FINAL

Risk Assessment and Closure Certification for the Former Incinerator Spray Pond at the Radford Army Ammunition Plant

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Radford, Virginia

January 1998

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1.0 *INTRODUCTION*

Alliant Techsystems, Inc. (Alliant) has prepared this closure report for the former incinerator spray pond (HWMU-39).

The purpose of this report is to certify that closure of the RFAAP (United States Environmental Protection Agency (USEPA) ID No. VA1210020730) incinerator spray pond (ISP) was performed in accordance with the approved closure plan, dated 18 August 1995 and modified 9 October 1997. A copy of the 9 October 1997 modification is included as **Attachment 1**. This report will satisfy the following objectives:

- Facility history/description;
- ISP history/description;
- Documentation of closure procedures;
- Risk assessment for risk-based closure;
- Independent professional engineer certification; and
- Attachments providing figures, tables, photographs, chains-of-custody, sample analyses, photographs and other relevant information for this project.

Each of the objectives listed above will be discussed in the remaining sections of the report.

2.0 *DESCRIPTION/SITE HISTORY*

2.1 *DESCRIPTION*

2.1.1 *Facility Description*

The RFAAP is a government owned industrial complex located in southwestern Virginia. It encompasses approximately 4,104 acres and is located in Pulaski and Montgomery Counties. The facility is located approximately five miles northeast of the city of Radford, 10 miles west of Blacksburg, and 47 miles southwest of Roanoke (see **Figure 1**). The New River divides the RFAAP into two portions commonly known as the "Horseshoe Area" and the "Main Manufacturing Area." The "Horseshoe Area" lies mainly to the north and west in Pulaski County. The "Main Manufacturing Area" lies in Montgomery County to the south and east.

The ISP is located in the northcentral portion of the "Horseshoe Area." (see **Figure 2**).

2.1.2 *Spray Pond Description*

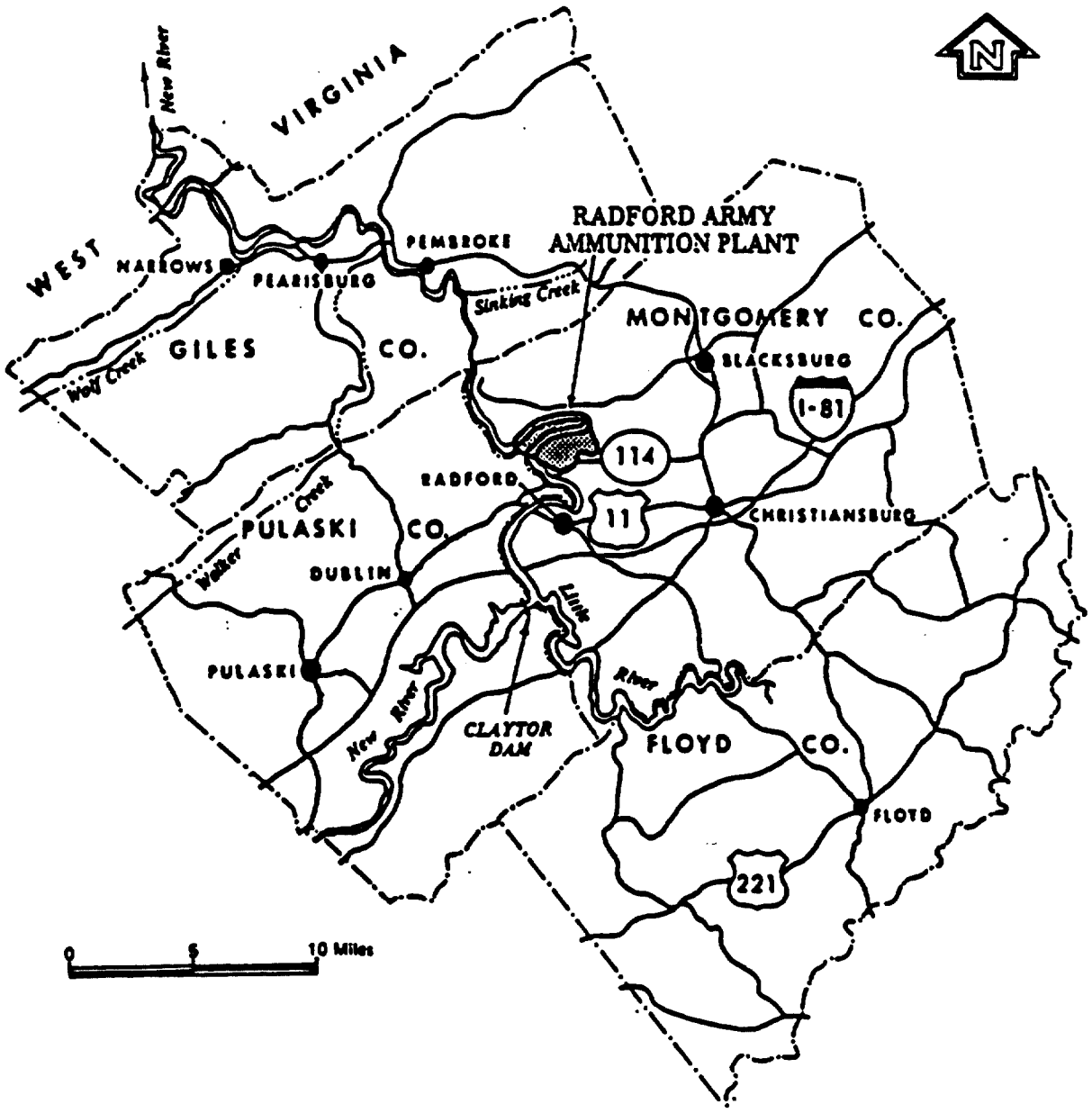
The spray pond was a concrete-lined, rectangular impoundment with dimensions of 76 x 60 x 5 feet deep. The maximum water level was three feet deep for a volume of 13,680 cubic feet or 102,340 gallons. Perforated pipes in the spray pond were used to try to prevent sludges from forming by blowing air and creating turbulence in the water.

2.2 *SITE HISTORY*

2.2.1 *Facility Background*

RFAAP was operated under contract by Hercules Aerospace Corporation from 1941 to 1995. Alliant purchased the operations of Hercules RFAAP in 1995 and is the current facility contractor. This facility, which contains over 1,696 buildings and occupies close to 3.65 million square feet, is the top manufacturer of solid propellants in the United States. The major products manufactured at this facility are solvent and solventless propellants that include single base

Figure 1


VIRGINIA
New River
WEST
NARROWS
PEARISBURG
PEMBROKE
RADFORD ARMY
AMMUNITION PLANT
Sinking Creek
MONTGOMERY CO.
BLACKSBURG
GILES
CO.
Wolf Creek
I-81
114
RADFORD
11
CHRISTIANSBURG
PULASKI
CO.
Walker
Creek
DUBLIN
Little
River
PULASKI
New River
CLAYTOR
DAM
FLOYD
CO.
FLOYD
221
0
5
10 Miles
N

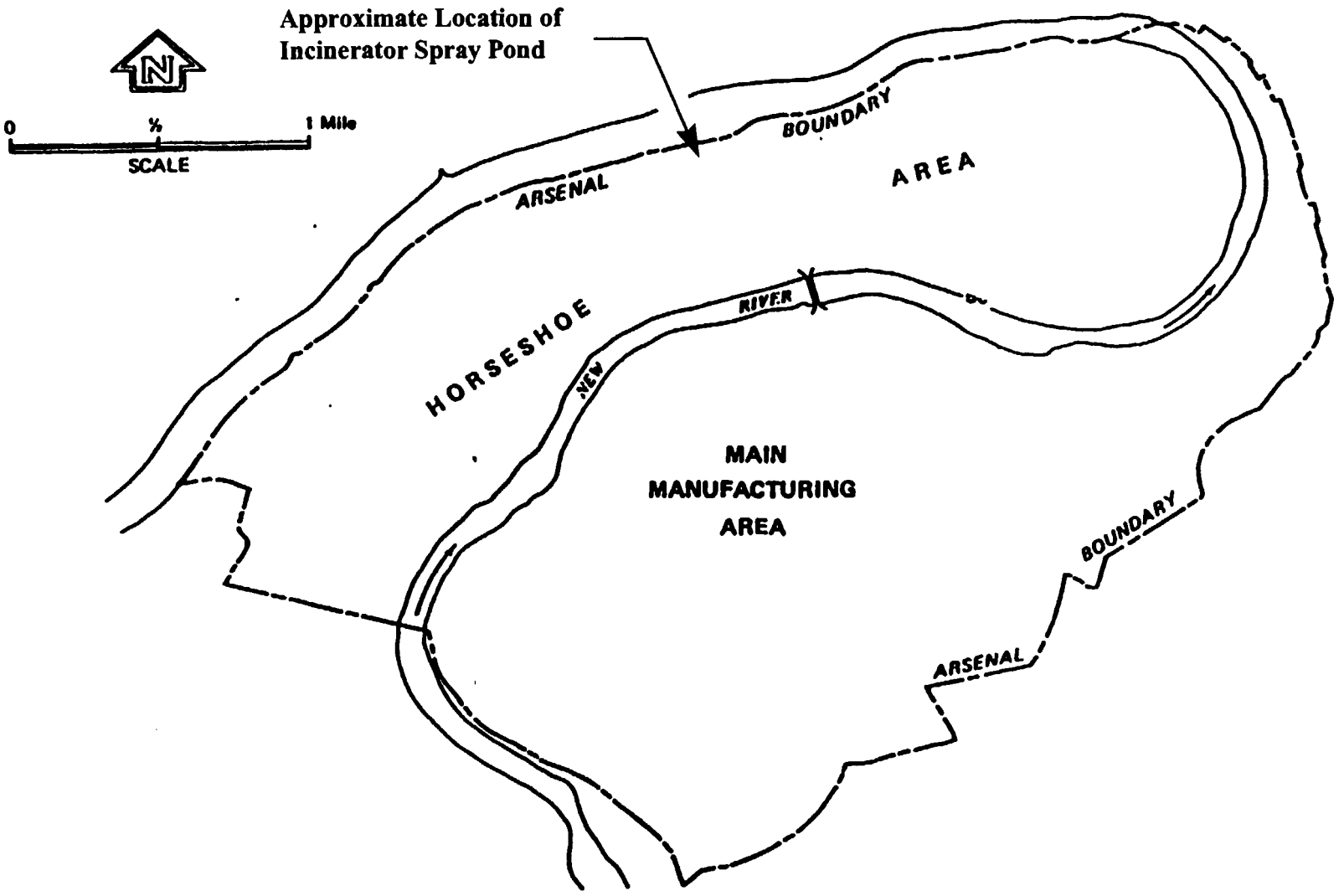

Approximate Location of
Incinerator Spray Pond
N
0
½
1 Mile
SCALE
ARSENAL
BOUNDARY
AREA
HORSESHOE
NEW
RIVER
MAIN
MANUFACTURING
AREA
BOUNDARY
ARSENAL

Figure 2

(nitrocellulose), double base (nitrocellulose and nitroglycerin), and triple base (nitrocellulose, nitroglycerin, and nitroguanidine) propellants; cast propellants; and high energy propellants. These propellants are ultimately used in small arms, anti-tank weapons, anti-aircraft weapons, rockets, torpedoes, missile systems, igniters, and other numerous ordnance-related items.

2.2.2 *Incinerator Spray Pond Background*

In 1979, two incinerators were constructed and the incineration of waste and off-specification explosives and propellants began. These incineration operations became regulated subsequent to the promulgation of the federal hazardous waste regulations under the Resource Conservation and Recovery Act (RCRA) in 1980.

Beginning in 1979, RFAAP operated a spray pond for the collection of incinerator scrubber wastewaters. The wastewater was then reused as scrubber water for the incinerator. In August 1990, the Army and Hercules discovered that the scrubber waters collected in the ISP contained lead from the incinerated propellants and the sludges which formed in the spray pond met the standards for a characteristic hazardous waste under Part III of the Virginia Hazardous Waste Management Regulations (VHWMR).

The Army and Hercules notified the Department of Waste Management (VDWM) of the contamination by letters dated 2 and 9 August 1990. Subsequent discussions between the Army, Hercules, and VDWM resulted in controls designed to prevent further contamination of the ISP and to introduce agitation of the scrubber water to prevent hazardous waste sludges from forming.

By letter dated 3 March 1992, the Army and Hercules informed the Director of VDWM and the Director of the then State Water Control Board that sludges contaminated with lead meeting the levels of toxicity required for classification as a characteristic hazardous waste under Part III of the VHWMR were continuing to accumulate in the ISP.

The ISP ceased operations in May 1992. An enforcement order was signed by the Virginia Department of Environmental Quality (VADEQ), the U. S. Army, and Hercules which became effective on 22 June 1993. A Schedule of Compliance contained in the order required submission and implementation of a closure plan. A closure plan was

completed 18 August 1995, with a subsequent revision dated 9 October 1997.

3.0 CLOSURE PLAN PROCEDURES

3.1 DEVELOPMENT OF BACKGROUND LEVELS

The hazardous constituents of concern (HCOCs) for this unit were identified in Table 3-2 of Section 3.5.1 of the ISP closure plan (see **Figure 3**). Background levels for these HCOCs were then developed. Samples were collected in the vicinity of the ISP which were neither influenced by the activities at the ISP nor in an area likely influenced by past environmental activities. The tolerance limits for a normal distribution of the sample results were calculated with 95% coverage and 95% confidence. The upper tolerance limit became the reasonable background value for each constituent. These background levels were approved by VADEQ on 22 May 1997 and became the target cleanup levels for ISP closure.

Information pertaining to the development of the background levels can be found in **Attachment 2.**

3.2 HEALTH AND SAFETY

Safety issues are a significant concern at RFAAP. Each employee/contractor/visitor allowed access to the site is required to wear coveralls, a hard hat, safety shoes, and safety glasses. Gloves and a face shield were utilized for power washing and other decontamination activities. Based on operational knowledge and early field sampling activities, no respirators or other PPE will be required.

3.3 CONCRETE AND PIPING REMOVAL

The ISP consisted of a concrete basin with metal pipes through which air was circulated in order to prevent formation of sludges in the basin. ERM professionals arriving on-site to observe the demolition of the ISP encountered the concrete basin with the piping already removed. The piping was decontaminated and sold as scrap metal to a recycler. Recent rain events had caused storm water to accumulate in the basin. A sample of the accumulated storm water was collected and analyzed for the hazardous characteristic of RCRA heavy metals

Figure 3

TABLE 3-2 HAZARDOUS CONSTITUENTS OF CONCERN

Contaminant	SW-846 Method	PQL Water (μg/L)	PQL Soil (μg/Kg)
2,4-Dinitrotoluene	8090	0.2	13
2,6 Dinitrotoluene	8090	0.1	7
Di-n-butylphthalate	8061	3.3	220
Diethylphthalate	8061	2.5	170
Resorcinol	8270	100	_
Antimony	6020	0.2	0.2
Arsenic	6020	0.2	0.2
Barium	6020	0.2	0.2
Beryllium	6020	0.2	0.2
Cadmium	6020	0.2	0.2
Chromium	6020	0.2	0.2
Lead	6020	0.2	0.2
Mercury	7470 or 7471	2	2
Nickel	6020	0.2	0.2
Silver	6020	0.2	0.2
Thallium	6020	0.2	0.2

Note: - = Not determined, Method 8270 may be used. The detection limit must be consistent with the detection limit of other constituents using this method, and documented through the QA/QC.

Table 3-2 from Section 3.5.1 of the ISP Closure Plan Listing Hazardous Constituents of Concern

using the Toxicity Characteristic Leaching Procedure (TCLP). The result for lead was 5.3 mg/kg. All other metals were below the regulatory thresholds. Alliant personnel stated that the storm water would be pumped to the wastewater treatment plant per discussions with VADEQ. Remaining sludges were placed in Department of Transportation (DOT) approved 55-gallon drums and sent off-site for treatment as D008 characteristic hazardous waste.

Natural gas lines pass in the vicinity of the ISP; proper care was exercised to prevent encroachment of the excavation to the pipe locations.

Upon removal of the storm water, the approved contractor began the demolition of the bottom of the concrete basin. A representative sample of concrete was tested for the hazardous characteristic of lead using the TCLP. The result indicated a TCLP lead concentration of approximately 0.5 parts per million (ppm). Once the floor of the ISP had been removed, the side walls were removed. Trucks hauled the concrete to a state approved landfill in Roanoke, Virginia, owned by Joe Bandy and Son, Inc. A total of 988.63 tons of concrete was disposed in this landfill.

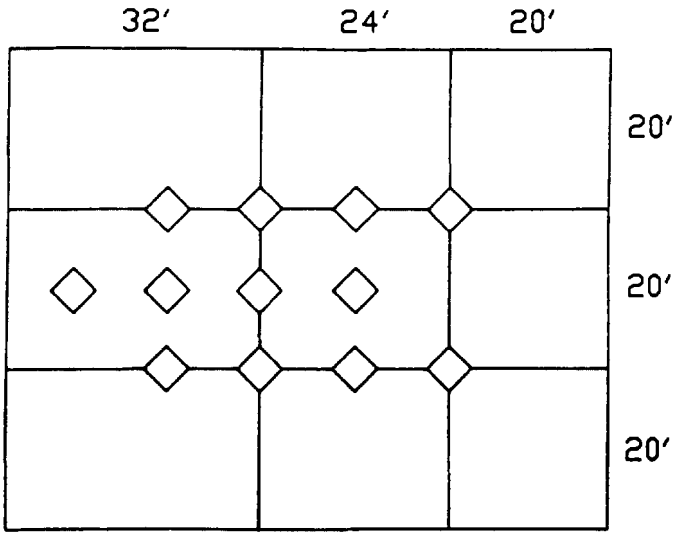
3.4 *SOIL SAMPLING*

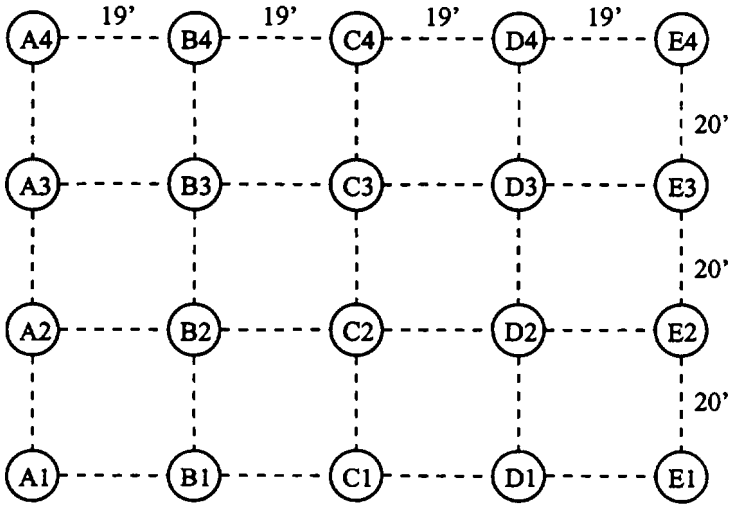
3.4.1 *On-Site Soil Screening*

With the onset of concrete removal, preparations began for sampling according to the sampling grid described in the closure plan. **Figure 4** shows the approximate layout of the sampling grid. Initial samples were analyzed on-site using a PaceScan 3000 instrument, with a detection limit of 12.5 parts per million (ppm) for total lead. The screening efforts focused on lead since this was the metal which had been previously detected in the ISP sludges.

Samples of the surficial soil (soil directly beneath the 16 to 20 inch layer of concrete) were collected during the time of the concrete demolition. Four samples exceeded the 19.0 ppm target level for total lead as analyzed by the PaceScan 3000 instrument, with ranges from approximately 21 ppm to 540 ppm.

Figure 4





Location of Concrete Joints and Potential Sampling Grid as Provided in the ISP Closure Plan. The sampling grid has be relabeled for this sampling activity.

Six samples were taken at varying depths (from 6 inches to 24 inches) below the level of the concrete. These sample results were below the detection limit (BDL) of 12.5 ppm.

With the sample results indicated above and the spread of concrete debris in the surficial soils, the decision was made to remove six inches of soil directly beneath the concrete prior to field testing according to the grid layout shown in **Figure 4.**

3.4.2 *Six Inch Layer On-Site Soil Screening*

Removal of the six inch layer occurred in stages. Initially, the northeast end was excavated with samples collected and analyzed for lead from grid nodes A1 to C4 using the PaceScan 3000. The results of this analyses are shown in the table below:

Sample Location	Result (ppm)	Sample Location	Result (ppm)
A1	18	B3	18
A2	71.5	B4	35
A3	BDL	C1	18
A4	36	C2	27
B1	32	C3	16.5
B2	42.5	C4	33.5

Two additional samples were collected from the six inch layer: E1 and halfway between nodes D1 and D2 (labeled as D1/2) produced results of 18 ppm and 20.5 ppm, respectively. Based on the results above, sampling was halted at the six inch depth and begun at the twelve inch level.

3.4.3 *Twelve Inch Layer On-Site Soil Screening*

Instead of removing an additional six inches of soil prior to sampling, an auger was used to collect samples from the twelve inch level at the grid nodes. The following table presents the sample results at this depth:

Sample Location	Result (ppm)	Sample Location	Result (ppm)
A1	BDL	C3	18
A2	BDL	C4	16.5
A3	BDL	D1	BDL

A4	BDL	D2	BDL
B1	BDL	D3	14
		D3 (dup.)	BDL
B2	BDL	D4	BDL
B3	BDL	E1	BDL
		E1 (dup.)	14
B4	18	E2	BDL
C1	BDL	E3	BDL
C2	BDL	E4	BDL

None of the samples collected from the 12 inch level exceeded the 19 ppm threshold for lead. To certify clean closure, confirmation sampling was performed at locations identified using a random number generator.

3.4.4 *Confirmation Sampling*

The confirmation samples were collected from eight grid nodes identified by a random number generator. The collection equipment was decontaminated between each sampling event as specified in Section 3.8.3 of the ISP Closure Plan. The samples went to REIC Laboratory in Beaver, West Virginia, to be analyzed for the HCOCs shown in Figure 3. A copy of the results of these analyses can be found in **Attachment 3**, including results for the equipment blank, field blank, and the trip blank. A trip blank sample bottle was not included in the sample containers supplied by the laboratory; a separate sample container was filled with distilled water at the site and sent for analysis.

Threshold exceedances of the twelve inch confirmation samples were as follows:

Contaminant	Location	Result (ppm)	Threshold (ppm)
Barium	D1	150	125.75
	E1	208	125.75
Chromium	C2	34.2	30.55
Lead	C2	22.8	19
	E1	36.2	19

3.4.5 *18 Inch and 24 Inch Samples*

Because of the exceedances shown in the table in Section 3.4.4, additional samples were collected at the 18 and 24 inch levels at the same grid points selected by the random number generator for the 12 inch confirmation sampling. Decontamination procedures outlined in the closure plan were followed between each sample. An equipment blank, field blank, and a sample duplicate were also collected and submitted to the lab for analysis. A spare sample container was filled with distilled water at the site and included as the trip blank.

Although samples were collected from the 18 and 24 inch levels, it was decided to remove the soil to the 18 inch level, leaving the 24 inch level in place. The following samples collected from the 24 inch level exceeded the background thresholds for arsenic, barium, and chromium:

Contaminant	Location	Result (ppm)	Threshold (ppm)
Arsenic	D1	6.46	5.43
Barium	E1	199	125.75
Chromium	A1	31.3	30.55
	A4	32.6	30.55
	C2	37.5	30.55
	D1	34.3	30.55
	D3	36.5	30.55
	E2	31.5	30.55

Following receipt of the analyses for these samples, Alliant proceeded to excavate the soils from the ISP to a depth of 24 inches (below the original depth of the concrete basin). Decontamination and safety procedures as outlined in the ISP Closure Plan were followed. The excavated soil was staged on-site placed on and covered by plastic sheeting until analyses determined it was acceptable as cover material by the Montgomery County Regional Landfill. Upon approval of the analytical results, 275.33 tons of soil were hauled to the permitted Montgomery County Regional Landfill. At this time, Alliant exercised its option to perform a risk assessment for risk-based closure of the ISP as outlined in Section 3.7.6 of the amended ISP Closure Plan.

3.4.6 *Closure of the Incinerator Spray Pond*

After completion of the risk assessment for risk-based closure (described in Section 4.0 of this closure report), backfilling of the ISP commenced. Clean soil was placed into the excavation and compacted in approximate one foot lifts. The excavation was graded to promote positive drainage and power-seeded to promote re-vegetation. Photographs documenting the progress of the excavation activities can be found in **Attachment 5.**

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4.0 RISK ASSESSMENT FOR RISK-BASED CLOSURE

4.1 GENERAL

Once clean closure could not be established based on the results of the soil samples collected below the ISP, RFAAP elected to perform a risk assessment (RA). The risk assessment detailed herein was conducted in accordance with the VADEQ document titled "Guidance for Development of Health Based Cleanup Goals Using Decision Tree/REAMS Program" (herein after "Virginia Risk Guidance"), and Section 3.7.6 of the amended closure plan. Successful risk-based closure would demonstrate that the concentrations of the HCOCs would not pose an unacceptable risk to the potentially exposed population.

4.2 SITE EVALUATION

At the time this RA was completed, the area encompassed by the former ISP was approximately eight to nine feet deep. This depth accounted for removal of the concrete from the ISP along with the excavation of an additional 18 to 24 inches of soil from beneath the concrete liner. The entire excavated area was approximately 100 feet by 80 feet which accounts for some side slope removal due to stability problems.

4.3 EXPOSURE ASSESSMENT

4.3.1 *Media and Exposure Pathways*

Exposure to the HCOCs potentially involves multiple receptors and various media pathways. We will look first at the current potential receptors and pathways.

RFAAP continues to operate as an industrial complex; as such, access is limited by the use of gated entrances and security personnel. On-site workers in the vicinity of the ISP are one potentially significant human receptor. Because of the security associated with RFAAP, we assume only escorted guests are subject to the risk associated with the

ISP area. In the unlikely event a trespasser crosses the area of concern, the trespasser would most likely be subject to the same risk associated with a site visitor. In either situation, visitors which frequent the area of concern are unlikely to experience the same risk associated with an on-site worker. Therefore, under the current scenario, a RFAAP worker is the primary human receptor.

An RFAAP worker can be subject to multiple exposure pathways: inhalation of particulate matter, ingestion, and dermal contact. Soil particles can become windborne and inhaled by the on-site worker. Additionally, a worker can physically handle the contaminated soil, which can lead to absorption by the skin or accidental ingestion. Risks associated with soil contamination can be assumed to be minimal in this instance, however. The soil samples which produced the contaminated soil results are located approximately nine feet below grade, beneath the former ISP concrete liner. The excavation has been backfilled with clean material. We have assumed the eight to nine foot layer of clean soil is a sufficient barrier to soil particle inhalation, ingestion, and dermal contact. Because no complete pathways exist for ground water (no drinking water wells exist), we have assumed the risks corresponding to potential human receptors for the current working conditions is insignificant.

The closure plan for the ISP states that a future residential/industrial use of the property must be considered in the RA. Assuming residential homes are built on the property, on-site residents will experience a much greater potential risk than visitors or trespassers, simply by their proximity to the contamination source.

As with a RFAAP worker, on-site residents will be subject daily to the contaminant concentrations of the soil and ground water. In addition to inhalation of soil particulates, ingestion, and dermal contact with the contaminated soil, no restrictions have been placed by RFAAP on the use of ground water in the area. Therefore, residents can also be exposed through ingestion and dermal contact with ground water. Again, as with the RFAAP worker, we can assume an incomplete pathway for risks associated with soil contamination; however, we have elected not to make this assumption for the assessment of risk. We conservatively assumed that soils excavated during housing construction or well construction have been evenly spread across the remainder of the parcel. This could bring contaminated material to the surface, creating a complete exposure pathway via soil inhalation, ingestion, and/or dermal contact.

The potential pathways quantitatively modeled for this RA pertain to an on-site resident. The potential exposure routes include soil inhalation, ingestion, and dermal contact, and ground water ingestion and dermal contact. Each potential exposure pathway was quantitatively evaluated using the REAMS model exposure assumptions (where applicable), the March 1997 USEPA Region III Risk Based Concentration Table of toxicity values presented in **Table 1**, and default values provided in the existing closure plan.

4.3.2 *Site Conceptual Exposure Model (SCEM)*

The SCEM is based on existing and future site conditions and depicts the potential exposure routes and media for the site (**Figure 5**). The SCEM presents the primary applicable migration pathways and identifies the exposure routes and potentially affected populations which warrant either further consideration and/or quantitative risk characterization. **Table 2** provides a summary of the exposure pathways to human populations. While there are multiple potential exposure pathways to humans, only the future on-site resident was quantitatively evaluated for this assessment. The remaining receptor pathways were qualitatively evaluated and determined to be insignificant when compared to the risk associated with a future on-site resident.

4.4 *HAZARDOUS CONTAMINANTS OF CONCERN (HCOC)*

To determine the HCOCs, samples were collected by ERM in the vicinity of the ISP to determine a statistical background value for various contaminants. This statistical background value became the threshold value against which future samples would be compared to determine if a particular sample was "contaminated," i.e., above the statistically generated threshold value.

ERM collected samples at the ISP at a depth of 18 inches to 24 inches below the base of the existing excavation. The following results indicate the three contaminants which exceed the background threshold concentrations as described above. It is these three contaminants for which this RA is being performed. The location of the samples with respect to the ISP excavation and the threshold values for the listed contaminants are included. Only those tests which exceed the background (threshold) values are included in this table.

Table 1
Toxicity Values
Radford Army Ammunition Plant
Radford, Virginia

Contaminant	CAS No.	Carcinogen?	Carcinogenic Effects		Non-Carcinogenic Effects	
			Oral Slope Factor (CPSo) (Kg•day/mg)	Inhalation Slope Factor (CPSi) (Kg•day/mg)	Chronic Oral Reference Dose (RfDo) (mg/kg/day)	Chronic Inhalation Reference Dose (RfDi) (mg/kg/day)
Inorganics						
Arsenic	7440382	Yes	1.50E+00	1.51E+01	3.00E-04	~
Barium	7440393	No	~	~	7.00E-02	1.43E-04
Chromium III	16065831	No	~	~	1.00E+00	5.71E-07

Note: Toxicity values taken from USEPA Region III list (Roy Smith Tables-17 March 1997)

~: Not available/Not applicable

ERM

Figure 5
Site Conceptual Exposure Model

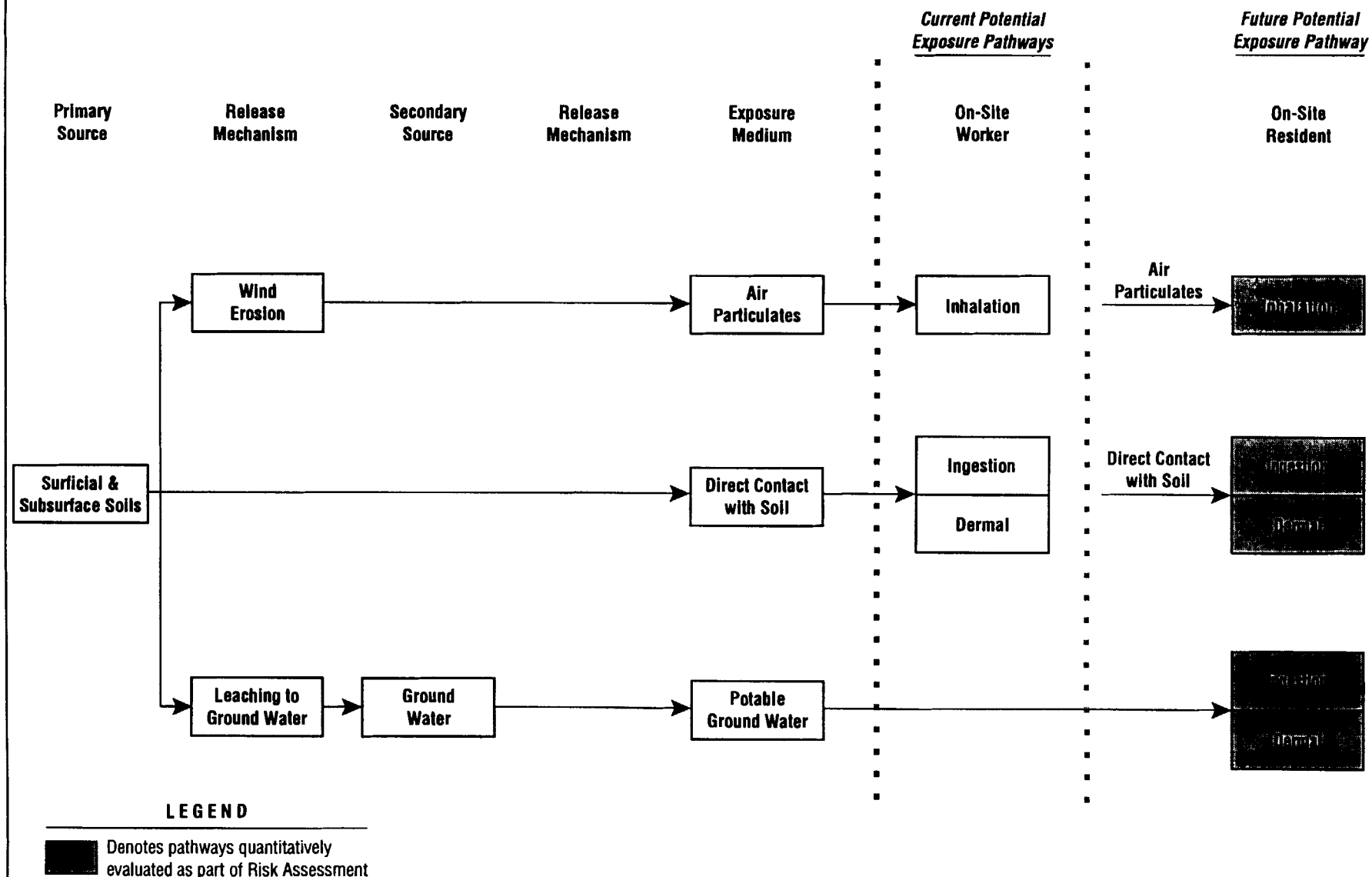

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Table 2

Summary of Potential Exposure Pathways Considered in the Risk Assessment

Radford Army Ammunition Plant
Radford, Virginia

Exposure Medium/ Exposure Route	Current Site Access		Future Site Access		
	RAAP Worker	Visitor	Resident	Construction Worker	Trespasser/Visitor
Soils					
Inhalation	~	~	X	~	~
Ingestion	~	~	X	~	~
Dermal Contact	~	~	X	~	~
Migration to Groundwater					
Ingestion	~	~	X	~	~
Dermal Contact	~	~	X	~	~

"X" Indicates that the pathway was modeled quantitatively in the Risk Assessment.
"~" Indicates that the pathway was qualitatively evaluated, but was determined to be an insignificant exposure route compared to that of a future long-term resident

Contaminant	Location	Result (ppm)	Threshold (ppm)
Arsenic	D1	6.46	5.43
Barium	E1	199	125.75
Chromium	A1	31.3	30.55
	A4	32.6	30.55
	C2	37.5	30.55
	D1	34.3	30.55
	D3	38.5	30.55
	E2	31.5	30.55

4.5 *TOXICITY ASSESSMENT*

The toxicological assessment involved the identification of adverse health effects associated with exposure to a chemical and the relationship between the extent of exposure and the likelihood of adverse health effects. Toxicity values for carcinogens are represented by potency slope factors (CPSs) and toxicity values for non-carcinogenic chemicals are represented by reference doses (RfDs). The toxicity values used in this risk assessment for the HCOCs were derived from the USEPA Region III Risk-Based Concentration Table-March 1997, and are presented in **Table 5**.

Of the three HCOCs for this RA, only arsenic exhibits carcinogenic effects. The USEPA Region III Risk-Based Concentration Table provides oral and inhalation slope factors for arsenic. Similarly, this table provides oral and inhalation references doses for non-carcinogenic effects for each of the metals, except for the inhalation reference dose for arsenic. In this instance, no RfD exists for arsenic. Where a reference dose for one exposure pathway is not available (i.e., arsenic), the toxicity value for another exposure pathway of the same metal is substituted (if available). Therefore, the RfD for inhalation for the non-carcinogenic effects of arsenic is assumed to be equal to the RfD for the ingestion of arsenic. Although it is recognized that substitution of the exposure route-specific toxicity value may not be applicable for all compounds, it was determined that a more conservative risk estimate is derived by retaining the exposure route without a published toxicity value for consideration in the overall RA.

4.6 *CONTAMINANT CONCENTRATION AT THE POINT OF EXPOSURE*

The table in Section 4.4 provides the sample results which exceed the threshold values determined for the RFAAP ISP site. The development of the concentrations at the points of exposure required selecting the sample with the highest concentration exceeding the threshold value. For arsenic and barium, only one sample exceeded the threshold. For chromium, we used 38.5 parts per million (ppm) in the calculations of risk and exposure point concentrations.

For migration of the contaminant from soil to ground water, the maximum contaminant levels (MCLs) for the HCOCs mark the starting points for determination of the contaminant concentrations. The MCL is the maximum contamination allowed in drinking water. Demonstrating a concentration at this level and below gives an acceptable risk for the contaminant in question.

4.7 *RISK EVALUATION AND SUMMARY*

This section combines the information developed in the exposure and toxicity assessment sections to estimate the potential risks to human health posed by the contaminants detected. The excess cancer risk (carcinogens) and the hazard quotient (HQ - non-carcinogens) for exposure to each chemical by each route of exposure, exposure pathway, category of receptor, and exposure case are initially estimated separately. The separate cancer risks are then summed across chemicals and across all exposure routes to obtain the total excess cancer risk for that population. The HQ is also summed across chemical, exposure routes, and pathways applicable to the same population.

For this RA, arsenic is the only HCOC which has demonstrated carcinogenic effects, and subsequently, has cancer slope factors for various media. Normally, the lifetime carcinogenic risk shall not exceed 1×10^{-6} (i.e., one case of cancer per 1,000,000 population) for individual carcinogens, and 1×10^{-4} cumulative risk for multiple carcinogens. In this instance, a cancer risk for arsenic of 1×10^{-3} is considered acceptable. The reason we used this risk level is discussed in the question and answer section of the USEPA Region III Risk-Based Concentration Table dated March 17, 1997, and summarized here. A 1988 risk management policy by USEPA suggests

carcinogenic risk for arsenic up to 1×10^{-3} is acceptable because cancers of this origin tend to have a low mortality rate. Therefore, this RA must demonstrate that the maximum concentration of arsenic must give a cumulative carcinogenic risk of less than 1×10^{-3}.

The risk tables for the exposure pathways can be found in **Attachment 4**, pages 1, 2, and 3; the results of the risk calculations are shown in **Table 3**. The cumulative carcinogenic risk associated with the inhalation, ingestion, and dermal absorption of arsenic in soil is approximately 2.93×10^{-5}, well below the allowable risk level of 1×10^{-3}.

All three HCOCs have quantified non-carcinogenic effects as indicated by the RfDs given in **Table 4**. The cumulative non-carcinogenic risk for the three HCOCs must have a hazard index (HI) of less than one, where the HI is the sum of the HQs calculated for each relevant route of exposure for each HCOC. Another aspect of non-carcinogenic risk calculations is that effects are not cumulative for a lifetime, and the susceptibility of effects differs between adults and children. Therefore, different equations and default parameters are necessary to calculate the risks attributed to adults and the risks attributed to children. Likewise, separate HIs must be calculated for both adults and children.

The risk tables for the exposure pathways can be found in **Attachment 4**, pages 4 through 9; the results of the HI calculations are shown in **Table 4** and summarized here. For adults, the HI is approximately 0.131; for children, approximately 0.515. Both values fall below the HI threshold of one.

Another potential area of contamination is the migration of contaminants to ground water. Percolation through the contaminated zone may generate leachate which can reach the ground water. As shown in **Table 5**, the Soil Screening Level Partitioning Equation was used to estimate the screening level in soil which will generate a concentration no greater than the MCL in the ground water. Using default parameters as necessary, the calculated screening level in soil for each contaminant was determined to be above the maximum concentration detected. The table on the following page illustrates the results.

Table 3

On-site Resident

Human Exposure to Soils (Carcinogen)

Radford Army Ammunition Plant

Radford , Virginia

Contaminant	CAS No.	Maximum All Soils Conc. (mg/Kg)	Calculated Air (Dust) Conc. (mg/m3)	Carcinogenic IELCR		
				Ingestion	Dermal	Dust Inhalation
Inorganics						
Arsenic (as carcinogen)	7440382	6.46	9.51E-09	1.52E-05	*1.41E-05*	3.93E-08

Totals	1.52E-05	1.41E-05	3.93E-08

IELCR:	2.93E-05

NOTES:

~: Not available/Not applicable

Dust concentrations in air calculated by multiplying maximum soil concentration by the PEF.

IELCR - Individual Excess Lifetime Cancer Risk

All concentrations are the maximum detected concentrations.

Values in italics are calculated using oral factors (CPSo)

Table 4

On-site Resident

Human Exposure to Soils (Non-carcinogen)

Radford Army Ammunition Plant

Radford , Virginia

Contaminant	CAS No.	Carcinogen?	Maximum All Soils Conc. (mg/Kg)	Calculated Air (Dust) Conc. (kg/m3)	Non-Carcinogenic (Adult) Hazard Quotient (HQ)			Non-Carcinogenic (Child) Hazard Quotient (HQ)		
					Ingestion	Dermal	Dust Inhalation	Ingestion	Dermal	Dust Inhalation
Inorganics										
Arsenic	7440382	Yes	6.46	9.51E-09	2.95E-02	*6.65E-02*	*8.69E-06*	2.75E-01	*1.20E-01*	*2.43E-05*
Barium	7440393	No	199	2.93E-07	3.89E-03	*2.74E-03*	5.61E-04	3.63E-02	*4.94E-03*	1.57E-03
Chromium III	16065831	No	38.5	5.67E-08	5.27E-05	*3.72E-05*	2.72E-02	4.92E-04	*6.69E-05*	7.62E-02
Totals					**3.34E-02**	**6.93E-02**	**2.78E-02**	**3.12E-01**	**1.25E-01**	**7.78E-02**

NOTES:

~: Not available/Not applicable

Dust concentrations in air calculated by multiplying maximum soil concentration by the PEF.

All concentrations are the maximum detected concentrations.

Values in italics are calculated using oral factors (CPSo or RfDo)

Hazard Index (Adult):	**1.31E-01**
Hazard Index (Child):	**5.15E-01**

Table 5
Soil Screening Level Partitioning Equation for Migration to Ground Water
Radford Army Ammunition Plant
Radford, Virginia

Screening Level in Soil (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/\rho_b]$

where:
C_w = target soil leachate concentration (mg/L)
K_d = soil-water partition coefficient (L/kg)
θ_w = water filled soil porosity (L_{water}/L_{soil})
θ_a = n-θ_w, air filled soil porosity (L_{air}/L_{soil})
where: $n = 1 - \rho_b/\rho_s$, soil porosity (L_{pore}/L_{soil})
where: ρ_s = soil particle density (kg/L)
H' = Henry's law constant (dimensionless)
ρ_b = dry soil bulk density (kg/L)

ARSENIC

Screening Level in Soil (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/\rho_b]$

where: C_w =	1	0.05 x 20	(MCL x default attenuation factor (DAF)*)
K_d =	29		(Soil Screening Guidance: User's Guide, Attachment C, page C-7)
θ_w =	0.3		(default value)
θ_a =	0.133962	1 -(1.5 / 2.65)- 0.3	(($1 - \rho_b/\rho_s$) - θ_w, default values)
H' =	0		(assumed to be zero for inorganics)
ρ_b =	1.5		(default value)

Screening Level in Soil (mg/kg) = 29.2 Highest Detected Value (mg/kg) = 6.46

* The default DAF equals 20 for sources up to 0.5 acres in size. The ISP excavation for closure is approximately 0.2 acres. Therefore, the concentration of arsenic in the soil which will leach to the ground water and produce ground water concentrations approximately equal to the MCL is 29.2 mg/kg, assuming the default parameters provided in the EPA document Soil Screening Guidance: User's Guide (April 1996) are used.

BARIUM

Screening Level in Soil (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/\rho_b]$

where: C_w =	40	2 x 20	(MCL x default attenuation factor (DAF)*)
K_d =	41		(Soil Screening Guidance: User's Guide, Attachment C, page C-7)
θ_w =	0.3		(default value)
θ_a =	0.133962	1 -(1.5 / 2.65)- 0.3	(($1 - \rho_b/\rho_s$) - θ_w, default values)
H' =	0		(assumed to be zero for inorganics)
ρ_b =	1.5		(default value)

Screening Level in Soil (mg/kg) = 1,648 Highest Detected Value (mg/kg) = 199

* The default DAF equals 20 for sources up to 0.5 acres in size. The ISP excavation for closure is approximately 0.2 acres. Therefore, the concentration of barium in the soil which will leach to the ground water and produce ground water concentrations approximately equal to the MCL is 21,208 mg/kg, assuming the default parameters provided in the EPA document Soil Screening Guidance: User's Guide (April 1996) are used.

CHROMIUM

Screening Level in Soil (mg/kg) = $C_w [K_d + (\theta_w + \theta_a H')/\rho_b]$

where: C_w =	2	0.1 x 20	(MCL x default attenuation factor (DAF)*)
K_d =	1.80E+06		(Soil Screening Guidance: User's Guide, Attachment C, page C-7)
θ_w =	0.3		(default value)
θ_a =	0.133962	1 -(1.5 / 2.65)- 0.3	(($1 - \rho_b/\rho_s$) - θ_w, default values)
H' =	0		(assumed to be zero for inorganics)
ρ_b =	1.5		(default value)

Screening Level in Soil (mg/kg) = 4.E+06 Highest Detected Value (mg/kg) = 38.5

* The default DAF equals 20 for sources up to 0.5 acres in size. The ISP excavation for closure is approximately 0.2 acres. Therefore, the concentration of chromium in the soil which will leach to the ground water and produce ground water concentrations approximately equal to the MCL is 336 mg/kg, assuming the default parameters provided in the EPA document Soil Screening Guidance: User's Guide (April 1996) are used.

Contaminant	Screening Level (mg/kg)	Maximum Level Detected (mg/kg)	Below Screening Level?
Arsenic	29.2	6.46	Yes
Barium	1,648	199	Yes
Chromium	A	38.5	Yes

A = According to Appendix A of the 1996 *Soil Screening Guidance: Users Guide*, there is no generic soil screening value for chromium III because; "Pathway not a concern in any soil contamination concentration."

Therefore, potential impacts to ground water will not exceed the acceptable criteria (MCLs).

In summary, the maximum concentrations of the HCOCs pose an acceptable risk under the current use and to a potential future residential population. The cumulative carcinogenic risk associated with inhalation, ingestion, and dermal absorption of arsenic in soil is near 3×10^{-5}, well below the risk level of 1×10^{-3}. The non-carcinogenic risk for the same three pathways is approximately 0.13 and 0.52 for adults and children, respectively. These risks are below the target HI of one. Comparing the calculated soil screening values to the HCOC's maximum detected levels demonstrates the HCOCs do not pose a threat to migrate from the soil to the ground water at levels equal to or above the MCLs. Therefore, the soil concentrations of HCOCs remaining in the ISP area meet the acceptable risk levels as outlined in the ISP Closure Plan and the Virginia Risk Guidance for risk-based closure.

5.0 *COMPLIANCE CERTIFICATION*

Environmental Resources Management certifies that the closure of the incinerator spray pond at the Radford Army Ammunition Plant in Radford, Virginia, was performed and completed in accordance with the Virginia Department of Environmental Quality approved Closure Plan dated 18 August 1995, and amended 9 October 1997.

Catherine C. Warner	026444	VA	2-4-98
Catherine C. Warner	Registration No.	State	Date

for Radford Army Ammunition Plant

Resident Manager	2/24/98
Title	Date

Attachment 1

October 1997 Closure Plan Amendment

Rec'd ENV 10-20-97

97-174 c: Jake. ENV file Radder Olsen Barker

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

George Allen
Governor

Becky Norton Dunlop
Secretary of Natural Resources

Street address: 629 East Main Street, Richmond, Virginia 23219
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Fax (804) 698-4500 TDD (804) 698-4021
http://www.deq.state.va.us

Thomas L. Hopkins
Director

(804) 698-4000
1-800-592-5482

Certified Mail
Return Receipt Requested

October 9, 1997

C.A. Jake
Alliant Techsystems Inc.
Environmental Manager
Radford Army Ammunition Plant
P.O. Box 1
Radford, VA 24141-0100

RE: Radford Army Ammunition Plant (RAAP)
EPA ID# VA1210020730
Incinerator Spray Pond Closure Plan Amendment

Dear Ms. Jake:

Your letter requesting an amendment to the approved closure plan for RAAP's incinerator spray pond was submitted to the Department of Environmental Quality (DEQ) on October 3, 1997. The amendment will allow for RAAP to pursue closure to risk-based standards for the referenced hazardous waste management unit.

Based on the information submitted, the amendment requested is approved. An update to the closure plan's pages are attached and will need to be added to the closure plan. Please update your closure plan as needed.

As provided in Rule 2A:2 of the Supreme Court of Virginia, you have 30 days from the date of service of this decision to initiate an appeal by filing a notice of appeal with:

Thomas L. Hopkins, Director
Virginia Department of Environmental Quality
629 East Main Street

P.O. Box 10009
Richmond, Virginia 23240-0009

In the event that this decision is served to you by mail, the date of service will be calculated as three days after the postmark date. Please refer to Part Two A of the Rules of the Supreme Court of Virginia, which describes the required content of the Notice of Appeal, including specifications of the Circuit Court to which the appeal is taken, and additional requirements concerning appeals from decisions of administrative agents.

If you should have any questions, concerning this matter, please contact Debra Miller, Environmental Engineer Senior, of my staff at (804) 698-4206.

Sincerely,

Leslie A Romanchik

for Thomas L. Hopkins

Attachment
cc: Jerry Redder, Alliant Techsystems-RAAP
Robert Greaves, EPA Region III
Leslie Romanchik, DEQ (w/out Attachment)
Debra Miller, DEQ
Glenn VonGonten, DEQ
Claire Ballard, DEQ (w/out Attachment)
Aziz Farahmand, DEQ/RRO-Compliance
CENTRAL HW FILES

d. Following resampling, comparison to background[1] along with additional 6-inch soil layer excavation (if required) will be performed in accordance with the protocols previously outlined.

If, upon following these protocols in an attempt to achieve clean closure, the pond surface soils have been removed from the hot spot(s) down to a sufficient level without achievement of clean closure for all closure parameters, Radford Army Ammunition Plant (RAAP) will:

* Implement the contingent closure and post-closure procedures of this plan; or
* Continue with removal activities and sampling of soil layers, as detailed above; or
* Perform closure to risk based standards as detailed in §3.7.6 of this closure plan.

As previously stated, the facility reserves the option, at any point during the incinerator spray pond subsoils assessment, to abandon attempts to demonstrate clean closure to either background or risk based standards, and immediately implement contingent closure and post-closure.

3.7.6 Risk-Based Closure

As an alternative to clean closure to background standards, specified above, or in conjunction with background standards, RAAP may propose to demonstrate that the concentrations of hazardous constituents detected do not pose an unacceptable level of risk to human health and the environment. The facility may present this proposal to the DEQ following the requirements as outlined in this section and as detailed in Appendix A.

In order to estimate the risk for HCOCs, a risk assessment will be conducted according to the 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 goals/performance standards will be a hazard index of 1.0 for non-carcinogens and an individual carcinogenic risk of $1x10^{-06}$ and cumulative carcinogenic risk of $1x10^{-04}$. This risk assessment will be conducted assuming a future residential use of the property.

The Department will review the risk assessment report to determine that it conforms to risk assessment requirements for residential risk-based protocols. If acceptable, attainment of the closure standards may then be demonstrated using the residential risk-based assessment in lieu of the clean closure to background standards established under §3.7.1 Background Sampling For Soil Assessment.

If the Incinerator Spray Pond cannot meet the residential risk closure standards, then RAAP may propose to modify this closure plan for industrial risk-based closure. Modification will require notification of the DEQ and the submittal of a closure amendment, in accordance with 9 VAC 20-60-580.C (previously, VHWMR §9.6.C)

[1] (Optional) The background critical value described thus far will have been computed from the top layer (0-6 inches) of the background area. It may be necessary to sample background at lower intervals (6-12 inches, 12-24 inches) for comparison at lower intervals to avoid bias. This option should be implemented if, for example, distinctly different soil types are encountered at depth, thereby necessitating re-establishment of background.

Note, for the remaining sections of the closure plan, any discussions of "clean" closure of the incinerator spray ponds' subsoils, will signify either clean closure to background levels and/or closure to risk based closure standards, as described in this section.

3.8 Field Quality Control

To ensure the collection of representative samples, the following field quality control procedures will be utilized during the closure operations.

Equipment blanks will be collected after every 20th sample. If equipment blanks indicate contamination, then resampling will occur only if sample results are above cleanup levels. Samples will be analyzed for the hazardous constituents of concern identified in this document. Laboratory quality control will be according to the methods detailed in SW-846.

Laboratory quality control will be according to the methods detailed in SW-846.

Appendix A

RISK-BASED CLOSURE

1. Introduction

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

2. Risk-Based Evaluation

In order to estimate the risk for hazardous constituents of concern (HCOC) associated with the materials remaining in a HWMU, 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 risk.

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 associated with the closure performance standards (risk goals) will include:

i. a hazard index of 1.0 or less for non-carcinogens;

ii. a risk of 1E-06 or less for individual carcinogens;

iii. cumulative risk of 1E-04 or less for all carcinogens; and

iv. the concentrations of HCOC remaining in the HWMU will not result in contamination of other environmental media of concern, including the groundwater underneath the unit.

Compliance with the closure standard shall be verified by comparing the calculated individual and cumulative risk/hazard for all HCOC that failed the background statistical comparison (if such comparison is preformed) to the risk goals.

The risk assessment will be conducted assuming a future residential/industrial use of the property. The methodology and equations for estimating the exposure concentration are 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. Then HCOC for the risk assessment are identified (See Section 3 of this document).

In the next step, the exposure assumptions outlined in the Virginia Risk Guidance will be employed to estimate the risk. 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 estimate risk (obtained from the Virginia Risk Guidance) 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 conducted 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. In certain situations, groundwater sampling is preferable.

3. Identification of Hazardous Constituents of Concern for Risk Assessment

For the purpose of REAMS evaluation associated with a HWMU, HCOC are those closure constituents present at concentrations statistically exceeding the background levels. If the concentrations of a closure constituent did not statistically exceed the background levels, no further risk-based evaluation for such constituent is required.

4. 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 potential exposure posed by the HWMU.

With regard to the soil, a residential exposure will be assumed 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 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 require 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 impact to the groundwater underneath the HWMU, REAMS fate and transport modeling[2] will be required to assess impact from residual soil contamination 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), 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.

4.1 Ingestion of Soil

The equation for potential chemical intake by soil ingestion 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.

4.2 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 HCOC 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 Virginia Risk 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).

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[2]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 Risk Guidance. The closure report must include evaluation of model results (concentrations reaching the groundwater) and a copy of SESOIL output file.

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). In order to estimate the amount of a particular HCOC which may potentially be absorbed through the skin, chemical-specific dermal absorption factors (ABS_{derm}) are used.

4.3 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 HCOC 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 to derive an ambient air particulate concentration. Justification for and documentation of the model(s) used will be submitted to the Department as part of the risk assessment.

4.4 Inhalation of Volatilized HCOC in Soil

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

5. 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-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.

5.1 Inhalation and oral RfDs and SFs

RfDs and 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.

5.2 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.

6. Evaluation of Risk

Using the toxicity criteria and identified exposure pathways discussed above, and the procedures described in the Virginia Risk Guidance, the risk presented by the HCOC will be estimated. The estimated risk 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).

6.1 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 risk for contaminants will be calculated as per the equations and assumptions described in Tables 1 through 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.

6.2. Risk Estimation

Health risk assessments are based on the relationship involving intake, contaminant concentration, risk, and toxicity. Chronic daily intake (CDI), a product of intake and contaminant concentration, are estimated using the exposure equations and assumptions associated with each route of exposure. CDIs are then combined with the RfDs or SFs to determine the resulting risk. For carcinogen(s), cumulative potential risk ($RISK_c$) can be calculated as follows:

$$RISK_c = CDI_{ingestion} * SF_{ingestion} + CDI_{dermal} * SF_{dermal} + CDI_{inhalation\text{-}VOCs} * Sf_{inhalation\text{-}VOCs} + CDI_{inhalation\text{-}particles} * SF_{inhalation\text{-}particles}$$

For noncarcinogen(s), cumulative hazard index (HI_c) can be calculated as follows:

$$Hi_c = CDI_{ingestion} / RfD_{ingestion} + CDI_{dermal} / RfD_{dermal} + CDI_{inhalation\text{-}VOCs} / RfD_{inhalation\text{-}VOCs} + CDI_{inhalation\text{-}particles} / RfD_{inhalation\text{-}particles}$$

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

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	$\frac{VF \times IRA_{adj} \times ET \times EF}{At_c}$	$\frac{VF \times IRA_a \times ET \times EF_o \times ED_o}{BW_a \times AT_c}$
Inhalation of emitting particles from soil	$\frac{PEF \times IRA_{adj} \times ET \times EF}{AT_c}$	$\frac{PEF \times IRA_a \times ET \times EF_o \times ED_o}{BW_a \times AT_c}$

Table 2
Risk Assessment Algorithm for Non-carcinogenic Exposure

Exposure Route	Chronic Daily Intake (CDI), mg/L-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	$\frac{VF \times IRA_c \times ET \times EF \times ED_c}{BW_c \times AT_n}$	$\frac{VF \times IRA_a \times ET \times EF_o \times ED_o}{BW_a \times AT_n}$
Inhalation of emitting particles from soil	$\frac{PEF \times IRA_c \times ET \times EF \times ED_c}{BW_c \times AT_n}$	$\frac{PEF \times IRA_a \times ET \times EF_o \times ED_o}{BW_a \times AT_n}$

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 risk 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	Unit	Value	Reference
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 Fish	kg/day	0.28 0.122 0.054	c,d

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	kg/m^3	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	kg/m^3	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.

Attachment 2

Soil Background Development

Environmental
Resources
Management, Inc.

3140 Chaparral Drive, SW
Suite 201
Roanoke, VA 24018
(540) 776-3545
(540) 776-8530 (fax)

FILE

2 April 1997
Reference: L0706.05.01

Mr. Arne Olsen
Alliant Techsystems
P. O. Box 1
Radford, Virginia 24141-0100

ERM

Re: Incinerator Spray Pond Closure,
Background Soil Sampling Results

Dear Arne:

The following represents the updated report for background soil sampling results for the Incinerator Spray Pond based on our 26 March 1997 telephone conversation.

Alliant Techsystems, Inc. (Alliant) is submitting background soil sampling results and revised critical values in support of closure of the Incinerator Spray Pond at the Radford Army Ammunition Plant in Radford, Virginia. These changes are being made in response to comments received from the Virginia Department of Environmental Quality (DEQ) on 26 March 1997. Changes include recalculation of the critical values for chromium, lead, mercury, nickel, and thallium using analytical values reported between the method detection limit and practical quantitation limit (PQL). It is noted that because the reported values are less than the laboratory PQL, the values may not be true or accurate values. Basing the critical values on these analytical results may lower cleanup levels. Secondly, the critical values were recalculated using 95% data coverage and 95% confidence level.

The background critical values are based on samples taken on 2 January 1996 and 5 December 1996. In accordance with Section 3.7.1 of the approved closure plan for the Incineratory Spray Pond, Alliant collected and analyzed six background soil samples for the constituents provided in Table 3-2A, *"Hazardous Constituents of Concern."* The following statistical operations were conducted on the data:

- Check for possible data outliers;
- Test assumptions of data normality;

- Check for adequate number of samples collected; and
- Calculation of background critical values.

Table 1 summarizes the analytical results and indicates the hazardous constituents of concern, Practical Quantitation Limit (PQL), units, and results. **Table 2** provides the calculated soil background critical values. Analytical methods, statistical methods, and conclusions are discussed further below.

Data

Background soil sampling results with the Practical Quantitation Limits for the 2 January 1996 sampling events were submitted on 25 March 1996. As indicated in the 28 May 1996 and 28 October 1996 letters from DEQ to Ms. C. A. Jake, Alliant Techsystems, Inc., several analytical methods did not conform to Table 3-2 of the approved closure plan for the Incinerator Spray Pond, dated 24 August 1995. However, because most constituents were detected above the PQL, DEQ accepted the results for all the constituents in Table 3-2 with the exception of arsenic, di-n-butyl phthalate, diethyl phthalate, and resorcinol. Consequently, additional soil samples were collected and analyzed for these constituents on 5 December 1996. The analytical methods used were those identified in the updated Table 3-2A enclosed with DEQ's 28 October 1996 letter.

The analytical methods used for antimony, barium, chromium, lead, mercury, nickel, and thallium were not those identified in the approved closure plan. However, these constituents were detected at levels above the method detection limit for the methods used. Because the constituents were detected, DEQ indicated its approval of the methods in DEQ's 28 October 1996 letter to C.A. Jake, Alliant Techsystems.

Alliant resampled and re-analyzed for arsenic, di-n-butyl phthalate, diethyl phthalate, and resorcinol in December 1996 because of several concerns. First, the analytical method utilized in the first sampling event, SW-846 Method 8061, could not confirm the presence of diethyl phthalate because the ions in the clay soil matrix interfere with the laboratory instrumentation. Second, the recovery of several surrogates was not within acceptable ranges. Finally, the non-detected values for resorcinol and diethyl phthalate were based upon a Mass Spectral Library Search only. Although DEQ later approved the use of Method 8270B for these

INCINERATOR SPRAY POND BACKGROUND SOIL RESULTS
BASIC RESULTS (CONDENSED)
FOR ALL DATES

COMPANY: Alliant Techsystems Inc.
SITE: Incin. Spray Pond
PROGRAM: Closure
PROGRAM TYPE: Soil
DATA GROUP:

All Duplicates Used

PARAMETER	UNIT	SAMPLE NUMBER	SAMPLE DATE	RESULT	DETECTION LIMIT	COMMENT CODE
LOCATION ID: Background						
RAAP LIST						
2,4-DINITROTOLUENE	PPB	BG1	01/02/1996	Non-Detec	130.00000	
2,4-DINITROTOLUENE	PPB	BG2	01/02/1996	Non-Detec	130.00000	
2,4-DINITROTOLUENE	PPB	BG3	01/02/1996	Non-Detec	130.00000	
2,4-DINITROTOLUENE	PPB	BG4	01/02/1996	Non-Detec	130.00000	
2,4-DINITROTOLUENE	PPB	BG5	01/02/1996	Non-Detec	130.00000	
2,4-DINITROTOLUENE	PPB	BG6	01/02/1996	Non-Detec	130.00000	
2,6-DINITROTOLUENE	PPB	BG1	01/02/1996	Non-Detec	70.00000	
2,6-DINITROTOLUENE	PPB	BG2	01/02/1996	Non-Detec	70.00000	
2,6-DINITROTOLUENE	PPB	BG3	01/02/1996	Non-Detec	70.00000	
2,6-DINITROTOLUENE	PPB	BG4	01/02/1996	Non-Detec	70.00000	
2,6-DINITROTOLUENE	PPB	BG5	01/02/1996	Non-Detec	70.00000	
2,6-DINITROTOLUENE	PPB	BG6	01/02/1996	Non-Detec	70.00000	
ANTIMONY	PPM	BG1	01/02/1996	3.370	1.50000	
ANTIMONY	PPM	BG2	01/02/1996	3.250	1.50000	
ANTIMONY	PPM	BG3	01/02/1996	3.700	1.50000	
ANTIMONY	PPM	BG4	01/02/1996	5.480	1.50000	
ANTIMONY	PPM	BG5	01/02/1996	2.140	1.50000	
ANTIMONY	PPM	BG6	01/02/1996	4.200	1.50000	
ARSENIC	PPM	BG1	01/02/1996	2.250	1.25000	
ARSENIC	PPM	BG2	01/02/1996	3.880	1.25000	
ARSENIC	PPM	BG3	01/02/1996	2.900	1.25000	
ARSENIC	PPM	BG4	01/02/1996	2.070	1.25000	
ARSENIC	PPM	BG5	01/02/1996	1.910	1.25000	
ARSENIC	PPM	BG6	01/02/1996	1.760	1.25000	
BARIUM	PPM	BG1	01/02/1996	66.100	1.00000	
BARIUM	PPM	BG2	01/02/1996	82.300	1.00000	
BARIUM	PPM	BG3	01/02/1996	63.000	1.00000	

(continues)

INCINERATOR SPRAY POND BACKGROUND SOIL RESULTS
BASIC RESULTS (CONDENSED)
FOR ALL DATES

PARAMETER	UNIT	SAMPLE NUMBER	SAMPLE DATE	RESULT	DETECTION LIMIT	COMMENT CODE
BARIUM	PPM	BG4	01/02/1996	93.300	1.00000	
BARIUM	PPM	BG5	01/02/1996	91.500	1.00000	
BARIUM	PPM	BG6	01/02/1996	74.600	1.00000	
BERYLLIUM	PPM	BG1	01/02/1996	0.702	0.10000	
BERYLLIUM	PPM	BG2	01/02/1996	0.538	0.10000	
BERYLLIUM	PPM	BG3	01/02/1996	0.451	0.10000	
BERYLLIUM	PPM	BG4	01/02/1996	0.920	0.10000	
BERYLLIUM	PPM	BG5	01/02/1996	0.895	0.10000	
BERYLLIUM	PPM	BG6	01/02/1996	0.817	0.10000	
CADMIUM	PPM	BG1	01/02/1996	Non-Detec	0.05000	
CADMIUM	PPM	BG2	01/02/1996	Non-Detec	0.05000	
CADMIUM	PPM	BG3	01/02/1996	Non-Detec	0.05000	
CADMIUM	PPM	BG4	01/02/1996	0.058	0.05000	
CADMIUM	PPM	BG5	01/02/1996	0.054	0.05000	
CADMIUM	PPM	BG6	01/02/1996	0.053	0.05000	
CHROMIUM	PPM	BG1	01/02/1996	17.000	25.00000	
CHROMIUM	PPM	BG2	01/02/1996	16.000	25.00000	
CHROMIUM	PPM	BG3	01/02/1996	19.000	25.00000	
CHROMIUM	PPM	BG4	01/02/1996	23.500	25.00000	
CHROMIUM	PPM	BG5	01/02/1996	21.500	25.00000	
CHROMIUM	PPM	BG6	01/02/1996	21.500	25.00000	
DI-N-BUTYL PHTHALATE	PPB	BG1	01/02/1996	Non-Detec	330.00000	
DI-N-BUTYL PHTHALATE	PPB	BG2	01/02/1996	Non-Detec	330.00000	
DI-N-BUTYL PHTHALATE	PPB	BG3	01/02/1996	Non-Detec	330.00000	
DI-N-BUTYL PHTHALATE	PPB	BG4	01/02/1996	Non-Detec	330.00000	
DI-N-BUTYL PHTHALATE	PPB	BG5	01/02/1996	Non-Detec	330.00000	
DI-N-BUTYL PHTHALATE	PPB	BG6	01/02/1996	Non-Detec	330.00000	
DIETHYL PHTHALATE	PPB	BG1	01/02/1996	Non-Detec	330.00000	
DIETHYL PHTHALATE	PPB	BG2	01/02/1996	Non-Detec	330.00000	
DIETHYL PHTHALATE	PPB	BG3	01/02/1996	Non-Detec	330.00000	
DIETHYL PHTHALATE	PPB	BG4	01/02/1996	Non-Detec	330.00000	
DIETHYL PHTHALATE	PPB	BG5	01/02/1996	Non-Detec	330.00000	
DIETHYL PHTHALATE	PPB	BG6	01/02/1996	Non-Detec	330.00000	
LEAD	PPM	BG1	01/02/1996	11.000	50.00000	
LEAD	PPM	BG2	01/02/1996	10.000	50.00000	
LEAD	PPM	BG3	01/02/1996	13.000	50.00000	
LEAD	PPM	BG4	01/02/1996	14.500	50.00000	
LEAD	PPM	BG5	01/02/1996	11.500	50.00000	
LEAD	PPM	BG6	01/02/1996	14.500	50.00000	
MERCURY	PPM	BG1	01/02/1996	0.250	1.00000	
MERCURY	PPM	BG2	01/02/1996	0.250	1.00000	
MERCURY	PPM	BG3	01/02/1996	0.200	1.00000	
MERCURY	PPM	BG4	01/02/1996	0.150	1.00000	
MERCURY	PPM	BG5	01/02/1996	0.100	1.00000	
MERCURY	PPM	BG6	01/02/1996	0.250	1.00000	

(continues)

INCINERATOR SPRAY POND BACKGROUND SOIL RESULTS
BASIC RESULTS (CONDENSED)
FOR ALL DATES

PARAMETER	UNIT	SAMPLE NUMBER	SAMPLE DATE	RESULT	DETECTION LIMIT	COMMENT CODE
NICKEL	PPM	BG1	01/02/1996	5.400	7.50000	
NICKEL	PPM	BG2	01/02/1996	3.500	7.50000	
NICKEL	PPM	BG3	01/02/1996	4.700	7.50000	
NICKEL	PPM	BG4	01/02/1996	10.600	7.50000	
NICKEL	PPM	BG5	01/02/1996	11.500	7.50000	
NICKEL	PPM	BG6	01/02/1996	9.400	7.50000	
RESORCINOL	PPB	BG1	01/02/1996	Non-Detec	330.00000	
RESORCINOL	PPB	BG2	01/02/1996	Non-Detec	330.00000	
RESORCINOL	PPB	BG3	01/02/1996	Non-Detec	330.00000	
RESORCINOL	PPB	BG4	01/02/1996	Non-Detec	330.00000	
RESORCINOL	PPB	BG5	01/02/1996	Non-Detec	330.00000	
RESORCINOL	PPB	BG6	01/02/1996	Non-Detec	330.00000	
SILVER	PPM	BG1	01/02/1996	0.025	0.01000	
SILVER	PPM	BG2	01/02/1996	0.017	0.01000	
SILVER	PPM	BG3	01/02/1996	0.017	0.01000	
SILVER	PPM	BG4	01/02/1996	0.076	0.01000	
SILVER	PPM	BG5	01/02/1996	0.045	0.01000	
SILVER	PPM	BG6	01/02/1996	0.037	0.01000	
THALLIUM	PPM	BG1	01/02/1996	0.160	0.50000	
THALLIUM	PPM	BG2	01/02/1996	0.125	0.50000	
THALLIUM	PPM	BG3	01/02/1996	0.180	0.50000	
THALLIUM	PPM	BG4	01/02/1996	0.280	0.50000	
THALLIUM	PPM	BG5	01/02/1996	0.245	0.50000	
THALLIUM	PPM	BG6	01/02/1996	0.270	0.50000	

---------- End of Report ----------

Table 2: Critical Values
Incinerator Spray Pond Closure

Parameter	Upper Tolerance Limit (UTL)	Practical Quantitation Limit (PQL)
2,4-Dinitrotoluene	130.0 ppb	130.0 ppb
2,6-Dinitrotoluene	70.0 ppb	70.0 ppb
Antimony	7.8 ppm	1.5 ppm
Arsenic	5.43 ppm	1.25 ppm
Barium	125.75 ppm	1.00 ppm
Beryllium	1.44 ppm	0.1 ppm
Cadmium	0.071 ppm	0.05 ppm
Chromium	30.55 ppm	25.0 ppm
Di-n-butyl phthalate	330.0 ppb	330.0 ppb
Diethyl phthalate	330.0 ppb	330.0 ppb
Lead	19.4 ppm	50.0 ppm
Mercury	0.44 ppm	1.0 ppm
Nickel	20.1 ppm	7.5 ppm
Resorcinol	330.0 ppb	330.0 ppb
Silver	0.12 ppm	0.01 ppm
Thallium	0.45 ppm	0.5 ppm

constituents, Alliant resample and reanalyze for these constituents on 5 December 1996.

SW-846 Method 6020 was utilized for analysis of arsenic. However, the laboratory Minimum Qualifying Limit (MQL) was 1.25 ppm versus 0.2 ppm identified in Table 3-2A. This discrepancy was due to the nature of the sample matrix and the digestion method used. Soils, especially clayey/silty soils, present special interference problems in laboratory analysis. The clay particles contain ionic charges and higher natural levels of metals which tend to interfere with the more sensitive laboratory equipment. Because arsenic was detected above the laboratory MQL, resampling will not be necessary.

Outliers

The data were checked for possible outliers using the Outlier Test, which follows ASTM Standard E178-75. The Monitor System, developed by Entech Systems, Inc., who also developed GRITSTAT, contains the same programs as GRITSTAT. These programs allow users to perform evaluations on more than one constituent at a time. The Outlier Test program is particularly useful for statistically detecting and verifying suspected outliers and locating possible data entry errors. It uses a standard t-test to compare the largest value from a sample set to the remaining values and then designates the possibility of this value being an outlier as "Yes" or "No." If the report indicates "Yes" for any parameter, it then lists the following information about it:

- The value of the possible outlier;
- Sampling location;
- Sample date; and
- Sample number.

No possible outliers were identified for any of the parameters. The test report is included with this letter as **Attachment A.**

Normality

The data were checked for normality using the Shapiro-Wilk Goodness-of-Fit Test. This program systematically designates the underlying distribution as normal, lognormal, or non-normal. If the data fails the test of normality, the program automatically takes the logs of the data and repeats the procedure. The Data Distribution program and report also computes:

- Sample size;
- Percentage of non-detects in each sample set;
- Coefficient of Kurtosis;
- Coefficient of skewness; and

- Coefficient of variation.

The report is included with this letter as **Attachment B**. As expected, the following compounds were not detected in any of the six samples and the data set is, therefore, non-normal:

2,4-Dinitrotoluene
2,6-Dinitrotoluene
Di-n-butyl phthalate
Diethyl phthalate
Resorcinol

The following compounds were detected above the method detection limit, but in some cases below the PQL, in all six samples and normally distributed:

Antimony
Arsenic
Barium
Beryllium
Chromium
Lead
Mercury
Nickel
Silver
Thallium

One compound, cadmium, was detected in 50% of the background samples. A non-normal distribution results when more than 50% of the samples are non-detects. In accordance with DEQ's *Guidance on Statistical Methods for Groundwater Data Analysis at a Solid Waste or Hazardous Waste Site*, Version 2.0 (10 August 1995), Alliant performed the recommended functions for data with more than 15% but less than or equal to 50% non-detected values.

The data set excluding non-detected values was checked for normality. As indicated in **Attachment B**, the detected only data for cadmium were normally distributed.

Appropriate Sample Numbers

A simple check to ensure that an appropriate number of samples were taken for analysis was completed for each parameter which had detected results. An appropriate number of samples could not be calculated for those parameters which had non-detected results.

The method is listed in Chapter 9, *Sampling Plan*, of SW-846, and summarized in **Attachment C** of this letter. Use of this alternate method was approved in a letter to J. J. Redder of Alliant Techsystems from C. L. Parker IV of DEQ dated 15 November 1995.

This method calculates an appropriate number of samples based on the variance as computed by the actual sample results. Then the calculated appropriate number of samples is compared to the actual number of sample measurements taken, which was six for each parameter, to ensure that an adequate number of background samples were taken. The calculated appropriate number of samples should be less than or equal to the actual number of samples taken.

Only barium, for which an appropriate number of 16 samples was calculated, did not pass this test. Alliant believes additional samples for barium are not necessary for the successful closure of this unit. barium is not a constituent of primary concern for closure of this unit; the mean concentration of barium in the samples is 78.5 mg/kg, or 28% of the naturally occurring mean concentration of 280 mg/kg for the eastern United States.

Critical Values

Based on the previous calculations and evaluations, **Table 2** provides the calculated critical soil values for the Incinerator Spray Pond. In accordance with DEQ's guidance, an upper tolerance limit (UTL) was calculated for the data that were detected in all six background samples, using the Tolerance Limits method. A 95% level of coverage and a 95% confidence level were chosen. The calculated UTLs are listed in **Attachment D**.

For cadmium, which had 50% non-detect values and a normal distribution of detected-only values, Cohen's method of adjustment was used to calculate the mean, standard deviation, and UTL. The laboratory

Environmental
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Management, Inc.

PQL was used as the background value for those constituents with 100% non-detected values.

An electronic copy of this document has been enclosed with this report. If you have any questions regarding this letter or would like any additional information, please call me at (540) 776-3545.

Sincerely,

Christel E. Compton

Christel E. Compton
Branch Manager

CC:db
enclosures: Table 1: Incinerator Spray Pond Analytical Results
Table 2: Critical Values
Attachments A-D

Attachment A
Outlier Test Report

BACKGROUND SOIL SAMPLES
OUTLIER TEST
FOR ALL DATES

COMPANY: Alliant Techsystems Inc.
SITE: Incin. Spray Pond
PROGRAM: Closure
PROGRAM TYPE: Soil
DATA GROUP:

All Duplicates Used — Non-Detects = Detection Limit/2
Significance Level (1 - alpha): 95%

LOCATION	POSSIBLE OUTLIER?	SAMPLE NUMBER	SAMPLE DATE	VALUE	SAMPLE SIZE	MEAN	CALCULATED T	TABULAR T
RAAP LIST								
PARAMETER: 2,4-DINITROTOLUENE								**UNIT: PPB**
Background	NO							
PARAMETER: 2,6-DINITROTOLUENE								**UNIT: PPB**
Background	NO							
PARAMETER: ANTIMONY								**UNIT: PPM**
Background	NO							
PARAMETER: ARSENIC								**UNIT: PPM**
Background	NO							
PARAMETER: BARIUM								**UNIT: PPM**
Background	NO							

(continues)

BACKGROUND SOIL SAMPLES
OUTLIER TEST
FOR ALL DATES

LOCATION	POSSIBLE OUTLIER?	SAMPLE NUMBER	SAMPLE DATE	VALUE	SAMPLE SIZE	MEAN	CALCULATED T	TABULAR T
PARAMETER: BERYLLIUM								**UNIT: PPM**
Background	NO							
PARAMETER: CADMIUM								**UNIT: PPM**
Background	NO							
PARAMETER: CHROMIUM								**UNIT: PPM**
Background	NO							
PARAMETER: DI-N-BUTYL PHTHALATE								**UNIT: PPB**
Background	NO							
PARAMETER: DIETHYL PHTHALATE								**UNIT: PPB**
Background	NO							
PARAMETER: LEAD								**UNIT: PPM**
Background	NO							
PARAMETER: MERCURY								**UNIT: PPM**
Background	NO							
PARAMETER: NICKEL								**UNIT: PPM**
Background	NO							
PARAMETER: RESORCINOL								**UNIT: PPB**
Background	NO							

(continues)

BACKGROUND SOIL SAMPLES
OUTLIER TEST
FOR ALL DATES

LOCATION	POSSIBLE OUTLIER?	SAMPLE NUMBER	SAMPLE DATE	VALUE	SAMPLE SIZE	MEAN	CALCULATED T	TABULAR T
PARAMETER: SILVER								**UNIT: PPM**
Background	NO							
PARAMETER: THALLIUM								**UNIT: PPM**
Background	NO							

---------- End of Report ----------

The Monitor System, TM

Attachment B
Normality Test Report and
Descriptive Statistics

BACKGROUND SOIL SAMPLES
DATA DISTRIBUTION
FOR ALL DATES

COMPANY: Alliant Techsystems Inc.
SITE: Incin. Spray Pond
PROGRAM: Closure
PROGRAM TYPE: Soil
DATA GROUP:

All Duplicates Used — Non-Detects = Detection Limit/2
Significance Level (1 - alpha): 95%

LOCATION ID	SAMPLE SIZE	% N-Ds	SHAPIRO-WILK DISTRIBUTION	CALCULATED W	TABULAR W	SKEWNESS	KURTOSIS	COEFFICIENT OF VARIATION
RAAP LIST								
PARAMETER: 2,4-DINITROTOLUENE								**UNIT: PPB**
Background	6	100	Non-Normal	0.0000	0.7880	0.00	0.00	0.00
PARAMETER: 2,6-DINITROTOLUENE								**UNIT: PPB**
Background	6	100	Non-Normal	0.0000	0.7880	0.00	0.00	0.00
PARAMETER: ANTIMONY								**UNIT: PPM**
Background	6	0	Normal	0.9687	0.7880	0.25	1.77	0.30
PARAMETER: ARSENIC								**UNIT: PPM**
Background	6	0	Normal	0.8583	0.7880	0.77	1.81	0.33
PARAMETER: BARIUM								**UNIT: PPM**
Background	6	0	Normal	0.9173	0.7880	-0.01	1.00	0.16

(continues)

BACKGROUND SOIL SAMPLES
DATA DISTRIBUTION
FOR ALL DATES

LOCATION ID	SAMPLE SIZE	% N-Ds	SHAPIRO-WILK DISTRIBUTION	CALCULATED W	TABULAR W	SKEWNESS	KURTOSIS	COEFFICIENT OF VARIATION
PARAMETER: BERYLLIUM								**UNIT: PPM**
Background	6	0	Normal	0.9127	0.7880	-0.27	1.08	0.27
PARAMETER: CADMIUM								**UNIT: PPM**
Background	6	50	Non-Normal	0.7243	0.7880	0.02	0.73	0.41
PARAMETER: CHROMIUM								**UNIT: PPM**
Background	6	0	Normal	0.9380	0.7880	-0.07	1.09	0.15
PARAMETER: DI-N-BUTYL PHTHALATE								**UNIT: PPB**
Background	6	100	Non-Normal	0.0000	0.7880	0.00	0.00	0.00
PARAMETER: DIETHYL PHTHALATE								**UNIT: PPB**
Background	6	100	Non-Normal	0.0000	0.7880	0.00	0.00	0.00
PARAMETER: LEAD								**UNIT: PPM**
Background	6	0	Normal	0.9068	0.7880	0.01	1.02	0.15
PARAMETER: MERCURY								**UNIT: PPM**
Background	6	0	Normal	0.8308	0.7880	-0.49	1.30	0.32
PARAMETER: NICKEL								**UNIT: PPM**
Background	6	0	Normal	0.8897	0.7880	0.01	0.88	0.45

(continues)

BACKGROUND SOIL SAMPLES
DATA DISTRIBUTION
FOR ALL DATES

LOCATION ID	SAMPLE SIZE	% N-Ds	SHAPIRO-WILK DISTRIBUTION	CALCULATED W	TABULAR W	SKEWNESS	KURTOSIS	COEFFICIENT OF VARIATION
PARAMETER: RESORCINOL								**UNIT: PPB**
Background	6	100	Non-Normal	0.0000	0.7880	0.00	0.00	0.00
PARAMETER: SILVER								**UNIT: PPM**
Background	6	0	Normal	0.8693	0.7880	0.71	1.84	0.56
PARAMETER: THALLIUM								**UNIT: PPM**
Background	6	0	Normal	0.9120	0.7880	-0.11	0.98	0.30

---------- End of Report ----------

NORMALITY CHECK ON DETECTED VALUES - 50% NON-DETECT
DATA DISTRIBUTION
FOR ALL DATES

COMPANY: Alliant Techsystems Inc.
SITE: Incin. Spray Pond
PROGRAM: Closure
PROGRAM TYPE: Soil
DATA GROUP:

All Duplicates Used Non-Detects Ignored
Significance Level (1 - alpha): 95%

LOCATION ID	SAMPLE SIZE	% ND's	SHAPIRO-WILK DISTRIBUTION	CALCULATED W	TABULAR W	SKEWNESS	KURTOSIS	COEFFICIENT OF VARIATION
RAAP LIST								
PARAMETER: CADMIUM								UNIT: PPM
Background								
	3	0	Normal	0.8928	0.7670	0.32	0.67	0.04

---------- End of Report ----------

INCINERATOR SPRAY POND BACKGROUND SOIL RESULTS
DESCRIPTIVE STATISTICS
FOR ALL DATES

COMPANY: Alliant Techsystems Inc.
SITE: Incin. Spray Pond
PROGRAM: Closure
PROGRAM TYPE: Soil
DATA GROUP:

All Duplicates Used — Non-Detects = Detection Limit/2

PARAMETER / UNIT	SAMPLE SIZE	% N-Ds	MEAN	SAMPLE MEDIAN	STANDARD DEVIATION	VARIANCE	MINIMUM	MAXIMUM
LOCATION ID: Background								
RAAP LIST								
ANTIMONY								
PPM	6	0	3.690	3.535	1.110	1.233	2.140	5.480
ARSENIC								
PPM	6	0	2.462	2.160	0.800	0.640	1.760	3.880
BARIUM								
PPM	6	0	78.467	78.450	12.741	162.339	63.000	93.300
BERYLLIUM								
PPM	6	0	0.721	0.760	0.193	0.037	0.451	0.920
CADMIUM								
PPM	6	50	0.040	> 49% N-D's	0.017	0.000	Non-Detect	0.058
CHROMIUM								
PPM	6	0	19.750	20.250	2.911	8.475	16.000	23.500
LEAD								
PPM	6	0	12.417	12.250	1.882	3.542	10.000	14.500
MERCURY								
PPM	6	0	0.200	0.225	0.063	0.004	0.100	0.250
NICKEL								
PPM	6	0	7.517	7.400	3.390	11.494	3.500	11.500
SILVER								
PPM	6	0	0.036	0.031	0.022	0.001	0.017	0.076
THALLIUM								
PPM	6	0	0.210	0.213	0.064	0.004	0.125	0.280

---------- End of Report ----------

The Monitor System, TM

Attachment C
Appropriate Number of Samples

ALLIANT TECHSYSTEMS, INC.
INCINERATOR SPRAY POND BACKGROUND SOIL SAMPLES
APPROPRIATE NUMBER OF SAMPLES CHECK
SW-846 CHAPTER 9 *SAMPLING PLAN*

Variance of Sample, s^2

$$s^2 = \frac{\sum X_i^2 - (\sum X_i)^2/n}{n-1}$$ where n=number of sample measurements.

Appropriate Number of Samples, n

$$n = \frac{t^2 s^2}{RT - X}$$

where RT = regulatory threshold,
X = sample mean, and
t = value based on the number of degrees of freedom (n-1)

The results for the following parameters were non-detect and, therefore, an appropriate number of samples could not be calculated:

2,4-Dinitrotoluene
2,6-Dinitrotoluene
Di-n-butyl phthalate
Diethyl phthalate
Resorcinol

Although many of the results for most of the following parameters were below the PQL, an appropriate number of samples was calculated using the laboratory detection limit.

Antimony =	2.7	Number of Actual Samples = 6
Arsenic =	0.0	
Barium =	**16.4**	
Beryllium =	0.1	
Cadmium =	0.0	
Chromium =	1.3	
Lead =	1.2	
Mercury =	0.0	
Nickel =	3.3	
Silver =	0.4	
Thallium =	0.0	

Attachment D
Critical Values

UPPER TOLERANCE LIMIT FOR 50% NON-DETECTS
TOLERANCE LIMITS
FOR ALL DATES

COMPANY: Alliant Techsystems Inc.
SITE: Incin. Spray Pond
PROGRAM: Closure
PROGRAM TYPE: Soil
DATA GROUP:

All Duplicates Used — Cohen's Method Used For Non-Detects
Tolerance Coefficient (Y): 95% — Level Of Coverage (P): 95%

LOCATION ID	SAMPLE SIZE	% NON-DETECT	MEAN	REGULATORY LIMIT	UPPER TOLERANCE LIMIT
RAAP LIST					
PARAMETER: CADMIUM					UNIT: PPM
Background	6	50	0.050	0.000	0.071

---------- End of Report ----------

UPPER TOLERANCE LIMITS FOR 100% DETECTED
TOLERANCE LIMITS
FOR ALL DATES

COMPANY: Alliant Techsystems Inc.
SITE: Incin. Spray Pond
PROGRAM: Closure
PROGRAM TYPE: Soil
DATA GROUP:

All Duplicates Used — Non-Detects = Detection Limit/2
Tolerance Coefficient (Y): 95% — Level Of Coverage (P): 95%

LOCATION ID	SAMPLE SIZE	% NON-DETECT	MEAN	REGULATORY LIMIT	UPPER TOLERANCE LIMIT
RAAP LIST					
PARAMETER: ANTIMONY					**UNIT: PPM**
Background	6	0	3.690	0.000	7.810
PARAMETER: ARSENIC					**UNIT: PPM**
Background	6	0	2.462	0.000	5.430
PARAMETER: BARIUM					**UNIT: PPM**
Background	6	0	78.467	0.000	125.749
PARAMETER: BERYLLIUM					**UNIT: PPM**
Background	6	0	0.721	0.000	1.436
PARAMETER: CHROMIUM					**UNIT: PPM**
Background	6	0	19.750	0.000	30.553

(continues)

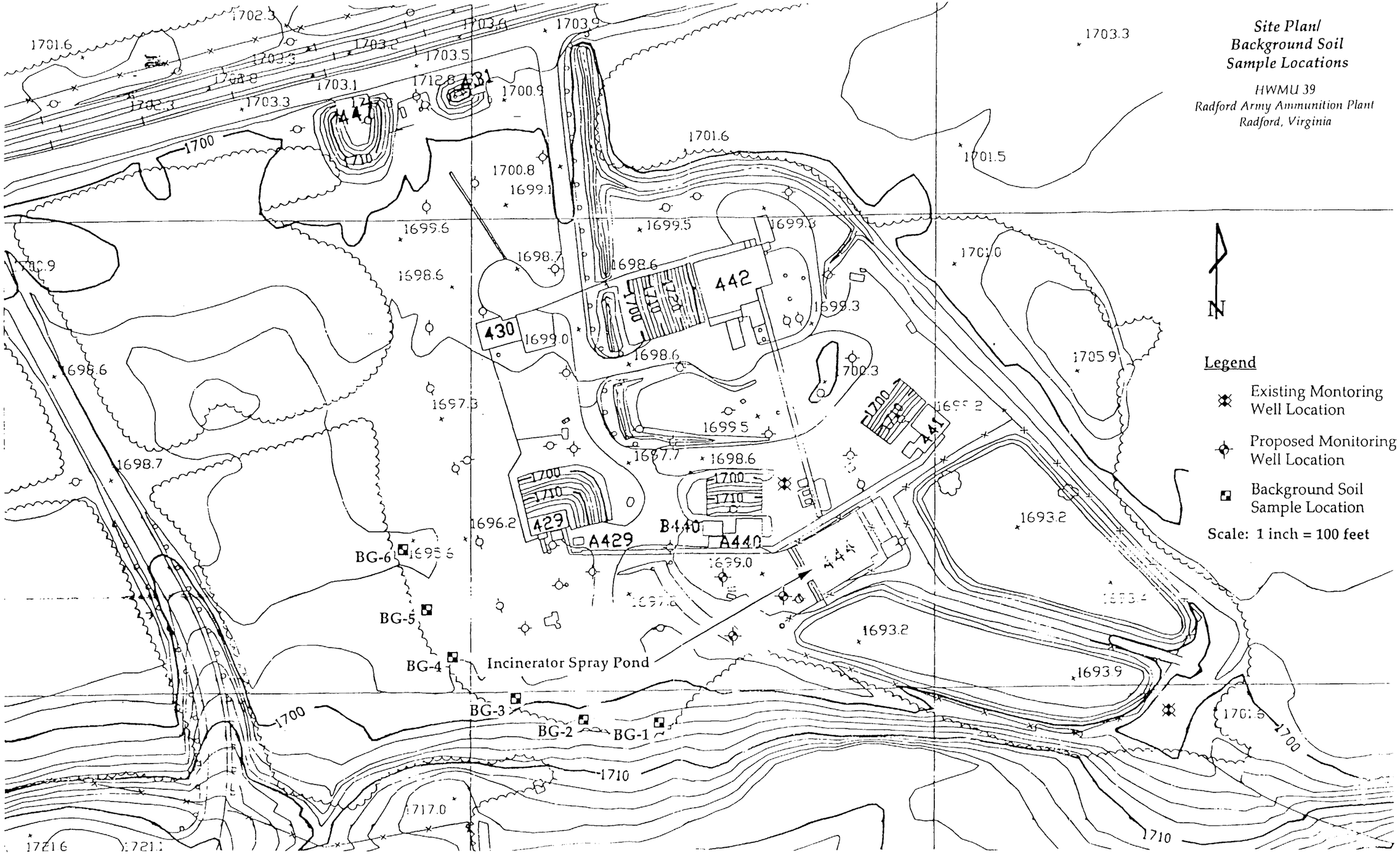
UPPER TOLERANCE LIMITS FOR 100% DETECTED TOLERANCE LIMITS FOR ALL DATES

LOCATION ID	SAMPLE SIZE	% NON-DETECT	MEAN	REGULATORY LIMIT	UPPER TOLERANCE LIMIT
PARAMETER: LEAD					**UNIT: PPM**
Background	6	0	12.417	0.000	19.401
PARAMETER: MERCURY					**UNIT: PPM**
Background	6	0	0.200	0.000	0.435
PARAMETER: NICKEL					**UNIT: PPM**
Background	6	0	7.517	0.000	20.098
PARAMETER: SILVER					**UNIT: PPM**
Background	6	0	0.036	0.000	0.120
PARAMETER: THALLIUM					**UNIT: PPM**
Background	6	0	0.210	0.000	0.447

---------- End of Report ----------

Site Plan/
Background Soil
Sample Locations

HWMU 39
Radford Army Ammunition Plant
Radford, Virginia



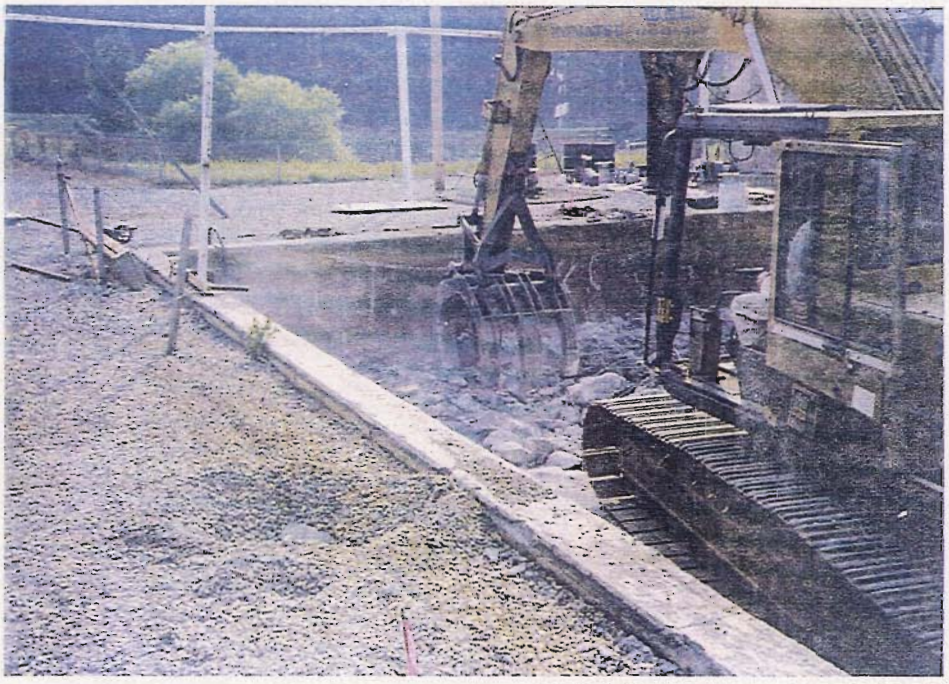
Legend

- Existing Montoring Well Location
- Proposed Monitoring Well Location
- Background Soil Sample Location

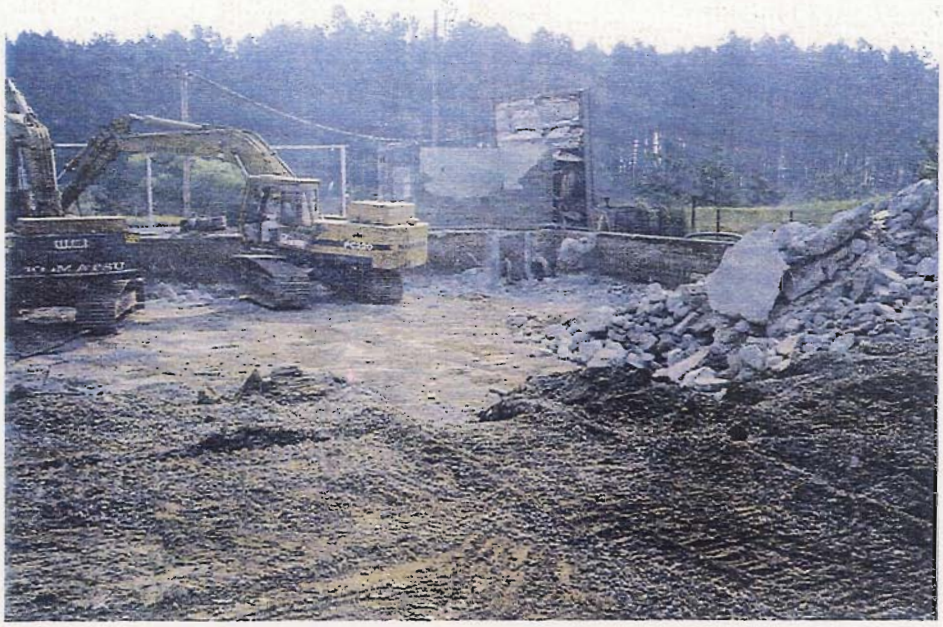
Scale: 1 inch = 100 feet

Source: Reference Drawings, Radford Army Ammunition Plant, Hercules Incorporated.

Photograph 1: Incinerator Spray Pond (ISP) with metal piping removed.



Photograph 2: Removal of the concrete base of the ISP.



Photograph 3: Concrete removal from the ISP.

Photograph 4: ISP following concrete demolition and removal. Notice the red flags designating grid sample locations.

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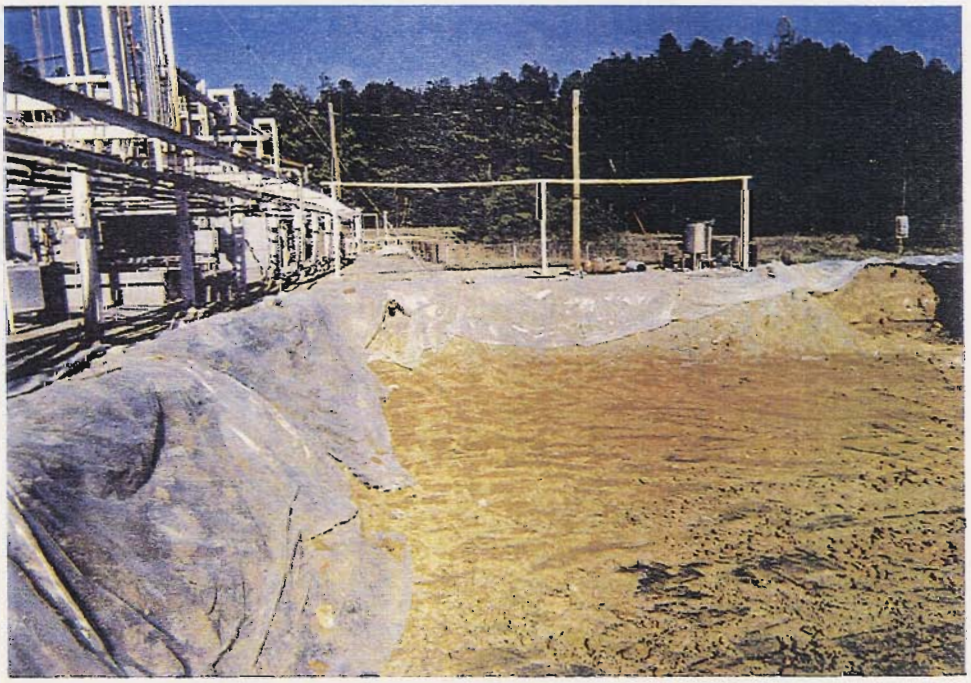
Photograph 5: Decontamination of excavation equipment.

Photograph 6: Additional excavation of approximately 18 inches of soil from the bottom of the original ISP excavation.

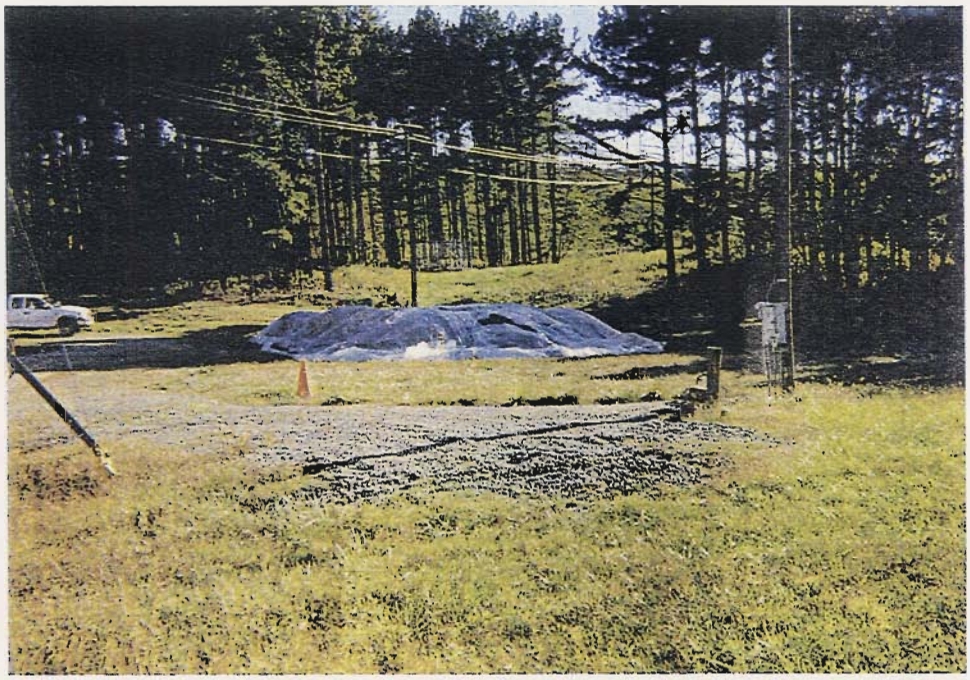
Photograph 7: Continued excavation of approximately 18 inches of soil from the ISP.



Photograph 8: ISP following the completion of excavation activities.

So

Photograph 9: Staging excavated material on plastic.



Photograph 10: Covering excavated soil at staging area with plastic.

Sample Chain of Custody

W.O. Number: 176E4.07.01 Project Name: RAAP- Site 39

Sampler: R. Miller / R. Estes

ERM T.R. Number	Date	Time	COMP	GRAB	Sample Location	Number of Containers	See Attached List						Remarks
025398	1-2-96	11:15		X	BG-1 (4.5')	1	X			96-	000	61	* 2-week Turn Around
025399	1-2-96	11:30		X	BG-2 (4.5')	1	X				000	62	Send Results to:
025400	1-2-96	11:50		X	BG-3 (4.5')	1	X				000	63	Christel Ackerman
025401	1-2-96	12:15		X	BG-4 (4.5')	1	X				000	64	ERM, Inc.
025402	1-2-96	12:30		X	BG-5 (4.5')	1	X				000	65	(540) 776-3545
025403	1-2-96	12:55		X	BG-6 (4.5')	1	X				000	66	(540) 776-8530 (FAX)
025404	1-2-96	12:00		X	BGD-3 (4.5')	4	X				000	67	
025405	1-2-96	10:40		X	FIELD BLANK	6	X				000	68	Invoice Jerry Redder,
025406	1-2-96	13:10		X	EQUIP BLANK	6	X				000	69	RAAP, directly
025448	12-19-95 [redacted]	12:00		X	TRIP BLANK	7	X				000	70	

Sample Relinquished	Date	Time	Sample Received by:	Date	Time	Reason for Transfer
Robert C. Estes	1-3-96	10:50	Timothy White	1-3-96	10:50	Transferred to CVLC rep.
			[signature]	1/3/96	1715	

Copies: White and Yellow copies accompany sample shipments to laboratory. Yellow copy retained by laboratory. White copy to be returned to ERM for files. Pink copy retained by sampler. Gold copy extra as needed (warehouse). 4.94

CENTRAL VIRGINIA
LABORATORIES & CONSULTANTS, INC.
P.O. Box 10938 Lynchburg, Virginia 24506
OFFICE: 3109 Odd Fellows Road • (804) 847-2852 • 800-296-1470 • FAX (804) 847-2830

Christel Ackerman
Environmental Resources Management, Inc.
3140 Chaparral Drive, Suite 201
Roanoke, Virginia 24018

PROJECT NAME:		RAAP Site 39	RAAP Site 39	RAAP Site 39	RAAP Site 39
PROJECT NUMBER:		176E4.07.01	176E4.07.01	176E4.07.01	176E4.07.01
CUSTOMER ID:		BG - 1 (4.5')	BG - 2 (4.5')	BG - 3 (4.5')	BG - 4 (4.5')
CVLC ID:		96-00061	96-00062	96-00063	96-00064
COLLECTION DATE :	**Grab:**	01/02/96	01/02/96	01/02/96	01/02/96
COLLECTION TIME (hours):	**Grab:**	1115	1130	1150	1215
RELINQUISHED DATE:		01/03/96	01/03/96	01/03/96	01/03/96
RELINQUISHED TIME (hours):		1050	1050	1050	1050
RECEIVED DATE:		01/03/96	01/03/96	01/03/96	01/03/96
RECEIVED TIME (hours):		1715	1715	1715	1715

NG = Not Given

Comments:
The presence of Diethyl Phthalate detected by method SW 8061 in several of the samples was not confirmed by mass spectrometry. Therefore, Diethyl Phthalate for these samples was reported by SW-846 Method 8270.

Respectfully Submitted,

Janet M. Zwetolitz
Laboratory Director

January 16, 1996
Report Date

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC
Analytical Results

PROJECT NAME:		RAAP Site 39	RAAP Site 39	RAAP Site 39	RAAP Site 39
PROJECT NUMBER:		176E4.07.01	176E4.07.01	176E4.07.01	176E4.07.01
CUSTOMER ID:		BG - 5 (4.5')	BG - 6 (4.5')	BGD - 3 (4.5')	Field Blank
CVLC ID:		96-00065	96-00066	96-00067	96-00068
COLLECTION DATE :	**Grab:**	01/02/96	01/02/96	01/02/96	01/02/96
COLLECTION TIME (hours):	**Grab:**	1230	1255	1200	1040
RELINQUISHED DATE:		01/03/96	01/03/96	01/03/96	01/03/96
RELINQUISHED TIME (hours):		1050	1050	1050	1050
RECEIVED DATE:		01/03/96	01/03/96	01/03/96	01/03/96
RECEIVED TIME (hours):		1715	1715	1715	1715

NG = Not Given

Comments:

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC
Analytical Results

PROJECT NAME:		RAAP Site 39	RAAP Site 39
PROJECT NUMBER:		176E4.07.01	176E4.07.01
CUSTOMER ID:		Equip Blank	Trip Blank
CVLC ID:		96-00069	96-00070
COLLECTION DATE :	**Grab:**	01/02/96	12/19/95
COLLECTION TIME (hours):	**Grab:**	1310	1200
RELINQUISHED DATE:		01/03/96	01/03/96
RELINQUISHED TIME (hours):		1050	1050
RECEIVED DATE:		01/03/96	01/03/96
RECEIVED TIME (hours):		1715	1715

NG = Not Given

Comments:

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC
Analytical Results

			BG - 1 (4.5') 96-00061	BG - 2 (4.5') 96-00062	BG - 3 (4.5') 96-00063	BG - 4 (4.5') 96-00064
INORGANIC COMPOUNDS	**SW-846 Method**	**DL (MG/KG)**	**MG/KG**	**MG/KG**	**MG/KG**	**MG/KG**
Antimony, Total	7041	0.150	3.37	3.25	3.70	5.48
Arsenic, Total	7060	0.50	ND	ND[1]	ND	ND
Barium, Total	6010A	0.100	66.1	82.3	63.0	93.3
Beryllium, Total	6010A	0.0100	0.702	0.538	0.451	0.920
Cadmium, Total	7131	0.0050	ND	ND	ND	0.058
Chromium, Total	7190	2.50	17.0	16.0	19.0	23.5
Lead, Total	7420	5.0	11.0	10.0	13.0	14.5
Mercury, Total	7471	0.10	0.25	0.25	0.20	0.15
Nickel, Total	7520	0.750	5.40	3.50	4.70	10.6
Silver, Total	7761	0.0010	0.0255	0.0170	0.0170	0.0765
Thallium, Total	7841	0.050	0.160	0.125	0.180	0.280

ND = Not Detected

[1]The spike recovery was not within the acceptable range. Therefore, the reported result is estimated.

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC
Analytical Results

INORGANIC COMPOUNDS	SW-846 Method	DL (MG/KG)	BG - 5 (4.5') 96-00065 MG/KG	BG - 6 (4.5') 96-00066 MG/KG	BGD - 3 (4.5') 96-00067 MG/KG
Antimony, Total	7041	0.150	2.14	4.20	3.40
Arsenic, Total	7060	0.50	ND	ND	ND
Barium, Total	6010A	0.100	91.5	74.6	58.5
Beryllium, Total	6010A	0.0100	0.895	0.817	0.521
Cadmium, Total	7131	0.0050	0.054	0.053	ND
Chromium, Total	7190	2.50	21.5	21.5	19.5
Lead, Total	7420	5.0	11.5	14.5	11.5
Mercury, Total	7471	0.10	0.10	0.25	0.10
Nickel, Total	7520	0.750	11.5	9.40	4.50
Silver, Total	7761	0.0010	0.0450	0.0370	0.0205
Thallium, Total	7841	0.050	0.245	0.270	0.185

ND = Not Detected

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC
Analytical Results

			Field Blank	Equip Blank	Trip Blank
			96-00068	96-00069	96-00070
INORGANIC COMPOUNDS	SW-846 Method	DL (MG/L)	MG/L	MG/L	MG/L
Antimony, Total	7041	0.003	ND	ND	ND
Arsenic, Total	7060	0.001	ND	ND	ND
Barium, Total	6010A	0.002	ND	ND	ND
Beryllium, Total	6010A	0.0002	ND	ND	ND
Cadmium, Total	7131	0.0001	ND	ND	ND
Chromium, Total	7191	0.001	ND	ND	ND
Lead, Total	7421	0.001	ND	ND	ND
Mercury, Total	7470	0.0002	0.0002	0.0002	0.0002
Nickel, Total	7520	0.015	ND	ND	ND
Silver, Total	7761	0.0002	ND	ND	ND
Thallium, Total	7841	0.001	ND	ND	ND

ND = Not Detected

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC
Analytical Results

SW-846 METHOD 8061	DL(UG/KG)	BG - 1 (4.5') 96-00061 UG/KG	BG - 2 (4.5') 96-00062 UG/KG	BG - 3 (4.5') 96-00063 UG/KG	BG - 4 (4.5') 96-00064 UG/KG
Di-n-butyl-phthalate	220	ND	ND	ND	ND
Diethyl phthalate	170	ND	ND	ND	ND

ND = Not Detected

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC

Analytical Results

SW-846 METHOD 8061	DL(UG/KG)	BG - 5 (4.5') 96-00065 UG/KG	BG - 6 (4.5') 96-00066 UG/KG	BGD - 3 (4.5') 96-00067 UG/KG
Di-n-butyl-phthalate	220	ND	ND	ND

ND = Not Detected

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC
Analytical Results

SW-846 METHOD 8061	DL(UG/L)	Field Blank 96-00068 UG/L	Equip Blank 96-00069 UG/L	Trip Blank 96-00070 UG/L
Di-n-butyl-phthalate	3.3	ND	ND	ND

ND = Not Detected

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC

Analytical Results

SW-846 METHOD 8090	DL(UG/KG)	BG - 1 (4.5') 96-00061 UG/KG[1]	BG - 2 (4.5') 96-00062 UG/KG[1]	BG - 3 (4.5') 96-00063 UG/KG	BG - 4 (4.5') 96-00064 UG/KG[1]
2,4-Dinitrotoluene	13	ND	ND	ND	ND
2,6-Dinitrotoluene	7	ND	ND	ND	ND

ND = Not Detected

[1]The recovery for each surrogate was not within the acceptable range. Therefore, the reported results are estimated.

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC

Analytical Results

SW-846 METHOD 8090	DL(UG/KG)	BG - 5 (4.5') 96-00065 UG/KG	BG - 6 (4.5') 96-00066 UG/KG[1]	BGD - 3 (4.5') 96-00067 UG/KG
2,4-Dinitrotoluene	13	ND	ND	ND
2,6-Dinitrotoluene	7	ND	ND	ND

ND = Not Detected

[1]The recovery for each surrogate was not within the acceptable range. Therefore, the reported results are estimated.

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC

Analytical Results

SW-846 METHOD 8090	DL(UG/L)	Field Blank 96-00068 UG/L	Equip Blank 96-00069 UG/L	Trip Blank 96-00070 UG/L
2,4-Dinitrotoluene	0.2	ND	ND	ND
2,6-Dinitrotoluene	0.1	ND	ND	ND

ND = Not Detected

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC
Analytical Results

SW-846 METHOD 8270	DL(UG/KG)	BG - 1 (4.5') 96-00061 UG/KG	BG - 2 (4.5') 96-00062 UG/KG	BG - 3 (4.5') 96-00063 UG/KG	BG - 4 (4.5') 96-00064 UG/KG
Resorcinol[1]	330	ND	ND	ND	ND

ND = Not Detected

[1]**Please Note: Values obtained above are based upon an NBS Mass Spectral Library Search only - these values should be considered approximations.**

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC
Analytical Results

SW-846 METHOD 8270	DL(UG/KG)	BG - 5 (4.5') 96-00065 UG/KG	BG - 6 (4.5') 96-00066 UG/KG	BGD - 3 (4.5') 96-00067 UG/KG
Resorcinol[1]	330	ND	ND	ND
Diethyl phthalate	170	ND	ND	ND

ND = Not Detected

[1]**Please Note: Values obtained above are based upon an NBS Mass Spectral Library Search only - these values should be considered approximations.**

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC
Analytical Results

SW-846 METHOD 8270	DL(UG/L)	Field Blank 96-00068 UG/L	Equip Blank 96-00069 UG/L	Trip Blank 96-00070 UG/L
Resorcinol[1]	100	ND	ND	ND
Diethyl phthalate	2.5	ND[2]	ND[2]	<5.9[2]

ND = Not Detected

[1]**Please Note: Values obtained above are based upon an NBS Mass Spectral Library Search only - these values should be considered approximations.**

[2] **The recovery for each surrogate was not within the acceptable range. Therefore, the reported results are estimated.**

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC

Analytical Results

		BG - 1 (4.5') 96-00061	BG - 2 (4.5') 96-00062	BG - 3 (4.5') 96-00063	BG - 4 (4.5') 96-00064
SURROGATE COMPOUND	**RECOVERY RANGE**	**PERCENT RECOVERY (%)**			
SW-846 Method 8061					
Diphenyl Phthalate	40 - 125	98	75	98	83
SW-846 Method 8090					
Dibutyl Chlorendate	40 - 125	24[1]	37[1]	40	38[1]
SW-846 Method 8270					
Phenol-d6	24 - 113	127[1]	77	84	70
2-Fluorophenol	25 - 121	90	70	74	67
2,4,6-Tribromophenol	19 - 122	77	74	61	59
Nitrobenzene-d5	23 - 118	30	62	61	68
2-Fluorobiphenyl	30 - 115	21[1]	99	40	48
p-Terphenyl-d14	18 - 137	20	60	51	64

[1]**The recovery for each surrogate was not within the acceptable range. Therefore, the reported results are estimated.**

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC
Analytical Results

SURROGATE COMPOUND	RECOVERY RANGE	BG - 5 (4.5') 96-00065	BG - 6 (4.5') 96-00066	BGD - 3 (4.5') 96-00067
		PERCENT RECOVERY (%)		
SW-846 Method 8061				
Diphenyl Phthalate	40 - 125	88	103	102
SW-846 Method 8090				
Dibutyl Chlorendate	40 - 125	56	39[1]	48
SW-846 Method 8270				
Phenol-d6	24 - 113	70	74	54
2-Fluorophenol	25 - 121	68	70	55
:,4,6-Tribromophenol	19 - 122	64	56	47
Nitrobenzene-d5	23 - 118	65	70	49
2-Fluorobiphenyl	30 - 115	46	48	35
p-Terphenyl-d14	18 - 137	65	53	52

CENTRAL VIRGINIA LABORATORIES AND CONSULTANTS, INC
Analytical Results

SURROGATE COMPOUND	RECOVERY RANGE	Field Blank 96-00068	Equip Blank 96-00069	Trip Blank 96-00070
		PERCENT RECOVERY (%)		
SW-846 Method 8061				
Diphenyl Phthalate	40 - 125	81	55	101
SW-846 Method 8090				
Dibutyl Chlorendate	45 - 120	93	54	71
SW-846 Method 8270				
Phenol-d6	10 - 94	40	41	36
2-Fluorophenol	21 - 100	54	56	48
2,4,6-Tribromophenol	10 - 123	65	83	60
Nitrobenzene-d5	35 - 114	63	34[1]	56
2-Fluorobiphenyl	43 - 116	42[1]	22[1]	40[1]
p-Terphenyl-d14	33 - 133	47	30	46

[1]**The recovery for each surrogate was not within the acceptable range. Therefore, the reported results are estimated.**

LEGEND

Spike Failure

The matrix spike sample analysis provides information about the effect of each sample matrix on the digestion and measurement methodology. Spike recoveries must be within specified limits. However, according to EPA Document No. EPA/540/R/94/082, **LABORATORY DATA VALIDATION FUNCTIONAL GUIDELINES FOR EVALUATING ORGANIC ANALYSES**, December, 1994 (Laboratory Functional Guidelines), if the sample result is outside the acceptable range, the results are reported as estimated.

Surrogate Failure

Laboratory performance on individual samples is established by means of spiking activities. All samples are spiked with surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific sample results is frequently subjective and demands analytical experience and professional judgement.

Elevated Detection Limit

Often during analysis, an interferant or high concentration of a compound may create the need to dilute a sample. When the sample is diluted, the Method Detection Limit is elevated by the factor of the dilution.

Method Detection Limit

The Method Detection Limit is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero.

Attachment 3

Chains of Custody and Sample Results

CHAIN OF CUSTODY RECORD NO. 5[illegible]7

REIC Laboratory
225 Industrial Park Rd.
P.O. Box 286, Beaver, WV 25813
Phone: 304-255-2500 or 800-999-0105
FAX: 304-255-2572

CLIENT: Alliant Techsystems Inc.
ADDRESS: P.O. Box 1
CITY/STATE/ZIP: Radford, VA 24141
BILL TO: Same
CITY/STATE/ZIP:

CONTACT PERSON: Arne Olsen
TELEPHONE/FAX: 540/639-8220
SITE ID & STATE: RAAP
PROJECT ID: Incin. Spray Pond Closure
SAMPLER: C Compton, ERM

SAMPLE LOG AND ANALYSIS REQUEST

TURNAROUND TIME REQUIREMENTS
REGULAR: ___
*RUSH: ___ 5-Day ___ 3-Day ___ 2-Day ___ 1-Day
*Rush work needs prior Laboratory approval and will include surcharges

PRESERVATIVES
0 No Preservative
1 Hydrochloric Acid
2 Nitric Acid
3 Sulfuric Acid
4 Sodium Thiosulfate
5 Sodium Hydroxide
6 Zinc Acetate
7 EDTA

PRESERVATIVE CODES — NOTE PRESERVATIVES →

SAMPLE ID	NO. & TYPE OF CONTAINERS	SAMPLING DATE / TIME	MATRIX	SAMPLE COMP / GRAB	2,4-Dinitrotoluene	2,6-Dinitrotoluene	Dinitrotoluene	Diethylphthalate	Phosphorus	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel	Silver	Thallium	COMMENTS
A1 12"	2/glass	8/19/97	Sil		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
A4 12"	2/glass				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
B2 12"	2/glass				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
C2 12"	2/glass				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
D2 12"	2/glass				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
D3 12"	2/glass				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
D3 12" Dupl.	2/glass				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
E1 12"	2/glass				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
~~E3 12" SC~~																					
E2 12"	2/glass				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

Relinquished by: (Signature) — Date/Time: 8-19-97 — Received by: (Signature) — Date/Time — Relinquished by: (Signature) — Date/Time — Received by: (Signature) — Date/Time: 8-21-97 1330

Special Requests:
Sample Condition: Good? Y N
Temperature Upon Arrival 4.4

Shipment: Hand-Del: Courier: UPS: FedEx:
Shipment Date: FAX Results: Y N

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EIC

CHAIN OF CUSTODY RECORD NO. 53 9

REIC Laboratory
225 Industrial Park Rd.
P.O. Box 286, Beaver, WV 25813
Phone: 304-255-2500 or 800-999-0105
FAX: 304-255-2572

CLIENT: Alliant Techsystems Inc.
ADDRESS: P.O. Box 1
CITY/STATE/ZIP: Radford, VA 24141
BILL TO: Same
CITY/STATE/ZIP:

CONTACT PERSON: Ane Olsen
TELEPHONE/FAX: 540/639-8220
SITE ID & STATE: RAAP
PROJECT ID: Incinerator Spray Pond Closure
SAMPLER: C. Compton, ERM

SAMPLE LOG AND ANALYSIS REQUEST

TURNAROUND TIME REQUIREMENTS
REGULAR: ___
*RUSH: ___ 5-Day ___ 3-Day ___ 2-Day ___ 1-Day
*Rush work needs prior Laboratory approval and will include surcharges

PRESERVATIVES
0 No Preservative
1 Hydrochloric Acid
2 Nitric Acid
3 Sulfuric Acid
4 Sodium Thiosulfate
5 Sodium Hydroxide
6 Zinc Acetate
7 EDTA

PRESERVATIVE CODES — NOTE PRESERVATIVES → 0 0 0 0 0 0 0 0 0 0

ANALYSIS REQUESTED & METHOD

SAMPLE ID	NO. & TYPE OF CONTAINERS	SAMPLING DATE / TIME	MATRIX	SAMPLE COMP / GRAB	2,4-Dinitrotoluene	Diethylphthalate	Antimony	Barium	Cadmium	Lead	Nickel	Silver	Thallium	COMMENTS
Equipment Blank	2/glass	8/19/97	Soil	GRAB	X	X	X	X	X	X	X	X	X	
Field Blank	↓	↓	↓		X	X	X	X	X	X	X	X	X	
Trip Blank	↓	↓	↓		X	X	X	X	X	X	X	X	X	

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[signature]	8-19-97					Mike [signature]	8/21/97

Special Requests:
Sample Condition: Good? Y N
Temperature Upon Arrival 4°C

Shipment: Hand-Del: Courier: UPS: FedEx: Shipment Date: FAX Results: Y N

ALLIANT SAMPLE #: A1 12"
REIC SAMPLE #: 54113-1

DATE SAMPLED: 08-19-97
MATRIX: SOLID
MOISTURE: 18%

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
antimony	ND	mg/kg	7041	2.50	08-25-97/MS
arsenic	3.02	mg/kg	7060A	2.50	08-26-97/MS
barium	78.5	mg/kg	6010A	2.50	08-25-97/GM
beryllium	ND	mg/kg	6010A	0.63	08-25-97/GM
cadmium	0.030	mg/kg	7131A	0.025	08-26-97/MS
chromium	25.5	mg/kg	6010A	2.50	08-25-97/GM
lead	16.5	mg/kg	6010A	12.0	08-25-97/GM
mercury	ND	mg/kg	7470A	0.10	08-27-97/MS
nickel	13.5	mg/kg	6010A	2.50	08-25-97/GM
silver	ND	mg/kg	6010A	1.25	08-25-97/GM
thallium	0.16	mg/kg	7841	0.12	08-25-97/MS

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
2,4-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
2,6-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
diethylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
di-n-butylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
resorcinol	ND	mg/kg	8270B	0.200	08-26-97/WP

Surrogates	% Recovery
nitrobenzene-d5	34
2-fluorobiphenyl	30
p-terphenyl-d14	61

ND - None Detected at MQL
MQL - Minimum Quantifying Level

ALLIANT SAMPLE #: A4 12"
REIC SAMPLE #: 54113-2

DATE SAMPLED: 08-19-97
MATRIX: SOLID
MOISTURE: 22%

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
antimony	ND	mg/kg	7041	2.50	08-25-97/MS
arsenic	2.90	mg/kg	7060A	2.50	08-26-97/MS
barium	85.2	mg/kg	6010A	2.50	08-25-97/GM
beryllium	ND	mg/kg	6010A	0.63	08-25-97/GM
cadmium	0.030	mg/kg	7131A	0.025	08-26-97/MS
chromium	30.0	mg/kg	6010A	2.50	08-25-97/GM
lead	17.2	mg/kg	6010A	12.0	08-25-97/GM
mercury	ND	mg/kg	7470A	0.10	08-27-97/MS
nickel	15.3	mg/kg	6010A	2.50	08-25-97/GM
silver	ND	mg/kg	6010A	1.25	08-25-97/GM
thallium	0.14	mg/kg	7841	0.12	08-25-97/MS

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
2,4-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
2,6-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
diethylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
di-n-butylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
resorcinol	ND	mg/kg	8270B	0.200	08-26-97/WP

Surrogates	% Recovery
nitrobenzene-d5	29
2-fluorobiphenyl	30
p-terphenyl-d14	34

ND - None Detected at MQL
MQL - Minimum Quantifying Level

ALLIANT SAMPLE #: B2 12"
REIC SAMPLE #: 54113-3

DATE SAMPLED: 08-19-97
MATRIX: SOLID
MOISTURE: 16%

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
antimony	ND	mg/kg	7041	2.50	08-25-97/MS
arsenic	3.62	mg/kg	7060A	2.50	08-26-97/MS
barium	83.8	mg/kg	6010A	2.50	08-25-97/GM
beryllium	ND	mg/kg	6010A	0.63	08-25-97/GM
cadmium	0.040	mg/kg	7131A	0.025	08-26-97/MS
chromium	26.2	mg/kg	6010A	2.50	08-25-97/GM
lead	19.1	mg/kg	6010A	12.0	08-25-97/GM
mercury	ND	mg/kg	7470A	0.10	08-27-97/MS
nickel	15.0	mg/kg	6010A	2.50	08-25-97/GM
silver	ND	mg/kg	6010A	1.25	08-25-97/GM
thallium	0.15	mg/kg	7841	0.12	08-25-97/MS

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
2,4-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
2,6-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
diethylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
di-n-butylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
resorcinol	ND	mg/kg	8270B	0.200	08-26-97/WP

Surrogates	% Recovery
nitrobenzene-d5	33
2-fluorobiphenyl	30
p-terphenyl-d14	61

ND - None Detected at MQL
MQL - Minimum Quantifying Level

ALLIANT SAMPLE #: C2 12"
REIC SAMPLE #: 54113-4

DATE SAMPLED: 08-19-97
MATRIX: SOLID
MOISTURE: 27%

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
antimony	ND	mg/kg	7041	2.50	08-25-97/MS
arsenic	4.65	mg/kg	7060A	2.50	08-26-97/MS
barium	86.7	mg/kg	6010A	2.50	08-25-97/GM
beryllium	ND	mg/kg	6010A	0.63	08-25-97/GM
cadmium	0.045	mg/kg	7131A	0.025	08-26-97/MS
chromium 30.55 ppm	34.2	mg/kg	6010A	2.50	08-25-97/GM
lead 19 ppm	22.8	mg/kg	6010A	12.0	08-25-97/GM
mercury	ND	mg/kg	7470A	0.10	08-27-97/MS
nickel	14.6	mg/kg	6010A	2.50	08-25-97/GM
silver	ND	mg/kg	6010A	1.25	08-25-97/GM
thallium	0.21	mg/kg	7841	0.12	08-25-97/MS

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
2,4-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
2,6-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
diethylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
di-n-butylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
resorcinol	ND	mg/kg	8270B	0.200	08-26-97/WP

Surrogates	% Recovery
nitrobenzene-d5	34
2-fluorobiphenyl	37
p-terphenyl-d14	64

ND - None Detected at MQL
MQL - Minimum Quantifying Level

ALLIANT SAMPLE #: D1 12"
REIC SAMPLE #: 54113-5

DATE SAMPLED: 08-19-97
MATRIX: SOLID
MOISTURE: 19%

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
antimony	ND	mg/kg	7041	2.50	08-25-97/MS
arsenic	ND	mg/kg	7060A	2.50	08-26-97/MS
barium 1260ppm	150	mg/kg	6010A	2.50	08-25-97/GM
beryllium	ND	mg/kg	6010A	0.63	08-25-97/GM
cadmium	0.042	mg/kg	7131A	0.025	08-26-97/MS
chromium	17.2	mg/kg	6010A	2.50	08-25-97/GM
lead	13.0	mg/kg	6010A	12.0	08-26-97/TJ
mercury	ND	mg/kg	7470A	0.10	08-27-97/MS
nickel	7.85	mg/kg	6010A	2.50	08-25-97/GM
silver	ND	mg/kg	6010A	1.25	08-25-97/GM
thallium	ND	mg/kg	7841	0.12	08-25-97/MS

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
2,4-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
2,6-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
diethylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
di-n-butylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
resorcinol	ND	mg/kg	8270B	0.200	08-26-97/WP

Surrogates	% Recovery
nitrobenzene-d5	35
2-fluorobiphenyl	41
p-terphenyl-d14	84

ND - None Detected at MQL
MQL - Minimum Quantifying Level

ALLIANT SAMPLE #: D3 12"
REIC SAMPLE #: 54113-6

DATE SAMPLED: 08-19-97
MATRIX: SOLID
MOISTURE: 15%

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
antimony	ND	mg/kg	7041	2.50	08-25-97/MS
arsenic	ND	mg/kg	7060A	2.50	08-26-97/MS
barium	41.2	mg/kg	6010A	2.50	08-25-97/GM
beryllium	ND	mg/kg	6010A	0.63	08-25-97/GM
cadmium	ND	mg/kg	7131A	0.025	08-26-97/MS
chromium	14.6	mg/kg	6010A	2.50	08-25-97/GM
lead	9.50	mg/kg	7421	0.25	08-26-97/TJ
mercury	ND	mg/kg	7470A	0.10	08-27-97/MS
nickel	6.62	mg/kg	6010A	2.50	08-25-97/GM
silver	ND	mg/kg	6010A	1.25	08-25-97/GM
thallium	ND	mg/kg	7841	0.12	08-25-97/MS

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
2,4-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
2,6-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
diethylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
di-n-butylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
resorcinol	ND	mg/kg	8270B	0.200	08-26-97/WP

Surrogates	% Recovery
nitrobenzene-d5	32
2-fluorobiphenyl	35
p-terphenyl-d14	58

ND - None Detected at MQL
MQL - Minimum Quantifying Level

ALLIANT SAMPLE #: D3 12" DUPL. **DATE SAMPLED:** 08-19-97
REIC SAMPLE #: 54113-7 **MATRIX:** SOLID
MOISTURE: 17%

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
antimony	ND	mg/kg	7041	2.50	08-25-97/MS
arsenic	ND	mg/kg	7060A	2.50	08-26-97/MS
barium	46.2	mg/kg	6010A	2.50	08-25-97/GM
beryllium	ND	mg/kg	6010A	0.63	08-25-97/GM
cadmium	ND	mg/kg	7131A	0.025	08-26-97/MS
chromium	11.3	mg/kg	6010A	2.50	08-25-97/GM
lead	10.2	mg/kg	7421	0.25	08-26-97/TJ
mercury	ND	mg/kg	7470A	0.10	08-27-97/MS
nickel	5.08	mg/kg	6010A	2.50	08-25-97/GM
silver	ND	mg/kg	6010A	1.25	08-25-97/GM
thallium	ND	mg/kg	7841	0.12	08-26-97/MS

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
2,4-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
2,6-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
diethylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
di-n-butylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
resorcinol	ND	mg/kg	8270B	0.200	08-26-97/WP

Surrogates	% Recovery
nitrobenzene-d5	33
2-fluorobiphenyl	38
p-terphenyl-d14	60

ND - None Detected at MQL
MQL - Minimum Quantifying Level

Page 9
Alliant Hercules, Inc.
Job #: 0897-54113

ALLIANT SAMPLE #: E1 12" **DATE SAMPLED:** 08-19-97
REIC SAMPLE #: 54113-8 **MATRIX:** SOLID
MOISTURE: 22%

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
antimony	ND	mg/kg	7041	2.50	08-25-97/MS
arsenic	ND	mg/kg	7060A	2.50	08-26-97/MS
barium 126 ppm	208	mg/kg	6010A	2.50	08-25-97/GM
beryllium	ND	mg/kg	6010A	0.63	08-25-97/GM
cadmium	0.050	mg/kg	7131A	0.025	08-26-97/MS
chromium	25.4	mg/kg	6010A	2.50	08-25-97/GM
lead 19 ppm	36.2	mg/kg	6010A	12.0	08-26-97/TJ
mercury	ND	mg/kg	7470A	0.10	08-27-97/MS
nickel	14.9	mg/kg	6010A	2.50	08-25-97/GM
silver	ND	mg/kg	6010A	1.25	08-25-97/GM
thallium	0.12	mg/kg	7841	0.12	08-25-97/MS

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
2,4-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
2,6-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
diethylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
di-n-butylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
resorcinol	ND	mg/kg	8270B	0.200	08-26-97/WP

Surrogates	% Recovery
nitrobenzene-d5	35
2-fluorobiphenyl	43
p-terphenyl-d14	82

ND - None Detected at MQL
MQL - Minimum Quantifying Level

ALLIANT SAMPLE #: E2 12"
REIC SAMPLE #: 54113-9

DATE SAMPLED: 08-19-97
MATRIX: SOLID
MOISTURE: 18%

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
antimony	ND	mg/kg	7041	2.50	08-25-97/MS
arsenic	ND	mg/kg	7060A	2.50	08-26-97/MS
barium	38.2	mg/kg	6010A	2.50	08-25-97/GM
beryllium	ND	mg/kg	6010A	0.63	08-25-97/GM
cadmium	ND	mg/kg	7131A	0.025	08-26-97/MS
chromium	14.2	mg/kg	6010A	2.50	08-25-97/GM
lead	8.48	mg/kg	6010A	12.0	08-26-97/TJ
mercury	ND	mg/kg	7470A	0.10	08-27-97/MS
nickel	6.90	mg/kg	7421	0.25	08-25-97/GM
silver	ND	mg/kg	6010A	1.25	08-25-97/GM
thallium	ND	mg/kg	7841	0.12	08-25-97/MS

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
2,4-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
2,6-dinitrotoluene	ND	mg/kg	8270B	0.200	08-26-97/WP
diethylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
di-n-butylphthalate	ND	mg/kg	8270B	0.200	08-26-97/WP
resorcinol	ND	mg/kg	8270B	0.200	08-26-97/WP

Surrogates	% Recovery
nitrobenzene-d5	29
2-fluorobiphenyl	34
p-terphenyl-d14	62

ND - None Detected at MQL
MQL - Minimum Quantifying Level

Page 11
Alliant Hercules, Inc.
Job #: 0897-54113

ALLIANT SAMPLE #: EQUIPMENT BLANK **DATE SAMPLED:** 08-19-97
REIC SAMPLE #: 54113-10 **MATRIX:** LIQUID

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
antimony	ND	mg/l	7041	0.010	08-25-97/MS
arsenic	ND	mg/l	7060A	0.010	08-26-97/MS
barium	ND	mg/l	6010A	0.10	08-25-97/GM
beryllium	ND	mg/l	6010A	0.004	08-25-97/GM
cadmium	ND	mg/l	7131A	0.001	08-26-97/MS
chromium	ND	mg/l	7191	0.010	08-26-97/TJ
lead	ND	mg/l	7421	0.010	08-22-97/TJ
mercury	ND	mg/l	7470A	0.002	08-26-97/MS
nickel	ND	mg/l	6010A	0.10	08-25-97/GM
silver	ND	mg/l	6010A	0.050	08-25-97/GM
thallium	ND	mg/l	7841	0.005	08-25-97/MS

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
2,4-dinitrotoluene	ND	mg/l	8270B	0.010	08-26-97/WP
2,6-dinitrotoluene	ND	mg/l	8270B	0.010	08-26-97/WP
diethylphthalate	ND	mg/l	8270B	0.010	08-26-97/WP
di-n-butylphthalate	ND	mg/l	8270B	0.010	08-26-97/WP
resorcinol	ND	mg/l	8270B	0.010	08-26-97/WP

Surrogates	% Recovery
nitrobenzene-d5	64
2-fluorobiphenyl	73
p-terphenyl-d14	124

ND - None Detected at MQL
MQL - Minimum Quantifying Level

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Alliant Hercules, Inc.
Job #: 0697-54113

ALLIANT SAMPLE #: FIELD BLANK **DATE SAMPLED:** 08-19-97
REIC SAMPLE #: 54113-11 **MATRIX:** LIQUID

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
antimony	ND	mg/l	7041	0.010	08-25-97/MS
arsenic	ND	mg/l	7060A	0.010	08-28-97/MS
barium	ND	mg/l	6010A	0.10	08-25-97/GM
beryllium	ND	mg/l	6010A	0.004	08-25-97/GM
cadmium	ND	mg/l	7131A	0.001	08-26-97/MS
chromium	ND	mg/l	7191	0.010	08-28-97/TJ
lead	ND	mg/l	7421	0.010	08-22-97/TJ
mercury	ND	mg/l	7470A	0.002	08-26-97/MS
nickel	ND	mg/l	6010A	0.10	08-25-97/GM
silver	ND	mg/l	6010A	0.050	08-25-97/GM
thallium	ND	mg/l	7841	0.005	08-25-97/MS

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
2,4-dinitrotoluene	ND	mg/l	8270B	0.010	08-26-97/WP
2,6-dinitrotoluene	ND	mg/l	8270B	0.010	08-26-97/WP
diethylphthalate	ND	mg/l	8270B	0.010	08-26-97/WP
di-n-butylphthalate	ND	mg/l	8270B	0.010	08-26-97/WP
resorcinol	ND	mg/l	8270B	0.010	08-26-97/WP

Surrogates	% Recovery
nitrobenzene-d5	79
2-fluorobiphenyl	76
p-terphenyl-d14	121

ND - None Detected at MQL
MQL - Minimum Quantifying Level

Page 13
Alliant Hercules, Inc.
Job #: 0897-54113

ALLIANT SAMPLE #: TRIP BLANK **DATE SAMPLED:** 08-19-97
REIC SAMPLE #: 54113-12 **MATRIX:** LIQUID

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
antimony	ND	mg/l	7041	0.010	08-25-97/MS
arsenic	ND	mg/l	7060A	0.010	08-28-97/MS
barium	ND	mg/l	6010A	0.10	08-25-97/GM
beryllium	ND	mg/l	6010A	0.004	08-25-97/GM
cadmium	ND	mg/l	7131A	0.001	08-26-97/MS
chromium	ND	mg/l	7191	0.010	08-28-97/TJ
lead	ND	mg/l	7421	0.010	08-22-97/TJ
mercury	ND	mg/l	7470A	0.002	08-26-97/MS
nickel	ND	mg/l	6010A	0.10	08-25-97/GM
silver	ND	mg/l	6010A	0.050	08-25-97/GM
thallium	ND	mg/l	7841	0.005	08-25-97/MS

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	MQL	ANALYZED/BY
2,4-dinitrotoluene	ND	mg/l	8270B	0.010	08-26-97/WP
2,6-dinitrotoluene	ND	mg/l	8270B	0.010	08-26-97/WP
diethylphthalate	ND	mg/l	8270B	0.010	08-26-97/WP
di-n-butylphthalate	ND	mg/l	8270B	0.010	08-26-97/WP
resorcinol	ND	mg/l	8270B	0.010	08-26-97/WP

Surrogates	% Recovery
nitrobenzene-d5	61
2-fluorobiphenyl	70
p-terphenyl-d14	116

ND - None Detected at MQL
MQL - Minimum Quantifying Level

DATE 9-2-97 APPROVED Ivan W. Leef
Ivan W. Leef
Janet M. Satterfield
Janet M. Satterfield

REIC

CHAIN OF CUSTODY RECORD NO. 55421

REIC Laboratory
225 Industrial Park Rd.
P.O. Box 286, Beaver, WV 25813
Phone: 304-255-2500 or 800-999-0105
FAX: 304-255-2572

CLIENT: Alliant Techsystems Inc
ADDRESS: P.O. Box 1
CITY/STATE/ZIP: Radford, VA 24141
BILL TO: Same
CITY/STATE/ZIP:

CONTACT PERSON: Arne Olsen
TELEPHONE/FAX: 540/639-8220
SITE ID & STATE: RAAP - VA
PROJECT ID: Incin. Spray Pond Closure
SAMPLER: C. Compton, ERM

SAMPLE LOG AND ANALYSIS REQUEST

TURNAROUND TIME REQUIREMENTS
REGULAR: ___
*RUSH: ___ 5-Day ___ 3-Day ___ 2-Day ___ 1-Day
*Rush work needs prior Laboratory approval and will include surcharges

PRESERVATIVES
0 No Preservative
1 Hydrochloric Acid
2 Nitric Acid
3 Sulfuric Acid
4 Sodium Thiosulfate
5 Sodium Hydroxide
6 Zinc Acetate
7 EDTA

PRESERVATIVE CODES — NOTE PRESERVATIVES →

SAMPLE ID	NO. & TYPE OF CONTAINERS	SAMPLING DATE / TIME	MATRIX	SAMPLE COMP / GRAB	ANALYSIS REQUESTED & METHOD: 2,6-Dinitrotoluene	Diethyl Phthalate	Antimony	Barium	Cadmium	Lead	Nickel	Silver	Thallium	COMMENTS
A1 18"	2/glass	9/[illegible] 10:00 10:05	Soil	Grab	X	X	X	X	X	X	X	X	X	
A1 24"		10:08 10:10			X	X	X	X	X	X	X	X	X	
A4 18"		10:12 10:15			X	X	X	X	X	X	X	X	X	
A4 24"		10:20 10:22			X	X	X	X	X	X	X	X	X	
B2 18"		10:45 10:47			X	X	X	X	X	X	X	X	X	
B2 24"		10:52 10:55			X	X	X	X	X	X	X	X	X	
C2 18"		11:15 11:17			X	X	X	X	X	X	X	X	X	
C2 24"		11:22 11:25			X	X	X	X	X	X	X	X	X	
D1 18"		12:35 12:37			X	X	X	X	X	X	X	X	X	
D1 24"		12:43 12:47			X	X	X	X	X	X	X	X	X	

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time

Methods per DEQ approved plan - A. Olsen

Hand-Del Courier UPS FedEx

Sample Condition: Good? Y N

Temperature Upon Arrival °C

Shipment Date: FAX Results: Y N

REIC

CHAIN OF CUSTODY RECORD NO. 55420

REIC Laboratory
225 Industrial Park Rd.
P.O. Box 286, Beaver, WV 25813
Phone: 304-255-2500 or 800-999-0105
FAX: 304-255-2572

CLIENT: Alliant Techsystems Inc.
ADDRESS: P.O. Box 1
CITY/STATE/ZIP: Radford, VA 24141
BILL TO: Same
CITY/STATE/ZIP:

CONTACT PERSON: Arne Olsen
TELEPHONE/FAX: 540/639-8220
SITE ID & STATE: RAAP - VA.
PROJECT ID: Incin. Spray Pond Closure
SAMPLER: C. Compton, ERM

SAMPLE LOG AND ANALYSIS REQUEST

TURNAROUND TIME REQUIREMENTS
REGULAR: ___
*RUSH: ___ 5-Day ___ 3-Day ___ 2-Day ___ 1-Day
*Rush work needs prior Laboratory approval and will include surcharges

PRESERVATIVES
0 No Preservative
1 Hydrochloric Acid
2 Nitric Acid
3 Sulfuric Acid
4 Sodium Thiosulfate
5 Sodium Hydroxide
6 Zinc Acetate
7 EDTA

PRESERVATIVE CODES — NOTE PRESERVATIVES →

SAMPLE ID	NO. & TYPE OF CONTAINERS	SAMPLING DATE / TIME	MATRIX	SAMPLE COMP / GRAB	2,4-Dinitrotoluene	Diethyl Phthalate	Diphenylamine	Barium	Aluminum	Lead	Nickel	Silver	Thallium	COMMENTS
D3 18"	2/glass	9/8/97 12:53	Soil	Grab	X	X	X	X	X	X	X	X	X	
D3 24"		13:00 13:01			X	X	X	X	X	X	X	X	X	
E1 18"		13:12 13:15			X	X	X	X	X	X	X	X	X	
E1 24"		13:20 13:22			X	X	X	X	X	X	X	X	X	
E1 18" Dupl.		13:25 13:27			X	X	X	X	X	X	X	X	X	
E2 24" Dupl.		13:33 13:35			X	X	X	X	X	X	X	X	X	
E2 18"		13:37 13:39			X	X	X	X	X	X	X	X	X	
E2 24"		13:45 13:48			X	X	X	X	X	X	X	X	X	
Equip. Blank		14:01 14:02	H_2O		X	X	X	X	X	X	X	X	X	
Field Blank	↓	14:08 14:10	H_2O	↓	X	X	X	X	X	X	X	X	X	

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time

Special Requests: Methods per DEQ approved plan - A. Olsen
Sample Condition: Good? Y N
Temperature Upon Arrival °C

Shipment: Hand-Del: Courier: UPS: FedEx:
Shipment Date: FAX Results: Y N

ALLIANT TECHSYSTEMS INC.
P O BOX 1
RADFORD VIRGINIA 24141

REIC JOB #: 0997-54714
SITE ID: RAAP - VA
PROJECT ID: INCIN. SPRAY POND CLOSURE
CUSTODY NO.: 53420 AND 53421

Prepared By:
REI Consultants, Inc.
P O Box 286
Beaver WV 25813

Phone: 304-255-2500
800-999-0105
Fax: 304-255-2572

ALLIANT SAMPLE #: A1 18" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-1 **MATRIX:** SOLID
MOISTURE: 20%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-24-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-24-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	80

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	30
2-fluorobiphenyl	38
p-terphenyl-d14	43

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	3100	ug/kg	7060A	200	09-23-97/TJ
barium	94800	ug/kg	6010A	1000	09-16-97/MS
beryllium	800	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	25700	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	13700	ug/kg	6010A	7500	09-18-97/MS
silver	48	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: A1 24"
REIC SAMPLE #: 54714-2
DATE SAMPLED: 09-08-97
MATRIX: SOLID
MOISTURE: 19%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-24-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-24-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	88

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	33
2-fluorobiphenyl	40
p-terphenyl-d14	47

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	2560	ug/kg	7060A	200	09-23-97/TJ
barium	116000	ug/kg	6010A	1000	09-16-97/MS
beryllium	800	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	31300	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	20100	ug/kg	6010A	7500	09-18-97/MS
silver	30	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: A4 18" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-3 **MATRIX:** SOLID
MOISTURE: 17%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-24-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-24-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	104

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	26
2-fluorobiphenyl	34
p-terphenyl-d14	40

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	2990	ug/kg	7060A	200	09-23-97/TJ
barium	101000	ug/kg	6010A	1000	09-16-97/MS
beryllium	780	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	36400	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	20700	ug/kg	6010A	7500	09-18-97/MS
silver	50	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: A4 24" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-4 **MATRIX:** SOLID
MOISTURE: 19%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-24-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-24-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	94

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	26
2-fluorobiphenyl	34
p-terphenyl-d14	39

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	2400	ug/kg	7060A	200	09-23-97/TJ
barium	101000	ug/kg	6010A	1000	09-16-97/MS
beryllium	720	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	32600	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	17600	ug/kg	6010A	7500	09-18-97/MS
silver	ND	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: B2 18" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-5 **MATRIX:** SOLID
MOISTURE: 18%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-24-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-24-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	88

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	29
2-fluorobiphenyl	37
p-terphenyl-d14	42

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	2610	ug/kg	7060A	200	09-23-97/TJ
barium	89600	ug/kg	6010A	1000	09-16-97/MS
beryllium	750	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	34300	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	16800	ug/kg	6010A	7500	09-18-97/MS
silver	ND	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: B2 24" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-6 **MATRIX:** SOLID
MOISTURE: 19%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-24-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-24-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	100

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	26
2-fluorobiphenyl	32
p-terphenyl-d14	38

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	2450	ug/kg	7060A	200	09-23-97/TJ
barium	88100	ug/kg	6010A	1000	09-16-97/MS
beryllium	820	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	29700	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	17400	ug/kg	6010A	7500	09-18-97/MS
silver	ND	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: C2 18" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-7 **MATRIX:** SOLID
MOISTURE: 23%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-24-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-24-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	94

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	27
2-fluorobiphenyl	32
p-terphenyl-d14	41

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	4580	ug/kg	7060A	200	09-23-97/TJ
barium	123000	ug/kg	6010A	1000	09-16-97/MS
beryllium	880	ug/kg	6010A	100	09-18-97/MS
cadmium	50	ug/kg	7131A	50	09-17-97/TJ
chromium	37900	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	20800	ug/kg	6010A	7500	09-18-97/MS
silver	ND	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: C2 24" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-8 **MATRIX:** SOLID
MOISTURE: 20%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-24-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-24-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	89

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	29
2-fluorobiphenyl	30
p-terphenyl-d14	41

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	3410	ug/kg	7060A	200	09-23-97/TJ
barium	102000	ug/kg	6010A	1000	09-16-97/MS
beryllium	800	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	37500	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	19400	ug/kg	6010A	7500	09-18-97/MS
silver	ND	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: D1 18" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-9 **MATRIX:** SOLID
MOISTURE: 20%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-24-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-24-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	96

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	25
2-fluorobiphenyl	32
p-terphenyl-d14	38

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	2330	ug/kg	7060A	200	09-23-97/TJ
barium	103000	ug/kg	6010A	1000	09-16-97/MS
beryllium	650	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	31200	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	11600	ug/kg	6010A	7500	09-18-97/MS
silver	40	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: D1 24" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-10 **MATRIX:** SOLID
MOISTURE: 25%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-24-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-24-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	86

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-21-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-21-97/WP
resorcinol	ND	ug/kg	8270B	330	09-21-97/WP

Surrogates	% Recovery
nitrobenzene-d5	50
2-fluorobiphenyl	38
p-terphenyl-d14	61

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	6460	ug/kg	7060A	200	09-23-97/TJ
barium	98200	ug/kg	6010A	1000	09-16-97/MS
beryllium	1280	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	34300	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	11600	ug/kg	6010A	7500	09-18-97/MS
silver	25	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: D3 18" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-11 **MATRIX:** SOLID
MOISTURE: 21%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-24-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-24-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	84

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	27
2-fluorobiphenyl	31
p-terphenyl-d14	53

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	3050	ug/kg	7060A	200	09-23-97/TJ
barium	126000	ug/kg	6010A	1000	09-16-97/MS
beryllium	900	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	39000	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	19100	ug/kg	6010A	7500	09-18-97/MS
silver	45	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: D3 24" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-12 **MATRIX:** SOLID
MOISTURE: 21%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-25-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-25-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	90

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	24
2-fluorobiphenyl	33
p-terphenyl-d14	56

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	3500	ug/kg	7060A	200	09-23-97/TJ
barium	112000	ug/kg	6010A	1000	09-16-97/MS
beryllium	1000	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	38500	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	16700	ug/kg	6010A	7500	09-18-97/MS
silver	ND	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: E1 18" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-13 **MATRIX:** SOLID
MOISTURE: 19%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-25-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-25-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	114

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	27
2-fluorobiphenyl	34
p-terphenyl-d14	52

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	1740	ug/kg	7060A	200	09-23-97/TJ
barium	211000	ug/kg	6010A	1000	09-16-97/MS
beryllium	1000	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	29800	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	17500	ug/kg	6010A	7500	09-18-97/MS
silver	68	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: E1 24" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-14 **MATRIX:** SOLID
MOISTURE: 22%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-25-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-25-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	100

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	26
2-fluorobiphenyl	32
p-terphenyl-d14	49

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	1680	ug/kg	7060A	200	09-23-97/TJ
barium	199000	ug/kg	6010A	1000	09-16-97/MS
beryllium	1020	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	25100	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	15.3	ug/kg	6010A	7500	09-18-97/MS
silver	25	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: E1 18" DUP. **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-15 **MATRIX:** SOLID
MOISTURE: 20%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-25-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-25-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	100

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	28
2-fluorobiphenyl	39
p-terphenyl-d14	57

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	1860	ug/kg	7060A	200	09-23-97/TJ
barium	113000	ug/kg	6010A	1000	09-16-97/MS
beryllium	1520	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	26100	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	12700	ug/kg	6010A	7500	09-18-97/MS
silver	30	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: E1 24" DUP. **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-16 **MATRIX:** SOLID
MOISTURE: 21%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-25-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-25-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	114

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-20-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-20-97/WP
resorcinol	ND	ug/kg	8270B	330	09-20-97/WP

Surrogates	% Recovery
nitrobenzene-d5	27
2-fluorobiphenyl	34
p-terphenyl-d14	56

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	2940	ug/kg	7060A	200	09-23-97/TJ
barium	110000	ug/kg	6010A	1000	09-16-97/MS
beryllium	650	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	28300	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	12800	ug/kg	6010A	7500	09-18-97/MS
silver	30	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: E2 18" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-17 **MATRIX:** SOLID
MOISTURE: 19%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-25-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-25-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	86

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-21-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-21-97/WP
resorcinol	ND	ug/kg	8270B	330	09-21-97/WP

Surrogates	% Recovery
nitrobenzene-d5	25
2-fluorobiphenyl	41
p-terphenyl-d14	53

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	3690	ug/kg	7060A	200	09-23-97/TJ
barium	100000	ug/kg	6010A	1000	09-16-97/MS
beryllium	820	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	36200	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	20600	ug/kg	6010A	7500	09-18-97/MS
silver	ND	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: E2 24" **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-18 **MATRIX:** SOLID
MOISTURE: 20%

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/kg	8090	130	09-25-97/JA
2,6-dinitrotoluene	ND	ug/kg	8090	70	09-25-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	88

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/kg	8270B	330	09-21-97/WP
di-n-butyl phthalate	ND	ug/kg	8270B	330	09-21-97/WP
resorcinol	ND	ug/kg	8270B	330	09-21-97/WP

Surrogates	% Recovery
nitrobenzene-d5	35
2-fluorobiphenyl	30
p-terphenyl-d14	56

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/kg	7041	1000	09-16-97/TJ
arsenic	4390	ug/kg	7060A	200	09-23-97/TJ
barium	85400	ug/kg	6010A	1000	09-16-97/MS
beryllium	820	ug/kg	6010A	100	09-18-97/MS
cadmium	ND	ug/kg	7131A	50	09-17-97/TJ
chromium	31500	ug/kg	6010A	25000	09-16-97/MS
lead	ND	ug/kg	6010A	50000	09-16-97/MS
mercury	ND	ug/kg	7471	200	09-17-97/TJ
nickel	16700	ug/kg	6010A	7500	09-18-97/MS
silver	ND	ug/kg	7761	*25	09-17-97/GM
thallium	ND	ug/kg	7841	500	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: EQUIP. BLANK **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-19 **MATRIX:** LIQUID

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/l	8090	25	09-25-97/JA
2,6-dinitrotoluene	ND	ug/l	8090	15	09-25-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	78

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/l	8270B	25	09-21-97/WP
di-n-butyl phthalate	ND	ug/l	8270B	25	09-21-97/WP
resorcinol	ND	ug/l	8270B	25	09-21-97/WP

Surrogates	% Recovery
nitrobenzene-d5	48
2-fluorobiphenyl	64
p-terphenyl-d14	71

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/l	7041	10	09-16-97/TJ
arsenic	ND	ug/l	7060A	10	09-23-97/TJ
barium	ND	ug/l	6010A	100	09-16-97/MS
beryllium	ND	ug/l	6010A	4	09-18-97/MS
cadmium	ND	ug/l	7131A	1	09-17-97/TJ
chromium	ND	ug/l	7191	10	09-25-97/KC
lead	ND	ug/l	7421	10	09-24-97/KC
mercury	ND	ug/l	7470A	1	09-17-97/TJ
nickel	ND	ug/l	6010A	100	09-18-97/MS
silver	ND	ug/l	7761	5	09-17-97/GM
thallium	ND	ug/l	7841	5	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: FIELD BLANK **DATE SAMPLED:** 09-08-97
REIC SAMPLE #: 54714-20 **MATRIX:** LIQUID

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/l	8090	25	09-25-97/JA
2,6-dinitrotoluene	ND	ug/l	8090	15	09-25-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	82

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/l	8270B	25	09-21-97/WP
di-n-butyl phthalate	ND	ug/l	8270B	25	09-21-97/WP
resorcinol	ND	ug/l	8270B	25	09-21-97/WP

Surrogates	% Recovery
nitrobenzene-d5	50
2-fluorobiphenyl	66
p-terphenyl-d14	67

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/l	7041	10	09-16-97/TJ
arsenic	ND	ug/l	7060A	10	09-23-97/TJ
barium	ND	ug/l	6010A	100	09-16-97/MS
beryllium	ND	ug/l	6010A	4	09-18-97/MS
cadmium	ND	ug/l	7131A	1	09-17-97/TJ
chromium	ND	ug/l	7191	10	09-25-97/KC
lead	ND	ug/l	7421	10	09-24-97/KC
mercury	ND	ug/l	7470A	1	09-17-97/TJ
nickel	ND	ug/l	6010A	100	09-18-97/MS
silver	ND	ug/l	7761	5	09-17-97/GM
thallium	ND	ug/l	7841	5	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

ALLIANT SAMPLE #: TRIP BLANK **MATRIX:** LIQUID
REIC SAMPLE #: 54714-21

SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
2,4-dinitrotoluene	ND	ug/l	8090	25	09-25-97/JA
2,6-dinitrotoluene	ND	ug/l	8090	15	09-25-97/JA

Surrogate	% Recovery
tetrachloro-m-xylene	74

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
diethylphthalate	ND	ug/l	8270B	25	09-21-97/WP
di-n-butyl phthalate	ND	ug/l	8270B	25	09-21-97/WP
resorcinol	ND	ug/l	8270B	25	09-21-97/WP

Surrogates	% Recovery
nitrobenzene-d5	46
2-fluorobiphenyl	61
p-terphenyl-d14	34

TOTAL METALS

PARAMETER	RESULT	UNIT	METHOD	PQL	ANALYZED/BY
antimony	ND	ug/l	7041	10	09-16-97/TJ
arsenic	ND	ug/l	7060A	10	09-23-97/TJ
barium	ND	ug/l	6010A	100	09-16-97/MS
beryllium	ND	ug/l	6010A	4	09-18-97/MS
cadmium	ND	ug/l	7131A	1	09-17-97/TJ
chromium	ND	ug/l	7191	10	09-25-97/KC
lead	ND	ug/l	7421	10	09-24-97/KC
mercury	ND	ug/l	7470A	1	09-17-97/TJ
nickel	ND	ug/l	6010A	100	09-18-97/MS
silver	ND	ug/l	7761	5	09-17-97/GM
thallium	ND	ug/l	7841	5	09-17-97/TJ

ND - None Detected at PQL
PQL - Practical Quantitation Limit
* - Silver reported to Method Detection Limit

DATE 9-26-97

APPROVED Joseph Robertson
For Janet M. Satterfield

Ivan W Leef
Ivan W. Leef

Attachment 4

Risk Tables for Exposure Pathways

On-site Residential Exposure - Carcinogen
Inhalation of COPCs from Soil Particles
Radford Army Ammunition Plant
Radford, Virginia

Equations: Intake (mg/kg-day) = $\frac{PEF \times IRA_{adj} \times ET \times EF}{AT_c}$

Risk = Intake x Slope Factor (SF-Chemical Specific)

Hazard Quotient = Intake/Reference Dose (RfD-Chemical Specific)

Variable Abbreviation	Variable	REAMS Default Value	User Defined Value
PEF	Particulate Emission Factor in Air (kg/m3)	1.47E-09	
IRA_{adj}	Inhalation Rate (unitless)	11.66	
ET	Exposure Time (hours/day)	24	
EF	Exposure Frequency (days/year)	350	
AT_c	Averaging Time (period over which exposure is averaged - days)	25,550	

On-site Resident Exposure - Carcinogen
Ingestion of COPCs in On-site Soils
Radford Army Ammunition Plant
Radford, Virginia

Equations: Intake (mg/kg-day) = $\frac{CS \times IRS_{adj} \times CF \times FI \times EF}{AT_c}$

Risk = Intake x Slope Factor (SF-Chemical Specific)

Hazard Quotient = Intake / Reference Dose (RfD-Chemical Specific)

Variable Abbreviation	Variable	REAMS Default Value	User Defined Value
CS	Chemical Concentration in Soil (mg/Kg)	~	Chemical Specific*
IRS_{adj}	Ingestion Rate (unitless)	114.29	
CF	Conversion Factor (1.0E-06 kg/mg)	0.000001	
FI	Fraction Ingested from Contaminated Source Residential (unitless)	1.0	
EF	Exposure Frequency (days/year)	350	
AT_c	Averaging Time (period over which exposure is averaged - days)	25,550	

Notes:
* Maximum Detected Concentration

On-site Resident Exposure - Carcinogen
Dermal Contact with COPCs in Soil
Radford Army Ammunition Plant
Radford, Virginia

Equations: Absorbed Dose (mg/kg-day) = $\frac{CS \times CF \times SAS_{adj} \times AF \times ABS \times EF}{AT_c}$

Risk = Intake x Slope Factor (SF-Chemical Specific)

Hazard Quotient = Intake / Reference Dose (RfD-Chemical Specific)

Variable Abbreviation	Variable	REAMS Default Value	User Defined Value
CS	Chemical Concentration in Soil (mg/Kg)	~	Chemical Specific*
CF	Volumetric Conversion Factor for Soil (1.0E-06 kg/mg)	0.000001	
SAS_{adj}	Skin Surface Area Available for Contact (cm2/event)	2,290	
AF	Soil Adherence Factor (mg/cm2)	~	1.45 (Given)
ABS	Chemical-specific Absorption Factor (unitless)	~	Chemical Specific**
EF	Exposure Frequency (days/year)	350	
AT_c	Averaging Time (period over which exposure is averaged - days)	25,550	

Notes:
* Maximum Soil Concentration
** Value from "Assessing Dermal Exposure From Soil" (USEPA, 1995)

On-site Residential (Adult) Exposure - Non-carcinogen
Inhalation of COPCs from Soil Particles
Radford Army Ammunition Plant
Radford, Virginia

Equations: Intake (mg/kg-day) = $\frac{PEF \times IRA_a \times ET \times EF \times ED}{BW_a \times AT_n}$

Risk = Intake x Slope Factor (SF-Chemical Specific)

Hazard Quotient = Intake/Reference Dose (RfD-Chemical Specific)

Variable Abbreviation	Variable	REAMS Default Value	User Defined Value
PEF	Particulate Emission Factor in Air (kg/m3)	1.47E-09	
IRA_a	Inhalation Rate (m3/hour)	0.833	
ET	Exposure Time (hours/day)	24	
EF	Exposure Frequency (days/year)	350	
ED	Exposure Duration (years)	30	
BW_a	Adult Body Weight (kg)	70	
AT_n	Averaging Time (period over which exposure is averaged - days)	10,950	

On-site Residential (Child) Exposure - Non-carcinogen
Inhalation of COPCs from Soil Particles
Radford Army Ammunition Plant
Radford, Virginia

Equations: Intake (mg/kg-day) = $\frac{PEF \times IRA_c \times ET \times EF \times ED}{BW_c \times AT_n}$

Risk = Intake x Slope Factor (SF-Chemical Specific)

Hazard Quotient = Intake/Reference Dose (RfD-Chemical Specific)

Variable Abbreviation	Variable	REAMS Default Value	User Defined Value
PEF	Particulate Emission Factor in Air (kg/m3)	1.47E-09	
IRA_c	Inhalation Rate (m3/hour)	0.5	
ET	Exposure Time (hours/day)	24	
EF	Exposure Frequency (days/year)	350	
ED	Exposure Duration (years)	6	
BW_c	Child Body Weight (kg)	15	
AT_n	Averaging Time (period over which exposure is averaged - days)	2,190	

On-site Resident (Adult) Exposure - Non-carcinogen
Ingestion of COPCs in On-site Soils
Radford Army Ammunition Plant
Radford, Virginia

Equations: Intake (mg/kg-day) = $\frac{CS \times IRS_a \times CF \times FI \times EF \times ED_a}{BW_a \times AT_a}$

Risk = Intake x Slope Factor (SF-Chemical Specific)

Hazard Quotient = Intake / Reference Dose (RfD-Chemical Specific)

Variable Abbreviation	Variable	REAMS Default Value	User Defined Value
CS	Chemical Concentration in Soil (mg/Kg)	~	Chemical Specific*
IRS_a	Ingestion Rate - Adult (mg/soil/day)	100	
CF	Conversion Factor (1.0E-06 kg/mg)	0.000001	
FI	Fraction Ingested from Contaminated Source Residential (unitless)	1.0	
EF	Exposure Frequency (days/year)	350	
ED_a	Exposure Duration (years)	30	
BW_a	Adult Body Weight (kg)	70	
AT_n	Averaging Time (period over which exposure is averaged - days)	10,950	

Notes:
* Maximum Detected Concentration

Res-Ingest Soil.

On-site Resident (Child) Exposure - Non-carcinogen
Ingestion of COPCs in On-site Soils
Radford Army Ammunition Plant
Radford, Virginia

Equations: Intake (mg/kg-day) = $\frac{CS \times IRS_c \times CF \times FI \times EF \times ED_c}{BW_c \times AT_c}$

Risk = Intake x Slope Factor (SF-Chemical Specific)

Hazard Quotient = Intake / Reference Dose (RfD-Chemical Specific)

Variable Abbreviation	Variable	REAMS Default Value	User Defined Value
CS	Chemical Concentration in Soil (mg/Kg)	~	Chemical Specific*
IRS_c	Ingestion Rate - Child (mg/soil/day)	200	
CF	Conversion Factor (1.0E-06 kg/mg)	0.000001	
FI	Fraction Ingested from Contaminated Source Residential (unitless)	1.0	
EF	Exposure Frequency (days/year)	350	
ED_c	Exposure Duration (years)	6	
BW_c	Child Body Weight (kg)	15	
AT_n	Averaging Time (period over which exposure is averaged - days)	2,190	

Notes:
* Maximum Detected Concentration

On-site Resident (Adult) Exposure - Non-carcinogen
Dermal Contact with COPCs in Soils
Radford Army Ammunition Plant
Radford, Virginia

Equations: Absorbed Dose (mg/kg-day) = $\frac{CS \times CF \times SA_a \times AF \times ABS \times EF \times ED_a}{BW_a \times AT_n}$

Risk = Intake x Slope Factor (SF-Chemical Specific)

Hazard Quotient = Intake / Reference Dose (RfD-Chemical Specific)

Variable Abbreviation	Variable	REAMS Default Value	User Defined Value
CS	Chemical Concentration in Soils (mg/Kg)	~	Chemical Specific*
CF	Volumetric Conversion Factor for Soil (1.0E-06 kg/mg)	0.000001	
SA_a	Skin Surface Area Available for Contact (Adult - cm2/event)	~	4,860 (Given)
AF	Soil Adherence Factor (mg/cm2)	~	1.45 (Given)
ABS	Chemical-specific Absorption Factor (unitless)	~	Chemical Specific**
EF	Exposure Frequency (days/year)	350	
ED_a	Exposure Duration (years)	30	
BW_a	Adult Body Weight (kg)	70	
AT_n	Averaging Time (period over which exposure is averaged - days)	10,950	

Notes:
* Maximum Soil Concentration
** Value from "Assessing Dermal Exposure From Soil" (USEPA, 1995)

On-site Resident (Child) Exposure - Non-carcinogen
Dermal Contact with COPCs in Soils
Radford Army Ammunition Plant
Radford, Virginia

Equations: Absorbed Dose (mg/kg-day) = $\frac{CS \times CF \times SA_c \times AF \times ABS \times EF \times ED_c}{BW_c \times AT_n}$

Risk = Intake x Slope Factor (SF-Chemical Specific)

Hazard Quotient = Intake / Reference Dose (RfD-Chemical Specific)

Variable Abbreviation	Variable	REAMS Default Value	User Defined Value
CS	Chemical Concentration in Soil (mg/Kg)	~	Chemical Specific*
CF	Volumetric Conversion Factor for Soil (1.0E-06 kg/mg)	0.000001	
SA_c	Skin Surface Area Available for Contact (Child - cm2/event)	1,875	
AF	Soil Adherence Factor (mg/cm2)	~	1.45 (Given)
ABS	Chemical-specific Absorption Factor (unitless)	~	Chemical Specific**
EF	Exposure Frequency (days/year)	350	
ED_c	Exposure Duration (years)	6	
BW_c	Adult Body Weight (kg)	15	
AT_n	Averaging Time (period over which exposure is averaged - days)	2,190	

Notes:
* Maximum Soil Concentration
** Value from "Assessing Dermal Exposure From Soil" (USEPA, 1995)

[redacted]

Alliant Techsystems Inc.
Radford Army Ammunition Plant
Route 114
P.O. Box 1
Radford, VA 24141-0100

February 24, 1998

98-815-048

Ms. Debra Miller
Virginia Department of Environmental Quality
Office of Permitting Management
629 East Main Street
Richmond, VA 23219

Subject: Risk Assessment and Closure Certification
Incinerator Spray Pond (HWMU 39)
Radford Army Ammunition Plant
EPA ID# VA1210020730

Dear Ms. Miller:

Enclosed are two copies of the "*Risk Assessment and Closure Certification for the Former Incinerator Spray Pond*" and the soil sample Quality Assurance package for the incinerator spray pond (HWMU 39) at the Radford Army Ammunition Plant in Radford, Virginia.

Background soil samples were collected in accordance with the approved "*Closure, Contingent Closure and Contingent Post-Closure Plans for Radford Army Ammunition Plant's Incinerator Spray Pond (HWMU 39).*" Upper tolerance limits for each Hazardous Constituent of Concern (HCOC) were calculated based on the background analytical results and were approved by DEQ in a May 22, 1997 letter. These background tolerance limits set the cleanup thresholds for the closure.

Construction activities began July 11, 1997 and were completed October 16, 1997. Mr. Mike Scott and Ms. Kim Batwinas of the Virginia Department of Environmental Quality West Central Regional Office performed a site inspection of the incinerator spray pond on October 22, 1997. Verbal approval to backfill the excavation was provided by Mr. Mike Scott with the understanding that if the risk assessment indicated further soils should be excavated from the unit, the backfilled material would have to be removed. Alliant began backfilling and compaction activities on October 24, 1997 and completed these activities on October 31, 1997.

Three HCOCs exceeded background tolerance limits at the twenty-four (24) inch depth: arsenic, barium, and chromium. A risk assessment was performed for these HCOCs using the REAMS model. As provided in the table below, the results indicate risks below the residential thresholds. Section 4.0 in the attached report provides the details of the REAMS model risk assessment.

Contaminant	Location	Result (ppm)	Threshold (ppm)	Hazard Quotient
Arsenic	D1	6.46	5.43	0.49
Barium	E1	199	125.75	0.05
Chromium	A1	31.3	30.55	
	A4	32.6	30.55	
	C2	37.5	30.55	
	D1	34.3	30.55	
	D3	38.5	30.55	0.104*
	E2	31.5	30.55	
TOTAL				0.644

* Highest concentration of chromium used for hazard quotient calculation. All hazard quotient calculations include both adult and child risks.

If you have any questions or would like additional information, please coordinate with Jerry Redder (540)639-7536 (Jerry_Redder@ATK.com) or Christel Compton (540)639-8211 (Christel_Compton@ATK.com).

Sincerely,

C. A. Jake

C.A. Jake, Supervisor
Environmental

Enclosures

cc. Mary Beck, USEPA Region III (3)
Rob Thompson, USEPA Region III (2)
Devlin Harris, DEQ West Central Regional Office - Roanoke
Mike Scott, DEQ West Central Regional Office - Roanoke
R.L. Richardson, RFAAP ACO

Coordination: M.L. Griffith R.L. Richardson

R.L. Richardson

bc. Administrative File
Envir. File, w/ enclosure
R. Davie, RFAAP ACO - w/ enclosure
Jim Small, IOC - w/o enclosure
D.W. Shead - w/o enclosure
C.A. Jake - w/o enclosure
J.J. Redder - w/o enclosure
C.E. Compton - w/o enclosure