

# ***Inactive Hazardous Sites Program***

## **GUIDELINES FOR ADDRESSING PRE-REGULATORY LANDFILLS AND DUMPS**



***December 2013***

***Department of Environment and Natural Resources  
Division of Waste Management  
Superfund Section  
Inactive Hazardous Sites Branch  
Pre-Regulatory Landfill Unit***

*217 West Jones Street  
1646 Mail Service Center  
Raleigh, North Carolina 27699-1646  
Telephone: (919) 707-8200*

**<http://www.portal.ncdenr.org/web/wm/sf/ihome>**



## Table of Contents

<b>SECTION</b>	<b>PAGE</b>
General.....	1
Document Requirements.....	1
Remedial Investigation-First Phase .....	2
Remedial Investigation-Contaminant Delineation Phase .....	4
Remediation.....	8
Public Comment.....	9
Remedial Action Completion Report.....	9
Report Certifications for Remedial Investigation and Remedial Action Work Plans and Reports.....	9
<b>FIGURES</b>	
Figure 1.....	C-5
Figure 2.....	C-6
<b>APPENDICES</b>	
Appendix A: Sensitive Environments.....	A-1
Appendix B: Laboratory Analyses .....	B-1
1. Non-Gas Samples.....	B-1
2. Gas Samples.....	B-3
Appendix C: Standard Field Protocols.....	C-1
Appendix D: Definitions.....	D-1

### **General**

This document provides a general outline for addressing pre-1983 non-industrial landfills and dumps (landfills that ceased accepting waste prior to January 1, 1983) that are not subject to the North Carolina Division of Waste Management's 15A NCAC 13B post-closure regulations administered by the Solid Waste Section. In 2007 the legislation established funding for contaminant assessment and remedial measures at these Pre-Regulatory Landfills and Dumps. This work is completed by the Pre-Regulatory Landfill Unit (Unit) of the Inactive Hazardous Sites Branch (Branch). The Unit also oversees, and approves for reimbursement, contaminant investigations conducted by local governments.

**Due to the wide range of conditions encountered at Pre-Regulatory Landfills, these guidelines will not address every conceivable situation.** Sites where assessments are conducted by local governments, the environmental consultant for the local government may need to consider proposing additional analyses and sample collection based on existing site-specific conditions and future land use.

Separate work plans, cost estimates and proposed schedules are required for each phase of investigation and must be approved by the Unit prior to implementation. Direct questions regarding the guidelines to the Unit staff at (919) 707-8200.

### **Document Requirements**

Submit final documents in PDF. Documents generally larger than about 20 megabytes (MB) should be separated into sections to accommodate the 20 MB size requirement. For details on electronic document submittal, please refer to our website at:

[http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=cb794534-e1a2-4c7a-b4c2-faf3c8d056d9&groupId=38361](http://portal.ncdenr.org/c/document_library/get_file?uuid=cb794534-e1a2-4c7a-b4c2-faf3c8d056d9&groupId=38361)

### **Remedial Investigation - First Phase Work**

The first phase of remedial investigation should include at a minimum, the items listed below. Prior to conducting the work, prepare a work plan for review and approval by Unit staff.

Generally, landfills and dumps included in the Pre-Regulatory Landfill Inventory have a site summary report (first phase environmental site assessment) on file. If any of the items listed below are already on file with our office, then these items do not need to be duplicated.

File documents can be accessed on the web at:

<https://edm.nc.gov/DENR-Portal/>

All of the items below must be provided in either the work plan or the report as directed by staff.

1. A summary of historical operations including, but not limited to: a chronological listing of owners and operators, written documentation and interviews with individuals who have historical knowledge to provide verification of time operated, types of waste received, other relevant information about disposal operations, and current property use.
2. Aerial photography and Sanborn Fire Insurance maps, if available, showing site conditions from pristine land, during the active life of the landfill and at present conditions.
3. If historical research indicates that the landfill received a large amount of industrial waste (i.e. more than expected at a municipal solid waste landfill of that time period) or if known or suspected areas of hazardous substance disposal exists (i.e. hot spots) contact the Unit. Waste characterization of exposed wastes or hot spots may be required prior to any other investigation activities.
4. Site geographic coordinates (GPS) (unless available from NC Superfund Section files) at the site entrance and at points delineating the suspected extent of waste disposal area. Report all coordinates in latitude and longitude by decimal degrees to the seventh order using the North American Datum of 1983 (NAD83) format and differential corrections (listed clockwise around the perimeter of the waste disposal area beginning with the northern point). Also report the coordinates in latitude and longitude using WGS 84 format.
5. Most currently available United States Geological Survey topographic maps showing coverage within a 1,000 foot radius of the center of the waste disposal area (at disposal areas greater than 8 acres, coverage should extend 1,000 feet from the edge of estimated waste disposal area). Include topographic contours (light shading) on all supporting figures.
6. Survey of all water supply wells, springs and surface water intakes used a water sources within 1,000 feet of the waste disposal perimeter identified through visual inspection, available maps, online resources and local utility offices. Provide distances to landfill on a table and locations on a scaled map.
7. Map locations and tabularized information summarizing the identity and location of surface water bodies within 1000 feet of the edge of waste including information

regarding the type of water body (e.g. stream, lake, storm water ditch; perennial or intermittent) name, and flow direction. List current water source owners and users (if other than the owner) and addresses in the table and cross reference to the map. Collection and analysis of samples from these water sources may be required based on site conditions during a second phase.

8. Site map(s) identifying areas of the site property(ies) that are paved or landscaped, the type and extent of ground cover, general surface conditions, structures, sumps, septic systems, storm water conduit and other underground utilities (use multiple maps if necessary to clearly show all required information). Draw all maps to scale and include a bar scale (in feet), legend, and north arrow.
9. Vicinity map(s) identifying property lines, underground utilities and zoning classifications on the site properties and all properties located within 500 feet of the waste disposal perimeter.
10. The results of a sensitive environment survey of the site property(ies) and all property within 500 feet of the waste disposal perimeter. If any are identified, provide map(s) to document location. The results should be provided in a table that includes contracts, responses and any documentation.

*Note:* If a sensitive environment is identified (as defined in Appendix A), then it is necessary to conduct an evaluation to delineate the sensitive environment boundary, determine if any special sampling is necessary and whether site remediation may do more harm than good.

11. A geophysical study to delineate the horizontal extent of waste. If a site has been redeveloped or waste is considered to be in contact with groundwater, then the vertical extent of waste should also be determined using geophysical methods. Collect coordinate data using survey grade GPS for delineating the waste limits on a site survey plat (to be prepared and certified by a professional land surveyor during subsequent work phases). Tabularized data and study figures drawn to scale with a bar scale (in feet), legend and north arrow should be included with the results.

12. A description of local geologic, hydrogeologic and soil conditions.

### **Remedial Investigation - Contaminant Delineation**

After the first phase of the remedial investigation, an investigation delineating the extent of contamination follows. Appendices B and C of this document provide an outline of necessary sample analyses and field protocols. The identity and extent of each contaminant in each affected environmental medium for unrestricted use levels must be determined.

The contaminant delineation work can be conducted in phase(s) and must include at a minimum, the items described below. Large sites make a phased approach and separate work plans for each phase more practical. Commonly the surface vapor study would come first, followed by groundwater testing and then the structural vapor intrusion potential study. However, site-specific conditions may alter this order. Submit a contaminant delineation work plan, cost estimate and schedule for each phase of work to the Unit for review and approval that includes the following relevant information:

1. Proposed boring locations and depths for purposes of confirming the edge of waste based on results from previous investigations.
2. A site map showing the proposed locations of soil samples, soil borings and any additional sampling of other media. Include anticipated screened intervals for proposed monitoring wells. Well installation must comply with the most current 15A NCAC 2C well construction standards.
3. Proposed sampling and analytical methods for all target media (see Appendix B - Laboratory Analyses, Laboratory Analytical Parameters) including quality assurance/quality control measures.
4. A description of procedures to manage drill cuttings, purge water and decontamination water.
5. A schedule for site activities and reporting.
6. A proposed evaluation of above ground air space near the landfill surface and of subsurface vapor from within the waste to determine the potential for unacceptable levels of hazardous vapors at the surface. A subsequent evaluation may be required to determine the potential for subsurface vapors from wastes or contaminated groundwater to migrate into existing or future structures.
  - a. Collect readings across the landfill on a grid with spacing dependent on site conditions (a maximum 100 foot spacing) using field instrumentation. Record measurements of methane, hydrogen sulfide, total volatile organic compounds (VOCs) and mercury at each grid point. Record barometric pressure readings at least every hour during the screening. Do not perform the screening on a rainy day or an exceedingly windy day. If any compounds are detected or if the survey was conducted during a period of rising barometric pressure, a second confirmation survey will need to be conducted on a later day. Record background readings upwind of, but in close proximity to, the landfill area. Place temporary flagging (i.e. wooden stakes) at all grid points with detectable concentrations of any of the contaminants listed above. Collect coordinate data using GPS in decimal degrees to the seventh order for accurate locations.

- b. After groundwater sampling and the above-ground landfill vapor evaluation have been completed, use those results to target subsurface vapor sample locations. Install gas probes a minimum spacing of one gas probe every two acres across the landfill using previous data and information on the location of known chemical waste disposal to help target locations. Areas exhibiting odors, stressed vegetation, or bubbling water should be investigated. At landfills less than two (2) acres in size, gas from at least one probe should be tested. More may be necessary based on site conditions. Use field instruments to test for-methane, hydrogen sulfide, total volatile organic compounds (VOCs) along with barometric pressure, oxygen and carbon dioxide. If mercury was previously detected at the surface, collect a sample for laboratory analysis for mercury at that location. Screen all probe(s) within the waste. Seal the probe(s) at least five feet below ground surface with the screen bottom at least two feet above seasonal high groundwater (if encountered). If groundwater is encountered in the waste, alternate methods may be used as provided in Appendix C. Readings can be collected with field instrumentation. Refer to Appendix C for further details on probe installation procedures, and field quality control procedures.
7. An evaluation of vapor intrusion potential for current and future structures on or within 500 feet of the landfill waste perimeter and within 100 feet of the perimeter of the groundwater volatile organic contaminant plume. Additional information is included in the *Supplemental Guidelines for the Evaluation of Structural Vapor Intrusion Potential* can be found at:  
[http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=9949e2f4-3308-4eb6-ba8c-0b61566047e3&groupId=38361](http://portal.ncdenr.org/c/document_library/get_file?uuid=9949e2f4-3308-4eb6-ba8c-0b61566047e3&groupId=38361)
  - a. Evaluation of potential for vapor intrusion into existing or future structures will **not** be necessary when –
    - i. the landfill has no volatile contaminants (any compound with a Henry’s law constant less than  $1 \times 10^{-5}$  and includes not just VOCs but some SVOCs and metals) in groundwater,
    - ii. a 500 foot buffer exists on the property around the edge of the waste,
    - iii. the groundwater contaminant plume has not and will not come within 100 feet of existing and future structures,
    - iv. no structures are currently present on the landfill disposal area, and
    - v. land use restrictions will be employed at the property so that no structure will be allowed on the landfill or within 500 feet of the waste foot print and within 100 feet of anywhere the groundwater volatile contaminant plumes could migrate.
  - b. If a vapor intrusion potential evaluation is needed, proceed as follows.
    - i. Determine sample locations: The vapor intrusion potential evaluation will include laboratory analysis of subsurface air samples from within the waste along with subsurface air samples collected around the landfill perimeter. These samples will be used to determine the potential for vapors from the waste or contaminated groundwater to migrate into existing or future buildings on the property or surrounding properties.

Hot spots of groundwater contamination, contaminant detections during the above ground vapor screening steps, and plans for development of the property will govern where the in-landfill samples are collected. If land use restrictions will be employed at the property so that no structure will be allowed on the landfill, the initial vapor intrusion evaluation can be limited to the perimeter of the landfill.

- ii. Seal the base of the probe(s) at least five feet below ground surface with the screen bottom at least two feet above seasonal high groundwater (if encountered). If groundwater is encountered in the waste, a shallower seal depth may be needed so that the screen bottom will be two feet above groundwater.
  - iii. Following collection of laboratory samples at the gas probe(s), collect readings using field instrumentation for methane, hydrogen sulfide, oxygen, and carbon dioxide, if the sampling point was not part of the previous field screening in Section 6. If methane is detected, collect samples for laboratory analysis of mercury as well.
  - iv. Compare the results of shallow soil gas testing (less than 5 feet below ground surface) to the Indoor Air Screening Levels and deeper soil gas results (greater than 5 feet below ground surface) to the Soil Gas Screening Levels on the Division's Vapor Intrusion Screening Tables. If the results of the soil gas testing exceed acceptable risk targets further vapor intrusion potential evaluation will be needed for structures on or within 500 feet of the landfill. For vacant lots, land use restrictions or other remediation will be needed to prevent exposure.
8. Proposed procedures for sampling all water sources (wells, springs and/or seeps) located within 500 feet of the waste disposal area. These samples must be analyzed for complete analytical scans (see Appendix B - Laboratory Analyses, Laboratory Analytical Parameters).
  9. If surface water features traverse or adjoin the waste disposal area, a proposal for collection and analysis of surface water and sediment samples (see Appendix B - Laboratory Analyses, Laboratory Analytical Parameters). At a minimum, collect one set of samples, immediately downstream (of the waste disposal area), one set from where the stream traverses or contacts the site and one set immediately upstream (of the waste disposal area). Note: Collect samples in a downstream to upstream progression.
  10. A groundwater contour and flow map showing land surface topography, surface water features and monitoring well locations should be included in the report summarizing the results of this phase of the investigation. Also include field notes, boring logs, well completion logs, screened intervals records for temporary and permanent well construction (non-residential well construction record form GW-1).
  11. Additional contaminant delineation work phase(s) for identifying the extent of contaminated media may include soil, sediment, surface water, groundwater and landfill gas. A site map which indicates the locations of surface soil samples, soil borings,

sediment and surface water samples, monitoring points, boring locations, laboratory reports and well screen intervals when the installing monitoring wells must be provided in work plans and reports for the work phase. Well installation and abandonment must comply with the most current 15A NCAC 2C well construction standards.

12. A site survey plat (prepared and sealed by a NC registered land surveyor) meeting the requirements of N.C.G.S. 47-30 and the county Register of Deeds which includes at a minimum includes: scale, benchmarks, north arrow, locations of property boundaries, disposal areas delineated by geophysical or other methods, wells, and identification of all adjacent property owners.

## **Remediation**

One or more of the following remedial action requirements may apply to the remedial action and may be required in the remedial action plan:

1. Consent of the site's owner to the imposition of land use restrictions.
2. A summary of the results of the remedial investigation; include a discussion of contaminated media, contaminants of concern, and the extent of the contamination.
3. At landfills with less than 100,000 cubic yards of waste (approximately two (2) acres on average) non-containment remedies will be evaluated in the remedial action plan. This is especially important at landfills having groundwater contamination and/or those having the potential for vapor intrusion into structures.
4. The installation of erosion control measures to manage at least a twenty-five year storm event. Unit meetings and discussions with the Division of Water Resources should be conducted to ensure stormwater and erosion control regulatory compliance.
5. Removal and proper disposal of any exposed waste and/or surface debris.
6. Excavation of waste to create a buffer between the waste disposal area and/or other receptors.
7. Excavation and removal of waste "hotspots" causing localized groundwater or vapor contamination.
8. Slope stabilization.
9. Installation of an engineered landfill cover.
10. Repair of existing landfill cover or installation of other barriers as appropriate.
11. In remedies where fill material (soil) will be placed on the site, collect composite samples for laboratory analysis of the material to confirm it is clean prior to placement. Generally, divide the fill material into segments that are approximately 100 cubic yards, within each segment, use either random or biased selection to locate at least three borings, within each segment, use either random or biased selection to locate at least three borings. Collect samples from two depths within each boring (minimum six samples per segment). Alternatively with in-situ borrow sources, evaluate land conditions and determine sampling frequency by a grid and/or random pattern. If found to be elevated, then additional sampling may be required for the source or additional source locations may be considered.
12. Additional efforts to stop leachate seepage.
13. Development and implementation of a monitoring plan for groundwater, landfill gas, surface water and/or sediment.

14. Control, removal and/or treatment of contaminated media including: groundwater, landfill gas, surface water, soils and/or sediment.
15. Any confirmation sampling needed.
16. Recordation of land use restrictions and the associated notice of contamination, approved by the Unit. If a complete waste removal is conducted and no contamination in excess of unrestricted use standards remains in any media, land use restrictions and a notice will not be needed. Instructions for Recordation of Notices can be found at: <http://portal.ncdenr.org/web/wm/sf/ihs/ihsguide>.
17. Applicable permits and approvals.

### **Public Comment**

A **draft remedial action plan** will be made available for public comment prior to implementation. After review of the draft remedial action plan, the Unit will distribute copies to the local health director and the public library closest to the site location. Notice of a 45 day public comment period will be mailed to persons that have requested to be on the mailing list for the site (N.C.G.S. 130A-310.4(c)(2)) and published weekly for three consecutive weeks in a local newspaper. If significant public interest exists, the Unit will hold a hearing. Interested parties will be given 30 days notice of the hearing and have an additional 20 days after the hearing to submit comments. If no significant public interest exists, the Unit may still will hold a public meeting. The Unit will evaluate and consider all public comments before finalizing the remedial action plan.

### **Remedial Action Completion Report**

A remedial action completion report will present the results of the remedy, final drawings, post confirmation sampling and monitoring requirements.

### **Report Certifications for Remedial Investigation and Remedial Action Work Plans and Reports**

1. A signed and notarized certification by the consultant responsible for the day to day remedial activities stating, "I certify that, to the best of my knowledge, after thorough investigation, the information contained in or accompanying this certification is true, accurate, and complete."
2. Any work that would constitute the "practice of engineering" as defined by G.S. 89C shall be performed under the responsible charge of, and signed and sealed by, a professional engineer registered in the state of North Carolina. Any work that would constitute the "public practice of geology" as defined by G.S. 89E shall be performed under the responsible charge of, and signed and sealed by, a geologist licensed in the state of North Carolina.
3. For units of local government seeking remedial investigation reimbursement and developers performing voluntary remedial investigations under direct state oversight, the following certification is required: A signed and notarized certification by a representative of the remediating party stating, "I certify that, to the best of my knowledge, after thorough investigation, the information contained in or accompanying this certification is true,

accurate, and complete.”

## **Appendix A: Sensitive Environments**

An evaluation on the waste disposal area and areas within 500 feet of the waste perimeter (not including roads and right of ways) for the existence of any of the environmentally sensitive areas listed below. Refer to Appendix C of the Inactive Hazardous Sites Program's guidance document for contacts that should be made in order to identify these areas. The most current edition of the *Inactive Hazardous Sites Program Guideline for Assessment and Cleanup* may be found at: <http://portal.ncdenr.org/web/wm/sf/ihs/ihsguide>. Outline the information received through these contacts in the remedial investigation first phase work plan or report. Knowledge of the presence of these sensitive environments is necessary to determine if any special sampling (such as aquatic toxicity testing) is required and whether site remediation may do more harm than good (for example, excavation and destruction of a wetland versus leaving in place residual contamination which will not significantly impact the wetland environment).

### State Parks

Areas Important to Maintenance of Unique Natural Communities

Sensitive Areas Identified Under the National Estuary Program

Designated State Natural Areas

State Seashore, Lakeshore and River Recreational Areas

Rare Species (state and federal Threatened and Endangered)

Sensitive Aquatic Habitat

State Wild and Scenic Rivers

National Seashore, Lakeshore and River Recreational Areas

National Parks or Monuments

Federal Designated Scenic or Wild Rivers

Designated and Proposed Federal Wilderness and Natural Areas

National Preserves and Forests

Federal Land designated for the protection of Natural Ecosystems

State-Designated Areas for Protection or Maintenance of Aquatic Life

State Preserves and Forests

Terrestrial Areas Utilized for Breeding by Large or Dense Aggregations of  
Animals

National or State Wildlife Refuges

Marine Sanctuaries

National and State Historical Sites

Areas Identified Under Coastal Protection Legislation

Coastal Barriers or Units of a Coastal Barrier Resources System

Spawning Areas Critical for the Maintenance of Fish/Shellfish Species within  
River, Lake or Coastal Tidal Waters

Migratory Pathways and Feeding Areas Critical for Maintenance of Anadromous  
Fish Species within River Reaches or Areas in Lakes or Coastal Tidal  
Waters in which such Fish Spend Extended Periods of Time

State Lands Designated for Wildlife or Game Management

Wetlands

Areas likely to serve as a natural area attractive to terrestrial ecological receptors.

Areas of stressed vegetation or wildlife.

## **Appendix B: Laboratory Analyses**

### **Laboratory Analytical Parameters**

#### 1. Non-Gas Samples

All initial analyses of all non-gas samples should include complete analytical scans for the parameters listed below. Subsequent delineation work phases can be limited to compounds detected in the first phase and their degradations compounds. For SW-846 methods, the latest editions of SW-846, including any subsequent updates which have been incorporated into the edition, must be used.

- Volatile and Semi-Volatile Organic Compounds: SW-846 Methods 8260/8270.

*Initial groundwater testing must use the most current USEPA Contract Laboratory Program Target Compound List and include a library search (using National Institute of Standards and Technology mass spectral library) to produce a list of tentatively identified compounds (TICs). The library search should identify TICs for the largest 10 peaks in each analytical fraction having reasonable agreement with reference spectra (i.e. relative intensities of major ions agree within  $\pm 20\%$ ). The list of identified TICs should not include laboratory control sample compounds, surrogates, matrix spike compounds, internal standards, system monitoring compounds or target compounds. Any TICs that have reasonable agreement with reference spectra, and are detected in more than one sample in an area of concern (or in the sole sample collected, in an area), should be included in all subsequent analytical work unless the compound is a laboratory contaminant, naturally-occurring or otherwise a non-toxic anthropogenic sourced constituent. Quantification of these specific TICs must be performed before cleanup levels can be determined. Check with the laboratory on possible procedures.*

- 1,4 Dioxane: SW-846 Method 8260 SIM.

*Include in analysis if any chlorinated volatile organic compounds detected or if 1,4-dioxane is a suspected contaminant on its own.*

- Metals and inorganics including antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, nickel, selenium, silver, zinc, mercury, thallium, ammonia, sulfate and nitrate: US EPA Method or method published in Standard Methods for the Examination of Water and Wastewater having the lowest detection limits or having detection limits below unrestricted use remediation goals and the 15A NCAC 2L standards.

*Complete metal scans will need to use SW-846 method 6020. Water samples should not be filleted prior to digestion.*

- Hexavalent chromium: For soils, sediments and waste – SW-846 Method 3060 alkaline digestion coupled with a US EPA Method or method published in

- Standard Methods for the Examination of Water and Wastewater having the lowest detection limits or having detection limits below unrestricted use remediation goals and the 15A NCAC 2L standards. There is up to a 30 day holding time prior to extraction. For water samples – US EPA Method 218.6 as modified by US EPA Region IV should be used. The preservation procedure in this modification allows for up to a 28-day holding time.

*Analysis for hexavalent chromium only needed if total chromium results exceed the hexavalent chromium unrestricted use targets and two times natural background concentrations for soils or the 15A NCAC 2L standard for groundwater.*

*Water samples for hexavalent chromium analysis must be filtered in the field within 15 minutes of collection. Bottles must be pre-preserved as specified in the US EPA Region IV modification to Method 218.6. Laboratories should contact the US EPA in Region IV for the methodology. Otherwise, samples are held to a 24- hour holding time using other US EPA method or Standards Method: Selection of methods and pre-preservation of bottles should be discussed with the laboratory prior to sample collection.*

- Pesticides, PCBs, herbicides, dioxins, formaldehyde, phosphorous, or other suspect contaminants: US EPA Method or method published in Standard Methods for the Examination of Water and Wastewater having the lowest detection limits or having detection limits below unrestricted use remediation goals and the 15A NCAC 2L standards.

*Analyze only if suspected at the site.*

- Dissolved methane: US EPA, RSK 147 or 175.

*Include at landfills where methane migration is a concern. Concentrations greater than 28 mg/l could potentially cause flammable or explosive levels in confined spaces like crawl spaces, well houses or pipes.*

The laboratory must be provided a copy of **Appendix B** to ensure appropriate analyte lists are used in the analysis of samples.

After the initial phase to identify contaminants of concern in each media, subsequent samples only need to be analyzed for contaminants detected and their degradation products. If laboratory sample dilutions were performed on Phase I samples, subsequent phase samples must be analyzed for the entire analytical fraction previously diluted in addition to the above items. Sample dilutions raise analytical detection limits and can mask the presence of other constituents at lower concentrations.

Phase II and subsequent samples should be analyzed using the methods specified above for Phase I samples. Other methods published may be substituted, if the substitute methods achieve equal or lower detection limits or if they achieve the unrestricted use

remediation goals and the 15A NCAC 2L standards.

### Gas Samples

Collect samples and analyze for these parameters **only** if they were detected at unacceptable levels during the above ground field screening.

- Volatile Organic Compounds: Method TO-15 using Summa canisters (individual certification)
- Mercury: NIOSH 6009
- Hydrogen Sulfide: US EPA 918 Method 15

For details on vapor sample collection and analysis procedures, please see the Branch's Supplemental Guidelines for the evaluation of Structural Vapor Intrusion Potential at: <http://portal.ncdenr.org/web/wm/sf/ih/s/ihsguide>

### Data Reporting

Laboratory reports submitted with remedial investigation reports must include the items listed below. Full CLP documentation packages are not required.

1. The laboratory report must state that the laboratory is either certified for applicable parameters under 15A NCAC Subchapter 2H .0800 and provide its certification number, or that it is a contract laboratory under the US EPA's Contract Laboratory Program.
2. A signed statement from the laboratory that the samples were received in good condition, at the required temperature and that analysis of the samples complied with all procedures outlined in the analytical method, unless otherwise specified. Any deviation from the methods, additional sample preparation, sample dilution and unrectified analytical problems, must be justified in a narrative with the laboratory report.
3. Laboratory sheets for all analytical results, including sample identification, sampling dates, date samples were received by laboratory, extraction dates, analysis dates, analytical methods used, dilution factors and sample quantitation limits.
4. The laboratory must provide a written explanation for any sample having sample quantitation limits that exceed 10 times the US EPA method detection limits.
5. Laboratory sheets for all laboratory quality control samples, including results for bias and precision and control limits used. The following minimum laboratory quality control sample reporting information must be provided: (a) at least one matrix spike and one matrix spike duplicate per sample delivery group or 14-day period, whichever is more frequent (control limits must be specified); (b) at least one method blank per sample delivery group or 12-hour period, whichever is less; and (c) system monitoring compounds, surrogate recovery required by the method and laboratory control sample analysis (acceptance criteria must be specified). All samples that exceed control

6. limits/acceptance criteria must be flagged in the laboratory report. The results of any library searched performed for ‘tentatively identified compounds.’”
7. Data quality should be reviewed and validated by both the remediating party and the laboratory. Any quality control concerns, data qualifiers or flags should be evaluated and discussed in the associated report.
8. All constituents detected must be reported even if they were not definitively quantified. All estimated concentrations with data qualifiers must be reported.
9. Completed chain-of-custody with associated air bill (if applicable) attached.
10. The laboratory report should include the names of the individuals performing each analysis, the quality assurance officer reviewing the data and the laboratory manager.

## **Appendix C: Standard Field Protocols**

1. Unless otherwise noted below, field procedures relating to sample collection techniques, sample containers, sample preservation, equipment decontamination and field measurement procedures, should comply with the most current version of the U. S. Environmental Protection Agency (U.S. EPA) Region IV Science And Ecosystem Support Division (SESD) *Field Branches Quality System and Technical Procedures*. This information is available from the U.S. EPA Region IV SESD at:  
<http://www.epa.gov/region4/sesd/fbqstp/>
2. In addition to the standard protocols outlined in the U.S. EPA information referenced above, please observe the following procedures:
  - a. Field QC samples: (i) minimum of one duplicate sample, per medium, per container type, per field day; (ii) equipment rinsate blanks and trip blanks for VOA analysis (VOA) are strongly recommended.  
  
*Note:* If site conditions warrant more limited QA/QC testing, contact the Branch.
  - b. Soil, sediment and waste samples for VOA should be collected directly into sample containers without mixing.
  - c. Collect coordinates (GPS) of all soil sampling and boring locations or stake and flag until the remedial investigation is complete.
  - d. A professional land surveyor, registered in North Carolina, must survey all permanent monitoring point locations.
  - e. Filtration of groundwater samples for metals analysis before acid digestion is not permitted. If turbidity is a problem, collect groundwater samples using low-flow purging and sampling techniques. Additional well development may also be necessary. Rapid analyses of samples is also recommended to reduce contact time with the acid preservative. Note that samples for hexavalent chromium analysis should not receive acid preservatives and should be collected in a separate container from those for other metals analysis.
  - f. For surface waters that are very shallow (less than six inches deep) or highly turbid, samples may be collected in a separate collection container and then decanted into the sample container. Samples for organic analysis must be decanted into the sample container immediately. Samples for metals analysis may be allowed to settle for a few minutes prior to decanting. All collection containers must be made of the same materials as the sample container. They must be pre-cleaned and handled in the same manner.
  - g. Investigation derived wastes or IDW (may include drill cuttings and muds, sampling materials, purge water, soil and residuals from testing) generated as part

of remedial investigation activities may be discharged or stored in the area of contamination and are not subject to RCRA as long as the material:

- stays on site and remains in the contaminated area,
  - is secured,
  - does not increase the spread of contamination or concentrations in a particular medium,
  - does not cause mobilizations of contaminants.
- and
- does not introduce contamination to uncontaminated soil (causing an increase in contaminant concentrations).

In residential and public use areas, IDW will require off-property management unless it meets unrestricted use levels and permission from the property owner has been granted. IDW cannot be discharged to another area of concern.

### 3. Landfill Gas Evaluation

#### a. General

- Please see the IHSB residential Vapor Intrusion Screening Levels at: [http://portal.ncdenr.org/c/document\\_library/get\\_file?uuid=f2bf20c6-571c-4318-9fa0-0d36c34f4b52&groupId=38361](http://portal.ncdenr.org/c/document_library/get_file?uuid=f2bf20c6-571c-4318-9fa0-0d36c34f4b52&groupId=38361)
- Each field instrument must be able to quantify at levels at or below vapor intrusion screening levels while maintaining valid upper and lower limits of detection specified by the manufacturer.
- Surface screening of ambient air (above ground) conditions may require different instrumentation than required for subsurface oxygen deficient environments.
- Make sure the appropriate calibration gas is used for the appropriate instrument.

#### b. Field Instrument Parameters and Equipment

- **Common landfill gases:** methane (using an infrared sensor capable of detecting methane at 2,500 ppm or 0.25% by volume of air and 5% LEL), oxygen, carbon dioxide and barometric pressure. For reference 10,000 ppm of methane in air equals 1% by volume or 20% LEL. (The global background concentration for surface methane is about 0.75 ppm from decay of vegetation.)
- **Hydrogen sulfide:** Use a gold film sensor or equivalent for ambient air or an attachment with an infrared sensor for subsurface. The minimum instrument detection limit must meet the IHSB residential vapor intrusion screening levels.
- **Mercury:** Use a gold film sensor or equivalent for measuring concentrations in ambient air or a high-frequency driven electrodeless discharge lamp for subsurface vapors. The minimum instrument detection limit must meet the

- Branch residential vapor intrusion screening levels.
- **Temperature and humidity.**

c. Field Instrument Calibration/Quality Assurance Data

Landfill gas evaluation reports should include all the following instrument data:

- The instrument manufacturer, model number, serial number, date of factory calibration and maintenance, set up parameters.
- Detection limits.
- A summary of **field calibration** procedures employed (using those recommended by the manufacturer and bump test to verify proper calibration and instrument accuracy before, during and after evaluation,) type(s) of calibration gas used along with expiration dates.
- Any additional field calibration conducted as required for changing field conditions.
- Name(s) of person conducting the evaluation,
- Brief description of weather conditions and other possible impacts on data: windy, nearby exhaust from vehicles etc.
- Date and time began/end.
- Ambient temperature, humidity and barometric pressure readings (at least hourly).
- All field instrument calibration dates.
- Additional field calibration as needed for changing field conditions (barometric pressure, temperature etc.).
- Report methane in % LEL any % by volume and micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). Hydrogen sulfide, mercury and volatile organic compounds should be reported in micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ).

d. Field Instrument Survey Results

Provide a table that includes sample location, readings, (note other things that may affect the results like a water trap, filters, increasing barometer pressure, significant change in the temperature, etc.).

At least two (2) readings must be collected anywhere there is equal to or greater than 2% change in the reading.

Duplicate readings of at least one background and two monitoring points should be collected for all direct read instruments.

e. Landfill Gas Probes/Wells Installation

Subsurface air samples from within the waste and along the landfill perimeter may require the installation of probes/wells (Figure 1). These points will be used to evaluate the potential for vapors associated with waste degradation.

The probe/well(s) should be sealed at least five feet below ground surface (as a more shallow depth may draw air from the surface) and the screen bottom must be at least two feet above seasonal high groundwater (if encountered).

At sites where geologic conditions prevent meeting these requirements, flux chambers may be used. Recess the flux chamber (Figure 2) into the ground surface and seal with grout or hydrated bentonite. Attach to the chamber air tight fittings that allow connections to either field instruments and/or summa canisters. Use water trap filters in the sample line when moisture or liquid is found in a probe/wells(s). Record the length of time a calibrated field instrument is connected to the flux chamber when taking a reading so the procedure may be duplicated if re-testing is needed. The results collected from flux chambers are qualitative, not quantitative. Flux chamber results should be compared to the indoor air screening concentrations—column A located on the Division of Waste Management’s Residential Vapor Intrusion Screening Tables.

The Branch has additional guidance on vapor intrusion evaluation methodology. Please see the IHSB Supplemental Guidelines for the Evaluation of Structural Vapor Intrusion Potential at: <http://portal.ncdenr.org/web/wm/sf/ihb/ihsguide> .

**Figure 1: Landfill Gas Monitoring Probe**

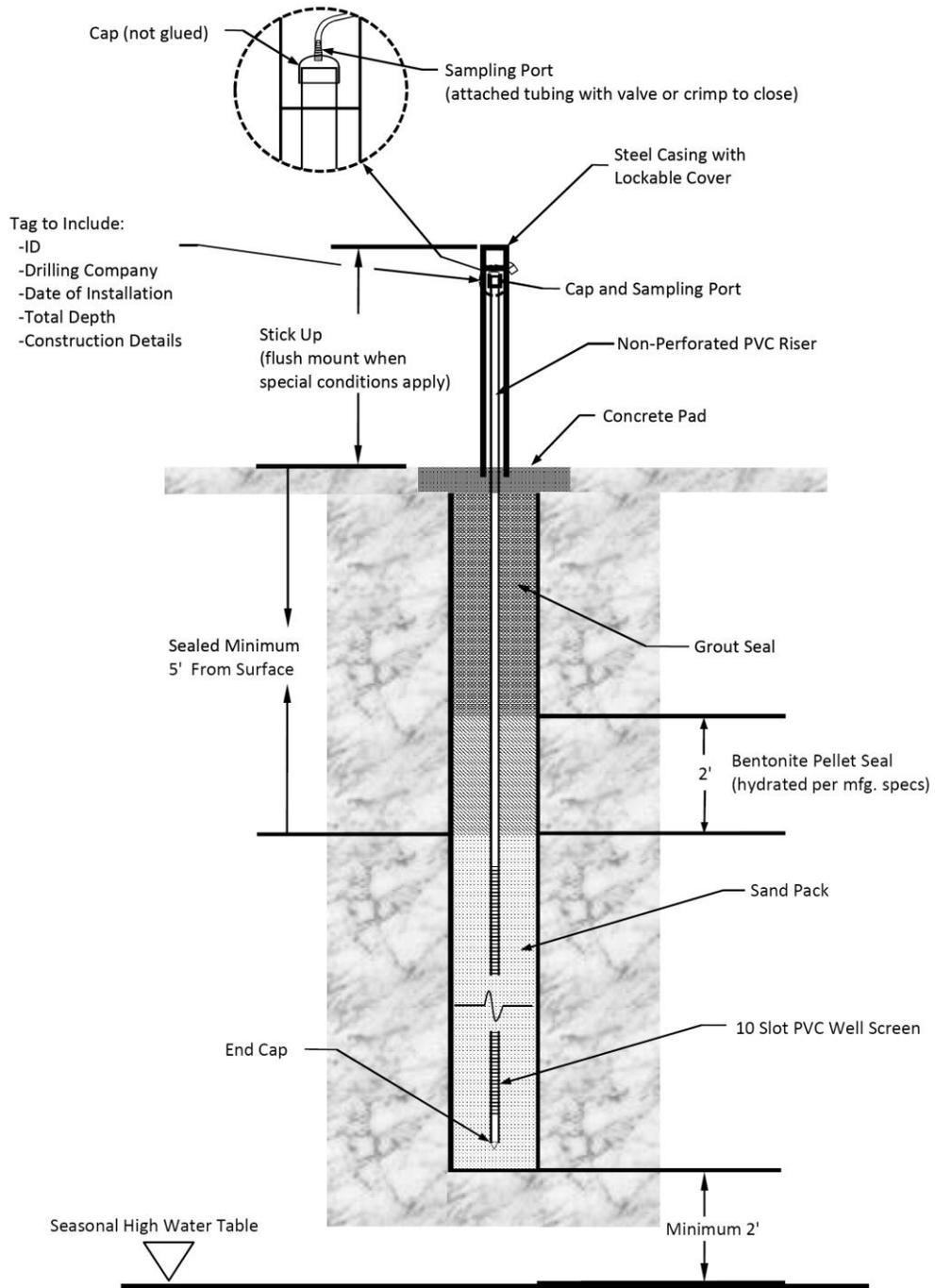
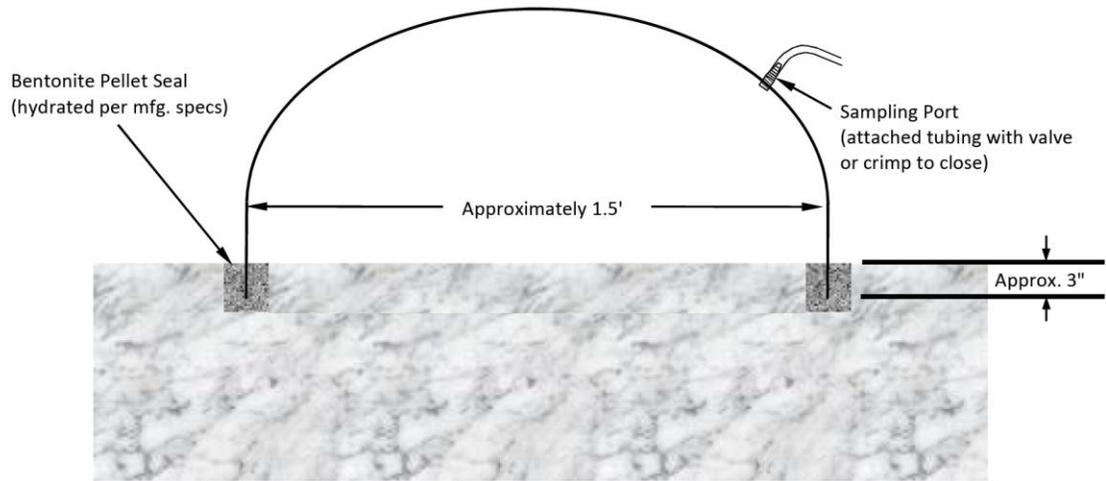
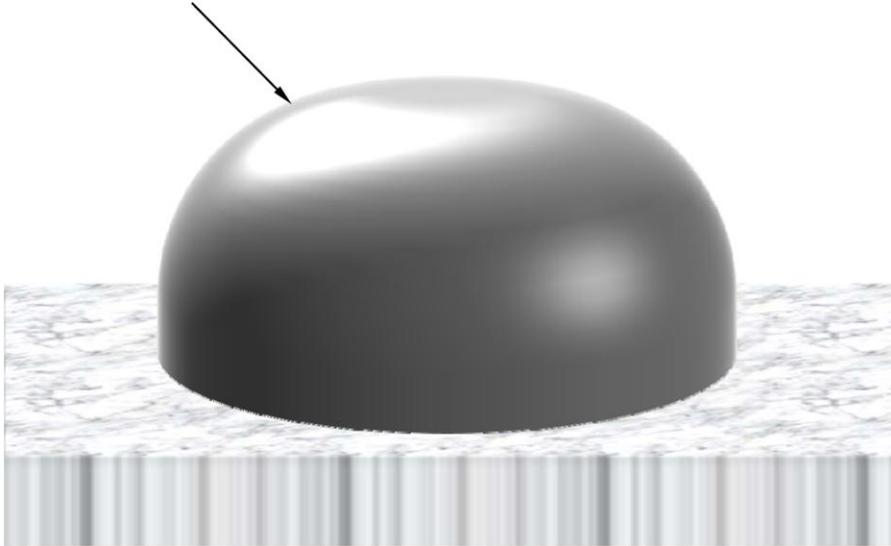


Figure 2: Flux Chamber



Constructed of Impermeable, Inert Material



## **Appendix D: Definitions**

The following definitions apply to this guidance:

**Pre-1983 landfill:** any land area, whether publicly or privately owned, on which municipal solid waste disposal occurred prior to January 1, 1983. This does not include any landfill used primarily for industrial waste disposal. (Ref.; G.S. 130A-290(a) (21a))

**Property/Properties:** the parcel/parcels that include the waste disposal area/site and anywhere contamination from the landfill has come to be located.

**Site:** any area where a hazardous substance or waste has been deposited, stored, disposed of, placed, or otherwise come to be located.

**Waste disposal area:** the estimated or actual waste disposal footprint derived from investigation activities regardless of the number of properties on which it is located.