on the site base map.

NOTES: *The measured point at top of casing must be permanently marked or noted in the field. The table of potentiometric surface elevations should be part of the potentiometric contour map if space allows.*

d. Summary table of dissolved contaminant concentrations in groundwater

- Include "at risk" water supply wells, contaminated supply wells, monitor wells, sample identification numbers referenced on base map, analytical methods and units of measure

12. Appendices

a. relevant information

- Standard operating procedures used at site for sampling, equipment decontamination, field screening, well construction, well gauging, etc.
- Boring logs and soil descriptions
- Well construction records
- Chain-of-custody forms
- Laboratory reports for all samples
- List and/or copies of permits received, permitting agency, permit number and date issued
- Other documentation as appropriate (e.g., tank/line tightness results, aquifer tests)

15.3 CORRECTIVE ACTION PLAN

The CAP describes the proposed remedial actions at a site. The CAP's are required when the CSA indicates that additional remedial action is necessary.

Submit the CAP to the regional office for approval. **Approval of the CAP is conditional upon approval of any required permits.** Responsible parties and owners/operators may, in the interest of minimizing environmental contamination and promoting more effective cleanup, initiate groundwater and soil remediation before CAP approval. However, they must notify the appropriate regional office of their intentions to begin remediation, comply with any conditions imposed by the Department, and incorporate the self-initiated remedial measures into the CAP. Public notice of the CAP is required for regulated UST before approval is final. The Department encourages soil and groundwater cleanups to proceed as soon as possible, sometimes without the appropriate regional office approval. The CAP approval is required but should not hinder the initiation or progress of a cleanup.

Guidelines for preparation of a CAP report appear below. Because the CAP report format addresses both soil and groundwater contamination, address **each** applicable medium (i.e., soils, groundwater) separately within the report. Do **not** submit a separate report for both soil and groundwater.

15.4 CORRECTIVE ACTION PLAN (CAP) REPORT GUIDELINES

1. **Table of Contents** (please number all pages of text)

2. **Introduction**

   a. Site Name, location (attach 7 1/2 minute USGS topo map with quad name, and site map indicating city and road names/numbers), Responsible Parties (owners/operators if UST site), Property Owner, Incident # (if known)

   b. Purpose of CAP (e.g. response to Notice Of Violation (NOV) and/or Notice of Regulatory Requirements (NORR), remediation of soil, groundwater, surface water, vapors)

      - State cause of contamination and source(s)
      - Cite specific regulations violated
      - Cite substances exceeding the groundwater standards and the soil remediation guidelines (and, if applicable, cite the naturally occurring concentrations)
      - State the classification of the affected groundwater

   c. **Brief** Summary of Initial Remedial Actions to Date

      - Tank/Soil excavation - specify number, contents and capacity of tanks removed, date(s) of removal, tank condition, dimensions of excavation and quantity of soil excavated.
      - Soil treatment/disposal (quantities and methods)
      - Free product recovery (quantities and methods)
      - Any other corrective actions taken
      - Specify additional quantities of soil, free product, etc. that need to be remediated

   d. Reference Previous Reports Submitted
      (UST Closure Report, (if applicable), Initial Abatement and Site Check, Free Product Recovery, Initial Site Characterization, Comprehensive Site Assessment (CSA), etc.)
      - Cite titles, report dates, and dates submitted to regional office
      - From Comprehensive Site Assessment (CSA) report (see CSA Report Guidelines for contents), attach plume maps/cross sections indicating the lateral and vertical extent of contamination for free product, soil, and dissolved groundwater contamination; note water levels and data/reference points on all cross sections

      Do not attach a copy of any report as an appendix !

e. Reference Any Previous Permits/Certificates
(e.g. Certificates of Approval or Soil Remediation Permits, interim discharge permits, etc.)
- Cite permit number
- Cite approval/permit issue dates

3. Objectives of the CAP

a. Statement of goals and expected accomplishments (e.g. free product recovery, containment or retardation of plume migration, reduction of contaminant concentrations and reduction in areal/vertical extent of plume, protection of nearby water supplies, etc.)

b. Target cleanup concentrations for soil and/or groundwater (include Table summarizing existing levels and target clean-up levels)

NOTE: *If Site Sensitivity Evaluation (SSE) was performed to obtain soil clean-up levels, reference submitted documentation.*

c. Target startup and completion dates of Corrective Action Plan
- Submittal of pilot test data
- Submittal of necessary permit applications
- Commencement of remedial actions
- System installation
- System activation
- System shut-down
- Estimated time frame to achieve clean-up goals, target clean-up concentrations
- Project completion date (to satisfaction of DEM)

4. Exposure Assessment

a. Present Table summarizing historical analytical data. Note violations of groundwater standards and soil clean-up levels (See Site Sensitivity Evaluation (SSE) Section)

b. **Briefly** discuss the physical and chemical characteristics of the contaminants, including their toxicity and persistence.

c. Identify all significant pathways for human exposure, considering:
- Release scenario and source characterization
- Fate and transport of contaminants within affected media
- Current and future uses of affected media (soil, air, surface water, groundwater, biota)
- Exposure points and routes (ingestion, inhalation, etc.)

d. Discuss the potential effects of residual contamination (post-remedial) on nearby surface water and groundwater.

e. Identify potential receptors at greatest risk assuming no further corrective action. (Consider current and future uses of nearby surface water and groundwater.)

5. Evaluation of Remedial Alternatives

NOTE: *Address each medium (soil, groundwater, surface water, vapors, etc.) separately, and present a table summarizing the following:*

a. Discussion of Remedial Options:
- Feasibility of various alternatives
- Options for disposal of groundwater
- Advantages vs. disadvantages
- Cost estimates (capital and yearly overhead estimates)
- Alternate Water Supplies

b. Statement of Recommendation and Rationale for Selection:
- For remediation of affected medium (soil, groundwater, surface water, etc.)
- For any discharge and associated permitting, if necessary

6. Proposed Corrective Action Plan

NOTE: *Address each medium (e.g., soil, groundwater, etc.) separately.*

a. Overview/General Description of System

b. Conceptual Design/Process Flow Diagram

NOTE: *Detailed design plans and specifications along with the operational characteristics and performance standards of each system component should be placed in the Appendix.*

c. Basis for Selection of Recommended Remediation
   - Results of bench tests/pilot studies
   - Results of aquifer tests
   - Diagram of radius of influence with recovery wells superimposed on plume map
   - Flow rates, injection rates determined
   - Anticipated effluent concentrations after each unit of treatment

NOTE: *Include data compiled, calculations, pump curves, performance charts, etc., in the Appendix*

d. System Layout Superimposed on Base Map (include all components of the system - groundwater and vapor recovery wells, air/water injection wells, interceptor trenches, infiltration galleries, groundwater treatment units, discharge points, piping, etc.)

e. System Security and Safety Measures (e.g. security fence, automated system controls and shutoff, explosion proof systems)

f. Limitations (Discussion of limiting factors such as site restrictions, climate, biofouling, technological feasibility, type of contaminants, impacts on environmental receptors, etc. Also discuss proposed methods of dealing with the limitation)

g. Operation and Maintenance of the System
   - System startup information/data (e.g., where applicable, initial influent concentrations, dissolved oxygen levels, pH, etc.)
   - Modifications to system, if necessary
   - Certified operator, if necessary
   - Automated/manual controls
   - Maintenance plan and schedule

h. Follow-up Monitoring, System Evaluation, and Reporting
   - Sampling plan (locations, sampling methods, frequency, and analytical methods)
   - Plan for periodic monitoring to detect changes in groundwater movement, plume geometry, and qualitative characteristics of the plume; and to assess site response to disposal of effluent (Consult with appropriate regional office).
   - Evaluation of the effectiveness of the system (e.g., accomplishment of goals regarding free product recovery, retardation of plume migration, reduction in areal/vertical extent of contamination, contaminant removal efficiencies, achievement of target cleanup concentrations)

7. Permits

List all required permits for soil and groundwater remediation. *Attach copies of completed applications in the Appendix.* *DO NOT SUBMIT ANY FORMAL PERMIT APPLICATION WHEN SUBMITTING CORRECTION ACTION PLAN FOR REVIEW.*

Note: *Original application and appropriate number of plan copies should be submitted to the appropriate permitting agency.*

8. Report Certification by NC Professional Engineer and/or Geologist

9. References

10. Appendices

Include the following, if applicable:

- Cost Estimates for Remedial Technologies (attach prepared estimates and quotes obtained)
- Detailed design & specifications of system components
- Pump curves, performance charts
- Design calculations
- Aquifer test data/calculations
- Copies of completed permit applications

NOTE: *Do **NOT** include any previously submitted reports in the Appendix. Previous reports should be cited in the Introduction Section (under 2d of this outline.)*

15.5 SITE CLOSURE

Site closure may occur when information is provided to document that site remediation has achieved the cleanup levels or standards specified by the regulatory agency.

1. Sites which currently violate groundwater standards

NCAC Title 15A Subchapter 2L "Classifications and Water Quality Standards Applicable to Groundwaters of North Carolina", outlines the procedures for discontinuance of remedial action for sites which have documented violations of the groundwater standards.

2. Sites which have violated groundwater standards, have undergone remediation and are currently below the groundwater standards

For sites which have documented violations of the groundwater standards and have been undergoing active remediation, the following information will be required before "no further action" at the site will be considered:

a. Four consecutive quarters of data documenting no contamination above NCAC 15A 2L standards while the remediation system is operational.

and

b. four consecutive quarters of data documenting no contamination above NCAC 15A 2L standards after the remediation system has been shut down.

or

c. Achievement of an asymptotic relationship between the cleanup goal and cleanup results.

NOTE: *Appropriate analytical methods, with the lowest detection levels technically feasible, should be used to obtain the data required above.*

16.0 PERMIT REQUIREMENTS FOR THE REMEDIATION OF CONTAMINATED GROUNDWATER AT NON-HAZARDOUS WASTE SITES

Since the majority of the state's citizens rely upon groundwater as their source of drinking water, there is increasing concern for the protection and restoration of this resource with regard to spills and underground leaks of petroleum products and other chemicals. Rules in NCAC 15A 2L, which govern the protection and the restoration of groundwater resources, require that contaminated groundwater be remediated to a level of compliance with established quality standards.

Where groundwater is withdrawn from the subsurface, it must be disposed of in accordance with State Statute and Rule. N.C.G.S 143-215.1, requires that no wastewater (which includes contaminated groundwater) be disposed of without the appropriate permit(s). This section describes the major types of groundwater remediation methods and the type of prior approval(s) associated with each method. Table 8, summarizes the permits required for the following methods.

16.1 DESCRIPTION, DESIGN AND OPERATION CONSIDERATIONS ASSOCIATED WITH VARIOUS GROUNDWATER REMEDIATION METHODS

IN-SITU TREATMENT

I. This includes all remediation activities which do not involve the withdrawal and subsequent disposal of groundwater. Since no wastewater disposal permits are required, compliance with all applicable statutes, rules and environmental standards will be a requirement for approval to implement a Corrective Action Plan (CAP). If in-situ treatment involves the introduction of chemicals or bacteria into the subsurface for the remediation process, the CAP must include (1) a description of the type(s) and concentrations of additives, (2) the method and frequency by which the additives will be discharged on or below land surface, and (3) documentation (computer models, results of previous pilot studies, published reports, etc.) that both support the effectiveness of the proposed process and demonstrate that applicable water, air or land quality standards will not be contravened.

GROUNDWATER RECOVERY, TREATMENT AND DISPOSAL

II. (a) DISPOSAL VIA INFILTRATION GALLERIES. A Non-Discharge Permit is required by 15A NCAC 2H.0200 (Waste Not Discharged To Surface Waters). The design and operation of these galleries must be in accordance with those rules. The permit application must include the documentation specified in I (1-3) above. The galleries must operate as "closed-loop" systems (i.e. fluids introduced into the subsurface will be captured through the recovery portion of the remediation system). The level of treatment of the contaminated groundwater, prior to discharge into a

gallery, shall be as follows: (1) If the gallery is to be located outside the contaminant plume, or outside the compliance boundary as defined in 15A NCAC 2L .0107, or on property other than that on which the source of the groundwater contamination occurred, the treated groundwater being disposed of must not contain concentrations of contaminants in excess of those specified in the groundwater quality standards [15A NCAC 2L .0202]; (2) In all other instances, the treated groundwater shall not contain more than 5% of the concentration of contaminants in the groundwater influent.

(b) DISPOSAL BY INJECTION WELL SYSTEM. A Non-Discharge Permit is required. No separate permit for injection well construction and/or operations will be issued. Instead, regulatory compliance with the injection well rules (15A NCAC 2C.0200) will be controlled through conditions incorporated into the Non-Discharge Permit. The level of treatment of contaminated groundwater, prior to discharge into an injection well shall be the same as that specified in item II(a)(1) and (2) above. Additionally, the injection wells must be constructed and operated such that (1) the injected liquid does not exit the well bore above or below the demonstrated vertical extent of the contaminant plume, and (2) operation of the remediation system will not result in a contravention of groundwater quality standards at the compliance boundary (15A NCAC 2C.0107), and (3) they are operated as a closed-loop system as described in (a) above.

(c) DISPOSAL BY SPRAY IRRIGATION - A Non-Discharge Permit is required. Dependent upon the level of volatile material in the contaminated groundwater and the potential threat that those compounds may present to public health, Air Quality registration and/or increased buffer zones between the spray site and the property boundary may be required. The level of required treatment of the contaminated groundwater, prior to spray irrigation, will be dependent upon the calculated threat of contravening water quality standards.

(d) DISPOSAL VIA TREATMENT LAGOONS - A Non-Discharge Permit is required. If the lagoon is designed to operate as an infiltration system, the level of required treatment for contaminated groundwater entering the lagoon will be dependent upon the lagoon's location and will be in accordance with the specifications outlined in items II(a)(1) and (2) above.

(e) DISPOSAL VIA MUNICIPAL WASTEWATER TREATMENT PLANTS - A Pretreatment Permit must be obtained from the appropriate municipal authority. Since this permit will specify the type, concentration and volume of wastewater acceptable at the facility, municipal approval is required prior to finalizing plans for the on-site remediation system.

(f) DISPOSAL VIA STORM SEWERS, DRY DITCHES OR SURFACE WATER BODIES - An NPDES General Permit is required. Design and operation of facilities that utilize one or more of these disposal options must be in accordance with 15A NCAC 2B.0100 (Wastewater Discharged to Surface Water). Major permitting considerations include (but are not limited to) types and concentrations of contaminants and location and daily volume of discharge. It is important to note that a general permit is not acceptable for contaminants other than petroleum.

(g) DISPOSAL VIA PUMP & HAUL - a Non-Discharge Permit is required. For emergency situations, this permit is issued by the regional office. This disposal method should be considered as a long-term solution only when other disposal options are not practical.

NOTE: *There are significant differences in processing time for the various permits required for remediation. Issuance of a NPDES permit and the associated authorization to construct, may take a year or more following the submittal of the application. Issuance of a NPDES General Permit takes less time than other NPDES permits. Issuance of a non-discharge permit, related to groundwater remediation, generally takes two to three months from receipt of a complete application. The Division allows up to 90 days for a review of a complete permit application. Well construction permits are issued in less than 15 days.*

Delays in permit processing can be significantly reduced by the submittal of complete application packages. The delay of implementation of a Corrective Action Plan at a site, as a result of an incomplete permit applications will not be considered beyond the control of the person responsible for the corrective action. Enforcement action may be recommended by the regional Groundwater staff if the delays affect deadlines which were established by the DEM Director.

Table 8

Permit Requirements For Groundwater Remediation

Remediation Methods (2)	Types of Prior Approval Required				
	Non-Discharge Permit	NPDES Permit	Air Quality Permit/ Registration	Well Construction Permit	Injection Well Operations Permit
I. In-Situ (i.e. Air-sparging; nutrient/O_2 addition to promote biodegradation; addition of select bacteria to promote/enhance biodegradation; thermal treatment, etc.)	(3)	(3)	(1)	(3)	(3), (4)
II. Recovery and (possibly) treatment, with final disposal by means of:					
(a) Infilration Gallery	√		(1)	(4)	
(b) Injection Well System	√		(1)	(4)	√(4), (5)
(c) Spray Irrigation	√		(1)	(4)	
(d) Treatment Lagoon	√		(1)	(4)	
(e) Storm Sewer/Sanitary Sewer/Dry Ditch/Surface Water Body		√(6)	(1)	(4)	
(f) Pump and Haul	√			(4)	

Legend For Table 8

1) For remediation treatment systems that result in emissions to the atmosphere Air Quality Registration (or in some cases an Air Quality Permit) is required. Contact staff in the Air Quality Section of the appropriate Regional Office prior to construction of such systems.

2) An Erosion Control Plan must be approved prior to the construction of any remediation system in which the construction will result in the disturbance of more than one (l) acre of land. Implementation of the plan will then be incorporated into the approval of an Corrective Action Plan (CAP) and any required permit. Contact the staff in Land Quality in the appro priate Regional Office prior to construction of such systems.

3) No permit is required. As part of the state's review of any Corrective Action Plan proposing this remediation method, there must be a demonstration, based on computer modeling. Pilot studies or published reports, showing that the proposed method will not result in a violation of any environmental rule or standards and does not present a threat to human health or the environment, is adequate. The Division reserves the authority to require a permit if it deems appropriate.

4) A well construction permit will be required in the following situations:
   a) For monitor wells constructed on property other than that on which the contaminant source is located, or if the well owner does not own the land upon which the well is located.
   b) For recovery wells where groundwater or other liquids will be withdrawn from the subsurface.
   c) For injection wells where anything other than pretreated petroleum contaminated groundwater or air is introduced into the subsurface via a well.

5) Except for pretreated, petroleum-contaminated groundwater, the disposal of wastes on the introduction of contaminants into the subsurface, via wells is prohibited by statute and rule. No separate permit to construct and operate an injection well is required; however, requirements for compliance with the Rules governing injection wells will be incorporated into the Non-Discharge Permit.

6) Where discharge is to a municipal waste treatment facility, a pretreatment certification by that facility replaces the need for a NPDES Permit.