

**North Carolina Department of Environmental Quality
Division of Waste Management
Hazardous Waste Section**

GENERATOR CLOSURE GUIDELINES

June 28, 2016

**NOTE: This document replaces the clean-up guidance
“*Generator Closure Guidelines*” revised December 2, 2013**

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1.0 Purpose and Application

The purpose of this document is to ensure the consistent assessment and clean up of sites contaminated with hazardous waste, or constituents from releases of hazardous waste. Sites with releases of hazardous waste, or hazardous waste constituents are subject to NC Hazardous Waste Management Rules administered by the Hazardous Waste Section (HWS). The “generator closure” process described here is used by the HWS Compliance Branch (Branch) to address releases where (1) soil can be cleaned up to background or risk-based clean-up levels **and** (2) groundwater has not been affected. A generator closure is limited to site assessment and removal of surface and subsurface soil or debris. Successfully completed generator closures are not subject to RCRA permitting requirements. If groundwater is determined to be contaminated, the jurisdiction for the site is referred to another branch or section within DWM. For example, a site may initiate activities as a generator closure then, due to groundwater contamination or soil contamination that cannot be remediated, be referred to another branch or section within the division.

2.0 Regulatory Requirements

A. Hazardous Waste

The Division of Waste Management’s (DWM) HWS has jurisdiction for the remediation of contamination resulting from the spill or release of hazardous wastes as defined in 40 CFR 261, and adopted by reference in 15A NCAC 13A .0106. The HWS must be notified when such a release or contamination is discovered. Sites using this guidance must submit reports to the Compliance Branch Chemist for review and approval. See the list in Appendix 7 for Branch contacts and phone numbers.

Hazardous Waste Section

Physical Address:

217 West Jones Street, Raleigh, NC 27603

Mailing Address:

1646 Mail Service Center, Raleigh, NC 27699-1646

919-707-8200

B. Underground Storage Tanks

DWM’s Underground Storage Tank Section has jurisdiction for remediating contamination from underground or above ground storage tanks that do not hold hazardous wastes. This section also issues permits for land application of petroleum contaminated soil, land application of non-hazardous contaminated soil originating from DWM sites, and disposal of petroleum contaminated soil at dedicated disposal sites.

Division of Waste Management/ Underground Storage Tank Section

Physical Address:

217 West Jones Street, Raleigh, NC 27603

Mailing Address:

1637 Mail Service Center, Raleigh North Carolina 27699-1637

919-707-8171

C. Solid Waste

DWM’s Solid Waste Section regulates the management of solid waste disposal. You may need to coordinate with this section when evaluating disposal options for contaminated soil and media.

Solid Waste Section

Physical Address:

217 West Jones Street, Raleigh, NC 27603

Mailing Address:
1646 Mail Service Center, Raleigh, NC 27699-1646
919-707-8200

D. Pesticide Contamination

The Pesticide Section of the NC Department of Agriculture's Consumer Services must be contacted when pesticide contamination of soil or groundwater at any concentration is known or suspected.

North Carolina Department of Agriculture, Pesticide Section
2109 Blue Ridge Road, Raleigh, North Carolina 27607
919-733-3556

E. Water Resources

Releases to surface waters must be reported to the Division of Water Resources. Contamination complaints associated with water supply wells are also under DWR jurisdiction unless it is clear the complaint is directly related to a source for which DWM is responsible (see above).

Division of Water Resources/ Water Quality Programs
1617 Mail Service Center, Raleigh, North Carolina 27699-1617
919-807-6300

F. Dry-cleaning Facilities

DWM's Superfund Section must be contacted when contamination of soil or groundwater is known or suspected from dry-cleaning operations.

Superfund Section/ Dry-cleaning Solvent Clean-up Program
Physical Address:
217 West Jones Street, Raleigh, NC 27603
Mailing Address:
1646 Mail Service Center, Raleigh, NC 27699-1646
919-707-8200

3.0 Initial Site Actions /Site Characterization and Reporting

Generator closure provisions are used to clean up releases of hazardous waste or hazardous waste constituents where groundwater has not been impacted. Clean-up activities under a generator closure are limited to contamination assessment and removal of surface and subsurface soil or debris. The discussion below provides more detail about the generator closure process.

When a discharge or release of hazardous waste is discovered, a responsible party (RP) is required to notify the HWS immediately. (See the HWS contacts listed in Appendix 7). Any detectable amount of a contaminant released to the environment is considered a discharge. The RP is required to take immediate action to stop and control the discharge and to prevent and mitigate any fire, explosion or vapor hazards.

After the initial response actions to contain and control the release, the RP must determine the presence of soil and/or groundwater contamination. The RP must submit two copies of an Initial Site Sampling Plan (ISSP) that details the intended site assessment activities to the Branch for approval. The format for the ISSP is outlined in Appendix 3. When approved, the ISSP and any conditions specified by the HWS must

be carried out following the plan's schedule. After the ISSP activities are performed, submit a report of the initial site assessment to the Branch for review. The ISSP should be incorporated into the Assessment and Clean-up Plan, if contamination is discovered. The report should include (1) a description of the activities performed (in a format consistent with the ISSP), and (2) the analytical results (in a format consistent with the Laboratory Reporting Format in Appendix 3).

If contamination has been discovered, its extent must be determined. The RP must submit two copies of an Assessment and Clean-up Plan (ACP) for review that describes the actions necessary to define the extent of contamination and to remediate the contamination. When releases are small and the extent of contamination is readily defined and removed, the ISSP and ACP may be combined. All plans and reports must be submitted to the HWS Compliance Branch Chemist for review (See Appendix 7). When approved, the RP must implement the ACP following the approved schedule. When contamination has been remediated to below the specified clean-up levels (see Section 4.0), the RP must submit two copies of a Closure Report to the Branch Chemist. Where sites have been remediated to appropriate clean-up levels, the Branch will issue a letter stating that no further action is required. When contamination cannot be cleaned up to the specified levels documented in the Closure Report, the site will be referred to the appropriate division or branch for oversight.

NOTE: The letter of “no further action” is for the specific contamination event documented in the Closure Report. It is not applicable to other areas of contamination at the site or contamination that may be discovered at the site in the future. If the facility is operating under the terms of an enforcement document, actions must be undertaken by the compliance dates set within the enforcement document. The enforcement document may set requirements that the facility must comply with in addition to the requirements specified in this guidance. A “no further action” letter does not denote complete compliance with any enforcement action.

4.0 Clean-up Requirements

The HWS requires contaminated soil to be remediated to risk-based levels that protect both human health and the underlying groundwater, or site-specific background levels. The HWS requires contaminated groundwater to be remediated to NC 2L standards or site-specific background levels.

4.1 Soil Clean-Up Levels

For sites being remediated to the risk-based clean-up level, the RP must determine, for each contaminant detected at the site, the (1) health-based residential level for direct contact with soil and (2) soil screening level protective of groundwater. The lower of these two values will be the clean-up level for each contaminant of concern. The Preliminary Soil Remediation Goals, both health-based residential soil remediation goals and soil remediation goals protective of groundwater, are available at the following web link.

<http://deq.nc.gov/about/divisions/waste-management/waste-management-permit-guidance/inactive-hazardous-sites-guidance-documents>

The HWS has the discretion to adjust soil clean-up levels based on site-specific information, the most recent toxicological data, the potential for adverse effects to surface water or indoor air, other relevant exposure situations or technical impracticability.

4.2 Site-specific Background Levels

Site-specific background soil samples may be collected to establish natural metal concentrations. Samples must be collected according to Section 5.5.B. Once approved by the Branch, these background levels may be used as alternative clean-up levels for metals only.

THE FINAL CLEAN-UP LEVEL FOR EACH SOIL CONTAMINANT IS THE:

- ❖ **Lowest of the residential risk-based concentration or the soil screening level protective of groundwater, or**
- ❖ **Site-specific background soil concentrations (metals only)**

Residential and soil screening levels are provided in the Preliminary Soil Remediation Goals Table

4.3 Groundwater Clean-Up Levels

If groundwater contamination is detected during a generator closure, remediation oversight will be transferred to the appropriate division or branch. Groundwater clean-up levels are either site-specific background levels or the State's Classifications and Water Quality Standards Applicable to the Groundwaters of North Carolina (2L Standards). NC 2L standards are available on the Internet at <http://deq.nc.gov/about/divisions/water-resources/planning/classification-standards/groundwater-standards>

5.0 Minimum Sampling Requirements

5.1 Introduction

This section provides general guidance on minimum sampling requirements to determine (1) if contamination exists and (2) the horizontal and vertical extent of the contamination. At some sites, additional sampling and analysis based on site-specific conditions will be required.

To determine the presence of contamination for each area of concern, the ISSP must propose, at a minimum, the collection of samples described below. If contamination is present, the next phase of the investigation must define the extent of each contaminant in each area of concern, for each environmental medium contaminated. The RP must provide the activities proposed to define and remediate the extent of contamination in the ACP.

Note: If releases are small and the extent of contamination is readily defined and removed, the ISSP and ACP activities may be combined.

Analytical requirements for the samples collected are discussed in Appendix 1. All samples must be collected and handled using the Appendix 2 guidelines.

An alternative Incremental Sampling Methodology (ISM) may be proposed instead of the minimum discrete sampling techniques for the ISSP and ACP. Incremental Sampling Methodology is a structured composite sampling and processing protocol having specific elements designed to reduce data variability and increase sample representativeness for a specified volume of soil under investigation. The online ISM

guidance document is available on the Interstate Technology and Regulatory Council web link at <http://www.itrcweb.org/Guidance>

5.2. Minimum Soil Sample Collection

Initial Site Sampling

The purpose of the soil investigation is to identify and characterize the chemical nature all releases to the site soil.

Suspected spills and areas of concern should be determined by using knowledge of releases or discharges, historical research (such as investigating waste management records), maps, aerial photographs, and employee interviews, as applicable.

Samples must be collected from **each known or suspected** area of contamination, e.g., near any vessels used to store chemical product or waste streams; any units used to manage hazardous substances; disposal areas; spill areas; areas of stressed vegetation; potentially contaminated ponding areas, ditches, culverts or other drainage features that may have received runoff from a contaminated area; underground pathways such as sewer or utility lines; and drinking water wells within 1,500' of the site (whether in use or not).

The required sampling strategy depends on whether there is visible evidence of contamination.

Visible Evidence of Contamination

At least one soil grab sample must be collected centrally from the most visibly contaminated location in each area of release or possible release.

No Visible Evidence of Contamination

1. Surface Release:

- a. Sample areas where contamination would be likely to occur such as run-off, pooling or ponding areas, valve and piping locations, or possible disposal areas.

If no visible evidence exists, conduct sampling by first establishing a grid with line intersections (nodes) spaced no farther than 20 feet apart.

Samples must be collected from each grid node.

Samples for volatile organic contaminants must be collected six to 18 inches below ground surface and consist of unmixed (i.e., non-composited) grab samples.

- b. Where the actual contaminants released are either unknown or mobile contaminants, a soil boring must be advanced to the depth of contaminant non-detection. Field screening devices may be used following the Appendix 4 guidelines.

Borings must be centrally located in each area of concern and sampled at intervals from the ground surface to the depth of contaminant non-detection. Intervals for sample collection should be based on the type of contaminant, the depth of the boring and site specific conditions. Suggested intervals for sampling are:

- (1) 6 - 18 inches below ground surface;
- (2) at least every 5 feet along the boring to the depth of contaminant non-detection.

Choose additional sampling depths, if necessary, based on visual and field-screening evidence.

Samples collected for volatile organic analysis must be collected as unmixed grab samples. Delineation of volatile organic compounds in soil requires sample collection procedures consistent with SW-846 Method 5035. At a minimum, facilities should sample the sampling points using Method 5035 to confirm that soil contamination has been

outermost delineated.

All borings must be backfilled with a grout or grout bentonite mixture as soon as is feasible following the North Carolina Well Construction Standards.

<http://deq.nc.gov/about/divisions/water-resources/water-resources-rules/nc-administrative-code-statutes>

NOTE: If the remediating party decides not to advance a boring within an area due to grossly contaminated conditions or concern for rupturing buried vessels, the groundwater must be sampled by installing a minimum of three wells immediately surrounding the suspect area. Once groundwater flow patterns are clearly defined, wells will be required on the hydraulically down gradient perimeter of the area of concern. (See Section 5.3 for groundwater monitoring guidance).

2. Subsurface Release:

Subsurface releases may occur from septic tanks, underground storage tanks, buried drums, etc. Areas where subsurface releases have been identified or are suspected must be sampled according to the preceding section for “No visible evidence of contamination.” Historical research and geophysical surveys may be used to identify underground disposal areas, e.g., buried drum and underground tanks.

Site Assessment Sampling

The purpose of the site assessment investigation is to delineate the horizontal and vertical extent of contamination in each area of concern. The extent is defined by concentrations less than or equal to the method detection limit (MDL) or naturally occurring background levels (metals). An area of concern is a known release area or an area where contamination was detected during the initial site sampling. Samples should be collected at the expected vertical and lateral boundaries for each area of contamination. Field screening methods may be used according to the guidelines in Appendix 4 to help in the determination of these boundaries. If field-screening methods are used, collect soil samples at the expected vertical and lateral boundaries of each contaminated area and send them to the laboratory for analysis. Information about the history of the release and the nature of the contaminant(s) (e.g., mobility, solubility, and density) may help in the determination of the depth at which samples should be collected and the analysis selected. Soil samples from historical releases must be analyzed for the original contaminants and any breakdown products. If the alternative Incremental Sampling Methodology (ISM) is proposed for the ISSP and ACP, consult with your HWS Compliance Branch Contact listed in Appendix 7.

5.3. Minimum Groundwater Sample Collection

The purpose of the groundwater investigation is to determine if groundwater has been contaminated by a release from the site.

The HWS determines if the uppermost groundwater aquifer must be sampled. During the site investigation, the RP must determine the following site conditions:

- depth to the water table,
- depth of the contamination,
- mobility of the contaminants,
- site-specific conditions that may encourage contaminant mobility, e.g., sandy soil and contaminant density,
- the volume of contaminants released,
- the history of the release, and
- the extent and effectiveness of initial response actions.

The HWS considers this information to determine if the groundwater must be sampled. If the HWS determines that the groundwater must be sampled, the proposed groundwater investigation activities must be included in the ACP.

If the uppermost aquifer must be sampled, the RP must characterize subsurface conditions and determine the groundwater flow direction. Site characterization will include, at a minimum, the installation of one boring to auger refusal for sites in the Piedmont or mountains, or into the first substantial confining layer for sites in the coastal plain. Groundwater flow direction is determined by installing a minimum of three borings in the uppermost aquifer. Each boring must be completed according to ASTM D-1586 and the soil classified by ASTM D-2488. Monitoring wells must be installed in the three uppermost aquifer borings. Screen each well in the uppermost aquifer only. The elevation of the top of casing at each well site must be determined. Use stabilized groundwater level readings to determine the groundwater flow direction.

Note: If temporary wells are installed and used to determine the groundwater flow direction, the casing must be removed and the borings backfilled with grout or grout bentonite mixture as soon as technically feasible and according to the North Carolina Well Construction Standards.

<http://deq.nc.gov/about/divisions/water-resources/water-resources-rules/nc-administrative-code-statutes>

Once the groundwater flow direction has been determined, the RP must confirm that the monitoring wells are installed so that they will immediately detect a release to the groundwater from the area being investigated. When the wells are properly located, the RP must obtain groundwater quality samples to determine if there has been any impact. All samples must be collected and handled according to the guidelines in Appendix 2. The specific list of contaminants of concern for the site will be determined by the Branch.

When the groundwater investigation is complete, the RP must submit a report that describes the investigation's results in a format consistent with the ACP format in Appendix 3B.

5.4. Minimum Surface Water and Sediment Sample Collection

The purpose of a surface water/sediment investigation is to identify and characterize the chemical nature of all releases of hazardous substances to surface water or sediments. Surface water assessment is necessary when there is a potential for contaminants to migrate to surface waters. If stream assessment is required, at

least one water and one sediment sample must be collected at the following areas: (1) immediately upstream of the site, (2) at the area(s) where contaminants are likely to enter the stream, and (3) immediately downstream of the site. These samples must be analyzed for the contaminants of concern identified at the site. If a pond or lake is suspected of being contaminated, grid or other sampling strategies will be necessary. The Branch **must** be contacted if pond or lake sampling is required.

5.5. Other Sample Collection

A. Abandoned or Buried Containers or Tanks

Any abandoned or buried containers or tanks containing unknown materials or hazardous substances must be excavated. Then, sample and analyze the contents for parameters sufficient to meet disposal or treatment facility requirements per Section 6.

NOTE: Excavation of containers holding unknown materials must be conducted using extreme caution. Only personnel trained to conduct this type of excavation under OSHA and other applicable regulations may excavate and sample unknown materials.

Container disposal/storage areas must be sampled as described in Section 5.2. Soil samples will also be required at the time of container or tank excavation. Sample in the immediate vicinity of all joints and junctures of subsurface pipe associated with any underground tanks known or suspected to contain hazardous substances. Post-excavation sampling must be conducted according to Section 6. Manage soil excavated in association with buried containers or tanks according to Section 7.

B. Background Samples

Site-specific background soil samples may be collected to establish natural metal concentrations. However, if the RP needs to prove that constituents of concern are at background levels, then background concentrations must be statistically established according to an approved plan or accepted guidance. Samples must be located away from roadways, railways, parking areas, areas affected by facility processes and other sources of contamination. The samples must be collected from depths and soil types representative of the contaminated soil, but should not be collected from top soil (0-6 inches). A **minimum** of five soil samples, not composited, is required to determine background levels.

C. Floors, Concrete, Asphalt, etc.

Collecting samples through various structures may be necessary to determine if contamination is present in the soil below. For example, floors, sumps, storage pads, etc. often consist of concrete or asphalt. This will require that a core be drilled through the surface allowing the sample to be taken. If the structure is to be removed, or if the contaminant is likely to be absorbed into the core material, analyze the core as well. After sampling, repair the boring to prevent contaminants migrating to underlying soil. Determine sample location(s) by observing cracks, joints, drains, low areas, stains and other factors that may influence contaminant migration through and beneath these structures. Refer to Section 5.2 for sample location guidance.

6.0 Minimum Requirements for Confirmation Sampling and Analysis

6.1 Introduction

This section provides general guidance on the minimum "post-remediation" sampling and analyses required to demonstrate compliance with HWS clean-up levels. At many sites, the RP will need to prescribe additional sampling and analysis based on site-specific conditions.

6.2. Post-Excavation Sampling

Post-excavation sampling must be designed to verify that all soil/waste above HWS clean-up levels has been removed. Collect non-composited samples immediately after excavation. Sample excavations as follows:

- A. Design a sampling grid over the base and sidewalls of the excavation. Grid nodes must be no more than 20 feet apart. At each grid node, collect a sample from 0-3 inches into the base or sidewall. The **minimum** number of samples for **all** excavations is five: one sample from each sidewall and one from the bottom of the excavation.
- B. Collect biased samples from residual contamination areas, based on visible or field-screening evidence.
- C. Contamination levels above clean-up levels require further excavation and post-excavation sampling.

NOTE: Excavations may not be backfilled until Branch approval is received.

All post-excavation (i.e., confirmation) samples must be analyzed for the entire list of constituents developed during the site assessment. Analyze confirmation samples using USEPA methods with detection limits less than or equal to HWS clean-up levels, or USEPA methods with the lowest available detection limits for each contaminant of concern (See Appendix 1).

6.3. Roll-off Container Sampling for Waste Characterization

A. Collection Procedure for Non-volatiles

One composite sample must be collected from each roll-off container or 25 cubic yards of soil in other large-volume containers. A minimum of two sampling locations must be selected at random in the roll-off container, or per 25 cubic yards of soil. Using an auger or a shelby tube, collect a portion of soil from the upper, middle and bottom portion of the sampling device at each sample location. Mix samples per the USEPA Region IV SOP manual¹ requirements. Composite them into one sample for laboratory analysis. (See Table 4 for container types and sample holding times).

B. Collection Procedure for Volatiles

Collect at least two grab samples from each roll-off or 25 cubic yards in other large-volume containers. Select sample locations at random. Collect samples by filling two sample containers at each sample location. Sample aliquots must be collected from the middle or lower portion of the

¹ *US Environmental Protection Agency Region IV Environmental Investigations Standard Operating Procedures and Quality Assurance Manual* (EPA SOP). This manual is available on the Internet at <http://www.epa.gov/region4/sesd/fbqstp/> or from the US EPA Region IV, Science and Ecosystems Support Division.

boring at each sample location using an auger or shelby tube. Samples may not be mixed. (See Table 4 for types of containers to use and sample holding times).

C. Analytical Methods for Waste Determination

To determine the appropriate disposal method for contaminated soil, the RP must determine if the soil is a hazardous waste or not. If listed wastes were released, manage the soil as a listed hazardous waste with a waste code corresponding to that of the original waste released.

NOTE: If sampling was conducted according to, and the contaminant levels are below those specified in the Hazardous Waste Section *Contained-In Policy for Soil Contaminated with Listed Hazardous Waste*, the soil may not have to be managed as a listed hazardous waste. This policy does not apply to characteristic hazardous wastes.

If the release is not a listed waste, the RP must determine if the material is a characteristic hazardous waste. At a minimum, the applicable tests are: Method 1311 (TCLP) for toxicity characteristic and any other tests for characteristics that may apply to the waste (ignitability, reactivity, and corrosivity). If any of the TC constituents or other characteristics are exceeded, store, manage, and dispose of the material as a hazardous waste.

NOTE: TCLP analysis is only used to characterize wastes, it is inappropriate for determining if clean-up levels have been reached.

TCLP has a provision that allows using a total waste analysis to demonstrate that a waste does not exhibit the toxicity characteristic. Use the following formula to make this determination

$$M = C/20 \quad \text{where:}$$

M = maximum theoretical leachate level (mg/L);

C = concentration of analyte in the soil (mg/kg), total concentration; and

mg/L= ppm= mg/kg.

6.4 Container Sampling

NOTE: Sample containers of hazardous or unknown materials with extreme caution. Only personnel trained to conduct this type of sampling under OSHA and other applicable regulations may sample containers holding hazardous or unknown materials.

Sample containers according to the EPA SOP Section 13.4.3. Sample each container of unknown material separately and do not composite with other containers. If the material is layered or sediment/sludge is present, sample and analyze each layer separately.

Analytical methods for waste determination

For unknown materials, the minimum analytical tests are: total volatile and semi-volatile analysis, **plus** TCLP metals and organics, **plus** tests for hazardous characteristics (ignitability, reactivity, and corrosivity).

TSD facilities may also require additional testing for treatment or disposal purposes (e.g., Btu and ash content). Contact the waste disposal facility before collecting samples if additional analyses may be required

7.0 Procedures for Excavating Soil and Excavated Soil Management

During remediation, the RP should only excavate soil that is necessary to remove the contamination. Excavated soil/sediment **must** be containerized; it may **not** be stockpiled. A container may consist of a roll-off, drums or other types of containers appropriate for, and compatible with, the type of contaminated soil. Keep the containers closed to prevent rain from entering or wind from blowing the soil. If the soil contaminant concentrations are unknown, or the soil is a hazardous waste, the containers must comply with all of the container requirements specified in 40 CFR 262.34, adopted by reference at 15A NCAC 13A .0107.

Excavated soil that is contaminated is a waste and must be disposed of properly. If the soil contains a listed or characteristic hazardous waste, it must be manifested to a permitted TSD facility. If contaminated soil/sediment is a non-hazardous waste, it may be disposed in a municipal landfill, or by some other approved disposal method. Some disposal methods for contaminated soil require a permit from DWQ's Aquifer Protection Section (See Section 2 for appropriate contacts). See Section 6 for the procedures to make a waste determination for contaminated soil.

NOTE: **Excavations may not be backfilled with contaminated soil. If sampling was conducted according to, and the contaminant levels are below those specified in the Hazardous Waste Section *Contained-In Policy for Soil Contaminated with Listed Hazardous Waste*, the soil may not have to be managed as a listed hazardous waste. This policy is not applicable to characteristic hazardous wastes.**

7.1 Notification Requirements under RCRA

All hazardous wastes generated during a clean up count toward the site generator category, including excavated soil that is hazardous. If the site does not have an EPA Identification Number **or** if the quantity of waste generated will cause the site to change generator status, the RP must contact the Branch for the appropriate form to change status or obtain an ID number.

8.0 Site Closure

When remediation is complete, submit two copies of a Closure Report to the Branch. The Branch will review the documentation to ensure the site has been adequately cleaned up and all pertinent information is provided. If the Closure Report is approved, a letter of "no further action" will be sent to the RP. The letter only applies to the specific contamination event documented in the Closure Report. It is not applicable to other areas of contamination at the site, or contamination that may be discovered, at the site.

NOTE: **If the facility is operating under the terms of an enforcement document, actions must be undertaken within the compliance dates set within the enforcement document. In addition to the guidance requirements, the enforcement document may set requirements that the facility must comply with. A "no further action" letter does not denote complete compliance with any enforcement action.**

APPENDIX 1 ANALYTICAL METHODS

Analytical methods that are appropriately sensitive for the detection of the contaminants of concern at the site must be used to analyze for all samples. All analyses must be performed using either an SW-846² method or an equivalent analytical method. SW-846 serves as a compendium of methods that are approved, but not mandatory, to comply with the RCRA regulatory requirements. Specific analytical methods are not mandated. However, use general quality assurance/quality control (QA/QC) procedures for analyses using SW-846 methods, as specified in Chapter One of SW-846, as well as any method-specific quality control criteria. Additionally, the HWS strongly recommends that a NC certified laboratory be used to run the appropriate methods. To obtain a current list of NC Certified Laboratories, call the Division of Water Quality, Laboratory Section at (919) 733-3908. If a non-certified laboratory is chosen, refer to Appendix 3A for additional data reporting requirements.

Table 2 lists EPA methods for the detection of organics and metals. Table 3 specifies the minimum analysis required for contaminated soil and groundwater. For other media (sediments) or constituents that may not be detected by these methods, see the following web site for further guidance and information on EPA analytical methods: <https://www.epa.gov/hw-sw846>.

At a minimum, compounds not covered by the listed methods must be analyzed using a method capable of detecting and achieving method detection limits (MDLs) at or below the applicable clean-up level.

Footnotes:

² US EPA 1990, *Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods*, US EPA SW-846, Third Edition, November 1990, or most recent edition.

TABLE 2. EPA ANALYTICAL METHOD SUMMARY

EPA Methods	Summary for Organics				
<u>Method</u>	<u>Volatile Organic Compounds by GC</u>	<u>Volatile Organic Compounds by GC/MS</u>	<u>Semi-volatile Organic Compounds by GC/MS</u>	<u>Pesticides (organochlorine) and PCBs by GC</u>	<u>Herbicides (chlorinated) by GC</u>
SW-846	8021B aromatic and halogenated volatiles via PID/EC	8260B	8270D	8081B 8082A	8151A
EPA 500 Series	502.2 volatile organic compounds via PID/EC	524.2 purgeable organic compounds	525.2	508	515.1 515.2
EPA 600 Series	601/602 purgeable halocarbons-ECD	624 purgeable organics	625	608	
Standard Methods	6220A volatile aromatic 6230A volatile halocarbons	6210A volatile organics	6410	6630	6640
EPA Method	Summary for Metals				
<u>Method</u>	<u>Mercury by Cold Vapor Atomic Absorption Spectroscopy</u>	<u>Trace Metals by Flame and Graphite Furnace Atomic Absorption Spectroscopy</u>		<u>Trace Metals by ICP</u>	<u>Trace Metals by ICP-MS</u>
SW-846	7470A 7471B	7000 Series		6010C	6020A
EPA 200 Series	245.1/245.5	200 Series		200.7	200.8
Standard Methods	3500-HG B	3000 Series		3120	
CLP SOW	245.1 245.2 245.5	200 Series CLP-M		200.7 CLP-M	

Analytes not covered by the methods above should be analyzed using a method capable of detecting and achieving MDLs at or below the applicable clean-up level. RPs should communicate with the laboratory on the appropriate method to use when analyzing site-specific constituents. Ensure that the method used is capable of detecting the analyte of concern at an appropriately sensitive level.

TABLE 3. MINIMUM ANALYSIS FOR SOIL AND GROUNDWATER

Suspected Contaminant	Analytical Method for Soil	Analytical Methods for Groundwater
Used/ Waste Oil	EPA Method 8021 or 8260 (volatiles); 8270 (semi-volatiles) and EPA Method 9071 (Oil and Grease) and EPA 8082 (PCBs) and EPA 3050 or 3051 preparation: Total Metals (Chromium and Lead)	Standard Method 6210D and 625** plus 10 largest non-target peaks identified and Metals (Standard Method 3030C * prep): Lead and Chromium
Metals	Total Metals	Metals
Solvents a. Halogenated/ non-halogenated b. Ethylene Glycol c. Formaldehyde	a. EPA Method 8021 b. EPA Method 8260 and 8270 c. EPA Method 8015 if appropriate for known solvent	a. 6230D or 6210D b. GC-FID c. Chromatropic Acid Method
Unknown: non-petroleum	8260 (volatiles) and 8270 (semi-volatiles) and 8081 (pesticides), 8082 (PCBs) and Total Metals	Standard Method 6210D and 625* plus 10 largest non-target peaks identified and Metals: Lead and Chromium
Pesticides	SW-8081B/8082A	Standard Method 6630

* Once contaminants have been identified by GC/MS methods, more economical compound specific methods may be used. (For example, if no “acids” were detected by GC/MS Method 625, subsequently analyze by 625 for “Base Neutrals” only, or use GC Method 610.)

NOTE: Additional analytical methods may be required if contaminated soil is to be disposed of or treated at a permitted facility. Contact the disposal facility for its specific requirements.

APPENDIX 2 SAMPLE COLLECTION GUIDELINES AND HOLDING TIMES

A. Sample Preparation

The type of sample container used depends on the type of analysis needed. First, the RP must determine the type(s) of contaminants expected and the proper analytical methods to be used (See Appendix 1). Refer to Table 4 to determine the proper containers, preservation techniques and holding times for samples. You may also consult with the laboratory analyzing the samples, or refer to Appendix A of the EPA SOP. Unless otherwise noted, field procedures must comply with the most current version of the EPA SOP. The HWS strongly recommends that a NC Certified laboratory be used to perform the required analyses. The RP should ask the laboratory about any specific sample handling procedures required by the analytical methods used.

Commercial laboratories sell kits for sample collection and transport. They include all the items needed (containers, labels, shipping cartons, etc.) for sample collection and shipment. If an RP uses these services, they must carefully follow the instructions provided and not discard any preservative that may have been added to the containers. If the RP does not choose to use a customized laboratory kit, use only new containers that are appropriate for the contaminants to be sampled. Check with the laboratory that will be running the analysis about appropriate sample containers and preservation for each method. **If proper sampling and QA/QC protocols are not followed, test results will not be valid.**

Sample containers should be labeled before sample collection. Each label should include the sample location and/or well number, sample identification, the date and time of collection, the analyses to be performed, the preservative added (if any), the sampler's initials, and any other pertinent information for sample identification. The RP must also prepare the storage and transport containers (ice chests, etc.) before collecting samples so each sample can be placed in an environment chilled to approximately 4°C (40 °F) immediately after collection.

B. Sample Storage and Transport

Samples should be stored for transport in a manner that prevents breakage. Samples should be kept at a temperature of approximately 4° C (40 °F) following collection. Use ice if necessary. Transport samples to the laboratory as soon as possible. Avoid unnecessary handling of the sample containers. Heating (room temperature or above, including exposure to sunlight) or freezing of the sample containers must be avoided. The time between sampling and delivery to a laboratory should be kept to a minimum. Do not exceed the holding times of the samples (see Table 4).

A chain-of-custody form must accompany the samples to the laboratory. Complete all sections on the form. See Figure 1 for a sample chain-of-custody form. At a minimum, a chain-of-custody form must include: the site name and location, sample collector, sample number, date and time of collection, type of sample, analysis required, the signature of the collector, time relinquished, the signature of the receiver, time received, grab or composite sample designation and other pertinent information.

TABLE 4. RECOMMENDED CONTAINERS, HOLDING TIMES AND PRESERVATION

ANALYTICAL GROUP	SOIL/ SEDIMENT CONTAINER	SOIL/ SEDIMENT PRESERVATION	SOIL/ SEDIMENT HOLDING TIME (DAYS)	WATER CONTAINER (VOLUME OF SAMPLE)	WATER PRESERVATION	WATER HOLDING TIME (DAYS)	WASTE CONTAINER (VOLUME OF SAMPLE)	WASTE PRESERVATION	WASTE HOLDING TIME (DAYS)
Inorganics									
pH	8 oz. Glass jar with Teflon lid	NA	--	500 mil polyethylene	--	--	8 oz. Glass jar with Teflon lid	NA	Indefinite
Flash Point	--	--	--	--	--	--	8 oz. Glass jar with Teflon lid	NA	Indefinite
BTU	--	--	--	--	--	--	8 oz. Glass jar with Teflon lid	NA	Indefinite
Ash Content	--	--	--	--	--	--	8 oz. Glass jar with Teflon lid	NA	Indefinite
Turbidity	--	--	--	500 mil polyethylene	Cool to 4°C	2	--	--	--
Conductivity	--	--	--	500 mil polyethylene	Cool to 4°C	28 - on-site if possible	--	--	--
Temperature	--	--	--	500 mil polyethylene	NA	within 15 minutes	--	--	--
Oil and Grease	8 oz. Glass jar with Teflon lid	Cool to 4°C	28	One liter glass (Teflon lid)	50% H ₂ SO ₄ (pH<2.0) Cool to 4°C	28	8 oz. Glass jar with Teflon lid	Cool to 4°C	28
Total Metals	8 oz. Glass jar with Teflon lid	Cool to 4°C	180	One liter polyethylene	50% HNO ₃ (pH<2)	180	8 oz. Glass jar with Teflon lid	Cool to 4°C	180
Mercury	8 oz. Glass jar with Teflon lid	Cool to 4°C	180	One liter polyethylene	50% HNO ₃ (pH<2)	28	8 oz. Glass jar with Teflon lid	Cool to 4°C	180
Metals TCLP	8 oz. Glass jar with Teflon lid	Cool to 4°C	180 to extract/180 to analyze	One liter polyethylene	Cool to 4°C	180 to extract/180 to analyze	8 oz. Glass jar with Teflon lid	Cool to 4°C	180 to extract/180 to analyze
Chrome VI	8 oz. Glass jar with Teflon lid	Cool to 4°C	180	One liter polyethylene	Cool to 4°C	1	8 oz. Glass jar with Teflon lid	Cool to 4°C	180

TABLE 4. (cont'd.) RECOMMENDED CONTAINERS, HOLDING TIMES AND PRESERVATION

ANALYTICAL GROUP	SOIL/ SEDIMENT CONTAINER	SOIL/ SEDIMENT PRESERVATION	SOIL/ SEDIMENT HOLDING TIME (DAYS)	WATER CONTAINER (VOLUME OF SAMPLE)	WATER PRESERVATION	WATER HOLDING TIME (DAYS)	WASTE CONTAINER (VOLUME OF SAMPLE)	WASTE PRESERVATION	WASTE HOLDING TIME (DAYS)
Cyanide	8 oz. Glass jar with Teflon lid	Cool to 4°C	14	One liter polyethylene	NaOH to pH >12 Cool to 4°C	14	8 oz. Glass jar with Teflon lid	Cool to 4°C	14
ORGANICS									
VOCs	2 oz glass Teflon septum lid	Cool to 4°C	14	40 ml glass (Teflon septum lid)	HCL 50%/ Cool to 4°C	14 with preservative/ 7 without	8 oz. Glass jar with Teflon lid	Cool to 4°C	14
VOCs- TCLP	2 oz glass Teflon septum lid	Cool to 4°C	14 to extract/14 to analyze	40 ml glass (Teflon septum lid)	Cool to 4°C	14 to extract/14 to analyze	8 oz. Glass jar with Teflon lid	Cool to 4°C	14 to extract/ 14 to analyze
Extractable SVOCs including herbicides, pesticides and PCB	8 oz. Glass jar with Teflon lid	Cool to 4°C	14 to extract/ 40 to analyze	One gallon amber glass (Teflon lid)	Cool to 4°C	7 to extract/ 40 to analyze	8 oz. Glass jar with Teflon lid	Cool to 4°C	14 to extract/ 40 to analyze
Extractable-TCLP	8 oz. Glass jar with Teflon lid	Cool to 4°C	14 to TCLP extraction/ 7 to solvent extraction/ 40 to analyze	One gallon amber glass (Teflon lid)	Cool to 4°C	14 to TCLP extraction/ 7 to solvent extraction/ 40 to analyze	8 oz. Glass jar with Teflon lid	Cool to 4°C	14 to TCLP extraction/ 7 to solvent extraction/ 40 to analyze
Dioxins	consult lab	consult lab	30 to extract/45 to analyze	consult lab	consult lab	30 to extract/45 to analyze	consult lab	consult lab	30 to extract/45 to analyze

Footnotes: (1) Consult 40 CFR 136, Table II for latest requirements.
 NA Not applicable.
 -- No information or does not apply.

C. Soil Sample Collection

Collect soil samples under the charge of a professional engineer, licensed geologist or other knowledgeable environmental sampling professional. Collect soil samples using methods that cause the least disturbance the soil's internal structure and reduce its exposure to heat, sunlight and open air. Do not allow samples to be contaminated by other site material or other samples.

While collecting samples from potentially contaminated soil, avoid contact with skin or other body parts. Wear disposable gloves, and change them between samples to avoid cross-contamination. At a minimum, use a clean, stainless steel sample apparatus to collect each sample. Decontaminate it between each sample collection event. Do not use plastic, galvanized, chrome, rusted or painted equipment to collect samples.

Ideally, samples should be collected from soil cores. For practical reasons, however, it may be necessary to collect samples from a backhoe bucket, hand auger, etc. Collect the sample from material that has not contacted the equipment surface, especially if it is painted or rusted. Avoid the loss of contaminants from the sample. Volatile organic compound (VOC) samples must be collected with minimal handling and agitation; do not mix. Power equipment may be used (power augers, etc.) to aid sample collection, but make every effort to avoid sample contamination with fuels, oils, greases, etc.

Once removed from the ground, immediately place each sample in a proper container required for the method of analysis. The sample should fill the entire volume of the container, leaving no headspace unless the method requires otherwise. Refer to Table 4 or the selected laboratory, for the required sample containers and volume of soil required for each analytical method. If necessary, add preservative before filling sample jars. As soon as the sample is collected, immediately cap, seal and store the container at 4 °C (40 °F).

D. Standard Field Protocols

In addition to the standard protocols listed here and in the EPA SOP Manual, please observe the following:

- Field QC samples: (1) collect a minimum of one duplicate sample per medium, per container type, per field day; (2) equipment rinsate blanks, field blanks and VOA trip blanks are strongly recommended.
- Collect soil, sediment and waste samples for volatile organic analysis directly into sample containers without mixing.
- Stake and flag (or survey) all soil sampling and boring locations until the investigation is complete.
- All monitoring well and water level measuring point locations must be surveyed by a Professional Land Surveyor registered in North Carolina.
- Do not filter water samples for metals before analysis. Data from field-filtered samples will not be accepted. If excess turbidity is a problem, use low-flow purge and sample methods.
- Place excavated soil, drill cuttings and well development, and purge and decontamination water in containers until laboratory data is available to decide how treat or dispose of the material. Materials exceeding HWS clean-up levels may not be replaced on the site. Manage listed or characteristic hazardous wastes according to RCRA requirements.

E. Decontamination

Make arrangements ahead of time for on-site field decontamination of any sampling or measuring equipment that will be reused to collect more than one sample. It is necessary to decontaminate sampling equipment between sampling events to reduce the possibility of cross-contamination. All decontamination procedures must be included in reports as necessary. Follow the EPA SOP Manual for field decontamination techniques.

Soil Sampling

- Wear protective gloves for each sample. Change them between collecting each sample.
- Select all sampling equipment based on the material's chemical compatibility with the contaminants potentially present and the source being sampled. Decontaminate all sampling equipment between each sample collected.
- Transport equipment in a way that does not allow it to become contaminated.

Groundwater Sampling

In addition to the above:

- To reduce the possibility of cross-contamination, do not reuse braided cord, even if cleaned. Teflon coated wire, single strand stainless wire, or other monofilament line can be reused if decontaminated between each use.
- Decontaminate or replace the inside and outside of pumps and reusable hoses/lines between each use. Ensure that hoses, lines and exposed gaskets are either constructed of non-reactive materials or replaced between each use.

APPENDIX 3 REPORTING FORMATS AND CONTENT

A. Initial Site Sampling Plan (ISSP)

The RP must submit two copies of an ISSP to the Compliance Branch for approval **before** commencing any site activity other than initial emergency response actions. If the clean up is being conducted under the terms of an enforcement document, include the site-specific actions specified to be completed to return to compliance. Upon Branch approval of the ISSP, the RP must implement the plan according to the approved schedule. Refer to Section 3 of this guidance for the sequence to submit work plans and reports.

1. Introduction

The purpose of the ISSP is to identify all releases of hazardous substances to the environment, characterize the chemical nature of such releases, collect sufficient sampling data to compile a list of contaminants of concern, and determine if a clean up is necessary.

2. Content of the Initial Site Sampling Plan

The ISSP must contain the information described below, **as applicable**. It must be presented in the following order. **Sections that are not applicable to your site should be documented as such:**

Title Page

- Site name and location.
- Persons responsible for the site or the release, including address and phone number. List the current property owner(s), if different, including address and phone number.
- Consultant/contractor information including name, address and phone number.

Site Description:

- Site location information including street address, longitude and latitude.
- Site history, **as it relates to the investigation**. Include a description of property ownership and uses and a summary of actual and potential sources of the contamination. Include a summary of hazardous waste and hazardous substance management practices employed at the site. Use RCRA waste codes where applicable. Include a description of the facility's past and current RCRA status; a summary of the nature of all on-site hazardous substance releases (including one-time releases or spills) and a summary of any previous and ongoing environmental investigations at the site.
- United States Geological Survey topographic maps (1/24,000 scale) sufficient to display the topography within a one-mile radius of the site.
- A site map including scale, benchmarks and north arrow. Include, **as they relate to the investigation:** locations of property boundaries, buildings, structures, all perennial and intermittent surface water features, drainage ditches, dense vegetation, known and suspected spill or disposal areas, underground utilities, storage vessels, existing on-site wells and an identification of adjacent property land usage.
- A description of local geologic and hydrogeologic conditions, including the depth to water table, if known.

Source Characterization

- A description of the source(s) of the release. Include the compound(s) released, compound mobility (density), the date discovered, the estimated quantity of the release, and the cause of the release(s). Use hazardous waste codes when appropriate.
- A summary of any assessment activities conducted and corrective actions performed to date including emergency response and initial abatement activities.
- Site-specific conditions that may encourage contaminant mobility, e.g., sandy soils.

Receptor Information

- An inventory and map of all wells, springs and surface-water intakes and other sources of potable water within 1,500 feet of the site. If the site is greater than one hundred (100) acres in size, the inventory and map must cover a one-mile radius from the center of each source area.
- An evaluation of the site and all adjacent property for the existence of any environmentally sensitive areas as defined in Appendix 5.

Proposed Methods of Investigation

- Proposed methods, locations, depths of, and justification for all sample collection points for all media (soil, water, sediment, containerized wastes, etc.). Include monitoring well locations and anticipated screened intervals, if applicable, for each known or suspected area of contamination (refer to Section 5 and Appendix 1 and 2 of this guidance). Include plans for any special assessment such as a geophysical survey. Locate all proposed sample points on the map.
- Proposed analytical parameters and analytical methods for all samples. Describe equipment and personnel decontamination procedures. Proposed field and laboratory procedures for quality assurance/quality control (refer to Appendix 1 and 2 and Section 5 of this guidance).

Schedule

- A proposed schedule for site activities and reporting.

Other Information

- Any other information required by the Branch or considered relevant by the remediating party.

B. Assessment and Clean-up Plan (ACP)

Once it is determined that contamination exists at the site, the RP must prepare an ACP that includes, at a minimum, the information listed below. Two copies of the ACP must be submitted to the Branch for approval. If the site clean up is being conducted under the terms of an enforcement document, include the additional requirements described in the enforcement document. Upon Branch approval of the ACP, the RP must implement the plan according to the approved schedule. Refer to Section 3 of this guidance for the sequence for submitting work plans and reports.

1. Introduction

The purpose of the ACP investigation is to delineate the horizontal and vertical extent of contamination in each area of concern and the proposed areas of excavation or remediation. Clean-up activities are usually conducted in an initial assessment phase proposed in the ISSP. The next step is the delineation of contamination and removal phase proposed by the ACP. In some cases (e.g., if releases are small and the extent of contamination is easily defined and removed) activities may be combined in these documents. If

the ACP and ISSP are combined, all items required for both documents must be included in the ACP. The Branch must approve the ACP before it is implemented.

To delineate the extent of contamination, collect and analyze samples to the method detection limit (MDL) or, for metals only, to the naturally occurring background levels (metals only). Remediate the site to the Preliminary Soil Remediation Goals clean-up levels or the site-specific natural background levels for metals (Section 5.5) for each constituent of concern. The Branch determines clean-up levels for any contaminants not listed in the tables.

2. Content of the Assessment and Clean-up Plan

ACPs must be organized in sections that correspond to the following. At minimum it must include:

Introduction:

- A synopsis of purpose and objectives of the ISSP.

Site Description:

- A summary description and map(s) of the site location and setting.
- A summary of the site geologic and hydrologic conditions, including a description of soil and unsaturated zone characteristics. If known, include a description of the groundwater flow gradient, direction, and estimated rate of migration.

Receptor Information:

- Discuss any human or sensitive environmental populations, or areas that may be impacted by site conditions.

Initial Investigation Results:

- A narrative description of the initial investigation activities, including a discussion of any variances from the approved ISSP.
- A map, drawn to scale, showing all existing soil, surface water and sediment sample locations. If applicable, include monitoring well locations in relation to the areas of contamination.
- A description of all laboratory quality control and quality assurance procedures used during the investigation.
- Tabulation of analytical results for all sampling (soil, water, containerized wastes, etc.). Include sampling dates, soil-sampling depths, and copies of all laboratory-reports. Use the data-reporting format shown in Appendix 3C.
- Soil, groundwater, surface water and sediment contaminant delineation maps and cross-sections. Include scale and sampling points with contaminant concentrations.
- A description of the procedures used and the results of any special assessments conducted.
- If groundwater monitoring was conducted, include the following data. More information may be requested.
 1. The boring logs and water levels from the borings/wells.
 2. The location of borings/wells on the site map. These wells must include a **minimum** of one up gradient and two down gradient wells.
 3. The construction design for each well including depth and screened interval.
 4. The sample collection and analysis procedures used to sample groundwater quality monitoring wells.
 5. Results of the groundwater quality samples.

Proposed Investigation Activities

- A narrative description of the planned activities to define the extent of contamination.
- A map, drawn to scale, showing all proposed soil, surface water and sediment sample locations. Include monitoring well locations in relation to areas of contamination.
- If applicable, a description of proposed groundwater monitoring well locations. Include design and installation procedures, drilling methods, and well construction techniques and materials.
- A description of proposed laboratory QA/QC.

Excavation/ Remediation Information:

- A description of the estimated depth and volume of areas to be excavated.
- A description of proposed disposal options for excavated soil/sediment. Include both hazardous and non-hazardous waste options as applicable. The destination facility information must include name, address, phone number and, if applicable, EPA ID number. (Section 7)
- A description of proposed procedures to manage excavated soil, drill cuttings, purge water and decontamination water. (Sections 6 and 7)
- A description of any obstacles to excavation that may exist.
- A discussion of any other remediation that may be necessary (such as for sediment, or surface water contamination identified). (Section 5.5)

Other Information

- Include any other information required by the Branch or considered relevant by the remediating party. To clarify, attach copies of site photographs or document site activities, as applicable.

C. HWS Minimum Laboratory Data Report Requirements

Analytical results must be compiled in an appropriate report and submitted to the Hazardous Waste Section. The laboratory report must include the following information.

1. General information

- Facility Name and, if applicable, an EPA ID Number;
- Laboratory contact and phone number;
- NC Laboratory certification number (if applicable);
- Date of report preparation.

2. Case Narrative

The case narrative must be written on the laboratory letterhead and the release of data authorized by the laboratory manager or his/her designee. The case narrative must consist of the following information:

- Whether the holding times were met or exceeded;
- Whether the samples were received in good condition and at the required temperature/preservation;
- Discussion of possible reasons for any quality control criteria outside acceptance limits;
- Justification for any deviation from the methods, additional sample preparation, sample dilution and analytical problems not rectified;
- Observations regarding any events that may affect sample integrity or data quality.

3. Chain-of-Custody Forms
Submit legible copies of complete sampling COC forms for each sample. See Figure 2 for the information required on the form.

4. Summary of Analytical Results
Include the following information in the summary of results for each environmental sample:
 - Client's sample identification and the corresponding laboratory identification;
 - Analytical methodology used; when applicable, cite EPA method numbers;
 - Sample matrix (soil, water, waste, etc.);
 - Date of sample extraction/digestion, as applicable;
 - Date and time of analysis;
 - Identification of the instrument type used for analysis;
 - Weight or volume of sample used for analysis/extraction/digestion;
 - Dilution or concentration factor for the samples;
 - Percent moisture in the soil samples;
 - MDLs and sample quantitation limits (SQLs). The lab must report and quantify any estimated values where the constituent was detected at or above the MDL but below the SQL;
 - Definitions of any data qualifiers used;
 - Analytical results and units of detection. Report all results on a "dry weight" basis.

5. Summary of QA/QC Results
List laboratory results for all laboratory quality control samples. Include results for accuracy and precision and the control limits used. The following are required:
 - Instrument calibration. Report the concentration of the initial and continuing calibration standards and the date and time of analysis;
 - Method/Preparation Blank Analysis. List the environmental samples and QC analysis associated with each method blank (e.g., run logs). Report the concentration of any analyte found in the method blanks;
 - Surrogate Standard Recovery. Report the name and concentration of each surrogate compound added. List the percent recoveries of all surrogates in the samples, method blanks, matrix spike/matrix spike duplicates and other QC analyses. Include the acceptable recovery criteria and indicate when criteria are not met;
 - Matrix spike/matrix spike duplicate analysis. Report the name and concentration of each spiking compound. Spike samples with all specified compounds of interest. List the sample results, spiked sample results, percent recovery, and the relative percent difference. Include the acceptable recovery criteria and indicate when criteria are not met.
 - Laboratory duplicate analysis, as applicable. Report the relative percent difference between duplicate analyses.
 - Laboratory QC check sample or control sample analysis. Report the percent recovery for each analyte in the laboratory QC sample. List the acceptable control limits and indicate when criteria are not met.

6. Results of other QC criteria as applicable
For example, ICP interference check sample, post digest spike, method of standard additions, trip blanks, field blanks, and equipment blanks, etc.

7. Additional Reporting Requirements for non-certified laboratories

Submit a:

- Copy of the laboratory's Quality Assurance Plan.
- Results from the laboratory's Precision and Accuracy Study for each method run for the sampling results submitted.
- Results from the laboratory's MDL studies.
- Results from the laboratory's annual Performance Evaluation Study. If the laboratory does not participate in a Performance Evaluation Study, then the HWS may require the laboratory to analyze a performance evaluation sample to check its performance before accepting data.

8. Field Screening Data Requirements

Record the following each sampling day. If conditions change during field monitoring, note the changes.

For Flame Ionization Detectors, Photoionization Detectors (and similar instruments) report:

- The temperature;
- The relative humidity;
- Calibration gas;
- Results in ppm associated with each confirmation sample collected;
- Lamp eV (for Photoionization-type detectors).

D. Closure Report

Within thirty (30) days after clean-up activities are complete, or as specified by an enforcement document, submit two copies of a Closure Report to the Branch. The report should demonstrate the site has been cleaned up according to approved procedures and in compliance with any enforcement document.

Content of the Closure Report

The Closure Report must include at least the following:

Summary of Investigation Activities

- Description of site conditions and identified areas of contamination.
- Maps showing site location, surrounding areas, sampling locations, and areas/extent of contamination.
- Sample results (if not provided in previous submissions) using the laboratory data reporting requirements in Appendix 3C.
- Groundwater sample results if applicable. Use the laboratory data-reporting format in Appendix 3C.
- Identify any sample results in excess of clean-up levels.

Remediation Activities

- A description of remediation activities and any causes for deviations from the approved plan(s).
- Clean-up levels used for each contaminant of concern.
- Map(s) showing areas of contamination, excavated areas and any remaining contamination.
- Volume and disposition of excavated soil and other wastes (contaminated water, waste in containers, etc.) removed from the site. The name and address for all disposal/ treatment facilities used.
- Laboratory data used to determine disposal options for excavated soil and other wastes removed from the site (contaminated waters, wastes in containers, etc.). Use the laboratory data reporting format in Appendix 3C.
- Copies of disposal permits needed (e.g. land application permits), if applicable. Copies of manifests for hazardous wastes shipped and bills-of-lading for non-hazardous wastes shipped off-site.

Results of Confirmation Sampling

- Post-excavation soil sampling results for all areas of contamination. Use the laboratory data reporting requirements in Appendix 3C. Identify any sample results in excess of clean-up levels.
- Map(s) depicting locations and results of post-excavation samples.

Conclusion:

- A statement that the applicable/approved clean-up standards have been met
- OR
- A statement that site contamination exists beyond the scope of a generator closure. Include a description of the existing conditions that will require further investigation and/or remediation.

APPENDIX 4 FIELD SCREENING METHODS

Portable environmental monitoring equipment such as flame ionization detectors, photoionization detectors and immunoassay kits, are useful tools for on-site sample screening and selection. During site characterization, these tools can be used to speed up groundwater and soil investigations. However, there are several factors that limit their applicability for determining the extent of hazardous waste contamination in soil. Refer to Appendix 3C for data reporting requirements when using portable field screening tools.

NOTE: Due to the lack of specificity, accuracy, precision and QA/QC, field screening data will not be acceptable for confirming the presence, nature or extent of contamination. Only laboratory results are acceptable.

A. Flame Ionization Detectors (FIDs)

Description

FIDs measure organic gas concentrations by using the principle of hydrogen flame ionization. Air is pulled through a filter at a specified rate and into a detector chamber where the air sample is exposed to a hydrogen flame. While exposed to the flame, any organic vapors present are burned, leaving positively charged carbon molecules. These positively charged particles form an electrical field, which can then be measured. These measurements allow the FID to determine the type of compound(s) present.

Uses

FIDs are most sensitive for monitoring straight-chained (alkanes, alkenes and alkynes) or aromatic hydrocarbons such as benzene, hexane, etc. FIDs are not designed for monitoring halogenated hydrocarbons, nitro-hydrocarbons (amines and amides) or oxygenated hydrocarbons (esters, ethers, aldehydes, etc.). A response may be received when a FID is used to screen for these compounds. However, the more halogenated, nitrogenated or oxygenated the carbon molecules are, the less sensitive the FID is.

Limitations

The gas used to calibrate the FID will affect its ability to detect organic vapors. When the instrument is calibrated to methane, the relative response rates are given in Table 5. If the FID has been calibrated to another organic gas, the response rates will change.

Table 5. Response Rates for FIDs

Organic Vapor	Relative Response
Methane (reference)	100% (reference)
Acetylene	225%
Benzene	150%
Ethylene	85%
Butane	63%
Propane	70%
Toluene	110%

Low temperatures can affect the response rates. FIDs are required to be turned on for at least 10 minutes before screening to warm up the ignition chamber. Temperatures below 40 °F do not allow the FIDs to warm up.

The practice of putting a soil sample in a plastic bag and allowing vapors to collect in the bag for later screening is not allowed. This is due to limited sample size and possible cross-contamination from leaching petroleum hydrocarbons from the bag itself

Flame Ionization Detectors must not be used:

- In temperatures less than 40 °F
- When humidity is greater than 85%
- To monitor oxygenated compounds
- To monitor halogenated compounds
- To monitor for metals.

Documentation Required

Date, Time, Weather, Temperature, Warm up time, Calibration gas and results, Results

B. Photoionization Detectors (PIDs)

Description

Photoionization detectors use an ultraviolet (UV) light source to ionize a sample and detect its concentration in much the same way a FID uses a hydrogen gas flame to ionize VOCs. Ionization occurs when a molecule absorbs the high energy UV light produced by the PID's lamp and causes the temporary loss of an electron. This process causes the molecule to become positively charged and capable of being measured. Commercial PIDs are generally offered with UV lamps of 9.5 electron volts (eV), 10.6eV or 11.7eV with the 10.6eV lamp being the standard.

All elements and chemicals can be ionized, but they differ in the energy required. The energy required to displace an electron and ionize a compound is called its ionization potential (IP). It is measured in electron volts. To find the IP of a compound, consult a chemical dictionary. If the IP of the sample gas is less than the eV output of the lamp, the PID can measure the sample gas. For example, benzene has an IP of 9.24eV and can be read by the "standard" 10.6eV lamp. Acetic acid has an IP of 10.66eV and may be read only by an 11.7eV lamp. The standard calibration gas for PIDs is isobutylene with an IP of 10.6eV.

Uses

PIDs may be used to detect a variety of compounds including aromatic hydrocarbons (e.g., benzene, toluene, xylene), ketones and aldehydes, chlorinated hydrocarbons (trichloroethene, tetrachloroethane, etc.), sulfur compounds, amines and amides, alcohols, and saturated and unsaturated hydrocarbons (butane, hexane, butadiene, etc.). PIDs can also detect some inorganic compounds, including ammonia and chlorine. Generally, the lower the IP of a gas, the more sensitive the PID is to the gas.

Limitations

PIDs must not be used:

- To measure radiation, oxygen, nitrogen, carbon dioxide or carbon monoxide;
- To measure hydrogen cyanide, sulfur dioxide or acid gases;

- If the humidity is greater than 85%.

Documentation Required

Date, Time, Weather, Temperature, Lamp eV, Calibration gas and results, Results

C. Immunoassay Field Test Kits (IFTs)**Description**

IFTs come in a variety of formats. Ready-to-use units typically involve the use of a wide range of chemical specific antibodies, reagents, standards, enzyme conjugates and chromogenic substrates. IFTs typically involve the mixing of reagents with the environmental media (sample) in measured amounts. A specified, noticeable change in the sample is used to measure the presence and concentration of the compound being measured. This change often involves color.

Uses

IFTs are generally used for the quick detection of specific compounds in the field. They can be used to detect compounds that cannot be accurately measured by other portable devices.

Limitations

The IFT may only be used to detect the specific compound it was designed to measure. Humidity and particulates may interfere with chemical detection. Use the IFT exactly as the directions specify.

Documentation Required

Date, Time, Weather, Temperature, Compound(s) tested, Method for testing (number of pumps etc), Results

APPENDIX 5 DEFINITIONS AS USED IN THIS DOCUMENT

Accuracy

Refers to the closeness of agreement between an observed value in a laboratory analytical method and an accepted reference value for that method.

Analyte

A chemical compound measured or detected in a sample.

Aquifer

A body of rock or other geologic material that is sufficiently permeable to conduct groundwater and to yield significant quantities of water to wells or springs.

Area of Concern

Each area where contamination was detected in the initial site assessment or known area of release.

Assessment and Clean-up Plan (ACP)

The second phase of a site investigation structured to define the extent of each contaminant, in each area of concern, for each medium that is contaminated to concentrations less than or equal to the MDL, and the proposed remediation of each area of concern.

Background Level

Site-specific natural level of a compound. Usually only determined for metals.

Bedrock

A general term used to describe solid rock that underlies soil or other unconsolidated, superficial material. Bedrock cannot readily be excavated without the use of explosives or heavy rock cutting equipment.

Biased Sample

A sample collected based on information about the medium being sampled, or based on the judgment and knowledge of the sample collector. Not a statistical approach.

Blanks

Used to identify and isolate the possible sources of contamination that may be introduced into a sample at some point during the collecting, transporting, handling and analytical process.

Branch

Refers to the Compliance Branch of the Hazardous Waste Section

Clean-up Level

The level of a compound that is both protective of human health and the underlying groundwater.
The level at which no further remedial actions are required.

Closure Report

The final report submitted to the Branch documenting clean-up activities at a site.

Composite Sample

A sample consisting of a mixture of individual grab samples.

Contaminant of Concern

The compounds identified in each media at a site above the specified clean-up level.

Confining Layer

A layer having very low hydraulic conductivity in relationship to adjacent units. It restricts the movement of water into and out of an aquifer (e.g., dense unfractured clay).

Confirmed Release

A release for which a laboratory result of sampled media shows any contaminant above the method detection limit.

Department

Refers to the North Carolina Department of Environmental Quality (NC DEQ).

Discharge

A release.

Division

Refers to the Division of Waste Management of the NC DEQ.

Environmentally Sensitive Area

Areas protected by the NC Division of Parks and Recreation, The National Park Service, or the US Forest Service. They include: state parks, areas important to the maintenance of unique natural communities; sensitive areas identified under the National Estuary Program, designated state natural areas, national and state seashore, Lakeshore and River Recreational Areas, rare species (state and federal threatened and endangered), sensitive aquatic habitats, national parks or monuments, federal designated Wild and Scenic Rivers, designated and proposed Federal Wilderness and Natural Areas, national preserves and forests, federal land designated for the protection of natural ecosystems

Generator Closure

Sites with contamination resulting from releases of hazardous waste or hazardous waste constituents without groundwater contamination. Sites can be closed if remediated to background or risk-based clean-up levels.

Grab sample

An individual sample collected from a single source usually collected instantaneously.

Groundwater

The waters occurring in the subsurface under saturated conditions.

Hazardous Waste

Discarded material that, due to its quantity, concentration or physical or chemical characteristics, may cause, or significantly contribute to, an increase in mortality, irreversible or incapacitating reversible illness, or pose a substantial threat or potential hazard to human health or the environment when improperly treated, stored, transported, disposed, or otherwise managed. Federal regulations define a waste a hazardous waste if it exhibits a characteristic of a hazardous wastes (40 CFR 261.20 through 251.24); has been listed as hazardous (40 CFR 261.31 through 261.33); or is a mixture containing a listed hazardous waste and a non-hazardous solid waste, unless the mixture is specifically excluded or no longer exhibits any of the characteristics of a hazardous waste.

Hazardous Waste Constituent

A compound in the EPA list of hazardous wastes in 40 CFR 261 Subpart D, a compound listed in Table 1 of 40 CFR 261.24, or a compound listed in Appendix IX of 40 CFR 264.

Initial Site Sampling Plan (ISSP)

The plan of intended actions to be taken to (1) identify all releases of hazardous substances to the environment, (2) characterize the chemical nature of such releases, and (3) collect sufficient sampling data to compile a list of contaminants of concern.

In Situ Soil

Soil or fill material that is in the ground and has not been excavated.

Method Detection Limit (MDL)

The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. It is determined from analysis of a sample in a given matrix containing the analyte.

Precision

The closeness of agreement between randomly selected individual measurements or test results. It is a measure of the laboratory's ability to reproduce analytical results.

Receptor

Any human, plant or animal, well or surface water body that is, or has the potential to be, adversely affected by the release or migration of contaminants.

Release

Any spilling, leaking, emitting, discharging, escaping, leaching or disposing of a substance into groundwater, surface water or soil.

Representative Sample

A sample that reflects the characteristics of the “population” or medium being sampled.

Responsible Party

An owner or operator of a site who is responsible for a discharge or release.

Risk-Based Level

Concentrations of contaminants in soil that are protective of human contact with soil through the inhalation, dermal and ingestion pathways (residential). The Preliminary Soil Remediation Goals (PRGs) Table is available at the following web link.

<http://deq.nc.gov/about/divisions/waste-management/waste-management-permit-guidance/inactive-hazardous-sites-guidance-documentsSection>

Refers to the Hazardous Waste Section of the Division of Waste Management

Soil Screening Level

A conservatively calculated level of a constituent in a soil that is protective of human health and the groundwater being contaminated above NC 2L standards from the leaching or migration of contaminant through the soil. The Protection of Groundwater PSRGs are in the Preliminary Soil Remediation Goals Table is available at the following web link.

<http://deq.nc.gov/about/divisions/waste-management/waste-management-permit-guidance/inactive-hazardous-sites-guidance-documentsSpill>

A release.

Surface Water

All waters of the state as defined in G.S. 143-212, except underground waters.

Uppermost Aquifer

The saturated portion of the uppermost geologic formation, group of formations, or part of a formation that can yield a significant amount of groundwater to wells or springs.

APPENDIX 6 ACRONYMS

ACP	Assessment and Clean-up Plan (Phase II- extent of contamination)
ASTM	American Society for Testing and Materials
CFR	Code of Federal Regulations
CF	Correction Factor
DWM	Division of Waste Management
EPA	Environmental Protection Agency
EPA ID	Environmental Protection Agency Identification Number
EPA SOP	Environmental Investigations Standard Operating Procedures and Quality Assurance Manual
eV	Electron Volt
FID	Flame Ionization Detector
GC	Gas Chromatograph
GC/MS	Gas Chromatograph/Mass Spectrometry
HWS	Hazardous Waste Section
IFT	Immunoassay Field Test
IMAC	Interim Maximum Allowable Concentration
IP	Ionization Potential
ISM	Incremental Sampling Methodology
ISSP	Initial Site Sampling Plan (Phase I- initial site sampling plan)
ITRC	Interstate Technology and Regulatory Council
MDL	Method Detection Limit
NC	North Carolina
NC DEQ	Department of Environmental Quality
NCAC	North Carolina Administrative Code
NCGS	North Carolina General Statutes
PCB	Polychlorinated Biphenyl
OEEB	Occupational and Environmental Epidemiology Branch
PID	Photo Ionization Detector
PQL	Practical Quantitation Limit
PSRG	Preliminary Soil Remediation Goal
QA/QC	Quality Assurance/ Quality Control
RCRA	Resource Conservation and Recovery Act
RP	Responsible Party
SSL	Soil Screening Levels
TCLP	Toxic Characteristic Leaching Procedure
2L	North Carolina Groundwater Quality Standards
TSD	Treatment Storage Disposal (facility)
USEPA	United States Environmental Protection Agency
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound

APPENDIX 7
HAZARDOUS WASTE COMPLIANCE BRANCH CONTACTS

Submit all reports to the Branch Environmental Chemist for your Region.

If you do not know your Region, see the map at the following link:

<http://deq.nc.gov/about/divisions/waste-management/frequently-asked-questions/hazardous-waste-section-faq>

(Hazardous Waste Regional/County Contacts)