CLOSURE AND POST CLOSURE PLAN AMENDMENT

HAZARDOUS WASTE MANAGEMENT UNIT 7

RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA
EPA ID No. VA1210020730

Draper Aden Associates
Engineering ◆ Surveying ◆ Environmental Services

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

In 1989, Radford Army Ammunition Plant (Radford AAP; EPA ID No. VA1210020730) closed Hazardous Waste Management Unit 7 (HWMU-7) in accordance with the Virginia Department of Environmental Quality (VDEQ) approved Closure Plan for the Unit dated May 1988. HWMU-7 was an unlined holding and neutralization basin that received spills, runoff, and wash down waters from the Acid Tank Farms in the Oleum Plant Area; waste sulfuric acid and caustics from oleum production; and waste caustic mixed with acidic water for neutralization. At the time of closure, HWMU-7 was drained of all waters, the residual material was treated in-place with flyash and cement kiln dust to achieve a target pH range of 6.3 and 10.5, and the basin was filled with the residual material and stone and capped. Following closure, Radford AAP monitored HWMU-7 in accordance with the post-closure care and groundwater monitoring procedures specified in the May 1988 Closure Plan. HWMU-7 was classified as an interim status Unit until the VDEQ issued the *Post-Closure Permit for Hazardous Waste Management Unit 7* (effective date October 30, 1999); the VDEQ subsequently revised the October 1999 *Post-Closure Permit*, and issued the *Final Hazardous Waste Post-Closure Permit for HWMUs 5, 7, 10, and 16* (October 4, 2002). From October 1999 to the present, Radford AAP has monitored HWMU-7 in accordance with the post-closure care and groundwater monitoring procedures specified in the *Post-Closure Permits*, as appropriate.

In October and November 2002, Radford AAP conducted subsurface investigations to determine the nature and extent of the residual material contained in closed HWMUs 5 and 7. Radford AAP intended to implement source removal activities in 2003 in support of clean closures for both Units; the results of the subsurface investigations would be used in the preparation of Amended Closure Plans for both Units. However, the laboratory analytical data collected during the subsurface investigations indicated that the residual material in the Units was not hazardous; therefore, Radford AAP chose to pursue clean closure of the Units while leaving the residual material in-place. Quantitative risk assessments compiled in accordance with the USEPA *Risk Assessment Guidance for Superfund* (RAGS) indicated that the residual material in the Units did not pose a threat to human health and/or the environment. Radford AAP submitted the results of the subsurface investigations and risk assessment to the VDEQ in the *Field Investigation Report and Risk Assessment for Units 5 and 7* (March 2003). In correspondence to Radford AAP dated June 25, 2003, the VDEQ indicated that in order for Radford AAP to continue pursuing clean closure for HWMUs 5 and 7, revised Closure Plans that include procedures and standards for clean closure must be submitted for each Unit. The VDEQ indicated that the revised Closure Plans must be prepared in accordance with the *Draft Guidance Manual for Closure Plans and Post-Closure Plans* (*Draft Guidance*) dated September 28, 2001. A copy of the June 25, 2003 correspondence is included in **Appendix A**.

Radford AAP has prepared this *Closure and Post-Closure Plan Amendment for Hazardous Waste Management Unit 7* (*Amended Closure Plan*) in accordance with the requirements specified in the June 25, 2003 correspondence from the VDEQ. The *Amended Closure Plan* has been

prepared in accordance with the *Draft Guidance Manual for Closure Plans and Post-Closure Plans* (*Draft Guidance*) dated September 28, 2001.

1.2 PURPOSE AND OBJECTIVE

The purpose of the *Amended Closure Plan* is to demonstrate that HWMU-7 does not contain characteristically hazardous wastes, and does not contain hazardous constituents at concentrations that pose a risk to human health and the environment. Accordingly, the objective of this plan is to perform those activities necessary to demonstrate that the previous closure activities were successful, and that the Unit no longer meets the definition of a hazardous waste unit. Therefore, the act of post-closure monitoring at the Unit is no longer warranted. This *Amended Closure Plan* will provide documentation of all procedures and data gathering efforts necessary to attain clean closure for HWMU-7 in compliance with the Virginia Hazardous Waste Management Regulations (VHWMR), 9 VAC 20-60-12, et seq., and with the requirements of the Resource Conservation and Recovery Act (RCRA) as presented in Title 40 of the Code of Federal Regulations (CFR). With the attainment of clean closure for soil and groundwater, Radford AAP will seek to end the post-closure care period for HWMU-7.

2.0 CLOSURE PERFORMANCE STANDARDS

HWMU-7 is a closed hazardous waste surface impoundment. The Closure Performance Standards, as presented in 40 CFR 264.111, specify that the owner/operator of a hazardous waste surface impoundment must close the Unit 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

(c) Complies with the closure requirements of this subpart, including but not limited to the requirements of 40 CFR 264.228.

In 1989, HWMU-7 was closed in accordance with the closure requirements of 40 CFR 264.111 and 264.228. The Unit was closed with residual material left in-place as detailed in the VDEQ-approved Closure Plan dated May 1988. The goal of the *Amended Closure Plan* is to provide a means for Radford AAP to achieve clean closure for HWMU-7, thereby ending the post-closure care period for the Unit. Such a process is allowed by 40 CFR 264.117(a)(2), which states:

> "...any time during the post-closure period for a particular unit, the Director may, in accordance with the permit modification procedures in parts 124 and 270:
> (i) Shorten the post-closure care period applicable to the hazardous waste management unit...if he finds that the reduced period is sufficient to protect human health and the environment (e.g., leachate or groundwater monitoring results, characteristics of the hazardous wastes, application of advanced technology, or alternative disposal, treatment, or re-use techniques indicate that the hazardous waste management unit or facility is secure)."

2.1 CLEAN CLOSURE FOR SOIL

In the June 25, 2003 correspondence (**Appendix A**), the VDEQ indicated that clean closure may be achieved for HWMU-7 with the residual material remaining in-place if samples of the residual material do not exceed the land disposal restriction (LDR) treatment standards specified in 40 CFR 268 Subpart D. In addition, the VDEQ indicated that the soil and any liner material immediately beneath the residual material must be sampled to determine whether they meet the clean closure standards listed in the *Draft Guidance*, which include analytical non-detection, comparison to background, and/or risk assessment in accordance with *"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 VDEQ, along with other risk-based guidance provided by the VDEQ.

2.2 CLEAN CLOSURE FOR GROUNDWATER

The groundwater at HWMU-7 currently is monitored in accordance with the requirements of the *Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Management Units 5, 7 10, and 16* (October 4, 2002). In the event that the residual material and underlying soils at HWMU-7 meet the clean closure standards specified by the VDEQ, Radford AAP will attempt to demonstrate clean closure for groundwater at HWMU-7 as well. Using the quarterly groundwater monitoring data from the quarter in which the soil samples are collected, clean closure for groundwater at HWMU-7 will be demonstrated by comparing the groundwater sample analytical results to the Groundwater Protection Standards (GPSs) for the Unit. The GPSs for HWMU-7 are based on USEPA Maximum Contaminant Levels (MCLs) for drinking water, or on VDEQ-derived Alternate Concentration Limits (ACLs) for constituents without MCLs. Due to the fact that Radford AAP is an industrial facility with no users of groundwater, comparison of HWMU-7 groundwater data to residential drinking water standards will provide the most conservative assessment of risk.

Radford AAP will continue to monitor groundwater at HWMU-7 in accordance with the *Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Management Units 5, 7 10, and 16* (October 4, 2002) until certifications for clean closure of soil and groundwater at HWMU-7 have been issued by the VDEQ. Upon receipt of certification of clean closure from the VDEQ, Radford AAP will request a reduction in the post-closure period for HWMU-7 in accordance with 40 CFR 264.117(a)(2). Radford AAP assumes that certifications for clean closure of soil and groundwater will trigger the reduction of the post-closure period and signify the completion of post-closure care at HWMU-7.

In the event that HWMU-7 attains clean closure for soil, but does not attain clean closure for groundwater, Radford AAP will continue to monitor groundwater at HWMU-7 in accordance with the *Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Management Units 5, 7 10, and 16* (October 4, 2002). However, clean closure for soil would indicate that the original closure activities conducted in 1989 were clearly successful, and that the residual material left in-place does not represent hazardous waste. Therefore, corrective action in the form of source removal would have occurred with the closure activities conducted in 1989. In accordance with 40 CFR 264.100(f), Radford AAP proposes that groundwater monitoring at HWMU-7 would cease in the event that the GPSs are not exceeded for a period of (3) consecutive years following the attainment of clean closure for soil.

2.3 CLOSED IN-PLACE

In the unlikely event that HWMU-7 is unable to attain clean closure for soil, the Unit will remain closed with the residual material in-place. If this occurs, the Unit will remain in post-closure care in accordance with the *Final Hazardous Waste Post-Closure Permit for HWMUs 5, 7, 10, and 16* (October 4, 2002).

3.0 RADFORD AAP FACILITY DESCRIPTION

3.1 LOCATION

The Radford AAP is located in the mountains of southwestern Virginia within Pulaski and Montgomery Counties. The installation consists of two noncontiguous areas - the Radford Unit (or Main Section) and the New River Ammunition Storage Area Unit. The Main Section is located approximately 4 miles northeast of the city of Radford, approximately 10 miles west of Blacksburg, and 47 miles southwest of Roanoke, Virginia. The New River Unit is located approximately 6 miles west of the Main Section, near the town of Dublin, Virginia. All uses of the terms "Radford AAP" or "the Facility" in this document refer to the Main Section only.

The Radford AAP is situated in one of a series of narrow valleys typical of the Valley and Ridge physiographic province of the Appalachian Highland Region of North America. Oriented in a northeast-southwest direction, the valley is approximately 25 miles long. The valley has a width of approximately eight miles at the southwest end and narrows to approximately two miles at the northeast end. The Radford AAP lies along the New River in the relatively narrow northeast corner of the valley. The maximum elevation at Radford AAP is 2,225 feet above mean sea level (msl) in the southeast corner and the minimum elevation is approximately 1,675 feet above msl along the New River at the northern property boundary.

The Radford AAP is divided by the New River into two areas (**Figure 1**). The southern area, which comprises approximately two-thirds of Radford AAP, is called the "Main Plant Area." The remaining northern one-third section is called the "Horseshoe Area," and is located within the meander of the New River. The entire Radford AAP is secured by artificial barriers to prevent unknowing or unauthorized entry. The Facility perimeter is surrounded by a six-foot chain link fence with three-strand barbed wire top guard. The access gates and perimeter fencing at the Radford AAP are posted with no trespassing signs. The signs are posted in sufficient number so as to be seen from any approach to the restricted portions of the property.

Forty three (43) Solid Waste Management Units (SWMUs) and eight (8) HWMUs are located in both the Main Plant Area and the Horseshoe Area (**Figure 2**). This Amended Closure Plan is specifically for HWMU-7. As shown on **Figure 2**, HWMU-7 is located in the Main Plant Area.

3.2 HISTORY

The Radford AAP is a government-owned, contractor-operated (GOCO) military industrial installation supplying solvent and solventless propellant grains and trinitrotoluene (TNT) explosives. From its inception as a GOCO installation in 1940 until 1995, the Radford AAP was operated by Hercules Incorporated. On March 6, 1995, Alliant Techsystems, Inc. bought out Hercules Incorporated and took over operation of the Radford AAP. On April 1, 1999, the division of Alliant Techsystems, Inc. which operates the Radford AAP became a

limited liability corporation under the name of Alliant Ammunition and Powder Company, L.L.C.

Construction of the Radford AAP production facility began in 1940 with the impending participation of the United States in World War II, and the determination by Congress of a need for increased ammunition production facilities. Initially, Radford AAP consisted of two distinct areas - a smokeless-powder plant (Radford Ordnance Works [ROW]) and a bag-manufacturing and loading plant for artillery, cannon, and mortar projectiles (New River Ordnance Works [NROW]). These two production facilities were operated separately from 1940 to 1945. Late in 1945, ROW was designated as the Radford Arsenal, and NROW was designated as a subpost. By January 1950, NROW was made an integral part of the Radford Arsenal and no longer considered a subpost. The arsenal was renamed Radford Ordnance Plant in 1961 and was finally redesignated as the Radford AAP in August 1963 (USATHAMA, 1984).

Expansion of both ROW and NROW continued throughout World War II. Late in 1945, the Radford Unit was placed on standby status. The following year, the nitric acid area of the plant was reactivated to produce ammonium nitrate fertilizer, an activity that continued until 1949 under contract with Hercules Powder Company (later Hercules Incorporated). In September 1945, the NROW was declared surplus; but in April 1946, the magazine areas were changed from surplus to standby status. Between December 1946 and January 1948, large parcels of the NROW plant manufacturing area were sold (USATHAMA, 1984). These parcels were excess land holdings that had never been used for production purposes.

Between 1952 and 1958, Goodyear Aircraft Corporation of Akron, Ohio was contracted to manufacture component parts used in missile production at the Radford AAP. The close coordination required between Goodyear and Hercules resulted in Goodyear moving its assembly and coating operations to Radford AAP. In 1958, Hercules took over the Goodyear operations at the Plant (USATHAMA, 1984). Since 1968, Radford AAP has produced TNT on an intermittent basis.

3.3 RESPONSIBILITY

Based on discussions with Facility personnel, the general responsibilities assigned to the Radford AAP have not changed from those outlined by USATHAMA (1976), these include:

- Manufacturing of explosives and propellants;
- Handling and storage of strategic and critical materials as directed for other government agencies;
- Operation and maintenance, as directed, of active facilities in support of current operations. Maintenance and/or lay-away, in accordance with Ammunition Procurement and Supply Agency instructions, of standby facilities, including any machinery and packaged lines received from

industry, in such conditions as will permit rehabilitation and resumption of production within the time limitations prescribed;

- Receipt, surveillance, maintenance, renovation, demilitarization, salvage, storage, and issue of assigned Field Service Stock and industrial stock as required or directed;

- Procurement, receipt, storage, and issue of necessary supplies, equipment, components, and essential materials;

- Mobilization planning, including review and revision of plant as required;

- Custodial maintenance and administrative functions of subinstallations; and

- Support services for tenants.

These responsibilities are met through the efforts of the operating contractor, Alliant Ammunition and Powder Company, L.L.C. The Administrative Contracting Officer (ACO) and his staff provide technical assistance and administer the contracts with the civilian operating contractors. Radford AAP provides logistics support for tenant activities such as the U.S. Army Research, Development and Acquisition Information Systems Agency, (USARDAISA) which is charged with performing data processing activities during peacetime.

3.4 INDUSTRIAL OPERATIONS

From 1941 to the present, the principal end-products produced at Radford AAP have been single-base and multi-base propellants, and cast and solventless propellants. In the manufacture of these products, oleum (concentrated sulfuric acid), nitric acid, nitroglycerine (NG), and nitrocellulose are used. Since 1968, Radford AAP has produced TNT on an intermittent basis.

HWMU-7 is a former unlined holding and neutralization basin associated with the management and treatment of: spills, runoff, and wash down waters from the Acid Tank Farms in the Oleum Plant Area; waste sulfuric acid and caustics from oleum production; and waste caustic mixed with acidic water.

4.0 HAZARDOUS WASTE MANAGEMENT UNIT 7

4.1 UNIT DESCRIPTION

HWMU-7 is a former unlined holding and neutralization basin located on the floodplain of the New River. The location of HWMU-7 is 37°11'12" N latitude and 80°33'15" W longitude. A Site Plan for HWMU-7 is illustrated in **Figure 3**. Intermittent drainages are located to the north and south of the Unit, and the New River is located approximately 225 feet to the west of the Unit.

When HWMU-7 was in operation, the impoundment measured approximately 90 feet wide by 160 feet long by 12 feet deep (side slope at 2:1). The resulting maximum capacity of the Unit was 566,131 gallons (75,685 cubic feet or 2,803 cubic yards). The closed HWMU-7 consists of a mound measuring approximately 90 feet wide by 160 feet long by 7 feet high, with a bottom elevation of approximately 1,711.1 feet above msl and a top elevation of approximately 1,718.3 feet above msl. The closed HWMU-7 is capped with a composite liner consisting of (from top to bottom):

- vegetative cover;
- 1 foot to 1.5 feet of topsoil;
- 1.25 feet to 2 feet of clay;
- 0.5 foot to 1.5 feet of sand (drainage layer; 10^{-3} cm/sec permeability); and
- a 30-mil PVC membrane liner.

The 30-mil PVC membrane liner is underlain by the neutralized residual material. The residual material in turn is underlain by a clay liner ranging in thickness from 1.75 feet to 3 feet throughout most of the Unit. At the northern end of the Unit, the neutralized residual material is underlain by native soils.

4.2 UNIT HISTORY

4.2.1 Operational History

HWMU-7 was put into operation in 1972. During operation, influent into HWMU-7 included: spills, runoff, and wash down waters from the Acid Tank Farms in the Oleum Plant Area; waste sulfuric acid and caustics from oleum production; and waste caustic mixed with acidic water for neutralization. The wastes were characteristically hazardous as corrosive (EPA I.D. No. D002). The acidic waste waters were both nitric (NO_3) and sulfuric (SO_4) in origin with a pH ranging from 1.5 to 1.6 and a dominant constituent of mixed acids. The waste caustics were also corrosive in characteristic (pH >12.5), resulting in a similar EPA designation of D002. The dominant constituent of the caustic wastes was sodium hydroxide. The relative abundance of both waste streams was less than 1 percent. As the primary function of the Unit was to neutralize high and low pH influents, the Unit could be interpreted to meet the criteria of a T31 –

Neutralization treatment unit under the RCRA Treatment, Storage and Disposal (TSD) Handling Codes designation system.

During a hydrographic survey conducted in December 1984, the thickness of accumulated sediments (primarily residues of lime precipitation) in HWMU-7 was measured at approximately 5 feet. According to Radford AAP personnel, no waste stream from the NC-line was ever discharged to HWMU-7. Therefore, no reactive wastes were likely present in HWMU-7. According to EP toxicity analyses conducted on the lagoon influent water and sediment, several heavy metals were detected in low concentrations (i.e., nonhazardous). The pH of the lagoon water was 11.4 when the analysis was conducted, which was also classified as nonhazardous. However, as the pH of the lagoon's influent was known to fluctuate (below 2.0 and above 12.5), the wastewater was classified as a corrosive substance. The results of the EP toxicity analysis conducted on the lagoon water and sediment are presented below. The samples collected from the lagoon water and sediment indicate that heavy metals were not present in concentrations that would classify the wastes as hazardous.

EP Toxicity Parameter	Lagoon Water Concentration	Sediment Concentration
pH	11.4 s.u..	ND
Arsenic	ND	ND
Barium	ND	0.33 mg/l
Cadmium	0.016 mg/l	0.027 mg/l
Chromium	ND	0.73 mg/l
Lead	ND	0.58 mg/l
Mercury	ND	ND
Selenium	ND	ND
Silver	ND	0.027 mg/l

ND: Non-detect.

4.2.2 Unit Closure and Post-Closure Care

Radford AAP ceased operation of HWMU-7 in 1986, and closed the Unit in 1989 in accordance with the VDEQ-approved Closure Plan dated May 1988. At the time of closure, HWMU-7 was drained of all waters, the residual material was treated in-place with flyash and cement kiln dust to achieve a target pH range of 6.3 and 10.5, and the basin was filled with the residual material and stone and capped. No waste has been processed through HWMU-7 since it was closed. A copy of the May 1988 Closure Plan and the certification of closure are included (on CD-ROM) in **Appendix B**.

The May 1988 Closure Plan (**Appendix B**) documents the closure performance standards, environmental assessment of closure methods, and justifications of in-place closure that were used for HWMUs 5, 7, and 16. The four major sections of the May 1988 Closure Plan are discussed below:

Waste Characterization/Maximum Waste Inventory – Includes physical descriptions of HWMUs 5, 7, and 16, along with detailed descriptions of each Unit's functions.

Construction Procedure – Details basic closure construction procedures and the methods by which wastes and contaminated soils were handled during closure construction. Additional specific or unique information regarding site preparation, demolition cleanup, soil treatment, soil sampling and soil sample analysis is included.

Soil Treatment – Includes special instructions for soil treatment prior to and during closure. Presents the two objectives of the soil treatment program: 1) to neutralize acidic sediments and soils, and 2) to solidify soft subsoils for greater manageability. The objectives were accomplished by using pH as a guide for acidity, and by testing compressive strength. Also describes procedures including but not limited to: cover system analysis, drain installation, backfill, grading, drainage control, performance evaluation, and certification of closure.

Post-Closure Care and Groundwater Monitoring – Presents basic procedures for groundwater monitoring, inspections, maintenance, and contingency activities for the Units. Also includes engineering specifications for construction procedures, standards to be used, testing requirements, construction submittals, materials to be used, quality controls, unsatisfactory materials, and specific special construction instructions.

Certifications of closure for HWMUs 5, 7, and 16 were submitted to the VDEQ in letters dated October 26, 1989 and January 4, 1990. Following closure, Radford AAP monitored HWMU-7 in accordance with the post-closure care and groundwater monitoring procedures specified in the May 1988 Closure Plan. HWMU-7 was classified as an interim status Unit until the VDEQ issued the *Post-Closure Permit for Hazardous Waste Management Unit 7* (effective date October 30, 1999); the VDEQ subsequently revised the October 1999 *Post-Closure Permit*, and issued the *Final Hazardous Waste Post-Closure Permit for HWMUs 5, 7, 10, and 16* (October 4, 2002). Since 1999, Radford AAP has monitored HWMU-7 in accordance with the post-closure care and groundwater monitoring procedures specified in the *Post-Closure Permits*, as appropriate.

4.2.3 October/November 2002 Field Investigation

In October and November 2002, Radford AAP conducted subsurface investigations to determine the nature and extent of the residual material contained in closed HWMUs 5 and 7. Radford AAP intended to implement source removal activities in 2003 in support of clean closures for both Units; the results of the subsurface investigations would be used in the preparation of amended Closure Plans for both Units. Samples of the residual material and the soil surrounding the Units were analyzed for the USEPA Target Analyte List (TAL) inorganic compounds and for the USEPA Target Compound List (TCL) organic compounds. In addition, composite samples of the residual material for both Units were submitted for waste characterization analysis in accordance with 40 CFR 261 Subpart C – Characteristics of Hazardous Waste.

A summary of the TAL inorganic constituents and the TCL organic constituents detected in the soil and residual material samples from HWMU-7 during the October/November 2002

Field Investigation is presented in **Table 1**. As shown in **Table 1**, only TAL inorganic constituents were detected in the samples of the residual material; no TCL organic constituents were detected in any of the residual material samples. Three TCL organic constituents were detected in the base clay and native soil beneath the residual material. The waste characterization analytical results for the composite sample of residual material from HWMU-7 indicated that the residual material was not hazardous. Based on the analytical results for the soil and residual material samples, Radford AAP chose to pursue clean closure of HWMU-7 while leaving the residual material in-place. Quantitative risk assessments compiled in accordance with the USEPA RAGS indicated that the residual material in HWMU-7 did not pose a threat to human health and/or the environment. Radford AAP submitted the results of the subsurface investigations and risk assessment to the VDEQ in the *Field Investigation Report and Risk Assessment for Units 5 and 7* (March 2003). A copy of the March 2003 *Field Investigation Report* is included (on CD-ROM) in **Appendix B**.

5.0 OVERVIEW OF CLOSURE PROCEDURES

The *Amended Closure Plan* presents the procedures for collection and evaluation of additional data that will be used to demonstrate clean closure for HWMU-7 in compliance with the June 25, 2003 correspondence (**Appendix A**), and with the VHWMR and RCRA as presented in 40 CFR Part 264.

5.1 SOIL SAMPLE COLLECTION AND ANALYSIS

In the June 25, 2003 correspondence, the VDEQ indicated that Radford AAP must sample the soil and liner material (if any) beneath the residual material to determine whether the soil and liner material meet the clean closure standards listed in the *Draft Guidance*. A total of eight (8) soil samples will be collected from the native soils and clay liner immediately beneath the residual material. To facilitate soil sample collection, eight (8) soil borings will be advanced through the clay liner beneath HWMU-7 and into the underlying native soils using a track-mounted Geoprobe® rig. The soil samples will be submitted for laboratory analysis for the USEPA Target Analyte List (TAL) inorganic compounds and for the USEPA Target Compound List (TCL) organic compounds. The laboratory analytical results will be subjected to Level IV data validation.

5.2 GROUNDWATER SAMPLE COLLECTION AND ANALYSIS

The groundwater at HWMU-7 will be sampled in accordance with the procedures specified in the *Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Management Units 5, 7 10, and 16* (October 4, 2002).

5.3 CLEAN CLOSURE EVALUATION

5.3.1 Residual Material

In order for Radford AAP to achieve clean closure of HWMU-7 with the residual material remaining in-place, the VDEQ indicated that Radford AAP must demonstrate that the residual material does not exceed the Land Disposal Restrictions (LDR) treatment standards specified in 40 CFR 286 Subpart D. The results of the October/November 2002 Field Investigation indicated only 16 TAL inorganic constituents were detected in the residual material samples; no TCL organic constituents were detected in the residual material samples. Of the 16 detected TAL inorganic constituents, only nine (9) are listed in 40 CFR 268.48 – Universal Treatment Standards.

The LDR Universal Treatment Standards for inorganic constituents specified in 40 CFR 268.48 are based on Toxicity Characteristic Leaching Procedure (TCLP) concentrations. The inorganic constituent TCLP concentrations detected in the residual material composite sample collected during the October/November 2002 Field Investigation were well below their respective Universal Treatment Standards. Therefore, the residual material contained in HWMU-7 complies with the LDRs.

5.3.2 Soil Samples

The TAL inorganic constituents and TCL organic constituents detected in the eight (8) soil samples will be used to develop the list of hazardous constituents of concern (HCOCs) for HWMU-7. The HCOCs will be used to determine whether the soil and liner material beneath the Unit meet the clean closure standards listed in the *Draft Guidance.*

In the event that the soil sample analytical results indicate non-detection for all HCOCs, the clay liner and native soils beneath HWMU-7 will be considered to meet the clean closure decontamination standard. In the event that HCOCs are detected in the soil samples, Radford AAP may demonstrate clean closure by either: 1) statistical comparison of the soil sample HCOC concentrations to the background HCOC concentrations, or 2) a risk assessment evaluation of the HCOCs present in the soil samples.

Detected inorganic HCOCs will be compared to the inorganic constituent background values established during the August/September 2001 Facility-Wide Background Study conducted by the IT Corporation (**Appendix B**). If the concentrations of inorganic HCOCs in all soil samples are below the appropriate background values, the clay liner and native soils beneath HWMU-7 will meet the clean closure decontamination standard. If the concentration of any inorganic HCOC in a soil sample exceeds its respective background value, Radford AAP may attempt to demonstrate that the concentrations of the inorganic HCOCs detected in the clay liner and/or native soils do not pose an unacceptable risk to human health and the environment. No TCL organic compounds were detected in the background soil samples collected during the August/September 2001 Facility-Wide Background Study; therefore, comparisons to background concentrations will not be possible for any organic HCOCs detected in the clay liner and native soils beneath HWMU-7. If any organic HCOCs are detected in the in the clay liner and native soils beneath HWMU-7, Radford AAP may attempt to demonstrate that the detected organic HCOCs concentrations do not pose an unacceptable risk to human health and the environment.

Clean closure of the clay liner and native soils beneath HWMU-7 may be demonstrated by a risk-based assessment as an alternative to the non-detection decontamination standard or the statistical comparison of soil samples to background levels. In this way, Radford AAP may attempt to demonstrate that the concentrations of HCOCs detected in the clay liner and native soils do not pose an unacceptable level of risk to human health and the environment. The risk assessment will be conducted in accordance with the VDEQ 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 VDEQ, along with other risk-based guidance provided by the VDEQ.

5.3.3 Groundwater

Using the quarterly groundwater monitoring data from the quarter in which the soil samples are collected, clean closure for groundwater at HWMU-7 will be demonstrated by comparing the groundwater sample analytical results to the Groundwater Protection Standards (GPSs) for the Unit.

6.0 CLOSURE SAMPLING AND ANALYSIS PLAN – SOIL SAMPLES

In the June 25, 2003 correspondence (**Appendix A**), the VDEQ indicated that the soil and any liner material immediately beneath the residual material must be sampled to determine whether they meet the clean closure standards listed in the *Draft Guidance.* The residual material in HWMU-7 is underlain by a clay liner ranging in thickness from 1.75 feet to 3 feet throughout most of the Unit. At the northern end of the Unit, the residual material is underlain by native soils.

This Closure Sampling and Analysis Plan (SAP) for soil samples has been developed to ensure high quality of the sampling results, to verify the analytical results, and to assess the analytical error. This SAP is consistent with USEPA SW-846 (Test Methods for Evaluating Solid Waste, 3rd Edition, November 1986, as updated). All procedures detailed in this SAP will be followed when soil sampling occurs.

6.1 SOIL SAMPLE COLLECTION PROCEDURES

In order to meet the requirements of the VDEQ, a total of eight (8) soil samples will be collected from the native soils and clay liner immediately beneath the residual material. To facilitate soil sample collection, eight (8) soil borings will be advanced through the clay liner beneath HWMU-7 and into the underlying native soils. The proposed boring locations are illustrated in **Figure 4**.

The soil borings will be advanced using a track-mounted Geoprobe® rig. The Geoprobe® system utilizes direct-push technology to facilitate sample collection. At each boring location, soil core samples will be collected continuously using a four-foot long, 1.5-inch diameter piston-type sampler. Each soil core sample will be collected and retained in a non-reactive acetate liner within the four-foot sampler. Following sample collection, the acetate liner will be split longitudinally to expose the soil core, which will be visually inspected and classified in the field by a geologist. It is anticipated that visual observation will allow for the differentiation between residual material, the clay liner, and native soils. The depth below ground surface of the contact between the residual material, clay liner, and native soils will be recorded for each boring and plotted on a map using in-field triangulation with a known point. Schematic cross sections of the Unit will be compiled from the data.

A total of eight (8) soil samples will be collected from the native soils and clay liner encountered in the eight (8) soil borings. The soil samples will be submitted for laboratory analysis for the USEPA Target Analyte List (TAL) inorganic compounds and for the USEPA Target Compound List (TCL) organic compounds. The laboratory analytical results will be subjected to Level IV data validation.

6.1.1 Sample Containers and Preservation

Soil sample containers will consist of pre-cleaned, 16-ounce, glass jars equipped with Teflon-lined lids. The containers will be prepared prior to sampling by the contract laboratory in accordance procedures for appropriate analytical method as specified in SW-846. After collection, the soil samples will be placed in a cooler chilled to approximately 4 °C and sealed with a custody seal for shipment to the analytical laboratory under chain-of-custody.

All soil sample containers shall be packed in a cooler chilled to approximately 4° C with ice as soon as they are collected. Upon the completion of activities at the Unit, the coolers will be packed with additional ice and sealed with a custody seal for transport to the contract laboratory. The samples will be shipped to the laboratory by common carrier.

6.1.2 Sample Label and Seal

Each sample will be assigned a unique identification number. The sample identification number will include symbols/numbers to indicate the following information:

- the name of the Facility,
- the name of the closure Unit from which the sample is collected,
- the depth from which the sample is collected, and
- the laboratory analyses associated with the sample.

The sample labels will display the sample identification number, the sampling date and time, the initials of the sampler, the preservative(s) used (if any), and the type of analytical test. Project names and project number are optional. All sample containers will be labeled in advance of or at the time of sampling. The sample information will be printed on the label in a legible manner. The identification on the label, as described above, should be sufficient to enable cross reference with the analytical laboratory logbook.

Labels should be affixed to sample containers prior to or at the time of sampling, and should be filled out at the time of collection.

Before packing a sample into the sample shipping container, or before the sample leaves the custody of sampling personnel, a sample custody seal will be affixed over the lid/cap of the sample container in a manner that it is necessary to break the seal to open the sample container. The seal must include the following information:

- Sample identification number (this number must be identical with the number on the sample label).
- Name of sampler.
- Date and time of sampling.

All entries will be printed in waterproof ink.

6.1.3 Sample Packaging and Shipping

Sample packaging and shipping will comply with the U.S. Postal Service regulations, Department of Transportation regulations, Virginia regulations governing transportation of hazardous materials, if applicable, and USEPA SW-846 (Chapter 9).

When the sample containers are shipped to the laboratory, a minimum of two custody seals will be placed on the shipping container in such a way that the shipping containers cannot be opened in transport without breaking the seal. In addition, the shipping sample containers will be sealed with strapping tape in a manner that the shipping container cannot be opened without cutting through the tape.

In the event that final receipt by the laboratory of any shipping container or sample bottle indicates evidence of compromised sample integrity, the laboratory QA/QC officer or his/her representative shall notify the operator within 24 hours of receipt. Subsequent to notification, sample integrity will be evaluated and appropriate actions will be taken to assure representative samples. Sample integrity determinations and needs for additional actions will be conducted according to QA/QC guidance from USEPA SW-846. Resampling will be conducted if determined necessary.

6.2 FIELD DOCUMENTATION

Sampling events that occur during the closure activities will be recorded in a field notebook. All pertinent sampling and field survey information will be recorded in the logbook. All logs will be kept in a waterproof, bound notebook with numbered pages. All entries will be printed in waterproof ink. No pages will be removed. Corrections will be made by drawing a single line through the incorrect data and initializing and dating the correction that was made to the side of the error. Entries in the logbook should contain at a minimum the following information:

- Location of sampling point.
- Name and address of field contact.
- Type of sample (i.e., soil).
- Number and volume of samples taken.
- Purpose of sampling (i.e., closure activities).
- Description of sampling point and sampling methodology.
- Date and time of collection.
- Parameters for analysis.
- Sample identification number.
- Sample distribution and transport method (i.e., name of laboratory, name of courier).
- Field observations
- Any field measurements taken (i.e., pH, conductivity).
- Appearance of the samples.
- Relevant field conditions.
- Signatures of personnel responsible for observations.

6.3 CHAIN-OF-CUSTODY DOCUMENTATION

The soil sampling program will incorporate a chain-of-custody program to track the route and handlers of the soil samples. The monitoring of sample possession from field sampling to laboratory analysis is important in the event that unexpected lab results occur and the security of transportation is evaluated. This documentation will contain several records and logs that assist in the quality control of the program.

The chain-of-custody record will be filled out for the Unit and will accompany the samples to the contract laboratory. The completed form will be returned to Radford AAP with the analyses for each Unit. An example chain-of-custody form is included in **Appendix C**. The sample possession will be established from time of collection to the time of analysis. This record will contain the following information:

- sample identification and location
- signature of sampler
- date and time of sampling
- sample type
- well identification
- number of containers
- required analysis
- signatures of person(s) involved in possession
- times and dates of possession
- method of transportation
- statement for packing on ice
- temperature during shipment (min & max)
- internal temperature upon arrival at laboratory

The chain-of-custody form will be forwarded to the laboratory with the samples. As a precaution against this record being lost or altered, the sampling personnel will retain a copy of the chain-of-custody form documenting all information up until the first change of sample custody.

A sample analysis request sheet can further clarify the samples for each requested constituent. This additional check sheet will be utilized when necessary. This sheet sent along with the samples will contain the following information:

- name of person receiving samples
- laboratory sample number
- date of sample receipt
- analysis to be performed
- internal temperature during shipping

6.4 DECONTAMINATION

All downhole probing tools will be decontaminated prior to initiating field activities, between each boring, and prior to demobilization from the Site using a non-phosphate detergent/distilled water solution wash followed by a distilled water rinse. Between soil samples, the direct-push samplers will be washed using a non-phosphate detergent/distilled water solution followed by a distilled water rinse.

6.5 BORING ABANDONMENT

Upon completion of the borings and collection of the necessary samples, each borehole will be sealed with a bentonite slurry to the ground surface. The geosynthetic layer within the cap for HWMU-7 will be penetrated by the Geoprobe® borings. However, due to the fact that laboratory analytical data collected during previous subsurface investigations indicate that the residual material in HWMU-7 is not hazardous, no additional measures will be taken to repair the geosynthetic layer within the cap.

6.6 DISPOSITION OF INVESTIGATION-DERIVED WASTE

All rinsate water that is generated during decontamination activities will be collected in containers and subsequently emptied into the Biological Wastewater Treatment Plant at Radford AAP.

The soil cuttings and waste Geoprobe® sample collection sleeves will be containerized within a steel drum and staged at a central location on-site pending proper disposal.

6.7 ANALYTICAL PROCEDURES

Aliquots of the eight soil samples will be submitted to Severn Trent Laboratories of North Canton, Ohio for analysis for the USEPA Target Analyte List (TAL) inorganic compounds. Separate aliquots of the eight soil samples will be submitted to Lancaster Laboratories of Lancaster, Pennsylvania for analysis for the USEPA Target Compound List (TCL) organic compounds.

The analytical methods set forth in USEPA SW-846 (Test Methods for Evaluating Solid Waste, latest edition) will be used to analyze all constituents. Recommended analytical methods and associated quantitation limits are listed in **Table 2**. The laboratory analytical results will be subjected to Level IV data validation.

6.8 QUALITY ASSURANCE/QUALITY CONTROL

During sample collection and analysis, Radford AAP and the laboratories 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 appropriate QA/QC samples, sample data, laboratory data, and laboratory QA/QC control procedures specified within the *Amended Closure Plan* will be discussed and summarized in the Closure Report as it pertains to the demonstration of closure. All of the QA/QC laboratory data will be included with all other field and sampling data and will be provided in an Appendix of the Closure Report.

6.8.1 Field QA/QC Program

The field QA/QC program is designed to ensure the reliability and validity of the field data gathered as part of the Closure soil sampling program. The field QA/QC program consists of routine collection and analysis of trip and equipment blanks and blind duplicates.

For each day of soil sampling, one trip blank shall be filled with laboratory-grade reagent water in the laboratory that has been selected to conduct the TCL organic compounds analyses. The trip blank shall be analyzed only for the same volatile organic compounds for which the soil samples will be analyzed. The trip blank shall accompany the sampling kit, in the transport cooler, at all times.

Equipment blanks will be collected to monitor the decontamination of any non-dedicated equipment that may be used in the sampling process. The equipment blank shall be prepared by filling the sampling device with laboratory-grade reagent water and transferring the water from the sampling device to the sample containers. The equipment blank will be returned to the laboratory for analysis for the maximum number of constituents being analyzed in the soil samples. One equipment blank will be collected during each day of soil sampling at HWMU-7. The equipment blank will be analyzed for the TAL inorganic and TCL organic constituents.

One field duplicate sample will be collected during each day of soil sampling at HWMU-7. The field duplicate will be analyzed for the TAL inorganic and TCL organic constituents. The field duplicate will collected by simultaneously aliqouting a sample into separate containers. The containers for field duplicates should be labeled as such.

The occurrence of constituents in blank samples may serve to invalidate the analytical results of the affected constituents. Additional blanks or duplicate samples may be prepared and analyzed to address specific, unanticipated conditions.

6.8.2 Laboratory QA/QC Program

The contract laboratories 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. Copies of the Severn Trent Laboratories Quality Assurance Plan and of the Lancaster Laboratories Quality Assurance Plan are included (on CD-ROM) in **Appendix B**.

Each contract laboratory will keep a logbook to document the processing steps that are applied to each soil sample. All sample preparation techniques and instrumental methods must be identified in this logbook. The results of the analysis of all quality control samples should be

identified specific to each batch of soil samples analyzed. The logbook should also include the time, date, and name of person who performed each processing step.

Dilution during analyses has a major impact on the overall quality and usability of the soil sample data. Large dilution factors may mask hazardous constituents that are present at low concentrations, which may result in constituent concentrations not being identified completely. Therefore, when multiple analyses using sequential dilutions are required, the results from these multiple analyses will be reported.

In addition to the trip and equipment blanks and blind duplicates collected for the field QA/QC program, the laboratory shall prepare and analyze at least one matrix spike for each sampling batch or every 20 samples. The laboratory shall also prepare and analyze either one matrix duplicate or matrix spike duplicate for each analytical method employed. Sufficient sample volume shall be collected in the field so that the laboratory can prepare the matrix spike and matrix spike duplicate.

6.9 HEALTH AND SAFETY PLAN

During the soil sample collection activities, health and safety requirements as per 29 CFR Parts 1910.120 must be followed by all personnel present at the Site. All contractors will adopt, as a minimum, the Radford AAP Facility Health and Safety Plan (HASP). The Radford AAP HASP outlines the minimum health and safety requirements for the facility. The contractors will assure that all personnel entering the Site have had all appropriate health and safety training required by the Occupational Safety and Health Administration (OSHA) and USEPA, and that all requirements of the HASP are implemented.

7.0 CLOSURE SAMPLING AND ANALYSIS PLAN – GROUNDWATER SAMPLES

The groundwater at HWMU-7 will be sampled in accordance with the procedures specified in the *Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Management Units 5, 7 10, and 16* (October 4, 2002).

8.0 CLEAN CLOSURE STANDARDS

8.1 CLEAN CLOSURE STANDARDS FOR RESIDUAL MATERIAL

In the June 25, 2003 correspondence (**Appendix A**), the VDEQ indicated that clean closure may be achieved for HWMU-7 with the residual material remaining in-place if samples of the residual material do not exceed the land disposal restriction (LDR) treatment standards specified in 40 CFR 268 Subpart D.

During the October/November 2002 Field Investigation, three (3) samples of the residual material were submitted for laboratory analyses for TAL inorganic constituents and TCL organic constituents. As shown in **Table 1**, only 16 TAL inorganic constituents were detected in the three residual material samples; no TCL organic constituents were detected in the three residual material samples. Of the 16 detected TAL inorganic constituents, only nine (9) are listed in 40 CFR 268.48 – Universal Treatment Standards.

The LDR Universal Treatment Standards for inorganic constituents specified in 40 CFR 268.48 are based on Toxicity Characteristic Leaching Procedure (TCLP) concentrations. During the October/November 2002 Field Investigation, a composite sample (Unit-7-TCLP) was collected from the residual material obtained from the nine borings advanced within the limits of HWMU-7. Composite sample Unit-7-TCLP was submitted to the laboratory for waste characterization analysis, including TCLP analysis for the inorganic constituents listed in 40 CFR 268.48. As shown in **Table 3**, the inorganic constituent TCLP concentrations detected in composite sample Unit-7-TCLP were well below their respective Universal Treatment Standards. Therefore, the residual material contained in HWMU-7 complies with the LDRs. Copies of the laboratory certificates of analysis for composite sample Unit-7-TCLP are included in **Appendix D**. This information also will be included in the Closure Report for HWMU-7.

8.2 CLEAN CLOSURE STANDARDS FOR SOIL

In the June 25, 2003 correspondence, the VDEQ indicated that the soil and any liner material immediately beneath the residual material at HWMU-7 must be sampled to determine whether they meet the clean closure standards listed in the *Draft Guidance*. In accordance with the *Draft Guidance*, achievement of clean closure for soils at HWMU-7 will be demonstrated by comparing the concentrations of hazardous constituents of concern (HCOCs) in subsurface soil samples to one of the following three clean closure standards, as appropriate:

1. **Analytical Non-Detection** – The concentrations of HCOCs in the compliance samples are below the method detection limits (MDLs) for the analytical test methods presented in Section 6.7.

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 VDEQ 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 (i.e., the HCOCs do not pose an unacceptable risk to human health or the environment) using 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 by the VDEQ, along with other risk-based guidance provided by the VDEQ.

8.2.1 Hazardous Constituents of Concern

In order for Radford AAP to achieve clean closure for HWMU-7, all hazardous waste or HCOCs must be removed from the Unit to levels such that direct contact with any parts of the Unit or with 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 VDEQ-established exposure levels. The HCOCs for HWMU-7 will be compiled from the TAL inorganic constituents and TCL organic constituents detected in the clay liner and/or native soils beneath HWMU-7.

8.2.2 Analytical Non-Detection

In the event that the soil sample analytical results indicate non-detection for all of the HCOCs analyzed using the test methods and detection limits presented in Section 6.7, the specific sample locations exhibiting the non-detects will be deemed to be uncontaminated. Should all soil sample analytical results indicate non-detection for all HCOCs, then the soils at HWMU-7 will be considered to meet the clean closure decontamination standard.

In the event that HCOCs are detected in the soil samples, Radford AAP may demonstrate clean closure by either: 1) statistical comparison of the soil sample HCOC concentrations to the background HCOC concentrations, or 2) a risk assessment evaluation of the HCOCs present in the soil samples.

8.2.3 Comparison to Background

8.2.3.1 Establishment of Background Concentrations

In August and September 2001, the IT Corporation conducted a Facility-Wide Background Study at the Main Manufacturing Area and the New River Unit of Radford AAP in accordance with a USEPA Region III-approved Work Plan. A copy of the *Radford Army Ammunition Plant Facility-Wide Background Report* (December 2001) is included (on CD-ROM) in **Appendix B**. As stated in the *Facility-Wide Background Report*, the primary objective of the study was to collect soil samples representative of background conditions to establish a baseline for inorganic constituents of concern at Radford AAP. Sampling locations were

positioned in tree stands to ensure associated soil samples were representative of areas that had not been affected by previous site activities or releases. Wherever possible, background sample locations were placed in tree stands estimated to predate potential construction activity at each location. The background soil samples were analyzed for the USEPA TAL inorganic compounds and for the USEPA TCL organic compounds. No TCL organic compounds were detected in the background soil samples.

Following the collection and analysis of the background soil samples, IT Corporation initially calculated facility-wide point estimates for the background soil data as confidence limits. As a result of discussions with the USEPA and VDEQ, the final facility-wide point estimates for the background soil data were calculated as tolerance limits. The use of tolerance limits rather than confidence limits evolved from comments questioning the use of the 95% upper confidence limit (UCL) as the point estimate for the background value. The 95% UCL was originally included in the Facility-Wide Background Study as a general point of reference. A confidence interval is used for comparisons within a single population. A compliance data set is then typically compared to a known standard. Using the 95% UCL as a single point comparison or background value, however, is likely to result in classifying many chemicals as greater than background when they are not. These misclassifications would be due to the 95% UCL representing an estimate of the mean. Such misclassifications could occur as often as 50% of the time. A tolerance limit is used for comparisons of similar but distinct populations. A concentration range is defined from a background data set, within which a large proportion of compliance data should fall with high probability. Therefore, it was recommended that a 95% upper tolerance limit (UTL) be developed in the Background Study for use as point-by-point comparisons.

8.2.3.2 Comparison to Background – Inorganic Constituents

The 95% UTLs calculated by the IT Corporation for the inorganic constituents detected in the background soil samples from the Main Manufacturing Area are summarized in **Table 4**. These facility-wide background values, in conjunction with the Unit-specific background concentrations detected in the sample from boring 7GP-16 during the October/November 2002 Field Investigation (**Table 1**), will be used in the initial comparisons to background for any inorganic HCOCs detected in the soil samples obtained from the clay liner and native soils beneath HWMU-7. If the concentration of every inorganic HCOC in 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. If the concentration of any inorganic HCOC in a soil sample exceeds its respective UTL, Radford AAP may attempt to demonstrate that the concentrations of the inorganic HCOCs detected in the clay liner and/or native soils beneath HWMU-7 do not pose an unacceptable risk to human health and the environment.

8.2.3.3 Comparison to Background – Organic Constituents

No TCL organic compounds were detected in the background soil samples collected during the August and September 2001 Facility-Wide Background Study. In addition, no TCL

organic compounds were detected in the Unit-specific background sample collected from boring 7GP-16 during the October/November 2002 Field Investigation. Therefore, comparisons to background concentrations will not be possible for any organic HCOCs detected in the clay liner and/or native soils beneath HWMU-7. If any organic HCOCs are detected in the in the clay liner and/or native soils beneath HWMU-7, Radford AAP may attempt to demonstrate that the detected organic HCOCs concentrations do not pose an unacceptable risk to human health and the environment.

8.2.4 Risk Assessment

Clean closure of the clay liner and native soils beneath HWMU-7 may be demonstrated by a risk-based assessment as an alternative to the non-detection decontamination standard or the statistical comparison of soil samples to background levels. Radford AAP may propose to demonstrate that the concentrations of hazardous constituents detected and remaining in the clay liner and native soils do not pose an unacceptable level of risk to human health and the environment. The risk assessment will be conducted in accordance with the VDEQ 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 VDEQ, along with other risk-based guidance provided by the VDEQ.

A copy of the VDEQ Risk Assessment Guidance is provided in **Appendix E**. The risk assessment protocol detailed in **Appendix E** includes risk formulas for both residential and occupational/industrial exposure scenarios. As stated in the Risk Assessment Guidance, a residential exposure scenario initially will be assumed for the purpose of attempting to document unrestricted closure of the soil. If the risk for potential residential exposure does not exceed the performance standards, unrestricted closure of soil will be documented/accepted. If the site cannot be clean closed for residential use, then the option to pursue restricted closure (commercial/industrial) will be exercised. Use of the commercial/industrial exposure scenario to demonstrate clean closure will require Radford AAP to enact a deed restriction that eliminates the possibility of future residential use of the Site. The requirements for establishing such a deed restriction are detailed in the VDEQ document "*Guidelines for Developing Health-Based Cleanup Goals Using Risk Assessment at A Hazardous Waste Site Facility for Restricted Industrial Use*," dated June 1995 (included in **Appendix E**).

The Risk Exposure and Analysis Modeling System (REAMS) Program requires fate and transport modeling in the event that HCOCs remain in soils at the Unit. The fate and transport modeling used in REAMS is necessary to demonstrate that the HCOCs remaining in soils should not result in contamination of the groundwater underneath the Unit above acceptable risk-based levels.

8.3 CLEAN CLOSURE STANDARDS FOR GROUNDWATER

The groundwater at HWMU-7 currently is monitored in accordance with the requirements of the *Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Management*

Units 5, 7 10, and 16 (October 4, 2002). In the event that the residual material and underlying soils at HWMU-7 meet the clean closure standards specified by the VDEQ, Radford AAP will attempt to demonstrate clean closure for groundwater at HWMU-7 as well. Using the quarterly groundwater monitoring data from the quarter in which the soil samples are collected, clean closure for groundwater at HWMU-7 will be demonstrated by comparing the groundwater sample analytical results to the Groundwater Protection Standards (GPSs) for the Unit. The GPSs for HWMU-7 are based on USEPA Maximum Contaminant Levels (MCLs) for drinking water, or on VDEQ-derived Alternate Concentration Limits (ACLs) for constituents without MCLs. Due to the fact that Radford AAP is an industrial facility with no users of groundwater, comparison of groundwater data to residential drinking water standards will provide the most conservative assessment of risk.

Radford AAP will continue to monitor groundwater at HWMU-7 in accordance with the *Final Hazardous Waste Post-Closure Care Permit for Hazardous Waste Management Units 5, 7 10, and 16* until certifications for clean closure of soil and groundwater at HWMU-7 have been issued by the VDEQ. Upon receipt of certification of clean closure from the VDEQ, Radford AAP will request a reduction in the post-closure period for HWMU-7 in accordance with 40 CFR 264.117(a)(2). Radford AAP assumes that certifications for clean closure of soil and groundwater will trigger the reduction of the post-closure period and signify the completion of post-closure care at HWMU-7.

9.0 CLOSURE COST ESTIMATE AND FINANCIAL ASSURANCE

40 CFR Subpart H (Financial Requirements) specifies the requirements for cost estimates and financial assurance for closure and post-closure care (40 CFR 264.140 through 264.151). The following is directly cited from § 264.140(c):

> "States and the Federal government are exempt from the requirements of this subpart."

Radford AAP is a federal government installation; therefore, HWMU-7, and all other HWMUs at the Radford AAP, are exempt from the requirements of 40 CFR 264 Subpart H.

10.0 SCHEDULE FOR CLOSURE

The sampling activities to support clean closure of HWMU-7 outlined in this *Amended Closure Plan* constitute closure activities. The original closure activities conducted in 1989 were clearly successful, and the residual material left in-place does not represent hazardous waste. Accordingly, for purposes of scheduling, Radford AAP proposes to conduct all activities associated with the sampling and analysis within 90 days of approval of this *Amended Closure Plan*. The schedule of associated modifications and amendments to the Permit is as follows in order of submission:

Type	Reason	Submitted Simultaneously With	Public Comment	VDEQ Response Timeline	Regulatory Citation
Class II Permit Modification	Modification of Post-Closure Care Plans	Amended Closure Plan	60 Days	120 Days	40 CFR 270.42 Appendix I, Section E.5
Class III Permit Modification	Clean Closure – Reduction of Post-Closure Care Period	Closure Report	60 Days	Indefinite	40 CFR 270.42 Appendix I, Section E.3

11.0 CLOSURE PLAN AMENDMENT

Any future amendment of the Closure Plan will be conducted in accordance with the requirements of the regulations under 40 CFR 264.112. These regulations specify the following requirements:

1. The written notification or request to the Director of the VDEQ 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 of the VDEQ to authorize a change in the approved closure plan whenever the following occurs:

   i. Changes in operating plans or facility design affect the closure plan.

   ii. There is a change in the expected year of closure.

   iii. 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.

   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 40 CFR 264.112(c)(4), the Director may request modifications to the closure plan under the conditions described in 40 CFR 264.112(c)(2).

12.0 CERTIFICATION OF CLOSURE

Radford AAP and an independent professional engineer, registered in the Commonwealth of Virginia, will both certify that HWMU-7 has been closed in accordance with the specifications in this Closure Plan. The certification statements will be in accordance with 40 CFR 270.11 – Signatories to Permit Applications and Reports. The certifications will be made by an authorized person described in 40 CFR 270.11(a), or by a duly authorized representative of that person as delineated in 40 CFR 270.11(b).

The certification of closure by the Radford AAP and the professional engineer will be in accordance with the requirements of 40 CFR 270.11(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.*

The certification of closure will be submitted by registered mail to the VDEQ within 60 days of completion of closure within the Closure Report. (Within 240 days after initiation of closure.)

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 also will include a determination that appropriate closure plan procedures and 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 VDEQ. 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 Closure Plan.

13.0 CLOSURE REPORT

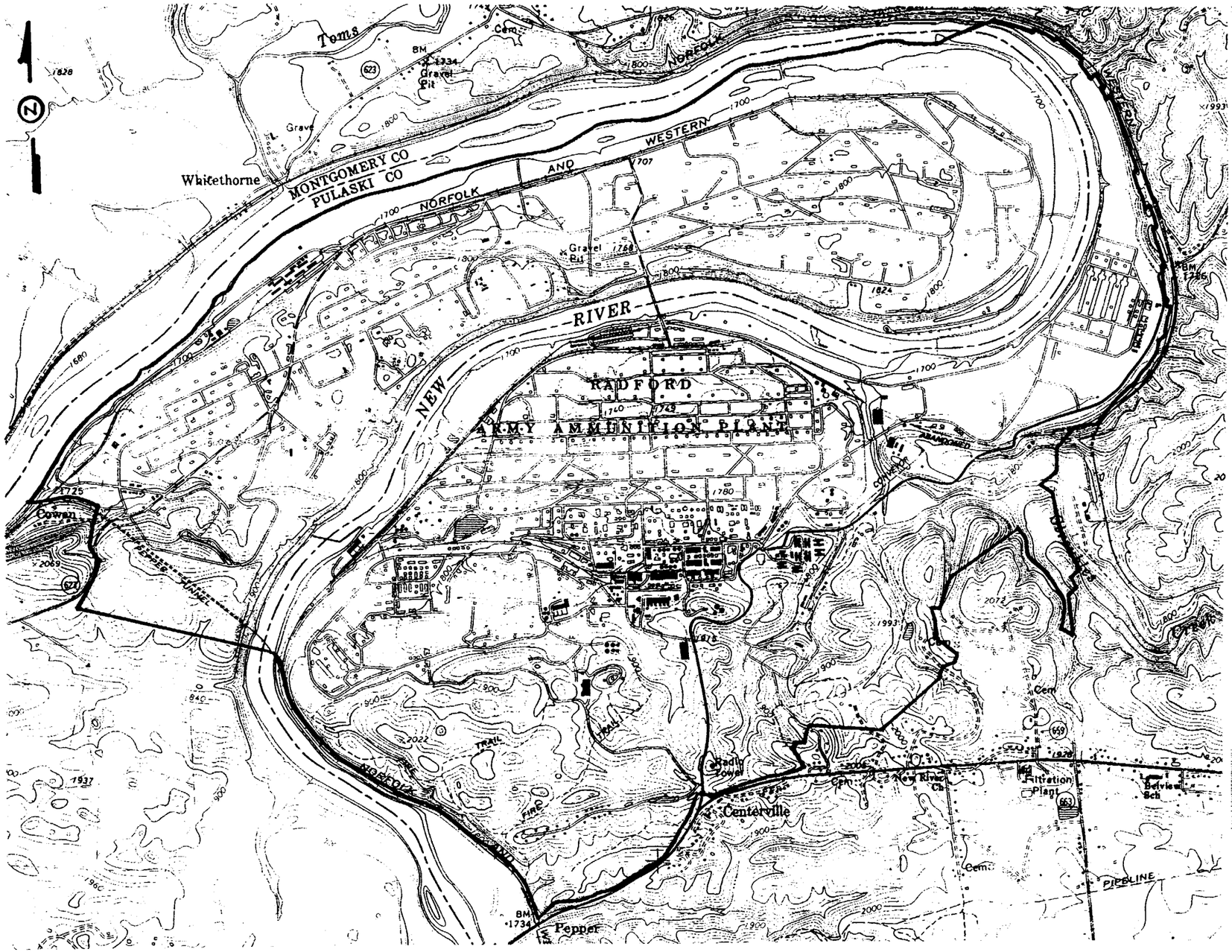
In accordance with 40 CFR 264.115 – Certification of Closure, a Closure Report will be submitted to the Director of the VDEQ to provide documentation supporting the certification of closure and to demonstrate that HWMU-7 has been closed in accordance with the procedures, criteria, decontamination standards, and performance standards of the *Amended Closure Plan*. The Closure Report will provide sufficiently detailed and summary information for the following items, as applicable, 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 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. The Closure Report also will include the certification of closure statements of Radford AAP and the independent professional engineer registered in the Commonwealth of Virginia.

The Closure Report will be submitted in conjunction with a Class III Permit Modification requesting a reduction of the post-closure care period based on the results of the closure sampling activities proposed in this *Amended Closure Plan*. In the event that clean closure for both soil and groundwater is attained, Radford AAP will request in the Closure Report the reduction of the post-closure care period for HWMU-7, thereby signifying the completion of post-closure care at the Unit. Radford AAP will continue to monitor groundwater at HWMU-7 in accordance with the *Final Permit* (October 4, 2002) until certifications for clean closure of soil and groundwater at HWMU-7 have been issued by the VDEQ.

In the event that HWMU-7 attains clean closure for soil, but does not attain clean closure for groundwater, Radford AAP will continue to monitor groundwater at HWMU-7 in accordance with the *Final Permit* (October 4, 2002). However, clean closure for soil would indicate that the original closure activities conducted in 1989 were clearly successful, and that the residual material left in-place does not represent hazardous waste. Therefore, corrective action in the form of source removal would have occurred with the closure activities conducted in 1989. In this case, the Class III Permit Modification will propose that groundwater monitoring at HWMU-7 will cease (and the post-closure care period for the Unit will be reduced) in the event that the GPSs are not exceeded for a period of (3) consecutive years following the attainment of clean closure for soil, in accordance with 40 CFR 264.100(f).

In the unlikely event that HWMU-7 is unable to attain clean closure for soil, the Unit will remain closed with the residual material in-place. If this occurs, the Unit will remain in post-closure care in accordance with the *Final Permit* (October 4, 2002), and a Class III Permit Modification will not be submitted with the Closure Report.

FIGURES

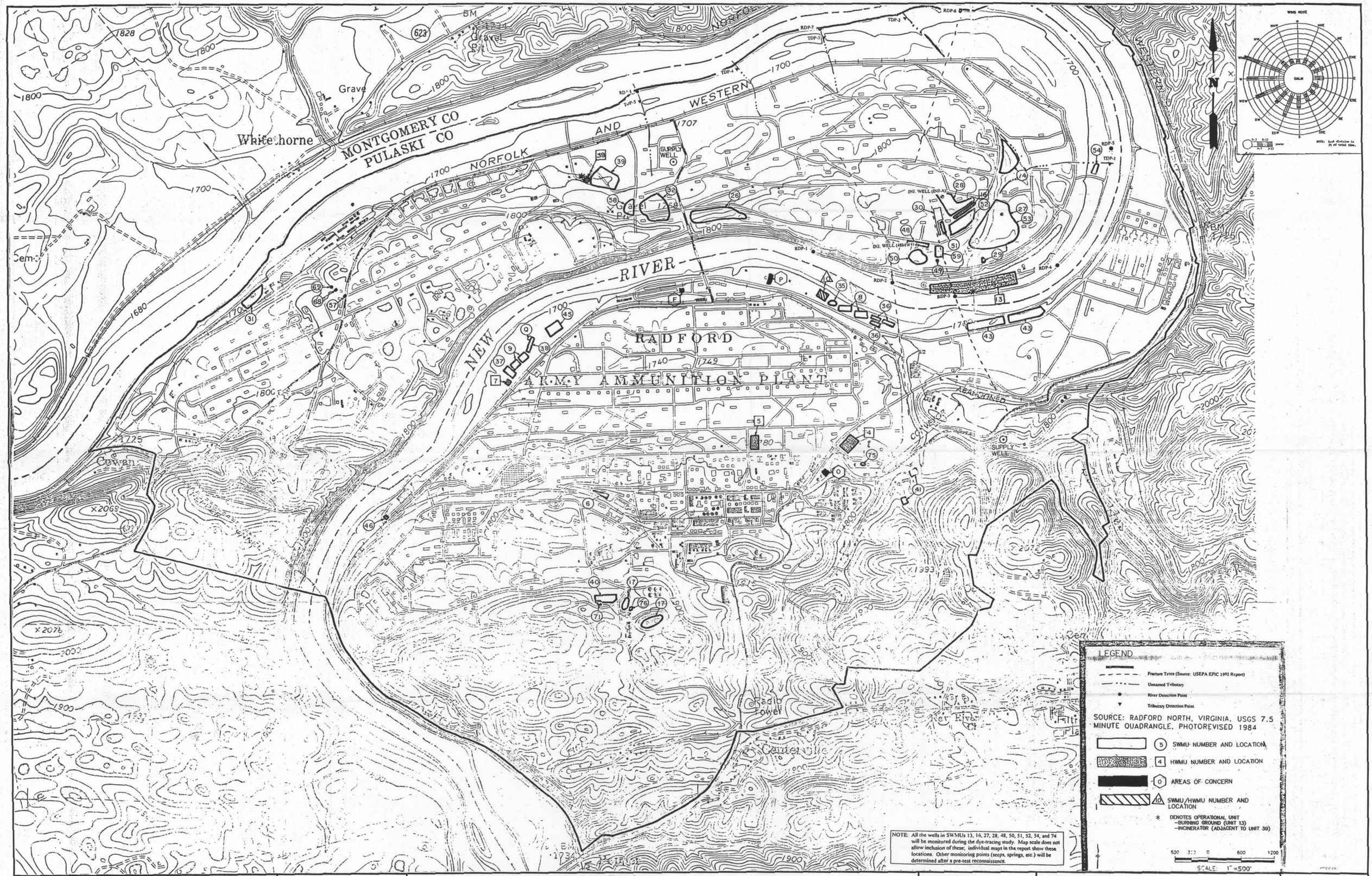


LEGEND

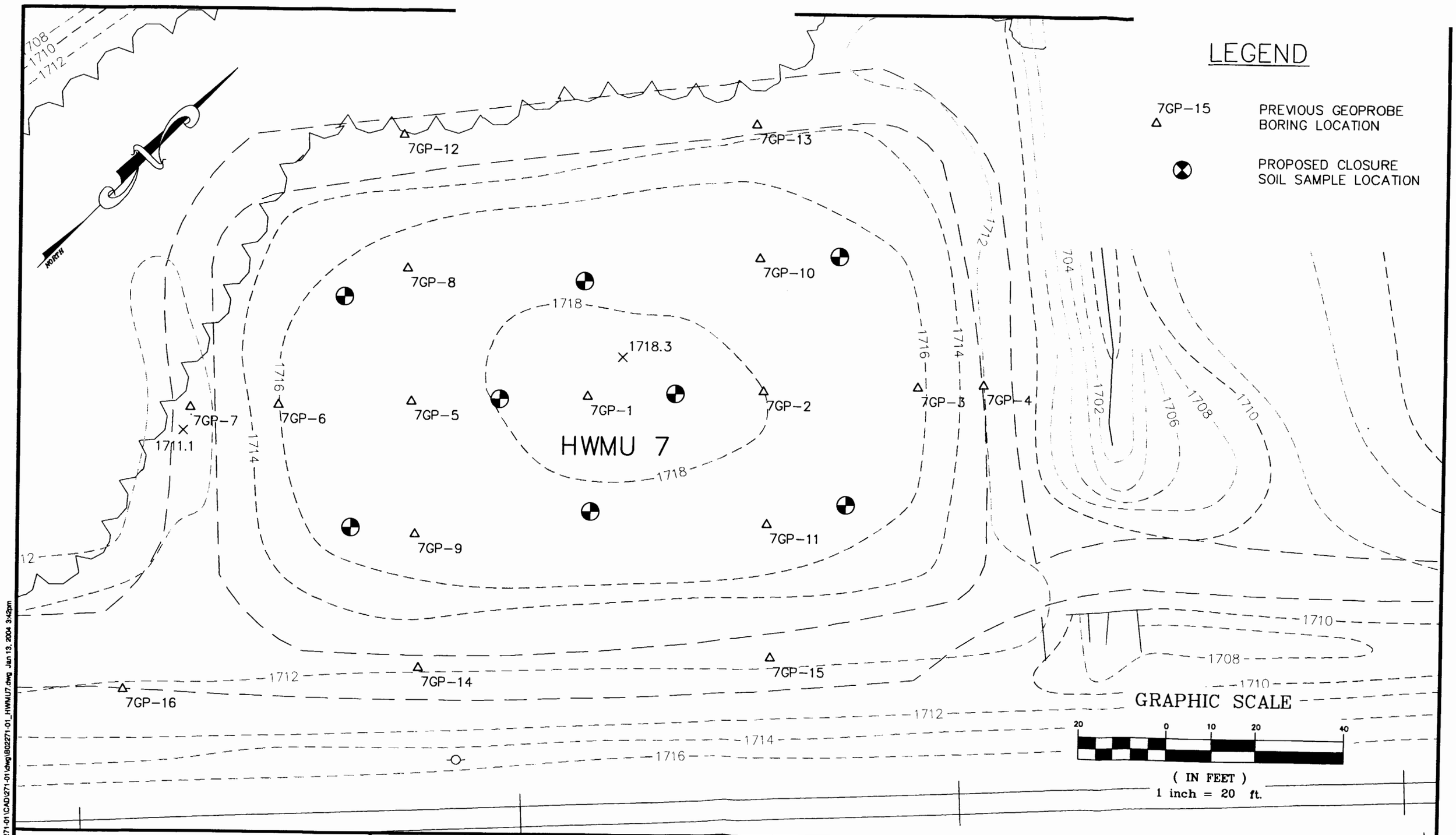
——— PROPERTY LINE

APPEND.DWG

Draper Aden Associates CONSULTING ENGINEERS Blacksburg, Virginia – Richmond, Virginia – Nashville, Tennessee	DESIGNED RGM DRAWN JFF CHECKED AEK DATE 6–11–97	SITE LOCATION MAP RADFORD ARMY AMMUNITION PLANT MONTGOMERY COUNTY, VIRGINIA	SCALE: 1" = 2000' PLAN NO.	FIGURE 1



Draper Aden Associates CONSULTING ENGINEERS Blacksburg, Virginia – Richmond, Virginia – Nashville, Tennessee	DESIGNED RGM DRAWN JFF CHECKED AEK DATE 6–10–97	WASTE MANAGEMENT UNIT LOCATIONS RADFORD ARMY AMMUNITION PLANT MONTGOMERY COUNTY, VIRGINIA	REVISIONS: REV. 8-24-99	SCALE: 1" = 500' PLAN № T-7774-00	FIGURE 2



P:\B02\200\B02271\B02271-01\CAD\271-01\dwg\B02271-01_HWMU7.dwg Jan 13, 2004 3:42pm

Draper Aden Associates
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Blacksburg, VA 24060
540-552-0444 Fax: 540-552-0291
Richmond, VA
Charlottesville, VA
Raleigh-Durham, NC

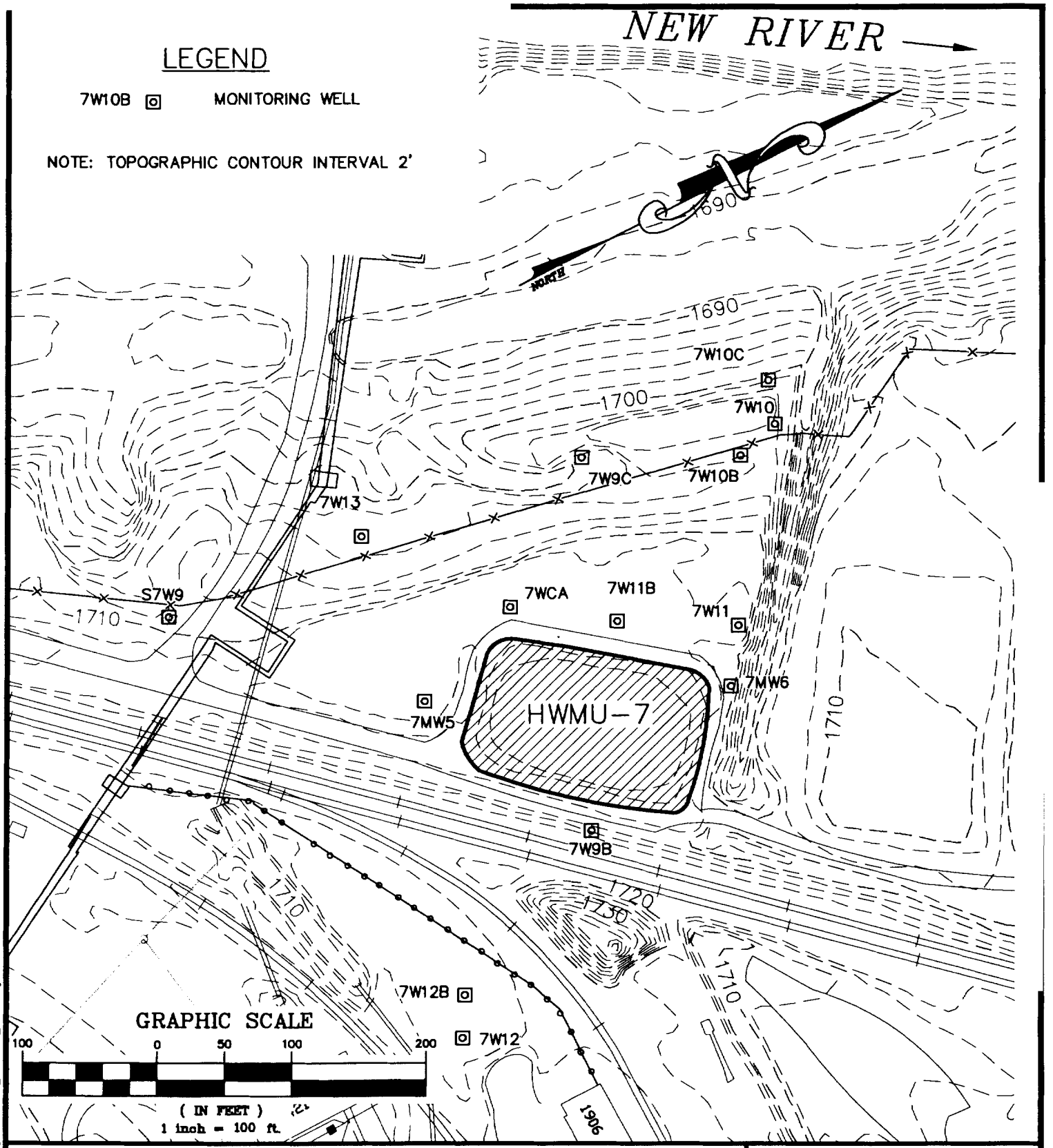
DESIGNED	RGM
DRAWN	DRW
CHECKED	MDL
DATE	01/13/04

HWMU-7 PROPOSED CLOSURE SOIL SAMPLE LOCATION PLAN
RADFORD ARMY AMMUNITION PLANT
MONTGOMERY COUNTY, VIRGINIA

SCALE: 1"=20'

PLAN NO. B02271-01

FIGURE 4



HWMU-7 SITE PLAN

RADFORD ARMY AMMUNITION PLANT

RADFORD, VIRGINIA

SCALE: 1"=100'

PLAN NO. B02271-01

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Hampton Roads, VA
Raleigh-Durham, NC

DESIGNED	RGM
DRAWN	DRW
CHECKED	AEK
DATE	01/16/04

FIGURE 3

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TABLES

TABLE 1

HAZARDOUS WASTE MANAGEMENT UNIT 7
SUMMARY OF TAL INORGANIC CONSTITUENTS AND TCL ORGANIC CONSTITUENTS DETECTED IN RESIDUAL MATERIAL AND SOIL SAMPLES
RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA

Analyte / Sample Location	Date	Concentrations in mg/kg																				
		Aluminum	Arsenic*	Barium*	Beryllium*	Calcium	Chromium*	Cobalt	Copper	Iron	Lead*	Magnesium	Manganese	Nickel*	Potassium	Selenium*	Vanadium	Zinc	Cyanide*	4,4-DDD*	4,4-DDE*	N-Nitrosodiphenylamine*
7GP-1 (1-3') (cap)	11/01/02	11100	3.8	66.9	0.7	7490	24.1	11.5	22.8	19400	8.1	4290	662	13.5	774	~	28	17.4	~	~	~	~
7GP-2 (8-12') (residual material)	11/01/02	8790	2.7	40.9	1.2	~	22	12.5	22	23300	2.8	3140	274	21.6	1070	~	21.1	15	~	~	~	~
7GP-5 (6-11') (residual material)	11/01/02	20000	3.5	55.6	~	~	22.8	~	10	23600	11	787	187	7.2	732	~	60.6	24.2	~	~	~	~
7GP-8 (5-8') (residual material)	11/01/02	22400	2.4	55	~	1570	20.1	~	12.7	23200	10.3	1090	280	8.5	1040	~	61.8	28.1	~	~	~	~
7GP-2 (13.5-14.5') (base clay)	11/01/02	19700	3.1	70.9	0.84	~	22.5	16.2	14.2	29300	13.6	2000	407	11.4	1390	~	57.7	32.6	~	0.0035	~	~
7GP-3 (10-11') (native soil)	11/01/02	11700	26.1	229	1.5	28100	32.8	8.1	23.2	15900	35.1	2440	145	15.9	2970	3.5	42.1	33.8	0.69	~	0.0025	0.75
7GP-4 (3-4') (adjacent soil)	11/01/02	5290	~	69.2	~	749	10.1	~	5.1	9860	5.8	1590	292	6.3	729	~	14	35	~	~	~	~
7GP-16 (3-4') (Unit background)	11/01/02	6650	~	106	~	1230	11.5	~	5.1	10800	5.4	1890	422	7.7	809	~	15.4	39.7	~	~	~	~

NOTES:
~: Not detected above the Limit of Quantitation (LOQ).
*: Hazardous Constituent (listed in Appendix VIII to 40 CFR Part 261).

TABLE 2

HAZARDOUS WASTE MANAGEMENT UNIT 7
TAL INORGANIC AND TCL ORGANIC CONSTITUENTS LIST
RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA

Analyte	SW-846 Method	Limit of Quantitation	Limit of Detection	Units
Aluminum	6010B	20	5.5	mg/kg
Antimony	6010B	6	0.2	mg/kg
Arsenic	6010B	1	0.11	mg/kg
Barium	6010B	20	0.073	mg/kg
Beryllium	6010B	0.5	0.019	mg/kg
Cadmium	6010B	0.5	0.022	mg/kg
Calcium	6010B	500	22	mg/kg
Chromium	6010B	1	0.13	mg/kg
Cobalt	6010B	5	0.077	mg/kg
Copper	6010B	2.5	0.38	mg/kg
Iron	6010B	10	6.1	mg/kg
Lead	6010B	0.3	0.14	mg/kg
Magnesium	6010B	500	1.7	mg/kg
Manganese	6010B	1.5	0.13	mg/kg
Mercury	7471A	0.1	0.018	mg/kg
Nickel	6010B	4	0.25	mg/kg
Potassium	6010B	500	2.9	mg/kg
Selenium	6010B	0.5	0.43	mg/kg
Silver	6010B	1	0.077	mg/kg
Sodium	6010B	500	22	mg/kg
Thallium	6010B	1	0.42	mg/kg
Vanadium	6010B	5	0.066	mg/kg
Zinc	6010B	2	1.3	mg/kg
4,4-DDD	8081A/8082	0.002	0.0004	mg/kg
4,4-DDE	8081A/8082	0.002	0.0004	mg/kg
4,4-DDT	8081A/8082	0.002	0.0004	mg/kg
Aldrin	8081A/8082	0.001	0.0002	mg/kg
alpha-BHC	8081A/8082	0.001	0.0002	mg/kg
Aroclor-1016	8081A/8082	0.02	0.005	mg/kg
Aroclor-1221	8081A/8082	0.02	0.01	mg/kg
Aroclor-1232	8081A/8082	0.02	0.005	mg/kg
Aroclor-1242	8081A/8082	0.02	0.006	mg/kg
Aroclor-1248	8081A/8082	0.02	0.005	mg/kg
Aroclor-1254	8081A/8082	0.02	0.006	mg/kg
Aroclor-1260	8081A/8082	0.02	0.005	mg/kg
beta-BHC	8081A/8082	0.001	0.0002	mg/kg
Chlordane-alpha	8081A/8082	0.002	0.0002	mg/kg
Chlordane-gamma	8081A/8082	0.002	0.0002	mg/kg
delta-BHC	8081A/8082	0.001	0.0002	mg/kg
Dieldrin	8081A/8082	0.002	0.0004	mg/kg
Endosulfan I	8081A/8082	0.001	0.0002	mg/kg
Endosulfan II	8081A/8082	0.002	0.0004	mg/kg

TABLE 2

HAZARDOUS WASTE MANAGEMENT UNIT 7
TAL INORGANIC AND TCL ORGANIC CONSTITUENTS LIST
RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA

Analyte	SW-846 Method	Limit of Quantitation	Limit of Detection	Units
Endosulfan Sulfate	8081A/8082	0.002	0.0004	mg/kg
Endrin	8081A/8082	0.002	0.0004	mg/kg
Endrin Aldehyde	8081A/8082	0.002	0.001	mg/kg
Endrin Ketone	8081A/8082	0.002	0.0004	mg/kg
gamma-BHC (lindane)	8081A/8082	0.001	0.0002	mg/kg
Heptachlor	8081A/8082	0.001	0.0002	mg/kg
Heptachlor epoxide	8081A/8082	0.001	0.0002	mg/kg
Methoxychlor	8081A/8082	0.02	0.005	mg/kg
Toxaphene	8081A/8082	0.04	0.01	mg/kg
1,1,1-Trichloroethane	8260B	0.005	0.001	mg/kg
1,1,2,2-Tetrachloroethane	8260B	0.005	0.001	mg/kg
1,1,2-Trichloroethane	8260B	0.005	0.001	mg/kg
1,1-Dichloroethane	8260B	0.005	0.001	mg/kg
1,1-Dichloroethene	8260B	0.005	0.001	mg/kg
1,2-Dichloroethane	8260B	0.005	0.001	mg/kg
1,2-Dichloropropane	8260B	0.005	0.001	mg/kg
2-Butanone (methyl ethyl ketone)	8260B	0.01	0.004	mg/kg
2-Hexanone	8260B	0.01	0.004	mg/kg
4-Methyl-2-pentanone (methyl isobutyl ketone)	8260B	0.01	0.004	mg/kg
Acetone	8260B	0.02	0.007	mg/kg
Benzene	8260B	0.005	0.001	mg/kg
Bromodichloromethane	8260B	0.005	0.001	mg/kg
Bromoform	8260B	0.005	0.001	mg/kg
Bromomethane	8260B	0.005	0.002	mg/kg
Carbon Disulfide	8260B	0.005	0.001	mg/kg
Carbon Tetrachloride	8260B	0.005	0.001	mg/kg
Chlorobenzene	8260B	0.005	0.001	mg/kg
Chloroethane	8260B	0.005	0.002	mg/kg
Chloroform	8260B	0.005	0.001	mg/kg
Chloromethane	8260B	0.005	0.002	mg/kg
cis-1,2-Dichloroethene	8260B	0.005	0.001	mg/kg
cis-1,3-Dichloropropene	8260B	0.005	0.001	mg/kg
Dibromochloromethane	8260B	0.005	0.001	mg/kg
Ethylbenzene	8260B	0.005	0.001	mg/kg
Methylene Chloride	8260B	0.005	0.002	mg/kg
Styrene	8260B	0.005	0.001	mg/kg
Tetrachloroethene	8260B	0.005	0.001	mg/kg
Toluene	8260B	0.005	0.001	mg/kg
Total Xylenes	8260B	0.005	0.001	mg/kg
trans-1,2-Dichloroethene	8260B	0.005	0.001	mg/kg
trans-1,3-Dichloropropene	8260B	0.005	0.001	mg/kg
Trichloroethene	8260B	0.005	0.001	mg/kg

TABLE 2

HAZARDOUS WASTE MANAGEMENT UNIT 7
TAL INORGANIC AND TCL ORGANIC CONSTITUENTS LIST
RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA

Analyte	SW-846 Method	Limit of Quantitation	Limit of Detection	Units
Vinyl Chloride	8260B	0.005	0.001	mg/kg
1,2,4-Trichlorobenzene	8270C	0.4	0.04	mg/kg
1,2-Dichlorobenzene	8270C	0.4	0.04	mg/kg
1,3-Dichlorobenzene	8270C	0.4	0.04	mg/kg
1,4-Dichlorobenzene	8270C	0.4	0.04	mg/kg
2,2'-oxybis(1-Chloropropane)	8270C	0.4	0.04	mg/kg
2,4,5-Trichlorophenol	8270C	0.4	0.04	mg/kg
2,4,6-Trichlorophenol	8270C	0.4	0.04	mg/kg
2,4-Dichlorophenol	8270C	0.4	0.04	mg/kg
2,4-Dimethylphenol	8270C	0.4	0.04	mg/kg
2,4-Dinitrophenol	8270C	2.4	0.8	mg/kg
2,4-Dinitrotoluene	8270C	0.4	0.08	mg/kg
2,6-Dinitrotoluene	8270C	0.4	0.04	mg/kg
2-Chloronaphthalene	8270C	0.4	0.04	mg/kg
2-Chlorophenol	8270C	0.4	0.04	mg/kg
2-Methylnaphthalene	8270C	0.4	0.04	mg/kg
2-Methylphenol	8270C	0.4	0.04	mg/kg
2-Nitroaniline	8270C	0.4	0.04	mg/kg
2-Nitrophenol	8270C	0.4	0.04	mg/kg
3,3-Dichlorobenzidine	8270C	1	0.08	mg/kg
3-Nitroaniline	8270C	0.4	0.08	mg/kg
4,6-Dinitro-2 methylphenol	8270C	1	0.2	mg/kg
4-Bromophenyl-phenylether	8270C	0.4	0.04	mg/kg
4-Chloro-3-methylphenol	8270C	0.4	0.08	mg/kg
4-Chloroaniline	8270C	0.4	0.04	mg/kg
4-Chlorophenyl-phenylether	8270C	0.4	0.04	mg/kg
4-Methylphenol	8270C	0.4	0.08	mg/kg
4-Nitroaniline	8270C	0.4	0.08	mg/kg
4-Nitrophenol	8270C	1	0.2	mg/kg
Acenaphthene	8270C	0.4	0.04	mg/kg
Acenaphthylene	8270C	0.4	0.04	mg/kg
Anthracene	8270C	0.4	0.04	mg/kg
Benzo(a)anthracene	8270C	0.4	0.04	mg/kg
Benzo(a)pyrene	8270C	0.4	0.04	mg/kg
Benzo(b)fluoranthene	8270C	0.4	0.04	mg/kg
Benzo(g,h,i)perylene	8270C	0.4	0.04	mg/kg
Benzo(k)fluoranthene	8270C	0.4	0.04	mg/kg
bis(2-Chloroethoxy)methane	8270C	0.4	0.04	mg/kg
bis(2-chloroethyl)ether	8270C	0.4	0.04	mg/kg
bis-(2-Ethylhexyl)phthalate	8270C	0.4	0.08	mg/kg
Butylbenzylphthalate	8270C	0.4	0.08	mg/kg
Carbazole	8270C	0.4	0.04	mg/kg

TABLE 3

HAZARDOUS WASTE MANAGEMENT UNIT 7
SUMMARY OF INORGANIC CONSTITUENT TCLP CONCENTRATIONS
FOR SAMPLE UNIT-7-TCLP
RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA

Analyte	Unit-7-TCLP	40 CFR 268.48 Universal Treatment Standards	Units
Antimony	nd	1.15	mg/l
Arsenic	0.0056	5	mg/l
Barium	0.521	21	mg/l
Cadmium	nd	0.11	mg/l
Chromium	nd	0.6	mg/l
Lead	nd	0.75	mg/l
Mercury	nd	0.025	mg/l
Nickel	0.0115	11	mg/l
Selenium	nd	5.7	mg/l
Silver	nd	0.14	mg/l
Thallium	nd	0.2	mg/l
Vanadium	nd	1.6	mg/l
Zinc	0.0474	4.3	mg/l

NOTES:
nd: Not detected above the laboratory Method Detection Limit (MDL).

TABLE 4

FACILITY-WIDE BACKGROUND CONCENTRATIONS
SUBSURFACE SOIL - MAIN MANUFACTURING AREA
RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA

CONSTITUENT	Frequency of Detection	Minimum Concentration	Maximum Concentration	Arithmetic Mean Concentration	Coefficient of Variation	Distribution	95% UTL of the Mean
Aluminum	22/22	8,710	47,900	21,223	0.517	Lognormal	56,307
Arsenic	20/22	1.2	35.9	7.73	1.16	Lognormal	64.5
Barium	19/22	25.2	155	71.5	0.623	Normal	176
Beryllium	11/22	0.79	5.3	1.01	1.16	Neither	1.3
Cadmium	12/22	0.57	2.5	0.778	0.805	Lognormal	3.33
Chromium	22/22	10.8	75.8	32.3	0.427	Lognormal	82.8
Cobalt	16/22	6.8	94.3	18.3	1.33	Lognormal	118
Copper	22/22	3.3	34.4	17	0.611	Normal	41.4
Iron	22/22	14,300	67,700	32,595	0.352	Normal	59,560
Lead	22/22	5.6	256	31.3	1.84	Neither	256
Manganese	22/22	39.4	1,760	428	0.939	Lognormal	3,143
Mercury	10/22	0.038	0.27	0.0729	0.865	Neither	0.154
Nickel	22/22	4.8	94.2	20.4	1.01	Lognormal	93.2
Thallium	12/22	1.4	5	1.76	0.729	Neither	2.61
Vanadium	22/22	27	114	61.9	0.329	Normal	110
Zinc	22/22	14.7	598	112	1.28	Lognormal	674

NOTES:
Source: *Radford Army Ammunition Plant Facility-Wide Background Study*, IT Corporation, December 2001.

APPENDIX A

VDEQ CORRESPONDENCE DATED JUNE 25, 2003

TABLE 2

HAZARDOUS WASTE MANAGEMENT UNIT 7
TAL INORGANIC AND TCL ORGANIC CONSTITUENTS LIST
RADFORD ARMY AMMUNITION PLANT, RADFORD, VIRGINIA

Analyte	SW-846 Method	Limit of Quantitation	Limit of Detection	Units
Chrysene	8270C	0.4	0.04	mg/kg
Dibenz(a,h)anthracene	8270C	0.4	0.04	mg/kg
Dibenzofuran	8270C	0.4	0.04	mg/kg
Diethylphthalate	8270C	0.4	0.08	mg/kg
Dimethylphthalate	8270C	0.4	0.08	mg/kg
Di-n-butylphthalate	8270C	0.4	0.08	mg/kg
Di-n-octylphthalate	8270C	0.4	0.08	mg/kg
Fluoranthene	8270C	0.4	0.04	mg/kg
Fluorene	8270C	0.4	0.04	mg/kg
Hexachlorobenzene	8270C	0.4	0.04	mg/kg
Hexachlorobutadiene	8270C	0.4	0.08	mg/kg
Hexachlorocyclopentadiene	8270C	1	0.2	mg/kg
Hexachloroethane	8270C	0.4	0.04	mg/kg
Indeno(1,2,3-cd)pyrene	8270C	0.4	0.04	mg/kg
Isophorone	8270C	0.4	0.04	mg/kg
Naphthalene	8270C	0.4	0.04	mg/kg
Nitrobenzene	8270C	0.4	0.04	mg/kg
N-Nitroso-di-n-propylamine	8270C	0.4	0.04	mg/kg
N-Nitrosodiphenylamine	8270C	0.4	0.04	mg/kg
Pentachlorophenol	8270C	1	0.2	mg/kg
Phenanthrene	8270C	0.4	0.04	mg/kg
Phenol	8270C	0.4	0.04	mg/kg
Pyrene	8270C	0.4	0.04	mg/kg
Cyanide	9012A	0.5	0.5	mg/kg

NOTES:

Actual sample quantitation and detection limits will be adjusted based on dry weight.

Limits provided above may change based on dry weight, matrix variability, instrumentation, and method detection limit studies.

AR # 05-01
Rec'd 07-01-2003
C: Jake
Kedron
Diana
McKenna
Env Fac

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

W. Tayloe Murphy, Jr.
Secretary of Natural Resources

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Robert G. Burnley
Director

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1-800-592-5482

June 25, 2003

Ms. C. A. Jake
Environmental Manager
Alliant Ammunition and Powder Company, LLC
Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, Virginia 24141

Re: Radford Army Ammunition Plant (RFAAP), Radford, VA
EPA ID No. VA1210020730
Field Investigation Report and Risk Assessment for Units 5 and 7[1]
(Unit 5/S04; Unit 7/S04)

Dear Ms. Jake:

The Department of Environmental Quality, Office of Waste Permitting (the Department) has reviewed the *Field Investigation Report and Risk Assessment for Units 5 and 7* (*Report*) submitted with your correspondence of March 5, 2003. According to previous discussions and correspondence, RFAAP will attempt to remove the sources of contamination by achieving clean closure at the units. RFAAP had originally planned to revise the closure plans for HWMUs 5 and 7 based upon the results of the initial investigative sampling. Since, RFAAP believes the sampling results may already show that concentrations of contaminants are not a risk to human health or the environment, the *Report* provides a risk assessment instead of revised closure plans.

The May 27, 1988 approved closure plans for HWMUs 5 and 7 provided for closure only by landfilling (i.e., wastes in-place and capping). Therefore, if RFAAP wishes to continue pursuing clean closure of the capped units, revised closure plans that include procedures and standards for clean closure must be submitted. To assist with the revising the closure plans, an electronic copy of

[1] PCCP
Permit Event Code/NA

the Department's *Draft Guidance Manual for Closure Plans and Post-Closure Plans (Draft Guidance)*, September 28, 2001 has been provided to Mr. J. Redder of your staff.

Concerning the *Field Investigation Report and Risk Assessment for Units 5 and 7*, the Department is providing the following comments:

1) The closure requirements for hazardous waste surface impoundments of 40 CFR 264.228(a)(1) requires the removal or decontamination of "contaminated containment system components (liners, etc.), contaminated subsoils, and structures and equipment contaminated with waste and leachate." Therefore, in order to demonstrate clean closure of these units, the soil and liner material immediately beneath the wastes must be sampled as well to determine if they meet clean closure standards.
2) EPA Region III Risk-Based Concentration (RBC) and Soil Screening Levels (SSLs) are not appropriate clean closure standards. Refer to Section 3.13 of the *Draft Guidance* for the requirements of all acceptable clean closure standards (i.e., analytical non-detection, background, and risk-based).
3) If RFAAP intends to demonstrate that clean closure may be achieved with wastes in-place, every sample of waste must not exceed the land disposal restrictions (LDRs) treatment standards specified in 40 CFR 286, Subpart D.

In addition to the above comments, the Department recommends that the revised closure plans include more than one option for meeting clean closure standards (e.g., no removal of wastes or soils, excavation and removal of contaminated materials, etc.) in order to minimize the need for future revisions. Please submit the revised closure plans within ninety (90) calendar days calendar of receipt of this letter.

The Department has also received the Professional Geologist's certification submitted with your correspondence of April 30, 2003. However, as indicated in comment 5 of the Department's October 18, 2002 letter, 40 CFR 264.115 requires that the certification be signed by an independent Professional Engineer registered in the Commonwealth of Virginia. Please provide the P.E. certification within thirty (30) calendar days of receipt of this letter.

If you have questions, please contact me at (804) 698-4131 or by e-mail at gweng@deq.state.va.us.

Sincerely,

Garwin W. Eng
Environmental Engineer Senior
Office of Waste Permitting

c: Robert N. Davie, III
Radford Army Ammunition Plant
SMARF-OP, P. O. Box 2
Radford, Virginia 24141-0099

Robert G. Thomson – EPA Region III (3HS13)
Aziz Farahmand – WCRO, DEQ
Leslie A. Romanchik – DEQ
Mark S. Leeper – DEQ
Howard F. Freeland – DEQ
Central Hazardous Waste File

APPENDIX B
(CD-ROM)

MAY 1988 CLOSURE PLAN FOR UNITS 5, 7, AND 16

FIELD INVESTIGATION REPORT AND RISK ASSESSMENT FOR HAZARDOUS WASTE MANAGEMENT UNITS 5 AND 7

FACILITY-WIDE BACKGROUND STUDY REPORT

SEVERN TRENT LABORATORIES QUALITY ASSURANCE PLAN

LANCASTER LABORATORIES QUALITY ASSURANCE PLAN

APPENDIX C

EXAMPLE CHAIN-OF-CUSTODY FORM

CHAIN OF CUSTODY RECORD

Laboratory:

Client: **Attn:** **Address:** **Phone:** **Fax:** **Fax:**	**Consultant:** **Attn:** **Address:** **Phone:** **Fax:**	**Sample Site:** **Location:** **Event:** **DAA JN:** **Lab JN:**	**Project Specific (PS) or Batch (B) QC:** ☐PS ☐B **Sample Collection for Project Complete? (See Note 1)** ☐YES ☐NO **Carrier:** _____ **Tracking Number:** _____ _____

Box 1: Matrix		Box 2: Preservative		Box 3: Filtered/Unfiltered	Box 4: Sample Type	Invoice
SW Surface Water	T Trip Blank	A HCL	E NaOH	F Filtered	G Grab	
GW Groundwater	E Equipment Blank	B HNO_3	F ZnAc	U Unfiltered	C Composite	**Copy to Consultant:** ☐YES ☐NO
L Leachate	P Product	C H_2SO_4	G Other (Specify)	**Box 5: Sample Container Type**		**Bill:** ☐Client ☐Consultant
S Soil	O Other	D NaHSO4	H None	P Plastic V VOA AG Amber Glass CG Clear Glass		**Preserved and shipped on ice:** ☐YES ☐NO

Box 4 - Sample Type											***GENERAL NOTES: See attached target analyte list.***
Box 3 - Filtered/Unfiltered											
Required pH of Sample											
Box 2 - Preservative											
Box 5 - Sample Container Type											
Sample ID	**Date:**	**Time**	**Box 1: Matrix**	**Number of Bottles**							

Clients Special Instructions:

Received by lab in Good Condition _____ Yes _____ No Custody Seal Intact _____ Yes _____ No Temperature upon arrival _____ Received on Ice _____ Yes _____ No

Describe problems, if any:

Sampler Name (Print):	Date:	#1 Relinquished by (Signature):	Date:	#2 Relinquished by (Signature):	Date:	Sample Storage Time Requested:
Sampler Signature:	Time:	Company Name:	Time:	Company Name:	Time:	
Sampler Name (Print):	Date:	#1 Received by (Signature):	Date:	#2 Received by (Signature):	Date:	30 DYS ORG/6 MTHS INORG
Sampler Signature:	Time:	Company Name:	Time:	Company Name:	Time:	

APPENDIX D

LABORATORY CERTIFICATES OF ANALYSIS FOR COMPOSITE SAMPLE UNIT-7-TCLP

Lancaster Laboratories

REPRINT

Lancaster Laboratories Sample No. SW 3933071

Unit 7 TCLP Composite Soil Sample
HWMU-5 & HWMU-7 Investigation

Collected:11/01/2002 14:00

Account Number: 11200

Submitted: 11/02/2002 10:20
Reported: 11/12/2003 at 09:12
Discard: 12/13/2003

Draper Aden Associates, Inc.
2206 South Main Street
Blacksburg VA 24060

UNIT7 SDG#: RAR01-09

CAT No.	Analysis Name	CAS Number	Dry Result	Dry Method Detection Limit	Units	Dilution Factor
00111	Moisture	n.a.	15.5	0.50	%	1
	"Moisture" represents the loss in weight of the sample after oven drying at 103 - 105 degrees Celsius. The moisture result reported above is on an as-received basis.					
00394	pH	n.a.	7.15	0.010		1
	The pH was performed on a 1:1 slurry (25 gms. of sample and 25 ml. of deionized water) after being tumbled for 30 min.					
00496	Corrosivity	n.a.	See Below		See Below	1
	Corrosivity: The pH of a 1:1 slurry (with deionized water) was 7.15 indicating that the waste is not corrosive. A waste is corrosive if it exhibits a pH equal to or less than 2 or equal to or greater than 12.5.					
00542	Ignitability	n.a.	See Below		See Below	1
	The sample did not spontaneously ignite when exposed to air or water. The sample did not ignite by friction. The sample vapors did not ignite when exposed to a flame using a closed cup apparatus.					
01121	Reactivity	n.a.	See Below		See Below	1
	Reactivity: The sample was extracted by the interim method described in SW 846, Chapter 7.3. This solution was analyzed for cyanide and sulfide. This waste is not considered reactive and hazardous because it does not generate a quantity of hydrogen cyanide exceeding 250 mg/kg or hydrogen sulfide exceeding 500 mg/kg. These interim threshold limits were established by the Solid Waste Branch of EPA, July, 1992. These results do not reflect total cyanide or total sulfide.					
01122	Sulfide (Reactivity)	n.a.	N.D.	27.	mg/kg	1
01123	Cyanide (Reactivity)	n.a.	N.D.	100.	mg/kg	1

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor

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Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories

REPRINT

Lancaster Laboratories Sample No. SW 3933071

Unit 7 TCLP Composite Soil Sample
HWMU-5 & HWMU-7 Investigation

Collected:11/01/2002 14:00

Account Number: 11200

Submitted: 11/02/2002 10:20
Reported: 11/12/2003 at 09:12
Discard: 12/13/2003

Draper Aden Associates, Inc.
2206 South Main Street
Blacksburg VA 24060

UNIT7 SDG#: RAR01-09

00111	Moisture	EPA 160.3 modified	1	11/07/2002 09:55	Nadine Fegley	1
00394	pH	SW-846 9045C (modified)	1	11/05/2002 16:35	Luz M Groff	1
00496	Corrosivity	SW-846 Chapter 7	1	11/05/2002 16:35	Luz M Groff	1
00542	Ignitability	40 CFR 261.21	1	11/15/2002 18:50	Justin M Bowers	1
01121	Reactivity	SW-846 Chapter 7.3	1	11/15/2002 07:40	Susan E Hibner	1
01122	Sulfide (Reactivity)	SW-846 9034	1	11/15/2002 07:40	Susan E Hibner	1
01123	Cyanide (Reactivity)	SW-846 9012A (modified)	1	11/15/2002 21:01	Venia B McFadden	1

Lancaster Laboratories

REPRINT

Lancaster Laboratories Sample No. TL 3933072

Unit 7 TCLP Composite Soil Sample
TCLP NON-VOLATILE EXTRACTION
HWMU-5 & HWMU-7 Investigation
Collected:11/01/2002 14:00

Account Number: 11200

Submitted: 11/02/2002 10:20
Reported: 11/12/2003 at 09:12
Discard: 12/13/2003

Draper Aden Associates, Inc.
2206 South Main Street
Blacksburg VA 24060

U7NVE SDG#: RAR01-10

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit	Units	Dilution Factor
00259	Mercury	7439-97-6	N.D.	0.000079	mg/l	1

The metal analyses were performed on a non-volatile leachate prepared according to the procedure specified in SW-846, Chapter 7.4 (Revision 3, December, 1994). A sample is considered to have failed the Toxicity Characteristic (TC) test and is considered a hazardous waste if any of the metal concentrations (mg/l) in the leachate exceed the following maxima (100 times the Primary Drinking Water Standards):

Arsenic	5.0	Cadmium	1.0	Lead	5.0	Selenium	1.0
Barium	100.0	Chromium	5.0	Mercury	0.2	Silver	5.0

01335	Arsenic	7440-38-2	0.0056 J	0.0049	mg/l	1
01336	Selenium	7782-49-2	N.D.	0.0048	mg/l	1
01746	Barium	7440-39-3	0.521	0.00044	mg/l	1
01749	Cadmium	7440-43-9	N.D.	0.00094	mg/l	1
01751	Chromium	7440-47-3	N.D.	0.0020	mg/l	1
01755	Lead	7439-92-1	N.D.	0.0089	mg/l	1
01766	Silver	7440-22-4	N.D.	0.0014	mg/l	1
07022	Thallium	7440-28-0	N.D.	0.0095	mg/l	1
07044	Antimony	7440-36-0	N.D.	0.0099	mg/l	1
07047	Beryllium	7440-41-7	N.D.	0.00050	mg/l	1
07061	Nickel	7440-02-0	0.0115	0.0019	mg/l	1
07071	Vanadium	7440-62-2	N.D.	0.0017	mg/l	1
07072	Zinc	7440-66-6	0.0474	0.0049	mg/l	1
00950	TCLP Pesticides					
01972	Gamma BHC - Lindane	58-89-9	N.D.	0.000012	mg/l	1
01973	Heptachlor	76-44-8	N.D.	0.000010	mg/l	1
01974	Heptachlor Epoxide	1024-57-3	N.D.	0.000016	mg/l	1
01975	Methoxychlor	72-43-5	N.D.	0.00010	mg/l	1
01976	Endrin	72-20-8	N.D.	0.000024	mg/l	1
01977	Chlordane	57-74-9	N.D.	0.00025	mg/l	1
01978	Toxaphene	8001-35-2	N.D.	0.0015	mg/l	1

The pesticide/herbicide analyses were performed on a non-volatile toxicity characteristic leachate of the submitted waste. The leachate was prepared according to the procedure specified in the March 29 and the June 29, 1990

Lancaster Laboratories

REPRINT

Lancaster Laboratories Sample No. TL 3933072

Unit 7 TCLP Composite Soil Sample
TCLP NON-VOLATILE EXTRACTION
HWMU-5 & HWMU-7 Investigation
Collected:11/01/2002 14:00

Account Number: 11200

Submitted: 11/02/2002 10:20
Reported: 11/12/2003 at 09:12
Discard: 12/13/2003

Draper Aden Associates, Inc.
2206 South Main Street
Blacksburg VA 24060

U7NVE SDG#: RAR01-10

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit	Units	Dilution Factor

Federal Registers.
A sample is considered to have failed the Toxicity Characteristic (TC) test and is therefore considered a hazardous waste if any of the contaminant concentrations (mg/l) in the leachate exceed the following maxima:

Chlordane	0.03	Methoxychlor	10.0
Endrin	0.02	Toxaphene	0.5
Heptachlor (and epoxide)	0.008	2,4-D	10.0
Lindane	0.4	2,4,5-TP(Silvex)	1.0

The limits are published in March 29, 1990 Federal Register, pp. 11845-6.

00952	TCLP Herbicides					
01979	2,4-D	94-75-7	N.D.	0.0020	mg/l	1
01980	2,4,5-TP	93-72-1	N.D.	0.00020	mg/l	1
00949	TCLP Acid Base/Neutrals					
03324	Pyridine	110-86-1	N.D.	0.0040	mg/l	1
03325	1,4-Dichlorobenzene	106-46-7	N.D.	0.0020	mg/l	1
03326	2-Methylphenol	95-48-7	N.D.	0.0020	mg/l	1
03327	4-Methylphenol	106-44-5	N.D.	0.0040	mg/l	1

3-Methylphenol and 4-methylphenol cannot be resolved under the chromatographic conditions used for sample analysis. The result reported for 4-methylphenol represents the combined total of both compounds.

03328	Hexachloroethane	67-72-1	N.D.	0.0020	mg/l	1
03329	Nitrobenzene	98-95-3	N.D.	0.0020	mg/l	1
03330	Hexachlorobutadiene	87-68-3	N.D.	0.0020	mg/l	1
03331	2,4,6-Trichlorophenol	88-06-2	N.D.	0.0020	mg/l	1
03332	2,4,5-Trichlorophenol	95-95-4	N.D.	0.0020	mg/l	1
03333	2,4-Dinitrotoluene	121-14-2	N.D.	0.0020	mg/l	1
03334	Hexachlorobenzene	118-74-1	N.D.	0.0020	mg/l	1
03335	Pentachlorophenol	87-86-5	N.D.	0.0060	mg/l	1

The semivolatile analyses were performed on a non-volatile toxicity characteristic leachate of the submitted waste. The leachate was prepared according to the procedure specified in SW-846, Chapter 7.4 (Revision 3, 12/94). If the TCLP extract contains any one of the Toxicity Characteristic (TC) constituents in an amount equal to or exceeding the concentrations

Lancaster Laboratories

REPRINT

Lancaster Laboratories Sample No. TL 3933072

Unit 7 TCLP Composite Soil Sample
TCLP NON-VOLATILE EXTRACTION
HWMU-5 & HWMU-7 Investigation
Collected:11/01/2002 14:00

Account Number: 11200

Submitted: 11/02/2002 10:20
Reported: 11/12/2003 at 09:12
Discard: 12/13/2003

Draper Aden Associates, Inc.
2206 South Main Street
Blacksburg VA 24060

U7NVE SDG#: RAR01-10

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit	Units	Dilution Factor

specified in 40 CFR part 261.24, the waste possesses the characteristic of toxicity and is a hazardous waste. These limits are listed below in mg/L. Other limits may apply for analyses performed under other regulations.

Total Methylphenols	200.0	Nitrobenzene	2.0
1,4-Dichlorobenzene	7.5	Pentachlorophenol	100.0
2,4-Dinitrotoluene	0.13	Pyridine	5.0
Hexachlorobenzene	0.13	2,4,5-Trichlorophenol	400.0
Hexachlorobutadiene	0.5	2,4,6-Trichlorophenol	2.0
Hexachloroethane	3.0		

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
00259	Mercury	SW-846 7470A	1	11/08/2002 06:46	Deborah A Krady	1
01335	Arsenic	SW-846 6010B	1	11/11/2002 03:23	Donna R Sackett	1
01336	Selenium	SW-846 6010B	1	11/12/2002 06:29	Donna R Sackett	1
01746	Barium	SW-846 6010B	1	11/11/2002 03:23	Donna R Sackett	1
01749	Cadmium	SW-846 6010B	1	11/12/2002 06:29	Donna R Sackett	1
01751	Chromium	SW-846 6010B	1	11/12/2002 06:29	Donna R Sackett	1
01755	Lead	SW-846 6010B	1	11/12/2002 06:29	Donna R Sackett	1
01766	Silver	SW-846 6010B	1	11/11/2002 03:23	Donna R Sackett	1
07022	Thallium	SW-846 6010B	1	11/12/2002 06:29	Donna R Sackett	1
07044	Antimony	SW-846 6010B	1	11/11/2002 03:23	Donna R Sackett	1
07047	Beryllium	SW-846 6010B	1	11/11/2002 03:23	Donna R Sackett	1
07061	Nickel	SW-846 6010B	1	11/12/2002 06:29	Donna R Sackett	1
07071	Vanadium	SW-846 6010B	1	11/11/2002 03:23	Donna R Sackett	1
07072	Zinc	SW-846 6010B	1	11/12/2002 06:29	Donna R Sackett	1
00950	TCLP Pesticides	SW-846 8081A	1	11/08/2002 12:23	Douglas D Seitz	1
00952	TCLP Herbicides	SW-846 8151A	1	11/08/2002 23:24	Michele D Hamilton	1
00949	TCLP Acid Base/Neutrals	SW-846 8270C	1	11/08/2002 13:59	Chad A Moline	1
00816	Water Sample Herbicide Extract	SW-846 8151A	1	11/08/2002 08:25	Amanda W Herr	1
00817	Water Sample Pest. Extraction	SW-846 3510C	1	11/07/2002 23:00	Sharon L Jones	1

Lancaster Laboratories

REPRINT

Lancaster Laboratories Sample No. TL 3933072

Unit 7 TCLP Composite Soil Sample
TCLP NON-VOLATILE EXTRACTION
HWMU-5 & HWMU-7 Investigation
Collected:11/01/2002 14:00

Account Number: 11200

Submitted: 11/02/2002 10:20
Reported: 11/12/2003 at 09:12
Discard: 12/13/2003

Draper Aden Associates, Inc.
2206 South Main Street
Blacksburg VA 24060

U7NVE SDG#: RAR01-10

00947	TCLP Non-volatile Extraction	SW-846 1311	1	11/06/2002 13:40	Carlene A Landis	n.a.
04731	TCLP Leachate Extraction	SW-846 3510C	1	11/07/2002 17:25	JoElla L Rice	1
05705	WW/TL SW 846 ICP Digest (tot)	SW-846 3010A	1	11/07/2002 22:10	Annamaria Stipkovits	1
05713	WW SW846 Hg Digest	SW-846 7470A	1	11/07/2002 20:21	Nelli S Markaryan	1

Lancaster Laboratories

REPRINT

Lancaster Laboratories Sample No. TL 3933073

Unit 7 TCLP Composite Soil Sample
TCLP ZERO HEADSPACE EXTRACTION
HWMU-5 & HWMU-7 Investigation
Collected:11/01/2002 14:00

Account Number: 11200

Submitted: 11/02/2002 10:20
Reported: 11/12/2003 at 09:12
Discard: 12/13/2003

Draper Aden Associates, Inc.
2206 South Main Street
Blacksburg VA 24060

U7ZHE SDG#: RAR01-11

CAT No.	Analysis Name	CAS Number	As Received Result	As Received Method Detection Limit	Units	Dilution Factor
03636	TCLP by 8260					
05386	Vinyl Chloride	75-01-4	N.D.	0.020	mg/l	20
05390	1,1-Dichloroethene	75-35-4	N.D.	0.016	mg/l	20
05396	Chloroform	67-66-3	N.D.	0.016	mg/l	20
05399	Carbon Tetrachloride	56-23-5	N.D.	0.020	mg/l	20
05401	Benzene	71-43-2	N.D.	0.010	mg/l	20
05402	1,2-Dichloroethane	107-06-2	N.D.	0.020	mg/l	20
05403	Trichloroethene	79-01-6	N.D.	0.020	mg/l	20
05409	Tetrachloroethene	127-18-4	N.D.	0.016	mg/l	20
05413	Chlorobenzene	108-90-7	N.D.	0.016	mg/l	20
06305	2-Butanone	78-93-3	N.D.	0.060	mg/l	20

The volatile organic analyses were performed on a zero headspace toxicity characteristic leachate of the submitted waste. The leachate was prepared according to the procedure specified in SW-846, Chapter 7.4 (Revision 3, 12/94).
If the TCLP extract contains any one of the Toxicity Characteristic (TC) constituents in an amount equal to or exceeding the concentrations specified in 40 CFR Part 261.24, the waste possesses the characteristic of toxicity and is a hazardous waste. These limits are listed below in mg/L. Other limits may apply for analyses performed under other regulations.

Benzene	0.5	1,1-Dichloroethene	0.7
Carbon Tetrachloride	0.5	Methyl Ethyl Ketone (2-Butanone)	200.0
Chlorobenzene	100.0	Tetrachloroethene	0.7
Chloroform	6.0	Trichloroethene	0.5
1,2-Dichloroethane	0.5	Vinyl Chloride	0.2

Laboratory Chronicle

CAT No.	Analysis Name	Method	Trial#	Analysis Date and Time	Analyst	Dilution Factor
03636	TCLP by 8260	SW-846 8260B	1	11/10/2002 19:28	Susan McMahon-Luu	20

MEMBER ACIL
Lancaster Laboratories, Inc.
2425 New Holland Pike
PO Box 12425
Lancaster, PA 17605-2425
717-656-2300 Fax: 717-656-2681

Lancaster Laboratories

REPRINT

Lancaster Laboratories Sample No. TL 3933073

Unit 7 TCLP Composite Soil Sample
TCLP ZERO HEADSPACE EXTRACTION
HWMU-5 & HWMU-7 Investigation
Collected:11/01/2002 14:00

Account Number: 11200

Submitted: 11/02/2002 10:20
Reported: 11/12/2003 at 09:12
Discard: 12/13/2003

Draper Aden Associates, Inc.
2206 South Main Street
Blacksburg VA 24060

U7ZHE SDG#: RAR01-11

00946	TCLP Zero Headspace Extraction	SW-846 1311	1	11/04/2002 12:45	David G Splain Jr	n.a.
01163	GC/MS VOA Water Prep	SW-846 5030B	1	11/10/2002 19:28	Susan McMahon-Luu	n.a.

MEMBER ACIL
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APPENDIX E

VDEQ Risk Assessment Guidance

RISK-BASED CLOSURE

1. Introduction

This document discusses the protocol for conducting a risk assessment to implement closure of hazardous waste management unit (HWMU) in accordance with Title 9 of the Virginia Administrative Code, Section 20-60-10 et seq. (Formerly the Virginia Hazardous Waste Management Regulations).

1. Risk-Based Evaluation In order to estimate the risk for chemicals of concern (COCs) a risk assessment will be conducted according to the Virginia DEQ document titled "Guidance for development of health based cleanup goals using decision tree/REAMS program (herein after "Virginia Risk Guidance") (November 1, 1994) prepared by Old Dominion University and the approved closure plan. The risk assessment report will contain the following sections:

- site evaluation,
- development of a site conceptual model,
- identification of contaminants of concern,
- identification of media and exposure pathways,
- toxicity assessment,
- estimation of contaminant concentration at the point of exposure, and
- summary of health risks.

The submission instructions contained in Appendix IX of the Virginia Risk Guidance will be reviewed prior to submitting the report to confirm that all necessary risk issues have been addressed. The risk goals/performance standards will be a hazard index of 1.0 for non-carcinogens and an individual carcinogenic risk of 1E-06 and cummulative carcinogenic risk of 1E-04.

Compliance with the closure standard will be verified by comparing the calculated individual and cumulative risk/hazard for all the contaminants of concern (COC) that failed background comparison to the risk-based performance standards.

The risk assessment will be conducted assuming a future residential/industrial use of the property. The methodology/equation for estimating the exposure concentration is presented in subsequent sections.

The initial step in the risk assessment will be to develop a site conceptual exposure model (SCEM) which depicts all potential exposure routes and media for the site and the receptors which may be exposed. The procedure for identification of contaminants of concern for health based is presented in section 2.... (from other section in the closure plan)

Once the SCEM is completed, the exposure assumptions outlined in the Virginia Risk Guidance will be employed to estimate the health risks and develop a cleanup criteria. Information will also be taken as needed from U.S. EPA documents and databases (e.g., the Risk Assessment Guidance for Superfund (RAGS), and the Integrated Risk Information System (IRIS)). The chemical intake equations and exposure parameter assumptions used to calculate estimate risks (obtained from Virginia risk assessment guidance/REAMS) are shown in Tables 1 through 4. Additional details on the approach and assumptions used for each potential exposure pathway are provided below.

As a part of the Risk Exposure and Analysis Modeling System (REAMS) evaluation, fate and transport modeling is necessary to demonstrate that the residual soil concentrations of contaminants of concern would not result in contamination of other environmental media of concern including the groundwater underneath the closure unit. For this purpose, representative soil sample(s) will be collected around the unit (subjected to closure) for analysis of the properties listed on page 62 of the REAMS document. [It is often less expensive to obtain this information from an agriculture lab rather than from an environmental lab]. In certain situations, groundwater sampling may be preferable.

2. Identification of Contaminants of Concern

Contaminants of concern includes those constituents detected during the closure soil and groundwater sampling which may be related to past waste management practices and whose concentrations statistically exceeded background levels. Please note that if the concentration of contaminants detected in the soil and groundwater did not exceed the background levels, no further risk-based evaluation will be required. Only those constituents of concern having concentrations that are statistically greater than background concentrations will be subject to REAMS evaluation to estimate the risks.

Also, for the purpose of evaluating the impact to groundwater, only those constituents which statistically exceeded the upgradient or background well concentration will be subjected to REAMS evaluation.

3. Exposure Assessment

The exposure assessment will identify transport mechanisms for the contaminants of concern that may potentially impact human receptors. The results of this assessment will be used to document the current and future exposure potential posed by the site.

With regard to soil, the following exposure assumptions will apply. Initially, a residential exposure will be assumed for the purpose of attempting to document unrestricted closure of the soil. If the risk for potential residential exposure does not exceed the performance standards, unrestricted closure of soil will be documented/accepted. If the site cannot be clean closed for residential use, then the option to pursue restricted closure (commercial/industrial) will be exercised. Closure to commercial/industrial scenario will requirement the facility to enact a deed restriction that eliminates the possibility of future residential use of the site. The requirements for establishing such a deed restriction are detailed in VDEQ=s Guidelines for Developing Health-Based Cleanup Goals Using Risk Assessment at A Hazardous Waste Site Facility for Restricted Industrial Use, dated June 1995. (A copy of this document is attached.)

Exposure routes will include ingestion, dermal absorption, and inhalation of vapors and dust particles.

With regard to groundwater, REAMS fate and transport modeling[1] will be required to assess residual soil contamination impacts to the groundwater. If the groundwater does not qualify for clean closure, the scope of future groundwater monitoring will be discussed with VDEQ. The groundwater exposure routes to be evaluated include ingestion, dermal absorption, and inhalation of volatiles emitted from the contaminated groundwater.

The exposure assumptions presented in the following sections are based on residential exposure. These constitute a reasonable maximum exposure scenario (RME),

[1] REAMS includes the unsaturated zone fate and transport model SESOIL. The purpose of running the model is two fold: a) determine whether the contaminants will reach the groundwater table in next 30 years. b) calculate the risk associated with the estimated concentration in the groundwater. For constituents with a promulgated MCL, the estimated concentration will be directly compared against the MCL. However, prior to running the SESOIL model the facility should obtain all the information identified on page 62, of the Virginia guidance document. The closure report must include evaluation of model results (concentrations reaching the groundwater) and a copy of SESOIL output file.

an exposure which is unlikely to occur but is reasonably possible. The exposure pathways for residential exposure include ingestion of soil, dermal contact with soil, inhalation of resuspended soil particulates, and inhalation of volatile organic compounds. Exposure to groundwater at the site is discussed in Section xxx.

3.1.1 Ingestion of Soil

The equation for potential chemical intake by soil ingestion for residential scenario on site is included in Table 1. This scenario also assumes that weather or other conditions (e.g., frozen ground/ snow /other cover) do not affect exposure and that all soil ingested is from contaminated areas of the site. These assumptions are protective of human health and the environment.

3.1.2 Dermal Contact with Soil

The equation for calculating the potential absorbed chemical dose by dermal contact with contaminated soil is provided in table 1. This scenario assumes that weather or other conditions (e.g., frozen ground/ snow or other cover) do not affect exposure, that contaminated soil remains on the skin long enough for the COCs to be absorbed and that all soil adhering to the skin is from contaminated areas of the site.

The skin surface areas (SA) used in the dermal pathway have been identified in REAMS guidance as 4,860 cm^2 for adults, which is the 50th percentile value for the arms, hands and lower legs (U.S. EPA, 1989b - See Attachment A).

A skin-soil adherence factor of 1.45 mg/cm^2 will be used in the dermal intake calculations. The U.S. EPA guidance for dermal exposure assessment (*Dermal Exposure Assessment: Principles and Applications*, EPA/600/8-91/011B) states that a range of values from 0.1 mg/cm^2 to 1.5 mg/cm^2 per event appear possible for dermal adherence factors (AF). The
In order to estimate the amount of a particular COC which may potentially be absorbed through the skin, chemical-specific dermal absorption factors (ABS_{derm}) are used.

3.1.3 Inhalation of Resuspended Soil

The equation for potential chemical intake by inhalation of resuspended contaminated soil is included in Table 1. An inhalation rate of 0.83 m^3/hr will be used as specified in the Virginia Risk Guidance. This scenario assumes that the concentration of COCs in indoor dust will be equal to that in outdoor soil and that weather or other conditions, (e.g., frozen ground/snow or other cover) do not affect resuspension or exposure.

However, an appropriate model or equations in table-1, will be used to estimate the potential amount of respirable particulate matter generated by wind erosion. The estimated generation rate for eroded particulate matter will then be used derive an ambient air particulate concentration. Documentation for these models will be presented to the Department.

3.1.4 Inhalation of Volatilized COCs in Soil

Since the COCs have appreciable vapor pressures, they are expected to volatilize from soil. Inhalation of COCs as volatilized vapors is considered for this risk assessment. The equations in Table-1 will be considered for estimating the intake for this condition.

4. Toxicity Assessment

The two principle indices of toxicity used in risk assessment are the reference dose (RfD) and the cancer slope factor (SF). An RfD is the intake or dose per unit of body weight (mg/kg-day) that is unlikely to result in toxic (non-carcinogenic) effects to human populations, including sensitive subgroups (e.g., the very young or elderly). The RfD allows for the existence of a threshold dose below which no adverse effects occur.

The SF is used to express the cancer risk attributable to a discrete unit of intake; that is, the cancer risk per milligram ingested per kilogram of bodyweight per day ($[mg/kg\text{-}day]^{-1}$). The SF is an estimate of the upper-bound probability of an individual developing cancer as a result of exposure to a particular carcinogen. Unlike the RfD, the SF assumes that there is no threshold dose below which the probability of developing cancer is zero. Note that SFs are only developed for those chemicals which have been shown to be carcinogens in man or in at least several animal species. A carcinogenic weight of evidence rating is used to describe the strength of the experimental evidence for carcinogenicity. The U.S. EPA has developed SFs for most chemicals with weight of evidence ratings of "A" (known human carcinogen) or "B" (probable human carcinogen).

RfDs and SFs are derived by the U.S. EPA for the most toxic chemicals generally associated with chemical releases to the environment for which adequate toxicological data are available. If both the carcinogenic and non-carcinogenic effects of a particular compound are significant, both values may be established. However, in most cases only one value is available.

4.1 Inhalation and oral RfDs and SFs -

SFs pertinent to the oral and inhalation exposure pathways will be obtained from U.S. EPA's IRIS database. The IRIS (Integrated Risk Information System) on-line database

was established by the U.S. EPA to provide risk assessors with peer reviewed toxicological data on chemicals commonly encountered at environmental sites of contamination. If data is not available from IRIS, it will be obtained from the Health Effects Assessment Summary Tables (HEAST), a compilation of toxicity values produced by the USEPA on a quarterly basis. The hierarchy presented in Appendix III of Virginia Risk guidance will be followed for using these sources.

4.2 Dermal RfDs and SFs -

Chemical specific oral-route absorption values (ABS_{oral}) are used to adjust the oral RfD or SF, which is computed from an administered dose, for use in the dermal exposure pathway. This correction is necessary due to the differences in absorption between the skin and the gastrointestinal tract. By correcting the administered-dose oral RfD or SF for the fraction expected to be absorbed in the gut, a dermal absorption factor can be used to estimate the correct dose received through the skin.

5. Evaluation of Risks

Using the toxicity criteria and identified exposure pathways discussed above, and the procedures described in the VDEQ guidance document (REAMS, November 1994), the risks presented by the COC will be estimated. The estimated risks will consider the effects from multiple constituents and all routes of exposure. The risk goals will be a total cumulative hazard index of 1.0 for multiple noncarcinogens and a total cumulative carcinogenic risk of 1E-04 for multiple carcinogens. However, the risk from each individual carcinogen shall not exceed 1E-06 (i.e., one case of cancer per 1,000,000 population).

5.1 Estimation of exposure concentration

For the contaminants detected at the site, an exposure point concentration (EPC) for each exposure pathway will be calculated for each contaminant by estimating the 95th upper confidence limit (UCL) on the arithmetic mean of the concentrations. If the calculated 95th UCL is greater than the maximum detected concentration, then the maximum detected concentration will be used as the EPC. The risks for contaminants will be calculated as per the equations and assumptions described in Table 1 through Table 4. If for a contaminant both carcinogenic and noncarcinogenic risk-based cleanup goal exists, the lower of the two will be used as a pathway specific to estimate the risk.

5.2. Risk Estimation

Health risk assessments are based on the relationship between risk, dose and toxicity:

$$Risk = Dose * Toxicity$$

Since dose is the product of the contaminant concentration multiplied by exposure (the intake), equation (1) becomes:

$$Risk = Intake\ rate * Contaminant\ conc. * Toxicity$$

(Please note that the term CDI in attached tables 1-4, includes intake rate and contaminant conc)

To estimate the intake, the exposure equations and assumptions discussed in Section 1, are used. The intake estimates for each route of exposure are then combined with the RfDs or SFs to determine the resulting risk.

For Carcinogens Risk:

$$Cancer\ Risk = (Intake_{oral} * Cont.conc. * SF_{oral})$$

$$+ (Intake_{inhal} * Cont.conc. * SF_{inhal}) + (Intake_{derm} * Cont.conc. * SF_{derm})$$

For Noncarcinogens:

$$Hazard\ Index = (Intake_{oral} * Cont.conc. * \frac{1}{RfD_{oral}}) + (Intake_{inhal} * Cont.conc. * \frac{1}{RfD_{inhal}})$$

$$+ (Intake_{derm} * Cont.conc. * \frac{1}{RfD_{derm}})$$

where, taking into account all COCs and relevant exposure pathways, the excess cancer risk is 10^{-6} or the hazard index is 1.0.

Using REAMS software a maximum acceptable contaminant concentrations will be calculated which meets the cumulative risk criteria. This process will be used in this risk assessment to derive the health-based cleanup criteria for the site. If the estimated risks satisfy the risk based performance standards, the soils/groundwater will be considered clean closed.

Table 1
Risk Assessment Algorithm for Carcinogenic Exposure

Exposure Route	Chronic Daily Intake (CDI) - mg/L-day	
	Residential Exposure	Occupational/Industrial Exposure
Ground Water		
Ingestion	$\frac{CW \times IRW_{adj} \times EF}{AT_c}$	$\frac{CW \times IRW_a \times EF_o \times ED_o}{BW_a \times AT_c}$
Inhalation	$\frac{CW \times IRA_{adj} \times EF \times K}{AT_c}$	$\frac{CW \times IRA_a \times EF_o \times ED_o \times K}{BW_a \times AT_c}$
Dermal	$\frac{CW \times SAW_{adj} \times PC \times ET \times EF \times CF}{AT_c}$	$\frac{CW \times SAW_a \times PC \times ET \times EF_o \times ED_o \times CF}{BW_a \times AT_c}$
Soil		
Ingestion	$\frac{CS \times IRS_{adj} \times CF \times FI \times EF}{AT_c}$	$\frac{CS \times IR \times CF \times FI \times EF_o \times ED_o}{BW_a \times AT_c}$
Dermal	$\frac{CS \times CF \times SAS_{adj} \times AF \times ABS \times EF}{AT_c}$	$\frac{CS \times CF \times SAS_a \times AF \times ABS \times EF_o \times ED_o}{BW_a \times AT_c}$
Inhalation of vaporizing VOCs from soil	$\frac{CS \times 1/VF \times IRA_{adj} \times ET \times EF}{At_c}$	$\frac{CS \times 1/VF \times IRA_a \times ET \times EF_o \times ED_o}{BW_a \times AT_c}$
Inhalation of emitting particles from soil	$\frac{CS \times 1/PEF \times IRA_{adj} \times ET \times EF}{AT_c}$	$\frac{CS \times 1/PEF \times IRA_a \times ET \times EF_o \times ED_o}{BW_a \times AT_c}$

Table 2
Risk Assessment Algorithm for Non-carcinogenic Exposure

Exposure Route	Chronic Daily Intake (CDI) (mg/kg-day)	
	Residential Exposure	Occupational/Industrial Exposure
Ground Water		
Ingestion	$\frac{CW \times IRW_c \times EF \times ED_c}{BW_c \times AT_n}$	$\frac{CW \times IRW_a \times EF_o \times ED_o}{BW_a \times AT_n}$
Inhalation	$\frac{CW \times IRA_c \times EF \times ED_c \times K}{BW_c \times AT_n}$	$\frac{CW \times IRA_a \times EF_o \times ED_o \times K}{BW_a \times AT_n}$
Dermal	$\frac{CW \times SAW_c \times PC \times ET \times EF \times ED_c \times CF}{BW_c \times AT_n}$	$\frac{CW \times SAW_a \times PC \times ET \times EF_o \times ED_o \times CF}{BW_a \times AT_n}$
Soil		
Ingestion	$\frac{CS \times IRS_c \times CF \times FI \times EF \times ED_c}{BW_c \times AT_n}$	$\frac{CS \times IRS_a \times CF \times FI \times EF_o \times ED_o}{BW_a \times AT_n}$
Dermal	$\frac{CS \times CF \times SA_c \times AF \times ABS \times EF \times ED_c}{BW_c \times AT_n}$	$\frac{CS \times CF \times SA \times AF \times ABS \times EF_o \times ED_o}{BW_a \times AT_n}$
Inhalation of vaporizing VOCs from soil	$\frac{CS \times 1/VF \times IRA_c \times ET \times EF \times ED_c}{BW_c \times AT_n}$	$\frac{CS \times 1/VF \times IRA_a \times ET \times EF_o \times ED_o}{BW_a \times AT_n}$
Inhalation of emitting particles from soil	$\frac{CS \times 1/PEF \times IRA_c \times ET \times EF \times ED_c}{BW_c \times AT_n}$	$\frac{CS \times 1/PEF \times IRA_a \times ET \times EF_o \times ED_o}{BW_a \times AT_n}$

Note: Occupational noncarcinogenic risk assessment is based on adult exposure

Table 3
Age Adjusted Factors

$$IRA_{adj} = \frac{ED_c \times IRA_c}{Bw_c} + \frac{(ED_{tot} - ED_c) \times IRA_a}{BW_a}$$

$$IRW_{adj} = \frac{ED_c \times IRW_c}{Bw_c} + \frac{(ED_{tot} - ED_c) \times IRW_a}{BW_a}$$

$$SAW_{adj} = \frac{ED_c \times SAW_c}{Bw_c} + \frac{(ED_{tot} - ED_c) \times SAW_a}{BW_a}$$

$$IRS_{adj} = \frac{ED_c \times IRS_c}{Bw_c} + \frac{(ED_{tot} - ED_c) \times IRS_a}{BW_a}$$

$$SAS_{adj} = \frac{ED_c \times Sa_c}{Bw_c} + \frac{(ED_{tot} - ED_c) \times SA_a}{BW_a}$$

Note regarding age adjusted factor:

Because contact rate with tap water, ambient air, and residential soil are different for children and adults, carcinogenic risks during the first 30 years of life were calculated using age adjusted factor. These factors approximate the integrated exposure from birth until age 30 by combining contact rates, body weights, and exposure durations for two age groups - small children and adults.

Table 4
Exposure Variables Included in Tables 1, 2, and 3

Symbol	Term	Units	Value	References
ABS	Absorption factor	-	User specified	
AF	Adherence factor	-	1.45	a, c
AT_c	Averaging time carcinogens	days	25550	
AT_n	Averaging time non-carcinogens	days	ED x 365	
BW_a	Body weight adult	kg	70	c
BW_c	Body weight child	kg	15	c
CF	Conversion factor	-	0.000001	-
CS	Chemical concentration in soil	mg/Kg-day	User specified	
CW	Chemical concentration in water	mg/L	User specified	
ED_C	Exposure duration child	years	6	c
ED_{total} ED	Exposure duration for carcinogen total or Residential	years	30	c
ED_O	Exposure duration occupational	years	25	c
EF	Exposure frequency residential	days	350	c
ET	Exposure Time General/Occupational Groundwater Surface Water - ingestion Surface water - dermal Air -inhalation	hrs/day	 8.0 0.2 2.6 2.6 24.0	c, d
FI	Fraction ingested Residential Occupational	-	 1.0 0.5	b
IRA_a	Inhalation rate air adult	m^3/day	20	b
IRA_{adj}	Inhalation rate - air adjusted	-	11.66	
IRA_c	Inhalation rate child	m^3/day	12	b
IRA_a	Inhalation rate adult	m^3/day	20	b
IR	Ingestion rate food Fruit/veggies	kg/day	0.28 0.122	c,d

	Fish		0.054	
IRS_a	Ingestion rate soil adult	mg/day	100	b
IRS_c	Ingestion rate soil child	mg/day	200	b
IRS_{adj}	Ingestion - soil adjusted	-	114.29	
IRS_C	Ingestion rate soil child	mg/day	200	b
IRW_a	Ingestion rate water adult	L/day	2	b
IRW_{adj}	Ingestion -water adjusted	L-y/kg-d	1.09	
IRW_c	Ingestion rate water child	L/day	1	b
K	Volatilization factor, water to air	-	0.5	
PC	Permeability constant	cm/hr	User specified	b
PEF	Particulate emission factor	$m^{3/}$ kg	6.789926E08	f
SAW_c	Surface area child groundwater dermal surface water dermal	cm^2	7500	b,e
SAS_a SAS_c	Surface area soil occupational - adult child	cm^2/event	4500 1875	e
SAS_{adj}	Surface area soil ajusted	cm^2/event	2290	
SAW_a	Surface area for water contact adult	cm^2	820	b
SAW_{adj}	Surface area for water contact	cm^2/event	9200	
VF	Volatilazation factor, soil to air	$m^{3/}$kg	User specified	-

References:

a. Risk Assessment Guidance for Superfund, Volume I, EPA/540/1-89/002, December 1989.

b. Region III values

c. Exposure Factors handbook, EPA/600/8-89/043, July 1989

d. Human health evaluation manual supplemental guidance, OSWER Directive 9285.6-03. March 25, 1991.

e. Dermal exposure Assessment, Principles and Applications, Interim Report. EPA/600/8-91/011b. January 1992.

f. Technical Background Document for Draft Soil Screening Level Guidance. Office of Solid Waste and Emergency Response. EPA/540/R-94/101. December 1994.

GUIDELINES FOR DEVELOPING HEALTH-BASED CLEANUP GOALS USING RISK ASSESSMENT AT A HAZARDOUS WASTE SITE FACILITY FOR RESTRICTED INDUSTRIAL USE

THE DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF WASTE RESOURCE MANAGEMENT

June 1, 1995

INTRODUCTION

This guidance document is intended for use by any facility conducting risk assessment pursuant to the risk based performance standards/closure requirements of ' 9.6 and '10.6.B., of VHWMR and evaluating the site for current and foreseeable industrial use. The information is intended solely for guidance. The document provides guidance on a) what approaches the Department considers acceptable for meeting the general requirements set forth in the closure performance section, b) situations where the industrial use may not apply and c) situations for which the Department will not accept the industrial use scenario.

The facilities using the guidance should be aware that there may be other alternatives such as evaluation for residential use (unrestricted use) for demonstrating the clean closure of the site. It is important that this material is used in conjunction with the Department risk assessment guidance titled "Guidance for Development of Health Based Cleanup Goals using Decision Tree/REAMS" November 1, 1994 developed by Old Dominion University, Norfolk, Virginia.

For the purpose of risk characterization it is necessary to determine the current and foreseeable uses of the site, and establish the acceptable cleanup levels. The Department prefers to clean close the site for residential use or unrestricted use. This applies both for the groundwater and soils. However, in the event the facility wishes to use the land (soils) for a restricted industrial use, the facility shall demonstrate so by provide the following additional information along with a residential risk assessment. The Department will use the residential risk assessment as a baseline to evaluate the proposed restricted site use.

A. Industrial Use

1. The Department recognizes a distinction between the current use of the site and foreseeable (hypothetical) which has not yet occurred and requires the facility to conduct the risk assessment for both the scenarios. For the purpose of risk characterization, the facility must identify current uses of the site and evaluate the activities to protect the present receptors. The facility shall also identify the future use of the site and evaluate the activities to protect future exposures for the designated future use. For the purpose of foreseeable industrial use of the site, the Department requires the facility to evaluate the impact to the groundwater (consistency with the current closure

performance standards '9.6.B and 10.6.B. of VHWMR). The residual contamination in-place shall not become a source of contamination to other media, such as leaching of wastes into the groundwater or surface water. For the purpose of risk assessment the facility must consider the groundwater as a potential drinking water source. However, on a site-specific basis the Department may allow use of institutional controls to minimize the leaching of wastes (residual contamination) to the groundwater.

2. In order for the Department to accept the current and foreseeable use of the site for industrial activity, the owner of the facility must present the signed acceptance letter provided in Appendix A which restricts land use for industrial only. The letter becomes part of the approved closure plan. The purpose of signing the letter is to notify the future owners of a property and local officials and the Department as to what uses and activities are consistent with a level of no significant risk at the site. This describes conditions under which site may pose a significant risk and establishes the necessity to evaluate the site conditions for future changes in site usage. The purpose of signing this letter does not permanently restrict changes in site use, however it insures that any proposed changes would require an evaluation of the residual contamination and the possible increase in exposure.

3. General Considerations

The facility must provide the following information which the Department will evaluate in making a determination to allow industrial site use:

a. A description of need and justification for the proposed use of the site. An explaination of the situation which prevents the facility from achieving clean closure for unrestricted use.

b. Duration of the proposed use of the site.

c. Cost and beneficial use of the proposed action in lieu of demonstration of a clean closure for

unrestricted use of the site.

d. Whether or not the site is zoned or has been otherwise officially designated for industrial use;

f. Whether or not the site is currently used for industrial purpose or has a history of use for industrial purposes;

g. Whether or not adjacent properties are currently used or designated for industrial use;

h. Whether or not the site is expected to be used for industrial purposes for the foreseeable future due to a) zoning, b) statutory or regulatory restrictions, c) adjacent land use, and/or d) other factors;

i. Other information beleived by the facility to pertinent;

j. Signed letter provided in the Appendix A.

k. Practical capability of the owner. The information shall include an indication of financial capability of the owner or operator to achieve a clean closure for unrestricted use of the site.

B. Based on the information received, the Director will consider the following factors:

1. Potential overall effect on public health, welfare, and safety of the proposed use of the site. Considerations will be given to the cost benefit analysis, distance to the existing nearest exposure point, potential adverse effects on groundwater quality, the current and future uses of the groundwater, and the potentical adverse effects on hydraulically connected surface water quality.

C. The following are some of the situations where the facility is not required to evaluate the industrial use scenario.

1. The on-site concentrations are below the background

concentrations.

2. The site is evaluated for residential and the concentrations are below the acceptable cleanup level for unrestricted use.

D. Following are some of the situation where the Department will not allow the evaluation of the site for Industrial use.

1. If the current use of site is not industrial and the facility assumes that the future use will be industrial. In such situations, prior to any approval of industrial use scenario, and location of the site with respect to the surrounding land use shall be evaluated.

2. For situation where the Department during an enforcement action has made a determination that the future use of site will not be industrial.

E. Risk Assessment

The facility shall consider the industrial use algorithm provided in the REAMS model. For more details refer to the Department document titled "Guidance for Development of Health Based Cleanup Goals using the Decision Tree/REAMS Program" dated November 1, 1994 by Old Dominion University, Norfolk, Virginia.

If you need any further information, please call Leslie Romanchik at (804) 698-4129 or Sanjay V. Thirunagari at (804) 698-4193.

Guidelines for conducting risk assessment/closure for industrial use

Attachment A

Guidelines for conducting risk assessment/closure for industrial use

NOTICE OF USE LIMITATION
' 9.6.B. & 10.6.B., VHWMR

Hazardous Waste Site Name:

I.D. No:

This Notice of Use Limitation ("Notice") is made as of the __ day of _____, 19__, by [Name and address of current property owner or owners], together with his/her/its/their successors and assigns, (collectively "Owner").

W I T N E S S E T H:

WHEREAS, _____ (name of Owner), of _____ County, Virginia, [is] [are] the owner(s) in fee simple of [that] [those] certain parcel(s) of [vacant] land located in _____ (Town/City), _____County, Virginia, with the buildings and improvements thereon, ("Property");

WHEREAS, said parcel(s) of land, which is more particularly bounded and described in Exhibit A, attached hereto and made a part hereof (" the Property") is subject to this Notice of Use Limitation. The Property is shown on a plan [recorded and/or registered herewith] [recorded and/or registered in _____ County Registry of Deeds/Land Registration Office in Plan Book _____, Plan _____, or as Land Court Plan No. _____.];

[WHEREAS, a portion of the Property is more specifically subject to this Notice of Use Limitation. This portion of the Property is more particularly bounded and described in Exhibit A-1, attached hereto and made a part hereof. This portion is shown on a plan [to be recorded herewith] [recorded in _____ County Registry of Deeds in Plan Book _____, Plan _____.];

WHEREAS, the Property [portion of the Property] comprises [all] [part of] a disposal site as the result of a release of hazardous waste. Exhibit A-1 is a sketch plan showing the relationship of the [Property] [portion of the Property] subject to this Notice of Use Limitation to the boundaries of said disposal site (to the extent such boundaries have been established). Exhibit A-1 is attached hereto and made a part hereof.]

Guidelines for conducting risk assessment/closure for industrial use

WHEREAS, one or more response actions have been selected for [the Disposal Site] [portion of the Disposal Site] in accordance with closure performance standards of '9.6.B., or 10.6.B., of Virginia Hazardous Waste Management Regulations. Said response actions are based upon (a) the restriction of human access to and contact with hazardous material in soil [and/or groundwater] and/or (b) the restriction of certain activities occurring in, on, through, over or under the [Property] [Portion of the Property].

NOW, THEREFORE, notice is hereby given that the use limitations set forth are as follows:

1. Permitted Activities and Uses Set Forth in the UL The use limitation provides that a condition of No Significant Risk to health, safety, public welfare or the environment (such condition being defined in the Closure Plan) exists for any foreseeable period of time so long as any of the following activities and uses occur on the [Property] [portion of the Property]:

1. ;
2. ; and
3. Such other uses which, in the Opinion of an owner or Registered Professional Engineer, shall present no greater risk of harm to health, safety, public welfare or the environment than the activities and uses set forth in this paragraph.

continued

2. Uses Inconsistent with the notification. Uses which are inconsistent with the notification, and which, if implemented at the [Property] [portion of the Property], may result in a significant risk of harm to health, safety, public welfare or the environment, are as follows:

1. ;
2. ; and
3. .

3. Obligations and Conditions Set Forth in the notification. If applicable, obligations and/or conditions to be undertaken and/or maintained at the [Property] [portion of the Property] to maintain a condition of No Significant Risk as set forth in the notification shall include the following:

1. ;
2. ; and
3. .

4. Proposed Changes in Uses. Any proposed changes in activities and uses at the [Property] [portion of the Property] which may result in higher levels of exposure to hazardous material than currently exist shall be evaluated by a Registered Professional Engineer or Department of Environmental Quality representative who shall render an opinion, in accordance with '9.6 and 10.6., of VHWMR, as to whether the proposed changes will present a significant risk of harm to health, safety, public welfare or the environment. Any and all requirements set forth in the notice to ensure a condition of No Significant Risk in the implementation of the proposed activity or use shall be satisfied before any such activity or use is commenced.

5. Violation of a Response Action Outcome. The activities, uses and/or exposures upon which this Notice is based shall not change at any time to cause a significant risk of harm to health, safety, public welfare, or the environment due to exposure to hazardous material without the prior evaluation of DEQ, and without additional response actions, if necessary, to achieve or maintain a condition of No Significant Risk.

If the activities, uses, and/or exposures upon which this Notice is based change without the prior evaluation and additional response actions determined to be necessary by DEQ in accordance with ''9.6 and 10.6., of the VHWMR the owner or operator of the [Property] [portion of the Property] subject to this Notice at the time that the activities, uses and/or exposures change, shall comply with the requirements set forth in ''9.6. and 10.6., of VHWMR.

6. Incorporation Into Deeds, Mortgages, Leases, and Instruments of Transfer. This Notice shall be incorporated either in full or by reference into all deeds, easements, mortgages, leases, licenses, occupancy agreements or any other instrument of transfer, whereby an interest in and/or a right to use the Property or a portion thereof is conveyed.

Owner hereby authorizes and consents to the filing and recordation and/or registration of this Notice to become effective when executed and sealed by the undersigned P.E, and recorded and/or registered with the appropriate Registry(ies) of Deeds and/or Land Registration Office(s).

WITNESS the execution hereof under seal this _____ day of _____, 19__.

_____
Owner

continued

COMMONWEALTH OF VIRGINIA

_____, '' _____, 19__

Then personally appeared the above named _____ and acknowledged the foregoing to be _____ free act and deed before me,

_____
Notary Public
My Commission Expires:

The undersigned P.E. hereby certifies that he/she executed the aforesaid Notice of Use Limitation and that in his/her Opinion this Notice of Use Limitation is consistent with the Department of Environmental Quality performance standards for restricted use of site, and '9.6 and '10.6., of VHWMR.

Date: _____ _____
P.E.
[SEAL]