Draft

GUIDANCE MANUAL
FOR

CLOSURE PLANS
AND POST-CLOSURE PLANS
FOR

HAZARDOUS WASTE MANAGEMENT FACILITIES

Virginia Department of Environmental Quality
Office of Waste Permitting
Division of Waste Program Coordination

September 28, 2001

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd.) **Page**

TABLE OF CONTENTS (Cont'd.)

TABLE OF CONTENTS (Cont'd.)

LIST OF APPENDICES

APPENDIX A

1. EPA Region III Technical Guidance – Chemical Concentration Data Near The Detection Limit, by Dr. Roy L. Smith, EPA, 1991.

2. DEQ Memorandum, SW-846 Methods Table, from Khoa Nguyen, P.E., February 18, 1999.

APPENDIX B

1. Sampling Equipment Decontamination: Standard Operating Procedure (SOP) No. 2006.

APPENDIX C

1. Hazardous Waste Closure Statistical Analysis Guidance, by Charlotte Carroll, Statistician, Office of Technical Support, Division of Waste Program Coordination, DEQ, 1999.

APPENDIX D

1. Risk-based Closure Guidance, by Sanjay Thirunagari, Toxicologist, Office of Technical Support, Division of Waste Program Coordination, DEQ, 1999.

2. Guidelines For Developing Health-based Cleanup Goals Using Risk-Assessment At A Hazardous Waste Site Facility For Restricted Industrial Use, DEQ, June 1, 1995.

3. Risk Exposure and Analysis Modeling System (REAMS) Training Manual (Windows Version), by Sanjay Thirunagari, Office of Technical Support, Division of Waste Programs Coordination, DEQ, August 19, 1998.

APPENDIX E

1. Example Quality Assurance/Quality Control Plan for sampling.

2. Example Sampling and Analysis Plan, DEQ.

TABLE OF CONTENTS (Cont'd.)

LIST OF APPENDICES

APPENDIX F

APPENDIX G

APPENDIX H

APPENDIX I

TABLE OF CONTENTS (Cont'd.)

Page

LIST OF FIGURES

Forward

This guidance manual is not intended to be a substitute for the applicable regulatory requirements under the Virginia Hazardous Waste Management Regulations (VHWMR), 9 VAC 20-60-12, et seq., of the Virginia Administrative Code (formerly VR 672-10-1), the Resource Conservation and Recovery Act (RCRA) regulations, as amended. This guidance manual is designed to supplement the above cited regulations and to help provide clarification regarding the nature and content of closure plans and post-closure plans required by the DEQ. It is the responsibility of all owners and operators of regulated facilities to ensure that their closure plan and post-closure plan submittals are in compliance with applicable regulatory requirements.

It should be noted that guidance development is a continuing process; therefore, this manual may be changed and supplemented with new, revised guidance by the DEQ and the EPA at any point in time. Furthermore, additional information may be required in a closure plan by the DEQ on a case-by-case basis. Therefore, the DEQ recommends that facilities and their representatives contact the Office of Waste Permitting, DEQ, Richmond, Virginia, for further site specific guidance prior to development of their site specific closure plan(s), and if applicable, their post-closure plan.

All questions pertaining to closure requirements for HWM facilities, specific HWMUs, or this document should be directed to Debra Miller, Hazardous Waste Permit Manager, Office of Waste Permitting, Division of Waste Program Coordination, DEQ, at (804) 698-4206, damiller@deq.state.va.us.

1.0 INTRODUCTION

1.1 PURPOSE OF MANUAL

The purpose of this manual is to provide guidance for the development of closure plans and post-closure plans for hazardous waste management (HWM) facilities in accordance with the Commonwealth of Virginia Hazardous Waste Management Regulations (VHWMR), 9 VAC 20-60-12, et seq., of the Virginia Administrative Code (formerly VR 672-10-1), the Resource Conservation and Recovery Act (RCRA) regulations, as amended, and in accordance with guidance from the EPA and the Virginia Department of Environmental Quality (DEQ). (Please note that 9 VAC 20-60-12, et seq., incorporates text from Title 40 of the Code of Federal Regulations (CFR) by reference, including, but not limited to 40 CFR Parts 124, 260, 261, 262, 264, 265, 266, 268, 270, 273, and 279.)

The guidance in this manual is not a substitute for the applicable regulatory requirements, but is designed to supplement the regulations and to help provide clarification regarding the content of closure plans and post-closure plans required by the DEQ.

Please note that all owners or operators of HWM facilities with regulated hazardous waste management units (HWMUs) must submit closure plans to the DEQ, Division of Waste Program Coordination, Office of Waste Permitting, and receive formal approval from the Director prior to implementation of closure activities.

Approval of closure plans and post-closure plans by the DEQ is in accordance with the requirements under 40 CFR Part 264 and 265, Subpart G, Closure and Post-Closure, as applicable. (Part 265 is for Interim Status facilities.)

In addition to the above, facilities with specific types of HWMUs require approval of closure plans and post-closure plans in accordance with the requirements specified under 40 CFR Part 264, Subpart F, Releases From Solid Waste Management Units, and for Interim Status facilities, in accordance with 40 CFR Part 265, Subpart F, Groundwater Monitoring. This means that specific types of HWM facilities must address groundwater monitoring requirements as a condition of both closure and post-closure care. (See § 264.90 and § 265.90, Applicability.) Guidance within this manual helps clarify which facilities are subject to Subpart F requirements as a condition of closure and post-closure care.

1.2 SCOPE OF MANUAL & MANUAL USERS GUIDE

The scope of this manual is to provide both general and detailed guidance regarding closure plans and post-closure plans for HWM facilities in accordance with the requirements of the VHWMR and the RCRA regulations.

General or overview guidance is provided within Section 2.0, General Guidance, for the development of both closure plans and post closure plans. Section 2.2 provides definitions regarding the two types of closure demonstrations ("clean closure" and closure with hazardous waste "closed in-place"), while Section 2.3 provides definitions of common terminology that are utilized within the VHWMR and the RCRA regulations.

Section 2.4 provides regulatory citations regarding the regulated HWMUs, which are subject to closure, and provides summary information and verbatim regulatory text regarding the closure and post-closure care requirements.

Section 2.5 provides the verbatim closure performance standards specified in the regulations. The closure performance standards provide the main premise, criteria, and standards for closure of all regulated units and provide the applicable citations for the closure requirements of the various types of regulated units subject to closure.

The general purpose of a closure plan and a post-closure plan is discussed in Section 2.6, while Section 2.7 provides summaries of the closure plan submittal requirements for the various types of HWMUs. The closure plan submittal requirements are dependent upon the type and nature of the HWMU undergoing closure, and include one of the following: 1) a written closure plan, 2) a written closure plan and a written contingent closure plan and written contingent post-closure plan, or 3) a written closure plan and a written post-closure plan. All HWM facilities with HWMUs are subject to closure and are required to submit written closure plans to the DEQ for approval prior to implementation of closure.

Section 2.8 provides summary information regarding the design requirements and required contents of closure plans and post-closure plans. **Section 2.8 also identifies when a HWM facility must include groundwater monitoring as a condition of closure in accordance with the requirements of 40 CFR Part 264, Subpart F, Releases From Solid Waste Management Units, and 40 CFR Part 265, Subpart F, Groundwater Monitoring. Facilities with specific solid waste management units (SWMUs), which are identified in Subpart F, must comply with the requirements to monitor, detect, characterize, and respond to releases from the SWMU to the uppermost aquifer. Facilities subject to Subpart F requirements must ensure that hazardous constituents under a regulated unit do not exceed the concentration limits under § 264.94 in the uppermost aquifer underlying the waste**

management unit point of compliance during closure and during the compliance period.

Section 2.9 provides a general overview of the common elements of typical closure plans and post-closure plans in Figure 2-1, and the common elements of typical post-closure plans in Figure 2-2. Figure 2-3 provides a flow chart of the typical closure process.

Section 2.10 provides guidance on the interface between closure of HWMUs and corrective action (CA). HWMUs with hazardous waste "closed in-place" may require CA remediation measures to protect human health and the environment.

Section 3.0, Components of a Closure Plan, provides both general and detailed guidance regarding the typical components in a closure plan and the type of information that the DEQ believes is appropriate and/or necessary for approval of a closure plan by the Director of the DEQ.

An overview of the typical components of a closure plan is provided in Figure 3-1, Outline of Components of a Closure Plan. General guidance is provided in Section 3.0 regarding the recommended format, organization, and content of closure plans. In addition, Section 3.0 provides a section or subsection for each component of a closure plan that is identified in Figure 3-1. Each section and subsection provides general and detailed information which may include regulatory citations, regulatory requirements, general and detailed guidance, recommendations, and/or examples of the type of information that the DEQ believes is appropriate for the various component parts of a closure plan.

Please note that detailed and comprehensive guidance for the development of a post-closure plan is not provided in this manual. Post-closure plans should be developed in accordance with the unit specific regulatory requirements delineated within the VHWMR and the RCRA regulations and in accordance with unit specific closure guidance from the DEQ.

In addition, this manual does not provide detailed guidance for compliance with the groundwater monitoring requirements for both closure and post-closure care under 40 CFR Part 264 and Part 265, Subpart F. Facilities with HWMUs which are subject to groundwater monitoring requirements for closure and post-closure care should follow the unit specific and general regulatory requirements specified under Parts 264 and 265, Subpart G, and Subpart F, as appropriate.

Appendices are included in this manual to further assist facilities in the development of closure plans and post-closure plans. The appendices include additional information and guidance regarding regulatory requirements and provide recommendations, example procedures, and other information that may be useful in the development of closure plans and post-closure plans. Appendix H includes a copy of the RCRA permit application checklist for Part B, Subpart I, Closure, Post-Closure, and Financial Assurance Requirements specified under the regulations. Appendix I

provides the DEQ's web site address and file location to obtain a copy of the RCRA permit application checklists Parts A and B, if needed.

2.0 GENERAL GUIDANCE

2.1 INTRODUCTION

The purpose of this part of the manual is to provide an overview or general guidance for the development of closure plans, and post-closure plans for hazardous waste management units (HWMUs) in accordance with the Commonwealth of Virginia Hazardous Waste Management Regulations (VHWMR), the Resource Conservation and Recovery Act (RCRA) regulations, as amended, and in accordance with guidance from the EPA and the Virginia Department of Environmental Quality (DEQ). (Please note that the VHWMR, 9 VAC 20-60-12, et seq., incorporates several texts from Title 40 of the Code of Federal Regulations (CFR) by reference, including, but not limited to 40 CFR Parts 124, 260, 261, 262, 264, 265, 266, 268, 270, 273, and 279.)

Section 2.2 provides definitions regarding the two types of closure demonstrations ("clean closure" and closure with hazardous waste "closed in-place"). Section 2.3 provides definitions of common terminology that are utilized within the VHWMR and the RCRA regulations.

Section 2.4 provides the regulatory citations for the types of regulated units or HWMUs which are subject to closure requirements, and also provides summary information regarding the requirements for closure and post-closure care.

Section 2.5 provides the verbatim closure performance standards regulatory requirements that are specified in the regulations. The closure performance standards provide the main premise, criteria, and standards for closure of all regulated units and provide the applicable citations for the closure requirements of the various types of regulated units subject to closure.

The general purpose of a closure plan and a post-closure plan are discussed in Section 2.6, while Section 2.7 provides summaries of closure plan submittal requirements for the various types of HWMUs. The closure plan submittal requirements are dependent upon the type and nature of the HWMU undergoing closure, and include one of the following:

1. A written closure plan.

2. A written closure plan, a written contingent closure plan, and written contingent post-closure plan.

3. A written closure plan and a written post-closure plan.

Section 2.8 provides summary information regarding the design requirements and required contents of closure plans and post-closure plans for the various types of regulated units.
Section 2.8 also identifies when a HWM facility must include groundwater monitoring as a condition of closure in accordance with the requirements of 40 CFR Part 264, Subpart F, Releases From Solid Waste Management Units, and 40 CFR Part 265, Subpart F, Groundwater Monitoring. This means that specific HWMU types and designs are subject to Subpart F requirements and they must address groundwater monitoring requirements as a condition of both closure and post-closure care.

Facilities with specific solid waste management units (SWMUs), which are identified in Subpart F, must comply with the requirements to monitor, detect, characterize, and respond to releases from the SWMU to the uppermost aquifer. Facilities subject to Subpart F requirements must ensure that hazardous constituents under a regulated unit do not exceed the concentration limits under § 264.94 in the uppermost aquifer underlying the waste management unit point of compliance during closure and during the compliance period.

Section 2.9 of this general guidance provides summary figures of the common elements of typical closure plans and post-closure plans, and provides a flow chart of the typical processes associated with closure of regulated units as follows:

1. Figure 2-1, Common Elements In Closure Plans.

2. Figure 2-2, Common Elements In Post-Closure Plans.

3. Figure 2-3, Typical Closure Process.

Section 2.10 provides general guidance on the interface between closure of HWMUs and corrective action (CA). HWMUs with hazardous waste “closed in-place” may require CA remediation measures to protect human health and the environment.

In accordance with the VHWMR, all closures of HWMUs require certification of closure by an independent Professional Engineer (P.E.), registered in the Commonwealth of Virginia and the owner/operator of the facility. Therefore, closure plans and/or post-closure plans which are developed for a HWM facility should be reviewed by a P.E. to help assure the closure plan's procedures and processes are in accordance with the regulatory requirements and are sufficient to meet a P.E.'s requirements for closure certification. (Detailed guidance regarding the specifics of the certification requirements are provided in Section 3.22, Certification of Closure.)

In addition, please note that all owners or operators of facilities with HWMUs subject to closure under 40 CFR 264 or 265 shall submit closure plans and post-closure plans to the DEQ, Division of Waste Program Coordination, Office of Waste Permitting, and receive formal approval prior to

implementation of closure activities. Approval of closure plans and post-closure plans by the Director of the DEQ is in accordance with the requirements under the VHWMR, the RCRA regulations, as amended, and in accordance with guidance from the EPA and the DEQ.

2.2 TYPES OF CLOSURE

The purpose of this section is to define and describe the two different types of closure demonstrations for HWMUs under the VHWMR and the RCRA regulations. Understanding the two types of closure demonstrations under the regulations is essential to understanding the full regulatory requirements for closure and post-closure care.

There are two types of closure demonstrations for hazardous waste management units (HWMUs) regulated under the VHWMR and the RCRA as follows:

1. **Clean Closure** – When a facility is able to demonstrate that a HWMU is closed in accordance with the closure performance standards of the regulations and the decontamination standards of the closure plan, then the HWMU closure is referred to as a "clean closure." (This term may be applied to the HWMU structures, soils, and groundwater, as applicable.)

   In a "clean closure" demonstration, all hazardous waste and hazardous waste constituents have been removed from a HWMU to levels such that direct contact with any remaining hazardous waste constituents after closure will not pose a threat to human health and/or the environment, nor adversely impact any environmental media (soil, sediments, groundwater, surface water, and air) in excess of the acceptable risk-based exposure levels.

   Container storage facilities, tank systems with secondary containment, incinerators, and containment buildings, and drip pads are various types of HWMUs that typically should be able to attain "clean closure," if they were designed and operated properly.

2. **Closed In-Place** – When a facility subject to the RCRA is unable to demonstrate "clean closure" of a HWMU in accordance with the closure performance standards of the regulations and the "clean closure" decontamination standards of the closure plan, then the facility must be closed with hazardous waste "closed in-place."

   Except for container management storage facilities, HWM facilities that have HWMUs with hazardous waste "closed in-place" must comply with the closure requirements of a landfill under 40 CFR Part 264, Subpart N. Facilities with hazardous waste "closed in-place" must meet post-closure care requirements specified in the regulations. Such facilities must include groundwater monitoring

as a condition of closure and post-closure care.

When a HWM facility is unable to close a HWMU in accordance with an approved closure plan and they are unable to practicably remove or decontaminate the subsoil or the site has contaminated groundwater, then the facility would be required to amend the closure plan so to close the HWMU with hazardous waste "closed in-place." (The time frame for submittal of an amended written closure plan is delineated in the regulations.)

When a HWM facility which has operated a 1) regulated tank system, 2) surface impoundment, 3) waste pile, 4) incinerator, or 5) drip pad HWMU, and the facility must close any of these HWMUs with hazardous waste "closed in-place," then the facility must amend the closure plan to comply with the closure requirements of a landfill. In addition, such a facility would be required to develop a post-closure plan to comply with the post-closure care and use requirements of the property as specified for a landfill. (See 40 CFR Part 264, Subpart N, §264.310.)

The closure requirements for hazardous waste management (HWM) facilities that store containers of hazardous waste specifies the following (Subpart I, § 264.178, Closure):

> *At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases, and soil containing or contaminated with hazardous waste or hazardous waste residues must be decontaminated or removed.*

When a container management facility is unable to achieve "clean closure," that is, to decontaminate or remove all soil containing hazardous waste and/or when groundwater is contaminated from such a facility, then the facility must close the container management unit with hazardous waste "closed in-place."

There are no provisions in the VHWMR or the RCRA Regulations to close a container management facility as a landfill when such a facility cannot be "clean closed." Therefore, a HWM facility which has a container storage HWMU with hazardous waste "closed in-place" must further address the remaining contamination at the site under corrective action (CA) under the Hazardous Solid Waste Amendments (HSWA) of the RCRA, of 1984.

In the Commonwealth of Virginia, the DEQ has been authorized HSWA authority for corrective action for hazardous waste management facilities that have Hazardous Waste Management Permits. In the Commonwealth of Virginia, non-permitted hazardous waste management facilities are required to address corrective action requirements under the

authority of the EPA. (The DEQ received partial delegation of the HSWA authority on September 9, 2000.)

2.3 DEFINITIONS

The purpose of this section is to provide definitions of common terms related with closure of hazardous waste management facilities under the VHWMR and the RCRA regulations. Understanding the basic definitions under the VHWMR and the RCRA regulations is essential to understanding the full regulatory requirements for closure and post-closure care.

Definitions of terms, general standards, and overview information applicable to the VHWMR and the RCRA regulations are identified under 40 CFR Part 260, Hazardous Waste Management System: General. Section 260.10, Definitions.

In general, most of the definitions under the RCRA have been incorporated into the VHWMR by reference. However, the VHWMR identifies how specific incorporated text of the RCRA shall be interpreted under the VHWMR in-lieu of the verbatim interpretation provided under the RCRA. **The VHWMR, under 9 VAC 20-60-14, Definitions Derived from Incorporations of Reference Texts, identifies that:**

> *These incorporated texts are fully a part of these regulations (9 VAC 20-60-12 et seq., Virginia Hazardous Waste Management Regulations); however, definitions, additions, modifications and exemptions stated in the text written herein direct how the incorporated text shall be interpreted, and they take precedence over the verbatim interpretation of the incorporated text. These incorporated texts include definitions that are fully a part of these regulations and generally applicable throughout all incorporated text and all text written herein; however, stated in the text written herein are directions as to how the incorporated text shall be interpreted, and these directions take precedence over the verbatim interpretation of the incorporated text.*

As examples, and as specified under 9 VAC 20-60-14, *"Director" shall supplant the "Administrator," "Assistant Administrator," "Assistant Administrator for Solid Waste and Emergency Response" and the "Regional Administrator," wherever they appear. ... "Qualified engineer" means an engineer licensed as a certified professional engineer in the Commonwealth of Virginia.*

Therefore, with the above in mind, when one interprets the federal regulations under the RCRA, it is imperative to check 9 VAC 20-60-12 et seq., VHWMR, in order to establish how incorporated text of the RCRA regulations is to be literally interpreted under the VHWMR.

The definitions of common terms applicable to closure under the VHWMR and the RCRA regulations and specified in Parts 260 through 265 and 268, are identified under 40 CFR Part 260, § 260.10, Definitions, as follows:

1. **Active Life** – *Active life of a facility means the period from the initial receipt of hazardous waste at the facility until the Regional Administrator receives certification of final closure.*

2. **Active Portion** – *Active portion means that portion of a facility where treatment, storage, or disposal operations are being or have been conducted after the effective date of Part 261 of this chapter and which is not a closed portion. (See also "closed portion" and "inactive portion.")* (The effective date of RCRA, Part 261 is November 19, 1980.)

3. **Aquifer** –*Aquifer means a geologic formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs.*

4. **Closed Portion** – *Closed portion means that portion of a facility which an owner or operator has closed in accordance with the approved facility closure plan and all applicable closure requirements. (See also "active portion" and inactive portion.")*

5. **Container** – *Container means any portable device in which a material is stored, transported, treated, disposed of, or otherwise handled.*

6. **Containment Building** – *Containment building means a hazardous waste management unit that is used to store or treat hazardous waste under the provisions of subpart DD of parts 264 or 265 of this chapter.*

7. **Disposal** – *Disposal means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwaters.*

8. **Disposal Facility** – *Disposal facility means a facility or part of a facility at which hazardous waste is intentionally placed into or on any land or water, and at which waste will remain after closure. The term disposal facility does not include a corrective action management unit into which remediation wastes are placed.*

9. **Existing Hazardous Waste Management (HWM) Facility or Existing Facility** – *Existing hazardous waste management (HWM) facility or existing facility means a facility which was in operation or for which construction commenced on or before November 19, 1980.* (See § 260.10 for the complete definition.)

10. **Facility** – Facility means:

(1) All contiguous land, and structures, other appurtenances, and improvements on the land, used for treating, storing, or disposing of hazardous waste. A facility may consist of several treatment, storage, or disposal operational units (e.g., one or more landfills, surface impoundments, or combinations of them).

(2) For the purpose of implementing corrective action under § 264.101, all contiguous property under the control of the owner or operator seeking a permit under subtitle C of RCRA. This definition also applies to facilities implementing corrective action under RCRA Section 3008(h).

(3) Notwithstanding paragraph (2) of this definition, a remediation waste management site is not a facility that is subject to 40 CFR 264.101, but is subject to corrective action requirements if the site is located within such a facility.

11. **Final Closure** – *Final closure means the closure of all hazardous waste management units at the facility in accordance with all applicable closure requirements so that hazardous waste management activities under Parts 264 and 265 of this chapter are no longer conducted at the facility unless subject to the provisions in § 262.34, Accumulation Time.*

12. **Generator –** *Generator means any person, by site, whose act or process produces hazardous waste identified or listed in part 261 of this chapter or whose act first causes a hazardous waste to become subject to regulation.*

13. **Groundwater –** *Groundwater means water below the land surface in a zone of saturation.*

Unless otherwise stated, groundwater is to be included when water is referred to within this document.

14. **Hazardous Waste** – *Hazardous waste means a hazardous waste as defined in § 261.3*

of this chapter.

14. **Hazardous Waste Constituent** – *Hazardous waste constituent means a constituent that caused the Administrator to list the hazardous waste in Part 261, subpart D, of this chapter, or a constituent listed in Table 1 of § 261.24 of this chapter.*

Table 1 of § 261.24 is the Maximum Concentration of Contaminants For The Toxicity Characteristic, which uses the Toxicity Characteristic Leaching Procedure (TCLP), Test Method 1311 in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846, as incorporated by reference in § 260.11 of this chapter.

16. **Hazardous Waste Management Unit (HWMU)** - *Hazardous Waste Management Unit is a contiguous area of land on or in which hazardous waste is placed, or the largest area in which there is significant likelihood of mixing hazardous waste constituents in the same area. Examples of hazardous waste management units include a surface impoundment, a waste pile, a land treatment area, a landfill cell, an incinerator, a tank and its associated piping and underlying containment system, and a container storage area. A container alone does not constitute a unit; the unit includes containers and the land or pad upon which they are placed.*

17. **In Operation –** *In operation refers to a facility which is treating, storing, or disposing of hazardous waste.*

18. **Inactive Portion** – *Inactive portion means that portion of a facility which is not operated after the effective date* of Part 261 of this chapter. (See also "active portion" and "closed portion.")*

*** The effective date of RCRA, Part 261 is November 19, 1980.**

19. **Incinerator –** *Incinerator means any enclosed device that:*

(1) Uses controlled flame combustion and neither meets the criteria for classification as a boiler, sludge dryer, or carbon regeneration unit, nor is listed as an industrial furnace; or

(2) Meets the definition of infrared incinerator or plasma arc incinerator.

19. **Industrial Furnace** – *Industrial furnace means any of the following enclosed devices that are integral components of manufacturing processes and that use thermal treatment to accomplish recovery of materials or energy:*

(1) Cement kilns
(2) Lime kilns
(3) Aggregate kilns
(4) Phosphate kilns
(5) Coke ovens
(6) Blast furnaces
(7) Smelting, melting and refining furnaces (including pyrometallurgical devices such as cupolas, reverberator furnaces, sintering machine, roasters, and foundry furnaces)
(8) Titanium dioxide chloride process oxidation reactors
(9) Methane reforming furnaces
(10) Pulping liquor recovery furnaces
(11) Combustion devices used in the recovery of sulfur values for spent sulfuric acid
(12) Halogen acid furnaces (HAFs) for the production of acid from halogenated hazardous waste generated by chemical production facilities where the furnace is located on the site of a chemical production facility, the acid product has a halogen acid content of at least 3 %, the acid product is used in a manufacturing process, and, except for hazardous waste burned as fuel, hazardous waste fed to the furnace has a minimum halogen content of 20 % as-generated.
(13) Such other devices as the Administrator, after notice and comment, add to this list on the basis of one or more of the following factors:

(i) The design and use of the device primarily to accomplish recovery of material products;
(ii) The use of the device to burn or reduce raw materials to make a material product;
(iii) The use of the device to burn or reduce secondary materials as effective substitutes for raw materials, in processes using raw materials as principal feedstocks;
(iv) The use of the device to burn or reduce secondary materials as ingredients in an industrial process to make a material product;
(v) The use of the device in common industrial practice to produce a material product;
(vi) The use of the device in common industrial practice to produce a material product; and
(vii) Other factors, as appropriate.

21. **Landfill** – *Landfill means a disposal facility or part of a facility where hazardous waste is placed in or on land and which is not: a pile, a land treatment facility, a surface impoundment, an underground injection well, a salt dome formation, a salt bed formation, an underground mine, a cave, or a corrective action management unit.*

22. **Landfill Cell** – *Landfill cell means a discrete volume of a hazardous waste landfill which uses a liner to provide isolation of wastes from adjacent cells or wastes. Examples of landfill cells are trenches and pits.*

23. **Land Treatment Facility** – *Land treatment facility means a facility or part of a facility at which hazardous waste is applied onto or incorporated into the soil surface; such facilities are disposal facilities if the waste will remain after closure.*

24. **Leachate** – *Leachate means any liquid, including any suspended components in the liquid, that has percolated through or drained from hazardous waste.*

25. **Leak-Detection System** – *Leak-detection system means a system capable of detecting the failure of either the primary or secondary containment structure or the presence of a release of hazardous waste or accumulated liquid in the secondary containment structure. Such a system must employ operational controls (e.g., daily visual inspections for releases into the secondary containment system of aboveground tanks) or consist of an interstitial monitoring device designed to detect continuously and automatically the failure of the primary or secondary containment structure or the presence of a release of hazardous waste into the secondary containment structure.*

26. **Liner** – *Liner means a continuous layer of natural or man-made materials, beneath or on the sides of a surface impoundment, landfill, or landfill cell, which restricts the downward or lateral escape of hazardous waste, hazardous waste constituents, or leachate.*

27. **Management or Hazardous Waste Management** – *Management or hazardous waste management means the systematic control of the collection, source separation, storage, transportation, processing, treatment, recovery, and disposal of hazardous waste.*

28. **Manifest** – *Manifest means the shipping document EPA form 8700-22 and, if necessary, EPA form 8700-22A, originated and signed by the generator in accordance with the instructions included in the appendix to Part 262.*

29. **Manifest Document Number** – *Manifest document number means the U.S. EPA twelve digit identification number assigned to the generator plus a unique five digit document number assigned to the manifest by the generator for recording and reporting purposes.*

30. **Miscellaneous Unit** – *Miscellaneous unit means a hazardous waste management unit where hazardous waste is treated, stored, or disposed of and that is not a container, tank, surface impoundment, pile, land treatment unit, landfill, incinerator, boiler, industrial furnace, underground injection well with appropriate technical standards under 40 CFR part 146, containment building, corrective action management unit, or unit eligible for research, development, and demonstration permit under §270.65.*

31. **On-site** – *On-site means the same or geographically contiguous property which may be divided by public or private right-of-way, provided the entrance and exit between the properties is at a cross-roads, intersection, and access is by crossing as opposed to going along, the right-of-way. Non-contiguous properties owned by the same person, but connected by a right-of-way which he controls and to which the public does not have access, is also considered on-site property.*

32 **Operator** – *Operator means the person responsible for the overall operation of a facility.*

33. **Owner** – *Owner means the person who owns a facility or part of a facility.*

34. **Partial Closure** – *Partial closure means the closure of a hazardous waste management unit in accordance with the applicable closure requirements of Parts 264 and 265 of this chapter at a facility that contains other active hazardous waste management units. For example, partial closure may include the closure of a tank (including its associated piping and underlying containment systems), landfill cell, surface impoundment, waste pile, or other hazardous waste management unit, while other units of the same facility continue to operate.*

DEQ note: "Partial closure" is the closure of one HWMU where one or several HWMUs still exist at a facility. Each "partial closure" event is subject to all the closure requirements of the regulations. "Partial closure" must be addressed explicitly in the closure plan. The closure plan needs to specify details how the facility is going to "partially close" and include: the extent of "partial closure," parameters associated with "partial closure," closure schedule, and include the financial assurance, etc.

35. **Run-off** – *Run-off means any rainwater, leachate, or other liquid that drains over land from any part of a facility.*

36. **Run-on** – *Run-on means any rainwater, leachate, or other liquid that drains over land onto any part of a facility.*

37. **Saturated Zone or Zone of Saturation –** *Saturated zone or zone of saturation means that part of the earth's crust in which all voids are filled with water.*

38. **Sludge** –*Sludge means any solid, semi-solid, or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant, or air pollution control facility exclusive of the treated effluent from a wastewater treatment plant.*

39. **Solid Waste** – *Solid waste means a sold waste as defined in § 261.2 of this chapter.*

40. **Storage** – *Storage means the holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere.*

41. **Subsoils** - It should be noted that, in the context of the regulations, subsoils are considered by the EPA and the DEQ to be both unsaturated and saturated subsoils. Therefore all HWMU contaminated soils and subsoils, unsaturated and saturated, which are in exceedence of the closure performance standards, must be removed and properly disposed or decontaminated at closure in accordance with closure performance standards in order for the requirements of Subpart F to no longer apply to a regulated facility. **(Note: The term subsoils is not defined under the RCRA, under § 260.10, but is defined herein for the purpose of this guidance manual based upon guidance received from the EPA.)**

42. **Sump** – *Sump means any pit or reservoir that meets the definition of a tank and those troughs/trenches connected to it that serve to collect hazardous waste for transport to hazardous waste storage, treatment, or disposal facilities; except that as used in the landfill, surface impoundment, and waste pile rules, "sump" means any lined pit or reservoir that serves to collect liquids drained from a leachate collection and removal system or leak detection system for subsequent removal from the system.*

43. **Surface Impoundment or Impoundment** – *Surface impoundment or impoundment means a facility or part of a facility which is a natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials (although it*

may be lined with man-made materials), which is designed to hold an accumulation of liquid wastes or wastes containing free liquids, and which is not an injection well. Examples of surface impoundments are holding, storage, settling, and aeration pits, ponds, and lagoons.

44. **Tank** – *Tank means a stationary device, designed to contain an accumulation of hazardous waste which is constructed primarily of non-earthen materials (e.g., wood, concrete, steel, plastic) which provides structural support.*

45. **Tank System** – *Tank system means a hazardous waste storage or treatment tank and its associated ancillary equipment and containment system.*

46. **Treatment** – *Treatment means any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste, or so as to recover energy or material resources from the waste, or so as to render such waste non-hazardous, or less hazardous; safer to transport, store, or dispose of; or amenable for recovery, amenable for storage, or reduced in volume.*

47. **Treatment Zone** –*Treatment Zone means a soil area of the unsaturated zone of a land treatment unit within which hazardous constituents are degraded, transformed, or immobilized.*

48. **Underground Tank** – *Underground tank means a device meeting the definition of a "tank" in § 260.10 whose entire surface area is totally below the surface of and covered by the ground.*

49. **Unsaturated Zone or Zone of Aeration** - *Unsaturated zone or zone of aeration means the zone between the land surface and the water table.*

50. **Uppermost Aquifer** – *Uppermost aquifer means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary.*

51. **Waste Pile** – *Waste pile means any non-containerized accumulation of solid, nonflowing hazardous waste that is used for treatment or storage and that is not a containment building.*

52. **Wastewater Treatment Unit –** *Wastewater treatment unit means a device which:*

(1) Is part of a wastewater treatment facility that is subject to regulation under either Section 402 or 307(b) of the Clean Water Act; and

(2) Receives and treats or stores an influent wastewater that is a hazardous waste as defined in § 261.3 of this chapter, or that generates and accumulates a wastewater treatment sludge that is a hazardous waste as defined in § 261.3 of this chapter, or treats or stores a wastewater treatment sludge which is a hazardous waste as defined in § 261.3 of this chapter; and

(3) Meets the definition of a tank or tank system in § 260.10 of this chapter.

For definitions of other terminology utilized under the RCRA regulations, please refer to 40 CFR Part 260, § 260.10, Definitions, and 9 VAC 20-60-12 et seq., VHWMR, 9 VAC 20-60-14.

2.4 REGULATED HWMUs SUBJECT TO CLOSURE – APPLICABILITY & OTHER REQUIREMENTS

Owners and operators of all active treatment, storage, disposal (TSD) facilities are subject to closure and some facilities are subject to post closure requirements of the VHWMR and the RCRA, as amended. Active TSD facilities are those facilities that have operated regulated hazardous waste management units (HWMUs) after November 19, 1980.

Written closure plans are required for facilities with Hazardous Waste Management Permits, for Interim Status facilities, and for any non-permitted facilities which are subject to the closure requirements of the VHWMR and the RCRA regulations under either 40 CFR Part 264 and 265, under Subpart G. (Enforcement Orders usually require closure in accordance with Part 264.)

Closure and post-closure requirements for permitted facilities are identified under 40 CFR Part 264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, And Disposal Facilities, Subpart G. Unit specific closure requirements are specified under 40 CFR Part 264, Subpart I through X, and Subpart DD.

For Interim Status facilities, closure and post-closure requirements are identified under 40 CFR Part 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, Subpart G. The unit specific closure requirements for Interim Status facilities are specified under 40 CFR Part 265, Subpart J through Subpart X, and Subpart DD.

The unit specific closure and post-closure requirements are specified in 40 CFR Part 264 and 265 under the regulation subpart, unit description, and regulatory citations, respectively as follows (Part 265 provides Interim Status standards):

1. Subpart I, Use and Management of Containers, § 264.178.

2. Subpart J, Tank Systems, § 264.197, § 265.197.

3. Subpart K, Surface Impoundments, § 264.228, § 265.228.

4. Subpart L, Waste Piles, § 264.258, § 265.258.

5. Subpart M, Land Treatment, § 264.280, § 265.280.

6. Subpart N, Landfills, § 264.310, § 265.310.

7. Subpart O, Incinerators, § 264.351, § 265.351.

8. Subpart P, Thermal Treatment, § 265.381.

9. Subpart Q, Chemical, Physical, and Biological Treatment, § 265.404.

10. Subpart W, Drip Pads, § 264.575, § 265.445.

11. Subpart X, Miscellaneous Units, § 264.601 through 264.603.

12. Subpart DD, Containment Buildings, § 264.1102, § 265.1102.

The applicability and other requirements for closure and post-closure of regulated units are delineated under 40 CFR Part 264 and 265, Subpart G – Closure and Post Closure, as follows (Part 265 provides Interim Status standards):

1. § 264.110 and § 265.110, Applicability.

2. § 264.111 and § 265.111, Closure Performance Standard.

3. § 264.112 and § 265.112, Closure Plan; Amendment of Plan.

4. § 264.113 and § 265.113, Closure; Time Allowed for Closure.

5. § 264.114 and § 265.114, Disposal or Decontamination of Equipment, Structures, and Soils.

6. § 264.115 and § 265.115, Certification of Closure.

7. § 264.116 and § 265.116, Survey Plat.

8. § 264.117 and § 265.117, Post-Closure Care and Use of Property.

9. § 265.118 and § 265.118, Post-Closure Plan; Amendment of Plan.

10. § 264.119 and § 265.119, Post-Closure Notices.

11. § 264.120 and § 265.120, Certification of Completion of Post-Closure Care.

The applicability requirements specified under Subpart G for closure and post-closure is the same for Hazardous waste management (HWM) facilities subject to permit requirements under Part 264 and for facilities subject to interim status requirements under Part 265. (See § 264.110 and § 265.110.)

With reference to the above citations, the closure and post-closure care requirements for the various types of HWMUs undergoing closure may be determined by reviewing the regulations under 40 CFR Part 264, Subpart G, Closure and Post Closure § 264.110, Applicability, which states:

Except as § 264.1 provides otherwise:

(a) Sections 264.111 through 264.115 (which concern closure) apply to the owners and operators of all hazardous waste management facilities; and

(b) Sections 264.116 through 264.120 (which concern post-closure care) apply to the owners and operators of:

(1) All hazardous waste disposal facilities;

(2) Waste piles and surface impoundments from which the owner or operator intends to remove the wastes at closure to the extent that these sections are made applicable to such facilities in § 264.228 (Closure and post-closure care for surface impoundments under Subpart K) *or § 264.258* (Closure and post-closure care for waste piles under Subpart L);

(3) Tank systems that are required under § 264.197 (Closure and post-closure care for tank systems under Subpart J) *to meet the requirements for landfills; and*

(4) Containment buildings that are required under § 264.1102 (Closure and post-closure care for containment buildings under Subpart DD) *to meet the requirement for landfills.*

2.4.1 Financial Assurance Requirements

In addition to the closure requirements specified under 40 CFR Part 264 and 265, Subparts G, the VHWMR and the RCRA regulations require all regulated facilities to comply with financial assurance requirements. The financial assurance requirements of a closure plan are delineated under 40 CFR Part 264 and 265, Subparts H, Financial Requirements, under § 264.140, Applicability, and § 264.142, Cost Estimate For Closure, and for Interim Status facilities under § 265.140, § 265.142, respectively. Excerpted text from the regulations under Part 264, Subpart H specifies the following:

§ 264.140, Applicability

(a) The requirements of §§ 264.142, 264.143, and 264.147 through 264.151 apply to owners and operators of all hazardous waste facilities, except as provided otherwise in this section or in § 264.1. ...

§ 264.142, Cost Estimate for Closure

(a) The owner or operator must have a detailed written estimate, in current dollars, of the cost of closing the facility in accordance with the requirements in §§ 264.111 through 264.115 and applicable closure requirements in §§ 264.178, 264.197, 264.228, 264.258, 264.280, 264.310, 264.351, 264.601, and 264.1102.

The cost basis for financial assurance must be provided by detailed engineering calculations and cost estimates and include details related with the entire closure process associated with the HWMU decontamination, the disposal of hazardous and other wastes, and the final closure report. Closure costs include the following: general labor, equipment rental, sampling, laboratory analyses, hazardous waste transportation and disposal, HWMU decontamination, transportation and disposal of all wastes generated during closure, and engineering and other administrative costs associated with a survey (if applicable), generation of the engineering report and closure certification, and other

administrative and legal costs associated with deed restrictions, if needed. The financial assurance requirements for closure helps ensure that adequate funding is available to adequately close the facility in compliance with the regulations.

2.4.2 Groundwater Monitoring Requirements

Specific HWMUs require closure plans and post-closure plans to be developed in accordance with the requirements specified under 40 CFR Part 264, Subpart F, Releases From Solid Waste Management Units, and for Interim Status facilities, in accordance with 40 CFR Part 265, Subpart F, Groundwater Monitoring. Subpart F specifies the types of HWM facilities that must address groundwater monitoring and response program requirements during the active life of the unit and as a condition of both closure and post-closure care. (See § 264.90 and § 265.90, Applicability.) Subpart F § 264.101, Corrective Action For Solid Waste Management Units, specifies that all solid waste management units are subject to the requirements of corrective action and the financial assurance responsibility for completing corrective action.

The Subpart F requirements of Part 264, § 264.90 and § 265.90, Applicability, requires that the owner or operator of **the following types of HWMUs that receive hazardous waste after July 26, 1982, must comply with the requirements of Subpart F, § 264.91 through § 264.100,** unless the owner or operator is exempted under § 264.1, or the facility's regulated units meet specific engineered requirements, or the Director finds there is no potential for migration of hazardous wastes, hazardous waste constituents, or liquid from the regulated unit to the uppermost aquifer during the active life (including the closure period) and the post-closure care period specified under § 264.117:

1. Surface Impoundment.

2. Waste Pile.

3. Land Treatment Unit.

4. Landfill.

The requirements of Subpart F, § 264.91 through § 264.100 are for purposes of detecting, characterizing and responding to releases to the uppermost aquifer, and to ensure that any such release does not pose a threat to human health or the environment.

In addition to the above, § 264.90 indicates that the regulations in **Subpart F may apply to miscellaneous units when necessary** to assure to comply with § 264.60, Environmental Performance Standards, through § 264.603, Post Closure Care.

Facilities with other types of units may also be subject to Subpart F requirements at closure and post-closure and/or be required to demonstrate that there is no potential for contamination of the uppermost aquifer and/or to monitor the groundwater for potential releases from the Solid waste management units.

The regulatory requirements under Part 264, Subpart F, § 264.90, Applicability, specifies the following:

(a) (1) Except as provided in paragraph (b) of this section, the regulations in this subpart apply to owners or operators of facilities that treat, store, or dispose of hazardous waste. The owner or operator must satisfy the requirements identified in paragraph (a)(2) of this section for all wastes (or waste constituents thereof) contained in solid waste management units at the facility, regardless of the time at which waste was place in such units.

*(2) All solid waste management units must comply with the requirements in § 264.101 (Corrective Action For Solid Waste Management Units**). A surface impoundment, waste pile, and land treatment unit or landfill that receives hazardous waste after July 26, 1982 (hereinafter referred to as a "regulated unit") must comply with the requirements of §264.91 through § 264.100 in lieu of § 264.101 for the purposes of detecting, characterizing, and responding to releases to the uppermost aquifer.** The financial responsibility requirements of § 264.101 apply to regulated units.*

(b) The owner or operator's regulated unit or units are not subject to regulation for release into the uppermost aquifer under this subpart if:

(1) The owner or operator is exempted under § 264.1, or

(2) He operates a unit which the Administrator finds:

(i) Is an engineered structure,

(ii) Does not receive or contain liquid waste or waste containing free liquids.,

(iii) Is designed and operated to exclude liquid, precipitation, and

other run-on and run-off,

(iv) Has both inner and outer layers of containment enclosing the waste,

(v) Has a leak detection system built into each containment layer,

(vi) The owner or operator will provide continuing operation and maintenance of these leak detection systems during the active life of the unit and the closure and post-closure care periods, and

(vii) To a reasonable degree of certainty, will not allow hazardous constituents to migrate beyond the outer containment layer prior to the end of the post-closure period.

(3) The Regional Administrator finds, pursuant to § 264.280(d), that the treatment zone of a land treatment unit that qualifies as a regulated unit does not contain levels of hazardous constituents that are above background levels of those constituents by an amount that is statistically and if an unsaturated zone monitoring program meeting the requirements of § 264.278 has not shown a statistically significant increase in hazardous constituents below the treatment zone during the operating life of the unit. An exemption under this paragraph can only relieve an owner or operator of responsibility to meet the requirements of this subpart during the post-closure care period; or

(4) The Regional Administrator finds that there is no potential for migration of liquid from a regulated unit to the uppermost aquifer during the active life of the regulated unit (including the closure period) and the post-closure period specified under § 264.117. This documentation must be certified by a qualified geologist or geotechnical engineer. In order to provide an adequate margin of safety in the prediction of potential migration of liquid, the owner or operator must base any predictions made under this paragraph on assumptions that maximize the rate of liquid migration.

(5) He designs and operates a pile in compliance with § 264.250(c).

(c) The regulations under this subpart apply during the active life of the regulated

unit (including the closure period). After closure of the regulated unit, the regulations in this subpart:

(1) Do not apply if all waste, waste residues, contaminated containment system components, and contaminated subsoils are removed or decontaminated at closure.

(2) Apply during the post-closure care period under § 264.117 if the owner or operator is conducting a detection monitoring program under § 264.98; or

(3) Apply during the compliance period under § 264.96 if the owner or operator is conducting a compliance monitoring program under § 264.99 or a corrective action program under § 264.100.

(d) Regulations in this subpart may apply to miscellaneous units when necessary to comply with § 264.601 through § 264.603.

If a facility with a regulated unit (one of the four types of units listed above) is unable to demonstrate compliance with the Subpart F requirements, the construction, liner, and other regulatory requirements specified under Subpart G, and is unable to demonstrate there is no potential for migration of hazardous wastes, hazardous waste constituents, or liquid from the regulated unit to the uppermost aquifer during active life of the regulated unit and the post-closure period specified under § 264.117, .then the HWM facility will be required to comply with the groundwater monitoring requirements specified under Subpart F as a condition of closure and post-closure care. Facilities must refer to 40 CFR Part 264 Subpart F or Part 265 Subpart F for Interim Status facilities for the details of the regulatory requirements.

It should be noted that, in the context of the regulations, subsoils are considered by the EPA and the DEQ to be both unsaturated and saturated subsoils. Therefore all HWMU contaminated soils and subsoils, unsaturated and saturated, which are in exceedence of the closure performance standards, must be removed and properly disposed or decontaminated at closure in accordance with closure performance standards in order for the requirements of Subpart F to no longer apply to a regulated facility.

2.5 CLOSURE PERFORMANCE STANDARDS

Closure performance standards apply to the owners and operators of all HWM facilities managing regulated units under the authority of the VHWMR and the RCRA, as amended.

The closure performance standards provide the main premise, criteria, and standards for closure of all regulated units. Therefore, it is imperative that facilities ensure that their closure plan is designed to comply with the general closure performance standards and the unit specific closure requirements delineated under the regulations for their HWMU(s).

Closure performance standards, under 40 CFR Part 264 and 265 (Interim Status facilities), Subpart G, Closure and Post-Closure, § 264.111 and § 265.111, respectively, specify the following:

> *The owner or operator must close the facility in a manner that:*
>
> *(a) Minimizes the need for further maintenance; and*
>
> *(b) Controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere; and*
>
> **for 40 CFR Part 264**
>
> *(c) Complies with the closure requirements of this subpart, including but not limited to the requirements of §§ 264.178, 264.197, 264.228, 264.258, 264.280, 264.310, 264.351, 264.601 through 264.603, and 264.1102.*
>
> **for 40 CFR Part 265**
>
> *(c) Complies with the closure requirements of this subpart, including but not limited to the requirements of §§ 265.197, 265.228, 265.258, 265.280, 265.310, 265.351, 265.381, 265.404, and 264.1102.*

Section 2.2 of this manual provides the appropriate subpart descriptions and regulatory citations pertaining to the unit specific closure requirements. It is imperative that the HWM facility develop the closure plan and post-closure plan to comply with the unit specific closure requirements of their HWMU(s) as delineated in the regulations.

2.6 GENERAL PURPOSE OF A CLOSURE PLAN AND A POST- CLOSURE PLAN

This section provides the general purpose of a closure plan and a post-closure plan to meet regulatory requirements, and should help clarify the meaning of different closure plan terminology

that is utilized in the regulations.

The different types of closure plans and closure plan terminology identified in the VHWMR and the RCRA are as follows: 1) Closure Plan, 2). Post-Closure Plan, 3) Contingent Closure Plan, and a 4) Contingent Post-Closure Plan.

Each type of closure plan terminology has a distinct meaning and purpose as follows:

1. **Closure Plan** – The general purpose of the closure plan is to provide documentation of all steps, procedures, data gathering efforts, and the cost basis to close a facility's hazardous waste management units (HWMUs) in compliance with the Virginia Hazardous Waste Management Regulations (VHWMR), 9 VAC 20-60-12, et seq., and the Resource Conservation and Recovery Act (RCRA) regulations, as amended.

   More specifically, the purpose of the closure plan is to:

   1. Document the planned procedures for proper handling and manifesting of hazardous waste from the facility site to an off-site permitted treatment storage and disposal (TSD) facility.

   2. Document the planned procedures a facility will follow for the disposal or decontamination of equipment, structures, and soils and to close the HWMU(s) in accordance with the VHWMR and the RCRA regulations. The plan helps assure the HWMU is properly decontaminated and it establishes decontamination standards of the HWMU so to comply with the closure performance standards of the regulations.

   3. Provide a description of other activities necessary during the closure period to ensure that all partial closures and final closure satisfy the closure performance standards, including, but not limited to, groundwater monitoring, leachate collection, and run-on and run-off control.

   4. Set the schedule for closure activities from the time of initiation of closure of the HWMU to the submittal date required for the closure report.

   5. Provide the procedures needed for certification of closure.

   6. Provide the cost basis for the financial assurance so to assure the closures of the HWMU(s) are in accordance with the regulations.

2. **Post-Closure Plan**. – The general purpose of the post-closure plan is to provide documentation of the HWM facility's planned post-closure care of HWMU(s) with hazardous waste "closed in-place." The post-closure plan is designed to control, minimize, or eliminate further releases from the closed HWMU, and to prevent direct contact with any constituents remaining at the site so there poses no threat to human health and the environment.

The post-closure plan identifies the nature of the HWMU(s) that have hazardous waste "closed in-place," and it identifies the maintenance, monitoring, and other procedures or arrangements for post-closure care to comply with VHWMR and the RCRA regulations. In addition, the post-closure plan provides the cost basis for post-closure care.

More specifically, the purpose of a post-closure plan is to:

1. Document the nature of the facility's HWMUs that have hazardous waste "closed in place."

2. Document the specific procedures, activities, and frequencies of post-closure care, maintenance, and monitoring.

3. Set the schedule and period for post-closure care.

4. Establish land use restrictions and mechanisms for land-use restrictions of the HWM facility's site.

5. Provide the cost basis for financial assurance needed to meet the post-closure care requirements specified for the entire post-closure care period. (Typically 30 years.)
6. Provide the name, address, and phone number(s) of the person(s) or office to contact regarding care of the facility's hazardous waste disposal unit during the post-closure care period.

All facilities that have HWMUs with hazardous waste "closed in-place" are considered hazardous waste disposal units. Facilities with hazardous waste disposal units must be closed so to comply with the closure and post-closure care and use requirements of the property as specified for a landfill under 40 CFR Part 264, Subpart N, §264.310. The owner or operator of a hazardous waste disposal unit must have a written post-closure plan.

The RCRA regulations specifically identify the types of HWMUs where a facility must submit both a written closure plan and post-closure plan to comply with closure requirements. Section 2.7 below provides a summary of the regulations closure plan submittal requirements.

3. **Contingent Closure Plan and Contingent Post-Closure Plan** – A contingent closure plan and contingent post-closure plan are required for specific types of HWMUs, as a contingency, in case the owner or operator of a HWM facility finds that they cannot close the facility in accordance with the approved closure plan, and not all of the contaminated subsoil of a HWMU can be practicably removed or decontaminated.

When a HWM facility is unable to practicably remove or decontaminate all subsoil of a HWMU, the facility must close the HWMU with hazardous wastes "closed in-place." The contingent closure plan identifies the contingency plan that may be needed to close the HWMU with hazardous wastes "closed in-place." The contingent post-closure plan identifies the plan for post-closure care of the facility's HWMU(s) with hazardous wastes "closed in-place" if it is determined during closure that clean closure cannot be achieved.

All facilities that have HWMUs with hazardous waste "closed in-place" are considered hazardous waste disposal units. Facilities with hazardous waste disposal units must be closed so to comply with the closure and post-closure care and use requirements of the property as specified for a landfill under 40 CFR Part 264, Subpart N, §264.310.

The RCRA regulations identify the specific types of HWMUs that require a written contingent closure plan and contingent post-closure plan, in addition to the written closure plan. Section 2.7 below provides a summary of the closure plan submittal requirements specified in the regulations.

2.7 SUMMARY OF CLOSURE PLAN SUBMITTAL REQUIREMENTS

In accordance with 40 CFR Part 264 and Part 265, Subpart G, Closure and Post Closure, § 264.112(a) and § 265.112(a), Closure Plan; Amendment of Plan, the owner or operator of a HWM facility must have a written closure plan.

HWM facilities with specific types of HWMUs are required to initially develop a written closure plan, a written contingent closure plan, and a written contingent post-closure plan to comply with closure requirements of the regulations. Other HWM facilities with specific types of HWMUs are required to initially develop a written closure plan, and a written post-closure plan. The specific closure plan submittal requirements depend not only upon the type of HWMU, but the nature of construction of the HWMU. The specific closure plan submittal requirements are fully delineated in

the regulations; however, this section provides guidance and regulatory citations to help facilities determine the closure plan submittal requirements specified in the regulations.

Facilities that are required to only initially develop a written closure plan include those which manage hazardous waste in HWMUs in accordance with regulatory requirements as follows:

1. Subpart I – Use and Management of Containers. (See § 264.178)

2. Subpart J - Tank systems with secondary containment in accordance with §264.193 (b) through (f), Containment and Detection of Releases, or tanks systems which have been granted a variance from the secondary containment requirements in accordance with §264.193(g). (See § 264.197)

3. Subpart K - Surface impoundments with double liners in accordance with §264.221(a), Design and Operating Requirements, or surface impoundments exempt under §264.221(b). (See § 264.228)

4. Subpart L -Waste piles with double liners in accordance with §264.251(a)(1), Design and Operating Requirements, or waste piles exempt under §264.250(c) or §264.251(b). (See § 264.258)

5. Subpart O - Incinerators. (See § 264.351)

6. Subpart W - Drip pads that are constructed with a liner in accordance with §264.573 (b)(1), Design and Operating Requirements. (See § 264.575)

When a HWM facility is unable to close a HWMU in accordance with an approved closure plan and they are unable to practicably remove or decontaminate the subsoil, then the facility would be required to amend the closure plan so to close the HWMU with hazardous waste "closed in-place." The time frame for submittal of an amended written closure plan is delineated in the regulations.

When a HWM facility which has operated a regulated tank system, surface impoundment, waste pile, incinerator, or a drip pad HWMU, and the facility must close any of these HWMUs with hazardous waste "closed in-place," then the facility must amend the closure plan to comply with the closure requirements of a landfill. In addition, such a facility would be required to develop a post-closure plan to comply with the post-closure care and use requirements of the property as specified for a landfill. (See 40 CFR Part 264, Subpart N, §264.310.)

The closure requirements for hazardous waste management (HWM) facilities that store containers of hazardous waste specifies the following (Subpart I, § 264.178, Closure):

> *At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases, and soil containing or contaminated with hazardous waste or hazardous waste residues must be decontaminated or removed.*

When a container management facility is unable to achieve "clean closure," that is, to decontaminate or remove all soil containing hazardous waste and/or when groundwater is contaminated from such a facility, then the facility must close the container management unit with hazardous waste "closed in-place."

There are no provisions in the VHWMR or the RCRA Regulations to close a container management facility as a landfill when such a facility cannot be "clean closed." Therefore, a HWM facility which has a container storage HWMU with hazardous waste "closed in-place" must further address the remaining contamination at the site under corrective action (CA) under the Hazardous Solid Waste Amendments (HSWA) of the RCRA, of 1984. In the Commonwealth of Virginia, the DEQ has been authorized HSWA authority for corrective action for hazardous waste management facilities that have Hazardous Waste Management Permits. In the Commonwealth of Virginia, non-permitted hazardous waste management facilities are required to address corrective action requirements under the authority of the EPA. (The DEQ received partial delegation of the HSWA authority on September 9, 2000.)

In accordance 40 CFR Part 264, the regulations specify that facilities with the following types of HWMUs must include a written contingent closure plan and written contingent post-closure plan along with the written closure plan in the permit application:

1. Subpart J - Tank systems without secondary containment in accordance with §264.193 (b) through (f), Containment and Detection of Releases, or tank systems which have not been granted a variance from the secondary containment requirements in accordance with §264.193(g). (See § 264.197)

2. Subpart K - Surface impoundments without double liners in accordance with §264.221(a), Design and Operating Requirements, or not exempt under §264.221(b). (See § 264.228)

3. Subpart L - Waste piles without double liners in accordance with §264.251(a)(1), Design and Operating Requirements, or not exempt under §264.250(c) or §264.251(b). (See § 264.258)

4. Subpart W – Drip pads that are not constructed with a liner in accordance with §264.573 (b)(1), Design and Operating Requirements. (See § 264.575)

In accordance with 40 CFR Part 264.118, Post-Closure Plan, the owner or operator of a hazardous waste disposal unit must have a written closure plan and a written post-closure plan, which complies with the closure and post-closure care requirements of a landfill under 40 CFR Part 264, Subpart N. A hazardous waste disposal unit is any TSD unit that is closed with hazardous waste "closed in-place."

Example hazardous waste disposal units which require a written closure plan and a written post-closure plan in the permit application include the following:

1. Subpart M - Land treatment units. (See § 264.280)

2. Subpart N - Landfills. (See § 264.310)

3. Subpart X - Open Burn and Open Detonation (OB/OD) sites. (See § 264.603)

2.8 DESIGN REQUIREMENTS & CONTENT OF CLOSURE PLANS AND POST-CLOSURE PLANS

The requirements of a closure plan and amendment of a plan are fully delineated under § 264.112.

The design requirements or the content of a closure plan is delineated in § 264.112(b) and for Interim Status facilities in § 265.112(b) Content of Plan, respectively, as follows:

> *Content of Plan. The plan must identify steps necessary to perform partial and/or final closure of the facility at any point during its active life. The closure plan must include, at least:*
>
> 1. *A description of how each hazardous waste management unit at the facility will be closed in accordance with § 264.111 and § 265.111(Closure Performance Standards).*
>
> 2. *A description of how final closure of the facility will be conducted in accordance with § 264.111 and § 265.111. The description must identify the maximum extent of the operations which will be unclosed during the active life of the facility.*
>
> 3. *An estimate of the maximum inventory of hazardous wastes ever on-site over*

the active life of the facility and a detailed description of the methods to be used during partial closures and final closure, including, but not limited to, methods for removing, transporting, treating, storing, or disposing of all hazardous wastes, and identification of the type(s) of the off-site hazardous waste management units to be used, if applicable.

4. *A detailed description of the steps needed to remove or decontaminate all hazardous waste residues and contaminated system components, equipment, structures, and soils during partial and final closure, including, but not limited to, procedures for cleaning equipment and removing contaminated soils, methods for sampling and testing surrounding soils, and criteria for determining the extent of decontamination required to satisfy the closure performance standard.*

5. *A detailed description of other activities necessary during the closure period to ensure that all partial closures and final closure satisfy the closure performance standards, including, but not limited to, groundwater monitoring, leachate collection, and run-on and run-off control.*

6. *A schedule for closure of each hazardous waste management unit and for final closure of the facility. The schedule must include, at a minimum, the total time required to close each hazardous waste management unit and the time required for intervening closure activities which will allow tracking of the progress of partial and final closure. (For example, in the case of a landfill unit, estimates of the time required to treat or dispose of all hazardous waste inventory and of the time required to place a final cover must be included.)*

For Part 264

7. *For facilities that use trust funds to establish financial assurance under § 264.143 or § 264.145 and that are expected to close prior to the expiration of the permit, an estimate of the expected year of final closure.*

For Part 265

7. *An estimate of the expected year of final closure for facilities that use trust funds to demonstrate financial assurance under § 265.143 or § 265.145 and whose remaining operating life is less than twenty years, and for facilities without approved closure plans.*

In addition to the above, the closure plan requirements under § 264.112(a), Written Plan, specifies the following:

> *The Director's approval of the plan must ensure that the approved closure plan is consistent with § 264.111 through § 264.115 and the applicable requirements of subpart F of this part, §§ 264.178, 264.197, 264.228, 264.258, 264.280, 264.310, 264.351, 264.601, and 264.1102. Until final closure is completed and certified in accordance with § 264.115, a copy of the approved plan and all approved revisions must be furnished to the Director upon request, including requests by mail.*

See Section 2.4 of this manual for a description of the above regulatory citations.

The design requirements of a closure plan are further delineated under 40 CFR Part 264 and 265, Subparts H, Financial Requirements, under § 264.140, Applicability, and § 264.142, Cost Estimate for Closure, and for Interim Status facilities under § 265.140, § 265.142, respectively. **See Section 2.4.1, Financial Assurance Requirements.**

The closure and post-closure requirements for permitted landfills are specified under 40 CFR Part 264, Subpart N, § 264.310, and for Interim Status Facilities, under 265, Subpart N, § 265.310. Excerpted text from the regulations under Subpart N, § 264.310 specifies the following:

> *(a) At final closure of the landfill or upon closure of any cell, the owner or operator must cover the landfill or cell with a final cover designed and constructed to:*
>
> *(1) Provide long-term minimization of migration of liquids through the closed landfill;*
>
> *(2) Function with a minimum of maintenance;*
>
> *(3) Promote drainage and minimize erosion or abrasion of the cover;*
>
> *(4) Accommodate settling and subsidence so that the cover's integrity is maintained; and*
>
> *(5) Have permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.*
>
> *(b) After final closure, the owner or operator must comply with all post-closure*

requirements contained in § 264.117 through §264.120, including maintenance and monitoring throughout the post-closure care period (specified in the permit under § 264.117). The owner or operator must:

(1) Maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events;

(2) Continue to operate the leachate collection and removal system until leachate is no longer detected;

(3) Maintain and monitor the leak detection system in accordance with §264.301(c)(3)(iv) and§264.301(c)(4) and §264.303(c), and comply with all other applicable leak detection system requirements of this part;

(4) Maintain and monitor the groundwater monitoring system and comply with all other applicable requirements of subpart F of this part;

(5) Prevent run-on and run-off from eroding or otherwise damaging the final cover; and

(6) Protect and maintain surveyed benchmarks used in complying with § 264.309.

In addition to the above, facilities with specific types of HWMUs (specific surface impoundments, waste piles, land treatment units, and landfills) are required to develop closure plans and post-closure plans in accordance with the requirements specified under 40 CFR Part 264, Subpart F, Releases From Solid Waste Management Units, and for Interim Status facilities, in accordance with 40 CFR Part 265, Subpart F, Groundwater Monitoring. (See Section 2.4.2, Groundwater Monitoring Requirements.) The requirements of Subpart F, § 264.90 through § 264.100 are for purposes of detecting, characterizing and responding to releases to the uppermost aquifer, and to ensure that any such release does not pose a threat to human health or the environment.

If a facility with a regulated unit (See Section 2.4.2) is unable to demonstrate compliance with the Subpart F requirements, the construction, liner, and other regulatory requirements specified under Subpart G, and is unable to demonstrate there is no potential for migration of hazardous wastes, hazardous waste constituents, or liquid from the regulated unit to the uppermost aquifer during active life of the regulated unit and the

post-closure period specified under § 264.117, then the HWM facility will be required to comply with the groundwater monitoring requirements specified under Subpart F as a condition of closure and post-closure care. Facilities must refer to 40 CFR Part 264 Subpart F or Part 265 Subpart F for Interim Status facilities for the details of the regulatory requirements.

In addition to the above, § 264.90 indicates that the regulations in **Subpart F may apply to miscellaneous units when necessary** to assure to comply with § 264.60, Environmental Performance Standards, through § 264.603, Post Closure Care.

Facilities with other types of units may also be subject to Subpart F requirements at closure and post-closure and/or be required to demonstrate that there is no potential for contamination of the uppermost aquifer and/or to monitor the groundwater for potential releases from the Solid waste management units.

2.9 COMMON ELEMENTS OF TYPICAL CLOSURE PLANS AND POST-CLOSURE PLANS

The required content of a closure plan and post-closure plan varies depending upon the type of the HWMU and the nature of the design of the HWMU that is being closed.

Closure and post-closure requirements for HWMUs are identified in 40 CFR Part 264 and 265, Subpart G, while the unit specific closure requirements are specified under Subparts I through X, and Subpart DD. Groundwater monitoring requirements related with closure and post-closure are identified under 40 CFR Part 264 and 265, Subpart F. Financial assurance requirements related with closure and post-closure are identified under 40 CFR Part 264 and 265, Subpart H.

Sections 2.4 through 2.8 of this manual provides summary information to help ascertain the unit specific closure and post-closure care regulatory requirements and to assist facilities in development of closure plans and post-closure plans so to comply with the regulations.

Although requirements for closure may vary for the various types of HWMUs, the contents of a closure plan typically contains many common elements. A list of the common elements in closure plans may include, but is not limited to, the items provided in Figure 2-1, Common Elements In Closure Plans.

Once a closure plan is approved, the closure is implemented by the owner/operator of a facility and a series of systematic procedures and processes are followed to close the HWMU(s). An example schematic of the procedures or activities that often occur in the closure process are depicted at the end of this section in Figure 2-3, Typical Closure Process.

If a contingent closure plan is required for a HWMU, the facility will be required to develop three types of closure plans. The first closure plan documents procedures for a "clean closure." The second closure plan, called the contingent closure plan, documents the procedures for closure with hazardous waste "closed in-place." The third closure plan is the contingent post-closure plan, which documents the post-closure care for units closed with hazardous waste "closed in-place."

A contingent closure plan must be designed to meet the closure requirements for a landfill, as specified under 40 CFR Part 264, (or 265 for Interim Status facilities), Subpart N, § 264.310 and § 265.310.

A contingent post-closure plan or a post-closure plan must be designed to meet the post-closure care requirements for a landfill as specified under 40 CFR Part 264, (or 265 for Interim Status facilities), Subpart N, § 264.310 and § 265.310.

All post-closure plans are required to include site topographic maps, site plans, and plans and specifications of key engineered systems, engineered features, such as caps, leachate collection systems, wells, etc., for closure and post-closure of the facility. Such engineered features will require maintenance and care, and monitoring during the post-closure care period.

Although requirements for a post-closure plan may vary for the various types of HWMUs, the contents of a post-closure plan typically contains many common elements. A list of the common elements in post-closure plans may include, but is not limited to, those items provided in Figure 2-2, Common Elements In Post-Closure Plans.

All permitted HWM facilities with approved closure plans or post-closure plans must submit a written notification of or request for a permit modification to the Director of the DEQ to authorize a change in operating plans, facility design, or the approved closure plan in accordance with the applicable procedures in 40 CFR Parts 124 and 270. (See 40 CFR Part 264, Subpart G, § 264.112, Closure Plan; Amendment of Plan.)

All Interim Status HWM facilities may amend the closure plan at any time prior to the notification of partial or final closure of the facility. An owner or operator with an approved closure plan must submit a written request to the Director of the DEQ to authorize a change to the approved closure plan. The written request must include a copy of the amended closure plan for approval by the Director. (See 40 CFR Part 265, Subpart G, § 265.112, Closure Plan; Amendment of Plan.)

2.10 CORRECTIVE ACTION

On September 9, 2000, the Virginia DEQ received partial delegation of authority from the EPA under the Hazardous Solid Waste Amendments (HSWA) of the RCRA, of 1984, for corrective action (CA) for hazardous waste management facilities that have Hazardous Waste Management Permits. For non-permitted hazardous waste management facilities, the EPA retains the CA authority under the HSWA.

Corrective action may be required for HWM facilities which close a HWMU with hazardous waste "closed in-place." When a HWM facility is unable to “clean-close” a HWMU in accordance with an approved closure plan and they are unable to practicably remove or decontaminate the subsoil and/or if groundwater is contaminated resulting from the HWMU operations, then the facility would be required to amend the closure plan so to close the HWMU with hazardous waste "closed in-place."

There are no provisions in the VHWMR and the RCRA Regulations under Subpart I, § 264.178, Closure, to close a container management facility as a landfill when the container management facility cannot be “clean closed.” Therefore, a HWM facility which has a container storage HWMU with hazardous waste "closed in-place" must further address the remaining contamination at the site under corrective action (CA) under HSWA authority.

When a HWM facility which has operated a regulated tank system, surface impoundment, waste pile, incinerator, or a drip pad HWMU, and the facility must close any of these HWMUs with hazardous waste "closed in-place," then the facility must amend the closure plan to comply with the closure requirements of a landfill. In addition, such a facility would be required to develop a post-closure plan to comply with the post-closure care and use requirements of the property as specified for a permitted landfill. The closure and post-closure requirements for permitted landfills are specified under 40 CFR Part 264, Subpart N, § 264.310, and for Interim Status Facilities, under 265, Subpart N, § 265.310. (Excerpts of the requirements of Subpart N, § 264.310 are provided under Section 2.8, Design Requirements and Content of Closure Plans and Post-closure Plans.)

HWMUs which are required to close in accordance with requirements of landfills under Subpart N are required to develop closure plans and post-closure plans in accordance with the requirements specified under 40 CFR Part 264, Subpart F, Releases From Solid Waste Management Units, and for Interim Status facilities, in accordance with 40 CFR Part 265, Subpart F, Groundwater Monitoring. The requirements of Subpart F, § 264.90 through § 264.100 are for purposes of detecting, characterizing and responding to releases to the uppermost aquifer, and to ensure that any such release does not pose a threat to human health or the environment. (See Section 2.4.2, Groundwater Monitoring Requirements.)

Part 264 Subpart F specifies the types of HWM facilities that must address groundwater monitoring and the response program requirements during the active life of the unit and as a condition of both closure and post-closure care. (See § 264.90 and § 265.90, Applicability.)

The regulatory requirements under Part 264, Subpart F, § 264.90, Applicability, specifies the following:

(a) (1) Except as provided in paragraph (b) of this section, the regulations in this subpart apply to owners or operators of facilities that treat, store, or dispose of hazardous waste. The owner or operator must satisfy the requirements identified in paragraph (a)(2) of this section for all wastes (or waste constituents thereof) contained in solid waste management units at the facility, regardless of the time at which waste was place in such units.

(2) All solid waste management units must comply with the requirements in § 264.101 (Corrective Action For Solid Waste Management Units) ***. A surface impoundment, waste pile, and land treatment unit or landfill that receives hazardous waste after July 26, 1982 (hereinafter referred to as a "regulated unit") must comply with the requirements of §264.91 through § 264.100 in lieu of § 264.101 for the purposes of detecting, characterizing, and responding to releases to the uppermost aquifer.*** *The financial responsibility requirements of § 264.101 apply to regulated units.*

Corrective Action requirements for HWM facilities are specified under Subpart F, § 264.100, Corrective Action Program, and § 264.101, Corrective Action For Solid Waste Management Units. Corrective action will be specified in a permit in accordance with requirements of § 264.100 and § 264.101 and Subpart S of Part 264.

The owner or operator of the HWM facility must implement CA within the facility and beyond the facility property boundary, where necessary to protect human health and the environment from all releases of hazardous waste or constituents from any solid waste management unit at the facility, regardless of the time at which waste was place in such unit, so to protect human health and the environment. The CA Permit will contain schedules of compliance for CA and assurances of financial responsibility for completing such CA in accordance with the VHWMR and the RCRA Regulations.

Figure 2-1 Common Elements In Closure Plans

1. Introduction.

2. Closure performance standards for the HWMUs.

3. A general description and background of the HWMU facility.

4. HWMUs descriptions and background. Provide the identification of processes that were used to generate the hazardous waste and the procedures that were used to manage the hazardous waste at the facility.

5. A site topographic map, a site plan, and photographs of the HWM facility and the HWMUs. Facilities which have HWMUs with hazardous waste "closed in-place" must provide survey plats of the closed unit in accordance with the regulations. The site plan (and survey plat when required) must indicate the location and dimensions of HWMUs in respect to permanent and surveyed structures. Land based units, such as landfills and impoundments must indicate the location and dimensions of HWMUs in respect to a permanent survey benchmarks and USGS datum. (§ 264.116 and § 265.116)

6. An estimate of the maximum spatial extent of the facility operation and the HWMU operation.

7. Identification of hazardous waste codes managed and listing of the hazardous waste constituents of concern (HCOCs) that were managed at the facility.

8. An estimate of the maximum inventory of hazardous wastes managed at the facility and at the HWMUs undergoing closure.

9. Procedures and documentation (manifests) for removal and shipment of the hazardous waste inventory to a RCRA permitted treatment, storage, or disposal (TSD) facility.

10. Details of procedures for HWMU decontamination and specific HWMU closure requirements.

    Includes, but is not limited to: the identification of the selected HCOCs test methods, practical or estimated quantitation levels of the HCOCs test methods, the decontamination standards that will be utilized, the sampling plan which identifies the type and extent of sampling required (typically involves sampling of washwater, rinsewater, and soils from the HWMU and background sampling), the QA/QC plan, the type of statistical analyses to be used for the sampling data, the plan for the risk-based assessment of the data, etc. (Specific HWMUs, depending upon the type of unit and the nature of construction, require installation of wells and groundwater monitoring for closure. See Section 2.7 of this manual and Part 264, 265, Subpart F.)

Figure 2-1 (Cont'd) Common Elements in Closure Plans

11. Details of procedures for decontamination of all equipment used in the closure process.

12. Documentation of procedures for disposal of all hazardous waste and all other wastes generated during the closure process.

13. The closure schedule and time allowed for closure and submittal of the closure certification and closure report.

    All hazardous wastes must be treated, removed, or disposed off-site within 90 days of final receipt of hazardous waste. Partial or final closure is to be completed 180 days after final receipt of hazardous waste or 180 days from approval of the closure plan. The closure report and closure certification statements are to be submitted to the DEQ 60 days after completion of closure (240 days after closure is initiated). The Director of DEQ may grant an extension of the closure schedule if the owner/operator justifies the need.

14. The cost estimate for closure. (The cost estimate must be provided and be based upon a third party closure of the HWMUs and be based upon a detailed engineering cost estimate.)

15. Financial assurance to comply with the cost estimate for closure.

16. Procedures for closure plan amendment and/or development of a post-closure plan.

17. Closure certification statements by owner/operator and the independent P.E., certified in the Commonwealth of Virginia.

18. Details of a Closure Report.

    The closure plan needs to indicate that the closure activities will be documented in a closure report that is to be submitted 60 days after completion of closure (typically, 240 days after start of closure activities). The closure report summarizes the closure activities, findings, and conclusions, and includes the closure certification statements. The closure report includes supporting calculations and necessary detail to support the report's summary and conclusions. The closure report includes all documentation related with the closure, including, but not limited to the following: all waste manifests, supporting calculations, sampling documentation, chain of custody documentation, laboratory data, qualitative analyses and quality control (QA/QC) procedures, QA/QC data from the laboratory, statistical analyses, risk-based assessment, modeling, etc., required to demonstrate closure in accordance with the decontamination standards and closure performance standards specified in the approved closure plan.

Figure 2-2 Common Elements In Post-Closure Plans

1. Introduction.

2. Closure performance standards for the HWMU. Reference to the groundwater protection standards in the groundwater monitoring plan.

3. A general description and background of the HWM facility.

4. HWMU(s) descriptions and background and identification of HWMUs requiring post-closure care.

5. Site topographic maps, site plans, and a survey plat. The site plan and survey plat must indicate the location and dimensions of HWMUs in respect to permanent and surveyed structures. All land based units, such as landfills and surface impoundments, etc., must indicate the location and dimensions of the closed HWMUs in respect to a permanent survey benchmarks and USGS datum. (§ 264.116 and § 265.116)

6. "As-built" engineering drawings, and plans and specifications of the key engineered systems, wells, and features that will require maintenance and care, and monitoring.

7. The specified length of the post-closure care period. (A 30-year period of post-closure care for each HWMU is typically required. The Director is authorized to extend or reduce the period based upon justifiable cause.)

8. Information to comply with the post-closure care requirements specified in the regulations. Post-closure plan information includes, but is not limited to the following:

    1. The groundwater monitoring system and monitoring activities in accordance with 40 CFR Part 264, Subpart F, Releases From Solid Waste Management Units.

        It is imperative to note that the requirements of Subpart F apply to all facilities required to close HWMUs with hazardous waste "closed in-place." Such facilities must submit a written post-closure plan. The groundwater monitoring plan is a component part of the post-closure plan. The groundwater monitoring plan includes, but is not limited to, the identification of the following specifics:

        - Groundwater protection standards.
        - Identification of hazardous constituents.
        - Concentration limits of hazardous constituents & hazardous waste decomposition products
        - Points of compliance.

Figure 2-2 (Cont'd) Common Elements in Post-Closure Plans

- General groundwater monitoring requirements. Includes the identification of
- Hazardous constituents and indicator parameters to be monitored.
- Detection monitoring program.
- Corrective action program for the HWM facility.

2. An operation and maintenance (O & M) manual. The O & M manual should address maintenance of the following at the facility:

   - Security.
   - The integrity of the HWMU(s) cover/ cap, and vegetative cover.
   - The surface water run-on and run-off drainage system for erosion control.
   - The leachate collection system.
   - Monitoring activities for leak detection.
   - The groundwater monitoring system and monitoring activities in accordance with 40 CFR Part 264, Subpart F.

9. The limited use statement and deed restriction of the property during the post-closure care period.

10. The name, address, phone number, etc., of the legal owner of the closed facility.
The facility's contact name(s), organization, address, and phone number(s), facsimile number(s), etc., during the post-closure care period.

11. The basis of the cost estimate for post-closure care.

    Post-closure cost estimates are required for all disposal facilities based on 30 years of post-closure care, except federal facilities, which require a technical and economic feasibility analysis (TEFA). Cost estimates must be based upon a detailed engineering evaluation. In addition, the cost estimate must be updated annually for inflation. Any future changes in the facility's capacity, units, operations or maintenance, care, and/or design that increases costs must be reflected in future revised cost estimates.

12. The amount of financial assurance and specific mechanism must be specified. The amount of financial assurance must be based upon the detailed costs estimated for post-closure care, maintenance, and monitoring during the entire post-closure care period, which is typically 30 years. The institution that holds the financial assurance should be clearly delineated.

13. The requirement for the post-closure certification by owner and the independent P.E., certified in the Commonwealth of Virginia.

Figure 2-3, Typical Closure Process

(Use figure/schematic from Khoa Nguyen's draft closure plan guidance document.)

3.0 COMPONENTS OF A CLOSURE PLAN

3.1 INTRODUCTION

The purpose of this part of the manual is to provide both general and detailed guidance regarding the recommended components of a closure plan and the type of information that the DEQ believes is appropriate and/or necessary for approval of a closure plan by the Director of the DEQ.

The guidance, herein, is in accordance with the Commonwealth of Virginia Hazardous Waste Management Regulations (VHWMR), the Resource Conservation and Recovery Act (RCRA) regulations, as amended, and in accordance with guidance from the EPA and the Virginia Department of Environmental Quality (DEQ). (Please note that the VHWMR, 9 VAC 20-60-12, et seq., incorporates several texts from Title 40 of the Code of Federal Regulations (CFR) by reference, including, but not limited to 40 CFR Parts 124, 260, 261, 262, 264, 265, 266, 268, 270, 273, and 279.)

This part of the manual provides general guidance on the recommended format, organization, and content of closure plans. This part also provides an overview of the typical components of a closure plan in Figure 3-1, Outline of Components of A Closure Plan.

A section or subsection is provided under this part of the manual for each component of a closure plan identified in Figure 3-1. Each section and subsection provides information which may include: regulatory citations, regulatory requirements, general and detailed guidance, recommendations, and/or examples of the type of information that the DEQ believes is appropriate for the various component parts of a closure plan.

Please note that this guidance manual is not a substitute for the applicable regulatory requirements, but is designed to supplement the regulations and to provide clarification regarding the content of closure plans required by the Virginia Department of Environmental Quality (DEQ).

Therefore, the DEQ recommends that facilities and their representatives refer to the VHWMR and the RCRA regulations, as amended, and that they contact the Office of Waste Permitting, DEQ, for further site specific guidance prior to development of their closure plan(s).

3.2 OVERVIEW OF TYPICAL COMPONENTS A CLOSURE PLAN

The DEQ has identified typical component parts or elements of a closure plan that are either recommended and/or required in order to obtain approval of the closure plan by the Director. **An outline of the recommended components of a closure plan is provided in Figure 3-1.**

Some of the detailed information that is recommended by the DEQ in closure plans is to provide a more complete administrative record regarding the HWM facility's operations and closures, and to provide information which is pertinent to the corrective action component of the VHWMR and the RCRA, as amended. Information regarding a HWM facility's operations may help minimize duplication of effort in future documentation initiatives and help provide essential information pertaining to a potential need for future corrective action for regulated activities under the VHWMR and the RCRA regulations.

To further assist facilities in developing closure plans, copies of the EPA/DEQ RCRA Permit Application checklists for closure, post-closure and financial requirements are provided in Appendix H. Appendix I includes the EPA/DEQ RCRA Permit Application checklist for landfill facilities and the web site address for the remainder of the RCRA Permit Application checklist for Part A and B. The above checklists should be used as a guide in closure plan development to help assure that the plan is in compliance with the applicable closure regulatory requirements.

General and detailed guidance is provided on the recommended contents of a closure plan in the following subsections of this manual. The general and detailed guidance is based upon both regulatory requirements and guidance from the EPA and the DEQ. Where appropriate, the regulatory requirements and citations are provided under the various sections of this guidance manual.

3.3 TITLE PAGE

Regardless of the style or format used, the closure plan should include a title page, which includes the following information:

1. A title, which indicates the scope and nature of the closure, plan.
   (e.g., Closure Plan for Hazardous Waste Surface Impoundment, Contingent Closure Plan for Surface Impoundment, Post-Closure Plan for Surface Impoundment, etc.)

2. Legal name and location of the facility.

3. EPA ID number.

Figure 3-1 OUTLINE OF COMPONENTS OF A CLOSURE PLAN

1. Title Page (Facility, Name, Address, EPA I.D. No., Date, & Consultant Information)

2. Introduction (Purpose & Objective of Plan).

3. Closure Performance Standards.

4. General HWM Facility Description, Location, and Background.

5 HWMUs Undergoing Closure - Description, Location and Background.

    1. Figures, Maps, site plans, and photographs of the HWM facility site and HWMUs.

    2. Hazardous Waste Codes Managed and Hazardous Waste Constituents of Concern. (HCOCs). (Basis for listing of HCOCs should be provided by inclusion of laboratory data, MSDS sheets, and/or other information pertinent to the generation of the hazardous waste. Disposal of hazardous waste requires a complete and detailed chemical and physical waste analysis so to comply with 40 CFR Part 264.13 and 265.13. At a minimum, the analysis must contain all the information which must be known to treat, store, or dispose of the waste in accordance with the above Parts 264 or 265, and 268 (Land Disposal Restrictions).)

    3. Extent of HWMU Facility Operation and Maximum HWMUs Waste Inventory.

6. Overview of Closure Procedures.

7. Hazardous Constituents of Concern (HCOCs) Analytical Test Methods.
(Includes EQL/PQLs, MDLs for both water and soil sample mediums based upon the analytical laboratory chosen and SW-846, Methods.)

8. QA/QC Plan and Procedures. (Based upon the analytical laboratory chosen and SW-846, QA/QC requirements and test methods.)

9. Closure Sampling and Analyses Plan. (Includes all field sampling procedures, equipment, sample handling, preservation, shipping, and chain-of-custody procedures.)

    1. Sampling of HWMUs and Areas Impacted by HWMUs.
    2. Background Sampling.
    3. Sampling Equipment Decontamination Procedures.

10. Health and Safety Plan for Closure Activities.

Figure 3-1 (Cont'd) OUTLINE OF COMPONENTS OF A CLOSURE PLAN

11. Clean Closure Decontamination Standards.

    1. Analytical Non-Detection.
    2. Comparison To Background (Includes Statistical Design and Methods).
    3. Risk Assessment.
    4. Alternative to Decontamination.

12. HWMU Waste Inventory Removal and Manifests to a TSD.

13. Decontamination or Disposal of HWMUs – Equipment, Structures, and Soils.

    1. Excavation Plan.

14. Temporary Decontamination Areas & Procedures.

    1. Small Equipment.
    2. Large Equipment.
    3. Decontamination Washwaters, Rinseate, and Residues Sampling.

15. Management, Characterization, & Disposal of Closure Generated Wastes.

    1. Solid Wastes.
    2. Liquid Wastes.
    3. Other Miscellaneous Wastes/Management of PPE.

16. Closure Cost Estimate with Supporting Calculations.

17. Financial Assurance for Closure.

18. Schedule For Closure.

19. Closure Plan Amendment – Contingent Closure & Post-Closure Plans

20. Certification of Closure by Owner/Operator & P.E.

21. Closure Report.

4. Date of the Closure Plan and revision date, if applicable.

5. The Consultant's name, address, phone number, and fax number that prepared the closure plan. Include the name of the Project Manager.

3.4 FORMAT, ORGANIZATION, AND CONTENT OF A CLOSURE PLAN

There are no requirements for format and organization of a closure plan; however, in order to help ensure consistency in submitted documents, the DEQ requests that the information be organized and presented in a manner which is somewhat similar to that provided in this guidance manual. Consistency in the organization of content in closure plan submittals should help facilitate the efficient review and approval, and help the DEQ provide better customer service.

All closure plans submittals should use a consistent format, nomenclature, and terminology throughout to avoid confusion. The closure plan should be written so the information is clear to a reader that is unfamiliar with the facility site and the HWMUs undergoing closure. Discrepancies and inconsistencies within a closure plan may be sufficient to preclude approval by the DEQ and require revision and resubmittal to ensure the plan is clear in its intent, purpose, or procedures, and to ensure that it is in compliance with the requirements of the VHWMR and the RCRA.

The DEQ requests that all closure plans include the following:

1. A format, which includes section numbers and section titles.

2. An organization which is logical and somewhat similar to that specified in this guidance manual (See Figure 3-1, Outline of Components of a Closure Plan.)

3. Sequentially numbered pages.

4. Tables with table I.D. numbers and table titles. (e.g., Table 2-1, Hazardous Waste Inventory at the Container Storage Area, Table 2-2, Hazardous Waste Constituents of Concern, etc.)

5. Figures with figure I.D. numbers and figure titles. (e.g., Figure 2-1, Site Plan of Company XYZ, Richmond, VA.)

6. Content which is in accordance with the guidance in this manual and in compliance with the requirements of the VHWMR and the RCRA.

7. Appendices, which provide supporting information, when appropriate.

3.5 INTRODUCTION (PURPOSE & OBJECTIVE OF PLAN)

An introduction section is helpful to orient the reader regarding the nature, purpose, and objective of the closure plan. The introduction section helps provide the necessary documentation and essential information for the administrative record related with a facility's planned closure and closure of specific hazardous waste management units (HWMUs).

The introduction provides the name, location of the HWM facility, and the nature and identity of the HWMUs undergoing closure. In addition, the introduction cites the regulations and any other regulatory mechanism associated with the subject closure. (e.g., VHWMR, RCRA regulations, Consent Order, etc.) The introduction should also provide the facility's EPA identification number and identify the current status of the facility under RCRA Info (Oracle database system). (i.e., indicate whether the facility is a permitted facility, an interim status facility, a large quantity generator, small quantity generator, etc.)

The DEQ recommends that the closure plan introduction provide the following types of information:

1. The name and location of the HWM facility.

2. The nature and identity of the hazardous waste management units (HWMUs) undergoing closure.

3. Briefly discuss the nature, purpose, and objective (scope) of the closure plan.

   Explain the reason or basis behind the closure plan, and provide reference to the appropriate regulations and any other regulatory mechanism associated with the subject closure. That is, refer to the VHWMR and the RCRA, and appropriate regulatory citations under these regulations. If the closure is required by an administrative Consent Order, reference the Order and provide the date the Order was issued to the facility owner/operator. (A copy of the Consent Order should be provided in an Appendix of the closure plan, if applicable.)

   For example, text could be provided similar to the following:

   > The purpose of the closure plan is to provide documentation of all steps and procedures and data gathering efforts necessary to close the hazardous waste container storage facilities and waste pile in compliance with the Virginia Hazardous Waste Management Regulations (VHWMR), 9 VAC 20-60-12, et seq. (formerly VR 672-10-1), the Resource Conservation and Recovery Act (RCRA) regulations, and the Hazardous and Solid Waste Amendments (HSWA) of the RCRA, and the

Consent Order between Company XYZ, Inc., and the DEQ, dated September 15, 1999. (See Appendix A for a copy of the Consent Order.)

The main purpose of the closure plan is to allow Company XYZ, Inc., to demonstrate compliance in compliance with the closure performance standards specified in the VHWMR and the RCRA regulations, as amended. Section 1.2 of this Closure Plan provides the site specific performance standards for the container storage area and the waste pile area, which are the two HWMUs covered by this closure plan.

4. The facility's EPA identification number.

5. The current status of the facility under RCRA Info indicating whether the facility is a permitted facility, an interim status facility, a large quantity generator, small quantity generator, etc.

6. This section may also include a statement indicating whether the closure plan is designed to achieve a "final closure" or "partial closure" of the HWM facility. If the closure plan is designed for "partial closure" then details of how the facility is going to "partially close" needs to be provided in the body of the closure plan. In addition, this section may also include a statement indicating whether the closure plan is designed to achieve "clean closure" or is designed to demonstrate closure with hazardous waste "closed in-place."

7. This is section may also may include a statement whether the facility will attempt to close the facility's HWMU(s) based upon the decontamination standards of non-detect, background standards, or to risk-based standards.

8. The introduction should also indicate the type closure plan that is being submitted. The submitted document could be a closure plan, a contingent closure plan, or contingent post-closure plan of a HWM facility. Also indicate whether a contingent closure plan and a contingent post-closure plan are included with the closure plan submittal, if required for the type of HWMU(s) and design, which is undergoing closure.

9. The closure plan could also indicate information similar to the following:

> If this facility is unable to attain "clean closure" for the hazardous waste management units, then an amended closure plan and post-closure plan will be submitted to the DEQ for approval to provide for closure with hazardous waste "closed in-place, " and for the post closure care and use of the property, respectively.

3.6 CLOSURE PERFORMANCE STANDARDS

Closure performance standards apply to the owners and operators of all HWM facilities managing regulated units under the authority of the VHWMR and the RCRA, as amended.

The closure performance standards provide the main premise, criteria, and standards for closure of all regulated units. It is imperative that facilities ensure that their closure plan is designed to comply with the general closure performance standards and the unit specific closure requirements delineated under the regulations for their HWMU(s).

The general closure performance standards and the unit specific closure requirements specified in the RCRA regulations need to be reiterated and provided in the submitted closure plan under a section entitled "Closure Performance Standards."

Closure performance standards, under 40 CFR Part 264 and 265 (Interim Status facilities), Subpart G, Closure and Post-Closure, § 264.111 and § 265.111, respectively, specify the following:

> *The owner or operator must close the facility in a manner that:*
>
> *(a) Minimizes the need for further maintenance; and*
>
> *(b) Controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere; and*
>
> **for 40 CFR Part 264**
>
> *(c) Complies with the closure requirements of this subpart, including but not limited to the requirements of §§ 264.178, 264.197, 264.228, 264.258, 264.280, 264.310, 264.351, 264.601 through 264.603, and 264.1102.*
>
> **for 40 CFR Part 265**
>
> *(c) Complies with the closure requirements of this subpart, including but not limited to the requirements of §§ 265.197, 265.228, 265.258, 265.280, 265.310, 265.351, 265.381, 265.404, and 264.1102.*

Section 2.2 of this manual provides the appropriate subpart descriptions and regulatory citations pertaining to the unit specific closure requirements. It is imperative that the HWM facility develop the closure plan and post-closure plan so to comply with the unit specific closure requirements of their HWMU(s) as delineated in the regulations.

The DEQ believes that the inclusion of the exact and appropriate regulatory language for the general and unit specific closure performance standards will help ensure that the closure plan is designed to meet all of the required closure performance standards and help avoid confusion to parties involved with closure of the specific HWMU(s) of the facility.

For example, 40 CFR Part 264, §264.258, Closure and Post-Closure Care (For Waste Piles), specifies that "At closure, the owner or operator shall remove or decontaminate all waste residues, contaminated containment system components (liners, etc.), contaminated subsoils, and structures and equipment contaminated with waste and leachate, and manage them as hazardous wastes unless §261.3(d) of this chapter applies. (See §264.258 for remaining closure performance standards applicable for waste piles.)

3.7 GENERAL FACILITY DESCRIPTION, LOCATION, AND BACKGROUND

The VHWMR under 9 VAC 20-60-980, Application for Permit, 9 VAC 20-60-990, Interim Status, and 9 VAC 20-60-1010, Contents of Part B, specifies the information requirements pertaining to the general facility description, location, and background for permitted facilities and Interim Status facilities, or other facilities subject to the requirements of the regulations. Facilities that are subject to the regulations which do not have a permit must ensure that closure plans include the general facility description, location, and background information required in the RCRA Permit Applications, Parts A and B.

The VHWMR and the RCRA regulations, under 40 CFR Part 264 and 265 (Interim Status facilities), Subpart G, §264.112 and §265.112, Closure Plan: Amendment of plan, specifies the required content of a closure plan. The above section of the regulations also requires the plan to describe the maximum extent of the operations that will be unclosed during the active life of the facility.

Therefore, the closure plan needs to clearly identify the HWM facility and HWMUs subject to closure and provide pertinent information regarding the unit(s) description, location, and background of the facility operations.

A section of the closure plan should be provided which includes basic information that documents and provides the administrative record regarding the legal facility name, previous facility names, the

facility description, location, and general background information regarding the nature of operations at the facility site.

The DEQ recommends the following type of information be provided under this section to meet the regulatory requirements:

1. The legal name of the company, location and mailing address, and facility contact name and contact title, phone and fax numbers.

2. The acreage of the facility site.

3. The nature of the current facility's operations and the SIC Code of the business.

4. The period that the company has been operating at the subject site.

5. The names of other company's that have operated at the site and the dates of their operation. Also indicate the nature of other company's operations at the site.

6. The EPA ID number and the date the current facility was issued an EPA ID number. Provide the date when the current facility began generating and managing hazardous waste at the site.

7. The periods the facility operated under Interim Status, as a permitted facility, large quantity generator, small quantity generator, etc., if applicable.

8. The nature and extent of the HWM facility operations should be clearly described and identified in the text and in appropriate figures. Provide a discussion of the various HWM facility operations and processes that generate hazardous waste at the site. Identify the hazardous waste generating processes by name and location and identify the related hazardous waste generated by hazardous waste codes. (The above helps provide the documentation supporting the basis for the hazardous codes and the constituents of concern (HCOCs) within the closure plan.)

9. Identify all of the HWMUs at the site, from past and present operations. Identify the HWMUs by description, location, size, and period of operation. All HWMUs should be identified on a site plan of the facility. All HWMUs that have been closed must be identified.

10. Identify the current means of hazardous waste management at the site. For example, identify less than 90-day accumulation areas that are currently utilized for hazardous waste

management, etc., and if the management area is different from the above identified HWMUs.

The above historical information regarding the HWM facility, along with the specific HWMUs closure information, is used to evaluate the adequacy of the proposed closure plan design. In addition, the above historical information may also be useful for any potential future corrective action related with the facility site.

3.7.1 FACILITY AND HWMUs - Detailed Description, Location, and Background

The VHWMR and the RCRA regulations, under 40 CFR Part 264 and 265 (Interim Status facilities), Subpart G, §264.112 and §265.112, Closure Plan: Amendment of plan, specifies the required content of a closure plan. The regulations also require the plan to describe the maximum extent of the operations that will be unclosed during the active life of the facility.

The closure plan needs to clearly identify the HWM facility and HWMUs undergoing closure and provide pertinent information regarding the unit(s) description, location, and background.

The following types of information should be addressed in the closure plan and provided for the administrative record under this section:

1. **HWMU Description, Age, Design, Plans and Specifications** - The HWMUs which will require closure need to be clearly identified and described by information similar the following: HWMU type, (unit name and unit number, if appropriate), HWMU description, location, age, size of the unit, design, plans and specifications, construction information, secondary containment or liner information, whether the HWMU is under roof, etc. (Design plans and specifications for the HWMUs and may be provided in an appendix to the closure plan or another part of the application, if appropriate.)

   Provide details associated with secondary containment, if present, such as the curbing dimensions and nature of the curbing material, etc. (When a wall is contiguous to a storage area without any other secondary containment then, the wall will be considered as secondary containment and require decontamination to demonstrate closure.)

   Discuss stormwater management associated with each HWMU undergoing closure. Refer the reader to the site plan figures where appropriate. In accordance with the regulations, HWMUs must be designed to prevent run-on into the containment system, unless the collection system has sufficient capacity to contain run-on that might enter the system. Describe dikes, berms, drainage system, etc. used to prevent run-on, or provide calculations demonstrating that the containment system has sufficient excess capacity to contain run-on

up to a 24 hour-25 year storm event.

2. **Figures (Topographic Maps, Site Plans) & Photographs** - The overall HWM facility and individual HWMUs undergoing closure should be clearly identified and located on a topographic map and a site plan and characterized with photographs of the HWMUs. The information required under this part may be provided under multiple figures (maps) or site plans or combined under one topographic map or site plan, if the scale of the site and HWMUs makes one figure feasible.

The DEQ recommends that information be provided similar to the following:

1. **Large Scale Map** - Provide a large scale topographic map (U.S.G.S. type, 1:24,000 scale) of the facility site which clearly shows the facility and facility boundaries and the surrounding area. (Identify the U.S.G.S. quadrangle series map which the above map is derived.) Include a north arrow, a scale, contour lines showing area topography, the area drainage, drainage ditches, streams, surface impoundments, dwellings, buildings, roads, and other topographic features typically found on U.S.G.S. topographic maps. Show the topographic details and land use of the facility and area surrounding the HWMUs and land area up to one mile from the facility site.

2. **Small Scale Map &/or Site Plan** - Provide a small-scale topographic map or site plan of the facility site of sufficient scale and detail. Show the facility buildings, the company property line, and the locations, dimensions and boundaries of the HWMUs areas.

   Include a north arrow, a scale, contour lines showing area topography, the area drainage, drainage ditches, storm sewers, streams, surface impoundments, dwellings, buildings, roads, and other topographic features typically found on U.S.G.S. topographic maps.

   The DEQ recommends that any wells within one-quarter mile from the HWMUs should be identified if there has been a potential release from the facility's HWMUs undergoing closure.

   The DEQ also recommends that the 100-year floodplain boundary be shown on the smaller scale topographic map or site plan, if it is present at the facility site.

   The Site Plan, should identify the exact location of the HWMUs relative to buildings, structures, etc. based upon either a site survey by a licensed surveyor registered in

the Commonwealth of Virginia, or based upon triangulation or other comprehensive measurements from previous surveyed benchmarks or surveyed locations of other structures at the site.

Clearly show the surveyed locations and measurements and accurately depict the dimensions and boundaries of the HWMUs relative to the site-surveyed buildings, benchmarks, and the U.S.G.S. datum reference used for the surveyed site plan, if used.

Please note that when a HWM facility must close a HWMU with hazardous wastes "closed in-place," they must comply with requirements of § 264.116 or § 265.116, Survey Plat, and §264.309, §265.309, Surveying and Recordkeeping.

3. **Photographs** - Photographs of the HWMUs should be provided from different perspectives and include close-up pictures and landscape photographs which show the nature of the HWMUs in relation to the surrounding facility. The close-up pictures should reveal the nature and condition of the HWMUs and to show potential migration pathways, which would need to be investigated by soil borings, etc. The photographs should be included in an Appendix.

3. **Hazardous Wastes Managed** - Identify the hazardous wastes and hazardous waste code numbers managed at the facility and in each HWMU at the facility subject to closure. Provide a summary of this information in a table. Separate tables of this information should be provided for each HWMU, if the hazardous wastes and waste codes managed are different from unit to unit.

A general discussion should be provided regarding the type of processes that generated the hazardous wastes and the identification of the various hazardous wastes and hazardous waste constituents generated and managed at the facility.

4. **HCOCs** – Identify the hazardous waste constituents of concern (HCOCs) managed at each HWMU at the facility. Provide a summary of this information in a table. Separate tables of this information should be provided for each HWMU, if the HCOCs managed are different from unit to unit. The presence and levels of HCOCs are evaluated during closure to establish compliance with the closure performance standards for the facility's HWMUs.

The basis for HCOCs is a critical component part of a closure plan. It is important to

identify all applicable HCOCs since the objective of closure sampling is to identify the nature and extent of contamination attributed to the HCOCs. **HCOCs should be those hazardous constituents historically managed at the facility and the HWMUs**, which are identified in the RCRA under 40 CFR Part 261, Appendix VII, Basis For Listing Hazardous Wastes, and Appendix VIII, Hazardous Constituents. **Where closure requires groundwater monitoring, then the groundwater monitoring parameters are based upon constituents in Part 264, Appendix IX, Groundwater Monitoring List**.

Part 264, Appendix IX, Groundwater Monitoring List, includes approximately 23 constituents that are not in the list of Part 261, Appendix VIII. Many of the additional 23 constituents in Part 264, Appendix IX, are either indicator parameters or other groundwater parameters that may be used to further evaluate the potential impact of hazardous waste decomposition products to other media and the potential impact to human health and the environment.

Where releases from the HWMU structures have potentially occurred and resulted in contamination of other media (soils, subsoils, groundwater, surface-water, wetlands, or the atmosphere), then the HCOCs may be expanded beyond those listed in Part 261, Appendices VII and VIII, and Part 264, Appendix IX, to include other hazardous waste decomposition by-products from the hazardous wastes which were managed on-site.

When the HCOCs list also includes parameters from Part 264, Appendix IX, and other decomposition by-products, then the parameters from Appendix IX and the other identified decomposition by-products should only be included in the sampling of and evaluation of other media and should not be the basis of closure of equipment or structures of the HWMUs.

The listings of the hazardous waste codes and hazardous waste constituents are to be based upon the facility's comprehensive review and compilation of all chemicals and materials managed in the operations that generated the hazardous waste at the facility.

Please note that the basis for listing of HCOCs should be supported by inclusion of Material Safety Data Sheets (MSDSs), raw material or product specification sheets, and/or other appropriate information pertinent to the operations that generate the hazardous wastes. (Provide MSDSs and other supporting information in the appendices of the closure plan.)

If hazardous waste is currently on site, then laboratory data of the hazardous wastes managed at the HWMUs undergoing closure should be provided as a primary basis of the closure HCOCs. (Provide laboratory data and MSDSs in the appendices of the closure

plan.)

The disposal of hazardous waste requires a complete and detailed chemical and physical waste analysis so to comply with requirements of 40 CFR Part 264.13 or 265.13, General Waste Analysis. At a minimum, the analysis must contain all the information which must be known to treat, store, or dispose of the waste in accordance with the requirements of the above Parts 264 or 265, and 268 (Land Disposal Restrictions).

5. **Past Releases** - Discuss whether there have been any past releases from the HWM facility operations or specific HWMUs subject to closure. If there has been a past release from the HWM facility operations, specific HWMUs, other solid waste management units (SWMUs), or anywhere on the facility's site, please discuss the nature and quantity of the releases, and remediation efforts associated with the releases. Information pertaining to releases from manufacturing processes, product storage, sewer lines, etc., may impact the design for the sampling plan which is a component part of the closure plan. Any past releases should be identified in the facility site plans, as appropriate.

6. **Site Assessment and Site Characterization** - Provide a preliminary assessment of the integrity of the HWM facility and HWMUs subject to closure and a site characterization including a discussion of the physical condition of the HWMUs. (e.g., indicate whether cracks or migration pathways are visible in the secondary containment provided for the unit.) The site characterization should provide a description of the depths, nature and properties of the site soils, geology, hydrogeology, depth to groundwater, and hydrology (surface run-on and run-off) at the site in relation to the HWMUs.

7. **Stormwater Management** - The HWM facility must demonstrate adequate measures to prevent surface run-on to the HWMUs and demonstrate adequate secondary containment to prevent run-off from the HWMUs up to a 24 hour-25 year storm event. The facility needs to provide information regarding the storm water drainage and/or management in relation to the HWMUs subject to closure.

   Discuss stormwater management associated with each HWMU subject to closure. Refer the reader to the site plan figures where appropriate. In accordance with the regulations, HWMUs must be designed to prevent run-on into the containment system, unless the collection system has sufficient capacity to contain run-on that might enter the system. Describe dikes, berms, drainage system, etc. used to prevent run-on, or provide calculations which demonstrates that the containment system has sufficient excess capacity to contain run-on up to a 24 hour-25 year storm event.

(The Virginia Erosion and Sediment Control Handbook should be useful in providing the basis of the evaluation and in calculating run-on and run-off. The above handbook is available from the Division of Soil and Water Conservation, Virginia Department of Conservation and Recreation.)

If the HWMUs subject to closure are served by a storm water management system, sedimentation basin, etc., show the drainage system and basin in a site plan, and discuss the stormwater management in relation to the run-off from the HWMUs. Also provide the overall dimensions and the nature of construction of the facility's storm water management system and sedimentation basin, etc. (e.g., earthen, concrete, basin, etc.).

Also indicate whether the facility's storm water discharge is covered under the Virginia Pollutant discharge Elimination System (VPDES) General Storm Water Permit. If so, provide specifics associated with the VPDES permit.

3.7.2 Extent of HWMUs Operation - Maximum Inventory of HWMUs Subject to Closure

The VHWMR and the RCRA regulations, under 40 CFR Part 264 and 265 (Interim Status facilities), Subpart G, §264.112 and §265.112, Closure Plan: Amendment of plan, specifies the required content of a closure plan. The above sections of the regulations require an estimate of the maximum inventory of hazardous wastes ever on-site over the active life of the facility. The regulations also require the plan to describe the maximum extent of the operations that will be unclosed during the active life of the facility.

Therefore, the DEQ recommends the following information be provided for the administrative record under this section:

1. **Maximum Inventory during Life of Facility** - Provide the maximum inventory of hazardous waste in storage, treatment, and/or disposal at any time during the life of the facility. Provide the units of measurement such as total gallons, pounds or tons, cubic feet or cubic yards, etc. If the inventory is stored in 55-gallon drums or containers, also provide the total number of 55-gallon drums, containers, etc., in each HWMU. Also indicate if drums were stacked and/or stored on pallets or how drums or containers were managed in the HWMUs. Information should be summarized in a table where appropriate.

   Provide the basis for the estimated maximum inventory. (Provide the supporting calculations where necessary. For example, indicate the time period the waste was generated, the rate of waste generated volume in gallons and/or cubic yards/unit time, and

the overall volume of waste generated in gallons, cubic yards, etc. If a waste pile was generated, indicate the maximum dimensions (length x width x height), cubic yards and tons/cubic yard of the hazardous waste pile.)

2. **Maximum Inventory at Time of Closure** - Provide the maximum inventory of hazardous waste in storage, treatment, and/or disposal at the time of closure of the HWMUs undergoing closure. Provide the units of measurement such as total gallons, pounds or tons, cubic feet or cubic yards, and if stored in drums or containers, also provide the total number of 55-gallon drums, containers, etc., stored in each HWMU. This information should be summarized in a table.

3.8 OVERVIEW OF CLOSURE PROCEDURES

The DEQ recommends that a closure plan should include an overview section, which provides a general summary of the closure procedures and processes that are proposed to close the HWM facility and individual HWMUs so to comply with the Closure Performance Standards and the VHWMR and the RCRA. The overview text should also provide a brief discussion of the criteria and standards utilized in determining whether any of the contaminated residues and environmental media contains hazardous waste constituents. In addition a brief summary should be provided regarding the appropriate methods of disposal of all wastes generated during the closure process.

An overview section should provide information similar to the following:

1. Indicate that the facility is subject to the closure requirements of the VHWMR and the RCRA regulations, under 40 CFR Part 264, (or Part 265 for Interim Status facilities), Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities. Indicate that the HWM facility must demonstrate closure of the HWMUs in accordance with the closure performance standards and closure requirements for a hazardous waste container storage facility, surface impoundment, etc., whichever is applicable. (Refer the reader to the closure plan performance standards identified in the Closure Plan under Section 1.0, Introduction.)

2. The closure plan is designed to provide documentation of the closure of the HWMUs in accordance with the VHWMR and the RCRA, and that any hazardous waste constituents remaining after closure will not adversely impact any environmental media in excess of the DEQ established exposure levels and that direct contact with any constituents remaining from the site will not pose a threat to human health and/or the environment.

3. The closure procedures require that all wastes, waste residues, aggregates, soils, wastewaters, and rinseates that are generated from the closure activities of the HWMUs be

segregated and stored in separate containers, and representatively sampled and tested so to assure compliance with the VHWMR and the RCRA. All wastes, wastewaters, rinseates, soils, and residues related with the closure of the HWMUs will be stored on-site in temporary storage containers in accordance with regulations. No waste piles will be created during closure activities. Waste debris, soils, and residues will be stored in large roll-off containers, if needed.

Indicate that the Regional Office of DEQ will be notified of the temporary (less than 90-day) storage of hazardous waste and other wastes associated with closure at the HWM Facility. The Regional Office will be notified a minimum 15 days prior to commencement of closure activities.

4. In accordance with the EPA=s AContained in Policy,@ contaminated environmental debris or media is subject to regulation under the RCRA if they Acontain@ hazardous waste. Contaminated residues and environmental media "contain" hazardous waste when the following occurs:

    1. When the residues or media (e.g., soil, aggregate, wastewaters, etc.) exhibit a characteristic of hazardous waste in accordance with 40 CFR Part 261, Subpart C, Characteristics of hazardous Waste, § 261.20.

    2. When a residue, waste, or wastewater removed from a regulated unit, which manages a listed waste under 40 CFR Part 261, Subpart D, Lists of Hazardous Wastes, contains a hazardous constituent from Part 261 Appendix VI or VIII.

    3. When the residues or media are contaminated with concentrations of hazardous waste constituents that are above health or risk-based levels.

5. Any soil, subsoil, residues, and equipment contaminated with hazardous waste and any leachate from the HWMUs are required to be managed as a hazardous waste in accordance with the VHWMR and the RCRA. That is, any soils, subsoils, sediments, residues, materials, wastewaters, or equipment contaminated with hazardous waste constituents are required to be disposed in a permitted hazardous waste landfill, unless demonstrated by testing that they are nonhazardous in accordance with specified decontamination standards of the approved closure plan and the VHWMR and the RCRA regulations. (See the three criteria or standards above which determine whether a residue, waste, wastewater, or media are considered hazardous waste.)

    The demonstration by testing includes the analyses for all HCOCs specified in the approved closure plan and analyses to demonstrate compliance with the Toxicity Characteristic

Leachate Procedure (TCLP) for the contaminants listed in Table 1 under 40 CFR Part 261 § 261.24, Toxicity Characteristic.

All soils, subsoils, sediments, residues, materials, wastewaters, or leachate or other wastes generated during closure that are demonstrated to be hazardous must be treated or disposed so to comply with 40 CFR Part 268, Land Disposal Restrictions, Subpart D, Treatment Standards, § 268.40, Applicability of Treatment Standards.

All waste materials generated in the closure process that are demonstrated as non-hazardous are required to be disposed of as a solid waste in accordance with the VHWMR. Disposal of all non-hazardous wastes will require documentation of disposal from the authority regulated under the Virginia Solid Waste Management Regulations (VSWMR).

Wastewaters generated in the closure process that are demonstrated as non-hazardous are required to be disposed to a publicly or privately owned wastewater treatment plant regulated by the Clean Water Act (CWA) or equivalent. Disposal of all non-hazardous wastewaters will require documentation of prior approval for disposal, and documentation of disposal from the authority regulated under the CWA.

6. This overview should also provide a brief summary of the nature and contents of the key procedures or components to be followed in the Closure Plan in order to demonstrate "clean closure." The overview summary may include a very brief overview discussion, which addresses information similar to the following:

   1. Reiterate the maximum inventory and the physical and chemical nature of the hazardous wastes on-site. Discuss the manner in which the hazardous waste is stored on-site, such as whether the wastes are in 55-gallon drums, in a sludge-like state in a surface impoundment, etc.

      Refer the reader to the appropriate section of the closure plan that provides the hazardous waste codes and hazardous waste constituents of the wastes managed in each HWMU. Indicate that the hazardous waste will be managed in accordance with the Health and Safety Plan developed for the facility closure.

   2. Discuss the general methods of hazardous waste removal and disposal to a permitted TSD facility so to assure compliance with the VHWMR and the RCRA, and LDR requirements.

   3. Summarize the decontamination procedures to be used for the HWMUs and identify

the methods of handling, temporary storage, and disposal of wastes generated during closure including debris, residues, linings, soils/subsoils, wastewaters, rinseate washes, etc.

4. Summarize the general procedures to be used to verify the decontamination of the HWMUs equipment, structures, and soils, and the potential reiterative procedures that may be needed to achieve "clean closure."

3.9 HCOCs - ANALYTICAL TEST METHODS

The closure plan must identify the selected analytical test method to be utilized for each HCOC, and the associated practical quantitation limits (PQLs) or estimated quantitation limits (EQLs) and the method detection limits (MDLs) for each type of medium to be sampled. (Please note that the PQL and EQL are two different terms commonly used to describe the same test method limits by analytical laboratories.)

Most closure plans typically require analyses of water and a soil (or solid) medium. Solid mediums typically have a higher test PQL/EQL and MDL than the corresponding test limits for the water mediums. This is due to a required extraction procedure of the analyte from the solid phase prior to testing for the HCOCs. Therefore, each HCOC test method typically has different PQLs/EQLs and MDLs for the water and soil mediums.

The closure plan needs to provide a HCOCs Analytical Test Methods Table which lists all HCOCs, the corresponding test methods chosen, and the PQLs/EQLs, and MDLs for each method and medium to be tested (water and solid matrix). The HCOCs analytical test methods table will provide a primary basis for decisions whether the HWMUs achieve compliance with the decontamination standards and closure performance standards. In addition, the above table will also provide the primary criteria to establish whether the wastes, wastewaters, soils, and residues generated from closure are ultimately required to be disposed as a hazardous waste or non-hazardous waste.

For RCRA-related analytical work, the EPA and the DEQ typically require the use of analytical methods specified in Test Methods for Evaluating Solid Waste Physical/Chemical Methods, SW-846, 3rd edition, November 1986, as updated.

An updated **electronic version of SW-846** is provided on EPA's web page at: **http://www.epa.gov/epaoswer/hazwaste/test/main.htm.**

An enclosed memorandum from the DEQ entitled "SW-846 Methods Table," dated February 18, 1999, provides the DEQ's most updated comprehensive list of updated

methods that have been published by the EPA. (See Appendix A.) The noted PQLs/EQLs and MDLs noted in SW-846 and the DEQ guidance provide typical detection limits that have been achieved by laboratories using the approved test methods. (Please note that the methods and detection limits in the table in Appendix A are subject to change by the EPA.)

The DEQ's "SW-846 Methods Table" should be used to help establish the appropriate analytical test methods for each HCOC and medium to be tested.

The DEQ recommends that the facility obtain the services of an analytical laboratory for assistance in selecting the analytical test methods for the HCOCs and to establish the PQLs/EQLs and MDLs for each medium to be tested. The test methods must comply with SW-846 Methods. The test methods, PQLs/EQLs, and MDLs vary from one laboratory facility to another and the analytical limits are often dependent upon the specific analytical instrumentation or equipment utilized. (The established HCOC test methods, PQLs/EQLs, and MDLs will be evaluated in the submitted closure plan; they must be sufficient to comply with regulatory requirements for the Director's approval of the closure plan.)

Typically, more than one test method is available for the analysis of a constituent. However, the critical factor associated with the different analytical test methods lies primarily in the PQLs/EQLs and the MDLs that the test method and analytical equipment are capable of achieving. The PQL/EQL is often at 5 to 10 times the MDL for a specific test method utilizing a specific piece of equipment. However, the relationship between the PQL/EQL and the MDL varies depending upon the laboratory, test method, analytical constituents, and mediums tested.

In accordance with SW-846, the definitions of a PQL/EQL and MDL are as follows:

1. ***EQL*** *- The estimated quantitation limit (EQL) is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The EQL is generally 5 to 10 times the MDL. However, it may be nominally chosen within these guidelines to simplify data reporting. For many analytes, the EQL analyte concentration is selected as the lowest non-zero standard in the calibration curve. Sample EQLs are highly matrix-dependent. The EQLs in SW-846 are provided for guidance and may not always be achievable.*

2. ***MDL*** *– The method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99 % confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte.*

Note: Also see Appendix A for EPA Region III Technical Guidance – Chemical Concentration Data Near The Detection Limit, by Dr. Roy L. Smith, EPA, 1991, for a discussion of reporting analytical data near the detection limit.

In general, the DEQ recommends that the selected analytical test method should have the lowest PQL/EQL for each hazardous waste constituent of concern (HCOC) being tested. This is to ensure that reliably quantifiable results are obtained whenever possible. In addition, the test methods with the lowest PQL/EQL detection levels are necessary if the facility wishes to demonstrate and achieve clean closure decontamination by the analytical non-detection decontamination standard and the comparison to background standard.

If facility chooses to close their HWMUs using risk-based criteria as the decontamination standard, then the facility may chose analytical test methods with PQLs/EQLs that are sufficient to demonstrate compliance with risk-based concentration levels and closure performance standards under the DEQ's Guidance for risk-based closure. (For risk-based closure, the DEQ utilizes the "Guidance for Development of Health Based Cleanup Goals Using Decision Tree/Risk Exposure and Analysis Modeling System **(**REAMS) Program, 1994, and Risk Based Methodology," as amended, along with other risk-based guidance guidance provided by the DEQ.) (See Section 3.13.3)

Other factors that should be considered when selecting analytical test methods include the expected concentrations of parameters in background areas, experience, literature, maximum contaminant levels (MCLs) for drinking water, etc. (It should be noted that test method detection levels based upon MCLs are only applicable to the water mediums. Other exposure pathways may require analytical detection levels below MCLs.)

The closure plan should specify that the laboratory reports will provide the PQLs/EQLs and the MDLs for each parameter and medium tested

Please note that all residues, debris, soils, wastes, wastewaters, etc., that are generated during closure must be analyzed for Toxicity Characteristic Leachate Procedure (TCLP) constituents in addition to the required testing of established HCOCs to establish whether the wastes generated are hazardous waste or non-hazardous. The chosen test methods for the TCLP constituents must achieve the analytical detection levels for each medium to meet the TCLP constituent levels specified in 40 CFR Part 261, Subpart C, §261.24, Toxicity Characteristic. (Other than the required TCLP analyses, all other HCOCs parameters must be tested at analytical detection levels based upon guidance in this section.)

3.10 QA/QC PROCEDURES

The closure plan must include a general statement that the facility and laboratory performing the analytical testing will follow quality assurance and quality control (QA/QC) procedures consistent with chapter one of SW-846, 3rd Edition, November 1986, as updated. The QA/QC procedures must be followed during demonstration of closure to assure that the analytical results are accurate and precise and that proper procedures were utilized in the closure of the facility.

In addition to providing the above general statement, the details of the QA/QC procedures utilized in the field and the laboratory should be provided in the closure plan.
The text of the closure plan should provide detailed discussion of excerpted text from the QA/QC procedures in SW-846 or the text may refer the reader to an Appendix in the closure plan which provides the essential QA/QC detail to document that proper QA/QC procedures will be employed during closure activities and during laboratory testing. If the QA/QC procedures and protocols are referenced to an appendix, the appendix should include the appropriate QA/QC detail as specified in the SW-846 Manual, Chapter one, etc. The specific QA/QC procedures chosen should be clearly documented for each of the sampling areas and mediums to be sampled based upon the sample types and HCOCs.

The QA/QC manual of the laboratory should be briefly summarized as it pertains to the sample handling and analyses associated with the closure plan. As an alternative, a copy of the laboratory's Quality Assurance Plan may be submitted as a component part of the facility's closure plan.

The analytical laboratory's QA/QC sample requirements and QA/QC procedures, which are in compliance with SW-846, chapter one, should be a primary basis of the QA/QC sampling and QA/QC procedures utilized in the closure plan. The requirement for QA/QC samples significantly increase the number of samples that are required in the closure sampling plan. (See Section 3.11.)

SW-846, chapter one, Section 3.4.1, Control Samples, specifies the following:

> *Control samples are quality control (QC) samples that are introduced into a process to monitor the performance of the system. Control samples, which may include blanks (e.g., trip, equipment, and laboratory), duplicates, spikes, analytical standards, and reference materials, can be used in different phases of the data collection process beginning with sampling and continuing through transportation, storage, and analysis.*
>
> *Each day of sampling, at least one field duplicate, and one equipment rinsate should be collected for each matrix sampled. If this frequency is not appropriate for the*

sampling equipment and method, then the appropriate changes should be clearly identified in the quality assurance project plan (QAPjP). When samples are collected for volatile organic analysis, a trip blank is also recommended for each day that samples are collected. In addition, for each sampling batch (20 samples of one matrix type), enough volume should be collected for at least one sample so as to allow the laboratory to prepare one matrix spike and either one matrix duplicate or one matrix spike duplicate for each analytical method employed. This means that the following control samples are recommended:

- *Field duplicate (one per day per matrix type).*
- *Equipment rinsate (one per day per matrix type).*
- *Trip blank (one per day, volatile organics only).*
- *Matrix spike (one per batch [20 samples of each matrix type]).*
- *Matrix duplicate or matrix spike duplicate (one per batch).*

Additional control samples may be necessary in order to assure data quality to meet the project-specific data quality objectives.

SW-846, chapter one, Section 5.0, Definitions specifies the following terms in Italics:

1. **Duplicates:**

   1. ***Field Duplicates*** *– Independent samples which are collected as close as possible to the same point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analyzed independently. These duplicates are useful in documenting the precision of the sampling process.*

   2. ***Matrix Duplicates*** *– An intralaboratory split sample which is used to document the precision of a method in a given sample matrix.*

   3. ***Matrix Spike Duplicates*** *- Intralaboratory split samples spiked with identical concentrations of target analyte(s). The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.*

2. Blanks:

1. ***Equipment blank or Equipment Rinsate*** *– A sample of analyte-free water which has been used to rinse the sampling equipment. It is collected after completion of decontamination and prior to sampling. This blank is useful in documenting adequate decontamination of sampling equipment.*

2. ***Method Blank*** *– An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.*

3. ***Trip Blank*** *– A sample of analyte-free media taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organics in samples.*

4. **Field blank** – (Not defined in SW-846, but recommended by the DEQ in a sampling and QA/QC plan.) - A field blank is a sample of laboratory grade water that is prepared in the field at the sampling site and is treated exactly as the other samples being collected. The purpose of the field blank sample is to detect possible background contamination that may affect the sample concentration. Corrections to the analytical data are not performed in the laboratory based on analysis of the field blank. Field blank samples are project-specific and are only done when included in the sampling plan. Field blank samples should be taken for each day that samples are taken and shipped from the facility being closed.

Sample protocols, labeling, preservation, and chain of custody procedures must be utilized for all blank and duplicate QA/QC samples in accordance with procedures specified in SW-846. The duplicate and blank samples are required to be analyzed for all parameters specified in Hocus Table specified within the closure plan.

The closure plan should specify that:

1. The appropriate QA/QC samples, sample data, and laboratory data, and laboratory QA/QC control procedures specified within the closure plan will be discussed and summarized in the closure report as it pertains to the demonstration of closure.

2. All of the QA/QC laboratory data will be included with all other field and sampling data and will be provided in an Appendices of the Closure Report.

An example QA/QC plan for sampling is provided in Appendix E. In addition, the EPA provides guidance for QA/QC plans under the following:

1. Guidance on Quality Assurance Project Plans (QA/G-5) – Go to URL: **http://www.epa.gov/quality/qs-docs/g5-final.pdf**. This guidance includes Quality Assurance Sampling Plan for Environmental Response (QASPER) software that compiles user-selected, technical text and user-provided, site-specific information into a QA/QC Sampling Plan.

2. EPA Guidance for Quality Assurance Project Plans – Go to URL: **http://www.epa.gov/swerust1/epaqag5.pdf**.

3.11 Closure Sampling and Analysis Plan

A sampling and analysis plan should be provided within the closure plan. The sampling and analysis plan is an important planning tool used to ensure adequate procedures are followed and that sufficient types of sampling and analysis are performed to demonstrate closure of the HWMUs in accordance with the decontamination standards and performance standards of the closure plan, and to assure compliance with the requirements of the VHWMR, the RCRA regulations, and with the EPA publication SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 1986, as amended. The sampling and analysis plan should be developed based upon the requirements of the SW-846 Methods Manual and specifically, Chapter Nine, Sampling Plan, and Chapter One, Quality Control.

The sampling and analysis plan, in essence, helps establish a blue print for closure and sampling related procedures and activities. The sampling and analysis plan identifies the quantity and type of samples to be taken to demonstrate closure and proper characterization of the wastes for disposal purposes. The closure sampling and analysis plan also includes a description of all sampling methods and procedures, sampling equipment, sample handling, sample preservation, and sample chain of custody procedures. In addition, the sampling and analysis plan also helps establish the basis of the cost of closure of the facility's HWMUs.

The RCRA regulations require the use of discrete grab sampling for compliance with concentration level standards for all nonwastewaters. For wastewaters, compliance with concentration level standards is based on the maximums (based upon composite or grab samples) for any one day, except for D004 through D011, which must be based on grab sampling. (See 40 CFR Part 268, Subpart D, Treatment Standards, § 268.40(b), Applicability of Treatment Standards, and footnotes of table, Treatment Standards For Hazardous Wastes, under § 268.40.

To demonstrate closure, discrete sampling and analyses is required for all compliance and background samples of rinseates, soils, sediments, groundwater, etc. Composite sampling is generally not acceptable to demonstrate compliance with the decontamination standards of a HWMU. Where multiple grab samples are taken and/or required to demonstrate compliance, then statistical analyses of the discrete sample data is utilized to demonstrate compliance with the closure decontamination standards or the closure performance standards.

Representative composite samples of nonwastewater containerized wastes, such as, soils, sediments, and debris in roll-off boxes, drums, etc., is believed appropriate to characterize containers of wastes generated during closure activities. Composite samples of a containerized solid wastes that consist of multiple grab samples from a single container are believed to be more representative than a single grab sample of the solid medium to characterize waste within a container. (This is especially true for large containers such as 20 cu. yd. roll-off boxes.

All containerized wastes should be individually and representatively sampled to reflect the entire contents of the container. Each waste stream or type of wastes, wastewaters, residues, soils, subsoils, or other waste mediums generated during closure of HWMUs should be individually and representatively sampled in accordance with guidance in SW-846, Chapter Nine. Each type of waste must be kept segregated from other types of wastes. A type of waste from one HWMU should not be combined with the same type of waste from another HWMU unless discrete grab samples of each waste stream proceeds mixing of the combined wastes.

The purpose of the sampling and analyses plan is to:

1. Demonstrate closure of the HWMUs by providing an adequate number of representative compliance samples, QA/QC samples, and background samples in accordance with guidance in SW-846, as amended.

2. Identify potential contamination of media that may have resulted from the operation of the HWMUs.

3. Establish representative background conditions for inorganic parameters.

4. Identify the protocols for sampling, sample handling, preservation, chain of custody, and shipping.

5. Establish the necessary decontamination procedures for sampling equipment between samples.

6. Establish the proper means of disposal of all wastes, wastewaters, residues, soils, etc., generated during the closure process. The Regulations require sampling and analysis of all waste streams and types of wastes generated during closure .

7. Provide the basis for the sampling costs and the potential laboratory analytical costs. Most often, the laboratory costs are a significant cost component of the closure activities. (The sampling plan is essential for providing an accurate closure cost estimate for the financial assurance for closure of the HWMUs.)

The number and types of samples established in the sampling and analysis plan are based upon the requirements of the regulations, EPA and the DEQ guidance, SW-846, as amended, professional judgement, and the reiterative process that must consider the following factors:

1. The number and types of HWMUs that are subject to closure and the size, nature of the design and construction of the HWMUs, and the potential for migration of hazardous waste and HCOCs from the HWMUs.

   The sampling plan for the HWMUs must be sufficient to meet the unit specific closure requirements of the VHWMR and the RCRA regulations and guidance provided by the EPA and the DEQ. DEQ Guidance is provided in this manual under Section 2.4, Regulated HWMUs Subject to Closure - Applicability & Other Requirements. (Also see Sections 3.11.2, HWMUs Sampling, and 3.11.3, Background Sampling.)

2. The quantities and types of equipment (tanks, pumps, and other ancillary items) within the HWMUs.

3. The quantities and types of mediums to be sampled to demonstrate closure of each HWMU. These may include, but are not limited to, samples of: water (final rinseates), soils, sediments, and groundwater.

4. The anticipated types and quantities (volumes) of closure generated wastes from each HWMU. (May include washwaters and rinseates, residues, soils/subsoils, construction debris, obsolete equipment, and other wastes.) Consider the number of mediums and containers to be sampled.

5. The types of HCOCs that need to be tested to demonstrate compliance with the decontamination standards.

6. The number and types of samples needed to dispose of the closure generated wastes. Includes sampling and analysis for HCOCs and the Toxicity Characteristic Leachate Procedure (TCLP) for the contaminants listed in Table 1 under 40 CFR Part 261 § 261.24, Toxicity Characteristic.

7. The number and type of samples needed to comply with characterization of the hazardous waste inventory, if not already provided by previous analytical data. The RCRA requires a detailed chemical and physical waste analysis of all wastes to comply with 40 CFR Part 264.13 and 265.13, and Part 268 (Land Disposal Restrictions).

8. The sampling and QA/QC guidance to demonstrate closure in accordance with requirements of the laboratory and SW-846, as amended. (See SW-846, Chapter One, Quality Control, and Chapter Nine, Sampling Plan.)

9. The number of and type of samples needed to comply with statistical analysis requirements for each medium for the background samples and the compliance samples for each HWMU.

10. Compliance with other regulatory requirements.

Tables should be provided which summarize and itemize the estimated number of samples necessary for closure of each HWMU under the closure plan. The total number of samples and related potential analytical requirements will provide a sound basis for the sampling and analytical costs of the closure cost estimate in the closure plan.

Please note that the disposal of the hazardous waste requires a complete and detailed chemical and physical waste analysis to comply with 40 CFR Part 264 and 265, § 264.13 and § 265.13, General Waste Analysis. Therefore, if the hazardous wastes in the HWMUs have not undergone analytical testing to comply with the VHWMR and the RCRA testing requirements, the facility should be required to representatively sample and test the hazardous wastes generated from the HWM facility and include the data as a basis of establishing the HCOCs for closure of the facility. At a minimum, the analysis must contain all the information necessary to treat, store, or dispose of the waste in accordance with the above Parts 264 or 265, and 268 (Land Disposal Restrictions).

Guidance is provided by the EPA for development of sampling plans under "Guidance on Quality Assurance Project Plans (QA/G-5). **http://www.epa.gov/quality/qs-docs/g5-final.pdf**. The above EPA guidance includes Quality Assurance Sampling Plan for Environmental Response (QASPER) software that compiles user-selected, technical text and user-provided, site-specific information into a QA/QC Sampling Plan.

3.11.1 Sampling Approaches

Different sampling approaches may be utilized to demonstrate closure of HWMUs.

According to OSWER Directive 9360.4-10, dated November 1991, Removal Program Representative Sampling Guidance, Volume 1: Soil, Interim Final, representative sampling approaches include: judgmental sampling, random sampling, stratified random sampling, systematic grid sampling, bias sampling, search sampling, and transect sampling.

Each sampling approach has different assumptions and is appropriate for different situations depending on how much is known about possible distribution of contamination in the HWMU and in the area potentially impacted by the HWMU. It is up to the closure plan developer to establish and propose a sampling plan scheme which is the most appropriate for the regulated unit and to delineate the extent of potential contamination emanating from the unit. However, the sampling plan scheme must be sufficient in its scope, design, and detail to obtain the approval of the DEQ.

Random sampling is the most common sampling approach used to demonstrate closure of HWMUs.

If a random sampling scheme is selected, the closure plan should provide the following:

1. The method used for generating the random numbers.

2. The random numbers generated.

3. The random number grids developed for each HMWU. Also show the random grid locations relative to the dimensions of each HWMU.

Often a combination of bias sampling and random sampling is used in developing a sampling plan for closure of a HWMU.

Bias sampling is often used to evaluate soils, subsoils, groundwater, wetlands, sedimentation basins, surface waters, or other mediums that may have been impacted by the release of hazardous waste or hazardous waste constituents. Bias sampling is used to evaluate the presence of HCOCs beneath migration pathways (cracks, seams, etc.) found in the structure or in the secondary containment of the HWMU. Bias sampling may be used to evaluate suspected hot spots in target areas near the HWMU, potential migration of HCOCs based upon the knowledge of historical waste management activities, the conditions of the HWMUs, and location of the HWMUs. Bias sampling is also used for selecting the background samples.

One of the uses of the bias sampling approach is to help identify highly contaminated areas from the operation of a HWMU. If an area of high contamination is found, then removal of the hot spot areas may help avoid the need for a site-wide excavation of soils and bring the HWMU site to a satisfactory condition to allow closure in accordance with the closure plan decontamination standards and the regulations.

The RCRA regulations require the use of discrete grab sampling to demonstrate compliance with concentration level standards for all nonwastewaters. For wastewaters, compliance with concentration level standards is based on the maximums (based upon composite or grab samples) for any one day, except for D004 through D011, which must be based on grab sampling. (See 40 CFR Part 268, Subpart D, Treatment Standards, § 268.40(b), Applicability of Treatment Standards, and footnotes of table, Treatment Standards For Hazardous Wastes, under § 268.40.

To demonstrate closure, discrete sampling and statistical analyses is required for compliance and background samples of rinseates, soils, sediments, groundwater, etc. Where multiple samples are taken to demonstrate compliance, statistical analyses of the discrete samples is utilized to demonstrate compliance with the decontamination standards, perfomance standards and the regulations.

Composite sampling is generally not acceptable to demonstrate compliance with the decontamination standards of a HWMU. Composite sampling is generally not satisfactory due to: the RCRA regulations, SW-846 requirements, the nature of HCOCs, the need to perform statistical analyses of the data, and the need to isolate hot spots, which may pose a risk to human health and the environment.

Representative composite samples of nonwastewater containerized wastes such as soils, sediments, and debris, which may contain hazardous waste, is believed to be appropriate to characterize containers of waste generated during closure activities. Composite samples of a containerized solid waste that consist of multiple grab samples from a single container are believed to be more representative than a single grab sample of the solid medium within the container, especially when the container is relatively large, such as 20 cu. yd. Roll-off containers.

3.11.2 HWMU Sampling

The sampling plan for the HWM facility's HWMUs must be sufficient to demonstrate closure in accordance with the requirements of the regulations. The sampling plan for the HWMUs must be

sufficient to meet the unit specific closure requirements of the VHWMR and the RCRA regulations. Guidance is provided in this manual under Section 2.2, Regulated HWMUs Subject to Closure - Applicability & Other Requirements.

The closure and post-closure requirements for permitted facilities are identified under 40 CFR Part 264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, And Disposal Facilities, Subpart G. The unit specific closure requirements are specified under 40 CFR Part 264, Subpart J through Subpart I through X, and Subpart DD.

For Interim Status facilities, closure and post-closure requirements are identified under 40 CFR Part 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, Subpart G. The unit specific closure requirements for Interim Status facilities are specified under 40 CFR Part 265, Subpart J through Subpart X, and Subpart DD.

The sampling plan should enable the facility to demonstrate closure of each HWMU in compliance with the closure plan's decontamination standards and performance standards and with the unit specific closure requirements of the regulations.

The sampling scheme should enable a facility to determine if the HWMU structure and HWMU equipment are decontaminated in accordance with regulatory requirements and to establish whether any soils, subsoils, sediments, groundwater, etc., have been contaminated as a result of the operations of the HWMUs.

The number and types of samples that are needed to establish closure of the facility's HWMUs in accordance with the regulations depends upon the unit specific closure requirements and consideration of the numerous factors listed in Section 3.11, Closure Sampling and Analyses Plan.

The types of mediums that may be sampled to demonstrate closure of a HWMU may include, but are not limited to the following:

1. Water (groundwater, leachates, wastewaters, washwaters, & final rinseates).

2. Solid and hazardous wastes.

3. Soils and subsoils.

4. Sediments of surface waters or stormwater management systems.

The sampling for the HWMUs should be based upon the nature of the design and construction of the HWMUs undergoing closure and the potential for migration of hazardous waste and HCOCs

from the HWMUs.

The sampling plan to demonstrate closure of HWMUs should be based on the requirements of the regulations, guidance in Section 3.11 of this manual, and the guidance under the following items:

1. **Wash and Final Rinseate Water Samples** – Verification of the decontamination of HWMU structures and equipment typically involves the collecting final rinseate water samples from the structure, and collecting separate final rinseate from each individual piece of equipment (each tank, pump, piping, ancillary equipment, etc.) of the HWMU. The final rinseate is to utilize analyte-free (deionized) water.

   The final rinseate samples are taken after all of the hazardous wastes have been removed from the unit structure and the individual equipment, and after the HWMU and equipment have been cleaned, pressure washed, steam cleaned, and rinsed, etc., in accordance with the decontamination procedures specified in the closure plan. The final rinseate of each HWMU structure and each piece of equipment are to be individually sampled and tested for the HCOCs to determine whether the HWMU structure and individual equipment meets the decontamination standards.

   Washwaters and rinse waters from the HWMU and equipment may be combined in common containers and tested to establish the proper method of disposal. All wastes, washwaters, and rinse waters generated during closure need to be sampled and tested for HCOCs and for TCLP parameters to characterize the waste for disposal in accordance with regulations.

2. **Solid and Hazardous Wastes –** Inventories of solid and hazardous wastes in each HWMU that are subject to closure must be properly characterized in accordance with the testing requirements of the RCRA prior to shipment to a permitted TSD. The RCRA requires a detailed chemical and physical waste analysis of all wastes to comply with 40 CFR Part 264.13 and 265.13, and Part 268 (Land Disposal Restrictions.). If the wastes in the HWMUs have not been properly characterized, then testing requirements for the solid and hazardous wastes should be delineated in the closure plan.

3. **Soil and Subsoil Samples & Locations for Each HWMU** - A general discussion needs to be provided on the number of soil and subsoil samples and the corresponding sample locations to be taken from each HWMU if migration pathways are identified from a HWMU or if soil and subsoil sampling is required. The soil and subsoil sampling is to assess the extent of the vertical and horizontal migration of hazardous wastes or hazardous waste constituents from the HWMUs. The sampling grid locations for each HWMU need to be

provided in a figure that relates the sample locations to a site benchmark and the north arrow. The minimum total number of samples from each HWMU and the potential number of samples should be summarized in a table. This section should use guidance from SW-846, Chapter Nine, Sampling Plan, and should also be based upon DEQ sampling guidance provided in Appendix C.

Based upon experience, the DEQ recommends sampling at a minimum of eight different soil sampling locations at each HWMU, and for background samples. Other soil sampling areas associated with the closure of the HWMU should have a minimum of five samples.

The minimum number of eight soil sample locations is recommended for each HWMU and background sampling due to the following: the typical nature and distribution of HCOCs often found at contaminated sites, the unequal distributions and variances between the compliance data and the background data, the problems associated with statistical analysis of non-detects of HCOCs, and the limited holding times of the samples.

Often, the distributions of the background sample data and/or the compliance sample data are not normal or lognormal (non-parametric). The existence of non-parametric data in one or both of the data sets dictates the use of non-parametric statistical testing procedure to demonstrate closure. The non-parametric testing procedure should utilize a minimum of eight samples to demonstrate closure of a HWMU. Non-parametric test statistics typically require more samples than parametric tests to achieve the same statistical power.

If migration pathways are identified from a HWMU, then the vertical and horizontal extent of the contamination from the unit should be investigated as follows:

1. **Vertical Extent of Contamination** - The vertical extent of the contamination needs to be established by systematic soil sampling if migration pathways are present in the HWMU. The soil sampling depth intervals should be provided from the bottom of the HWMU structure to a depth of two feet below the structure. **The typical soil sampling intervals beneath a HWMU are: 0-6, 6-12, 12-18, and 18-24 inches.**

   An example soil sampling approach for a container storage HWMU with potential migration pathways is provided as follows:

   Soil sampling will be required if cracks or gaps in the secondary containment surfaces are identified. If soil sampling is required, a minimum of one soil sample will be obtained from beneath each crack or gap identified. One additional soil sample will be taken for every 10 linear feet of crack or gap

identified in the secondary containment system. (Two samples points for every 10 linear feet of crack that breaches the secondary containment.)

If soil sampling is required under a HWMU, a minimum of eight discrete sample locations is required for each HWMU.

At each soil sampling point, the concrete slab will be core drilled with a six inch core bit and the soil sample will be removed, taking care to avoid mixing of the soil. Soil samples will be obtained from the surface, and at 6, 12, 18, and 24 inches below the base of the concrete slab. The soil sampling device will be cleaned between sampling to avoid cross-contamination. Cleaning of the soil sampling device will be performed between each soil sample in accordance with sampling equipment decontamination procedures.

2. **Horizontal Extent of Contamination** - If soils are contaminated beneath the HWMU which need removal to comply with decontamination standards and regulations, then the horizontal extent of the contamination may need to be determined. In addition, if the HWMU does not have adequate secondary containment, then the horizontal or areal extent of potential contamination from the HWMU may need to be determined.

If a HWMU has no secondary containment or if contamination is found under a HWMU, the DEQ recommends text similar to the following to establish the horizontal extent of contamination:

Should soil contamination be detected beneath a HWMU that exceeds the closure plan "clean closure" decontamination standards, then the horizontal extent of potential contamination outside the HWMU boundary will be evaluated by systematic soil sampling. The initial soil sampling scheme of the closure plan will be laterally extended beyond the initial sampling plan design (e.g., 40 ft x 30 ft area) by sampling in incremental two feet distances in each direction of the original HWMU sample grid until soil contamination is either not detected or is shown to be in compliance with the closure plan decontamination standards and performance standards.

In the above expanded soil sampling scheme, eight randomly selected sample locations will be established at the perimeter of each incremental two feet distance outside the original designated HWMU area (40 ft x 30 ft); the eight random samples will include two samples per side. Sampling protocol (including sample depths and analyses) will follow procedures established for

the initial soil sampling design of the HWMU.

The soil sampling data from each extended two foot sampling zone will not be statistically manipulated to allow a dilution effect of the original sample data or any subsequent extended two feet sampling zone. That is, each set of sampling data from each additional two feet of extended sampling area will be statistically evaluated separately from the original data set and any subsequent data sets created by the incremental two feet sampling protocol noted above.

3. **Sidewall Sampling of Excavations** - Sidewall sampling of an excavation is appropriate for HWMUs that are below grade, such as underground tanks, surface impoundments, and landfills. The purpose of sidewall sampling is to assess the lateral or areal extent of the contamination from the HWMU.

For wall sampling, two approaches are currently and widely utilized. The first approach involves an evaluation of all the sidewalls collectively by taking a minimum of one sample from each wall of the excavation pit. The second approach is more conservative and involves the evaluation of each sidewall independently from the other sidewalls. This second approach requires more samples since a minimum number of samples must be taken from each sidewall based upon the statistical tests in the approved closure plan. In this second approach, the data from each sidewall sampling is statistically evaluated independently from the data from the other sidewalls. (Please note that the minimum number of samples depends upon the statistical test chosen and whether the sampling data distribution is parametric (normally or lognormally distributed) or the data is non-parametric.)

4. **Runoff from the HWMU** - The potential runoff of hazardous waste and or hazardous waste constituents from the HWMU should be evaluated based upon the nature and design of the HWMU, presence and adequacy of secondary containment, and the calculated run-on and run-off up to a 25-year, 24-hour storm event.

If there is potential for runoff from the HWMU, a sampling scheme should be developed to assess the potential migration of HCOCs to the stormwater management system and soils of a stormwater catchment basin, if one exists, which serves the areas of the HWMUs. Sampling of the storm sewer and stormwater catchment basin on-site may be needed to help establish compliance with the closure performance standards specified in the VHWMR and the RCRA, and to assess the need for potential future corrective action associated with the HWMU.

If runoff from the HWMU is to be assessed, A minimum of five samples should be taken from the receiving stormwater management system (storm sewer conveyance system, ditch, drop inlet, etc.), and catchment basin, if one exists at the site. The random sampling methodology is satisfactory to select sediment sample locations of the sediment catchment basin (Similar to that used for the soils of the HWMU). A minimum of 5 samples should be taken from a catchment or sedimentation basin, if it exists. The sediment sampling protocols (including sample depths and analyses) should follow procedures established for the initial soil sampling design of the HWMU. Sediment samples should be from 0-6, and 6-12 inches.

5. **Groundwater Samples & Locations for HWMUs** – Specific HWMUs require closure plans and post-closure plans to be developed in accordance with the requirements specified under 40 CFR Part 264, Subpart F, Releases From Solid Waste Management Units, and for Interim Status facilities, in accordance with 40 CFR Part 265, Subpart F, Groundwater Monitoring.

Subpart F specifies the types of HWM facilities that must address groundwater monitoring and response program requirements during the active life of the unit and as a condition of both closure and post-closure care. (See § 264.90 and § 265.90, Applicability.) Subpart F also specifies that all solid waste management units are subject to the requirements of corrective action and the financial assurance responsibility for completing corrective action.

The Subpart F requirements of Part 264, § 264.90 and § 265.90, Applicability, requires that the owner or operator of **the following types of HWMUs that receive hazardous waste after July 26, 1982, must comply with the requirements of Subpart F, § 264.91 through § 264.100,** unless the owner or operator is exempted under § 264.1, or the facility's regulated units meet specific engineered requirements, or the Director finds there is no potential for migration of hazardous wastes, hazardous waste constituents, or liquid from the regulated unit to the uppermost aquifer during the active life (including the closure period) and the post-closure care period specified under § 264.117:

1. Surface Impoundment.

2. Waste Pile.

3. Land Treatment Unit.

4. Landfill.

The requirements of Subpart F, § 264.91 through § 264.100 are for purposes of detecting, characterizing and responding to releases to the uppermost aquifer and to ensure that any such release does not pose a threat to human health or the environment.

In addition to the above, § 264.90 indicates that the regulations in **Subpart F may apply to miscellaneous units when necessary** to assure to comply with § 264.60, Environmental Performance Standards, through § 264.603, Post Closure Care.

Facilities with other types of units may also be subject to Subpart F requirements at closure and post-closure and/or be required demonstrate that there is no potential for contamination of the uppermost aquifer and/or to monitor the groundwater for potential releases from the solid waste management units.

A HWM facility, which has one of the four types of regulated units listed above, must provide written documentation that it complies with the requirements of Subpart F and the construction, liner, and other regulatory requirements specified under Subpart G of Part 264 and 265, and other appropriate requirements under the respective HWMU type subpart(s), in order for the DEQ to make a determination whether there is no potential for migration of hazardous wastes, hazardous waste constituents, or liquid from the regulated unit to the uppermost aquifer during active life of the regulated unit and the post-closure period specified under § 264.117. Facilities with other types of units may also be required to demonstrate that there is no potential for contamination of the uppermost aquifer, if the DEQ requests such information.

If the regulated facility is unable to demonstrate compliance with the Subpart F requirements, the construction, liner, and other regulatory requirements specified under Subpart G, and is unable to demonstrate there is no potential for contamination of the uppermost aquifer, then the HWM facility will be required to comply with the groundwater monitoring requirements specified under Subpart F as a condition of closure and post-closure care. Facilities must refer to 40 CFR Part 264 Subpart F or Part 265 Subpart F for Interim Status facilities for the details of the regulatory requirements.

It should be noted that in the context of the regulations, subsoils are considered by the EPA and the DEQ to be both unsaturated and saturated subsoils. Therefore, all of the contaminated subsoils, unsaturated and saturated, must be removed or decontaminated at closure in accordance with closure performance standards in order for the requirements of Subpart F to no longer apply to a regulated facility.

3.11.3 Background Sampling

Background samples are needed for statistical evaluation of the data for closure of HWMUs. **Background samples are typically needed from the water source used for the decontamination procedures and from unimpacted soils near the HWM facility.**

The sampling plan should provide essential information regarding background sampling that is based upon the following guidance:

1. **Sampling & Handling Methods** - Background soil samples and water samples will be collected, handled, preserved, and shipped in a manner identical to that of the closure compliance samples for the same mediums.

2. **QA/QC Procedures** - All Quality Assurance/Quality Control procedures for sampling, handling, and preservation procedures specified in this closure plan will be followed for background samples.

3. **Sample IDs & Locations** - All background samples will be identified by sample number and location on a site plan. If the background sampling locations are not included in the approved closure plan, then the location of background samples will require separate approval by the DEQ prior to sampling.

4. **Background Water Samples** - Background water samples will be taken from the potable water supply, which is used as the source of washwater and rinseate water in the decontamination of the HWMUs. Facility potable water will be collected from the cold water tap after running the tap fully open for a minimum period of five minutes, if the potable water source is to be used for decontamination.

   Background final rinseate samples may also be taken from a background structure which is of similar construction materials to the HWMU structure, and if the background structure has not been impacted by the facility's HWMUs operations and HCOCs managed at the facility site. The final rinseate samples from a background structure will be taken after decontamination by washing and rinsing in the same manner as the HWMUs undergoing closure.

5. **Background Soil and Subsoil Samples** - The background soil and subsoil samples should not be from an area that has been impacted by the HWM facility operations or impacted by the HCOCs and other constituents managed in the HWMUs.

   Rationale for the site selection of the background soil sample locations needs to be provided.

Background soil samples should be collected from an area where soils are of the same type and texture and where the geology is similar to that found at the locations of the HWMUs subject to closure. Where compliance samples are taken from surface soils (0-6 in.), then it is imperative that a set of background soil samples are also taken from surface soils (0-6 in.) and the surface background soils have the same type and texture as the compliance samples. Where background subsoil samples are needed to compare to the subsoil beneath the HWMUs, then a set of background subsoil samples should be taken at the appropriate subsoil horizons and depths that are most representative of the properties and textures of the subsoil horizons found underneath the HWMU.

Documentation needs to be provided regarding the nature and properties of the soils and subsoils, the soil type and texture at the locations of the background soil samples and compared to the nature and properties the soils and subsoils, soil types and textures of the HWMUs that are subject to closure.

The background soil and subsoil samples should be of the same properties, type and texture, and be from the same soil horizons, if possible, as the corresponding soil or subsoil samples from the HWMUs. **Soil boring logs should be used to verify and document the nature and properties of background soils in comparison with soils and subsoils from the HWMUs.**

The DEQ recommends sampling at a minimum of eight discrete sampling locations for background soil samples. (See Section 3.11.2, HWMUs Sampling, for the rationale for a minimum of eight discrete samples.)

3.11.4 Sampling Techniques, Sampling Equipment, & Protocol

General reference to sampling procedures in SW-846 Test Methods for Evaluating Solid Waste Field Manual, Chapter One, is inadequate to ensure proper sampling procedures and techniques are followed to document closure of regulated units.

The selected sampling techniques, equipment, and sample handling protocols from the SW-846 need to be clearly specified in the main text of the closure plan or briefly summarized in the main body of the text with the essential details provided in an appendix. The specific sampling techniques, sampling equipment, and protocols chosen should be clearly documented for each of the sampling areas and mediums to be sampled.

Common sampling handling protocols also need to be stated and include, but are not

limited to the following:

1. Sampling personnel will wear a new pair of gloves for each sample collected.

2. All samples will be properly labeled at the time of sampling.

3. Following collection of the samples, the sample containers will be placed in a cooler with ice and maintained at approximately 4°C until received by the laboratory.

4. Strict chain of custody procedures will be maintained for all samples. A log of all samples and chain of custody records will be maintained and included in the final closure report as an appendix.

3.11.5 Sampling Equipment Decontamination Procedures

The decontamination procedures for reusable sampling equipment and tools are critical to the sampling plan for closure of HWMUs. The documentation of the decontamination procedures helps ensure against cross-contamination from one sample to another and helps maintain the integrity of the sample data. The integrity of sample data is critical to establishing representative conditions that exist at each HWMU and in the background sampling, and in establishing closure of each HWMU.

Therefore, it is imperative that the closure plan includes a full description of the sampling equipment decontamination procedures that are to be utilized during closure activities.

Decontamination procedures may vary depending on whether the HCOCs are inorganic or organic constituents. **Appendix B contains useful guidance from the OSWER Directive 9360.4-07, Compendium of ERT Waste Sampling Procedures, January 1991.** The above information provides the detail of the EPA recommended procedures for decontamination of sampling equipment.

A summary of the recommended decontamination procedures by EPA is as follows:

1. Where applicable, physically remove the material from the sampling equipment by using a mechanical means such as a metal or nylon brushes, or high-pressure water.

2. Wash the equipment with a non-phosphorous detergent solution.

3. Rinse with tap water.

4. Rinse with distilled/deionized water.

5. Rinse with 10% nitric acid if the hazardous constituents to be analyzed include trace metals.

6. Rinse with distilled/deionized water.

7. Rinse with pesticide grade solvent (acetone or hexane) if the sample will be analyzed for trace organics.

8. Rinse with distilled/deionized water.

9. Air-dry the equipment completely.

In addition to the above, the closure plan also needs to provide information that addresses the following items:

1. A designated decontamination area will be established prior to soil sampling. This area will be lined with an impervious plastic layer. Decontamination liquids must not be allowed to accumulate on this liner. At the end of the sampling event, the area will be cleaned. (See Section 3-16)

2. The decontamination wastewater generated will be stored in clean containers in a designated area onsite. The decontamination wastewater will be managed and tested in accordance with regulations and properly disposed. (See Section 3.8, Section 3.16, and 3-17.)

3. Except for the disposable items, all reusable sampling equipment will be decontaminated prior to use in the field, between each sample, and upon completion of all sampling activities at the end of sampling each day.

3.12 HEALTH AND SAFETY PLAN

A health and safety plan (HSP) is not required as part of the closure plan and should not be submitted to the DEQ. However, the Occupational Safety and Health Act (OSHA) Regulations under 29 CFR Part 1910 and 1926 requires a HSP be developed for closure activities and that it be maintained at the facility.

The DEQ advises that the owner/operator of a hazardous waste management facility develop a HSP for all closure activities so to fully comply with the OSHA Regulations referenced above. In the Commonwealth of Virginia, compliance and enforcement of the OSHA regulations under 29

C.F.R. 1910.120, falls under the authority of the Virginia Office of Safety and Health, the Virginia Department of Labor and Industry. Therefore, the above office should be contacted to determine the major elements and requirements for a Health and Safety Plan under the OSHA Regulations.

The DEQ recommends that the HSP consider the chemicals and HCOCs which have been managed at the HWM facility, the specific HWMU(s) that are undergoing closure, other nearby HWMUs, nearby solid waste management units (SWMUs), material storage areas, material transfer systems, and the various chemical, physical, and biological processes at the facility. The HSP should consider all hazardous wastes, hazardous waste constituents, or other hazardous materials or chemicals that have been historically managed at the facility site, as they may have been released to the environment and pose a risk to the safety of the workers and others.

Please note that the general information below is provided only to alert the facility owner regarding the general nature of the type of requirements in a HSP. The DEQ must emphasize that compliance with the requirements under OSHA Regulations is the sole responsibility of the owner/operator of the HWM facility undergoing closure.

A HSP designates a Site Safety Officer that is present during all closure activities. The HSP requirements for the Site Safety Officer are delineated in the OSHA Regulations reference above. The HSP designates the level of personal protective equipment (PPE) that will be required for the workers that close the HWM facility. The HSP also specifies procedures required to protect human health and the environment during closure. The HSP also includes procedures for decontamination of the personnel that come into contact with the HWMUs during closure. The HSP specifies access limitations to the staging and decontamination areas to prevent unauthorized entry to the HWMU and closure areas during closure activities at the site. In addition, the HSP includes the addresses and telephone numbers of local hospitals, emergency care, and emergency response facilities that may be needed should an emergency arise.

3.13 CLEAN CLOSURE DECONTAMINATION STANDARDS

In accordance with the VHWMR and the RCRA, 40 CFR Part 264, Subpart G, the owner or operator must close the HWMU facility in compliance with §264.111, Closure Performance Standards. Each closure plan should specify the general closure performance standards specified under Subpart G and the unit closure performance standards that are applicable to the type of HWMU undergoing closure. (See Section 3.6) The closure performance standards are the primary basis for closure of regulated HWMUs.

For many types of HWMUs undergoing closure, the DEQ determines compliance with the closure performance standards, in part, by establishing "clean closure" decontamination standards for the HWMUs. Container storage facilities, tank systems, incinerators, containment buildings, are types

of HWMUs that typically should be able to attain "clean closure."

When a facility's HWMU has achieved "clean closure," all hazardous waste or hazardous waste constituents (HCOCs) have been removed from the HWMU to levels such that direct contact with any parts of the HWMU or any HCOCs that remain after closure will not pose a threat to human health and/or the environment, nor adversely impact any environmental media in excess of the DEQ established exposure levels.

Achievement of "clean closure" is demonstrated by the systematic removal of hazardous wastes, by decontamination of the equipment, structures, and soils and subsoils (if needed), and by comparison of the HCOCs in the sample compliance data to one of the three decontamination standards in the closure plan.

The three decontamination standards are:

1. **Analytical non-detection** - The concentrations of HCOCs in the compliance samples are below the method detection limits (mdls) of the analytical test methods in the approved closure plan.

2. **Comparison to Background levels using Statistical Methods** - The concentrations of HCOCs in the compliance samples are below or not statistically different from the background sample levels using the appropriate statistical methods and performance standards specified in the DEQ guidance.

3. **Risk Assessment Standards and Criteria** - The concentrations of the HCOCs in the compliance samples are at levels that meet the acceptable risk-based performance standards using the appropriate risk-based assessment criteria and standards specified in the DEQ guidance. (The HCOCs do not pose an unacceptable risk to human health or the environment.)

As an alternative to the above, a facility may demonstrate "clean closure" by disposal of the equipment, structures, and soils in a regulated treatment or disposal facility as a means to comply with the closure requirements of the VHWMR and the RCRA. However, this alternative requires some confirmatory sampling of the soils and subsoils underneath the HWMUs. (See Section 3.13.4, Alternative to Decontamination of Waste Management Structures and Equipment.)

The following subsections provide further guidance regarding the various methods to demonstrate closure to comply with the “clean-closure” decontamination standards.

3.13.1 Analytical Non-Detection

The analytical test methods with the lowest practical quantitation limit or estimated quantitation limit (PQL/EQL) for each HCOC must be used if the "non-detection" criterion is to be the basis for "clean closure." (Please note that the PQL and EQL are two different terms commonly used to describe the same test method limits by analytical laboratories.) (See Section 3.9, HCOCs Analytical Test Methods, for further guidance**.) The method detection limit (MDL) is the lowest concentration that can reliably be distinguished from zero, but is below the PQL.** At the MDL, the analyte is proven to be present, but its reported concentration is an estimate.

In accordance with SW-846, the definitions of a PQL/EQL and MDL are as follows:

1. ***EQL*** *- The estimated quantitation limit (EQL) is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The EQL is generally 5 to 10 times the MDL. However, it may be nominally chosen within these guidelines to simplify data reporting. For many analytes, the EQL analyte concentration is selected as the lowest non-zero standard in the calibration curve. Sample EQLs are highly matrix-dependent. The EQLs in SW-846 are provided for guidance and may not always be achievable.*

2. ***MDL*** *– The method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99 % confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte.*

Non-detected analytes should be reported as the detection limit with the code "U" or specified as not detected (ND). Analytes detected above the detection limit, but below the quantitation limit (PQL, etc.), should be reported as an estimated concentration with the code "J".

If an HCOC in the rinse water sample is above the detection limit, the performance standard will still be met if the HCOC is less than or equal to that of the corresponding HCOCs concentration in the equipment blank, field blank, raw water, or trip blank.

If soil and subsoil samples are deemed necessary, and the analyses of a soil or subsoil sample results in analytical non-detection for all of the HCOCs analyzed using the approved test methods and detection limits of the approved closure plan, then the specific sample locations showing the non-detects will be deemed to be uncontaminated. Should all soil and subsoil compliance samples

result in non-detection for all HCOCs, then the soils and subsoils related with the HWMU will be considered to meet the clean closure decontamination standard.

If soil and subsoil samples detect the presence of HCOCs, then the facility may demonstrate clean closure by one of the following: 1) statistical comparison of the compliance samples HCOCs to the background levels HCOCs, 2) a risk assessment evaluation of the HCOCs present in the samples, or by 3) further decontamination (soil removal) and soil sampling to demonstrate achievement of non-detect levels or risk-based levels acceptable to the DEQ.

3.13.2 Comparison to Background Levels - Statistical Design and Methods

Attainment of the "clean closure" decontamination standard may be demonstrated through the use of a statistical comparison of the HCOCs concentrations in the HWMUs compliance samples to the HCOCs concentrations found in the background samples. Final rinseate sample concentrations are compared to background water sample concentrations, while the concentrations of soils and subsoils from the HWMUs are compared to the concentrations of the background soils and subsoils, etc.

The statistical comparison of HCOCs in compliance samples to background samples is typically utilized for the comparison of inorganic constituents in soils and groundwater when the inorganics are a HCOC within the closure plan. Inorganic constituents are found in nature, while organics should not typically be found in the natural environment. However, trace levels of organics may be found in soils, sediments, water sources, and groundwater, due to general ambient pollution from anthropogenic sources.

When the closure is to be based upon comparison of compliance samples to background samples, the closure plan should indicate the following:

1. The location of all background samples will be approved by the Department prior to sampling (if the background sample locations are not already identified in the closure plan).

2. The background samples will be in taken in accordance with the background sampling procedures specified in the closure plan. (Note that the closure plan should reiterate the essential guidance specified in Section 3.11.3, Background Sampling, of this manual.)

3. The background samples will be collected in a manner identical to that of the compliance samples for the matrix being sampled.

4. Background sampling will follow all Quality Assurance/Quality Control (QA/QC) procedures of the approved closure plan.

There are several types of statistical procedures and methods that may be approved by the DEQ to demonstrate compliance with the background clean-closure decontamination standard. **Guidance from the DEQ is provided in Appendix C on closure statistical analysis and on the recommended statistical methods for use in closure demonstrations.**

Regardless of the statistical methods chosen, the closure plan needs to specifically provide the essential details of the statistical design and statistical methods that are chosen to demonstrate clean closure. (The statistical design should comply with the statistical performance standards delineated in the guidance in Appendix C.)

Furthermore, the DEQ recommends the use of the following EPA documents to help develop the statistical analysis and related sampling sections of the closure plan:

1. "Guidance Document on the Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities," dated April 1989.

2. "Statistical Analysis of Groundwater Monitoring Data at the RCRA Facilities" Addendum to Interim Final Guidance, dated July 1992.

The above EPA guidance documents should be consulted regarding the use and effect of non-detects, outliers, and on statistical procedures and analyses.

Normality of the sample analytical results should be demonstrated for all HCOCs by use of both of the following:

1. Probability Plots.

2. The Shapiro-Wilk test as specified in Chapter 1 of the EPA document "Statistical Analysis of Groundwater Monitoring Data at the RCRA Facilities" Addendum to Interim Final Guidance, July 1992.

Please note that analytical non-detect results need to be managed consistent with the recommendations of the above EPA guidance documents. The presence of non-detects from sample analyses may affect the statistical analysis chosen and require additional sampling from the minimum sampling proposed or recommended. For these reasons, the DEQ recommends that closure plans include statistical methods for parametric and non-parametric analysis. In addition, the DEQ recommends that the minimum number of samples to demonstrate closure be based upon the non-parametric statistical method which requires a higher number of samples.

In addition, samples should not be considered to be "outliers," unless full documentation is provided in the closure report which demonstrates justification that a sample is an outlier. There is the potential that a sample with a high HCOC value represents the detection of a "contamination hot spot." When a sample appears to be an outlier, the facility should resample the appropriate matrix and sample location with multiple samples to statistically evaluate the area of concern.

For additional guidance pertaining to the statistical design of the closure plan, please contact Mr. Hassan Keceli, Office of Technical Assistance, Division of Waste Program Coordination, DEQ at (804) 698-4246.

To further assist facility owners and operators, an example of the nature and detail of a statistical design and methods is provided below. This example may be used as a model for future closure plan submittals. The example statistical design is for the Upper Tolerance Limit statistical test procedure, which is used for parametric analysis (normal or lognormal distributions.)

3.13.2.1 Example of a Statistical Design and Methods for a Closure Plan

Statistical comparison of hazardous constituent concentrations in rinseate or soil samples to those of uncontaminated background samples may be made by the following procedures as specified below:

1. The Upper Tolerance Limit procedure. (Parametric statistical procedure.)

2. An alternate non-parametric statistical procedure.

The tolerance limit method may only be used when the raw background data and the compliance data are normally distributed or the log transformation of the raw background data and the compliance data are normally distributed.

Normality of the sample analytical results will be demonstrated for all HCOCs by use of both of the following:

1. Probability Plots.

2. The Shapiro-Wilk test as specified in Chapter 1 of the EPA document "Statistical Analysis of Groundwater Monitoring Data at the RCRA Facilities" Addendum to Interim Final Guidance, July 1992.

The EPA guidance documents below will be followed regarding the use and effect of non-

detects, outliers, and on statistical procedures and analyses:

1. "Guidance Document on the Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities," dated April 1989.

2. "Statistical Analysis of Groundwater Monitoring Data at the RCRA Facilities" Addendum to Interim Final Guidance, dated July 1992.

Analytical non-detect results will be managed consistent with the recommendations in Chapter 2 of the EPA guidance document cited in item No. 2 above and consistent with DEQ guidance.

Upper Tolerance Limits Procedure

An upper tolerance limits statistical procedure may be used to statistically demonstrate decontamination. For this procedure a minimum of eight background samples will be collected and analyzed for all necessary constituents pursuant to Sections __ and __. Background samples of uncontaminated media will be taken as described in Sections __, above.

Using the data from the analyses of the eight background samples, an upper tolerance limit (UTL) for each hazardous waste constituent of concern (HCOC) will be calculated as:

$$UTL = x + (K_{95}(0.95,n) * s)$$

Where: x = the mean of the measured values.
s = the standard deviation of the measured values.
k = k-factor for one sided tolerance limit test.

The parameter $K_{95}(0.95,n)$ establishes the confidence interval for the UTL such that there is a 95% chance that at least 95% of the time, the actual constituent background concentration will be below the this upper bound. Table, K-Factors for One Sided Normal Tolerance Limits, identifies the value of this parameter as a function of n. The value of K for eight samples (n = 8) is 3.188.

The results of the analyses of the rinse water samples from the containment area or piece of equipment will be compared to the appropriate UTL for all HCOCs analyzed in accordance with this closure plan. If the concentration of every analyte in a sample is below the appropriate UTL, then that item will meet the clean closure decontamination standard.

If soil samples are deemed necessary, the results of the analyses of each soil sample will be compared to the appropriate UTL for all HCOCs in accordance with this closure plan. If the concentration of every analyte from all depths of a soil sample is below the appropriate UTL, that

sampling location will be deemed to be uncontaminated. Should all soil samples be uncontaminated in this fashion, the soil will have met the clean closure decontamination standard. Should some soil samples demonstrate contamination, further soil sampling and removal will be conducted pursuant to Section ___ of this closure plan.

Alternate Statistical Procedure

If the background data is not normally or log-normally distributed, then an alternate non-parametric statistical procedure must be used.

A non-parametric Analysis of Variance (ANOVA) procedure such as the Kruskal-Wallis Test or the Wilcoxon Rank-Sum Test is recommended. For the above procedures, at least eight soil samples from the HWMU and eight soil samples from the background soils will be compared.

Guidance in the EPA document "Statistical Analysis of Groundwater Monitoring Data at the RCRA Facilities" Addendum to Interim Final Guidance, July 1992, should be used for non-parametric comparison of compliance data to background data. The nature and detail of an alternate statistical design and methods should be provided similar to the detail provided for the Upper Tolerance Limit statistical procedure shown above.

All HCOCs that are not normally or log-normally distributed will be analyzed and included in the non-parametric ANOVA procedure selected. Decontamination of an area will be demonstrated by no significant statistical difference for data of all HCOCs between background and the HWMUs.

3.13.3 Risk Assessment

Clean closure of HWMUs may be demonstrated by a risk-based assessment as an alternative to the non-detection decontamination standard or the statistical comparison of compliance samples to background levels. The facility may propose to demonstrate that the concentrations of hazardous constituents detected and remaining in the HWMU equipment, structures, soils and subsoils do not pose an unacceptable level of risk to human health and the environment.

If a risk assessment is conducted to determine the site-specific decontamination standards, then the closure plan must specify that risk assessment will be conducted to comply with the risk-based closure criteria and guidance provided by DEQ.

All risk assessments will be conducted in accordance with the DEQ documents titled "Guidance for Development of Health Based Cleanup Goals Using Decision Tree/Risk Exposure and Analysis Modeling System (REAMS) Program, 1994, and Risk Based

Methodology," as amended by the DEQ, along with other risk-based guidance provided by the DEQ.

The DEQ's Risk Assessment Guidance is provided in Appendix D. The risk assessment protocol detailed in Appendix D includes risk formulas for both residential and occupational/industrial exposure scenarios.

Appendix D also includes generic language that can be utilized to establish the basis of text in the closure plan for a risk-based assessment of closure. The DEQ's risk-based guidance should be discussed in the text of the closure plan and the DEQ's guidance in Appendix D should be included in an appendix of the closure plan.

It should be noted that the DEQ's Risk Exposure and Analysis Modeling System (REAMS) Program requires fate and transport modeling if HCOCs remain in soils as a result of operations of the HWMU. The fate and transport modeling used in REAMS is necessary to demonstrate that the HCOCs remaining is soils should not result in contamination of the groundwater underneath the unit above acceptable risk-based levels.

When the risk-based decontamination standards are exceeded, then additional decontamination, removal actions, and sampling will be required until the facility demonstrates compliance with the risk-based decontamination standard or an alternative proposal is provided to achieve closure of the HWMUs in accordance with regulations.

If you should have any questions pertaining to the procedures associated with the DEQ's risk assessment protocol or REAMS guidance, please contact Mr. Sanjay Thirunagari, Toxicologist, Office of Technical Support, Division of Waste Program Coordination, DEQ at (804) 698-4193.

3.13.4 Alternative to Decontamination Standards

As an alternative to further decontamination procedures (at any time in the closure procedures), the facility may elect to demolish any or all portions of the hazardous waste storage units and manage them as hazardous waste prior to transporting off-site for disposal at a permitted hazardous waste TSD facility.

If the above alternative to demonstrate clean closure is selected, then:

1. Sampling and analysis of underlying soils prescribed by the closure plan will be necessary to demonstrate clean closure.

2. Prior to implementation of this alternative, the facility must submit a proposed soil sampling plan to ensure the plan is comprehensive enough in scope to meet agency criteria for clean closure of the HWMUs. Formal approval of the soil sampling plan by the DEQ will be required before implementation of this alternative.

3.14 HWMU INVENTORY REMOVAL AND MANIFESTS TO A TSD

In accordance with the VHWMR and the RCRA, under 40 CFR Part 264, Subpart G, § 264.112, the closure plan needs to specify the methods for removing, transporting, treating, storing, or disposing of all hazardous waste, identification of and the type(s) of off-site hazardous waste management unit(s) to be used.

The planned detailed description of the methods and procedures to be utilized for the removal of the hazardous wastes and other on-site management must be provided. The types of off-site treatment, storage, or disposal (TSD) facilities that are to manage the hazardous wastes need to be specified.

The closure plan should also specify that the accumulation of hazardous waste will be carried out in accordance with the RCRA, 40 CFR Part 262, §262.34, and that the accumulation period will be less than 90 days. (Provide justification for a longer time period of storage, if needed.)

The 90-day accumulation period will begin the day the waste is generated. Hazardous waste generated by the closure activities needs to be stored in a designated storage area or accumulation areas on-site. **The DEQ's Regional Office needs to be notified 15 days prior to the facility use of any new accumulation areas.**

The closure plan needs to specify that the closure report will provide a summary table of information related with the hazardous waste inventory removal from each HWMU undergoing closure. **The closure report inventory removal summary table for each HWMU undergoing closure should include information similar to the following:**

1. A table title such as, HWMU Container Storage Area No 1 – Hazardous Waste Inventory Removal Summary.

2. A description of the hazardous waste by chemical name and hazardous waste codes.

3. The amount of hazardous waste removed under each shipment (e.g., 20, 55-gallon drums, 2, 20 cu yd roll off containers, etc.)

4. The corresponding inventory removal listing, which shows the number and size of the

containers removed, the EPA hazardous waste code numbers on all of the containers shipped, and the dates of shipment to an off-site TSD. (This information must correspond with the information on the manifests. Copies of the manifests need to be provided in an appendix of the closure report.)

The closure report must identify the off-site TSD facility name, address, EPA ID Number, telephone number, and facility contact that is used for disposal or treatment of the hazardous wastes removed during closure.

3.15 DECONTAMINATION OR DISPOSAL OF HWMUs - EQUIPMENT, STRUCTURES, AND SOILS

The closure plan must clearly identify the equipment, structures, and soils related with the operation and management of each HWMU and provide the detailed description of the steps needed to decontaminate or dispose of all facility equipment, structures, and soils, which have been contaminated or may be contaminated with the hazardous wastes or hazardous waste constituents.

The procedures for decontamination and disposal of HWMUs should include information similar to the following:

1. A list of the specific equipment, structures, and soils of each HWMU, which will be decontaminated and/or evaluated for decontamination. by sampling and analysis. (e.g., Identify tanks, secondary containment, sumps, pumps, piping, valves, and other ancillary equipment used to manage the hazardous waste at the HWMU. Identify potential areas that may need sampling and further decontamination, such as subsoils under secondary containment, etc.)

2. Decontamination procedures of the facility's HWMUs equipment, structures, and soils and subsoils, etc. This includes the Excavation Plan and Procedures that may be needed.

3. The HCOCs and the decontamination standards that determine when decontamination is achieved should be referenced and briefly discussed and summarized to establish when the HWMUs structures, equipment, soils and subsoils are "clean-closed".

4. The planned or potential disposal of contaminated equipment, structures, soils, and residues, in accordance with regulations should be described. If the closure plan intends to dispose of specific equipment or components of the HWMUs versus decontaminating, then the list of equipment, etc., that are planned to be disposed should also be identified in the closure plan.

The nature of the content of decontamination procedures is dependent upon the nature and type of

HWMUs undergoing closure, whether migration pathways from the HWMUs are present, and the potential extent of contamination that may have resulted from the operations of the HWMUs.

The decontamination procedures for secondary containment systems for container storage HWMUs and tank systems HWMUs are fairly standard and straightforward. General guidance and boilerplate procedures for decontamination of container storage and tank systems are provided in Appendix F.

Decontamination Sampling verification is critical to demonstrate closure of HWMUs and tanks, and other equipment in HWMUs. Prior to beginning the decontamination process, a pre-wash equipment sample blank should be collected by running deionized water through the decontamination equipment (high-pressure washer, steam equipment, etc.) (Samples should be taken from the decontamination equipment spray nozzle, etc.)

After high-pressure washing and rinsing the HWMUs and each piece of equipment, tank, etc., within the HWMUs, a final rinseate sample will be collected from each HWMU, and each piece of equipment, tank, etc. In addition a post-rinse sample should be collected from the high pressure washing equipment by pouring deionized water over the surface area of the equipment similar to the pre-wash equipment sample blank.

Decontamination procedures will be repeated for any HWMU or equipment in a HWMU until all HCOCs are at levels in the final rinseate samples that demonstrate compliance with the "clean closure" decontamination standards of the closure plan.

Guidance for decontamination procedures for other types of HWMUs should be based upon the specific requirements for the type of regulated unit which are subject to closure. Section 2.2 of this manual provides regulatory citations to help identify the applicable closure requirements for the various types of HWMUs. In addition, the permit application checklists in Appendix H and I should assist facilities in establishing the regulatory requirements for each type of regulated units.

3.15.1 Excavation Plan

Excavation of a HWMU structure, secondary containment structure, and the soils and subsoils beneath a HWMU may be necessary if the facility is unable to demonstrate decontamination in accordance with the decontamination standards.

The excavation plan is an important component part of a closure plan, similar to the sampling plan. The excavation plan can be an important cost component associated with the total cost of closure of HWMUs.

Implementation of the excavation plan in closure is based upon the compliance sampling data results and the statistical comparison of the compliance sample data to background samples and/or the evaluation of the sampling data by a risk-based assessment.

The excavation plan, which is a part of the closure plan, should specify details based upon the guidance provided in the following items below:

1. **Conditions that trigger excavation** - The closure plan should indicate that soils and subsoils which fail the statistical and/or REAMS risk-based analysis decontamination standards will be excavated to a depth where the soils and subsoils demonstrate compliance with the decontamination standards.

2. **Vertical Extent of Excavation** – The vertical extent of contamination should be established based upon the following:

    1. The vertical extent of excavation will be based upon the extent of contamination that will be established by systematic vertical sampling of migration pathways and data evaluation using the plan's "clean closure" decontamination standards. The proposed vertical sampling protocol and depths should be delineated.

    2. Typically, the soil sampling depth intervals should be provided from the bottom of the HWMU structure to a depth of two feet below the structure. The typical soil sampling intervals beneath a HWMU are: 0-6, 6-12, 12-18, and 18-24 inches.

    3. If sampling and analyses of soils and/or sediments shows HCOCs at levels which exceed all decontamination standards, then the soil and/or sediment will be removed to the bottom depth of the first six inch sample interval which shows compliance with the decontamination standards. That is, excavation of soils will be to the bottom of the first clean sample depth interval. This ensures removal of all soil/sediment that are shown not to meet the clean closure standards.

    4. If the initial sampling does not show compliance with decontamination standards at the deepest depths of the initially proposed sampling scheme (e.g. 2-ft), then additional vertical samples will be taken until samples show levels of HCOCs within the decontamination standards.

    5. If soil or sediment contains HCOCs above the decontamination standards specified in this closure plan, then soil or sediment excavation will be conducted down to maximum depth of one of the following:

1. The bottom of the first soil sampling interval depth where sampling analytical data indicates compliance with the decontamination standards (clean closure conditions).

2. The local seasonal high water table if less than five feet. (The seasonal high water table depth should be established with concurrence from the Office of Waste Permitting, DEQ.)

3. The local bedrock, if less than five feet.

6. If soil contamination exists above the decontamination standard at depths greater than five feet, then either the DEQ will be formally notified for the potential need to amend the approved closure plan so to achieve "clean closure" or to close the HWMU with hazardous waste "closed in-place" in accordance with the applicable regulations for the HWMU in the VHWMR. (A facility would be required to address any remaining contamination under the corrective action program under HSWA of the RCRA, of 1984.)

3. **Horizontal Extent of Excavation** - The horizontal extent of contamination should be established based upon the following:

1. The horizontal extent of excavation will be based upon the extent of contamination that will be established by systematic sampling of migration pathways and data evaluation using the plan's "clean closure" decontamination standards. The proposed horizontal sampling protocol and depths should be delineated.

2. If soils are contaminated beneath the HWMU which need removal to comply with decontamination standards and regulations and if the secondary containment is insufficient to prevent runoff from the HWMU, then the horizontal extent of the contamination may need to be determined.

3. Some sampling plans include soil sampling of an area outside the actual HWMU boundary by inclusion of a buffer area outside the HWMU (e.g., 2 - 3 feet) to assess the horizontal extent of the contamination outside the HWMU. The adequacy of the soil sampling plan to determine the horizontal extent of contamination should be based upon the nature of the site and the operations and management of the HWMU undergoing closure.

If the horizontal extent of the contamination is to be evaluated by a sampling scheme

that includes a buffer zone outside the HWMU area proper, then the closure plan should specify that excavation will be conducted to include the buffer zone outside the HWMU boundary.

4. An example sampling plan to establish the horizontal extent of contamination outside a HWMU boundary is provided in Section 3.11.2, HWMUs Sampling.

4. **Storage, Treatment, and Disposal of the Excavated Soil, Subsoils, Consruction Debris, and/or Residues** - The excavated soils, subsoils, construction debris, and residues should be stored in large roll-off containers. The method of management and disposal of the excavated soils, etc. needs to be specified in the closure plan. The sampling and analytical testing protocol for all soils, subsoils, sediments, debris, and residues need to be provided to establish the proper means of disposal so to comply with the VHWMR and the RCRA. (See Section 3.8, Overview Of Closure Procedures, and Section 3.11, Closure Sampling and Analyses Plan, 3.17, Management, Characterization, and Disposal of Closure Generated Wastes.)

5. **Backfilling Areas of Excavation** - Any areas of excavation should be backfilled with clean fill or soil to the original grade of the site prior to termination of closure activities. In addition, the site should also be seeded and vegetative cover established, where appropriate for the site, or the site should be reclaimed to similar conditions of the surrounding area.

Please note that backfilling and reclamation of a HWMU site must not occur until the DEQ performs the closure site inspection and formally approves the "clean closure" of the HWMUs.

3.16 Temporary decontamination Areas and Procedures

Construction of temporary decontamination areas is necessary to decontaminate all equipment to be used in the decontamination of the HWMUs. Generally, a large equipment decontamination area is needed and a small equipment decontamination area is needed.

The small equipment decontamination area should be used for decontaminating the sampling equipment, personal protective equipment, and any other small equipment used for decontamination of the HWMUs and related areas. The large equipment decontamination area is typically used for any large machinery and equipment used for excavation and decontamination of the HWMUs. The nature and size of temporary decontamination areas is dependent upon the nature of the equipment that may be utilized in the decontamination and/or excavation processes.

The closure plan needs to discuss how all the equipment used in the closure process is decontaminated and the frequency of decontamination. In addition, criteria for decontamination of the equipment need to be specified.

The closure plan should provide information regarding the temporary decontamination areas and decontamination procedures similar to the guidance example text under the following items:

1. **All Temporary Decontamination Areas** - All equipment will be washed in containers or in equipment decontamination areas. All equipment decontamination areas will be constructed of sufficient materials and thickness, and contain sufficient number of layers to create an impervious surface which allows for the collection of all washwater, rinseate, and residues in tanks or containers. Construction of temporary decontamination areas is necessary to decontaminate all substantial equipment to be used in the HWMUs decontamination processes. **Prior to decontamination of the HWMUs, sampling, and/or excavation activities, temporary decontamination areas will be constructed for the following:**

    1. **Small Equipment** - The small equipment decontamination area will be used for decontaminating sampling equipment, personal protective equipment, and any other small tools or equipment used for decontamination of the HWMUs and related areas. The small equipment decontamination area will effectively contain all washwater and rinsewater and residues generated during the decontamination process.

    2. **Large Equipment** - The large equipment decontamination area will have dimensions of sufficient size to contain the entire size of the largest piece of equipment used to decontaminate the HWMUs. (e.g., 30-ft x 30-ft.) The decontamination area will be graded with at least a 2% slope toward one corner of the area. A berm constructed with sandbags, or an equivalent material, will be constructed around the edges of the decontamination area. The berm will effectively contain all washwater and rinsewater and residues generated during the decontamination process.

        The decontamination area will drain into either a constructed sump or the low corner area where all washwater, rinseate, and residues will be removed by pump, bailing, etc., to appropriate containers for storage, sampling and testing, and disposal in accordance with regulations. The decontamination area will be lined with an appropriate number of synthetic plastic liners of sufficient gauge thickness to prevent loss of the washwater, rinsewater, and residues from the temporary

decontamination containment area. In addition, the constructed liner must have sufficient thickness and number of layers to be able to sustain the stresses caused by moving the heavy equipment in and out of the area for decontamination.

The proposed decontamination areas have been designed so they do not meet the definition of a surface impoundment as defined under the VHWMR/RCRA.

2. **Equipment Decontamination Procedures** - All equipment will be decontaminated upon the completion of work at each HWMU site and whenever the equipment is removed from the HWMU site.

The methods of decontamination of the sampling equipment, small equipment, and heavy equipment need to be specified in this section of the closure plan. The procedures, equipment, chemicals, reagents, and rinseates used to decontaminate the small equipment and sampling equipment should be indicated. This typically involves the washing of the equipment with detergent and brushes and rinsing with potable water.

The procedures for cleaning all sampling equipment must be specified and is to be in accordance with cleaning procedures specified for sampling equipment in the sampling plan. Cleaning of sampling equipment typically requires specific cleaning agents, multiple rinses using potable water, acetone, and then distilled water. (See Section 3.11.5, Sampling Equipment Decontamination Procedures.)

Decontamination of heavy equipment typically involves scraping, heavy brushing, and high pressure washing with detergents, and rinsing of the equipment that comes into contact with the contamination of the HWMUs.

All decontamination will take place in the constructed temporary decontamination areas. All decontamination wastewater and residues, and final rinseates will be properly segregated and containerized and tested in accordance with the closure plan and properly disposed in accordance with the procedures specified in this closure plan and the RCRA regulations. (See Section 3.17)

The decontamination washwaters (wastewaters), rinseates, soils, and residues collected in the decontamination areas will be managed as potentially contaminated with hazardous waste and tested for the hazardous waste HCOCs, and TCLP constituents, as specified in the Closure Plan. The proper management of the wastes generated from the closure activities will be based the requiremenst specified in Section 3.17.

Any disposable items, such as protective clothing, sampling equipment, filters, clean-up

materials, decontamination liner materials, etc., will be containerized and disposed of as hazardous waste.

3.17 Management, Characterization, and Disposal of Closure-Generated Wastes

The closure procedures require that all closure- generated wastes be segregated from one another and stored in separate containers, and representatively sampled and tested so to assure compliance with the VHWMR and the RCRA.

The closure plan should provide information similar to the following items regarding the management, characterization, and disposal of closure-generated wastes:

1. **Proper Storage of All Closure-Generated Wastes** - All Wastes, washwaters, rinseates, wastewaters, leachates, waste residues, aggregates, soils and subsoils, construction debris that are generated from the closure activities of the HWMUs will be segregated from one another and stored on-site in storage containers in accordance with regulations. **No waste piles will be created during closure activities.** All wastes generated from closure will be stored in roll-off containers, if needed.

2. **Notification of DEQ Regarding Temporary Storage** - The Regional Office of DEQ will be notified of the temporary (less than 90-day) storage of hazardous waste and other wastes associated with closure of the HWMUs. The **generator must notify DEQ Regional Office at least 15 days prior to establishing a new waste accumulation area.** All wastes generated by the closure activities will be stored in a designated waste accumulation area on site.

3. **Management of All Wastes** - All wastes generated from closure of the HWMUs will be managed as residues or media that is potentially contaminated with hazardous waste constituents.

4. **Contained in Policy** – *Under the EPA=s AContained-in policy," contaminated media (i.e., debris, soil, groundwater, sediments) that contain RCRA wastes must be managed as if they were hazardous waste until the media no longer contain the hazardous waste (i.e., until decontaminated) or until they are delisted.*

   To date, the EPA has not issued any definitive guidance as to when, or at what levels, environmental media contaminated with hazardous waste no longer contain the hazardous waste. Until such guidance is issued, the Regions or authorized States may determine these levels on a case-specific basis. The EPA also suggests that when

making a determination as to when contaminated media no longer contains a hazardous waste that a risk assessment approach be used that addresses the public health and environmental impacts of the hazardous constituents remaining.

Any debris, wastes, washwaters, rinseates, wastewaters, leachate, soils, subsoils, residues, and equipment contaminated with waste from the HWMUs are required to be managed as a hazardous waste in accordance with the VHWMR and the RCRA and are required to be disposed in a permitted hazardous waste landfill or a RCRA permitted treatment storage disposal (TSD) facility, unless demonstrated by testing that they are nonhazardous in accordance with specified decontamination standards of the approved closure plan and testing requirements for generated wastes specified in the VHWMR and the RCRA. (See the three standards below, which determine whether equipment, debris, residues, waste, wastewater, or media, are considered hazardous.

Contaminated residues and/or environmental media contain hazardous waste when the following occurs:

1. When the residues or media (e.g., aggregate, wastewaters, soil, and groundwater, etc.) exhibit a characteristic of hazardous waste in accordance with 40 CFR Part 261, Subpart C, Characteristics of hazardous Waste, § 261.20.

2. When a residue, waste, or wastewater removed from a regulated unit, which manages a listed waste under 40 CFR Part 261, Subpart D, Lists of Hazardous Wastes, contains a hazardous constituent from Part 261 Appendix VI or VIII.

3. When a contaminated media ((i.e., debris, soil, sediments, or groundwater) are contaminated with concentrations of hazardous waste constituents that are above health or risk-based levels.

5. **Demonstration by Testing** - The demonstration by testing includes the analyses for all HCOCs or underlying hazardous constituents (UHCs) managed at the facility that are identified in Part 261, Appendix VI and VIII, and an analyses to demonstrate that the waste or media does not exhibit a hazardous characteristic in accordance with Part 261, Subpart C, Characteristics of Hazardous Waste. This includes demonstration of compliance with the characteristics of ignitability, corrosivity, and reactivity and the toxicity characteristic. (See Toxicity Characteristic Leachate Procedure (TCLP) for the contaminants listed in Table 1 under 40 CFR Part 261 § 261.24).

5. **Disposal of Hazardous Wastes** - All wastes (solids and liquids) generated during closure that are demonstrated to be hazardous must be disposed in a permitted hazardous waste

landfill or a RCRA permitted treatment storage disposal (TSD) facility. Disposal of regulated wastes must comply with 40 CFR Part 268, Land Disposal Restrictions, Subpart D, Treatment Standards, § 268.40, Applicability of Treatment Standards, and comply with § 268.48, Universal Treatment Standards, for wastewaters and non-wastewaters. (See § 268.48, for definitions of wastewater and non-wastewaters.) **Land disposal restriction treatment standards for contaminated soil are delineated under § 268.49, Alternative LDR treatment standards for contaminated soil.**

Disposal of all hazardous wastes will require manifest documentation of shipment to a permitted TSD. Transportation of hazardous waste generated during closure activities will be in accordance with the VHWMR and require a transporter with a current Hazardous Waste Transporter Permit.

7. **Disposal of Non-Hazardous Solid Wastes** -All waste materials (other than non-hazardous wastewaters) generated in the closure process that are demonstrated as non-hazardous are required to be disposed of as a solid waste in accordance with the VHWMR. Disposal of all non-hazardous wastes will require documentation of disposal from the authority regulated under the Virginia Solid Waste Management Regulations (VSWMR).

8. **Non-Hazardous Wastewaters** - Wastewaters generated in the closure process that are demonstrated as non-hazardous are required to be disposed to a publicly or privately owned wastewater treatment plant regulated by the Clean Water Act (CWA) or equivalent. Disposal of all non-hazardous wastewaters will require documentation of prior approval for disposal, and documentation of disposal from the authority regulated under the CWA.

9. **Reusable Equipment** - All reusable equipment that is used in the decontamination and closure process, including the large equipment, wet-dry vacuum, pressure washers, steam cleaners, sampling equipment, shovels, buckets, brooms, etc., will be thoroughly washed with a detergent solution and rinsed twice with clean water. A final rinseate using analyte free deionized water will be collected and tested for compliance with decontamination standards or the items will be disposed of as hazardous wastes.

10. **Expendable and Disposable Items** - Expendable or disposable items used in the decontamination process of any of the hazardous waste units, such as mops, brooms, gloves, coveralls, and boots, will be containerized and properly disposed of as hazardous waste. Such expendable items which have only been in contact with wash solutions and/or rinseate which subsequent analyses have shown do not display a hazardous characteristic or do not contain any listed hazardous constituents, may be disposed of as non-hazardous waste.

3.17.1 Management of PPE

Personal Protective Equipment (PPE) is required for workers that decontaminate HWMUs under the OSHA Regulations. (See requirements of Section 3.12, Health and Safety Plan.)

The extent of the PPE required for workers is dependent upon the requirements of the Health and Safety Plan, which is required by the OSHA Regulations.

The detailed decontamination procedures of PPE are not required in the closure plan. However, the closure plan should specify measures or procedures to prevent migration of HCOCs via unclean PPE. **At a minimum, the closure plan should specify PPE management information similar to the following:**

1. PPE will be decontaminated between uses/areas, and upon completion of work.

2. All decontamination will take place in the temporary decontamination area.

3. The wastewater, rinse water, and residues generated from the PPE decontamination will be handled, managed, and disposed as hazardous wastes unless tests indicates disposal to a Subtitle D Sanitary landfill is acceptable. The PPE will also be handled, managed, and disposed as hazardous wastes at the end of the closure, unless tests indicates disposal to a Subtitle D Sanitary landfill is acceptable.

3.18 CLOSURE COST ESTIMATE

The VHWMR and the RCRA regulations, under 40 CFR Part 264 and 265 (Interim Status facilities), Subpart H, § 264.142, § 265.142, requires that the owner or operator of a regulated facility must have a detailed written cost estimate, in current dollars, of closing the facility in accordance with the requirements in § 264.111 through § 264.115, and for Interim Status facilities § 265.111 through § 265.115, and the applicable specific closure and post-closure requirements for the various types of regulated units identified in the regulations. (For facilities subject to Permitting requirements, see §§ 264.178, 264.197, 264.228, 264, 258, 264.280, 264.310, 264.351, 264.601 through 264.603, and 264.1102 for the specific closure and post-closure requirements of the different types of regulated units.) (Similar citations are provided under Part 265, Interim Status Standards.)

The financial assurance requirements for closure helps ensure that adequate funding is available to adequately close the facility in compliance with the regulations. **However, it should be noted that closure cost estimates and financial assurance for closure are not required for federally-owned and operated facilities.**

The applicable closure requirements for the various types of regulated units are identified under the regulations. Closure requirements must be followed to establish the closure cost estimate for a facility's HWMUs.

The regulations require two important common factors for all regulated units that must be utilized in establishing the closure cost estimate:

1. The closure cost estimate must equal the cost of final closure at the point in the facility's active life when the extent and manner of its operation would make closure the most expensive.

2. The closure cost estimate must be based on the costs to the owner or operator of hiring a third party to close the facility.

Cost estimates vary depending upon the nature of the HWMUs undergoing closure, the most expensive closure scenario that is anticipated, and the scope of closure activities specified in the closure plan.

It is critical that the closure cost estimate comply with the regulations, that all costs items are supported by sufficient line item details and calculations, and that cost estimates should be verifiable. The cost basis for financial assurance should be provided by detailed engineering calculations and cost estimates for all items related with closure of the facility, including the costs of generating the closure report.

The DEQ recommends use of the EPA RCRA Guidance Manual for Subpart G, Closure & Post-Closure Care Standards & Subpart H, Cost Estimating Requirements, January 1987, OSWER Policy Directive No. 9476.00-5, to assist facilities in the development of this section of the closure plan.

The closure cost estimate should include the costs on a per unit basis as well as total costs for all items. (i.e., sample analysis – 20 samples at $350 each – total = $7,000) The basis of financial assurance for closure should include, but not be limited to, the following cost items:

1. General labor.

2. Professional Engineer and closure project management.

3. Equipment rental and subcontracted services.

4. Sampling.

5. Laboratory analyses of samples.

6. HWMUs hazardous waste inventory disposal

7. HWMUs structures and HWMUs equipment decontamination or disposal. Includes potential costs for removal and disposal of the HWMUs structures, and costs related with excavation and removal of debris, soils, subsoils, etc., to comply with the clean closure decontamination standards.

8. Decontamination of equipment used in the closure process.

9. Storage, Transportation, and disposal of all closure related wastes.

10. Closure report generation and closure certification by the P.E.

11. A 15 percent contingency cost should also be added for administration overhead for unforeseen expenses.

A summary table outline of the closure costs by cost items should be included in the main body of the closure plan. All rationale and supporting calculations and costs for the estimated closure need to be itemized in detail in work sheets and included in an appendix. Relevant references, assumptions, and other documentation, such as, telephone conversations leading to the development of the closure cost estimate items, should be included to support the basis of the closure cost estimate.

An example closure cost estimate summary is provided in Appendix G. The example closure cost estimate summary was developed in accordance with The EPA's OSWER Policy Directive #9476 Guidance Manual: Cost Estimates for Closure and Post-Closure Plans (Subparts G and H), dated November 1986. (Please note that the closure cost estimate in a closure plan needs to include the detailed supporting calculations and the supporting information and references, which provides the basis of costs used in the estimate in an appendix. The detailed costs should be based upon the nature and type of HWMUs and HWMUs equipment undergoing closure and based upon the following EPA guidance: RCRA Guidance Manual for Subpart G, Closure & Post-Closure Care Standards & Subpart H, Cost Estimating Requirements, January 1987, OSWER Policy Directive No. 9476.00-5.

In addition, a cost estimating Excel Spreadsheet has been developed by the DEQ which helps

provide a cost estimate for development of landfills and other land-based disposal units. An example of the detail of this spreadsheet is provided in Appendix G. (Contact the DEQ for an updated electronic copy of this cost-estimating tool.)

3.19 FINANCIAL ASSURANCE FOR CLOSURE

The VHWMR and the RCRA, under 40 CFR Part 264 and 265 (Interim Status facilities), Subpart H, Financial Requirements, § 264.143 and § 265.143, requires that the owner or operator of a regulated facility must establish financial assurance for closure of the facility. **However, it should be noted that financial assurance for closure is not required for federally-owned and operated facilities.**

Financial assurance must be sufficient to comply with the closure cost estimate of the approved closure plan. Although the financial assurance is not required to be established as a component part of the closure plan, it must be provided for closure of all regulated units in order to comply with regulatory requirements. **In accordance with § 264.143 and § 265.143, the owner/operator must provide a copy of the established financial assurance mechanism for the facility closure to the DEQ.**

The owner or operator must choose from the following financial assurance mechanisms:

1. Closure trust fund.

2. Surety bond guaranteeing payment into a closure trust fund.

3. Surety bond guaranteeing performance of closure.

4. Closure letter of credit.

5. Closure insurance.

6. Financial test and corporate guarantee for closure.

7. Use of multiple financial mechanisms.

The requirements of each of the above financial mechanisms are specified in the RCRA Regulations, under 40 CFR Part 264 and 265, Subpart H, § 264.143 and § 265.143.

For assistance in complying with the financial assurance requirements, contact the Office of Financial Assurance, Division of Waste Program Coordination, DEQ.

3.20 SCHEDULE FOR CLOSURE

The VHWMR and the RCRA regulations, under 40 CFR Part 264 and 265 (Interim Status facilities), Subpart H, § 264.112 and § 265.112, require that the owner or operator of a regulated facility must include a schedule for closure of each HWMU and the final closure of the facility. The time allowed for closure is further specified under § 264.113 and § 265.113.

The closure plan schedule needs to comply with the regulations, which specify:

1. The schedule must include, at a minimum, the total time required to close each HWMU and the time required for closure activities, which will allow tracking of the progress of partial and final closure. (For example, in the case of a landfill unit, estimates of the time required to treat or dispose of all hazardous waste inventories, and the time required to place a final cover over the unit must be included.)

2. **Within 90 days after receiving the final volume of hazardous or non-hazardous wastes, the owner or operator must treat, remove from the unit or facility, or dispose of all hazardous wastes either, on-site or off-site, in accordance with the approved closure plan.** The Director may approve a longer period if the owner or operator complies with all applicable requirements for requesting a modification to the permit or closure plan. (See §264.113 or §265.113.)

3. **A closure period of 180 days is allowed to complete closure and another 60 days to submit the closure certifications. Also, hazardous wastes generated during closure can only be accumulated for less than 90 days without a permit.**

4. The Director may approve an extension to the closure period, if the owner or operator complies with all applicable requirements for requesting a modification to the permit or closure plan. (See §264.113 or §265.113.) The regulations require that the owner or operator submit a written extension request to the Director of the DEQ for consideration at least 30 days prior to the existing deadline of closure period, if the closure will require more than 180 days to complete.

3.21 CLOSURE PLAN AMENDMENT

The VHWMR and the RCRA, under 40 CFR Part 264 and 265 (Interim Status facilities), Subpart H, § 264.112, § 265.112 requires that the owner or operator of a regulated facility must submit a written notification of or request for a modification of the approved closure plan to the Director of the DEQ in accordance with the applicable procedures in 40 CFR Parts 124 and 270.

The closure plan should specify that amendment of the closure plan will be in accordance with the requirements of the regulations under 40 CFR Part 264 or Part 265 (Interim Status facilities), Subpart H, § 264.112 or § 265.112. These regulations specify the following requirements:

1. The written notification or request to the Director, DEQ, must include a copy of the amended closure plan for review and approval.

2. The owner or operator must submit a written notification or a modification request to the Director, DEQ, to authorize a change in the approved closure plan whenever the following occurs:

    1. Changes in operating plans or facility design affect the closure plan.

    2. There is a change in the expected year of closure.

    3. In conducting partial or final closure activities, unexpected events require a modification of the approved closure plan.

3. The owner or operator must submit a written request for a permit modification including a copy of the amended closure plan for approval at least 60 days prior to the proposed change in facility design or operation, or no later than 30 days after an unexpected event has occurred which has affected the closure plan.

    If an unexpected event occurs during the partial or final closure period, the owner or operator must request a modification no later than 30 days after the unexpected event.

    An owner or operator of a surface impoundment or a waste pile that intends to remove all hazardous waste at closure and is not otherwise required to prepare a contingent closure plan under § 264.228(c)(1)(i) or § 264.258(c)(1)(i), must submit an amended closure plan to the Director no later than 60 days from the date that the owner or operator or Director determines that the HWMU must be closed as a landfill, subject to the requirements of § 264.310, or no later than 30 days from that date, if the determination is made during partial or final closure. (Interim status facilities should refer to Part 265 for corresponding citations and requirements.)

    The Director will approve, disapprove, or modify the amended plan in accordance with the procedures in parts 124 and 270.

4. In accordance with the authority under § 264.112(c)(4), the Director may request modifications to the closure plan under the conditions described in § 264.112(c)(2). (Interim status facilities should refer to Part 265 for corresponding citations and requirements.)

If amendment of the closure plan is required to close a HWMU with hazardous wastes "closed in-place," the facility is required to close the HWMU in accordance with the closure requirements of a landfill. In these circumstances, the closure plan will need to be modified or amended to reflect the closure requirements of a landfill and post closure plan must be developed to comply with the post-closure care requirements specified under § 264.310 or § 265.310.

3.22 CERTIFICATION OF CLOSURE

The VHWMR and the RCRA regulations, under 40 CFR Part 264 and Part 265 (Interim Status facilities), §264.115 and §265.115, Certification of Closure, requires that the owner or operator must submit to the Director, by registered mail, a certification that the hazardous waste management facility (or specific HWMU(s), as applicable) has been closed in accordance with the specifications in the approved closure plan. The certification must be signed by the owner or operator and by an independent professional engineer registered in the Commonwealth of Virginia. The certification must be submitted within 60 days of completion of closure of each HWMU and 60 days of the completion of final closure of the facility. (240 days after the initiation of closure)

The closure plan should specify that closure certification and the closure report will be in accordance with the following certification requirements, which are delineated in the VHWMR and the RCRA:

1. The owner/operator and an independent professional engineer, registered in the Commonwealth of Virginia, will both certify that the HWM facility (or HWMU subject to closure) has been closed in accordance with the specifications in the approved closure plan. The certification statements will be in accordance with the VHWMR, under 9 VAC 20-60-1030, Signatories to Permit Applications and Reports. The certifications will be by an authorized person describe in 9 VAC 20-60-1030.A. or by a duly authorized representative of that person as delineated in 9 VAC 20-60-1030.B.

2. The certification of closure by the owner/operator and the professional engineer will be in accordance with the requirements of the VHWMR, under 9 VAC 20-60-1030.D. and will be signed, dated, include the title of the person certifying the closure, and include the certification text that is specified within the regulations as follows:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

3. The certification of closure will be submitted by registered mail to DEQ within 60 days of completion of closure within the Closure Report. (Within 240 days after initiation of closure.)

The certification statement must be by an authorized person or by a duly authorized representative of that person in accordance with the regulations under 9 VAC 20-60-1030, as follows:

A. Applications. All permit applications shall be signed as follows:

1. For a corporation – By a responsible corporate officer.

2. For a partnership or sole proprietorship - By a general partner or the proprietor, respectively.

3. For a municipality, state, federal, or other public agency - By a principal executive officer or ranking elected official.

B. *Reports. All reports required by permits and other information requested by the Director shall be signed by a person describe in 9 VAC 20-60-1030.A. or by a duly authorized representative of that person. A person is a duly authorized representative only if all of the following items are met:*

1. The authorization is made in writing by the person described in 9 VAC 20-60-1030A.

2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a

well field, superintendent or position of equivalent responsibility.

3. The written authorization is submitted to the Director.

Please note that closure of a HWMU or HWM facility regulated under a Hazardous Waste Management Permit, must be in accordance with the applicable conditions, criteria, and standards, and requirements specified in the permit's closure plan. Any proposed changes to the procedures or conditions of closure from those procedures or conditions that are specified in the facility's permit closure plan will require the submittal of a permit modification request to the Director of the DEQ. The Director must approve all permit modifications or changes to an approved closure plan prior to use of modified procedures, criteria, or standards as a basis to demonstrate closure. (See §264.112 and §265.112.) **Certification of closure cannot be approved unless the closure demonstration is in accordance with the approved closure plan.**

The Certification Statement section of the closure plan should specify information similar to the following:

> Prior to signing the closure certification statement, the engineer will review all procedures, systems, analytical data, laboratory reports, QA/QC Plan, QA/QC procedures, QA/QC data, calculations, statistical analyses, and risk-based assessment evaluations, criteria, and conclusions. The engineer's review will also include a determination that appropriate closure plan procedures, systems, including QA/QC procedures, have been followed and observed in the closure activities at the site and by the contracted laboratory, and that the appropriate equations have been correctly applied and calculated as specified in the closure plan and appropriate guidance documents of the EPA and the DEQ. In addition, prior to certification of closure, the engineer's review will verify demonstration that the data verifies that the decontamination standards of the closure plan have been achieved, and that the facility has been closed in accordance with the closure performance standards of the approved closure plan.

3.23 CLOSURE REPORT

As a standard operating practice, the DEQ requires documentation supporting the engineer's certification of closure by the submittal of a closure report to the Director, DEQ. The closure report must demonstrate that the closure of the HWM facility (or HWMU(s) has been achieved in accordance with the procedures, systems, criteria, decontamination standards, and performance standards of the approved closure plan. The DEQ also requires that the closure report include the certification of closure statements from the owner/ operator and the independent P.E., registered in the Commonwealth of Virginia.

The DEQ's requirement for documentation of the engineer's certification of closure is in accordance with the authority and requirements under §264.115 and §265.115, Certification of Closure, which states:

> *Documentation supporting the independent registered professional engineer's certification must be furnished to the Director upon request until he releases the owner or operator from the financial assurance requirements for closure under § 264.143(i).*

This Section of the closure plan should specify the following:

1. The closure report will be submitted to the Director of the DEQ to provide documentation supporting the certification of closure and to demonstrate that the HWM facility, or HWMU(s), have been closed in accordance with the procedures, criteria, decontamination standards, and performance standards of the approved closure plan.

2. The closure report will provide sufficiently detailed and summary information for the following items which demonstrate that the closure decontamination standards have been achieved and that the facility has been closed in accordance with the closure performance standards of the approved closure plan: closure procedures, decontamination procedures, hazardous waste inventory disposal, closure generated waste disposal, manifests of all wastes, sampling procedures, sampling analytical test data, laboratory reports, the QA/QC plan and procedures, QA/QC data, calculations, statistical analyses of the data, risk-based assessment calculations, model evaluations, results, and conclusions.

3. The closure report will also include the certification of closure statements of the owner/operator and the independent professional engineer, registered in the Commonwealth of Virginia.

Please note that if the submitted closure report is deficient in its documentation to support its conclusions or if the closure demonstration is not in accordance with the closure plan and/or the DEQ's guidance for risk assessments, etc., then the facility would be requested to provide the essential documentation to amend the submitted closure report and to comply with the requirements of the approved closure plan. **If additional supporting information is needed to verify closure and to amend the closure report, then the additional supporting information should be provided from the owner/operator with additional and newly dated certification statements by the independent P.E., registered in the Commonwealth of Virginia.**

The closure report should clearly identify whether the HWM facility closure is either a "partial closure," or a "final closure" in accordance with § 260.10, Definitions, as follows:

1. **Partial Closure** – *Partial closure means the closure of a hazardous waste management unit in accordance with the applicable closure requirements of Parts 264 and 265 of this chapter at a facility that contains other active hazardous waste management units. For example, partial closure may include the closure of a tank (including its associated piping and underlying containment systems), landfill cell, surface impoundment, waste pile, or other hazardous waste management unit, while other units of the same facility continue to operate.*

2. **Final Closure** – *Final closure means the closure of all hazardous waste management units at the facility in accordance with all applicable closure requirements so that hazardous waste management activities under Parts 264 and 265 of this chapter are no longer conducted at the facility unless subject to the provisions in § 262.34, Accumulation Time.*

In addition to the above, the closure report should clearly document whether the closure demonstration of each closed HWMU of the facility's is either a "clean closure," or is closed with hazardous waste "closed in-place" in accordance with the following definitions:

1. **Clean Closure** – When a facility is able to demonstrate that a HWMU is closed in accordance with the closure performance standards of the regulations and the decontamination standards of the closure plan, then the HWMU closure is referred to as a "clean closure."

   In a "clean closure" demonstration, all hazardous waste and hazardous waste constituents have been removed from a HWMU to levels such that direct contact with any remaining hazardous waste constituents after closure will not pose a threat to human health and/or the environment, nor adversely impact any environmental media in excess of the acceptable risk-based exposure levels.

2. **Closed In-Place** – When a facility subject to the RCRA is unable to demonstrate "clean closure" of a HWMU in accordance with the closure performance standards of the regulations and the "clean closure" decontamination standards of an approved closure plan, then the facility must be closed with hazardous waste "closed in-place."

   Except for container management storage facilities under Supart I, HWM facilities that have HWMUs with hazardous waste "closed in-place" must comply with the

closure requirements of a landfill under 40 CFR Part 264, Subpart N. Facilities with hazardous waste "closed in-place" must meet post-closure care requirements specified in the regulations. Such facilities must include groundwater monitoring as a condition of closure and post-closure care.

When a HWM facility is unable to close a HWMU in accordance with an approved closure plan and they are unable to practicably remove or decontaminate the subsoil or the site has contaminated groundwater, then the facility would be required to amend the closure plan so to close the HWMU with hazardous waste "closed in-place." (The time frame for submittal of an amended written closure plan is delineated in the regulations.)

When a HWM facility which has operated a 1) regulated tank system, 2) surface impoundment, 3) waste pile, 4) incinerator, or 5) drip pad HWMU, and the facility must close any of these HWMUs with hazardous waste "closed in-place," then the facility must amend the closure plan to comply with the closure requirements of a landfill. In addition, such a facility would be required to develop a post-closure plan to comply with the post-closure care and use requirements of the property as specified for a landfill. (See 40 CFR Part 264, Subpart N, §264.310.)

When a container management facility is unable to achieve "clean closure," that is, to decontaminate or remove all soil containing hazardous waste and/or when groundwater is contaminated from such a facility, then the facility must close the container management unit with hazardous waste "closed in-place."

There are no provisions in the VHWMR or the RCRA Regulations to close a container management facility as a landfill when such a facility cannot be "clean closed." Therefore, a HWM facility which has a container storage HWMU with hazardous waste "closed in-place" must further address the remaining contamination at the site under corrective action (CA) under the Hazardous Solid Waste Amendments (HSWA) of the RCRA, of 1984.

In the Commonwealth of Virginia, the DEQ has been authorized HSWA authority for corrective action for hazardous waste management facilities that have Hazardous Waste Management Permits. In the Commonwealth of Virginia, non-permitted hazardous waste management facilities are required to address corrective action requirements under the authority of the EPA. (The DEQ received partial delegation of the HSWA authority on September 9, 2000.)

When the Closure Report and certifications of closure demonstrate that the facility's HWMUs have been closed in accordance with the approved closure plan, then the Director of the DEQ provides

approval of closure in accordance with the report findings and certifications.

When the Director of the DEQ determines that the HWM facility has been "clean closed," then the DEQ will authorize the release of the facility from the financial assurance requirements for closure.

To assist facilities, a summary list is provided below of information that should be included in the closure report. The closure report should provide:

1. Certifications of Closure Statements of the owner/operator and the P.E.

2. A summary of closure procedures and activities completed during decontamination and closure of each HWMU. The summary should include sufficient summary and detailed information from the approved closure plan. The closure report should refer the reader to the approved closure plan, when needed.

3. Documentation of HWMUs waste inventories have been removed and disposed to a regulated treatment storage or disposal (TSD) facility. Copies of manifest records shipment to a regulated TSD needs to be provided in an appendix.

4. Documentation of management and characterization of all wastes generated during closure activities in accordance with closure plan and the regulations. Copies of manifest records of the disposal of all closure generated wastes to a regulated TSD, solid waste disposal facility, or facility regulated under the clean water act, as appropriate.

5. Documentation of the sampling locations in the text and figures that correspond with the sample identities and information provided in the text, tables, and laboratory reports.

6. Documentation of the vertical and horizontal extent of excavation in both the narrative text and in figures, if applicable. (The depth to clean soil samples, etc., should be demonstrated.)

7. Documentation of all sampling analytical tests data, QA/QC plan, QA/QC procedures, and the QA/QC data.

8 Summary tables of all sampling data results to support the closure findings and conclusions.

9. A discussion and summary of QA/QC procedures, data results, implications, findings, and conclusions.

10. All statistical analyses and calculations supporting the closure conclusions.

11. All risk-based assessment calculations, summary tables, and evaluations, findings, and conclusions. Supporting risk based information and calculations should be provided in the Appendices.

12. Appendices that include all: sampling and chain-of-custody documentation, laboratory data sheets and certifications for all compliance, background, and QA/QC samples.

14. For a facility subject to closure under the industrial/occupational scenario, or a facility which achieves "closure in-place," a signed Notice of Use Limitation should also be included in the closure report. A copy of a Notice of Use Limitation statement is included in the Guidelines for Developing Health-Based Cleanup Goals Using Risk Assessment at Hazardous Waste Site Facility for Restricted Industrial Use (DEQ, June 1995).

GLOSSARY OF TERMS AND ACRONYMS

Please note that Section 2.3, Definitions, of this Guidance Manual provides definitions of common terms applicable to closure under the VHWMR and the RCRA regulations specified under 40 CFR Part 260, Hazardous Waste Management System: General. Section 260.10, Definitions. Section 2.3 should be referred to in addition to the Glosssary of Terms and Acronyms below to clarify the meaning and the intent of this guidance. All regulations identified below are further identified under References and Web Sites.

DEQ – Department of Environmental Quality.

EQL/PQL – Estimated quantitation limit/Practical quantitation limit.

HCOCs – Hazardous constituents of concern.

HWMU – Hazardous waste management unit.

MCL – Maximum contaminant level.

MDL – Method detection limit.

MSDS – Material safety data sheets.

ND – Non-detected.

P.E. – Professional engineer.

QA/QC – Quality assurance/Quality control.

SWMU – Solid waste management unit.

TSD Facility – Treatment, storage, and disposal facility.

Regulations - In this manual, the term "Regulations" refers to the VHWMR and the RCRA Regulations, which are incorporated by reference into the VHWMR.

VHWMR – Virginia Hazardous Waste Management Regulations.

VSWMR – Virginia Solid Waste Management Regulations.

References and Web Sites

1. Virginia Hazardous Waste Management Regulations (VHWMR), 9 VAC 20-60-12, et seq., of the Virginia Administrative Code (formerly VR 672-10-1). Go to URL: **http://www.deq.state.va.us/waste/wastereg60.html**.

2. Virginia Solid Waste Management Regulations (VSWMR), 9 VAC 20-60-80-10, et seq., of the Virginia Administrative Code (formerly VR 672-20-10). Go to URL: **http://www.deq.state.va.us/waste/wastereg80.html**.

3. Resource Conservation and Recovery Act (RCRA) – 40 CFR Parts 260 – 266, 268, 270 – 273, 279, 280 – 282, and 148. Go to URL: **http://www.epa.gov/docs/epacfr40/chapt-1.info/subch-1.htm**.

4. RCRA Permit Application Checklist of EPA/DEQ for Part A and B is available on the DEQ Web site, under Waste Programs, RCRA, Guidance for RCRA Permit Applications. Go to URL: **http://www.deqstate.va.us/waste/guidance.html**.

5. Guidance on Quality Assurance Project Plans (QA/G-5) – Go to URL: **http://www.epa.gov/quality/qs-docs/g5-final.pdf**. This guidance includes Quality Assurance Sampling Plan for Environmental Response (QASPER) software that compiles user-selected, technical text and user-provided, site-specific information into a QA/QC Sampling Plan.

6. EPA Guidance for Quality Assurance Project Plans. Go to URL: **http://www.epa.gov/swerust1/epaqag5.pdf**.

7. Land Disposal Restrictions: Summary of Requirements, Revised August 2001, Office of Solid Waste and Emergency Response & Enforcement and Compliance Assurance, EPA530-R-01-007. Go to URL: **http://www/epa/gov/epaoswer/hazwaste/ldr/ldr-sum.pdf**.

8. RCRA Orientation Manual. Go to URL: **http://www.epa.gov/epaoswer/general/orientat.pdf**.

9. RCRA online. Go to URL: **http://www.epa.gov/rcraonline.pdf**.

10. EPA Region III Risk-based Concentration Table. Go to URL: **http://www.epa.gov/reg3hwmd/risk/riskmenu.htm**.

11. The EPA Quality System. Go to URL: **http://www.epa.gov/quality1**.

12. SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 1986, as amended. Go to URL: **http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm**.

APPENDIX A

1. EPA Region III Technical Guidance – Chemical Concentration Data Near The Detection Limit, by Dr. Roy L. Smith, EPA, 1991,

2. DEQ Memorandum, SW-846 Methods Table, from Khoa Nguyen, P.E., dated February 18, 1999.

APPENDIX B

1. Sampling Equipment Decontamination: Standard Operating Procedure (SOP) No. 2006

APPENDIX C

1. Hazardous Waste Closure Statistical Analysis Guidance, by Charlotte Carroll, Statistician, Office of Technical Support, Division of Waste Program Coordination, DEQ, dated 1999, and revised by Hassan Keceli, January, 2001.

APPENDIX D

1. Risk-based Closure Guidance, by Sanjay Thirunagari, Toxicologist, Office of Technical Support, Division of Waste Program Coordination, DEQ, dated 1999.

2. Guidelines For Developing Health-based Cleanup Goals Using Risk-Assessment At A Hazardous Waste Site Facility For Restricted Industrial Use, DEQ, dated June 1, 1995.

3. Risk Exposure and Analysis Modeling System (REAMS) Training Manual (Windows Version), by Sanjay Thirunagari, Office of Technical Support, Division of Waste Programs Coordination, DEQ, dated August 19, 1998.

APPENDIX E

1. Example Quality Assurance/Quality Control Plan for sampling.

2. Example Sampling and Analysis Plan, DEQ.

APPENDIX F

1. Decontamination Procedures for Tanks and Secondary Containment Systems, by Khoa Nguyen, P.E., Office of Waste Permitting, Division of Waste Program Coordination, DEQ, dated 1999.

2. Decontamination Procedures For Secondary Containment of a Container Storage HWMU, by Richard J. Criqui, Jr., C.P.S.S., Office of Waste Permitting, Division of Waste Program Coordination, DEQ, dated 1999.

APPENDIX G

1. DEQ Closure Cost Estimates For Two HWMUs, Container Storage Areas, Company XYZ Technology, Inc., Winchester, Virginia - EPA ID No. VAD000XXXXX - Closure Plan for a Hazardous Waste Container Storage Area, dated July 27, 2000

2. DEQ Cost Estimating Excel Spreadsheet, 1999 – This cost estimating Excel Spreadsheet has been developed by the DEQ which helps provide a cost estimate for development of landfills and other land-based disposal units. (Contact the DEQ for an updated electronic copy of this cost-estimating tool for land-based units.)

   (Please note that Closure Plan cost estimates need to be substantially more detailed than the cost estimates provided above; the basis of costs used in the estimate need to be provided with more supporting detail and references.)

APPENDIX H

1. RCRA Permit Application Checklist of EPA/DEQ for Part B, Subpart I, Closure, Post-Closure and Financial Assurance Requirements, 40 CFR 264.110 through 264.151, 264.178, 264.197, 264.228, 264.258, 264.280, 264.310, and 264.351.

   (Please note that the above checklist is the primary basis for the closure plan submittal requirements of the EPA and the DEQ. However, additional information may be requested to comply with informational requirements from the RCRA Permit Application Part A or B, depending upon the available information and documentation of the facility and the management of hazardous waste at the facility and the HWMUs undergoing closure.)

APPENDIX I

1. RCRA Permit Application Checklist of EPA/DEQ for Part A and B is available on the DEQ Web site, under Waste Programs, RCRA, Guidance for RCRA Permit Applications. Go to URL: **http://www.deqstate.va.us/waste/guidance.html**.

(Please note that the checklist under Appendix H is the primary basis for the closure plan submittal requirements of the EPA and the DEQ. However, additional information may be requested to comply with informational requirements from the RCRA Permit Application Part A or B, depending upon the available information and documentation of the facility and the management of hazardous waste at the facility and the HWMUs undergoing closure.)