Delivery Order No. 0008
Environmental Services
Program Support
DACA31-94-D-0064

RADFORD ARMY AMMUNITION PLANT, VIRGINIA

Facility-Wide Background Study Report

Prepared for:
USACE Baltimore District
10 S. Howard St.
Baltimore, MD 21201

Prepared by:
IT Corporation
2113 Emmorton Park Rd.
Edgewood, MD 21040

Final Document

December 2001

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

W. Tayloe Murphy, Jr.
Secretary of Natural Resources

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Robert G. Burnley
Director

(804) 698-4000
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May 29, 2002

Mr. James McKenna
Radford Army Ammunition Plant
SIORF-SE-EQ
P.O. Box 2
Radford, VA 24141-0099

RE: Final Facility-Wide Background Study Report (Report)

Dear Mr. McKenna:

This office has reviewed the referenced final document and concurs with the Report. No revisions to the document are required.

If you have any questions, please call me at 804.698.4308.

Sincerely,

Mark S. Leeper
Remedial Project Manager

cc: Norman L. Auldridge - WCRO, DEQ
Durwood Willis - DEQ
Robert Thompson, Region III, U.S.EPA, 3HS13

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Date: February 14, 2002

In reply
Refer to 3HS13

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commander,
Radford Army Ammunition Plant
Attn: SIORF-SE-EQ (Jim McKenna)
P.O. Box 2
Radford, VA 24141-0099

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

Re: Radford Army Ammunition Plant
Facility-Wide Background Study Report
Document submittal and review

Dear Mr. McKenna and Ms. Jake:

The U.S. Environmental Protection Agency (EPA) has reviewed the Army's December, 2001 *Facility-Wide Background Study Report* for use at the Radford Army Ammunition Plant (RFAAP) and the New River Ammunition Storage Depot (NRASD). Based upon our review, the *Facility-Wide Background Study Report* is approved. In accordance with Part II. (E)(5) of RFAAP's Corrective Action Permit, the *Facility-Wide Background Study Report* is now final. EPA expects that future site-specific *Work Plans* and *Reports* for the investigation of areas at the RFAAP and NRASD will reference the final *Facility-Wide Background Study Report*.

If you have any questions, please call me at 215-814-3357.

Sincerely,

Robert Thomson

Robert Thomson, PE
Federal Facilities Branch

cc: Russell Fish, EPA
Leslie Romanchik, VDEQ-RCRA
Sharon Wilcox, VDEQ-CERCLA
Mark Leeper, VDEQ-CERCLA

COMMONWEALTH *of* VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

January 29, 2002

Mr. James McKenna
Radford Army Ammunition Plant
SIORF-SE-EQ
P.O. Box 2
Radford, VA 24141-0099

RE: Final Facility-Wide Background Study Report (Report)

Dear Mr. McKenna:

This office has reviewed the referenced final document and concurs with the Report. No revisions to the document are required.

If you have any questions, please call me at 804.698.4308.

Sincerely,

Mark S. Leeper

Mark S. Leeper
Remedial Project Manager

cc: Norman L. Auldridge - WCRO, DEQ
Durwood Willis - DEQ
Robert Thompson, Region III, U.S.EPA, 3HS13

Final [illegible] Background
Study Report

McKenna, Jim

rom: msleeper@deq.state.va.us
nt: Monday, January 28, 2002 12:25 PM
o: McKenna, Jim
Cc: dhwillis@deq.state.va.us
Subject: ...no subject...

Hey Jim,

Sorry I couldn't make the RAB. Someday soon I hope. I would like to kill two birds with this email.

First, in regards to the January 17th 2002 conference call regarding WPA 009, we discussed all the areas in which I had concerns and through the call this office concurs with WPA 009 and no revisions are needed.

Secondly, the Final Facility Wide Background Study Report (Study), dated December 2001, has been reviewed and this office concurs with the Study and no revisions are needed.

Hard copy letters will follow shortly documenting the concurrence for both documents.

anks,

Mark S. Leeper
Federal Facilities Program
Remedial Project Manager
VA Department of Environmental Quality
phone: 804.698.4308 fax: 804.698.4383

m: Thomson.Bob@epamail.epa.gov
nt: Wednesday, January 09, 2002 11:58 AM
To: Jim_McKenna@atk.com
Cc: Jerome_Redder@atk.com; msleeper@deq.state.va.us; sswilcox@deq.state.va.us; dhwillis@deq.state.va.us
Subject: Radford documents

Based upon the Army's draft revised Site Screening Process document submittal on 10/26/01, the draft revised document is acceptable to EPA. Therefore, at this time the Region requests that a formal final version be submitted to EPA and VaDEQ for approval. The final version should include a cover page. EPA requires 3 copies of the final document.

With respect to the Background Report, EPA has received the final December, 2001 version of the Background Report. The final Report is being circulated for tox review to insure that all comments were addressed. EPA expects to have an approval letter out the second week in February, barring any unforeseen problems with the Report (I do not anticipate any).

Rob Thomson

ATK
ALLIANT TECHSYSTEMS

Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24141
USA

December 20, 2001

Mr. Robert Thomson
U. S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Subject: Facility-Wide background Study Report
Final Document December 2001
Radford Army Ammunition Plant
EPA ID# VA1 210020730

Dear Mr. Thomson:

Enclosed are three certified copies of the subject report. We are submitting this as a final report.

This report has been revised to address draft EPA March 2001comments and Virginia Department of Quality (VDEQ) September 10, 2001 comments. Responses to these comments are attached. Please note the VDEQ September 10, 2001 comments overcame the VDEQ April 2, 2001 comments as well as the minutes of the meeting held July 17, 2001. Responses to the VDEQ April 2, 2001 comments and the minutes of the July 17, 2001 meeting are also attached for completeness of the record.

Please coordinate with and provide any questions or comments to myself at (540) 639-8266, Jerry Redder of my staff (540) 639-7536 or Jim McKenna, ACO Staff (540) 639-8641.

Sincerely,

C. A. Jake

C. A. Jake, Environmental Manager
Alliant Ammunition and Powder Company LLC

Enclosure

c: w/enclosure
Mark Leeper, DEQ Central
Sharon Wilcox, DEQ-Central
E. A. Lohman, DEQ-WCRO

w/o enclosure
Russell Fish, P.E., EPA Region III

01-815-222
JJRedder

copy in 439 &
report

Concerning the following:

Facility-Wide Background Study Report
Radford Army Ammunition Plan
December 2001

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

SIGNATURE:
PRINTED NAME: Brian A. Butler
TITLE: LTC, CM, Commanding
Radford AAP

SIGNATURE:
PRINTED NAME: Ken Dolph
TITLE: Vice President Operations
Alliant Ammunition and Powder Company LLC

01-815-222
JJRedder

Response to Draft Comments from USEPA Region III
Dated March, 2001
Draft Facility-Wide Background Study Report
Radford Army Ammunition Plant

1. **Comment: Section 2.4, Field Sampling, Page 2-2:** This section does not contain a subsection discussing field observations and air monitoring (PID) readings. Please revise this section to include a discussion of significant field observations and air monitoring readings obtained during the sampling events.
   Response: Section 2.4 was revised to include a discussion of field observations and air monitoring data. Please see the third paragraph of Section 2.4.1 on page 2-12.

2. **Section 4.1.1, Analytical Methodology, page 4-1:** The third paragraph states that PID screening was used to monitor organic compounds and relocate borings as necessary. Section 2, Background Sampling, did not contain a discussion of field activities or air monitoring readings. Please revise the text to indicate what levels detected on the PID would have necessitated a relocation of the boring and which, if any, boring location(s) were relocated as a result of PID readings.
   Response: Section 4.1.1 was revised to evaluate the revised Sec.2 (Comment #1) and clarify whether borings were relocated and why. Please see the third paragraph of Section 4.1.1 on page 4-1.

3. **Section 4.1.1, Analytical Methodology, page 4-1:** The second paragraph of 4.1.1 states that "Results demonstrated that selected locations did not exhibit explosive contamination or were not impacted by previous facility operations associated with releases." If this is true, then any location on either facility having non-detect for explosives would be non-impacted by DoD operations regardless of other TCL or TAL findings at these future sampling locations. Please amend this sentence to read "Results indicated that selected locations did not exhibit explosive contamination or were not impacted by previous facility operations associated with releases."
   Response: Sentence was revised as proposed. Please see the second paragraph of Section 4.1.1 on page 4-1.

4. **Section 4.1.2, Data Validation and Qualifiers, pages 4-1 and 4-9:** The discussions of this section are focused upon target analyte list (TAL) metals, and omit TCL considerations. Since samples were analyzed for TCL VOC and SVOC, their data quality evaluation criteria should be included within this section. Please revise the text to include a discussion of the VOC and SVOC data validation and qualifiers.
   Response: Section 4.1.2 was revised to include a discussion of VOC and SVOC data validation including qualifiers. The qualifiers are defined in Section 4.1.2 on page 4-1. The validation criteria are described for metals (Section 4.1.2.1 on page 4-1), VOCs (Section 4.1.2.2 on page 4-9), and SVOCs (Section 4.1.2.3 on page 4-10).

5. **Section 4.2, Statistical Approach, pages 4-10 through 4-20:** This section details the statistical methodology utilized for this background study. Table 4-8, Statistical Test, describes the equations utilized for the necessary calculations; and Tables 4-9, Surface Soil Statistical Summary and 4-10 Subsurface Soil Statistical Summary, describe the results of the individual statistical tests conducted. The actual calculations and variables utilized are not provided in the report for verification. Please include an additional table or appendix which details the individual calculations conducted in this section.
Response: The output for each of the statistical analyses is provided in Appendix G.

6. **Section 4.3, Confidence Limits, pages 4-20 through 4-24:** This section details the statistical methodology utilized to calculate the 95% upper confidence limit (UCL) for the combined data sets. Table 4-8, Statistical Tests, describes the equations utilized for the necessary calculations and Tables 4-11, Occurrence and Distribution of Chemicals Combined Surface Soil (MMA and NRU) and 4-12 Occurrence and Distribution of Chemicals Combined Subsurface Soil (MMA and NRU), describe the results of the individual statistical tests conducted. The actual calculations and variables utilized are not provided in the report for verification. Please include an additional table or appendix which details the individual calculations conducted in this section.
Response: The output for the 95% UCL calculations is provided in Appendix G.

7. **Section 4.1.3, Data Grouping, page 4-20:** The last paragraph of this section states that the coefficient of variation (CV) was used to evaluate the data variability for element distribution across soil type, with elements having CVs of less than one being grouped together, and elements with CVs greater than one further evaluated to address the causes of variability. This step is not depicted in Figures 4-1 and 4-2. Please include this step in the appropriate figures, and elaborate on the use of CVs and the resulting groups formed based on the outcome of these calculations.
Response: Text was added to explain that CVs were used to identify chemicals that exhibited high variability (i.e., the CV was greater than 1) for further evaluation. (Please see fourth paragraph of Section 4.1.3 on page 4-11). After further review, the flow chart (Figure 4-1) was not expanded to include the CV because this value was not used in the screening or decision-making process. Due to subsequent discussions with the USEPA and VaDEQ regarding the data groups for the background study, it was agreed that the background data sets (surface and subsurface soil, MMA and NRU soil) would be combined. Therefore, none of the data groups resulted from the evaluation of CV values.

8. **Table 4-11, Occurrence and Distribution of Chemicals Combined Surface Soil (MMA and NRU), page 4-22:** This table lists the 95% UCL in surface soils for the combined data sets (MMA and NRU). As it may be necessary in the future to view each area independently, the table should include the individual area calculations in addition to the combined 95% UCL calculation. Please revise

the table to include the individual area (MMA and NRU) 95% UCL calculations in addition to the combined 95% UCL calculation.
Response: Table was revised to include MMA and NRU 95% UCL numbers as well as the combined 95% UCL. The values for the individual areas are shown in Tables 4-13 and 4-14 on pages 30 and 31.

9. **Table 4-12, Occurrence and Distribution of Chemicals Combined Subsurface Soil (MMA and NRU), page 4-22:** This table lists the 95% UCL in subsurface soils for the combined data sets (MMA and NRU). As it may be necessary in the future to view each area independently, the table should include the individual area calculations in addition to the combined 95% UCL calculation. Please revise the table to include the individual area (MMA and NRU) 95% UCL calculations in addition to the combined 95% UCL calculation.
Response: Table was revised to include MMA and NRU 95% UCL numbers as well as the combined 95% UCL. The values for the individual areas are shown in Tables 4-15 and 4-16 on pages 32 and 33.

10. **Section 5.1, Background Sample Locations, page 5-1:** This section reads that "Additionally, semivolatile and volatile organic compounds were evaluated as secondary markers to substantiate the selection of true background locations. Analytical results demonstrated that organic contaminants had not impacted the selected locations, indicating that sample locations represented background conditions." The organic results were not provided in this report. Please revise the report to include the organic results obtained or delete those two sentences from the report.
Response: Organic results are provided in Appendix B.

11. **Section 5.1, Background Sample Locations, page 5-1:** This section reads that "Explosive results were negative, proving background sampling locations had not been impacted by RFAAP operations." If this is true, then any location on the Site having non-detect for explosives would be non-impacted by RFAAP operations regardless of other TCL or TAL findings at these future sampling locations. Please amend this sentence to read "Explosive results were negative, indicating background sampling locations had not been impacted by RFAAP operations."
Response: The sentence was revised as suggested. Please see Section 5.1 on page 5-1.

12. **Section 5:** The 95 % UCL was used as a point estimate of the background data. However, when we compare on-site contamination at RFI sites to background, we need to answer two questions: (1) Are there any hot spots on-site? (2) Is the average concentration on-site the same or higher than the average concentration of background? Given the data in the draft *Background Report*, we should be able to answer these questions for RFI type sites using hypothesis testing. Therefore, EPA is requesting that, for RFI sites, the Army propose a methodology (ies) in the draft revised *Background Report* for accomplishing this end.

Response: The 95% UCL was included in the report as a general point of reference, at the request of the Installation, for site prioritization purposes. At the time the Background Workplan was developed there was intent for point-to-point comparisons. As described in the Background Study Workplan, the intent was to use hypothesis testing for RFI sites. Such hypothesis testing would include tests for similarities in shape and location between the site and background data sets. Depending on these initial tests other tests (e.g., t-test or Mann-Whitney U, or Kolmogorov-Smirnov) would be used to assess whether there is a difference between the means. Likewise, statistical procedures also would be used for assessing outliers.

Although not contemplated during the development of the Site-Screening Process for Site Screening Areas (SSA), the 95% UCLs could be used for point-to-point comparisons. However, using the 95% UCL as a single point comparison or background is very likely to result in classifying many chemicals as greater than background when they are not. This is due to the fact that the 95% UCL is an estimate of the mean, which would likely result in misclassification as much as 50 percent of the time. Therefore, the Army suggests that a 95% upper tolerance limit (95% UTL) approach be included in the Background Study report and used for point-to-point comparisons in the SSP.

The following discussion further explains the Army's position regarding UTL versus UCL:

Three types of statistical intervals are often constructed from environmental data: Confidence, Tolerance and Prediction. They are mathematically similar, but have very different purposes:

Appropriate Use	***Interval Type***	***Purpose***
Comparison Within A Single Population.	*Confidence Interval:*	*To compare a compliance data set to a known standard (i.e., USEPA, 1989; 1992).*
Comparison of Similar But Distinct Populations.	*Tolerance Interval:*	*To define a concentration range from background data, within which a large proportion of compliance data should fall with high probability (i.e., USEPA, 1989; 1992).*
	Prediction Interval:	*To define a concentration range from background data, within which the next K compliance values should fall with high probability (i.e., USEPA, 1989; 1992).*

A Confidence Interval contains a specified population parameter (generally the mean) with a specified level of confidence (USEPA, 1989). " It offers little information about the highest or most extreme sample concentrations one is likely to observe over time" (USEPA, 1989). For these reasons, Confidence Limits are generally constructed on *compliance data, not on background data. The limits for compliance data can then be compared to a known standard (e.g., RBCs, MCLs, GWPSs) to assess if the mean value of the compliance data might be statistically above the standard (cf., VDEQ, 1998; 2000).*

If a statistically robust data set, and thus good information about the population mean, is available (implying a tightly constrained confidence interval and low UCL), then a large portion of the population of individual values used to construct the UCL will actually be above the UCL. Therefore, an exceedance of the UCL by an individual sample result in a separate compliance population is not indicative of the site being above background.

The appropriate Interval to be constructed on background data for comparison to individual compliance points is a Tolerance Interval (USEPA, 1989; 1992). The UTL approach compares individual compliance point sample values to individual values in the background population, e.g. the 95th percentile of the population. If the compliance population is within background, we expect no more than 5% individual values to be above the 95th percentile of the background population. Tolerance intervals are robust for normally distributed data. For lognormal data sets, lognormal tolerance intervals can be constructed; however, caution must be used to discern spurious results. In the event that a data set is lognormally distributed and the results of a lognormal tolerance interval calculation appear erroneous (based on a UTL that is an outlier as compared to the known spread of the background data set), one should use a prediction interval approach on the lognormal data.

As a result of subsequent discussions with USEPA and Virginia Department of Quality (VaDEQ), it was agreed that the point estimates for background soil would be calculated as 95% UTL values and based on a single data set consisting of surface and subsurface soil data for the MMA and NRU areas (VaDEQ comments dated September 10, 2001). The rationale for using the 95% UTLs as point estimates for constituents from the combined data sets is described in Section 4.5 on page 4-29 and Section 5.2 on page 5-1. The calculated 95% UTLs are presented in Table 5-1 on page 5-2.

Hot spots need to be defined by two parameters: aerial extent and concentration. The size of a hot spot is best examined through adequate sampling design. The concentration that defines a hot spot can be addressed through a risk-based comparison or through a background-based comparison. Both of the extent and the concentration parameters require proper sampling plan development. The number of samples at the SSAs is unlikely to be adequate for statistical hot-spot evaluation. Hot-spots are best addressed with purposeful sampling at suspected release points for the SSP. The hot-spot issue at RFI sites will be addressed during the development of the RFI Work Plans. This approach was explained in Section 4.5 on page 4-28 and Section 5-2 on page 5-1.

13. **Section 5:** Please include language in Section 5 stating that the Facility-Wide inorganic point estimates for surface soil "background" and subsurface soil "background" can be used in the evaluation of Site-Screening Areas.

Response: The suggested language was added to Section 5.2 on page 5-1.

14. **Appendix A, Drilling Log MMAU1:** This drilling log does not show PID screening readings. Please clarify why readings were omitted on this boring or revise the log to indicate the PID readings obtained.
Response: Log in Appendix A was revised to indicate PID readings.

15. **Appendix B, Data Validation Reports:** This appendix does not contain the VOC and SVOC data validation and summary sheets. Please revise this appendix to include the VOC and SVOC data validation package and sample summary sheets.
Response: Appendix B was revised to include VOC and SVOC data validation data and sample summary sheets.

References:

United States Environmental Protection Agency, 1989, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Interim Final Guidance: Office of Solid Waste, Waste Management Division: EPA / 530-SW-89-026.

United States Environmental Protection Agency, 1992, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Addendum to Interim Final Guidance: Office of Solid Waste, Waste Management Division.

Virginia Department of Environmental Quality, 1998, Data Analysis Plan for Solid Waste Facilities: Office of Technical Services: Memorandum to Solid Waste Facilities/Consultants from Charlotte Carroll and Sanjay Thirunagari., June 15, 1998.

Virginia Department of Environmental Quality, 2000, Data Analysis Guidelines for Solid Waste Facilities Operating in Virginia: Office of Waste Programs, Technical Support: Revised November 14, 2000.

Response to Comments from VDEQ (September 10, 2001)
Draft Facility-Wide Background Study Report
Radford Army Ammunition Plant

General: Comments from VDEQ dated April 2, 2001 were superseded by comments from September 10, 2001. These comments from VDEQ are considered to be **Final** and have been reconciled with USEPA Region III.

Comment: Having reviewed the revised surface soil and subsurface soil data, the statistical analysis of that data, including the soil type groupings and the 95% Upper Tolerance Limits, and having compared it with much of the currently existing site data, additional consideration was given to the practical application of this background data to the site screening process. Each potentially contaminated site at the facility is located in an area where excavation of surface soils has occurred at some point in the facility operations; therefore, the technical rationale behind a statistical comparison of surface soil, natural area, background data to subsurface soil, excavated area, site data is questioned.

Given the conditions of mixed surface and subsurface soils at the potentially contaminated sites, it is recommended that the background data for both surface and subsurface soils be combined for each element to determine the 95% UTL to be used in conjunction with the USEPA Region III RBCs for human health risk screening, and with various ecological screening data for ecological screening purposes. This will not only simplify the screening process, but will add power to the statistical comparison and prevent the unnecessary, and costly, carrying forward of naturally occurring elements into the full-fledged risk assessment process.

This recommendation has been made following consultation with Mr. Robert Thomson, USEPA Region III.

Response: The rationale for combining background soil data sets and calculating 95% UTLs as point estimates for background soil is described in Section 4.5 on page 4-29 and Section 5.2 on page 5-1. The 95% UTL values are provided in Table 5-1 on page 5-2.

Response to Comments from VDEQ (April 2, 2001)
Draft Facility-Wide Background Study Report
Radford Army Ammunition Plant

General: Following discussions with VDEQ and USEPA regarding the soil data groupings and the point estimates, these comments were superseded by comments from VDEQ dated September 10, 2001.

Comment:
Based upon their statistical evaluation of the analytical data provided in the report, surface and subsurface soils should be evaluated separately. Within each stratum (surface and subsurface) data for each chemical constituent (aluminum, antimony, arsenic, etc.) can be grouped into either one or two groups by soil type (Braddock, Unison, Wheeling, etc.).

The Department used the Tukey method[1] to conduct simultaneous comparison of the constituent mean concentrations, by chemical constituent, for the seven different soil types at a 95% confidence limit. The resulting groups observed for each surface soil chemical constituent are marked with a code 1 or 2. Surface soil types with code "1" may be combined into one data set and those with code "2" may be combined into second data set for each chemical constituent. Data sets marked with an asterisk (*) contain outliers that should not be included in the data set for the background comparison. See Table 1 below.

For example, the cobalt data for the Braddock Loam and Groseclose and Poplimento Silt Loam in the surface soil types can be combined into one statistical data set; and the cobalt data for the Unison-Urban Land Complex, Wheeling Sandy Loam, Cabro Silty Clay Loam, Lowell Silt Loam, and Wurno-Newberg-Faywood Silt Loam surface soil types can be combined into a second statistical data set. Statistical comparisons from future potentially contaminated sites would compare aluminum data from a surface soil sample in Braddock Loam to aluminum data from the Braddock Loam and Groseclose and Poplimento Silt Loam data set.

---

[1] Robert V. Hogg and Johannes Ledolter, Applied Statistics for Engineers and Physical Scientists, - 2nd ed. New York: Macmilllan Publishing Company, 1992

Table 1 Surface Soil Groupings

Constituents	Braddock	Unison	Wheeling	Cabro	Groseclose	Lowell	Wurno
Aluminum	1	1	1	1	1	1	1
Antimony	1	1	1	1	1	1	1
Arsenic	1	2	1	1	1	1	1
Barium	1	1	2	1	1	1	1
Beryllium	1	1	2	1	1	2	2
Cadmium	1	1	1	1	1	1	1
Chromium	1	1	1	1	1	1	1
Cobalt	1	2	2	2	1	2	2
Copper	1	1	1	1	1	1	1
Iron	1	1	1	1	1	1	1
Lead	1	1*	1	1	1	1	1
Maganese	1	1	1	1	1	1	1
Mercury	1*	1	1	1	1	1	1
Nickel	1	2	2	2	2	2	2
Selenium	1	1	1	1	1	1	1
Silver	1	1	1	1	1	1	1
Thallium	1	1	1	1	1	1	1
Vanadium	1	1	1	1	1	1	1
Zinc	1	1*	2	1	1	1	1

Similarly, subsurface soil has been marked with code 1or 2. Soil types with code "1" may be combined as one background data set and those with code "2" may be combined as a second background data set for each constituent.

Table 2 Subsurface Soil

Constituents	Braddock	Unison	Wheeling	Cabro	Groseclose	Lowell	Wurno
Aluminum	1	2	2	1	2	2	2
Antimony	1	1	1	1	1	1	1
Arsenic	1	1	1	1	1	1	1
Barium	1	1	2	1	1	1	1
Beryllium	1	1	1	1	1	1	1
Cadmium	1	1	1	1	1	1	1
Chromium	1	1	1	1	1	1	1
Cobalt	1	2	2	2	2	2	2
Copper	1	2	2	1	2	2	2
Iron	1	1	1	1	1	1	1
Lead	1	2	1	1	1	1	1
Maganese	1	1	1	1	1	1	1
Mercury	1	1	1	1	1	1	1
Nickel	1	2	2	2	2	2	2
Selenium	1	1	1	1	1	1	1
Silver	1	1	1	1	1	1	1
Thallium	1	1	1	1	1	1	1
Vanadium	1	2	1	2	1	1	1
Zinc	1	1*	2	1	1	1	1

Notes for tables 1 and 2 on prior page:

* Indicates that soil type has outlier(s)

The detection limits for some of the constituents varied between soil types.

Based on the above information, the facility may develop two background data sets for surface and subsurface soils.

The facility must conduct an outlier test on grouped background data sets as part of the revisions to this document and prior to developing the statistical limits for comparing on-site against background levels. Outliers from the background data set are to be excluded prior to establishing the 95% upper confidence limit (UCL) on the mean of the background data.

When performing statistical comparisons of the potentially contaminated area sample results to the background results, the facility may use a Student's t-test, provided the data sets follow normal distributions and other test specific assumptions (eg. variance). The facility also has the option to calculate the 95% upper confidence limit on background data (excluding outliers) and compare the individual on-site sample concentrations to the established UCL.

Response:
It is emphasized that the approach and methods used in the Background Study report had been accepted by both EPA Region III and VDEQ in the Workplan prior to its implementation. The Tukey method presented by VDEQ is no more valid a statistical approach than the methods employed per the Workplan. Further, during presentation of the Workplan, the possibility of certain elements not "passing" the 95% confidence interval was discussed. This possibility was not considered to invalidate the data, rather that data would simply have to be evaluated within the appropriate context. It should be noted that the elements, identified by the Army, as failing the statistical tests were still relatively high in confidence interval albeit not 95%. Finally, these elements (aluminum, barium, iron, lead, vanadium, zinc) are rarely risk drivers in a risk assessment. A comparison of RBC values for these elements indicate that the calculated UCL is either below the residential RBC for that element or between the residential and industrial RBC values.

The approach recommended in VDEQ's comments represents a significant change. The implementation of the Commonwealth of Virginia's approach would be difficult since there would have to be at least four different background data sets for each element. This would inevitably lead to data sets that would not be statistically significant. The selection of the background data set would also have to change based on the soil type and element.

Another difficulty with the implementation of the Commonwealth's approach would occur when samples are collected that involve multiple soil types or where soil types are not clearly distinguishable. For example, which background data set would be used if the samples collected from the site are from multiple soil types and the background analysis indicated that there are differences between the data for some or all of the elements?

The Army proposes the following course of action. Evaluation of outlier will proceed using an appropriate statistical method (eg., Box and Whisker diagram). P-values will be evaluated using another statistical package to assess whether differences will result from the values already calculated. Finally, a meeting to discuss finalization of the Background Study report may prove to be more successful than multiple response and comment rounds.

Memorandum

To: Sharon Wilcox, Virginia Department of Environmental Quality
Rob Thomson, Environmental Protection Agency

From: Jim McKenna, Radford Army Ammunition Plant, RFAAP
Jerry Redder, Alliant Ammunition and Powder Company, LLC

Date: July 23, 2001

Re: Summary of Minutes for July 17, 2001 Meeting at the Virginia Department of Environmental Quality (VDEQ) Concerning Background Studies at Radford Army Ammunition Plant (RFAAP)

ATTENDEES:

Jim McKenna, RFAAP
Jerry Redder, AAPC
John Tesner, USACE
Drew Rak, USACE
Sharon Wilcox, VDEQ
Sanjay Thirunagari, VDEQ
Hassan Kaceli, VDEQ
Jeffrey Parks, IT Group
Cindy Hassan, IT Group
Rick Cole, URS Corp.

TELECONFERENCE PARTICIPANTS:

Rob Thomson, US EPA
Bob Goodman, IT Group
Alvaro Alvarado, US EPA

NOTE TAKER:

Rick Cole, URS Corp.

SUMMARY OF MEETING MINUTES

Jim McKenna began the meeting at 9:15 with a brief history of the Background Study, providing an overview of the project to date, followed by introductions of the participants and their respective roles in the project.

Sharon Wilcox asked why the Parson's background data from 1996 data was not incorporated. John Tesner indicated that there were issues that related to sample locations (i.e., some of the sample locations did not have coordinates) and collection that compromised the quality of the data; therefore, the Army withdrew this report with EPA consent.

After completion of project overview, John Tesner explained the meeting objective, which was to discuss the technical concerns of Virginia Department of Environmental Quality (VDEQ) relative to the method used by the Army to calculate inorganic background concentrations.

John Tesner then asked Cindy Hassan to briefly outline of background study process and the statistical procedures used to develop the calculated background concentrations. Ms. Hassan then proceeded to describe the technical approach used by IT and acknowledge that there are other methods, such as the Tukey statistical method used by VDEQ, to arrive at similar results.

Sanjay Thirunagari asked Cindy Hassan if before she proceeded further into the explanation of the statistical approach to explain what the ultimate use of the background data would be. Sanjay Thirunagari discussed that VDEQ had grouped data by soil type, while IT had relied more heavily on the physical description and chemistry and had grouped the data sets as surface and subsurface). He commented that we can still make this data work so that a background data set can be achieved for use on the project.

Cindy Hassan explained that there were three points to consider when looking at soil types and ultimate use of the data. The first point being that there was significant consideration given in the field to selection of samples by soil type, and data from the different sets had been combined by individual elemental comparisons across different soil types. The second point is that the Chemicals of Potential Concern (COPCs) will be selected by comparison to U.S. Environmental Protection Agency (USEPA) Region III risk based concentrations (RBCs). Those chemicals with detected concentrations less than the respective RBC will be dropped from further consideration as a COPC. Once COPCs are selected then the data will be compared to background levels. At that point, it will be appropriate to consider soil type and look at elemental composition of site samples relative to background comparison samples. The third point is that the existing background samples were selected from representative soil types to provide a data set that could be developed into a quick reference set of background comparison values.

Cindy Hassan then went on to address VDEQ's first concern regarding combination of background data sets and explained that the soil characteristics were considered during the combination of different data sets among the similar soil types. This combination was based upon a physical and chemical properties of each soil type; similar soil types were grouped together. The study identified four soil groups in the New River Unit (NRU) and three major groups in the Main Manufacturing Unit (MMA).

John Tesner and Jim McKenna commented that the soil types encountered were based on the selection of background locations that would be representative of areas that contained Solid Waste Management Units (SWMUs).

Cindy Hassan explained that for each soil type a qualitative evaluation between soil types was performed in which the physical and chemical composition of each type was compared. The conclusion of this evaluation was that the soil types were similar enough that data sets could be combined into one data set for the surface soil and one data set for the subsurface soil.

Cindy Hassan then began a brief discussion of the outlier issues explaining that the data sets were reviewed for possible extraneous data values, but their analyses did not result in the rejection of data. Since these locations were specifically selected to represent background, there was a reluctance to eliminate a data point unless there was a Quality Control concern. IT's review of the data did not reveal a justification to remove data points from the background population. Cindy Hassan then explained that the background data set was used to derive point estimate values using the 95 percent Upper Confidence Level (UCL) on the mean and 95 percent Upper Tolerance Level (UTL) approaches. Previous discussion and comments from EPA indicated that EPA had agreed to a preference to use the 95 percent UTL approach.

Sanjay Thirunagari then expressed that it will be key for VDEQ to know how the background data will be used. After which the group can then look at methodology derivation of background estimates.

Drew Rak then explained that the primary use would be as background comparison criteria for use in the following:

1. Site screening process (SSP) (95% UTL approach).
2. Background comparison in RFI (mean-to-mean comparison e.g., t-test).

The different soil types in the MMU and the NRU were being combined in order to achieve the power and confidence necessary for a meaningful means comparison. Drew Rak noted that the low number of samples per soil type in the VDEQ analysis would not allow for a meaningful mean-to-mean comparison.

Drew Rak reviewed the flowchart for statistical evaluation as depicted in the meeting handout. He then explained that the previous 1996 soil data was used to estimate the number of sampling locations for this background study. The minimum relative detectable difference and coefficient of variation were used to predict the number of samples to collect. This approach and number of sample locations was discussed and agreed to by Dr. Lynn Flowers of EPA, as well as EPA's subsequent approval of Work Plan Addendum 10. Drew Rak then proceeded to describe the screen out of macronutrients.

Drew Rak explained that elements with a low number of detections (greater than 80 percent below detection limit) were dropped from the statistical process. As a result, there were smaller, but focused data sets containing 14 elements for surface and 16 for subsurface. During the comparison between data sets, there was generally good agreement between NRU and MMA data and also between surface and subsurface data. The surface and subsurface data sets were kept separate due to separate pathways evaluations that are completed during risk assessment.

Hassan Kaceli explained that VDEQ is looking at the differences in the seven different soil types in the two areas; certain soil types could be combined then compared statistically.

Sanjay Thirunagari referenced his previous question that the ultimate use of the data should be determined. For onsite detections, they should be below the 95 percent UTL. The mean of onsite data could be compared to the mean of background data set with an appropriate statistical test. He expressed concern that combination of soil types could mask differences between soil types.

Sanjay Thirunagari indicated that he had no problem with 95 percent UTL, or mean-to-mean comparison if background data are normally distributed and random sampling was conducted. The 95 percent UTL approach should be used if a grid sampling approach is used.

Rob Thomson/Alvaro Alvarado commented that USEPA has experience with many Federal facilities that have many AOCs; for areas with low risk it is difficult to prove there is no risk. It is important that we focus on sites where we have an obvious risk.

John Tesner re-iterated that sites will be screened by a comparison with RBCs. Sharon Wilcox and Sanjay Thirunagari commented that values below the RBCs will not be a concern.

Hassan Kaceli commented that the data NRU & MMA can be combined; any sample with the same soil type can be grouped by each element. Sanjay Thirunagari elaborated that, for example, the Unison soil type with similar elemental compositions could be combined in one background data set. For risk assessment, surface data would be combined to evaluate risk. Then samples within same soil type would be combined and the risk from each background soil type would be compared to the constituents contained in the site surface soil.

Sharon Wilcox clarified the VDEQ proposed grouping of the different soil types by each element into two groupings for surface soil and two grouping for subsurface soil. She used the example of Subsurface Group 1 would contain soil types except Unison. Group 2 would contain the other soil types. Alvaro Alvarado indicated that VDEQ's approach made sense. John Tesner asked for additional clarification of the element by element basis, with each element having either one or two soil groups. There were several minutes of discussion relative to soil types and the low number of samples that may be available in a particular group, for example Arsenic, which could have a data set with only 4 data points.

John Tesner pointed out that the statistical evaluation performed by the Army resulted in seven elements that did not pass the statistical evaluation. These seven elements are different than the seven elements VDEQ indicated are statistically different. John Tesner indicated that soil type comparison was done on a qualitative basis. Drew Rak pointed out that the VDEQ approach requires that the 95%UTL approach be used for derivation of background values. Sanjay Thirunagari questioned whether the UTL could be used with four data points. Alvaro Alvarado indicated that for arsenic in Unison Soil, the arsenic concentration is less than 10 ppm, and at that concentration, this level will not drive a risk that will result in cleanup. Sanjay pointed out that it is a mute point (there was a general comment regarding 20 ppm); do not have to worry over arsenic risk. John Tesner emphasized the point that for many of the elements the derived background concentration is less than the RBC.

Bob Goodman provided the following calculated background values (in milligrams per kilogram) using the Army combined data set and the VDEQ Groups 1 and 2.

	rmy ombined ata Set	VDEQ Group 1	VDEQ Group 2
Al	20	16	23
Ba	67	51	140
Pb	13	11	520

← *Small data set*

Drew Rak commented that with small data sets; the approach will capture variability by using the 95 percent UTL to calculate background values. Sanjay Thirunagari commented that to use the 95 percent UTL approach the data set must have a normal distribution; otherwise, the maximum value will be used for a non-normal distribution.

John Tesner commented that the SSP currently includes a surface and a sub-surface table of background point values that were derived using UTL calculations. Using the VDEQ approach including soil types for each element, what will those tables look like now? There is an expectation that comparison to these values will provide a decision point. Rob Thomson commented that background numbers that are too low will result in remediation of too many sites; if a higher number is selected, then too few are remediated. Sharon Wilcox indicated that the RBC would be the driving number.

There were several minutes of discussion as the group worked through two examples using aluminum and beryllium to illustrate the VDEQ methodology of looking at each element and whether it has a single soil group or two groups. If there is more than one group for the particular element, then the data set should be selected that matches the soil type of the environmental sample. Once the data set is selected (Group 1 or Group 2), then if the data set distribution is normal, then the 95 percent UTL calculated value will be used for background point comparison. If the Group 1 or 2 data set distribution is non-normal, then the maximum value of the background data set is used as point comparison value. Sanjay Thirunagari indicated that he was comfortable with the point to point comparison and use of the 95 percent UTL; however, all site sample points must pass the comparison. There was general discussion that the Army will apply the VDEQ approach to the data sets and generate a new set of background numbers for comparison. Sanjay Thirunagari indicates that if the numbers calculated by the VDEQ approach is similar to the numbers calculated by the Army, then VDEQ may accept the Army approach.

Jim McKenna and John Tesner indicated that the Army would create a new background point-values table using the VDEQ approach and compare with existing Army background point values. If the values are close, then the group will proceed with finalization of the report using the current statistical approach utilized by the Army. Sharon Wilcox indicated that VDEQ will be satisfied with that approach if VDEQ values are close to the Army values. The Army will prepare the table and submit in a letter to VDEQ for review.

Jim McKenna requested a discussion of the outliers in the letter to make sure that VDEQ outstanding comments are addressed. Cindy Hassan indicated that based on the box and whisker plots that were completed as part of the outlier evaluation, the outlier do not have a significant impact on the data. Alvaro Alvarado expressed caution in deleting a data point. Sharon Wilcox wants notification of outliers that are used as maximum values. Cindy Hassan indicated that typically outliers are discussed in the uncertainties section of the Risk Assessment. Sanjay Thirunagari indicated that if the outliers made a significant difference in the calculated background values, then resampling may be required. Jerry Redder recommended that in the new table, outliers that have a significant impact for resampling to be identified. Sharon Wilcox expressed that the number of samples should be added to the table.

John Tesner then summarized saying that the Army would put a new table together, which would contain the background point values using the 95 percent UTL (for SSP and RFI application) and UCL (for informational) approaches for the soil types as defined in the VADEQ analyses. This table will also contain the sample size that was used for these UTL/UCL calculations and the residential and industrial RBC's for the compounds. This table ~~and letter~~ will be distributed to the group. A time frame of Mid-August was suggested for the table completion and a conference call. The meeting adjourned at 12:45 p.m.

McKenna, Jim

om: McKenna, Jim
nt: Wednesday, October 10, 2001 11:35 AM
o: 'sswilcox@deq.state.va.us'; McKenna, Jim
Cc: 'john e tesner'; 'rob thomson'; Redder, Jerome; dmharris@deq.state.va.us; dhwillis@deq.state.va.us; msleeper@deq.state.va.us
Subject: RE: Background Study table

All:

Will revise table and background study report and send out shortly. Rob is this ok with you?

-----Original Message-----
From: sswilcox@deq.state.va.us [mailto:sswilcox@deq.state.va.us]
Sent: Wednesday, October 10, 2001 11:40 AM
To: Jim_McKenna@ATK.COM
Cc: 'john e tesner'; 'rob thomson'; Redder, Jerome; THOMSON.BOB@epamail.epa.gov; dmharris@deq.state.va.us; dhwillis@deq.state.va.us; msleeper@deq.state.va.us
Subject: re: Background Study table

The revised table is acceptable. I suggest, for ease of reading in the future, that the final column include the to-be-screened -against value so one isn't hunting back and forth between the two central columns.

ron Skutle Wilcox
medial Project Manager
Department of Environmental Quality
629 East Main Street, 4th Floor P.O. Box 10009
Richmond, VA 23219 Richmond, VA 23240
sswilcox@deq.state.va.us
804-698-4143 phone
804-698-4383 fax
---------- Original Text ----------

From: "McKenna, Jim" <Jim_McKenna@ATK.COM>, on 10/10/2001 9:40 AM:

Sharon,

As I recall you were going to handle finishing up the background study report. Attached table has been revised per your 10 Sept 2001 letter. Sent this table out earlier with the 9/20-21/2001 conference call minutes but I don't think I cc'd you. In any case all that is needed is to review this table and if it is ok then we can revise the background study report and submit it as final.

Let us know.

Jim

<<Final Combined UTL SUM.xls>>

Copy in 459

DRAFT Summary of Total Soil Data at Radford
Upper Tolerance Limits (UTLs)

Chemical	MMA/NRU and Surface/Subsurface Soil Data				Residential Screening RBC [c], mg/kg	Industrial Screening RBC [c], mg/kg	Background Basis
	Frequency of Detection	Range of data, mg/kg	Statistical Distribution [a]	95% UTL mg/kg [b]			
ALUMINUM	79/79(100)	3,620 - 47,900	L	40,041	7,800	200,000	95% UTL
ARSENIC	76/79(96)	1.2 - 35.9	L	15.8	0.43	3.8	95% UTL
BARIUM	63/79(80)	23.4 - 174	L	209	550	14,000	RBC
BERYLLIUM	40/79(51)	0.61 - 5.4	U	1.02	16	410	RBC
CADMIUM	13/79(16)	0.62 - 2.5	NP	0.69	3.9	100	RBC
CHROMIUM	79/79(100)	6.3 - 75.8	L	65.3	23	610	95% UTL
COBALT	57/79(72)	5.9 - 130	L	72.3	160	4,100	RBC
COPPER	77/79(97)	1.6 - 38.7	L	53.5	310	8,200	RBC
IRON	79/79(100)	7,250 - 67,700	N	50,962	2,300	61,000	95% UTL
LEAD	79/79(100)	2.1 - 256	U	26.8	400	1,000	RBC
MANGANESE	79/79(100)	16.7 - 2,040	L	2,543	160	4,100	95% UTL
MERCURY	19/79(24)	0.038 - 1.2	NP	0.130	0.78	20	RBC
NICKEL	63/79(80)	4.6 - 94.2	L	62.8	160	4,100	RBC
THALLIUM	16/79(20)	1.3 - 5.0	NP	2.11	0.55	14	95% UTL
VANADIUM	79/79(100)	12.2 - 114	L	108	55	1,400	95% UTL
ZINC	79/79(100)	4.7 - 598	L	202	2,300	61,000	RBC

[a] Statistical Distribution: N = Normal distribution; L = Lognormal distribution; U = Undetermined distribution; NP = Nonparametric distribution for data sets with greater than 50% nondetects.

[b] 95% Upper Tolerance Limit calculated for the indicated distribution.

[c] RBC = Region III risk-based concentration adjusted for a Hazard Quotient = 0.1 to account for potential cumulative effects (dated May 8, 2001).

Note: Highlighted values are below the residential screening RBC.

McKenna, Jim

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m: McKenna, Jim
: Friday, September 28, 2001 7:42 AM
'rob thomson'; 'mark leeper'
Cc: 'john e tesner'; 'Andrew Rak'; 'Barnes, Kenneth G'; 'peter rissell'; 'Parks, Jeffrey N'; Redder, Jerome; Davie, Robert
Subject: Sept 20-21 teleconference notes & background study numbers

All:

Please see the attached files for the subject as above (SAB). Note your action items.

Status of Radford AAP/ATK action items: Jerry has located the SWMU 76 UST paperwork and is sending under separate cover to Rob Thomson, Mark Leeper and John Tesner. I have contacted our command and we have relooked at the Radford AAP situation and pesticide screening samples are in. We will propose 1 to 2 samples per site for screening purposes. That does it for Radford AAP/ATK direct action items. Of course I will be working with John Tesner and Jeff Parks on their direct action items as well as scheduling, programming, budgeting, etc, etc.

Thanks,
Jim

PS Rob, Mark: Also please look over the background numbers and provide comments or concurrence so we can get moving on finalizing the Background Study report.

WPA12Sept20-21
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SUM.xls

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MEETING MINUTES FOR RADFORD AAP
WORK PLAN ADDENDUM 12
20-21 SEPTEMBER 2001

Day 1:
20 September 2001
Time: 1300-1600

Participants:

USEPA, Region III: Rob Thomson
VDEQ: Mark Leeper, Sharon Wilcox
RFAAP: Jim McKenna
ATK: Jerry Redder
USAEC: Pete Rissell
OSC: Ken Barnes
USACE, Baltimore District: John Tesner, Andrew Rak
IT Group: Jeff Parks, Mark Thomas, Tim Leahy

GENERAL ISSUES

1. Pesticide sampling:

Jim McKenna stated the Army's positions; that pesticides were not manufactured at RFAAP, that there has been no identified location were pesticides were regularly mixed or stored, and the Army's uncertainty regarding the end use of data especially as it relates to BTAG screening values.

Rob Thomson of EPA stated that EPA wants sampling, but in a rational way. There would be no need to collect pesticide samples from former sampling locations nor is 100 percent sampling required for all new sampling. Further, Mr. Thomson stated that EPA needs to be able to document that pesticide releases didn't occur in conjunction with other releases at a site. In addition, if a site were seeking a No Further Action (NFA) status then it would be incumbent upon EPA and VDEQ to be able to show that pesticides were not an issue at the site. Sharon Wilcox of VDEQ concurred with this assessment from EPA adding that she thought that the number of samples per site would vary based on site conditions (e.g., the presence of a single runoff area from a site may require only one sample) and/or site size.

The Army and EPA agreed that pesticides receive analysis in laboratories when PCB's are being analyzed. This could possibly reduce the financial impact of adding pesticide sampling given that some sites will already be performing PCB sampling.

The Army advanced the idea that Tentatively Identified Compound (TIC) analyses that has already been included in the Site Screening Process (SSP) document, would provide indication as to the presence or absence of pesticide compounds. EPA did not agree with this assertion stating that their opinion is that TIC analyses identifies classes of compounds not specific compounds.

The discussion concluded with the Army agreeing to take this issue back to Command, but this may yet be an issue that requires Tier II involvement to resolve. The Army will continue to apprise the team as to the results of these discussions.

2. COPC Residential/Industrial

VDEQ stated that there is room to make risk management decisions on COPC's that fall between residential and industrial RBC's. This represents a clarification to their comments on WPA 12.

In the ensuing conversation relative to the role of BTAG and BTAG screening values, Rob Thomson indicated that a pre-remedial site screening process was now available from BTAG.

3. Groundwater

In order to respond to VDEQ comments regarding the inclusion of groundwater data in WPA 12, Jim McKenna restated its intent for the study of groundwater at RFAAP. The goals of WPA 9 and the Current Conditions report were discussed. Also, the plans for an expanded investigation of groundwater to include the balance of the Main Manufacturing Area were reiterated. VDEQ concurred with this discussion stating that this was "... a good game plan."

It was established that removing the label DNE (Does Not Exceed) from tables in the Current Conditions report will satisfy VDEQ comments.

4. Air Pathway

Both VDEQ and EPA stated that air sampling would not be required at this time. Air sampling would become necessary should a completed air pathway be established. VDEQ clarified their comment regarding the air pathway stating that they took exception with the assertion made in WPA 12 that air was not considered a complete pathway prior to the investigation. It was agreed that presumptive language relative to the completeness of risk pathways would be removed from the WPA.

5. BTAG Issues

The group quickly agreed on the need for another meeting that would include the BTAG in order to clarify their issues. It was also agreed that this meeting needed to occur ASAP. Drew Rak from USACE was tasked with contacting Bruce Pluta from EPA Region III BTAG to set up this meeting.

6. Surface soil sampling depth, end use of data

After some discussion on this issue, the group agreed on the following regarding surface soil sampling at RFAAP:

- Future surface soil sampling, including that proposed in WPA's 9 and 12, would be defined as soil in the first six inches below the root mat.
- Sampling for VOC compounds (where proposed) would occur from the interval between 6 and 12 inches in realization that the volatile nature of VOC compounds makes their detection in the 0-6 inch interval unlikely.

- Previous surface soil sampling, that until now had been 0 to 2 feet at Radford AAP, is considered valid for evaluation of surface soil. Additional sampling from previous sampling locations is not required.

SITE SPECIFIC ISSUES

SWMU 39
Based on review of the additional figures and tables provided to meeting attendee's in preparation for this conference, and explanation provided by the Army, EPA and VDEQ approved the proposed sampling locations and analyte suites.

It was agreed that the vertical sampling profile would be adjusted to capture subsurface soil in the intervals from 1 to 3 feet and the interval from 3 to 5 feet in order to better capture intervals were COPC's may be present. This did not result in an addition of samples, rather it was an adjustment to proposed sampling depths.

SWMU 48, 49, 50, 59
Upon discussion of VDEQ comments regarding inclusion of dioxin/furan sampling, it was agreed that these analyte suites were not required for SWMU's 48 and 50. The attendee's agreed that dioxin/furan analyte suites would be included at sites where burning activities had taken place; or where ash, burned material, or burn residue was suspected of being deposited. SWMU's 48 and 50 did not appear to meet this criteria. VDEQ requested and the attendee's agreed that they be given time to double check why the comment was made initially to ensure that there was no other rationale for the inclusion of dioxins/furans.

With regards to SWMU 48, the Army agreed that some additional sampling for explosives was justified. Additional characterization samples for explosives will be proposed by the Army. The use of immunoassay test kits for this purpose was discussed and approved by EPA and VDEQ.

Additionally, at the request of VDEQ, proposed boring 49SB02 will be advanced to a depth of 17-19 feet in order to assess the interval where relatively high TPH detection's had previously occurred. This will be an additional sample at this location and will receive the same analytical analyses as other sample intervals proposed at this location.
A discussion ensued as to the final disposition of SWMU 50 in light of the recent delisting of calcium sulfate sludge as a listed hazardous waste for explosive manufacture. Depending on analytical results (i.e., no COPC's), and review of Commonwealth regulations, no further action may be an appropriate remedy.

Based on review of the additional figures and tables related to SWMU 59, and explanation provided by the Army, EPA and VDEQ approved the proposed sampling locations and analyte suites.

SWMU 58
The Army agreed with VDEQ that given the sites reported history, the inclusion of dioxin/furan analyte suites was appropriate for SWMU 58. Otherwise, based on review of the additional figures and tables provided, and explanation provided by the Army, EPA and VDEQ approved the proposed sampling locations and analyte suites.

It was agreed that the vertical sampling profile would be adjusted to capture subsurface soil in the intervals from 0-2', 2-4', and 4-6' below ground surface where it begins beneath the rubble pile that is the primary feature of SWMU 58. This will not result in additional samples, rather it is an adjustment to the previously proposed sampling depths.

Day 2:
21 September 2001
Time: 0900-1200

Participants:

USEPA Region III: Rob Thomson
VDEQ: Mark Leeper
RFAAP: Jim McKenna
ATK: Jerry Redder
USAEC: Pete Rissell
USACE, Baltimore District: John Tesner, Andrew Rak
IT Group: Jeff Parks, Mark Thomas, Tim Leahy

GENERAL ISSUES

1. ER, A Program Definitions (i.e., Active vs. Inactive sites)
Jim McKenna provided definition of the program regarding the eligibility of SWMU's at Radford AAP. The Army's policy is that sites that were active beyond 17 October 1986 are considered active, therefore, ineligible for ER, A funding. This includes SWMU 17. The Army understands that it has an obligation to investigate SWMU's as named in the Installation's RCRA permit (October 2000), and will continue to pursue actions at active sites via separate funding mechanisms, programs, and documentation.

2. VDEQ review status
Jim McKenna recommended that VDEQ contact USACE's hydrogeologist, Mr. Drew Clemens (617-480-7732) for Radford AAP as they perform their review of WPA 9. VDEQ stated that WPA 9 comments will be made available the first week of October.

VDEQ agreed in the future to send out "draft" comments initially in order to allow the Army to address the issues more expeditiously and allow for the removal of comments when they become finalized.

USEPA agreed to accept these meeting minutes as the Army's response to draft USEPA comments.

The Army will submit formal responses to VDEQ's comments on WPA 12, since those comments were submitted as final.

3. Project schedule

The Army stated that adjusted project schedules will be provided for WPA 9 and 12 once WPA 9 comments are received/resolved and BTAG issue are resolved. At this time it is estimated that IT could be in the field in the November/December 2001 timeframe.

4. Background Study

Verified with EPA and VDEQ that the intent of the most recent comments from VDEQ was to have a single value for background that represented the 95% UTL calculated from a single combined data set. This was confirmed. IT will calculate these values and have them ready for distribution by COB 28 September.

5. SSP Issues

The group agreed that the remaining issues related to the SSP are to be resolved at the proposed BTAG meeting.

SITE SPECIFIC ISSUES

Former Lead Furnace Area (FLFA)

Jerry Redder from ATK provided a description and status of the non-ER, A funded project currently being executed at SWMU 17. He also discussed the solid waste permit being pursued at SWMU 17 as requested by VDEQ.

Based on review of the additional figures and tables provided for FLFA, and explanation provided by the Army, EPA and VDEQ tentatively approved the proposed sampling locations and analyte suites with the following issues pending resolution:

- The Army/ATK is to look for existing data/information regarding SWMU 76.
- Mark Leeper (VDEQ) will look into the Commonwealth's specific concerns at SWMU 17 that may relate to FLFA.
- The appropriate lead screening level may be an open issue relative to BTAG. This will need to be discussed a the upcoming BTAG meeting.
- The Army needs to screen the site data again versus recalculated background lead levels.

Building 4343

Based on review of the additional figures and tables provided for Building 4343, and explanation provided by the Army, EPA and VDEQ approved the proposed sampling locations and analyte suites. Also, cyanide will be added to the analyte list for this site based on its general use in metal finishing operations.

The Army agreed to look at ways of moving forward more quickly with this site. The Army noted that the IAP workshop, scheduled for Spring 2002, will provide the best opportunity to discuss moving project phases and funding.

New River

Building Debris Disposal Trench (BDDT)

The Army addressed or received clarification regarding several of VDEQ's comments. EPA believes that BTAG will want to discuss BDDT at the upcoming meeting.

Based on review of the additional figures and tables provided for BDDT, and explanation provided by the Army, EPA and VDEQ approved the proposed sampling locations and analyte suites. The Army agreed to modify the figure presented to show the extent of rip-rap at BDDT. This rip-rap extends to Avenue A though this is not evident on the figure.

Igniter Assembly Area (IAA)

Based on review of the additional figures and tables provided for IAA, the Army agreed to increase the number of samples collected as follows:

- Three additional subsurface soil samples will be collected and analyzed for TAL metals in the vicinity of IASB05 at a depth interval of 4-6 feet bgs (depth of elevated mercury detection).
- Three surface soil samples will be collected and analyzed in the vicinity of both SS11 and SS-12 (six additional samples).
- One subsurface soil sample from the 2-4 foot interval will be collected in the vicinity of both SS-11 and SS-12 (two additional samples).
- TAL metals analyses will be included at the other proposed sampling locations contained in WPA 12 for IAA.

Northern Burning Ground (NBG)

Based on review of the additional figures and tables provided for NBG, and explanation provided by the Army, EPA and VDEQ approved the proposed sampling locations and analyte suites.

Western Burning Ground (WBG)

Based on review of the additional figures and tables provided for WBG, and explanation provided by the Army, EPA and VDEQ tentatively approved the proposed sampling locations and analyte suites pending the outcome of the forthcoming BTAG meeting. Drew Rak recommended that surface water data be compared to Ambient Water Quality Criteria instead of MCL's in preparation for the BTAG meeting.

Rail Yard

Based on review of the additional figures and tables provided for the Rail Yard, and explanation provided by the Army, EPA and VDEQ tentatively approved the proposed sampling locations and analyte suites pending verification of site drainage and topography in the southeast portion of the site in the area near the unnamed creek.

DRAFT Summary of Total Soil Data at Radford
Upper Tolerance Limits (UTLs)

Chemical	MMA/NRU and Surface/Subsurface Soil Data				Residential Screening RBC [c], mg/kg	Industrial Screening RBC [c], mg/kg	Background Basis
	Frequency of Detection	Range of data, mg/kg	Statistical Distribution [a]	95% UTL mg/kg [b]			
ALUMINUM	79/79(100)	3,620 - 47,900	L	40,041	7,800	200,000	95% UTL
ARSENIC	76/79(96)	1.2 - 35.9	L	15.8	0.43	3.8	95% UTL
BARIUM	63/79(80)	23.4 - 174	L	209	550	14,000	RBC
BERYLLIUM	40/79(51)	0.61 - 5.4	U	1.02	16	410	RBC
CADMIUM	13/79(16)	0.62 - 2.5	NP	0.69	3.9	100	RBC
CHROMIUM	79/79(100)	6.3 - 75.8	L	65.3	23	610	95% UTL
COBALT	57/79(72)	5.9 - 130	L	72.3	160	4,100	RBC
COPPER	77/79(97)	1.6 - 38.7	L	53.5	310	8,200	RBC
IRON	79/79(100)	7,250 - 67,700	N	50,962	2,300	61,000	95% UTL
LEAD	79/79(100)	2.1 - 256	U	26.8	400	1,000	RBC
MANGANESE	79/79(100)	16.7 - 2,040	L	2,543	160	4,100	95% UTL
MERCURY	19/79(24)	0.038 - 1.2	NP	0.130	0.78	20	RBC
NICKEL	63/79(80)	4.6 - 94.2	L	62.8	160	4,100	RBC
THALLIUM	16/79(20)	1.3 - 5.0	NP	2.11	0.55	14	95% UTL
VANADIUM	79/79(100)	12.2 - 114	L	108	55	1,400	95% UTL
ZINC	79/79(100)	4.7 - 598	L	202	2,300	61,000	RBC

[a] Statistical Distribution: N = Normal distribution; L = Lognormal distribution; U = Undetermined distribution; NP = Nonparametric distribution for data sets with greater than 50% nondetects.

[b] 95% Upper Tolerance Limit calculated for the indicated distribution.

[c] RBC = Region III risk-based concentration adjusted for a Hazard Quotient = 0.1 to account for potential cumulative effects (dated May 8, 2001).

Note: Highlighted values are below the residential screening RBC.

n:\p\radford\data analysis\Final Combined UTL SUM.xls(UTL SUM)

COMMONWEALTH *of* VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

Street address: 629 East Main Street, Richmond, Virginia 23219
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Fax (804) 698-4500 TDD (804) 698-4021
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James S. Gilmore, III
Governor

John Paul Woodley, Jr.
Secretary of Natural Resources

Dennis H. Treacy
Director

(804) 698-4000
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September 10, 2001

Mr. James McKenna
Radford Army Ammunition Plant
SIORF-SE-EQ
P.O. Box 2
Radford, VA 24141-0099

RE: Facility Wide Background Study Report
Main Manufacturing Area, Horseshoe Area, and New River Unit
Surface & Subsurface Soils
Radford Army Ammunition Plant

Dear Mr. McKenna:

Having reviewed the revised surface soil and subsurface soil data, the statistical analysis of that data, including the soil type groupings and the 95% Upper Tolerance Limits, and having compared it with much of the currently existing site data, additional consideration was given to the practical application of this background data to the site screening process. Each potentially contaminated site at the facility is located in an area where excavation of surface soils has occurred at some point in the facility operations; therefore, the technical rationale behind a statistical comparison of surface soil, natural area, background data to surface soil, excavated area, site data is questioned.

Given the conditions of mixed surface and subsurface soils at the potentially contaminated sites, it is recommended that the <u>background data for both surface and subsurface soils be combined</u> for each element to determine the 95% UTL to be used, in conjunction with the US EPA Region III RBCs for human health risk screening, and with various ecological screening data for ecological risk screening purposes. This will not only simplify the screening process, but will add power to the statistical comparison and prevent the unnecessary, and costly, carrying forward of naturally occurring elements into the full fledged risk assessment process.

Copy 43

This recommendation has been made following consultation with Mr. Robert Thomson, US EPA Region III. If you have any questions regarding this matter, please contact Mr. Mark Leeper at (804) 698-4308.

Very truly,

Sharon Wilcox

Sharon Skutle Wilcox
Office Of Remediation Programs

cc: Robert Thompson, Region III, U.S.EPA
J. J. Redder, Alliant Techsystems
John Tesner, U.S. ACE, Baltimore District
Sanjay Thirungari, VDEQ CO
Garwin Eng, VDEQ, CO
Durwood Willis, VDEQ, CO
Mark Leeper, VDEQ, CO
Elizabeth Lohman, VDEQ, WCRO

McKenna, Jim

From: McKenna, Jim
Sent: Wednesday, August 22, 2001 7:00 AM
To: sharon wilcox (E-mail); rob thomson (E-mail); Mark Leeper (E-mail)
Cc: john e tesner (E-mail); Andrew Rak (E-mail); Redder, Jerome
Subject: Background Study, Tables

All:

Attached file contains the table of concentrations for surface and subsurface soil per the 17 July 2001 meeting. From the 17 July meeting we agreed to hold a conference call to wrap up VDEQ's comments on the background study. Also attached the meeting minutes I sent out on 8/1/2001. Don't know what everyone's schedule is but I'd like to get this done this Friday or early next week. John Tesner will send out a separate email to coordinate this call.

Thanks,

Jim

VDEQ Summary Table.xls

eeting minutes: 7/17/2001 Radford ...

Copy in 43g

DRAFT Summary of Background Surface Soil Data at Radford

	Combined MMA and NRU			VaDEQ Group 1			VaDEQ Group 2			Residential Screening RBC [c], mg/kg	Industrial Screening RBC [c], mg/kg	Recommend. Conc.
Chemical	Max. Conc., mg/kg (Sample Size)	95% UTL mg/kg [a]	95% UCL mg/kg [b]	Max. Conc., mg/kg (Sample Size)	95% UTL mg/kg [a]	95% UCL mg/kg [b]	Max. Conc., mg/kg (Sample Size)	95% UTL mg/kg [a]	95% UCL mg/kg [b]			
ALUMINUM	20100 (28)	21,623 [d]	9,896	20100 (28)	21,263 [d]	9,896				7,800	200,000	21,623 [1]
ARSENIC	10.2 (28)	10.6 [d]	4.5	9.3 (24)	8.8	4	10.2 (4)	24.5 [d]	10.2	0.43	3.8	10.6 [3]
BARIUM	174 (28)	321 [d]	101	119 (24)	130 [d]	65	174 (4)	249 [d]	170	550	14,000	RBC [2]
BERYLLIUM	1.5 (28)	0.72	0.71	1.1 (16)	1.1	1.1	1.5 (12)	1.8 [d]	1.0	16	410	RBC [2]
CHROMIUM	53.3 (28)	61.1 [d]	26.1	53.3 (28)	61.1 [d]	26.1				23	610	61.1 [1]
COBALT	45.4 (28)	59.2 [d]	18.3	11.8 (8)	11.8	11.8	45.4 (20)	74.2 [d]	23.6	160	4,100	RBC [2]
COPPER	13.6 (28)	15.3 [d]	7.7	13.6 (28)	15.3 [d]	7.7				310	8,200	RBC [2]
IRON	63000 (28)	62,093	25,258	63000 (28)	62,093	25,258				2,300	61,000	62,043 [1]
LEAD	225 (28)	219	35.5	225 (28)	219	35.5				400	1,000	RBC [2]
MANGANESE	2040 (28)	4,202 [d]	1,193	2040 (28)	4,202 [d]	1,193				160	4,100	4,202 [1]
NICKEL	18.1 (28)	10.8	8.3	ND (4)	ND	ND	18.1 (24)	19.3 [d]	9.5	160	4,100	RBC [2]
VANADIUM	101 (28)	92.1	41	101 (28)	92.1	41				55	1,400	92.1 [1]
ZINC	216 (28)	169	56	216 (24)	161	52	65.9 (4)	84.1 [d]	65.5	2,300	61,000	RBC [2]

[a] 95% Upper Tolerance Limit (UTL) calculated for the indicated distribution. For sample sizes with 4 data points, the normal UTL was calculated.

[b] Upper Confidence Limit calculated for the indicated distribution

ND = there were no detected samples for this chemical and the UCL was not calculated.

[c] RBC = Region III risk-based concentration adjusted for a Hazard Quotient = 0.1 to account for potential cumulative effects (dated May 8, 2001).

[d] Calculated UTL exceeds maximum value.

Note: Highlighted values are below the residential screening RBC.

Recommended Concentrations

(1) Per VaDEQ comment letter of 2 April and meeting of 17 July, this element is to be considered as a single data group. The calculated UTL is recommended for the background concentration.

(2) Calculated values are below the Residential Screening RBC. It was agreed during the meeting of 17 July that the residential RBC would be the appropriate background concentration.

(3) The UTL for the combined data set falls between the UTLs for the Group 1 and Group 2 data sets. Arsenic is the only metal in this group. Therefore, it is recommended that a single value (calculated UTL from the combined data set) be used for the background concentration.

DRAFT Summary of Background Subsurface Soil Data at Radford

	Combined MMA and NRU			VaDEQ Group 1			VaDEQ Group2			Residential Screening RBC [c], mg/kg	Industrial Screening RBC [c], mg/kg	Recommend. Conc.
Chemical	Max. Conc., mg/kg (sample size)	95% UTL mg/kg [a]	95% UCL mg/kg [b]	Max. Conc., mg/kg (sample size)	95% UTL mg/kg [a]	95%UCL mg/kg [b]	Max. Conc., mg/kg (sample size)	95% UTL mg/kg [a]	95% UCL mg/kg [b]			
ALUMINUM	47900 (51)	44,557	20,413	21100 (11)	25,205 [d]	15,631	47900 (40)	53,207 [d]	22,720	7,800	200,000	44,557 [3]
ARSENIC	35.9 (51)	22.1	7.02	35.9 (51)	22.1	7.02				0.43	3.8	22.1 [1]
BARIUM	164 (51)	199 [d]	67.4	164 (43)	137	51.2	155 (8)	252 [d]	142	550	14,000	RBC [2]
BERYLLIUM	5.4 (51)	1.30	1.25	5.4 (51)	1.30	1.25				16	410	RBC [2]
CADMIUM	2.5 (51)	0.886	0.616	2.5 (51)	0.886	0.616				3.9	100	RBC [2]
CHROMIUM	75.8 (51)	66.2	34.6	75.8 (51)	66.2	34.6				23	610	66.2 [1]
COBALT	130 (51)	99.5	28.1	10 (6)	10.2 [d]	10.2 [d]	130 (45)	111	31.7	160	4,100	RBC [2]
COPPER	38.7 (51)	36.3	17.7	21.5 (11)	39.1 [d]	13.6	38.7 (40)	39.3 [d]	19.9	310	8,200	RBC [2]
IRON	67700 (51)	58,378	34,466	67700 (51)	58,378	34,466				2,300	61,000	58,378 [1]
LEAD	256 (51)	34.0	25.5	36 (43)	29.5	13.3	256 (8)	1,823 [d]	521 [d]	400	1,000	RBC [2]
MANGANESE	1760 (51)	2,084 [d]	579	1760 (51)	2,084 [d]	579				160	4,100	2,084 [1]
MERCURY	0.27 (51)	0.124	0.0874	0.27 (51)	0.124	0.0874				0.78	20	RBC [2]
NICKEL	94.2 (51)	85.1	26.4	10.3 (6)	17.7 [d]	8.6	94.2 (45)	98.6 [d]	30.1	160	4,100	RBC [2]
THALLIUM	5 (51)	2.60	1.31	5 (51)	2.60	1.31				0.55	14	2.6 [1]
VANADIUM	114 (51)	105	59.2	79.5 (38)	82.0 [d]	55.1	114 (13)	132 [d]	75.0	55	1,400	105 [3]
ZINC	598 (51)	271	78.4	598 (43)	265	74.7	93.4 (8)	124 [d]	82.5	2,300	61,000	RBC [2]

[a] 95% Upper Tolerance Limit calculated for the indicated distribution.

[b] 95% Upper Confidence Limit calculated for the indicated distribution

[c] RBC = Region III risk-based concentration adjusted for a Hazard Quotient = 0.1 to account for potential cumulative effects (dated May 8, 2001).

[d] Calculated UTL exceeds maximum value.

Note: Highlighted values are below the residential screening RBC.

Recommended Concentrations

(1) Per VaDEQ comment letter of 2 April and meeting of 17 July, this element is to be considered as a single data group. The calculated UTL is recommended for the background concentration.

(2) Calculated values are below the Residential Screening RBC. It was agreed during the meeting of 17 July that the residential RBC would be the appropriate background concentration.

(3) The UTL for the combined data set falls between the UTLs for the Group 1 and Group 2 data sets. Aluminum and vanadium are the only metals in this group. Therefore, it is recommended that a single value (calculated UTL from the combined data set) be used for the background concentration.

McKenna, Jim

From: McKenna, Jim
Sent: Wednesday, August 01, 2001 9:47 AM
To: sharon wilcox (E-mail); rob thomson (E-mail); john e tesner (E-mail); Andrew Rak (E-mail); Parks Jeffrey N (E-mail); rick cole (E-mail); Redder, Jerome
Subject: Meeting minutes: 7/17/2001 Radford AAP Facility Wide Background Study

All:

Subject meeting minutes attached.

Jim

July 17 2001
eeting Minutes.doc

copy in 43g

Memorandum

To: Sharon Wilcox, Virginia Department of Environmental Quality
Rob Thomson, Environmental Protection Agency

From: Jim McKenna, Radford Army Ammunition Plant, RFAAP
Jerry Redder, Alliant Ammunition and Powder Company, LLC

Date: July 23, 2001

Re: Summary of Minutes for July 17, 2001 Meeting at the Virginia Department of Environmental Quality (VDEQ) Concerning Background Studies at Radford Army Ammunition Plant (RFAAP)

ATTENDEES:

Jim McKenna, RFAAP
Jerry Redder, AAPC
John Tesner, USACE
Drew Rak, USACE
Sharon Wilcox, VDEQ
Sanjay Thirunagari, VDEQ
Hassan Kaceli, VDEQ
Jeffrey Parks, IT Group
Cindy Hassan, IT Group
Rick Cole, URS Corp.

TELECONFERENCE PARTICIPANTS:

Rob Thomson, US EPA
Bob Goodman, IT Group
Alvaro Alvarado, US EPA

NOTE TAKER:

Rick Cole, URS Corp.

SUMMARY OF MEETING MINUTES

Jim McKenna began the meeting at 9:15 with a brief history of the Background Study, providing an overview of the project to date, followed by introductions of the participants and their respective roles in the project.

Sharon Wilcox asked why the Parson's background data from 1996 data was not incorporated. John Tesner indicated that there were issues that related to sample locations (i.e., some of the sample locations did not have coordinates) and collection that compromised the quality of the data; therefore, the Army withdrew this report with EPA consent.

After completion of project overview, John Tesner explained the meeting objective, which was to discuss the technical concerns of Virginia Department of Environmental Quality (VDEQ) relative to the method used by the Army to calculate inorganic background concentrations.

John Tesner then asked Cindy Hassan to briefly outline of background study process and the statistical procedures used to develop the calculated background concentrations. Ms. Hassan then proceeded to describe the technical approach used by IT and acknowledge that there are other methods, such as the Tukey statistical method used by VDEQ, to arrive at similar results.

Sanjay Thirunagari asked Cindy Hassan if before she proceeded further into the explanation of the statistical approach to explain what the ultimate use of the background data would be. Sanjay Thirunagari discussed that VDEQ had grouped data by soil type, while IT had relied more heavily on the physical description and chemistry and had grouped the data sets as surface and subsurface). He commented that we can still make this data work so that a background data set can be achieved for use on the project.

Cindy Hassan explained that there were three points to consider when looking at soil types and ultimate use of the data. The first point being that there was significant consideration given in the field to selection of samples by soil type, and data from the different sets had been combined by individual elemental comparisons across different soil types. The second point is that the Chemicals of Potential Concern (COPCs) will be selected by comparison to U.S. Environmental Protection Agency (USEPA) Region III risk based concentrations (RBCs). Those chemicals with detected concentrations less than the respective RBC will be dropped from further consideration as a COPC. Once COPCs are selected then the data will be compared to background levels. At that point, it will be appropriate to consider soil type and look at elemental composition of site samples relative to background comparison samples. The third point is that the existing background samples were selected from representative soil types to provide a data set that could be developed into a quick reference set of background comparison values.

Cindy Hassan then went on to address VDEQ's first concern regarding combination of background data sets and explained that the soil characteristics were considered during the combination of different data sets among the similar soil types. This combination was based upon a physical and chemical properties of each soil type; similar soil types were grouped together. The study identified four soil groups in the New River Unit (NRU) and three major groups in the Main Manufacturing Unit (MMA).

John Tesner and Jim McKenna commented that the soil types encountered were based on the selection of background locations that would be representative of areas that contained Solid Waste Management Units (SWMUs).

Cindy Hassan explained that for each soil type a qualitative evaluation between soil types was performed in which the physical and chemical composition of each type was compared. The conclusion of this evaluation was that the soil types were similar enough that data sets could be combined into one data set for the surface soil and one data set for the subsurface soil.

Cindy Hassan then began a brief discussion of the outlier issues explaining that the data sets were reviewed for possible extraneous data values, but their analyses did not result in the rejection of data. Since these locations were specifically selected to represent background, there was a reluctance to eliminate a data point unless there was a Quality Control concern. IT's review of the data did not reveal a justification to remove data points from the background population. Cindy Hassan then explained that the background data set was used to derive point estimate values using the 95 percent Upper Confidence Level (UCL) on the mean and 95 percent Upper Tolerance Level (UTL) approaches. Previous discussion and comments from EPA indicated that EPA had agreed to a preference to use the 95 percent UTL approach.

Sanjay Thirunagari then expressed that it will be key for VDEQ to know how the background data will be used. After which the group can then look at methodology derivation of background estimates.

Drew Rak then explained that the primary use would be as background comparison criteria for use in the following:

1. Site screening process (SSP) (95% UTL approach).
2. Background comparison in RFI (mean-to-mean comparison e.g., t-test).

The different soil types in the MMU and the NRU were being combined in order to achieve the power and confidence necessary for a meaningful means comparison. Drew Rak noted that the low number of samples per soil type in the VDEQ analysis would not allow for a meaningful mean-to-mean comparison.

Drew Rak reviewed the flowchart for statistical evaluation as depicted in the meeting handout. He then explained that the previous 1996 soil data was used to estimate the number of sampling locations for this background study. The minimum relative detectable difference and coefficient of variation were used to predict the number of samples to collect. This approach and number of sample locations was discussed and agreed to by Dr. Lynn Flowers of EPA, as well as EPA's subsequent approval of Work Plan Addendum 10. Drew Rak then proceeded to describe the screen out of macronutrients.

Drew Rak explained that elements with a low number of detections (greater than 80 percent below detection limit) were dropped from the statistical process. As a result, there were smaller, but focused data sets containing 14 elements for surface and 16 for subsurface. During the comparison between data sets, there was generally good agreement between NRU and MMA data and also between surface and subsurface data. The surface and subsurface data sets were kept separate due to separate pathways evaluations that are completed during risk assessment.

Hassan Kaceli explained that VDEQ is looking at the differences in the seven different soil types in the two areas; certain soil types could be combined then compared statistically.

Sanjay Thirunagari referenced his previous question that the ultimate use of the data should be determined. For onsite detections, they should be below the 95 percent UTL. The mean of onsite data could be compared to the mean of background data set with an appropriate statistical test. He expressed concern that combination of soil types could mask differences between soil types.

Sanjay Thirunagari indicated that he had no problem with 95 percent UTL, or mean-to-mean comparison if background data are normally distributed and random sampling was conducted. The 95 percent UTL approach should be used if a grid sampling approach is used.

Rob Thomson/Alvaro Alvarado commented that USEPA has experience with many Federal facilities that have many AOCs; for areas with low risk it is difficult to prove there is no risk. It is important that we focus on sites where we have an obvious risk.

John Tesner re-iterated that sites will be screened by a comparison with RBCs. Sharon Wilcox and Sanjay Thirunagari commented that values below the RBCs will not be a concern.

Hassan Kaceli commented that the data NRU & MMA can be combined; any sample with the same soil type can be grouped by each element. Sanjay Thirunagari elaborated that, for example, the Unison soil type with similar elemental compositions could be combined in one background data set. For risk assessment, surface data would be combined to evaluate risk. Then samples within same soil type would be combined and the risk from each background soil type would be compared to the constituents contained in the site surface soil.

Sharon Wilcox clarified the VDEQ proposed grouping of the different soil types by each element into two groupings for surface soil and two grouping for subsurface soil. She used the example of Subsurface Group 1 would contain soil types except Unison. Group 2 would contain the other soil types. Alvaro Alvarado indicated that VDEQ's approach made sense. John Tesner asked for additional clarification of the element by element basis, with each element having either one or two soil groups. There were several minutes of discussion relative to soil types and the low number of samples that may be available in a particular group, for example Arsenic, which could have a data set with only 4 data points.

John Tesner pointed out that the statistical evaluation performed by the Army resulted in seven elements that did not pass the statistical evaluation. These seven elements are different than the seven elements VDEQ indicated are statistically different. John Tesner indicated that soil type comparison was done on a qualitative basis. Drew Rak pointed out that the VDEQ approach requires that the 95%UTL approach be used for derivation of background values. Sanjay Thirunagari questioned whether the UTL could be used with four data points. Alvaro Alvarado indicated that for arsenic in Unison Soil, the arsenic concentration is less than 10 ppm, and at that concentration, this level will not drive a risk that will result in cleanup. Sanjay pointed out that it is a mute point (there was a general comment regarding 20 ppm); do not have to worry over arsenic risk. John Tesner emphasized the point that for many of the elements the derived background concentration is less than the RBC.

Bob Goodman provided the following calculated background values (in milligrams per kilogram) using the Army combined data set and the VDEQ Groups 1 and 2.

	rmy ombined ata Set	VDEQ Group 1	VDEQ Group 2
Al	20	16	23
Ba	67	51	140
Pb	13	11	520

← *Small data set*

Drew Rak commented that with small data sets; the approach will capture variability by using the 95 percent UTL to calculate background values. Sanjay Thirunagari commented that to use the 95 percent UTL approach the data set must have a normal distribution; otherwise, the maximum value will be used for a non-normal distribution.

John Tesner commented that the SSP currently includes a surface and a sub-surface table of background point values that were derived using UTL calculations. Using the VDEQ approach including soil types for each element, what will those tables look like now? There is an expectation that comparison to these values will provide a decision point. Rob Thomson commented that background numbers that are too low will result in remediation of too many sites; if a higher number is selected, then too few are remediated. Sharon Wilcox indicated that the RBC would be the driving number.

There were several minutes of discussion as the group worked through two examples using aluminum and beryllium to illustrate the VDEQ methodology of looking at each element and whether it has a single soil group or two groups. If there is more than one group for the particular element, then the data set should be selected that matches the soil type of the environmental sample. Once the data set is selected (Group 1 or Group 2), then if the data set distribution is normal, then the 95 percent UTL calculated value will be used for background point comparison. If the Group 1 or 2 data set distribution is non-normal, then the maximum value of the background data set is used as point comparison value. Sanjay Thirunagari indicated that he was comfortable with the point to point comparison and use of the 95 percent UTL; however, all site sample points must pass the comparison. There was general discussion that the Army will apply the VDEQ approach to the data sets and generate a new set of background numbers for comparison. Sanjay Thirunagari indicates that if the numbers calculated by the VDEQ approach is similar to the numbers calculated by the Army, then VDEQ may accept the Army approach.

Jim McKenna and John Tesner indicated that the Army would create a new background point-values table using the VDEQ approach and compare with existing Army background point values. If the values are close, then the group will proceed with finalization of the report using the current statistical approach utilized by the Army. Sharon Wilcox indicated that VDEQ will be satisfied with that approach if VDEQ values are close to the Army values. The Army will prepare the table and submit in a letter to VDEQ for review.

Jim McKenna requested a discussion of the outliers in the letter to make sure that VDEQ outstanding comments are addressed. Cindy Hassan indicated that based on the box and whisker plots that were completed as part of the outlier evaluation, the outlier do not have a significant impact on the data. Alvaro Alvarado expressed caution in deleting a data point. Sharon Wilcox wants notification of outliers that are used as maximum values. Cindy Hassan indicated that typically outliers are discussed in the uncertainties section of the Risk Assessment. Sanjay Thirunagari indicated that if the outliers made a significant difference in the calculated background values, then resampling may be required. Jerry Redder recommended that in the new table, outliers that have a significant impact for resampling to be identified. Sharon Wilcox expressed that the number of samples should be added to the table.

John Tesner then summarized saying that the Army would put a new table together, which would contain the background point values using the 95 percent UTL (for SSP and RFI application) and UCL (for informational) approaches for the soil types as defined in the VADEQ analyses. This table will also contain the sample size that was used for these UTL/UCL calculations and the residential and industrial RBC's for the compounds. This table will be distributed to the group. A time frame of Mid-August was suggested for the table completion and a conference call. The meeting adjourned at 12:45 p.m.

From: McKenna, Jim
Sent: Friday, May 04, 2001 9:59 AM
To: 'rob thomson'
Cc: Redder, Jerome; 'john e tesner'
Subject: FW: Background Study Response to Comments

Rob,

Per my email about two weeks, I promised we would send our detailed response to the VADEQ's review comments on the Facility Wide Background Study Report. It is in the attached file below. Also we have provided a response to EPA's draft comments received via 4/16/2001 email and it is attached as separate file below.

I have reviewed what John Tesner has prepared in these files and concur. I would re-iterate I do not like the direction VADEQ is taking and perhaps a Richmond, VA meeting would be in order.

John, I'm officially off today and I don't have time to convert these files into WP so please follow up with Rob ASAP/today to ensure that he has readable/workable electronic files.

Thanks,
Jim

From: Tesner, John E NAB02[SMTP:John.E.Tesner@nab02.usace.army.mil]
Sent: Thursday, May 03, 2001 5:49 PM
To: Jim McKenna (E-mail)
Subject: Background Study Response to Comments

Response to Response to
comments EPA.doccomments VADEQ.do

Jim-
As discussed. Let me just say a couple things. After riding the fence a bit regarding level of detail, I made the decision to go with the format you see. I didn't think the other info provided by the others, could be explained or presented easily. That leads into why you'll see a suggestion for a meeting at the end of the VADEQ comments. At this point I recommend it. We could even do it in Richmond if its more palatable, but I think face to face will help.

Also, if you find stupid spelling/grammatical errors, target me first. I was the author of the re-write, but had a lot of input from Drew, IT, and to some extent URS.

JT
<<Response to comments EPA.doc>> <<Response to Comments VADEQ.doc>>

Response to Draft Comments from USEPA Region III (transmitted via e-mail 16 April 2001)
Draft Facility-Wide Background Study Report
Radford Army Ammunition Plant

General: Comments from USEPA are considered to be in **Draft** until VADEQ comments are reconciled and incorporated.

1. **Comment: Section 2.4, Field Sampling, Page 2-2:** This section does not contain a subsection discussing field observations and air monitoring (PID) readings. Please revise this section to include a discussion of significant field observations and air monitoring readings obtained during the sampling events.
   Response: Section 2.4 will be revised to include a discussion of field observations and air monitoring data.

2. **Section 4.1.1, Analytical Methodology, page 4-1:** The third paragraph states that PID screening was used to monitor organic compounds and relocate borings as necessary. Section 2, Background Sampling, did not contain a discussion of field activities or air monitoring readings. Please revise the text to indicate what levels detected on the PID would have necessitated a relocation of the boring and which, if any, boring location(s) were relocated as a result of PID readings.
   Response: Section 4.1.1 will be revised to evaluate the revised Sec.2 (Comment #1) and clarify whether borings were relocated and why.

3. **Section 4.1.1, Analytical Methodology, page 4-1:** The second paragraph of 4.1.1 states that "Results demonstrated that selected locations did not exhibit explosive contamination or were not impacted by previous facility operations associated with releases." If this is true, then any location on either facility having non-detect for explosives would be non-impacted by DoD operations regardless of other TCL or TAL findings at these future sampling locations. Please amend this sentence to read "Results indicated that selected locations did not exhibit explosive contamination or were not impacted by previous facility operations associated with releases."
   Response: Sentence will be revised as proposed.

4. **Section 4.1.2, Data Validation and Qualifiers, pages 4-1 and 4-9:** The discussions of this section are focused upon target analyte list (TAL) metals, and omit TCL considerations. Since samples were analyzed for TCL VOC and SVOC, their data quality evaluation criteria should be included within this section. Please revise the text to include a discussion of the VOC and SVOC data validation and qualifiers.
   Response: Section 4.1.2 will be revised to include a discussion of VOC and SVOC data validation including qualifiers.

5. **Section 4.2, Statistical Approach, pages 4-10 through 4-20:** This section details the statistical methodology utilized for this background study. Table 4-8,

Statistical Test, describes the equations utilized for the necessary calculations; and Tables 4-9, Surface Soil Statistical Summary and 4-10 Subsurface Soil Statistical Summary, describe the results of the individual statistical tests conducted. The actual calculations and variables utilized are not provided in the report for verification. Please include an additional table or appendix which details the individual calculations conducted in this section.
Response: The output for each of the statistical analyses will be provided in an appendix.

6. **Section 4.3, Confidence Limits, pages 4-20 through 4-24:** This section details the statistical methodology utilized to calculate the 95% upper confidence limit (UCL) for the combined data sets. Table 4-8, Statistical Tests, describes the equations utilized for the necessary calculations and Tables 4-11, Occurrence and Distribution of Chemicals Combined Surface Soil (MMA and NRU) and 4-12 Occurrence and Distribution of Chemicals Combined Subsurface Soil (MMA and NRU), describe the results of the individual statistical tests conducted. The actual calculations and variables utilized are not provided in the report for verification. Please include an additional table or appendix which details the individual calculations conducted in this section.
Response: The output for the 95% UCL calculations will be provided in an appendix.

7. **Section 4.1.3, Data Grouping, page 4-20:** The last paragraph of this section states that the coefficient of variation (CV) was used to evaluate the data variability for element distribution across soil type, with elements having CVs of less than one being grouped together, and elements with CVs greater than one further evaluated to address the causes of variability. This step is not depicted in Figures 4-1 and 4-2. Please include this step in the appropriate figures, and elaborate on the use of CVs and the resulting groups formed based on the outcome of these calculations.
Response: The flow chart will be expanded and language will be added to the text to elaborate on the use of the CV in the decision-making process.

8. **Table 4-11, Occurrence and Distribution of Chemicals Combined Surface Soil (MMA and NRU), page 4-22:** This table lists the 95% UCL in surface soils for the combined data sets (MMA and NRU). As it may be necessary in the future to view each area independently, the table should include the individual area calculations in addition to the combined 95% UCL calculation. Please revise the table to include the individual area (MMA and NRU) 95% UCL calculations in addition to the combined 95% UCL calculation.
Response: Table will be revised to include MMA and NRU 95% UCL numbers as well as the combined 95% UCL.

9. **Table 4-12, Occurrence and Distribution of Chemicals Combined Subsurface Soil (MMA and NRU), page 4-22:** This table lists the 95% UCL in subsurface soils for the combined data sets (MMA and NRU). As it may be necessary in the future to view each area independently, the table should include the individual

area calculations in addition to the combined 95% UCL calculation. Please revise the table to include the individual area (MMA and NRU) 95% UCL calculations in addition to the combined 95% UCL calculation.
Response: Table will be revised to include MMA and NRU 95% UCL numbers as well as the combined 95% UCL.

10. **Section 5.1, Background Sample Locations, page 5-1:** This section reads that "Additionally, semivolatile and volatile organic compounds were evaluated as secondary markers to substantiate the selection of true background locations. Analytical results demonstrated that organic contaminants had not impacted the selected locations, indicating that sample locations represented background conditions." The organic results were not provided in this report. Please revise the report to include the organic results obtained or delete those two sentences from the report.
Response: Organic results will be provided as an appendix.

11. **Section 5.1, Background Sample Locations, page 5-1:** This section reads that "Explosive results were negative, proving background sampling locations had not been impacted by RFAAP operations." If this is true, then any location on the Site having non-detect for explosives would be non-impacted by RFAAP operations regardless of other TCL or TAL findings at these future sampling locations. Please amend this sentence to read "Explosive results were negative, indicating background sampling locations had not been impacted by RFAAP operations."
Response: The sentence will be revised as suggested.

12. **Section 5:** The 95 % UCL was used as a point estimate of the background data. However, when we compare on-site contamination at RFI sites to background, we need to answer two questions: (1) Are there any hot spots on-site? (2) Is the average concentration on-site the same or higher than the average concentration of background? Given the data in the draft *Background Report*, we should be able to answer these questions for RFI type sites using hypothesis testing. Therefore, EPA is requesting that, for RFI sites, the Army propose a methodology (ies) in the draft revised *Background Report* for accomplishing this end.
Response: The 95% UCL was included in the report as a general point of reference, at the request of the Installation, for site prioritization purposes. At the time the Background Workplan was developed there was intent for point-to-point comparisons. As described in the Background Study Workplan, the intent was to use hypothesis testing for RFI sites. Such hypothesis testing would include tests for similarities in shape and location between the site and background data sets. Depending on these initial tests other tests (e.g., t-test or Mann-Whitney U, or Kolmogorov-Smirnov) would be used to assess whether there is a difference between the means. Likewise, statistical procedures also would be used for assessing outliers.

Although not contemplated during the development of the Site-Screening Process for Site Screening Areas (SSA), the 95% UCLs could be used for point-to-point comparisons. However, using the 95% UCL as a single point comparison or background is very likely to result in classifying many chemicals as greater than background when they are not. This is due to the fact that the 95% UCL is an estimate of the mean, which would likely result in misclassification as much as 50 percent of the time. Therefore, the Army suggests that a 95% upper tolerance limit (95% UTL) approach be included in the Background Study report and used for point-to-point comparisons in the SSP.

The following discussion further explains the Army's position regarding UTL versus UCL:

Three types of statistical intervals are often constructed from environmental data: Confidence, Tolerance and Prediction. They are mathematically similar, but have very different purposes:

Appropriate Use	***Interval Type***	***Purpose***
Comparison Within A Single Population.	*Confidence Interval:*	*To compare a compliance data set to a known standard (i.e., USEPA, 1989; 1992).*
Comparison of Similar But Distinct Populations.	*Tolerance Interval:*	*To define a concentration range from background data, within which a large proportion of compliance data should fall with high probability (i.e., USEPA, 1989; 1992).*
	Prediction Interval:	*To define a concentration range from background data, within which the next K compliance values should fall with high probability (i.e., USEPA, 1989; 1992).*

A Confidence Interval contains a specified population parameter (generally the mean) with a specified level of confidence (USEPA, 1989). " It offers little information about the highest or most extreme sample concentrations one is likely to observe over time" (USEPA, 1989). For these reasons, Confidence Limits are generally constructed on compliance data, not on background data. The limits for compliance data can then be compared to a known standard (e.g., an RBCs, MCLs, GWPSs) to assess if the mean value of the compliance data might be statistically above the standard (cf., VDEQ, 1998; 2000).

If a statistically robust data set, and thus good information about the population mean, is available (implying a tightly constrained confidence interval and low UCL), then a large portion of the population of individual values used to construct the UCL will actually be above the UCL. Therefore, an exceedance of the UCL by an individual sample result in a separate compliance population is not indicative of the site being above background.

The appropriate Interval to be constructed on background data for comparison to individual compliance points is a Tolerance Interval (USEPA, 1989; 1992). The UTL *approach compares individual compliance point sample values to individual values in the background population, e.g the 95th percentile of the population. If the compliance population is within background, we expect no more than 5% individual values to be above the 95th percentile of the background population. Tolerance intervals are robust for normally distributed data. For lognormal data sets, lognormal tolerance intervals can be constructed; however, caution must be used to discern spurious results. In the event that a data set is lognormally distributed and the results of a lognormal tolerance interval calculation appear erroneous (based on a UTL that is an outlier as compared to the known spread of the background data set), one should use a prediction interval approach on the lognormal data.*

Hot spots need to be defined by two parameters: aerial extent and concentration. The size of a hot spot is best examined through adequate sampling design. The concentration that defines a hot spot can be addressed through a risk-based comparison or through a background-based comparison. Both of the extent and the concentration parameters require proper sampling plan development. The number of samples at the SSAs is unlikely to be adequate for statistical hot-spot evaluation. Hot-spots are best addressed with purposeful sampling at suspected release points for the SSP. The hot-spot issue at RFI sites will be addressed during the development of the RFI Work Plans.

13. **Section 5:** Please include language in Section 5 stating that the Facility-Wide inorganic point estimates for surface soil "background" and subsurface soil "background" can be used in the evaluation of Site-Screening Areas.
Response: The suggested language will be added to Section 5.

14. **Appendix A, Drilling Log MMAU1:** This drilling log does not show PID screening readings. Please clarify why readings were omitted on this boring or revise the log to indicate the PID readings obtained.
Response: Log will be revised to indicate PID readings.

15. **Appendix B, Data Validation Reports:** This appendix does not contain the VOC and SVOC data validation and summary sheets. Please revise this appendix to include the VOC and SVOC data validation package and sample summary sheets.
Response: Appendix B will be revised to include VOC and SVOC data validation data and sample summary sheets.

References:

United States Environmental Protection Agency, 1989, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Interim Final Guidance: Office of Solid Waste, Waste Management Division: EPA / 530-SW-89-026.

United States Environmental Protection Agency, 1992, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Addendum to Interim Final Guidance: Office of Solid Waste, Waste Management Division.

Virginia Department of Environmental Quality, 1998, Data Analysis Plan for Solid Waste Facilities: Office of Technical Services: Memorandum to Solid Waste Facilities/Consultants from Charlotte Carroll and Sanjay Thirunagari., June 15, 1998.

Virginia Department of Environmental Quality, 2000, Data Analysis Guidelines for Solid Waste Facilities Operating in Virginia: Office of Waste Programs, Technical Support: Revised November 14, 2000.

Response to Comments from VADEQ (April 2, 2001)
Draft Facility-Wide Background Study Report
Radford Army Ammunition Plant

General: Comments from VADEQ are considered to be **Final** and will need to be reconciled and incorporated with USEPA, Region III comments.

Comment:
Based upon their statistical evaluation of the analytical data provided in the report, surface and subsurface soils should be evaluated separately. Within each stratum (surface and subsurface) data for each chemical constituent (aluminum, antimony, arsenic, etc.) can be grouped into either one or two groups by soil type (Braddock, Unison, Wheeling, etc.).

The Department used the Tukey method[1] to conduct simultaneous comparison of the constituent mean concentrations, by chemical constituent, for the seven different soil types at a 95% confidence limit. The resulting groups observed for each surface soil chemical constituent are marked with a code 1 or 2. Surface soil types with code "1" may be combined into one data set and those with code "2" may be combined into second data set for each chemical constituent. Data sets marked with an asterisk (*) contain outliers that should not be included in the data set for the background comparison. See Table 1 below.

For example, the cobalt data for the Braddock Loam and Groseclose and Poplimento Silt Loam in the surface soil types can be combined into one statistical data set; and the cobalt data for the Unison-Urban Land Complex, Wheeling Sandy Loam, Cabro Silty Clay Loam, Lowell Silt Loam, and Wurno-Newberg-Faywood Silt Loam surface soil types can be combined into a second statistical data set. Statistical comparisons from future potentially contaminated sites would compare aluminum data from a surface soil sample in Braddock Loam to aluminum data from the Braddock Loam and Groseclose and Poplimento Silt Loam data set.

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[1] Robert V. Hogg and Johannes Ledolter, Applied Statistics for Engineers and Physical Scientists, - 2nd ed. New York: Macmilllan Publishing Company, 1992

Table 1 Surface Soil Groupings

Constituents	Braddock	Unison	Wheeling	Cabro	Groseclose	Lowell	Wurno
Aluminum	1	1	1	1	1	1	1
Antimony	1	1	1	1	1	1	1
Arsenic	1	2	1	1	1	1	1
Barium	1	1	2	1	1	1	1
Beryllium	1	1	2	1	1	2	2
Cadmium	1	1	1	1	1	1	1
Chromium	1	1	1	1	1	1	1
Cobalt	1	2	2	2	1	2	2
Copper	1	1	1	1	1	1	1
Iron	1	1	1	1	1	1	1
Lead	1	1*	1	1	1	1	1
Maganese	1	1	1	1	1	1	1
Mercury	1*	1	1	1	1	1	1
Nickel	1	2	2	2	2	2	2
Selenium	1	1	1	1	1	1	1
Silver	1	1	1	1	1	1	1
Thallium	1	1	1	1	1	1	1
Vanadium	1	1	1	1	1	1	1
Zinc	1	1*	2	1	1	1	1

Similarly, subsurface soil has been marked with code 1or 2. Soil types with code "1" may be combined as one background data set and those with code "2" may be combined as a second background data set for each constituent.

Table 2 Subsurface Soil

Constituents	Braddock	Unison	Wheeling	Cabro	Groseclose	Lowell	Wurno
Aluminum	1	2	2	1	2	2	2
Antimony	1	1	1	1	1	1	1
Arsenic	1	1	1	1	1	1	1
Barium	1	1	2	1	1	1	1
Beryllium	1	1	1	1	1	1	1
Cadmium	1	1	1	1	1	1	1
Chromium	1	1	1	1	1	1	1
Cobalt	1	2	2	2	2	2	2
Copper	1	2	2	1	2	2	2
Iron	1	1	1	1	1	1	1
Lead	1	2	1	1	1	1	1
Maganese	1	1	1	1	1	1	1
Mercury	1	1	1	1	1	1	1
Nickel	1	2	2	2	2	2	2
Selenium	1	1	1	1	1	1	1
Silver	1	1	1	1	1	1	1
Thallium	1	1	1	1	1	1	1
Vanadium	1	2	1	2	1	1	1
Zinc	1	1*	2	1	1	1	1

Notes for tables 1 and 2 on prior page:

* Indicates that soil type has outlier(s)

The detection limits for some of the constituents varied between soil types.

Based on the above information, the facility may develop two background data sets for surface and subsurface soils.

The facility must conduct an outlier test on grouped background data sets as part of the revisions to this document and prior to developing the statistical limits for comparing on-site against background levels. Outliers from the background data set are to be excluded prior to establishing the 95% upper confidence limit (UCL) on the mean of the background data.

When performing statistical comparisons of the potentially contaminated area sample results to the background results, the facility may use a Student's t-test, provided the data sets follow normal distributions and other test specific assumptions (eg. variance). The facility also has the option to calculate the 95% upper confidence limit on background data (excluding outliers) and compare the individual on-site sample concentrations to the established UCL.

Response:
It is emphasized that the approach and methods used in the Background Study report had been accepted by both EPA Region III and VADEQ in the Workplan prior to its implementation. The Tukey method presented by VADEQ is no more valid a statistical approach than the Mann-Whitney, Student-t, and Levene's methods employed per the Workplan. Further, during presentation of the Workplan, the possibility of certain elements not "passing" the 95% confidence interval was discussed. This possibility was not considered to invalidate the data, rather that data would simply have to be evaluated within the appropriate context. It should be noted that the elements, identified by the Army, as failing the statistical tests were still relatively high in confidence interval albeit not 95%. Finally, these elements (aluminum, barium, iron, lead, vanadium, zinc) are rarely risk drivers in a risk assessment. A comparison of RBC values for these elements indicate that the calculated UCL is either below the residential RBC for that element or between the residential and industrial RBC values.

The approach recommended in VADEQ's comments represents a significant change. The implementation of the Commonwealth of Virginia's approach would be difficult since there would have to be at least four different background data sets for each element. This would inevitably lead to data sets that would not be statistically significant. The selection of the background data set would also have to change based on the soil type and element.

Another difficulty with the implementation of the Commonwealth's approach would occur when samples are collected that involve multiple soil types or where soil types are not clearly distinguishable. For example, which background data set would be used if the samples collected from the site are from multiple soil types and the background analysis indicated that there are differences between the data for some or all of the elements?

The Army proposes the following course of action. Evaluation of outlier will proceed using an appropriate statistical method (eg., Box and Whisker diagram). P-values will be evaluated using another statistical package to assess whether differences will result from the values already calculated. Finally, a meeting to discuss finalization of the Background Study report may prove to be more successful than multiple response and comment rounds.

[illegible]
draft comment

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

March xx, 2001

In reply
Refer to 3HS13

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commander,
Radford Army Ammunition Plant
Attn: SIORF-SE-EQ (Jim McKenna)
P.O. Box 2
Radford, VA 24141-0099

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

Re: Radford Army Ammunition Plant
Draft Report submittals and reviews

Dear Mr. McKenna and Ms. Jake:

The U.S. Environmental Protection Agency (EPA) has reviewed the Army's draft *Facility-Wide Background Study Report*, dated January, 2001 for the New River Storage Depot (NRU), and the Radford Army Ammunition Plant (RAAP). Based upon our review, EPA has the following comments:

1. **Section 2.4, Field Sampling, Page 2-2:** This section does not contain a subsection discussing field observations and air monitoring (PID) readings. Please revise this section to

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include a discussion of significant field observations and air monitoring readings obtained during the sampling events.

2. **Section 4.1.1, Analytical Methodology, page 4-1:** The third paragraph states that PID screening was used to monitor organic compounds and relocate borings as necessary. Section 2, Background Sampling, did not contain a discussion of field activities or air monitoring readings. Please revise the text to indicate what levels detected on the PID would have necessitated a relocation of the boring and which, if any, boring location(s) were relocated as a result of PID readings.

3. **Section 4.1.1, Analytical Methodology, page 4-1:** The second paragraph of 4.1.1 states that "Results demonstrated that selected locations did not exhibit explosive contamination or were not impacted by previous facility operations associated with releases." If this is true, then any location on either facility having non-detect for explosives would be non-impacted by DoD operations regardless of other TCL or TAL findings at these future sampling locations. Please amend this sentence to read "Results indicated that selected locations did not exhibit explosive contamination or were not impacted by previous facility operations associated with releases."

4. **Section 4.1.2, Data Validation and Qualifiers, pages 4-1 and 4-9:** The discussions of this section are focused upon target analyte list (TAL) metals, and omit TCL considerations. Since samples were analyzed for TCL VOC and SVOC, their data quality evaluation criteria should be included within this section. Please revise the text to include a discussion of the VOC and SVOC data validation and qualifiers.

5. **Section 4.2, Statistical Approach, pages 4-10 through 4-20:** This section details the statistical methodology utilized for this background study. Table 4-8, Statistical Test, describes the equations utilized for the necessary calculations; and Tables 4-9, Surface Soil Statistical Summary and 4-10 Subsurface Soil Statistical Summary, describe the results of the individual statistical tests conducted. The actual calculations and variables utilized are not provided in the report for verification. Please include an additional table or appendix which details the individual calculations conducted in this section.

6. **Section 4.3, Confidence Limits, pages 4-20 through 4-24:** This section details the statistical methodology utilized to calculate the 95% upper confidence limit (UCL) for the combined data sets. Table 4-8, Statistical Tests, describes the equations utilized for the necessary calculations and Tables 4-11, Occurrence and Distribution of Chemicals Combined Surface Soil (MMA and NRU) and 4-12 Occurrence and

Distribution of Chemicals Combined Subsurface Soil (MMA and NRU), describe the results of the individual statistical tests conducted. The actual calculations and variables utilized are not provided in the report for verification. Please include an additional table or appendix which details the individual calculations conducted in this section.

7. **Section 4.1.3, Data Grouping, page 4-20:** The last paragraph of this section states that the coefficient of variation (CV) was used to evaluate the data variability for element distribution across soil type, with elements having CVs of less than one being grouped together, and elements with CVs greater than one further evaluated to address the causes of variability. This step is not depicted in Figures 4-1 and 4-2. Please include this step in the appropriate figures, and elaborate on the use of CVs and the resulting groups formed based on the outcome of these calculations.

8. **Table 4-11, Occurrence and Distribution of Chemicals Combined Surface Soil (MMA and NRU), page 4-22:** This table lists the 95% UCL in surface soils for the combined data sets (MMA and NRU). As it may be necessary in the future to view each area independently, the table should include the individual area calculations in addition to the combined 95% UCL calculation. Please revise the table to include the individual area (MMA and NRU) 95% UCL calculations in addition to the combined 95% UCL calculation.

9. **Table 4-12, Occurrence and Distribution of Chemicals Combined Subsurface Soil (MMA and NRU), page 4-22:** This table lists the 95% UCL in subsurface soils for the combined data sets (MMA and NRU). As it may be necessary in the future to view each area independently, the table should include the individual area calculations in addition to the combined 95% UCL calculation. Please revise the table to include the individual area (MMA and NRU) 95% UCL calculations in addition to the combined 95% UCL calculation.

10. **Section 5.1, Background Sample Locations, page 5-1:** This section reads that "Additionally, semivolatile and volatile organic compounds were evaluated as secondary markers to substantiate the selection of true background locations. Analytical results demonstrated that organic contaminants had not impacted the selected locations, indicating that sample locations represented background conditions.". The organic results were not provided in this report. Please revise the report to include the organic results obtained or delete those two sentences from the report.

11. **Section 5.1, Background Sample Locations, page 5-1:** This section reads that "Explosive results were negative, proving

background sampling locations had not been impacted by RFAAP operations." If this is true, then any location on the Site having non-detect for explosives would be non-impacted by RFAAP operations regardless of other TCL or TAL findings at these future sampling locations. Please amend this sentence to read "Explosive results were negative, indicating background sampling locations had not been impacted by RFAAP operations.".

12. **Section 5:** The 95 % UCL was used as a point estimate of the background data. However, when we compare on-site contamination at RFI sites to background, we need to answer two questions: (1) Are there any hot spots on-site? (2) Is the average concentration on-site the same or higher than the average concentration of background? Given the data in the draft *Background Report*, we should be able to answer these questions for RFI type sites using hypothesis testing. Therefore, EPA is requesting that, for RFI sites, the Army propose a methodology(ies) in the draft revised *Background Report* for accomplishing this end.

13. **Section 5:** Please include language in Section 5 stating that the Facility-Wide inorganic point estimates for surface soil "background" and subsurface soil "background" can be used in the evaluation of Site-Screening Areas.

14. **Appendix A, Drilling Log MMAU1:** This drilling log does not show PID screening readings. Please clarify why readings were omitted on this boring or revise the log to indicate the PID readings obtained.

15. **Appendix B, Data Validation Reports:** This appendix does not contain the VOC and SVOC data validation and summary sheets. Please revise this appendix to include the VOC and SVOC data validation package and sample summary sheets.

This concludes EPA's review of the Army's draft *Facility-Wide Background Study Report*, dated January, 2001 for the NRU and the RAAP. The referenced draft *Report* is disapproved by EPA in its current form, and must be revised to reflect the comments above. **As it exists, the data presented in the current background *Report* cannot be used to eliminate contaminants of concern until the Report is finalized.** Per Part II, Section E.4.e. of the EPA RCRA Corrective Action Permit, the Army is required to revise the draft document and submit a revised draft copy to EPA for review within 60 days of the receipt of EPA comments on the draft document. Part II, Section E.4.f. of the Permit allows for an additional 20 days for issuing the revised draft document to EPA, provided that timely notice is given, i.e. within 10 days. Additional time extensions can be requested under Part II, Section F. of the permit.

If you have any questions, please call me at 215-814-3357.

Sincerely,

Robert Thomson, PE
Federal Facilities Branch

cc: Russell Fish, EPA
Lynn Flowers, EPA
Leslie Romanchik, VDEQ-RCRA
Sharon Wilcox, VDEQ-CERCLA

COMMONWEALTH *of* VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

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April 2, 2001

Mr. James McKenna
Radford Army Ammunition Plant
SIORF-SE-EQ
P.O. Box 2
Radford, VA 24141-0099

RE: Draft Facility-Wide Background Study Report
Radford Army Ammunition Plant, January 2001

Dear Mr. McKenna:

Thank you for the opportunity to review the above referenced document. I have had Mr. Sanjay Thirunagari and Mr. Hasan Keceli, of our Office of Technical Support review the Draft Facility-Wide Background Study Report, dated January 2001, for the appropriate application and interpretation of the statistical methods utilized.

Based upon their statistical evaluation of the analytical data provided in the report, surface and subsurface soils should be evaluated separately. Within each stratum (surface and subsurface) data for each chemical constituent (aluminum, antimony, arsenic, etc.) can be grouped into either one or two groups by soil type (Braddock, Unison, Wheeling, etc.).

The Department used the Tukey method[1] to conduct simultaneous comparison of the constituent mean concentrations, by chemical constituent, for the seven different soil types at a 95% confidence limit. The resulting groups observed for each surface soil chemical constituent are marked with a code 1 or 2. Surface soil types with code "1" may be combined into one data set and those with code "2" may be combined into second data set for each chemical constituent. Data sets marked with an asterisk (*) contain outliers which should not be included in the data set for the background comparison. See Table 1 below.

For example, the cobalt data for the Braddock Loam and Groseclose and Poplimento Silt Loam in the surface soil types can be combined into one statistical data set; and the cobalt data for the Unison-Urban Land Complex, Wheeling Sandy Loam, Cabro Silty Clay Loam, Lowell Silt Loam, and Wurno-Newberg-Faywood Silt Loam surface soil types can be combined into a second statistical data set. Statistical comparisons from future potentially contaminated sites would compare

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[1] Robert V. Hogg and Johannes Ledolter, Applied Statistics for Engineers and Physical Scientists, - 2^{nd} ed. New York: Macmilllan Publishing Company, 1992

aluminum data from a surface soil sample in Braddock Loam to aluminum data from the Braddock Loam and Groseclose and Poplimento Silt Loam data set.

Table 1 Surface Soil Groupings

Constituents	Braddock	Unison	Wheeling	Cabro	Groseclose	Lowell	Wurno
Aluminum	1	1	1	1	1	1	1
Antimony	1	1	1	1	1	1	1
Arsenic	1	2	1	1	1	1	1
Barium	1	1	2	1	1	1	1
Beryllium	1	1	2	1	1	2	2
Cadmium	1	1	1	1	1	1	1
Chromium	1	1	1	1	1	1	1
Cobalt	1	2	2	2	1	2	2
Copper	1	1	1	1	1	1	1
Iron	1	1	1	1	1	1	1
Lead	1	1*	1	1	1	1	1
Maganese	1	1	1	1	1	1	1
Mercury	1*	1	1	1	1	1	1
Nickel	1	2	2	2	2	2	2
Selenium	1	1	1	1	1	1	1
Silver	1	1	1	1	1	1	1
Thallium	1	1	1	1	1	1	1
Vanadium	1	1	1	1	1	1	1
Zinc	1	1*	2	1	1	1	1

Similarly, subsurface soil has been marked with code 1or 2. Soil types with code "1" may be combined as one background data set and those with code "2" may be combined as a second background data set for each constituent.

Table 2 Subsurface Soil

Constituents	Braddock	Unison	Wheeling	Cabro	Groseclose	Lowell	Wurno
Aluminum	1	2	2	1	2	2	2
Antimony	1	1	1	1	1	1	1
Arsenic	1	1	1	1	1	1	1
Barium	1	1	2	1	1	1	1
Beryllium	1	1	1	1	1	1	1
Cadmium	1	1	1	1	1	1	1
Chromium	1	1	1	1	1	1	1
Cobalt	1	2	2	2	2	2	2
Copper	1	2	2	1	2	2	2
Iron	1	1	1	1	1	1	1
Lead	1	2	1	1	1	1	1
Maganese	1	1	1	1	1	1	1
Mercury	1	1	1	1	1	1	1
Nickel	1	2	2	2	2	2	2
Selenium	1	1	1	1	1	1	1
Silver	1	1	1	1	1	1	1
Thallium	1	1	1	1	1	1	1
Vanadium	1	2	1	2	1	1	1
Zinc	1	1*	2	1	1	1	1

Notes for tables 1 and 2 on prior page:

* Indicates that soil type has outlier(s)

The detection limits for some of the constituents varied between soil types.

Based on the above information, the facility may develop two background data sets for surface and subsurface soils.

The facility must conduct an outlier test on grouped background data sets as part of the revisions to this document and prior to developing the statistical limits for comparing on-site against background levels. Outliers from the background data set are to be excluded prior to establishing the 95% upper confidence limit (UCL) on the mean of the background data.

When performing statistical comparisons of the potentially contaminated area sample results to the background results, the facility may use a Student's t-test, provided the data sets follow normal distributions and other test specific assumptions (eg., variance). The facility also has the option to calculate the 95% upper confidence limit on background data (excluding outliers) and compare the individual on-site sample concentrations to the established UCL.

If you have any questions regarding this information, I can be reached at (804) 698-4143.

Very truly,

Sharon Skutle Wilcox
Office Of Remediation Programs

cc: Robert Thompson, Region III, U.S.EPA
Robert Weld, VDEQ
Sanjay Thirunagari, VDEQ

ATK
ALLIANT TECHSYSTEMS

Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24141
USA

February 9, 2001

Mr. Robert Thomson
U. S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Subject: Facility-Wide Background Study Report
Radford Army Ammunition Plant
EPA ID# VA1 210020730

Dear Mr. Thomson:

Enclosed is one certified copy of the subject report. Your five additional copies and Mr. Willis' and Ms. Wilcox's copies will be sent under separate cover.

The contents of this report are based on the field work executed in accordance with Work Plan Addendum 10: Facility-Wide Background Study as approved by EPA on December 12, 2000.

Please coordinate with and provide any questions or comments to myself at (540) 639-8266, Jerry Redder of my staff (540) 639-7536 or Jim McKenna, ACO Staff (540) 639-8641.

Sincerely,

C. A. Jake

C. A. Jake, Environmental Manager
Alliant Ammunition and Powder Company LLC

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Concerning the following document

Facility-Wide Background Study Report
Radford Army Ammunition Plant
January 2001

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

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01-815-34
JJRedder

Delivery Order No. 0008
Environmental Services
Program Support
DACA31-94-D-0064

RADFORD ARMY AMMUNITION PLANT, VIRGINIA

Facility-Wide Background Study Report

Prepared for:

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Prepared by:

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Final Document

December 2001

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)

2. REPORT DATE
December 2001

3. REPORT TYPE AND DATES COVERED
Background Study Report, 2001

4. TITLE AND SUBTITLE
Facility-Wide Background Study Report

5. FUNDING NUMBERS
USACE, Baltimore District
Contract No. DACA31-94-0064
Delivery Order 0008

6. AUTHOR(S)
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8. PERFORMING ORGANIZATION REPORT NUMBER
ESPS 08-34

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
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10 South Howard Street
Baltimore, MD 21201

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
Report is contained in one volume.

12a. DISTRIBUTION/AVAILABILITY STATEMENT

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

The IT Corporation was tasked to conduct a Facility-Wide Background Study at the Main Manufacturing Area and New River Unit of Radford Army Ammunition Plant (RFAAP). Task objectives were to characterize naturally occurring background soil inorganic concentrations to establish a baseline for inorganic compounds of concern at RFAAP. Data was statistically evaluated across soil types, soil horizons, and study areas to assess the potential for expanding the effective data into one set. Statistical tests demonstrated that the data was statistically similar across soil types and study areas, resulting in one set of background values for both surface and subsurface soils.

14. SUBJECT TERMS
RFAAP, Facility-Wide Background Study, Statistical Evaluation

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT
Unclassified

18. SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

19. SECURITY CLASSIFICATION OF ABSTRACT
Unclassified

20. LIMITATION OF ABSTRACT
None

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LIST OF ACRONYMS AND ABBREVIATIONS

%D—Percent Difference
%R—Percent Recovery
%RSD—Percent Relative Standard Deviation
ATK—Alliant Techsystems, Inc.
BFB—Bromofluorobenzene
bgs—below ground surface
COC—Chain-of-Custody
COPC—Chemical of Potential Concern
CRQL—Contract Required Quantitation Limit
CVAA—Cold Vapor Atomic Absorption
CV—Coefficient Of Variation
DFTPP—Decafluorotriphenylphosphine
EPIC—Environmental Photographic Interpretation Center
ERIS—Environmental Restoration Information System
GC/MS—Gas Chromatography/Mass Spectroscopy
GFAA—Graphite Furnace Atomic Absorption
GPS—Global Positioning System
HWMUs—Hazardous Waste Management Units
ICP—Inductively Coupled Plasma Emission Spectroscopy
IDM—Investigative-Derived Material
LCS—Laboratory Control Samples
MMA—Main Manufacturing Area
MDL—Method Detection Limit
MQL—Minimum Quantitation Limit
MRL—Method Reporting Limit
MS/MSD—Matrix Spike/Matrix Spike Duplicate
msl—mean sea level
ND—Not Detected
NRU—New River Unit
PID—Photoionization Detector
QAPA—Quality Assurance Plan Addendum
QA—Quality Assurance
QC—Quality Control
RBC—Risk-Based Concentration
RDX—hexahydro-1,3,5-trinitro-1,3,5-triazine
RFAAP—Radford Army Ammunition Plant
RPD—Relative Percent Difference
RRF—Relative Response Factor
SSA—Site-Screening Area
SSP—Site-Screening Process
SVOCs—Semivolatile Organic Compounds
SWMUs—Solid Waste Management Units
TCLP—Toxicity Characteristic Leachate Procedure
TCL—Target Compound List
TIC—Tentatively Identified Compound
TNT—Trinitrotoluene
UCL—Upper Confidence Limit
USEPA—U.S. Environmental Protection Agency
UTL—Upper Tolerance Limit
VDEQ—Virginia Department of Environmental Quality
VOCs—Volatile Organic Compounds

EXECUTIVE SUMMARY

A Facility-Wide Background Study was conducted at the Main Manufacturing Area and the New River Unit of RFAAP in accordance with Work Plan Addendum No. 10. Task objectives were to characterize naturally occurring background soil inorganic concentrations within the MMA and the NRU. Scope of work activities included the collection of background soil samples to establish a baseline for inorganic compounds of concern at RFAAP. Background sample locations were selected based on soil types and collected in areas not impacted by installation activities. Associated soils were evaluated based on formation properties and chemical and physical characteristics.

Explosives were selected as primary background markers, and semivolatile and volatile organic compounds were selected as secondary markers to discern potential contamination associated with selected background sample locations. Explosives and organic compound results confirmed the selected background locations had not been impacted by facility operations and were indicative of natural background conditions.

Statistical performance objectives designated for the background study were designed to ensure study data were scientifically based and statistically valid. Data were evaluated across soil types, soil horizons, and study areas to assess the potential for developing a universal background data set. Statistical tests demonstrated that surface soil data for both the MMA and NRU could be combined into one facility-wide data set. Similarly, subsurface soil data were also combined from both areas to obtain a facility-wide subsurface data set.

Point estimate values were subsequently developed to represent background concentrations for future site comparisons. The 95% upper confidence limit was selected as the statistic to assess background point estimates for surface and subsurface soil samples. Results from the previously attempted background study (Parsons 1996) were evaluated, and it was demonstrated that inclusion of the prior data set would compromise the statistical validity of the current background study.

Further work was performed in response to review comments from the USEPA and VDEQ. As a result of subsequent discussions with the agencies, this Final Facility-Wide Background Study reflects two major revisions: 1) facility-wide point estimates for background soil data are calculated as tolerance limits rather than confidence limits, and 2) background data for soil (surface and subsurface, MMA and NRU) are combined into a single data set. The final set of point estimates for the background data set, therefore, are based on calculated 95% UTLs for a single facility-wide data set that represents surface and subsurface soil from the MMA and NRU areas. These values are included in the Facility-Wide Background Study as a point of reference for point-by-point comparisons for site screening.

1.0 Installation Description

Radford Army Ammunition Plant (RFAAP) is a government-owned, contractor-operated industrial complex located in Radford, Virginia. It is owned by the U.S. Department of the Army and was operated under contract with Hercules, Inc., from 1941 until 1995 when Alliant Techsystems, Inc. (ATK), became the operating contractor. The installation consists of two noncontiguous areas: the Main Manufacturing Area (MMA) and the New River Unit (NRU).

The MMA contains numerous buildings and facilities. The NRU was constructed in 1940 and operated as a bag-manufacturing and loading plant for artillery, cannon, and mortar projectiles.

1.1 LOCATION

The MMA is located approximately 10 mi west of Blacksburg and 37 mi southwest of Roanoke (Figure 1-1). It lies in one of a series of narrow valleys typical of the Appalachian Mountain region. The valley is oriented in a northeast-southwest direction and is approximately 25 mi long and 8 mi wide at the southwest end, narrowing to 2 mi at its northeast end. The facility is situated along the New River in the relatively narrow northeast region of the valley and is divided into northern and southern areas. The northern half, or "Horseshoe Area," is located within the meander of the New River; the southern area contains the MMA.

The NRU is located approximately 6 mi southwest of the MMA of RFAAP and 43 mi southwest of Roanoke. It is located east of the town of Dublin in Pulaski County, VA, in the southern portion of the Appalachian Mountain region. The facility is approximately 1.5 mi north of Claytor Lake and approximately 2 mi northwest of Claytor Lake Dam.

1.2 ENVIRONMENTAL SETTING

1.2.1 Climate

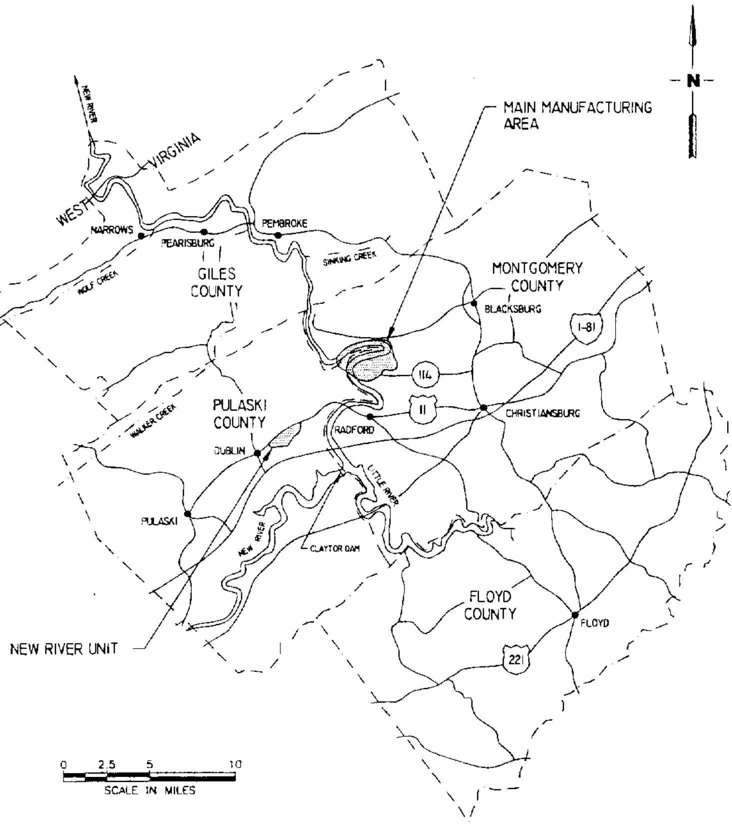
The climate of the area encompassing RFAAP is classified as "moderate continental," and is characterized by moderately mild winters and warm summers. Prevailing winds are from the southwest, with an average yearly wind speed between 8 and 10 mi/hr (SCS 1985). Average monthly temperature ranges from 29.6°F in January to 72°F in July, with an annual average temperature of about 52°F. Average monthly precipitation ranges from about 2.5 in. to 4.1 in. with an annual total precipitation between 36.9 in. and 41.5 in. (NCDC 1999). Lake evaporation was measured at 32 in./yr in the same area. Potential evapotranspiration has been calculated at 30 in./yr using the Thornthwaite method (Parsons 1996). Based on these data, the net precipitation in the vicinity of RFAAP ranges between 6.9 in. and 11.5 in. annually. Snowfall in the vicinity of RFAAP averages 17 in. annually. Montgomery and Pulaski Counties lie in one of the areas of highest occurrence of dense fog in the United States. Dense fog can be expected to occur between 20 and 45 days/yr.

1.2.2 Physiography

RFAAP lies within the Valley and Ridge Province of the Appalachian physiographic division. The Valley and Ridge Province is characterized by a series of long, narrow, flat-topped mountain ridges separated by valleys of varying widths. Either of these landforms may predominate; the mountains may be widely spaced and isolated or so closely spaced that the lowlands are disconnected or absent.

RFAAP exhibits prominent karstic features including sinkhole, caves, and caverns. Karst landforms occur in carbonate rock formations as the result of the dissolution of rock by naturally occurring carbonic acid in rainwater. As the rock is dissolved, cavities or caverns are formed beneath the earth's surface. Occasionally, large caverns collapse producing a depression or sinkhole on the surface. Numerous sinkholes are apparent along the western and southern boundaries of the facility.

Figure 1-1
RFAAP and Vicinity Map



Topography within the MMA of the installation varies from a relatively flat floodplain to elevated uplands in the extreme southeast section. The New River forms the RFAAP boundary on the north, with an elevation approximately 1,675 ft above mean sea level (msl). The eastern boundary represents a transition from a floodplain elevation of 1,680 ft msl to an upland elevation of 1,900 ft msl. The southern boundary traverses terrain consisting of creek bottoms and sharply rising summits. The western boundary follows the bluff line overlooking the New River to a point where the Norfolk and Western Railroad crosses the western portion of the Horseshoe Area.

The topography at the NRU contains some relatively flat areas but is dominated by undulating terrain and occasional sinkholes. The highest elevation is approximately 2,160 ft msl in the western portion of the site, and the lowest elevation is approximately 1,860 ft msl at Hazel Hollow located in the northeastern section of the site. One stream flows to the southeast corner of the NRU. Several intermittent streams merge into Hazel Hollow to carry surface runoff to the northeast corner of the NRU.

1.3 LAND USE/DEMOGRAPHICS

The area around MMA has not been highly developed because of the steep terrain surrounding the area. Land use in the vicinity of the facility has been mostly rural; less rugged areas have been primarily used for agriculture. The majority of counties situated in the New River Valley, which includes Montgomery, Pulaski, Giles, and Floyd are forested. The Jefferson National Forest is located approximately 2 mi north of the facility. 38% of the area of the New River Valley is classified as nonforest land, including agricultural land, developed land, and water acreage (NRVPDC 1994). The Blacksburg, Christiansburg VPI Water Authority owns four parcels of land adjacent to the facility. There are approximately 200 private residences located adjacent to the facility (Dames & Moore 1992). The largest substantial development, Fairlawn, is located about 2 mi southwest of the MMA boundary.

In 1990, the city of Radford, located about 4 mi southwest of the MMA, had a population of 15,940, which is equivalent to 1,626 people/mi^2 and the adjacent city of Dublin had 1,156 people/mi^2. Population densities for Montgomery and Pulaski Counties included 190 and 108 persons/mi^2, respectively (NRVPDC 1994). According to the U.S. Census Bureau, the town of Dublin in 1999 had an estimated population of 2,009 people, which is equivalent to approximately 1,155 people/mi^2. The estimated population in 1999, for Montgomery and Pulaski Counties was 76,997 and 34,407 people, respectively (U.S. Census Bureau 2000). The current estimated population densities are 198 and 108 persons/mi^2, respectively.

1.4 GEOLOGY

RFAAP is located in the New River Valley, at the northwest terminus of the southern Valley and Ridge Province. The New River crosses the Valley and Ridge Province approximately perpendicular to the regional strike of bedrock and it chiefly cuts Cambrian and Ordovician limestone and dolomite. The valley is covered by river flood plain and terrace deposits; karst topography is dominant. Deep clay-rich residuum is prevalent in areas underlain by carbonate rocks. Karst features include sinkholes, caverns, and springs caused by the dissolution of calcium carbonate by naturally occurring carbonic acid in rainwater. The greatest areas of karst features are controlled by bedrock stratigraphy and structure, and by the presence of major drainages. Late Cambrian and Mid-Ordovician limestones are more soluble than Cambrian and Lower Ordovician dolomite and shaley dolomite; therefore, they have the greatest number of sinkholes and caverns. However, both rock types show increased karst development in areas of low bedrock dip, where bedding is intensely folded, cleaved or jointed, and near major drainages.

The Elbrook and McCrady/Price Formations are the rock outcrops at the Installation. The Elbrook Formation is composed of thickly bedded, blue-gray dolomite interspersed with blue-gray to white limestone; brown, green, and red shale; argillaceous limestone; and brecciated limestone (colors range from mottled light- to dark-gray and yellow-brown). Sinkholes, solution channels, pinnacled surfaces, and springs are common to the Elbrook, which ranges from 1,400 to 2,000 ft thick. The strike of bedding in the Elbrook Formation is variable throughout the region. The general orientation of bedding is seen in the nearly east-west alignment of sinkholes at the installation and the surrounding area. Most sinkholes in the area are oval shaped and elongated with respect to the strike of the bedding; they most likely represent fractured or faulted zones within the underlying Elbrook Formation. The McCrady/Price Formations outcrop in a fenster (window) east of the main plant area along Stroubles Creek. This Formation may be up to 1,500 ft thick and consists of mottled red and green shale and mudstone interspersed with brownish-green siltstone and sandstone.

Max Meadows tectonic breccia, which is evidence of the close proximity of the Pulaski fault surface, is observed within and in the vicinity of the facility. This tectonic breccia consists of poorly sorted, angular to subrounded clasts of massive dolomite, laminated dolomites, and finely-laminated greenish gray calcareous mudstones in a fine- to very fine-grained matrix of crushed dolomite. Clasts range from less than 1 in. to more than 3 ft in length. The breccias are massive to crudely layered and are well to poorly indurated. The breccia, which is most fine-grained along the fault contact (Schultz 1986), is an integral part of the highly deformed rocks along the base of the Pulaski thrust sheet. Tectonic breccia has been described along the entire strike (310 mi) of the Pulaski thrust sheet.

The installation is also underlain by unconsolidated sedimentary deposits, including: alluvial plain sediments deposited by the New River prior to entrenchment, residual deposits from in-place weathering of parent bedrock, and colluvial deposits developed by residual slope wash. Alluvial plain deposits commonly line the New River and Stroubles Creek; as either recent floodplain material or as geologically older terraces. For example, three alluvial terraces are evident on the horseshoe loop that exhibit an upward textural fining. Gravels and silty, clayey sands form the basal unit, which are overlain by finer micaceous silts and clays. Sporadic cobbles and boulders (known as river jack) occur as lenses throughout the alluvial strata. Thickness of the alluvial deposits varies from a few to 50 ft, with an average of 20 ft.

Residual deposits (clays and silts) are a result of chemical and physical weathering of the parent bedrock, which is composed primarily of Elbrook dolomite. Residual deposits generally underlie the alluvium along the New River and in the Horseshoe Area. The exception is where the residuum has been eroded to bedrock and replaced by alluvium. Overburden depths vary from a few to 70 ft.

Photo. 1 Northerly view of sample location MMAB1 within the Braddock Loam soil type at the MMA

Colluvial deposits are generally formed from mass-wasting of slopes and escarpments. In general, these deposits are a heterogeneous mixture of alluvium, residuum, and rock debris that has moved from its original position. These deposits are generally interbedded between the strata of alluvium and residuum; thickness is variable.

The NRU is located within the middle section of the Ridge and Valley province (Thornbury 1965). The rocks, which underlie this site, are Middle Cambrian limestones, dolomites and shales of the Elbrook formation. The thickness of the Elbrook formation in this area is approximately 1,500 ft. The uppermost portion of the Elbrook is characterized by interbedded sandy, commonly cross-bedded, fine-grained dolomite containing thin lenses of fine to medium-grained sandstone. This is followed by cyclic sequences of medium-gray, finely laminated; fine-grained dolomite with crossbedding, bioturbated fine-grained dolomite with burrowed areas filled with slightly coarser-grained dolomite. The percentage of limestone diminishes with depth. The basal unit is 25–50 ft of fine-grained finely laminated, light greenish-gray, phyllitic, dolomitic mudstone and interbedded dolomite. This formation is thought to be part of the Pulaski overthrust sheet. Most of the rock units trend northeast-southwest. Southeastward dipping thrust faults and asymmetric folds overturned to the northwest are common (Dietrich 1990).

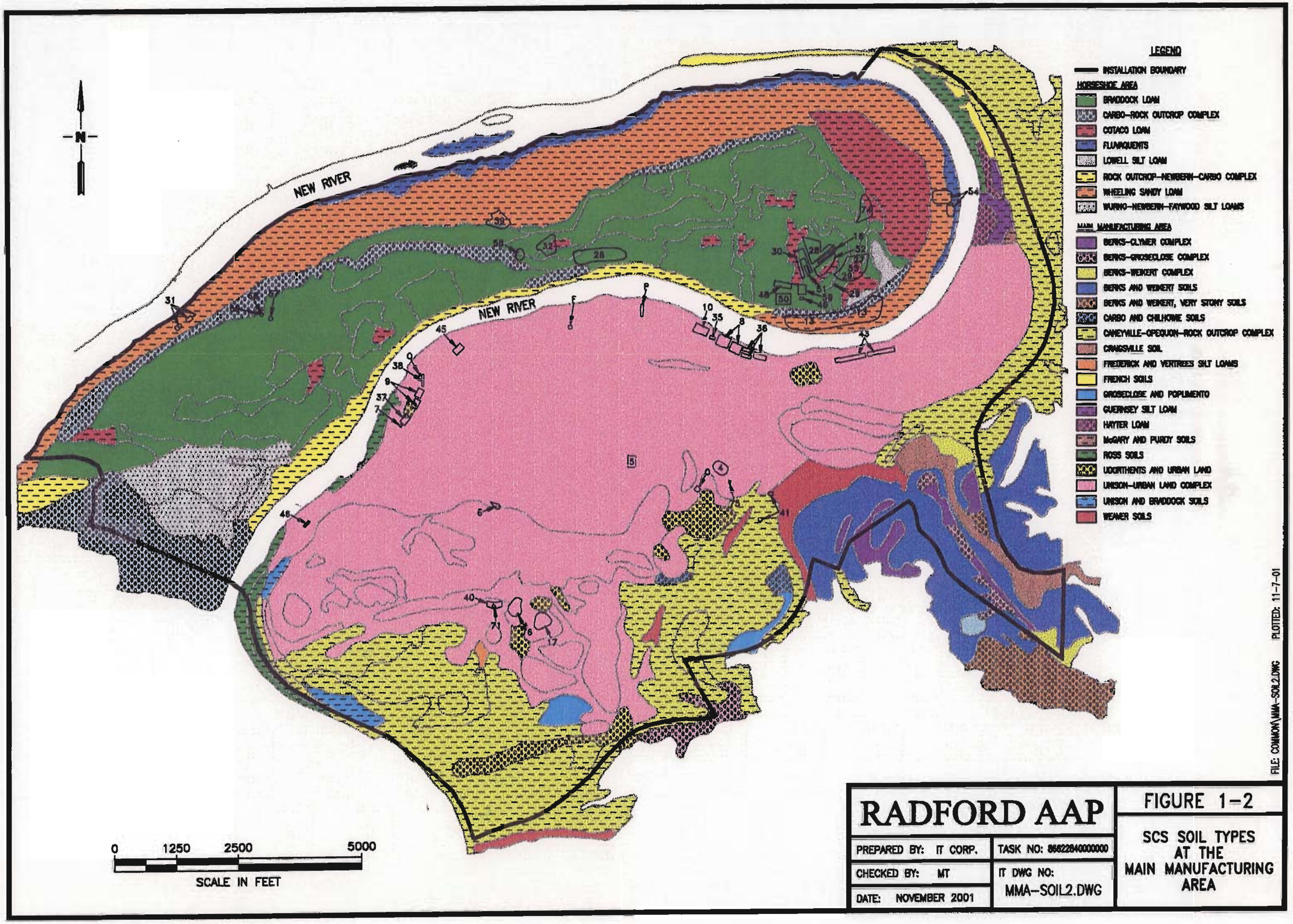
1.5 SOIL TYPES

Soil Conservation Service (1985) map units were employed to identify soil types within the current facility boundaries of the MMA and the NRU. Soil types associated within the MMA and NRU were assessed, and background sampling locations were selected to include the major soil types.

1.5.1 Main Manufacturing Area

The MMA is underlain by 27 soil types, as depicted graphically on Figure 1-2. The Braddock Loam, Unison-Urban Land Complex, and Wheeling Sandy Loam were identified as the most prevalent soil types that underlay the solid waste management units (SWMUs) and areas of concern identified in the MMA. These three soil types account for approximately 72% of the soils (excluding rock outcrop) at the MMA. The focus of this background investigation was these three soil types because they account for approximately 72% of the soils at the MMA.

Photo. 2 Braddock Loam soil profile for sample location MMAB1: surface (A horizon) and subsurface (B and C horizons) collected from the MMA



RADFORD AAP

PREPARED BY: IT CORP.
TASK NO: 856622840000000
CHECKED BY: MT
IT DWG NO: MMA-SOIL2.DWG
DATE: NOVEMBER 2001

FIGURE 1-2

SCS SOIL TYPES
AT THE
MAIN MANUFACTURING
AREA

Braddock Loam. The Braddock Loam comprises about 21% of the MMA. This soil type has a variable slope between 2% and 30% and does not have a seasonal high water table within 6 ft of the surface. Photo 1 shows an example of the landscape surrounding a Braddock Loam sample location at the MMA. Typically, the surface layer is dark yellowish-brown, 7 in. thick. The subsoil, which is a yellowish-red and red clay, extends to a depth of 60 in. or more. Photo 2 shows a Braddock Loam soil profile collected from the MMA (A horizon: 0-10 in.; B horizon: 10-48 in.; C horizon: 48-84 in.). Depth to bedrock is more than 60 in. deep. Permeability of the Braddock Loam soil is moderate, natural fertility is low, and organic matter content is moderately low. This soil type is acidic or very strongly acidic.

Photo. 3 Northwest view of sample location MMAU3 within the Unison-Urban Land Complex soil type at the MMA

Unison-Urban Land Complex. This complex makes up about 40% of the surface area of RFAAP, and consists of about 50% deep and well drained Unison soils, 30% Urban Land, and 20% other soils. This complex of soils varies in slope from 2 to 25%. Photo 3 shows an example of the landscape surrounding a Unison-Urban Land Complex sample location at the MMA. In an undisturbed area, the Unison soils have a 15-in.-thick surface layer of dark brown loam and a 43-in.-thick subsoil of yellowish-red, sticky plastic clay underlain by a red sandy clay loam to a depth of 58 in. This clay-rich layer is typically underlain by a brown sand to about 10 ft below ground surface (bgs), which then grades into a brown clay. Photo 4 shows a Unison-Urban Land Complex soil profile collected from the MMA (A horizon: 0-9 in.; B horizon: 9-42 in.; C horizon: 42-72 in.). Urban land is covered by pavement or structures; the original soil has been physically altered or obscured so that classification is not practical.

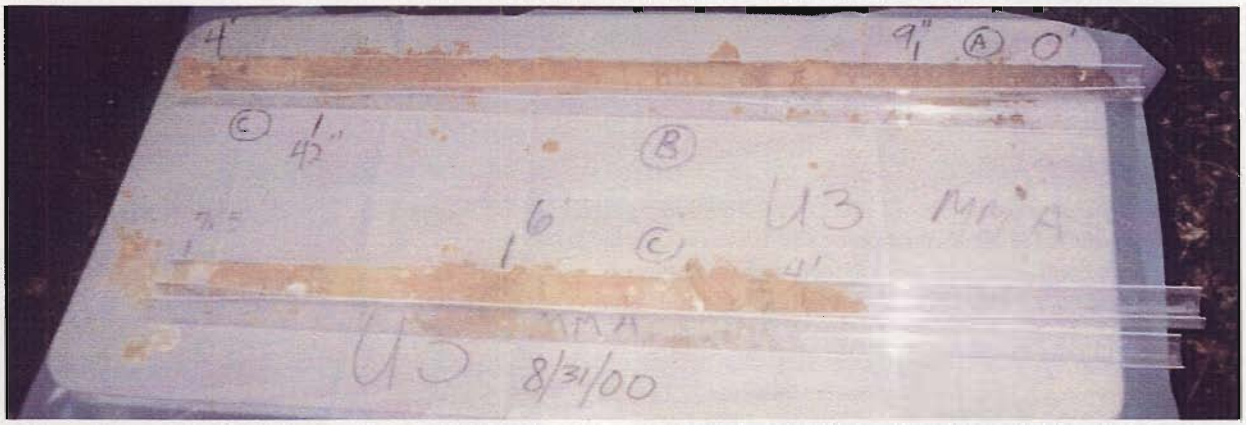


Photo. 4 Unison-Urban Land Complex soil profile for sample location MMAU3: surface (A horizon) and subsurface (B and C horizons) collected from the MMA

Permeability is moderate in Unison soils, natural fertility is low, and organic matter content is low to moderate. The soil is medium to strongly acidic.

Wheeling Sandy Loam. The Wheeling Sandy Loam comprises approximately 11% of the MMA soils and is level to nearly level (slopes ranging from 0 to 2%). Photo 5 shows an example of the landscape surrounding a Wheeling Sandy Loam sample location at the MMA. The seasonal high water table is not within 6 ft of the surface.

Photo. 5 Southwest view of co-located sample location MMAW2/W3 within the Wheeling Sandy Loam soil type at the MMA

Typically, the surface layer is a 10-in.-thick, dark brown sandy loam underlain by a 42-in.-thick subsoil. The upper part of the subsoil is dark brown gravely sandy loam to a depth of 60 in. or more. At greater than 60 in. in depth, the soil is predominantly a mixture of silt and sand, with minor amounts of clay. Photo 6 shows a Wheeling Sandy Loam soil profile collected from the MMA (A horizon: 0-7 in.; B horizon: 7-48 in.; C horizon: 48-60 in.). Depth to bedrock is at least 60 in.

Photo. 6 Wheeling Sandy Loam soil profile for sample location MMAW2: surface (A horizon) and subsurface (B and C horizons) collected from the MMA

Permeability and available water capacity of Wheeling soils is moderate; surface runoff is slow. Natural fertility is medium, organic matter content is moderately low, and soil is moderately to strongly acidic. Hazard of erosion in this soil type is slight.

1.5.2 New River Unit

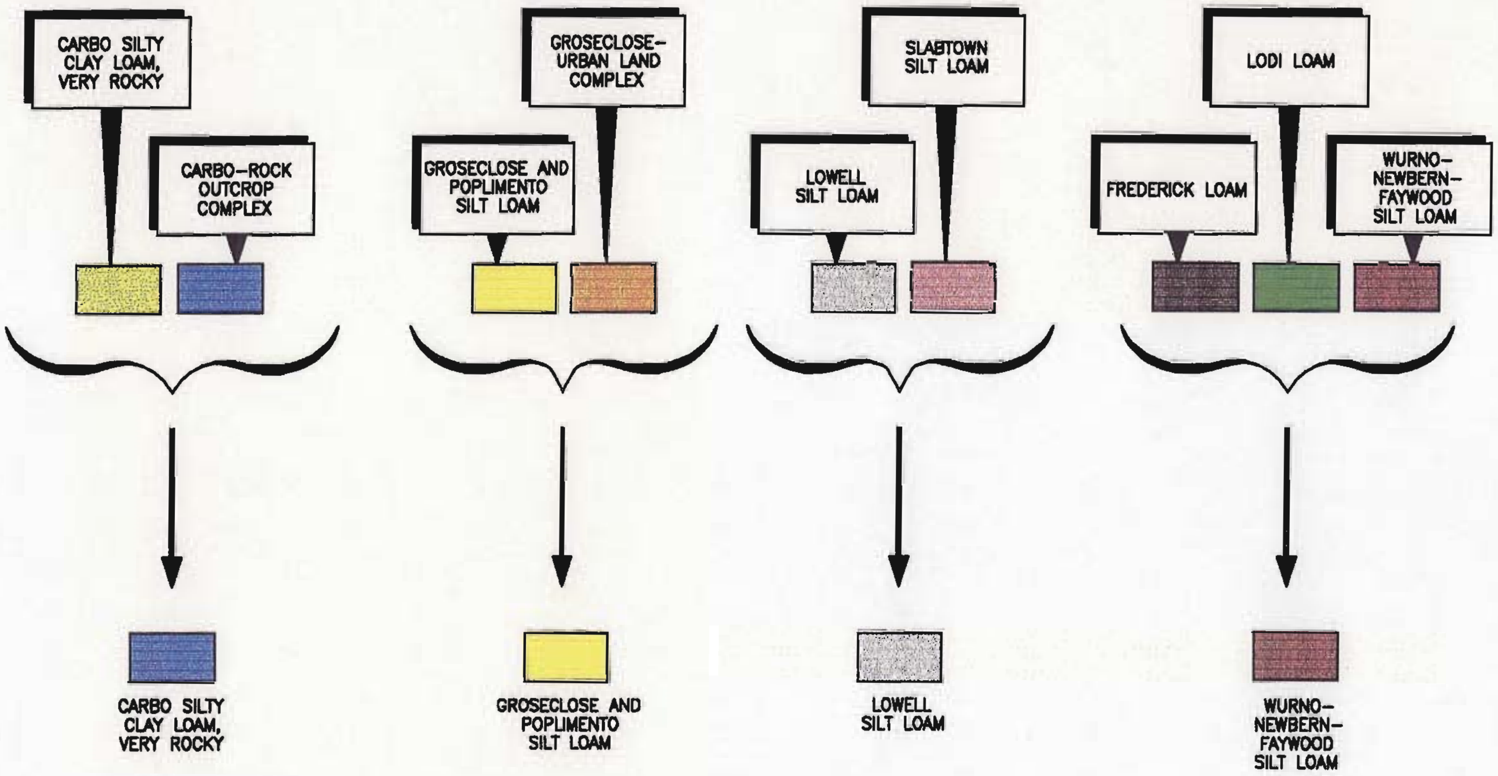
The NRU is underlain by 11 soil types as depicted graphically on Figure 1-3. A soil grouping approach was adopted that included the evaluation of soil formation properties, physical and chemical soil characteristics associated with each soil series, and delineation of associated family groups. Four soil groupings were selected for background sampling at the NRU including, Carbo Silty Clay Loam (very rocky), Groseclose and Poplimento Silt Loam, Lowell Silt Loam, and the Wurno-Newbern-Faywood Silt Loam. These four soil groupings account for 78% of the soils at the NRU. Figure 1-4 depicts the grouping of these soil types.

Photo. 7 Northwest view of sample location NRUC1 within the Carbo Silty Clay Loam soil type of the MMA

The Carbo series are formed in material weathered from limestone bedrock. Members of this family include Carbo Silty Clay Loam, Carbo Silty Clay Loam (very rocky), and the Carbo-Rock Outcrop Complex. The grouping of these soils was based on the Carbo family designation.

The Urban Land Complex represents disturbed Groseclose soils. Background samples collected from the Groseclose and Poplimento series will take Urban Land Complex soil characteristics into account.

The Lowell series consists of deep and very deep well-drained soils formed in residuum of limestone interbedded with thin layers of shale on upland ridgetops and sideslopes. Soils of the Slabtown series are deep, moderately well drained and have moderately slow permeability. Slabtown soils were formed in weathered material of mixed colluvium and underlying limestone residuum and are geographically associated with the Carbo, Faywood, Federick, Lodi, Lowell, Poplimento, and Wurno series. This soil series was grouped with the Lowell series based on its chemical and physical properties.



FILE: RADFORD\ADDENDUM10\WKPLAN\FLOWCHART.DWG PLOTTED: 12-29-00

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FIGURE 1-4

NEW RIVER UNIT SOIL GROUPINGS

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IT DWG NO: FLOWCHART.DWG
DATE: NOVEMBER 2001

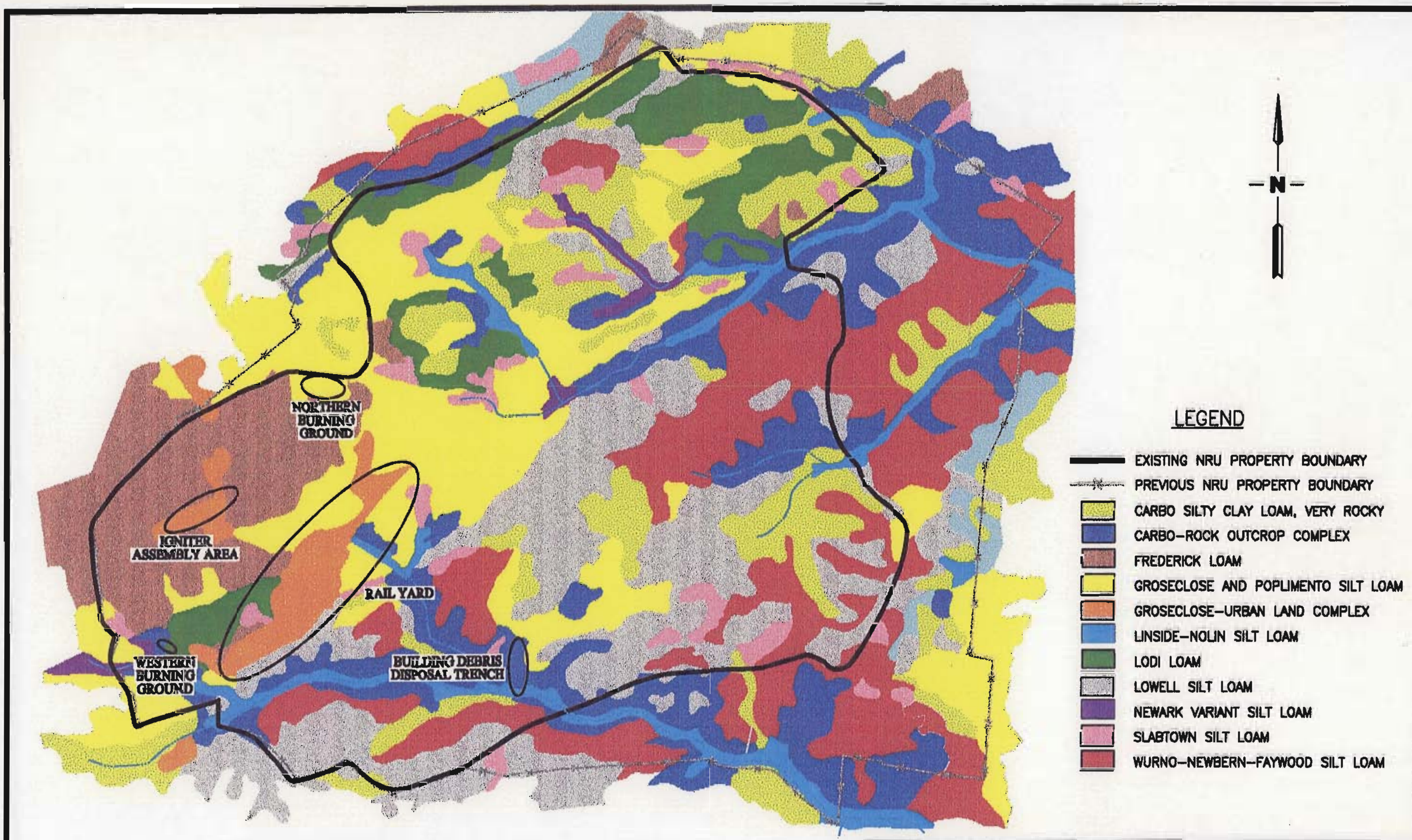

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FIGURE 1-3

SCS SOIL TYPES AT
THE NEW RIVER UNIT

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CHECKED BY: MT
DATE: NOVEMBER 2001
TASK NO: 86622840000000
IT DWG NO:
NRU-SOIL2.DWG

The Lodi and Federick series are from the same family and are formed in residuum weathered from limestone rocks with interbedded sandstone and shale. These soils are consistent with the Wurno-Newbern-Faywood series in that permeability ranges from moderately slow to moderate, and soil pH ranges from strongly acidic to mildly alkaline.

Photo. 8 Carbo Silty Clay Loam (very rocky) soil profile for sample location NRUC1: surface (A horizon) and subsurface (B and C horizons) collected from the NRU

Carbo Silty Clay Loam (very rocky). The Carbo silty clay loam comprises 12% of the NRU and consists of strongly sloping to steep soils (7%–30% slopes) that are 20 to 40 in. deep to bedrock and do not have a seasonal high water table. This soil is located on ridgetops and convex side slopes along drainageways. Rock outcrops cover 1%–10% of the surface area. Photo 7 shows an example of the landscape surrounding a Carbo Silty Clay Loam sample location at the NRU. The surface layer of this soil is a 5-in.-thick layer of dark yellowish strong brown silty clay loam that is underlain by a 26-in.-thick subsoil of strong brown clay. Photo 8 shows a Carbo Silty Clay Loam soil profile collected from the NRU (A horizon: 0-11 in.; B horizon: 11-72 in.). Bedrock is at a depth of 31 in. Permeability of this soil is slow, and runoff is medium to rapid; available water capacity is low. Natural fertility is high, and the organic matter content is moderately low. Reaction is slightly acid to mildly alkaline in these soils.

Groseclose and Poplimento Silt Loams. The Groseclose and Poplimento silt loams comprise 19% of the NRU and are grouped together because they have no major differences in use and management. These soils consist of moderately steep and steep soils (slopes ranging from 2% to 30%) that are at least 48 in. deep to bedrock and do not have a seasonal high water table. These soils exist on side slopes and ridgetops in irregularly shaped areas. Photo 9 shows an example of the landscape surrounding a Groseclose and Poplimento Silt Loam sample location at the NRU.

Groseclose soils typically have an 8-in.-thick surface layer of dark yellowish brown silt loam that is underlain by a 54-in.-thick subsoil. The upper portion of the subsoil consists of strong brown silty clay, the middle part is yellowish red and strong brown clay, while the lower portion consists of brownish yellow silty clay loam. At depths greater than 54 in., the substratum is a yellowish brown silty clay loam to a depth of at least 67 in.

Photo. 9 Northerly view of co-located sample location NRUG2/G3 within the Groseclose and Poplimento soil type at the NRU

Poplimento soils generally consist of a 7-in.-thick surface layer of dark yellowish brown silt loam that is underlain by a 37-in.-thick subsoil. The upper portion is strong brown silt loam, the middle portion is yellowish brown and strong brown clay, while the lower part consists of reddish yellow clay. The substratum extends to a depth of at least 60 in. and consists of reddish yellow and strong brown silty clay loam. Photo 10 shows a Groseclose and Poplimento Silt Loam soil profile collected from the NRU (A horizon: 0-7 in.; B horizon: 7-34 in.; C horizon: 34-57 in.).

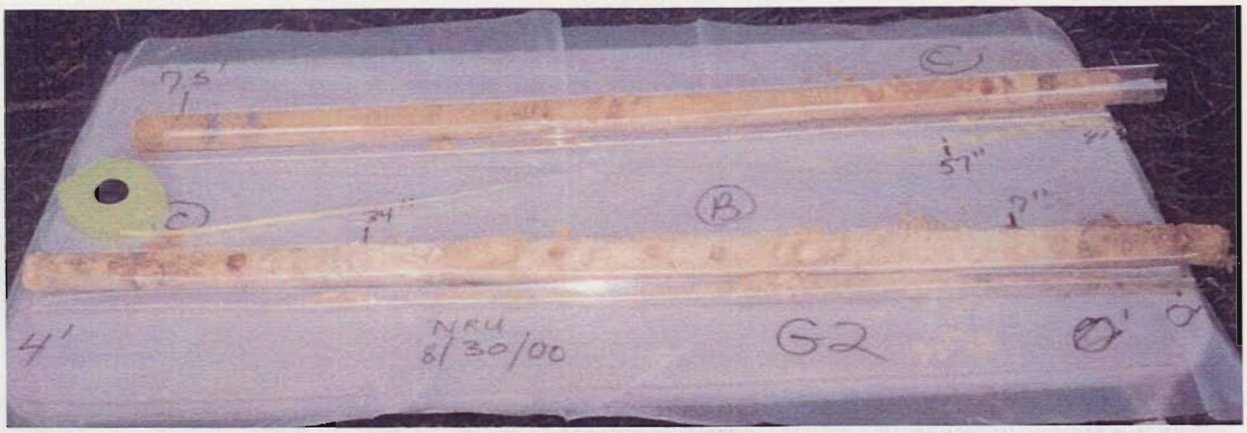


Photo. 10 Groseclose and Poplimento Silt Loam soil profile for sample location NRUG2: surface (A horizon) and subsurface (B and C horizons) collected from the NRU

Permeability in Groseclose soils is characterized as slow and moderately slow in Poplimento soils. Water capacity is moderate and surface runoff is rapid. Groseclose soils are low in natural fertility and medium in Poplimento soils. Both soil types contain a moderately low organic matter content. Groseclose soils are strongly acidic, while Poplimento soils have a medium acid content. Both soil types pose a severe erosion hazard.

Lowell Silt Loam. The Lowell silt loam comprises about 18% of the NRU and consists of gently to steeply sloping (2 to 30%) soils located on ridgetops, side slopes, and on convex side slopes. Photo 11 shows an example of the landscape surrounding a Lowell Silt Loam sample location at the NRU. These soils do not have a seasonal high water table within 6 ft of the surface.

The surface layer is typically dark yellowish brown silt loam 11 in. thick and is underlain by a 27-in.-thick subsoil consisting of dominantly strong brown and reddish yellow silty clay and clay. The substratum is yellowish brown shaly silt loam to a depth of 60 in. or more. Photo 12 shows a Lowell Silt Loam soil profile collected from the NRU (A horizon: 0-12 in.; B horizon: 12-42 in.; C horizon: 42-55 in.). Bedrock is at a depth of at least 40 in. Permeability of this soil is moderately slow and runoff is rapid; available water capacity is moderate. Reaction in these soils ranges from very strongly acidic to mildly alkaline.

Photo. 11 Northerly view of co-located sample location NRUL1/L2 within the Lowell Silt Loam soil type at the NRU

Photo. 12 Lowell Silt Loam soil profile for sample location NRUL1: surface (A horizon) and subsurface (B and C horizons) collected at the NRU

Natural fertility is high and organic matter content is moderately low.

Wurno-Newbern-Faywood Silt Loams. The Wurno-Newbern-Faywood silt loams comprise approximately 12% of the soils at the NRU and consist of moderately steep to steep soils (7%–30%) that do not have a seasonal high water table. Photo 13 shows an example of the landscape surrounding a Wurno-Newbern-Faywood Silt Loam sample location at the NRU. Bedrock is at a depth of 20 to 40 in. in the Wurno and Faywood soils and 10 to 20 in. in the Newbern soils. This unit is very intermingled and consists of approximately 35% Wurno, 30% Newbern, 25% Faywood, and 10% other soils.

Wurno soils typically have a surface layer of yellowish brown silt loam 8-in. thick underlain by a 6-in.-thick subsoil of brownish yellow very shaly silty clay loam. The substratum is partially weathered shale 13 in. thick. Bedrock is at a depth of 27 in. Permeability is moderate, and runoff is rapid; available water capacity is very low. Reaction ranges from slightly acid to mildly alkaline.

Newbern soils generally have a 5-in.-thick surface layer of yellowish brown silt loam underlain by an 8-in.-thick subsoil of brownish yellow shaly silt loam. The substratum is 5-in. thick and consists of brownish yellow shale and silt loam. Bedrock is at a depth of 18 in. Permeability of the Newbern soils is moderate, and runoff is medium to rapid; available water capacity is very low. Reaction ranges from slightly acid to mildly alkaline.

Photo. 13 Easterly view of sample location NRUW3 in the Wurno-Newbern-Faywood Silt Loam soil type at the NRU

Photo. 14 Wurno-Newbern-Faywood soil profile for sample location NRUW3: surface (A horizon) and subsurface (B and C horizons) collected at the NRU

Typically, the Faywood soils have a 10-in.-thick surface layer of yellowish brown silt loam and an 18-in.-thick subsoil. The upper part of the subsoil consists of yellowish brown silty clay. Photo 14 shows a Wurno-Newbern-Faywood Silt Loam soil profile collected from the NRU (A horizon: 0-10 in.; B horizon: 10-34 in.; C horizon: 34-45 in.). Depth to bedrock is 18 in. Permeability of the Faywood soils is moderately slow, and runoff is medium to rapid; available water capacity is low. Natural fertility is high, and organic matter content is moderate. Reaction of the soil ranges from neutral to strongly acidic throughout.

1.5.3 Chemical and Physical Properties

Soil chemical and physical properties are often evaluated to adjust land uses to the limitations and potentials of natural resources and the environment. Soil scientists, conservationists, engineers, and others collect field data to predict soil behavior that can potentially affect various soil uses and management. A brief description of select chemical and physical soil properties follows below. Tables 1-1 (MMA) and 1-2 (NRU) present the SCS physical and chemical characteristics associated with soil types sampled during background sampling activities. Values for properties listed in these tables represent averages for the entire soil column.

Table 1-1
Physical and Chemical Properties of Soil Types Sampled at the Main Manufacturing Area

Soil Name	Depth (in.)	Clay (%)	Moist Bulk Density (g/cm^3)	Permeability (in./hr)	Soil pH	Organic Matter (%)
Braddock	A: 0–7 B: 7–60	10–55	1.20–1.50	0.6–6.0	4.5–5.5	1–2
Unison	A: 0–10 B: 10–52 C: 52–60	10–70	1.30–1.65	0.6–2.0	4.5–6.0	1–3
Wheeling	A: 0–10 B: 10–52 C: 52–60	8–30	1.20–1.50	0.6–20	5.1–6.0	1–3

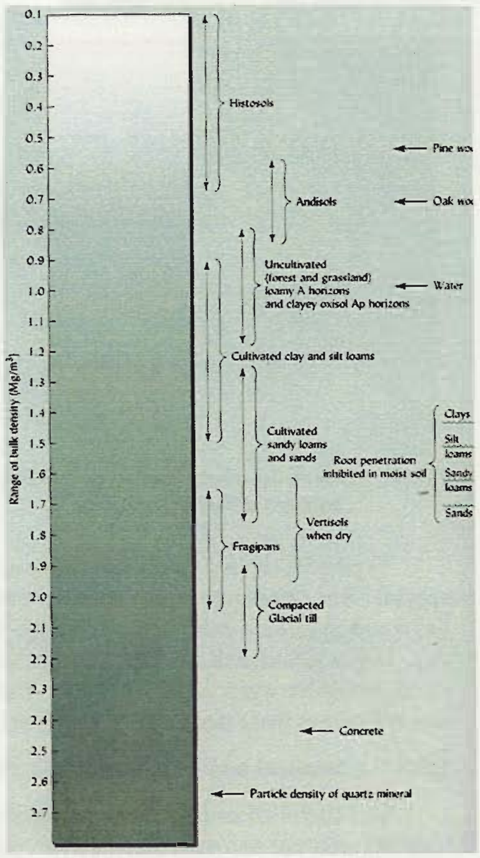
Source: SCS 1985.

Clay. Soil particles less than 0.002 mm are classified as clay and have a very large specific surface area, allowing them a significant capacity to adsorb water and other substances. Clay composition percentages greatly influences soil fertility and the physical conditions of the soil. Clay directly affects the permeability and the plasticity of a soil by generally lowering the soil's permeability and increasing the plasticity. Because pores between clay particles are very small and convoluted, movement of both water and air is very slow. Fate and transport of chemical compounds are hindered when passing through a soil with a high composition of clay due to clay's ability to adsorb cations and to retain soil moisture. Soil properties and behavior can be greatly influenced depending on the kind of clay and the amount present.

During hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) and TNT field screening activities, if a soil sample contained a high composition of clay, eluant separation was delayed during the soil extraction procedure because of the clay's strong adsorption properties.

Moist Bulk Density. The bulk density of a soil is defined as the wet weight per unit volume of dry soil. The volume includes both the solids and the pore space. It is assessed by obtaining a known volume of soil, drying it to remove the water, and weighing the dry mass. Bulk density is important because it reflects the porosity of a soil. Loose, porous soils have lower bulk densities than tight, compacted soil. The bulk density of a soil increases with compaction. Typical soil bulk densities for fine sands, silt loams, and silty clay loams are 1.5, 1.35, and 1.25 g/cm^3, respectively. Figure 1-5 presents a range of typical bulk densities for a variety of soils and soil materials.

Figure 1–5
Typical Bulk Densities for a Variety of Soils and Soil Materials



Source: The Nature and Properties of Soils.

Permeability. Permeability is a physical and chemical property that estimates the ability of a soil to transmit water or air. In saturated soil conditions permeability is taken into account because it estimates the rate of the downward movement of water. Soil conditions in the field that may affect permeability include particular structure, porosity, and texture. Sandy soil permits fast movement of percolating water, and lowers the opportunity for dissolved chemicals to be adsorbed.

Clay and organic soils tend to hold water and dissolved chemicals longer. Also, these soils have more surface area on which chemical compounds can be adsorbed, in comparison with sandy soils. The sandier the soil, the greater the chance of a compound of concern reaching groundwater.

Table 1-2
Physical and Chemical Properties of Soil Groupings Sampled at the New River Unit

Soil Group	Soil Type	Depth (in.)	Clay (%)	Moist Bulk Density (g/cm^3)	Permeability (in./hr)	Soil pH	Organic Matter (%)
Carbo Silty Clay Loam, Very Rocky	Carbo Silty Clay Loam, Very Rocky	A: 0–5 B: 5–31	20–80	1.20–1.50	0.06–2.0	4.5–7.8	0.5–3
	Carbo-Rock Outcrop Complex						
Groseclose and Poplimento Silt Loam	Groseclose Silt Loam	A: 0–8 B: 8–62 C: 62–67	7–60	1.25–1.60	0.06–6.0	4.5–5.5	1–2
	Groseclose Urban Land Complex						
	Poplimento Silt Loam	A: 0–7 B: 7–44 C: 44–70	17–60	1.20–1.60	0.2–2.0	4.5–6.0	0.5–2
Lowell Silt Loam	Lowell Silt Loam	A: 0–11 B: 11–38 C: 38–60	12–60	1.20–1.70	0.2–2.0	4.5–7.8	1–4
	Slabtown Silt Loam	A: 0–18 B: 18–76	10–60	1.25–1.55	0.6–2.0	5.1–7.8	1–3
Wurno-Newbern-Faywood Silt Loam	Frederick Loam	A: 0–7 B: 7–50	13–80	1.25–1.65	0.6–6.0	4.5–6.0	1–3
	Lodi Loam	A: 0–8 B: 8–65	10–60	1.20–1.65	0.6–6.0	4.5–5.5	0.5–2
	Wurno Silt Loam	A: 0–8 B: 8–14 C: 14–27	10–55	1.20–1.60	0.6–2.0	6.1–7.8	1–2
	Newbern Silt Loam	A: 0–5 B: 5–13 C: 13–18	10–27	1.20–1.60	0.6–2.0	5.6–7.8	1–2
	Faywood Silt Loam	A: 0–10 B: 10–28	15–60	1.30–1.45	0.06–6.0	5.1–7.3	1–4

Source: SCS 1985.

Soil pH. Soil pH is a measure of acidity or alkalinity and is an important physical and chemical property because it is an indication of soil reaction potential. Soil reaction influences the fate of many pollutants, affecting their breakdown and potential movement from the soil into groundwater and streams.

Most soils range in pH from slightly less than 2.0 to slightly more than 11.0, although sulfuric acid forms and pH may decrease to below 2.0 when some naturally wet soils that contain sulfides are drained. The descriptive terms to use for ranges in pH are as follows:

Ultra acid	<3.5
Extremely acid	3.5-4.4
Very strongly acid	4.5-5.0
Strongly acid	5.1-5.5
Moderately acid	5.6-6.0
Slightly acid	6.1-6.5
Neutral	6.6-7.3
Slightly alkaline	7.4-7.8
Moderately alkaline	7.9-8.4
Strongly alkaline	8.5-9.0
Very strongly alkaline	>9.0

The pH of forest soils is important, because it influences the microbial population of the soil, the availability of phosphorus, calcium, magnesium, and trace elements, and the rate of nitrification. Because tree litter is commonly acidic and releases hydrogen ions upon decomposition, forest soils are often more acidic than grassland or agricultural soils. In addition, trees may naturally acidify the soil by taking up calcium, magnesium, and other elements that form bases in the soil (Bockheim 1990). A review of pH results across soil types did not yield outstanding trends. High soil pH results were generally associated with limestone and shale parent material.

Organic Matter Content. Organic matter content is expressed as a percentage, by weight, of the soil material that is a composition of plant and animal residues in the soil at various stages of decomposition. Available water capacity and infiltration rate are affected by organic matter content.

Raw plant residues, on the surface, help reduce surface wind speed and water runoff. Removal, incorporation, or burning of residues predisposes the soil to serious erosion. The resistant or stable fraction of soil organic matter contributes mainly to nutrient holding capacity (cation exchange capacity) and soil color. This fraction of organic matter decomposes very slowly and therefore, has less influence on soil fertility than the "active" organic fraction (Alberta 1985).

2.0 Background Sampling

2.1 PREVIOUS INVESTIGATION REVIEW

A previous attempt was made to identify site-specific background concentrations within the MMA (Parsons 1996). Accuracy issues associated with sampling location and data variability precluded the quantitative use of this information. Shortcomings identified from the previous attempt were incorporated into the design of this background study to ensure the production of defensible and statistically significant data.

2.2 SAMPLE LOCATION SELECTION

Aerial photographs, facility base maps, and topographic maps were evaluated to ensure background sampling locations were representative of areas that were impacted minimally by facility operations. Aerial photographs dating from 1949 to 1986 were reviewed to evaluate facility activities. Topographic and facility base maps were evaluated to provide additional information, including ground elevation, land features, water bodies, and associated physical features of the study area.

2.2.1 Aerial Photographs

Aerial photographs (EPIC 1992) were used to evaluate construction and SWMU activities occurring between 1949 and 1986 and to identify physical features potentially affecting environmental conditions at the MMA and NRU.

Environmental Photographic Interpretation Center (EPIC) interpretive results indicated specific signature features and environmental conditions. The certainty associated with these signatures were further qualified by the terms "possible" and "probable" when definite feature identification was not discernible. Because these interpretations were performed on the full-size original aerial photographs, the level of resolution associated with the photographic prints presented in the report, in some instances, does not provide the same level of detail necessary to verify the annotation. Aerial photograph interpretations were used to locate tree stands that predated construction activities to ensure background sampling locations were positioned in areas that had not been impacted by previous installation activities.

2.2.2 Facility Base and Topographic Maps

Facility base and topographic maps were evaluated to further refine the understanding of construction activity, land use, and associated physical features of the study area. The topographic maps used to provide information on ground elevation, land features, water bodies, and minimally impacted areas included the Radford North (MMA) and Dublin (NRU) quadrangles. This information was used to position sample locations upgradient and upslope of SWMUs, hazardous waste management units (HWMUs), and areas of concern.

2.2.3 Accessibility

Sampling locations were positioned in tree stands to ensure associated soil samples were representative of areas that had not been affected by previous site activities or SWMU releases. Wherever possible, background sample locations were placed in tree stands estimated to predate potential construction activity at each location. Potential issues affecting or limiting accessibility to sampling locations included, the density or thickness of tree stands, drainage ditches, and slope grade. Grubbing and clearing activities were required at both the MMA and NRU to provide access of direct push sampling equipment to sample locations positioned within dense growth tree stands. Activities consisted of tree, ground cover, and debris removal to clear paths for direct push equipment access and maneuverability (Photo. 15).

Photo. 15 Grubbing and clearing activities within the MMA

Soil borings were advanced using a truck-mounted or Bobcat-mounted direct push (Geoprobe) rig, depending on accessibility of the equipment at a particular sample location. The truck-mounted rig was employed in more open and spacious areas where the terrain was relatively flat. The Bobcat-mounted rig was utilized in areas of dense woods, rugged terrain, and where maneuverability restricted the use of the truck-mounted equipment. Hand auger sampling methods were employed at two background sample locations at the MMA. This soil sampling method was used at these two locations because steep slope conditions prevented safe access of direct push sampling equipment.

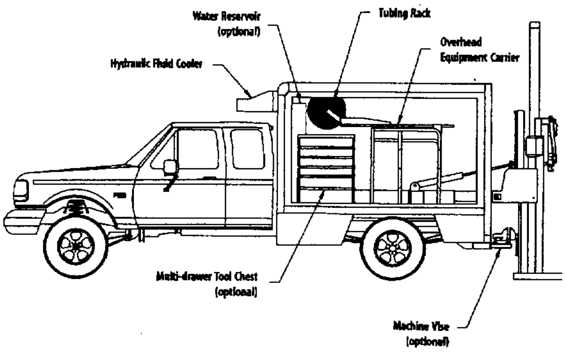
2.3 SAMPLE LOCATIONS

Background Study field investigation activities were conducted during the months of August and September of 2000 in accordance with the Addendum No. 10, as approved by USEPA Region III. Field activities were performed at both the MMA and the NRU and consisted of soil sampling, IDM management, and Global Positioning System (GPS) activities. The primary objective of the study was to collect samples representative of background conditions to establish a baseline for inorganic compounds of concern at RFAAP.

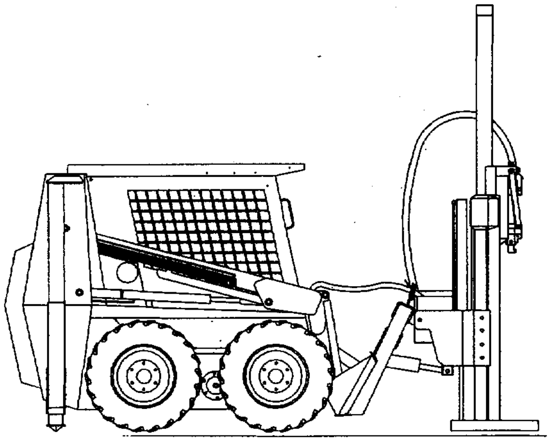
Thirty-four environmental samples were collected from three of the proposed soil types (Braddock Loam, Wheeling Sandy Loam, and the Unison-Urban Land Complex) at the MMA. Twelve of the 34 samples were collected from the surface (A horizon) and 22 of the 34 samples were collected from the subsurface soil (B and, when available, C horizon).

Forty-five environmental samples were collected from four soil groupings, including Carbo Silty Clay Loam (very rocky), Groseclose and Poplimento Silt Loam, Lowell Silt Loam, and the Wurno-Newbern-Faywood Silt Loam. Sixteen soil samples were collected from the surface (A horizon), and 29 soil samples were collected from the subsurface (B and, when available, C horizon).

Sampling locations at the MMA and NRU are presented on Figures 2-1 and 2-2, respectively. A complete list of samples collected, including sample matrices, depths dates, and analyses is presented in Table 2-1. Specific sample location descriptions and associated photographs are included in Appendix C.



Sketch of truck-mounted Geoprobe



Sketch of Bobcat-mounted Geoprobe

2.4 FIELD SAMPLING

Twenty-eight soil borings were advanced and sampled during background study field investigation activities. Twelve of the borings were completed at the MMA, and 16 of the locations were advanced at the NRU. Soil borings were advanced using a truck-mounted direct push Geoprobe, Bobcat-mounted direct push Geoprobe, or hand auger, depending upon accessibility of the soil sampling location.

Seventy-nine environmental samples were collected during the study: 34 were collected at the MMA, and 45 samples were collected from the NRU. A complete listing of samples collected in support of the field investigation effort is presented in Table 2-1.

2.4.1 Soil Sampling

Three soil types at the MMA (Braddock Loam, Wheeling Sandy Loam, Unison-Urban Land Complex) and four soil groupings at the NRU (Carbo Silty Clay Loam [very rocky], Groseclose and Poplimento Silt Loam, Lowell Silt Loam, Wurno-Newbern-Faywood Silt Loam) were sampled and analyzed as part of the background study. One surface (A horizon) and up to two subsurface soil samples (one each from the B horizon and, when available, C horizon) were collected at each boring location and analyzed for metals and pH.

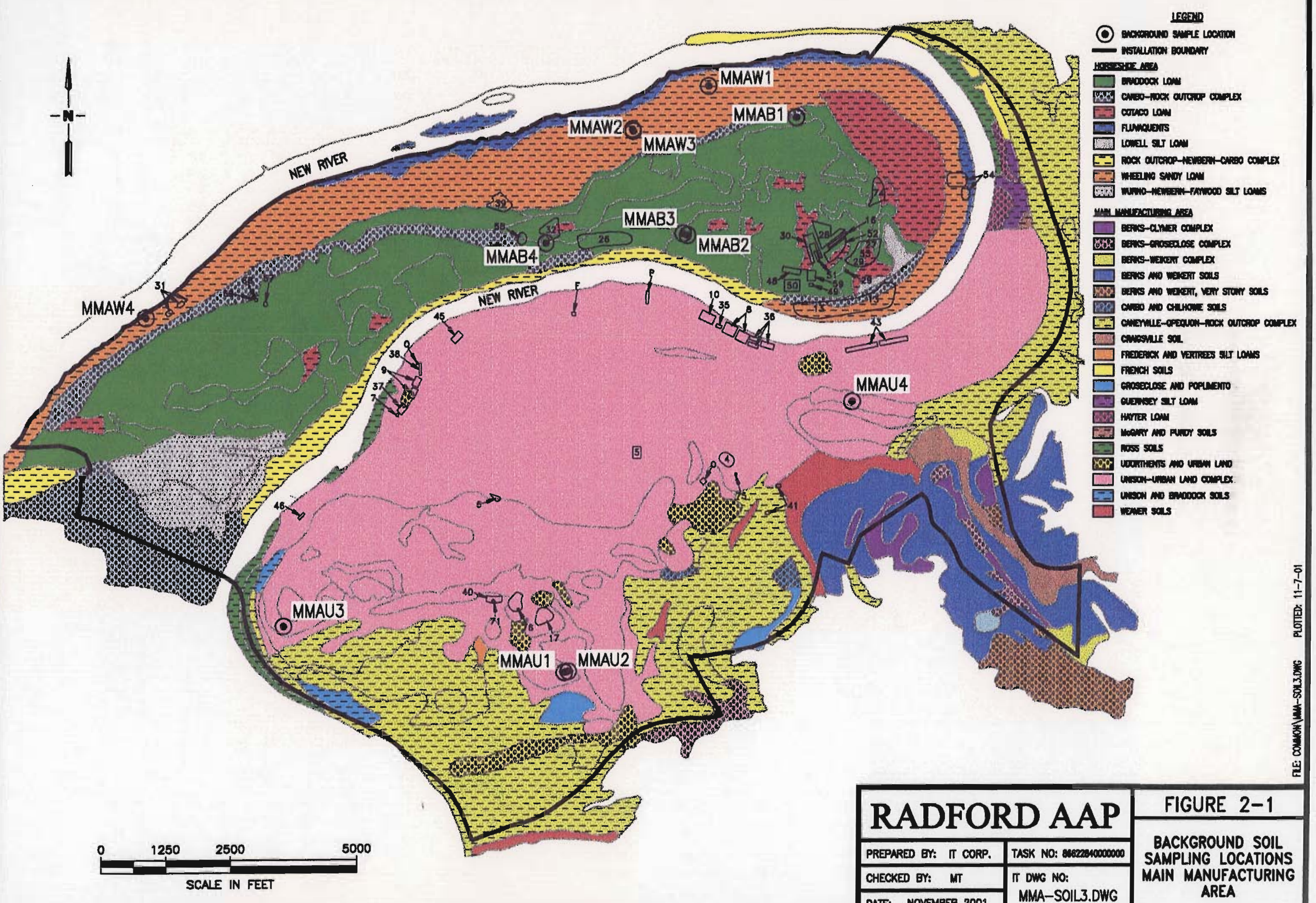


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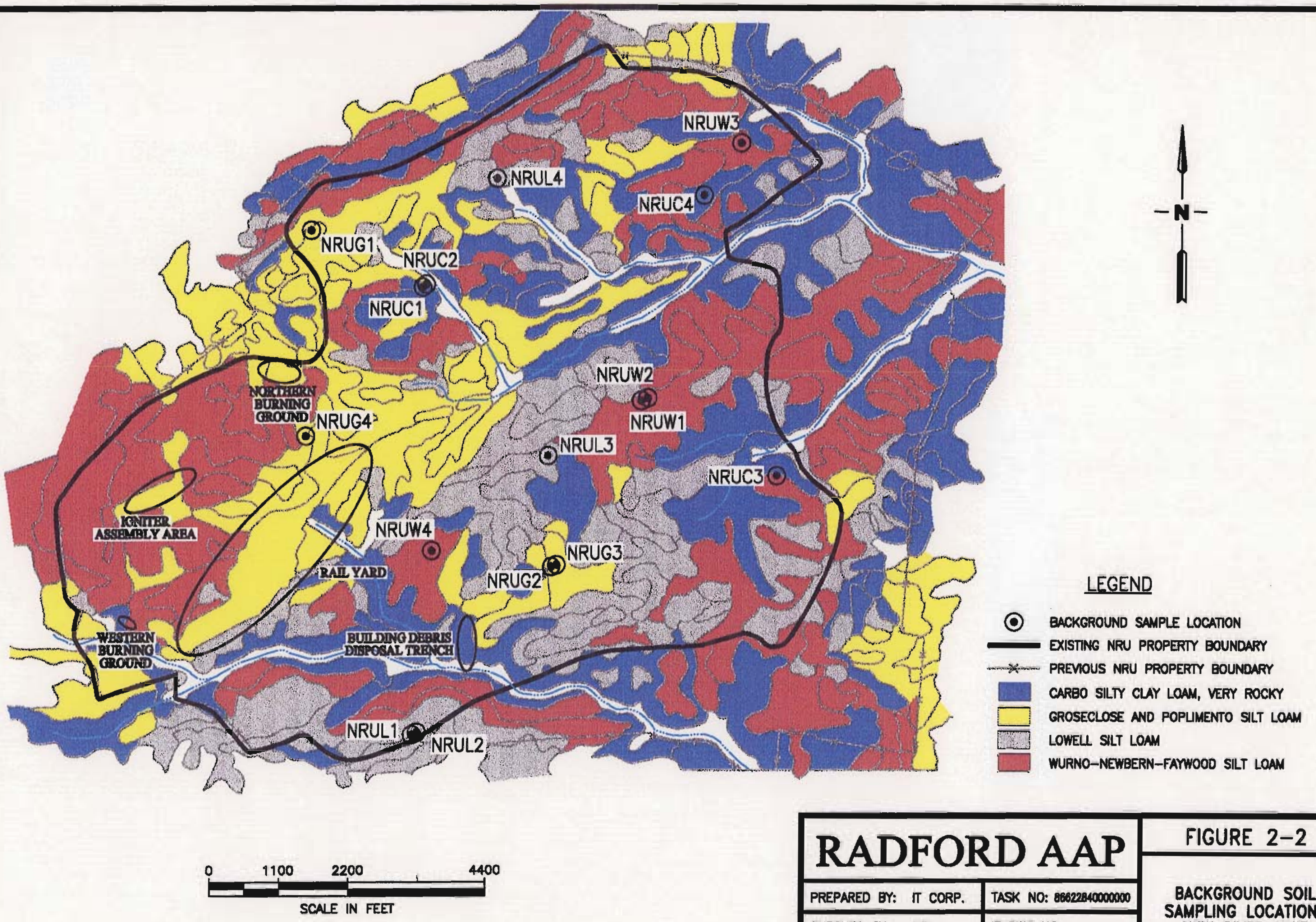
FIGURE 2-1

BACKGROUND SOIL
SAMPLING LOCATIONS
MAIN MANUFACTURING
AREA

PREPARED BY: IT CORP.
TASK NO: 86622840000000
CHECKED BY: MT
IT DWG NO: MMA-SOIL3.DWG
DATE: NOVEMBER 2001



FILE: COMMON\NRU-SOIL3.DWG PLOTTED: 11-7-01

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FIGURE 2-2

BACKGROUND SOIL
SAMPLING LOCATIONS
NEW RIVER UNIT

PREPARED BY: IT CORP.
TASK NO: 86622840000000
CHECKED BY: MT
IT DWG NO: NRU-SOIL3.DWG
DATE: NOVEMBER 2001

Table 2-1
Facility-Wide Background Study Sampling Program (Continued)

Soil Type/ Grouping	Sample ID	Matrix	Depth Top (in. bgs)	Depth Bottom (in. bgs)	Date Collected	TAL Metals 3050B/6010B (solid) 7471A (Hg solid) 3010A/6010B (aqueous) 7470A (Hg aqueous)	pH 9045C (solid)	VOCs 5035/8260B (solid) 5030B/8260B (aqueous)	SVOCs 3540C/8270C (solid) 3520C/8270C (aqueous)	TCLP Metals 1311/3010A/ 6010B 1311/7470A (Hg)	RDX Immunoassay Field Test Kit 4051	TNT Immunoassay Field Test Kit 4050
Wheeling Sandy Loam	MMAW1A	Soil	0	12	9/5/00	●	●					
	MMAW1B	Soil	12	48	9/5/00	●	●					
	MMAW1C	Soil	48	72	9/5/00	●	●					
	MMAW2A	Soil	0	7	9/6/00	●	●		●		●	●
	MMAW2B	Soil	7	48	9/6/00	●	●	●	●		●	●
	MMAW2C	Soil	48	60	9/6/00	●	●	●	●		●	●
	MMAW3A	Soil	0	12	9/6/00	●	●					
	MMAW3B	Soil	12	48	9/6/00	●	●					
	MMAW3C	Soil	48	60	9/6/00	●	●					
	MMAW4A	Soil	0	9	9/5/00	●	●					
	MMAW4B	Soil	9	42	9/5/00	●	●					
	MMAW4C	Soil	42	72	9/5/00	●	●					
Main Manufacturing Area QA/QC Samples												
	MMAW3CD	Soil	48	60	9/6/00	●	●					
	MMAU3BD	Soil	9	42	8/31/00	●	●					
	MMAB2BD	Soil	12	60	9/6/00	●	●					
	MMAW2CD	Soil	48	60	9/6/00	●	●	●	●		●	●
	083100R4	Water	N/A	N/A	8/31/00	●		●	●		●	●
	090700RB	Water	N/A	N/A	9/7/00	●						
	083100T2	Water	N/A	N/A	8/31/00			●				

Table 2-1
Facility-Wide Background Study Sampling Program (Continued)

Soil Type/ Grouping	Sample ID	Matrix	Depth Top (in. bgs)	Depth Bottom (in. bgs)	Date Collected	TAL Metals 3050B/6010B (solid) 7471A (Hg solid) 3010A/6010B (aqueous) 7470A (Hg aqueous)	pH 9045C (solid)	VOCs 5035/8260B (solid) 5030B/8260B (aqueous)	SVOCs 3540C/8270C (solid) 3520C/8270C (aqueous)	TCLP Metals 1311/3010A/ 6010B 1311/7470A (Hg)	RDX Immunoassay Field Test Kit 4051	TNT Immunoassay Field Test Kit 4050
New River Unit Environmental/Field Screening Samples												
Lowell Silt Loam	NRUL1A	Soil	0	12	8/29/00	●	●		●		●	●
	NRUL1B	Soil	12	42	8/29/00	●	●	●	●		●	●
	NRUL1C	Soil	42	55	8/29/00	●	●	●	●		●	●
	NRUL2A	Soil	0	12	8/30/00	●	●					
	NRUL2B	Soil	12	33	8/30/00	●	●					
	NRUL2C	Soil	33	60	8/30/00	●	●					
	NRUL3A	Soil	0	9	8/29/00	●	●					
	NRUL3B	Soil	9	75	8/29/00	●	●					
	NRUL3C	Soil	75	90	8/29/00	●	●					
	NRUL4A	Soil	0	10	8/29/00	●	●					
	NRUL4B	Soil	10	38	8/29/00	●	●					
	NRUL4C	Soil	38	60	8/29/00	●	●					
Wurno-Newbern-Faywood Silt Loam	NRUW1A	Soil	0	7	8/30/00	●	●		●		●	●
	NRUW1B	Soil	7	38	8/30/00	●	●	●	●		●	●
	NRUW1C	Soil	38	48	8/30/00	●	●	●	●		●	●
	NRUW2A	Soil	0	9	8/30/00	●	●					
	NRUW2B	Soil	9	28	8/30/00	●	●					
	NRUW2C	Soil	28	48	8/30/00	●	●					
	NRUW3A	Soil	0	10	8/29/00	●	●					
	NRUW3B	Soil	10	34	8/29/00	●	●					
	NRUW3C	Soil	34	45	8/29/00	●	●					
	NRUW4A	Soil	0	10	8/29/00	●	●					
	NRUW4B	Soil	10	31	8/29/00	●	●					
	NRUW4C	Soil	31	46	8/29/00	●	●					

Table 2-1
Facility-Wide Background Study Sampling Program (Continued)

Soil Type/ Grouping	Sample ID	Matrix	Depth Top (in. bgs)	Depth Bottom (in. bgs)	Date Collected	TAL Metals 3050B/6010B (solid) 7471A (Hg solid) 3010A/6010B (aqueous) 7470A (Hg aqueous)	pH 9045C (solid)	VOCs 5035/8260B (solid) 5030B/8260B (aqueous)	SVOCs 3540C/8270C (solid) 3520C/8270C (aqueous)	TCLP Metals 1311/3010A/ 6010B 1311/7470A (Hg)	RDX Immunoassay Field Test Kit 4051	TNT Immunoassay Field Test Kit 4050
Carbo Silty Clay Loam	NRUC1A	Soil	0	11	8/30/00	●	●		●		●	●
	NRUC1B	Soil	11	72	8/30/00	●	●	●	●		●	●
	NRUC2A	Soil	0	11	8/30/00	●	●					
	NRUC2B	Soil	11	72	8/30/00	●	●					
	NRUC3A	Soil	0	10	8/29/00	●	●					
	NRUC3B	Soil	10	18	8/29/00	●	●					
	NRUC4A	Soil	0	7	8/29/00	●	●					
	NRUC4B	Soil	7	30	8/29/00	●	●					
	NRUC4C	Soil	30	48	8/29/00	●	●					
Groseclose and Poplimento Silt Loam	NRUG1A	Soil	0	12	8/29/00	●	●					
	NRUG1B	Soil	12	53	8/29/00	●	●					
	NRUG1C	Soil	53	70	8/29/00	●	●					
	NRUG2A	Soil	0	7	8/30/00	●	●		●		●	●
	NRUG2B	Soil	7	34	8/30/00	●	●	●	●		●	●
	NRUG2C	Soil	34	57	8/30/00	●	●	●	●		●	●
	NRUG3A	Soil	0	12	8/30/00	●	●					
	NRUG3B	Soil	12	35	8/30/00	●	●					
	NRUG3C	Soil	35	67	8/30/00	●	●					
	NRUG4A	Soil	0	6	8/30/00	●	●					
	NRUG4B	Soil	6	39	8/30/00	●	●					
	NRUG4C	Soil	39	72	8/30/00	●	●					

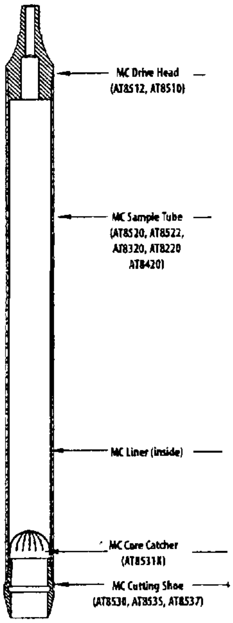
Table 2-1
Facility-Wide Background Study Sampling Program (Continued)

Soil Type/ Grouping	Sample ID	Matrix	Depth Top (in. bgs)	Depth Bottom (in. bgs)	Date Collected	TAL Metals 3050B/6010B (solid) 7471A (Hg solid) 3010A/6010B (aqueous) 7470A (Hg aqueous)	pH 9045C (solid)	VOCs 5035/8260B (solid) 5030B/8260B (aqueous)	SVOCs 3540C/8270C (solid) 3520C/8270C (aqueous)	TCLP Metals 1311/3010A/ 6010B 1311/7470A (Hg)	RDX Immunoassay Field Test Kit 4051	TNT Immunoassay Field Test Kit 4050
New River Unit QA/QC Samples												
	NRUL4BD	Soil	10	38	8/29/00	●	●					
	NRUG2BD	Soil	7	34	8/30/00	●	●	●	●			
	NRUG2CD	Soil	34	57	8/30/00	●	●		●			
	NRUW4CD	Soil	31	46	8/29/00	●	●					
	NRUL2BD	Soil	12	33	8/30/00	●	●					
	082800R1	Water	N/A	N/A	8/28/00	●	●	●	●			
	083000R2	Water	N/A	N/A	8/30/00	●						
	083000R3	Water	N/A	N/A	8/30/00	●	●					
	082800T1	Water	N/A	N/A	8/28/00			●	●			
Investigative-Derived Material Samples												
	MMADW1	Soil	N/A	N/A	9/7/00					●		
	MMADW2	Water	N/A	N/A	9/7/00					●		
	NRUDW1	Soil	N/A	N/A	9/5/00					●		
	NRUDW2	Water	N/A	N/A	9/5/00					●		

bgs = below ground surface.

Two sample locations from each soil type were clustered within a ½-acre radius of each other to evaluate organic concentrations and demonstrate that sample locations were representative of background conditions. One sample was collected from each soil horizon of the cluster and screened for the presence/absence of explosive constituents (RDX and TNT). Once field screening results indicated the absence of explosive constituents, a surface soil sample was collected from the A soil horizon and analyzed for semivolatile organic compounds (SVOCs), TAL metals, and pH. Subsurface soil samples from the B and C horizons (as applicable) were then collected and analyzed for volatile organic compounds (VOCs), SVOCs, TAL metals, and pH.

Borings were field screened using a MiniRae 2000 photoionization detector (PID) for the presence of organic vapors. PID field screening levels were not observed above background levels in the borings. No other significant field observations were noted during sampling activities.

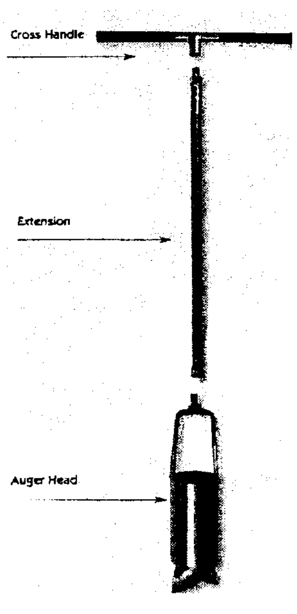


Sketch of open-tube Macro-Corer

Stratigraphic characterization of the soils was completed by the project geologist using the Unified Soil Classification System following the procedures outlined in SOP 20.6 of the MWP. Soil characterization information was then transferred to electronic lithologic boring logs and are presented in Appendix A.

2.4.1.1 Direct Push Sampling Equipment. Twenty-six of the 28 soil borings were advanced with a truck- or Bobcat-mounted Geoprobe equipped with 1.25-in.-diam. push rods; 4-ft-long, 2-in.-diam. stainless steel open-tube Macro-Core samplers; and stainless steel cutting shoes. The Macro-Core samplers were lined with a dedicated 4-ft-long, 1.5-in.-diam. Teflon sample tube. Using a hydraulic percussion hammer, the Geoprobe drove the open-tube Macro-Core sampler to the proposed sampling depth. Following the withdrawal of the Macro-Core and the removal of the Teflon tube, a cutting device was used to remove a 1-3/8-in. section along the length of the tube for soil stratigraphic characterization and sample processing. Once adequate sample volume was achieved, the boring hole was backfilled with bentonite chips. Excess soil cuttings remaining after sample processing were temporarily stored in a 55-gal drum.

2.4.1.2 Hand Auger Sampling Equipment. Soil samples were collected from two locations using a stainless steel hand auger. Hand auger equipment consisted of either a 2- or 4-in. stainless steel auger head, 4-ft stainless steel extension rods, and a plastic-coated cross handle. The auger head was slowly advanced to the desired sampling depth by manually applying pressure and turning the cross handle in a clockwise direction. This process was used to stratigraphically characterize the soil cuttings for an accurate assessment of the soil horizons. Once the desired depth was achieved, the auger head was extracted from the borehole. The soil sample was then recovered from the auger head using a decontaminated stainless steel trowel. Soil cuttings were staged on plastic in 6-inch depth intervals to assist in the assessment and positive identification of each soil horizon (Photo. 16). Once adequate sample volume was achieved, the boring hole was backfilled with bentonite chips. Excess soil cuttings remaining after sample processing were transferred and temporarily stored in a 55-gal drum.



Sketch of hand auger sampling equipment

2.4.2 RDX/TNT Field Screening

Photo. 16 View of MMAB4 hand auger soil cuttings

One sample was collected from each soil horizon of a clustered boring from each soil type and screened for the presence/absence of explosive constituents (RDX and TNT). Samples were field screened using RDX and TNT immunoassay test kits following the procedures outlined in SOP 30.13 of Work Plan Addendum 10 (IT Corp 2000). Sample results were below 0.5 mg/kg, indicating neither RDX or TNT were present. Table 2-1 presents a complete list of samples screened for explosive constituents.

Samples were analyzed for RDX for field screening using immunoassay method U.S. Environmental Protection Agency (USEPA) SW-846 4051. This method is a test kit procedure for screening soils to assess when RDX is present at concentrations above 0.5 mg/kg and provides an estimate of the concentration of RDX by comparison with a reference. The method is performed using an extract of a soil sample. Samples and an enzyme conjugate reagent are added to immobilized RDX antibody. The enzyme-RDX conjugate "competes" with RDX present in the sample for binding to an immobilized RDX antibody. The enzyme-RDX conjugate bound to the antibody then catalyzes a colorless substrate to a colored product. The test was interpreted by comparing the color produced by a sample to the response produced by a reference reaction.

Samples were analyzed for TNT for field screening using immunoassay method USEPA SW-846 4050. This method involved a test kit procedure for screening soils to assess when TNT was present at concentrations above 0.5 mg/kg and provide an estimate for the concentration of TNT by comparison with a reference. The method was performed using an extract of a soil sample. Samples and an enzyme-TNT conjugate reagent were added to an immobilized TNT antibody. The enzyme-TNT conjugate "competed" with TNT present in the sample for binding to the immobilized TNT antibody. The enzyme-TNT conjugate bound to the TNT antibody then catalyzed a colorless substrate to a colored product. The test was interpreted by comparing the color produced by a sample to the response produced by a reference reaction.

2.4.3 Investigative Derived Material

Activities were performed in accordance with Work Plan Addendum No. 10, as approved by USEPA Region III, regarding the identification, handling, and disposal of nonhazardous investigative-derived materials (IDM). Material disposal was documented in the field logbook. Specific compliance issues that were confronted during investigative activities included the following:

- **Accumulation and storage.** IDM accumulated during field sampling activities included soil cuttings, decontamination water, direct push acetate liners, and PPE. Soil cuttings and decontamination water were stored in separate appropriately labeled 55-gallon steel drums. Direct push acetate liners and used PPE were stored together in 55-gallon drums. Containerized materials were stored at ATK-approved areas.

- **Material characterization.** Soil cuttings and decontamination water were sampled before disposal to assess waste characteristics, in accordance with 40 Code of Federal Regulations (CFR) 264 and Virginia Hazardous Waste Management Regulations. Based on analytical results, soil and decontamination water sampled were classified as nonhazardous materials.

- **Transporter, storage, and disposal facility.** Soil cuttings, acetate liners, and PPE were disposed of at Tazewell County Landfill in Tazewell, VA. Before disposal, waste profile results were provided to the installation, IDM management subcontractor, and the disposal facility for review and approval. An alternate straight bill of lading was obtained before transport of IDM from the accumulation and storage areas to the disposal facility. Disposal records were provided to the Installation and are also kept on file by the IT Corporation.

- **Decontamination water.** Following analysis, the Installation and RFAAP Wastewater Treatment Plant engineer were provided with a copy of the decontamination water sample results for review.

After receiving approval, decontamination water from both the MMA and the NRU was disposed into the collection system of the Wastewater Treatment Plant.

2.4.4 Global Positioning System Activities

Sample location coordinates and elevations were obtained using a Trimble Pathfinder Pro XRS GPS. The Pathfinder Pro XRS system was used to obtain real-time position information with submeter accuracy and elevations at 1.5 to 2 times the horizontal accuracy. Position information was recorded in the U.S. State [Virginia (South)] Plane Coordinate System (measured in U.S. survey feet) using the North American Datum 1927. Position information will be entered into the Environmental Restoration Information System (ERIS) database when available.

Because of the significant thickness of the tree canopy at three of the sample locations, coordinates were recorded from offset locations outside of the tree stands. The offsets were accurately measured with a measuring tape in the field and subsequently corrected. GPS coordinates and offset measurements were logged in the field logbook. Sample location coordinates and elevations presented in Table 2-2 have been entered into the project coordinate system and placed on the appropriate maps.

Table 2-2
Facility-Wide Background Study Soil Sampling Location Coordinates

Sample ID	Northing[1]	Easting[1]	Elevation[2]
MMAB1	322754.74	1409440.92	1775.79
MMAB2	320488.18	1407197.33	1864.67
MMAB3	320455.40	1407283.00	1873.21
MMAB4	320307.27	1404474.28	1810.97
MMAU1	311874.44	1404852.06	1981.12
MMAU2	311894.11	1404927.43	1984.71
MMAU3	312818.61	1399297.22	1865.59
MMAU4	317114.33	1410570.69	1739.69
MMAW1	323380.27	1407708.13	1701.63
MMAW2	322524.87	1406195.59	1721.48
MMAW3	322490.09	1406208.06	1713.45
MMAW4	318887.05	1396623.75	1706.53
NRUC1	290201.32	1371017.04	2097.89
NRUC2	290249.23	1371073.44	2095.13
NRUC3	287199.88	1376699.21	2065.71
NRUC4	291651.58	1375527.09	1994.78
NRUG1	291100.64	1369289.30	2127.55
NRUG2	285754.38	1373142.44	2048.85
NRUG3	285805.98	1373194.73	2055.94
NRUG4	287847.94	1369157.99	2081.28
NRUL1	283098.57	1370857.28	2079.74
NRUL2	283137.30	1370938.17	2083.87
NRUL3	287529.94	1373041.77	2070.23
NRUL4	291929.19	1372212.65	2066.71
NRUW1	288400.94	1374521.86	2094.89
NRUW2	288406.80	1374603.18	2090.78
NRUW3	292482.85	1376121.87	2059.68
NRUW4	286025.86	1371167.20	2086.39

[1] Virginia State Planar Coordinate System (NAD 27) measured in U.S. survey feet

[2] Feet above mean sea level.

3.0 Quality Assurance

Quality Assurance (QA) is defined as the overall system for assuring the reliability of data produced. The system integrates the quality planning, assessment, and improvement efforts of various groups in the organization to provide the independent QA program necessary to establish and maintain an effective system for collection and analysis of environmental samples and related activities. The program also encompasses the generation of usable and complete data as well as its subsequent review, validation, and documentation.

The accuracy and integrity of background data were ensured through the implementation of internal quality control measures in accordance with Work Plan Addendum No. 10, as approved by USEPA Region III. QA and quality control activities, including field quality control, laboratory quality control, and data management, were integrated into the background study program.

The analytical services for the background study were provided by the following USACE-validated laboratories:

- Envirosystems, Inc., Columbia, MD. Envirosystems, Inc., used USEPA-SW846, 3rd ed., Test Methods for Evaluating Solid Waste, Update III (USEPA 1996) methodologies in providing analytical support for pH and USEPA CLP SOW OLMO 4.2 (USEPA 1999) for VOCs and SVOCs. Metals analyses were subcontracted to Severn Trent Laboratories.
- Severn Trent Laboratories (STL), Sparks, MD. STL used USEPA-SW846, 3rd ed., Test Methods for Evaluating Solid Waste, Update III (USEPA 1996) methodologies in providing analytical support for TAL metals and Toxicity Characteristic Leachate Procedure (TCLP) metals.

3.1 ANALYTICAL METHODS

Analytical protocols used were in accordance with USEPA-approved methods for the analysis to include USEPA TAL metals, Target Compound List (TCL) VOCs, SVOCs, and pH. Samples collected to characterize investigative-derived materials were analyzed for hazardous waste characteristics. The methodologies are included below.

- **Inorganics.** Samples were analyzed for USEPA TAL metals using a combination of inductively coupled plasma emission spectroscopy (ICP) and cold vapor atomic absorption (CVAA). Trace metals were analyzed using USEPA SW-846 Method 3010A/6010B (USEPA 1996) for aqueous samples and Method 3050B/6010B (USEPA 1996) for solid samples. The pH was analyzed using USEPA SW-846 Method 9045C (USEPA 1996) for solid samples.
- **Organics.** Samples were analyzed for TCL VOCs using USEPA CLP SOW OLMO 4.2 (USEPA 1999) for aqueous and solid matrices using purge and trap technology. The EnCore sampling technique was used for the soil samples.

  Samples were analyzed for TCL semivolatiles using USEPA CLP SOW OLMO 4.2 (USEPA 1999).
- **TCLP Extraction.** Soil samples collected for material characterization were extracted using the TCLP SW-846 Method 1311 (USEPA 1996).

3.2 FIELD QUALITY CONTROL

3.2.1 Field Samples

Table 3-1 presents a summary of field quality control samples collected during background sampling activities, including the purpose of each quality control element and the required collection frequency that was adhered to during field sampling activities.

Sample Management. Sample management quality control consisted of the following field QA items. The number and types of environmental and quality control samples collected during the background sampling event are included in Table 3-2.

Table 3-1
Field Quality Control Samples Collected During Background Study Sampling Activities

Control	Purpose of Sample	Frequency	Number of Samples Collected				Total
			MMA		NRU		
			Aqueous	Solid	Aqueous	Solid	
Duplicate sample	Ensure precision in sample homogeneity	10%	NA	4	NA	6	10
Rinse blank	Ensure the decontamination of sampling equipment has been adequately performed to assess cross-contamination and/or incidental contamination to the sample container	5%	NA	2	NA	3	5
Temperature blank	Verify sample cooler temperature during transport	Per cooler	NA	2	NA	2	4
Trip blank	Assess if cross-contamination occurs during shipment or storage with aqueous VOC samples	Per cooler	1	NA	1	NA	2

NA = not applicable.

Table 3-2
Number and Type of Samples Collected During Background Study Sampling Activities

Sample	Area		Total Samples
	MMA	NRU	
Surface Soil	12	16	28
Subsurface Soil	22	29	51
Total Environmental	**34**	**45**	**79**
Trip Blank	1	1	2
Rinse Blank	2	3	5
MS	2	3	5
MSD	2	3	5
Field Duplicate	4	6	10
Total QC	**11**	**16**	**27**
Investigative Derived Material (aqueous)	1	1	2
(solid)	1	1	2
Total IDM	**2**	**2**	**4**
Total Samples	**47**	**63**	**110**

- **Sample identification.** The sample identification number was consistent with past nomenclature at RFAAP. The sample identification consisted of an alphanumeric designation related to the site location, soil group type, sampling location number, and sampled depth.
- **Site location code.** The first two characters were identified by the site location abbreviation. The identification included the following:

MMA = Main Manufacturing Area
NRU = New River Unit

- **Sample/media type.** The second two characters were the sample/media type. Sample types were designated by the following codes:
    - B = Braddock Loam
    - C = Carbo Silty Clay, Very Rocky
    - DW = IDM
    - G = Groseclose and Poplimento Silt Loam
    - L = Lowell Silt Loam
    - U = Unison-Urban Land Complex
    - W = Wheeling Sandy Loam or Wurno-Newbern-Faywood Silt Loam
- **Sampling location number.** The next one or two characters were the number of the sampling location (e.g., 1, 2, 3, . . . , 9, 10, 11, . . .).
- **Sampled depth.** At sites where there were several samples to be collected at different horizons, the sequential collection order was followed by a letter in alphabetic order indicating shallow to deep depths (e.g., A, B, C), where A was the surface soil sample or A horizon.

Envirosystems, Inc.	
Site Name: RFAAP	Date: 08/31/00
Sample I.D.: MMAB1A	Time: 0940
Analysis Required: TAL Metals & pH	Preservative: ICE
	Sampled by: MT/GZ

Example sample container label

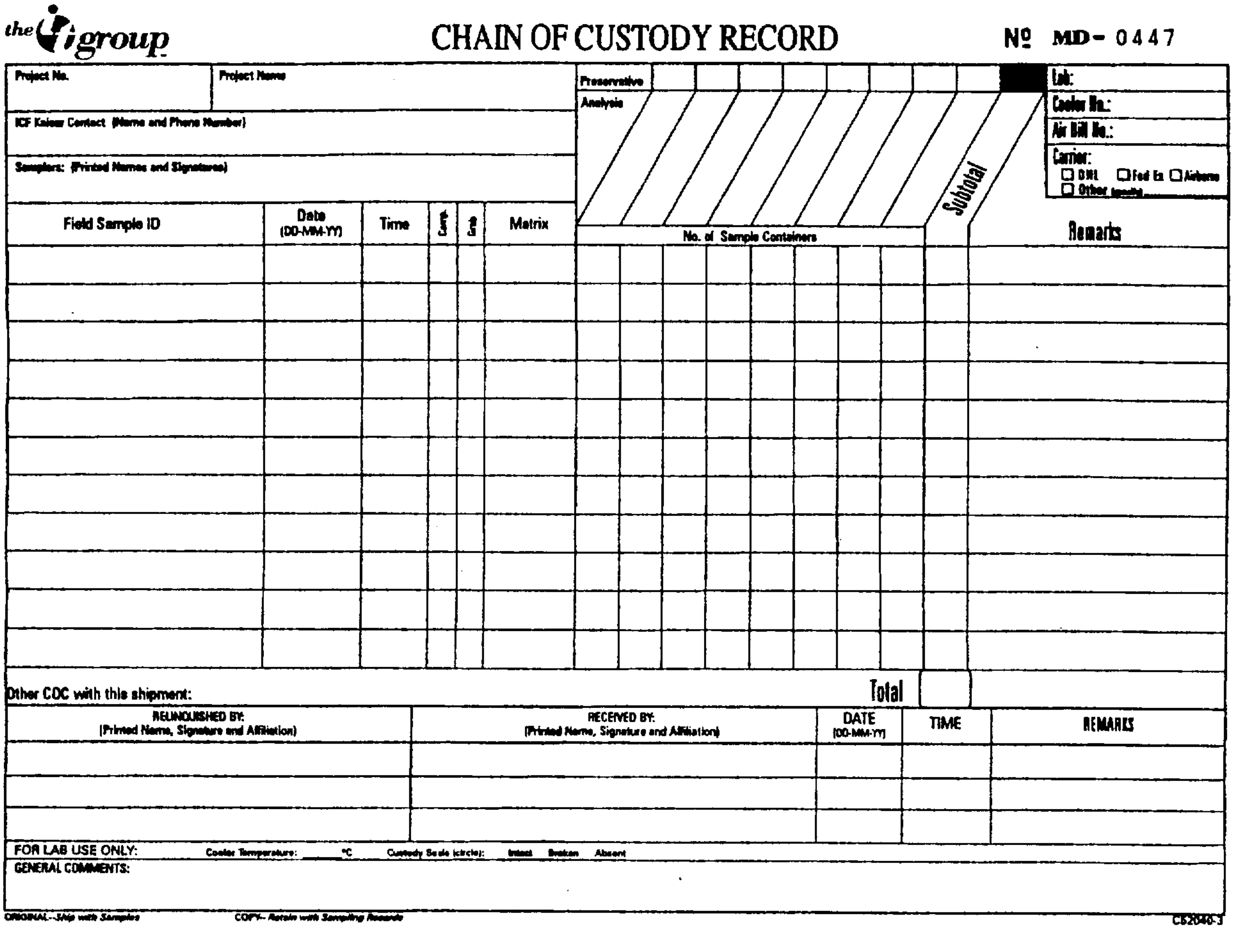
- **Duplicate.** Duplicate samples were identified with a "D" designation. A record of the samples that correspond to the duplicates was kept in the field logbook.
- **Quality control samples.** QC samples were identified by date (mo,day,yr), followed by QC sample type, and sequential order number at one digit. The QC sample types included:
    - R = Rinse Blank
    - T = Trip Blank

Documentation. Information pertinent to the sampling effort was recorded in a field logbook and the associated samples were traced by a Chain-of-Custody (COC) Form. Entries were made in indelible ink on consecutively numbered pages, and corrections consisted of line-out deletions that were initialed and dated.

Each sample container was labeled in waterproof ink with the sample identification, sampling date, required laboratory analyses, and preservatives. The sample labels were permanently affixed to the sample container using polyethylene tape.

Chain-of-custody procedures. Sampling was evidenced through the completion of a COC Form, which accompanied the samples in the field, during transit to the laboratory, and upon receipt by the laboratory. The COC form was filled out using indelible ink and annotated to indicate time and date that samples were relinquished to the shipping facility (Federal Express). In addition, shipping coolers were affixed with custody seals.

Field Parameter Form procedures. Documentation of collected samples was provided to the laboratory on electronic Field Parameter Forms. Field Parameter Forms were filled out based on information recorded in field logbooks and were completed at the end of each sampling week for every sample, including QC samples. The completed forms contained the following information fields for encoding chemical data into the ERIS database:



the IT group

CHAIN OF CUSTODY RECORD

№ MD- 0447

Project No.

Project Name

ICF Kaiser Contact (Name and Phone Number)

Samplers: (Printed Names and Signatures)

Preservative

Analysis

Lab:

Cooler No.:

Air Bill No.:

Carrier:
☐ DHL ☐ Fed Ex ☐ Airborne
☐ Other (specify)

Field Sample ID	Date (DD-MM-YY)	Time			Matrix	No. of Sample Containers								Subtotal	Remarks

Other COC with this shipment: Total

RELINQUISHED BY: (Printed Name, Signature and Affiliation)	RECEIVED BY: (Printed Name, Signature and Affiliation)	DATE (DD-MM-YY)	TIME	REMARKS

FOR LAB USE ONLY: Cooler Temperature: ____ °C Custody Seals (circle): Intact Broken Absent

GENERAL COMMENTS:

ORIGINAL--Ship with Samples COPY-- Retain with Sampling Records C52040-3

3.2.1.1 Field Performance Audit. A field audit of site activities was conducted on September 7, 2000, by the QA/QC Manager and Project Chemist. During this audit current field practices were compared to the operating procedures outlined in the project work plans (i.e., Work Plan, QAP).

Two minor deficiencies were identified that were associated with project documentation. Field activities associated with the audited work phase were compliant and found satisfactory with work plan specifications. The matrix spike/matrix spike duplicate (MS/MSD) QC sample and soil horizons were not clearly identified in the logbook. This information was captured in other documentation associated with the project. Following audit completion, deficiencies were discussed with the field staff and corrective action was taken.

3.2.2 Laboratory Quality Control

3.2.2.1 Data Review and Validation. Data obtained from the laboratory was reviewed by the IT QA Manager to assess whether the project-specific data quality objectives, as defined in the Quality Assurance Plan Addendum (QAPA), were met. An in-depth discussion of the validation process and copies of the validation reports are presented in Appendix B.

3.2.2.2 Data Reduction. Data reduction procedures address the reliability of computations and the overall accuracy of the data reduction. Data reduction included computation of analytical results from raw instrument data and summary statistics, including standard errors, confidence intervals, test of hypotheses relative to the parameters, and model validation. The numerical transformation algorithms used for data reduction were verified against a known problem set to ensure that the reduction methods are correct.

3.2.2.3 Data Quality Measurements. Data quality objectives were developed concurrently with the work plan to ensure (1) the reliability of field sampling, chemical analyses, and physical analyses; (2) the collection of sufficient data; (3) the quality of data generated was acceptable for its intended use; and (4) valid assumptions could be inferred from the data. Attainment of data quality objectives was assessed through evaluation of data collected using data quality indicators.

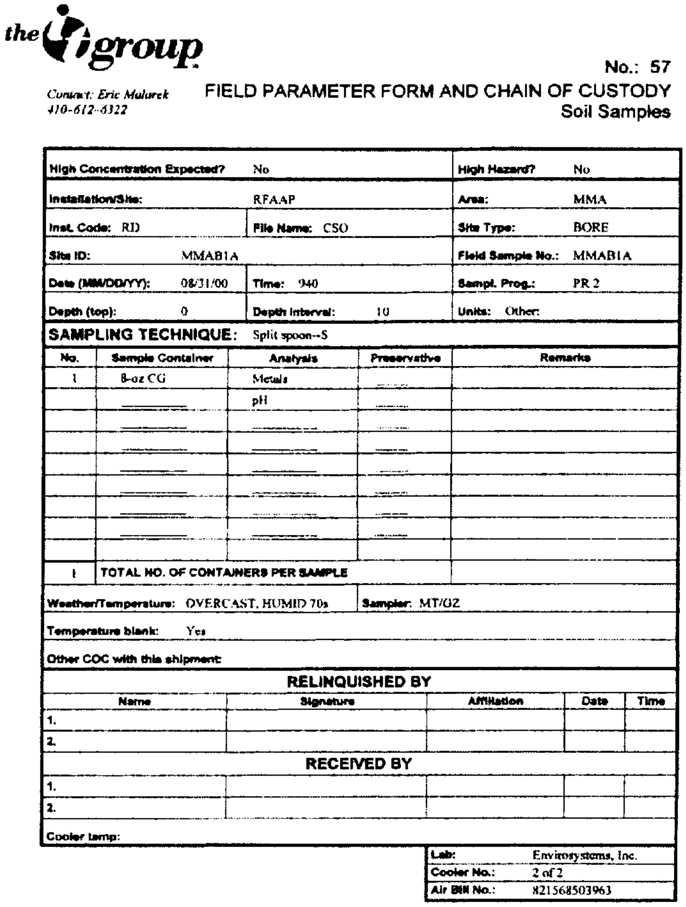
Table 3-3 outlines the data quality indicators as to their definitions, project goals, sampling and analytical assessments. Data quality was assessed through the evaluation of sampling activities and field measurements associated with the chemical analytical data in order to assess the reliability of the chemical analyses and the accuracy and precision of information acquired from the laboratory.

Precision. Method or laboratory precision by the laboratory was evaluated during the validation process. Overall sampling or field precision was evaluated during the data review process. Precision is measured by calculating and evaluating the relative percent difference (RPD) between the results of field or laboratory duplicates. The RPD is calculated by the following equation:

$$\text{RPD}\ (\%) = \frac{/\text{XA} - \text{XB})/}{\text{XM} * 100} \qquad (1)$$

where

XA and XB = duplicate analyses, and
XM = the mean value of duplicate analyses (XA + XB)/2.



the group

No.: 57

Contact: Eric Malarek
410-612-6322

FIELD PARAMETER FORM AND CHAIN OF CUSTODY
Soil Samples

High Concentration Expected? No		**High Hazard?** No	
Installation/Site: RFAAP		**Area:** MMA	
Inst. Code: RD	**File Name:** CSO	**Site Type:** BORE	
Site ID: MMAB1A		**Field Sample No.:** MMAB1A	
Date (MM/DD/YY): 08/31/00	**Time:** 940	**Sampl. Prog.:** PR 2	
Depth (top): 0	**Depth Interval:** 10	**Units:** Other:	

SAMPLING TECHNIQUE: Split spoon--S

No.	Sample Container	Analysis	Preservative	Remarks
1	8-oz CG	Metals		
		pH		
1	TOTAL NO. OF CONTAINERS PER SAMPLE			

Weather/Temperature: OVERCAST, HUMID 70s **Sampler:** MT/OZ

Temperature blank: Yes

Other COC with this shipment:

RELINQUISHED BY

Name	Signature	Affiliation	Date	Time
1.				
2.				

RECEIVED BY

1.				
2.				

Cooler temp:

Lab:	Envirosystems, Inc.
Cooler No.:	2 of 2
Air Bill No.:	821568503963

Field duplicates were collected on a 10% frequency per matrix to identify the cumulative precision of the sampling and analytical process, which includes the homogenization of soil and sediment samples. Precision was checked by regularly obtaining duplicate samples for each parameter and each media. Precision of field duplicates was assessed through calculation of the RPD between the positive results detected in the original sample and the field duplicate. The advisory limits were established by the USEPA Region III guidelines.

In instances where either the sample or the duplicate was non-detect "U," rejected "R," or blank contaminated "B" for a particular compound, a duplicate assessment was not performed. Sample results exceeding guidance values should be considered as estimated. Table 3-4 presents a summary of non-conformance field duplicate values. Sample values noted should be considered usable and estimated for the samples and compounds listed.

Accuracy. Accuracy is the measure of bias in a system. The accuracy of the results are measured by percent recovery (%R):

$$\%\text{R} = \frac{\text{test value}}{\text{true value}} * 100 \qquad (2)$$

or

$$\%\text{R} = \frac{\text{spiked value - unspiked sample}}{\text{amount spiked}} * 100 \qquad (3)$$

Table 3-3
Background Study Data Quality Indicators

Data Quality Indicator	Definition	Goal	Sampling Assessment	Analytical Assessment
Precision	Quantitative measure of the variability of a group of measurements in comparison to the average value	Low relative percent difference	Duplicate samples	MS/MSD
Accuracy	Bias in a measurement system	Low bias	Blank contamination	Analysis spike results
Representativeness	Degree to which the measured results accurately reflect the medium being sampled	100%	Holding times, blanks, associated documentation	Inferred from accuracy, precision, and completeness evaluation
Completeness	Percentage of measurements which are judged to be usable	98±2%	Records review	Data validation
Comparability	Qualitative parameter expressing the confidence with which one data set can be compared with another	High	Work plans, quality documents	Analytical methods
Sensitivity	Quantitative measure of the level of detection and quantitation.	High	Review of analytical method or procedures and instrumentation	Analysis of MDL studies and practical quantitation limits per analytical method

Laboratory analytical accuracy was assessed through the use of laboratory blanks (method and instrument), laboratory control samples (LCS), and MSs. Laboratory analytical accuracy was reviewed during the validation of data. Sampling accuracy was assessed by evaluating the results of the rinse water. The data validation qualifiers would be applied for analytical non-conformances as outlined in the USEPA validation guidance.

- ***Method blanks.*** A method blank is a volume of analyte-free water or soil that is processed through the entire analytical scheme (i.e., extraction, digestion, concentration, and analysis) as with the actual samples. Method blanks monitor potential laboratory-induced contamination. Method blanks were found to be less than the method reporting limit (MRL).

- ***Laboratory control sample.*** The LCS was analyzed to assess general method performance by the ability of the laboratory to successfully recover the target analytes from a control matrix. LCS recoveries were found to be within acceptable limits during the validation process.

- ***Matrix Spikes.*** The MS was used to assess the performance of the method as applied to a particular project matrix. MS non-conformances were found in every sample delivery group. Antimony was found to produce low recoveries and was qualified bias low. In some cases, antimony was excessively low in recovery, and non-detects were rejected. Other bias low recoveries included the elements arsenic, selenium, chromium, potassium, vanadium, beryllium, cobalt, lead, and manganese for select spiked samples. Data were qualified "L" or "UL" in accordance with USEPA Region III guidance and were found to be estimated and usable.

- ***Rinse blanks.*** The blank contamination assessment was performed to assess the impact of contaminant contributions originating from non-point sources, such as field sampling equipment decontamination procedures. Rinse blank contamination assessment was completed through identifying appropriate sources of water and completing rinse blanks as required by the QAPA. In accordance with the USEPA data validation guidelines (USEPA 1995), the detected concentration in the sample was considered "B-qualified" if the sample concentration was within five times (10 times for common laboratory contaminants such as acetone, 2-butanone, methylene chloride, phthalate esters) the concentration of the associated rinse blank.

Table 3-4
Field Duplicate Summary Greater than 35%

[Units in mg/kg]

FIELD ID	ANALYTE	RESULT	LAB QUALIF	VAL QUALIF	DUP ID	DUP RESULT	LAB QUALIF	VAL QUALIF	RPD
MMAW2C	Aluminum	4430	N		MMAW2CD	19900	N		127%
MMAW2C	Arsenic	4.7			MMAW2CD	15.3			106%
MMAW2C	Chromium	11			MMAW2CD	35.4			105%
MMAW2C	Copper	5			MMAW2CD	21.3			124%
MMAW2C	Iron	10100	N		MMAW2CD	35500	N		111%
MMAW2C	Lead	10.8			MMAW2CD	23.6			74.4%
MMAW2C	Vanadium	23.1			MMAW2CD	75.2			106%
MMAW2C	Zinc	14.4	E	J	MMAW2CD	37.7	E	J	89.4%
MMAW3C	Thallium	3.2			MMAW3CD	1.2			90.9%
NRUG2B	Arsenic	2.5	N	J	NRUG2BD	3.6		J	36.1%
NRUG2B	Iron	10500			NRUG2BD	24600			80.3%
NRUG2C	Arsenic	4.3	N	J	NRUG2CD	2.4		J	56.7%
NRUG2C	Cobalt	70.1		J	NRUG2CD	41.1			52.2%
NRUG2C	Manganese	523	*	J	NRUG2CD	364	N	L	35.9%
NRUL2B	Copper	19.7		J	NRUL2BD	4.2		J	130%
NRUL2B	Magnesium	2310	E	J	NRUL2BD	1240	E	J	60.3%
NRUL2B	Nickel	8.9		L	NRUL2BD	5.7		L	43.8%
NRUL2B	Potassium	1700	N	L	NRUL2BD	956	N	L	56.0%
NRUW4C	Calcium	149			NRUW4CD	243			48.0%
NRUW4C	Cobalt	7.6	N	J	NRUW4CD	27.4	N	J	113%
NRUW4C	Manganese	68.3	*		NRUW4CD	187	*		93.0%

*= duplicate analysis not within control limits.
E = reported value is estimated because of the presence of interferences.
J = analyte present. Reported value may not be accurate or precise (estimated).
L = analyte present. Reported value may be biased low (estimated).
N = laboratory spike sample recovery not within control limits.

Rinse blank 0083000R3 contained trace levels of arsenic and selenium. Associated samples within the five times action level were qualified "B" in accordance with USEPA Region III guidance (Appendix D). These samples were evaluated at one-half of each sample MRL.

A discussion of the blank results is provided within each validation report in Appendix B. Table 3-5 indicates those data that are "B" flagged due to blank contamination. The table summarizes samples qualified for the background study field investigation due to rinse blank contamination. Those compounds that were detected in both the blanks and the associated samples below the USEPA guidance blank action levels are listed.

Completeness. Completeness is a measure of the amount of information that must be collected during the field investigation to allow for successful achievement of the objectives. An adequate amount and type of data must be collected for conclusions to be valid. Missing data may reduce the precision of estimates or introduce bias, thus lowering the confidence level of the conclusions. While completeness has been historically presented as a percentage of the data that is considered usable, this does not take into account critical sample locations or critical analytical parameters.

The amount and type of data that may be lost due to sampling or analytical error cannot be predicted or evaluated in advance. The importance of lost or suspect data will be evaluated in terms of the sample location, analytical parameter, nature of the problem, decision to be made, and the consequence of an erroneous decision. Critical locations or parameters for which data is found to be inadequate will either be re-sampled and re-analyzed or the data will be appropriately qualified based on the decision of the project QA manager. The completeness goal percentage of usable data is set at 98±2%. Completeness was calculated using the following equation:

$$\% \text{ Completeness} = \frac{\text{No. of usable data}}{\text{No. of requested analyses}} \qquad (4)$$

Table 3-5
B-Qualified Data Summary

[Units in mg/kg]

FIELD ID	ANALYTE	RESULT	LAB QUALIF
NRUC2A	Arsenic	2.6	N
NRUC2B	Arsenic	4.8	N
NRUG3A	Arsenic	3.6	
NRUG3B	Arsenic	3.8	N
NRUG3C	Arsenic	2.7	N
NRUG4A	Arsenic	2.8	N*
NRUG4B	Arsenic	3.2	N*
NRUL2A	Arsenic	5.1	
NRUL2A	Selenium	0.77	N
NRUL2BD	Arsenic	4.7	
NRUL2C	Arsenic	4.2	
NRUW2B	Arsenic	2.8	

* = duplicate analysis not within control limits.
B = the analyte or compound has been detected in the sample and laboratory method blank and/or associated field sample.
N = laboratory spike sample recovery not within control limits.

The number of samples actually collected with acceptable results were compared to the number of samples proposed in the QAPA. The percent completeness was with the acceptable range relative to the number of samples planned.

Representativeness. Representativeness is a measure of the degree to which the measured results accurately reflect the medium being sampled. It is a qualitative parameter that is addressed through the proper design of the sampling program in terms of sample location, number of samples, and actual material collected as a "sample" of the whole.

Sampling protocols were developed to assure that samples collected are representative of the media. Field handling protocols (e.g., storage, handling in the field, and shipping) were designed to protect the representativeness of the collected samples. Proper field documentation and QC inspections were used to establish that protocols were followed and that sample identification and integrity was maintained.

Comparability. Comparability is the confidence with which one data set can be compared to another. Comparability was controlled through the use of SOPs that have been developed to standardize the collection of measurements and samples and approved analytical technique with defined QC criteria. USEPA-SW846, 3rd ed., *Test Methods for Evaluating Solid Waste,* Update III (USEPA 1996) methodologies for inorganics and USEPA CLP SOW OLMO 4.2 (USEPA 1999) for organics were used in providing laboratory analytical support for this project. Laboratory SOPs were developed from these methods. Consistent and proper calibration of equipment throughout the field exercises, as described in the Master Quality Assurance Plan and QAPA, will assist in the comparability of measurements. Field documentation and QA audits were used to establish that protocols for sampling and measurement follow appropriate SOPs.

Sensitivity (quantitation and detection limits). The term sensitivity is used broadly to describe the method detection, quantitation, and reporting limits established to meet project-specific data quality objectives; and not limited to the definition which describes the capability of a method or instrument to discriminate between measurement responses. The method detection limits (MDLs) and the minimum quantitation limits (MQLs) published within USEPA methods are based upon a reagent water matrix, and are not necessarily reflective of typical sample matrices; therefore, care will be taken in establishing limits for laboratory analysis. Methods were selected based upon their sensitivity, technological, and economical considerations while keeping the screening values and available methodology in mind. The published limits may not be achievable for environmental samples, but they should compare reasonably with control samples. This compliance is verified during data validation process. Each target compound for every sample was reported at a specific MRL or Contract Required Quantitation Limit (CRQL). The target analytes detected above the MDL but less than the MRL (inorganics) or CRQL (organics) were reported as estimated values. Target analytes detected above the upper calibration standard were diluted and analyzed within established calibration windows.

The MQLs and MDLs were compared at the onset of the project. The MDL is the minimum concentration of an analyte that can be measured and reported with a 99% confidence that the analyte is above zero and is identified from the analysis of a sample in a given matrix containing the analyte. The MDLs are derived by the method based upon 40 CFR (Code of Federal Regulations) Chapter 136 Appendix B. The MDL established using this procedure was used to assess the importance of the measurement of a future sample. The laboratory MDLs derived were less than the MQLs. The laboratory has statistically derived MDLs below the MQLs. The MDL values are different and change periodically because each MDL is laboratory, instrument, analyst, matrix, and method specific.

The MQL and the CRQL are the values at which the laboratory has demonstrated the ability to reliably quantitate the target value of an analyte for the method performed. The MQL and the CRQL are based upon the lowest calibration standard used for the initial calibration curve or the lowest verification standard performed. Data is calculated over a linear range. The highest concentration of the standards is truncated until linearity is achieved (minimum of three concentration levels must remain). The resulting highest concentration within the linear range represents the upper quantitation limit.

The laboratory used a MRL for each sample. The MRL is the USACE term for sample quantitation limit (USACE 1998). The reporting limit is the threshold value below which the laboratory reports non-detected values as "U," "ND," or "<" and will vary for each sample based upon dilution, sample volumes, percent moistures (for solids), and the method performed. Positive values found in blanks (method, rinse, trip) above the MDL were reported. Positive results below the MRL and above the MDL are to be reported as estimated for organics. For inorganics, results below the Contract Required Detection Limit and above the MDL are reported as estimated. Non-detects were reported at the reporting limit for organics and the MDL for inorganics. The units for aqueous samples were µg/L and for solid samples were µg/g.

3.2.2.4 Laboratory Systems Audit. Laboratory activities performed under contract to IT are required to meet applicable contractual and project requirements. Before the submittal of project samples to the laboratory, the QA/QC Manager and the Project Chemist verified that technical requirements were planned and work pre-requisites were identified and met. Within the scope of laboratory system audits, definable features of work included analytical support for soil analysis and verification of the following:

- The requisite validations were achieved;
- The Laboratory Quality Assurance Plan was reviewed and accepted by IT;
- Laboratory equipment was of appropriate type, sensitivity, and quantity for its intended use;
- Facilities were appropriate for the expected sample load;
- Responsibilities were assigned and communicated;
- Laboratory staff were qualified to perform their jobs;
- Subcontracting restrictions were not been violated; and
- Approved procedures and controls were in place.

Discrepancies between actual conditions and approved plans or procedures were resolved, and corrective actions for unsatisfactory and nonconforming conditions were verified by the Project QA/QC Manager before granting approval to begin work.

The laboratory was evaluated by the Project QA Manager and Chemist to evaluate each definable feature of work including, but not limited to, the following:

- Size and appearance of the facility;
- Quantity, age, availability, scheduled maintenance, and performance of instrumentation;
- Availability, appropriateness, utilization, and adherence to the SOPs and methods;

- Staff qualifications, experience, and personnel training programs;
- Reagents, standards, and sample storage facilities;
- Standard preparation logbooks and raw data;
- Bench sheets and analytical logbook maintenance and review; and
- Review of the laboratory's sample analysis/data package inspection procedures.

A formal audit report was provided to the IT Project Manager and support staff. Results of the onsite audit were documented and maintained as part of the QA documentation. Discrepancies between actual practices and approved plans/procedures were resolved and corrective actions for unsatisfactory and non-conforming conditions or practices were verified by the Project QA/QC Manager before granting approval to continue work.

4.0 Data Analysis

4.1 DATA EVALUATION

4.1.1 Analytical Methodology

Environmental samples collected in support of the background study were analyzed using a suite of USEPA-approved methodologies to attain project DQOs, as specified in Work Plan Addendum 10. Site reconnaissance, field screening, and analytical methodologies for background markers were used to demonstrate the selected background locations did not exhibit contamination from previous facility operations.

Explosives were selected as background markers because of past practices and chemicals of concern were likely to be explosives. A review of potential explosives associated with the installation identified TNT and RDX as viable indicator compounds for explosives screening. Explosive immunoassay analyses were conducted for surface and subsurface soil samples using USEPA SW-846 methods 4050 and 4051. Results indicated that selected locations did not exhibit explosive contamination or were not impacted by previous facility operations associated with releases. Specific details associated with field screening activities are presented in Section 3.1.2.

PID screening was used to monitor organic compounds and relocate the borings as necessary. A PID reading above background levels would have necessitated that a boring be relocated. PID readings were not observed above background levels in the borings; therefore, no borings were relocated as a result of PID readings. Borings were also clustered in ¼- to ½-acre groupings to discern potential organic compound contamination.

USEPA SW-846, 3rd ed., *Test Methods for Evaluation Solid Waste,* Update III (USEPA 1996) were used to assess the inorganic soil composition. Trace metals were analyzed using a combination of ICP, graphite furnace atomic absorption (GFAA), and CVAA for mercury. Tables 4-1 through 4-7 presents the metals data results, reporting limits for non-detects, and associated validation qualifiers.

USEPA *Contract Lab Program Statement of Work OLM 4.2* (USEPA 1999) methodologies were employed to assess the semivolatile and volatile organic characterization of soil locations. Volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) were analyzed using gas chromatography mass spectrometry. The data results and associated validation qualifiers can be found within the validation reports in Appendix B.

4.1.2 Data Validation and Qualifiers

Data were validated using the SW–846 method-specific criteria and laboratory SOPs. The *Innovative Approaches to Data Validation for USEPA Region III* (USEPA 1995) was used to provide validation qualification scheme. Validation reports include a tabular listing of sample IDs, parameters qualified, and specific information on why the qualification was performed. Reports are categorized in accordance with sample delivery groups and are located in Appendix B. Data qualifiers are included in the data tables as appropriate. Qualifiers that resulted in the use of data included the following:

J — results estimated analyte is present and reported values may not be accurate or precise
K — results estimated biased high analyte is present and reported values may be biased high
L — results estimated biased low analyte is present and reported values may be biased low
B — not detected substantially above the level reported in laboratory or field blanks
U — results not detected, presented as < reporting limits in data tables
UJ — results estimated not detected and quantitation limit may be inaccurate or imprecise
UL — results estimated biased low not detected and quantitation limit is probably higher
R — results rejected due to quality control issues

4.1.2.1 Metals Validation Criteria. Laboratory performance criteria were evaluated for inorganics included the following. Further discussion may be found in the validation reports in Appendix B.

- **Holding times.** 180 days for metals and 28 days for mercury. Preservation: Cool, 4°C ± 2°C for soil samples and cool, 4°C ± 2°C and HNO_3 pH<2 for aqueous samples.

Table 4-1
Background Metals Concentration, Braddock Loam

[Units in mg/kg]

Sample ID Date Depth (Inches)	MMAB1A 8/31/00 0-10	MMAB2A 9/6/00 0-12	MMAB3A 9/6/00 0-9	MMAB4A 8/31/00 0-6	MMAB1B 8/31/00 10-48	MMAB2B 9/6/00 12-60	MMAB2BD 9/6/00 12-60	MMAB3B 9/6/00 9-42	MMAB4B 8/31/00 6-51	MMAB1C 8/31/00 48-84	MMAB4C 8/31/00 51-53
Aluminum	5370	6660	5630	3700	11800	16000	12900	10100	12500	15300	12500
Antimony	0.68R	<7.3L ND	<6.8L ND	0.67R	0.68R	<7.6L ND	<7L ND	<7L ND	0.69R	0.67R	0.69R
Arsenic	1.9J	2.4	2.3	1.5J	1.2J	3.8	3.2	3.3	1.9J	<1.1 ND	1.8J
Barium	114	62.9	99.1	39.9	47.1	58	59.1	63.9	38.4	42.6	27.4
Beryllium	<0.57 ND	<0.61 ND	<0.56 ND	<0.56 ND	<0.57 ND	<0.63 ND	<0.58 ND	<0.59 ND	<0.57 ND	<0.56 ND	<0.57 ND
Cadmium	<0.57 ND	<0.61 ND	<0.56 ND	<0.56 ND	<0.57 ND	<0.63 ND	<0.58 ND	<0.59 ND	<0.57 ND	<0.56 ND	<0.57 ND
Calcium	395J	<609 ND	<563 ND	116J	398J	<629 ND	<581 ND	586	120J	<110 ND	<120 ND
Chromium	9L	15.8	10.5	8.7L	17.4L	26.2	22.7	22.4	20.9L	12.6L	33.6L
Cobalt	<5.7 ND	<6.1 ND	<5.6 ND	<5.6 ND	<5.7 ND	<6.3 ND	<5.8 ND	<5.9 ND	<5.7 ND	10.2	<5.7 ND
Copper	2.2J	13.2	4	<1.1L ND	3.3J	7.5	5.7	6	5.5J	4.3J	4.5J
Iron	7490	9230	7300	7250	24700	22600	18000	14900	28900	22900	24000
Lead	9.4J	52	10.2	17.1J	8.2J	8.6	8.5	10.7	9.8J	6.9J	10.2J
Magnesium	247J	<609 ND	<563 ND	158J	490J	<629 ND	<581 ND	<586 ND	522J	971J	350J
Manganese	924L	396	567	506L	125L	136	155	464	130L	189L	170L
Mercury	<0.11 ND	1.2	0.07	<0.11 ND	<0.11 ND	0.18	0.13	0.1	<0.11 ND	<0.11 ND	<0.11 ND
Nickel	<4.6L ND	<4.9 ND	<4.5 ND	<4.4L ND	4.9L	5.9	4.9	4.8	6.3L	6.8L	10.3
Potassium	242L	<609 ND	<563 ND	174L	579L	<629 ND	<581 ND	<586 ND	694L	1010L	474L
Selenium	<0.57L ND	<0.61 ND	<0.56 ND	<0.56L ND	<0.57L ND	<0.63 ND	<0.58 ND	<0.59 ND	<0.57L ND	<0.56L ND	<0.57L ND
Silver	<1.1 ND	4.3	<0.56 ND	<1.1 ND	<1.1 ND	<0.63 ND	<0.58 ND	<0.59 ND	<1.1 ND	<1.1 ND	<1.1 ND
Sodium	<120 ND	<609 ND	<563 ND	124 ND	114 ND	<629 ND	<581 ND	<586 ND	<120 ND	<110 ND	<120 ND
Thallium	<1.1 ND	<1.2 ND	<1.1 ND	<1.1 ND	<1.1 ND	2.3	<1.2 ND	1.4	<1.1 ND	<1.1 ND	<1.1 ND
Vanadium	14.7L	20.3	15.7	15L	42.2L	47.1	38.6	31	56.4L	51.4L	39.6L
Zinc	16.9J	30.2J	12.8J	10J	25J	18.9J	16.9J	14.7J	31.1J	361J	26.1J

Table 4-2
Background Metals Concentration,
Unison Urban Land Complex

[Units in mg/kg]

Sample ID Date Depth (Inches)	MMAU1A 9/7/00 0-10	MMAU2A 9/7/00 0-10	MMAU3A 8/31/00 0-9	MMAU4A 9/6/00 0-10	MMAU1B 9/7/00 10-52	MMAU2B 9/7/00 10-52	MMAU3B 8/31/00 9-42	MMAU3BD 8/31/00 9-42	MMAU4B 9/6/00 10-58	MMAU1C 9/7/00 52-60	MMAU2C 9/7/00 52-60	MMAU3C 8/31/00 42-72	MMAU4C 9/6/00 58-76
Aluminum	5710	4730	6800	9950	42900	21500	14000	12100	18200	47900	26200	8710	45100
Antimony	<6.7L ND	<7L ND	0.69R	<9L ND	<7.5L ND	<8.2L ND	0.69R	0.69R	<7.5L ND	<7.4L ND	<8.1L ND	0.66R	<9LND
Arsenic	7.2	4.5	1.8J	10.2	19.8	16.8	1.7J	1.2J	14	35.9	12.6	<1.1 ND	18.4
Barium	<22.3 ND	<23.4 ND	57.9	119	53.1	<27.3 ND	48.5	46.5	85.4	82.6	<27 ND	25.2	72.4
Beryllium	<0.56 ND	<0.59 ND	<0.58 ND	1.1	2.3	<0.68 ND	<0.58 ND	<0.58 ND	1.3	5.3	<0.68 ND	<0.55 ND	2.6
Cadmium	<0.56 ND	<0.59 ND	<0.58 ND	0.82	0.92	<0.68 ND	<0.58 ND	<0.58 ND	1.2	1.3	0.78	<0.55 ND	2.2
Calcium	<557 ND	<585 ND	389J ND	1690	<624 ND	<682 ND	314J	290J	1210	954	<675 ND	<110 ND	2020
Chromium	13.6	10.9	18.3L	23.2	36.1	39.1	22.1L	19L	35.3	39.7	49.8	10.8L	75.8
Cobalt	6.5	<5.9 ND	10.1	16.1	86.8	7.1	<5.8 ND	<5.8 ND	19	94.3	10.4	12.3	13.2
Copper	5.7	5.3	5.4J	11.4	34.4	23	10.7J	8.6J	16.9	31.7	26	3.4J	31.9
Iron	15100	9990	17800	22900	31400	38900	33300	29300	36900	35100	41900	14300	67700
Lead	13.7	10.9	10.5J	225	26.8	23.7	9.5J	9.1J	256	18.7	33.4	5.6J	144
Magnesium	1140	<585 ND	669J	1430	37700	689	972J	902J	2820	58100	784	555J	16200
Manganese	99.4	43	404L	1910	282	39.4	121L	99.4L	1760	366	52.8	169L	815
Mercury	<0.037 ND	<0.039 ND	<0.12 ND	<0.05 ND	0.12	0.16	<0.12 ND	<0.12 ND	0.05	0.11	0.27	<0.11 ND	0.08
Nickel	4.6	<4.7 ND	5.2L	11	59.6	17.7	9L	7.5L	17.6	94.2	23.7	5.8L	35.9
Potassium	<557 ND	<585 ND	654L	<752 ND	6220	<682 ND	1050L	961L	<623 ND	10900	<675 ND	591L	861
Selenium	<0.56 ND	<0.59 ND	<0.58L ND	<0.75 ND	<0.62 ND	<0.68 ND	<0.58L ND	<0.58L ND	<0.62 ND	<0.62 ND	<0.68 ND	<0.55L ND	<0.75ND
Silver	<0.56 ND	<0.59 ND	<1.2 ND	<0.75 ND	<0.62 ND	<0.68 ND	<1.2 ND	<1.2 ND	<0.62 ND	<0.62 ND	<0.68 ND	<1.1 ND	<0.75ND
Sodium	<557 ND	<585 ND	<120 ND	<752 ND	<624 ND	<682 ND	<120 ND	<120 ND	<623 ND	<620 ND	<675 ND	<110 ND	<750ND
Thallium	<1.1 ND	<1.2 ND	<1.2 ND	2.1	1.8	<1.4 ND	<1.2 ND	<1.2	3.2	2.9	<1.4 ND	<1.1 ND	5
Vanadium	31.3	22.5	35L	37.8	68.8	84.4	64.2L	57.9L	57.5	75	85.2	27L	114
Zinc	35J	14.4J	94.1J	216J	96J	44.7J	46.2J	34.2J	341J	218J	60.3J	19.8J	598J

Table 4-3
Background Metals Concentration, Wheeling Sandy Loam

[Units in mg/kg]

Sample ID	MMAW1A	MMAW2A	MMAW3A	MMAW4A	MMAW1B	MMAW2B	MMAW3B	MMAW4B	MMAW1C	MMAW2C	MMAW2CD	MMAW3C	MMAW4C
Date	**9/5/00**	**9/6/00**	**9/6/00**	**9/5/00**	**9/5/00**	**9/6/00**	**9/6/00**	**9/5/00**	**9/5/00**	**9/6/00**	**9/6/00**	**9/6/00**	**9/5/00**
Depth (Inches)	**0-12**	**0-7**	**0-12**	**0-9**	**12-48**	**7-48**	**12-48**	**9-42**	**48-72**	**48-60**	**48-60**	**48-60**	**42-72**
Aluminum	11100	12800	15400	10300	13600	21600	24000	16800	20000	4430	19900	25600	22700
Antimony	<7.7L ND	<7.4L ND	<7L ND	<7.1L ND	<7.4L ND	<6.8L ND	<7.3L ND	<7.9L ND	<6.7L ND	<6.9L ND	<7.4L ND	<7.2L ND	<7.9L ND
Arsenic	2.6	2.5	2.7	1.9	2.3	3.2	3.9	2.2	3.1	4.7	15.3	4	3.6
Barium	130	174	150	135	134	116	155	100	119	<23 ND	<24.5 ND	123	141
Beryllium	0.79	0.93	0.99	0.72	0.87	1.1	1.1	0.79	1	<0.58 ND	<0.61 ND	1.3	1.2
Cadmium	<0.64 ND	<0.62 ND	0.67	<0.59 ND	0.62	<0.57 ND	1.1	<0.66 ND	2.5	<0.58 ND	0.65	1.2	1.1
Calcium	920	7340	2200	1300	906	952	1250	1030	1210	<576 ND	<613 ND	1060	1200
Chromium	25.2	27	26.1	19.1	26	33.6	40.7	27.7	29.8	11	35.4	40.2	34.3
Cobalt	11.9	12.3	13.1	8.1	12.9	17.4	20.9	14.1	15.7	<5.8 ND	6.8	20	21.2
Copper	11.7	13.2	13.6	7.6	12.3	22	25.8	12.2	20	5	21.3	27.5	23.7
Iron	20100	20500	23800	15600	22800	35900	40700	27200	34100	10100	35500	43900	39500
Lead	12	15	13.6	14.7	10.6	13.3	16.6	10	11.5	10.8	23.6	16	14.3
Magnesium	2460	5930	3020	2370	3220	4750	5850	4440	5570	<576 ND	637	5690	6270
Manganese	650	822	776	287	694	627	771	389	546	47.4	37.6	735	674
Mercury	<0.043 ND	<0.041 ND	<0.039 ND	<0.04 ND	<0.04 ND	0.038	<0.041 ND	<0.044 ND	<0.037 ND	0.038	<0.041 ND	<0.04 ND	<0.044 ND
Nickel	11.5	13.2	13.5	9.8	13.4	18.9	21.7	14.8	18	<4.6 ND	17.2	21.6	20.8
Potassium	1110	1430	1360	<592 ND	1560	2650	2980	1300	2720	<576 ND	<613 ND	2920	2120
Selenium	<0.64 ND	<0.62 ND	<0.58 ND	<0.59 ND	<0.62 ND	<0.57 ND	<0.61 ND	<0.66 ND	<0.56 ND	<0.58 ND	<0.61 ND	<0.6 ND	<0.65 ND
Silver	<0.64 ND	<0.62 ND	<0.58 ND	<0.59 ND	<0.62 ND	<0.57 ND	<0.61 ND	<0.66 ND	<0.56 ND	<0.58 ND	<0.61 ND	<0.6 ND	<0.65 ND
Sodium	<638 ND	<616 ND	<579 ND	<592 ND	<615 ND	<566 ND	<608 ND	<655 ND	<559 ND	<576 ND	<613 ND	<597 ND	<655 ND
Thallium	2	<1.2 ND	2	1.3	2.1	<1.1 ND	3.1	2.2	2.5	<1.2 ND	<1.2 ND	3.2	3.1
Vanadium	36.4	37.9	43.6	29.2	41.4	67	74	50.1	61	23.1	75.2	79.5	69.7
Zinc	54.9J	65.9J	61.1J	58.1J	64J	70.3J	93.4J	76.1J	68.8J	14.4J	37.7J	84.8J	76.5J

Table 4-4
Background Metals Concentration, Groseclose and Poplimento Silt Loam

[Units in mg/kg]

Sample ID	NRUG1A	NRUG2A	NRUG3A	NRUG4A	NRUG1B	NRUG2B	NRUG2BD	NRUG3B	NRUG4B	NRUG1C	NRUG2C	NRUG3C	NRUG4C
Date	8/29/00	8/30/00	8/30/00	8/30/00	8/29/00	8/30/00	8/30/00	8/30/00	8/30/00	8/29/00	8/30/00	8/30/00	8/30/00
Depth (Inches)	0-12	0-7	0-12	0-6	12-53	7-34	7-34	12-35	6-39	53-70	34-57	35-67	39-72
Aluminum	5010	10700	7260	3770J	6850	7050	8160	8860	6130J	6280	17600	10500	7420J
Antimony	<0.69L ND	0.69R	0.67R	0.69R	<0.7L ND	0.68R	0.68R	0.69R	0.71R	<0.69L ND	0.74R	0.73R	0.72R
Arsenic	2J	4.1J	3.6B	2.8B	3.4J	2.5J	3.6J	3.8B	3.2B	5.1J	4.3J	2.7B	7.4J
Barium	26.8	40.7	45.7	23.4J	<23 ND	30.4	32.5	<23 ND	<24 ND	<23 ND	38.7	<24 ND	<24 ND
Beryllium	<0.57L ND	0.64	0.62J	<0.58J ND	<0.59L ND	<0.56 ND	<0.57 ND	<0.58 ND	<0.59J ND	<0.57L ND	1.6	<0.61 ND	<0.6J ND
Cadmium	<0.57 ND	<0.57 ND	<0.56 ND	<0.58 ND	<0.59 ND	<0.56 ND	<0.57 ND	<0.58 ND	<0.59 ND	<0.57 ND	<0.61 ND	<0.61 ND	<0.6 ND
Calcium	534	434J	571J	825	<120 ND	237J	239J	304J	622	<110 ND	388J	223J	227
Chromium	8.8J	25.9L	29.8L	9.8J	15.5J	18.6L	24.3L	30.1L	13.6J	14.2J	33.1L	25.6L	23.7J
Cobalt	<5.7L ND	8.3J	11.8	5.9L	<5.9L ND	17.4J	18	31.1J	<5.9L ND	<5.7L ND	70.1J	36.6J	23.9
Copper	<1.1 ND	11J	4.6J	3.9J	1.6J	4.2J	4.6J	2.3J	4J	1.6J	21.3J	13.4J	6.1J
Iron	8790	30900	27000	9490J	18900	10500	24600	31000	17400J	24300	34200	31100	38100J
Lead	8.9L	12.5	18J	23.6	7.5L	9.6	12J	13.8	13.8	7.4	14.5	7.2	35.5
Magnesium	261L	1230	913J	311J	139L	1050	1400J	416	333J	<110L ND	2010	624	227J
Manganese	141	301J	458L	306	35.8	368J	399L	512J	69	16.7	523J	931J	664
Mercury	<0.11 ND	<0.11 ND	<0.11 ND	<0.12 ND	0.13	<0.11 ND	<0.11 ND	<0.12 ND	<0.12 ND	0.11	<0.12 ND	<0.12 ND	0.14
Nickel	<4.6 ND	9.2	5.9L	<4.6 ND	<4.7 ND	6.6L	7.9L	<4.6L ND	<4.8 ND	<4.6 ND	35.3	29.6	6.6
Potassium	191	671	438L	220J	156	613	705L	408	207J	123	1360	618	211J
Selenium	<0.57 ND	<0.57L ND	<0.56L ND	<0.58L ND	<0.59 ND	<0.56L ND	<0.57L ND	<0.58L ND	<0.59L ND	<0.57 ND	<0.61L ND	<0.61L ND	<0.6L ND
Silver	<1.1 ND	<1.1 ND	<1.1 ND	<1.2 ND	<1.2 ND	<1.1 ND	<1.1 ND	<1.2 ND	<1.2 ND	<1.1 ND	<1.2 ND	<1.2 ND	<1.2 ND
Sodium	<110 ND	<110 ND	<110 ND	<120 ND	<120 ND	<110 ND	<110 ND	<120 ND	<120 ND	<110 ND	<120 ND	<120 ND	<120 ND
Thallium	<1.1 ND	<1.1 ND	<1.1 ND	<1.2 ND	<1.2 ND	<1.1 ND	<1.1 ND	<1.2 ND	<1.2 ND	<1.1 ND	<1.2 ND	<1.2 ND	<1.2 ND
Vanadium	15.1J	47.2L	41L	15J	29.7J	29.9L	41.3L	47.6L	26.5J	31.5J	56.1L	47.2L	40.9J
Zinc	7.1	26.7J	28.5J	24.6J	4.7	15.4J	19.7J	11.1J	10J	6	28J	33J	14.4J

Table 4-5
Background Metals Concentration, Carbo Silty Clay Loam

[Units in mg/kg]

Sample ID	NRUC1A	NRUC2A	NRUC3A	NRUC4A	NRUC1B	NRUC2B	NRUC3B	NRUC4B	NRUC4C
Date	8/30/00	8/30/00	8/29/00	8/29/00	8/30/00	8/30/00	8/29/00	8/29/00	8/29/00
Depth (Inches)	0-11	0-11	0-10	0-7	11-72	11-72	10-18	7-30	30-48
Aluminum	6260	4440	20100J	5650J	11900	16600	21100J	10000J	12200J
Antimony	0.7R	0.72R	0.73R	0.7R	0.79R	0.76R	0.73R	0.73R	0.76R
Arsenic	3.4J	2.6B	1.6J	6.1J	4.9J	4.8B	1.2J	2.6J	3.9J
Barium	24.5	30	56.7J	<23 ND	<26 ND	48.1	45.5J	<24 ND	<25 ND
Beryllium	<0.58 ND	0.61	0.87J	<0.58J ND	<0.66 ND	3.4	0.91J	<0.61J ND	<0.64J ND
Cadmium	<0.58 ND	<0.6 ND	<0.61 ND	<0.58 ND	<0.66 ND	<1.3 ND	<0.61 ND	<0.61 ND	<0.64 ND
Calcium	238J	715J	1810	<120 ND	280J	1860J	25700	244	140
Chromium	14.5L	11.3L	32.2J	22.3J	27.2L	47.6L	31.2J	14.5J	19.2J
Cobalt	8.6J	33.6J	11.4L	<5.8L ND	<6.6J ND	89.1J	10.3L	<6.1L ND	<6.4L ND
Copper	6.3J	4.1J	9J	2.9J	16.8J	21.5J	11.8J	5.9J	9.7J
Iron	19400	10100	31900J	20400J	35800	39400	28400J	17300J	25200J
Lead	15.4	24.7	11.5	13	11	28	3.5	6.6	8
Magnesium	280	448	20400J	259J	219	2150	48100J	279J	326J
Manganese	231J	482J	498	186	58.2J	205J	308	33	36.4
Mercury	<0.12 ND	<0.12 ND	<0.12 ND	<0.12 ND	<0.13 ND	<0.13 ND	<0.12 ND	0.12	<0.13 ND
Nickel	5.9L	<4.8L	18.1	<4.7 ND	12.7	44.8	21.5	<4.8 ND	7.8
Potassium	166	233	2350J	291J	180	618	5390J	402J	473J
Selenium	<0.58L ND	<0.6L ND	<0.61L ND	<0.58L ND	<0.66L ND	<1.3L ND	<3.1L ND	<0.61L ND	<0.64L ND
Silver	<1.2 ND	<1.2 ND	<1.2 ND	<1.2 ND	<1.3 ND	<2.6 ND	<1.2 ND	<1.2 ND	<1.3 ND
Sodium	<120 ND	<120 ND	<120 ND	<120 ND	<130 ND	<130 ND	148	<120 ND	<130 ND
Thallium	<1.2 ND	<1.2 ND	<1.2 ND	<1.2 ND	<1.3 ND	<1.3 ND	<1.2 ND	<1.2 ND	<1.3 ND
Vanadium	32.6L	19.7L	42.5J	26.6J	66.8L	68.9L	38.3J	22J	34.3J
Zinc	17.2J	15.9J	56.3J	10.9J	29.8J	28.4J	40.8J	7.4J	9.8J

Table 4-6
Background Metals Concentration, Lowell Silt Loam

[Units in mg/kg]

Sample ID Date Depth (Inches)	NRUL1A 8/29/00 0-12	NRUL2A 8/30/00 0-12	NRUL3A 8/29/00 0-9	NRUL4A 8/29/00 0-10	NRUL1B 8/29/00 12-42	NRUL2B 8/30/00 12-33	NRUL2BD 8/30/00 12-33	NRUL3B 8/29/00 9-75	NRUL4B 8/29/00 10-38	NRUL4BD 8/29/00 10-38	NRUL1C 8/29/00 42-55	NRUL2C 8/30/00 33-60	NRUL3C 8/29/00 75-90	NRUL4C 8/29/00 38-60
Aluminum	5740	10800	16000	6750	12500	13200	10300	24800	6580	7380	26600	20500	32800	12100
Antimony	0.66R	0.69R	<0.72L ND	<0.69L ND	0.71R	0.71R	0.71R	<0.86L ND	<0.67L ND	<0.67L ND	0.74R	0.75R	<0.84L ND	<0.7L ND
Arsenic	3.8J	5.1B	3.7J	9.3J	2.7J	6.9J	4.7B	3.1J	5.7J	7.1J	2.5J	4.2B	3.7J	4.2J
Barium	63.6	79	59.4	109	30.4	32.6	27.9	57.2	38.7	39.2	47.5	34	63.4	42.7
Beryllium	0.72	0.89J	0.72J	1J	<0.59 ND	<0.59 ND	<0.59 ND	1.2J	<0.56L ND	<0.56L ND	2	0.96J	2.3J	1.6J
Cadmium	<0.55 ND	<0.58 ND	<0.6 ND	<0.57 ND	<0.59 ND	<0.59 ND	<0.59 ND	<0.72 ND	<0.56 ND	<0.56 ND	<1.2 ND	<0.62 ND	<0.7 ND	<0.59 ND
Calcium	885J	1380J	918	1310	536J	618J	585J	527	520	517	619J	844J	532	744
Chromium	27L	28.2L	34.4J	31.2J	24.8L	35.2L	40L	39J	25.1J	35.5J	33.9L	49.5L	36.4J	30.9J
Cobalt	15.3J	25.9	16.3J	21.8J	12J	29.4	34.6	11.4J	18.5J	19.3J	8.9J	7	12.5J	20J
Copper	3.2J	5.1J	11.6J	5.1J	5.6J	19.7J	4.2J	27.6J	1.6J	1.2J	29.5J	16.6J	23.8J	11.1J
Iron	19400	25200	32000	24300	24400	32500	26100	41000	21300	29800	44200	33100	36500	29200
Lead	21.4	26.8J	15.3L	76.7L	8.7	17.7J	16J	9.7L	16.6L	17.7L	10	7.9J	8.9L	13.4L
Magnesium	792	2010J	7480L	420L	2010	2310J	1240J	4890L	295L	374L	9200	3610J	42800L	712L
Manganese	1110J	1530L	711	1710	245J	654L	785L	305	735	717	156J	62.8L	262	501
Mercury	<0.11 ND	<0.12 ND	<0.12 ND	0.13	<0.12 ND	<0.12 ND	<0.12 ND	0.19	<0.11 ND	<0.11 ND	<0.12 ND	<0.12 ND	<0.14 ND	<0.12 ND
Nickel	4.6L	9.4	15.3	7	8.5L	8.9L	5.7L	27.1	<4.5 ND	4.8	26	18.5	31	13.2
Potassium	344	960L	1530	581	1390	1700L	956L	1710	418	468	6340	3020L	10000	624
Selenium	0.64L	0.77B	<0.6 ND	<0.57 ND	<0.59L ND	<0.59L ND	<0.59L ND	<3.6 ND	<0.56 ND	<0.56 ND	<1.2L ND	<0.62L ND	<3.5 ND	<2.9 ND
Silver	<1.1 ND	<1.2 ND	<1.2 ND	<1.1 ND	<1.2 ND	<1.2 ND	<1.2 ND	<1.4 ND	<1.1 ND	<1.1 ND	<2.4 ND	<1.2 ND	<1.4 ND	<1.2 ND
Sodium	<110 ND	<120 ND	<120 ND	<110 ND	<120 ND	<120 ND	<120 ND	<140 ND	<110 ND	<110 ND	<120 ND	<120 ND	<140 ND	<120 ND
Thallium	<1.1 ND	<1.2 ND	<1.2 ND	<1.1 ND	<1.2 ND	<1.2 ND	<1.2 ND	<1.4 ND	<1.1 ND	<1.1 ND	<1.2 ND	<1.2 ND	<1.4 ND	<1.2 ND
Vanadium	31.9L	45.9L	52.9J	38.7J	36.7L	52.3L	40.4L	63.5J	34.1J	47.3J	64.6L	48.6L	60.6J	41.4J
Zinc	29.2J	39.6J	39	55.1	12.6J	20.7J	14.8J	29.4	9	10.6	30.9J	30.4J	56.5	17.8

Facility-Wide Background Study
Final Document
ESPS08-34
December 2001

Table 4-7
Background Metals Concentration, Wurno-Newbern-Faywood Silt Loam

[Units in mg/kg]

Sample ID Date Depth (Inches)	NRUW1A 8/30/00 0-7	NRUW2A 8/30/00 0-9	NRUW3A 8/29/00 0-10	NRUW4A 8/29/00 0-10	NRUW1B 8/30/00 7-38	NRUW2B 8/30/00 9-28	NRUW3B 8/29/00 10-34	NRUW4B 8/29/00 10-31	NRUW1C 8/30/00 38-48	NRUW2C 8/30/00 28-48	NRUW3C 8/29/00 34-45	NRUW4C 8/29/00 31-46	NRUW4CD 8/29/00 31-46
Aluminum	5450	14600	3620	8100	14900	17300	10800J	14500	33900	29700	10200J	16700	18500
Antimony	0.7R	0.72R	<0.7L ND	<0.73L ND	0.75R	0.74R	0.74R	<0.74L ND	0.79R	0.79R	0.73R	<0.8L ND	<0.8L ND
Arsenic	2J	7.6J	2.3J	3J	1.6J	2.8B	3	2.8J	1.9J	<1.3 ND	10.7J	2.2J	2.3J
Barium	36.4	60.8	<23 ND	75.3	43.1	40.1	28.5J	36.2	164	63.2	46.6J	35.4	32.6
Beryllium	<0.58 ND	1.2	<0.59L ND	1.5J	0.93	<0.62 ND	<0.61J ND	0.78J	2.1	1.3J	5.4J	1.4J	1.4J
Cadmium	<0.58 ND	<1.2 ND	<0.59 ND	<0.61 ND	<0.63 ND	<0.62 ND	<0.61 ND	<0.62 ND	<1.3 ND	<0.66 ND	<0.61 ND	<0.66 ND	<0.66 ND
Calcium	808J	1180J	426	1140	717J	1050J	330	412	3540J	5430J	709	149	243
Chromium	22.5L	53.3L	6.3J	25.7J	30L	30L	14.4J	30.3J	48.9L	50.9L	26J	27.2J	28.3J
Cobalt	10.2J	45.4J	<5.9L ND	26.3J	8.7J	<6.2 ND	<6.1L ND	6.2J	13.4J	12.2	130	7.6J	27.4J
Copper	2.9J	8.5J	3.3J	5.1J	9.1J	8.1J	9J	15.7J	29.3J	38.7J	12.3J	26.3J	27.9J
Iron	22900	63000	7470	33700	32300	31600	17300J	35300	44100	42800	18500J	40600	42200
Lead	17.1	26.8	10.3L	28.8L	6.5	5.7J	8.4	6.7L	2.1	4.5J	12.6	6.8L	8.2L
Magnesium	690	8080	363L	1080L	1300	5570J	860J	1780L	51300	42700J	10600J	7070L	8270L
Manganese	445J	1860J	91.7	2040	240J	188L	33.2	121	359J	284L	419	68.3	187
Mercury	<0.12 ND	<0.12 ND	<0.12 ND	<0.12 ND	<0.13 ND	<0.12 ND	<0.12 ND	<0.12 ND	<0.13 ND	<0.13 ND	<0.12 ND	0.19	0.16
Nickel	<4.7L ND	16.8	<4.7 ND	7.9	11.6	11.7	7	17.3	43.1	33.6	51.1	29.2	29.6
Potassium	291	1990	366	587	469	1600L	676J	1260	5670	6120L	1870J	4630	5600
Selenium	<0.58L ND	<1.2L ND	<0.59 ND	<0.61 ND	<0.63L ND	<0.62L ND	<0.61L ND	<1.2 ND	<1.3L ND	<0.66L ND	<0.61L ND	<3.3 ND	<3.3 ND
Silver	<1.2 ND	<2.4 ND	<1.2 ND	<1.2J ND	<1.3 ND	<1.2 ND	<1.2 ND	<1.2 ND	<2.6 ND	<1.3 ND	<1.2 ND	<1.3 ND	<1.3 ND
Sodium	<120 ND	<120 ND	<120 ND	<120 ND	<130 ND	123	<120 ND	<120 ND	<130 ND	130	<120 ND	<130 ND	151
Thallium	<1.2 ND	<1.2 ND	<1.2 ND	<1.2 ND	<1.3 ND	<1.2 ND	<1.2 ND	<1.2 ND	<1.3 ND	<1.3 ND	<1.2 ND	<1.3 ND	<1.3 ND
Vanadium	39.1L	101L	12.2J	48.1J	51.3L	53.6L	29.1J	53J	77.6L	61.2L	32.3J	62.8J	65.3J
Zinc	27.9J	56.2J	14.9	35.4	16.9J	20.7J	11.8J	27.8	69.8J	57J	33.7J	34.2	35.8

4-8

- **Initial and continuing calibration.** Performed at the beginning of sample analysis and at a frequency of 10% or every 2 hours to assess calibration frequency and accuracy. MRL standards were evaluated for ICP and for CVAA. Concentration was evaluated at 2 times the greater of MRL or MDL for analytes (except Al, Ba, Ca, Fe, Mg, Na, and K) at the beginning and at the end (for ICP) of a sample run or a minimum of twice per 8 hours. For GFAA/CVAA, concentration was evaluated at the MRL at the beginning of the run. Recovery range was evaluated between 90% and 110%.
- **Blanks assessment.** Evaluated to assess the existence and magnitude of contamination problems. No contaminant should be detected in the blank > the MRL. Sample values < five times (5×) the maximum concentration detected in the QC blanks and > the MRL were qualified "B."
- **ICP Interference Check Sample.** Verified interelement and background correction factors. Interference check samples run at the beginning and end of each sample analysis run with control limits between 80% and 120%.
- **Matrix spike sample analysis.** Designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology. The spike recoveries must be within 75%–125% or established recoveries, with the exception of samples that have concentrations exceeding the spike concentration by a factor of four or more. When MS recovery limits are not met, a post-digestion spike addition should produce a minimum level of 10 to 100 times the MDL.
- **Duplicate sample analysis.** Demonstrated acceptable method precision by the laboratory at the time of analysis. Duplicate analyses are also performed to generate data in order to assess the long-term precision of the analytical method on various matrices. A control limit of 20% RPD was used.
- **Laboratory Control Samples.** Monitored overall performance of each step during the analysis, including the sample preparation. Solid LCS results must fall within the established limits, depending upon the LCS lot standard used.
- **ICP serial dilution.** Assessed whether or not significant physical or chemical interferences exist due to sample matrix during ICP analysis. If the analyte concentration in the original sample is a factor of 10 above MDL, then an analysis of a 5-fold dilution should agree within 10% difference of the original result.
- **Calculation verification.** The percent difference (%D) between calculated and reported results should be <10%. Samples below the MRL and above the MDL were qualified "J," estimated.

4.1.2.2 VOC Validation Criteria. Laboratory performance criteria evaluated for VOCs included the following. Further discussion may be found in the validation reports in Appendix B.

- **Holding times.** 14 days for VOCs. Preservation: Cool, 4°C ± 2°C for soil samples and cool, 4°C ± 2°C and HCl pH<2 for aqueous samples.
- **Initial calibration.** Performed at the beginning of sample analysis to assess calibration frequency and accuracy. Compliance requirements for satisfactory instrument calibration were established to ensure that the instrument used was capable of producing acceptable qualitative and quantitative data for volatile target compounds. Initial calibration demonstrates that the instrument was capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve. The minimum relative response factor (RRF) must be ≤ 0.05. Percent relative standard deviation (%RSD) must be ≤ 15% for each target compound and must be ≤ 30% for each calibration check compound.
- **Continuing calibration.** Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used was capable of producing acceptable qualitative and quantitative data for volatile target compounds. Continuing calibration establishes the 12-hour relative response factors on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis. The %D between the initial calibration RRF and the continuing calibration RRF must be within 20% for target compounds.

- **Blanks assessment.** The purpose of blank analyses was to identify the presence and magnitude of contamination problems resulting from field (rinse blanks) and laboratory activities. A method blank analysis must be performed after the calibration standards and once every 12-hour time period beginning with the injection of bromofluorobenzene (BFB). No contaminants should be detected in the associated blanks > MRL. Positive sample results were reported and qualified "B" if the concentration of the compound in the sample was ≤ 10 times (10x) the maximum amount in a blank for the common laboratory contaminants methylene chloride, acetone and 2-butanone, or 5 times (5x) the maximum amount for other volatile target compounds.

- **Instrument performance check.** The analysis of the instrument performance check solution was performed at the beginning of each 12-hour period during which samples are analyzed. The instrument performance check solution, BFB, must meet the specified ion abundance criteria.

- **Matrix spike and spike duplicate sample analysis.** Designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology as well as acceptable method precision by the laboratory at the time of analysis. The spike recoveries must be within established limits, with the exception of samples that have concentrations exceeding the spike concentration by a factor of four or more. Matrix spike duplicate analyses are also performed to generate data in order to assess the long-term precision of the analytical method on various matrices using RPD. RPD recoveries must be within established limits.

- **Laboratory control samples.** Monitored overall performance of each step during the analysis, including the sample preparation. LCS results must fall within the established recovery limits.

- **System monitoring compounds (Surrogates).** Laboratory performance on individual samples is established by means of spiking activities. The system monitoring compounds were added to the samples and blanks to measure their recovery. %Rs must be within the specified control limits.

- **Internal standards.** Internal standards performance check ensures that gas chromatography/mass spectroscopy (GC/MS) sensitivity and response are stable during each analytical run. Specific criteria include area count of –50% to +100% and retention time of ± 30 seconds from the associated calibration standards.

- **Calculation verification.** The %D between calculated and reported results should be < 10%. Samples below the MRL and above the MDL were qualified "J," estimated. Tentatively identified compounds (TICs) were qualified as estimated "J".

4.1.2.3 SVOC Validation Criteria. Laboratory performance criteria evaluated for SVOCs included the following. Further discussion may be found in the validation reports in Appendix B.

- **Holding times.** 7 days to extract/40 days analysis for aqueous and 14 days to extract/40 days analysis for soils for SVOCs. Preservation: Cool, 4°C ± 2°C for soil and aqueous samples.

- **Initial calibration.** Performed at the beginning of sample analysis to assess calibration frequency and accuracy. Compliance requirements for satisfactory instrument calibration were established to ensure that the instrument used was capable of producing acceptable qualitative and quantitative data for compounds on the semivolatile TCL. Initial calibration demonstrates that the instrument was capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve. The minimum RRF criteria must be ≤ 0.05. Initial calibration %RSD must be ≤ 15% on the average for compounds (≤ 30% for continuing calibration checks).

- **Continuing calibration.** Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used was capable of producing acceptable qualitative and quantitative data for semivolatile target compounds. Continuing calibration standards containing both target and surrogates compounds are analyzed at the beginning of each 12-hour analysis period following the analysis of the instrument performance check and prior to the analysis of blanks and samples. The minimum RRFs for semivolatile target compounds and surrogates must be ≤ 0.05. The %D between the initial calibration RRF and the continuing calibration RRF must be within ≤ 20% for target compounds.

- **Blanks assessment.** The purpose of blank analyses was to identify the presence and magnitude of contamination problems resulting from field (rinse blanks) and laboratory activities. A method/extraction blank analysis must be performed after the calibration standards and once every 12-hour time period beginning with the injection of decafluorotriphenylphosphine (DFTPP). No contaminants should be detected in associated blanks > MRL. Positive sample results were reported and qualified "B" if the concentration of the compound in the sample was ≤ 10 times (10x) the maximum amount in a blank for the common laboratory contaminants phthalate esters, or 5 times (5x) the maximum amount for other semivolatile target compounds.
- **Instrument performance check.** The analysis of the instrument performance check solution was performed at the beginning of each 12-hour period during which samples are analyzed. The instrument performance check solution, DFTPP, must meet the specified ion abundance criteria.
- **Matrix spike and spike duplicate sample analysis.** Designed to provide information about the effect of each sample matrix on the sample preparation procedures and the measurement methodology as well as acceptable method precision by the laboratory at the time of analysis. The spike recoveries must be within established limits, with the exception of samples that have concentrations exceeding the spike concentration by a factor of four or more. Matrix spike duplicate analyses are also performed to generate data in order to assess the long-term precision of the analytical method on various matrices using RPD. RPD recoveries must be within established limits.
- **Laboratory Control Samples.** Monitored overall performance of each step during the analysis, including the sample preparation. LCS results must fall within the established recovery limits.
- **System Monitoring Compounds (Surrogates).** Laboratory performance on individual samples is established by means of spiking activities. The system monitoring compounds were added to the samples and blanks to measure their recovery. %Rs must be within the specified control limits.
- **Internal Standards.** Internal standards performance check ensures that GC/MS sensitivity and response are stable during each analytical run. Specific criteria include area count of –50% to +100% and retention time of ± 30 seconds from the associated calibration standards.
- **Calculation verification.** The %D between calculated and reported results should be < 10%. Samples below the MRL and above the MDL were qualified "J," estimated. TICs were qualified as estimated "J".

4.1.3 Data Grouping

An iterative screening approach was used to identify inorganic elements that would be included in the statistical evaluation. This preliminary screening was designed to ensure the adequacy of data grouping within both the MMA and NRU.

Macronutrients were eliminated because these elements generally are not risk drivers and have associated average daily intakes. Elements classified as macronutrients included calcium, magnesium, potassium, and sodium. Data were then reviewed from each area to discern elements that were not detected above the MRL. A target value of 80% was used to eliminate analytes that were not detected in the samples.

Further refinement of the data screening process yielded additional elements that were eliminated. These elements were detected either once or twice across the respective soil type. Additional rationale was integrated into the decisionmaking process to validate initial assumptions. For example, mercury was detected twice (0.07, 1.2 mg/kg) within the MMA Braddock Loam surface soil type. Because the mercury concentration for the Braddock Loam soil in the Eastern United States is in the range 0–1.2 mg/kg, the decision to eliminate mercury from the background evaluation was verified. A comparison of surface and subsurface soil concentrations within the MMA and NRU against the Eastern U.S. is presented in Appendix E. Additionally, graphical presentations for the distribution of mean soil concentrations within MMA and NRU soil types are included in Appendix E.

The coefficient of variation (CV), defined as the standard deviation divided by the mean, was used to evaluate the data variability for element distribution across soil types. Although CVs were not applied in the screening process, these values were used for comparison purposes. Elements with CVs less than 1.00 were combined into one data grouping. Elements with CVs greater than 1.00 were further evaluated to address the causes of variability.

4.2 STATISTICAL APPROACH

The statistical approach designed for RFAAP is depicted graphically in Figure 4-1. Equations associated with specific tests are presented in Table 4-8. Frequency of detects were calculated by element grouped within the MMA and NRU in accordance with Figure 4-2. Statistical criteria were established in conjunction with the percentage of calculated non-detects.

Elements that contained non-detects at a frequency greater than 80 percent were eliminated from further processing. These elements were not evaluated because no meaningful statistic can be generated from data sets that contain a large percentage of non-detected values. Additionally, one-half the reporting level was used as the concentration for non-detects.

Elements that contained non-detects at a frequency less than 50% were first evaluated using the Shapiro-Wilk test. Data sets from the MMA and NRU were individually tested to assess whether they were normally distributed. When the data sets did not follow a normal distribution, data points were log transformed and the Shapiro-Wilk test was used to assess whether the data were lognormally distributed. When data from both the MMA and NRU were both normally distributed, the F-test was applied to assess whether there was a statistical difference between the variances of the two groups. When data from both the MMA and NRU were both lognormally distributed, then the F-test was applied to the log transformed data. When the elements from the MMA and NRU had different distributions or did not pass either the normal and lognormal distribution test, the Mann-Whitney U test was used to assess the statistical significance between the data sets.

Results from the F-test were used to assess the appropriate Student's t-test. For example, when the variances were found to be similar, the Student's t-test was calculated using equal variances. Conversely, t-tests were calculated using unequal variances when the F-test demonstrated that the variances between the data sets were not similar.

The Student's t-test was used to assess statistical differences between the means of the data groups. No statistical differences between the means of the two groups demonstrated that the data could be combined into one set. Statistical differences between the group means would necessitate the use of separate background comparison values for each area.

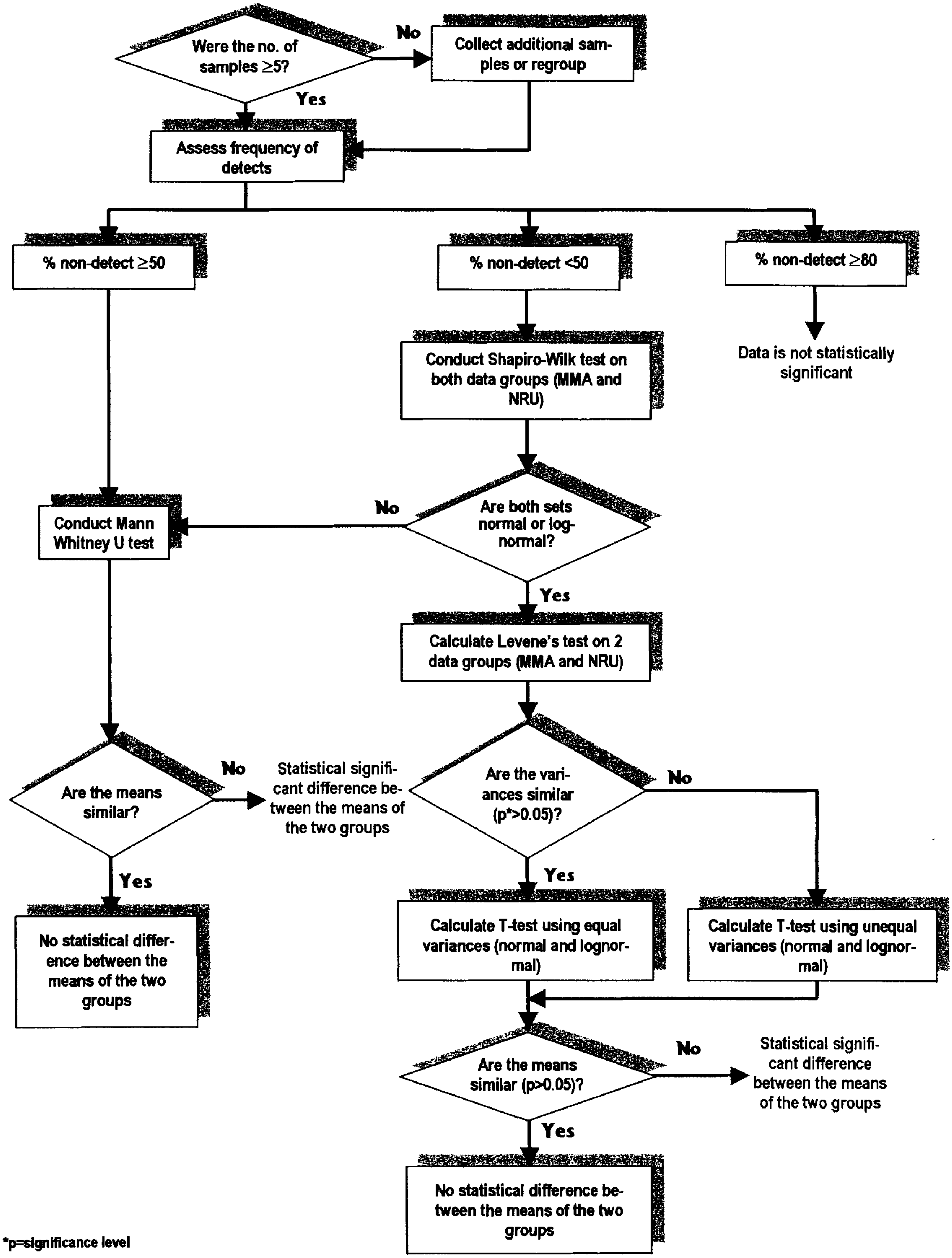
Statistical comparisons were performed separately for surface and subsurface soil samples within the MMA and NRU in accordance with Work Plan Addendum No. 10. The decision to segregate the data by surface versus subsurface soil took into account the treatment of background concentrations during risk assessment activities. For example, surface soil samples directly impact ecological risk management decisions, whereas subsurface soils are factored heavily into human health risk decisions.

Table 4-9 presents the statistical summary for elements evaluated in the surface soil. The output from the statistical comparisons is included as Appendix F. Thallium results were reassessed and eliminated because there were not enough detected results to demonstrate statistical significance. Although thallium was detected in 4 of 12 samples in the MMA, there were no detections of thallium in the 16 samples for the NRU. Therefore, the statistical comparison between the groups could not be performed. The Shapiro-Wilk test was used to assess the distribution of elements. Seven of the remaining thirteen inorganic surface soil elements (Figure 4-2) passed the test for normality or lognormality, including:

- Aluminum
- Chromium
- Copper
- Iron
- Manganese
- Vanadium
- Zinc

Figure 4–1

Statistical Approach for Radford Backgound Study



*p=significance level

Figure 4–2
Element Screening Process

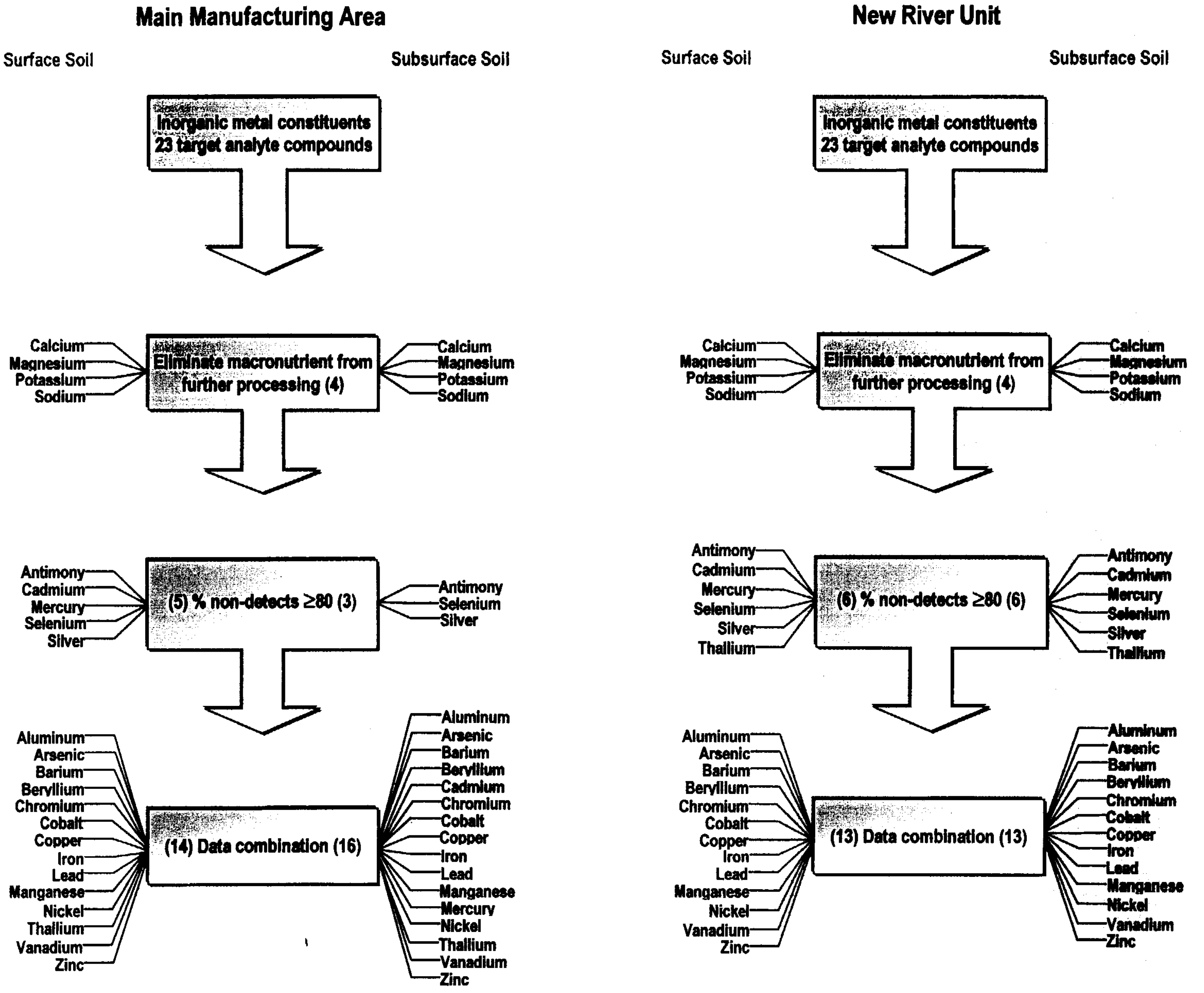


Table 4-8
Statistical Test

Test Name	Test	Equation	Hypothesis
Shapiro-Wilk	Normality	$W = \frac{1}{d}\left[\sum_{i=1}^{k} a_i (x_{n-i+1} - x_i)\right]^2 \quad d = \sum_{i=1}^{n} x_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)^2$ $W < W_{0.05}$ reject H_0 and accept H_a $W >= W_{0.05}$ accept H_0 and reject H_a where a_i = Shapiro-Wilk coefficient k = number of pairs of measurements x_i =i^{th} data value in the ordered data set x_i^2 = square of the i^{th} data value in the ordered data set n = number of data points W = Shapiro-Wilk test statistic $W_{0.05}$ = Shapiro-Wilk quantile at the 0.05 significant level	H_0: Population has a normal (lognormal) distribution H_a: Population does not have a normal (lognormal) distribution
F-test	Equality of Variances	$F_{test} = s_1^2 / s_2^2$ $s^2 = \frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})^2$ $F_{test} < F_{critical,\ 0.05}$ *reject* H_o *and accept* H_a $F_{test} \geq F_{critical,\ 0.05}$ *accept* H_o *and reject* H_a where s_1^2 = sample variance from Population 1 s_2^2 = sample variance from Population 2 n = number of data points in Population "i" x_i = individual data value in Population "i" $\bar{X}$ = arithmetic mean for data in Population "i" $F_{critical,\ 0.05}$ = F statistic at the 0.05 significance level	H_0: Populations have equal variances H_a: Populations have unequal variances

Table 4-8 (Continued)

Test Name	Test	Equation	Hypothesis
Student's t-test	Equality of Means	$T_{test} = \frac{\bar{x}_1 - \bar{x}_2}{s\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}$ $s = \left[\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}\right]^{0.5}$ $T_{test} < T_{n1+n2-2,0.95}$ reject H_0 and accept H_a $T_{test} >= T_{n1+n2-2,0.95}$ accept H_0 and reject H_a where s = estimated pooled standard deviation n_1 = number of data points in group 1 n_2 = number of data points in group 2 x_1 = arithmetic mean from group 1 x_2 = arithmetic mean from group 2 s_1 = standard deviation from group 1 s_2 = standard deviation from group 2 T_{test} = T-test Test statistic $T_{n1+n2-2,0.95}$ = T-test at the 0.05 significant level	H_0: Populations have equal means H_a: Populations have unequal means
Mann Whitney	Equality of Medians	$U = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$ $U_{0.05} = Z_{0.95}\sigma_U + 0.5 + \mu_U$ $\sigma_U = \sqrt{\frac{n_1 n_2 (N+1)}{12}}$ no ties $\sigma_U = \sqrt{\frac{n_1 n_2}{N^2-N} x \frac{N^3-N-\sum T}{12}}$ ties $\sum T = \sum (t_i^3 - t_i)$ $N = n_1 + n_2$ $\mu_U = \frac{n_1 n_2}{2}$ $U < U_{0.05}$ reject H_0 and accept H_a $U >= U_{0.05}$ accept H_0 and reject H_a where n_1 = number of data points in group 1 n_2 = number of data points in group 2 R_1 = sum of the ranks of the data points in group 1* σ_U = standard error of the U distribution μ_U = mean of the U distribution t_i = number of ties in a group of tied values U = Mann Whitney test statistic $U_{0.05}$ = Mann Whitney one-tailed value at the 0.05 significant level	H_0: Populations have equal medians H_a: Populations have unequal medians *When two or more observations have exactly the same value, the rank assigned to each of the tied ranks is the mean of the ranks that would have been assigned to these ranks had they not been tied. For example, if the 2 values tied on the third rank, then each value would be assigned a rank of 3.5 [(3+4)/2].

Table 4–8 (Continued)

Test Name	Test	Equation	Hypothesis
95% Upper confidence limit on the mean – normal distribution	95 % Upper confidence limit	$95\%UCL_N = \bar{x} + t_{0.95,n-1}\frac{s}{\sqrt{n}}$ where $\bar{x}$ = arithmetic mean $t_{0.95,n-1}$ = student t distribution value s = arithmetic standard deviation n = number of data points $95\%UCL_N$ = one-sided upper 95% confidence limit for a normal distribution	Not applicable
95% Upper confidence limit on the mean – lognormal distribution	95% Upper confidence limit on the mean – lognormal distribution	$95\%UCL_L = \exp\left(\bar{y} + 0.5s_y^2 + \frac{s_y H_{0.95}}{\sqrt{n-1}}\right)$ where $\bar{y}$ = arithmetic mean of the ln transformed data s_y^2 = arithmetic variance of the ln transformed data s_y = arithmetic standard deviation of the ln transformed data $H_{0.95}$ = value used to compute one-sided confidence limit on a log-normal mean n = number of data points $95\%UCL_L$ = one-sided upper 95% confidence limit for a lognormal distribution	Not applicable
Coefficient of Variation	Coefficient of Variation	$CV = \frac{s}{\bar{x}}$ where $\bar{x}$ = arithmetic mean of the background concentration s = arithmetic standard deviation	Not applicable

Table 4-8 (Continued)

Test Name	Test	Equation	Hypothesis
95% Upper tolerance limit – normal distribution	95% Upper tolerance limit	$UTL_{0.95} = \bar{x} + sK_{0.95,0.95}$ where $\bar{x}$ = arithmetic mean of the background concentration s = arithmetic standard deviation $K_{0.95,0.95}$ = factor for estimating the 95 percent confidence limit for the 95th quantile (Gilbert, 1987; Table A-3)	Not applicable
95% Upper tolerance limit – lognormal distribution	95% Upper tolerance limit – lognormal distribution	$UTL_{0.95} = \exp\left[\bar{y} + s_y K_{0.95,0.95}\right]$ where $\bar{y}$ = arithmetic mean of the log-transformed data, y = ln(x) s_y = standard deviation of the log-transformed data $K_{0.95,0.95}$ = factor for estimating the 95 percent confidence limit for the 95th quantile (Gilbert, 1987; Table A-3)	Not applicable
95% Upper confidence limit – nonparametric distribution	95% Upper confidence limit – nonparametric distribution	$95\%UCL_{np} = x_{[f(U)]}$ where $U = (n + 1 + Z_{0.95}\sqrt{n})/2$ n = number of data points $Z_{0.95}$ = upper 95% limit from a standard normal curve for a Z distribution [1.645] U = rank in an ascending order data set that corresponds to the one-sided 95% confidence limit on the median F(U) = U rounded up to an integer (e.g., 24.2 is 25)	Not applicable

Table 4–8 (Continued)

Test Name	Test	Equation	Hypothesis
95% Upper tolerance limit – nonparametric distribution	95% Upper tolerance limit – nonparametric distribution	$95\%UTL_{np} = x_{[f(U)]}$ where $U = p\,(n+1) + Z_{0.95}\,[np\,(1-p)]^{1/2}$ p = arithmetic mean n = number of data points $Z_{0.95}$ = upper 95% limit from a standard normal curve for a Z distribution [1.645] U = rank in an ascending order data set that corresponds to the one-sided 95% confidence limit on the median F(U) = U rounded up to an integer (e.g., 24.2 is 25)	Not applicable

Table 4-9
Surface Soil Statistical Summary

Compound	Distribution		Detected compounds		Test Type (c)	F-test Variances		T-test Means		Mann Whitney Means		Final result MMA = NRU (d)
	MMA (a)	NRU (b)	MMA (12)	NRU (16)		Similar	p-Value	Similar	p-Value	Similar	p-Value	
Aluminum	Lognormal	Lognormal	12	16	T-Test - Lognormal	Yes	0.30	Yes	0.46	====	===>	Same
Arsenic	Neither	Lognormal	12	16	MMU	====	====	====	===>	Yes	0.086	Same
Barium	Normal	Lognormal	10	14	MMU	====	====	====	===>	No	0.017	**Different**
Beryllium	Neither	Neither	5	10	MMU	====	====	====	===>	Yes	0.18	Same
Chromium	Lognormal	Lognormal	12	16	T-Test - Lognormal	Yes	0.14	Yes	0.098	====	===>	Same
Cobalt	Normal	Lognormal	7	13	MMU	====	====	====	===>	No	0.037	**Different**
Copper	Normal	Normal	11	15	T-Test - Normal	Yes	0.074	Yes	0.058	====	===>	Same
Iron	Lognormal	Lognormal	12	16	T-Test - Lognormal	Yes	0.23	No	0.021	====	===>	**Different**
Lead	Neither	Lognormal	12	16	MMU	====	====	====	===>	Yes	0.097	Same
Manganese	Lognormal	Lognormal	12	16	T-Test - Lognormal	Yes	0.40	Yes	0.33	====	===>	Same
Nickel	Neither	Neither	7	10	MMU	====	====	====	===>	Yes	0.38	Same
Vanadium	Lognormal	Lognormal	12	16	T-Test - Lognormal	Yes	0.087	Yes	0.051	====	===>	Same
Zinc	Lognormal	Lognormal	12	16	T-Test - Lognormal	Yes	0.062	Yes	0.10	====	===>	Same

(a) MMA = Main Manufacturing Area

(b) NRU = New River Unit

(c) T-Test - Normal = F and T-test using the data
T-Test - Lognormal = F and T-test using the log transformed data
MMU = Mann Whitney U test using the data

(d) Same = Indicates that there is not a statistically significant difference between the MMA and NRU groups based on a 5% significance level.
Different = Indicates that there is a statistically significant difference between the MMA and NRU groups based on a 5% significance level.

The F-test was used to assess that the Student's t-test for elements with similar variances could be used for the elements with the exception of copper. The Student's t-test for unequal variances was used for copper. T-test results indicated that the following elements were similar as indicated by the test result being greater than the 0.05 significance level (p):

- Aluminum
- Chromium
- Copper
- Iron
- Manganese
- Vanadium
- Zinc

The Mann Whitney U test was used to assess whether there was a statistically significant difference between the means for elements with distributions that were neither normal nor lognormal or in cases where each data set exhibited a different distribution (e.g., one set normal, the second set lognormal). Elements that were evaluated included:

- Arsenic
- Barium
- Beryllium
- Cobalt
- Lead
- Nickel

Barium, cobalt, and iron were the three elements that were demonstrated to be statistically significantly different. The significance levels for barium and iron were both 0.02. The significance level for cobalt was 0.04. An evaluation of the test results indicated that there was no statistical difference between the means for 77% (10 out of 13 elements) at a 0.05 significance level. The elements were further evaluated at the 0.02 significance level, and the 13 elements indicated that there was no statistically significant difference between the means. Because 85% of the elements were statistically similar at the 0.05 significance level and the remaining elements were statistically similar at the 0.02 significance level, MMA and NRU results will be combined to obtain one background surface soil data set.

Table 4-10 presents the statistical summary for elements evaluated in the subsurface soil. The output from the statistical comparisons is included as Appendix F. The Shapiro-Wilk test was used to assess the distribution of elements. Ten of the 13 subsurface elements (Figure 4-2) passed the test for normality or lognormality and included:

- Aluminum
- Arsenic
- Chromium
- Cobalt
- Copper
- Iron
- Manganese
- Nickel
- Vanadium
- Zinc

The F-test was used to assess whether there was a statistical significance between the variances for each element. The F-test indicated that the variances were similar for aluminum, chromium, cobalt, copper, iron, manganese, and nickel while the variances were different for arsenic, vanadium, and zinc. The Student's t-test for equal variances was used for the elements that were similar using the results from the F-test while the Student's t-test for unequal variances was used for the elements that were different. The Student's t-test (equal and unequal variances) results indicated that the following elements did not have a statistically significant difference between the means:

Table 4-10
Subsurface Soil Statistical Summary

Compound	Distribution		Detected compounds		Test Type	F-test Variances		T-test Means		Mann Whitney Means		Final result MMA = NRU
	MMA (a)	NRU (b)	MMA (22)	NRU (29)	(c)	Similar	p-Value	Similar	p-Value	Similar	p-Value	(d)
Aluminum	Lognormal	Lognormal	22	29	T-Test - Lognormal	Yes	0.37	No	0.008	====	===>	**Different**
Arsenic	Lognormal	Lognormal	20	28	T-Test - Lognormal	No	< 0.001	Yes	0.2	====	===>	Same
Barium	Normal	Neither	19	20	MMU	====	====	====	===>	No	< 0.001	**Different**
Beryllium	Neither	Neither	11	14	MMU	====	====	====	===>	Yes	0.37	Same
Chromium	Lognormal	Lognormal	22	29	T-Test - Lognormal	Yes	0.26	Yes	0.32	====	===>	Same
Cobalt	Lognormal	Lognormal	16	21	T-Test - Lognormal	Yes	0.37	Yes	0.37	====	===>	Same
Copper	Normal	Normal	22	29	T-Test - Normal	Yes	0.43	Yes	0.15	====	===>	Same
Iron	Normal	Normal	22	29	T-Test - Normal	Yes	0.059	Yes	0.29	====	===>	Same
Lead	Neither	Lognormal	22	29	MMU	====	====	====	===>	No	0.007	**Different**
Manganese	Lognormal	Lognormal	22	29	T-Test - Lognormal	Yes	0.37	Yes	0.11	====	===>	Same
Nickel	Lognormal	Lognormal	22	24	T-Test - Lognormal	Yes	0.13	Yes	0.22	====	===>	Same
Vanadium	Normal	Normal	22	29	T-Test - Normal	No	0.046	No	0.005	====	===>	**Different**
Zinc	Lognormal	Lognormal	22	29	T-Test - Lognormal	No	0.034	No	< 0.001	====	===>	**Different**

(a) MMA = Main Manufacturing Area
(b) NRU = New River Unit
(c) T-Test - Normal = F and T-test using the data
T-Test - Lognormal = F and T-test using the log transformed data
MMU = Mann Whitney U test using the data
(d) Same = Indicates that there is not a statistically significant difference between the MMA and NRU groups based on a 5% significance level.
Different = Indicates that there is a statistically significant difference between the MMA and NRU groups based on a 5% significance level.

- Arsenic
- Chromium
- Cobalt
- Copper
- Iron
- Manganese
- Nickel

Aluminum, vanadium, and zinc results from the Student's t-test indicated there was a statistically significant difference between the means at a 0.05 significance level. The significance levels for aluminum, vanadium, and zinc were 0.008, 0.005, and <0.001, respectively.

The Mann Whitney U test was used to assess whether there was a statistical significance difference between the means for elements:

- Barium
- Beryllium
- Lead

Beryllium was the one element from this group that exhibited no statistically significant difference between the groups based on the Mann Whitney U test results with a 0.05 significance level. The significance levels for barium and lead were <0.001 and 0.007, respectively.

Test evaluation results indicated that there was no statistically significant difference between the means for 62% of the elements (8 out of 13) at a 0.05 significance level. For the remaining five elements, the means were higher for the MMA as compared to the NRU. Because the majority of the elements were statistically similar at the 0.05 significance level, MMA and NRU results will be combined to obtain one background subsurface soil data set.

Beryllium was found to be the sole element from this group that was statistically similar based on Mann Whitney U test results.

Test evaluation results suggested that there was no statistical difference between the means for 62% of the elements. Since the majority of these elements are statistically similar, the MMA and NRU results will be combined to obtain one background subsurface soil data set at the site. Cadmium, mercury, and thallium were the elements that were non-detected in the data combination for NRU subsurface soils. Although these three elements were not statistically tested, 95%UCLs were calculated based on available data.

Point estimate values were used to represent the background concentration for future comparisons between site and background data. The 95 percent upper confidence limit (UCL) was selected as the statistic to assess background point estimate values. The requisite equation for determining the point estimate for the background value is based on distribution of the combined data set.

Point estimates were established for the 13 elements from the analysis of the surface and subsurface soil data sets. Cadmium, mercury, and thallium were not detected in the NRU subsurface soil data set; however, the combined data set contains greater than 20 percent detects. Since the subsurface soil data sets were combined, point estimates were also established for these three elements.

4.3 CONFIDENCE LIMITS

The Shapiro-Wilk test was used to assess the distribution of the combined data. When the combined data set (MMA and NRU) passed the test for normality, the equation for 95% UCL for normal distributions was used. When the combined data set was lognormal, the 95% UCL for lognormal distributions was used. When the combined data set did not pass either test or the initial distributions were not normally or lognormally distributed, the 95% UCL based on a nonparametric distribution was calculated. (Refer to Table 4-8 for 95% UCL equations.) Background 95% UCLs for surface soil values are presented in Table 4-11 and subsurface soil samples are presented in Table 4-12, including the associated distribution for combined data. The output for the summary statistics for Tables 4-11 and 4-12 is included in Appendix G.

Table 4-11
Occurrence and Distribution of Chemicals
Combined Surface Soil (MMA and NRU)

[Units in mg/kg]

Chemical	Frequency of Detection	Minimum Concentration	Maximum Concentration	Arithmetic Mean Concentration	Coefficient of Variation	Distribution	95% UCL of the Mean
Aluminum	28 / 28	3,620	20,100	8,300	0.515	Lognormal	9,896
Arsenic	28 / 28	1.50	10.2	3.73	0.624	Lognormal	4.53
Barium	24 / 28	23.4	174	66.4	0.692	Lognormal	101
Beryllium	15 / 28	0.610	1.50	0.609	0.577	Neither	0.72
Chromium	28 / 28	6.30	53.3	21.1	0.498	Lognormal	26.1
Cobalt	20 / 28	5.90	45.4	12.2	0.848	Lognormal	18.3
Copper	26 / 28	2.20	13.6	6.46	0.608	Normal	7.73
Iron	28 / 28	7,250	63,000	20,108	0.590	Lognormal	25,258
Lead	28 / 28	8.90	225	27.0	1.53	Neither	17.9
Manganese	28 / 28	43.00	2,040	695.9	0.85	Lognormal	1,193
Nickel	17 / 28	4.60	18.1	6.95	0.723	Neither	9.0
Vanadium	28 / 28	12.2	101	33.9	0.525	Lognormal	41.0
Zinc	28 / 28	7.10	216	41.2	0.977	Lognormal	56.3

Table 4-12
Occurrence and Distribution of Chemicals
Combined Subsurface Soil (MMA and NRU)

[Units in mg/kg]

Chemical	Frequency of Detection	Minimum Concentration	Maximum Concentration	Arithmetic Mean Concentration	Coefficient of Variation	Distribution	95% UCL of the Mean
Aluminum	51 / 51	6,130	47,900	17,847	0.545	Lognormal	20,413
Arsenic	48 / 51	1.20	35.9	5.51	1.15	Lognormal	7.02
Barium	39 / 51	25.2	164	51.9	0.773	Lognormal	67.5
Beryllium	25 / 51	0.780	5.40	1.03	1.12	Neither	0.96
Cadmium	12 / 51	0.570	2.50	0.529	0.883	Neither	0.66
Chromium	51 / 51	10.8	75.8	30.9	0.390	Lognormal	34.6
Cobalt	37 / 51	6.20	130	20.2	1.33	Lognormal	28.1
Copper	51 / 51	1.60	38.7	15.3	0.666	Normal	17.7
Iron	51 / 51	14,300	67,700	31,718	0.307	Lognormal	34,466
Lead	51 / 51	2.10	256	19.7	1.98	Neither	12.5
Manganese	51 / 51	16.7	1,760	355	0.922	Lognormal	579
Mercury	16 / 51	0.0380	0.270	0.0763	0.655	Neither	0.129
Nickel	46 / 51	4.80	94.2	19.0	0.901	Lognormal	26.4
Thallium	12 / 51	1.40	5.0	1.13	0.912	Neither	1.31
Vanadium	51/ 51	22.0	114	53.9	0.342	Lognormal	59.2
Zinc	51/ 51	4.70	598	62.7	1.66	Lognormal	78.4

4.4 COMPARISON TO PREVIOUS STUDY ATTEMPT

Data from the previously attempted background study were reviewed to evaluate accuracy and precision and evaluate the use of this data in the new data set. Several shortcomings were identified in the previous data set, including the following:

- The previous background attempt focused on the collection of site-specific background concentrations
- Background samples were collected at the MMA and were not collected at the NRU
- Surface soil samples had not been included in the background study design
- Data were not statistically evaluated to assess the potential for combining data sets
- Point estimates were developed for the Wheeling Sandy Loam and Unison-Urban Complex for each soil horizon resulting in four estimates
- Tolerance limits were used to develop point estimates as opposed to the 95% UCL
- Copper, iron, and manganese were eliminated from the data set without supporting rationale
- Uncertainty associated with the actual position of sampling locations
- High data variability

The uncertainty inherent in the previous background data set demonstrated that data results could not be incorporated into the study without compromising the current data set.

4.5 COMBINED DATA SET AND TOLERANCE LIMITS

As a result of subsequent discussions with USEPA and VDEQ, this Final Facility-Wide Background Study reflects two major revisions: 1) facility-wide point estimates for background soil data are calculated as tolerance limits rather than confidence limits, and 2) background data for soil (surface and subsurface, MMA and NRU) are combined into a single data set. The rationale for these changes is summarized in the following text.

The use of tolerance limits rather than confidence limits evolved from comments questioning the use of the 95% UCL as the point estimate for the background value. The 95% UCL was originally included in the Facility-Wide Background Study as a general point of reference. At the time the Work Plan for this Facility-Wide Background Study was developed, the intent was to use hypothesis testing for RFI sites. An additional use of the data set would include the use of point-by-point comparisons.

A confidence interval is used for comparisons within a single population. A compliance data set is then typically compared to a known standard (USEPA, 1989, 1992). Using the 95% UCL as a single point comparison or background value, however, is likely to result in classifying many chemicals as greater than background when they are not. These misclassifications would be due to the 95% UCL representing an estimate of the mean. Such misclassifications could occur as often as 50% of the time.

A tolerance limit is used for comparisons of similar but distinct populations. A concentration range is defined from a background data set, within which a large proportion of compliance data should fall with high probability (USEPA 1989, 1992). Therefore, it was recommended that a 95% upper tolerance limit (UTL) be developed in the Background Study for use as point-by-point comparisons. For reference, the 95% UTL values for each stratum (surface and subsurface soil) and each area of the study (MMA and NRU) are presented in Tables 4-13 through 4-16. The output for the summary statistics is provided in Appendix G. For comparison, the 95% UCLs calculated for this study are also presented in the table. For those constituents with CVs greater than 1, the use of the UTL will better accommodate the variability in the data set.

Background soil data sets were combined after evaluating various data groups. During discussions there were concerns about combining the MMA and NRU surface soil data because barium and iron demonstrated a statistically significant difference in the original statistical evaluation (see Section 4.2 and Table 4-9). Similarly, aluminum, barium, lead, vanadium, and zinc demonstrated statistically significant difference for the MMA and NRU subsurface soil data sets (see Section 4.2 and Table 4-10). The hypothesis that within each stratum (surface and subsurface), data for each chemical constituent could be grouped into either one or two groups by soil type was investigated.

A new set of background numbers was generated to assess whether the numbers calculated using this approach were similar to those calculated using the original approach. These comparisons demonstrated that the calculated UTLs were similar between the data groups and generally within the same order of magnitude. In addition, there was no particular trend in the UTLs for a given group, e.g., the highest UTL values are not consistently from the same group.

After further discussion and analysis of these comparisons it was agreed that combining the data sets would be appropriate because each potentially contaminated site at the facility is located in an area where excavation of surface soils has occurred at some point during facility operations. The combined surface and subsurface soil data set would most likely represent the conditions of mixed surface and subsurface soil at these sites. The final set of point estimates for the background data set was based on calculated 95% UTLs for a single data set that represented surface and subsurface soil from the MMA and NRU areas. These values are provided in Table 4-17. The output for the summary statistics is provided in Appendix G. For several constituents, the 95% UTLs are below the RBCs, which will be used to screen chemicals of potential concern (COPCs) at the sites. Those chemicals detected at concentrations below RBCs would be "screened out" of the risk assessment process and would not be carried forward for further quantitative evaluation. Thus, the potential for carrying naturally occurring elements through the quantitative risk assessment would be minimized. In addition, combining the data sets will result in greater statistical power for the comparisons due to the increased sample size and will better accommodate variability in the data set.

Table 4-13
Occurrence and Distribution of Chemicals
Surface Soil – Main Manufacturing Area

[Units in mg/kg]

Chemical	Frequency of Detection	Minimum Concentration	Maximum Concentration	Arithmetic Mean Concentration	Coefficient of Variation	Distribution	95% UCL of the Mean	95% UTL of the Mean
Aluminum	12 / 12	3,700	15,400	8,179	0.446	Lognormal	10,863	25,012
Arsenic	12 / 12	1.50	10.2	3.46	0.763	Lognormal	5.06	14.2
Barium	10 / 12	39.9	174	92.1	0.589	Normal	120	240
Beryllium	5 / 12	0.72	1.10	0.545	0.608	Neither	1.1	1.1
Chromium	12 / 12	8.70	27	17.3	0.397	Lognormal	22.7	50.7
Cobalt	7 / 12	6.50	16.1	7.71	0.632	Normal	10.2	21.1
Copper	11 / 12	2.20	13.6	7.82	0.591	Normal	10.2	20.5
Iron	12 / 12	7,250	23,800	14,755	0.428	Lognormal	20,116	48,077
Lead	12 / 12	9.40	225	33.7	1.82	Neither	225	225
Manganese	12 / 12	43.0	1,910	615	0.798	Lognormal	1,804	7,047
Nickel	7 / 12	4.60	13.5	6.70	0.701	Neither	13.5	13.5
Vanadium	12 / 12	14.7	43.6	28.3	0.362	Lognormal	36.5	78.9
Zinc	12 / 12	10.0	216	55.8	1.02	Lognormal	125	469

Table 4-14
Occurrence and Distribution of Chemicals
Surface Soil – New River Unit

[Units in mg/kg]

Chemical	Frequency of Detection	Minimum Concentration	Maximum Concentration	Arithmetic Mean Concentration	Coefficient of Variation	Distribution	95% UCL of the Mean	95% UTL of the Mean
Aluminum	16 / 16	3,620	20,100	8,391	0.574	Lognormal	11,053	26,989
Arsenic	16 / 16	1.60	9.30	3.94	0.542	Lognormal	5.11	12.1
Barium	14 / 16	23.4	109	47.1	0.570	Lognormal	71.3	206
Beryllium	10 / 16	0.610	1.50	0.657	0.562	Normal	0.819	1.59
Chromium	16 / 16	6.30	53.3	24.0	0.500	Lognormal	34.1	90.9
Cobalt	13 / 16	5.90	45.4	15.6	0.779	Lognormal	29.2	102
Copper	15 / 16	2.90	11.6	5.45	0.567	Normal	6.80	13.2
Iron	16 / 16	7,470	63,000	24,122	0.563	Lognormal	33,935	90,071
Lead	16 / 16	8.90	76.7	21.9	0.727	Lognormal	28.6	70.5
Manganese	16 / 16	91.7	2,040	756	0.881	Lognormal	1,548	5,710
Nickel	10 / 16	4.60	18.1	7.13	0.757	Lognormal	11.7	37.9
Vanadium	16 / 16	12.2	101	38.1	0.556	Lognormal	52.2	133
Zinc	16 / 16	7.10	56.3	30.3	0.521	Lognormal	43.6	118

Table 4-15
Occurrence and Distribution of Chemicals
Subsurface Soil – Main Manufacturing Area

[Units in mg/kg]

Chemical	Frequency of Detection	Minimum Concentration	Maximum Concentration	Arithmetic Mean Concentration	Coefficient of Variation	Distribution	95% UCL of the Mean	95% UTL of the Mean
Aluminum	22 / 22	8,710	47,900	21,223	0.517	Lognormal	25,783	56,307
Arsenic	20 / 22	1.2	35.9	7.73	1.16	Lognormal	16.7	64.5
Barium	19 / 22	25.2	155	71.5	0.623	Normal	87.8	176
Beryllium	11 / 22	0.790	5.30	1.01	1.16	Neither	1.1	1.3
Cadmium	12 / 22	0.570	2.50	0.778	0.805	Lognormal	1.11	3.33
Chromium	22 / 22	10.8	75.8	32.3	0.427	Lognormal	39.2	82.8
Cobalt	16 / 22	6.80	94.3	18.3	1.33	Lognormal	31.9	118
Copper	22 / 22	3.30	34.4	17.0	0.611	Normal	20.8	41.4
Iron	22 / 22	14,300	67,700	32,595	0.352	Normal	36,805	59,560
Lead	22 / 22	5.6	256	31.3	1.84	Neither	17.7	256
Manganese	22 / 22	39.4	1,760	428	0.939	Lognormal	847	3,143
Mercury	10 / 22	0.0380	0.270	0.0729	0.865	Neither	0.106	0.154
Nickel	22 / 22	4.80	94.2	20.4	1.01	Lognormal	29.6	93.2
Thallium	12 / 22	1.40	5.0	1.76	0.729	Neither	2.37	2.61
Vanadium	22/ 22	27.0	114	61.9	0.329	Normal	69.4	110
Zinc	22/ 22	14.7	598	112	1.28	Lognormal	186	674

Table 4-16
Occurrence and Distribution of Chemicals
Subsurface Soil – New River Unit

[Units in mg/kg]

Chemical	Frequency of Detection	Minimum Concentration	Maximum Concentration	Arithmetic Mean Concentration	Coefficient of Variation	Distribution	95% UCL of the Mean	95% UTL of the Mean
Aluminum	29 / 29	6,130	33,900	15,286	0.518	Lognormal	18,373	41,070
Arsenic	28 / 29	1.20	10.7	3.83	0.545	Lognormal	4.81	11.7
Barium	20 / 29	28.5	164	37.1	0.792	Neither	41.2	43.9
Beryllium	14 / 29	0.780	5.40	1.05	1.10	Neither	1.06	1.68
Cadmium	0 / 29	NA	NA	NA	NA	NA	NA	NA
Chromium	29 / 29	13.6	50.9	30.0	0.359	Lognormal	34.5	66.3
Cobalt	21 / 29	6.20	130	21.6	1.33	Lognormal	36.7	137
Copper	29 / 29	1.60	38.7	14.0	0.717	Normal	17.2	36.4
Iron	29 / 29	17,300	44,200	31,052	0.269	Normal	33,694	49,744
Lead	29 / 29	2.10	35.5	10.9	0.638	Lognormal	13.7	33.6
Manganese	29 / 29	16.7	931	299	0.834	Lognormal	605	2,271
Mercury	6 / 29	0.11	0.19	0.079	0.485	Neither	0.11	0.17
Nickel	24 / 29	4.80	51.1	18.0	0.797	Lognormal	31.2	111
Thallium	0 / 29	NA	NA	NA	NA	NA	NA	NA
Vanadium	29/ 29	22.0	77.6	47.9	0.302	Normal	52.5	80.3
Zinc	29/ 29	4.70	69.8	25.0	0.642	Lognormal	33.6	93.4

Table 4-17
Summary of Total Soil Data at Radford Upper Tolerance Limits (UTLs)

Chemical	MMA/NRU and Surface/Subsurface Soil Data				Residential Screening RBC [c], mg/kg	Industrial Screening RBC [c], mg/kg	Background Concentration
	Frequency of Detection	Range of data, mg/kg	Statistical Distribution [a]	95% UTL mg/kg [b]			
Aluminum	79/79(100)	3,620 - 47,900	L	40,041	7,800	200,000	40,041
Arsenic	76/79(96)	1.2 - 35.9	L	15.8	0.43	3.8	15.8
Barium	63/79(80)	23.4 - 174	L	209	550	14,000	209
Beryllium	40/79(51)	0.61 - 5.4	U	1.02	16	410	1.02
Cadmium	13/79(16)	0.62 - 2.5	NP	0.69	3.9	100	0.69
Chromium	79/79(100)	6.3 - 75.8	L	65.3	23	610	65.3
Cobalt	57/79(72)	5.9 - 130	L	72.3	160	4,100	72.3
Copper	77/79(97)	1.6 - 38.7	L	53.5	310	8,200	53.5
Iron	79/79(100)	7,250 - 67,700	N	50,962	2,300	61,000	50,962
Lead	79/79(100)	2.1 - 256	U	26.8	400	1,000	26.8
Manganese	79/79(100)	16.7 - 2,040	L	2,543	160	4,100	2,543
Mercury	19/79(24)	0.038 - 1.2	NP	0.130	0.78	20	0.13
Nickel	63/79(80)	4.6 - 94.2	L	62.8	160	4,100	62.8
Thallium	16/79(20)	1.3 - 5.0	NP	2.11	0.55	14	2.11
Vanadium	79/79(100)	12.2 - 114	L	108	55	1,400	108
Zinc	79/79(100)	4.7 - 598	L	202	2,300	61,000	202

[a] Statistical Distribution: N = Normal distribution; L = Lognormal distribution; U = Undetermined distribution; NP = Nonparametric distribution for data sets with greater than 50% nondetects.

[b] 95% Upper Tolerance Limit calculated for the indicated distribution.

[c] RBC = Region III risk-based concentration adjusted for a Hazard Quotient = 0.1 to account for potential cumulative effects (dated May 8, 2001).

Note: Highlighted values are below the residential screening RBC.

Table 2-1
Facility-Wide Background Study Sampling Program

Soil Type/ Grouping	Sample ID	Matrix	Depth Top (in. bgs)	Depth Bottom (in. bgs)	Date Collected	TAL Metals 3050B/6010B (solid) 7471A (Hg solid) 3010A/6010B (aqueous) 7470A (Hg aqueous)	pH 9045C (solid)	VOCs 5035/8260B (solid) 5030B/8260B (aqueous)	SVOCs 3540C/8270C (solid) 3520C/8270C (aqueous)	TCLP Metals 1311/3010A/ 6010B 1311/7470A (Hg)	RDX Immunoassay Field Test Kit 4051	TNT Immunoassay Field Test Kit 4050
Main Manufacturing Area Environmental/ Field Screening Samples												
Braddock Loam	MMAB1A	Soil	0	10	8/31/00	●	●					
	MMAB1B	Soil	10	48	8/31/00	●	●					
	MMAB1C	Soil	48	84	8/31/00	●	●					
	MMAB2A	Soil	0	12	9/6/00	●	●					
	MMAB2B	Soil	12	60	9/6/00	●	●					
	MMAB3A	Soil	0	9	9/6/00	●	●		●		●	●
	MMAB3B	Soil	9	42	9/6/00	●	●	●	●		●	●
	MMAB4A	Soil	0	6	8/31/00	●	●					
	MMAB4B	Soil	6	51	8/31/00	●	●					
	MMAB4C	Soil	51	53	8/31/00	●	●					
Unison Urban Land Complex	MMAU1A	Soil	0	10	9/7/00	●	●		●		●	●
	MMAU1B	Soil	10	52	9/7/00	●	●	●	●		●	●
	MMAU1C	Soil	52	60	9/7/00	●	●	●	●		●	●
	MMAU2A	Soil	0	10	9/7/00	●	●					
	MMAU2B	Soil	10	52	9/7/00	●	●					
	MMAU2C	Soil	52	60	9/7/00	●	●					
	MMAU3A	Soil	0	9	8/31/00	●	●					
	MMAU3B	Soil	9	42	8/31/00	●	●					
	MMAU3C	Soil	42	72	8/31/00	●	●					
	MMAU4A	Soil	0	10	9/6/00	●	●					
	MMAU4B	Soil	10	58	9/6/00	●	●					
	MMAU4C	Soil	58	76	9/6/00	●	●					

5.0 Conclusions

5.1 BACKGROUND SAMPLE LOCATIONS

Pre-selected background sample locations were positioned in the MMA and NRU in areas that had not been impacted by previous site operations. Explosives were selected as primary background markers given the history of installation propellant manufacturing activities. Field screening immunoassays were processed for RDX and TNT to evaluate potential explosive contamination. Explosives results were negative, indicating background sampling locations had not been impacted by RFAAP operations. Additionally, semivolatile and volatile organic compounds were evaluated as secondary markers to substantiate the selection of true background locations. Analytical results demonstrated that organic contaminants had not impacted the selected locations, indicating that sample locations represented background conditions.

5.2 STATISTICAL EVALUATION

Background sample results were validated in accordance with Work Plan Addendum No. 10, to assess analytical data limitations and report scientifically based and statistically valid data. Elements were eliminated from statistical testing that did not result in significant contributions to background evaluation. For example, macronutrients (calcium, potassium, magnesium, and sodium) were not evaluated statistically because they are not chemicals that drive remedial decisions. Non-detects greater than 80% were also eliminated because there was not enough data to perform statistical analysis.

Statistical testing was performed on the remaining elements to assess data distributions and evaluate the potential for combining the data into one data set. Testing results indicated that surface soils from both the MMA and NRU could be combined into one data set and subsurface soils from both areas could be combined into one data set.

Point estimates were then evaluated against the previously attempted background study (Parsons 1996) to assess the integration of prior data into the existing data set. Shortcomings identified in the previous data set, as specified in Section 4.4, precluded its use because of the high potential for compromising the current (year 2000) data.

As a result of subsequent discussions with USEPA and VDEQ, this Final Facility-Wide Background Study reflects two major revisions: 1) facility-wide point estimates for background soil data are calculated as tolerance limits rather than confidence limits, and 2) background data for soil (surface and subsurface, MMA and NRU) are combined into a single data set. The final set of point estimates for the background data set, therefore, are based on calculated 95% UTLs for a single facility-wide data set that represents surface and subsurface soil from the MMA and NRU areas. These values are included as a point of reference for point-by-point comparisons for site screening. These point estimates are summarized in Table 5-1.

Table 5-1
Facility-Wide Point Estimates for Radford AAP Soil

[Units in mg/kg]

Chemical Name	Range of data (mg/kg)	Background Concentration 95 % UTL (mg/kg)
Aluminum	3,620 - 47,900	40,041
Arsenic	1.2 - 35.9	15.8
Barium	23.4 - 174	209
Beryllium	0.61 - 5.4	1.02
Cadmium	0.62 - 2.5	0.69
Chromium	6.3 - 75.8	65.3
Cobalt	5.9 - 130	72.3
Copper	1.6 - 38.7	53.5
Iron	7,250 - 67,700	50,962
Lead	2.1 - 256	26.8
Manganese	16.7 - 2,040	2,543
Mercury	0.038 - 1.2	0.13
Nickel	4.6 - 94.2	62.8
Thallium	1.3 - 5.0	2.11
Vanadium	12.2 - 114	108
Zinc	4.7 - 598	202

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Appendix A

Lithologic Boring Logs

Appendix A
Lithologic Boring Logs Summary

Main Manufacturing Area	
Soil Type	**Sample ID**
Braddock Loam	MMAB1
	MMAB2
	MMAB3
	MMAB4
Unison Urban Land Complex	MMAU1
	MMAU2
	MMAU3
	MMAU4
Wheeling Sandy Loam	MMAW1
	MMAW2
	MMAW3
	MMAW4
New River Unit	
Soil Type	**Sample ID**
Carbo Silty Clay Loam	NRUC1
	NRUC2
	NRUC3
	NRUC4
Groseclose and Poplimento Silt Loam	NRUG1
	NRUG2
	NRUG3
	NRUG4
Lowell Silt Loam	NRUL1
	NRUL2
	NRUL3
	NRUL4
Wurno-Newbern-Faywood Silt Loam	NRUW1
	NRUW2
	NRUW3
	NRUW4

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Soil Boring **MMAB1**

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location MMA Proj. No. 866228
Surface Elev. 1775.8 ft. Total Hole Depth 7.5 ft. North 322754.735 ft. East 1409440.915 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson Log By Greg Zynda Date 8/31/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
MMAB1A (0-10")
MMAB1B (10"-4')
MMAB1C (4'-7')

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					SM	A Horizon - Slightly moist, silty fine SAND, 60-80% fine sand, organics on surface, Dark Yellowish Brown 10YR 4/4.
1				▨	CL	B Horizon - Strong brown, 7.5YR 5/6, fine SANDY CLAY, medium dense. Grades from sandy clay to clayey sand (10-15%) at 4', 5-25% sandstone gravel.
2	0.0	95%				
3						
4					SP	C Horizon - Fine to medium SAND, with 5% silt. Very loose, brownish-yellow, slightly moist.
5						
6	0.0	100%				
7						Dark Brown 7.5YR 3/2 Black 7.5YR Red 5YR 5/8 at bottom fine sands, very loose.
8						

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Soil Boring MMAB2

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location MMA Proj. No. 866228
Surface Elev. 1864.7 ft. Total Hole Depth 7.5 ft. North 320488.181 ft. East 1407197.334 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson Log By Greg Zynda Date 9/6/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
MMAB2A (0-12")
MMAB2B (12"-60")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0						A Horizon - Fine sandy SILT (40% silt), pine needles on surface, 10YR5/6
					ML	
1						B Horizon - Clayey fine SAND, 15% clay, slightly plastic, 10YR 5/6, slightly moist.
					SC	
2	0.0	100%				
						2.5YR 4/8 red, slightly moist CLAY with 5-10% fine sand.
3						
					CL	
4						
5						Sandy red CLAY, slightly moist, 50% fine to medium sand, low to medium density, slightly plastic.
	0.0	100%				
6						
					CL	
7						
8						

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Soil Boring **MMAB3**

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location MMA Proj. No. 866228
Surface Elev. 1873.2 ft. Total Hole Depth 7.5 ft. North 320455.402 ft. East 1407282.997 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson Log By Greg Zynda Date 9/6/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
MMAB3A (0-12")
MMAB3B (12"-48")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					SM	A Horizon - Silty fine SAND, pine needles on surface. Dark yellowish brown 10YR 4/4, slightly moist, low density
1						B Horizon - Yellowish brown 10YR 5/6 silty fine SAND, trace medium sand (>5%), trace clay (5-10%). Slightly moist, low to medium density, slightly plastic.
2	0.0	95%			SM	
3						
4						C Horizon - Yellowish red 5YR 4/6 CLAY, plastic (moderate). Moderate to very dense, 30-40% mottled (5YR 5/8), slightly moist.
5						
6	0.0	100%			CL	
7						
8						

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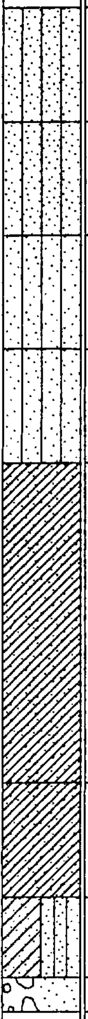
Drilling Log

Soil Boring **MMAB4**

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location MMA Proj. No. 866228
Surface Elev. 1811.0 ft. Total Hole Depth 4.5 ft. North 320307.266 ft. East 1404474.277 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 3 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core
Drill Co. Marshall, Miller & Associates Method Hand Auger
Driller S. Denson Log By Greg Zynda Date 8/31/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
MMAB4A (0-6")
MMAB4B (6"-51")
MMAB4C (51"-53")



Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					SM	A Horizon - SILTY FINE SAND (30% silt), loose to low density. pine needles on surface. Yellowish brown 10YR5/6. Slightly moist.
					SM	B Horizon - SILTY FINE SAND 30% sand. Strong brown 7.5YR 5/8.
1	0.0				ML S	Fine sandy SILT, slightly moist, mod. density, 40% fine sand.
						Same as above 20-30% SAND
2						Fine SANDY CLAY, with silt (20-30% sand and 20-30% silt). Yellowish red 5YR 5/6. Slightly plastic to plastic, mod. density.
					CL S	
3	0.0					
						Slightly moist fine to medium SANDY CLAY (40-50% clay), plastic. Red 2.5YR 5/8. Mod. density.
4					SC SM	CLAYEY fine to medium SAND (10-20% clay), trace sand and gravel, slightly moist.
					GC	C Horizon - Gravelly pieces of sandstone, (10-25% gravel). Gravelly, medium to coarse sand with 20-30% clay and silt. Yellowish red 5YR 5/8. Refusal at 53", sandstone rocks (river jack).
5						

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Soil Boring **MMAU1**

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location MMA Proj. No. 866228
Surface Elev. 1981.1 ft. Total Hole Depth 7.5 ft. North 311874.444 ft. East 1404852.06 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson Log By Greg Zynda Date 9/7/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
MMAU1A (0-10")
MMAU1B (10"-52")
MMAU1C (52"-60")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0				░	SM	A Horizon - Pale yellow, silty fine SAND, low density, slightly moist. (2.5YR 7/4)
1				▨		B Horizon - Slightly moist, yellowish red CLAY (5YR 5/8), dense, plastic. 10-30% mottling very pale brown 10YR 8/4."Mottled" material is silty. Alternative layers of silty material and red clay.
2	0.0	100%		▨		
3				▨		
4				▨	CL	
5				▨		
6	0.0	100%		▨		
7				▨		
8						

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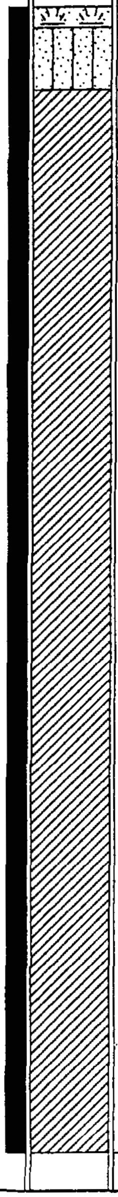
Soil Boring MMAU2

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location MMA Proj. No. 866228
Surface Elev. 1984.7 ft. Total Hole Depth 11.0 ft. North 311894.106 ft. East 1404927.432 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson Log By Greg Zynda Date 9/7/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
MMAU2A (0-10")
MMAU2B (10"-52")
MMAU2C (52"-60")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0						A Horizon - Leaves, dead tree branches on sandy angular gravel. (pinkish, yellowish from bedrock)
					SM	Slightly moist silty fine SAND, <5%clay, slightly plastic, low density. Olive yellow 2.5Y 6/6.
						B Horizon - Slightly moist 5YR 5/8, CLAY very dense, plastic, 10-20% mottling, occasional gravel pieces, angular pinkish and yellowish (5%). Mottling pink (5-15%) 7.5YR 8/4. Occasional tree roots.
2	0.0	100%				
4						C Horizon
6		100%			CL	
8						
	0.0	100%				
10						



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Drilling Log

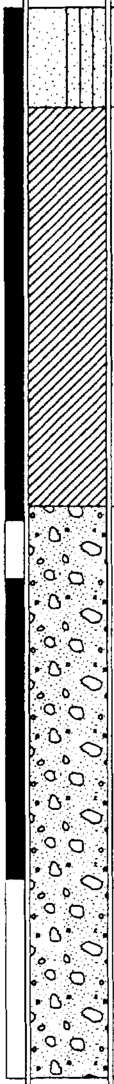
Soil Boring **MMAU3**

Page: 1 of 1

Project *RFAAP Background Study* Owner *US Army*
Location *MMA* Proj. No. *866228*
Surface Elev. *1865.6 ft.* Total Hole Depth *7.5 ft.* North *312818.613 ft.* East *1399297.218 ft.*
Top of Casing *NA* Water Level Initial *NA* Static *NA* Diameter *2 in.*
Screen: Dia *NA* Length *NA* Type/Size *NA*
Casing: Dia *NA* Length *NA* Type *NA*
Fill Material
Rig/Core *Geoprobe*
Drill Co. *Marshall, Miller & Associates* Method *Direct Push*
Driller *S. Denson* Log By *Greg Zynda* Date *8/31/00* Permit # *NA*
Checked By
License No.

COMMENTS
Sample ID's:
MMAU3A (0-9")
MMAU3B (9"-42")
MMAU3C (42"-6')

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					SP	A Horizon - Slightly moist, dark yellowish brown 10YR 4/6. SILTY FINE - MEDIUM SANDY loam. Roots and leaves on surface, loose to low density, crumbles easily, 20-30% silt.
						B Horizon - Slightly moist yellowish red CLAY to clayey fine to medium sand. Dense to medium dense.
1						
2	0.0	90%			CL	
3						
						C Horizon - Strong brown SILTY FINE AND COURSE SANDY GRAVEL, 50% gravel. slightly moist, loose gravel subangular up to 1.5" diameter.
4						
5					GP	
6	0.0	60%				Same as above, very loose, sandstone at bottom of core.
7						
8						



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Soil Boring **MMAU4**

Page: 1 of 1

Project *RFAAP Background Study* Owner *US Army*
Location *MMA* Proj. No. *866228*
Surface Elev. *1739.7 ft.* Total Hole Depth *7.5 ft.* North *317114.333 ft.* East *1410570.692 ft.*
Top of Casing *NA* Water Level Initial *NA* Static *NA* Diameter *3 in.*
Screen: Dia *NA* Length *NA* Type/Size *NA*
Casing: Dia *NA* Length *NA* Type *NA*
Fill Material Rig/Core
Drill Co. *Marshall, Miller & Associates* Method *Hand Auger*
Driller *S. Denson* Log By *Greg Zynda* Date *9/6/00* Permit # *NA*
Checked By License No.

COMMENTS
Sample ID's:
MMAU4A (0-10")
MMAU4B (10"-58")
MMAU4C (58"-76")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0				░		A Horizon - Fine sandy loam, 1/2" angular stones, tree roots near surface (0-4"), 5% gravel. Dark yellowish brown 10YR 4/4. Slightly moist, mod. density, slightly plastic, 2-3% organics.
1 2	0.0	100%		░		B Horizon - Same as above with more subangular gravel and stone. 10% gravel.
3				▦	CL ML	Silty CLAY, mod. plasticity, mod. density to dense, 5% subangular gravel. slightly moist. Trace brownish yellow 10YR 6/6 staining from weathered stone.
4				▦	CL ML	Silty CLAY, plastic, slightly dense, moist, slightly sticky, trace tree roots.
5				▦	CL ML	C Horizon - Brownish yellow, slightly moist, silty CLAY, dense brownish yellow slightly moist silty CLAY, dense, plastic, 10YR6/6 and reddish brown 5YR 4/6.
6 7	0.0	100%		▨	CL	Reddish Brown CLAY with sand at 73-76" (20%fine sand), slightly moist.
8						

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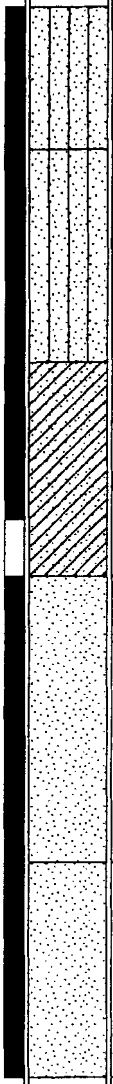
Drilling Log

Soil Boring **MMAW1**

Page: 1 of 1

Project *RFAAP Background Study* Owner *US Army*
Location *MMA* Proj. No. *866228*
Surface Elev. *1701.6 ft.* Total Hole Depth *7.5 ft.* North *323380.27 ft.* East *1407708.13 ft.*
Top of Casing *NA* Water Level Initial *NA* Static *NA* Diameter *2 in.*
Screen: Dia *NA* Length *NA* Type/Size *NA*
Casing: Dia *NA* Length *NA* Type *NA*
Fill Material Rig/Core *Geoprobe*
Drill Co. *Marshall, Miller & Associates* Method *Direct Push*
Driller *S. Denson and K. Carr* Log By *Greg Zynda* Date *9/6/00* Permit # *NA*
Checked By License No.

COMMENTS
Sample ID's:
MMAW1A (0-12")
MMAW1B (12"-48")
MMAW1C (48"-6')



Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					SM	A Horizon - Slightly moist, silty fine SAND, organics, roots from 0-6". 20-30% silt, Dark yellowish brown 10YR 3/4.
1					SM	B Horizon - Dark yellowish brown 10YR 3/4 silty fine SAND, 20-30% silt, slightly moist, trace clay (5%).
2	0.0	90%				
3					SC	Slightly moist, strong brown 7.5YR 4/6, clayey, silty fine to medium SAND (5-10% clay and 5-10% silt). Slightly plastic.
4						C Horizon - Fine to medium SAND with little silt and clay (5% clay and 5% silt). Slightly moist. Strong brown 7.5YR 4/6.
5					SP	
	0.0	100%				
6						Same as above, Strong brown 10YR 5/6.
7					SP	
8						

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Soil Boring **MMAW2**

Page: 1 of 1

Project *RFAAP Background Study* Owner *US Army*

Location *MMA* Proj. No. *866228*

Surface Elev. *1721.5 ft.* Total Hole Depth *7.5 ft.* North *322524.867 ft.* East *1406195.587 ft.*

Top of Casing *NA* Water Level Initial *NA* Static *NA* Diameter *2 in.*

Screen: Dia *NA* Length *NA* Type/Size *NA*

Casing: Dia *NA* Length *NA* Type *NA*

Fill Material Rig/Core *Geoprobe*

Drill Co. *Marshall, Miller & Associates* Method *Direct Push*

Driller *S. Denson* Log By *Greg Zynda* Date *9/6/00* Permit # *NA*

Checked By License No.

COMMENTS
Sample ID's:
MMAW2A (0-7")
MMAW2B (7"-48")
MMAW2C (48"-60")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					SM	A Horizon - Dark brown 10YR 3/3, pine needles on surface. Slightly moist silty fine SAND
						B Horizon - Silty fine SAND, slightly moist, dark yellowish brown 10YR 4/6 (5-15% silt)
1						
2	0.0	100%			SM	
3						
4						C Horizon - Silty fine SAND, with trace of medium sand (5-10%), slightly moist, yellowish brown 10YR 5/6
5						
6	0.0	100%			SM	
7						
8						

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Drilling Log

Soil Boring **MMAW3**

Page: 1 of 1

Project *RFAAP Background Study* Owner *US Army*
Location *MMA* Proj. No. *866228*
Surface Elev. *1713.4 ft.* Total Hole Depth *7.5 ft.* North *322490.086 ft.* East *1406208.064 ft.*
Top of Casing *NA* Water Level Initial *NA* Static *NA* Diameter *2 in.*
Screen: Dia *NA* Length *NA* Type/Size *NA*
Casing: Dia *NA* Length *NA* Type *NA*
Fill Material Rig/Core *Geoprobe*
Drill Co. *Marshall, Miller & Associates* Method *Direct Push*
Driller *S. Denson* Log By *Greg Zynda* Date *9/6/00* Permit # *NA*
Checked By License No.

COMMENTS
Sample ID's:
MMAW3A (0-12")
MMAW3B (12"-43")
MMAW3C (48"-60")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS
0					SM	A Horizon - Dark brown silty fine SAND, top soil, 2-3% organics, pine needles on surface.
1						B Horizon - Slightly moist, silty fine SAND 5-15% silt, yellowish brown 10YR 5/4
2	0.0	100%			SM	
3						
4						C Horizon - Slightly moist, yellowish brown silty, clayey fine SAND (5-10% silt and 5% clay). Slightly plastic and trace of medium sand.
5						
6	0.0	100%			SM	
7						
8						

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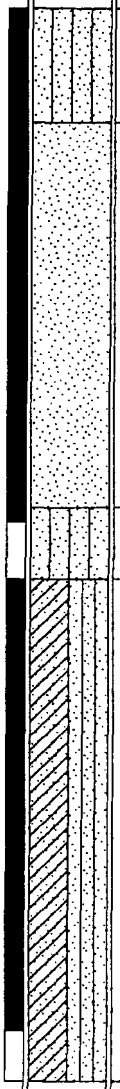
Drilling Log

Soil Boring **MMAW4**

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location MMA Proj. No. 866228
Surface Elev. 1706.5 ft. Total Hole Depth 7.5 ft. North 318887.053 ft. East 1396623.751 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson Log By Greg Zynda Date 9/5/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
MMAW4A (0-9")
MMAW4B (9"-3.5')
MMAW4C (3.5'-6')



Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					SM	A Horizon - Silty fine SAND (20% silt), shrub and grass roots to 9". Dark yellowish brown 10YR 3/4, slightly moist.
1						B Horizon - Yellowish brown 10YR 5/8 fine SAND with 5-10% silt. Slightly moist.
2	0.0	90%			SP	
3						
					SM	C Horizon - Slightly moist silty fine SAND with large gravel (10%) angular. Yellowish brown 10YR 5/8, 5% clay.
4						Slightly moist silty clayey fine to medium SAND with occasional gravel pieces. Dark yellowish brown 10YR 4/6.
5						
6	0.0	90%			SC	
7						
8						

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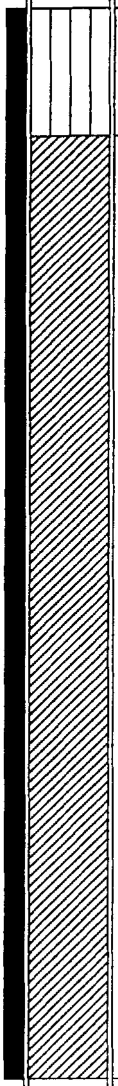
Soil Boring **NRUC1**

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location NRU Proj. No. 866228
Surface Elev. 2097.9 ft. Total Hole Depth 7.5 ft. North 290201.324 ft. East 1371017.041 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson and K. Carr Log By Greg Zynda Date 8/30/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
NRUC1A (0-11")
NRUC1B (11"-6')



Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					ML	A Horizon - SILTY loam, trace fine sand. Grass roots 0-3". Trace of clay, slightly moist. Olive yellow 2.5Y 6/6.
1						B Horizon - Yellowish brown 10YR 5/8 mod. dense to dense CLAY with 5% fine sand, 50-70% silt, plastic. 1-3% black specks, slightly moist.
2	0.0	100%				
3						
4					CL	
5						
6	0.0	100%				
7						
8						

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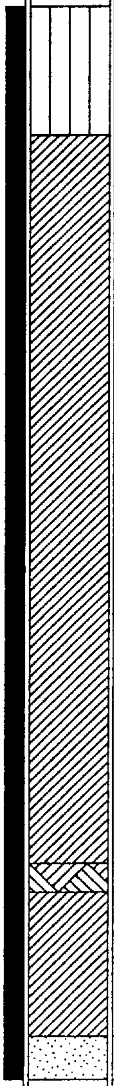
Drilling Log

Soil Boring **NRUC2**

Page: 1 of 1

Project *RFAAP Background Study* Owner *US Army*
Location *NRU* Proj. No. *866228*
Surface Elev. *2095.1 ft.* Total Hole Depth *7.5 ft.* North *290249.225 ft.* East *1371073.443 ft.*
Top of Casing *NA* Water Level Initial *NA* Static *NA* Diameter *2 in.*
Screen: Dia *NA* Length *NA* Type/Size *NA*
Casing: Dia *NA* Length *NA* Type *NA*
Fill Material Rig/Core *Geoprobe*
Drill Co. *Marshall, Miller & Associates* Method *Direct Push*
Driller *S. Denson and K. Car* Log By *Greg Zynda* Date *8/30/00* Permit # *NA*
Checked By License No.

COMMENTS
Sample ID's:
NRUC2A (0-11")
NRUC2B (11"-6')



Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					ML	A Horizon - Light olive brown 2.5YR 5/6. SILTY loam, trace fine sand (5%), low density, trace clay. Grass roots 0-3", slightly moist.
1						B Horizon - Yellowish brown 10YR 5/8 mod. dense to dense CLAY with 5% fine sand, 50-70% silt, plastic. 1-3% black specks.
2	0.0	100%				
3					CL	
4						
5						
	0.0	100%				
6						Weathered bedrock (limestone or dolomite).
					CL ML	Slightly moist, dense SILTY CLAY, 2-3% black specks.
7					SP	Low density fine to medium SAND, silt (20-40% silt), mottled 20-30% yellowish red and dark red.
8						

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Soil Boring **NRUC3**

Page: 1 of 1

Project RFAAP Background Study Owner US Army

Location NRU Proj. No. 866228

Surface Elev. 2065.7 ft. Total Hole Depth 1.5 ft. North 287199.883 ft. East 1376699.21 ft.

Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.

Screen: Dia NA Length NA Type/Size NA

Casing: Dia NA Length NA Type NA

Fill Material Rig/Core Geoprobe

Drill Co. Marshall, Miller & Associates Method Direct Push

Driller S. Denson and K. Carr Log By Greg Zynda Date 8/29/00 Permit # NA

Checked By License No.

COMMENTS
Sample ID's:
NRUC3A (0-10")
NRUC3B (10"-18")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0			█			Pine needles
			█	▥	ML	A Horizon - 10Y 5/4 yellowish brown slightly moist, crumbly SILT with 10% fine sand, trace of clay (5%), pine tree roots.
	0.0	100%	█	▥		
1			█	▨	CL ML	B Horizon - Yellow 2.5 Y 7/6, slightly moist, SILTY CLAY, crumbly, plastic.
2						
3						

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Drilling Log

Soil Boring **NRUC4**

Page: 1 of 1

Project RFAAP Background Study
Owner US Army
Location NRU
Proj. No. 866228
Surface Elev. 1994.8 ft.
Total Hole Depth 7.5 ft.
North 291651.576 ft.
East 1375527.088 ft.
Top of Casing NA
Water Level Initial NA
Static NA
Diameter 2 in.
Screen: Dia NA
Length NA
Type/Size NA
Casing: Dia NA
Length NA
Type NA
Fill Material
Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates
Method Direct Push
Driller S. Denson and K. Carr
Log By Greg Zynda
Date 8/29/00
Permit # NA
Checked By
License No.

COMMENTS
Sample ID's:
NRUC4A (0-7")
NRUC4B (7"-30")
NRUC4C (30"-48")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0						A Horizon - Moist, fine SANDY SILT, 50% fine sand, pale brown 10YR 6/3, mod-density. Slight moist, very mottled fine SANDY SILT, 20-40% fine sand. Strong brown 7.5YR 5/8.
1						
2	0.0	100%			SM	Strong brown SILTY FINE SAND, silty,clayey fine sand (10% clay, 20%silt), slightly moist to moist, dense, mottled
3						
4						Strong brown 7.5YR 5/8, SILTY CLAY 20-30% clay, with trace of fine sand (5%), slightly moist to moist, 20-30% mottled gray and strong brown.
5						
6	0.0	100%			CL	
7						
8						

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Drilling Log

Soil Boring **NRUG1**

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location NRU Proj. No. 866228
Surface Elev. 2127.5 ft. Total Hole Depth 8.0 ft. North 291100.639 ft. East 1369289.298 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material
Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson and K. Car Log By Greg Zynda Date 8/29/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
NRUG1A (0-12")
NRUG1B (12"-53")
NRUG1C (53"-70")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					OL	Pine needles, organic SILT with 5% clay. A Horizon - Olive yellow 2.5Y 6/6, slightly moist.
1						B Horizon - Slightly moist CLAYEY SILT (10% clay). No odors. Slightly stiff to stiff, slightly crumbly, 2-15% rusty mottling. Trace of rusty gravel pieces (iron stained). Reddish-yellow 7.5YR 6/6.
2	0.0	100%				
3						
4					CL ML	C Horizon - Slightly moist CLAYEY SILT (10% clay). No odors. Slightly stiff to stiff, slightly crumbly, 20-30% rusty mottling. Trace of rusty gravel pieces (iron stained). Reddish-yellow 7.5YR 6/6.
5						
6	0.0	100%				
7						Slightly moist, very mottled SILTY CLAY with 10% gravel-limestone. Yellowish brown 10YR 5/8.
8						

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Soil Boring **NRUG2**

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location NRU Proj. No. 866228
Surface Elev. 2048.8 ft. Total Hole Depth 7.5 ft. North 285754.381 ft. East 1373142.435 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson and K. Carr Log By Greg Zynda Date 8/30/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
NRUG2A (0-7")
NRUG2B (7"-34")
NRUG2C (34"-57")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					ML	A Horizon - Yellowish brown 10YR 5/6, CLAYEY SILT loam, slightly moist, mod. dense, 10% clay, slightly plastic.
						B Horizon - Dry to slightly moist SILT, trace fine sand (5%), very loose and crumbly, trace clay (5%). 10YR 7/4 very pale brown. 2-5% gravel angular
1						
					ML	
2	0.0	100%				
						C Horizon - Slightly moist SILTY CLAY (10-30% clay). Strong brown 7.5YR 5/8. Mod. dense to dense, 5-10% angular gravel, 1-2% black specks.
3						
					CL	
4						
						Slightly moist, SILTY CLAY with 30% angular gravel, weathered bedrock, mod. dense, brownish yellow 10YR 6/6.
5						
6	0.0	100%			CL	
7						
8						

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Drilling Log

Soil Boring **NRUG3**

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location NRU Proj. No. 866228
Surface Elev. 2055.9 ft. Total Hole Depth 7.5 ft. North 285805.982 ft. East 1373194.726 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson and K. Car Log By Greg Zynda Date 8/30/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
NRUG3A (0-12")
NRUG3B (12"-35")
NRUG3C (35"-67")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					ML	A Horizon - Olive yellow 2.5Y 6/6, dry to very slightly moist SILT with trace clay (5%). Pine needles on surface. Crumbly to slightly loose.
1 2	0.0	100%			ML	B Horizon - Olive yellow 2.5Y 6/6, slightly moist SILT loam, trace fine sand (5%), 5-15% clay, slightly plastic, mod. dense.
3 4 5					ML	C Horizon - Reddish yellow 7.5YR 6/6, CLAYEY SILT (10-20% clay). Mottled rusty color (5-15%).
6 7	0.0	100%		▨	CL ML	Strong brown SILTY CLAY (20-40% clay). Slightly moist, mod. plastic. 10% rusty mottling.
8						

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Drilling Log

Soil Boring NRUG4

Page: 1 of 1

Project RFAAP Background Study
Owner US Army
Location NRU
Proj. No. 866228
Surface Elev. 2081.3 ft.
Total Hole Depth 7.5 ft.
North 287847.944 ft.
East 1369157.992 ft.
Top of Casing NA
Water Level Initial NA
Static NA
Diameter 2 in.
Screen: Dia NA
Length NA
Type/Size NA
Casing: Dia NA
Length NA
Type NA
Fill Material
Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates
Method Direct Push
Driller S. Denson and K. Car
Log By Greg Zynda
Date 8/30/00
Permit # NA
Checked By
License No.

COMMENTS
Sample ID's:
NRUG4A (0-6")
NRUG4B (6"-39")
NRUG4C (39"-72")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					ML	A Horizon - Slighlty moist SILT loam, yellowish brown 10YR 5/6, 5-10% clay, 10-20% fine sand, dense, pine needles on the surface.
						B Horizon - Slightly moist, strong brown 7.5YR 5/6, SILTY CLAY loam, mod-dense, mod-plastic. Trace black specks (1%), 2-5% gravel angular with black staining on surface, with 5% fine sand.
1						
2	0.0	100%				
3						C Horizon - Slightly moist, SILTY CLAY loam, 5-25% gravel (angular maroon and gray), trace fine sand, dense, plastic, 1-2% black specks.
4					CL ML	
5	0.0	100%				
6						Same as above, slighlty moist with 5-10% gravel.
7						
8						

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Drilling Log

Soil Boring **NRUL1**

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location NRU Proj. No. 866228
Surface Elev. NA Total Hole Depth 7.5 ft. North 283098.573 ft. East 1370857.281 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material
Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson and K. Carr Log By Greg Zynda Date 8/30/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
NRUL1A (0-12")
NRUL1B (12"-42")
NRUL1C (42"-5.5')

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0				▥	ML	A Horizon - SILT, olive yellow 2.5YR 6/6, slightly moist, crumbly, trace of clay (5%). Pine needles on surface.
1				▨		B Horizon - CLAYEY SILT (10-20% clay), 10-20%mottling, slightly plastic, yellowish brown 10YR 5/6
2	0.0	100%		▨		
3				▨	CL ML	C Horizon - 30-40% mottled red CLAYEY SILT and silt (max 15% clay), slightly moist, reddish yellow 7.5YR 6/6.
4				▩		
5				▩		Strong brown CLAY and silty clay. Very dense, slightly moist, very plastic, piece of weathered bedrock at 7'.1% black flakes, trace (1-2%) grayish mottling.
6	0.0	100%		▧	CL	
7				▧		
8						

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Drilling Log

Soil Boring NRUL2

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location NRU Proj. No. 866228
Surface Elev. NA Total Hole Depth 7.5 ft. North 283137.296 ft. East 1370938.166 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson and K. Car Log By Greg Zynda Date 8/30/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
NRUL2A (0-12")
NRUL2B (12"-33")
NRUL2C (33"-60")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					ML	A Horizon - Slightly moist SILT, pine needles on the surface, light yellowish brown 2.5YR 6/4.
1				▨		B Horizon - Slightly moist CLAYEY SILT loam, 5-10% clay, slightly plastic, slightly dense to crumbly. Light yellowish brown 10YR 6/4.
2	0.0	100%		▨	CL ML	
3						Slightly moist SILT grading to SILTY CLAY. Dense, slightly plastic to plastic. Reddish brown 5YR 5/4.
4						
5					ML	Slightly moist SILT and CLAYEY SILT (15-40% clay). Dense to mod-dense. reddish yellow 7.5YR 6/8, 20-30% Mottled.
6	0.0	100%				
7						
8						

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Drilling Log

Soil Boring **NRUL3**

Page: 1 of 1

Project *RFAAP Background Study* Owner *US Army*
Location *NRU* Proj. No. *866228*
Surface Elev. *2070.2 ft.* Total Hole Depth *7.5 ft.* North *287529.935 ft.* East *1373041.768 ft.*
Top of Casing *NA* Water Level Initial *NA* Static *NA* Diameter *2 in.*
Screen: Dia *NA* Length *NA* Type/Size *NA*
Casing: Dia *NA* Length *NA* Type *NA*
Fill Material Rig/Core *Geoprobe*
Drill Co. *Marshall, Miller & Associates* Method *Direct Push*
Driller *S. Denson and K. Carr* Log By *Greg Zynda* Date *8/29/00* Permit # *NA*
Checked By License No.

COMMENTS
Sample ID's:
NRUL3A (0-9")
NRUL3B (9"-75")
NRUL3C (75"-90")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0						Brown organics, silt, and grass roots. A Horizon - Brownish yellow 10YR 6/6, slightly moist SILT.
1						B Horizon - Moist to slightly moist SILT, silty clay, clayey silt, trace of weathered bedrock pieces, blacked stained. Reddish yellow 7.5YR 6/6, dense to mod. dense, slightly plastic.
2	0.0	100%				
3					ML	
4						
5						
6	0.0	100%				C Horizon - Moist to slightly moist brownish yellow 10YR 6/6, CLAYEY SILTY and silt, dense slightly plastic with 30% weathered bedrock, laminated, stained black
7					CL	
8						

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Drilling Log

Soil Boring **NRUL4**

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location NRU Proj. No. 866228
Surface Elev. 2066.7 ft. Total Hole Depth 7.5 ft. North 291929.194 ft. East 1372212.647 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson and K. Car Log By Greg Zynda Date 8/29/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
NRUL4A (0-10")
NRUL4B (10"-38")
NRUL4C (38"-60")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					ML	A Horizon - Slightly moist, few fine tree roots. Crumbly SILT, 5-10% clay, dark grayish brown 10YR 4/2. Same as above. Light yellowish brown 2.5YR 6/4.
1						B Horizon - Olive yellow 2.5YR 6/4. Slightly moist, crumbly to moderate loose SILT with 5-10% clay. 2-5% rusty mottling, with 1-2% black specks.
2	0.0	95%				
3						C Horizon - Slightly moist SILT 5-15% clay, crumbly 5-15% mottling. Brownish-yellow 10YR 6/6.
4						
5					CL ML	Stiff, slightly moist, SILTY CLAY, dense, 30-60% clay, strong brown 7.5YR 5/6.
6	0.0	95%				
7						
8						

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Drilling Log

Soil Boring **NRUW1**

Page: 1 of 1

Project *RFAAP Background Study* Owner *US Army*
Location *NRU* Proj. No. *866228*
Surface Elev. *2094.9 ft.* Total Hole Depth *4.0 ft.* North *288400.943 ft.* East *1374521.864 ft.*
Top of Casing *NA* Water Level Initial *NA* Static *NA* Diameter *2 in.*
Screen: Dia *NA* Length *NA* Type/Size *NA*
Casing: Dia *NA* Length *NA* Type *NA*
Fill Material Rig/Core *Geoprobe*
Drill Co. *Marshall, Miller & Associates* Method *Direct Push*
Driller *S. Denson and K. Car* Log By *Greg Zynda* Date *8/30/00* Permit # *NA*
Checked By License No.

COMMENTS
Sample ID's:
NRUW1A (0-7")
NRUW1B (7"-38")
NRUW1C (38"-48")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0			■	▥	ML	A Horizon - Grayish brown 10YR 5/2, slightly moist, loose to low density, SILT loam, with grass roots from 0-2".
			■	▨	CL	B Horizon - Strong brown 7.5YR 5/8. Slightly moist, SILTY CLAY (15-40% clay), mod. dense to dense, slightly to mod. plastic.
1			■	▨		
2	0.0	100%	■	▨		
3			■	▥	CL ML	C Horizon - Slightly moist, brownish yellow 10YR 6/6 CLAYEY SILT, 15-30% clay), mod. density, plastic, 20-30% weathered bedrock (limestone). Refusal at 4'.
4						
5						

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Drilling Log

Soil Boring NRUW2

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location NRU Proj. No. 866228
Surface Elev. 2090.8 ft. Total Hole Depth 4.0 ft. North 288406.798 ft. East 1374603.182 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson and K. Carr Log By Greg Zynda Date 8/30/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
NRUW2A (0-9")
NRUW2B (9"-28")
NRUW2C (28"-48")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					ML	A Horizon - Grayish brown 10YR 5/2, slightly moist, loose to low density, SILT loam, with grass roots from 0-2".
1				▨	CL ML	B Horizon - Slightly moist to moist, CLAYEY SILT, 10-30% clay, mod. density, yellowish brown 10YR 5/8, mod plastic.
2	0.0	100%		▨		
				▨		C Horizon - CLAYEY SILT (10% clay). Light olive brown 2.5Y 5/6. Slightly moist to moist, mod. plastic, 20% weathered bedrock (limestone). Refusal at 4'.
3				▨	CL ML	
4						
5						

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Drilling Log

Soil Boring **NRUW3**

Page: 1 of 1

Project RFAAP Background Study Owner US Army
Location NRU Proj. No. 866228
Surface Elev. 2059.7 ft. Total Hole Depth 3.8 ft. North 292482.845 ft. East 1376121.867 ft.
Top of Casing NA Water Level Initial NA Static NA Diameter 2 in.
Screen: Dia NA Length NA Type/Size NA
Casing: Dia NA Length NA Type NA
Fill Material Rig/Core Geoprobe
Drill Co. Marshall, Miller & Associates Method Direct Push
Driller S. Denson and K. Car Log By Greg Zynda Date 8/29/00 Permit # NA
Checked By License No.

COMMENTS
Sample ID's:
NRUW3A (0-10")
NRUW3B (10"-34")
NRUW3C (34"-45")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0			■	▥	ML	A Horizon - Light yellowish-brown 2.5Y 6/4, slightly moist SILT with organics.
1			■	▨		B Horizon - SILTY CLAY, slightly moist, 30-50% clay. Slightly plastic, reddish-yellow 7.5YR 6/6, dense.
2	0.0	100%	■	▨	CL ML	
3			■	▥	ML	C Horizon - Yellow, slightly moist to dry, SILT, crumbly, trace of clay 5-10%. 15% Pieces of bedrock (limestone or dolomite) thinly laminated with black layers.
4						
5						

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Drilling Log

Soil Boring **NRUW4**

Page: 1 of 1

Project *RFAAP Background Study* Owner *US Army*

Location *NRU* Proj. No. *866228*

Surface Elev. *2086.4 ft.* Total Hole Depth *8.0 ft.* North *286025.858 ft.* East *1371167.197 ft.*

Top of Casing *NA* Water Level Initial *NA* Static *NA* Diameter *2 in.*

Screen: Dia *NA* Length *NA* Type/Size *NA*

Casing: Dia *NA* Length *NA* Type *NA*

Fill Material ______ Rig/Core *Geoprobe*

Drill Co. *Marshall, Miller & Associates* Method *Direct Push*

Driller *S. Denson and K. Carr* Log By *Greg Zynda* Date *8/29/00* Permit # *NA*

Checked By ______ License No. ______

COMMENTS
Sample ID's:
NRUW4A (0-10")
NRUW4B (10"-31")
NRUW4C (31"-46")

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0					ML	A Horizon - Organics and grass roots. Slightly moist, light olive brown 2.5Y 5/3, SILT Loam, with trace of fine sand and gravel (5%) Slightly moist, light yellowish brown SILT, trace of fine sand and clay.
1					CL ML	B Horizon - Reddish yellow 7.5YR 6/6, slightly moist, SILTY CLAY (20-30% clay), dense, 10-15% mottled.
2	0.0	95%				
3						C Horizon - Reddish yellow 7.5YR 6/8, slightly moist, slightly loose SILT, crumbly, 5% clay.
4					ML	Slight moist, 50% weathered bedrock (laminated with black staining), clay and silt, slightly loose.
5						Moist SILTY FINE SAND, reddish yellow 7.5YR 6/6, 5% clay, mod-density, 5-10% weathered bedrock.
6	0.0	100%			SM	
7						
8						

Appendix B

Data Validation Reports

Appendix B
Data Validation Reports

Data packages were validated to ensure compliance with specified analytical, QA/QC requirements, data reduction procedures, data reporting requirements, and required accuracy, precision, and completeness criteria.

Please note the following about the Form I's in Appendix B.

- Laboratory software limitations resulted in select compounds being manually calculated and changed during the data validation process to reflect the correct reporting limits. Since this was only done for non-detects, these changes had no affect on the contamination assessment. Changes by the analytical laboratory were initialed on the forms while un-initialed changes were made by the IT data validation team.
- Also, the line noted on the metals Form I's through aluminum or barium is an artifact from laboratory reproduction. Aluminum and/or barium were not rejected during the validation process.

Appendix B
Data Validation Report Summary

Data Validation Report Number	Sample ID		
Inorganics			
SDG F0I130290 (001166)	MMAB2BD	MMAU1A	MMAW4B
	MMAB3A	MMAU1B	MMAW4C
	MMAB3B	MMAU1C	MMAW1A
	MMAW2A	MMAW3A	MMAW1B
	MMAW2B	MMAW3B	MMAW1C
	MMAW2C	MMAW3C	MMAU4A
	MMAW2CD	MMAW3CD	MMAU4B
	MMAU2A	MMAB2A	MMAU4C
	MMAU2B	MMAB2B	MMAU2C
	MMAW4A		
SDG 001139 (T09852)	NRUW4A	NRUG1B	NRUW4B
	NRUG1C	NRUW4C	NRUL4A
	NRUW4CD	NRUL4B	NRUL3A
	NRUL4BD	NRUL3B	NRUL4C
	NRUL3C	NRUW3A	NRUG1A
SDG 001139 (T09869)	NRUW3B	NRUC3A	NRUW3C
	NRUC3B	NRUC4A	NRUG4A
	NRUC4B	NRUG4B	NRUC4C
	NRUG4C		
SDG 001145 (T09934)	NRUC1A	NRUC2A	NRUC1B
	NRUC2B	NRUL1C	NRUG3B
	NRUL1A	NRUW1B	NRUL1B
	NRUW1C	NRUW1A	NRUG3C
	NRUG2B	NRUG2C	NRUG2A
	NRUW2A		
SDG 001145 (T09950)	NRUW2B	NRUL2C	MMAU3BD
	NRUW2C	NRUL2BD	MMAB4A
	NRUG2BD	NRUG2CD	MMAB4B
	NRUL2A	NRUG3A	MMAB4C
	NRUL2B	MMAB1C	MMAU3A
	MMAU3B	MMAU3C	MMAB1A
	MMAB1B		
Volatiles			
SDG IT2	NRUC1B	NRUL1C	NRUL1B
	NRUG2B		
SDG IT3	NRUW1B	NRUW1C	NRUG2C
	NRUG2B		
SDG IT5	MMAB3B	MMAW2B	MMAW2C
	MMAW2CD	MMAU1B	MMAU1C
Semivolatiles			
SDG IT2	NRUC1A	NRUC1B	NRUL1C
	NRUL1A	NRUL1B	NRUW1A
	NRUG2B	NRUG2A	
SDG IT3	NRUW1B	NRUW1C	NRUG2C
	NRUG2BD	NRUG2CD	
SDG IT5	MMAB3A	MMAB3B	MMAW2A
	MMAW2B	MMAW2C	MMAW2CD
	MMAU1A	MMAU1B	MMAU1C

Appendix B
Data Validation Reports

Data validation assesses the acceptability or unacceptability of the data quality based on a set of pre-defined criteria. Data validation is defined as the systematic process for reviewing a data package against a set of criteria to provide assurance that the data is adequate for its intended uses. These criteria depend upon the type(s) of data involved and the purpose for which data are collected. The intended use of the data and the associated acceptance criteria for data quality is assessed before the data collection effort begins.

Data packages were validated to ensure compliance with specified analytical, QA/QC requirements, data reduction procedures, data reporting requirements, and required accuracy, precision, and completeness criteria.

The data obtained using USEPA performance based methods were validated by the project chemist. Samples analyzed for physical characterization and disposal characterization following TCLP and pH procedures do not require validation. Results were assessed for accuracy and precision of laboratory analysis to identify the limitations and quantity of data. The quality of the data collected in support of the sampling activity was considered acceptable, unless qualified rejected "R" or blank qualified "B" during the validation process. Samples qualified "J," "UJ," "L," "UL," or "K" were considered acceptable as estimated. These qualifiers and common laboratory are defined in Tables B–1 and B–2, respectively.

Table B–1
USEPA Region III Validation Qualifiers

Qualifier	Definition
No Code	Confirmed identification.
J	Analyte present, bias estimated. Reported value may not be accurate or precise.
K	Analyte present, bias high estimated. Reported value may be biased high.
L	Analyte present, bias low estimated. Reported value may be biased low.
UJ	Not detected, bias estimated. Reporting limit may be inaccurate or imprecise.
UL	Not detected, bias low estimated. Reporting limit is probably higher.
B	The compound has been detected in the associated sample and laboratory method blank and/or associated field sample. The compound reported is considered not detected substantially above the level reported in the laboratory and/or field blanks.
R	Unreliable result. Analyte may or may not be present in the sample.

Table B-2
Common Laboratory Qualifiers

Qualifier	Parameter Group	Definition
No Code	All	Confirmed identification.
U	All	Not detected. The associated number indicates the reporting limit for the sample.
B	Inorganics	The reported value was obtained from a reading <CRDL and ≥ MDL or IDL and is considered estimated.
B	Organics	The analyte or compound has been detected in the sample and laboratory method blank and indicates probable blank contamination.
J	Organics	Indicates an estimated value for (1) estimating a concentration as a tentatively identified compound as indicated by the mass spectral and retention time data, or (2) estimating a concentration <CRQL or MRL and ≥ MDL.
S	Dioxins	The response of a specific PCDD/PCDF isomer has exceeded the normal dynamic range. The corresponding signal is saturated and the reported analyte concentration is a "minimum estimate."
S	Inorganics	The reported value was identified by the Method of Standard Additions.
Q	Mass Spec	Presence of QC ion instabilities caused by quantitative interferences.
P	Gas Chromatography	Target analyte confirmation >40% difference for detected compound between the two GC columns. The lower of the two values was reported.
N	Organics	Indicates presumptive evidence of a compound for tentatively identified compounds using a library search.
N	Inorganics	Laboratory spike sample recovery not within control limits.
*	Inorganics	Duplicate analysis not within control limits.
+	Inorganics	Correlation coefficient for MSA is less than 0.995.
E	Organics	Identifies compounds whose concentrations exceed the upper level of the calibration range.
E	Inorganics	Reported value is estimated because of the presence of interferences.
D	Organics	Indicates sample was analyzed at a dilution.
W	Inorganics	Post-digestion spike for furnace AA analysis is outside of control limits with the sample absorbance less than 50% of spike absorbance.
EMPC	Dioxins	The ion-abundance ratio between the two characteristic PCDD/F ions is outside accepted ranges. The detected PCDD/F is reported as an estimated maximum possible concentration (EMPC).
R	Dioxins	To reject data for analytes whose extraction standard recoveries are considered unacceptable, or when other circumstances require its use.
V	Dioxins	To validate the data for analytes whose extraction standard recoveries are lower than the method's minimum requirement.

TO: Davida Trumbo

FROM: Kweku Acquah

SUBJECT: Radford Army Ammunition Plant Data Validation – TAL Metals
STL St. Louis, SDG F01130290 (001166)

DATE: November 24, 2000

The purpose of this memorandum is to present the data validation report for the samples collected at the Radford Army Ammunition Plant during the September 5-7, 2000 sampling events. Samples were analyzed for metals using methods SW-846 7471A (CVAA) for Mercury and SW-846 6010B (ICP) for all other metals. A total of twenty-eight soil samples were validated. The sample IDs are:

Field ID	Field ID	Field ID
MMAB2BD	MMAU1A	MMAW4B
MMAB3A	MMAU1B	MMAW4C
MMAB3B	MMAU1C	MMAW1A
MMAW2A	MMAW3A	MMAW1B
MMAW2B	MMAW3B	MMAW1C
MMAW2C	MMAW3C	MMAU4A
MMAW2CD	MMAW3CD	MMAU4B
MMAU2A	MMAB2A	MMAU4C
MMAU2B	MMAB2B	
MMAU2C	MMAW4A	

Data were reviewed by Kweku Acquah and validated using a combination of method-specific criteria, laboratory SOP, and the *Innovative Approaches to Data Validation for USEPA Region III* (June 1995). Parameters were validated at USEPA Region III Level IM2 and are presented in Table 1. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA Region III specifications.

Table 1. Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times
	X	Initial and Continuing Calibration
	X	Blank Analysis
	X	ICP Interference Check Sample (ICS)
X		Matrix Spike/Matrix Spike Duplicate
	X	Laboratory Control Sample (LCS)
X		ICP Serial Dilution
	X	Quantitation Verification

The quality data collected in support of this sampling activity is considered acceptable with the noted qualifications.

cc: Eric Malarek
Project File

RADFORD ARMY AMMUNITION PLANT
VALIDATION REPORT
TAL METALS REVIEW
SDG 001166 (F0I130290)

I-Holding Times

Form I, shipping and run logs.

The primary objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis. Holding time criteria: Cool @4 °C ± 2 °C, the maximum holding time is 180 days for metals and 28 days for mercury.

- All criteria were met. No qualifiers were applied.

II-Initial and Continuing Calibration

Form II

Requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run, and continuing calibration verification documents that the initial calibration is still valid.

ICP:	1- blank	Hg:	1 – blank
	3 – standards ($r \geq 0.995$)		5 – standards ($r \geq 0.995$)
	%R – 90-110%		%R – 80-120%

- ICP analysis for metals was run on 09/18-21/00. Mercury was analyzed on 09/19/00 with a correlation coefficient of 0.9999. All criteria were met. No qualifiers were applied.

III-Blank Analysis

Blanks are assessed to determine the existence and magnitude of contamination problems. No contaminant should be detected in the blank > the MRL. Any sample value < five times (5X) the maximum concentration detected in the QC blanks and > the MRL is qualified "B". Soil sample results and action levels were appropriately adjusted for moisture content during the blank analysis study. The associated rinse blanks are samples 083100R4 and 090700RB.

- There was no contaminant detected in any of the blanks >MRL. No qualifiers were applied.

IV-ICP Interference Check Sample (ICS)

Form IV

The ICP Interference Check Sample (ICS) verifies interelement and background correction factors. ICP Interference Check is performed at the beginning and end of each sample analysis run. Control limits are 80-120%.

- All criteria were met. No qualifiers were applied.

V-Matrix Spike/Matrix Spike Duplicate Analysis

The matrix spike sample analysis provides information about the effect of each sample matrix on the digestion and measurement methodology. Spike recovery (%R) must be within the specified control limits of 75-125%. However, spike recovery limits do not apply when sample concentration exceeds the spike added concentration by a factor of four or more. If the spike recovery is < 75% but > 30%, positive sample results are qualified as biased low, "L" and non-detects as biased low, "UL".

V-Matrix Spike/Matrix Spike Duplicate Analysis, Continued

- Samples MMAW2BS (DKA7E), MMAB3AS (DKA76) and MMAW2BD (DKA7E) were used for the MS/MSD analysis. %R for Aluminum (126.4%, 565.8%, -682.2%, 475.2%), Iron (619.0%, -28.0%, 383.5%, -124.1%) and Manganese (-4.6%, -115.7%, -64.2%) were outside the control limits. Since the sample concentrations for these elements exceeded the spike added concentration by a factor of four or more, no qualifiers were applied based on these outliers.

- %R for Antimony (56.3%, 66.2%, 57.1%, 63.2%) were below the control limits. Positive samples for this element were qualified as biased low, "L" and non-detects "UL".

VI-Laboratory Control Samples (LCS)

Forms VII, XIII

The laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation. All LCS results must fall within the specified control limits.

- All criteria were met. No qualifiers were applied.

VII-ICP Serial Dilution

Forms I, IX

The serial dilution of samples quantitated by ICP determines whether or not significant physical or chemical interferences exist due to sample matrix. If the analyte concentration in the original sample is a factor of 10 above MDL, then an analysis of a 5-fold dilution should agree within 10% difference of the original result.

- Percent difference (%D) for Zinc (23.2%, 14.7%) was above the control limit. Positive values for this element was qualified as estimated, "J" and non-detects had no qualifiers applied.

VIII-Quantitation Verification

Raw Data.

The accuracy of analytical results is verified through the calculation of several parameters. The percent difference (%D) between the calculated and the reported values should be within 10%. The following calculations were performed for verification:

ICP Sample: MMAB2BD (DKA5M), Lead

Conc. mg/kg = (conc. μg/mL) * (Final Volume mL)/(Weight g* % Solids as a fraction)

Conc. mg/kg = (0.07301 μg/mL)*(100 mL)/(1 g* 0.861) = 8.50 μg/g = 8.5 mg/kg

Reported concentration = 8.5 mg/kg
%D =0%.
Values were within 10% difference

VIII-Quantitation Verification, Continued

CVAA Sample: MMAB2BD (DKA5M), Hg

Conc. mg/kg = (conc. µg/L) * (Final Volume L)/(Weight g* % Solids as a fraction)

Conc. mg/kg = (0.630 µg/L)*(0.03 L)/(0.18 g* 0.861) = 0.122 µg/g = 0.122 mg/kg

Reported concentration = 0.13 mg/kg
%D = 6.15%.
Values were within 10% difference

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA5M **Client ID:** MMAB2BD

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259340

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 13.9

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.5	23.2	12900	N	1	ICPST	9/21/2000	9:05	
Antimony	206.84	0.28	7.0	7.0 ~~0.28~~	UN	1	ICPST	9/21/2000	9:05	UL
Arsenic	189.04	0.16	1.2	3.2		1	ICPST	9/21/2000	9:05	
~~Barium~~	~~493.41~~	~~0.37~~	~~23.2~~	~~59.1~~		~~1~~	~~ICPST~~	~~9/21/2000~~	~~9:05~~	
Beryllium	313.04	0.023	0.58	0.58 ~~0.30~~	~~B~~ U	1	ICPST	9/21/2000	9:05	
Cadmium	226.50	0.035	0.58	0.58 ~~0.30~~	~~B~~ U	1	ICPST	9/21/2000	9:05	
Calcium	317.93	4.8	581	581 ~~439~~	~~B~~ U	1	ICPST	9/21/2000	9:05	
Chromium	267.76	0.13	0.58	22.7		1	ICPST	9/21/2000	9:05	
Cobalt	228.62	0.12	5.8	5.8 ~~3.1~~	~~B~~ U	1	ICPST	9/21/2000	9:05	
Copper	324.75	0.19	2.9	5.7		1	ICPST	9/21/2000	9:05	
Iron	217.44	2.1	11.6	18000	N	1	ICPST	9/21/2000	9:05	
Lead	220.35	0.22	0.35	8.5		1	ICPST	9/21/2000	9:05	
Magnesium	279.08	4.8	581	581 ~~446~~	~~B~~ U	1	ICPST	9/21/2000	9:05	
Manganese	257.61	0.035	0.58	155	N	1	ICPST	9/21/2000	9:05	
Nickel	231.60	0.22	4.7	4.9		1	ICPST	9/21/2000	9:05	
Potassium	766.49	209	581	581 ~~285~~	~~B~~ U	1	ICP	9/20/2000	13:34	
Selenium	196.03	0.28	0.58	0.58 ~~0.28~~	U	1	ICPST	9/21/2000	9:05	
Silver	328.07	0.16	0.58	0.58 ~~0.16~~	U	1	ICPST	9/21/2000	9:05	
Sodium	589	20.8	581	581 ~~53.2~~	~~B~~ U	1	ICP	9/20/2000	13:34	
Thallium	190.86	0.38	1.2	1.2 ~~0.40~~	~~B~~ U	1	ICPST	9/21/2000	9:05	
Vanadium	292.40	0.14	5.8	38.6		1	ICPST	9/21/2000	9:05	
Zinc	213.86	0.093	2.3	16.9	E	1	ICPST	9/21/2000	9:05	J

Comments: Lot #: F0I130290 Sample #: 1

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA5M **Client ID:** MMAB2BD

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 13.9

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.019	0.039	0.13		1	CVAA	9/20/2000	10:23

Comments: Lot #: F0I130290 Sample #: 1

Version 4.10.4

U Result is less than the IDL

B Result is between IDL and RL

Form I Equivalent

Form I Copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA76 **Client ID:** MMAB3A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 11.2

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.5	22.5	5630	N	1	ICPST	9/23/2000	16:37	
Antimony	206.84	0.27	6.8	6.8 ~~0.27~~	UN	1	ICPST	9/23/2000	16:37	UL
Arsenic	189.04	0.16	1.1	2.3		1	ICPST	9/23/2000	16:37	
Barium	493.41	0.36	22.5	99.1		1	ICPST	9/23/2000	16:37	
Beryllium	313.04	0.023	0.56	0.56 ~~0.40~~	~~B~~U	1	ICPST	9/23/2000	16:37	
Cadmium	226.50	0.034	0.56	0.56 ~~0.17~~	~~B~~U	1	ICPST	9/23/2000	16:37	
Calcium	317.93	4.6	563	563 ~~479~~	~~B~~U	1	ICPST	9/23/2000	16:37	
Chromium	267.76	0.12	0.56	10.5		1	ICPST	9/23/2000	16:37	
Cobalt	228.62	0.11	5.6	5.6 ~~3.2~~	~~B~~U	1	ICPST	9/23/2000	16:37	
Copper	324.75	0.18	2.8	4.0		1	ICPST	9/23/2000	16:37	
Iron	217.44	2.0	11.3	7300	N	1	ICPST	9/23/2000	16:37	
Lead	220.35	0.21	0.34	10.2		1	ICPST	9/23/2000	16:37	
Magnesium	279.08	4.7	563	563 ~~255~~	~~B~~U	1	ICPST	9/23/2000	16:37	
Manganese	257.61	0.034	0.56	567	N	1	ICPST	9/23/2000	16:37	
Nickel	231.60	0.21	4.5	4.5 ~~3.1~~	~~B~~U	1	ICPST	9/23/2000	16:37	
Potassium	766.49	203	563	563 ~~237~~	~~B~~U	1	ICP	9/21/2000	8:25	
Selenium	196.03	0.27	0.56	0.56 ~~0.22~~	U	1	ICPST	9/23/2000	16:37	
Silver	328.07	0.16	0.56	0.56 ~~0.16~~	U	1	ICPST	9/23/2000	16:37	
Sodium	589	19.4	563	563 ~~81.6~~	~~B~~U	1	ICP	9/21/2000	8:25	
Thallium	190.86	0.37	1.1	~~0.56~~	~~B~~U	1	ICPST	9/23/2000	16:37	
Vanadium	292.40	0.14	5.6	15.7		1	ICPST	9/23/2000	16:37	
Zinc	213.86	0.090	2.3	12.8	E	1	ICPST	9/23/2000	16:37	J

Comments: Lot #: F0I130290 Sample #: 2

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA76 **Client ID:** MMAB3A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 11.2

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.019	0.038	0.077		1	CVAA	9/20/2000	10:25

Comments: Lot #: F0I130290 Sample #: 2

Version 4.10.4

U Result is less than the IDL

B Result is between IDL and RL

Form I Equivalent

Form I Copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA78 **Client ID:** MMAB3B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 14.7

Element	Wt./Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.6	23.5	10100	N	1	ICPST	9/23/2000	16:56	
Antimony	206.84	0.28	7.0	7.0 ~~0.33~~	~~B~~NU	1	ICPST	9/23/2000	16:56	UL
Arsenic	189.04	0.16	1.2	3.3		1	ICPST	9/23/2000	16:56	
Barium	493.41	0.38	23.5	63.9		1	ICPST	9/23/2000	16:56	
Beryllium	313.04	0.023	0.59	0.59 ~~0.36~~	~~B~~U	1	ICPST	9/23/2000	16:56	
Cadmium	226.50	0.035	0.59	0.59 ~~0.37~~	~~B~~U	1	ICPST	9/23/2000	16:56	
Calcium	317.93	4.8	586	586 ~~459~~	~~B~~U	1	ICPST	9/23/2000	16:56	
Chromium	267.76	0.13	0.59	22.4		1	ICPST	9/23/2000	16:56	
Cobalt	228.62	0.12	5.9	5.9 ~~4.4~~	~~B~~U	1	ICPST	9/23/2000	16:56	
Copper	324.75	0.19	2.9	6.0		1	ICPST	9/23/2000	16:56	
Iron	217.44	2.1	11.7	14900	N	1	ICPST	9/23/2000	16:56	
Lead	220.35	0.22	0.35	10.7		1	ICPST	9/23/2000	16:56	
Magnesium	279.08	4.9	586	586 ~~418~~	~~B~~U	1	ICPST	9/23/2000	16:56	
Manganese	257.61	0.035	0.59	464	N	1	ICPST	9/23/2000	16:56	
Nickel	231.60	0.22	4.7	4.8		1	ICPST	9/23/2000	16:56	
Potassium	766.49	211	586	586 ~~370~~	~~B~~U	1	ICP	9/21/2000	8:41	
Selenium	196.03	0.28	0.59	0.59 ~~0.28~~	U	1	ICPST	9/23/2000	16:56	
Silver	328.07	0.16	0.59	0.59 ~~0.16~~	U	1	ICPST	9/23/2000	16:56	
Sodium	589	20.2	586	586 ~~90.0~~	~~B~~U	1	ICP	9/21/2000	8:41	
Thallium	190.86	0.39	1.2	1.4		1	ICPST	9/23/2000	16:56	
Vanadium	292.40	0.14	5.9	31.0		1	ICPST	9/23/2000	16:56	
Zinc	213.86	0.094	2.3	14.7	E	1	ICPST	9/23/2000	16:56	J

Comments: Lot #: F0I130290 Sample #: 3

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA78 **Client ID:** MMAB3B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 14.7

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.020	0.039	0.10		1	CVAA	9/20/2000	10:28

Comments: Lot #: F0I130290 Sample #: 3

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7D **Client ID:** MMAW2A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259340

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 18.8

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.7	24.6	12800	N	1	ICPST	9/21/2000	9:09	
Antimony	206.84	0.30	7.4	7.4 ~~0.60~~	~~B~~NU	1	ICPST	9/21/2000	9:09	UL
Arsenic	189.04	0.17	1.2	2.5		1	ICPST	9/21/2000	9:09	
~~Barium~~	~~493.41~~	~~0.39~~	~~24.6~~	~~174~~		~~1~~	~~ICPST~~	~~9/21/2000~~	~~9:09~~	
Beryllium	313.04	0.025	0.62	0.93		1	ICPST	9/21/2000	9:09	
Cadmium	226.50	0.037	0.62	0.62 ~~0.36~~	~~B~~U	1	ICPST	9/21/2000	9:09	
Calcium	317.93	5.1	616	7340		1	ICPST	9/21/2000	9:09	
Chromium	267.76	0.14	0.62	27.0		1	ICPST	9/21/2000	9:09	
Cobalt	228.62	0.12	6.2	12.3		1	ICPST	9/21/2000	9:09	
Copper	324.75	0.20	3.1	13.2		1	ICPST	9/21/2000	9:09	
Iron	217.44	2.2	12.3	20500	N	1	ICPST	9/21/2000	9:09	
Lead	220.35	0.23	0.37	15.0		1	ICPST	9/21/2000	9:09	
Magnesium	279.08	5.1	616	5930		1	ICPST	9/21/2000	9:09	
Manganese	257.61	0.037	0.62	822	N	1	ICPST	9/21/2000	9:09	
Nickel	231.60	0.23	4.9	13.2		1	ICPST	9/21/2000	9:09	
Potassium	766.49	222	616	1430		1	ICP	9/20/2000	13:38	
Selenium	196.03	0.30	0.62	0.62 ~~0.30~~	U	1	ICPST	9/21/2000	9:09	
Silver	328.07	0.17	0.62	0.62 ~~0.17~~	U	1	ICPST	9/21/2000	9:09	
Sodium	589	21.2	616	616 ~~80.4~~	~~B~~U	1	ICP	9/20/2000	13:38	
Thallium	190.86	0.41	1.2	1.2 ~~0.41~~	U	1	ICPST	9/21/2000	9:09	
Vanadium	292.40	0.15	6.2	37.9		1	ICPST	9/21/2000	9:09	
Zinc	213.86	0.099	2.5	65.9	E	1	ICPST	9/21/2000	9:09	J

Comments: Lot #: F0I130290 Sample #: 4

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7D **Client ID:** MMAW2A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 18.8

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.021	0.041	0.041 ~~0.022~~	~~B~~ U	1	CVAA	9/20/2000	10:30

Comments: Lot #: F0I130290 Sample #: 4

Version 4.10.4

U Result is less than the IDL

B Result is between IDL and RL

Form 1 Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7E **Client ID:** MMAW2B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259340

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 11.7

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.5	22.7	21600	N	1	ICPST	9/21/2000	9:14	
Antimony	206.84	0.27	6.8	6.8 ~~1.1~~	~~B~~NU	1	ICPST	9/21/2000	9:14	VL
Arsenic	189.04	0.16	1.1	3.2		1	ICPST	9/21/2000	9:14	
~~Barium~~	~~493.41~~	~~0.36~~	~~22.7~~	~~116~~		~~1~~	~~ICPST~~	~~9/21/2000~~	~~9:14~~	
Beryllium	313.04	0.023	0.57	1.1		1	ICPST	9/21/2000	9:14	
Cadmium	226.50	0.034	0.57	0.57 ~~0.40~~	~~B~~U	1	ICPST	9/21/2000	9:14	
Calcium	317.93	4.7	566	952		1	ICPST	9/21/2000	9:14	
Chromium	267.76	0.13	0.57	33.6		1	ICPST	9/21/2000	9:14	
Cobalt	228.62	0.11	5.7	17.4		1	ICPST	9/21/2000	9:14	
Copper	324.75	0.18	2.8	22.0		1	ICPST	9/21/2000	9:14	
Iron	217.44	2.1	11.3	35900	N	1	ICPST	9/21/2000	9:14	
Lead	220.35	0.22	0.34	13.3		1	ICPST	9/21/2000	9:14	
Magnesium	279.08	4.7	566	4750		1	ICPST	9/21/2000	9:14	
Manganese	257.61	0.034	0.57	627	N	1	ICPST	9/21/2000	9:14	
Nickel	231.60	0.22	4.5	18.9		1	ICPST	9/21/2000	9:14	
Potassium	766.49	204	566	2650		1	ICP	9/20/2000	13:42	
Selenium	196.03	0.27	0.57	0.57 ~~0.27~~	U	1	ICPST	9/21/2000	9:14	
Silver	328.07	0.16	0.57	0.57 ~~0.16~~	U	1	ICPST	9/21/2000	9:14	
Sodium	589	19.5	566	566 ~~81.9~~	~~B~~U	1	ICP	9/20/2000	13:42	
Thallium	190.86	0.37	1.1	1.1 ~~0.37~~	U	1	ICPST	9/21/2000	9:14	
Vanadium	292.40	0.14	5.7	67.0		1	ICPST	9/21/2000	9:14	
Zinc	213.86	0.091	2.3	70.3	E	1	ICPST	9/21/2000	9:14	J

Comments: Lot #: F0I130290 Sample #: 5

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7E **Client ID:** MMAW2B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 11.7

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.019	0.038	0.039		1	CVAA	9/20/2000	10:38

Comments: Lot #: F0I130290 Sample #: 5

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

ST. LOUIS

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7H **Client ID:** MMAW2C

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259340

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 13.2

Element	Wt./Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.5	23.8	4430	N	1	ICPST	9/21/2000	9:42	
Antimony	206.84	0.28	6.9	6.9 ~~0.28~~	UN	1	ICPST	9/21/2000	9:42	UL
Arsenic	189.04	0.16	1.2	4.7		1	ICPST	9/21/2000	9:42	
~~Barium~~	~~493.41~~	~~0.37~~	~~23.0~~	~~23.0 11.7~~	~~BU~~	~~1~~	~~ICPST~~	~~9/21/2000~~	~~9:42~~	
Beryllium	313.04	0.023	0.58	0.58 ~~0.21~~	~~B~~U	1	ICPST	9/21/2000	9:42	
Cadmium	226.50	0.035	0.58	0.58 ~~0.19~~	~~B~~U	1	ICPST	9/21/2000	9:42	
Calcium	317.93	4.8	576	576 ~~130~~	~~B~~U	1	ICPST	9/21/2000	9:42	
Chromium	267.76	0.13	0.58	11.8		1	ICPST	9/21/2000	9:42	
Cobalt	228.62	0.12	5.8	5.8 ~~2.2~~	~~B~~U	1	ICPST	9/21/2000	9:42	
Copper	324.75	0.18	2.9	5.0		1	ICPST	9/21/2000	9:42	
Iron	217.44	2.1	11.5	10100	N	1	ICPST	9/21/2000	9:42	
Lead	220.35	0.22	0.35	10.8		1	ICPST	9/21/2000	9:42	
Magnesium	279.08	4.8	576	576 ~~177~~	~~B~~U	1	ICPST	9/21/2000	9:42	
Manganese	257.61	0.035	0.58	47.4	N	1	ICPST	9/21/2000	9:42	
Nickel	231.60	0.22	4.6	4.6 ~~3.0~~	~~B~~U	1	ICPST	9/21/2000	9:42	
Potassium	766.49	207	576	576 ~~272~~	~~B~~U	1	ICP	9/20/2000	14:05	
Selenium	196.03	0.28	0.58	0.58 ~~0.28~~	U	1	ICPST	9/21/2000	9:42	
Silver	328.07	0.16	0.58	0.58 ~~0.16~~	U	1	ICPST	9/21/2000	9:42	
Sodium	589	19.8	576	576 ~~54.4~~	~~B~~U	1	ICP	9/20/2000	14:05	
Thallium	190.86	0.38	1.2	1.2 ~~0.38~~	U	1	ICPST	9/21/2000	9:42	
Vanadium	292.40	0.14	5.8	23.1		1	ICPST	9/21/2000	9:42	
Zinc	213.86	0.092	2.3	14.4	E	1	ICPST	9/21/2000	9:42	J

Comments: Lot #: F0I130290 Sample #: 6

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7H **Client ID:** MMAW2C

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 13.2

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.019	0.038	0.038		1	CVAA	9/20/2000	10:46

Comments: Lot #: F0I130290 Sample #: 6

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7M **Client ID:** MMAW2CD

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259340

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 18.4

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.7	24.5	19900	N	1	ICPST	9/21/2000	9:47	
Antimony	206.84	0.29	7.4	7.4 ~~0.44~~	~~B~~NU	1	ICPST	9/21/2000	9:47	VL
Arsenic	189.04	0.17	1.2	15.3		1	ICPST	9/21/2000	9:47	
~~Barium~~	~~493.41~~	~~0.39~~	~~24.5~~	~~24.5 16.2~~	~~BU~~	~~1~~	~~ICPST~~	~~9/21/2000~~	~~9:47~~	
Beryllium	313.04	0.025	0.61	0.61 ~~0.50~~	~~B~~U	1	ICPST	9/21/2000	9:47	
Cadmium	226.50	0.037	0.61	0.65		1	ICPST	9/21/2000	9:47	
Calcium	317.93	5.1	613	613 ~~111~~	~~B~~U	1	ICPST	9/21/2000	9:47	
Chromium	267.76	0.14	0.61	35.4		1	ICPST	9/21/2000	9:47	
Cobalt	228.62	0.12	6.1	6.8		1	ICPST	9/21/2000	9:47	
Copper	324.75	0.20	3.1	21.3		1	ICPST	9/21/2000	9:47	
Iron	217.44	2.2	12.3	35500	N	1	ICPST	9/21/2000	9:47	
Lead	220.35	0.23	0.37	23.6		1	ICPST	9/21/2000	9:47	
Magnesium	279.08	5.1	613	637		1	ICPST	9/21/2000	9:47	
Manganese	257.61	0.037	0.61	37.6	N	1	ICPST	9/21/2000	9:47	
Nickel	231.60	0.23	4.9	17.2		1	ICPST	9/21/2000	9:47	
Potassium	766.49	221	613	613 ~~402~~	~~B~~U	1	ICP	9/20/2000	14:08	
Selenium	196.03	0.29	0.61	0.61 ~~0.29~~	U	1	ICPST	9/21/2000	9:47	
Silver	328.07	0.17	0.61	0.61 ~~0.17~~	U	1	ICPST	9/21/2000	9:47	
Sodium	589	21.1	613	53.0 ~~53.0~~	~~B~~U	1	ICP	9/20/2000	14:08	
Thallium	190.86	0.40	1.2	1.2 ~~0.83~~	~~B~~U	1	ICPST	9/21/2000	9:47	
Vanadium	292.40	0.15	6.1	75.2		1	ICPST	9/21/2000	9:47	
Zinc	213.86	0.098	2.5	37.7	E	1	ICPST	9/21/2000	9:47	J

Comments: Lot #: F0I130290 Sample #: 7

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7M **Client ID:** MMAW2CD

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 18.4

Element	Wt/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.020	0.041	0.041 ~~0.039~~	~~B~~U	1	CVAA	9/20/2000	10:48

Comments: Lot #: F0I130290 Sample #: 7

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7N **Client ID:** MMAU2A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259340

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 14.5

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.6	23.4	4730	N	1	ICPST	9/21/2000	9:52	
Antimony	206.84	0.28	7.0	7.0 ~~0.28~~	UN	1	ICPST	9/21/2000	9:52	UL
Arsenic	189.04	0.16	1.2	4.5		1	ICPST	9/21/2000	9:52	
~~Barium~~	~~493.41~~	~~0.37~~	~~23.4~~	~~23.4 11.6~~	~~B~~U	~~1~~	~~ICPST~~	~~9/21/2000~~	~~9:52~~	
Beryllium	313.04	0.023	0.59	0.59 ~~0.20~~	~~B~~U	1	ICPST	9/21/2000	9:52	
Cadmium	226.50	0.035	0.59	0.59 ~~0.18~~	~~B~~U	1	ICPST	9/21/2000	9:52	
Calcium	317.93	4.8	585	585 ~~109~~	~~B~~U	1	ICPST	9/21/2000	9:52	
Chromium	267.76	0.13	0.59	10.9		1	ICPST	9/21/2000	9:52	
Cobalt	228.62	0.12	5.9	5.9 ~~2.2~~	~~B~~U	1	ICPST	9/21/2000	9:52	
Copper	324.75	0.19	2.9	5.3		1	ICPST	9/21/2000	9:52	
Iron	217.44	2.1	11.7	9990	N	1	ICPST	9/21/2000	9:52	
Lead	220.35	0.22	0.35	10.9		1	ICPST	9/21/2000	9:52	
Magnesium	279.08	4.8	585	585 ~~182~~	~~B~~U	1	ICPST	9/21/2000	9:52	
Manganese	257.61	0.035	0.59	43.0	N	1	ICPST	9/21/2000	9:52	
Nickel	231.60	0.22	4.7	4.7 ~~3.2~~	~~B~~U	1	ICPST	9/21/2000	9:52	
Potassium	766.49	211	585	585 ~~211~~	U	1	ICP	9/20/2000	14:12	
Selenium	196.03	0.28	0.59	0.59 ~~0.28~~	U	1	ICPST	9/21/2000	9:52	
Silver	328.07	0.16	0.59	0.59 ~~0.16~~	U	1	ICPST	9/21/2000	9:52	
Sodium	589	20.1	585	585 ~~49.6~~	~~B~~U	1	ICP	9/20/2000	14:12	
Thallium	190.86	0.39	1.2	1.2 ~~0.39~~	U	1	ICPST	9/21/2000	9:52	
Vanadium	292.40	0.14	5.9	22.5		1	ICPST	9/21/2000	9:52	
Zinc	213.86	0.094	2.3	14.4	E	1	ICPST	9/21/2000	9:52	J

Comments: Lot #: F0I130290 Sample #: 8

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7N **Client ID:** MMAU2A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 14.5

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.020	0.039	0.039 ~~0.020~~	~~U~~ V	1	CVAA	9/20/2000	10:51

0.039

Comments: Lot #: F0I130290 Sample #: 8

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7T **Client ID:** MMAU2B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259340

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 26.7

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	3.0	27.3	21500	N	1	ICPST	9/21/2000	9:56	
Antimony	206.84	0.33	8.2	8.2 ~~0.53~~	~~B~~NV	1	ICPST	9/21/2000	9:56	VL
Arsenic	189.04	0.19	1.4	16.8		1	ICPST	9/21/2000	9:56	
Barium	493.41	0.44	27.3	27.3 ~~19.4~~	~~B~~V	1	ICPST	9/21/2000	9:56	
Beryllium	313.04	0.027	0.68	0.68 ~~0.57~~	~~B~~V	1	ICPST	9/21/2000	9:56	
Cadmium	226.50	0.041	0.68	0.68 ~~0.67~~	~~B~~V	1	ICPST	9/21/2000	9:56	
Calcium	317.93	5.6	682	682 ~~129~~	~~B~~V	1	ICPST	9/21/2000	9:56	
Chromium	267.76	0.15	0.68	39.1		1	ICPST	9/21/2000	9:56	
Cobalt	228.62	0.14	6.8	7.1		1	ICPST	9/21/2000	9:56	
Copper	324.75	0.22	3.4	23.0		1	ICPST	9/21/2000	9:56	
Iron	217.44	2.5	13.6	38900	N	1	ICPST	9/21/2000	9:56	
Lead	220.35	0.26	0.41	23.7		1	ICPST	9/21/2000	9:56	
Magnesium	279.08	5.7	682	689		1	ICPST	9/21/2000	9:56	
Manganese	257.61	0.041	0.68	39.4	N	1	ICPST	9/21/2000	9:56	
Nickel	231.60	0.26	5.5	17.7		1	ICPST	9/21/2000	9:56	
Potassium	766.49	246	682	682 ~~529~~	~~B~~V	1	ICP	9/20/2000	14:16	
Selenium	196.03	0.33	0.68	0.68 ~~0.33~~	U	1	ICPST	9/21/2000	9:56	
Silver	328.07	0.19	0.68	0.68 ~~0.19~~	U	1	ICPST	9/21/2000	9:56	
Sodium	589	23.5	682	682 ~~62.3~~	~~B~~V	1	ICP	9/20/2000	14:16	
Thallium	190.86	0.45	1.4	1.4 ~~0.80~~	~~B~~V	1	ICPST	9/21/2000	9:56	
Vanadium	292.40	0.16	6.8	84.4		1	ICPST	9/21/2000	9:56	
Zinc	213.86	0.11	2.7	44.7	E	1	ICPST	9/21/2000	9:56	J

Comments: Lot #: F0I130290 Sample #: 9

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7T **Client ID:** MMAU2B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 26.7

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.023	0.046	0.16		1	CVAA	9/20/2000	10:53

Comments: Lot #: F0I130290 Sample #: 9

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7V **Client ID:** MMAU2C

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259340

Weight: 1.00 *Volume:* 100 *Percent Moisture:* 25.9

Element	Wl./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.9	27.0	26200	N	1	ICPST	9/21/2000	10:01	
Antimony	206.84	0.32	8.1	8.1 ~~0.65~~	~~B~~NU	1	ICPST	9/21/2000	10:01	UL
Arsenic	189.04	0.19	1.4	12.6		1	ICPST	9/21/2000	10:01	
Barium	493.41	0.43	27.0	27.0 18.1	~~B~~U	1	ICPST	9/21/2000	10:01	
Beryllium	313.04	0.027	0.68	0.68 0.62	~~B~~U	1	ICPST	9/21/2000	10:01	
Cadmium	226.50	0.041	0.68	0.78		1	ICPST	9/21/2000	10:01	
Calcium	317.93	5.6	675	675 124	~~B~~U	1	ICPST	9/21/2000	10:01	
Chromium	267.76	0.15	0.68	49.8		1	ICPST	9/21/2000	10:01	
Cobalt	228.62	0.14	6.8	10.4		1	ICPST	9/21/2000	10:01	
Copper	324.75	0.22	3.4	26.0		1	ICPST	9/21/2000	10:01	
Iron	217.44	2.4	13.5	41900	N	1	ICPST	9/21/2000	10:01	
Lead	220.35	0.26	0.41	33.4		1	ICPST	9/21/2000	10:01	
Magnesium	279.08	5.6	675	784		1	ICPST	9/21/2000	10:01	
Manganese	257.61	0.041	0.68	52.8	N	1	ICPST	9/21/2000	10:01	
Nickel	231.60	0.26	5.4	23.7		1	ICPST	9/21/2000	10:01	
Potassium	766.49	243	675	675 ~~346~~	~~B~~U	1	ICP	9/20/2000	14:20	
Selenium	196.03	0.32	0.68	0.68 ~~0.32~~	U	1	ICPST	9/21/2000	10:01	
Silver	328.07	0.19	0.68	0.68 ~~0.10~~	U	1	ICPST	9/21/2000	10:01	
Sodium	589	23.2	675	675 ~~60.3~~	~~B~~U	1	ICP	9/20/2000	14:20	
Thallium	190.86	0.45	1.4	1.4 ~~0.87~~	~~B~~U	1	ICPST	9/21/2000	10:01	
Vanadium	292.40	0.16	6.8	85.2		1	ICPST	9/21/2000	10:01	
Zinc	213.86	0.11	2.7	60.3	E	1	ICPST	9/21/2000	10:01	J

Comments: Lot #: F0I130290 Sample #: 10

Version 4.10.4

U Result is less than the IDL
B *Result is between IDL and RL*

Form I Equivalent

Frm I OM

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7V **Client ID:** MMAU2C

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 25.9

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.023	0.045	0.27		1	CVAA	9/20/2000	10:56

Comments: Lot #: F0I130290 Sample #: 10

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7X **Client ID:** MMAU1A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259340

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 10.3

Element	Wt/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.4	22.3	5710	N	1	ICPST	9/21/2000	10:06	
Antimony	206.84	0.27	6.7	6.7 ~~0.27~~	UN	1	ICPST	9/21/2000	10:06	UL
Arsenic	189.04	0.16	1.1	7.2		1	ICPST	9/21/2000	10:06	
Barium	493.41	0.36	22.3	22.3 ~~16.3~~	~~B~~U	1	ICPST	9/21/2000	10:06	
Beryllium	313.04	0.022	0.56	0.56 ~~0.39~~	~~B~~U	1	ICPST	9/21/2000	10:06	
Cadmium	226.50	0.033	0.56	0.56 ~~0.27~~	~~B~~U	1	ICPST	9/21/2000	10:06	
Calcium	317.93	4.6	557	557 ~~108~~	~~B~~U	1	ICPST	9/21/2000	10:06	
Chromium	267.76	0.12	0.56	13.6		1	ICPST	9/21/2000	10:06	
Cobalt	228.62	0.11	5.6	6.5		1	ICPST	9/21/2000	10:06	
Copper	324.75	0.18	2.8	5.7		1	ICPST	9/21/2000	10:06	
Iron	217.44	2.0	11.2	15100	N	1	ICPST	9/21/2000	10:06	
Lead	220.35	0.21	0.33	13.7		1	ICPST	9/21/2000	10:06	
Magnesium	279.08	4.6	557	1140		1	ICPST	9/21/2000	10:06	
Manganese	257.61	0.033	0.56	99.4	N	1	ICPST	9/21/2000	10:06	
Nickel	231.60	0.21	4.5	4.6		1	ICPST	9/21/2000	10:06	
Potassium	766.49	201	557	557 ~~201~~	U	1	ICP	9/20/2000	14:24	
Selenium	196.03	0.27	0.56	0.56 ~~0.27~~	U	1	ICPST	9/21/2000	10:06	
Silver	328.07	0.16	0.56	0.56 ~~0.16~~	U	1	ICPST	9/21/2000	10:06	
Sodium	589	19.2	557	557 ~~43.0~~	~~B~~V	1	ICP	9/20/2000	14:24	
Thallium	190.86	0.37	1.1	1.1 ~~0.39~~	~~B~~V	1	ICPST	9/21/2000	10:06	
Vanadium	292.40	0.13	5.6	31.3		1	ICPST	9/21/2000	10:06	
Zinc	213.86	0.089	2.2	35.0	E	1	ICPST	9/21/2000	10:06	J

Comments: Lot #: F0I130290 Sample #: 11

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA7X **Client ID:** MMAU1A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 10.3

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.019	0.037	~~0.028~~	~~B~~ U	1	CVAA	9/20/2000	10:58

0.037

Comments: Lot #: F0I130290 Sample #: 11

Version 4.10.4

U Result is less than the IDL

B Result is between IDL and RL

Form 1 Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA81 **Client ID:** MMAU1B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 19.9

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.7	25.0	42900	N	1	ICPST	9/23/2000	17:10	
Antimony	206.84	0.30	7.5	7.5 ~~0.30~~	UN	1	ICPST	9/23/2000	17:10	UL
Arsenic	189.04	0.18	1.3	19.8		1	ICPST	9/23/2000	17:10	
Barium	493.41	0.40	25.0	53.1		1	ICPST	9/23/2000	17:10	
Beryllium	313.04	0.025	0.62	2.3		1	ICPST	9/23/2000	17:10	
Cadmium	226.50	0.038	0.62	0.92		1	ICPST	9/23/2000	17:10	
Calcium	317.93	5.1	624	624 ~~533~~	~~B~~U	1	ICPST	9/23/2000	17:10	
Chromium	267.76	0.14	0.62	36.1		1	ICPST	9/23/2000	17:10	
Cobalt	228.62	0.13	6.2	86.8		1	ICPST	9/23/2000	17:10	
Copper	324.75	0.20	3.1	34.4		1	ICPST	9/23/2000	17:10	
Iron	217.44	2.3	12.5	31400	N	1	ICPST	9/23/2000	17:10	
Lead	220.35	0.24	0.38	26.8		1	ICPST	9/23/2000	17:10	
Magnesium	279.08	5.2	624	37700		1	ICPST	9/23/2000	17:10	
Manganese	257.61	0.038	0.62	282	N	1	ICPST	9/23/2000	17:10	
Nickel	231.60	0.24	5.0	59.6		1	ICPST	9/23/2000	17:10	
Potassium	766.49	225	624	6220		1	ICP	9/21/2000	8:52	
Selenium	196.03	0.30	0.62	0.62 ~~0.30~~	U	1	ICPST	9/23/2000	17:10	
Silver	328.07	0.18	0.62	0.62 ~~0.18~~	U	1	ICPST	9/23/2000	17:10	
Sodium	589	21.5	624	624 ~~104~~	~~B~~U	1	ICP	9/21/2000	8:52	
Thallium	190.86	0.41	1.3	1.8		1	ICPST	9/23/2000	17:10	
Vanadium	292.40	0.15	6.2	68.8		1	ICPST	9/23/2000	17:10	
Zinc	213.86	0.10	2.5	96.0	E	1	ICPST	9/23/2000	17:10	J

Comments: Lot #: F0I130290 Sample #: 12

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA81 **Client ID:** MMAU1B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 19.9

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.021	0.042	0.12		1	CVAA	9/20/2000	11:01

Comments: Lot #: F0I130290 Sample #: 12

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA82 **Client ID:** MMAU1C

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 19.3

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.7	24.8	47900	N	1	ICPST	9/23/2000	17:14	
Antimony	206.84	0.30	7.4	7.4 ~~0.30~~	UN	1	ICPST	9/23/2000	17:14	UL
Arsenic	189.04	0.17	1.2	35.9		1	ICPST	9/23/2000	17:14	
~~Barium~~	~~493.41~~	~~0.40~~	~~24.8~~	~~82.6~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~17:14~~	
Beryllium	313.04	0.025	0.62	5.3		1	ICPST	9/23/2000	17:14	
Cadmium	226.50	0.037	0.62	1.3		1	ICPST	9/23/2000	17:14	
Calcium	317.93	5.1	620	954		1	ICPST	9/23/2000	17:14	
Chromium	267.76	0.14	0.62	39.7		1	ICPST	9/23/2000	17:14	
Cobalt	228.62	0.12	6.2	94.3		1	ICPST	9/23/2000	17:14	
Copper	324.75	0.20	3.1	31.7		1	ICPST	9/23/2000	17:14	
Iron	217.44	2.2	12.4	35100	N	1	ICPST	9/23/2000	17:14	
Lead	220.35	0.24	0.37	18.7		1	ICPST	9/23/2000	17:14	
Magnesium	279.08	5.1	620	58100		1	ICPST	9/23/2000	17:14	
Manganese	257.61	0.037	0.62	366	N	1	ICPST	9/23/2000	17:14	
Nickel	231.60	0.24	5.0	94.2		1	ICPST	9/23/2000	17:14	
Potassium	766.49	223	620	10900		1	ICP	9/21/2000	8:56	
Selenium	196.03	0.30	0.62	0.62 ~~0.30~~	U	1	ICPST	9/23/2000	17:14	
Silver	328.07	0.17	0.62	0.62 ~~0.17~~	U	1	ICPST	9/23/2000	17:14	
Sodium	589	21.3	620	620 ~~118~~	~~B~~U	1	ICP	9/21/2000	8:56	
Thallium	190.86	0.41	1.2	2.9		1	ICPST	9/23/2000	17:14	
Vanadium	292.40	0.15	6.2	75.0		1	ICPST	9/23/2000	17:14	
Zinc	213.86	0.099	2.5	218	E	1	ICPST	9/23/2000	17:14	J

Comments: Lot #: F0I130290 Sample #: 13

Version 4.10.4

U Result is less than the IDL

B Result is between IDL and RL

Form 1 Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA82 **Client ID:** MMAU1C

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 19.3

Element	Wl./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.021	0.041	0.11		1	CVAA	9/20/2000	11:08

Comments: Lot #: F0I130290 Sample #: 13

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA84 **Client ID:** MMAW3A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 13.7

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.5	23.2	15400	N	1	ICPST	9/23/2000	17:19	
Antimony	206.84	0.28	7.0	7.0 ~~0.53~~	~~B~~NU	1	ICPST	9/23/2000	17:19	UL
Arsenic	189.04	0.16	1.2	2.7		1	ICPST	9/23/2000	17:19	
~~Barium~~	~~493.41~~	~~0.37~~	~~23.2~~	~~150~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~17:19~~	
Beryllium	313.04	0.023	0.58	0.99		1	ICPST	9/23/2000	17:19	
Cadmium	226.50	0.035	0.58	0.67		1	ICPST	9/23/2000	17:19	
Calcium	317.93	4.8	579	2200		1	ICPST	9/23/2000	17:19	
Chromium	267.76	0.13	0.58	26.1		1	ICPST	9/23/2000	17:19	
Cobalt	228.62	0.12	5.8	13.1		1	ICPST	9/23/2000	17:19	
Copper	324.75	0.19	2.9	13.6		1	ICPST	9/23/2000	17:19	
Iron	217.44	2.1	11.6	23800	N	1	ICPST	9/23/2000	17:19	
Lead	220.35	0.22	0.35	13.6		1	ICPST	9/23/2000	17:19	
Magnesium	279.08	4.8	579	3020		1	ICPST	9/23/2000	17:19	
Manganese	257.61	0.035	0.58	776	N	1	ICPST	9/23/2000	17:19	
Nickel	231.60	0.22	4.6	13.5		1	ICPST	9/23/2000	17:19	
Potassium	766.49	209	579	1360		1	ICP	9/21/2000	9:00	
Selenium	196.03	0.28	0.58	0.58 ~~0.28~~	U	1	ICPST	9/23/2000	17:19	
Silver	328.07	0.16	0.58	0.58 ~~0.16~~	U	1	ICPST	9/23/2000	17:19	
Sodium	589	19.9	579	579 ~~118~~	~~B~~U	1	ICP	9/21/2000	9:00	
Thallium	190.86	0.38	1.2	2.8		1	ICPST	9/23/2000	17:19	
Vanadium	292.40	0.14	5.8	43.6		1	ICPST	9/23/2000	17:19	
Zinc	213.86	0.093	2.3	61.1	E	1	ICPST	9/23/2000	17:19	J

Comments: Lot #: F0I130290 Sample #: 14

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKA84 **Client ID:** MMAW3A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 13.7

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.019	0.039	~~0.031~~	~~B~~U	1	CVAA	9/20/2000	11:11

0.039

Comments: Lot #: F0I130290 Sample #: 14

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDT2 **Client ID:** MMAW3B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 17.8

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.7	24.3	24000	N	1	ICPST	9/23/2000	17:23	
Antimony	206.84	0.29	7.3	7.3 ~~1.2~~	~~B~~NU	1	ICPST	9/23/2000	17:23	VL
Arsenic	189.04	0.17	1.2	3.9		1	ICPST	9/23/2000	17:23	
~~Barium~~	~~493.41~~	~~0.39~~	~~24.3~~	~~155~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~17:23~~	
Beryllium	313.04	0.024	0.61	1.1		1	ICPST	9/23/2000	17:23	
Cadmium	226.50	0.037	0.61	1.1		1	ICPST	9/23/2000	17:23	
Calcium	317.93	5.0	608	1250		1	ICPST	9/23/2000	17:23	
Chromium	267.76	0.13	0.61	40.7		1	ICPST	9/23/2000	17:23	
Cobalt	228.62	0.12	6.1	20.9		1	ICPST	9/23/2000	17:23	
Copper	324.75	0.20	3.0	25.8		1	ICPST	9/23/2000	17:23	
Iron	217.44	2.2	12.2	40700	N	1	ICPST	9/23/2000	17:23	
Lead	220.35	0.23	0.37	16.6		1	ICPST	9/23/2000	17:23	
Magnesium	279.08	5.0	608	5850		1	ICPST	9/23/2000	17:23	
Manganese	257.61	0.037	0.61	771	N	1	ICPST	9/23/2000	17:23	
Nickel	231.60	0.23	4.9	21.7		1	ICPST	9/23/2000	17:23	
Potassium	766.49	219	608	2980		1	ICP	9/21/2000	9:03	
Selenium	196.03	0.29	0.61	0.61 ~~0.29~~	U	1	ICPST	9/23/2000	17:23	
Silver	328.07	0.17	0.61	0.61 ~~0.17~~	U	1	ICPST	9/23/2000	17:23	
Sodium	589	20.9	608	608 ~~136~~	~~B~~U	1	ICP	9/21/2000	9:03	
Thallium	190.86	0.40	1.2	3.1		1	ICPST	9/23/2000	17:23	
Vanadium	292.40	0.15	6.1	74.0		1	ICPST	9/23/2000	17:23	
Zinc	213.86	0.097	2.4	93.4	E	1	ICPST	9/23/2000	17:23	J

Comments: Lot #: F0I130290 Sample #: 16

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDT2 **Client ID:** MMAW3B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0259183

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 17.8

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.020	0.041	~~0.030~~ 0.041	~~B~~ U	1	CVAA	9/19/2000	17:47

Comments: Lot #: F0I130290 Sample #: 16

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDT3 **Client ID:** MMAW3C

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 16.3

Element	Wl/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.6	23.9	25600	N	1	ICPST	9/23/2000	17:28	
Antimony	206.84	0.29	7.2	7.2 ~~1.2~~	~~B~~NU	1	ICPST	9/23/2000	17:28	vC
Arsenic	189.04	0.17	1.2	4.0		1	ICPST	9/23/2000	17:28	
~~Barium~~	~~493.41~~	~~0.38~~	~~23.9~~	~~123~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~17:28~~	
Beryllium	313.04	0.024	0.60	1.3		1	ICPST	9/23/2000	17:28	
Cadmium	226.50	0.036	0.60	1.2		1	ICPST	9/23/2000	17:28	
Calcium	317.93	4.9	597	1060		1	ICPST	9/23/2000	17:28	
Chromium	267.76	0.13	0.60	40.2		1	ICPST	9/23/2000	17:28	
Cobalt	228.62	0.12	6.0	20.0		1	ICPST	9/23/2000	17:28	
Copper	324.75	0.19	3.0	27.5		1	ICPST	9/23/2000	17:28	
Iron	217.44	2.2	12.0	43900	N	1	ICPST	9/23/2000	17:28	
Lead	220.35	0.23	0.36	16.0		1	ICPST	9/23/2000	17:28	
Magnesium	279.08	5.0	597	5690		1	ICPST	9/23/2000	17:28	
Manganese	257.61	0.036	0.60	735	N	1	ICPST	9/23/2000	17:28	
Nickel	231.60	0.23	4.8	21.6		1	ICPST	9/23/2000	17:28	
Potassium	766.49	215	597	2920		1	ICP	9/21/2000	9:07	
Selenium	196.03	0.29	0.60	0.60 ~~0.29~~	U	1	ICPST	9/23/2000	17:28	
Silver	328.07	0.17	0.60	0.60 ~~0.17~~	U	1	ICPST	9/23/2000	17:28	
Sodium	589	20.5	597	597 ~~118~~	~~B~~U	1	ICP	9/21/2000	9:07	
Thallium	190.86	0.39	1.2	3.2		1	ICPST	9/23/2000	17:28	
Vanadium	292.40	0.14	6.0	79.5		1	ICPST	9/23/2000	17:28	
Zinc	213.86	0.096	2.4	84.8	E	1	ICPST	9/23/2000	17:28	J

Comments: Lot #: F0I130290 Sample #: 17

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDT3 **Client ID:** MMAW3C

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0259183

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 16.3

Element	Wt/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.020	0.040	~~0.037~~ 0.040	~~B~~U	1	CVAA	9/19/2000	17:58

Comments: Lot #: F0I130290 Sample #: 17

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDT4 **Client ID:** MMAW3CD

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 13.8

Element	Wl/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.5	23.2	25500	N	1	ICPST	9/23/2000	17:32	
Antimony	206.84	0.28	7.0	7.0 0.78	~~B~~NU	1	ICPST	9/23/2000	17:32	VL
Arsenic	189.04	0.16	1.2	4.2		1	ICPST	9/23/2000	17:32	
~~Barium~~	~~493.41~~	~~0.37~~	~~23.2~~	~~123~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~17:32~~	
Beryllium	313.04	0.023	0.58	1.2		1	ICPST	9/23/2000	17:32	
Cadmium	226.50	0.035	0.58	1.2		1	ICPST	9/23/2000	17:32	
Calcium	317.93	4.8	580	1050		1	ICPST	9/23/2000	17:32	
Chromium	267.76	0.13	0.58	40.5		1	ICPST	9/23/2000	17:32	
Cobalt	228.62	0.12	5.8	22.5		1	ICPST	9/23/2000	17:32	
Copper	324.75	0.19	2.9	27.2		1	ICPST	9/23/2000	17:32	
Iron	217.44	2.1	11.6	43600	N	1	ICPST	9/23/2000	17:32	
Lead	220.35	0.22	0.35	17.2		1	ICPST	9/23/2000	17:32	
Magnesium	279.08	4.8	580	5560		1	ICPST	9/23/2000	17:32	
Manganese	257.61	0.035	0.58	835	N	1	ICPST	9/23/2000	17:32	
Nickel	231.60	0.22	4.6	21.5		1	ICPST	9/23/2000	17:32	
Potassium	766.49	209	580	2930		1	ICP	9/21/2000	9:11	
Selenium	196.03	0.28	0.58	0.58 ~~0.28~~	U	1	ICPST	9/23/2000	17:32	
Silver	328.07	0.16	0.58	0.58 ~~0.16~~	U	1	ICPST	9/23/2000	17:32	
Sodium	589	19.9	580	580 ~~127~~	~~B~~U	1	ICP	9/21/2000	9:11	
Thallium	190.86	0.38	1.2	3.5		1	ICPST	9/23/2000	17:32	
Vanadium	292.40	0.14	5.8	79.1		1	ICPST	9/23/2000	17:32	
Zinc	213.86	0.093	2.3	83.1	E	1	ICPST	9/23/2000	17:32	J

Comments: Lot #: F0I130290 Sample #: 18

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDT4 **Client ID:** MMAW3CD

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0259183

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 13.8

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.019	0.039	~~0.037~~ 0.039	~~B~~V	1	CVAA	9/19/2000	17:52

Comments: Lot #: F0I130290 Sample #: 18

Version 4.10.4

U Result is less than the IDL

B Result is between IDL and RL

Form 1 Equivalent

Form I Copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDT6 **Client ID:** MMAB2A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 17.9

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.7	24.4	6660	N	1	ICPST	9/23/2000	17:37	
Antimony	206.84	0.29	7.3	7.3 ~~0.29~~	UN	1	ICPST	9/23/2000	17:37	VL
Arsenic	189.04	0.17	1.2	2.4		1	ICPST	9/23/2000	17:37	
~~Barium~~	~~493.41~~	~~0.39~~	~~24.4~~	~~62.9~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~17:37~~	
Beryllium	313.04	0.024	0.61	0.61 ~~0.34~~	~~B~~U	1	ICPST	9/23/2000	17:37	
Cadmium	226.50	0.037	0.61	0.61 ~~0.36~~	~~B~~U	1	ICPST	9/23/2000	17:37	
Calcium	317.93	5.0	609	609 ~~339~~	~~B~~U	1	ICPST	9/23/2000	17:37	
Chromium	267.76	0.13	0.61	15.8		1	ICPST	9/23/2000	17:37	
Cobalt	228.62	0.12	6.1	6.1 ~~3.9~~	~~B~~U	1	ICPST	9/23/2000	17:37	
Copper	324.75	0.20	3.1	13.2		1	ICPST	9/23/2000	17:37	
Iron	217.44	2.2	12.2	9230	N	1	ICPST	9/23/2000	17:37	
Lead	220.35	0.23	0.37	52.0		1	ICPST	9/23/2000	17:37	
Magnesium	279.08	5.0	609	609 ~~566~~	~~B~~U	1	ICPST	9/23/2000	17:37	
Manganese	257.61	0.037	0.61	396	N	1	ICPST	9/23/2000	17:37	
Nickel	231.60	0.23	4.9	4.9 ~~3.7~~	~~B~~U	1	ICPST	9/23/2000	17:37	
Potassium	766.49	219	609	609 ~~219~~	U	1	ICP	9/21/2000	9:15	
Selenium	196.03	0.29	0.61	0.61 ~~0.29~~	U	1	ICPST	9/23/2000	17:37	
Silver	328.07	0.17	0.61	4.3		1	ICPST	9/23/2000	17:37	
Sodium	589	20.9	609	609 ~~96.0~~	~~B~~U	1	ICP	9/21/2000	9:15	
Thallium	190.86	0.40	1.2	1.2 ~~0.93~~	~~B~~U	1	ICPST	9/23/2000	17:37	
Vanadium	292.40	0.15	6.1	20.3		1	ICPST	9/23/2000	17:37	
Zinc	213.86	0.097	2.4	30.2	E	1	ICPST	9/23/2000	17:37	J

Comments: Lot #: F0I130290 Sample #: 19

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDT6 **Client ID:** MMAB2A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0259183

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 17.9

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.028	0.041	1.2		1	CVAA	9/19/2000	17:54

Comments: Lot #: F0I130290 Sample #: 19

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDT9 **Client ID:** MMAB2B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 20.5

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.7	25.2	16000	N	1	ICPST	9/23/2000	17:41	
Antimony	206.84	0.30	7.6	7.6 ~~0.30~~	UN	1	ICPST	9/23/2000	17:41	UL
Arsenic	189.04	0.18	1.3	3.8		1	ICPST	9/23/2000	17:41	
~~Barium~~	~~493.41~~	~~0.40~~	~~25.2~~	~~58.0~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~17:41~~	
Beryllium	313.04	0.025	0.63	0.63 ~~0.30~~	~~B~~ U	1	ICPST	9/23/2000	17:41	
Cadmium	226.50	0.038	0.63	0.63 ~~0.61~~	~~B~~ U	1	ICPST	9/23/2000	17:41	
Calcium	317.93	5.2	629	629 ~~500~~	~~B~~ U	1	ICPST	9/23/2000	17:41	
Chromium	267.76	0.14	0.63	26.2		1	ICPST	9/23/2000	17:41	
Cobalt	228.62	0.13	6.3	6.3 ~~3.2~~	~~B~~ U	1	ICPST	9/23/2000	17:41	
Copper	324.75	0.20	3.1	7.5		1	ICPST	9/23/2000	17:41	
Iron	217.44	2.3	12.6	22600	N	1	ICPST	9/23/2000	17:41	
Lead	220.35	0.24	0.38	8.6		1	ICPST	9/23/2000	17:41	
Magnesium	279.08	5.2	629	629 ~~602~~	~~B~~ U	1	ICPST	9/23/2000	17:41	
Manganese	257.61	0.038	0.63	136	N	1	ICPST	9/23/2000	17:41	
Nickel	231.60	0.24	5.0	5.9		1	ICPST	9/23/2000	17:41	
Potassium	766.49	226	629	629 ~~467~~	~~B~~ U	1	ICP	9/21/2000	9:19	
Selenium	196.03	0.30	0.63	0.63 ~~0.30~~	U	1	ICPST	9/23/2000	17:41	
Silver	328.07	0.18	0.63	0.63 ~~0.18~~	U	1	ICPST	9/23/2000	17:41	
Sodium	589	21.6	629	629 ~~108~~	~~B~~ U	1	ICP	9/21/2000	9:19	
Thallium	190.86	0.42	1.3	2.3		1	ICPST	9/23/2000	17:41	
Vanadium	292.40	0.15	6.3	47.1		1	ICPST	9/23/2000	17:41	
Zinc	213.86	0.10	2.5	18.9	E	1	ICPST	9/23/2000	17:41	J

Comments: Lot #: F0I130290 Sample #: 20

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDT9 **Client ID:** MMAB2B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0259183

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 20.5

Element	Wl/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.021	0.042	0.18		1	CVAA	9/19/2000	17:57

Comments: Lot #: F0I130290 Sample #: 20

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTA **Client ID:** MMAW4A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 15.6

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.6	23.7	10300	N	1	ICPST	9/23/2000	17:46	
Antimony	206.84	0.28	7.1	7.1 ~~0.28~~	UN	1	ICPST	9/23/2000	17:46	VL
Arsenic	189.04	0.17	1.2	1.9		1	ICPST	9/23/2000	17:46	
~~Barium~~	~~493.41~~	~~0.38~~	~~23.7~~	~~135~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~17:46~~	
Beryllium	313.04	0.024	0.59	0.72		1	ICPST	9/23/2000	17:46	
Cadmium	226.50	0.036	0.59	0.59 ~~0.47~~	~~B~~U	1	ICPST	9/23/2000	17:46	
Calcium	317.93	4.9	592	1300		1	ICPST	9/23/2000	17:46	
Chromium	267.76	0.13	0.59	19.1		1	ICPST	9/23/2000	17:46	
Cobalt	228.62	0.12	5.9	8.1		1	ICPST	9/23/2000	17:46	
Copper	324.75	0.19	3.0	7.6		1	ICPST	9/23/2000	17:46	
Iron	217.44	2.1	11.9	15600	N	1	ICPST	9/23/2000	17:46	
Lead	220.35	0.23	0.36	14.7		1	ICPST	9/23/2000	17:46	
Magnesium	279.08	4.9	592	2370		1	ICPST	9/23/2000	17:46	
Manganese	257.61	0.036	0.59	287	N	1	ICPST	9/23/2000	17:46	
Nickel	231.60	0.23	4.7	9.8		1	ICPST	9/23/2000	17:46	
Potassium	766.49	213	592	592 ~~356~~	~~B~~U	1	ICP	9/21/2000	9:23	
Selenium	196.03	0.28	0.59	0.59 ~~0.28~~	U	1	ICPST	9/23/2000	17:46	
Silver	328.07	0.17	0.59	0.59 ~~0.17~~	U	1	ICPST	9/23/2000	17:46	
Sodium	589	20.4	592	592 ~~119~~	~~B~~U	1	ICP	9/21/2000	9:23	
Thallium	190.86	0.39	1.2	1.3		1	ICPST	9/23/2000	17:46	
Vanadium	292.40	0.14	5.9	29.2		1	ICPST	9/23/2000	17:46	
Zinc	213.86	0.095	2.4	58.1	E	1	ICPST	9/23/2000	17:46	J

Comments: Lot #: F0I130290 Sample #: 21

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTA **Client ID:** MMAW4A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 15.6

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.020	0.040	~~0.032~~ 0.040	~~B~~U	1	CVAA	9/20/2000	11:13

Comments: Lot #: F0I130290 Sample #: 21

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTF **Client ID:** MMAW4B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 23.7

Element	Wl./Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.9	26.2	16800	N	1	ICPST	9/23/2000	17:50	
Antimony	206.84	0.32	7.9	7.9 ~~0.99~~	~~B~~N✓	1	ICPST	9/23/2000	17:50	UL
Arsenic	189.04	0.18	1.3	2.2		1	ICPST	9/23/2000	17:50	
~~Barium~~	~~493.41~~	~~0.42~~	~~26.2~~	~~100~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~17:50~~	
Beryllium	313.04	0.026	0.66	0.79		1	ICPST	9/23/2000	17:50	
Cadmium	226.50	0.039	0.66	0.66 ~~0.65~~	~~B~~✓	1	ICPST	9/23/2000	17:50	
Calcium	317.93	5.4	655	1030		1	ICPST	9/23/2000	17:50	
Chromium	267.76	0.14	0.66	27.7		1	ICPST	9/23/2000	17:50	
Cobalt	228.62	0.13	6.6	14.1		1	ICPST	9/23/2000	17:50	
Copper	324.75	0.21	3.3	12.2		1	ICPST	9/23/2000	17:50	
Iron	217.44	2.4	13.1	27200	N	1	ICPST	9/23/2000	17:50	
Lead	220.35	0.25	0.39	10.8		1	ICPST	9/23/2000	17:50	
Magnesium	279.08	5.4	655	4440		1	ICPST	9/23/2000	17:50	
Manganese	257.61	0.039	0.66	389	N	1	ICPST	9/23/2000	17:50	
Nickel	231.60	0.25	5.2	14.8		1	ICPST	9/23/2000	17:50	
Potassium	766.49	236	655	1300		1	ICP	9/21/2000	9:26	
Selenium	196.03	0.32	0.66	0.66 ~~0.32~~	U	1	ICPST	9/23/2000	17:50	
Silver	328.07	0.18	0.66	0.66 ~~0.18~~	U	1	ICPST	9/23/2000	17:50	
Sodium	589	22.5	655	655 152	~~B~~N	1	ICP	9/21/2000	9:26	
Thallium	190.86	0.43	1.3	2.2		1	ICPST	9/23/2000	17:50	
Vanadium	292.40	0.16	6.6	50.1		1	ICPST	9/23/2000	17:50	
Zinc	213.86	0.11	2.6	76.1	E	1	ICPST	9/23/2000	17:50	J

Comments: Lot #: F0I130290 Sample #: 22

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTF **Client ID:** MMAW4B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 23.7

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.022	0.044	~~0.026~~ 0.044	~~B~~ V	1	CVAA	9/20/2000	11:16

Comments: Lot #: F0I130290 Sample #: 22

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTG **Client ID:** MMAW4C

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 23.6

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.9	26.2	22700	N	1	ICPST	9/23/2000	18:04	
Antimony	206.84	0.31	7.9	7.9 ~~1.3~~	~~B~~NU	1	ICPST	9/23/2000	18:04	VL
Arsenic	189.04	0.18	1.3	3.6		1	ICPST	9/23/2000	18:04	
~~Barium~~	~~493.41~~	~~0.42~~	~~26.2~~	~~141~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~18:04~~	
Beryllium	313.04	0.026	0.65	1.2		1	ICPST	9/23/2000	18:04	
Cadmium	226.50	0.039	0.65	1.1		1	ICPST	9/23/2000	18:04	
Calcium	317.93	5.4	655	1200		1	ICPST	9/23/2000	18:04	
Chromium	267.76	0.14	0.65	34.3		1	ICPST	9/23/2000	18:04	
Cobalt	228.62	0.13	6.5	21.2		1	ICPST	9/23/2000	18:04	
Copper	324.75	0.21	3.3	23.7		1	ICPST	9/23/2000	18:04	
Iron	217.44	2.4	13.1	39500	N	1	ICPST	9/23/2000	18:04	
Lead	220.35	0.25	0.39	14.3		1	ICPST	9/23/2000	18:04	
Magnesium	279.08	5.4	655	6270		1	ICPST	9/23/2000	18:04	
Manganese	257.61	0.039	0.65	674	N	1	ICPST	9/23/2000	18:04	
Nickel	231.60	0.25	5.2	20.8		1	ICPST	9/23/2000	18:04	
Potassium	766.49	236	655	2120		1	ICP	9/21/2000	9:38	
Selenium	196.03	0.31	0.65	0.65 ~~0.31~~	U	1	ICPST	9/23/2000	18:04	
Silver	328.07	0.18	0.65	0.65 ~~0.18~~	U	1	ICPST	9/23/2000	18:04	
Sodium	589	22.5	655	655 ~~145~~	~~B~~U	1	ICP	9/21/2000	9:38	
Thallium	190.86	0.43	1.3	3.1		1	ICPST	9/23/2000	18:04	
Vanadium	292.40	0.16	6.5	69.7		1	ICPST	9/23/2000	18:04	
Zinc	213.86	0.11	2.6	76.5	E	1	ICPST	9/23/2000	18:04	J

Comments: Lot #: F0I130290 Sample #: 23

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTG **Client ID:** MMAW4C

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0258412

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 23.6

Element	WL/ Mass	IDL	Report Limit	Cone	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.022	0.044	~~0.032~~ 0.044	~~B~~U	1	CVAA	9/20/2000	11:18

Comments: Lot #: F0I130290 Sample #: 23

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I copy

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Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTH **Client ID:** MMAW1A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 21.6

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.8	25.5	11100	N	1	ICPST	9/23/2000	18:09	
Antimony	206.84	0.31	7.7	7.7 ~~0.51~~	~~B~~NU	1	ICPST	9/23/2000	18:09	UL
Arsenic	189.04	0.18	1.3	2.6		1	ICPST	9/23/2000	18:09	
~~Barium~~	~~493.41~~	~~0.41~~	~~25.5~~	~~130~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~18:09~~	
Beryllium	313.04	0.026	0.64	0.79		1	ICPST	9/23/2000	18:09	
Cadmium	226.50	0.038	0.64	0.64 ~~0.61~~	~~B~~U	1	ICPST	9/23/2000	18:09	
Calcium	317.93	5.3	638	920		1	ICPST	9/23/2000	18:09	
Chromium	267.76	0.14	0.64	25.2		1	ICPST	9/23/2000	18:09	
Cobalt	228.62	0.13	6.4	11.9		1	ICPST	9/23/2000	18:09	
Copper	324.75	0.20	3.2	11.7		1	ICPST	9/23/2000	18:09	
Iron	217.44	2.3	12.8	20100	N	1	ICPST	9/23/2000	18:09	
Lead	220.35	0.24	0.38	12.0		1	ICPST	9/23/2000	18:09	
Magnesium	279.08	5.3	638	2460		1	ICPST	9/23/2000	18:09	
Manganese	257.61	0.038	0.64	650	N	1	ICPST	9/23/2000	18:09	
Nickel	231.60	0.24	5.1	11.5		1	ICPST	9/23/2000	18:09	
Potassium	766.49	230	638	1110		1	ICP	9/21/2000	9:42	
Selenium	196.03	0.31	0.64	0.64 ~~0.31~~	U	1	ICPST	9/23/2000	18:09	
Silver	328.07	0.18	0.64	0.64 ~~0.18~~	U	1	ICPST	9/23/2000	18:09	
Sodium	589	21.9	638	638 ~~121~~	~~B~~U	1	ICP	9/21/2000	9:42	
Thallium	190.86	0.42	1.3	2.0		1	ICPST	9/23/2000	18:09	
Vanadium	292.40	0.15	6.4	36.4		1	ICPST	9/23/2000	18:09	
Zinc	213.86	0.10	2.6	54.9	E	1	ICPST	9/23/2000	18:09	J

Comments: Lot #: F0I130290 Sample #: 24

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTH **Client ID:** MMAW1A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0259183

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 21.6

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.021	0.043	~~0.022~~ 0.043	~~B~~U	1	CVAA	9/19/2000	18:00

Comments: Lot #: F0I130290 Sample #: 24

Version 4:10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTJ **Client ID:** MMAW1B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 18.7

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.7	24.6	13600	N	1	ICPST	9/23/2000	18:13	
Antimony	206.84	0.30	7.4	7.4 ~~0.79~~	~~B~~NU	1	ICPST	9/23/2000	18:13	VL
Arsenic	189.04	0.17	1.2	2.3		1	ICPST	9/23/2000	18:13	
~~Barium~~	~~493.41~~	~~0.39~~	~~24.6~~	~~134~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~18:13~~	
Beryllium	313.04	0.025	0.62	0.87		1	ICPST	9/23/2000	18:13	
Cadmium	226.50	0.037	0.62	0.62		1	ICPST	9/23/2000	18:13	
Calcium	317.93	5.1	615	906		1	ICPST	9/23/2000	18:13	
Chromium	267.76	0.14	0.62	26.0		1	ICPST	9/23/2000	18:13	
Cobalt	228.62	0.12	6.2	12.9		1	ICPST	9/23/2000	18:13	
Copper	324.75	0.20	3.1	12.3		1	ICPST	9/23/2000	18:13	
Iron	217.44	2.2	12.3	22800	N	1	ICPST	9/23/2000	18:13	
Lead	220.35	0.23	0.37	10.6		1	ICPST	9/23/2000	18:13	
Magnesium	279.08	5.1	615	3220		1	ICPST	9/23/2000	18:13	
Manganese	257.61	0.037	0.62	694	N	1	ICPST	9/23/2000	18:13	
Nickel	231.60	0.23	4.9	13.4		1	ICPST	9/23/2000	18:13	
Potassium	766.49	221	615	1560		1	ICP	9/21/2000	9:45	
Selenium	196.03	0.30	0.62	0.62 ~~0.30~~	U	1	ICPST	9/23/2000	18:13	
Silver	328.07	0.17	0.62	0.62 ~~0.17~~	U	1	ICPST	9/23/2000	18:13	
Sodium	589	21.1	615	615 ~~128~~	~~B~~U	1	ICP	9/21/2000	9:45	
Thallium	190.86	0.41	1.2	2.1		1	ICPST	9/23/2000	18:13	
Vanadium	292.40	0.15	6.2	41.4		1	ICPST	9/23/2000	18:13	
Zinc	213.86	0.098	2.5	64.0	E	1	ICPST	9/23/2000	18:13	J

Comments: Lot #: F0I130290 Sample #: 25

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTJ **Client ID:** MMAW1B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0259183

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 18.7

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.021	0.041	~~0.021~~ 0.041	U	1	CVAA	9/19/2000	18:02

Comments: Lot #: F0I130290 Sample #: 25

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID:	DKDTK			**Client ID:**	MMAW1C		
Matrix:	Soil	**Units:**	mg/kg	**Prep Date:**	9/15/2000	**Prep Batch:**	0259344
Weight:	1.00	**Volume:**	100	**Percent Moisture:**	10.6		

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.4	22.4	20000	N	1	ICPST	9/23/2000	18:18	
Antimony	206.84	0.27	6.7	6.7 1.2	~~B~~NU	1	ICPST	9/23/2000	18:18	UL
Arsenic	189.04	0.16	1.1	3.1		1	ICPST	9/23/2000	18:18	
~~**Barium**~~	~~493.41~~	~~0.36~~	~~22.4~~	~~119~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~18:18~~	
Beryllium	313.04	0.022	0.56	1.0		1	ICPST	9/23/2000	18:18	
Cadmium	226.50	0.034	0.56	0.91		1	ICPST	9/23/2000	18:18	
Calcium	317.93	4.6	559	1210		1	ICPST	9/23/2000	18:18	
Chromium	267.76	0.12	0.56	29.8		1	ICPST	9/23/2000	18:18	
Cobalt	228.62	0.11	5.6	15.7		1	ICPST	9/23/2000	18:18	
Copper	324.75	0.18	2.8	20.0		1	ICPST	9/23/2000	18:18	
Iron	217.44	2.0	11.2	34100	N	1	ICPST	9/23/2000	18:18	
Lead	220.35	0.21	0.34	11.5		1	ICPST	9/23/2000	18:18	
Magnesium	279.08	4.6	559	5570		1	ICPST	9/23/2000	18:18	
Manganese	257.61	0.034	0.56	546	N	1	ICPST	9/23/2000	18:18	
Nickel	231.60	0.21	4.5	18.0		1	ICPST	9/23/2000	18:18	
Potassium	766.49	201	559	2720		1	ICP	9/21/2000	9:49	
Selenium	196.03	0.27	0.56	0.56 ~~0.27~~	U	1	ICPST	9/23/2000	18:18	
Silver	328.07	0.16	0.56	0.56 ~~0.16~~	U	1	ICPST	9/23/2000	18:18	
Sodium	589	19.2	559	559 ~~127~~	~~B~~U	1	ICP	9/21/2000	9:49	
Thallium	190.86	0.37	1.1	2.5		1	ICPST	9/23/2000	18:18	
Vanadium	292.40	0.13	5.6	61.0		1	ICPST	9/23/2000	18:18	
Zinc	213.86	0.090	2.2	68.8	E	1	ICPST	9/23/2000	18:18	J

Comments: Lot #: F0I130290 Sample #: 26

Version 4.10.4

U **Result is less than the IDL**
B **Result is between IDL and RL**

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTK **Client ID:** MMAW1C

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0259183

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 10.6

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.019	0.037	~~0.021~~ 0.037	~~B~~ U	1	CVAA	9/19/2000	18:10

Comments: Lot #: F0I130290 Sample #: 26

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTL **Client ID:** MMAU4A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 33.5

Element	Wt./ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	3.3	30.1	9950	N	1	ICPST	9/23/2000	18:23	
Antimony	206.84	0.36	9.0	9.0 ~~0.36~~	UN	1	ICPST	9/23/2000	18:23	UL
Arsenic	189.04	0.21	1.5	10.2		1	ICPST	9/23/2000	18:23	
~~Barium~~	~~493.41~~	~~0.48~~	~~30.1~~	~~119~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~18:23~~	
Beryllium	313.04	0.030	0.75	1.1		1	ICPST	9/23/2000	18:23	
Cadmium	226.50	0.045	0.75	0.82		1	ICPST	9/23/2000	18:23	
Calcium	317.93	6.2	752	1690		1	ICPST	9/23/2000	18:23	
Chromium	267.76	0.17	0.75	23.2		1	ICPST	9/23/2000	18:23	
Cobalt	228.62	0.15	7.5	16.1		1	ICPST	9/23/2000	18:23	
Copper	324.75	0.24	3.8	11.4		1	ICPST	9/23/2000	18:23	
Iron	217.44	2.7	15.0	22900	N	1	ICPST	9/23/2000	18:23	
Lead	220.35	0.29	0.45	225		1	ICPST	9/23/2000	18:23	
Magnesium	279.08	6.2	752	1430		1	ICPST	9/23/2000	18:23	
Manganese	257.61	0.045	0.75	1910	N	1	ICPST	9/23/2000	18:23	
Nickel	231.60	0.29	6.0	11.0		1	ICPST	9/23/2000	18:23	
Potassium	766.49	271	752	752 ~~516~~	~~B~~U	1	ICP	9/21/2000	9:53	
Selenium	196.03	0.36	0.75	0.75 ~~0.36~~	U	1	ICPST	9/23/2000	18:23	
Silver	328.07	0.21	0.75	0.75 ~~0.21~~	U	1	ICPST	9/23/2000	18:23	
Sodium	589	25.9	752	752 ~~173~~	~~B~~U	1	ICP	9/21/2000	9:53	
Thallium	190.86	0.50	1.5	2.1		1	ICPST	9/23/2000	18:23	
Vanadium	292.40	0.18	7.5	37.8		1	ICPST	9/23/2000	18:23	
Zinc	213.86	0.12	3.0	216	E	1	ICPST	9/23/2000	18:23	J

Comments: Lot #: F0I130290 Sample #: 27

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form 1 Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTL **Client ID:** MMAU4A

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0259183

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 33.5

Element	Wt/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.025	0.050	~~0.049~~ 0.050	~~B~~U	1	CVAA	9/19/2000	18:12

Comments: Lot #: F0I130290 Sample #: 27

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTM **Client ID:** MMAU4B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/15/2000 **Prep Batch:** 0259344

Weight: 1.00 **Volume:** 100 **Percent Moisture:** 19.7

Element	Wt/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	2.7	24.9	18200	N	1	ICPST	9/23/2000	18:27	
Antimony	206.84	0.30	7.5	7.5 ~~0.44~~	~~B~~NU	1	ICPST	9/23/2000	18:27	UL
Arsenic	189.04	0.17	1.3	14.0		1	ICPST	9/23/2000	18:27	
~~Barium~~	~~493.41~~	~~0.40~~	~~24.9~~	~~85.4~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~18:27~~	
Beryllium	313.04	0.025	0.62	1.3		1	ICPST	9/23/2000	18:27	
Cadmium	226.50	0.037	0.62	1.2		1	ICPST	9/23/2000	18:27	
Calcium	317.93	5.1	623	1210		1	ICPST	9/23/2000	18:27	
Chromium	267.76	0.14	0.62	35.3		1	ICPST	9/23/2000	18:27	
Cobalt	228.62	0.13	6.2	19.0		1	ICPST	9/23/2000	18:27	
Copper	324.75	0.28	3.1	16.9		1	ICPST	9/23/2000	18:27	
Iron	217.44	2.3	12.5	36900	N	1	ICPST	9/23/2000	18:27	
Lead	220.35	0.24	0.37	256		1	ICPST	9/23/2000	18:27	
Magnesium	279.08	5.2	623	2820		1	ICPST	9/23/2000	18:27	
Manganese	257.61	0.037	0.62	1760	N	1	ICPST	9/23/2000	18:27	
Nickel	231.60	0.24	5.0	17.6		1	ICPST	9/23/2000	18:27	
Potassium	766.49	224	623	623 ~~564~~	~~B~~U	1	ICP	9/21/2000	9:57	
Selenium	196.03	0.30	0.62	0.62 ~~0.30~~	U	1	ICPST	9/23/2000	18:27	
Silver	328.07	0.17	0.62	0.62 ~~0.17~~	U	1	ICPST	9/23/2000	18:27	
Sodium	589	21.4	623	623 ~~130~~	~~B~~U	1	ICP	9/21/2000	9:57	
Thallium	190.86	0.41	1.3	3.2		1	ICPST	9/23/2000	18:27	
Vanadium	292.40	0.15	6.2	57.5		1	ICPST	9/23/2000	18:27	
Zinc	213.86	0.10	2.5	341	E	1	ICPST	9/23/2000	18:27	J

Comments: Lot #: F0I130290 Sample #: 28

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTM **Client ID:** MMAU4B

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0259183

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 19.7

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.021	0.042	0.057		1	CVAA	9/19/2000	18:14

Comments: Lot #: F0I130290 Sample #: 28

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

Form I Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTN Client ID: MMAU4C

Matrix: Soil Units: mg/kg Prep Date: 9/15/2000 Prep Batch: 0259344

Weight: 1.00 Volume: 100 Percent Moisture: 33.3

Element	Wl/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time	
Aluminum	308.22	3.3	30.0	45100	N	1	ICPST	9/23/2000	18:32	
Antimony	206.84	0.36	9.0	9.0 ~~0.34~~	~~B~~NU	1	ICPST	9/23/2000	18:32	VL
Arsenic	189.04	0.21	1.5	18.4		1	ICPST	9/23/2000	18:32	
~~Barium~~	~~493.41~~	~~0.48~~	~~30.0~~	~~72.4~~		~~1~~	~~ICPST~~	~~9/23/2000~~	~~18:32~~	
Beryllium	313.04	0.030	0.75	2.6		1	ICPST	9/23/2000	18:32	
Cadmium	226.50	0.045	0.75	2.2		1	ICPST	9/23/2000	18:32	
Calcium	317.93	6.2	750	2020		1	ICPST	9/23/2000	18:32	
Chromium	267.76	0.17	0.75	75.8		1	ICPST	9/23/2000	18:32	
Cobalt	228.62	0.15	7.5	13.2		1	ICPST	9/23/2000	18:32	
Copper	324.75	0.24	3.8	31.9		1	ICPST	9/23/2000	18:32	
Iron	217.44	2.7	15.0	67700	N	1	ICPST	9/23/2000	18:32	
Lead	220.35	0.29	0.45	144		1	ICPST	9/23/2000	18:32	
Magnesium	279.08	6.2	750	16200		1	ICPST	9/23/2000	18:32	
Manganese	257.61	0.045	0.75	815	N	1	ICPST	9/23/2000	18:32	
Nickel	231.60	0.29	6.0	35.9		1	ICPST	9/23/2000	18:32	
Potassium	766.49	270	750	861		1	ICP	9/21/2000	10:01	
Selenium	196.03	0.36	0.75	0.75 ~~0.36~~	U	1	ICPST	9/23/2000	18:32	
Silver	328.07	0.21	0.75	0.75 ~~0.21~~	U	1	ICPST	9/23/2000	18:32	
Sodium	589	25.8	750	750 ~~174~~	~~B~~U	1	ICP	9/21/2000	10:01	
Thallium	190.86	0.50	1.5	5.0		1	ICPST	9/23/2000	18:32	
Vanadium	292.40	0.18	7.5	114		1	ICPST	9/23/2000	18:32	
Zinc	213.86	0.12	3.0	598	E	1	ICPST	9/23/2000	18:32	J

Comments: Lot #: F0I130290 Sample #: 29

Version 4.10.4

U Result is less than the IDL

B Result is between IDL and RL

Form 1 Equivalent

Form 1 Copy

STL-ST. LOUIS

Metals Data Reporting Form

Sample Results

Lab Sample ID: DKDTN **Client ID:** MMAU4C

Matrix: Soil **Units:** mg/kg **Prep Date:** 9/19/2000 **Prep Batch:** 0259183

Weight: 0.18 **Volume:** 30 **Percent Moisture:** 33.3

Element	WL/ Mass	IDL	Report Limit	Conc	Q	DF	Instr	Anal Date	Anal Time
Mercury	253.7	0.025	0.050	0.082		1	CVAA	9/19/2000	18:17

Comments: Lot #: F0I130290 Sample #: 29

Version 4.10.4

U Result is less than the IDL
B Result is between IDL and RL

Form I Equivalent

MEMORANDUM

TO: Davida Trumbo

FROM: Kweku Acquah

SUBJECT: Radford Army Ammunition Plant Data Validation – TAL Metals
STL Baltimore, SDG 001139 (T09852)

DATE: November 24, 2000

The purpose of this memorandum is to present the data validation report for the samples collected at the Radford Army Ammunition Plant during the August 29, 2000 sampling event. Samples were analyzed for metals using methods SW-846 7841(GFAA) for Thallium, SW-846 7471A (CVAA) for Mercury, and SW-846 6010B (ICP) for all other metals. A total of fifteen soil samples were validated. The sample IDs are:

Field Sample ID	Field Sample ID
NRUW4A	NRUG1B
NRUW4B	NRUG1C
NRUW4C	NRUL4A
NRUW4CD	NRUL4B
NRUL3A	NRUL4BD
NRUL3B	NRUL4C
NRUL3C	NRUW3A
NRUG1A	

Data were reviewed by Kweku Acquah and validated using a combination of method-specific criteria, laboratory SOP, and the *Innovative Approaches to Data Validation for USEPA Region III* (June 1995.) Parameters were validated at USEPA Region III Level IM2 and are presented in Table 1. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA Region III specifications.

Table 1. Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times
	X	Initial and Continuing Calibration
	X	Blank Analysis
	X	ICP Interference Check Sample (ICS)
X		Matrix Spike/Matrix Spike Duplicate
X		Duplicate Sample Analysis
	X	Laboratory Control Sample (LCS)
X		ICP Serial Dilution
	X	Quantitation Verification

The quality of data collected in support of this sampling activity is considered acceptable with the noted qualifications.

cc: Eric Malarek
Project File

RADFORD ARMY AMMUNITION PLANT
VALIDATION REPORT
TAL METALS REVIEW
SDG 001139 (T09852)

I-Holding Times

Form I, shipping and run logs.

The primary objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis. Holding time criteria: Cool @4 °C ± 2 °C the maximum holding time is 180 days for metals and 28 days for mercury.

- All criteria were met for all the samples. No qualifiers were applied.

II-Initial and Continuing Calibration

Form II

Requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run, and continuing calibration verification documents that the initial calibration is still valid.

ICP:	1- blank	Hg:	1 – blank	AA:	1 - blank
	3 – standards ($r \geq 0.995$)		5 – standards ($r \geq 0.995$)		5 – standards ($r \geq 0.995$)
	%R – 90-110%		%R – 80-120%		%R – 90-110%

- ICP analysis for metals was run on 09/26-27/00. Thallium was analyzed on 09/26/00 with a correlation coefficient of 0.9964. Mercury was analyzed on 09/21/00 with a correlation coefficient of 0.9999. All criteria were met. No qualifiers were applied.

Continuing Calibration for MRL

The instrument calibration near the method reporting limit (MRL) must be verified for each analyte MRL standards are evaluated using the following criteria:

CRI –MRL criteria for ICP:
A CRI must be run at a concentration of 2X MRL, or 2X the MDL, whichever is greater, for each ICP analyte (except Al, Ba, Ca, Fe, Mg, Na and K) at the beginning and end of each sample run or a minimum of twice per 8 hours.

CRA –MRL criteria for GFAA/CVAA:
The linearity of the analytical curve must be verified near the MRL for Graphite Furnace AA (GFAA). A CRA must be run at a concentration equal to the MRL, or the MDL, whichever is greater, at the beginning of each sample run.

The MRL standard recoveries should be between 90-110% of the true values. If the recovery for the CRI or CRA is > 110% and the reported sample result is > MDL or MRL, but < 2X MRL, the result is qualified as biased high, "K" and no qualifiers for non-detects. Table 2 summarizes the MRL standards study.

TABLE 2. MRL STANDARDS STUDY.

Elements	Samples Affected
Antimony (114.8%)	None
Chromium (148.7%)	None
Mercury (1025%)	None

III-Blank Analysis

Form III

Blanks are assessed to determine the existence and magnitude of contamination problems. No contaminant should be detected in the blank > the MRL. Any sample value < five times (5X) the maximum concentration detected in the QC blanks and > the MRL is qualified "B". Soil sample results and action levels were appropriately adjusted for moisture content during the blank analysis study. The associated rinse blank is sample 083000R2.

- There was no contaminant detected in any of the blanks >MRL. No qualifiers were applied.

IV-ICP Interference Check Sample (ICS)

Form IV

The ICP Interference Check Sample (ICS) verifies interelement and background correction factors. ICP Interference Check is performed at the beginning and end of each sample analysis run. Control limits are 80-120%.

- All criteria were met. No qualifiers were applied.

V-Matrix Spike/Matrix Spike Duplicate Analysis

The matrix spike sample analysis provides information about the effect of each sample matrix on the digestion and measurement methodology. Spike recovery (%R) must be within the specified control limits of 75-125%. However, spike recovery limits do not apply when sample concentration exceeds the spike added concentration by a factor of four or more. If the spike recovery is < 75% and the sample results are > MDL, the data for these samples are qualified as biased low, "L". If the spike recovery falls within the range of 30-74% and the sample results are < MRL, the data for these samples are qualified as detection limits biased low, "UL".

- Sample NRUW4A (T09852) was used for the MS/MSD analysis. %R for Aluminum (-577.2%, -597.9%), Iron (-1474.8%, -4757.9%) and Manganese (-2562.5%, -2325.6%) were grossly below the control limits. Since the sample concentrations for these elements exceeded the spike added concentration by a factor of four or more, no qualifiers were applied based on these outliers.

- %R for Antimony (28.2%, 32.4%), Beryllium (73.5%), Chromium (31.1%, 65.0%), Cobalt (57.7%, 57.6%), Lead (61.2%, 68.8%), Magnesium (70.6%, 71.5%) and Vanadium (60.44%) were below the control limits. Positive sample results for these elements were qualified as biased low, "L" and non-detects "UL".

VI-Duplicate Sample Analysis

Duplicate sample determinations are used to demonstrate acceptable method precision by the laboratory at the time of analysis. Duplicate analyses are also performed to generate data in order to determine the long-term precision of the analytical method on various matrices. The relative percent difference (RPD) should be ±20% for sample values > 5X MRL. A control limit of ± 2X MRL is used for sample values < five times MRL

- Sample NRUW4A (T09852) was used for the duplicate analysis. Relative percent difference (RPD) for Chromium (117.9%) and Vanadium (49.7%) were grossly above the control limit of 20%. Positive values for these elements were qualified as estimated, "J" and non-detects "UJ".

VII-Laboratory Control Samples (LCS)

Forms VII, XIII

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation. All LCS results must fall within the specified control limits.

- All criteria were met. No qualifiers were applied.

VIII-ICP Serial Dilution

Forms I, IX

The serial dilution of samples quantitated by ICP determines whether or not significant physical or chemical interferences exist due to sample matrix. If the analyte concentration in the original sample is a factor of 10 above MDL, then an analysis of a 5-fold dilution should agree within 10% difference of the original result.

- Percent difference (%D) for elements Arsenic (15.4%), Beryllium (32.0%), Copper (49.3%) and Cobalt (14.3%) were above the control limit. Positive values for these elements were qualified as estimated, "J" and non-detects had no qualifiers applied.

- Percent difference (%D) for elements Nickel (100.0%), Selenium (170.3%) and Silver (100.0%) were grossly above the control limit. Since the initial sample results for these elements were < a factor of 10 above their corresponding MDLs, no qualifiers were applied based on these outliers.

IX-Quantitation Verification

Raw Data.

The accuracy of analytical results is verified through the calculation of several parameters. The percent Difference (%D) between the calculated and the reported values should be within 10%. The following calculations were performed for verification:

ICP Sample: NRUW4CD (T09855), Aluminum

Conc. mg/kg = (conc. μg/L) * (Final Volume L)/(Weight g* % Solids as a fraction)

Conc. mg/kg = (140070 μg/L)*(0.1 L)/(1.0079 g* 0.753)= 18,455 μg/g = 18,455 mg/kg

Reported concentration = 18,500 mg/kg
%D =0.24%.
Values were within 10% difference

AA Sample : NRUW4CD (T09855), Thallium

Conc. mg/kg = (conc. μg/L) * (Final Volume L)/(Weight g* % Solids as a fraction)

Conc. mg/kg = (1.539 μg/L)*(0.1 L)/(1.0077 g* 0.753) = 0.20 μg/g = 0.20 mg/kg

Reported concentration = 0.20 mg/kg
%D = 0%.
Values were within 10% difference.

IX-Quantitation Verification (Cont.)

CVAA Sample: NRUW4CD (T09855), Hg

Conc. mg/kg = (conc. µg/L) * (Final Volume L)/(Weight g* % Solids as a fraction)

Conc. mg/kg = (0.256 µg/L)*(0.1 L)/(0.2083 g* 0.753) = 0.16 µg/g = 0.16 mg/kg

Reported concentration = 0.16 mg/kg
%D = 0%.
Values were within 10% difference

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EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09852

aboratory: STL BALTIMORE

DG No.: T09852

atrix: SOIL

Client ID: NRUW4A

ercent Solids: 82.4

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~8100~~			~~P~~	
7440-36-0	Antimony	0.73 ~~0.25~~	U	N	P	UL
7440-38-2	Arsenic	3.0		*	P	J
7440-39-3	Barium	75.3			P	
7440-41-7	Beryllium	1.5		N	P	~~K~~ J
7440-43-9	Cadmium	0.61 ~~0.02~~	U		P	
7440-70-2	Calcium	1140			P	
7440-47-3	Chromium	25.7		N*	P	~~K~~ J
7440-48-4	Cobalt	26.3		N	P	~~K~~ J
7440-50-8	Copper	5.1			P	J
7439-89-6	Iron	33700			P	
7439-92-1	Lead	28.8		N	P	L
7439-95-4	Magnesium	1080		N~~*~~	P	L
7439-96-5	Manganese	2040		*	P	
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV	
7440-02-0	Nickel	7.9			P	
7440-09-7	Potassium	587			P	
7782-49-2	Selenium	0.61 ~~0.42~~	~~B~~	V	P	
7440-22-4	Silver	1.2 ~~0.38~~	~~B~~	V	P	
7440-23-5	Sodium	120 ~~84.0~~	~~B~~	V	P	
7440-28-0	Thallium	1.2 ~~0.14~~	U		F	
7440-62-2	Vanadium	48.1		N*	P	~~K~~ J
7440-66-6	Zinc	35.4			P	

Corrections 9/28/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09853

Laboratory: STL BALTIMORE

SDG No.: T09852

Matrix: SOIL

Client ID: NRUW4B

Percent Solids: 81.2

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	14500			P	
7440-36-0	Antimony	0.74 ~~0.30~~	~~B~~	NVN	P	UL
7440-38-2	Arsenic	2.8		*	P	J
7440-39-3	Barium	36.2			P	
7440-41-7	Beryllium	0.78		N	P	KJ
7440-43-9	Cadmium	0.62 ~~0.02~~	U		P	
7440-70-2	Calcium	412			P	
7440-47-3	Chromium	30.3		N*	P	KJ
7440-48-4	Cobalt	6.1		N	P	KJ
7440-50-8	Copper	15.7			P	J
7439-89-6	Iron	35300			P	
7439-92-1	Lead	6.7		N	P	L
7439-95-4	Magnesium	1780		N	P	L
7439-96-5	Manganese	121		*	P	
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV	
7440-02-0	Nickel	17.3			P	
7440-09-7	Potassium	1260			P	
7782-49-2	Selenium	1.2 ~~0.32~~	U		P	
7440-22-4	Silver	1.2 ~~0.20~~	U		P	
7440-23-5	Sodium	120 ~~96.2~~	~~B~~	V	P	
7440-28-0	Thallium	1.2 ~~0.15~~	U		F	
7440-62-2	Vanadium	53.0		N*	P	KJ
7440-66-6	Zinc	27.8			P	

Corrections 9/28/00 JW

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740,
Tl by SW7841, Sb by 7041
"CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER: T09854

Laboratory: STL BALTIMORE

SDG No.: T09852

Matrix: SOIL

Client ID: NRUW4C

Percent Solids: 75.2

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	16700			P	
7440-36-0	Antimony	0.8 ~~0.28~~	U	N	P	UL
7440-38-2	Arsenic	2.2		*	P	J
7440-39-3	Barium	35.4			P	
7440-41-7	Beryllium	1.4		N	P	L J
7440-43-9	Cadmium	0.66 ~~0.03~~	U		P	
7440-70-2	Calcium	149			P	
7440-47-3	Chromium	27.2		N*	P	L J
7440-48-4	Cobalt	7.6		N	P	L J
7440-50-8	Copper	26.3			P	J
7439-89-6	Iron	40600			P	
7439-92-1	Lead	6.8		N	P	L
7439-95-4	Magnesium	7070		N~~*~~	P	L
7439-96-5	Manganese	68.3		*	P	
7439-97-6	Mercury	0.19			CV	
7440-02-0	Nickel	29.2			P	
7440-09-7	Potassium	4630			P	
7782-49-2	Selenium	3.3 ~~0.86~~	U		P	
7440-22-4	Silver	1.3 ~~0.21~~	U		P	
7440-23-5	Sodium	130 ~~103~~	~~B~~	U	P	
7440-28-0	Thallium	1.3 ~~0.16~~	U		F	
7440-62-2	Vanadium	62.8		N*	P	L J
7440-66-6	Zinc	34.2			P	

Corrections 9/28/00 JH

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09855

aboratory: STL BALTIMORE

DG No.: T09852

atrix: SOIL   Client ID: NRUW4CD

ercent Solids: 75.3   Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	18500			P	
7440-36-0	Antimony	0.8 ~~0.28~~	U	N	P	UL
7440-38-2	Arsenic	2.3		*	P	J
7440-39-3	Barium	32.6			P	
7440-41-7	Beryllium	1.4		N	P	~~L~~ J
7440-43-9	Cadmium	0.66 ~~0.03~~	U		P	
7440-70-2	Calcium	243			P	
7440-47-3	Chromium	28.3		N*	P	~~L~~ J
7440-48-4	Cobalt	27.4		N	P	~~L~~ J
7440-50-8	Copper	27.9			P	J
7439-89-6	Iron	42200			P	
7439-92-1	Lead	8.2		N	P	L
7439-95-4	Magnesium	8270		N*	P	L
7439-96-5	Manganese	187		*	P	
7439-97-6	Mercury	0.16			CV	
7440-02-0	Nickel	29.6			P	
7440-09-7	Potassium	5600			P	
7782-49-2	Selenium	3.3 ~~0.86~~	U		P	
7440-22-4	Silver	1.3 ~~0.21~~	U		P	
7440-23-5	Sodium	151			P	
7440-28-0	Thallium	1.3 ~~0.20~~	~~B~~	U	F	
7440-62-2	Vanadium	65.3		N*	P	~~L~~ J
7440-66-6	Zinc	35.8			P	

Correction 9/28/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09856

boratory: STL BALTIMORE

G No.: T09852

.trix: SOIL

Client ID: NRUL3A

:rcent Solids: 83.8

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	16000			P	
7440-36-0	Antimony	0.72 ~~0.31~~	~~B~~	N U	P	UL
7440-38-2	Arsenic	3.7		*	P	J
7440-39-3	Barium	59.4			P	
7440-41-7	Beryllium	0.72		N	P	K J
7440-43-9	Cadmium	0.6 ~~0.02~~	U		P	
7440-70-2	Calcium	918			P	
7440-47-3	Chromium	34.4		N*	P	K J
7440-48-4	Cobalt	16.3		N	P	K J
7440-50-8	Copper	11.6			P	J
7439-89-6	Iron	32000			P	
7439-92-1	Lead	15.3		N	P	L
7439-95-4	Magnesium	7480		N~~*~~	P	L
7439-96-5	Manganese	711		*	P	
7439-97-6	Mercury	0.12 ~~0.06~~	~~B~~	U	CV	
7440-02-0	Nickel	15.3			P	
7440-09-7	Potassium	1530			P	
7782-49-2	Selenium	0.6 ~~0.15~~	U		P	
7440-22-4	Silver	1.2 ~~0.19~~	U		P	
7440-23-5	Sodium	94.5	B		P	
7440-28-0	Thallium	1.2 ~~0.14~~	U		F	
7440-62-2	Vanadium	52.9		N*	P	K J
7440-66-6	Zinc	39.0			P	

Correction 9/28/00

= "P" ICP SW6010
= "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740,
Tl by SW7841, Sb by 7041
= "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09857

aboratory: STL BALTIMORE

DG No.: T09852

atrix: SOIL   Client ID: NRUL3B

ercent Solids: 69.5   Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	24800			P	
7440-36-0	Antimony	0.86 ~~0.30~~	U	N	P	UL
7440-38-2	Arsenic	3.1		*	P	J
7440-39-3	Barium	57.2			P	
7440-41-7	Beryllium	1.2		N	P	~~K~~ J
7440-43-9	Cadmium	0.72 ~~0.03~~	U		P	
7440-70-2	Calcium	527			P	
7440-47-3	Chromium	39.0		N*	P	~~K~~ J
7440-48-4	Cobalt	11.4		N	P	~~K~~ J
7440-50-8	Copper	27.6			P	J
7439-89-6	Iron	41000			P	
7439-92-1	Lead	9.7		N	P	L
7439-95-4	Magnesium	4890		N~~*~~	P	L
7439-96-5	Manganese	305		*	P	
7439-97-6	Mercury	0.19			CV	
7440-02-0	Nickel	27.1			P	
7440-09-7	Potassium	1710			P	
7782-49-2	Selenium	3.6 ~~0.92~~	U		P	
7440-22-4	Silver	1.4 ~~0.23~~	U		P	
7440-23-5	Sodium	140 ~~113~~	~~B~~	V	P	
7440-28-0	Thallium	1.4 ~~0.17~~	~~B~~	V	F	
7440-62-2	Vanadium	63.5		N*	P	
7440-66-6	Zinc	29.4			P	

Correction
JW 9/28/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09858

aboratory: STL BALTIMORE

DG No.: T09852

latrix: SOIL

Client ID: NRUL3C

ercent Solids: 71.2

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	32800			P	
7440-36-0	Antimony	0.84 ~~0.29~~	U	N	P	UL
7440-38-2	Arsenic	3.7		*	P	J
7440-39-3	Barium	63.4			P	
7440-41-7	Beryllium	2.3		N	P	LJ
7440-43-9	Cadmium	0.70 ~~0.03~~	U		P	
7440-70-2	Calcium	532			P	
7440-47-3	Chromium	36.4		N*	P	LJ
7440-48-4	Cobalt	12.5		N	P	LJ
7440-50-8	Copper	23.8			P	J
7439-89-6	Iron	36500			P	
7439-92-1	Lead	8.9		N	P	L
7439-95-4	Magnesium	42800		N~~*~~	P	L
7439-96-5	Manganese	262		*	P	
7439-97-6	Mercury	0.14 ~~0.08~~	~~B~~	U	CV	
7440-02-0	Nickel	31.0			P	
7440-09-7	Potassium	10000			P	
7782-49-2	Selenium	3.5 ~~0.91~~	U		P	
7440-22-4	Silver	1.4 ~~0.22~~	U		P	
7440-23-5	Sodium	140 ~~127~~	~~B~~	U	P	
7440-28-0	Thallium	1.4 ~~0.17~~	U		F	
7440-62-2	Vanadium	60.6		N*	P	LJ
7440-66-6	Zinc	56.5			P	

Corrections 9/28/00 JH

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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EPA SW846

LAB SAMPLE NUMBER

T09861

FORM 1
METALS ANALYSIS DATA SHEET

aboratory: STL BALTIMORE

DG No.: T09852

atrix: SOIL Client ID: NRUG1A

ercent Solids: 87.4 Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	5010			P	
7440-36-0	Antimony	0.69 ~~0.24~~	U	N	P	UL
7440-38-2	Arsenic	2.0		*	P	J
7440-39-3	Barium	26.8			P	
7440-41-7	Beryllium	0.57 ~~0.08~~	~~B~~	N U	P	UL
7440-43-9	Cadmium	0.57 ~~0.02~~	U		P	
7440-70-2	Calcium	534			P	
7440-47-3	Chromium	8.8		N*	P	K J
7440-48-4	Cobalt	5.7 ~~0.73~~	U	N	P	UL
7440-50-8	Copper	1.1 ~~0.64~~	~~B~~	U	P	
7439-89-6	Iron	8790			P	
7439-92-1	Lead	8.9		N	P	L
7439-95-4	Magnesium	261		N~~*~~	P	L
7439-96-5	Manganese	141		*	P	
7439-97-6	Mercury	0.11 ~~0.08~~	~~B~~	U	CV	
7440-02-0	Nickel	4.6 ~~1.5~~	~~B~~	U	P	
7440-09-7	Potassium	191			P	
7782-49-2	Selenium	0.57 ~~0.15~~	U		P	
7440-22-4	Silver	1.1 ~~0.18~~	U		P	
7440-23-5	Sodium	110 ~~87.3~~	~~B~~	U	P	
7440-28-0	Thallium	1.1 ~~0.14~~	U		F	
7440-62-2	Vanadium	15.1		N*	P	K J
7440-66-6	Zinc	7.1			P	

corrections 9/28/00 JH

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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LAB SAMPLE NUMBER

T09862

FORM 1
METALS ANALYSIS DATA SHEET

aboratory: STL BALTIMORE

DG No.: T09852

latrix: SOIL

Client ID: NRUG1B

ercent Solids: 85.4

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	6850			P	
7440-36-0	Antimony	0.70 ~~0.25~~	~~B~~	N U	P	UL
7440-38-2	Arsenic	3.4		*	P	J
7440-39-3	Barium	23 ~~12.5~~	~~B~~	U	P	
7440-41-7	Beryllium	0.59 ~~0.05~~	~~B~~	N U	P	UL
7440-43-9	Cadmium	0.59 ~~0.02~~	U		P	
7440-70-2	Calcium	120 ~~103~~	~~B~~	U	P	
7440-47-3	Chromium	15.5		N*	P	~~L~~ J
7440-48-4	Cobalt	5.9 ~~0.74~~	U	N	P	UL
7440-50-8	Copper	1.6			P	J
7439-89-6	Iron	18900			P	
7439-92-1	Lead	7.5		N	P	L
7439-95-4	Magnesium	139		N~~*~~	P	L
7439-96-5	Manganese	35.8		~~*~~	P	
7439-97-6	Mercury	0.13			CV	
7440-02-0	Nickel	4.7 ~~1.3~~	~~B~~	U	P	
7440-09-7	Potassium	156			P	
7782-49-2	Selenium	0.59 ~~0.15~~	U		P	
7440-22-4	Silver	1.2 ~~0.12~~	U		P	
7440-23-5	Sodium	120 ~~90.9~~	~~B~~	U	P	
7440-28-0	Thallium	1.2 ~~0.14~~	U		F	
7440-62-2	Vanadium	29.7		N*	P	~~L~~ J
7440-66-6	Zinc	4.7			P	

corrections 9/28/00 JW

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I. copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER: T09863

aboratory: STL BALTIMORE

DG No.: T09852

atrix: SOIL

Client ID: NRUG1C

ercent Solids: 87.3

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	6280			P	
7440-36-0	Antimony	0.69 ~~0.24~~	U	N	P	UL
7440-38-2	Arsenic	5.1		*	P	J
7440-39-3	Barium	23 ~~11.7~~	~~B~~	U	P	
7440-41-7	Beryllium	0.57 ~~0.03~~	U	N	P	UL
7440-43-9	Cadmium	0.57 ~~0.02~~	U		P	
7440-70-2	Calcium	110 ~~17.1~~	~~B~~	U	P	
7440-47-3	Chromium	14.2		N*	P	~~L~~ J
7440-48-4	Cobalt	5.7 ~~0.73~~	U	N	P	UL
7440-50-8	Copper	1.6			P	J
7439-89-6	Iron	24300			P	
7439-92-1	Lead	7.4		N	P	
7439-95-4	Magnesium	110 ~~94.4~~	~~B~~	~~N~~ U	P	UL
7439-96-5	Manganese	16.7		*	P	
7439-97-6	Mercury	0.11			CV	
7440-02-0	Nickel	4.6 ~~1.4~~	~~B~~	U	P	
7440-09-7	Potassium	123			P	
7782-49-2	Selenium	0.57 ~~0.15~~	U		P	
7440-22-4	Silver	1.1 ~~0.28~~	~~B~~	U	P	
7440-23-5	Sodium	110 ~~90.1~~	~~B~~	U	P	
7440-28-0	Thallium	1.1 ~~0.14~~	U		F	
7440-62-2	Vanadium	31.5		N*	P	~~L~~ J
7440-66-6	Zinc	6.0			P	

correction 9/28/00

M = "P" ICP SW6010

M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041

M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

LAB SAMPLE NUMBER

T09864

FORM 1
METALS ANALYSIS DATA SHEET

aboratory: STL BALTIMORE

DG No.: T09852

latrix: SOIL

Client ID: NRUL4A

ercent Solids: 87.2

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	6750			P	
7440-36-0	Antimony	0.69 ~~0.24~~	~~B~~	N U	P	UL
7440-38-2	Arsenic	9.3		*	P	J
7440-39-3	Barium	109			P	
7440-41-7	Beryllium	1.0		N	P	K J
7440-43-9	Cadmium	0.57 ~~0.02~~	U		P	
7440-70-2	Calcium	1310			P	
7440-47-3	Chromium	31.2		N*	P	K J
7440-48-4	Cobalt	21.8		N	P	K J
7440-50-8	Copper	5.1			P	J
7439-89-6	Iron	24300			P	
7439-92-1	Lead	76.7		N	P	L
7439-95-4	Magnesium	420		N*	P	L
7439-96-5	Manganese	1710		*	P	
7439-97-6	Mercury	0.13			CV	
7440-02-0	Nickel	7.0			P	
7440-09-7	Potassium	581			P	
7782-49-2	Selenium	0.57 ~~0.49~~	~~B~~	U	P	
7440-22-4	Silver	1.1 ~~0.18~~	U		P	
7440-23-5	Sodium	110 ~~95.4~~	~~B~~	U	P	
7440-28-0	Thallium	1.1 ~~0.14~~	U	W	P	
7440-62-2	Vanadium	38.7		N*	P	K J
7440-66-6	Zinc	55.1			P	

correction 9/28/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740,
Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09865

aboratory: STL BALTIMORE

DG No.: T09852

atrix: SOIL

Client ID: NRUL4B

ercent Solids: 89.3

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~6580~~			~~P~~	
7440-36-0	Antimony	0.67 ~~0.23~~	U	N	P	UL
7440-38-2	Arsenic	5.7		*	P	J
7440-39-3	Barium	38.7			P	
7440-41-7	Beryllium	0.56 ~~0.38~~	~~B~~	N U	P	UL
7440-43-9	Cadmium	0.56 ~~0.02~~	U		P	
7440-70-2	Calcium	520			P	
7440-47-3	Chromium	25.1		N*	P	kJ
7440-48-4	Cobalt	18.5		N	P	kJ
7440-50-8	Copper	1.6			P	J
7439-89-6	Iron	21300			P	
7439-92-1	Lead	16.6		~~N~~	P	L
7439-95-4	Magnesium	295		~~N*~~	P	L
7439-96-5	Manganese	735		~~*~~	P	
7439-97-6	Mercury	0.11 0.08	~~B~~	U	CV	
7440-02-0	Nickel	4.5 ~~4.2~~	~~B~~	U	P	
7440-09-7	Potassium	418			P	
7782-49-2	Selenium	0.56 ~~0.14~~	U		P	
7440-22-4	Silver	1.1 ~~0.18~~	U		P	
7440-23-5	Sodium	110 ~~90.2~~	~~B~~	U	P	
7440-28-0	Thallium	1.1 ~~0.13~~	U		F	
7440-62-2	Vanadium	34.1		N*	P	kJ
7440-66-6	Zinc	9.0			P	

Corrections 9/28/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09866

aboratory: STL BALTIMORE

DG No.: T09852

latrix: SOIL

Client ID: NRUL4BD

ercent Solids: 89.4

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~7380~~			P	
7440-36-0	Antimony	0.67 ~~0.33~~	~~B~~	N U	P	UL
7440-38-2	Arsenic	7.1		*	P	J
7440-39-3	Barium	39.2			P	
7440-41-7	Beryllium	0.56 ~~0.42~~	~~B~~	N U	P	UL
7440-43-9	Cadmium	0.56 ~~0.02~~	U		P	
7440-70-2	Calcium	517			P	
7440-47-3	Chromium	35.5		N*	P	~~L~~ J
7440-48-4	Cobalt	19.3		N	P	~~L~~ J
7440-50-8	Copper	1.2			P	J
7439-89-6	Iron	29800			P	
7439-92-1	Lead	17.7		N	P	L
7439-95-4	Magnesium	374		N*	P	L
7439-96-5	Manganese	717		*	P	
7439-97-6	Mercury	0.11 ~~0.05~~	~~B~~	U	CV	
7440-02-0	Nickel	4.8			P	
7440-09-7	Potassium	468			P	
7782-49-2	Selenium	0.56 ~~0.15~~	U		P	
7440-22-4	Silver	1.1 ~~0.25~~	~~B~~	U	P	
7440-23-5	Sodium	110 ~~83.4~~	~~B~~	U	P	
7440-28-0	Thallium	1.1 ~~0.13~~	U		F	
7440-62-2	Vanadium	47.3		N*	P	~~L~~ J
7440-66-6	Zinc	10.6			P	

Correction 9/28/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09867

aboratory: STL BALTIMORE

DG No.: T09852

atrix: SOIL

Client ID: NRUL4C

ercent Solids: 85.2

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~12100~~			~~P~~	
7440-36-0	Antimony	0.70 ~~0.25~~	U	N	P	UL
7440-38-2	Arsenic	4.2		*	P	J
7440-39-3	Barium	42.7			P	
7440-41-7	Beryllium	1.6		N	P	tJ
7440-43-9	Cadmium	0.59 ~~0.02~~	U		P	
7440-70-2	Calcium	744			P	
7440-47-3	Chromium	30.9		N*	P	tJ
7440-48-4	Cobalt	20.0		N	P	tJ
7440-50-8	Copper	11.1			P	J
7439-89-6	Iron	29200			P	
7439-92-1	Lead	13.4		N	P	L
7439-95-4	Magnesium	712		N*	P	L
7439-96-5	Manganese	501		*	P	
7439-97-6	Mercury	0.12 ~~0.09~~	~~B~~	U	CV	
7440-02-0	Nickel	13.2			P	
7440-09-7	Potassium	624			P	
7782-49-2	Selenium	2.9 ~~0.76~~	U		P	
7440-22-4	Silver	1.2 ~~0.19~~	U		P	
7440-23-5	Sodium	120 ~~93.3~~	~~B~~	U	P	
7440-28-0	Thallium	1.2 ~~0.14~~	U	W	F	
7440-62-2	Vanadium	41.4		N*	P	tJ
7440-66-6	Zinc	17.8			P	

corrections 9/28/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740,
Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09868

oratory: STL BALTIMORE

No.: T09852

rix: SOIL   Client ID: NRUW3A

rcent Solids: 85.2   Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~3620~~			P	
7440-36-0	Antimony	0.70 ~~0.25~~	~~B~~	N U	P	UL
7440-38-2	Arsenic	2.3		*	P	J
7440-39-3	Barium	23 ~~22.6~~	~~B~~	U	P	
7440-41-7	Beryllium	0.59 ~~0.12~~	~~B~~	N U	P	UL
7440-43-9	Cadmium	0.59 ~~0.02~~	U		P	
7440-70-2	Calcium	426			P	
7440-47-3	Chromium	6.3		N*	P	~~L~~J
7440-48-4	Cobalt	5.9 ~~2.3~~	~~B~~	N U	P	UL
7440-50-8	Copper	3.3			P	J
7439-89-6	Iron	7470			P	
7439-92-1	Lead	10.3		N	P	L
7439-95-4	Magnesium	363		N~~*~~	P	L
7439-96-5	Manganese	91.7		~~*~~	P	
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV	
7440-02-0	Nickel	4.7 ~~2.7~~	~~B~~	U	P	
7440-09-7	Potassium	366			P	
7782-49-2	Selenium	0.59 ~~0.15~~	U		P	
7440-22-4	Silver	1.2 ~~0.19~~	U		P	
7440-23-5	Sodium	120 ~~92.1~~	~~B~~	U	P	
7440-28-0	Thallium	1.2 ~~0.14~~	U		F	
7440-62-2	Vanadium	12.2		N*	P	~~L~~J
7440-66-6	Zinc	14.9			P	

Corrections 9/28/00 JW

= "P" ICP SW6010
= "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
= "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

MEMORANDUM

TO: Davida Trumbo

FROM: Kweku Acquah

SUBJECT: Radford Army Ammunition Plant Data Validation – TAL Metals
STL Baltimore, SDG 001139 (T09869)

DATE: November 25, 2000

The purpose of this memorandum is to present the data validation report for the samples collected at the Radford Army Ammunition Plant during the August 29, 2000 sampling event. Samples were analyzed for metals using methods SW-846 7841(GFAA) for Thallium, SW-846 7471A (CVAA) for Mercury, and SW-846 6010B (ICP) for all other metals. A total of ten soil samples were validated. The sample IDs are:

Field Sample ID	Field Sample ID
NRUW3B	NRUC3A
NRUW3C	NRUC3B
NRUC4A	NRUG4A
NRUC4B	NRUG4B
NRUC4C	NRUG4C

Data were reviewed by Kweku Acquah and validated using a combination of method-specific criteria, laboratory SOP, and the *Innovative Approaches to Data Validation for USEPA Region III* (June 1995.) Parameters were validated at USEPA Region III Level IM2 and are presented in Table 1. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA Region III specifications.

Table 1. Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times
X		Initial and Continuing Calibration
X		Blank Analysis
	X	ICP Interference Check Sample
X		Matrix Spike/Matrix Spike Duplicate
X		Duplicate Sample Analysis
	X	Laboratory Control Sample
X		ICP Serial Dilution
	X	Quantitation Verification

All of the data collected in support of this sampling activity is acceptable with the noted qualifications, except for antimony non-detects. Antimony non-detects were rejected due to extremely low spike recoveries in accordance with USEPA Region III guidance.

cc: Eric Malarek
Project File

RADFORD ARMY AMMUNITION PLANT

VALIDATION REPORT
TAL METALS REVIEW
SDG 001139 (TO9869)

I-Holding Times

Form I, shipping and run logs.

The primary objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis. Holding time criteria: Cool @4 °C ± 2 °C, the maximum holding time is 180 days for metals and 28 days for mercury.

- All criteria were met for all the samples. No qualifiers were applied.

II-Initial and Continuing Calibration

Form II

Requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run, and continuing calibration verification documents that the initial calibration is still valid.

ICP:	1- blank	Hg:	1 – blank	AA:	1 - blank
	3 – standards ($r \geq 0.995$)		5 – standards ($r \geq 0.995$)		5 – standards ($r \geq 0.995$)
	%R – 90-110%		%R – 80-120%		%R – 90-110%

- ICP analysis for metals was run on 09/26-27/00. Thallium was analyzed on 09/26/00 with a correlation coefficient of 0.9964. Mercury was analyzed on 09/21/00 with a correlation coefficient of 0.9999. All criteria were met. No qualifiers were applied.

Continuing Calibration for MRL

The instrument calibration near the method reporting limit (MRL) must be verified for each analyte MRL standards are evaluated using the following criteria:

CRI –MRL criteria for ICP:

A CRI must be run at a concentration of 2X MRL, or 2X the MDL, whichever is greater, for each ICP analyte (except Al, Ba, Ca, Fe, Mg, Na and K) at the beginning and end of each sample run or a minimum of twice per 8 hours.

The MRL standard recoveries should be between 90-110% of the true values. If the recovery for the CRI is > 110% and the reported sample result is > MDL or >MRL, but < 2X MRL, the result is qualified as biased high "K" and no qualifiers for non-detects. If the recovery for the CRI is between 50-89%, results > MDL or > MRL, but < 2X MRL are qualified as biased low, "L" and result < MDL or <MRL are qualified "UL". If the recovery for an element is < 50%, sample results > MDL or > MRL, but < 2X MRL are qualified as biased extremely low, "L" and results < MDL or < MRL are qualified as unusable, "R". Table 2 summarizes the MRL standards study.

TABLE 2. MRL STANDARDS STUDY.

Elements	Samples Affected
Antimony (114.8%)	None
Chromium (286.6%)	None
Cobalt (86.6%)	NRUW3B, NRUC4A, NRUC4B, NRUC4C, NRUC3A, NRUC3B, NRUG4A, NRUG4B
Copper (86.8%)	None
Manganese (49.3%)	None
Selenium (82.0, 70.0%)	All Samples

III-Blank Analysis

Form III

Blanks are assessed to determine the existence and magnitude of contamination problems. No contaminant should be detected in the blank > the MRL. Any sample value < five times (5X) the maximum concentration detected in the QC blanks and > the MRL is qualified "B". Table 3 summarizes the blank analysis study. Soil action levels cited are unadjusted for moisture content. Sample results and action levels are appropriately adjusted for moisture content during the blank analysis study. The associated rinse blanks are sample numbers 083000R2 and 083000R3.

Table 3. Blank Contamination Summary.

Element	Blank Source	Max. Equivalent Conc. mg/kg	5X Max Equivalent Conc. mg/kg	Affected Qualified B Samples
Arsenic	083000R3	1.05	5.25	NRUG4A, NRUG4B

IV-ICP Interference Check Sample (ICS)

Form IV

The ICP Interference Check Sample (ICS) verifies interelement and background correction factors. ICP Interference Check is performed at the beginning and end of each sample analysis run. Control limits are 80-120%.

- All criteria were met. No qualifiers were applied.

V-Matrix Spike/Matrix Spike Duplicate

The matrix spike sample analysis provides information about the effect of each sample matrix on the digestion and measurement methodology. Spike recovery (%R) must be within the specified control limits of 75-125%. However, spike recovery limits do not apply when sample concentration exceeds the spike concentration by a factor of four or more. If the spike recovery is < 75% and the sample results are > MRL, the data for these samples are qualified as biased low, "L". If the spike recovery falls within the range of 30-74% and the sample results are < MRL, the data for these samples are qualified as detection limits biased low, "UL". If spike recovery results fall < 30% and the sample results are < MRL, data for these samples are qualified as unusable, "R" and results > MRL are qualified as biased extremely low, "L".

- Sample NRUW3B (T09869) was used for the MS/MSD analysis. MS/MSD %R for Aluminum (283.4%, 720%) and Iron (-398.5%, 2415.3%) were grossly outside the control criteria. Since sample concentration for these elements exceeded the spike added concentration by a factor of four or more, no qualifiers were applied based on these outliers.

- %R for Arsenic (72.0%) and Selenium (59.0%, 61.7%) were below the control limits. Positive values for these elements were qualified as biased low, "L" and non-detects "UL".

- %R for Antimony (25.0%, 24.7%) was < 30%. Positive sample values for this element were qualified as biased extremely low, "L" and non-detects as unusable, "R".

VI-Duplicate Sample Analysis

Duplicate sample determinations are used to demonstrate acceptable method precision by the laboratory at the time of analysis. Duplicate analyses are also performed to generate data in order to determine the long-term precision of the analytical method on various matrices. The relative percent difference (RPD) should be ±20%.

- Sample NRUW3B (T09869) was used for the duplicate analysis. Relative percent difference (RPD) for Aluminum (29.5%), Beryllium (37.7%), Chromium (37.3%), Copper (44.6%), Iron (42.5%), Magnesium (39.1%), Potassium (28.5%), Vanadium (37.1%), and Zinc (43.1%) were above the control limit. Positive values for these elements were qualified as estimated, "J" and non-detects "UJ".

VII-Laboratory Control Samples (LCS)

Forms VII, XIII

The laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation. All LCS results must fall within the specified control limits.

- All criteria were met. No qualifiers were applied.

VIII-ICP Serial Dilution

Forms I, IX

The serial dilution of samples quantitated by ICP determines whether or not significant physical or chemical interferences exist due to sample matrix. If the analyte concentration in the original sample is a factor of 10 above MDL, then an analysis of a 5-fold dilution should agree within 10% difference of the original result.

- Percent difference (%D) for elements Arsenic (40.0%), Barium (10.7%) and Copper (39.2%) were either above or grossly above the control limit. Positive values for these elements were qualified as estimated, "J".

- Percent difference (%D) for elements Beryllium (46.4%), Cobalt (100.0%) and Nickel (100.0%) were also grossly above the control limit. Since the initial sample results for these elements were < a factor of 10 above their corresponding MDLs, no qualifiers were applied based on these outliers.

IX-Quantitation Verification

Raw Data.

The accuracy of analytical results is verified through the calculation of several parameters. The percent Difference (%D) between the calculated and the reported values should be within 10%. The following calculations were performed for verification:

ICP Sample: NRUW3C (T09870), Iron

Conc. mg/kg = (conc. µg/L) * (Final Volume L) / (Weight g * % Solids as a fraction)

Conc. mg/kg = (139330 µg/L) * (0.1 L) / (1.0059 g* 0.82) = 16,891 µg/g = 16,891 mg/kg

Reported concentration = 18,500 mg/kg
%D = 8.70%.
Values were within 10% difference

IX-Quantitation Verification (Cont.)

AA Sample: NRUW3C (T09870), Thallium

Conc. mg/kg = (conc. µg/L) * (Final Volume L) / (Weight g * % Solids as a fraction)

Conc. mg/kg = (1.433 µg/L) * (0.1 L) / (1.0059 g * 0.82) = 0.17 µg/g = 0.17 mg/kg

Reported concentration = 0.18 mg/kg
%D = 5.56%.
Values were within 10% difference.

CVAA Sample: NRUW3B (T09869), Hg

Conc. mg/kg = (conc. µg/L) * (Final Volume L) / (Weight g* % Solids as a fraction)

Conc. mg/kg = (0.108 µg/L) * (0.1 L) / (0.2084 g * 0.815) = 0.06 µg/g = 0.06 mg/kg

Reported concentration = 0.06 mg/kg
%D = 0%.
Values were within 10% difference

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EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09869

aboratory: STL BALTIMORE

DG No.: T09869

atrix: SOIL

Client ID: NRUW3B

ercent Solids: 81.5

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10800		~~*~~	P
7440-36-0	Antimony	0.74 ~~0.26~~	U	N	P
7440-38-2	Arsenic	3.0		N*	P
7440-39-3	Barium	28.5			P
7440-41-7	Beryllium	0.61 ~~0.34~~	~~B~~	V	P
7440-43-9	Cadmium	0.61 ~~0.02~~	U		P
7440-70-2	Calcium	330			P
7440-47-3	Chromium	14.4		*	P
7440-48-4	Cobalt	6.1 ~~4.5~~	~~B~~	V	P
7440-50-8	Copper	9.0		*	P
7439-89-6	Iron	17300		*	P
7439-92-1	Lead	8.4			P
7439-95-4	Magnesium	860		*	P
7439-96-5	Manganese	33.2			P
7439-97-6	Mercury	0.12 ~~0.06~~	~~B~~	V	CV
7440-02-0	Nickel	7.0			P
7440-09-7	Potassium	676		~~*~~	P
7782-49-2	Selenium	0.61 ~~0.16~~	U	N	P
7440-22-4	Silver	1.2 ~~0.20~~	U		P
7440-23-5	Sodium	120 ~~93.7~~	~~B~~	V	P
7440-28-0	Thallium	1.2 ~~0.18~~	U		F
7440-62-2	Vanadium	29.1		*	P
7440-66-6	Zinc	11.8		*	P

Corrections 9/29/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09870

aboratory: STL BALTIMORE

DG No.: T09869

atrix: SOIL Client ID: NRUW3C

ercent Solids: 82.0 Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10200		~~*~~	P
7440-36-0	Antimony	0.73 ~~0.25~~	U	N	P
7440-38-2	Arsenic	10.7		N*	P
7440-39-3	Barium	46.6			P
7440-41-7	Beryllium	5.4			P
7440-43-9	Cadmium	0.61 ~~0.02~~	U		P
7440-70-2	Calcium	709			P
7440-47-3	Chromium	26.0		*	P
7440-48-4	Cobalt	130			P
7440-50-8	Copper	12.3		*	P
7439-89-6	Iron	18500		*	P
7439-92-1	Lead	12.6			P
7439-95-4	Magnesium	10600		*	P
7439-96-5	Manganese	419			P
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV
7440-02-0	Nickel	51.1			P
7440-09-7	Potassium	1870		~~*~~	P
7782-49-2	Selenium	0.61 ~~0.16~~	U	N	P
7440-22-4	Silver	1.2 ~~0.18~~	U		P
7440-23-5	Sodium	120 ~~95.9~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.18~~	U	W	F
7440-62-2	Vanadium	32.3		*	P
7440-66-6	Zinc	33.7		*	P

Corrections 9/29/00 JW

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
"CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER: T09871

aboratory: STL BALTIMORE

DG No.: T09869

atrix: SOIL

Client ID: NRUC4A

ercent Solids: 85.9

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	5650		~~*~~	P
7440-36-0	Antimony	0.70 ~~0.34~~	~~B~~	NU	P
7440-38-2	Arsenic	6.1		N*	P
7440-39-3	Barium	23 ~~20.8~~	~~B~~	U	P
7440-41-7	Beryllium	0.58 ~~0.28~~	~~B~~	U	P
7440-43-9	Cadmium	0.58 ~~0.02~~	U		P
7440-70-2	Calcium	120 ~~104~~	~~B~~	U	P
7440-47-3	Chromium	22.3		*	P
7440-48-4	Cobalt	5.8 ~~5.5~~	~~B~~	U	P
7440-50-8	Copper	2.9		*	P
7439-89-6	Iron	20400		*	P
7439-92-1	Lead	13.0			P
7439-95-4	Magnesium	259		*	P
7439-96-5	Manganese	186			P
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV
7440-02-0	Nickel	4.7 ~~3.5~~	~~B~~	U	P
7440-09-7	Potassium	291		~~*~~	P
7782-49-2	Selenium	0.58 ~~0.15~~	U	N	P
7440-22-4	Silver	1.2 ~~0.19~~	U		P
7440-23-5	Sodium	120 ~~92.6~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.17~~	U		F
7440-62-2	Vanadium	26.6		*	P
7440-66-6	Zinc	10.9		*	P

Corrections 9/29/00 JW

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER: T09872

aboratory: STL BALTIMORE

G No.: T09869

atrix: SOIL

Client ID: NRUC4B

ercent Solids: 82.5

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10000		~~*~~	P
7440-36-0	Antimony	0.73 ~~0.37~~	~~B~~	N U	P
7440-38-2	Arsenic	2.6		N*	P
7440-39-3	Barium	24 ~~21.0~~	~~B~~	U	P
7440-41-7	Beryllium	0.61 ~~0.15~~	~~B~~	U	P
7440-43-9	Cadmium	0.61 ~~0.02~~	U		P
7440-70-2	Calcium	244			P
7440-47-3	Chromium	14.5		*	P
7440-48-4	Cobalt	6.1 ~~2.0~~	~~B~~	U	P
7440-50-8	Copper	5.9		*	P
7439-89-6	Iron	17300		*	P
7439-92-1	Lead	6.6			P
7439-95-4	Magnesium	279		*	P
7439-96-5	Manganese	33.0			P
7439-97-6	Mercury	0.12			CV
7440-02-0	Nickel	4.8 ~~4.5~~	~~B~~	U	P
7440-09-7	Potassium	402		~~*~~	P
7782-49-2	Selenium	0.61 ~~0.16~~	U	N	P
7440-22-4	Silver	1.2 ~~0.19~~	U		P
7440-23-5	Sodium	120 ~~92.2~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.18~~	U		F
7440-62-2	Vanadium	22.0		*	P
7440-66-6	Zinc	7.4		*	P

Corrections 9/29/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09873

aboratory: STL BALTIMORE

DG No.: T09869

latrix: SOIL

Client ID: NRUC4C

ercent Solids: 78.5

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	12200		~~*~~	P
7440-36-0	Antimony	0.76 ~~0.27~~	U	N	P
7440-38-2	Arsenic	3.9		N*	P
7440-39-3	Barium	24 ~~23.4~~	~~B~~	U	P
7440-41-7	Beryllium	0.64 ~~0.28~~	~~B~~	U	P
7440-43-9	Cadmium	0.64 ~~0.03~~	U		P
7440-70-2	Calcium	140			P
7440-47-3	Chromium	19.2		*	P
7440-48-4	Cobalt	6.4 ~~2.5~~	~~B~~	U	P
7440-50-8	Copper	9.7		*	P
7439-89-6	Iron	25200		*	P
7439-92-1	Lead	8.0			P
7439-95-4	Magnesium	326		*	P
7439-96-5	Manganese	36.4			P
7439-97-6	Mercury	0.13 ~~0.11~~	~~B~~	U	CV
7440-02-0	Nickel	7.8			P
7440-09-7	Potassium	473		~~*~~	P
7782-49-2	Selenium	0.64 ~~0.17~~	U	N	P
7440-22-4	Silver	1.3 ~~0.20~~	U		P
7440-23-5	Sodium	130 ~~98.6~~	~~B~~	U	P
7440-28-0	Thallium	1.3 ~~0.19~~	U		F
7440-62-2	Vanadium	34.3		*	P
7440-66-6	Zinc	9.8		*	P

Carruthers 9/29/00 JW

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09874

boratory: STL BALTIMORE

G No.: T09869

atrix: SOIL Client ID: NRUC3A

ercent Solids: 82.0 Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	20100		~~*~~	P
7440-36-0	Antimony	0.73 ~~0.36~~	~~B~~	NU	P
7440-38-2	Arsenic	1.6		N*	P
7440-39-3	Barium	56.7			P
7440-41-7	Beryllium	0.87			P
7440-43-9	Cadmium	0.61 ~~0.02~~	U		P
7440-70-2	Calcium	1810			P
7440-47-3	Chromium	32.2		*	P
7440-48-4	Cobalt	11.4			P
7440-50-8	Copper	9.0		*	P
7439-89-6	Iron	31900		*	P
7439-92-1	Lead	11.5			P
7439-95-4	Magnesium	20400		*	P
7439-96-5	Manganese	498			P
7439-97-6	Mercury	0.12 ~~0.07~~	~~B~~	U	CV
7440-02-0	Nickel	18.1			P
7440-09-7	Potassium	2350		~~*~~	P
7782-49-2	Selenium	0.61 ~~0.32~~	U	N	P
7440-22-4	Silver	1.2 ~~0.19~~	U		P
7440-23-5	Sodium	120 ~~95.9~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.18~~	U		F
7440-62-2	Vanadium	42.5		*	P
7440-66-6	Zinc	56.3		*	P

Corrections 9/29/00 JW

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740,
Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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EPA SW846

LAB SAMPLE NUMBER

T09875

FORM 1
METALS ANALYSIS DATA SHEET

aboratory: STL BALTIMORE

DG No.: T09869

atrix: SOIL

Client ID: NRUC3B

ercent Solids: 82.7

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	21100		~~*~~	P
7440-36-0	Antimony	0.73 ~~0.36~~	~~B~~	N U	P
7440-38-2	Arsenic	1.2		N*	P
7440-39-3	Barium	45.5			P
7440-41-7	Beryllium	0.91			P
7440-43-9	Cadmium	0.61 ~~0.02~~	U		P
7440-70-2	Calcium	25700			P
7440-47-3	Chromium	31.2		*	P
7440-48-4	Cobalt	10.3			P
7440-50-8	Copper	11.8		*	P
7439-89-6	Iron	28400		*	P
7439-92-1	Lead	3.5			P
7439-95-4	Magnesium	48100		*	P
7439-96-5	Manganese	308			P
7439-97-6	Mercury	0.12 ~~0.07~~	~~B~~	U	CV
7440-02-0	Nickel	21.5			P
7440-09-7	Potassium	5390		~~*~~	P
7782-49-2	Selenium	3.1 ~~0.79~~	U	N	P
7440-22-4	Silver	1.2 ~~0.19~~	U		P
7440-23-5	Sodium	148			P
7440-28-0	Thallium	1.2 ~~0.29~~	~~B~~	W U	F
7440-62-2	Vanadium	38.3		*	P
7440-66-6	Zinc	40.8		*	P

Correction 9/29/00 JW

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09877

boratory: STL BALTIMORE

G No.: T09869

itrix: SOIL

Client ID: NRUG4A

ercent Solids: 86.4

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	3770		~~*~~	P
7440-36-0	Antimony	0.69 ~~0.24~~	U	N	P
7440-38-2	Arsenic	2.8		N*	P
7440-39-3	Barium	23.4			P
7440-41-7	Beryllium	0.58 ~~0.09~~	~~B~~	U	P
7440-43-9	Cadmium	0.58 ~~0.02~~	U		P
7440-70-2	Calcium	825			P
7440-47-3	Chromium	9.8		*	P
7440-48-4	Cobalt	5.9			P
7440-50-8	Copper	3.9		*	P
7439-89-6	Iron	9490		*	P
7439-92-1	Lead	23.6			P
7439-95-4	Magnesium	311		*	P
7439-96-5	Manganese	306			P
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV
7440-02-0	Nickel	4.6 ~~1.9~~	~~B~~	U	P
7440-09-7	Potassium	220		~~*~~	P
7782-49-2	Selenium	0.58 ~~0.15~~	U	N	P
7440-22-4	Silver	1.2 ~~0.18~~	U		P
7440-23-5	Sodium	120 ~~90.6~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.17~~	~~B~~	U	F
7440-62-2	Vanadium	15.0		*	P
7440-66-6	Zinc	24.6		*	P

Corrections 9/29/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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EPA SW846

LAB SAMPLE NUMBER

T09878

FORM 1
METALS ANALYSIS DATA SHEET

oratory: STL BALTIMORE

No.: T09869

rix: SOIL

Client ID: NRUG4B

rcent Solids: 84.1

Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	6130		~~*~~	P
7440-36-0	Antimony	0.71 ~~0.25~~	U	N	P
7440-38-2	Arsenic	3.2		N*	P
7440-39-3	Barium	24 ~~10.7~~	~~B~~	U	P
7440-41-7	Beryllium	0.59 ~~0.06~~	~~B~~	U	P
7440-43-9	Cadmium	0.59 ~~0.02~~	U		P
7440-70-2	Calcium	622			P
7440-47-3	Chromium	13.6		*	P
7440-48-4	Cobalt	5.9 ~~3.4~~	~~B~~	U	P
7440-50-8	Copper	4.0		*	P
7439-89-6	Iron	17400		*	P
7439-92-1	Lead	13.8			P
7439-95-4	Magnesium	333		*	P
7439-96-5	Manganese	69.0			P
7439-97-6	Mercury	0.12 ~~0.07~~	~~B~~	U	CV
7440-02-0	Nickel	4.8 ~~2.0~~	~~B~~	U	P
7440-09-7	Potassium	207		~~*~~	P
7782-49-2	Selenium	0.59 ~~0.15~~	U	N	P
7440-22-4	Silver	1.2 ~~0.19~~	U		P
7440-23-5	Sodium	120 ~~91.9~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.18~~	U		F
7440-62-2	Vanadium	26.5		*	P
7440-66-6	Zinc	10.0		*	P

Corrected 9/29/00 JW

= "P" ICP SW6010

= "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041

= "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09879

boratory: STL BALTIMORE

G No.: T09869

atrix: SOIL Client ID: NRUG4C

ercent Solids: 83.7 Date Received: 08/31/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	7420		~~*~~	P
7440-36-0	Antimony	0.72 ~~0.36~~	~~B~~	N U	P
7440-38-2	Arsenic	7.4		N*	P
7440-39-3	Barium	24 ~~11.4~~	~~B~~	U	P
7440-41-7	Beryllium	0.60 ~~0.12~~	~~B~~	U	P
7440-43-9	Cadmium	0.60 ~~0.02~~	U		P
7440-70-2	Calcium	227			P
7440-47-3	Chromium	23.7		*	P
7440-48-4	Cobalt	23.9			P
7440-50-8	Copper	6.1		*	P
7439-89-6	Iron	38100		*	P
7439-92-1	Lead	35.5			P
7439-95-4	Magnesium	227		*	P
7439-96-5	Manganese	664			P
7439-97-6	Mercury	0.14			CV
7440-02-0	Nickel	6.6			P
7440-09-7	Potassium	211		~~*~~	P
7782-49-2	Selenium	0.60 ~~0.31~~	U	N	P
7440-22-4	Silver	1.2 ~~0.29~~	~~B~~	U	P
7440-23-5	Sodium	120 ~~89.5~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.18~~	~~B~~	U	F
7440-62-2	Vanadium	40.9		*	P
7440-66-6	Zinc	14.4		*	P

Corrections 9/29/00 JH

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

MEMORANDUM

TO: Davida Trumbo

FROM: Kweku Acquah

SUBJECT: Radford Army Ammunition Plant Data Validation – TAL Metals
STL Baltimore, SDG 001145 (T09934)

DATE: November 24, 2000

The purpose of this memorandum is to present the data validation report for the samples collected at the Radford Army Ammunition Plant during the August 29-30, 2000 sampling events. Samples were analyzed for metals using methods SW-846 7841(GFAA) for Thallium, SW-846 7471A (CVAA) for Mercury, and SW-846 6010B (ICP) for all other metals. A total of sixteen soil samples were validated. The sample IDs are:

Field Sample ID	Field Sample ID
NRUC1A	NRUC2A
NRUC1B	NRUC2B
NRUL1C	NRUG3B
NRUL1A	NRUW1B
NRUL1B	NRUW1C
NRUW1A	NRUG3C
NRUG2B	NRUG2C
NRUG2A	NRUW2A

Data were reviewed by Kweku Acquah and validated using a combination of method-specific criteria, laboratory SOP, and the *Innovative Approaches to Data Validation for USEPA Region III* (June 1995.) Parameters evaluated under data validation procedure Level IM2 are presented in Table 1. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA Region III specifications.

Table 1. Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times
X		Initial and Continuing Calibration
X		Blank Analysis
	X	ICP Interference Check Sample (ICS)
X		Matrix Spike/Matrix Spike Duplicate
X		Duplicate Sample Analysis
	X	Laboratory Control Sample (LCS)
X		ICP Serial Dilution
	X	Quantitation Verification

All of the data collected in support of this sampling activity is acceptable with the noted qualifications, except for antimony non-detects. Antimony non-detects were rejected due to extremely low spike recoveries in accordance with USEPA Region III guidance.

cc: Eric Malarek
Project File

RADFORD ARMY AMMUNITION PLANT
VALIDATION REPORT
TAL METALS REVIEW
SDG 0001145 (T09934)

I-Holding Times

Form I, shipping and run logs.

The primary objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis. Holding time criteria: Cool @4 °C ± 2 °C, the maximum holding time is 180 days for metals and 28 days for mercury.

- All criteria were met. No qualifiers were applied.

II-Initial and Continuing Calibration

Form II

Requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run, and continuing calibration verification documents that the initial calibration is still valid.

ICP:	1- blank	Hg:	1 – blank	AA:	1 - blank
	3 – standards (r≥0.995)		5 – standards (r≥0.995)		5 – standards (r≥0.995)
	%R – 90-110%		%R – 80-120%		%R – 90-110%

- ICP analysis for metals was run on 10/05/00. Thallium was analyzed on 10/03/00 with a correlation coefficient of 0.9993. Mercury was analyzed on 09/25/00 with a correlation coefficient of 0.9999. All criteria were met. No qualifiers were applied.

Continuing Calibration for MRL

The instrument calibration near the method reporting limit (MRL) must be verified for each analyte MRL standards are evaluated using the following criteria:

CRI –MRL criteria for ICP:

A CRI must be run at a concentration of 2X MRL, or 2X the MDL, whichever is greater, for each ICP analyte (except Al, Ba, Ca, Fe, Mg, Na and K) at the beginning and end of each sample run or a minimum of twice per 8 hours.

CRA –MRL criteria for GFAA/CVAA:

The linearity of the analytical curve must be verified near the MRL for Graphite Furnace AA (GFAA).A CRA must be run at a concentration equal to the MRL, or the MDL, whichever is greater, at the beginning of each sample run.

The MRL standard recoveries should be between 90-110% of the true values. If the recovery for the CRI or CRA is > 110% and the reported sample result is > MDL or >MRL, but < 2X MRL, the result is qualified as biased high "K" and no qualifiers for non-detects. If the recovery for the CRI or CRA is between 50-89%, results > MDL or > MRL, but < 2X MRL is qualified as biased low "L" and result < MDL or <MRL is qualified "UL". If the recovery for an element is < 50%, results > MDL or > MRL but < 2X MRL are qualified as biased extremely low, "L". Results < MDL or < MRL are qualified as unusable, "R". Table 2 summarizes the MRL standards study.

Continuing Calibration for MRL (Cont.)

TABLE 2. MRL STANDARDS STUDY.

Elements	Samples Affected
Copper (82.8%)	None
Lead (85.3%)	None
Manganese (30.0%)	None
Nickel (73.8%)	NRUC1A, NRUL1A, NRUW1A, NRUG2B, NRUC2A, NRUG3B, NRUL1B
Selenium (71.4%, 80.0%)	All Samples
Vanadium (85.0%)	None

III-Blank Analysis

Form III

Blanks are assessed to determine the existence and magnitude of contamination problems. No contaminant should be detected in the blank > the MRL. Any sample value < five times (5X) the maximum concentration detected in the QC blanks and > the MRL is qualified "B". Table 3 summarizes the blank analysis study. Soil action levels cited are unadjusted for moisture content. Sample results and action levels are appropriately adjusted for moisture content during the blank analysis study. The associated rinse blanks are sample numbers 082800R1 and 083000R3.

TABLE 3. BLANK ANALYSIS STUDY.
SDG 001145 (T09934)

Element	Blank Source	Max. Equivalent Conc. mg/kg	5X Max Equivalent Conc. mg/kg	Affected Qualified B Samples
Arsenic	083000R3	1.05	5.25	NRUC2A, NRUC2B, NRUG3B, NRUG3C

IV-ICP Interference Check Sample (ICS)

Form IV

The ICP Interference Check Sample (ICS) verifies interelement and background correction factors. ICP Interference Check is performed at the beginning and end of each sample analysis run. Control limits are 80-120%.

- All criteria were met. No qualifiers were applied.

V-Matrix Spike/Matrix Spike Duplicate Analysis

The matrix spike sample analysis provides information about the effect of each sample matrix on the digestion and measurement methodology. Spike recovery (%R) must be within the specified control limits of 75-125%. However, spike recovery limits do not apply when sample concentration exceeds the spike added concentration by a factor of four or more. If the spike recovery is < 75% and the sample results are > MRL, the data for these samples are qualified as biased low, "L". If the spike recovery falls within the range of 30-74% and the sample results are < MRL, the data for these samples are qualified as detection limits biased low, "UJ". If spike recovery results fall < 30% and the sample results are < MRL, data for these samples are qualified as unusable, "R" and results > MRL are qualified as biased extremely low, "L".

V-Matrix Spike/Matrix Spike Duplicate Analysis, Continued

- Sample NRUC1B (T09935) was used for the MS/MSD analysis. %R for Aluminum (-213.4%, -692.7%) and Iron (309.7%, -4207.8%) were outside the control limits. Since the sample concentrations for these elements exceeded the spike added concentration by a factor of four or more, no qualifiers were applied based on these outliers.

- %R for Arsenic (73.5%), Chromium (63.0%), Selenium (73.8%, 62.7%), and Vanadium (73.9%) were below the control limits. Positive sample results for these elements were qualified as biased low, "L" and non-detects "UL".

- %R for Antimony (24.2%, 10.2%) was < 30%. Positive sample results were qualified as biased extremely low, "L" and non-detects as unusable, "R".

VI-Duplicate Sample Analysis

Duplicate sample determinations are used to demonstrate acceptable method precision by the laboratory at the time of analysis. Duplicate analyses are also performed to generate data in order to determine the long-term precision of the analytical method on various matrices. The relative percent difference (RPD) should be ±20%.

- Sample NRUC1B (T09935) was used for the duplicate analysis. Relative percent difference (RPD) for Cobalt (58.8%) was grossly above the control limit. Positive values for this element was qualified as estimated, "J" and non-detects "UJ".

- RPD for Copper (24.9%), Manganese (21.1%), Mercury (23.3%), and Zinc (23.3%) were above the control limit. Positive values for these elements were qualified as estimated, "J" and non-detects had no qualifiers applied.

VII-Laboratory Control Samples (LCS)

Forms VII, XIII

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation. All LCS results must fall within the specified control limits.

- All criteria were met. No qualifiers were applied.

VIII-ICP Serial Dilution

Forms I, IX

The serial dilution of samples quantitated by ICP determines whether or not significant physical or chemical interferences exist due to sample matrix. If the analyte concentration in the original sample is a factor of 10 above MDL, then an analysis of a 5-fold dilution should agree within 10% difference of the original result.

- Percent difference (%D) for elements Arsenic (42.1%), Calcium (15.2%), and Copper (15.9%) were above the control limit. Positive values for these elements were qualified as estimated, "J" and non-detects had no qualifiers applied.

- Percent difference (%D) for elements Beryllium (20.0%), Cobalt (100.0%), Nickel (22.3%), and Potassium (100.0%) above the control limit. Since the initial sample results for these elements were < a factor of 10 above their corresponding MDLs, no qualifiers were applied based on these outliers.

IX-Quantitation Verification

Raw Data.

The accuracy of analytical results is verified through the calculation of several parameters. The percent difference (%D) between the calculated and the reported values should be within 10%. The following calculations were performed for verification:

ICP Sample: NRUC1A (T09934), Lead

Conc. mg/kg = (conc. μg/L) * (Final Volume L)/(Weight g* % Solids as a fraction)

Conc. mg/kg = (133.05 μg/L)*(0.1 L)/(1.0049 g* 0.858) = 15.4 μg/g = 15.4 mg/kg

Reported concentration = 15.4 mg/kg
%D =0%.
Values were within 10% difference

AA Sample : MS (T09935S), Thallium

Conc. mg/kg = (conc. μg/L) * (Final Volume L)/(Weight g* % Solids as a fraction)

Conc. mg/kg = (24.52 μg/L)*(0.1 L)/(1.0026 g* 0.7602) = 3.21 μg/g = 3.217 mg/kg

Reported concentration = 3.174 mg/kg
%D = 1.35%.
Values were within 10% difference.

CVAA Sample: NRUC1A (T09934), Hg

Conc. mg/kg = (conc. μg/L) * (Final Volume L)/(Weight g* % Solids as a fraction)

Conc. mg/kg = (0.116 μg/L)*(0.1 L)/(0.2072 g* 0.858) = 0.065 μg/g = 0.065 mg/kg

Reported concentration = 0.07 mg/kg
%D = 0.7%.
Values were within 10% difference

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09934

Laboratory: STL BALTIMORE

SDG No.: T09934

Matrix: SOIL

Client ID: NRUC1A

Percent Solids: 85.8

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	6260			P
7440-36-0	Antimony	0.70 ~~0.24~~	U	N	P
7440-38-2	Arsenic	3.4		N	P
7440-39-3	Barium	24.5			P
7440-41-7	Beryllium	0.58 0.37	~~B~~	U	P
7440-43-9	Cadmium	0.58 ~~0.02~~	U		P
7440-70-2	Calcium	238			P
7440-47-3	Chromium	14.5		N	P
7440-48-4	Cobalt	8.6			P
7440-50-8	Copper	6.3		E*	P
7439-89-6	Iron	19400			P
7439-92-1	Lead	15.4			P
7439-95-4	Magnesium	280			P
7439-96-5	Manganese	231		*	P
7439-97-6	Mercury	0.12 ~~0.07~~	~~B~~	U	CV
7440-02-0	Nickel	5.9			P
7440-09-7	Potassium	166			P
7782-49-2	Selenium	0.58 ~~0.15~~	U	N	P
7440-22-4	Silver	1.2 ~~0.19~~	U		P
7440-23-5	Sodium	120 ~~88.2~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.14~~	U		F
7440-62-2	Vanadium	32.6		N	P
7440-66-6	Zinc	17.2		*	P

WEN 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09935

Laboratory: STL BALTIMORE

SDG No.: T09934

Matrix: SOIL

Client ID: NRUC1B

Percent Solids: 76.0

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	11900			P
7440-36-0	Antimony	0.79 ~~0.28~~	U	N	P
7440-38-2	Arsenic	4.9		N	P
7440-39-3	Barium	26 ~~12.4~~	~~B~~	V	P
7440-41-7	Beryllium	0.66 ~~0.33~~	~~B~~	V	P
7440-43-9	Cadmium	0.66 ~~0.03~~	U		P
7440-70-2	Calcium	280			P
7440-47-3	Chromium	27.2		N	P
7440-48-4	Cobalt	6.6 ~~1.7~~	~~B~~	V	P
7440-50-8	Copper	16.8		E*	P
7439-89-6	Iron	35800			P
7439-92-1	Lead	11.0			P
7439-95-4	Magnesium	219			P
7439-96-5	Manganese	58.2		*	P
7439-97-6	Mercury	0.13 ~~0.10~~	~~B~~	V	CV
7440-02-0	Nickel	12.7			P
7440-09-7	Potassium	180			P
7782-49-2	Selenium	0.66 ~~0.17~~	U	N	P
7440-22-4	Silver	1.3 ~~0.21~~	U		P
7440-23-5	Sodium.	130 ~~103~~	~~B~~	V	P
7440-28-0	Thallium	1.3 ~~0.16~~	U		F
7440-62-2	Vanadium	66.8		N	P
7440-66-6	Zinc	29.8		*	P

WEM
10/[illegible]/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09936

ab. .tory: STL BALTIMORE

G No.: T09934

atrix: SOIL

Client ID: NRUL1C

ercent Solids: 81.6

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	26600			P
7440-36-0	Antimony	0.74 ~~0.26~~	U	N	P
7440-38-2	Arsenic	2.5		N	P
7440-39-3	Barium	47.5			P
7440-41-7	Beryllium	2.0			P
7440-43-9	Cadmium	1.2 ~~0.05~~	U		P
7440-70-2	Calcium	619			P
7440-47-3	Chromium	33.9		N	P
7440-48-4	Cobalt	8.9			P
7440-50-8	Copper	29.5		E*	P
7439-89-6	Iron	44200			P
7439-92-1	Lead	10.0			P
7439-95-4	Magnesium	9200			P
7439-96-5	Manganese	156		*	P
7439-97-6	Mercury	0.12 ~~0.09~~	~~B~~	U	CV
7440-02-0	Nickel	26.0			P
7440-09-7	Potassium	6340			P
7782-49-2	Selenium	1.2 ~~0.32~~	U	N	P
7440-22-4	Silver	2.4 ~~0.39~~	U		P
7440-23-5	Sodium	120 ~~109~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.15~~	U		F
7440-62-2	Vanadium	64.6		N	P
7440-66-6	Zinc	30.9		*	P

WCW 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
"CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09937

aboratory: STL BALTIMORE

DG No.: T09934

atrix: SOIL

Client ID: NRUL1A

ercent Solids: 90.8

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	5740			P
7440-36-0	Antimony	0.66 ~~0.26~~	~~B~~	N U	P
7440-38-2	Arsenic	3.8		N	P
7440-39-3	Barium	63.6			P
7440-41-7	Beryllium	0.72			P
7440-43-9	Cadmium	0.55 ~~0.02~~	U		P
7440-70-2	Calcium	885			P
7440-47-3	Chromium	27.0		N	P
7440-48-4	Cobalt	15.3			P
7440-50-8	Copper	3.2		E*	P
7439-89-6	Iron	19400			P
7439-92-1	Lead	21.4			P
7439-95-4	Magnesium	792			P
7439-96-5	Manganese	1110		*	P
7439-97-6	Mercury	0.11 ~~0.05~~	U		CV
7440-02-0	Nickel	4.6			P
7440-09-7	Potassium	344			P
7782-49-2	Selenium	0.64		N	P
7440-22-4	Silver	1.1 ~~0.17~~	U		P
7440-23-5	Sodium	110 ~~83.5~~	~~B~~	U	P
7440-28-0	Thallium	1.1 ~~0.13~~	U		F
7440-62-2	Vanadium	31.9		N	P
7440-66-6	Zinc	29.2		*	P

War 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740,
Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09938

Laboratory: STL BALTIMORE

SDG No.: T09934

Matrix: SOIL

Client ID: NRUL1B

Percent Solids: 84.1

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	12500			P
7440-36-0	Antimony	0.71 ~~0.25~~	U	N	P
7440-38-2	Arsenic	2.7		N	P
7440-39-3	Barium	30.4			P
7440-41-7	Beryllium	0.59 ~~0.41~~	~~B~~	U	P
7440-43-9	Cadmium	0.59 ~~0.02~~	U		P
7440-70-2	Calcium	536			P
7440-47-3	Chromium	24.8		N	P
7440-48-4	Cobalt	12.0			P
7440-50-8	Copper	5.6		E*	P
7439-89-6	Iron	24400			P
7439-92-1	Lead	8.7			P
7439-95-4	Magnesium	2010			P
7439-96-5	Manganese	245		*	P
7439-97-6	Mercury	0.12 ~~0.08~~	~~B~~	U	CV
7440-02-0	Nickel	8.5			P
7440-09-7	Potassium	1390			P
7782-49-2	Selenium	0.59 ~~0.15~~	U	N	P
7440-22-4	Silver	1.2 ~~0.19~~	U		P
7440-23-5	Sodium	120 ~~93.8~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.14~~	U		F
7440-62-2	Vanadium	36.7		N	P
7440-66-6	Zinc	12.6		*	P

WEW 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09939

Laboratory: STL BALTIMORE

SDG No.: T09934

Matrix: SOIL

Client ID: NRUW1A

Percent Solids: 85.5

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	5450			P
7440-36-0	Antimony	0.70 ~~0.24~~	U	N	P
7440-38-2	Arsenic	2.0		N	P
7440-39-3	Barium	36.4			P
7440-41-7	Beryllium	0.58 ~~0.36~~	~~B~~	U	P
7440-43-9	Cadmium	0.58 ~~0.02~~	U		P
7440-70-2	Calcium	808			P
7440-47-3	Chromium	22.5		N	P
7440-48-4	Cobalt	10.2			P
7440-50-8	Copper	2.9		E*	P
7439-89-6	Iron	22900			P
7439-92-1	Lead	17.1			P
7439-95-4	Magnesium	690			P
7439-96-5	Manganese	445		*	P
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV
7440-02-0	Nickel	4.7 ~~3.4~~	~~B~~	U	P
7440-09-7	Potassium	291			P
7782-49-2	Selenium	0.58 ~~0.18~~	~~B~~	N U	P
7440-22-4	Silver	1.2 ~~0.19~~	U		P
7440-23-5	Sodium	120 ~~88.0~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.14~~	U		F
7440-62-2	Vanadium	39.1		N	P
7440-66-6	Zinc	27.9		*	P

WEM 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09940

Laboratory: STL BALTIMORE

SDG No.: T09934

Matrix: SOIL

Client ID: NRUG2B

Percent Solids: 88.6

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	7050			P
7440-36-0	Antimony	0.68 ~~0.24~~	U	N	P
7440-38-2	Arsenic	2.5		N	P
7440-39-3	Barium	30.4			P
7440-41-7	Beryllium	0.56 ~~0.35~~	~~B~~	U	P
7440-43-9	Cadmium	0.56 ~~0.02~~	U		P
7440-70-2	Calcium	237			P
7440-47-3	Chromium	18.6		N	P
7440-48-4	Cobalt	17.4			P
7440-50-8	Copper	4.2		E*	P
7439-89-6	Iron	10500			P
7439-92-1	Lead	9.6			P
7439-95-4	Magnesium	1050			P
7439-96-5	Manganese	368		*	P
7439-97-6	Mercury	0.11 ~~0.05~~	U		CV
7440-02-0	Nickel	6.6			P
7440-09-7	Potassium	613			P
7782-49-2	Selenium	0.56 ~~0.15~~	U	N	P
7440-22-4	Silver	1.1 ~~0.18~~	U		P
7440-23-5	Sodium	110 ~~100~~	~~B~~	U	P
7440-28-0	Thallium	1.1 ~~0.13~~	U		F
7440-62-2	Vanadium	29.9		N	P
7440-66-6	Zinc	15.4		*	P

WEW 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740,
Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09941

Laboratory: STL BALTIMORE

SDG No.: T09934

Matrix: SOIL

Client ID: NRUG2A

Percent Solids: 87.4

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10700			P
7440-36-0	Antimony	0.69 ~~0.24~~	U	N	P
7440-38-2	Arsenic	4.1		N	P
7440-39-3	Barium	40.7			P
7440-41-7	Beryllium	0.64			P
7440-43-9	Cadmium	0.57 ~~0.02~~	U		P
7440-70-2	Calcium	434			P
7440-47-3	Chromium	25.9		N	P
7440-48-4	Cobalt	8.3			P
7440-50-8	Copper	11.0		E*	P
7439-89-6	Iron	30900			P
7439-92-1	Lead	12.5			P
7439-95-4	Magnesium	1230			P
7439-96-5	Manganese	301		*	P
7439-97-6	Mercury	0.11 ~~0.06~~	U		CV
7440-02-0	Nickel	9.2			P
7440-09-7	Potassium	671			P
7782-49-2	Selenium	0.57 ~~0.15~~	U	N	P
7440-22-4	Silver	1.1 ~~0.18~~	U		P
7440-23-5	Sodium	110 ~~91.4~~	~~B~~	V	P
7440-28-0	Thallium	1.1 ~~0.14~~	U		F
7440-62-2	Vanadium	47.2		N	P
7440-66-6	Zinc	26.7		*	P

WEM 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form 1 copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09942

a atory: STL BALTIMORE

DG No.: T09934

atrix: SOIL Client ID: NRUC2A

ercent Solids: 83.7 Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	4440			P
7440-36-0	Antimony	0.72 ~~0.25~~	U	N	P
7440-38-2	Arsenic	2.6		N	P
7440-39-3	Barium	30.0			P
7440-41-7	Beryllium	0.61			P
7440-43-9	Cadmium	0.60 ~~0.02~~	U		P
7440-70-2	Calcium	715			P
7440-47-3	Chromium	11.3		N	P
7440-48-4	Cobalt	33.6			P
7440-50-8	Copper	4.1		E*	P
7439-89-6	Iron	10100			P
7439-92-1	Lead	24.7			P
7439-95-4	Magnesium	448			P
7439-96-5	Manganese	482		*	P
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV
7440-02-0	Nickel	4.8 ~~4.6~~	~~B~~	U	P
7440-09-7	Potassium	233			P
7782-49-2	Selenium	0.6 ~~0.17~~	~~B~~	N U	P
7440-22-4	Silver	1.2 0.19	U		P
7440-23-5	Sodium	120 ~~90.6~~	~~B~~	U	P
7440-28-0	Thallium	1.2 0.14	U		F
7440-62-2	Vanadium	19.7		N	P
7440-66-6	Zinc	15.9		*	P

ww 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
"CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form 1 copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09943

aboratory: STL BALTIMORE

DG No.: T09934

atrix: SOIL

Client ID: NRUC2B

ercent Solids: 79.1

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	16600			P
7440-36-0	Antimony	0.76 ~~0.26~~	U	N	P
7440-38-2	Arsenic	4.8		N	P
7440-39-3	Barium	48.1			P
7440-41-7	Beryllium	3.4			P
7440-43-9	Cadmium	1.3 ~~0.05~~	U		P
7440-70-2	Calcium	1860			P
7440-47-3	Chromium	47.6		N	P
7440-48-4	Cobalt	89.1			P
7440-50-8	Copper	21.5		E*	P
7439-89-6	Iron	39400			P
7439-92-1	Lead	28.0			P
7439-95-4	Magnesium	2150			P
7439-96-5	Manganese	205		*	P
7439-97-6	Mercury	0.13 ~~0.11~~	~~B~~	U	CV
7440-02-0	Nickel	44.8			P
7440-09-7	Potassium	618			P
7782-49-2	Selenium	1.3 ~~0.33~~	U	N	P
7440-22-4	Silver	2.6 ~~0.40~~	U		P
7440-23-5	Sodium	130 ~~108~~	~~B~~	U	P
7440-28-0	Thallium	1.3 ~~0.15~~	U		F
7440-62-2	Vanadium	68.9		N	P
7440-66-6	Zinc	28.4		*	P

WEA 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740,
Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09944

ratory: STL BALTIMORE

DG No.: T09934

atrix: SOIL

Client ID: NRUG3B

ercent Solids: 86.9

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	8860			P
7440-36-0	Antimony	0.69 ~~0.24~~	U	N	P
7440-38-2	Arsenic	3.8		N	P
7440-39-3	Barium	23 ~~22.6~~	~~B~~	U	P
7440-41-7	Beryllium	0.58 ~~0.26~~	~~B~~	U	P
7440-43-9	Cadmium	0.58 ~~0.02~~	U		P
7440-70-2	Calcium	304			P
7440-47-3	Chromium	30.1		N	P
7440-48-4	Cobalt	31.1			P
7440-50-8	Copper	2.3		E*	P
7439-89-6	Iron	31000			P
7439-92-1	Lead	13.8			P
7439-95-4	Magnesium	416			P
7439-96-5	Manganese	512		*	P
7439-97-6	Mercury	0.12 ~~0.06~~	~~B~~	U	CV
7440-02-0	Nickel	4.6 ~~4.3~~	~~B~~	U	P
7440-09-7	Potassium	408			P
7782-49-2	Selenium	0.58 ~~0.15~~	U	N	P
7440-22-4	Silver	1.2 ~~0.18~~	U		P
7440-23-5	Sodium	120 ~~95.4~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.14~~	U		F
7440-62-2	Vanadium	47.6		N	P
7440-66-6	Zinc	11.1		*	P

Wer 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740,
Tl by SW7841, Sb by 7041
"CV" Cold Vapor AA - waters by SW7470, soils by SW7471

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09945

Laboratory: STL BALTIMORE

SDG No.: T09934

Matrix: SOIL

Client ID: NRUW1B

Percent Solids: 79.9

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	14900			P
7440-36-0	Antimony	0.75 ~~0.26~~	U	N	P
7440-38-2	Arsenic	1.6		N	P
7440-39-3	Barium	43.1			P
7440-41-7	Beryllium	0.93			P
7440-43-9	Cadmium	0.63 ~~0.02~~	U		P
7440-70-2	Calcium	717			P
7440-47-3	Chromium	30.0		N	P
7440-48-4	Cobalt	8.7			P
7440-50-8	Copper	9.1		E*	P
7439-89-6	Iron	32300			P
7439-92-1	Lead	6.5			P
7439-95-4	Magnesium	1300			P
7439-96-5	Manganese	240		*	P
7439-97-6	Mercury	0.13 ~~0.08~~	~~B~~	U	CV
7440-02-0	Nickel	11.6			P
7440-09-7	Potassium	469			P
7782-49-2	Selenium	0.63 ~~0.18~~	U	N	P
7440-22-4	Silver	1.3 ~~0.20~~	U		P
7440-23-5	Sodium	130 ~~96.5~~	~~B~~	U	P
7440-28-0	Thallium	1.3 ~~0.15~~	U		F
7440-62-2	Vanadium	51.3		N	P
7440-66-6	Zinc	16.9		*	P

WCW
10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09946

aboratory: STL BALTIMORE

DG No.: T09934

latrix: SOIL

Client ID: NRUW1C

ercent Solids: 76.3

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	33900			P
7440-36-0	Antimony	0.79 ~~0.27~~	U	N	P
7440-38-2	Arsenic	1.9		J	P
7440-39-3	Barium	164			P
7440-41-7	Beryllium	2.1			P
7440-43-9	Cadmium	1.3 ~~0.03~~	U		P
7440-70-2	Calcium	3540			P
7440-47-3	Chromium	48.9		J	P
7440-48-4	Cobalt	13.4			P
7440-50-8	Copper	29.3		E*	P
7439-89-6	Iron	44100			P
7439-92-1	Lead	2.1			P
7439-95-4	Magnesium	51300			P
7439-96-5	Manganese	359		*	P
7439-97-6	Mercury	0.13 ~~0.06~~	U		CV
7440-02-0	Nickel	43.1			P
7440-09-7	Potassium	5670			P
7782-49-2	Selenium	1.3 ~~0.34~~	U	N	P
7440-22-4	Silver	2.6 ~~0.42~~	U		P
7440-23-5	Sodium	130 ~~119~~	~~B~~	J	P
7440-28-0	Thallium	1.3 ~~0.16~~	U		F
7440-62-2	Vanadium	77.6		N	P
7440-66-6	Zinc	69.8		*	P

wcw 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M - "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER: T09947

Laboratory: STL BALTIMORE

SDG No.: T09934

Matrix: SOIL

Client ID: NRUG3C

Percent Solids: 82.2

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	10500			P
7440-36-0	Antimony	0.73 ~~0.25~~	U	N	P
7440-38-2	Arsenic	2.7		N	P
7440-39-3	Barium	24 ~~21.3~~	~~B~~	U	P
7440-41-7	Beryllium	0.61 ~~0.52~~	~~B~~	U	P
7440-43-9	Cadmium	0.61 ~~0.02~~	U		P
7440-70-2	Calcium	223			P
7440-47-3	Chromium	25.6		N	P
7440-48-4	Cobalt	36.6			P
7440-50-8	Copper	13.4		E*	P
7439-89-6	Iron	31100			P
7439-92-1	Lead	7.2			P
7439-95-4	Magnesium	624			P
7439-96-5	Manganese	931		*	P
7439-97-6	Mercury	0.12 ~~0.06~~	~~B~~	U	CV
7440-02-0	Nickel	29.6			P
7440-09-7	Potassium	618			P
7782-49-2	Selenium	0.61 ~~0.16~~	U	N	P
7440-22-4	Silver	1.2 ~~0.19~~	U		P
7440-23-5	Sodium	120 ~~100~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.15~~	U		F
7440-62-2	Vanadium	47.2		N	P
7440-66-6	Zinc	33.0		*	P

Wew 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09948

boratory: STL BALTIMORE

G No.: T09934

trix: SOIL

Client ID: NRUG2C

ercent Solids: 81.4

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	17600			P
7440-36-0	Antimony	0.74 ~~0.26~~	U	N	P
7440-38-2	Arsenic	4.3		N	P
7440-39-3	Barium	38.7			P
7440-41-7	Beryllium	1.6			P
7440-43-9	Cadmium	0.61 ~~0.02~~	U		P
7440-70-2	Calcium	388			P
7440-47-3	Chromium	33.1		N	P
7440-48-4	Cobalt	70.1			P
7440-50-8	Copper	21.3		E*	P
7439-89-6	Iron	34200			P
7439-92-1	Lead	14.5			P
7439-95-4	Magnesium	2010			P
7439-96-5	Manganese	523		*	P
7439-97-6	Mercury	0.12 ~~0.06~~	~~B~~	U	CV
7440-02-0	Nickel	35.3			P
7440-09-7	Potassium	1360			P
7782-49-2	Selenium	0.61 ~~0.16~~	U	N	P
7440-22-4	Silver	1.2 ~~0.20~~	U		P
7440-23-5	Sodium	120 ~~101~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.15~~	U		F
7440-62-2	Vanadium	56.1		N	P
7440-66-6	Zinc	28.0		*	P

wew 10/10/00

= "P" ICP SW6010
= "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
= "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

LAB SAMPLE NUMBER

T09949

FORM 1
METALS ANALYSIS DATA SHEET

aboratory: STL BALTIMORE

DG No.: T09934

atrix: SOIL

Client ID: NRUW2A

ercent Solids: 83.4

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	14600			P
7440-36-0	Antimony	0.72 ~~0.25~~	~~B~~	N U	P
7440-38-2	Arsenic	7.6		N	P
7440-39-3	Barium	60.8			P
7440-41-7	Beryllium	1.2			P
7440-43-9	Cadmium	1.2 ~~0.05~~	U		P
7440-70-2	Calcium	1180			P
7440-47-3	Chromium	53.3		N	P
7440-48-4	Cobalt	45.4			P
7440-50-8	Copper	8.5		E*	P
7439-89-6	Iron	63000			P
7439-92-1	Lead	26.8			P
7439-95-4	Magnesium	8080			P
7439-96-5	Manganese	1860		*	P
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV
7440-02-0	Nickel	16.8			P
7440-09-7	Potassium	1990			P
7782-49-2	Selenium	1.2 ~~0.31~~	U	N	P
7440-22-4	Silver	2.4 ~~0.38~~	U		P
7440-23-5	Sodium	120 ~~93.9~~	~~B~~	U	P
7440-28-0	Thallium	1.2 ~~0.14~~	U		F
7440-62-2	Vanadium	101		N	P
7440-66-6	Zinc	56.2		*	P

WER 10/10/00

"P" ICP SW6010

"F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041

"CV" Cold Vapor AA - waters by SW7470, soils by SW7471

MEMORANDUM

TO: Davida Trumbo

FROM: Kweku Acquah

SUBJECT: Radford Army Ammunition Plant Data Validation – TAL Metals
STL Baltimore, SDG 001145 (T09950)

DATE: November 24, 2000

The purpose of this memorandum is to present the data validation report for the samples collected at the Radford Army Ammunition Plant during the August 30, 2000 sampling event. Samples were analyzed for metals using methods SW-846 7841(GFAA) for Thallium, SW-846 7471A (CVAA) for Mercury, and SW-846 6010B (ICP) for all other metals. A total of nineteen soil samples were validated. The sample IDs are:

Field Sample ID	Field Sample ID	Field Sample ID	Field Sample ID
NRUW2B	NRUL2C	MMAU3BD	MMAU3B
NRUW2C	NRUL2BD	MMAB4A	MMAU3C
NRUG2BD	NRUG2CD	MMAB4B	MMAB1A
NRUL2A	NRUG3A	MMAB4C	MMAB1B
NRUL2B	MMAB1C	MMAU3A	

Data were reviewed by Kweku Acquah and validated using a combination of method-specific criteria, laboratory SOP, and the *Innovative Approaches to Data Validation for USEPA Region III* (June 1995.) Parameters were validated at USEPA Region III Level IM2 and are presented in Table 1. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA Region III specifications.

Table 1. Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times
X		Initial and Continuing Calibration
X		Blank Analysis
	X	ICP Interference Check Sample (ICS)
X		Matrix Spike/Matrix Spike Duplicate
	X	Duplicate Sample Analysis
	X	Laboratory Control Sample (LCS)
X		ICP Serial Dilution
	X	Quantitation Verification

All of the data collected in support of this sampling activity is acceptable with the noted qualifications, except for antimony non-detects. Antimony non-detects were rejected due to extremely low spike recoveries in accordance with USEPA Region III guidance.

cc: Eric Malarek
Project File

RADFORD ARMY AMMUNITION PLANT
VALIDATION REPORT
TAL METALS REVIEW
SDG 001145 (T09950)

I-Holding Times

Form I, shipping and run logs.

The primary objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis. Holding time criteria: Cool @4 °C ± 2 °C, the maximum holding time is 180 days for metals and 28 days for mercury.

- All criteria were met for all the samples. No qualifiers were applied.

II-Initial and Continuing Calibration

Form II

Requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run, and continuing calibration verification documents that the initial calibration is still valid.

ICP:	1- blank	Hg:	1 – blank	AA:	1 - blank
	3 – standards (r≥0.995)		5 – standards (r≥0.995)		5 – standards (r≥0.995)
	%R – 90-110%		%R – 80-120%		%R – 90-110%

- ICP analysis for metals was run on 10/05/00. Thallium was analyzed on 10/05/00 with a correlation coefficient of 0.9973. Mercury was analyzed on 09/25/00 with a correlation coefficient of 0.9999. All criteria were met. No qualifiers were applied.

Continuing Calibration for MRL

The instrument calibration near the method reporting limit (MRL) must be verified for each analyte MRL standards are evaluated using the following criteria:

CRI –MRL criteria for ICP:

A CRI must be run at a concentration of 2X MRL, or 2X the MDL, whichever is greater, for each ICP analyte (except Al, Ba, Ca, Fe, Mg, Na and K) at the beginning and end of each sample run or a minimum of twice per 8 hours.

CRA –MRL criteria for GFAA/CVAA:

The linearity of the analytical curve must be verified near the MRL for Graphite Furnace AA (GFAA). A CRA must be run at a concentration equal to the MRL, or the MDL, whichever is greater, at the beginning of each sample run. The MRL standard recoveries should be between 90-110% of the true values.

If the recovery for the CRI or CRA is > 110% and the reported sample result is > MDL or MRL, but < 2X MRL, the result is qualified as biased high, "K" and no qualifiers for non-detects. If the recovery for the CRI or CRA is between 50-89%, results > MDL or MRL, but < 2X MRL is qualified as biased low "L" and result < MDL or MRL is qualified "UL". If the recovery for an element is < 50%, results > MDL or MRL but < 2X MRL are qualified as biased extremely low, "L". Results < MDL or MRL are qualified as unusable, "R". Table 2 summarizes the MRL standards study.

Continuing Calibration for MRL (Cont.)

TABLE 2. MRL STANDARDS STUDY.

Elements	Samples Affected
Copper (82.8%)	MMAB4A, MMAB1A
Lead (85.3%)	None
Manganese (30.0%)	None
Nickel (73.8%)	NRUG2BD, NRUL2B, NRUL2BD, NRUG3A, MMAB1C, MAU3BD, MMAU3B, MMAB4A, MMAB4B, MMAU3A, MMAU3C, MMAB1A, MMAB1B
Selenium (71.4%, 80.0%)	All Samples
Vanadium (85.0%)	None

III-Blank Analysis

Form III

Blanks are assessed to determine the existence and magnitude of contamination problems. No contaminant should be detected in the blank > the MRL. Any sample value < five times (5X) the maximum concentration detected in the QC blanks and > the MRL is qualified "B". Table 3 summarizes the blank analysis study. Soil action levels cited are unadjusted for moisture content. Sample results and action levels are appropriately adjusted for moisture content during the blank analysis study. The associated rinse blanks are sample numbers 082800R1, 083000R3 and 090700RB.

TABLE 3. BLANK ANALYSIS STUDY.
SDG 001145 (T09950)

Element	Blank Source	Max. Equivalent Conc. mg/kg	5X Max Equivalent Conc. mg/kg	Affected Qualified B Samples
Arsenic	083000R3	1.05	5.25	NRUW2B, NRUL2A, NRUL2C, NRUL2BD, NRUG3A
Selenium	083000R3	0.91	4.55	NRUL2A

IV-ICP Interference Check Sample (ICS)

Form IV

The ICP Interference Check Sample (ICS) verifies interelement and background correction factors. ICP Interference Check is performed at the beginning and end of each sample analysis run. Control limits are 80-120%.

- All criteria were met. No qualifiers were applied.

V-Matrix Spike/Matrix Spike Duplicate Analysis

The matrix spike sample analysis provides information about the effect of each sample matrix on the digestion and measurement methodology. Spike recovery (%R) must be within the specified control limits of 75-125%. However, spike recovery limits do not apply when sample concentration exceeds the spike added concentration by a factor of four or more. If the spike recovery is > 125%, positive sample results are qualified as biased high, "K" and non-detects are not qualified. If the spike recovery is < 75% and the sample results are > MDL, the data for these samples are qualified as biased low, "L". If the spike recovery falls within the range of 30-74% and the sample results are < MDL, the data for these samples are qualified as detection limits biased low, "UL". If spike recovery results fall < 30% and the sample results are < MDL, data for these samples are qualified as unusable, "R" and results > MDL are qualified as biased extremely low, "L".

V-Matrix Spike/Matrix Spike Duplicate Analysis, Continued

- Sample NRUW2B (T09950) was used for the MS/MSD analysis. %R for Aluminum (239.3%, -850.3%), Iron (-983.0%, -5409.5%) and Magnesium (195.5%, 73.2%) were outside of the control limits. Since the sample concentrations for these elements exceeded the spike added concentration by a factor of four or more, no qualifiers were applied based on these outliers.

- For Manganese, MS %R (204.4%) was above the control limit and MSD %R (0.4%) was grossly below the control limit. All sample results for this element were positive and were qualified as biased low, "L".

- %R for Chromium (71.8%), Potassium (71.9%), Selenium (39.7%) and Vanadium (70.5%) were < lower control limit of 75%. Positive sample values for these elements were qualified as biased low, "L" and non-detects "UL".

- %R for Antimony (24.9%, 26.7%) was < 30%. Positive sample results for this element were qualified as biased extremely low, "L" and non-detects as unusable, "R".

VI-Duplicate Sample Analysis

Duplicate sample determinations are used to demonstrate acceptable method precision by the laboratory at the time of analysis. Duplicate analyses are also performed to generate data in order to determine the long-term precision of the analytical method on various matrices. The relative percent difference (RPD) should be ±20%.

- Sample NRUW2B (T09950) was used for the duplicate analysis. All criteria were met. No qualifiers were applied.

VII-Laboratory Control Samples (LCS)

Forms VII, XIII

The laboratory Control Sample (LCS) serves as a monitor of the overall performance of each step during the analysis, including the sample preparation. All LCS results must fall within the control established control limits.

- All criteria were met. No qualifiers were applied.

VIII-ICP Serial Dilution

Forms I, IX

The serial dilution of samples quantitated by ICP determines whether or not significant physical or chemical interferences exist due to sample matrix. If the analyte concentration in the original sample is a factor of 10 above MDL, then an analysis of a 5-fold dilution should agree within 10% difference of the original result.

- Percent difference (%D) for elements Antimony (100.0%), Cobalt (100.0%), and Nickel (16.5%) were above the control limit. Since the analyte concentrations in the original sample were < a factor of ten above their corresponding MDLs, no qualifiers were applied based on these outliers.

- Percent difference (%D) for elements Arsenic (18.2%), Beryllium (100.0%), Calcium (12.1%), Copper (37.7%), Lead (14.8%), Magnesium (14.7%), and Zinc (11.4%) were above the control limit. Positive values for these elements were qualified as estimated, "J" and non-detects had no qualifiers applied.

IX-Quantitation Verification

Raw Data.

The accuracy of analytical results is verified through the calculation of several parameters. The percent difference (%D) between the calculated and the reported values should be within 10%. The following calculations were performed for verification:

ICP Sample: NRUL2C (T09955), Aluminum

Conc. mg/kg = (conc. µg/L) * (Final Volume L)/(Weight (g)*% Solids as a fraction)

Conc. mg/kg = (164090 µg/L)*(0.1 L)/(1.0007 g* 0.801) = 20,471 µg/g = 20,471 mg/kg

Reported concentration = 20,500 mg/kg
%D =0.14%.
Values were within 10% difference

AA Sample: NRUL2C (T09955), Thallium
Conc. mg/kg = (conc. µg/L) * (Final Volume mL)/(Weight g* % Solids as a fraction)

Conc. mg/kg = (2.206 µg/L)*(0.1 L)/(1.0012 g* 0.801) = 0.28 µg/g = 0.28 mg/kg

Reported concentration = 0.28 mg/kg
%D = 0%.
Values were within 10% difference.

CVAA Sample: NRUL2C (T09955), Hg

Conc. mg/kg = (conc. µg/L) * (Final Volume L)/(Weight g* % Solids as a fraction)

Conc. mg/kg = (0.107 µg/L)*(0.1 L)/(0.2088 g* 0.801) = 0.06 µg/g = 0.06 mg/kg

Reported concentration = 0.06 mg/kg
%D = 0%.
Values were within 10% difference

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EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09950

Laboratory: STL BALTIMORE

SDG No.: T09950

Matrix: SOIL

Client ID: NRUW2B

Percent Solids: 81.2

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~17300~~			~~P~~	
7440-36-0	Antimony	0.74 ~~0.28~~	~~B~~	N U	P	R
7440-38-2	Arsenic	2.8			P	B
7440-39-3	Barium	40.1			P	
7440-41-7	Beryllium	0.62 ~~0.55~~	~~B~~	U	P	
7440-43-9	Cadmium	0.62 ~~0.02~~	U		P	
7440-70-2	Calcium	1050		~~E~~	P	J
7440-47-3	Chromium	30.0		N	P	L
7440-48-4	Cobalt	6.2 ~~5.1~~	~~B~~	U	P	
7440-50-8	Copper	8.1			P	J
7439-89-6	Iron	31600			P	
7439-92-1	Lead	5.7		E	P	J
7439-95-4	Magnesium	5570		E	P	J
7439-96-5	Manganese	188		N	P	L
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV	
7440-02-0	Nickel	11.7			P	
7440-09-7	Potassium	1600		N	P	L
7782-49-2	Selenium	0.62 ~~0.16~~	U	N	P	UL
7440-22-4	Silver	1.2 ~~0.20~~	U		P	
7440-23-5	Sodium	123			P	
7440-28-0	Thallium	1.2 0.15	U		F	
7440-62-2	Vanadium	53.6		N	P	L
7440-66-6	Zinc	20.7			P	J

WEN
10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER: T09951

Laboratory: STL BALTIMORE

SDG No.: T09950

Matrix: SOIL Client ID: NRUW2C

Percent Solids: 75.8 Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	29700			P	
7440-36-0	Antimony	0.79 ~~0.37~~	~~B~~	N U	P	R
7440-38-2	Arsenic	1.3 ~~1.0~~	~~B~~	U	P	
7440-39-3	Barium	63.2			P	
7440-41-7	Beryllium	1.3			P	J
7440-43-9	Cadmium	0.66 ~~0.03~~	U		P	
7440-70-2	Calcium	5430		~~E~~	P	J
7440-47-3	Chromium	50.9		N	P	L
7440-48-4	Cobalt	12.2			P	
7440-50-8	Copper	38.7			P	J
7439-89-6	Iron	42800			P	
7439-92-1	Lead	4.5		E	P	J
7439-95-4	Magnesium	42700		E	P	J
7439-96-5	Manganese	284		N	P	L
7439-97-6	Mercury	0.13 ~~0.06~~	U		CV	
7440-02-0	Nickel	33.6			P	
7440-09-7	Potassium	6120		N	P	L
7782-49-2	Selenium	0.66 ~~0.17~~	U	N	P	UL
7440-22-4	Silver	1.3 ~~0.21~~	U		P	
7440-23-5	Sodium	130	B		P	
7440-28-0	Thallium	1.3 ~~0.23~~	~~B~~	U	F	
7440-62-2	Vanadium	61.2		N	P	L
7440-66-6	Zinc	57.0			P	J

WEM 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740,
Tl by SW7841, Sb by 7041
"CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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LAB SAMPLE NUMBER

T09952

FORM 1
METALS ANALYSIS DATA SHEET

Laboratory: STL BALTIMORE

SDG No.: T09950

Matrix: SOIL

Client ID: NRUG2BD

Percent Solids: 88.4

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	8160			P	
7440-36-0	Antimony	0.68 ~~0.24~~	U	N	P	R
7440-38-2	Arsenic	3.6			P	J
7440-39-3	Barium	32.5			P	
7440-41-7	Beryllium	0.57 ~~0.49~~	~~B~~	U	P	
7440-43-9	Cadmium	0.57 ~~0.02~~	U		P	
7440-70-2	Calcium	239		~~E~~	P	J
7440-47-3	Chromium	24.3		N	P	L
7440-48-4	Cobalt	18.0			P	
7440-50-8	Copper	4.6			P	J
7439-89-6	Iron	24600			P	
7439-92-1	Lead	12.0		E	P	J Wem 10/10/00
7439-95-4	Magnesium	1400		E	P	J
7439-96-5	Manganese	399		N	P	L
7439-97-6	Mercury	0.11 ~~0.06~~	U		CV	
7440-02-0	Nickel	7.9			P	L
7440-09-7	Potassium	705		N	P	L
7782-49-2	Selenium	0.57 ~~0.15~~	U	N	P	UL
7440-22-4	Silver	1.1 ~~0.10~~	U		P	
7440-23-5	Sodium	110 98.7	~~B~~	U	P	
7440-28-0	Thallium	1.1 ~~0.14~~	U		F	
7440-62-2	Vanadium	41.3		N	P	L
7440-66-6	Zinc	19.7			P	J

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09953

Laboratory: STL BALTIMORE

SDG No.: T09950

Matrix: SOIL

Client ID: NRUL2A

Percent Solids: 86.7

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	10800			P	
7440-36-0	Antimony	0.69 ~~0.24~~	U	N	P	R
7440-38-2	Arsenic	5.1			P	B
7440-39-3	Barium	79.0			P	
7440-41-7	Beryllium	0.89			P	J
7440-43-9	Cadmium	0.58 ~~0.02~~	U		P	
7440-70-2	Calcium	1380		~~E~~	P	J
7440-47-3	Chromium	28.2		N	P	L
7440-48-4	Cobalt	25.9			P	
7440-50-8	Copper	5.1			P	J
7439-89-6	Iron	25200			P	
7439-92-1	Lead	26.8		E	P	J
7439-95-4	Magnesium	2010		E	P	J
7439-96-5	Manganese	1530		N	P	L
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV	
7440-02-0	Nickel	9.4			P	
7440-09-7	Potassium	960		N	P	L
7782-49-2	Selenium	0.77		N	P	B
7440-22-4	Silver	1.2 ~~0.18~~	U		P	
7440-23-5	Sodium	120 ~~97.5~~	~~B~~	U	P	
7440-28-0	Thallium	1.2 ~~0.14~~	U		F	
7440-62-2	Vanadium	45.9		N	P	L
7440-66-6	Zinc	39.6			P	J

WEW 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740,
Tl by SW7841, Sb by 7041
"CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09954

aboratory: STL BALTIMORE

DG No.: T09950

atrix: SOIL Client ID: NRUL2B

ercent Solids: 84.8 Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	13200			P	
7440-36-0	Antimony	0.71 ~~0.45~~	~~B~~	N U	P	R
7440-38-2	Arsenic	6.9			P	J
7440-39-3	Barium	32.6			P	
7440-41-7	Beryllium	0.59 ~~0.41~~	~~B~~	U	P	
7440-43-9	Cadmium	0.59 ~~0.02~~	U		P	
7440-70-2	Calcium	618		~~E~~	P	J
7440-47-3	Chromium	35.2		N	P	L
7440-48-4	Cobalt	29.4			P	
7440-50-8	Copper	19.7			P	J
7439-89-6	Iron	32500			P	
7439-92-1	Lead	17.7		E	P	J Wew 10/10/00
7439-95-4	Magnesium	2310		E	P	J
7439-96-5	Manganese	654		N	P	L
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV	
7440-02-0	Nickel	8.9			P	L
7440-09-7	Potassium	1700		N	P	L
7782-49-2	Selenium	0.59 ~~0.15~~	U	N	P	UL
7440-22-4	Silver	1.2 ~~0.19~~	U		P	
7440-23-5	Sodium	120 ~~115~~	~~B~~	U	P	
7440-28-0	Thallium	1.2 ~~0.14~~	U		F	
7440-62-2	Vanadium	52.3		N	P	L
7440-66-6	Zinc	20.7			P	J

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09955

aboratory: STL BALTIMORE

DG No.: T09950

atrix: SOIL

Client ID: NRUL2C

ercent Solids: 80.1

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~20500~~			P	
7440-36-0	Antimony	0.75 ~~0.42~~	~~B~~	N U	P	R
7440-38-2	Arsenic	4.2			P	B
7440-39-3	Barium	34.0			P	
7440-41-7	Beryllium	0.96			P	▼ J
7440-43-9	Cadmium	0.62 ~~0.02~~	U		P	
7440-70-2	Calcium	844		~~E~~	P	J
7440-47-3	Chromium	49.5		N	P	L
7440-48-4	Cobalt	7.0			P	
7440-50-8	Copper	16.6			P	J
7439-89-6	Iron	33100			P	
7439-92-1	Lead	7.9		E	P	J
7439-95-4	Magnesium	3610		E	P	J
7439-96-5	Manganese	62.8		N	P	L
7439-97-6	Mercury	0.12 ~~0.06~~	~~B~~	U	CV	
7440-02-0	Nickel	18.5			P	
7440-09-7	Potassium	3020		N	P	L
7782-49-2	Selenium	0.62 ~~0.16~~	U	N	P	UL
7440-22-4	Silver	1.2 ~~0.20~~	U		P	
7440-23-5	Sodium	120 ~~118~~	~~B~~	U	P	
7440-28-0	Thallium	1.2 ~~0.28~~	~~B~~	U	F	
7440-62-2	Vanadium	48.6		N	P	● L
7440-66-6	Zinc	30.4			P	J

WEM 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
"CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER: T09956

Laboratory: STL BALTIMORE

SDG No.: T09950

Matrix: SOIL   **Client ID:** NRUL2BD

Percent Solids: 84.6   **Date Received:** 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	10300			P	
7440-36-0	Antimony	0.71 0.43	~~B~~	NU	P	R
7440-38-2	Arsenic	4.7			P	B
7440-39-3	Barium	27.9			P	
7440-41-7	Beryllium	0.59 0.26	~~B~~	U	P	
7440-43-9	Cadmium	0.59 ~~0.02~~	U		P	
7440-70-2	Calcium	585		~~E~~	P	J
7440-47-3	Chromium	40.0		N	P	L
7440-48-4	Cobalt	34.6			P	
7440-50-8	Copper	4.2			P	J
7439-89-6	Iron	26100			P	
7439-92-1	Lead	16.0		E	P	J
7439-95-4	Magnesium	1240		E	P	J
7439-96-5	Manganese	785		N	P	L
7439-97-6	Mercury	0.12 ~~0.08~~	U		CV	
7440-02-0	Nickel	5.7			P	L
7440-09-7	Potassium	956		N	P	L
7782-49-2	Selenium	0.59 ~~0.15~~	U	N	P	UL
7440-22-4	Silver	1.2 ~~0.19~~	U		P	
7440-23-5	Sodium	120 ~~106~~	~~B~~	U	P	
7440-28-0	Thallium	1.2 ~~0.14~~	U		F	
7440-62-2	Vanadium	40.4		N	P	L
7440-66-6	Zinc	14.8			P	J

WEW 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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LAB SAMPLE NUMBER

T09957

FORM 1
METALS ANALYSIS DATA SHEET

aboratory: STL BALTIMORE

DG No.: T09950

atrix: SOIL

Client ID: NRUG2CD

ercent Solids: 82.8

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	14500			P	
7440-36-0	Antimony	0.72 ~~0.25~~	U	N	P	R
7440-38-2	Arsenic	2.4			P	J
7440-39-3	Barium	37.1			P	
7440-41-7	Beryllium	1.5			P	J
7440-43-9	Cadmium	0.60 ~~0.02~~	U		P	
7440-70-2	Calcium	390		~~E~~	P	J
7440-47-3	Chromium	31.8		N	P	L
7440-48-4	Cobalt	41.1			P	
7440-50-8	Copper	17.7			P	J WEN 10/10/00
7439-89-6	Iron	29600			P	
7439-92-1	Lead	12.2		E	P	J
7439-95-4	Magnesium	1590		E	P	J
7439-96-5	Manganese	364		N	P	L
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV	
7440-02-0	Nickel	31.1			P	
7440-09-7	Potassium	1120		N	P	L
7782-49-2	Selenium	0.60 ~~0.16~~	U	N	P	UL
7440-22-4	Silver	1.2 ~~0.19~~	U		P	
7440-23-5	Sodium	120 ~~112~~	~~B~~	U	P	
7440-28-0	Thallium	1.2 ~~0.29~~	~~B~~	U	F	
7440-62-2	Vanadium	48.4		N	P	L
7440-66-6	Zinc	23.7			P	J

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
"CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09958

Laboratory: STL BALTIMORE

SDG No.: T09950

Matrix: SOIL

Client ID: NRUG3A

Percent Solids: 89.9

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~7260~~			P	
7440-36-0	Antimony	0.67 ~~0.24~~	~~B~~	N U	P	R
7440-38-2	Arsenic	3.6			P	B
7440-39-3	Barium	45.7			P	
7440-41-7	Beryllium	0.62			P	J
7440-43-9	Cadmium	0.56 ~~0.02~~	U		P	
7440-70-2	Calcium	571		~~E~~	P	J
7440-47-3	Chromium	29.8		N	P	L
7440-48-4	Cobalt	11.8			P	
7440-50-8	Copper	4.6			P	J
7439-89-6	Iron	27000			P	
7439-92-1	Lead	18.0		E	P	J
7439-95-4	Magnesium	913		E	P	J
7439-96-5	Manganese	458		N	P	L
7439-97-6	Mercury	0.11 ~~0.05~~	U		CV	
7440-02-0	Nickel	5.9			P	L
7440-09-7	Potassium	438		N	P	L
7782-49-2	Selenium	0.56 ~~0.14~~	U	N	P	VL
7440-22-4	Silver	1.1 ~~0.18~~	U		P	
7440-23-5	Sodium	110 ~~107~~	~~B~~	U	P	
7440-28-0	Thallium	1.1 ~~0.13~~	U		F	
7440-62-2	Vanadium	41.0		N	P	L
7440-66-6	Zinc	28.5			P	J

WEW 10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER T09959

Laboratory: STL BALTIMORE

SDG No.: T09950

Matrix: SOIL **Client ID:** MMAB1C

Percent Solids: 90.0 **Date Received:** 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	15300			P	
7440-36-0	Antimony	0.67 ~~0.23~~	U	N	P	R
7440-38-2	Arsenic	1.1 ~~0.60~~	~~B~~	U	P	
7440-39-3	Barium	42.6			P	
7440-41-7	Beryllium	0.56 ~~0.37~~	~~B~~	U	P	
7440-43-9	Cadmium	0.56 ~~0.02~~	U		P	
7440-70-2	Calcium	110 ~~74.7~~	~~B~~	~~E~~ U	P	
7440-47-3	Chromium	12.6		N	P	L
7440-48-4	Cobalt	10.2			P	
7440-50-8	Copper	4.3			P	J Wav 10/10/00
7439-89-6	Iron	22900			P	
7439-92-1	Lead	6.9		E	P	J
7439-95-4	Magnesium	971		E	P	J
7439-96-5	Manganese	189		N	P	L
7439-97-6	Mercury	0.11 ~~0.06~~	U		CV	
7440-02-0	Nickel	6.8			P	L
7440-09-7	Potassium	1010		N	P	L
7782-49-2	Selenium	0.56 ~~0.14~~	U	N	P	UL
7440-22-4	Silver	1.1 ~~0.18~~	U		P	
7440-23-5	Sodium	110 ~~93.8~~	~~B~~	U	P	
7440-28-0	Thallium	1.1 ~~0.15~~	~~B~~	U	F	
7440-62-2	Vanadium	51.4		N	P	L
7440-66-6	Zinc	361			P	J

M = "P" ICP SW6010

M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041

M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09960

aboratory: STL BALTIMORE

DG No.: T09950

latrix: SOIL

Client ID: MMA~~Y~~3BD U wer 10/10/00

ercent Solids: 86.9

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~12100~~			~~P~~	
7440-36-0	Antimony	0.69 ~~0.24~~	U	N	P	R
7440-38-2	Arsenic	1.1			P	J
7440-39-3	Barium	46.5			P	
7440-41-7	Beryllium	0.58 ~~0.46~~	~~B~~	U	P	
7440-43-9	Cadmium	0.58 ~~0.02~~	U		P	
7440-70-2	Calcium	290		~~E~~	P	J
7440-47-3	Chromium	19.0		U	P	L
7440-48-4	Cobalt	5.8 ~~4.2~~	~~B~~	U	P	
7440-50-8	Copper	8.6			P	J wer 10/10/00
7439-89-6	Iron	29300			P	
7439-92-1	Lead	9.1		E	P	J
7439-95-4	Magnesium	902		E	P	J
7439-96-5	Manganese	99.4		N	P	L
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV	
7440-02-0	Nickel	7.5			P	L
7440-09-7	Potassium	961		N	P	L
7782-49-2	Selenium	0.58 ~~0.15~~	U	N	P	UL
7440-22-4	Silver	1.2 ~~0.18~~	U		P	
7440-23-5	Sodium	120 ~~98.2~~	~~B~~	U	P	
7440-28-0	Thallium	1.2 ~~0.14~~	U		F	
7440-62-2	Vanadium	57.9		N	P	L
7440-66-6	Zinc	34.2			P	J

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09961

Laboratory: STL BALTIMORE

SDG No.: T09950

Matrix: SOIL

Client ID: MMAB4A

Percent Solids: 90.0

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~3700~~			~~P~~	
7440-36-0	Antimony	0.67 ~~0.23~~	U	N	P	R
7440-38-2	Arsenic	1.5			P	J
7440-39-3	Barium	39.9			P	
7440-41-7	Beryllium	0.56 ~~0.20~~	~~B~~	U	P	
7440-43-9	Cadmium	0.56 ~~0.02~~	U		P	
7440-70-2	Calcium	116		~~E~~	P	J
7440-47-3	Chromium	8.7		N	P	L
7440-48-4	Cobalt	5.6 ~~3.9~~	~~B~~	U	P	
7440-50-8	Copper	1.1 ~~0.73~~	~~B~~	U	P	VL wer 10/10/00
7439-89-6	Iron	7250			P	
7439-92-1	Lead	17.1		E	P	J
7439-95-4	Magnesium	158		E	P	J
7439-96-5	Manganese	506		N	P	L
7439-97-6	Mercury	0.11 ~~0.05~~	U		CV	
7440-02-0	Nickel	4.4 ~~3.9~~	~~B~~	U	P	UL
7440-09-7	Potassium	174		N	P	L
7782-49-2	Selenium	0.56 ~~0.38~~	~~B~~	N U	P	UL
7440-22-4	Silver	1.1 ~~0.10~~	U		P	
7440-23-5	Sodium	124			P	
7440-28-0	Thallium	1.1 ~~0.13~~	U		F	
7440-62-2	Vanadium	15.0		N	P	L
7440-66-6	Zinc	10.0			P	J

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

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EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09962

Laboratory: STL BALTIMORE

SDG No.: T09950

Matrix: SOIL **Client ID:** MMAB4B

Percent Solids: 87.3 **Date Received:** 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~12500~~			~~P~~	
7440-36-0	Antimony	0.69 ~~0.24~~	U	N	P	R
7440-38-2	Arsenic	1.9			P	J
7440-39-3	Barium	38.4			P	
7440-41-7	Beryllium	0.57 ~~0.25~~	~~B~~	U	P	
7440-43-9	Cadmium	0.57 ~~0.02~~	U		P	
7440-70-2	Calcium	114		~~E~~	P	J
7440-47-3	Chromium	20.9		N	P	L
7440-48-4	Cobalt	5.7 ~~2.2~~	~~B~~	U	P	
7440-50-8	Copper	5.5			P	J WEW 10/10/00
7439-89-6	Iron	28900			P	
7439-92-1	Lead	9.8		E	P	J
7439-95-4	Magnesium	522		E	P	J
7439-96-5	Manganese	130		N	P	L
7439-97-6	Mercury	0.11 ~~0.06~~	U		CV	
7440-02-0	Nickel	6.3			P	L
7440-09-7	Potassium	694		N	P	L
7782-49-2	Selenium	0.57 ~~0.15~~	U	N	P	UL
7440-22-4	Silver	1.1 ~~0.10~~	U		P	
7440-23-5	Sodium	120 ~~103~~	~~B~~	U	P	
7440-28-0	Thallium	1.1 ~~0.14~~	U		F	
7440-62-2	Vanadium	56.4		N	P	L
7440-66-6	Zinc	31.1			P	J

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I copy

EPA SW846

LAB SAMPLE NUMBER

T09963

FORM 1
METALS ANALYSIS DATA SHEET

Laboratory: STL BALTIMORE

SDG No.: T09950

Matrix: SOIL

Client ID: MMAB4C

Percent Solids: 87.4

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	12500			P	
7440-36-0	Antimony	0.69 ~~0.38~~	~~B~~	N U	P	R
7440-38-2	Arsenic	1.8			P	J
7440-39-3	Barium	27.4			P	
7440-41-7	Beryllium	0.57 ~~0.24~~	~~B~~	U	P	
7440-43-9	Cadmium	0.57 ~~0.02~~	U		P	
7440-70-2	Calcium	120 ~~70.0~~	~~B~~	~~E~~ U	P	
7440-47-3	Chromium	33.6		N	P	L
7440-48-4	Cobalt	5.7 ~~4.4~~	~~B~~	U	P	
7440-50-8	Copper	4.5			P	J 10/10/00
7439-89-6	Iron	24000			P	
7439-92-1	Lead	10.2		E	P	J
7439-95-4	Magnesium	350		E	P	J
7439-96-5	Manganese	170		N	P	L
7439-97-6	Mercury	0.11 ~~0.06~~	U		CV	
7440-02-0	Nickel	10.3			P	
7440-09-7	Potassium	474		N	P	L
7782-49-2	Selenium	0.57 ~~0.15~~	U	N	P	UL
7440-22-4	Silver	1.1 ~~0.18~~	U		P	
7440-23-5	Sodium	120 ~~93.3~~	~~B~~	U	P	
7440-28-0	Thallium	1.1 ~~0.14~~	U		F	
7440-62-2	Vanadium	39.6		N	P	L
7440-66-6	Zinc	26.1			P	J

M = "P" ICP SW6010

M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041

"CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09964

aboratory: STL BALTIMORE

DG No.: T09950

atrix: SOIL

Client ID: MMAU3A

ercent Solids: 86.4

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~6800~~			~~P~~	
7440-36-0	Antimony	0.69 ~~0.24~~	U	N	P	R
7440-38-2	Arsenic	1.8			P	J
7440-39-3	Barium	57.9			P	
7440-41-7	Beryllium	0.58 ~~0.46~~	~~B~~	U	P	
7440-43-9	Cadmium	0.02	U		P	
7440-70-2	Calcium	389		~~E~~	P	J
7440-47-3	Chromium	18.3		N	P	L
7440-48-4	Cobalt	10.1			P	
7440-50-8	Copper	5.4			P	J Wau 10/10/00
7439-89-6	Iron	17800			P	
7439-92-1	Lead	10.5		E	P	J
7439-95-4	Magnesium	669		E	P	J
7439-96-5	Manganese	404		N	P	L
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV	
7440-02-0	Nickel	5.2			P	L
7440-09-7	Potassium	654		N	P	L
7782-49-2	Selenium	0.58 ~~0.15~~	U	N	P	UL
7440-22-4	Silver	1.2 ~~0.19~~	U		P	
7440-23-5	Sodium	120 ~~104~~	~~B~~	U	P	
7440-28-0	Thallium	1.2 ~~0.14~~	U		F	
7440-62-2	Vanadium	35.0		N	P	L
7440-66-6	Zinc	94.1			P	J

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09965

aboratory: STL BALTIMORE

DG No.: T09950

latrix: SOIL

Client ID: MMAU3B

ercent Solids: 86.6

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~14000~~			~~P~~	
7440-36-0	Antimony	0.69 ~~0.24~~	U	N	P	R
7440-38-2	Arsenic	1.7			P	J
7440-39-3	Barium	48.5			P	
7440-41-7	Beryllium	0.58 ~~0.53~~	~~B~~	U	P	
7440-43-9	Cadmium	0.58 ~~0.02~~	U		P	
7440-70-2	Calcium	314		~~E~~	P	J
7440-47-3	Chromium	22.1		N	P	L wer 10/10/00
7440-48-4	Cobalt	5.8 ~~5.4~~	~~B~~	U	P	
7440-50-8	Copper	10.7			P	J
7439-89-6	Iron	33300			P	
7439-92-1	Lead	9.5		E	P	J
7439-95-4	Magnesium	972		E	P	J
7439-96-5	Manganese	121		N	P	L
7439-97-6	Mercury	0.12 ~~0.06~~	U		CV	
7440-02-0	Nickel	9.0			P	L
7440-09-7	Potassium	1050		N	P	L
7782-49-2	Selenium	0.58 ~~0.15~~	U	N	P	UL
7440-22-4	Silver	1.2 ~~0.18~~	U		P	
7440-23-5	Sodium	120 ~~111~~	~~B~~	V	P	
7440-28-0	Thallium	1.2 ~~0.14~~	U		F	
7440-62-2	Vanadium	64.2		N	P	L
7440-66-6	Zinc	46.2			P	J

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER

T09966

aboratory: STL BALTIMORE

DG No.: T09950

atrix: SOIL

Client ID: MMAU3C

ercent Solids: 91.4

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~8710~~			~~P~~	
7440-36-0	Antimony	0.66 ~~0.23~~	U	N	P	R
7440-38-2	Arsenic	1.1 ~~0.37~~	~~B~~	U	P	
7440-39-3	Barium	25.2			P	
7440-41-7	Beryllium	0.55 ~~0.24~~	~~B~~	U	P	
7440-43-9	Cadmium	0.55 ~~0.02~~	U		P	
7440-70-2	Calcium	110 ~~75.0~~	~~B~~	E U	P	
7440-47-3	Chromium	10.8		N	P	L WEW 10/10/00
7440-48-4	Cobalt	12.3			P	
7440-50-8	Copper	3.4			P	J
7439-89-6	Iron	14300			P	
7439-92-1	Lead	5.6		E	P	J
7439-95-4	Magnesium	555		E	P	J
7439-96-5	Manganese	169		N	P	L
7439-97-6	Mercury	0.11 ~~0.05~~	U		CV	
7440-02-0	Nickel	5.8			P	L
7440-09-7	Potassium	591		N	P	L
7782-49-2	Selenium	0.55 ~~0.14~~	U	N	P	UL
7440-22-4	Silver	1.1 ~~0.17~~	U		P	
7440-23-5	Sodium	110 ~~90.7~~	~~B~~	U	P	
7440-28-0	Thallium	1.1 ~~0.13~~	U		F	
7440-62-2	Vanadium	27.0		N	P	L
7440-66-6	Zinc	19.8			P	J

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER: T09967

aboratory: STL BALTIMORE

DG No.: T09950

atrix: SOIL

Client ID: MMAB1A

ercent Solids: 87.8

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~5370~~			~~P~~	
7440-36-0	Antimony	0.68 ~~0.24~~	U	N	P	R
7440-38-2	Arsenic	1.9			P	J
7440-39-3	Barium	114			P	
7440-41-7	Beryllium	0.57 ~~0.51~~	~~B~~	U	P	
7440-43-9	Cadmium	0.57 ~~0.02~~	U		P	
7440-70-2	Calcium	395		~~E~~	P	J
7440-47-3	Chromium	9.0		N	P	L
7440-48-4	Cobalt	5.7 ~~3.3~~	~~B~~	U	P	
7440-50-8	Copper	2.2			P	10/10/00
7439-89-6	Iron	7490			P	
7439-92-1	Lead	9.4		E	P	J
7439-95-4	Magnesium	247		E	P	J
7439-96-5	Manganese	924		N	P	L
7439-97-6	Mercury	0.11 ~~0.06~~	U		CV	
7440-02-0	Nickel	4.6 ~~2.8~~	~~B~~	U	P	UL
7440-09-7	Potassium	242		N	P	L
7782-49-2	Selenium	0.57 ~~0.40~~	~~B~~	NU	P	UL
7440-22-4	Silver	1.1 0.18	U		P	
7440-23-5	Sodium	120 ~~95.0~~	~~B~~	U	P	
7440-28-0	Thallium	1.1 0.14	U		F	
7440-62-2	Vanadium	14.7		N	P	L
7440-66-6	Zinc	16.9			P	J

M = "P" ICP SW6010

M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740, Tl by SW7841, Sb by 7041

M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

Form I Copy

EPA SW846

FORM 1
METALS ANALYSIS DATA SHEET

LAB SAMPLE NUMBER
T09968

aboratory: STL BALTIMORE

DG No.: T09950

atrix: SOIL

Client ID: MMAB1B

ercent Solids: 88.4

Date Received: 09/01/00

Results for: TOTAL metals

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M	
~~7429-90-5~~	~~Aluminum~~	~~11800~~			~~P~~	
7440-36-0	Antimony	0.68 ~~0.24~~	U	N	P	R
7440-38-2	Arsenic	1.2			P	J
7440-39-3	Barium	47.1			P	
7440-41-7	Beryllium	0.57 ~~0.17~~	~~B~~	U	P	
7440-43-9	Cadmium	0.57 ~~0.02~~	U		P	
7440-70-2	Calcium	398		~~E~~	P	J
7440-47-3	Chromium	17.4		N	P	L
7440-48-4	Cobalt	5.7 ~~4.2~~	~~B~~	U	P	
7440-50-8	Copper	3.3			P	J
7439-89-6	Iron	24700			P	
7439-92-1	Lead	8.2		E	P	J
7439-95-4	Magnesium	490		E	P	J
7439-96-5	Manganese	125		N	P	L
7439-97-6	Mercury	0.11 ~~0.06~~	U		CV	
7440-02-0	Nickel	4.9			P	L
7440-09-7	Potassium	579		N	P	L
7782-49-2	Selenium	0.57 ~~0.15~~	U	N	P	UL
7440-22-4	Silver	1.1 ~~0.18~~	U		P	
7440-23-5	Sodium	114			P	
7440-28-0	Thallium	1.1 ~~0.14~~	U		F	
7440-62-2	Vanadium	42.2		N	P	L
7440-66-6	Zinc	25.0			P	J

10/10/00

M = "P" ICP SW6010
M = "F" Graphite Furnace AA As by SW7060, Pb by SW7421, Se by SW7740,
Tl by SW7841, Sb by 7041
M = "CV" Cold Vapor AA - waters by SW7470, soils by SW7471

MEMORANDUM

TO: Davida Trumbo

FROM: Kweku Acquah

SUBJECT: Radford Army Ammunition Plant Data Validation - Volatiles
Envirosystems Lab, SDG IT2

DATE: November 28, 2000

The purpose of this memorandum is to present the data validation report for the samples collected at the Radford Army Ammunition Plant during the August 29-30, 2000 sampling events. Samples were analyzed for volatile organic compounds (VOCs) using USEPA SOW method OLM 04.2 (May 1999). A total of four soil samples were validated. The sample IDs are:

Field Sample ID
NRUC1B
NRUL1C
NRUL1B
NRUG2B

Data were reviewed by Kweku Acquah and validated using a combination of method-specific criteria, laboratory SOP and the *Innovative Approaches to Data Validation for USEPA Region III* (June 1995.) Parameters evaluated under data validation procedure Level M3 are presented in Table 1. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA Region III specifications.

Table 1. Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times
	X	Instrument Performance Check
X		Initial Calibration
X		Continuing Calibration
X		Blank Analysis
	X	System Monitoring Compounds
	X	Laboratory Control Sample
	X	Matrix Spike/Matrix Spike Duplicate
	X	Internal Standards
	X	Quantitation Verification

The quality of data collected in support of this sampling activity is considered acceptable with the noted qualifications.

cc: Eric Malarek
Project File

RADFORD ARMY AMMUNITION PLANT
VALIDATION REPORT
VOLATILES REVIEW
SDG IT2

I-Holding Times

Form I.

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of analysis. Holding time criteria: For soil samples preserved and cooled @ 4°C ± 2°C, the maximum holding time is 14 days from sample collection to analysis.

- Holding time criteria were met. No qualifiers were applied.

II-Instrument Performance Check

Form V

The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples are analyzed. The instrument performance check solution, bromofluorobenzene (BFB), must meet the specified ion abundance criteria.

- All criteria were met. No qualifiers were applied.

III-Initial Calibration

Form VI and chromatograms.

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used is capable of producing acceptable qualitative and quantitative data for volatile target compounds. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve. Minimum Relative Response Factor (RRF) must be ≥0.05. Percent Relative Standard Deviation (%RSD) must be ≤15% for each target compound and must be ≤30% for each calibration check compound.

- For initial calibration performed on 09/12/00 on instrument HP73F, compounds Bromomethane (22.2%), Chloroethane (27.2%), 1,1-Dichloroethene (16.2%), Methylene Chloride (25.4%), 2-Butanone (21.9%) and 2-Hexanone (16.8%) were above the control limit. Positive values were qualified as estimated, "J" and non-detects had no qualifiers applied.

- For initial calibration performed on 09/12/00 on instrument HP73F, compounds Chloromethane (36.6%) and Acetone (33.3%) grossly exceeded the control limit (i.e > 30%). Positive values for these compounds were qualified as estimated, "J" and non-detects "UJ".

IV-Continuing Calibration

Form VII and chromatograms.

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used is capable of producing acceptable qualitative and quantitative data for volatile target compounds. Continuing calibration establishes the 12-hour relative response factors on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis. The percent Difference (%D) between the initial calibration RRF and the continuing calibration RRF must be within 20% for all target compounds.

- For continuing calibration performed on 09/12/00 @15:30 on instrument HP73F, compound Chloromethane (21.6%) exceeded the control limit. Since this compound had already been qualified "UJ" from the initial calibration and since it was a non-detect in all the samples, no further qualifiers were necessary.

IV-Continuing Calibration (Cont.)

- For continuing calibration performed on 09/12/00 @10:14 on instrument HP73F, compounds Chloromethane (21.7%) and 4-Methyl-2-Pentanone (26.6%) were above the control limit. Chloromethane had already been qualified from the initial calibration and no further qualification was necessary. Positive values for 4-Methyl-2-Pentanone were qualified as estimated, "J" and non-detects had no qualifiers applied.

- For continuing calibration performed on 09/12/00 @10:14 on instrument HP73F, compounds Chloromethane (50.2%), Vinyl Chloride (50.5%), Acetone (49%) and 2-Butanone (39.7%) were grossly outside the control criteria. Positive values for these compounds were qualified as estimated, "J" and non-detects "UJ".

V-Blank Analysis

Form I, IV and chromatograms

The purpose of blank analyses is to determine the presence and magnitude of contamination problems resulting from field and laboratory activities. A method blank analysis must be performed after the calibration standards and once every 12-hour time period beginning with the injection of BFB. No contaminants should be detected in any of the associated blanks. Positive sample results are reported and qualified "B", if the concentration of the compound in the sample is ≤ 10 times (10x) the maximum amount in any blank for the common laboratory contaminants methylene chloride, acetone and 2-butnone, or 5 times (5X) the maximum amount for other volatile target compounds. The associated rinse blank is sample number 082800R1. Table 2 summarizes the blank contamination analysis.

TABLE 2. BLANK CONTAMINATION SUMMARY.

Compound / Blank Sample #	10X Max. conc. µg/kg	Sample Affected
Acetone / 082800R1	440	NRUC1B

VI-System Monitoring Compounds (Surrogates)

Form II and chromatograms.

Laboratory performance on individual samples is established by means of spiking activities. The system monitoring compounds are added to all samples and blanks to measure their recovery. Percent Recoveries (%Rs) must be within the specified control limits.

Control Limits: Toluene-d8 (84-138%)
4-Bromofluorobenzene (59-113%)
1,2-Dichloroethane-d4 (70-121%)

- All criteria were met. No qualifiers were applied.

VII-Laboratory Control Samples

Form III and chromatograms.

Data for laboratory control samples are generated to determine long-term precision and accuracy of the analytical method. Laboratory control samples should be analyzed at a frequency of 1 per 20 samples or analytical batch for each matrix. Percent Recoveries (%Rs) must be within the specified control limits of 60-140%.

- All criteria were met. No qualifiers were applied.

VIII-Matrix Spike/Matrix Spike Duplicate

Form III and chromatograms.

Data for Matrix Spike/Matrix Spike Duplicates are generated to determine long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. The percent recoveries (%Rs) and the relative percent difference (RPD) must be within the specified control limits.

- Sample NRUC1B (00092519) was used for the MS/MSD analysis. %RPD for Chlorobenzene (22%) was above the control limit of 21%. Since this compound was a non-detect for all the samples, no qualifiers were applied based on these outliers.

IX-Internal Standards

Form VII and chromatograms.

Internal Standards performance check ensures that GC/MS sensitivity and response are stable during each analytical run. Specific criteria include area count of –50% to +100% and retention time of ±30 seconds from the associated calibration standards.

- All criteria were met. No qualifiers were applied.

X-Quantitation Verification

Form 1 and chromatograms.

The accuracy of analytical results is verified through the calculation of several parameters. Any positive value < RL and > MDL is reported as estimated "J." The percent difference (%D) between the calculated and the reported value should be within 10%.

Sample: NRUC1B (00092519)), 2-Butanone

Conc. µg/kg = (Ax * Is ng * Vt mL * DF) / (Ais * RRF * Va * Ws gm * Fs)

where:

Ax is the compound area
Is is the amount of internal standard injected (ng)
Vt is the total volume of the methanol extract (mL)
DF is the dilution factor
Ais is the corresponding internal standard area
RRF is the continuing calibration average relative response factor
Va is the volume of the aliquot of the methanol extract (µL)
Ws is the weight of the sample (g)
Fs is the fraction of solid [(100-%moisure)/100]

Conc. = (28323 * 50 ng * 5 mL) / (250673 *0.894 *1 mL* 4.6 gm * 0.77) = 9 µg/kg

Reported conc. = 9 µg/kg
%D = %
Values were within 10% difference.

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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUC1B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092519

Sample wt/vol: 4.6 (g/mL) G Lab File ID: H73FC883

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: not dec. 23 Date Analyzed: 09/12/00

GC Column: HP-VOC ID: 0.20 (mm) Dilution Factor: 1.0

Soil Extract Volume:_________(mL) Soil Aliquot Volume: _______(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	7	U uJ
75-01-4	Vinyl Chloride	7	U uJ
74-83-9	Bromomethane	7	U
75-00-3	Chloroethane	7	U
75-35-4	1,1-Dichloroethene	7	U
67-64-1	Acetone	27	B JB
75-15-0	Carbon Disulfide	7	U
75-09-2	Methylene Chloride	7	U
156-60-5	trans-1,2-Dichloroethene	7	U
75-34-3	1,1-Dichloroethane	7	U
156-59-2	cis-1,2-Dichloroethene	7	U
78-93-3	2-Butanone	9	J
67-66-3	Chloroform	7	U
71-55-6	1,1,1-Trichloroethane	7	U
56-23-5	Carbon Tetrachloride	7	U
71-43-2	Benzene	7	U
107-06-2	1,2-Dichloroethane	7	U
79-01-6	Trichloroethene	7	U
78-87-5	1,2-Dichloropropane	7	U
75-27-4	Bromodichloromethane	7	U
10061-01-5	cis-1,3-Dichloropropene	7	U
108-10-1	4-Methyl-2-Pentanone	7	U
108-88-3	Toluene	7	U

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1B
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUC1B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL

Lab Sample ID: 00092519

Sample wt/vol: 4.6(g/mL) G

Lab File ID: H73FC883

Level: (low/med) LOW

Date Received: 09/01/00

% Moisture: not dec. 23

Date Analyzed: 09/12/00

GC Column: HP-VOC ID: 0.20 (mm)

Dilution Factor: 1.0

Soil Extract Volume:________(mL)

Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
10061-02-6	trans-1,3-Dichloropropene	7	U
79-00-5	1,1,2-Trichloroethane	7	U
127-18-4	Tetrachloroethene	7	U
591-78-6	2-Hexanone	7	U
124-48-1	Dibromochloromethane	7	U
108-90-7	Chlorobenzene	7	U
100-41-4	Ethylbenzene	7	U
1330-20-7	Xylene (Total)	7	U
100-42-5	Styrene	7	U
75-25-2	Bromoform	7	U
79-34-5	1,1,2,2-Tetrachloroethane	7	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUL1C

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT

Lab Code: ENVSYS   Case No.: IT   SAS No.:   SDG No.: IT2

Matrix: (soil/water) SOIL   Lab Sample ID: 00092520

Sample wt/vol: 3.7 (g/mL) G   Lab File ID: H73FC881

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: not dec. 19   Date Analyzed: 09/12/00

GC Column: HP-VOC   ID: 0.20 (mm)   Dilution Factor: 1.0

Soil Extract Volume:__________(mL)   Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	8	U uJ
75-01-4	Vinyl Chloride	8	U uJ
74-83-9	Bromomethane	8	U
75-00-3	Chloroethane	8	U
75-35-4	1,1-Dichloroethene	8	U
67-64-1	Acetone	35	B J
75-15-0	Carbon Disulfide	8	U
75-09-2	Methylene Chloride	8	J J
156-60-5	trans-1,2-Dichloroethene	8	U
75-34-3	1,1-Dichloroethane	8	U
156-59-2	cis-1,2-Dichloroethene	8	U
78-93-3	2-Butanone	8	U uJ
67-66-3	Chloroform	8	U
71-55-6	1,1,1-Trichloroethane	8	U
56-23-5	Carbon Tetrachloride	8	U
71-43-2	Benzene	8	U
107-06-2	1,2-Dichloroethane	8	U
79-01-6	Trichloroethene	8	U
78-87-5	1,2-Dichloropropane	8	U
75-27-4	Bromodichloromethane	8	U
10061-01-5	cis-1,3-Dichloropropene	8	U
108-10-1	4-Methyl-2-Pentanone	5	J J
108-88-3	Toluene	8	U

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1B
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUL1C

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT

Lab Code: ENVSYS   Case No.: IT   SAS No.:   SDG No.: IT2

Matrix: (soil/water) SOIL   Lab Sample ID: 00092520

Sample wt/vol: 3.7(g/mL) G   Lab File ID: H73FC881

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: not dec. 19   Date Analyzed: 09/12/00

GC Column: HP-VOC   ID: 0.20 (mm)   Dilution Factor: 1.0

Soil Extract Volume:__________(mL)   Soil Aliquot Volume: _________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
10061-02-6	trans-1,3-Dichloropropene	8	U
79-00-5	1,1,2-Trichloroethane	8	U
127-18-4	Tetrachloroethene	8	U
591-78-6	2-Hexanone	8	U
124-48-1	Dibromochloromethane	8	U
108-90-7	Chlorobenzene	8	U
100-41-4	Ethylbenzene	8	U
1330-20-7	Xylene (Total)	8	U
100-42-5	Styrene	8	U
75-25-2	Bromoform	8	U
79-34-5	1,1,2,2-Tetrachloroethane	8	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
NRUL1C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092520

Sample wt/vol: 3.7 (g/mL) G Lab File ID: H73FC881

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: not dec. 19 Date Analyzed: 09/12/00

GC Column: HP-VOC ID: 0.20 (mm) Dilution Factor: 1.0

Soil Extract Volume:_______(mL) Soil Aliquot Volume: _______(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 0

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUL1B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092522

Sample wt/vol: 4.7(g/mL) G Lab File ID: H73FC880

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: not dec. 16 Date Analyzed: 09/12/00

GC Column: HP-VOC ID: 0.20 (mm) Dilution Factor: 1.0

Soil Extract Volume:__________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	6	U uJ
75-01-4	Vinyl Chloride	6	U uJ
74-83-9	Bromomethane	6	U
75-00-3	Chloroethane	6	U
75-35-4	1,1-Dichloroethene	6	U
67-64-1	Acetone	54	B JB
75-15-0	Carbon Disulfide	6	U
75-09-2	Methylene Chloride	5	J J
156-60-5	trans-1,2-Dichloroethene	6	U
75-34-3	1,1-Dichloroethane	6	U
156-59-2	cis-1,2-Dichloroethene	6	U
78-93-3	2-Butanone	6	U uJ
67-66-3	Chloroform	6	U
71-55-6	1,1,1-Trichloroethane	6	U
56-23-5	Carbon Tetrachloride	6	U
71-43-2	Benzene	6	U
107-06-2	1,2-Dichloroethane	6	U
79-01-6	Trichloroethene	6	U
78-87-5	1,2-Dichloropropane	6	U
75-27-4	Bromodichloromethane	6	U
10061-01-5	cis-1,3-Dichloropropene	6	U
108-10-1	4-Methyl-2-Pentanone	6	U
108-88-3	Toluene	6	U

FORM I, COPY

1B
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUL1B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092522

Sample wt/vol: 4.7 (g/mL) G Lab File ID: H73FC880

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: not dec. 16 Date Analyzed: 09/12/00

GC Column: HP-VOC ID: 0.20 (mm) Dilution Factor: 1.0

Soil Extract Volume:__________(mL) Soil Aliquot Volume: __________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
10061-02-6	trans-1,3-Dichloropropene	6	U
79-00-5	1,1,2-Trichloroethane	6	U
127-18-4	Tetrachloroethene	6	U
591-78-6	2-Hexanone	6	U
124-48-1	Dibromochloromethane	6	U
108-90-7	Chlorobenzene	6	U
100-41-4	Ethylbenzene	6	U
1330-20-7	Xylene (Total)	6	U
100-42-5	Styrene	6	U
75-25-2	Bromoform	6	U
79-34-5	1,1,2,2-Tetrachloroethane	6	U

FORM I, COPY

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUL1B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092522

Sample wt/vol: 4.7 (g/mL) G Lab File ID: H73FC880

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: not dec. 16 Date Analyzed: 09/12/00

GC Column: HP-VOC ID: 0.20 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
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FORM I VOA-TIC OLM04.2

FORM I, COPY

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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2B

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT

Lab Code: ENVSYS   Case No.: IT   SAS No.:   SDG No.: IT2

Matrix: (soil/water) SOIL   Lab Sample ID: 00092524

Sample wt/vol: 4.2 (g/mL) G   Lab File ID: H73FC894

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: not dec. 11   Date Analyzed: 09/13/00

GC Column: HP-VOC   ID: 0.20 (mm)   Dilution Factor: 1.0

Soil Extract Volume:_________(mL)   Soil Aliquot Volume: _________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	7	U uJ
75-01-4	Vinyl Chloride	7	U uJ
74-83-9	Bromomethane	7	U
75-00-3	Chloroethane	7	U
75-35-4	1,1-Dichloroethene	7	U
67-64-1	Acetone	120	B JB
75-15-0	Carbon Disulfide	7	U
75-09-2	Methylene Chloride	4	J
156-60-5	trans-1,2-Dichloroethene	7	U
75-34-3	1,1-Dichloroethane	7	U
156-59-2	cis-1,2-Dichloroethene	7	U
78-93-3	2-Butanone	14	J
67-66-3	Chloroform	7	U
71-55-6	1,1,1-Trichloroethane	7	U
56-23-5	Carbon Tetrachloride	7	U
71-43-2	Benzene	7	U
107-06-2	1,2-Dichloroethane	7	U
79-01-6	Trichloroethene	7	U
78-87-5	1,2-Dichloropropane	7	U
75-27-4	Bromodichloromethane	7	U
10061-01-5	cis-1,3-Dichloropropene	7	U
108-10-1	4-Methyl-2-Pentanone	7	U
108-88-3	Toluene	7	U

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EPA SAMPLE NO.

NRUG2B

1B
VOLATILE ORGANICS ANALYSIS DATA SHEET

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT

Lab Code: ENVSYS   Case No.: IT   SAS No.:   SDG No.: IT2

Matrix: (soil/water) SOIL   Lab Sample ID: 00092524

Sample wt/vol: 4.2 (g/mL) G   Lab File ID: H73FC894

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: not dec. 11   Date Analyzed: 09/13/00

GC Column: HP-VOC   ID: 0.20 (mm)   Dilution Factor: 1.0

Soil Extract Volume:__________(mL)   Soil Aliquot Volume: _________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
10061-02-6	trans-1,3-Dichloropropene	7	U
79-00-5	1,1,2-Trichloroethane	7	U
127-18-4	Tetrachloroethene	7	U
591-78-6	2-Hexanone	7	U
124-48-1	Dibromochloromethane	7	U
108-90-7	Chlorobenzene	7	U
100-41-4	Ethylbenzene	7	U
1330-20-7	Xylene (Total)	7	U
100-42-5	Styrene	7	U
75-25-2	Bromoform	7	U
79-34-5	1,1,2,2-Tetrachloroethane	7	U

Form I, copy.

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EPA SAMPLE NO.

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NRUG2B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092524

Sample wt/vol: 4.2 (g/mL) G Lab File ID: H73FC894

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: not dec. 11 Date Analyzed: 09/13/00

GC Column: HP-VOC ID: 0.20 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:

Number TICs found: 0 (ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
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MEMORANDUM

TO: Davida Trumbo

FROM: Kweku Acquah

SUBJECT: Radford Army Ammunition Plant Data Validation - Volatiles
Envirosystems Lab, SDG IT3

DATE: November 28, 2000

The purpose of this memorandum is to present the data validation report for the samples collected at the Radford Army Ammunition Plant during the August 30, 2000 sampling event. Samples were analyzed for volatile organic compounds (VOCs) using USEPA SOW method OLM 04.2 (May 1999). A total of four soil samples were validated. The sample IDs are:

Field Sample ID: NRUW1B NRUW1C NRUG2C NRUG2BD

Data were reviewed by Kweku Acquah and validated using a combination of method-specific criteria, laboratory SOP and the *Innovative Approaches to Data Validation for USEPA Region III* (June 1995). Parameters evaluated under data validation procedure Level M3 are presented in Table 1. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA Region III specifications.

Table 1. Laboratory Performance Criteria

Qualified		**Parameter**
Yes	**No**	
	X	Holding Times
	X	Instrument Performance Check
X		Initial Calibration
X		Continuing Calibration
X		Blank Analysis
	X	System Monitoring Compounds
	X	Laboratory Control Sample
	X	Internal Standards
X		Quantitation Verification

The quality of data collected in support of this sampling activity is considered acceptable with the noted qualifications.

cc:

Eric Malarek
Project File

RADFORD ARMY AMMUNITION PLANT
VALIDATION REPORT
VOLATILES REVIEW
SDG IT3

I-Holding Times

Form I.

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of analysis. Holding time criteria: For soil samples preserved and cooled @ 4°C ± 2°C, the maximum holding time is 14 days from sample collection to analysis.

- Holding time criteria were met. No qualifiers were applied.

II-Instrument Performance Check

Form V

The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples are analyzed. The instrument performance check solution, bromofluorobenzene (BFB), must meet the specified ion abundance criteria.

- All criteria were met. No qualifiers were applied.

III-Initial Calibration

Form VI and chromatograms.

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used is capable of producing acceptable qualitative and quantitative data for volatile target compounds. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve. The minimum relative response factor (RRF) must be ≥ 0.05. Percent relative standard deviation (%RSD) must be ≤ 15% for each target compound and must be ≤ 30% for each calibration check compound.

- For initial calibration performed on 09/12/00 on instrument HP73F, %RSD for compounds Bromomethane (22.2%), Chloroethane (27.2%), 1,1-Dichloroethene (16.2%), Methylene Chloride (25.4%), 2-Butanone (21.9%) and 2-Hexanone (16.8%) were above the control limit. Positive values for these compounds were qualified as estimated, "J", and non-detects had no qualifiers applied.

- For initial calibration performed on 09/12/00 on instrument HP73F, %RSD for compounds Chloromethane (36.6%) and Acetone (33.3%), were grossly above the control limit (i.e > 30%). Positive values for these compounds were qualified as estimated, "J" and non-detects "UJ".

IV-Continuing Calibration

Form VII and chromatograms.

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used is capable of producing acceptable qualitative and quantitative data for volatile target compounds. Continuing calibration establishes the 12-hour relative response factors on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis. The percent difference (%D) between the initial calibration RRF and the continuing calibration RRF must be within 20% for all target compounds.

IV-Continuing Calibration (Cont.)

- For continuing calibration performed on 09/12/00 @15:30 on instrument HP73F, %D for Chloromethane (21.6%) was above the control limit. Since this compound was a non-detect in all the samples and had been qualified "UJ" owing to an initial calibration criteria failure, no qualifiers were applied based on this outlier.

- For continuing calibration performed on 09/13/00 @10:14 on instrument HP73F, %D for compounds Chloroethane (21.7%), 2-Butanone (39.7%), 4-Methyl-2-Pentanone (26.6%), 2-Hexanone (37.1%) and 1,1,2,2-Tetrachloroethane (29.0%) were outside of the control criteria. Positive values for these compounds were qualified as estimated, "J" and non-detects had no qualifiers applied.

- For continuing calibration performed on 09/13/00 @10:14 on instrument HP73F, %D for compounds Chloromethane (50.2%), Vinyl Chloride (50.5%), and Acetone (49.0%) were grossly above the control limit (i.e >40%). Positive values for these compounds were qualified as estimated, "J" and non-detects "UJ".

V-Blank Analysis
Form I, IV and chromatograms
The purpose of blank analyses is to determine the presence and magnitude of contamination problems resulting from field and laboratory activities. A method blank analysis must be performed after the calibration standards and once every 12-hour time period beginning with the injection of BFB. No contaminants should be detected in any of the associated blanks. Positive sample results are reported and qualified "B", if the concentration of the compound in the sample is ≤ 10 times (10x) the maximum amount in any blank for the common laboratory contaminants methylene chloride, acetone and 2-butanone, or 5 times (5X) the maximum amount for other volatile target compounds. The associated rinse blank is sample number 082800R1. Table 2 summarizes the blank contamination analysis.

TABLE 2. BLANK CONTAMINATION SUMMARY.

Compound / Blank Sample #	**5X Max. conc. µg/kg**	**10X Max. conc. µg/kg**	**Samples Affected**
Acetone / 082800R1	N/A	440	All

VI-System Monitoring Compounds (Surrogates)
Form II and chromatograms.
Laboratory performance on individual samples is established by means of spiking activities. The system monitoring compounds are added to all samples and blanks to measure their recovery. Percent Recoveries (%Rs) must be within the specified control limits.

Control Limits: Toluene-d8 (84-138%)
4-Bromofluorobenzene (59-113%)
1,2-Dichloroethane-d4 (70-121%)

- All criteria were met. No qualifiers were applied.

VII-Laboratory Control Samples

Form III and chromatograms.

Data for laboratory control samples are generated to determine long-term precision and accuracy of the analytical method. Laboratory control samples should be analyzed at a frequency of 1 per 20 samples or analytical batch for each matrix. Percent Recoveries (%Rs) must be within the specified control limits of 60-140%.

- All criteria were met. No qualifiers were applied.

VIII-Internal Standards

Form VII and chromatograms.

Internal Standards performance check ensures that GC/MS sensitivity and response are stable during each analytical run. Specific criteria include area count of –50% to +100% and retention time of ±30 seconds from the associated calibration standards.

- All criteria were met. No qualifiers were applied.

IX-Quantitation Verification

Form 1 and chromatograms.

The accuracy of analytical results is verified through the calculation of several parameters. Any positive value < RL and > MDL is reported as estimated "J." The percent difference (%D) between the calculated and the reported value should be within 10%.

Sample: NRUW1B (00092529), 2-Butanone

Conc. µg/kg = (Ax * Is ng * Vt mL * DF) / (Ais * RRF * Va * Ws gm * Fs)

where:

Ax is the compound area
Is is the amount of internal standard injected (ng)
Vt is the total volume of the methanol extract (mL)
DF is the dilution factor
Ais is the corresponding internal standard area
RRF is the continuing calibration average relative response factor
Va is the volume of the aliquot of the methanol extract (mL)
Ws is the weight of the sample (g)
Fs is the fraction of solid [(100-%moisure)/100]

Conc. = 23995*50 ng*5 mL*1/258455*0.617*1 mL*4.56 g*0.79 = 10 µg/kg

Reported conc. = 10 µg/kg
%D = 0%
Values were within 10% difference.

Form I, copy

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EPA SAMPLE NO.

VOLATILE ORGANICS ANALYSIS DATA SHEET

NRUW1B

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT

Lab Code: ENVSYS   Case No.: IT3   SAS No.:   SDG No.: IT3

Matrix: (soil/water) SOIL   Lab Sample ID: 00092529

Sample wt/vol: 4.6 (g/mL) G   Lab File ID: H73FC895

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: not dec. 21   Date Analyzed: 09/13/00

GC Column: HP-VOC   ID: 0.20 (mm)   Dilution Factor: 1.0

Soil Extract Volume:__________(mL)   Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	7	U UJ
75-01-4	Vinyl Chloride	7	U UJ
74-83-9	Bromomethane	7	U
75-00-3	Chloroethane	7	U
75-35-4	1,1-Dichloroethene	7	U
67-64-1	Acetone	110	B JB
75-15-0	Carbon Disulfide	7	U
75-09-2	Methylene Chloride	5	J J
156-60-5	trans-1,2-Dichloroethene	7	U
75-34-3	1,1-Dichloroethane	7	U
156-59-2	cis-1,2-Dichloroethene	7	U
78-93-3	2-Butanone	10	J
67-66-3	Chloroform	7	U
71-55-6	1,1,1-Trichloroethane	7	U
56-23-5	Carbon Tetrachloride	7	U
71-43-2	Benzene	7	U
107-06-2	1,2-Dichloroethane	7	U
79-01-6	Trichloroethene	7	U
78-87-5	1,2-Dichloropropane	7	U
75-27-4	Bromodichloromethane	7	U
10061-01-5	cis-1,3-Dichloropropene	7	U
108-10-1	4-Methyl-2-Pentanone	7	U
108-88-3	Toluene	7	U

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1B

EPA SAMPLE NO.

VOLATILE ORGANICS ANALYSIS DATA SHEET

NRUW1B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092529

Sample wt/vol: 4.6 (g/mL) G Lab File ID: H73FC895

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: not dec. 21 Date Analyzed: 09/13/00

GC Column: HP-VOC ID: 0.20 (mm) Dilution Factor: 1.0

Soil Extract Volume:__________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
10061-02-6	trans-1,3-Dichloropropene	7	U
79-00-5	1,1,2-Trichloroethane	7	U
127-18-4	Tetrachloroethene	7	U
591-78-6	2-Hexanone	7	U
124-48-1	Dibromochloromethane	7	U
108-90-7	Chlorobenzene	7	U
100-41-4	Ethylbenzene	7	U
1330-20-7	Xylene (Total)	7	U
100-42-5	Styrene	7	U
75-25-2	Bromoform	7	U
79-34-5	1,1,2,2-Tetrachloroethane	7	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUW1B

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT

Lab Code: ENVSYS   Case No.: IT3   SAS No.:   SDG No.: IT3

Matrix: (soil/water) SOIL   Lab Sample ID: 00092529

Sample wt/vol: 4.6 (g/mL) G   Lab File ID: H73FC895

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: not dec. 21   Date Analyzed: 09/13/00

GC Column: HP-VOC   ID: 0.20 (mm)   Dilution Factor: 1.0

Soil Extract Volume:________(mL)   Soil Aliquot Volume: ________(uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUW1C

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT

Lab Code: ENVSYS   Case No.: IT3   SAS No.:   SDG No.: IT3

Matrix: (soil/water) SOIL   Lab Sample ID: 00092530

Sample wt/vol: 4.3 (g/mL) G   Lab File ID: H73FC896

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: not dec. 25   Date Analyzed: 09/13/00

GC Column: HP-VOC   ID: 0.20 (mm)   Dilution Factor: 1.0

Soil Extract Volume:_________(mL)   Soil Aliquot Volume: _______(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND	UG/KG	Q
74-87-3	Chloromethane	8	U uJ
75-01-4	Vinyl Chloride	8	U uJ
74-83-9	Bromomethane	8	U
75-00-3	Chloroethane	8	U
75-35-4	1,1-Dichloroethene	8	U
67-64-1	Acetone	31	B JB
75-15-0	Carbon Disulfide	8	U
75-09-2	Methylene Chloride	7	J J
156-60-5	trans-1,2-Dichloroethene	8	U
75-34-3	1,1-Dichloroethane	8	U
156-59-2	cis-1,2-Dichloroethene	8	U
78-93-3	2-Butanone	8	J
67-66-3	Chloroform	8	U
71-55-6	1,1,1-Trichloroethane	8	U
56-23-5	Carbon Tetrachloride	8	U
71-43-2	Benzene	8	U
107-06-2	1,2-Dichloroethane	8	U
79-01-6	Trichloroethene	8	U
78-87-5	1,2-Dichloropropane	8	U
75-27-4	Bromodichloromethane	8	U
10061-01-5	cis-1,3-Dichloropropene	8	U
108-10-1	4-Methyl-2-Pentanone	8	U
108-88-3	Toluene	8	U

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1B
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUW1C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092530

Sample wt/vol: 4.3 (g/mL) G Lab File ID: H73FC896

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: not dec. 25 Date Analyzed: 09/13/00

GC Column: HP-VOC ID: 0.20 (mm) Dilution Factor: 1.0

Soil Extract Volume:__________(mL) Soil Aliquot Volume: __________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
10061-02-6	trans-1,3-Dichloropropene	8	U
79-00-5	1,1,2-Trichloroethane	8	U
127-18-4	Tetrachloroethene	8	U
591-78-6	2-Hexanone	8	U
124-48-1	Dibromochloromethane	8	U
108-90-7	Chlorobenzene	8	U
100-41-4	Ethylbenzene	8	U
1330-20-7	Xylene (Total)	8	U
100-42-5	Styrene	8	U
75-25-2	Bromoform	8	U
79-34-5	1,1,2,2-Tetrachloroethane	8	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUW1C

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT

Lab Code: ENVSYS   Case No.: IT3   SAS No.:   SDG No.: IT3

Matrix: (soil/water) SOIL   Lab Sample ID: 00092530

Sample wt/vol: 4.3 (g/mL) G   Lab File ID: H73FC896

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: not dec. 25   Date Analyzed: 09/13/00

GC Column: HP-VOC   ID: 0.20 (mm)   Dilution Factor: 1.0

Soil Extract Volume:________(mL)   Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 0

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
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FORM I VOA-TIC   OLM04.2

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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092532

Sample wt/vol: 5.0(g/mL) G Lab File ID: H73FC897

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: not dec. 28 Date Analyzed: 09/13/00

GC Column: HP-VOC ID: 0.20 (mm) Dilution Factor: 1.0

Soil Extract Volume:__________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	7	U UJ
75-01-4	Vinyl Chloride	7	U UJ
74-83-9	Bromomethane	7	U
75-00-3	Chloroethane	7	U
75-35-4	1,1-Dichloroethene	7	U
67-64-1	Acetone	130	B JB
75-15-0	Carbon Disulfide	7	U
75-09-2	Methylene Chloride	7	U
156-60-5	trans-1,2-Dichloroethene	7	U
75-34-3	1,1-Dichloroethane	7	U
156-59-2	cis-1,2-Dichloroethene	7	U
78-93-3	2-Butanone	17	J
67-66-3	Chloroform	7	U
71-55-6	1,1,1-Trichloroethane	7	U
56-23-5	Carbon Tetrachloride	7	U
71-43-2	Benzene	7	U
107-06-2	1,2-Dichloroethane	7	U
79-01-6	Trichloroethene	7	U
78-87-5	1,2-Dichloropropane	7	U
75-27-4	Bromodichloromethane	7	U
10061-01-5	cis-1,3-Dichloropropene	7	U
108-10-1	4-Methyl-2-Pentanone	7	U
108-88-3	Toluene	7	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092532

Sample wt/vol: 5.0(g/mL) G Lab File ID: H73FC897

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: not dec. 28 Date Analyzed: 09/13/00

GC Column: HP-VOC ID: 0.20 (mm) Dilution Factor: 1.0

Soil Extract Volume:__________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
10061-02-6	trans-1,3-Dichloropropene	7	U
79-00-5	1,1,2-Trichloroethane	7	U
127-18-4	Tetrachloroethene	7	U
591-78-6	2-Hexanone	7	U
124-48-1	Dibromochloromethane	7	U
108-90-7	Chlorobenzene	7	U
100-41-4	Ethylbenzene	7	U
1330-20-7	Xylene (Total)	7	U
100-42-5	Styrene	7	U
75-25-2	Bromoform	7	U
79-34-5	1,1,2,2-Tetrachloroethane	7	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUG2C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092532

Sample wt/vol: 5.0 (g/mL) G Lab File ID: H73FC897

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: not dec. 28 Date Analyzed: 09/13/00

GC Column: HP-VOC ID: 0.20 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 0

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2BD

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092536

Sample wt/vol: 4.6(g/mL) G Lab File ID: H73FC898

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: not dec. 11 Date Analyzed: 09/13/00

GC Column: HP-VOC ID: 0.20 (mm) Dilution Factor: 1.0

Soil Extract Volume:__________(mL) Soil Aliquot Volume: __________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	6	U UJ
75-01-4	Vinyl Chloride	6	U UJ
74-83-9	Bromomethane	6	U
75-00-3	Chloroethane	6	U
75-35-4	1,1-Dichloroethene	6	U
67-64-1	Acetone	140	B JB
75-15-0	Carbon Disulfide	6	U
75-09-2	Methylene Chloride	4	J J
156-60-5	trans-1,2-Dichloroethene	6	U
75-34-3	1,1-Dichloroethane	6	U
156-59-2	cis-1,2-Dichloroethene	6	U
78-93-3	2-Butanone	16	J
67-66-3	Chloroform	6	U
71-55-6	1,1,1-Trichloroethane	6	U
56-23-5	Carbon Tetrachloride	6	U
71-43-2	Benzene	6	U
107-06-2	1,2-Dichloroethane	6	U
79-01-6	Trichloroethene	6	U
78-87-5	1,2-Dichloropropane	6	U
75-27-4	Bromodichloromethane	6	U
10061-01-5	cis-1,3-Dichloropropene	6	U
108-10-1	4-Methyl-2-Pentanone	6	U
108-88-3	Toluene	6	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2BD

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092536

Sample wt/vol: 4.6(g/mL) G Lab File ID: H73FC898

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: not dec. 11 Date Analyzed: 09/13/00

GC Column: HP-VOC ID: 0.20 (mm) Dilution Factor: 1.0

Soil Extract Volume:_________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
10061-02-6	trans-1,3-Dichloropropene	6	U
79-00-5	1,1,2-Trichloroethane	6	U
127-18-4	Tetrachloroethene	6	U
591-78-6	2-Hexanone	6	U
124-48-1	Dibromochloromethane	6	U
108-90-7	Chlorobenzene	6	U
100-41-4	Ethylbenzene	6	U
1330-20-7	Xylene (Total)	6	U
100-42-5	Styrene	6	U
75-25-2	Bromoform	6	U
79-34-5	1,1,2,2-Tetrachloroethane	6	U

FORM I, COPY

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUG2BD

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT

Lab Code: ENVSYS   Case No.: IT3   SAS No.:   SDG No.: IT3

Matrix: (soil/water) SOIL   Lab Sample ID: 00092536

Sample wt/vol: 4.6 (g/mL) G   Lab File ID: H73FC898

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: not dec. 11   Date Analyzed: 09/13/00

GC Column: HP-VOC   ID: 0.20 (mm)   Dilution Factor: 1.0

Soil Extract Volume:________(mL)   Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 0

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
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FORM I VOA-TIC   OLM04.2

MEMORANDUM

TO: Davida Trumbo

FROM: Kweku Acquah

SUBJECT: Radford Army Ammunition Plant Data Validation - Volatiles
Envirosystems Lab, SDG IT5

DATE: November 28, 2000

The purpose of this memorandum is to present the data validation report for the samples collected at the Radford Army Ammunition Plant during the September 6-7, 2000 sampling events. Samples were analyzed for volatile organic compounds (VOCs) using USEPA SOW method OLM 04.2 (May 1999). A total of six soil samples were validated. The sample IDs are:

Field Sample ID
MMAB3B
MMAW2B
MMAW2C
MMAW2CD
MMAU1B
MMAU1C

Data were reviewed by Kweku Acquah and validated using a combination of method-specific criteria, laboratory SOP and the *Innovative Approaches to Data Validation for USEPA Region III* (June 1995.) Parameters evaluated under data validation procedure Level M3 are presented in Table 1. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA Region III specifications.

Table 1. Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times
	X	Instrument Performance Check
	X	Initial Calibration
	X	Continuing Calibration
	X	Blank Analysis
	X	System Monitoring Compounds
	X	Matrix Spike/Matrix Spike Duplicate
	X	Internal Standards
X		Quantitation Verification

The quality of data collected in support of this sampling activity is considered acceptable with the noted qualification.

cc: Eric Malarek
Project File

RADFORD ARMY AMMUNITION PLANT
VALIDATION REPORT
VOLATILES REVIEW
SDG IT5

I-Holding Times

Form I.

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of analysis. Holding time criteria: For soil samples preserved and cooled @ 4°C ± 2°C, the maximum holding time is 14 days from sample collection to analysis.

- Holding time criteria were met. No qualifiers were applied.

II-Instrument Performance Check

Form V

The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples are analyzed. The instrument performance check solution, bromofluorobenzene (BFB), must meet the specified ion abundance criteria.

- All criteria were met. No qualifiers were applied.

III-Initial Calibration

Form VI and chromatograms.

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used is capable of producing acceptable qualitative and quantitative data for volatile target compounds. Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve. The minimum relative response factor (RRF) must be ≥ 0.05. Percent relative standard deviation (%RSD) must be ≤ 15% for each target compound and must be ≤ 30% for each calibration check compound.

- For initial calibration performed on 09/19/00 on instrument HP73F, Acetone (18.3%) was above the control limit. Since this compound was a non-detect in all the samples, no qualifiers were applied based on this outlier.

IV-Continuing Calibration

Form VII and chromatograms.

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used is capable of producing acceptable qualitative and quantitative data for volatile target compounds. Continuing calibration establishes the 12-hour relative response factors on which the quantitations are based and checks satisfactory performance of the instrument on a day-to-day basis. The percent difference (%D) between the initial calibration RRF and the continuing calibration RRF must be within 20% for all target compounds.

- For continuing calibration performed on 09/19/00 @15:39 on instrument HP73F, all criteria were met. No qualifiers were applied.

V-Blank Analysis

Form I, IV and chromatograms

The purpose of blank analyses is to determine the presence and magnitude of contamination problems resulting from field and laboratory activities. A method blank analysis must be performed after the calibration standards and once every 12-hour time period beginning with the injection of BFB. No contaminants should be detected in any of the associated blanks. Positive sample results are reported and qualified "B", if the concentration of the compound in the sample is ≤ 10 times (10x) the maximum amount in any blank for the common laboratory contaminants methylene chloride, acetone and 2-butnone, or 5 times (5X) the maximum amount for other volatile target compounds. The associated rinse blank is sample number 083100R4.

- There was a blank contamination of 4 µg/kg for compound 2-Hexanone (VBLKFF). Since this compound was a non-detect in all the samples, no qualifiers were applied based on this outlier.

VI-System Monitoring Compounds (Surrogates)

Form II and chromatograms.

Laboratory performance on individual samples is established by means of spiking activities. The system monitoring compounds are added to all samples and blanks to measure their recovery. Percent Recoveries (%Rs) must be within the specified control limits.

Control Limits: Toluene-d8 (84-138%)
4-Bromofluorobenzene (59-113%)
1,2-Dichloroethane-d4 (70-121%)

- All criteria were met. No qualifiers were applied.

VII-Matrix Spike/Matrix Spike Duplicate

Form III and chromatograms.

Data for Matrix Spike/Matrix Spike Duplicates are generated to determine long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. The percent recoveries (%Rs) and the relative percent difference (RPD) must be within the specified control limits.

- Sample MMAW2BD (00092621) was used for the MS/MSD analysis. All criteria were met. No qualifiers were applied.

VIII-Internal Standards

Form VII and chromatograms.

Internal Standards performance check ensures that GC/MS sensitivity and response are stable during each analytical run. Specific criteria include area count of –50% to +100% and retention time of ±30 seconds from the associated calibration standards.

- All criteria were met. No qualifiers were applied.

IX-Quantitation Verification

Form 1 and chromatograms.

The accuracy of analytical results is verified through the calculation of several parameters. Any positive value <RL and >MDL is reported as estimated "J." The percent Difference (%D) between the calculated and the reported value should be within 10%.

IX-Quantitation Verification (Cont.)

Sample: MMAW2BMS (00092621)), Chlorobenzene

Conc. µg/kg = (Ax * Is ng * Vt mL * DF) / (Ais * RRF * Va * Ws gm * Fs)

where:

Ax is the compound area
Is is the amount of internal standard injected (ng)
Vt is the total volume of the methanol extract (mL)
DF is the dilution factor
Ais is the corresponding internal standard area
RRF is the continuing calibration average relative response factor
Va is the volume of the aliquot of the methanol extract (µL)
Ws is the weight of the sample (g)
Fs is the fraction of solid [(100-%moisure)/100]

Conc. = (555436 * 50*5 * 1) / (585556 * 1.092 *1 * 5.10 *0.89) = 48 µg/kg

Reported conc. = 48 µg/kg
%D = 0%
Values were within 10% difference.

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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAB3B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092619

Sample wt/vol: 5.3 (g/mL) G Lab File ID: H73FC943

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: not dec. 9 Date Analyzed: 09/19/00

GC Column: HP-VOC ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:__________(mL) Soil Aliquot Volume: __________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	5	U
75-01-4	Vinyl Chloride	5	U
74-83-9	Bromomethane	5	U
75-00-3	Chloroethane	5	U
75-35-4	1,1-Dichloroethene	5	U
67-64-1	Acetone	5	U
75-15-0	Carbon Disulfide	5	U
75-09-2	Methylene Chloride	5	U
156-60-5	trans-1,2-Dichloroethene	5	U
75-34-3	1,1-Dichloroethane	5	U
156-59-2	cis-1,2-Dichloroethene	5	U
78-93-3	2-Butanone	5	U
67-66-3	Chloroform	5	U
71-55-6	1,1,1-Trichloroethane	5	U
56-23-5	Carbon Tetrachloride	5	U
71-43-2	Benzene	5	U
107-06-2	1,2-Dichloroethane	5	U
79-01-6	Trichloroethene	5	U
78-87-5	1,2-Dichloropropane	5	U
75-27-4	Bromodichloromethane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
108-10-1	4-Methyl-2-Pentanone	5	U
108-88-3	Toluene	5	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAB3B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092619

Sample wt/vol: 5.3 (g/mL) G Lab File ID: H73FC943

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: not dec. 9 Date Analyzed: 09/19/00

GC Column: HP-VOC ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
10061-02-6	trans-1,3-Dichloropropene	5	U
79-00-5	1,1,2-Trichloroethane	5	U
127-18-4	Tetrachloroethene	5	U
591-78-6	2-Hexanone	5	U
124-48-1	Dibromochloromethane	5	U
108-90-7	Chlorobenzene	5	U
100-41-4	Ethylbenzene	5	U
1330-20-7	Xylene (Total)	5	U
100-42-5	Styrene	5	U
75-25-2	Bromoform	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

MMAB3B

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT

Lab Code: ENVSYS   Case No.: IT5   SAS No.:   SDG No.: IT5

Matrix: (soil/water) SOIL   Lab Sample ID: 00092619

Sample wt/vol: 5.3 (g/mL) G   Lab File ID: H73FC943

Level: (low/med) LOW   Date Received: 09/08/00

% Moisture: not dec. 9   Date Analyzed: 09/19/00

GC Column: HP-VOC   ID: 0.25 (mm)   Dilution Factor: 1.0

Soil Extract Volume:________(mL)   Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 0

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAW2B

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT

Lab Code: ENVSYS   Case No.: IT5   SAS No.:   SDG No.: IT5

Matrix: (soil/water) SOIL   Lab Sample ID: 00092621

Sample wt/vol: 4.8 (g/mL) G   Lab File ID: H73FC944

Level: (low/med) LOW   Date Received: 09/08/00

% Moisture: not dec. 11   Date Analyzed: 09/19/00

GC Column: HP-VOC   ID: 0.25 (mm)   Dilution Factor: 1.0

Soil Extract Volume:__________(mL)   Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	6	U
75-01-4	Vinyl Chloride	6	U
74-83-9	Bromomethane	6	U
75-00-3	Chloroethane	6	U
75-35-4	1,1-Dichloroethene	6	U
67-64-1	Acetone	6	U
75-15-0	Carbon Disulfide	6	U
75-09-2	Methylene Chloride	6	U
156-60-5	trans-1,2-Dichloroethene	6	U
75-34-3	1,1-Dichloroethane	6	U
156-59-2	cis-1,2-Dichloroethene	6	U
78-93-3	2-Butanone	6	U
67-66-3	Chloroform	6	U
71-55-6	1,1,1-Trichloroethane	6	U
56-23-5	Carbon Tetrachloride	6	U
71-43-2	Benzene	6	U
107-06-2	1,2-Dichloroethane	6	U
79-01-6	Trichloroethene	6	U
78-87-5	1,2-Dichloropropane	6	U
75-27-4	Bromodichloromethane	6	U
10061-01-5	cis-1,3-Dichloropropene	6	U
108-10-1	4-Methyl-2-Pentanone	6	U
108-88-3	Toluene	6	U

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1B
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAW2B

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT

Lab Code: ENVSYS   Case No.: IT5   SAS No.:   SDG No.: IT5

Matrix: (soil/water) SOIL   Lab Sample ID: 00092621

Sample wt/vol: 4.8 (g/mL) G   Lab File ID: H73FC944

Level: (low/med) LOW   Date Received: 09/08/00

% Moisture: not dec. 11   Date Analyzed: 09/19/00

GC Column: HP-VOC   ID: 0.25 (mm)   Dilution Factor: 1.0

Soil Extract Volume: ________ (mL)   Soil Aliquot Volume: ________ (uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
10061-02-6	trans-1,3-Dichloropropene	6	U
79-00-5	1,1,2-Trichloroethane	6	U
127-18-4	Tetrachloroethene	6	U
591-78-6	2-Hexanone	6	U
124-48-1	Dibromochloromethane	6	U
108-90-7	Chlorobenzene	6	U
100-41-4	Ethylbenzene	6	U
1330-20-7	Xylene (Total)	6	U
100-42-5	Styrene	6	U
75-25-2	Bromoform	6	U
79-34-5	1,1,2,2-Tetrachloroethane	6	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

MMAW2B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092621

Sample wt/vol: 4.8 (g/mL) G Lab File ID: H73FC944

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: not dec. 11 Date Analyzed: 09/19/00

GC Column: HP-VOC ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 0

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAW2C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092622

Sample wt/vol: 4.3 (g/mL) G Lab File ID: H73FC945

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: not dec. 11 Date Analyzed: 09/19/00

GC Column: HP-VOC ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:__________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	7	U
75-01-4	Vinyl Chloride	7	U
74-83-9	Bromomethane	7	U
75-00-3	Chloroethane	7	U
75-35-4	1,1-Dichloroethene	7	U
67-64-1	Acetone	7	U
75-15-0	Carbon Disulfide	7	U
75-09-2	Methylene Chloride	7	U
156-60-5	trans-1,2-Dichloroethene	7	U
75-34-3	1,1-Dichloroethane	7	U
156-59-2	cis-1,2-Dichloroethene	7	U
78-93-3	2-Butanone	7	U
67-66-3	Chloroform	7	U
71-55-6	1,1,1-Trichloroethane	7	U
56-23-5	Carbon Tetrachloride	7	U
71-43-2	Benzene	7	U
107-06-2	1,2-Dichloroethane	7	U
79-01-6	Trichloroethene	7	U
78-87-5	1,2-Dichloropropane	7	U
75-27-4	Bromodichloromethane	7	U
10061-01-5	cis-1,3-Dichloropropene	7	U
108-10-1	4-Methyl-2-Pentanone	6	J J
108-88-3	Toluene	7	U

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1B
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAW2C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092622

Sample wt/vol: 4.3 (g/mL) G Lab File ID: H73FC945

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: not dec. 11 Date Analyzed: 09/19/00

GC Column: HP-VOC ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:__________(mL) Soil Aliquot Volume: _________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
10061-02-6	trans-1,3-Dichloropropene	7	U
79-00-5	1,1,2-Trichloroethane	7	U
127-18-4	Tetrachloroethene	7	U
591-78-6	2-Hexanone	7	U
124-48-1	Dibromochloromethane	7	U
108-90-7	Chlorobenzene	7	U
100-41-4	Ethylbenzene	7	U
1330-20-7	Xylene (Total)	7	U
100-42-5	Styrene	7	U
75-25-2	Bromoform	7	U
79-34-5	1,1,2,2-Tetrachloroethane	7	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

MMAW2C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092622

Sample wt/vol: 4.3 (g/mL) G Lab File ID: H73FC945

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: not dec. 11 Date Analyzed: 09/19/00

GC Column: HP-VOC ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 0

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAW2CD

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092623

Sample wt/vol: 4.6 (g/mL) G Lab File ID: H73FC946

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: not dec. 11 Date Analyzed: 09/19/00

GC Column: HP-VOC ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:_________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	6	U
75-01-4	Vinyl Chloride	6	U
74-83-9	Bromomethane	6	U
75-00-3	Chloroethane	6	U
75-35-4	1,1-Dichloroethene	6	U
67-64-1	Acetone	6	U
75-15-0	Carbon Disulfide	6	U
75-09-2	Methylene Chloride	6	U
156-60-5	trans-1,2-Dichloroethene	6	U
75-34-3	1,1-Dichloroethane	6	U
156-59-2	cis-1,2-Dichloroethene	6	U
78-93-3	2-Butanone	6	U
67-66-3	Chloroform	6	U
71-55-6	1,1,1-Trichloroethane	6	U
56-23-5	Carbon Tetrachloride	6	U
71-43-2	Benzene	6	U
107-06-2	1,2-Dichloroethane	6	U
79-01-6	Trichloroethene	6	U
78-87-5	1,2-Dichloropropane	6	U
75-27-4	Bromodichloromethane	6	U
10061-01-5	cis-1,3-Dichloropropene	6	U
108-10-1	4-Methyl-2-Pentanone	6	U
108-88-3	Toluene	6	U

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EPA SAMPLE NO.

VOLATILE ORGANICS ANALYSIS DATA SHEET

MMAU1B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092628

Sample wt/vol: 5.0(g/mL) G Lab File ID: H73FC947

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: not dec. 17 Date Analyzed: 09/19/00

GC Column: HP-VOC ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:__________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	6	U
75-01-4	Vinyl Chloride	6	U
74-83-9	Bromomethane	6	U
75-00-3	Chloroethane	6	U
75-35-4	1,1-Dichloroethene	6	U
67-64-1	Acetone	6	U
75-15-0	Carbon Disulfide	6	U
75-09-2	Methylene Chloride	6	U
156-60-5	trans-1,2-Dichloroethene	6	U
75-34-3	1,1-Dichloroethane	6	U
156-59-2	cis-1,2-Dichloroethene	6	U
78-93-3	2-Butanone	6	U
67-66-3	Chloroform	6	U
71-55-6	1,1,1-Trichloroethane	6	U
56-23-5	Carbon Tetrachloride	6	U
71-43-2	Benzene	6	U
107-06-2	1,2-Dichloroethane	6	U
79-01-6	Trichloroethene	6	U
78-87-5	1,2-Dichloropropane	6	U
75-27-4	Bromodichloromethane	6	U
10061-01-5	cis-1,3-Dichloropropene	6	U
108-10-1	4-Methyl-2-Pentanone	6	U
108-88-3	Toluene	6	U

FORM I, COPY

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VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAU1B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092628

Sample wt/vol: 5.0 (g/mL) G Lab File ID: H73FC947

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: not dec. 17 Date Analyzed: 09/19/00

GC Column: HP-VOC ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
10061-02-6	trans-1,3-Dichloropropene	6	U
79-00-5	1,1,2-Trichloroethane	6	U
127-18-4	Tetrachloroethene	6	U
591-78-6	2-Hexanone	6	U
124-48-1	Dibromochloromethane	6	U
108-90-7	Chlorobenzene	6	U
100-41-4	Ethylbenzene	6	U
1330-20-7	Xylene (Total)	6	U
100-42-5	Styrene	6	U
75-25-2	Bromoform	6	U
79-34-5	1,1,2,2-Tetrachloroethane	6	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

MMAU1B

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT

Lab Code: ENVSYS   Case No.: IT5   SAS No.:   SDG No.: IT5

Matrix: (soil/water) SOIL   Lab Sample ID: 00092628

Sample wt/vol: 5.0 (g/mL) G   Lab File ID: H73FC947

Level: (low/med) LOW   Date Received: 09/08/00

% Moisture: not dec. 17   Date Analyzed: 09/19/00

GC Column: HP-VOC   ID: 0.25 (mm)   Dilution Factor: 1.0

Soil Extract Volume:________(mL)   Soil Aliquot Volume: ________(uL)

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.				
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FORM I, COPY

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAU1C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092629

Sample wt/vol: 4.0(g/mL) G Lab File ID: H73FC948

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: not dec. 16 Date Analyzed: 09/19/00

GC Column: HP-VOC ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:__________(mL) Soil Aliquot Volume: ________(uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
74-87-3	Chloromethane	7	U
75-01-4	Vinyl Chloride	7	U
74-83-9	Bromomethane	7	U
75-00-3	Chloroethane	7	U
75-35-4	1,1-Dichloroethene	7	U
67-64-1	Acetone	7	U
75-15-0	Carbon Disulfide	7	U
75-09-2	Methylene Chloride	7	U
156-60-5	trans-1,2-Dichloroethene	7	U
75-34-3	1,1-Dichloroethane	7	U
156-59-2	cis-1,2-Dichloroethene	7	U
78-93-3	2-Butanone	7	U
67-66-3	Chloroform	7	U
71-55-6	1,1,1-Trichloroethane	7	U
56-23-5	Carbon Tetrachloride	7	U
71-43-2	Benzene	7	U
107-06-2	1,2-Dichloroethane	7	U
79-01-6	Trichloroethene	7	U
78-87-5	1,2-Dichloropropane	7	U
75-27-4	Bromodichloromethane	7	U
10061-01-5	cis-1,3-Dichloropropene	7	U
108-10-1	4-Methyl-2-Pentanone	7	U
108-88-3	Toluene	7	U

FORM I, COPY

1B

VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAU1C

Lab Name: ENVIROSYSTEMS, INC.　　Contract: IT

Lab Code: ENVSYS　　Case No.: IT5　　SAS No.:　　SDG No.: IT5

Matrix: (soil/water) SOIL　　Lab Sample ID: 00092629

Sample wt/vol: 4.0 (g/mL) G　　Lab File ID: H73FC948

Level: (low/med) LOW　　Date Received: 09/08/00

% Moisture: not dec. 16　　Date Analyzed: 09/19/00

GC Column: HP-VOC　ID: 0.25 (mm)　　Dilution Factor: 1.0

Soil Extract Volume: ________ (mL)　　Soil Aliquot Volume: ________ (uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
10061-02-6	trans-1,3-Dichloropropene	7	U
79-00-5	1,1,2-Trichloroethane	7	U
127-18-4	Tetrachloroethene	7	U
591-78-6	2-Hexanone	7	U
124-48-1	Dibromochloromethane	7	U
108-90-7	Chlorobenzene	7	U
100-41-4	Ethylbenzene	7	U
1330-20-7	Xylene (Total)	7	U
100-42-5	Styrene	7	U
75-25-2	Bromoform	7	U
79-34-5	1,1,2,2-Tetrachloroethane	7	U

Form I, copy

1F

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

MMAU1C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092629

Sample wt/vol: 4.0 (g/mL) G Lab File ID: H73FC948

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: not dec. 16 Date Analyzed: 09/19/00

GC Column: HP-VOC ID: 0.25 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(mL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
Number TICs found: 0 (ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
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MEMORANDUM

TO: Davida Trumbo

FROM: Kweku Acquah

SUBJECT: Radford Army Ammunition Plant Data Validation - Semivolatiles
Envirosystems Lab, SDG IT2

DATE: November 27, 2000

The purpose of this memorandum is to present the data validation report for the samples collected at the Radford Army Ammunition Plant during the August 29-30, 2000 sampling events. Samples were analyzed for semivolatile organic compounds (SVOCs) using USEPA SOW method OLM 04.2 (May 1999). A total of eight soil samples were validated. The sample IDs are:

Field Sample ID	Field Sample ID
NRUC1A	NRUL1B
NRUC1B	NRUW1A
NRUL1C	NRUG2B
NRUL1A	NRUG2A

Data were reviewed by Kweku Acquah and validated using a combination of method-specific criteria, laboratory SOP and the *Innovative Approaches to Data Validation for USEPA Region III* (June 1995.). Parameters evaluated under data validation procedure Level M3 are presented in Table 1. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA Region III specifications.

Table 1. Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times
	X	Instrument Performance Check
	X	Initial Calibration
X		Continuing Calibration
X		Blank Analysis
	X	Surrogate Spikes
	X	Matrix Spike/Matrix Spike Duplicate
	X	Internal Standards
X		Quantitation Verification

The quality of data collected in support of this sampling activity is considered acceptable with the noted qualifications.

cc: Eric Malarek
Project File

RADFORD ARMY AMMUNITION PLANT
VALIDATION REPORT
SEMIVOLATILES REVIEW
SDG IT2

I-Holding Times

Form I

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis. Holding time criteria: For semivolatile compounds in cooled (@4°C ± 2°C) soil samples, the maximum holding time is 14 days from sample collection to extraction and 40 days from extraction to analysis.

- All criteria were met and no qualifiers were applied.

II-Instrument Performance Check

Form V and chromatograms.

GC/MS instrument performance checks are performed to ensure mass resolution, identification and, to some degree, sensitivity. The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples are analyzed.

- The instrument performance check, decafluorotriphenylphosphine (DFTPP), met the ion abundance criteria. No qualification was applied.

III-Initial Calibration

Form VI and chromatograms.

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used is capable of producing acceptable qualitative and quantitative data for compounds on the semivolatile target compound list (TCL). Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve. Minimum relative response factor (RRF) criteria must be ≥ 0.05. Initial calibration percent relative standard deviation (%RSD) must be ≤ 15% on the average for all compounds (< 30% for CCCs).

- For initial calibration performed on 09/01/00 on instrument HP73G, 2,4-Dinitrophenol (26.0%) and 4,6-Dinitro-2-methylphenol (21.0%) were above the control limit. Since these compounds were non-detects in all the samples, no qualifiers were applied based on these outliers.

IV-Continuing Calibration

Form VII and chromatograms.

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used was capable of producing acceptable qualitative and quantitative data for semivolatile target compounds. Continuing calibration standards containing both target and surrogates compounds are analyzed at the beginning of each 12-hour analysis period following the analysis of the instrument performance check and prior to the analysis of blanks and samples. The minimum relative response factors (RRF) for semivolatile target compounds and surrogates must be ≥ 0.05. The percent difference (%D) between the initial calibration RRF and the continuing calibration RRF must be within ± 20% for all target compounds.

IV-Continuing Calibration (Cont.)

- For continuing calibration performed on 09/12/00 @09:17 on instrument HP73G, compounds 2,2'-oxybis [1-Chloropropane] (22.6%), 2-nitroaniline (24.1%), 2,6-Dinitrotlouene (24.6%), 4,6-Dinitro-2-methylphenol (39.3%), Carbazole (20.5%), Butylbenzylphthalate (28.3%), bis(2-Ethylhexyl)phthalate (36.0%) and Di-n-octylphthalate (43.3%) were outside of the control limits. Positive values for these compounds were qualified as estimated, "J" and non-detects had no qualifiers applied.

- For continuing calibration performed on 09/12/00 @09:17 on instrument HP73G, compound 2,4-Dinitrophenol (53.0%) was grossly above the control limit. Positive values for this compound were qualified as estimated, "J" and non-detects "UJ".

- For continuing calibration performed on 09/13/00 @14:37 on instrument HP73G, compounds 2-Nitrophenol (22.2%), 2,6-Dinitrotoluene (24.1%), Di-n-butylphthalate (27.4%) and Butylbenzylphthalate (37.3%) were above the control limit. Positive values for these compounds were qualified as estimated, "J" and non-detects had no qualifiers applied.

- For continuing calibration performed on 09/13/00 @14:37 on instrument HP73G, compounds bis(2-Ethylhexyl)phthalate (50.1%) and Di-n-octylphthalate (62.4%) were grossly above the control limit. Positive values for these compounds were qualified as estimated, "J" and non-detects "UJ".

- For continuing calibration performed on 09/14/00 @17:06 on instrument HP73G, compounds 2, 2' – oxybis (1-Chloropropane) (27.9%), N-Nitroso-di-n-propylamine (21.1%), 2-Nitrophenol (23.1%), 2-Methylnaphthalene (25.3%), 2,6-Dinitrotoluene (25.0%), 2,4-Dinitrophenol (35.1%) and 4-Nitrophenol (25.2%), Di-n-butylphthalate (29.6%), Butylbenzylphthalate (39.2%), bis(2-Ethylhexyl)phthalate (57.1%) and Di-n-octylphthalate (73.8%) were outside of the control limits. Since the samples were quantitated off a previous continuing calibration, no qualifiers were applied based on these outliers.

- For continuing calibration performed on 09/15/00 @07:59 on instrument HP73G, compounds 2-Methylnaphthalene (21.3%), Hexachlorocyclopentadiene (25.2%), 2,6-Dinitrotoluene (27.2%), 2,4-Dinitrophenol (50.0%), 4,6-Dinitro-2-methylphenol (23.1%), Di-n-butylphthalate (30.3%), Butylbenzylphthalate (37.9%), bis (2-Ethylhexyl)phthalate (52.7%), and Di-n-octylphthalate (77.8%) were above the control limit. Since the samples were quantitated off a previous continuing calibration, no qualifiers were applied based on these outliers.

V-Blank Analysis

Form I, IV and chromatograms

The purpose of blank analyses is to determine the presence and magnitude of contamination problems resulting from field and laboratory activities. The criteria for evaluation of blanks apply to any blank associated with the samples. The method blank must be analyzed on each GC/MS system used to analyze that specific group or set of samples. No contaminants should be detected in any of the associated blanks. Positive sample results are reported and qualified "B", if the concentration of the compound in the sample is ≤ 10 times (10X) the maximum amount in any blank for the common phthalate contaminants, or 5 times the maximum amount for the other compounds. The associated rinse blank is sample number 082800R1. Table 2 summarizes the blank contamination analysis.

TABLE 2. BLANK CONTAMINATION SUMMARY.

Compound / Blank Sample #	10X Max. conc. µg/kg	Samples Affected
Di-n-butylphthalate / 082800R1	660	All except NRUW1A
Diethylphthalate / SBLK02	780	NRUC1A, NRUW1A
Bis(2-Ethylhexyl)phthalate / SBLK02	5700	NRUC1A, NRUL1C, NRUL1A, NRUW1A,

VI-Surrogate Spikes

Form II and chromatograms.

Laboratory performance on individual samples is evaluated through the review of surrogate spike samples. Surrogate spikes are added to all samples and blanks to measure their recovery in sample and blank matrices.

- All criteria were met. No qualifiers were applied.

VII-Matrix Spike/Spike Duplicate

Form III and chromatograms.

MS/MSD are generated to determine long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. Specific criteria include the analyses of matrix spike and matrix spike duplicate samples at a frequency of one MS and MSD per 20 samples of similar matrix. MS and MSD recoveries and Relative Percent Differences between MS and MSD recoveries should be within the specified limits.

- Sample NRUC1B (00092519) was used for the MS/MSD analyses. All criteria were met and no qualifiers were applied.

VIII-Internal Standards

Form VIII and chromatograms.

Internal standards performance criteria ensure that GC/MS sensitivity and response are stable during every analytical run. Internal standard area counts for samples and blanks must not vary by more than a factor of two (- 50% to + 100%) from the associated calibration standard. The retention time of the internal standards in samples and blanks must not vary by more than ± 30 seconds from the retention time of the associated calibration standard. Positive results for compounds quantitated using internal standards outside of control criteria should be qualified as estimated "J" and non-detects as "UJ".

- All criteria were met for all target compounds. No qualifiers were applied.

IX-Quantitation Verification

Form 1, and chromatograms

The accuracy of analytical results was verified through the calculation of several parameters. Any target compound below the RL and above the MDL is reported as estimated "J". Any value in excess of the upper level of the calibration range was qualified as estimated "J". Tentatively Identified Compounds were also qualified as estimated, "J".

IX-Quantitation Verification (Cont.)

Sample: NRUC1A (00092518), Diethylphthalate .

Conc. (µg/kg) =Ax * Is * Vt * DF / Ais * RRF * Ws * Fs * Vi

where:

Ax is the compound area
Is is the amount of standard injected (ng)
Vt is the volume of total extract (µL)
DF is the dilution factor
Ais is the corresponding internal standard area
RRF is the Relative Response Factor from the continuing calibration std.
Vi is the volume of extract injected (µL)
Ws is the initial weight (gm)
Fs is the fraction of solid

Conc. µg/kg = 41690*40 ng*1000 µL*1/296008*1.196*30 gm*0.86*2 µL = 91 ng/g = 91 µg/kg

Reported Value = 91 µg/kg
% Difference = %
Values were within 10% difference.

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUC1A

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT2

Lab Code: ENVSYS   Case No.: IT2   SAS No.:   SDG No.: IT2

Matrix: (soil/water) SOIL   Lab Sample ID: 00092518

Sample wt/vol: 30.0(g/mL) G   Lab File ID: H73GC155

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 14   Decanted: (Y/N) N   Date Extracted: 09/08/00

Concentrated Extract Volume: 1000(uL)   Date Analyzed: 09/12/00

Injection Volume: 2.0(uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 6.0   Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	380	U
111-44-4	bis(2-Chloroethyl)Ether	380	U
95-57-8	2-Chlorophenol	380	U
95-48-7	2-Methylphenol	380	U
108-60-1	2,2'-oxybis(1-Chloropropane)	380	U
106-44-5	4-Methylphenol	380	U
621-64-7	N-Nitroso-di-n-propylamine	380	U
67-72-1	Hexachloroethane	380	U
98-95-3	Nitrobenzene	380	U
78-59-1	Isophorone	380	U
88-75-5	2-Nitrophenol	380	U
105-67-9	2,4-Dimethylphenol	380	U
120-83-2	2,4-Dichlorophenol	1900	U
91-20-3	Naphthalene	380	U
106-47-8	4-Chloroaniline	770	U
111-91-1	bis(2-Chloroethoxy)methane	380	U
87-68-3	Hexachlorobutadiene	380	U
59-50-7	4-Chloro-3-methylphenol	770	U
91-57-6	2-Methylnaphthalene	380	U
77-47-4	Hexachlorocyclopentadiene	380	U
88-06-2	2,4,6-Trichlorophenol	380	U
95-95-4	2,4,5-Trichlorophenol	380	U
91-58-7	2-Chloronaphthalene	380	U
88-74-4	2-Nitroaniline	1900	U
131-11-3	Dimethylphthalate	380	U
606-20-2	2,6-Dinitrotoluene	380	U
208-96-8	Acenaphthylene	380	U
99-09-2	3-Nitroaniline	1900	U
83-32-9	Acenaphthene	380	U
51-28-5	2,4-Dinitrophenol	380	U UJ
100-02-7	4-Nitrophenol	1900	U
132-64-9	Dibenzofuran	380	U
121-14-2	2,4-Dinitrotoluene	380	U

Form 1, cont

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUC1A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092518

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC155

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 14 Decanted: (Y/N) N Date Extracted: 09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/12/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.0 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	91	J JB
86-73-7	Fluorene	380	U
7005-72-3	4-Chlorophenyl-phenylether	380	U
100-01-6	4-Nitroaniline	1900	U
534-52-1	4,6-Dinitro-2-methylphenol	190	U
86-30-6	N-Nitrosodiphenylamine (1)	380	U
101-55-3	4-Bromophenyl-phenylether	380	U
118-74-1	Hexachlorobenzene	380	U
87-86-5	Pentachlorophenol	1900	U
85-01-8	Phenanthrene	380	U
120-12-7	Anthracene	380	U
86-74-8	Carbazole	380	U
84-74-2	Di-n-butylphthalate	61	J JB
206-44-0	Fluoranthene	380	U
129-00-0	Pyrene	380	U
85-68-7	Butylbenzylphthalate	380	U
91-94-1	3,3'-Dichlorobenzidine	770	U
56-55-3	Benzo(a)anthracene	380	U
218-01-9	Chrysene	380	U
117-81-7	bis(2-Ethylhexyl)phthalate	62	J JB
117-84-0	Di-n-octylphthalate	380	U UJ
205-99-2	Benzo(b)fluoranthene	380	U
207-08-9	Benzo(k)fluoranthene	380	U
50-32-8	Benzo(a)pyrene	380	U
193-39-5	Indeno(1,2,3-cd)pyrene	380	U
53-70-3	Dibenzo(a,h)anthracene	380	U
191-24-2	Benzo(g,h,i)perylene	380	U
541-73-1	1,3-Dichlorobenzene	380	U
106-46-7	1,4-Dichlorobenzene	380	U
95-50-1	1,2-Dichlorobenzene	380	U
120-82-1	1,2,4-Trichlorbenzene	380	U

FORM I, CONT

1G

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUC1A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092518

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC155

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 14 Decanted: (Y/N) N Date Extracted:09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/12/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.0 Extraction: (Type) SONC

Number TICs found: 29

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	14.47	140	J J
2. 3650-28-0	1,4-METHANO-1H-INDENE, OCTAH	14.63	140	NJ J
3.	UNKNOWN	14.93	500	J J
4.	UNKNOWN	15.04	110	J J
5. 470-40-6	THUJOPSENE	15.17	290	NJ
6.	UNKNOWN	15.68	210	J J
7. 19047-85-9	PHOSPHONIC ACID, DIOCTADECYL	16.03	96	NJ J
8. 301-02-0	9-OCTADECENAMIDE, (Z)-	16.10	280	NJ J
9.	UNKNOWN	16.38	97	J J
10. 1000210-28-9	7-ISOPROPYL-1,1,4A-TRIMETHYL	21.98	260	NJ J
11.	UNKNOWN	22.64	950	J J
12. 57-11-4	OCTADECANOIC ACID	22.82	220	NJ J
13. 19047-85-9	PHOSPHONIC ACID, DIOCTADECYL	23.91	160	NJ J
14. 511-15-9	2-PHENANTHRENOL, 4B,5,6,7,8,	23.97	480	NJ J
15. 511-15-9	2-PHENANTHRENOL, 4B,5,6,7,8,	24.22	1700	NJ J
16.	UNKNOWN	24.30	560	J J
17.	UNKNOWN	24.35	330	J J
18. 19047-85-9	PHOSPHONIC ACID, DIOCTADECYL	25.56	310	NJ J
19.	UNKNOWN	25.75	160	J J
20. 511-05-7	9(1H)-PHENANTHRENONE, 2,3,4,	26.70	270	NJ J
21.	UNKNOWN	26.82	170	J J
22.	UNKNOWN	27.10	240	J J
23. 301-02-0	9-OCTADECENAMIDE, (Z)-	27.72	330	J J
24.	UNKNOWN	29.83	160	J J
25. 474-62-4	CAMPESTEROL	30.77	230	NJ J
26.	UNKNOWN	30.89	2200	J J
27. 66088-17-3	OLEAN-12-EN-1-ONE, 3-HYDROXY	30.99	270	NJ J
28.	UNKNOWN	31.16	650	J J
29. 83-47-6	.GAMMA.-SITOSTEROL	31.34	680	NJ J
30.				

FORM 1, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUC1B

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT2

Lab Code: ENVSYS   Case No.: IT2   SAS No.:   SDG No.: IT2

Matrix: (soil/water) SOIL   Lab Sample ID: 00092519

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC156

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 23   Decanted: (Y/N) N   Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL)   Date Analyzed: 09/12/00

Injection Volume: 2.0 (uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 8.2   Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	430	U
111-44-4	bis(2-Chloroethyl)Ether	430	U
95-57-8	2-Chlorophenol	430	U
95-48-7	2-Methylphenol	430	U
108-60-1	2,2'-oxybis(1-Chloropropane)	430	U
106-44-5	4-Methylphenol	430	U
621-64-7	N-Nitroso-di-n-propylamine	430	U
67-72-1	Hexachloroethane	430	U
98-95-3	Nitrobenzene	430	U
78-59-1	Isophorone	430	U
88-75-5	2-Nitrophenol	430	U
105-67-9	2,4-Dimethylphenol	430	U
120-83-2	2,4-Dichlorophenol	2100	U
91-20-3	Naphthalene	430	U
106-47-8	4-Chloroaniline	860	U
111-91-1	bis(2-Chloroethoxy)methane	430	U
87-68-3	Hexachlorobutadiene	430	U
59-50-7	4-Chloro-3-methylphenol	860	U
91-57-6	2-Methylnaphthalene	430	U
77-47-4	Hexachlorocyclopentadiene	430	U
88-06-2	2,4,6-Trichlorophenol	430	U
95-95-4	2,4,5-Trichlorophenol	430	U
91-58-7	2-Chloronaphthalene	430	U
88-74-4	2-Nitroaniline	2100	U
131-11-3	Dimethylphthalate	430	U
606-20-2	2,6-Dinitrotoluene	430	U
208-96-8	Acenaphthylene	430	U
99-09-2	3-Nitroaniline	2100	U
83-32-9	Acenaphthene	430	U
51-28-5	2,4-Dinitrophenol	430	U UJ
100-02-7	4-Nitrophenol	2100	U
132-64-9	Dibenzofuran	430	U
121-14-2	2,4-Dinitrotoluene	430	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUC1B

Lab Name: ENVIROSYSTEMS, INC.　Contract: IT2

Lab Code: ENVSYS　Case No.: IT2　SAS No.:　SDG No.: IT2

Matrix: (soil/water) SOIL　Lab Sample ID: 00092519

Sample wt/vol: 30.0 (g/mL) G　Lab File ID: H73GC156

Level: (low/med) LOW　Date Received: 09/01/00

% Moisture: 23　Decanted: (Y/N) N　Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL)　Date Analyzed: 09/12/00

Injection Volume: 2.0 (uL)　Dilution Factor: 1.0

GPC Cleanup: (Y/N) N　pH: 8.2　Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	430	U
86-73-7	Fluorene	430	U
7005-72-3	4-Chlorophenyl-phenylether	430	U
100-01-6	4-Nitroaniline	2100	U
534-52-1	4,6-Dinitro-2-methylphenol	210	U
86-30-6	N-Nitrosodiphenylamine (1)	430	U
101-55-3	4-Bromophenyl-phenylether	430	U
118-74-1	Hexachlorobenzene	430	U
87-86-5	Pentachlorophenol	2100	U
85-01-8	Phenanthrene	430	U
120-12-7	Anthracene	430	U
86-74-8	Carbazole	430	U
84-74-2	Di-n-butylphthalate	67	J JB
206-44-0	Fluoranthene	430	U
129-00-0	Pyrene	430	U
85-68-7	Butylbenzylphthalate	430	U
91-94-1	3,3'-Dichlorobenzidine	860	U
56-55-3	Benzo(a)anthracene	430	U
218-01-9	Chrysene	430	U
117-81-7	bis(2-Ethylhexyl)phthalate	430	U UJ
117-84-0	Di-n-octylphthalate	430	U UJ
205-99-2	Benzo(b)fluoranthene	430	U
207-08-9	Benzo(k)fluoranthene	430	U
50-32-8	Benzo(a)pyrene	430	U
193-39-5	Indeno(1,2,3-cd)pyrene	430	U
53-70-3	Dibenzo(a,h)anthracene	430	U
191-24-2	Benzo(g,h,i)perylene	430	U
541-73-1	1,3-Dichlorobenzene	430	U
106-46-7	1,4-Dichlorobenzene	430	U
95-50-1	1,2-Dichlorobenzene	430	U
120-82-1	1,2,4-Trichlorbenzene	430	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUC1B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092519

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC156

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 23 Decanted: (Y/N) N Date Extracted:09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/12/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 8.2 Extraction: (Type) SONC

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 4

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	20.95	270	J J
2.	UNKNOWN	22.60	140	J J
3. 74685-29-3	9-EICOSENE, (E)-	25.56	210	NJ J
4. 301-02-0	9-OCTADECENAMIDE, (Z)-	27.71	250	NJ J
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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUL1C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092520

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC160

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 19 Decanted: (Y/N)N Date Extracted: 09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/12/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.4 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	410	U
111-44-4	bis(2-Chloroethyl)Ether	410	U
95-57-8	2-Chlorophenol	410	U
95-48-7	2-Methylphenol	410	U
108-60-1	2,2'-oxybis(1-Chloropropane)	410	U
106-44-5	4-Methylphenol	410	U
621-64-7	N-Nitroso-di-n-propylamine	410	U
67-72-1	Hexachloroethane	410	U
98-95-3	Nitrobenzene	410	U
78-59-1	Isophorone	410	U
88-75-5	2-Nitrophenol	410	U
105-67-9	2,4-Dimethylphenol	410	U
120-83-2	2,4-Dichlorophenol	2000	U
91-20-3	Naphthalene	410	U
106-47-8	4-Chloroaniline	810	U
111-91-1	bis(2-Chloroethoxy)methane	410	U
87-68-3	Hexachlorobutadiene	410	U
59-50-7	4-Chloro-3-methylphenol	810	U
91-57-6	2-Methylnaphthalene	410	U
77-47-4	Hexachlorocyclopentadiene	410	U
88-06-2	2,4,6-Trichlorophenol	410	U
95-95-4	2,4,5-Trichlorophenol	410	U
91-58-7	2-Chloronaphthalene	410	U
88-74-4	2-Nitroaniline	2000	U
131-11-3	Dimethylphthalate	410	U
606-20-2	2,6-Dinitrotoluene	410	U
208-96-8	Acenaphthylene	410	U
99-09-2	3-Nitroaniline	2000	U
83-32-9	Acenaphthene	410	U
51-28-5	2,4-Dinitrophenol	410	U uJ
100-02-7	4-Nitrophenol	2000	U
132-64-9	Dibenzofuran	410	U
121-14-2	2,4-Dinitrotoluene	410	U

FORM 1, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUL1C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092520

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC160

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 19 Decanted: (Y/N)N Date Extracted: 09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/12/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.4 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	410	U
86-73-7	Fluorene	410	U
7005-72-3	4-Chlorophenyl-phenylether	410	U
100-01-6	4-Nitroaniline	2000	U
534-52-1	4,6-Dinitro-2-methylphenol	200	U
86-30-6	N-Nitrosodiphenylamine (1)	410	U
101-55-3	4-Bromophenyl-phenylether	410	U
118-74-1	Hexachlorobenzene	410	U
87-86-5	Pentachlorophenol	2000	U
85-01-8	Phenanthrene	410	U
120-12-7	Anthracene	410	U
86-74-8	Carbazole	410	U
84-74-2	Di-n-butylphthalate	66	J ~~J~~ JB
206-44-0	Fluoranthene	410	U
129-00-0	Pyrene	410	U
85-68-7	Butylbenzylphthalate	410	U
91-94-1	3,3'-Dichlorobenzidine	810	U
56-55-3	Benzo(a)anthracene	410	U
218-01-9	Chrysene	410	U
117-81-7	bis(2-Ethylhexyl)phthalate	46	J JB
117-84-0	Di-n-octylphthalate	410	U UJ
205-99-2	Benzo(b)fluoranthene	410	U
207-08-9	Benzo(k)fluoranthene	410	U
50-32-8	Benzo(a)pyrene	410	U
193-39-5	Indeno(1,2,3-cd)pyrene	410	U
53-70-3	Dibenzo(a,h)anthracene	410	U
191-24-2	Benzo(g,h,i)perylene	410	U
541-73-1	1,3-Dichlorobenzene	410	U
106-46-7	1,4-Dichlorobenzene	410	U
95-50-1	1,2-Dichlorobenzene	410	U
120-82-1	1,2,4-Trichlorbenzene	410	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUL1C

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT2

Lab Code: ENVSYS   Case No.: IT2   SAS No.:   SDG No.: IT2

Matrix: (soil/water) SOIL   Lab Sample ID: 00092520

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC160

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 19   Decanted: (Y/N) N   Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL)   Date Analyzed: 09/12/00

Injection Volume: 2.0 (uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 6.4   Extraction: (Type) SONC

Number TICs found: 4   CONCENTRATION UNITS: (ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 57-10-3	N-HEXADECANOIC ACID	20.95	220	NJ J
2. 19047-85-9	PHOSPHONIC ACID, DIOCTADECYL	25.56	220	NJ J
3.	UNKNOWN	27.71	250	J J
4.	UNKNOWN	29.87	120	J J
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FORM I, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUL1A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092521

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC161

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 9 Decanted: (Y/N) N Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/12/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.8 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	360	U
111-44-4	bis(2-Chloroethyl)Ether	360	U
95-57-8	2-Chlorophenol	360	U
95-48-7	2-Methylphenol	360	U
108-60-1	2,2'-oxybis(1-Chloropropane)	360	U
106-44-5	4-Methylphenol	360	U
621-64-7	N-Nitroso-di-n-propylamine	360	U
67-72-1	Hexachloroethane	360	U
98-95-3	Nitrobenzene	360	U
78-59-1	Isophorone	360	U
88-75-5	2-Nitrophenol	360	U
105-67-9	2,4-Dimethylphenol	360	U
120-83-2	2,4-Dichlorophenol	1800	U
91-20-3	Naphthalene	360	U
106-47-8	4-Chloroaniline	730	U
111-91-1	bis(2-Chloroethoxy)methane	360	U
87-68-3	Hexachlorobutadiene	360	U
59-50-7	4-Chloro-3-methylphenol	730	U
91-57-6	2-Methylnaphthalene	360	U
77-47-4	Hexachlorocyclopentadiene	360	U
88-06-2	2,4,6-Trichlorophenol	360	U
95-95-4	2,4,5-Trichlorophenol	360	U
91-58-7	2-Chloronaphthalene	360	U
88-74-4	2-Nitroaniline	1800	U
131-11-3	Dimethylphthalate	360	U
606-20-2	2,6-Dinitrotoluene	360	U
208-96-8	Acenaphthylene	360	U
99-09-2	3-Nitroaniline	1800	U
83-32-9	Acenaphthene	360	U
51-28-5	2,4-Dinitrophenol	360	U uJ
100-02-7	4-Nitrophenol	1800	U
132-64-9	Dibenzofuran	360	U
121-14-2	2,4-Dinitrotoluene	360	U

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EPA SAMPLE NO.

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

NRUL1A

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT2

Lab Code: ENVSYS   Case No.: IT2   SAS No.:   SDG No.: IT2

Matrix: (soil/water) SOIL   Lab Sample ID: 00092521

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC161

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 9   Decanted: (Y/N) N   Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL)   Date Analyzed: 09/12/00

Injection Volume: 2.0 (uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 6.8   Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	360	U
86-73-7	Fluorene	360	U
7005-72-3	4-Chlorophenyl-phenylether	360	U
100-01-6	4-Nitroaniline	1800	U
534-52-1	4,6-Dinitro-2-methylphenol	180	U
86-30-6	N-Nitrosodiphenylamine (1)	360	U
101-55-3	4-Bromophenyl-phenylether	360	U
118-74-1	Hexachlorobenzene	360	U
87-86-5	Pentachlorophenol	1800	U
85-01-8	Phenanthrene	360	U
120-12-7	Anthracene	360	U
86-74-8	Carbazole	360	U
84-74-2	Di-n-butylphthalate	69	J JB
206-44-0	Fluoranthene	360	U
129-00-0	Pyrene	360	U
85-68-7	Butylbenzylphthalate	360	U
91-94-1	3,3'-Dichlorobenzidine	730	U
56-55-3	Benzo(a)anthracene	360	U
218-01-9	Chrysene	360	U
117-81-7	bis(2-Ethylhexyl)phthalate	1700	JB
117-84-0	Di-n-octylphthalate	360	U UJ
205-99-2	Benzo(b)fluoranthene	360	U
207-08-9	Benzo(k)fluoranthene	360	U
50-32-8	Benzo(a)pyrene	360	U
193-39-5	Indeno(1,2,3-cd)pyrene	360	U
53-70-3	Dibenzo(a,h)anthracene	360	U
191-24-2	Benzo(g,h,i)perylene	360	U
541-73-1	1,3-Dichlorobenzene	360	U
106-46-7	1,4-Dichlorobenzene	360	U
95-50-1	1,2-Dichlorobenzene	360	U
120-82-1	1,2,4-Trichlorbenzene	360	U

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EPA SAMPLE NO.

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NRUL1A

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT2

Lab Code: ENVSYS   Case No.: IT2   SAS No.:   SDG No.: IT2

Matrix: (soil/water) SOIL   Lab Sample ID: 00092521

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC161

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 9   Decanted: (Y/N) N   Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL)   Date Analyzed: 09/12/00

Injection Volume: 2.0 (uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 6.8   Extraction: (Type) SONC

Number TICs found: 28

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 7785-70-8	1R-.ALPHA.-PINENE	7.12	210	NJ J
2.	UNKNOWN	13.86	150	J J
3.	UNKNOWN	15.01	110	J J
4.	UNKNOWN	19.20	240	J J
5.	UNKNOWN	21.39	90	J J
6. 60-33-3	9,12-OCTADECADIENOIC ACID (Z	22.56	97	NJ J
7.	UNKNOWN	22.60	160	J J
8. 57-11-4	OCTADECANOIC ACID	22.81	250	NJ J
9.	UNKNOWN	23.23	110	J J
10.	UNKNOWN	23.49	98	J J
11.	UNKNOWN	23.57	180	J J
12.	UNKNOWN	23.88	95	J J
13.	UNKNOWN	24.22	200	J J
14.	UNKNOWN	24.55	130	J J
15.	UNKNOWN	24.94	150	J J
16. 7390-81-0	OXIRANE, HEXADECYL-	25.07	110	NJ J
17.	UNKNOWN	25.48	84	J J
18. 19047-85-9	PHOSPHONIC ACID, DIOCTADECYL	25.56	370	NJ J
19.	UNKNOWN	27.10	370	J J
20. 301-02-0	9-OCTADECENAMIDE, (Z)-	27.73	210	NJ J
21. 7098-21-7	TRITETRACONTANE	27.82	100	NJ J
22.	UNKNOWN	28.07	94	J J
23.	UNKNOWN	28.10	160	J J
24.	UNKNOWN	29.80	110	J J
25.	UNKNOWN	29.89	1300	J J
26.	UNKNOWN	31.13	100	J J
27.	UNKNOWN	31.22	160	J J
28. 83-47-6	.GAMMA.-SITOSTEROL	31.35	760	NJ J
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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUL1B

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT2

Lab Code: ENVSYS   Case No.: IT2   SAS No.:   SDG No.: IT2

Matrix: (soil/water) SOIL   Lab Sample ID: 00092522

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC174

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 16   Decanted: (Y/N) N   Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL)   Date Analyzed: 09/13/00

Injection Volume: 2.0 (uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 5.9   Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	390	U
111-44-4	bis(2-Chloroethyl)Ether	390	U
95-57-8	2-Chlorophenol	390	U
95-48-7	2-Methylphenol	390	U
108-60-1	2,2'-oxybis(1-Chloropropane)	390	U
106-44-5	4-Methylphenol	390	U
621-64-7	N-Nitroso-di-n-propylamine	390	U
67-72-1	Hexachloroethane	390	U
98-95-3	Nitrobenzene	390	U
78-59-1	Isophorone	390	U
88-75-5	2-Nitrophenol	390	U
105-67-9	2,4-Dimethylphenol	390	U
120-83-2	2,4-Dichlorophenol	1900	U
91-20-3	Naphthalene	390	U
106-47-8	4-Chloroaniline	790	U
111-91-1	bis(2-Chloroethoxy)methane	390	U
87-68-3	Hexachlorobutadiene	390	U
59-50-7	4-Chloro-3-methylphenol	790	U
91-57-6	2-Methylnaphthalene	390	U
77-47-4	Hexachlorocyclopentadiene	390	U
88-06-2	2,4,6-Trichlorophenol	390	U
95-95-4	2,4,5-Trichlorophenol	390	U
91-58-7	2-Chloronaphthalene	390	U
88-74-4	2-Nitroaniline	1900	U
131-11-3	Dimethylphthalate	390	U
606-20-2	2,6-Dinitrotoluene	390	U
208-96-8	Acenaphthylene	390	U
99-09-2	3-Nitroaniline	1900	U
83-32-9	Acenaphthene	390	U
51-28-5	2,4-Dinitrophenol	390	U UJ
100-02-7	4-Nitrophenol	1900	U
132-64-9	Dibenzofuran	390	U
121-14-2	2,4-Dinitrotoluene	390	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUL1B

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT2

Lab Code: ENVSYS   Case No.: IT2   SAS No.:   SDG No.: IT2

Matrix: (soil/water) SOIL   Lab Sample ID: 00092522

Sample wt/vol: 30.0(g/mL) G   Lab File ID: H73GC174

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 16   Decanted: (Y/N)N   Date Extracted: 09/08/00

Concentrated Extract Volume: 1000(uL)   Date Analyzed: 09/13/00

Injection Volume: 2.0(uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 5.9   Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	390	U
86-73-7	Fluorene	390	U
7005-72-3	4-Chlorophenyl-phenylether	390	U
100-01-6	4-Nitroaniline	1900	U
534-52-1	4,6-Dinitro-2-methylphenol	190	U
86-30-6	N-Nitrosodiphenylamine (1)	390	U
101-55-3	4-Bromophenyl-phenylether	390	U
118-74-1	Hexachlorobenzene	390	U
87-86-5	Pentachlorophenol	1900	U
85-01-8	Phenanthrene	390	U
120-12-7	Anthracene	390	U
86-74-8	Carbazole	390	U
84-74-2	Di-n-butylphthalate	70	J JB
206-44-0	Fluoranthene	390	U
129-00-0	Pyrene	390	U
85-68-7	Butylbenzylphthalate	390	U
91-94-1	3,3'-Dichlorobenzidine	790	U
56-55-3	Benzo(a)anthracene	390	U
218-01-9	Chrysene	390	U
117-81-7	bis(2-Ethylhexyl)phthalate	390	U UJ
117-84-0	Di-n-octylphthalate	390	U UJ
205-99-2	Benzo(b)fluoranthene	390	U
207-08-9	Benzo(k)fluoranthene	390	U
50-32-8	Benzo(a)pyrene	390	U
193-39-5	Indeno(1,2,3-cd)pyrene	390	U
53-70-3	Dibenzo(a,h)anthracene	390	U
191-24-2	Benzo(g,h,i)perylene	390	U
541-73-1	1,3-Dichlorobenzene	390	U
106-46-7	1,4-Dichlorobenzene	390	U
95-50-1	1,2-Dichlorobenzene	390	U
120-82-1	1,2,4-Trichlorbenzene	390	U

FORM I SV-2   OLM04.2

FORM I, COPY

1G
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUL1B

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT2

Lab Code: ENVSYS   Case No.: IT2   SAS No.:   SDG No.: IT2

Matrix: (soil/water) SOIL   Lab Sample ID: 00092522

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC174

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 16   Decanted: (Y/N) N   Date Extracted:09/08/00

Concentrated Extract Volume: 1000(uL)   Date Analyzed: 09/13/00

Injection Volume: 2.0(uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 5.9   Extraction: (Type) SONC

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 4

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		UNKNOWN	20.94	120	J J
2.		UNKNOWN	25.48	89	J J
3.	19047-85-9	PHOSPHONIC ACID, DIOCTADECYL	25.57	190	NJ J
4.	301-02-0	9-OCTADECENAMIDE, (Z)-	27.72	270	NJ J
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FORM I, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUW1A

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT2

Lab Code: ENVSYS   Case No.: IT2   SAS No.:   SDG No.: IT2

Matrix: (soil/water) SOIL   Lab Sample ID: 00092523

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC196

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 14   Decanted: (Y/N) N   Date Extracted: 09/14/00

Concentrated Extract Volume: 1000 (uL)   Date Analyzed: 09/14/00

Injection Volume: 2.0 (uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 6.8   Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	380	U
111-44-4	bis(2-Chloroethyl)Ether	380	U
95-57-8	2-Chlorophenol	380	U
95-48-7	2-Methylphenol	380	U
108-60-1	2,2'-oxybis(1-Chloropropane)	380	U
106-44-5	4-Methylphenol	380	U
621-64-7	N-Nitroso-di-n-propylamine	380	U
67-72-1	Hexachloroethane	380	U
98-95-3	Nitrobenzene	380	U
78-59-1	Isophorone	380	U
88-75-5	2-Nitrophenol	380	U
105-67-9	2,4-Dimethylphenol	380	U
120-83-2	2,4-Dichlorophenol	1900	U
91-20-3	Naphthalene	380	U
106-47-8	4-Chloroaniline	770	U
111-91-1	bis(2-Chloroethoxy)methane	380	U
87-68-3	Hexachlorobutadiene	380	U
59-50-7	4-Chloro-3-methylphenol	770	U
91-57-6	2-Methylnaphthalene	380	U
77-47-4	Hexachlorocyclopentadiene	380	U
88-06-2	2,4,6-Trichlorophenol	380	U
95-95-4	2,4,5-Trichlorophenol	380	U
91-58-7	2-Chloronaphthalene	380	U
88-74-4	2-Nitroaniline	1900	U
131-11-3	Dimethylphthalate	380	U
606-20-2	2,6-Dinitrotoluene	380	U
208-96-8	Acenaphthylene	380	U
99-09-2	3-Nitroaniline	1900	U
83-32-9	Acenaphthene	380	U
51-28-5	2,4-Dinitrophenol	380	U uJ
100-02-7	4-Nitrophenol	1900	U
132-64-9	Dibenzofuran	380	U
121-14-2	2,4-Dinitrotoluene	380	U

FORM I, COPY

1D
EPA SAMPLE NO.

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

NRUW1A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092523

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC196

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 14 Decanted: (Y/N) N Date Extracted: 09/14/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/14/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.8 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	130	J ~~J~~B
86-73-7	Fluorene	380	U
7005-72-3	4-Chlorophenyl-phenylether	380	U
100-01-6	4-Nitroaniline	1900	U
534-52-1	4,6-Dinitro-2-methylphenol	190	U
86-30-6	N-Nitrosodiphenylamine (1)	380	U
101-55-3	4-Bromophenyl-phenylether	380	U
118-74-1	Hexachlorobenzene	380	U
87-86-5	Pentachlorophenol	1900	U
85-01-8	Phenanthrene	380	U
120-12-7	Anthracene	380	U
86-74-8	Carbazole	380	U
84-74-2	Di-n-butylphthalate	810	J
206-44-0	Fluoranthene	380	U
129-00-0	Pyrene	380	U
85-68-7	Butylbenzylphthalate	380	U
91-94-1	3,3'-Dichlorobenzidine	770	U
56-55-3	Benzo(a)anthracene	380	U
218-01-9	Chrysene	380	U
117-81-7	bis(2-Ethylhexyl)phthalate	100	J ~~J~~B
117-84-0	Di-n-octylphthalate	380	U UJ
205-99-2	Benzo(b)fluoranthene	380	U
207-08-9	Benzo(k)fluoranthene	380	U
50-32-8	Benzo(a)pyrene	380	U
193-39-5	Indeno(1,2,3-cd)pyrene	380	U
53-70-3	Dibenzo(a,h)anthracene	380	U
191-24-2	Benzo(g,h,i)perylene	380	U
541-73-1	1,3-Dichlorobenzene	380	U
106-46-7	1,4-Dichlorobenzene	380	U
95-50-1	1,2-Dichlorobenzene	380	U
120-82-1	1,2,4-Trichlorbenzene	380	U

form I, copy

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EPA SAMPLE NO.

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NRUW1A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092523

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC196

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 14 Decanted: (Y/N) N Date Extracted: 09/14/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/14/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.8 Extraction: (Type) SONC

Number TICs found: 22

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	6.79	220	JB J
2. 1000154-28-6	CYCLOPENTENE, 1,2,3,4,5-PENT	6.83	120	NJB J
3.	UNKNOWN	7.39	99	J J
4.	UNKNOWN	7.44	170	JB J
5.	UNKNOWN	7.54	450	JB J
6.	UNKNOWN	20.06	120	J J
7. 57-10-3	N-HEXADECANOIC ACID	20.95	330	NJ J
8.	UNKNOWN	22.45	88	J J
9. 629-96-9	1-EICOSANOL	25.60	240	NJ J
10.	UNKNOWN	27.13	200	J J
11. 7683-64-9	SQUALENE	28.07	110	NJ J
12.	UNKNOWN	28.10	230	J J
13.	UNKNOWN	28.56	300	J J
14.	UNKNOWN	29.83	200	J J
15.	UNKNOWN	29.90	360	J J
16. 57-87-4	ERGOSTEROL	30.67	150	NJ J
17. 474-62-4	CAMPESTEROL	30.79	89	NJ J
18.	UNKNOWN	30.87	630	J J
19.	UNKNOWN	30.99	180	J J
20.	UNKNOWN	31.15	110	J J
21. 83-47-6	.GAMMA.-SITOSTEROL	31.36	350	NJ J
22.	UNKNOWN	31.60	140	J J
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FORM I, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092524

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC176

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 11 Decanted: (Y/N) N Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/13/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 5.7 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	370	U
111-44-4	bis(2-Chloroethyl)Ether	370	U
95-57-8	2-Chlorophenol	370	U
95-48-7	2-Methylphenol	370	U
108-60-1	2,2'-oxybis(1-Chloropropane)	370	U
106-44-5	4-Methylphenol	370	U
621-64-7	N-Nitroso-di-n-propylamine	370	U
67-72-1	Hexachloroethane	370	U
98-95-3	Nitrobenzene	370	U
78-59-1	Isophorone	370	U
88-75-5	2-Nitrophenol	370	U
105-67-9	2,4-Dimethylphenol	370	U
120-83-2	2,4-Dichlorophenol	1800	U
91-20-3	Naphthalene	370	U
106-47-8	4-Chloroaniline	740	U
111-91-1	bis(2-Chloroethoxy)methane	370	U
87-68-3	Hexachlorobutadiene	370	U
59-50-7	4-Chloro-3-methylphenol	740	U
91-57-6	2-Methylnaphthalene	370	U
77-47-4	Hexachlorocyclopentadiene	370	U
88-06-2	2,4,6-Trichlorophenol	370	U
95-95-4	2,4,5-Trichlorophenol	370	U
91-58-7	2-Chloronaphthalene	370	U
88-74-4	2-Nitroaniline	1800	U
131-11-3	Dimethylphthalate	370	U
606-20-2	2,6-Dinitrotoluene	370	U
208-96-8	Acenaphthylene	370	U
99-09-2	3-Nitroaniline	1800	U
83-32-9	Acenaphthene	370	U
51-28-5	2,4-Dinitrophenol	370	U uJ
100-02-7	4-Nitrophenol	1800	U
132-64-9	Dibenzofuran	370	U
121-14-2	2,4-Dinitrotoluene	370	U

FORM I, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092524

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC176

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 11 Decanted: (Y/N)N Date Extracted: 09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/13/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 5.7 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	370	U
86-73-7	Fluorene	370	U
7005-72-3	4-Chlorophenyl-phenylether	370	U
100-01-6	4-Nitroaniline	1800	U
534-52-1	4,6-Dinitro-2-methylphenol	180	U
86-30-6	N-Nitrosodiphenylamine (1)	370	U
101-55-3	4-Bromophenyl-phenylether	370	U
118-74-1	Hexachlorobenzene	370	U
87-86-5	Pentachlorophenol	1800	U
85-01-8	Phenanthrene	370	U
120-12-7	Anthracene	370	U
86-74-8	Carbazole	370	U
84-74-2	Di-n-butylphthalate	63	J JB
206-44-0	Fluoranthene	370	U
129-00-0	Pyrene	370	U
85-68-7	Butylbenzylphthalate	370	U
91-94-1	3,3'-Dichlorobenzidine	740	U
56-55-3	Benzo(a)anthracene	370	U
218-01-9	Chrysene	370	U
117-81-7	bis(2-Ethylhexyl)phthalate	370	U uJ
117-84-0	Di-n-octylphthalate	370	U uJ
205-99-2	Benzo(b)fluoranthene	370	U
207-08-9	Benzo(k)fluoranthene	370	U
50-32-8	Benzo(a)pyrene	370	U
193-39-5	Indeno(1,2,3-cd)pyrene	370	U
53-70-3	Dibenzo(a,h)anthracene	370	U
191-24-2	Benzo(g,h,i)perylene	370	U
541-73-1	1,3-Dichlorobenzene	370	U
106-46-7	1,4-Dichlorobenzene	370	U
95-50-1	1,2-Dichlorobenzene	370	U
120-82-1	1,2,4-Trichlorbenzene	370	U

FORM I, COPY

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EPA SAMPLE NO.

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

NRUG2B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092524

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC176

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 11 Decanted: (Y/N) N Date Extracted:09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/13/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 5.7 Extraction: (Type) SONC

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 15

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	5.50	120	J J
2.	UNKNOWN	5.67	170	J J
3.	UNKNOWN	6.79	300	J J
4.	UNKNOWN	7.01	94	J J
5.	UNKNOWN	7.39	110	J J
6.	UNKNOWN	7.44	340	J J
7.	UNKNOWN	7.54	200	J J
8.	UNKNOWN	8.70	81	J J
9. 57-10-3	N-HEXADECANOIC ACID	20.94	190	NJ J
10.	UNKNOWN	25.47	78	J J
11. 19047-85-9	PHOSPHONIC ACID, DIOCTADECYL	25.57	260	NJ J
12. 295-17-0	CYCLOTETRADECANE	27.11	160	NJ J
13. 301-02-0	9-OCTADECENAMIDE, (Z)-	27.72	270	NJ J
14. 13287-23-5	HEPTADECANE, 8-METHYL-	29.82	80	NJ J
15. 1119-87-5	1,2-DODECANEDIOL	29.88	92	NJ J
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FORM I SV-TIC OLM04.2

FORM I, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092525

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC177

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 13 Decanted: (Y/N) N Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/13/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.2 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	380	U
111-44-4	bis(2-Chloroethyl)Ether	380	U
95-57-8	2-Chlorophenol	380	U
95-48-7	2-Methylphenol	380	U
108-60-1	2,2'-oxybis(1-Chloropropane)	380	U
106-44-5	4-Methylphenol	380	U
621-64-7	N-Nitroso-di-n-propylamine	380	U
67-72-1	Hexachloroethane	380	U
98-95-3	Nitrobenzene	380	U
78-59-1	Isophorone	380	U
88-75-5	2-Nitrophenol	380	U
105-67-9	2,4-Dimethylphenol	380	U
120-83-2	2,4-Dichlorophenol	1800	U
91-20-3	Naphthalene	380	U
106-47-8	4-Chloroaniline	760	U
111-91-1	bis(2-Chloroethoxy)methane	380	U
87-68-3	Hexachlorobutadiene	380	U
59-50-7	4-Chloro-3-methylphenol	760	U
91-57-6	2-Methylnaphthalene	380	U
77-47-4	Hexachlorocyclopentadiene	380	U
88-06-2	2,4,6-Trichlorophenol	380	U
95-95-4	2,4,5-Trichlorophenol	380	U
91-58-7	2-Chloronaphthalene	380	U
88-74-4	2-Nitroaniline	1800	U
131-11-3	Dimethylphthalate	380	U
606-20-2	2,6-Dinitrotoluene	380	U
208-96-8	Acenaphthylene	380	U
99-09-2	3-Nitroaniline	1800	U
83-32-9	Acenaphthene	380	U
51-28-5	2,4-Dinitrophenol	380	U UJ
100-02-7	4-Nitrophenol	1800	U
132-64-9	Dibenzofuran	380	U
121-14-2	2,4-Dinitrotoluene	380	U

FORM I, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092525

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC177

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 13 Decanted: (Y/N)N Date Extracted: 09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/13/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.2 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	380	U
86-73-7	Fluorene	380	U
7005-72-3	4-Chlorophenyl-phenylether	380	U
100-01-6	4-Nitroaniline	1800	U
534-52-1	4,6-Dinitro-2-methylphenol	180	U
86-30-6	N-Nitrosodiphenylamine (1)	380	U
101-55-3	4-Bromophenyl-phenylether	380	U
118-74-1	Hexachlorobenzene	380	U
87-86-5	Pentachlorophenol	1800	U
85-01-8	Phenanthrene	380	U
120-12-7	Anthracene	380	U
86-74-8	Carbazole	380	U
84-74-2	Di-n-butylphthalate	55	J JB
206-44-0	Fluoranthene	380	U
129-00-0	Pyrene	380	U
85-68-7	Butylbenzylphthalate	380	U
91-94-1	3,3'-Dichlorobenzidine	760	U
56-55-3	Benzo(a)anthracene	380	U
218-01-9	Chrysene	380	U
117-81-7	bis(2-Ethylhexyl)phthalate	39	J JB
117-84-0	Di-n-octylphthalate	380	U uJ
205-99-2	Benzo(b)fluoranthene	380	U
207-08-9	Benzo(k)fluoranthene	380	U
50-32-8	Benzo(a)pyrene	380	U
193-39-5	Indeno(1,2,3-cd)pyrene	380	U
53-70-3	Dibenzo(a,h)anthracene	380	U
191-24-2	Benzo(g,h,i)perylene	380	U
541-73-1	1,3-Dichlorobenzene	380	U
106-46-7	1,4-Dichlorobenzene	380	U
95-50-1	1,2-Dichlorobenzene	380	U
120-82-1	1,2,4-Trichlorbenzene	380	U

FORM I, COPY

1G
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUG2A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT2

Lab Code: ENVSYS Case No.: IT2 SAS No.: SDG No.: IT2

Matrix: (soil/water) SOIL Lab Sample ID: 00092525

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC177

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 13 Decanted: (Y/N) N Date Extracted:09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/13/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.2 Extraction: (Type) SONC

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 16

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	5.67	160	J J
2.	UNKNOWN	6.79	270	J J
3.	UNKNOWN	7.39	99	J J
4.	UNKNOWN	7.44	300	J J
5.	UNKNOWN	7.54	170	J J
6.	UNKNOWN	22.61	230	J J
7. 57-11-4	OCTADECANOIC ACID	22.81	110	NJ J
8. 19047-85-9	PHOSPHONIC ACID, DIOCTADECYL	25.57	190	NJ J
9.	UNKNOWN	27.11	230	J J
10. 301-02-0	9-OCTADECENAMIDE, (Z)-	27.72	180	NJ J
11. 111-02-4	2,6,10,14,18,22-TETRACOSAHEX	28.07	93	NJ J
12.	UNKNOWN HYDROCARBON	29.83	210	J J
13.	UNKNOWN	29.88	280	J J
14.	UNKNOWN	30.76	79	J J
15. 14021-23-9	D-FRIEDOOLEAN-14-ENE, 3-METH	30.86	250	J J
16.	UNKNOWN HYDROCARBON	31.05	100	J J
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FORM I SV-TIC OLM04.2

MEMORANDUM

TO: Davida Trumbo

FROM: Kweku Acquah

SUBJECT: Radford Army Ammunition Plant Data Validation - Semivolatiles
Envirosystems Lab, SDG IT3

DATE: November 27, 2000

The purpose of this memorandum is to present the data validation report for the samples collected at the Radford Army Ammunition Plant during the August 30, 2000 sampling event. Samples were analyzed for semivolatile organic compounds (SVOCs) using USEPA SOW method OLM 04.2 (May 1999). A total of five soil samples were validated. The sample IDs are:

Field Sample ID
NRUW1B
NRUW1C
NRUG2C
NRUG2BD
NRUG2CD

Data were reviewed by Kweku Acquah and validated using a combination of method-specific criteria, laboratory SOP and the *Innovative Approaches to Data Validation for USEPA Region III* (June 1995.). Parameters evaluated under data validation procedure Level M3 are presented in Table 1. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA Region III specifications.

Table 1. Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times
	X	Instrument Performance Check
	X	Initial Calibration
X		Continuing Calibration
X		Blank Analysis
	X	Surrogate Spikes
	X	Internal Standards
X		Quantitation Verification

The quality of data collected in support of this sampling activity is considered acceptable with the noted qualifications.

cc: Eric Malarek
Project File

RADFORD ARMY AMMUNITION PLANT
VALIDATION REPORT
SEMIVOLATILES REVIEW
SDG IT3

I-Holding Times

Form I

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis. Holding time criteria: For semivolatile compounds in cooled (@4°C ± 2°C) water samples, the maximum holding time is 14 days from sample collection to extraction and 40 days from extraction to analysis.

- All criteria were met and no qualifiers were applied.

II-Instrument Performance Check

Form V and chromatograms.

GC/MS instrument performance checks are performed to ensure mass resolution, identification and, to some degree, sensitivity. The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples are analyzed.

- The instrument performance check, decafluorotriphenylphosphine (DFTPP), met the ion abundance criteria. No qualification was applied.

III-Initial Calibration

Form VI and chromatograms.

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used is capable of producing acceptable qualitative and quantitative data for compounds on the semivolatile target compound list (TCL). Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve. The minimum relative response factor (RRF) criteria must be ≥ 0.05. Initial calibration percent relative standard deviation (%RSD) must be ≤ 15% on the average for all compounds (< 30% for CCCs).

- For initial calibration performed on 09/01/00 on instrument HP73G, %RSD for compounds 2,4-Dinitrophenol (26.0%) and 4,6-Dinitro-2-methylphenol (21.0%) were above the control limit. Since these compounds were non-detects in all the samples, no qualifiers were applied based on these outliers.

IV-Continuing Calibration

Form VII and chromatograms.

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used was capable of producing acceptable qualitative and quantitative data for semivolatile target compounds. Continuing calibration standards containing both target and surrogates compounds are analyzed at the beginning of each 12-hour analysis period following the analysis of the instrument performance check and prior to the analysis of blanks and samples. The minimum Relative Response Factors (RRF) for semivolatile target compounds and surrogates must be ≥ 0.05. The percent difference (%D) between the initial calibration RRF and the continuing calibration RRF must be within ± 20% for all target compounds.

IV-Continuing Calibration (Cont.)

- For continuing calibration performed on 09/13/00 @14:37 on instrument HP73G, %D for compounds 2-Nitrophenol (22.2%), 2,6-Dinitrotoluene (24.1%), Di-n-butylphthalate (27.4%) and Butylbenzylphthalate (37.3%) were above the control limit. Positive values for these compounds were qualified as estimated, "J" and non-detects had no qualifiers applied.

- For continuing calibration performed on 09/13/00 @14:37 on instrument HP73G, %D for compounds bis (2-Ethylhexyl) phthalate (50.1%) and Di-n-octylphthalate (62.4%) were grossly above the control limit. Positive values for these compounds were qualified as estimated, "J" and non-detects "UJ".

- For continuing calibration performed on 09/14/00 @17:06 on instrument HP73G, %D for compounds 2,2'-oxybis (1-Chloropropane) (27.9%), N-Nitroso-di-n-propylamine (21.1%), 2-Nitrophenol (23.1%), 2-Methylnaphthalene (25.3%), 2,6-Dinitrotoluene (25.0%), 2,4-Dinitrophenol (35.1%), 4-Nitrophenol(25.2%), Di-n-butylphthalate (29.6%), Butylbenzylphthalate (39.2%) were above the control limit. Positive values for these compounds were qualified as estimated, "J" and non-detects had no qualifiers applied.

- For continuing calibration performed on 09/14/00 @17:06 on instrument HP73G, %D for compounds bis (2-Ethylhexyl) phthalate (57.1%) and Di-n-octylphthalate (73.8%) were grossly above the control limit. Since these compounds had already been qualified "UJ" in all the samples owing to a previous continuing calibration criteria failure, no further qualification was necessary.

- For continuing calibration performed on 09/15/00 @07:59 on instrument HP73G, %D for compounds Hexachlorocyclopentadiene (25.2%), 2,6-Dinitrotoluene (27.2%), 2,4-Dinitrophenol (50.0%), 4,6-Dinitro-2-methylphenol (23.1%), Di-n-butylphthalate (30.3%), Butylbenzylphthalate (37.9%), bis (2-Ethylhexyl) phthalate (52.7%) and Di-n-octylphthalate (77.8%) were either above or grossly above the control limits. Since the samples were quantitated off a previous continuing calibration, no qualifiers were applied based on these outliers.

V-Blank Analysis

Form I, IV and chromatograms

The purpose of blank analyses is to determine the presence and magnitude of contamination problems resulting from field and laboratory activities. The criteria for evaluation of blanks apply to any blank associated with the samples. The method blank must be analyzed on each GC/MS system used to analyze that specific group or set of samples. No contaminants should be detected in any of the associated blanks. Positive sample results are reported and qualified "B", if the concentration of the compound in the sample is ≤ 10 times (10X) the maximum amount in any blank for the common phthalate contaminants, or 5 times the maximum amount for the other compounds. Table 2 summarizes the blank contamination analysis. The associated rinse blank was sample number 082800R1.

TABLE 2. BLANK CONTAMINATION SUMMARY.

Compound / Blank Sample #	10X Max. conc. µg/kg	Samples Affected
Di-n-butylphthalate / 082800R1	660	All
Bis(2-Ethylhexyl)phthalate / SBLK02	5700	NRUG2BD, NRUG2CD

VI-Surrogate Spikes

Form II and chromatograms.
Laboratory performance on individual samples is evaluated through the review of surrogate spike samples. Surrogate spikes are added to all samples and blanks to measure their recovery in sample and blank matrices.

- All criteria were met and no qualifiers were applied.

VII-Internal Standards

Form VIII and chromatograms.
Internal standards performance criteria ensure that GC/MS sensitivity and response are stable during every analytical run. Internal standard area counts for samples and blanks must not vary by more than a factor of two (- 50% to + 100%) from the associated calibration standard. The retention time of the internal standards in samples and blanks must not vary by more than ± 30 seconds from the retention time of the associated calibration standard. Positive results for compounds quantitated using internal standards outside of control criteria should be qualified as estimated "J" and non-detects as "UJ".

- All criteria were met. No qualifiers were applied.

VIII-Quantitation Verification

Form 1, and chromatograms
The accuracy of analytical results was verified through the calculation of several parameters. Any target compound below the RL and above the MDL is reported as estimated "J". Any value in excess of the upper level of the calibration range was qualified as estimated "J". Tentatively Identified Compounds were also qualified as estimated, "J".

Sample: NRUW1C (00092530), Di-n-butylphthalate

Conc. (µg/kg) = (Ax * Is * Vt * DF) / (Ais * RRF * Ws * Fs * Vi)

where:
Ax is the compound area
Is is the amount of standard injected (ng)
Vt is the volume of total extract (µL)
DF is the dilution factor
Ais is the corresponding internal standard area
RRF is the Relative Response Factor from the continuing calibration std.
Vi is the volume of extract injected (µL)
Ws is the initial weight (gm)
Fs is the fraction of solid

Conc. µg/kg = (52169*40 ng*1000 µL*1) / (506961*1.367*30 gm*0.75*2 µL) = 67 µg/kg

Reported Value = 67 µg/kg
% Difference = 0%
Values were within 10% difference.

FORM I, COPY

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUW1B

Lab Name: ENVIROSYSTEMS, INC.　Contract: IT3

Lab Code: ENVSYS　Case No.: IT3　SAS No.:　SDG No.: IT3

Matrix: (soil/water) SOIL　Lab Sample ID: 00092529

Sample wt/vol: 30.0 (g/mL) G　Lab File ID: H73GC178

Level: (low/med) LOW　Date Received: 09/01/00

% Moisture: 21　Decanted: (Y/N) N　Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL)　Date Analyzed: 09/13/00

Injection Volume: 2.0 (uL)　Dilution Factor: 1.0

GPC Cleanup: (Y/N) N　pH: 6.3　Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	420	U
111-44-4	bis(2-Chloroethyl)Ether	420	U
95-57-8	2-Chlorophenol	420	U
95-48-7	2-Methylphenol	420	U
108-60-1	2,2'-oxybis(1-Chloropropane)	420	U
106-44-5	4-Methylphenol	420	U
621-64-7	N-Nitroso-di-n-propylamine	420	U
67-72-1	Hexachloroethane	420	U
98-95-3	Nitrobenzene	420	U
78-59-1	Isophorone	420	U
88-75-5	2-Nitrophenol	420	U
105-67-9	2,4-Dimethylphenol	420	U
120-83-2	2,4-Dichlorophenol	2000	U
91-20-3	Naphthalene	420	U
106-47-8	4-Chloroaniline	840	U
111-91-1	bis(2-Chloroethoxy)methane	420	U
87-68-3	Hexachlorobutadiene	420	U
59-50-7	4-Chloro-3-methylphenol	840	U
91-57-6	2-Methylnaphthalene	420	U
77-47-4	Hexachlorocyclopentadiene	420	U
88-06-2	2,4,6-Trichlorophenol	420	U
95-95-4	2,4,5-Trichlorophenol	420	U
91-58-7	2-Chloronaphthalene	420	U
88-74-4	2-Nitroaniline	2000	U
131-11-3	Dimethylphthalate	420	U
606-20-2	2,6-Dinitrotoluene	420	U
208-96-8	Acenaphthylene	420	U
99-09-2	3-Nitroaniline	2000	U
83-32-9	Acenaphthene	420	U
51-28-5	2,4-Dinitrophenol	420	U
100-02-7	4-Nitrophenol	2000	U
132-64-9	Dibenzofuran	420	U
121-14-2	2,4-Dinitrotoluene	420	U

FORM I, COPY

1D
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUW1B

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT3

Lab Code: ENVSYS   Case No.: IT3   SAS No.:   SDG No.: IT3

Matrix: (soil/water) SOIL   Lab Sample ID: 00092529

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC178

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 21   Decanted: (Y/N) N   Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL)   Date Analyzed: 09/13/00

Injection Volume: 2.0 (uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 6.3   Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	420	U
86-73-7	Fluorene	420	U
7005-72-3	4-Chlorophenyl-phenylether	420	U
100-01-6	4-Nitroaniline	2000	U
534-52-1	4,6-Dinitro-2-methylphenol	200	U
86-30-6	N-Nitrosodiphenylamine (1)	420	U
101-55-3	4-Bromophenyl-phenylether	420	U
118-74-1	Hexachlorobenzene	420	U
87-86-5	Pentachlorophenol	2000	U
85-01-8	Phenanthrene	420	U
120-12-7	Anthracene	420	U
86-74-8	Carbazole	420	U
84-74-2	Di-n-butylphthalate	48	J JB
206-44-0	Fluoranthene	420	U
129-00-0	Pyrene	420	U
85-68-7	Butylbenzylphthalate	420	U
91-94-1	3,3'-Dichlorobenzidine	840	U
56-55-3	Benzo(a)anthracene	420	U
218-01-9	Chrysene	420	U
117-81-7	bis(2-Ethylhexyl)phthalate	420	U UJ
117-84-0	Di-n-octylphthalate	420	U UJ
205-99-2	Benzo(b)fluoranthene	420	U
207-08-9	Benzo(k)fluoranthene	420	U
50-32-8	Benzo(a)pyrene	420	U
193-39-5	Indeno(1,2,3-cd)pyrene	420	U
53-70-3	Dibenzo(a,h)anthracene	420	U
191-24-2	Benzo(g,h,i)perylene	420	U
541-73-1	1,3-Dichlorobenzene	420	U
106-46-7	1,4-Dichlorobenzene	420	U
95-50-1	1,2-Dichlorobenzene	420	U
120-82-1	1,2,4-Trichlorbenzene	420	U

FORM I, COPY

1G

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUW1B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT3

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092529

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC178

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 21 Decanted: (Y/N) N Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/13/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.3 Extraction: (Type) SONC

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 10

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	5.66	150	J J
2.	UNKNOWN	6.79	300	J J
3.	UNKNOWN	7.01	88	J J
4.	UNKNOWN	7.39	110	J J
5.	UNKNOWN	7.44	350	J J
6.	UNKNOWN	7.54	180	J J
7. 74685-33-9	3-EICOSENE, (E)-	25.58	85	NJ J
8. 301-02-0	9-OCTADECENAMIDE, (Z)-	27.72	150	NJ J
9.	UNKNOWN	29.52	150	J J
10.	UNKNOWN	30.87	98	J J
11.				
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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUW1C

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT3

Lab Code: ENVSYS   Case No.: IT3   SAS No.:   SDG No.: IT3

Matrix: (soil/water) SOIL   Lab Sample ID: 00092530

Sample wt/vol: 30.0(g/mL) G   Lab File ID: H73GC179

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 25   Decanted: (Y/N)N   Date Extracted: 09/08/00

Concentrated Extract Volume: 1000(uL)   Date Analyzed: 09/13/00

Injection Volume: 2.0(uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 6.3   Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	440	U
111-44-4	bis(2-Chloroethyl)Ether	440	U
95-57-8	2-Chlorophenol	440	U
95-48-7	2-Methylphenol	440	U
108-60-1	2,2'-oxybis(1-Chloropropane)	440	U
106-44-5	4-Methylphenol	440	U
621-64-7	N-Nitroso-di-n-propylamine	440	U
67-72-1	Hexachloroethane	440	U
98-95-3	Nitrobenzene	440	U
78-59-1	Isophorone	440	U
88-75-5	2-Nitrophenol	440	U
105-67-9	2,4-Dimethylphenol	440	U
120-83-2	2,4-Dichlorophenol	2100	U
91-20-3	Naphthalene	440	U
106-47-8	4-Chloroaniline	880	U
111-91-1	bis(2-Chloroethoxy)methane	440	U
87-68-3	Hexachlorobutadiene	440	U
59-50-7	4-Chloro-3-methylphenol	880	U
91-57-6	2-Methylnaphthalene	440	U
77-47-4	Hexachlorocyclopentadiene	440	U
88-06-2	2,4,6-Trichlorophenol	440	U
95-95-4	2,4,5-Trichlorophenol	440	U
91-58-7	2-Chloronaphthalene	440	U
88-74-4	2-Nitroaniline	2100	U
131-11-3	Dimethylphthalate	440	U
606-20-2	2,6-Dinitrotoluene	440	U
208-96-8	Acenaphthylene	440	U
99-09-2	3-Nitroaniline	2100	U
83-32-9	Acenaphthene	440	U
51-28-5	2,4-Dinitrophenol	440	U
100-02-7	4-Nitrophenol	2100	U
132-64-9	Dibenzofuran	440	U
121-14-2	2,4-Dinitrotoluene	440	U

FORM I, COPY

1D

EPA SAMPLE NO.

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

NRUW1C

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT3

Lab Code: ENVSYS   Case No.: IT3   SAS No.:   SDG No.: IT3

Matrix: (soil/water) SOIL   Lab Sample ID: 00092530

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC179

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 25   Decanted: (Y/N) N   Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL)   Date Analyzed: 09/13/00

Injection Volume: 2.0 (uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 6.3   Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	440	U
86-73-7	Fluorene	440	U
7005-72-3	4-Chlorophenyl-phenylether	440	U
100-01-6	4-Nitroaniline	2100	U
534-52-1	4,6-Dinitro-2-methylphenol	210	U
86-30-6	N-Nitrosodiphenylamine (1)	440	U
101-55-3	4-Bromophenyl-phenylether	440	U
118-74-1	Hexachlorobenzene	440	U
87-86-5	Pentachlorophenol	2100	U
85-01-8	Phenanthrene	440	U
120-12-7	Anthracene	440	U
86-74-8	Carbazole	440	U
84-74-2	Di-n-butylphthalate	67	J B
206-44-0	Fluoranthene	440	U
129-00-0	Pyrene	440	U
85-68-7	Butylbenzylphthalate	440	U
91-94-1	3,3'-Dichlorobenzidine	880	U
56-55-3	Benzo(a)anthracene	440	U
218-01-9	Chrysene	440	U
117-81-7	bis(2-Ethylhexyl)phthalate	440	U uJ
117-84-0	Di-n-octylphthalate	440	U uJ
205-99-2	Benzo(b)fluoranthene	440	U
207-08-9	Benzo(k)fluoranthene	440	U
50-32-8	Benzo(a)pyrene	440	U
193-39-5	Indeno(1,2,3-cd)pyrene	440	U
53-70-3	Dibenzo(a,h)anthracene	440	U
191-24-2	Benzo(g,h,i)perylene	440	U
541-73-1	1,3-Dichlorobenzene	440	U
106-46-7	1,4-Dichlorobenzene	440	U
95-50-1	1,2-Dichlorobenzene	440	U
120-82-1	1,2,4-Trichlorbenzene	440	U

FORM 1, COPY

1G
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUW1C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT3

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092530

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC179

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 25 Decanted: (Y/N) N Date Extracted:09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/13/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.3 Extraction: (Type) SONC

Number TICs found: 9

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	5.66	210	J J
2.	UNKNOWN	6.79	340	J J
3.	UNKNOWN	7.01	97	J J
4.	UNKNOWN	7.39	130	J J
5.	UNKNOWN	7.44	390	J J
6.	UNKNOWN	7.53	210	J J
7. 57-10-3	N-HEXADECANOIC ACID	20.94	110	NJ J
8.	UNKNOWN	25.58	290	J J
9. 301-02-0	9-OCTADECENAMIDE, (Z)-	27.72	180	NJ J
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FORM I, COPY

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT3

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092532

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC180

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 28 Decanted: (Y/N) N Date Extracted: 09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/13/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 5.7 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	460	U
111-44-4	bis(2-Chloroethyl)Ether	460	U
95-57-8	2-Chlorophenol	460	U
95-48-7	2-Methylphenol	460	U
108-60-1	2,2'-oxybis(1-Chloropropane)	460	U
106-44-5	4-Methylphenol	460	U
621-64-7	N-Nitroso-di-n-propylamine	460	U
67-72-1	Hexachloroethane	460	U
98-95-3	Nitrobenzene	460	U
78-59-1	Isophorone	460	U
88-75-5	2-Nitrophenol	460	U
105-67-9	2,4-Dimethylphenol	460	U
120-83-2	2,4-Dichlorophenol	2200	U
91-20-3	Naphthalene	460	U
106-47-8	4-Chloroaniline	920	U
111-91-1	bis(2-Chloroethoxy)methane	460	U
87-68-3	Hexachlorobutadiene	460	U
59-50-7	4-Chloro-3-methylphenol	920	U
91-57-6	2-Methylnaphthalene	460	U
77-47-4	Hexachlorocyclopentadiene	460	U
88-06-2	2,4,6-Trichlorophenol	460	U
95-95-4	2,4,5-Trichlorophenol	460	U
91-58-7	2-Chloronaphthalene	460	U
88-74-4	2-Nitroaniline	2200	U
131-11-3	Dimethylphthalate	460	U
606-20-2	2,6-Dinitrotoluene	460	U
208-96-8	Acenaphthylene	460	U
99-09-2	3-Nitroaniline	2200	U
83-32-9	Acenaphthene	460	U
51-28-5	2,4-Dinitrophenol	460	U
100-02-7	4-Nitrophenol	2200	U
132-64-9	Dibenzofuran	460	U
121-14-2	2,4-Dinitrotoluene	460	U

FORM I, COPY

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EPA SAMPLE NO.

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

NRUG2C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT3

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092532

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC180

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 28 Decanted: (Y/N)N Date Extracted: 09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/13/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 5.7 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	460	U
86-73-7	Fluorene	460	U
7005-72-3	4-Chlorophenyl-phenylether	460	U
100-01-6	4-Nitroaniline	2200	U
534-52-1	4,6-Dinitro-2-methylphenol	220	U
86-30-6	N-Nitrosodiphenylamine (1)	460	U
101-55-3	4-Bromophenyl-phenylether	460	U
118-74-1	Hexachlorobenzene	460	U
87-86-5	Pentachlorophenol	2200	U
85-01-8	Phenanthrene	460	U
120-12-7	Anthracene	460	U
86-74-8	Carbazole	460	U
84-74-2	Di-n-butylphthalate	65	J JB
206-44-0	Fluoranthene	460	U
129-00-0	Pyrene	460	U
85-68-7	Butylbenzylphthalate	460	U
91-94-1	3,3'-Dichlorobenzidine	920	U
56-55-3	Benzo(a)anthracene	460	U
218-01-9	Chrysene	460	U
117-81-7	bis(2-Ethylhexyl)phthalate	460	U uJ
117-84-0	Di-n-octylphthalate	460	U uJ
205-99-2	Benzo(b)fluoranthene	460	U
207-08-9	Benzo(k)fluoranthene	460	U
50-32-8	Benzo(a)pyrene	460	U
193-39-5	Indeno(1,2,3-cd)pyrene	460	U
53-70-3	Dibenzo(a,h)anthracene	460	U
191-24-2	Benzo(g,h,i)perylene	460	U
541-73-1	1,3-Dichlorobenzene	460	U
106-46-7	1,4-Dichlorobenzene	460	U
95-50-1	1,2-Dichlorobenzene	460	U
120-82-1	1,2,4-Trichlorbenzene	460	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUG2C

ab Name: ENVIROSYSTEMS, INC. Contract: IT3

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092532

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC180

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 28 Decanted: (Y/N) N Date Extracted:09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/13/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 5.7 Extraction: (Type) SONC

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 8

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	5.66	230	J J
2.	UNKNOWN	6.78	290	J J
3.	UNKNOWN	7.39	120	J J
4.	UNKNOWN	7.44	360	J J
5.	UNKNOWN	7.54	250	J J
6.	UNKNOWN	20.95	94	J J
7. 19047-85-9	PHOSPHONIC ACID, DIOCTADECYL	25.59	160	NJ J
8. 301-02-0	9-OCTADECENAMIDE, (Z)-	27.71	210	NJ J
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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2BD

Lab Name: ENVIROSYSTEMS, INC. Contract: IT3

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092536

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC181

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 11 Decanted: (Y/N)N Date Extracted: 09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/14/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 7.6 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	370	U
111-44-4	bis(2-Chloroethyl)Ether	370	U
95-57-8	2-Chlorophenol	370	U
95-48-7	2-Methylphenol	370	U
108-60-1	2,2'-oxybis(1-Chloropropane)	370	U
106-44-5	4-Methylphenol	370	U
621-64-7	N-Nitroso-di-n-propylamine	370	U
67-72-1	Hexachloroethane	370	U
98-95-3	Nitrobenzene	370	U
78-59-1	Isophorone	370	U
88-75-5	2-Nitrophenol	370	U
105-67-9	2,4-Dimethylphenol	370	U
120-83-2	2,4-Dichlorophenol	1800	U
91-20-3	Naphthalene	370	U
106-47-8	4-Chloroaniline	740	U
111-91-1	bis(2-Chloroethoxy)methane	370	U
87-68-3	Hexachlorobutadiene	370	U
59-50-7	4-Chloro-3-methylphenol	740	U
91-57-6	2-Methylnaphthalene	370	U
77-47-4	Hexachlorocyclopentadiene	370	U
88-06-2	2,4,6-Trichlorophenol	370	U
95-95-4	2,4,5-Trichlorophenol	370	U
91-58-7	2-Chloronaphthalene	370	U
88-74-4	2-Nitroaniline	1800	U
131-11-3	Dimethylphthalate	370	U
606-20-2	2,6-Dinitrotoluene	370	U
208-96-8	Acenaphthylene	370	U
99-09-2	3-Nitroaniline	1800	U
83-32-9	Acenaphthene	370	U
51-28-5	2,4-Dinitrophenol	370	U
100-02-7	4-Nitrophenol	1800	U
132-64-9	Dibenzofuran	370	U
121-14-2	2,4-Dinitrotoluene	370	U

FORM I, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2BD

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT3

Lab Code: ENVSYS   Case No.: IT3   SAS No.:   SDG No.: IT3

Matrix: (soil/water) SOIL   Lab Sample ID: 00092536

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC181

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 11   Decanted: (Y/N) N   Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL)   Date Analyzed: 09/14/00

Injection Volume: 2.0 (uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 7.6   Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	370	U
86-73-7	Fluorene	370	U
7005-72-3	4-Chlorophenyl-phenylether	370	U
100-01-6	4-Nitroaniline	1800	U
534-52-1	4,6-Dinitro-2-methylphenol	180	U
86-30-6	N-Nitrosodiphenylamine (1)	370	U
101-55-3	4-Bromophenyl-phenylether	370	U
118-74-1	Hexachlorobenzene	370	U
87-86-5	Pentachlorophenol	1800	U
85-01-8	Phenanthrene	370	U
120-12-7	Anthracene	370	U
86-74-8	Carbazole	370	U
84-74-2	Di-n-butylphthalate	63	J ~~J~~ B
206-44-0	Fluoranthene	370	U
129-00-0	Pyrene	370	U
85-68-7	Butylbenzylphthalate	370	U
91-94-1	3,3'-Dichlorobenzidine	740	U
56-55-3	Benzo(a)anthracene	370	U
218-01-9	Chrysene	370	U
117-81-7	bis(2-Ethylhexyl)phthalate	43	J ~~J~~ B
117-84-0	Di-n-octylphthalate	370	U uJ
205-99-2	Benzo(b)fluoranthene	370	U
207-08-9	Benzo(k)fluoranthene	370	U
50-32-8	Benzo(a)pyrene	370	U
193-39-5	Indeno(1,2,3-cd)pyrene	370	U
53-70-3	Dibenzo(a,h)anthracene	370	U
191-24-2	Benzo(g,h,i)perylene	370	U
541-73-1	1,3-Dichlorobenzene	370	U
106-46-7	1,4-Dichlorobenzene	370	U
95-50-1	1,2-Dichlorobenzene	370	U
120-82-1	1,2,4-Trichlorbenzene	370	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

NRUG2BD

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT3

Lab Code: ENVSYS   Case No.: IT3   SAS No.:   SDG No.: IT3

Matrix: (soil/water) SOIL   Lab Sample ID: 00092536

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC181

Level: (low/med) LOW   Date Received: 09/01/00

% Moisture: 11   Decanted: (Y/N) N   Date Extracted: 09/08/00

Concentrated Extract Volume: 1000(uL)   Date Analyzed: 09/14/00

Injection Volume: 2.0(uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 7.6   Extraction: (Type) SONC

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 12

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	5.66	200	J J
2.	UNKNOWN	6.79	330	J J
3.	UNKNOWN	7.01	88	J J
4.	UNKNOWN	7.39	120	J J
5.	UNKNOWN	7.44	390	J J
6.	UNKNOWN	7.54	210	J J
7.	UNKNOWN	20.94	110	J J
8.	UNKNOWN	25.47	84	J J
9. 1454-85-9	1-HEPTADECANOL	25.59	140	NJ J
10.	UNKNOWN	27.13	98	J J
11. 301-02-0	9-OCTADECENAMIDE, (Z)-	27.72	230	NJ J
12.	UNKNOWN	29.89	290	J J
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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2CD

Lab Name: ENVIROSYSTEMS, INC.　Contract: IT3

Lab Code: ENVSYS　Case No.: IT3　SAS No.:　SDG No.: IT3

Matrix: (soil/water) SOIL　Lab Sample ID: 00092541

Sample wt/vol: 30.0(g/mL) G　Lab File ID: H73GC182

Level: (low/med) LOW　Date Received: 09/01/00

% Moisture: 18　Decanted: (Y/N)N　Date Extracted: 09/08/00

Concentrated Extract Volume: 1000(uL)　Date Analyzed: 09/14/00

Injection Volume: 2.0(uL)　Dilution Factor: 1.0

GPC Cleanup: (Y/N) N　pH: 6.6　Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	400	U
111-44-4	bis(2-Chloroethyl)Ether	400	U
95-57-8	2-Chlorophenol	400	U
95-48-7	2-Methylphenol	400	U
108-60-1	2,2'-oxybis(1-Chloropropane)	400	U
106-44-5	4-Methylphenol	400	U
621-64-7	N-Nitroso-di-n-propylamine	400	U
67-72-1	Hexachloroethane	400	U
98-95-3	Nitrobenzene	400	U
78-59-1	Isophorone	400	U
88-75-5	2-Nitrophenol	400	U
105-67-9	2,4-Dimethylphenol	400	U
120-83-2	2,4-Dichlorophenol	2000	U
91-20-3	Naphthalene	400	U
106-47-8	4-Chloroaniline	800	U
111-91-1	bis(2-Chloroethoxy)methane	400	U
87-68-3	Hexachlorobutadiene	400	U
59-50-7	4-Chloro-3-methylphenol	800	U
91-57-6	2-Methylnaphthalene	400	U
77-47-4	Hexachlorocyclopentadiene	400	U
88-06-2	2,4,6-Trichlorophenol	400	U
95-95-4	2,4,5-Trichlorophenol	400	U
91-58-7	2-Chloronaphthalene	400	U
88-74-4	2-Nitroaniline	2000	U
131-11-3	Dimethylphthalate	400	U
606-20-2	2,6-Dinitrotoluene	400	U
208-96-8	Acenaphthylene	400	U
99-09-2	3-Nitroaniline	2000	U
83-32-9	Acenaphthene	400	U
51-28-5	2,4-Dinitrophenol	400	U
100-02-7	4-Nitrophenol	2000	U
132-64-9	Dibenzofuran	400	U
121-14-2	2,4-Dinitrotoluene	400	U

FORM 1, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

NRUG2CD

Lab Name: ENVIROSYSTEMS, INC. Contract: IT3

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092541

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC182

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 18 Decanted: (Y/N) N Date Extracted: 09/08/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/14/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.6 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	400	U
86-73-7	Fluorene	400	U
7005-72-3	4-Chlorophenyl-phenylether	400	U
100-01-6	4-Nitroaniline	2000	U
534-52-1	4,6-Dinitro-2-methylphenol	200	U
86-30-6	N-Nitrosodiphenylamine (1)	400	U
101-55-3	4-Bromophenyl-phenylether	400	U
118-74-1	Hexachlorobenzene	400	U
87-86-5	Pentachlorophenol	2000	U
85-01-8	Phenanthrene	400	U
120-12-7	Anthracene	400	U
86-74-8	Carbazole	400	U
84-74-2	Di-n-butylphthalate	63	J JB
206-44-0	Fluoranthene	400	U
129-00-0	Pyrene	400	U
85-68-7	Butylbenzylphthalate	400	U
91-94-1	3,3'-Dichlorobenzidine	800	U
56-55-3	Benzo(a)anthracene	400	U
218-01-9	Chrysene	400	U
117-81-7	bis(2-Ethylhexyl)phthalate	62	J JB
117-84-0	Di-n-octylphthalate	400	U UJ
205-99-2	Benzo(b)fluoranthene	400	U
207-08-9	Benzo(k)fluoranthene	400	U
50-32-8	Benzo(a)pyrene	400	U
193-39-5	Indeno(1,2,3-cd)pyrene	400	U
53-70-3	Dibenzo(a,h)anthracene	400	U
191-24-2	Benzo(g,h,i)perylene	400	U
541-73-1	1,3-Dichlorobenzene	400	U
106-46-7	1,4-Dichlorobenzene	400	U
95-50-1	1,2-Dichlorobenzene	400	U
120-82-1	1,2,4-Trichlorbenzene	400	U

FORM I SV-2

OLM04.2

Form I, copy

EPA SAMPLE NO.

NRUG2CD

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

Lab Name: ENVIROSYSTEMS, INC. Contract: IT3

Lab Code: ENVSYS Case No.: IT3 SAS No.: SDG No.: IT3

Matrix: (soil/water) SOIL Lab Sample ID: 00092541

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC182

Level: (low/med) LOW Date Received: 09/01/00

% Moisture: 18 Decanted: (Y/N) N Date Extracted:09/08/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/14/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.6 Extraction: (Type) SONC

Number TICs found: 10

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		UNKNOWN	5.64	260	J J
2.		UNKNOWN	6.78	460	J J
3.		UNKNOWN	7.01	150	J J
4.		UNKNOWN	7.06	110	J J
5.		UNKNOWN	7.39	190	J J
6.		UNKNOWN	7.44	540	J J
7.		UNKNOWN	7.53	280	J J
8.		UNKNOWN	25.47	82	J J
9.	19047-85-9	PHOSPHONIC ACID, DIOCTADECYL	25.59	90	NJ J
10.	301-02-0	9-OCTADECENAMIDE, (Z)-	27.72	200	NJ J
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FORM I SV-TIC

MEMORANDUM

TO: Davida Trumbo

FROM: Kweku Acquah

SUBJECT: Radford Army Ammunition Plant Data Validation - Semivolatiles
Envirosystems Lab, SDG IT5

DATE: November 27, 2000

The purpose of this memorandum is to present the data validation report for the samples collected at the Radford Army Ammunition Plant during the September 6-7, 2000 sampling events. Samples were analyzed for semivolatile organic compounds (SVOCs) using USEPA SOW method OLM 04.2 (May 1999). A total of eight soil samples were validated. The sample IDs are:

Field Sample ID	Field Sample ID
MMAB3A	MMAW2CD
MMAB3B	MMAU1A
MMAW2A	MMAU1B
MMAW2B	MMAU1C
MMAW2C	

Data were reviewed by Kweku Acquah and validated using a combination of method-specific criteria, laboratory SOP and *Innovative Approaches to Data Validation for USEPA Region III* (June 1995.). Parameters evaluated under data validation procedure Level M3 are presented in Table 1. Data associated with parameters in compliance with quality control specifications have not been qualified. Data associated with parameters that did not comply with quality control specifications and directly impacted project data have been qualified in accordance with USEPA Region III specifications.

Table 1. Laboratory Performance Criteria

Qualified		Parameter
Yes	No	
	X	Holding Times
	X	Instrument Performance Check
	X	Initial Calibration
X		Continuing Calibration
X		Blank Analysis
	X	Surrogate Spikes
	X	Matrix Spike/Matrix Spike Duplicate
	X	Internal Standards
X		Quantitation Verification

The quality of data collected in support of this sampling activity is considered acceptable with the noted qualifications.

cc: Eric Malarek
Project File

RADFORD ARMY AMMUNITION PLANT
VALIDATION REPORT
SEMIVOLATILES REVIEW
SDG IT5

I-Holding Times

Form I

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of sample extraction and analysis. Holding time criteria: For semivolatile compounds in cooled (@4°C ± 2°C) soil samples, the maximum holding time is 14 days from sample collection to extraction and 40 days from extraction to analysis.

- The samples were analyzed 09/17-22/00. All criteria were met and no qualifiers were applied.

II-Instrument Performance Check

Form V and chromatograms.

GC/MS instrument performance checks are performed to ensure mass resolution, identification and, to some degree, sensitivity. The analysis of the instrument performance check solution must be performed at the beginning of each 12-hour period during which samples are analyzed.

- The instrument performance check, decafluorotriphenylphosphine (DFTPP), met the ion abundance criteria. No qualification was applied.

III-Initial Calibration

Form VI and chromatograms.

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used is capable of producing acceptable qualitative and quantitative data for compounds on the semivolatile target compound list (TCL). Initial calibration demonstrates that the instrument is capable of acceptable performance in the beginning of the analytical run and of producing a linear calibration curve. The minimum relative response factor (RRF) criteria must be ≥ 0.05. Initial calibration percent relative standard deviation (%RSD) must be ≤ 15% on the average for all compounds (< 30% for CCCs).

- For initial calibration performed on 09/01/00 on instrument HP73G, 2,4-Dinitrophenol (26.0%) and 4,6-Dinitro-2-methylphenol (21.0%) were above the control limit. Since these compounds were non-detects in all the samples, no qualifiers were applied based on these outliers.

IV-Continuing Calibration

Form VII and chromatograms.

Compliance requirements for satisfactory instrument calibration are established to ensure that the instrument used was capable of producing acceptable qualitative and quantitative data for semivolatile target compounds. Continuing calibration standards containing both target and surrogates compounds are analyzed at the beginning of each 12-hour analysis period following the analysis of the instrument performance check and prior to the analysis of blanks and samples. The minimum relative response factors (RRF) for semivolatile target compounds and surrogates must be ≥ 0.05. The percent difference (%D) between the initial calibration RRF and the continuing calibration RRF must be within ± 20% for all target compounds.

IV-Continuing Calibration (Cont.)

- For continuing calibration performed on 09/17/00 @15:19 on instrument HP73G, compounds Nitrobenzene (21.4%), 2-Methylnaphthalene (24.1%), 2-Nitroaniline (26.8%), 2,6-Dinitrotoluene (27.2%), 2,4-Dinitrophenol (31.3%), Di-n-butylphthalate (27.0%), Pyrene (21.5%), Butylbenzylphthalate (38.1%), bis(2-Ethylhexyl)phthalate (49.9%) and Di-n-octylphthalate (61.5%)%) were above the control limits. Positive values for these compounds were qualified as estimated, "J" and non-detects had no qualifiers applied.

- For continuing calibration performed on 09/22/00 @09:31 on instrument HP73G, %D for compounds 2,4-Dinitrophenol (58.2%), 4,6-Dinitro-2-methylphenol (45.3%) and Di-n-octylphthalate (44.0%) were grossly above the control limit (i.e > 2X CL). Positive values for these compounds were qualified as estimated, "J" and non-detects "UJ".

- For continuing calibration performed on 09/22/00 @09:31 on instrument HP73G, %D for compounds N-Nitroso-di-n-propylamine (21.6%), Hexachloroethane (21.0%), 2-Nitroaniline (31.8%), 2,6-Dinitrotoluene (24.1%), 3-Nitroaniline (21.8%), Carbazole (33.4%), Butylbenzylphthalate (28.7%) and bis(2-Ethylhexyl)phthalate (35.1%) were above the control limit. Positive values for these compounds were qualified as estimated, "J" and non-detects had no qualifiers applied.

V-Blank Analysis

Form I, IV and chromatograms

The purpose of blank analyses is to determine the presence and magnitude of contamination problems resulting from field and laboratory activities. The criteria for evaluation of blanks apply to any blank associated with the samples. The method blank must be analyzed on each GC/MS system used to analyze that specific group or set of samples. No contaminants should be detected in any of the associated blanks. Positive sample results are reported and qualified "B", if the concentration of the compound in the sample is ≤ 10 times (10X) the maximum amount in any blank for the common phthalate contaminants, or 5 times the maximum amount for the other compounds. Table 2 summarizes the blank contamination analysis. The associated rinse blank is sample number 083100R4.

TABLE 2. BLANK CONTAMINATION SUMMARY.

Compound/Blank Sample #	10X Max. conc. µg/kg	Samples Affected
Di-n-butylphthalate / SBLK14	9500	All
Bis(2-Ethylhexyl)phthalate / SBLK14	850	All except MMAB3B, MMAU1B

VI-Surrogate Spikes

Form II and chromatograms.

Laboratory performance on individual samples is evaluated through the review of surrogate spike samples. Surrogate spikes are added to all samples and blanks to measure their recovery in sample and blank matrices.

- All criteria were met. No qualifiers were applied.

VII-Matrix Spike/Spike Duplicate

Form III and chromatograms.

MS/MSD are generated to determine long-term precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis. Specific criteria include the analyses of matrix spike and matrix spike duplicate samples at a frequency of one MS and MSD per 20 samples of similar matrix. MS and MSD recoveries and Relative Percent Differences between MS and MSD recoveries should be within the specified limits.

- Sample MMAW2B (00092621) was used for the MS/MSD analyses. All criteria were met and no qualifiers were applied.

VIII-Internal Standards

Form VIII and chromatograms.

Internal standards performance criteria ensure that GC/MS sensitivity and response are stable during every analytical run. Internal standard area counts for samples and blanks must not vary by more than a factor of two (- 50% to + 100%) from the associated calibration standard. The retention time of the internal standards in samples and blanks must not vary by more than ± 30 seconds from the retention time of the associated calibration standard. Positive results for compounds quantitated using internal standards outside of control criteria should be qualified as estimated "J" and non-detects as "UJ".

- All criteria were met for all target compounds. No qualifiers were applied.

IX-Quantitation Verification

Form 1, and chromatograms

The accuracy of analytical results was verified through the calculation of several parameters. Any target compound below the RL and above the MDL is reported as estimated "J". Any value in excess of the upper level of the calibration range was qualified as estimated "J". Tentatively Identified Compounds were also qualified as estimated, "J".

Sample: MMAW2BMS (00092621MS), Phenol.

Conc. (µg/kg) =(Ax * Is * Vt * DF) / (Ais * RRF * Ws * Fs * Vi)

where:

Ax is the compound area
Is is the amount of standard injected (ng)
Vt is the volume of total extract (µL)
DF is the dilution factor
Ais is the corresponding internal standard area
RRF is the Relative Response Factor from the continuing calibration std.
Ws is the initial weight (g)
Fs is the fraction of solid
Vi is the volume of extract injected (µL)

Conc. µg/kg = (902023*40 ng*1000 µL*1) / 185144*3.035*30 gm*0.89*2 µL = 1202 µg/kg

Reported Value = 1200 µg/kg
% Difference = 0.16%
Values were within 10% difference.

FORM I, copy

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAB3A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092618

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC233

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 11 Decanted: (Y/N)N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/17/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 5.9 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	370	U
111-44-4	bis(2-Chloroethyl)Ether	370	U
95-57-8	2-Chlorophenol	370	U
95-48-7	2-Methylphenol	370	U
108-60-1	2,2'-oxybis(1-Chloropropane)	370	U
106-44-5	4-Methylphenol	370	U
621-64-7	N-Nitroso-di-n-propylamine	370	U
67-72-1	Hexachloroethane	370	U
98-95-3	Nitrobenzene	370	U
78-59-1	Isophorone	370	U
88-75-5	2-Nitrophenol	370	U
105-67-9	2,4-Dimethylphenol	370	U
120-83-2	2,4-Dichlorophenol	1800	U
91-20-3	Naphthalene	370	U
106-47-8	4-Chloroaniline	740	U
111-91-1	bis(2-Chloroethoxy)methane	370	U
87-68-3	Hexachlorobutadiene	370	U
59-50-7	4-Chloro-3-methylphenol	740	U
91-57-6	2-Methylnaphthalene	370	U
77-47-4	Hexachlorocyclopentadiene	370	U
88-06-2	2,4,6-Trichlorophenol	370	U
95-95-4	2,4,5-Trichlorophenol	370	U
91-58-7	2-Chloronaphthalene	370	U
88-74-4	2-Nitroaniline	1800	U
131-11-3	Dimethylphthalate	370	U
606-20-2	2,6-Dinitrotoluene	370	U
208-96-8	Acenaphthylene	370	U
99-09-2	3-Nitroaniline	1800	U
83-32-9	Acenaphthene	370	U
51-28-5	2,4-Dinitrophenol	370	U UJ
100-02-7	4-Nitrophenol	1800	U
132-64-9	Dibenzofuran	370	U
121-14-2	2,4-Dinitrotoluene	370	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAB3A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092618

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC233

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 11 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/17/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 5.9 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	370	U
86-73-7	Fluorene	370	U
7005-72-3	4-Chlorophenyl-phenylether	370	U
100-01-6	4-Nitroaniline	1800	U uJ
534-52-1	4,6-Dinitro-2-methylphenol	180	U
86-30-6	N-Nitrosodiphenylamine (1)	370	U
101-55-3	4-Bromophenyl-phenylether	370	U
118-74-1	Hexachlorobenzene	370	U
87-86-5	Pentachlorophenol	1800	U
85-01-8	Phenanthrene	370	U
120-12-7	Anthracene	370	U
86-74-8	Carbazole	370	U
84-74-2	Di-n-butylphthalate	650	B B
206-44-0	Fluoranthene	370	U
129-00-0	Pyrene	370	U
85-68-7	Butylbenzylphthalate	370	U
91-94-1	3,3'-Dichlorobenzidine	740	U
56-55-3	Benzo(a)anthracene	370	U
218-01-9	Chrysene	370	U
117-81-7	bis(2-Ethylhexyl)phthalate	150	JB JB
117-84-0	Di-n-octylphthalate	370	U uJ
205-99-2	Benzo(b)fluoranthene	370	U
207-08-9	Benzo(k)fluoranthene	370	U
50-32-8	Benzo(a)pyrene	370	U
193-39-5	Indeno(1,2,3-cd)pyrene	370	U
53-70-3	Dibenzo(a,h)anthracene	370	U
191-24-2	Benzo(g,h,i)perylene	370	U
541-73-1	1,3-Dichlorobenzene	370	U
106-46-7	1,4-Dichlorobenzene	370	U
95-50-1	1,2-Dichlorobenzene	370	U
120-82-1	1,2,4-Trichlorbenzene	370	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

MMAB3A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092618

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC233

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 11 Decanted: (Y/N) N Date Extracted:09/15/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/17/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 5.9 Extraction: (Type) SONC

Number TICs found: 30

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN HYDROCARBON	5.60	170	JB J
2.	UNKNOWN	6.79	120	J J
3. 7785-70-8	1R-.ALPHA.-PINENE	7.12	1200	NJ J
4.	UNKNOWN	7.44	110	JB J
5.	UNKNOWN	7.53	430	JB J
6.	UNKNOWN	8.42	290	J J
7.	UNKNOWN	9.43	120	J J
8.	UNKNOWN	15.01	180	J J
9.	UNKNOWN	17.13	370	J J
10.	UNKNOWN PHTHALATE	20.06	160	JB J
11. 57-10-3	N-HEXADECANOIC ACID	20.95	390	NJ J
12.	UNKNOWN	22.50	140	J J
13.	UNKNOWN	22.80	270	J J
14.	UNKNOWN	23.02	190	J J
15.	UNKNOWN	23.48	200	J J
16.	UNKNOWN	23.64	220	J J
17.	UNKNOWN	23.86	250	J J
18.	UNKNOWN	24.12	180	J J
19.	UNKNOWN	24.21	170	J J
20.	UNKNOWN	24.51	1200	J J
21. 20316-84-1	KAUR-16-EN-18-OIC ACID, (4.B	24.96	350	NJ J
22. 19047-85-9	PHOSPHONIC ACID, DIOCTADECYL	25.64	390	NJ J
23. 1599-67-3	1-DOCOSENE	27.18	270	NJ J
24.	UNKNOWN	28.61	150	J J
25.	UNKNOWN HYDROCARBON	29.82	350	J J
26.	UNKNOWN	29.91	1600	J J
27.	UNKNOWN	30.12	370	J J
28.	UNKNOWN	30.52	170	J J
29.	UNKNOWN HYDROCARBON	31.05	190	J J
30.	UNKNOWN	31.36	520	J J

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FORM 1, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAB3B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092619

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC234

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 9 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/17/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.1 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	360	U
111-44-4	bis(2-Chloroethyl)Ether	360	U
95-57-8	2-Chlorophenol	360	U
95-48-7	2-Methylphenol	360	U
108-60-1	2,2'-oxybis(1-Chloropropane)	360	U
106-44-5	4-Methylphenol	360	U
621-64-7	N-Nitroso-di-n-propylamine	360	U
67-72-1	Hexachloroethane	360	U
98-95-3	Nitrobenzene	360	U
78-59-1	Isophorone	360	U
88-75-5	2-Nitrophenol	360	U
105-67-9	2,4-Dimethylphenol	360	U
120-83-2	2,4-Dichlorophenol	1800	U
91-20-3	Naphthalene	360	U
106-47-8	4-Chloroaniline	730	U
111-91-1	bis(2-Chloroethoxy)methane	360	U
87-68-3	Hexachlorobutadiene	360	U
59-50-7	4-Chloro-3-methylphenol	730	U
91-57-6	2-Methylnaphthalene	360	U
77-47-4	Hexachlorocyclopentadiene	360	U
88-06-2	2,4,6-Trichlorophenol	360	U
95-95-4	2,4,5-Trichlorophenol	360	U
91-58-7	2-Chloronaphthalene	360	U
88-74-4	2-Nitroaniline	1800	U
131-11-3	Dimethylphthalate	360	U
606-20-2	2,6-Dinitrotoluene	360	U
208-96-8	Acenaphthylene	360	U
99-09-2	3-Nitroaniline	1800	U
83-32-9	Acenaphthene	360	U
51-28-5	2,4-Dinitrophenol	360	U UJ
100-02-7	4-Nitrophenol	1800	U
132-64-9	Dibenzofuran	360	U
121-14-2	2,4-Dinitrotoluene	360	U

FORM I, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAB3B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092619

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC234

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 9 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/17/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.1 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	360	U
86-73-7	Fluorene	360	U
7005-72-3	4-Chlorophenyl-phenylether	360	U
100-01-6	4-Nitroaniline	1800	U
534-52-1	4,6-Dinitro-2-methylphenol	180	U uJ
86-30-6	N-Nitrosodiphenylamine_(1)	360	U
101-55-3	4-Bromophenyl-phenylether	360	U
118-74-1	Hexachlorobenzene	360	U
87-86-5	Pentachlorophenol	1800	U
85-01-8	Phenanthrene	360	U
120-12-7	Anthracene	360	U
86-74-8	Carbazole	360	U
84-74-2	Di-n-butylphthalate	570	B B
206-44-0	Fluoranthene	360	U
129-00-0	Pyrene	360	U
85-68-7	Butylbenzylphthalate	360	U
91-94-1	3,3'-Dichlorobenzidine	730	U
56-55-3	Benzo(a)anthracene	360	U
218-01-9	Chrysene	360	U
117-81-7	bis(2-Ethylhexyl)phthalate	2600	B
117-84-0	Di-n-octylphthalate	360	U uJ
205-99-2	Benzo(b)fluoranthene	360	U
207-08-9	Benzo(k)fluoranthene	360	U
50-32-8	Benzo(a)pyrene	360	U
193-39-5	Indeno(1,2,3-cd)pyrene	360	U
53-70-3	Dibenzo(a,h)anthracene	360	U
191-24-2	Benzo(g,h,i)perylene	360	U
541-73-1	1,3-Dichlorobenzene	360	U
106-46-7	1,4-Dichlorobenzene	360	U
95-50-1	1,2-Dichlorobenzene	360	U
120-82-1	1,2,4-Trichlorbenzene	360	U

FORM I, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

MMAB3B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092619

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC234

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 9 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/17/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.1 Extraction: (Type) SONC

Number TICs found: 12

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		UNKNOWN HYDROCARBON	5.60	180	J J
2.		UNKNOWN	6.79	130	JB J
3.	1000152-27-1	CYCLOPENTENE, 1,2,3,3,4-PENT	6.83	79	NJ J
4.		UNKNOWN	7.44	100	JB J
5.		UNKNOWN	7.53	360	JB J
6.		UNKNOWN	8.42	190	J J
7.		UNKNOWN	9.43	120	J J
8.	74381-40-1	PROPANOIC ACID, 2-METHYL-, 1	17.13	250	NJ J
9.		UNKNOWN PHTHALATE	20.06	120	JB J
10.	1454-85-9	1-HEPTADECANOL	25.65	110	NJ J
11.	629-96-9	1-EICOSANOL	27.19	81	NJ J
12.		UNKNOWN	29.50	170	J J
13.					
14.					
15.					
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FORM I, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAW2A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092620

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC235

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 6 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/17/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.7 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	350	U
111-44-4	bis(2-Chloroethyl)Ether	350	U
95-57-8	2-Chlorophenol	350	U
95-48-7	2-Methylphenol	350	U
108-60-1	2,2'-oxybis(1-Chloropropane)	350	U
106-44-5	4-Methylphenol	350	U
621-64-7	N-Nitroso-di-n-propylamine	350	U
67-72-1	Hexachloroethane	350	U
98-95-3	Nitrobenzene	350	U
78-59-1	Isophorone	350	U
88-75-5	2-Nitrophenol	350	U
105-67-9	2,4-Dimethylphenol	350	U
120-83-2	2,4-Dichlorophenol	1700	U
91-20-3	Naphthalene	350	U
106-47-8	4-Chloroaniline	700	U
111-91-1	bis(2-Chloroethoxy)methane	350	U
87-68-3	Hexachlorobutadiene	350	U
59-50-7	4-Chloro-3-methylphenol	700	U
91-57-6	2-Methylnaphthalene	350	U
77-47-4	Hexachlorocyclopentadiene	350	U
88-06-2	2,4,6-Trichlorophenol	350	U
95-95-4	2,4,5-Trichlorophenol	350	U
91-58-7	2-Chloronaphthalene	350	U
88-74-4	2-Nitroaniline	1700	U
131-11-3	Dimethylphthalate	350	U
606-20-2	2,6-Dinitrotoluene	350	U
208-96-8	Acenaphthylene	350	U
99-09-2	3-Nitroaniline	1700	U
83-32-9	Acenaphthene	350	U
51-28-5	2,4-Dinitrophenol	350	U uJ
100-02-7	4-Nitrophenol	1700	U
132-64-9	Dibenzofuran	350	U
121-14-2	2,4-Dinitrotoluene	350	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAW2A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092620

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC235

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 6 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/17/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.7 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	350	U
86-73-7	Fluorene	350	U
7005-72-3	4-Chlorophenyl-phenylether	350	U
100-01-6	4-Nitroaniline	1700	U
534-52-1	4,6-Dinitro-2-methylphenol	170	U UJ
86-30-6	N-Nitrosodiphenylamine (1)	350	U
101-55-3	4-Bromophenyl-phenylether	350	U
118-74-1	Hexachlorobenzene	350	U
87-86-5	Pentachlorophenol	1700	U
85-01-8	Phenanthrene	350	U
120-12-7	Anthracene	350	U
86-74-8	Carbazole	350	U
84-74-2	Di-n-butylphthalate	370	B JB
206-44-0	Fluoranthene	350	U
129-00-0	Pyrene	350	U
85-68-7	Butylbenzylphthalate	350	U
91-94-1	3,3'-Dichlorobenzidine	700	U
56-55-3	Benzo(a)anthracene	350	U
218-01-9	Chrysene	350	U
117-81-7	bis(2-Ethylhexyl)phthalate	110	JB JB
117-84-0	Di-n-octylphthalate	350	U UJ
205-99-2	Benzo(b)fluoranthene	350	U
207-08-9	Benzo(k)fluoranthene	350	U
50-32-8	Benzo(a)pyrene	350	U
193-39-5	Indeno(1,2,3-cd)pyrene	350	U
53-70-3	Dibenzo(a,h)anthracene	350	U
191-24-2	Benzo(g,h,i)perylene	350	U
541-73-1	1,3-Dichlorobenzene	350	U
106-46-7	1,4-Dichlorobenzene	350	U
95-50-1	1,2-Dichlorobenzene	350	U
120-82-1	1,2,4-Trichlorbenzene	350	U

FORM I SV-2 OLM04.2

FORM I, COPY

1G
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

MMAW2A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092620

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC235

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 6 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/17/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.7 Extraction: (Type) SONC

Number TICs found: 28

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN HYDROCARBON	5.61	160	JB J
2.	UNKNOWN	6.79	110	JB J
3.	UNKNOWN	7.11	170	J J
4.	UNKNOWN	7.44	97	JB J
5.	UNKNOWN	7.54	560	JB J
6.	UNKNOWN	8.43	350	J J
7.	UNKNOWN	17.13	180	J J
8.	UNKNOWN	19.79	75	J J
9.	UNKNOWN PHTHALATE	20.06	85	JB J
10.	UNKNOWN	20.84	120	J J
11. 57-10-3	N-HEXADECANOIC ACID	20.96	420	NJB J
12. 56554-86-0	17-OCTADECENAL	25.06	96	NJ J
13. 6624-79-9	1-DOTRIACONTANOL	25.61	280	NJ J
14.	UNKNOWN	27.11	120	J J
15.	UNKNOWN	27.15	310	J J
16.	UNKNOWN	28.06	230	J J
17.	UNKNOWN	28.58	230	J J
18.	UNKNOWN HYDROCARBON	29.82	520	J J
19.	UNKNOWN	29.90	800	J J
20. 1000210-38-4	17-(1,5-DIMETHYLHEXYL)-10,13	30.11	120	NJ J
21.	UNKNOWN	30.87	110	J J
22. 630-06-8	HEXATRIACONTANE	31.06	410	NJ J
23.	UNKNOWN	31.31	170	J J
24. 83-47-6	.GAMMA.-SITOSTEROL	31.37	600	NJ J
25.	UNKNOWN	31.51	370	J J
26.	UNKNOWN	31.99	130	J J
27.	UNKNOWN	32.17	110	J J
28. 1058-61-3	STIGMAST-4-EN-3-ONE	32.30	430	NJ J
29.				
30.				

FORM I, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAW2B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092621

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC236

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 11 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/17/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 7.5 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	370	U
111-44-4	bis(2-Chloroethyl)Ether	370	U
95-57-8	2-Chlorophenol	370	U
95-48-7	2-Methylphenol	370	U
108-60-1	2,2'-oxybis(1-Chloropropane)	370	U
106-44-5	4-Methylphenol	370	U
621-64-7	N-Nitroso-di-n-propylamine	370	U
67-72-1	Hexachloroethane	370	U
98-95-3	Nitrobenzene	370	U
78-59-1	Isophorone	370	U
88-75-5	2-Nitrophenol	370	U
105-67-9	2,4-Dimethylphenol	370	U
120-83-2	2,4-Dichlorophenol	1800	U
91-20-3	Naphthalene	370	U
106-47-8	4-Chloroaniline	740	U
111-91-1	bis(2-Chloroethoxy)methane	370	U
87-68-3	Hexachlorobutadiene	370	U
59-50-7	4-Chloro-3-methylphenol	740	U
91-57-6	2-Methylnaphthalene	370	U
77-47-4	Hexachlorocyclopentadiene	370	U
88-06-2	2,4,6-Trichlorophenol	370	U
95-95-4	2,4,5-Trichlorophenol	370	U
91-58-7	2-Chloronaphthalene	370	U
88-74-4	2-Nitroaniline	1800	U
131-11-3	Dimethylphthalate	370	U
606-20-2	2,6-Dinitrotoluene	370	U
208-96-8	Acenaphthylene	370	U
99-09-2	3-Nitroaniline	1800	U
83-32-9	Acenaphthene	370	U
51-28-5	2,4-Dinitrophenol	370	U uJ
100-02-7	4-Nitrophenol	1800	U
132-64-9	Dibenzofuran	370	U
121-14-2	2,4-Dinitrotoluene	370	U

FORM I SV-1 OLM04.2

FORM I, COPY

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EPA SAMPLE NO.

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

MMAW2B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092621

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC236

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 11 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/17/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 7.5 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	370	U
86-73-7	Fluorene	370	U
7005-72-3	4-Chlorophenyl-phenylether	370	U
100-01-6	4-Nitroaniline	1800	U
534-52-1	4,6-Dinitro-2-methylphenol	180	U UJ
86-30-6	N-Nitrosodiphenylamine (1)	370	U
101-55-3	4-Bromophenyl-phenylether	370	U
118-74-1	Hexachlorobenzene	370	U
87-86-5	Pentachlorophenol	1800	U
85-01-8	Phenanthrene	370	U
120-12-7	Anthracene	370	U
86-74-8	Carbazole	370	U
84-74-2	Di-n-butylphthalate	510	B JB
206-44-0	Fluoranthene	370	U
129-00-0	Pyrene	370	U
85-68-7	Butylbenzylphthalate	370	U
91-94-1	3,3'-Dichlorobenzidine	740	U
56-55-3	Benzo(a)anthracene	370	U
218-01-9	Chrysene	370	U
117-81-7	bis(2-Ethylhexyl)phthalate	130	JB JB
117-84-0	Di-n-octylphthalate	370	U UJ
205-99-2	Benzo(b)fluoranthene	370	U
207-08-9	Benzo(k)fluoranthene	370	U
50-32-8	Benzo(a)pyrene	370	U
193-39-5	Indeno(1,2,3-cd)pyrene	370	U
53-70-3	Dibenzo(a,h)anthracene	370	U
191-24-2	Benzo(g,h,i)perylene	370	U
541-73-1	1,3-Dichlorobenzene	370	U
106-46-7	1,4-Dichlorobenzene	370	U
95-50-1	1,2-Dichlorobenzene	370	U
120-82-1	1,2,4-Trichlorbenzene	370	U

FORM I, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

MMAW2B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092621

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC236

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 11 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/17/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 7.5 Extraction: (Type) SONC

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 9

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		UNKNOWN HYDROCARBON	5.62	160	JB J
2.		UNKNOWN	6.80	130	JB J
3.		UNKNOWN	6.84	83	JB J
4.		UNKNOWN	7.45	110	JB J
5.		UNKNOWN	7.53	310	JB J
6.		UNKNOWN	8.43	130	J J
7.	74381-40-1	PROPANOIC ACID, 2-METHYL-, 1	17.13	270	NJ J
8.		UNKNOWN PHTHALATE	20.06	120	JB J
9.		UNKNOWN	29.51	83	J J
10.					
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FORM I, COPY

1C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAW2C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092622

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC239

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 11 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/17/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 7.0 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	370	U
111-44-4	bis(2-Chloroethyl)Ether	370	U
95-57-8	2-Chlorophenol	370	U
95-48-7	2-Methylphenol	370	U
108-60-1	2,2'-oxybis(1-Chloropropane)	370	U
106-44-5	4-Methylphenol	370	U
621-64-7	N-Nitroso-di-n-propylamine	370	U
67-72-1	Hexachloroethane	370	U
98-95-3	Nitrobenzene	370	U
78-59-1	Isophorone	370	U
88-75-5	2-Nitrophenol	370	U
105-67-9	2,4-Dimethylphenol	370	U
120-83-2	2,4-Dichlorophenol	1800	U
91-20-3	Naphthalene	370	U
106-47-8	4-Chloroaniline	740	U
111-91-1	bis(2-Chloroethoxy)methane	370	U
87-68-3	Hexachlorobutadiene	370	U
59-50-7	4-Chloro-3-methylphenol	740	U
91-57-6	2-Methylnaphthalene	370	U
77-47-4	Hexachlorocyclopentadiene	370	U
88-06-2	2,4,6-Trichlorophenol	370	U
95-95-4	2,4,5-Trichlorophenol	370	U
91-58-7	2-Chloronaphthalene	370	U
88-74-4	2-Nitroaniline	1800	U
131-11-3	Dimethylphthalate	370	U
606-20-2	2,6-Dinitrotoluene	370	U
208-96-8	Acenaphthylene	370	U
99-09-2	3-Nitroaniline	1800	U
83-32-9	Acenaphthene	370	U
51-28-5	2,4-Dinitrophenol	370	U UJ
100-02-7	4-Nitrophenol	1800	U
132-64-9	Dibenzofuran	370	U
121-14-2	2,4-Dinitrotoluene	370	U

1D FORM I, COPY

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAW2C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092622

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC239

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 11 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/17/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 7.0 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	370	U
86-73-7	Fluorene	370	U
7005-72-3	4-Chlorophenyl-phenylether	370	U
100-01-6	4-Nitroaniline	1800	U
534-52-1	4,6-Dinitro-2-methylphenol	180	U uJ
86-30-6	N-Nitrosodiphenylamine (1)	370	U
101-55-3	4-Bromophenyl-phenylether	370	U
118-74-1	Hexachlorobenzene	370	U
87-86-5	Pentachlorophenol	1800	U
85-01-8	Phenanthrene	370	U
120-12-7	Anthracene	370	U
86-74-8	Carbazole	370	U
84-74-2	Di-n-butylphthalate	290	JB JB
206-44-0	Fluoranthene	370	U
129-00-0	Pyrene	370	U
85-68-7	Butylbenzylphthalate	370	U
91-94-1	3,3'-Dichlorobenzidine	740	U
56-55-3	Benzo(a)anthracene	370	U
218-01-9	Chrysene	370	U
117-81-7	bis(2-Ethylhexyl)phthalate	110	JB JB
117-84-0	Di-n-octylphthalate	370	U uJ
205-99-2	Benzo(b)fluoranthene	370	U
207-08-9	Benzo(k)fluoranthene	370	U
50-32-8	Benzo(a)pyrene	370	U
193-39-5	Indeno(1,2,3-cd)pyrene	370	U
53-70-3	Dibenzo(a,h)anthracene	370	U
191-24-2	Benzo(g,h,i)perylene	370	U
541-73-1	1,3-Dichlorobenzene	370	U
106-46-7	1,4-Dichlorobenzene	370	U
95-50-1	1,2-Dichlorobenzene	370	U
120-82-1	1,2,4-Trichlorbenzene	370	U

1G FORM I, COPY

EPA SAMPLE NO.

MMAW2C

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092622

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC239

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 11 Decanted: (Y/N) N Date Extracted:09/15/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/17/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 7.0 Extraction: (Type) SONC

Number TICs found: 10

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN HYDROCARBON	5.60	190	JB J
2.	UNKNOWN HYDROCARBON	5.76	76	JB J
3.	UNKNOWN	6.79	140	JB J
4 1000154-28-6	CYCLOPENTENE, 1,2,3,4,5-PENT	6.83	96	JB J
5.	UNKNOWN	7.39	81	JB J
6.	UNKNOWN	7.44	120	JB J
7.	UNKNOWN	7.52	280	JB J
8.	UNKNOWN	17.13	190	J J
9.	UNKNOWN PHTHALATE	20.06	82	JB J
10. 74685-29-3	9-EICOSENE, (E)-	25.64	83	NJ J
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1C FORM I, COPY

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAW2CD

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092623

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC240

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 11 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/17/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.2 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	370	U
111-44-4	bis(2-Chloroethyl)Ether	370	U
95-57-8	2-Chlorophenol	370	U
95-48-7	2-Methylphenol	370	U
108-60-1	2,2'-oxybis(1-Chloropropane)	370	U
106-44-5	4-Methylphenol	370	U
621-64-7	N-Nitroso-di-n-propylamine	370	U
67-72-1	Hexachloroethane	370	U
98-95-3	Nitrobenzene	370	U
78-59-1	Isophorone	370	U
88-75-5	2-Nitrophenol	370	U
105-67-9	2,4-Dimethylphenol	370	U
120-83-2	2,4-Dichlorophenol	1800	U
91-20-3	Naphthalene	370	U
106-47-8	4-Chloroaniline	740	U
111-91-1	bis(2-Chloroethoxy)methane	370	U
87-68-3	Hexachlorobutadiene	370	U
59-50-7	4-Chloro-3-methylphenol	740	U
91-57-6	2-Methylnaphthalene	370	U
77-47-4	Hexachlorocyclopentadiene	370	U
88-06-2	2,4,6-Trichlorophenol	370	U
95-95-4	2,4,5-Trichlorophenol	370	U
91-58-7	2-Chloronaphthalene	370	U
88-74-4	2-Nitroaniline	1800	U
131-11-3	Dimethylphthalate	370	U
606-20-2	2,6-Dinitrotoluene	370	U
208-96-8	Acenaphthylene	370	U
99-09-2	3-Nitroaniline	1800	U
83-32-9	Acenaphthene	370	U
51-28-5	2,4-Dinitrophenol	370	U UJ
100-02-7	4-Nitrophenol	1800	U
132-64-9	Dibenzofuran	370	U
121-14-2	2,4-Dinitrotoluene	370	U

FORM I, COPY

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAW2CD

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT5

Lab Code: ENVSYS   Case No.: IT5   SAS No.:   SDG No.: IT5

Matrix: (soil/water) SOIL   Lab Sample ID: 00092623

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC240

Level: (low/med) LOW   Date Received: 09/08/00

% Moisture: 11   Decanted: (Y/N) N   Date Extracted: 09/15/00

Concentrated Extract Volume: 1000 (uL)   Date Analyzed: 09/17/00

Injection Volume: 2.0 (uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 6.2   Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	370	U
86-73-7	Fluorene	370	U
7005-72-3	4-Chlorophenyl-phenylether	370	U
100-01-6	4-Nitroaniline	1800	U
534-52-1	4,6-Dinitro-2-methylphenol	180	U UJ
86-30-6	N-Nitrosodiphenylamine (1)	370	U
101-55-3	4-Bromophenyl-phenylether	370	U
118-74-1	Hexachlorobenzene	370	U
87-86-5	Pentachlorophenol	1800	U
85-01-8	Phenanthrene	370	U
120-12-7	Anthracene	370	U
86-74-8	Carbazole	370	U
84-74-2	Di-n-butylphthalate	330	JB JB
206-44-0	Fluoranthene	370	U
129-00-0	Pyrene	370	U
85-68-7	Butylbenzylphthalate	370	U
91-94-1	3,3'-Dichlorobenzidine	740	U
56-55-3	Benzo(a)anthracene	370	U
218-01-9	Chrysene	370	U
117-81-7	bis(2-Ethylhexyl)phthalate	120	JB JB
117-84-0	Di-n-octylphthalate	370	U UJ
205-99-2	Benzo(b)fluoranthene	370	U
207-08-9	Benzo(k)fluoranthene	370	U
50-32-8	Benzo(a)pyrene	370	U
193-39-5	Indeno(1,2,3-cd)pyrene	370	U
53-70-3	Dibenzo(a,h)anthracene	370	U
191-24-2	Benzo(g,h,i)perylene	370	U
541-73-1	1,3-Dichlorobenzene	370	U
106-46-7	1,4-Dichlorobenzene	370	U
95-50-1	1,2-Dichlorobenzene	370	U
120-82-1	1,2,4-Trichlorbenzene	370	U

FORM I, COPY

1G
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

MMAW2CD

Lab Name: ENVIROSYSTEMS, INC.　Contract: IT5

Lab Code: ENVSYS　Case No.: IT5　SAS No.:　SDG No.: IT5

Matrix: (soil/water) SOIL　Lab Sample ID: 00092623

Sample wt/vol: 30.0 (g/mL) G　Lab File ID: H73GC240

Level: (low/med) LOW　Date Received: 09/08/00

% Moisture: 11　Decanted: (Y/N) N　Date Extracted:09/15/00

Concentrated Extract Volume: 1000(uL)　Date Analyzed: 09/17/00

Injection Volume: 2.0(uL)　Dilution Factor: 1.0

GPC Cleanup: (Y/N) N　pH: 6.2　Extraction: (Type) SONC

Number TICs found: 7

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		UNKNOWN HYDROCARBON	5.62	190	JB J
2.		UNKNOWN	6.79	140	JB J
3.	1000154-28-6	CYCLOPENTENE, 1,2,3,4,5-PENT	6.84	89	NJB J
4.		UNKNOWN	7.45	110	JB J
5.		UNKNOWN	7.53	300	JB J
6.	74381-40-1	PROPANOIC ACID, 2-METHYL-, 1	17.13	280	NJ J
7.		UNKNOWN PHTHALATE	20.06	110	JB J
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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAU1A

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092627

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC241

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 10 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/17/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.1 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	370	U
111-44-4	bis(2-Chloroethyl)Ether	370	U
95-57-8	2-Chlorophenol	370	U
95-48-7	2-Methylphenol	370	U
108-60-1	2,2'-oxybis(1-Chloropropane)	370	U
106-44-5	4-Methylphenol	370	U
621-64-7	N-Nitroso-di-n-propylamine	370	U
67-72-1	Hexachloroethane	370	U
98-95-3	Nitrobenzene	370	U
78-59-1	Isophorone	370	U
88-75-5	2-Nitrophenol	370	U
105-67-9	2,4-Dimethylphenol	370	U
120-83-2	2,4-Dichlorophenol	1800	U
91-20-3	Naphthalene	370	U
106-47-8	4-Chloroaniline	730	U
111-91-1	bis(2-Chloroethoxy)methane	370	U
87-68-3	Hexachlorobutadiene	370	U
59-50-7	4-Chloro-3-methylphenol	730	U
91-57-6	2-Methylnaphthalene	370	U
77-47-4	Hexachlorocyclopentadiene	370	U
88-06-2	2,4,6-Trichlorophenol	370	U
95-95-4	2,4,5-Trichlorophenol	370	U
91-58-7	2-Chloronaphthalene	370	U
88-74-4	2-Nitroaniline	1800	U
131-11-3	Dimethylphthalate	370	U
606-20-2	2,6-Dinitrotoluene	370	U
208-96-8	Acenaphthylene	370	U
99-09-2	3-Nitroaniline	1800	U
83-32-9	Acenaphthene	370	U
51-28-5	2,4-Dinitrophenol	370	U uJ
100-02-7	4-Nitrophenol	1800	U
132-64-9	Dibenzofuran	370	U
121-14-2	2,4-Dinitrotoluene	370	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAU1A

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT5

Lab Code: ENVSYS   Case No.: IT5   SAS No.:   SDG No.: IT5

Matrix: (soil/water) SOIL   Lab Sample ID: 00092627

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC241

Level: (low/med) LOW   Date Received: 09/08/00

% Moisture: 10   Decanted: (Y/N) N   Date Extracted: 09/15/00

Concentrated Extract Volume: 1000 (uL)   Date Analyzed: 09/17/00

Injection Volume: 2.0 (uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 6.1   Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	370	U
86-73-7	Fluorene	370	U
7005-72-3	4-Chlorophenyl-phenylether	370	U
100-01-6	4-Nitroaniline	1800	U
534-52-1	4,6-Dinitro-2-methylphenol	180	U UJ
86-30-6	N-Nitrosodiphenylamine (1)	370	U
101-55-3	4-Bromophenyl-phenylether	370	U
118-74-1	Hexachlorobenzene	370	U
87-86-5	Pentachlorophenol	1800	U
85-01-8	Phenanthrene	370	U
120-12-7	Anthracene	370	U
86-74-8	Carbazole	370	U
84-74-2	Di-n-butylphthalate	230	JB JB
206-44-0	Fluoranthene	370	U
129-00-0	Pyrene	370	U
85-68-7	Butylbenzylphthalate	370	U
91-94-1	3,3'-Dichlorobenzidine	730	U
56-55-3	Benzo(a)anthracene	370	U
218-01-9	Chrysene	370	U
117-81-7	bis(2-Ethylhexyl)phthalate	69	JB JB
117-84-0	Di-n-octylphthalate	370	U UJ
205-99-2	Benzo(b)fluoranthene	370	U
207-08-9	Benzo(k)fluoranthene	370	U
50-32-8	Benzo(a)pyrene	370	U
193-39-5	Indeno(1,2,3-cd)pyrene	370	U
53-70-3	Dibenzo(a,h)anthracene	370	U
191-24-2	Benzo(g,h,i)perylene	370	U
541-73-1	1,3-Dichlorobenzene	370	U
106-46-7	1,4-Dichlorobenzene	370	U
95-50-1	1,2-Dichlorobenzene	370	U
120-82-1	1,2,4-Trichlorbenzene	370	U

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EPA SAMPLE NO.

MMAU1A

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092627

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC241

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 10 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/17/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 6.1 Extraction: (Type) SONC

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 26

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	7.54	640	JB J
2.	UNKNOWN	8.42	230	J J
3. 103-82-2	BENZENEACETIC ACID	12.72	150	NJ J
4.	UNKNOWN	13.92	300	J J
5. 74381-40-1	PROPANOIC ACID, 2-METHYL-, 1	17.13	180	NJ J
6. 6627-88-9	PHENOL, 2,6-DIMETHOXY-4-(2-P	18.31	320	NJ J
7. 124-25-4	TETRADECANAL	18.41	190	NJ J
8.	UNKNOWN	19.24	450	J J
9. 1002-84-2	PENTADECANOIC ACID	19.95	200	NJ J
10.	UNKNOWN	20.48	420	J J
11. 506-12-7	HEPTADECANOIC ACID	21.90	380	NJ J
12.	UNKNOWN	22.62	490	J J
13. 57-11-4	OCTADECANOIC ACID	22.83	620	NJ J
14. 19047-85-9	PHOSPHONIC ACID, DIOCTADECYL	23.93	410	NJ J
15. 19047-85-9	PHOSPHONIC ACID, DIOCTADECYL	25.58	1400	NJ J
16.	UNKNOWN HYDROCARBON	26.37	310	J J
17. 74685-33-9	3-EICOSENE, (E)-	27.12	1400	NJ J
18.	UNKNOWN	29.07	200	J J
19.	UNKNOWN	29.90	180	J J
20.	UNKNOWN	29.98	140	J J
21.	UNKNOWN	30.75	160	J J
22.	UNKNOWN	30.99	270	J J
23. 1599-67-3	1-DOCOSENE	31.16	250	NJ J
24. 1000214-20-7	STIGMASTEROL, 22,23-DIHYDRO-	31.36	370	NJ J
25.	UNKNOWN	31.63	190	J J
26.	UNKNOWN	31.95	340	J J
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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAU1B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092628

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC272

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 17 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/22/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 4.6 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	400	U
111-44-4	bis(2-Chloroethyl)Ether	400	U
95-57-8	2-Chlorophenol	400	U
95-48-7	2-Methylphenol	400	U
108-60-1	2,2'-oxybis(1-Chloropropane)	400	U
106-44-5	4-Methylphenol	400	U
621-64-7	N-Nitroso-di-n-propylamine	400	U
67-72-1	Hexachloroethane	400	U
98-95-3	Nitrobenzene	400	U
78-59-1	Isophorone	400	U
88-75-5	2-Nitrophenol	400	U
105-67-9	2,4-Dimethylphenol	400	U
120-83-2	2,4-Dichlorophenol	1900	U
91-20-3	Naphthalene	400	U
106-47-8	4-Chloroaniline	800	U
111-91-1	bis(2-Chloroethoxy)methane	400	U
87-68-3	Hexachlorobutadiene	400	U
59-50-7	4-Chloro-3-methylphenol	800	U
91-57-6	2-Methylnaphthalene	400	U
77-47-4	Hexachlorocyclopentadiene	400	U
88-06-2	2,4,6-Trichlorophenol	400	U
95-95-4	2,4,5-Trichlorophenol	400	U
91-58-7	2-Chloronaphthalene	400	U
88-74-4	2-Nitroaniline	1900	U
131-11-3	Dimethylphthalate	400	U
606-20-2	2,6-Dinitrotoluene	400	U
208-96-8	Acenaphthylene	400	U
99-09-2	3-Nitroaniline	1900	U
83-32-9	Acenaphthene	400	U
51-28-5	2,4-Dinitrophenol	400	U UJ
100-02-7	4-Nitrophenol	1900	U
132-64-9	Dibenzofuran	400	U
121-14-2	2,4-Dinitrotoluene	400	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAU1B

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092628

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC272

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 17 Decanted: (Y/N)N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/22/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 4.6 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	400	U
86-73-7	Fluorene	400	U
7005-72-3	4-Chlorophenyl-phenylether	400	U
100-01-6	4-Nitroaniline	1900	U
534-52-1	4,6-Dinitro-2-methylphenol	190	U UJ
86-30-6	N-Nitrosodiphenylamine (1)	400	U
101-55-3	4-Bromophenyl-phenylether	400	U
118-74-1	Hexachlorobenzene	400	U
87-86-5	Pentachlorophenol	1900	U
85-01-8	Phenanthrene	400	U
120-12-7	Anthracene	400	U
86-74-8	Carbazole	400	U
84-74-2	Di-n-butylphthalate	320	JB JB
206-44-0	Fluoranthene	400	U
129-00-0	Pyrene	400	U
85-68-7	Butylbenzylphthalate	400	U
91-94-1	3,3'-Dichlorobenzidine	800	U
56-55-3	Benzo(a)anthracene	400	U
218-01-9	Chrysene	400	U
117-81-7	bis(2-Ethylhexyl)phthalate	3100	B J
117-84-0	Di-n-octylphthalate	400	U UJ
205-99-2	Benzo(b)fluoranthene	400	U
207-08-9	Benzo(k)fluoranthene	400	U
50-32-8	Benzo(a)pyrene	400	U
193-39-5	Indeno(1,2,3-cd)pyrene	400	U
53-70-3	Dibenzo(a,h)anthracene	400	U
191-24-2	Benzo(g,h,i)perylene	400	U
541-73-1	1,3-Dichlorobenzene	400	U
106-46-7	1,4-Dichlorobenzene	400	U
95-50-1	1,2-Dichlorobenzene	400	U
120-82-1	1,2,4-Trichlorbenzene	400	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

MMAU1B

Lab Name: ENVIROSYSTEMS, INC.   Contract: IT5

Lab Code: ENVSYS   Case No.: IT5   SAS No.:   SDG No.: IT5

Matrix: (soil/water) SOIL   Lab Sample ID: 00092628

Sample wt/vol: 30.0 (g/mL) G   Lab File ID: H73GC272

Level: (low/med) LOW   Date Received: 09/08/00

% Moisture: 17   Decanted: (Y/N) N   Date Extracted:09/15/00

Concentrated Extract Volume: 1000(uL)   Date Analyzed: 09/22/00

Injection Volume: 2.0(uL)   Dilution Factor: 1.0

GPC Cleanup: (Y/N) N   pH: 4.6   Extraction: (Type) SONC

Number TICs found: 11

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN HYDROCARBON	5.46	120	J J
2.	UNKNOWN	6.64	96	J J
3.	UNKNOWN	7.30	100	J J
4.	UNKNOWN	7.41	620	J J
5.	UNKNOWN	8.28	170	J J
6.	UNKNOWN	10.82	120	J J
7.	UNKNOWN	12.57	100	J J
8.	UNKNOWN	16.99	270	J J
9.	UNKNOWN PHTHALATE	19.91	96	J J
10. 57-10-3	N-HEXADECANOIC ACID	20.79	140	NJ J
11.	UNKNOWN	30.68	120	J J
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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAU1C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092629

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC243

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 16 Decanted: (Y/N) N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000 (uL) Date Analyzed: 09/18/00

Injection Volume: 2.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 5.4 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
108-95-2	Phenol	390	U
111-44-4	bis(2-Chloroethyl)Ether	390	U
95-57-8	2-Chlorophenol	390	U
95-48-7	2-Methylphenol	390	U
108-60-1	2,2'-oxybis(1-Chloropropane)	390	U
106-44-5	4-Methylphenol	390	U
621-64-7	N-Nitroso-di-n-propylamine	390	U
67-72-1	Hexachloroethane	390	U
98-95-3	Nitrobenzene	390	U
78-59-1	Isophorone	390	U
88-75-5	2-Nitrophenol	390	U
105-67-9	2,4-Dimethylphenol	390	U
120-83-2	2,4-Dichlorophenol	1900	U
91-20-3	Naphthalene	390	U
106-47-8	4-Chloroaniline	790	U
111-91-1	bis(2-Chloroethoxy)methane	390	U
87-68-3	Hexachlorobutadiene	390	U
59-50-7	4-Chloro-3-methylphenol	790	U
91-57-6	2-Methylnaphthalene	390	U
77-47-4	Hexachlorocyclopentadiene	390	U
88-06-2	2,4,6-Trichlorophenol	390	U
95-95-4	2,4,5-Trichlorophenol	390	U
91-58-7	2-Chloronaphthalene	390	U
88-74-4	2-Nitroaniline	1900	U
131-11-3	Dimethylphthalate	390	U
606-20-2	2,6-Dinitrotoluene	390	U
208-96-8	Acenaphthylene	390	U
99-09-2	3-Nitroaniline	1900	U
83-32-9	Acenaphthene	390	U
51-28-5	2,4-Dinitrophenol	390	U uJ
100-02-7	4-Nitrophenol	1900	U
132-64-9	Dibenzofuran	390	U
121-14-2	2,4-Dinitrotoluene	390	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

MMAU1C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092629

Sample wt/vol: 30.0(g/mL) G Lab File ID: H73GC243

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 16 Decanted: (Y/N)N Date Extracted: 09/15/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/18/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 5.4 Extraction: (Type) SONC

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/KG	Q
84-66-2	Diethylphthalate	390	U
86-73-7	Fluorene	390	U
7005-72-3	4-Chlorophenyl-phenylether	390	U
100-01-6	4-Nitroaniline	1900	U
534-52-1	4,6-Dinitro-2-methylphenol	190	U UJ
86-30-6	N-Nitrosodiphenylamine (1)	390	U
101-55-3	4-Bromophenyl-phenylether	390	U
118-74-1	Hexachlorobenzene	390	U
87-86-5	Pentachlorophenol	1900	U
85-01-8	Phenanthrene	390	U
120-12-7	Anthracene	390	U
86-74-8	Carbazole	390	U
84-74-2	Di-n-butylphthalate	220	JB JB
206-44-0	Fluoranthene	390	U
129-00-0	Pyrene	390	U
85-68-7	Butylbenzylphthalate	390	U
91-94-1	3,3'-Dichlorobenzidine	790	U
56-55-3	Benzo(a)anthracene	390	U
218-01-9	Chrysene	390	U
117-81-7	bis(2-Ethylhexyl)phthalate	58	JB JB
117-84-0	Di-n-octylphthalate	390	U UJ
205-99-2	Benzo(b)fluoranthene	390	U
207-08-9	Benzo(k)fluoranthene	390	U
50-32-8	Benzo(a)pyrene	390	U
193-39-5	Indeno(1,2,3-cd)pyrene	390	U
53-70-3	Dibenzo(a,h)anthracene	390	U
191-24-2	Benzo(g,h,i)perylene	390	U
541-73-1	1,3-Dichlorobenzene	390	U
106-46-7	1,4-Dichlorobenzene	390	U
95-50-1	1,2-Dichlorobenzene	390	U
120-82-1	1,2,4-Trichlorbenzene	390	U

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

MMAU1C

Lab Name: ENVIROSYSTEMS, INC. Contract: IT5

Lab Code: ENVSYS Case No.: IT5 SAS No.: SDG No.: IT5

Matrix: (soil/water) SOIL Lab Sample ID: 00092629

Sample wt/vol: 30.0 (g/mL) G Lab File ID: H73GC243

Level: (low/med) LOW Date Received: 09/08/00

% Moisture: 16 Decanted: (Y/N) N Date Extracted:09/15/00

Concentrated Extract Volume: 1000(uL) Date Analyzed: 09/18/00

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 5.4 Extraction: (Type) SONC

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/Kg

Number TICs found: 7

	CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.		UNKNOWN HYDROCARBON	5.61	87	JB J
2.		UNKNOWN	5.65	150	J J
3.		UNKNOWN	7.44	140	JB J
4.		UNKNOWN	7.53	320	JB J
5.		UNKNOWN	17.13	250	J J
6.		UNKNOWN PHTHALATE	20.06	81	JB J
7.		UNKNOWN	25.60	140	J J
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Appendix C

Sample Location Descriptions and Photographs

Appendix C
Field Sampling Photographs

Appendix C
Field Sampling Photographs (Continued)

Main Manufacturing Area

MMAB1. Sample location MMAB1 was in the eastern portion of the Horseshoe Area, west of Magazine Storage Area 1932. It is situated on level ground, approximately 8 ft upgradient and 50 ft from a service road. The boring was positioned approximately 2 to 3 ft inside a tree stand of loblolly pines (*Pinus taeda* L.) approximately 30–40 ft tall. The circumference of a representative loblolly pine measured 3 ft 9 in. (14 in. diameter), indicating the tree was at least 40–50 years old. A drainage ditch was located along the road that carries precipitation runoff away from the sample location.

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: MMAB1A (0–10 in. bgs), MMAB1B (10–48 in. bgs), and MMAB1C (48–84 in. bgs).

MMAB2. Sample location MMAB2 was in the south-central portion of the Horseshoe Area, east of SWMU 26, approximately 100 ft from the road and 75 ft inside a white pine tree stand. The white pines (*Pinus strobus*) were approximately 50–60 ft tall with tree circumferences ranging from 4 to 6 ft (15–28 in. diameter).

The boring was advanced to a depth of 7.5 ft bgs. A and B horizons were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: MMAB2A (0–12 in. bgs), and MMAB2B (12–60 in. bgs). Additionally, one duplicate soil sample was collected from the B horizon and analyzed for metals and pH: MMAB2BD (12–60 in. bgs).

MMAB3. Sample location MMAB3 was in the south-central portion of the Horseshoe Area, east of SWMU 26; co-located within a ½-acre radius and 60 ft east of boring MMAB2. The boring was positioned approximately 75 ft inside the same white pine tree stand as MMAB2.

The boring was advanced to a depth of 7.5 ft bgs. Both the A and B soil horizons were identified and sampled. Both soil horizons were field screened for RDX and TNT. Results indicated the absence of these explosive constituents. Following screening analysis, one soil sample was collected from each horizon and analyzed for SVOCs, VOCs (B horizon), metals, and pH: MMAB3A (0–9 in. bgs), and MMAB3B (9–42 in. bgs).

MMAB4. Sample location MMAB4 was in the central portion of the Horseshoe Area, on top of a steep slope above SWMU 32. It was positioned approximately 50 ft south and 30 ft above Magazine 4601–2, along the downslope edge of a pine tree stand. Trees were approximately 40 ft tall, with a representative tree circumference of 3 ft 8 in. (14 in. diameter).

The boring was advanced with a hand auger to a depth of 4.42 ft bgs. Hand auger refusal occurred at 4.42 ft due to large stones and small boulders (river jack). Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: MMAB4A (0–6 in. bgs), MMAB4B (6–51 in. bgs), and MMAB4C (51–53 in. bgs).

MMAU1. Sample location MMAU1 was south of the MMA, west of the main gate, on the right side of the road before Shipping and Receiving (Building 534). The boring was positioned approximately 30 ft inside a deciduous tree stand (e.g., oak, cherry, and maple) upgradient and approximately 40 ft from road. Trees were approximately 40–50 ft tall, with an average circumference of 6 ft 8 in. (26 in. diameter).

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified, sampled, and field-screened for RDX and TNT. Screening results indicated the absence of these explosive constituents. Following screening analysis, one soil sample was collected from each horizon and analyzed for SVOCs, VOCs (B horizon), metals, and pH: MMAU1A (0–10 in. bgs), MMAU1B (10–52 in. bgs), MMAU1C (52–60 in. bgs).

MMAU2. Sample location MMAU2 was south of the MMA, west of the main gate, on the right side of the road before Shipping and Receiving (Building 534). The boring was co-located within a ½-acre radius 80 ft east of boring MMAU1.

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: MMAU2A (0–10 in. bgs), MMAU2B (10–52 in. bgs), and MMAU2C (52–60 in. bgs).

MMAU3. Sample location MMAU3 was southwest of Building 7801, outside and approximately 100 ft from the MMA fence, on the western edge of the facility. The boring was positioned on top of a ridge above a dirt road in a deciduous tree forest (e.g., tulip poplar, oak, and maple). Trees were approximately 40–50 ft tall, with a representative tree circumference of 5 ft 5 in. (21 in. diameter), indicating that the trees were approximately 65–75 years old.

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: MMAU3A (0–9 in. bgs), MMAU3B (9–42 in. bgs), and MMAU3C (42–72). Additionally, one duplicate soil sample was collected from the B horizon and analyzed for metals and pH: MMAU3BD (9–42 in. bgs).

MMAU4. Sample location MMAU4 was in the eastern portion of the MMA, 70 ft south and outside of the fence surrounding Building 3904. The boring was positioned approximately 15 ft upslope of a former railroad track and 40 ft up a steep incline into a deciduous tree forest (e.g., oak and maple), where trees averaged 40–50 ft tall.

The boring was advanced with a hand auger to a depth of 6.5 ft bgs. Hand auger refusal occurred at a depth of 6.5 ft bgs due to large stones and highly compacted soil. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: MMAU4A (0–10 in. bgs), MMAU4B (10–58 in. bgs), and MMAU4C (58–76 in. bgs).

MMAW1. Sample location MMAW1 was in the northeastern portion of Horseshoe Area, approximately 65 ft north of Gate 19–C. The boring was positioned approximately 45 ft inside a pine tree forest, where trees were estimated to be 40 ft tall.

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: MMAW1A (0–12 in. bgs), MMAW1B (12–48 in. bgs), and MMAW1C (48–72).

MMAW2. Sample location MMAW2 was in the north central portion of Horseshoe Area. The boring was positioned approximately 115 ft south of the road and 60 ft inside a pine and deciduous tree stand (e.g., oak and maple). Trees were approximately 40–50 ft tall with a representative pine tree circumference of 3.6 ft (14 in. diameter).

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified, sampled, and field-screened for RDX and TNT. Screening results indicated the absence of these explosive constituents. Following screening analysis, one soil sample was collected from each horizon and analyzed for SVOCs, VOCs (B and C horizons), metals, and pH: MMAW2A (0–7 in. bgs), MMAW2B (7–48 in. bgs), MMAW2C (48–60 in. bgs).

A matrix spike and matrix spike duplicate (MS/MSD) sample was collected from the B horizon and analyzed for VOCs, SVOCs, metals and pH: MMAW2B (7–48 in. bgs). Additionally, a duplicate sample was collected from the C horizon and analyzed for VOCs, SVOCs, metals, and pH: MMAW2CD (48–60 in. bgs).

MMAW3. Sample location MMAW3 was in the north central portion of the Horseshoe Area within a ½-acre radius of boring MMAW2. The boring was positioned 51 ft south of MMAW2 and approximately 111 ft. inside a loblolly pine tree stand, 166 ft south from the roadway.

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: MMAW3A (0–12 in. bgs), MMAW3B (12–48 in. bgs), and MMAW3C (48–60 in. bgs). Additionally, one duplicate soil sample was collected from the C horizon and analyzed for metals and pH: MMAW3CD (48–60 in. bgs).

MMAW4. Sample location MMAW4 was in the northwestern portion of Horseshoe Area, 50 ft north of Gate 19–1, outside the fence, and approximately 50 ft south of the New River. The boring was positioned upgradient and approximately 65 ft north of the road, along a grassy area, approximately 20 ft inside the deciduous tree (e.g., locust and maple) and brush line.

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: MMAW4A (0–9 in. bgs), MMAW4B (9–42 in. bgs), and MMAW4C (42–72).

New River Unit

NRUC1. Sample location NRUC1 was east of Magazine 1125, on a moderate slope, upgradient and approximately 100 ft north of 12th Street. The boring was positioned in a tree stand containing pine, cedar, and deciduous (e.g., cherry) trees interspersed with grassy areas. Trees were approximately 15–30 ft tall, with a representative deciduous tree circumference of 3 ft (12 in. diameter).

The boring was advanced to a depth of 7.5 ft bgs. Both the A and B soil horizons were identified and sampled. Each soil horizon was field-screened for RDX and TNT. Screening results indicated the absence of these explosive constituents. Following screening analysis, one soil sample was collected from each horizon and analyzed for SVOCs, VOCs (B horizon), metals and pH: NRUC1A (0–11 in. bgs) and NRUC1B (11–72 in. bgs). Additionally, one MS and MSD sample was collected from the B horizon and analyzed for VOCs, SVOCs, metals, and pH: NRUC1B (11–72 in. bgs).

NRUC2. Sample location NRUC2 was east of Magazine 1125, on a moderate slope, upgradient and co-located within a ½-acre radius of NRUC1. The boring was positioned approximately 120 ft from the road in a tree stand containing pine, cedar, and deciduous (e.g., cherry) trees interspersed with grassy areas. Trees were approximately 15–30 ft tall, with a representative deciduous tree circumference of 3 ft (12 in. diameter).

The boring was advanced to a depth of 7.5 ft bgs. Both the A and B soil horizons were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: NRUC2A (0–11 in. bgs), NRUC2B (11–72 in. bgs).

NRUC3. Sample location NRUC3 was in the eastern portion of the NRU, adjacent to a grassy field approximately 100 ft northeast of Magazine 4603–15. The boring was positioned upgradient of Guard Road on a slight to moderate slope approximately 15 ft inside a pine tree stand. Trees were estimated to be 30–40 ft tall with a representative circumference of 3 ft 7 in. (14 in. diameter).

The boring was advanced to a depth of 1.5 ft bgs where refusal was caused by an outcrop of bedrock located near the surface. Both the A and B soil horizons were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: NRUC3A (0–10 in. bgs), NRUC3B (10–18 in. bgs).

NRUC4. Sample location NRUC4 was in the northeastern portion of the NRU, on the north side of access road near Magazine 4603–53. The boring was positioned upgradient (10°–20° slope) and approximately 100 ft from the road in a cedar tree stand interspersed with a grass. Cedar trees were estimated to range from 3 ft to 20 ft tall.

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: NRUC4A (0–7 in. bgs), NRUC4B (7–30 in. bgs), NRUC4C (30–48 in. bgs).

NRUG1. Sample location NRUG1 was in the northwestern portion of the NRU between Magazines 4603–33 and 4603–34. The boring was positioned upgradient and approximately 100 ft from the road in a loblolly pine tree stand. Trees were estimated to be approximately 40 ft tall with a representative tree circumference of 4 ft 7 in. (18 in. diameter).

The boring was advanced to a depth of 8 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: NRUG1A (0–12 in. bgs), NRUG1B (12–53 in. bgs), NRUG1C (53–70 in. bgs).

NRUG2. Sample location NRUG2 was in the south-central portion of the NRU, west of 16th Street and north of Magazine 1604. The boring was positioned upgradient and approximately 100 ft from the road and 75 ft inside a pine tree stand. Trees were estimated to be approximately 50 ft tall with a representative tree circumference of 4 ft 7 in. (18 in. diameter).

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified, sampled, and field-screened for RDX and TNT. Screening results indicated the absence of these explosive constituents. Following screening analysis, one soil sample was collected from each horizon and analyzed for SVOCs, VOCs (B and C horizon), metals, and pH: NRUG2A (0–7 in. bgs), NRUG2B (7–34 in. bgs), NRUG2C (34–57 in. bgs). Additionally, two duplicate soil samples were collected from the B and C horizon and analyzed for SVOCs, VOCs (B horizon), metals and pH: NRUG2BD (7–34 in. bgs) and NRUG2CD (34–57 in. bgs).

NRUG3. Sample location NRUG3 was in the south-central portion of the NRU, west of 16th Street and north of Magazine 1604. The boring was co-located within a ½-acre radius and 65 ft north of NRUG2. The boring was situated approximately 5–10 ft upgradient and 100 ft from the road and 75 ft. inside a pine tree stand. Trees were estimated to be 50 ft tall with a representative tree circumference of 4 ft 7 in. (18 in. diameter).

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: NRUG3A (0–12 in. bgs), NRUG3B (12–35 in. bgs), NRUG3C (35–67 in. bgs).

NRUG4. Sample location NRUG4 was in the west-central portion of the NRU, upgradient and approximately 150 ft northeast of Truck Loading Yard No. 2. The boring was positioned 100 ft inside a pine tree stand.

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: NRUG4A (0–6 in. bgs), NRUG4B (6–39 in. bgs), NRUG4C (39–72 in. bgs).

NRUL1. Sample location NRUL1 was in the southern portion of the NRU, on level ground, east of a former bagging plant. The boring was positioned approximately 100 ft north of Guard Road in a thick white pine tree stand. Trees were estimated to be 30–35 ft tall with a representative tree circumference of 2 ft 7 in. (10 in. diameter).

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified, sampled, and field-screened for RDX and TNT. Screening results indicated the absence of these explosive constituents. Following screening analysis, one soil sample was collected from each horizon and analyzed for SVOCs, VOCs (B and C horizon), metals, and pH: NRUL1A (0–12 in. bgs), NRUL1B (12–42 in. bgs), NRUL1C (42–55 in. bgs).

NRUL2. Sample location NRUL2 was in the southern portion of the NRU, on level ground, east of a former bagging plant. The boring was co-located within a ½-acre radius and 64 ft east of NRUL1 in a thick white pine tree stand. Trees were estimated to be 30–35 ft tall with a representative tree circumference of 2 ft 7 in. (10 in. diameter).

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: NRUL2A (0–12 in. bgs), NRUL2B (12–33 in. bgs), NRUL2C (33–60 in. bgs). Additionally, one duplicate soil sample was collected from the B horizon and analyzed for metals and pH: NRUL2BD (12–33 in. bgs).

NRUL3. Sample location NRUL3 was in the central portion of the NRU, approximately 200 ft southwest of Magazine 1614. The boring was positioned approximately 150 ft north and 15 ft upgradient of 14½ Street in a grassy uncut area interspersed with 15–20-ft-tall cedar trees. Average tree circumference was 10–12 in. (diameter ranging from 3 to 4 in.), indicating that trees were approximately 10–15 years old.

Macro-Core refusal occurred at 16 in. bgs after two direct push attempts within 5 ft of the initially proposed sample location because of near-surface bedrock. The sample location was moved to a new location downslope approximately 40 ft. and was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: NRUL3A (0-9 in. bgs), NRUL3B (9–75 in. bgs), NRUL3C (75–90 in. bgs).

NRUL4. Sample location NRUL4 was in the northern portion of the NRU, approximately 150 ft south of Old Rock Road. The boring was positioned on a gradual slope between two deciduous trees (oak and poplar) in a predominantly grassy field. Trees were estimated to be about 35–40 ft tall.

The boring was advanced to a depth of 7.5 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: NRUL4A (0–10 in. bgs), NRUL4B (10–38 in. bgs), NRUL4C (38–60 in. bgs). Additionally, one duplicate soil sample was collected from the B horizon and analyzed for metals and pH: NRUL4BD (10–38 in. bgs).

NRUW1. Sample location NRUW1 was in the east-central portion of the NRU, approximately 100 ft north of 14½ Street, northwest of Magazine 1817. The boring was positioned in a flat grassy area interspersed with loblolly pine trees. Trees were estimated to be 30–40 ft tall with a representative circumference of 4 ft 3 in. (16 in. diameter).

The boring was advanced to a depth of 4.0 ft bgs. Three soil horizons (A, B, and C) were identified, sampled, and field-screened for RDX and TNT. Screening results indicated the absence of these explosive constituents. Following screening analysis, one soil sample was collected from each horizon and analyzed for SVOCs, VOCs (B and C horizon), metals, and pH: NRUW1A (0–7 in. bgs), NRUW1B (7–38 in. bgs), NRUW1C (38–48 in. bgs).

NRUW2. Sample location NRUW2 was in the east-central portion of the NRU, approximately 100 ft north of 14½ Street, northwest of Magazine 1817. The boring was co-located within a ½-acre radius and 60 ft east from NRUW1.

The boring was advanced to a depth of 4.5 ft bgs, where auger refusal occurred when white-gray, limestone bedrock was encountered. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: NRUW2A (0–9 in. bgs), NRUW2B (9–28 in. bgs), NRUW2C (28–48 in. bgs).

NRUW3. Sample location NRUW3 was in the northeastern portion of the NRU, approximately 40–50 ft and 10° upgradient from the road and Magazine 4603–52. The boring was positioned in a stand of several locust trees (surrounded by uncut hay fields) estimated to range from 25 to 50 ft tall, with a representative circumference of 2 ft 2 in. (8 in. diameter).

The boring was advanced to a depth of 3.8 ft bgs, where Macro-Core refusal was caused by limestone/dolomite bedrock. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: NRUW3A (0–10 in. bgs), NRUW3B (10–34 in. bgs), NRUW3C (34–45 in. bgs).

NRUW4. Sample location NRUW4 was in the south-central portion of the NRU, north of the intersection of A Avenue and 13th Street. The boring was positioned across the road, 15 ft upgradient and northeast from Magazine 1206. The boring was situated beneath an approximately 20-ft-tall black walnut tree near a stand of cedar trees estimated to be 15 ft tall, with representative tree circumferences of 2 ft 2 in. (8 in. diameter).

The boring was advanced to a depth of 8 ft bgs. Three soil horizons (A, B, and C) were identified and sampled. One soil sample was collected from each horizon and analyzed for metals and pH: NRUW4A (0–10 in. bgs), NRUW4B (10–31 in. bgs), NRUW4C (31–46 in. bgs). Additionally, one duplicate soil sample was collected from the C horizon and analyzed for metals and pH: NRUW4CD (31–46 in. bgs).

Photo. C–1 View of sample location MMAB2 within the Braddock Loam soil type

Photo. C–2 Braddock Loam soil profile: surface (A horizon) and subsurface (B horizon) for sample location MMAB2

Photo. C–3 Braddock Loam soil profile: surface (A horizon) and subsurface (B horizon) for sample location MMAB3

Photo. C–4 View of sample location MMAB4 within the Braddock Loam soil type

Photo. C–5 View from sample location MMAB4 within the Braddock Loam soil type

Photo. C–6 View of sample location MMAU1 within the Unison-Urban Land Complex soil type

Photo. C–7 View of sample location MMAU2 within the Unison-Urban Land Complex soil type

Photo. C–8 Unison-Urban Complex soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location MMAU2

Photo. C–9 View of sample location MMAU4 within the Unison-Urban Land Complex soil type

Photo. C–10 View of sample location MMAU4 hand auger soil cuttings

Photo. C–11 View of sample location MMAW1 within the Wheeling Sandy Loam soil type

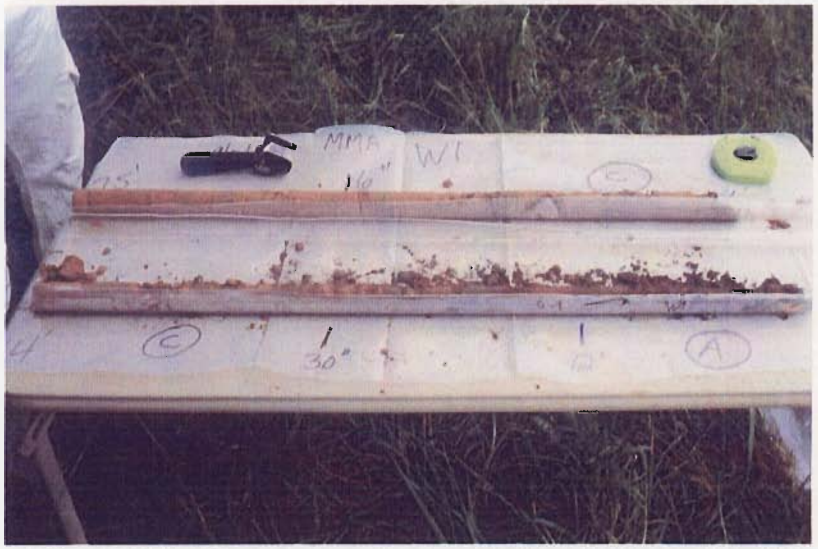


Photo. C–12 Wheeling Sandy Loam soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location MMAW1

Photo. C–13 Wheeling Sandy Loam soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location MMAW3

Photo. C–14 View of sample location MMAW4 within the Wheeling Sandy Loam soil type

Photo. C–15 Wheeling Sandy Loam soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location MMAW4

Photo. C–16 View of sample location NRUC2 within the Carbo Silty Clay Loam soil type

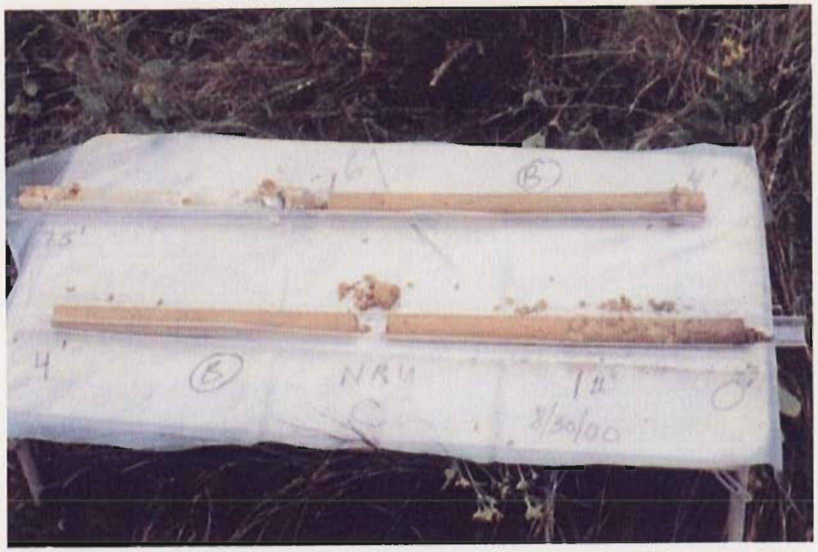


Photo. C–17 Carbo Silty Clay Loam soil profile: surface (A horizon) and subsurface (B horizon) for sample location NRUC2

Photo. C–18 View of sample location NRUC3 within the Carbo Silty Clay Loam soil type

Photo. C–19 Carbo Silty Clay Loam soil profile: surface (A horizon) and subsurface (B horizon) for sample location NRUC3

Photo. C–20 View of sample location NRUC4 within the Carbo Silty Clay Loam soil type

Photo. C–21 Carbo Silty Clay Loam soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location NRUC4

Photo. C–22 View of sample location NRUG1 within the Groseclose and Poplimento Silt Loam soil type

Photo. C–23 Groseclose and Poplimento Silt Loam soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location NRUG1

Photo. C–24 Groseclose and Poplimento Silt Loam soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location NRUG3

Photo. C–25 View of sample location NRUG4 within the Groseclose and Poplimento Silt Loam soil type

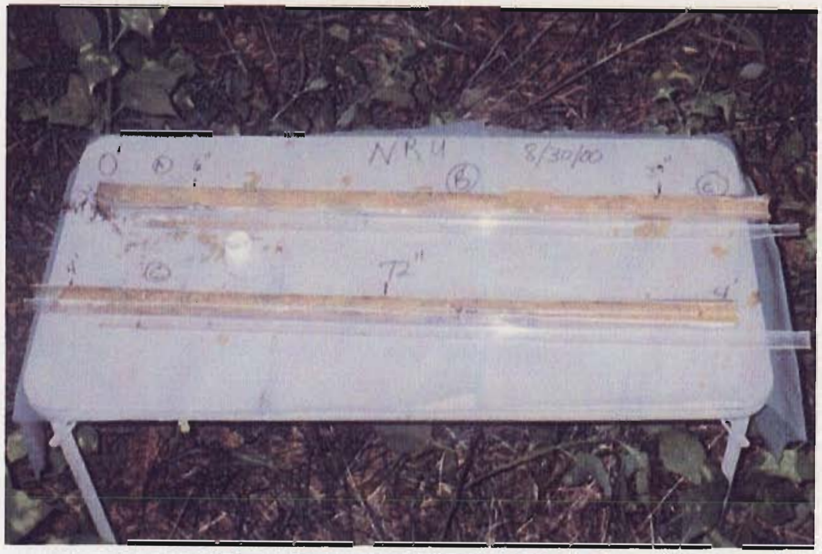


Photo. C–26 Groseclose and Poplimento Silt Loam soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location NRUG4

Photo. C–27 Lowell Silt Loam soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location NRUL2

Photo. C–28 View of sample location NRUL3 within the Lowell Silt Loam soil type

Photo. C–29 Lowell Silt Loam soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location NRUL3

Photo. C–30 View of sample location NRUL4 within the Lowell Silt Loam soil type

Photo. C–31 Lowell Silt Loam soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location NRUL4

Photo. C–32 View of sample location NRUW1 within the Wurno-Newbern-Faywood Silt Loam soil type

Photo. C–33 Wurno-Newbern-Faywood Silt Loam soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location NRUW1

Photo. C–34 Wurno-Newbern-Faywood Silt Loam soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location NRUW2

Photo. C–35 View of sample location NRUW4 within the Wurno-Newbern-Faywood Silt Loam soil type

Photo. C–36 Wurno-Newbern-Faywood Silt Loam soil profile: surface (A horizon) and subsurface (B and C horizons) for sample location NRUW4

Appendix D

USEPA Region III Guidance Memorandum

Appendix D
USEPA Region III Guidance Memorandum

From: Flowers.Lynn@epamail.epa.gov
Sent: Friday, September 08, 2000 16:05
To: Mervine@theitgroup.com
Cc: Rak, Andrew; Chassan@theitgroup.com; Evans, Christopher L;
Cooke.Maryt@epamail.epa.gov

Subject: RE: FW: Ft. Ritchie OU3 - Fish Tissue Risk Assessment

Mike et al,

Sorry for the very long delay in getting back to you guys. As I see it we have three issues: (1) the use of B-qualified INORGANIC data; (2) B-qualified data and mercury in the fish tissue study; and (3) dioxin TEQ calculations and B-qualified dioxin data in the fish tissue study

Here is my take (or the Region's stance) on these issues:

(1) The issue of B-qualified data is a complicated one. Note that there are two steps during data analysis where a qualifier is added.

First, the laboratory doing the analysis puts a qualifier on the data point, then a validator puts a second qualifier on the data point. These two qualifiers mean different things and the second one ends up being the only one we are concerned with. Across all EPA regions, an inorganic chemical that is given a B-qualifier in the first round (laboratory stage) means that chemical was detected at a concentration less than the CRDL (contract-required detection limit) but more than the instrument detection limit. Blank contamination is not considered until the next stage (validation). If an inorganic chemical then gets a B-qualifier at the second, validation stage, it means that the result is not detected substantially above the level reported in the laboratory field blank. And this is where Region III differs from the REST OF THE UNITED STATES (because we have our own guidelines from OASQA...Office of Analytical Services and Quality Assurance). In Region III, we give that data point a "B", but the rest of EPA gives the data point a "U." This means that the rest of EPA automatically uses the data point in risk calculations, etc. but at 1/2 the detection limit. We, in Region III, don't generally use the data point at all, but ask for sampling to be re-done if the data set is compromised by the exclusion or "rejection" of the data point(s). In some instances, we use the data but input 1/2 the detection limit. A lot of times it won't make much difference which way you do it (as long as you don't have a LOT OF B-QUALIFIED DATA THAT YOU ARE GOING TO REJECT). There is a push by OASQA to harmonize Region III with the rest of EPA on thisone...but it is difficult. The other regions, in essence, don't know that their "U" qualified data was really "B" qualified unless they look at the original data (which is difficult to do given time contraints). And we, in Region III are really faced with whether or not to use the data, re-sample because of a compromised data set, or reject the data and use a smaller data set. You just don't know whether or not the chemical is there. In a perfect world you would always re-sample. IT decided to eliminate the B-qualified data, i.e., it was "rejected", from the background soil survey. In this instance, it is probably OK because we still have a lot of data, and only a few chemicals were "victims" of B-qualification. It should be noted though, that the OU data sets should also have their "B" qualified data "rejected" for fairness/consistency when making comparisons with the background data sets.

(2) Re: B-qualified mercury and dioxin data from the fish tissue study

Unfortunately, every mercury data point in Lake Royer fish is "B-qualified" by the validator. If these data were to be rejected, it doesn't mean that mercury isn't a COPC, it would mean that you have no mercury data. You would have to re-sample or make a management decision to not re-sample. Perhaps a good alternative would be to use the data (you could go with using 1/2 the detection limit). Note that nickel and chromium data points are also ALL B-qualified, as well as all the data points for HPCDD and TCDF. Note also that a similar situation exists with Lake Wastler fish data. This situation is not like the one we were faced with in regards to the background soil study where there wasn't a huge compromise in choosing to reject the data. It would seem here that you would either want to use the data or re-sample

(3) Re: Dioxin TEQ calculations.

Thanks for re-checking the calculations. As stated above.you might not want to eliminate (reject) B-qualified data from this study because of mercury and the fact that all of the data for several dioxin congeners is B-qualified. I would suggest that all data be included in the risk assessment for fish at Ft. Ritchie (or re-sample).

Thanks-
Lynn Flowers

Appendix E

Comparison Tables and Histograms

Table E–1
Inorganic Soil Concentrations, Braddock Loam Surface vs. Eastern U.S.

[Units in mg/kg]

Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Braddock Loam Surface Soil								
Inorganics								
Aluminum	4/4	5,340	1,227	0.230	3,700-6,660	33,000	2.87	8.70E-05
Antimony	0/4					0.52	2.38	4.58E+00
Arsenic	4/4	2.0	0.4	0.202	1.5-2.4	4.8	2.56	5.33E-01
Barium	4/4	79.0	33.7	0.427	39.9-114	290	2.35	8.10E-03
Beryllium	0/4					0.55	2.53	4.60E+00
Cadmium	0/4					0.34	3.08	9.06E+00
Chromium	4/4	11.0	3.3	0.300	8.7-15.8	33	2.6	7.88E-02
Cobalt	0/4					5.9	2.57	4.36E-01
Copper	3/4	6.5	5.9	0.912	0-13.2	13	2.8	2.15E-01
Iron	4/4	7,818	947	0.121	7,250-9,230	14,000	2.87	2.05E-04
Lead	4/4	22.2	20.2	0.910	10.2-52.0	14	1.95	1.39E-01
Manganese	4/4	598	228	0.381	396-924	260	3.82	1.47E-02
Mercury	2/4	0.64	0.80	1.26	0-1.20	0.081	2.52	3.11E+01
Nickel	0/4					11	2.64	2.40E-01
Selenium	0/4					N/A	N/A	N/A
Silver	1/4	4.3			0-4.3	N/A	N/A	N/A
Thallium	0/4					7.7	1.58	2.05E-01
Vanadium	4/4	16.4	2.6	0.160	14.7-20.3	43	2.51	5.84E-02
Zinc	4/4	17.5	8.9	0.511	10.0-30.2	40	2.11	5.28E-02

*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

Table E–2
Inorganic Soil Concentrations, Unison Urban Land Complex Surface vs. Eastern U.S.

[Units in mg/kg]

Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Unison Urban Land Complex Surface Soil								
Inorganics								
Aluminum	4/4	6,798	2,265	0.333	4,730-9950	33,000	2.87	8.70E-05
Antimony	0/4					0.52	2.38	4.58E+00
Arsenic	4/4	5.9	3.6	0.608	1.8-10.2	4.8	2.56	5.33E-01
Barium	2/4	88.5	43.2	0.488	0-119	290	2.35	8.10E-03
Beryllium	1/4	1.10			0-1.1	0.55	2.53	4.60E+00
Cadmium	1/4	0.82			0-0.82	0.34	3.08	9.06E+00
Chromium	4/4	16.5	5.4	0.328	10.9-23.2	33	2.6	7.88E-02
Cobalt	3/4	10.9	4.8	0.445	6.5-16.1	5.9	2.57	4.36E-01
Copper	4/4	7.0	3.0	0.428	5.3-11.4	13	2.8	2.15E-01
Iron	4/4	16,448	5,385	0.327	9,990-22,900	14,000	2.87	2.05E-04
Lead	4/4	65.0	107	1.64	10.5-225	14	1.95	1.39E-01
Manganese	4/4	614	878	1.43	43.0-1910	260	3.82	1.47E-02
Mercury	0/4					0.081	2.52	3.11E+01
Nickel	3/4	6.9	3.5	0.510	0-11.0	11	2.64	2.40E-01
Selenium	0/4					N/A	N/A	N/A
Silver	0/4					N/A	N/A	N/A
Thallium	1/4	2.1			0-2.1	7.7	1.58	2.05E-01
Vanadium	4/4	31.7	6.7	0.210	22.5-37.8	43	2.51	5.84E-02
Zinc	4/4	89.9	90.6	1.01	14.4-216	40	2.11	5.28E-02

*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

Table E-3
Inorganic Soil Concentrations, Wheeling Sandy Loam Surface vs. Eastern U.S.

[Units in mg/kg]

Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Wheeling Sandy Loam Surface Soil								
Inorganics								
Aluminum	4/4	12,400	2,255	0.182	10,300-15,400	33,000	2.87	8.70E-05
Antimony	0/4					0.52	2.38	4.58E+00
Arsenic	4/4	2.4	0.4	0.148	1.9-2.7	4.8	2.56	5.33E-01
Barium	4/4	147	19.8	0.134	130-174	290	2.35	8.10E-03
Beryllium	4/4	0.86	0.12	0.145	0.72-0.99	0.55	2.53	4.60E+00
Cadmium	1/4	0.67			0-0.67	0.34	3.08	9.06E+00
Chromium	4/4	24.4	3.6	0.147	19.1-27	33	2.6	7.88E-02
Cobalt	4/4	11.4	2.2	0.196	8.1-13.1	5.9	2.57	4.36E-01
Copper	4/4	11.5	2.7	0.238	7.6-13.6	13	2.8	2.15E-01
Iron	4/4	20,000	3,369	0.168	15,600-23,800	14,000	2.87	2.05E-04
Lead	4/4	13.8	1.4	0.098	12.0-15.0	14	1.95	1.39E-01
Manganese	4/4	634	242	0.382	287-822	260	3.82	1.47E-02
Mercury	0/4					0.081	2.52	3.11E+01
Nickel	4/4	12.0	1.7	0.143	9.8-13.5	11	2.64	2.40E-01
Selenium	0/4					N/A	N/A	N/A
Silver	0/4					N/A	N/A	N/A
Thallium	3/4	1.8	0.4	0.229	0-2.0	7.7	1.58	2.05E-01
Vanadium	4/4	36.8	5.9	0.161	29.2-43.6	43	2.51	5.84E-02
Zinc	4/4	60.0	4.7	0.078	54.9-61.1	40	2.11	5.28E-02

*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

Table E–4
Inorganic Soil Concentrations, Carbo Silty Clay Loam Surface vs. Eastern U.S.

[Units in mg/kg]

Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Carbo Silty Clay Loam Surface Soil								
Inorganics								
Aluminum	4/4	9,113	7,364	0.808	4,440-20,100	33,000	2.87	8.70E-05
Antimony	0/4					0.52	2.38	4.58E+00
Arsenic	4/4	3.4	1.9	0.563	1.6-6.1	4.8	2.56	5.33E-01
Barium	3/4	37.1	17.2	0.465	0-56.7	290	2.35	8.10E-03
Beryllium	2/4	0.74	0.18	0.248	0-0.87	0.55	2.53	4.60E+00
Cadmium	0/4					N/A	N/A	N/A
Chromium	4/4	20.1	9.3	0.464	11.3-32.2	33	2.60	7.88E-02
Cobalt	3/4	17.9	13.7	0.767	0-33.6	5.9	2.57	4.36E-01
Copper	4/4	5.6	2.7	0.481	2.9-9	13	2.80	2.15E-01
Iron	4/4	20,450	8,932	0.437	10,100-31,900	14,000	2.87	2.05E-04
Lead	4/4	16.2	5.9	0.367	11.5-24.7	14	1.95	1.39E-01
Manganese	4/4	349	164	0.469	186-498	260	3.82	1.47E-02
Mercury	0/4					0.081	2.52	3.11E+01
Nickel	2/4	12.0	8.6	0.719	0-18.1	11	2.64	2.40E-01
Selenium	0/4					0.30	2.44	8.13E+00
Silver	0/4					N/A	N/A	N/A
Thallium	0/4					N/A	N/A	N/A
Vanadium	4/4	30.4	9.7	0.318	19.7-42.5	43	2.51	5.84E-02
Zinc	4/4	25.1	21.0	0.837	10.9-56.3	40	2.11	5.28E-02

*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

Table E–5

Inorganic Soil Concentrations, Groseclose and Poplimento Silt Loam Surface vs. Eastern U.S.

[Units in mg/kg]

Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Groseclose and Poplimento Silt Loam Surface Soil								
Inorganics								
Aluminum	4/4	6,685	3,042	0.455	3,770-10,700	33,000	2.87	8.70E-05
Antimony	0/4					0.52	2.38	4.58E+00
Arsenic	4/4	3.1	0.9	0.295	2-4.1	4.8	2.56	5.33E-01
Barium	4/4	34.2	10.7	0.314	23.4-45.7	290	2.35	8.10E-03
Beryllium	2/4	0.63	0.01	0.022	0-0.64	0.55	2.53	4.60E+00
Cadmium	0/4					N/A	N/A	N/A
Chromium	4/4	18.6	10.8	0.583	8.8-29.8	33	2.60	7.88E-02
Cobalt	3/4	8.7	3.0	0.342	0-11.8	5.9	2.57	4.36E-01
Copper	3/4	6.5	3.9	0.602	0-11	13	2.80	2.15E-01
Iron	4/4	19,045	11,551	0.607	8,790-30,900	14,000	2.87	2.05E-04
Lead	4/4	15.8	6.43	0.408	8.9-23.6	14	1.95	1.39E-01
Manganese	4/4	302	129	0.429	141-458	260	3.82	1.47E-02
Mercury	0/4					0.081	2.52	3.11E+01
Nickel	2/4	7.6	2.3	0.309	0-9.2	11	2.64	2.40E-01
Selenium	0/4					0.30	2.44	8.13E+00
Silver	0/4					N/A	N/A	N/A
Thallium	0/4					N/A	N/A	N/A
Vanadium	4/4	29.6	17.0	0.574	15-47.2	43	2.51	5.84E-02
Zinc	4/4	21.7	9.9	0.455	7.1-28.5	40	2.11	5.28E-02

*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

Table E–6
Inorganic Soil Concentrations, Lowell Silt Loam Surface vs. Eastern U.S.

[Units in mg/kg]

Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Lowell Silt Loam Surface Soil								
Inorganics								
Aluminum	4/4	9,823	4,663	0.475	5,740-16,000	33,000	2.87	8.70E-05
Antimony	0/4					0.52	2.38	4.58E+00
Arsenic	4/4	5.5	2.6	0.480	3.7-9.3	4.8	2.56	5.33E-01
Barium	4/4	77.8	22.5	0.289	59.4-109	290	2.35	8.10E-03
Beryllium	4/4	0.83	0.14	0.165	0.72-1	0.55	2.53	4.60E+00
Cadmium	0/4					N/A	N/A	N/A
Chromium	4/4	30.2	3.31	0.110	27-34.4	33	2.60	7.88E-02
Cobalt	4/4	19.8	5.0	0.250	15.3-25.9	5.9	2.57	4.36E-01
Copper	4/4	6.3	3.7	0.588	3.2-11.6	13	2.80	2.15E-01
Iron	4/4	25,225	5,186	0.206	19,400-32,000	14,000	2.87	2.05E-04
Lead	4/4	35.1	28.2	0.803	15.3-76.7	14	1.95	1.39E-01
Manganese	4/4	1,265	447	0.353	711-1,710	260	3.82	1.47E-02
Mercury	1/4	0.13			0-0.13	0.081	2.52	3.11E+01
Nickel	4/4	9.1	4.6	0.506	4.6-15.3	11	2.64	2.40E-01
Selenium	2/4	0.71	0.09		0-0.77	0.30	2.44	8.13E+00
Silver	0/4					N/A	N/A	N/A
Thallium	0/4					N/A	N/A	N/A
Vanadium	4/4	42.4	9.1	0.214	31.9-52.9	43	2.51	5.84E-02
Zinc	4/4	40.7	10.7	0.263	29.2-55.1	40	2.11	5.28E-02

*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

Table E–7
Inorganic Soil Concentrations, Wurno-Newbern-Faywood Loam Surface vs. Eastern U.S.

[Units in mg/kg]

Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Wurno-Newbern-Faywood Silt Loam Surface Soil								
Inorganics								
Aluminum	4/4	7,943	4,804	0.605	3,620-14,600	33,000	2.87	8.70E-05
Antimony	0/4					0.52	2.38	4.58E+00
Arsenic	4/4	3.7	2.6	0.703	2-7.6	4.8	2.56	5.33E-01
Barium	3/4	57.5	19.7	0.342	0-75.3	290	2.35	8.10E-03
Beryllium	2/4	1.35	0.21	0.157	0-1.5	0.55	2.53	4.60E+00
Cadmium	0/4					N/A	N/A	N/A
Chromium	4/4	27.0	19.5	0.724	6.3-53.3	33	2.60	7.88E-02
Cobalt	3/4	27.3	17.6	0.645	0-45.4	5.9	2.57	4.36E-01
Copper	4/4	5.0	2.6	0.516	2.9-8.5	13	2.80	2.15E-01
Iron	4/4	31,768	23,439	0.738	7,470-63,000	14,000	2.87	2.05E-04
Lead	4/4	20.8	8.6	0.416	10.3-28.8	14	1.95	1.39E-01
Manganese	4/4	1,109	984	0.887	91.7-2,040	260	3.82	1.47E-02
Mercury	0/4					0.081	2.52	3.11E+01
Nickel	2/4	12.4	6.3	0.510	0-16.8	11	2.64	2.40E-01
Selenium	0/4					0.30	2.44	8.13E+00
Silver	0/4					N/A	N/A	N/A
Thallium	0/4					N/A	N/A	N/A
Vanadium	4/4	50.1	37.2	0.743	12.2-101	43	2.51	5.84E-02
Zinc	4/4	33.6	17.3	0.514	14.9-56.2	40	2.11	5.28E-02

*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

Table E–8
Inorganic Soil Concentrations, Braddock Loam Subsurface vs. Eastern U.S.

[Units in mg/kg]

Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Braddock Loam Subsurface Soil								
Inorganics								
Aluminum	6/6	13,033	2,220	0.170	10,100-16,000	33,000	2.87	8.70E-05
Antimony	0/6	7.30	0.42	0.058	7.00-7.60	0.52	2.38	4.58E+00
Arsenic	5/6	2.1	1.2	0.592	0.6-3.8	4.8	2.56	5.33E-01
Barium	6/6	46.4	13.5	0.290	27.4-63.9	290	2.35	8.10E-03
Beryllium	0/6	0.29	0.01	0.044	0.28-0.32	0.55	2.53	4.60E+00
Cadmium	1/6	0.34	0.11	0.337	0.28-0.57	N/A	N/A	N/A
Chromium	6/6	22.2	7.3	0.327	12.6-33.6	33	2.6	7.88E-02
Cobalt	1/6	4.1	3.0	0.717	2.5-10.2	5.9	2.57	4.36E-01
Copper	6/6	5.2	1.5	0.285	3.3-7.5	13	2.8	2.15E-01
Iron	6/6	23,000	4,571	0.199	14,900-28,900	14,000	2.87	2.05E-04
Lead	6/6	9.1	1.4	0.157	6.9-10.7	14	1.95	1.39E-01
Manganese	6/6	206	129	0.627	125-464	260	3.82	1.47E-02
Mercury	2/6	0.08	0.05	0.608	0.06-0.18	0.081	2.52	3.11E+01
Nickel	6/6	6.5	2.0	0.311	4.8-10.3	11	2.64	2.40E-01
Selenium	0/6	0.29	0.01	0.044	0.28-0.32	0.3	2.44	8.13E+00
Silver	0/6	0.47	0.13	0.270	0.30-0.55	N/A	N/A	N/A
Thallium	2/6	0.98	0.73	0.742	1.4-2.3	N/A	N/A	N/A
Vanadium	6/6	44.6	9.0	0.202	31.0-56.4	43	2.51	5.84E-02
Zinc	6/6	79.5	138	1.74	14.7-361	40	2.11	5.28E-02

*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

Table E–9
Inorganic Soil Concentrations, Unison Urban Land Complex Subsurface vs. Eastern U.S.

[Units in mg/kg]

Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Unison Urban Land Complex Subsurface Soil								
Inorganics								
Aluminum	8/8	28,064	15,213	0.542	8,710-47,900	33,000	2.87	8.70E-05
Antimony	0/8	3.98	0.31	0.077	3.7-4.1	0.52	2.38	4.58E+00
Arsenic	7/8	15.0	11.1	0.744	0.55-35.9	4.8	2.56	5.33E-01
Barium	6/8	49.3	29.5	0.599	13.5-85.4	290	2.35	8.10E-03
Beryllium	4/8	1.59	1.77	1.11	0.28-5.30	0.55	2.53	4.60E+00
Cadmium	5/8	0.91	0.66	0.720	0.28-2.20	N/A	N/A	N/A
Chromium	8/8	38.6	19.2	0.497	10.8-75.8	33	2.6	7.88E-02
Cobalt	7/8	30.8	37.3	1.21	2.9-94.3	5.9	2.57	4.36E-01
Copper	8/8	22.3	11.1	0.499	3.4-34.4	13	2.8	2.15E-01
Iron	8/8	37,438	14,796	0.395	14,300-67,700	14,000	2.87	2.05E-04
Lead	8/8	64.7	89.2	1.38	5.6-256	14	1.95	1.39E-01
Manganese	8/8	451	585	1.30	39.4-1,760	260	3.82	1.47E-02
Mercury	6/8	0.11	0.07	0.653	0.05-0.27	0.081	2.52	3.11E+01
Nickel	8/8	32.8	30.3	0.924	5.8-94.2	11	2.64	2.40E-01
Selenium	0/8	0.32	0.03	0.099	0.28-0.38	0.3	2.44	8.13E+00
Silver	0/8	0.39	0.12	0.296	0.31-0.60	N/A	N/A	N/A
Thallium	4/8	1.9	1.6	0.846	0.6-5.0	N/A	N/A	N/A
Vanadium	8/8	72.0	25.1	0.348	27.0-114	43	2.51	5.84E-02
Zinc	8/8	178	202	1.13	19.8-598	40	2.11	5.28E-02

*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

Table E–10
Inorganic Soil Concentrations, Wheeling Sandy Loam Subsurface vs. Eastern U.S.

[Units in mg/kg]

Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Wheeling Sandy Loam Subsurface Soil								
Inorganics								
Aluminum	8/8	20,525	3,895	0.190	13,600-25,600	33,000	2.87	8.70E-05
Antimony	0/8	3.64	0.213	0.058	3.35-3.95	0.52	2.38	4.58E+00
Arsenic	8/8	4.7	4.3	0.917	2.2-15.3	4.8	2.56	5.33E-01
Barium	7/8	113	43.8	0.390	12.3-155	290	2.35	8.10E-03
Beryllium	7/8	0.96	0.31	0.325	0.31-1.30	0.55	2.53	4.60E+00
Cadmium	6/8	0.97	0.71	0.730	0.29-2.50	N/A	N/A	N/A
Chromium	8/8	33.5	5.5	0.163	26.0-40.7	33	2.6	7.88E-02
Cobalt	8/8	16.4	5.2	0.318	6.8-22.5	5.9	2.57	4.36E-01
Copper	8/8	20.6	5.7	0.276	12.2-27.5	13	2.8	2.15E-01
Iron	8/8	34,950	7,005	0.200	22,800-43,900	14,000	2.87	2.05E-04
Lead	8/8	14.6	4.5	0.306	10.0-23.6	14	1.95	1.39E-01
Manganese	8/8	573	253	0.441	47.4-835	260	3.82	1.47E-02
Mercury	2/8	0.02	0.01	0.329	0.02-0.04	0.081	2.52	3.11E+01
Nickel	8/8	18.3	3.1	0.169	13.4-21.7	11	2.64	2.40E-01
Selenium	0/8	0.30	0.02	0.060	0.28-0.33	0.3	2.44	8.13E+00
Silver	0/8	0.31	0.02	0.057	0.28-0.33	N/A	N/A	N/A
Thallium	6/8	2.2	1.1	0.493	0.6-3.2	N/A	N/A	N/A
Vanadium	8/8	58.2	18.9	0.325	23.1-79.5	43	2.51	5.84E-02
Zinc	8/8	71.5	16.5	0.231	37.7-93.4	40	2.11	5.28E-02

*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

Table E–11
Inorganic Soil Concentrations, Carbo Silty Clay Loam Subsurface vs. Eastern U.S.

[Units in mg/kg]

Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Carbo Silty Clay Loam Subsurface Soil								
Inorganics								
Aluminum	5/5	14,360	4,477	0.312	10,000-21,100	33,000	2.87	8.70E-05
Antimony	0/5					0.52	2.38	4.58E+00
Arsenic	5/5	3.5	1.6	0.452	1.2-4.9	4.8	2.56	5.33E-01
Barium	2/5	26.2	18.8	0.717	12.0-48.1	290	2.35	8.10E-03
Beryllium	2/5	1.05	1.34	1.27	0.31-3.40	0.55	2.53	4.60E+00
Cadmium	0/5	0.38	0.15	0.39	0.31-0.65	N/A	N/A	N/A
Chromium	5/5	27.9	12.8	0.458	14.5-47.6	33	2.60	7.88E-02
Cobalt	2/5	21.8	37.8	1.73	3.1-89.1	5.9	2.57	4.36E-01
Copper	5/5	13.1	6.1	0.465	5.9-21.5	13	2.80	2.15E-01
Iron	5/5	29,220	8,744	0.299	17,300-39,400	14,000	2.87	2.05E-04
Lead	5/5	11.4	9.7	0.845	3.5-28.0	14	1.95	1.39E-01
Manganese	5/5	128	123	0.961	33.0-205	260	3.82	1.47E-02
Mercury	1/5	0.08	0.03	0.337	0.06-0.12	0.081	2.52	3.11E+01
Nickel	4/5	17.8	16.6	0.932	2.4-44.8	11	2.64	2.40E-01
Selenium	0/5	0.63	0.53	0.845	0.31-1.55	0.30	2.44	8.13E+00
Silver	0/5	0.76	0.30	0.399	0.60-1.30	N/A	N/A	N/A
Thallium	0/5	0.6	0.03	0.043	0.6-0.7	N/A	N/A	N/A
Vanadium	5/5	46.1	20.8	0.451	22.0-68.9	43	2.51	5.84E-02
Zinc	5/5	23.2	14.2	0.612	7.4-40.8	40	2.11	5.28E-02

*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

Table E–12
Inorganic Soil Concentrations, Carbo Silty Clay Loam Subsurface vs. Eastern U.S.

[Units in mg/kg]

Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Groseclose and Poplimento Silt Loam Subsurface Soil								
Inorganics								
Aluminum	8/8	8,975	3,774	0.420	6,130-17,600	33,000	2.87	8.70E-05
Antimony	0/8	0.35	0.004	0.010		0.52	2.38	4.58E+00
Arsenic	8/8	4.2	1.5	0.355	2.7-7.4	4.8	2.56	5.33E-01
Barium	2/8	17.7	11.2	0.630	32.5-38.7	290	2.35	8.10E-03
Beryllium	1/8	0.46	0.46	1.01	0.29-1.60	0.55	2.53	4.60E+00
Cadmium	0/8	0.30	0.01	0.027	0.29-0.31	N/A	N/A	N/A
Chromium	8/8	22.5	7.4	0.328	13.6-33.1	33	2.60	7.88E-02
Cobalt	5/8	23.6	23.0	0.976	18.0-70.1	5.9	2.57	4.36E-01
Copper	8/8	6.9	7.0	1.02	1.6-21.3	13	2.80	2.15E-01
Iron	8/8	27,450	7,339	0.267	17,400-38,100	14,000	2.87	2.05E-04
Lead	8/8	14.0	9.2	0.662	7.2-35.5	14	1.95	1.39E-01
Manganese	8/8	394	331	0.841	16.7-931	260	3.82	1.47E-02
Mercury	3/8	0.08	0.04	0.427	0.06-0.14	0.081	2.52	3.11E+01
Nickel	4/8	11.1	13.4	1.21	2.3-35.3	11	2.64	2.40E-01
Selenium	0/8	0.30	0.01	0.027	0.29-0.31	0.30	2.44	8.13E+00
Silver	0/8	0.59	0.02	0.039	0.55-0.60	N/A	N/A	N/A
Thallium	0/8	0.6	0.02	0.039		N/A	N/A	N/A
Vanadium	8/8	40.1	10.2	0.255	26.5-56.1	43	2.51	5.84E-02
Zinc	8/8	15.9	10.3	0.647	4.7-33.0	40	2.11	5.28E-02

*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

Table E–13
Inorganic Soil Concentrations, Lowell Silt Loam Subsurface vs. Eastern U.S.

[Units in mg/kg]

Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Lowell Silt Loam Subsurface Soil								
Inorganics								
Aluminum	8/8	18,735	8,800	0.470	7,380-32,800	33,000	2.87	8.70E-05
Antimony	0/8	0.38	0.05	0.126	0.34-0.43	0.52	2.38	4.58E+00
Arsenic	8/8	4.3	1.8	0.414	2.5-7.1	4.8	2.56	5.33E-01
Barium	8/8	43.4	11.9	0.275	30.4-63.4	290	2.35	8.10E-03
Beryllium	5/8	1.12	0.80	0.718	0.28-2.30	0.55	2.53	4.60E+00
Cadmium	0/8	0.35	0.11	0.304	0.28-0.60	N/A	N/A	N/A
Chromium	8/8	36.3	7.2	0.199	24.8-49.5	33	2.60	7.88E-02
Cobalt	8/8	15.7	8.9	0.566	7.0-34.6	5.9	2.57	4.36E-01
Copper	8/8	16.9	10.2	0.601	3.2-11.6	13	2.80	2.15E-01
Iron	8/8	33,838	6,492	0.192	24,400-44,200	14,000	2.87	2.05E-04
Lead	8/8	11.8	4.0	0.342	7.9-17.7	14	1.95	1.39E-01
Manganese	8/8	381	265	0.696	62.8-785	260	3.82	1.47E-02
Mercury	1/8	0.08	0.05	0.597	0.06-0.19	0.081	2.52	3.11E+01
Nickel	8/8	17.3	9.9	0.572	4.8-31.0	11	2.64	2.40E-01
Selenium	0/8	0.85	0.69	0.818	0.30-1.80	0.30	2.44	8.13E+00
Silver	0/8	0.69	0.21	0.304	0.55-1.20	N/A	N/A	N/A
Thallium	0/8	0.6	0.1	0.086	0.6-0.7	N/A	N/A	N/A
Vanadium	8/8	51.9	10.3	0.199	36.7-64.6	43	2.51	5.84E-02
Zinc	8/8	26.1	14.6	0.560	10.6-56.5	40	2.11	5.28E-02

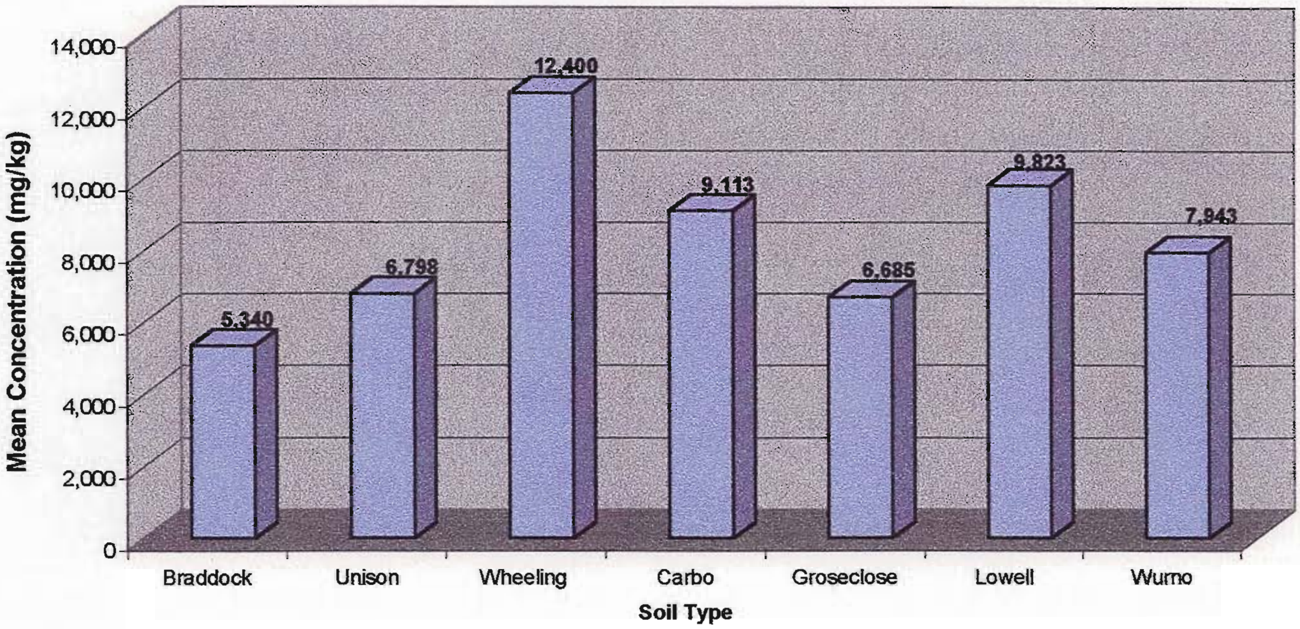
*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

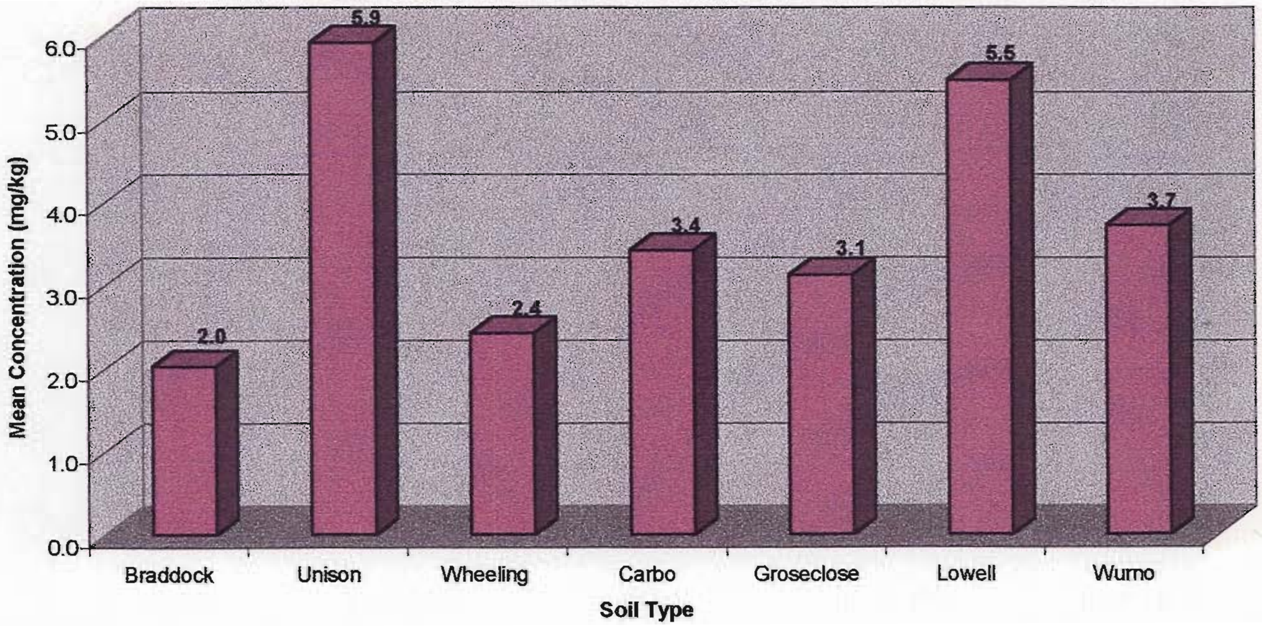
Table E-14
Inorganic Soil Concentrations, Wurno-Newbern-Faywood Silt Loam Subsurface vs. Eastern U.S.

[Units in mg/kg]

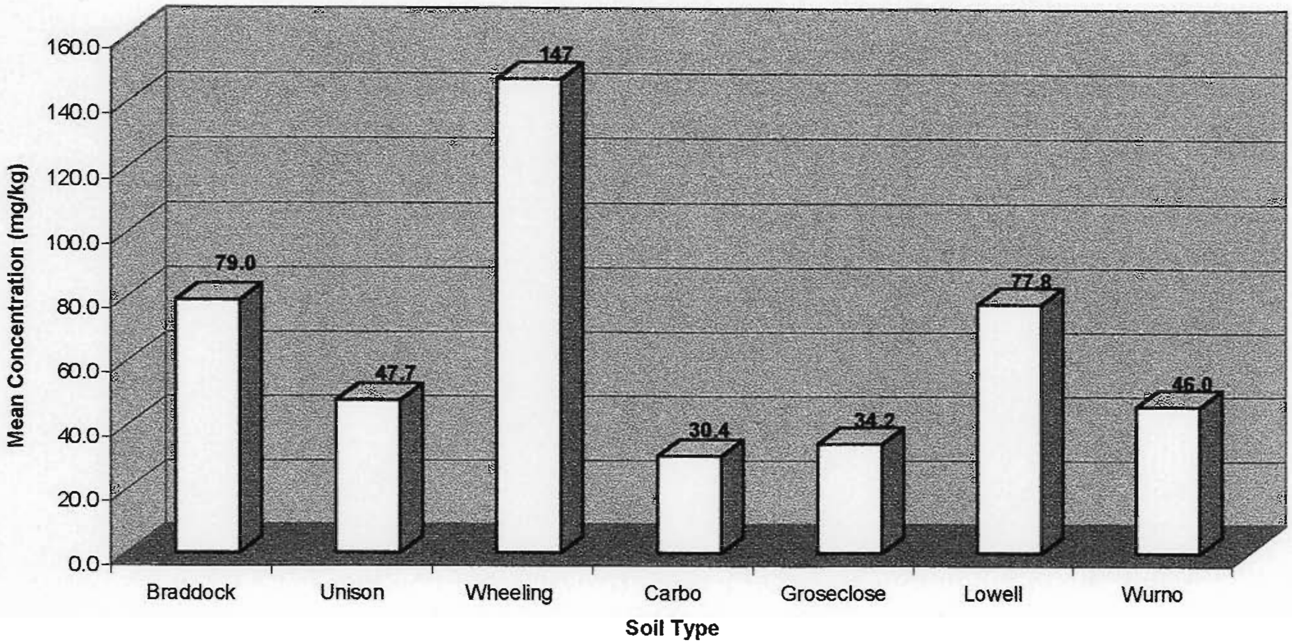
Analyte	Frequency of Detection	Mean	STD Dev	CV	Range of Concentrations	Arithmetic Mean in Eastern U.S.*	STD Dev in Eastern U.S.*	CV in Eastern U.S.*
Wurno-Newbern-Faywood Silt Loam Subsurface Soil								
Inorganics								
Aluminum	8/8	18,725	8,625	0.461	10,200-33,900	33,000	2.87	8.70E-05
Antimony	0/8	0.39	0.02	0.055	0.37-0.40	0.52	2.38	4.58E+00
Arsenic	7/8	3.6	3.2	0.887	1.6-10.7	4.8	2.56	5.33E-01
Barium	8/8	57.1	44.4	0.777	28.5-164	290	2.35	8.10E-03
Beryllium	6/8	1.99	1.74	0.874	0.78-5.40	0.55	2.53	4.60E+00
Cadmium	0/8	0.36	0.12	0.333	0.31-0.65	N/A	N/A	N/A
Chromium	8/8	32.4	12.0	0.372	14.4-50.9	33	2.60	7.88E-02
Cobalt	6/8	25.5	42.9	1.68	3.1-130	5.9	2.57	4.36E-01
Copper	8/8	18.8	11.6	0.619	8.1-38.7	13	2.80	2.15E-01
Iron	8/8	33,013	10,477	0.317	17,300-44,100	14,000	2.87	2.05E-04
Lead	8/8	6.8	2.9	0.423	2.1-12.6	14	1.95	1.39E-01
Manganese	8/8	211	129	0.610	33.2-419	260	3.82	1.47E-02
Mercury	1/8	0.08	0.05	0.579	0.06-0.19	0.081	2.52	3.11E+01
Nickel	8/8	25.6	16.2	0.633	7.6-51.1	11	2.64	2.40E-01
Selenium	0/8	0.56	0.46	0.830	0.31-1.65	0.30	2.44	8.13E+00
Silver	0/8	0.71	0.24	0.341	0.60-1.30	N/A	N/A	N/A
Thallium	0/8	0.6	0.03	0.043	0.6-0.7	N/A	N/A	N/A
Vanadium	8/8	52.9	16.2	0.305	29.1-77.6	43	2.51	5.84E-02
Zinc	8/8	34.2	20.1	0.586	11.8-69.8	40	2.11	5.28E-02

*Source: Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States.* U.S. Government Printing Office, Washington, DC. U.S.G.S. Professional Paper 1270.

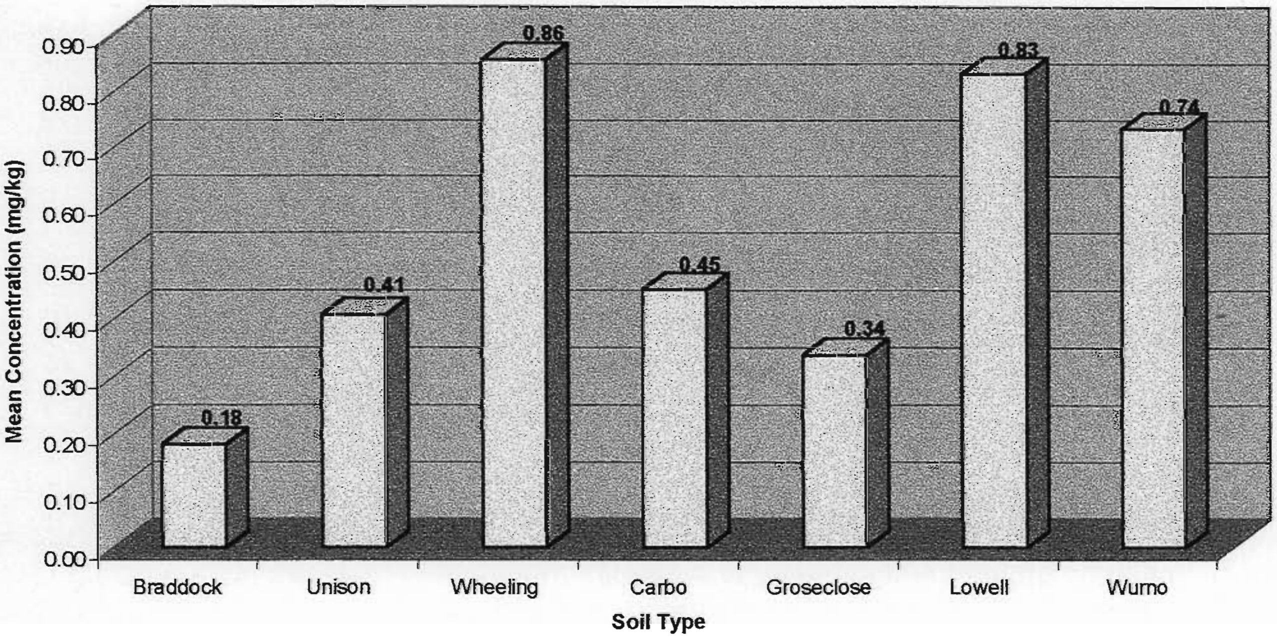

Average Aluminum Concentrations Detected in Surface Soil at RFAAP


Average Arsenic Concentrations Detected in Surface Soil at RFAAP

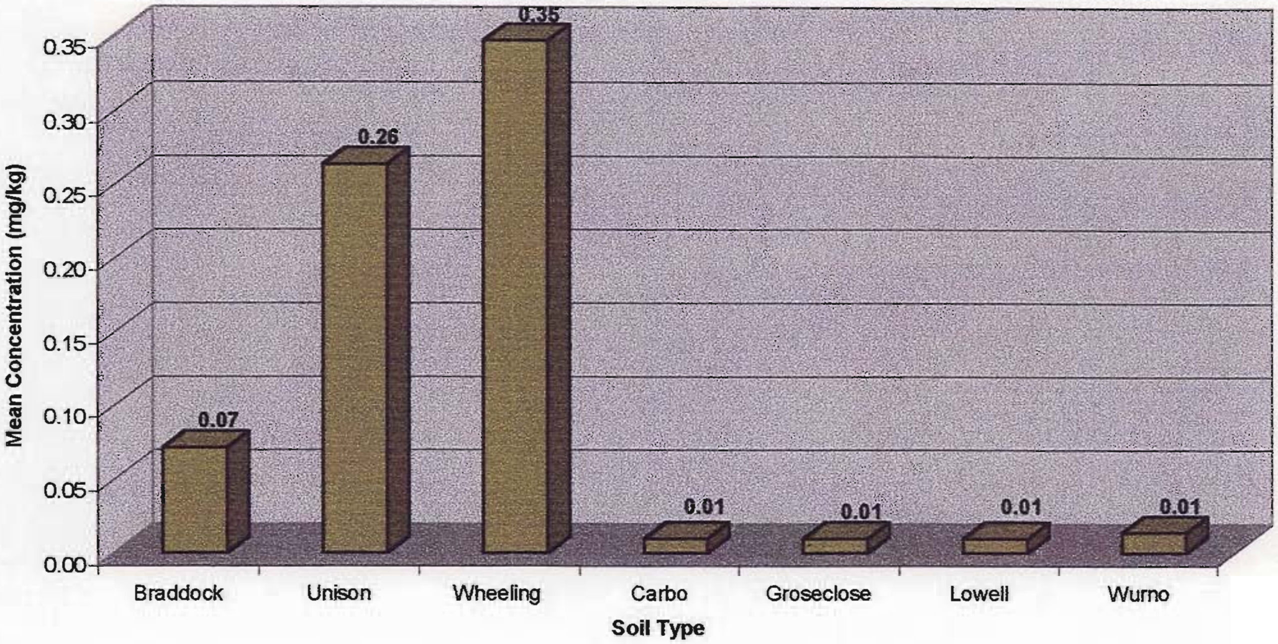
Average Barium Concentrations Detected in Surface Soil at RFAAP



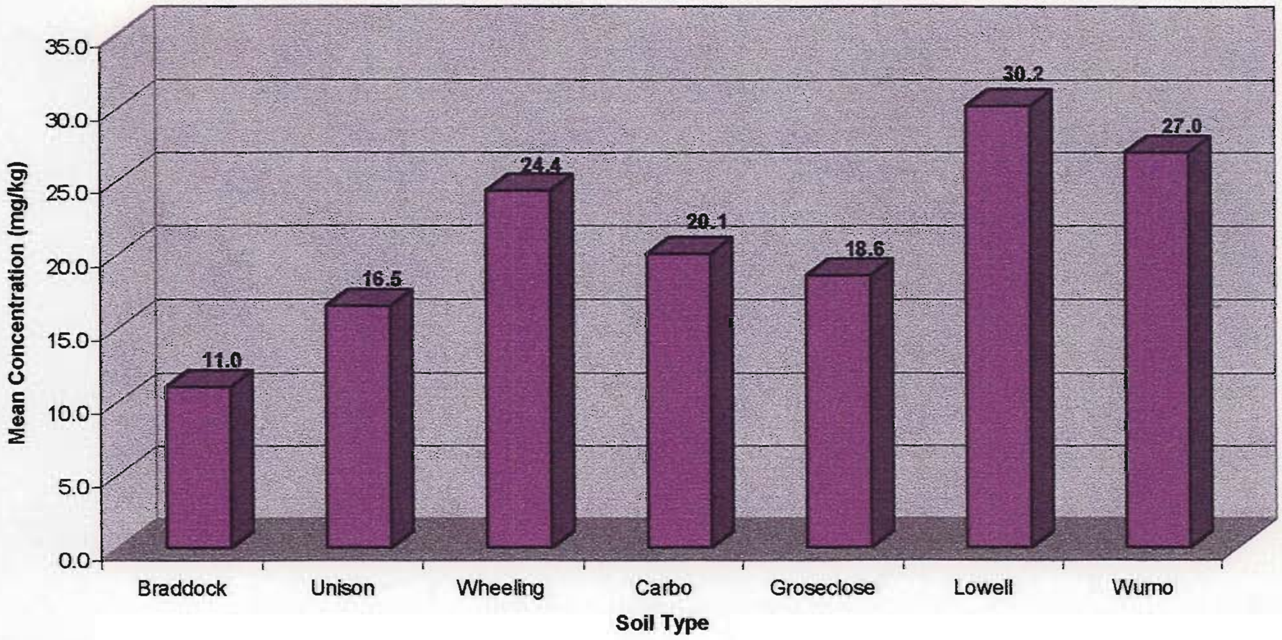
Average Beryllium Concentrations Detected in Surface Soil at RFAAP



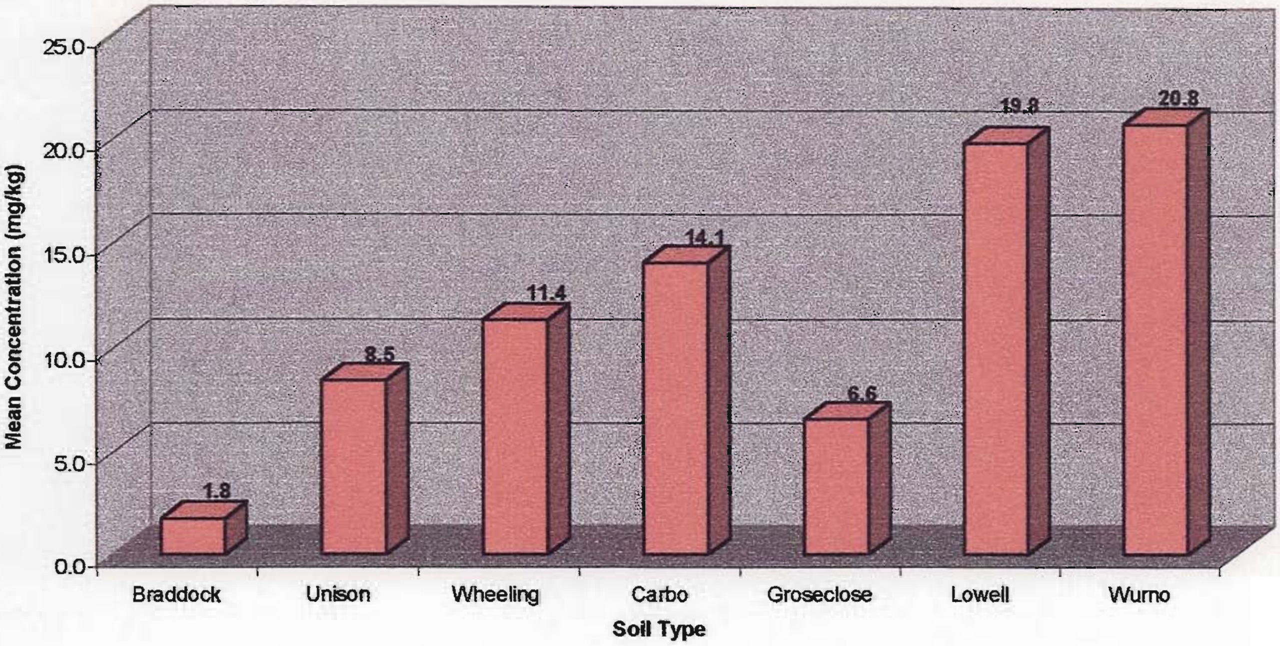
Average Cadmium Concentrations Detected in Surface Soil at RFAAP



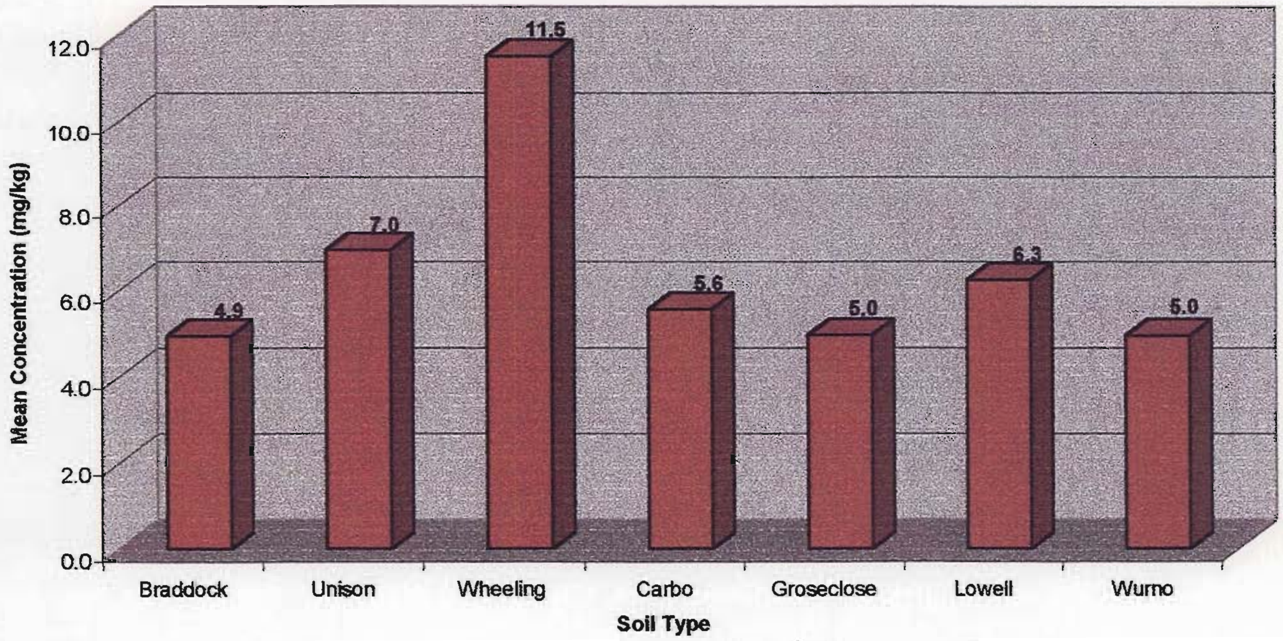
Average Chromium Concentrations Detected in Surface Soil at RFAAP



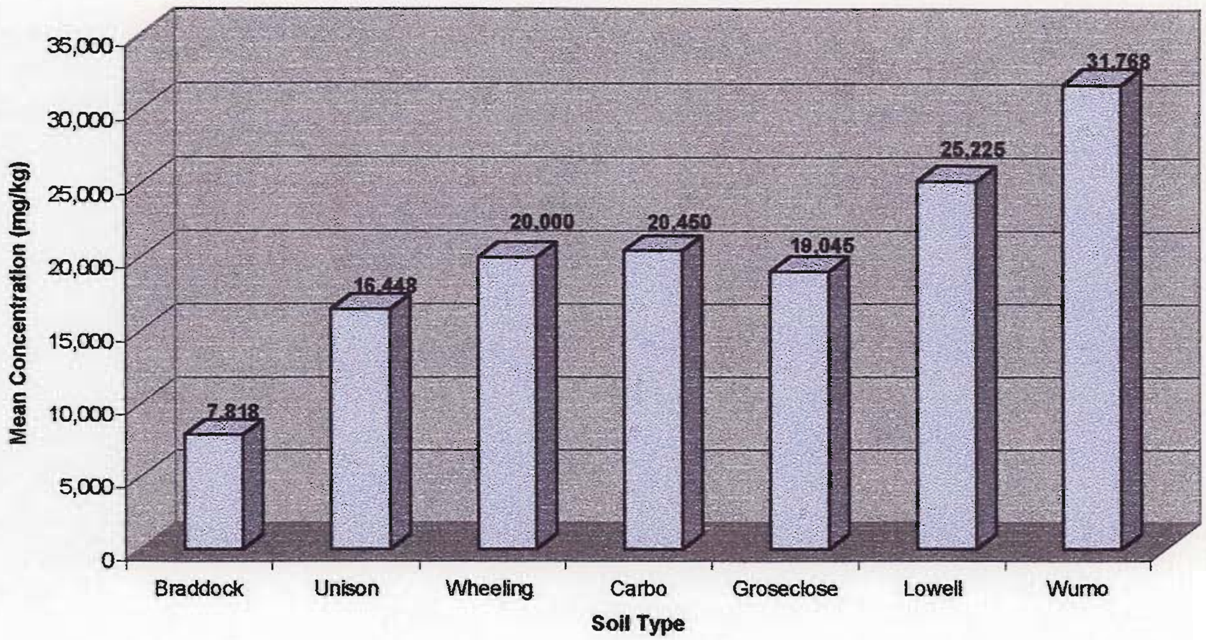
Average Cobalt Concentrations Detected in Surface Soil at RFAAP



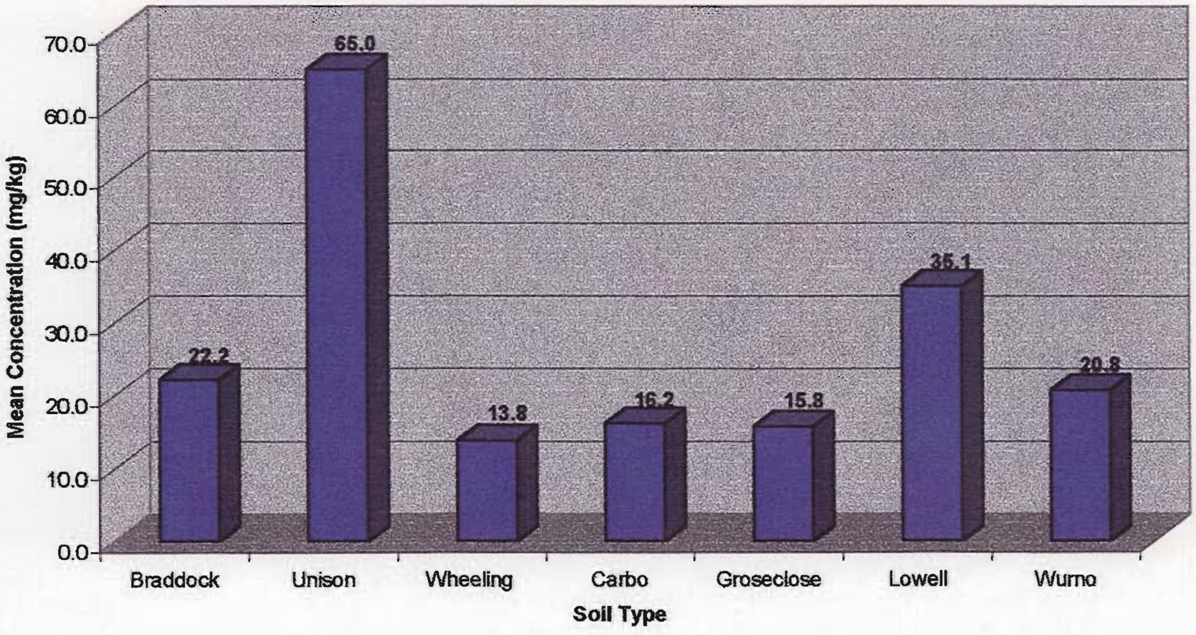
Average Copper Concentrations Detected in Surface Soil at RFAAP

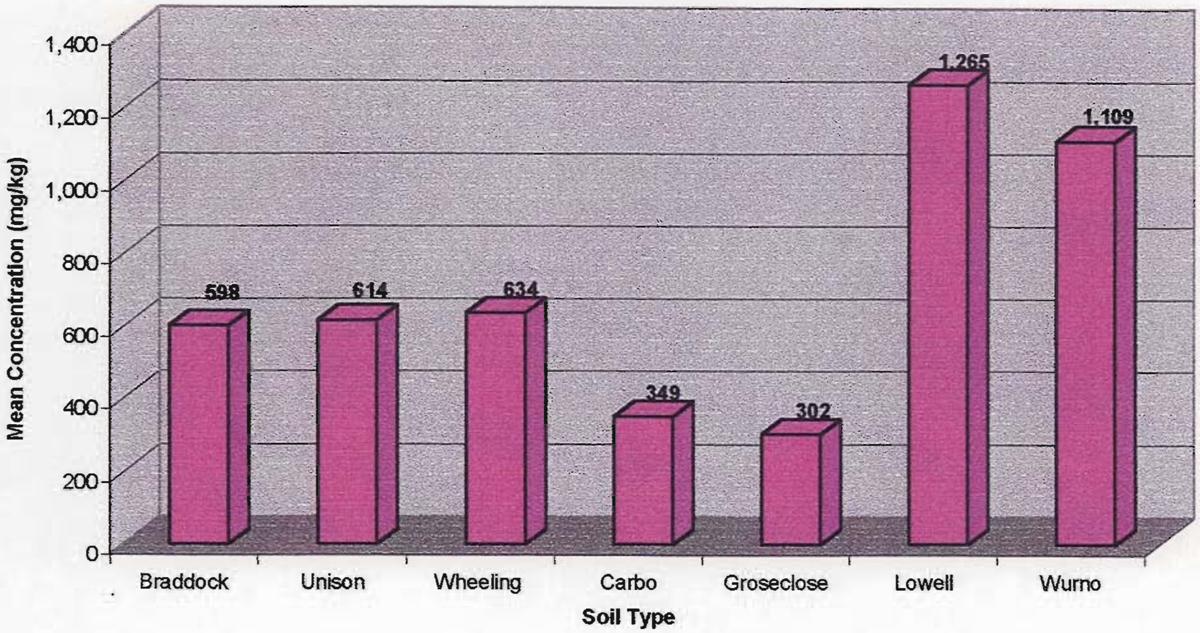


Average Iron Concentrations Detected in Surface Soil at RFAAP

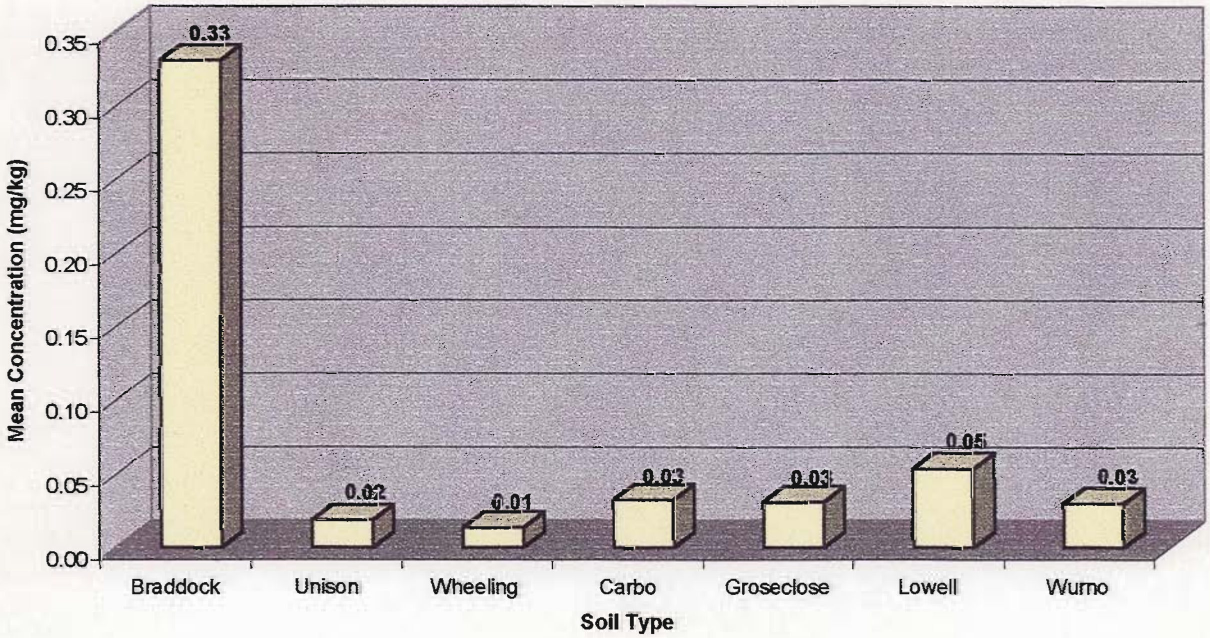


Average Lead Concentrations Detected in Surface Soil at RFAAP



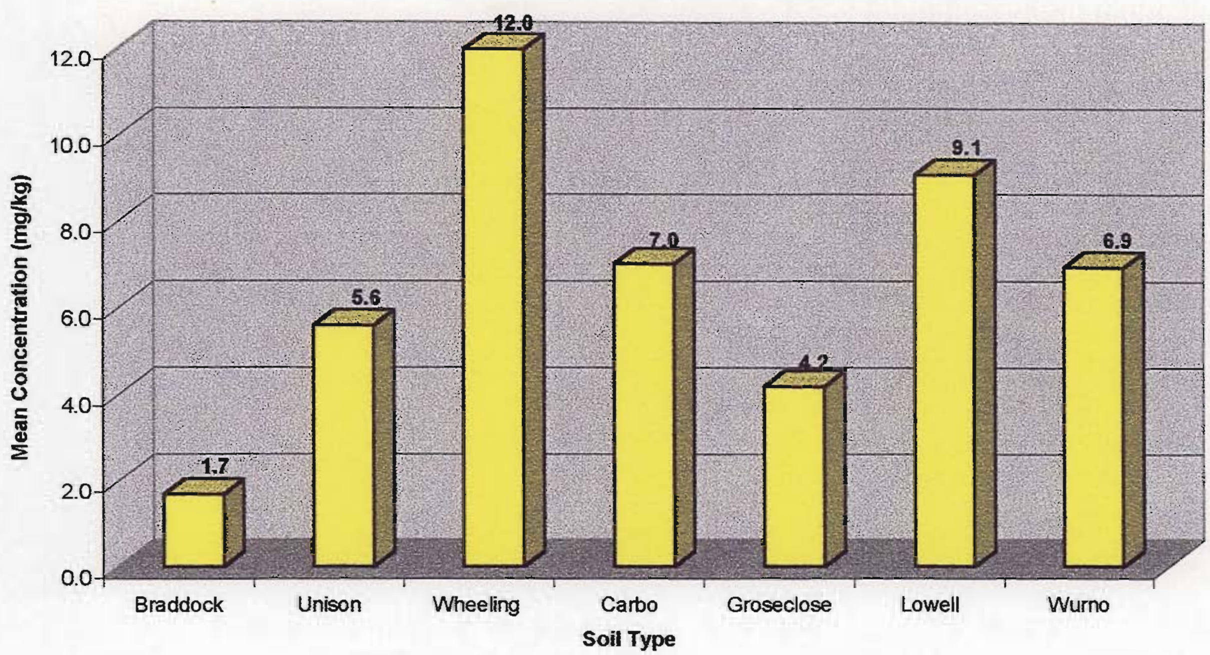


Average Manganese Concentrations in Surface Soil at RFAAP

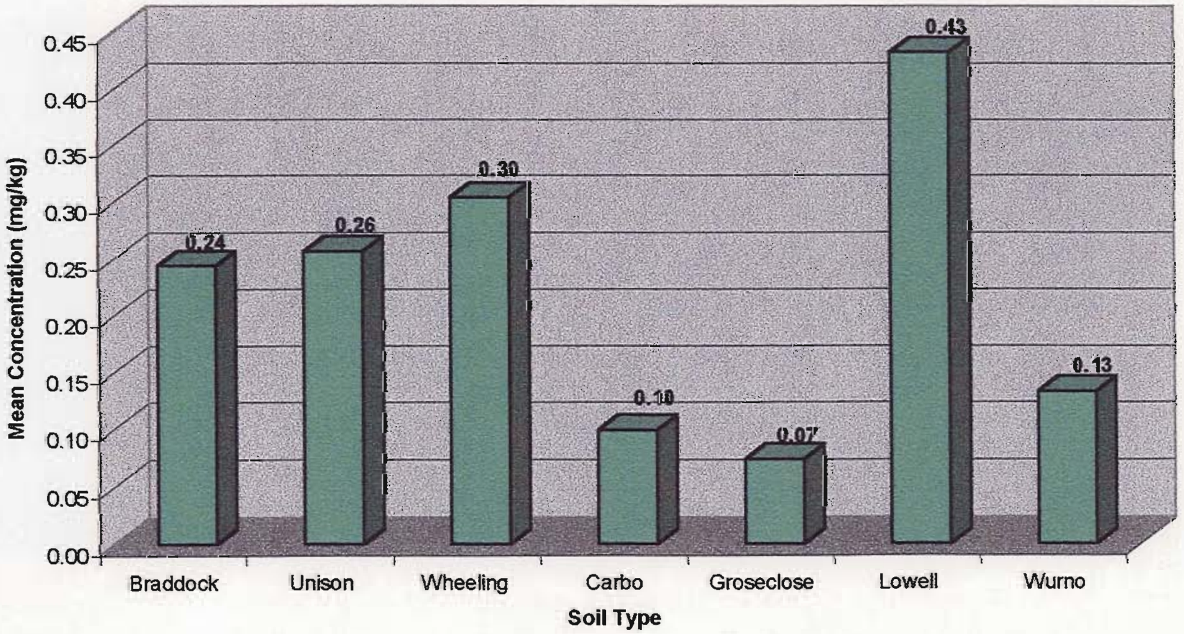


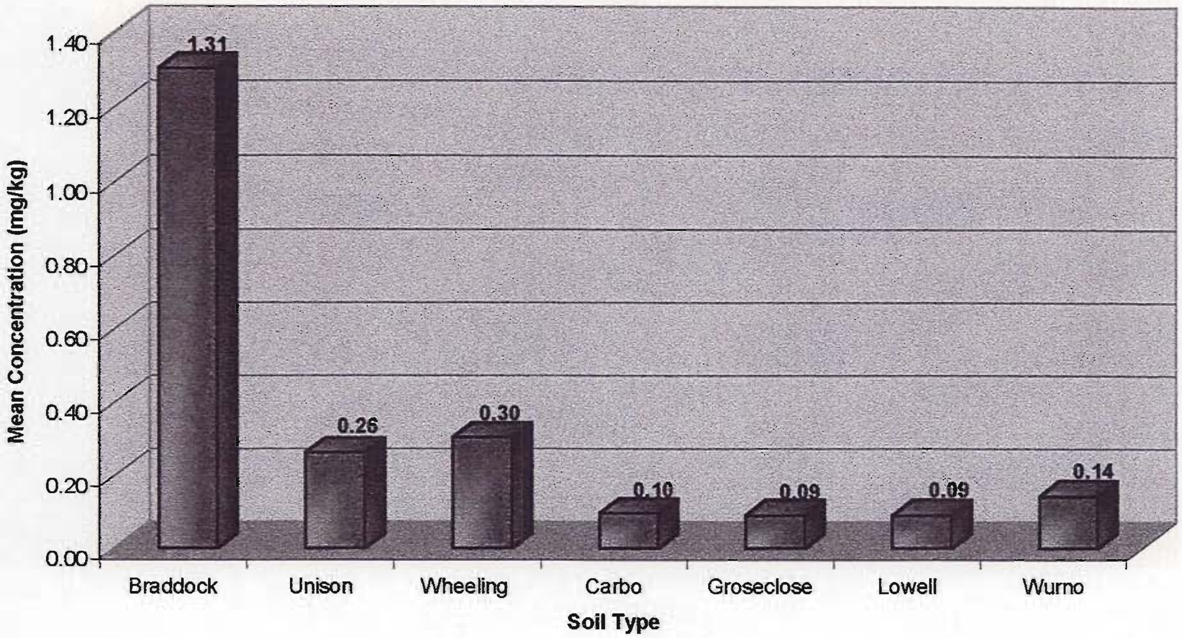
Average Mercury Concentrations Detected in Surface Soil at RFAAP

Average Nickel Concentrations Detected in Surface Soil at RFAAP

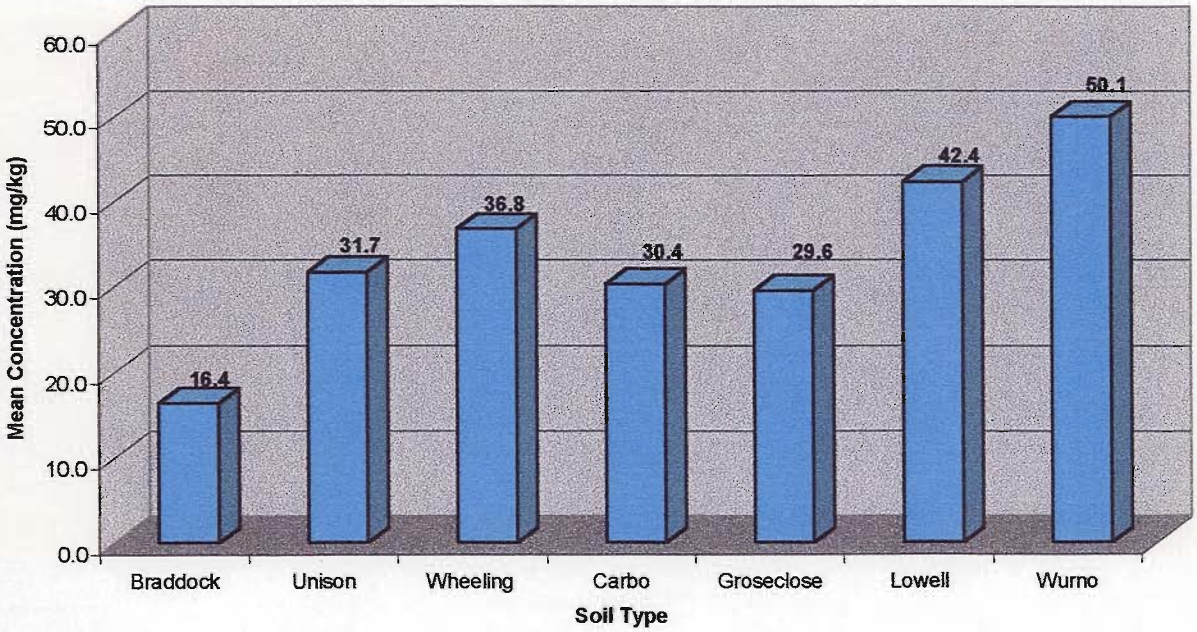


Average Selenium Concentrations in Surface Soil at RFAAP



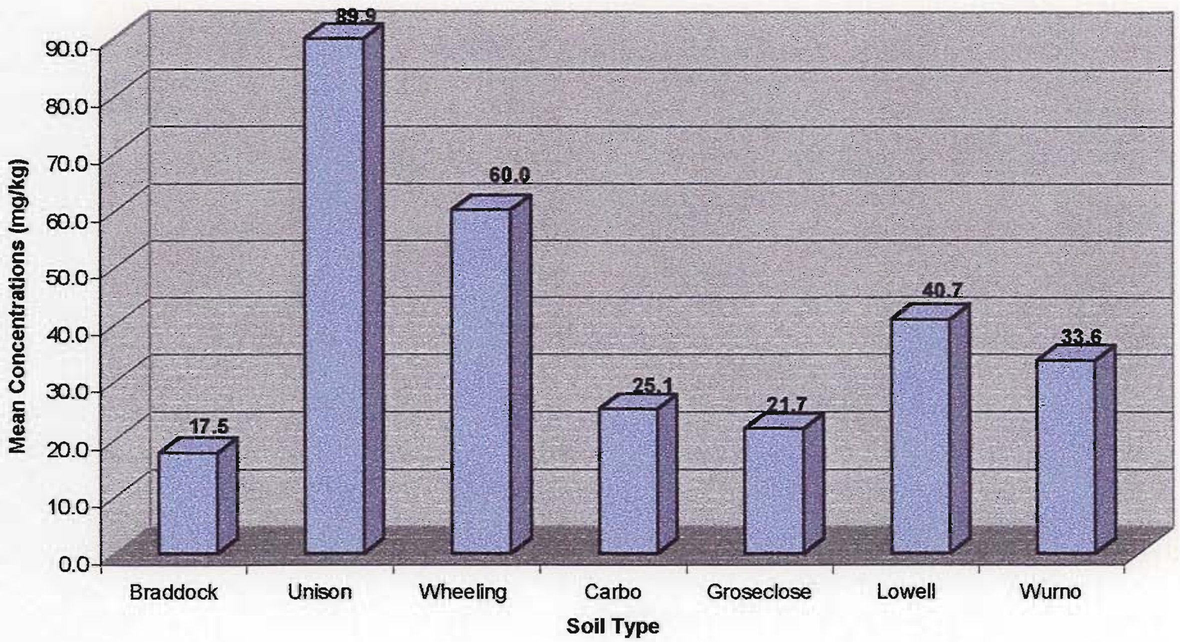


Average Silver Concentrations in Surface Soil at RFAAP



Average Vanadium Concentrations in Surface Soil at RFAAP

Average Zinc Concentrations Detected in Surface Soil at RFAAP



Appendix F

Statistical Comparisons Output

Surface Soil F-test and T-Test - Normal

F-Test Two-Sample for Variances

	MMA - COPPER	*NRU - COPPER*
Mean	7.820833333	5.446875
Variance	21.3588447	9.55115625
Observations	12	16
df	11	15
F	2.236257489	
P(F<=f) one-tail	0.074149998	
F Critical one-tail	2.506808983	

t-Test: Two-Sample Assuming Equal Variances

	MMA - COPPER	*NRU - COPPER*
Mean	7.820833333	5.446875
Variance	21.3588447	9.55115625
Observations	12	16
Pooled Variance	14.54671675	
Hypothesized Mean Difference	0	
df	26	
t Stat	1.629904653	
P(T<=t) one-tail	0.057589378	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.115178757	
t Critical two-tail	2.055530786	

Surface Soil F-test and T-Test - Lognormal

F-Test Two-Sample for Variances

	MMA - ALUMINUM	*NRU - ALUMINUM*
Mean	8.919999506	8.902283792
Variance	0.194653223	0.265867106
Observations	12	16
df	11	15
F	0.732144814	
P(F<=f) one-tail	0.304918267	
F Critical one-tail	0.367831099	

t-Test: Two-Sample Assuming Equal Variances

	MMA - ALUMINUM	*NRU - ALUMINUM*
Mean	8.919999506	8.902283792
Variance	0.194653223	0.265867106
Observations	12	16
Pooled Variance	0.235738155	
Hypothesized Mean Difference	0	
df	26	
t Stat	0.095546621	
P(T<=t) one-tail	0.462306643	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.924613286	
t Critical two-tail	2.055530786	

F-Test Two-Sample for Variances

	MMA - CHROMIUM	*NRU - CHROMIUM*
Mean	2.771343603	3.035719734
Variance	0.178236714	0.341543045
Observations	12	16
df	11	15
F	0.52185725	
P(F<=f) one-tail	0.140098705	
F Critical one-tail	0.367831099	

t-Test: Two-Sample Assuming Equal Variances

	MMA - CHROMIUM	*NRU - CHROMIUM*
Mean	2.771343603	3.035719734
Variance	0.178236714	0.341543045
Observations	12	16
Pooled Variance	0.272451905	
Hypothesized Mean Difference	0	
df	26	
t Stat	-1.32632183	
P(T<=t) one-tail	0.098133335	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.19626667	
t Critical two-tail	2.055530786	

F-Test Two-Sample for Variances

	MMA - IRON	*NRU - IRON*
Mean	9.505223576	9.942592127
Variance	0.217277044	0.337513901
Observations	12	16
df	11	15
F	0.643757317	
P(F<=f) one-tail	0.232987627	
F Critical one-tail	0.367831099	

t-Test: Two-Sample Assuming Equal Variances

	MMA - IRON	*NRU - IRON*
Mean	9.505223576	9.942592127
Variance	0.217277044	0.337513901
Observations	12	16
Pooled Variance	0.286644462	
Hypothesized Mean Difference	0	
df	26	
t Stat	-2.139180213	
P(T<=t) one-tail	0.020990188	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.041980376	
t Critical two-tail	2.055530786	

Surface Soil F-test and T-Test - Lognormal

F-Test Two-Sample for Variances

	MMA - MANGANES	*RU - MANGANESE*
Mean	6.066332948	6.23029537
Variance	1.042873034	0.919758371
Observations	12	16
df	11	15
F	1.133855443	
P(F<=f) one-tail	0.401603383	
F Critical one-tail	2.506808983	

t-Test: Two-Sample Assuming Equal Variances

	MMA - MANGANES	*RU - MANGANESE*
Mean	6.066332948	6.23029537
Variance	1.042873034	0.919758371
Observations	12	16
Pooled Variance	0.971845344	
Hypothesized Mean Difference	0	
df	26	
t Stat	-0.435529267	
P(T<=t) one-tail	0.333386362	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.666772723	
t Critical two-tail	2.055530786	

F-Test Two-Sample for Variances

	MMA - VANADIUM	*NRU - VANADIUM*
Mean	3.078896381	3.503458269
Variance	0.639724678	0.303625764
Observations	13	16
df	12	15
F	2.106951235	
P(F<=f) one-tail	0.087030147	
F Critical one-tail	2.475310623	

t-Test: Two-Sample Assuming Equal Variances

	MMA - VANADIUM	*NRU - VANADIUM*
Mean	3.078896381	3.503458269
Variance	0.639724678	0.303625764
Observations	13	16
Pooled Variance	0.453003059	
Hypothesized Mean Difference	0	
df	27	
t Stat	-1.6893635	
P(T<=t) one-tail	0.05133339	
t Critical one-tail	1.703288035	
P(T<=t) two-tail	0.102666781	
t Critical two-tail	2.051829142	

F-Test Two-Sample for Variances

	MMA - ZINC	*NRU - ZINC*
Mean	3.633143988	3.261213773
Variance	0.846348504	0.35902507
Observations	12	16
df	11	15
F	2.357352103	
P(F<=f) one-tail	0.062056864	
F Critical one-tail	2.506808983	

t-Test: Two-Sample Assuming Equal Variances

	MMA - ZINC	*NRU - ZINC*
Mean	3.633143988	3.261213773
Variance	0.846348504	0.35902507
Observations	12	16
Pooled Variance	0.565200369	
Hypothesized Mean Difference	0	
df	26	
t Stat	1.295483367	
P(T<=t) one-tail	0.103269009	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.206538018	
t Critical two-tail	2.055530786	

```
               Comparison of Two Samples   (Mann-Whitney U Test)
--------------------------------------------------------------------------------
Sample 1: SSDATA.MMA_SS_AS

Sample 2: SSDATA.NRU_SS_AS

Test: Unpaired

Average rank of first group = 12 based on 12 values.
Average rank of second group = 16.375 based on 16 values.
Large sample test statistic Z = 1.37025
Two-tailed probability of equaling or exceeding Z = 0.170607
One-tailed probability of equaling or exceeding Z = 0.085304

NOTE:  28 total observations.
```

```
               Comparison of Two Samples   (Mann-Whitney U Test)
--------------------------------------------------------------------------------
Sample 1: SSDATA.MMA_SS_BA

Sample 2: SSDATA.NRU_SS_BA

Test: Unpaired

Average rank of first group = 18.3333 based on 12 values.
Average rank of second group = 11.625 based on 16 values.
Large sample test statistic Z = -2.11257
Two-tailed probability of equaling or exceeding Z = 0.0346371
One-tailed probability of equaling or exceeding Z = 0.0173186

NOTE:  28 total observations.
```

```
               Comparison of Two Samples   (Mann-Whitney U Test)
--------------------------------------------------------------------------------
Sample 1: SSDATA.MMA_SS_BE

Sample 2: SSDATA.NRU_SS_BE

Test: Unpaired

Average rank of first group = 12.8333 based on 12 values.
Average rank of second group = 15.75 based on 16 values.
Large sample test statistic Z = 0.909004
Two-tailed probability of equaling or exceeding Z = 0.363346
One-tailed probability of equaling or exceeding Z = 0.181673

NOTE:  28 total observations.
```

```
               Comparison of Two Samples   (Mann-Whitney U Test)
--------------------------------------------------------------------------------
Sample 1: SSDATA.MMA_SS_CO

Sample 2: SSDATA.NRU_SS_CO

Test: Unpaired

Average rank of first group = 11.25 based on 12 values.
Average rank of second group = 16.9375 based on 16 values.
Large sample test statistic Z = 1.78805
Two-tailed probability of equaling or exceeding Z = 0.0737673
One-tailed probability of equaling or exceeding Z = 0.0368837

NOTE:  28 total observations.
```

```
               Comparison of Two Samples   (Mann-Whitney U Test)
--------------------------------------------------------------------------------
Sample 1: SSDATA.MMA_SS_PB

Sample 2: SSDATA.NRU_SS_PB

Test: Unpaired

Average rank of first group = 12.125 based on 12 values.
Average rank of second group = 16.2813 based on 16 values.
Large sample test statistic Z = 1.30022
Two-tailed probability of equaling or exceeding Z = 0.193524
One-tailed probability of equaling or exceeding Z = 0.096762

NOTE:  28 total observations.
```

```
               Comparison of Two Samples   (Mann-Whitney U Test)
--------------------------------------------------------------------------------
Sample 1: SSDATA.MMA_SS_NI

Sample 2: SSDATA.NRU_SS_NI

Test: Unpaired

Average rank of first group = 13.9167 based on 12 values.
Average rank of second group = 14.9375 based on 16 values.
Large sample test statistic Z = 0.302418
Two-tailed probability of equaling or exceeding Z = 0.76233
One-tailed probability of equaling or exceeding Z = 0.38117

NOTE:  28 total observations.
```

Subsurface Soil F-test and T-Test - Normal

F-Test Two-Sample for Variances

	MMA - COPPER	*NRU - COPPER*
Mean	16.99545455	14.00689655
Variance	107.6880736	100.7885222
Observations	22	29
df	21	28
F	1.068455726	
P(F<=f) one-tail	0.428449417	
F Critical one-tail	1.946222739	

t-Test: Two-Sample Assuming Equal Variances

	MMA - COPPER	*NRU - COPPER*
Mean	16.99545455	14.00689655
Variance	107.6880736	100.7885222
Observations	22	29
Pooled Variance	103.7454728	
Hypothesized Mean Difference	0	
df	49	
t Stat	1.037772987	
P(T<=t) one-tail	0.152234971	
t Critical one-tail	1.676551165	
P(T<=t) two-tail	0.304469943	
t Critical two-tail	2.009574018	

F-Test Two-Sample for Variances

	MMA - IRON	*NRU - IRON*
Mean	32595.45455	31051.72414
Variance	131659502.2	69987586.21
Observations	22	29
df	21	28
F	1.88118364	
P(F<=f) one-tail	0.059138964	
F Critical one-tail	1.946222739	

t-Test: Two-Sample Assuming Equal Variances

	MMA - IRON	*NRU - IRON*
Mean	32595.45455	31051.72414
Variance	131659502.2	69987586.21
Observations	22	29
Pooled Variance	96418407.33	
Hypothesized Mean Difference	0	
df	49	
t Stat	0.556053698	
P(T<=t) one-tail	0.290352288	
t Critical one-tail	1.676551165	
P(T<=t) two-tail	0.580704576	
t Critical two-tail	2.009574018	

F-Test Two-Sample for Variances

	MMA - VANADIUM	*NRU - VANADIUM*
Mean	61.89545455	47.9137931
Variance	414.5414069	209.4540887
Observations	22	29
df	21	28
F	1.979151658	
P(F<=f) one-tail	0.045927057	
F Critical one-tail	1.946222739	

t-Test: Two-Sample Assuming Unequal Variances

	MMA - VANADIUM	*NRU - VANADIUM*
Mean	61.89545455	47.9137931
Variance	414.5414069	209.4540887
Observations	22	29
Hypothesized Mean Difference	0	
df	36	
t Stat	2.738590104	
P(T<=t) one-tail	0.00476649	
t Critical one-tail	1.688297289	
P(T<=t) two-tail	0.00953298	
t Critical two-tail	2.02809133	

Subsurface Soil F-test and T-Test - Lognormal

F-Test Two-Sample for Variances

	MMA - ALUMINUM	*NRU - ALUMINUM*
Mean	9.855045455	9.513896552
Variance	0.212695093	0.246416596
Observations	22	29
df	21	28
F	0.863152468	
P(F<=f) one-tail	0.368497093	
F Critical one-tail	0.49432991	

t-Test: Two-Sample Assuming Equal Variances

	MMA - ALUMINUM	*NRU - ALUMINUM*
Mean	9.855045455	9.513896552
Variance	0.212695093	0.246416596
Observations	22	29
Pooled Variance	0.231964523	
Hypothesized Mean Difference	0	
df	49	
t Stat	2.505292543	
P(T<=t) one-tail	0.007804057	
t Critical one-tail	1.676551165	
P(T<=t) two-tail	0.015608113	
t Critical two-tail	2.009574018	

F-Test Two-Sample for Variances

	MMA - ARSENIC	*NRU - ARSENIC*
Mean	1.430409091	1.203275862
Variance	1.356504348	0.314681207
Observations	22	29
df	21	28
F	4.310725645	
P(F<=f) one-tail	0.000204895	
F Critical one-tail	1.946222739	

t-Test: Two-Sample Assuming Unequal Variances

	MMA - ARSENIC	*NRU - ARSENIC*
Mean	1.430409091	1.203275862
Variance	1.356504348	0.314681207
Observations	22	29
Hypothesized Mean Difference	0	
df	28	
t Stat	0.843491344	
P(T<=t) one-tail	0.203051142	
t Critical one-tail	1.701130259	
P(T<=t) two-tail	0.406102284	
t Critical two-tail	2.048409442	

F-Test Two-Sample for Variances

	MMA - CHROMIUM	*NRU - CHROMIUM*
Mean	3.387590909	3.332
Variance	0.191487872	0.149019786
Observations	22	29
df	21	28
F	1.284982872	
P(F<=f) one-tail	0.264245413	
F Critical one-tail	1.946222739	

t-Test: Two-Sample Assuming Equal Variances

	MMA - CHROMIUM	*NRU - CHROMIUM*
Mean	3.387590909	3.332
Variance	0.191487872	0.149019786
Observations	22	29
Pooled Variance	0.167220394	
Hypothesized Mean Difference	0	
df	49	
t Stat	0.480822084	
P(T<=t) one-tail	0.316391488	
t Critical one-tail	1.676551165	
P(T<=t) two-tail	0.632782975	
t Critical two-tail	2.009574018	

Subsurface Soil F-test and T-Test - Lognormal

F-Test Two-Sample for Variances

	MMA - COBALT	*NRU - COBALT*
Mean	2.3655	2.463517241
Variance	1.0458435	1.20874033
Observations	22	29
df	21	28
F	0.865234223	
P(F<=f) one-tail	0.370683392	
F Critical one-tail	0.49432991	

t-Test: Two-Sample Assuming Equal Variances

	MMA - COBALT	*NRU - COBALT*
Mean	2.3655	2.463517241
Variance	1.0458435	1.20874033
Observations	22	29
Pooled Variance	1.138927403	
Hypothesized Mean Difference	0	
df	49	
t Stat	-0.324847632	
P(T<=t) one-tail	0.373339641	
t Critical one-tail	1.676551165	
P(T<=t) two-tail	0.746679281	
t Critical two-tail	2.009574018	

F-Test Two-Sample for Variances

	MMA - MANGANESE	*NRU - MANGANESE*
Mean	5.615545455	5.239172414
Variance	1.07562026	1.240569148
Observations	22	29
df	21	28
F	0.867037732	
P(F<=f) one-tail	0.372576871	
F Critical one-tail	0.49432991	

t-Test: Two-Sample Assuming Equal Variances

	MMA - MANGANES	*RU - MANGANESE*
Mean	5.615545455	5.239172414
Variance	1.07562026	1.240569148
Observations	22	29
Pooled Variance	1.169876767	
Hypothesized Mean Difference	0	
df	49	
t Stat	1.230760929	
P(T<=t) one-tail	0.112143834	
t Critical one-tail	1.676551165	
P(T<=t) two-tail	0.224287669	
t Critical two-tail	2.009574018	

F-Test Two-Sample for Variances

	MMA - NICKEL	*NRU - NICKEL*
Mean	2.693090909	2.494344828
Variance	0.614050372	0.982848663
Observations	22	29
df	21	28
F	0.624765944	
P(F<=f) one-tail	0.134919433	
F Critical one-tail	0.49432991	

t-Test: Two-Sample Assuming Equal Variances

	MMA - NICKEL	*NRU - NICKEL*
Mean	2.693090909	2.494344828
Variance	0.614050372	0.982848663
Observations	22	29
Pooled Variance	0.824792252	
Hypothesized Mean Difference	0	
df	49	
t Stat	0.774018854	
P(T<=t) one-tail	0.221319139	
t Critical one-tail	1.676551165	
P(T<=t) two-tail	0.442638277	
t Critical two-tail	2.009574018	

Subsurface Soil F-tes, and T-Test - Lognormal

F-Test Two-Sample for Variances

	MMA - ZINC	*NRU - ZINC*
Mean	4.192954545	3.012344828
Variance	0.975241855	0.465526591
Observations	22	29
df	21	28
F	2.094921909	
P(F<=f) one-tail	0.034084067	
F Critical one-tail	1.946222739	

t-Test: Two-Sample Assuming Unequal Variances

	MMA - ZINC	*NRU - ZINC*
Mean	4.192954545	3.012344828
Variance	0.975241855	0.465526591
Observations	22	29
Hypothesized Mean Difference	0	
df	35	
t Stat	4.804556085	
P(T<=t) one-tail	1.4456E-05	
t Critical one-tail	1.689572855	
P(T<=t) two-tail	2.89119E-05	
t Critical two-tail	2.030110409	

```
                Comparison of Two Samples   (Mann-Whitney U Test)
-----------------------------------------------------------------------------------
Sample 1: SBDATA.MMA_BA_SB

Sample 2: SBDATA.NRU_BA_SB

Test: Unpaired

Average rank of first group = 33.5455 based on 22 values.
Average rank of second group = 20.2759 based on 29 values.
Large sample test statistic Z = -3.14858
Two-tailed probability of equaling or exceeding Z = 1.64081E-3
One-tailed probability of equaling or exceeding Z = 0.82041E-4

NOTE:  51 total observations.
```

```
                Comparison of Two Samples   (Mann-Whitney U Test)
-----------------------------------------------------------------------------------
Sample 1: SBDATA.MMA_BE_SB

Sample 2: SBDATA.NRU_BE_SB

Test: Unpaired

Average rank of first group = 25.1591 based on 22 values.
Average rank of second group = 26.6379 based on 29 values.
Large sample test statistic Z = 0.342808
Two-tailed probability of equaling or exceeding Z = 0.731739
One-tailed probability of equaling or exceeding Z = 0.365870

NOTE:  51 total observations.
```

```
                Comparison of Two Samples   (Mann-Whitney U Test)
-----------------------------------------------------------------------------------
Sample 1: SBDATA.MMA_PB_SB

Sample 2: SBDATA.NRU_PB_SB

Test: Unpaired

Average rank of first group = 31.9091 based on 22 values.
Average rank of second group = 21.5172 based on 29 values.
Large sample test statistic Z = -2.46313
Two-tailed probability of equaling or exceeding Z = 0.0137729
One-tailed probability of equaling or exceeding Z = 0.0068865

NOTE:  51 total observations.
```

Appendix G

Summary Statistics Output

Statistical Output for Surface Soil Data (Table 4-11)
Radford Army Ammunition Plant

Statistics	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM
No. of data points	28	14	28	28	28	28	28	28
No. of detects	28	0	28	24	15	2	23	28
Frequency of detects	100.00%	0.00%	100.00%	85.71%	53.57%	7.14%	82.14%	100.00%
Minimum of detects	3620	N/A	1.5	23.4	0.61	0.67	116	6.3
Maximum of detects	20100	N/A	10.2	174	1.5	0.82	7340	53.3
Minimum of nondetects	N/A	< 0.69	N/A	< 22.3	< 0.56	< 0.55	< 120	N/A
Maximum of nondetects	N/A	< 9	N/A	< 23.4	< 0.61	< 1.2	< 609	N/A
Arithmetic Mean (Gilbert 1987, Eq 4.3)	8300	2.483214	3.732143	66.391071	0.609107	0.335536	1026.464286	21.092857
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	4278.500083	1.670201	2.329847	45.947071	0.351521	0.131419	1352.13013	10.503718
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.515482	0.672596	0.624265	0.692067	0.577108	0.39167	1.31727	0.497975
Geometric Mean (Gilbert 1987, Eq 13.1)	7404.744637	1.585508	3.212641	50.157606	0.517535	0.320229	649.175324	18.586131
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	1.610486	3.203761	1.702027	2.281994	1.793476	1.318916	2.626603	1.697669
Shapiro-Wilk Coefficient (95%)	0.924	N/A	0.924	0.924	0.924	0.924	0.924	0.924
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	0.871	N/A	0.803	0.919	0.846	0.45	0.554	0.92
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	0.948	N/A	0.932	0.932	0.822	0.494	0.977	0.946
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution [a]	L	N/A	L	L	U	U	L	L
Median (Gilbert 1987, Eq 13.15 & 13.16)	6705	< 6.9	2.75	58.65	0.615	< 0.58	761.5	22.4
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	9677.21145	3.273723	4.4821	81.181028	0.722259	0.377838	1461.703052	24.473911
Std. Dev. - ln transformed data	0.476536	1.164326	0.53182	0.825049	0.584156	0.27681	0.965691	0.529256
H value	1.924402	3.077269	1.969047	2.253055	2.013532	1.789709	2.415173	1.966868
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	9896.193979	8.435604	4.526908	100.812811	0.769745	0.366021	1621.060927	26.122783
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	9676.682677	< 9	3.685226	73.571453	0.72	< 0.598522	919.704522	25.870452
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	17921.49099	6.84912	8.971503	169.716845	1.399607	0.631071	4067.134521	44.713619
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	21622.96043	33.2632	10.623304	320.711285	1.925088	0.596767	5695.031082	61.105816
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	11074.6484	< 9	6.140788	114.18967	0.72	0.82	1437.117778	25.791995
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Surface Soil Data (Table 4-11)
Radford Army Ammunition Plant

Statistics	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL
No. of data points	28	28	28	28	28	28	28	28
No. of detects	20	26	28	28	25	28	3	17
Frequency of detects	71.43%	92.86%	100.00%	100.00%	89.29%	100.00%	10.71%	60.71%
Minimum of detects	5.9	2.2	7250	8.9	158	43	0.07	4.6
Maximum of detects	45.4	13.6	63000	225	20400	2040	1.2	18.1
Minimum of nondetects	< 5.6	< 1.1	N/A	N/A	< 563	N/A	< 0.037	< 4.4
Maximum of nondetects	< 6.1	< 1.1	N/A	N/A	< 609	N/A	< 0.12	< 4.9
Arithmetic Mean (Gilbert 1987, Eq 4.3)	12.216071	6.464286	20107.5	26.960714	2261.410714	695.896429	0.092661	6.946429
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	10.364943	3.929279	11869.04958	41.344195	4144.475511	591.504727	0.218221	5.024586
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.848468	0.607844	0.59028	1.533498	1.832695	0.84999	2.355055	0.723334
Geometric Mean (Gilbert 1987, Eq 13.1)	8.781135	5.071981	17242.77445	18.415464	911.018645	473.440271	0.051831	5.312428
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	2.336781	2.264459	1.767817	2.018244	3.541902	2.640363	2.217937	2.137508
Shapiro-Wilk Coefficient (95%)	0.924	0.924	0.924	0.924	0.924	0.924	0.924	0.924
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	0.827	0.913	0.846	0.416	0.533	0.84	0.267	0.854
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	0.916	0.869	0.932	0.798	0.921	0.962	0.695	0.86
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution [a]	LQ	NQ	L	U	LQ	L	U	U
Median (Gilbert 1987, Eq 13.15 & 13.16)	10.15	5.2	19750	15.15	741	490	< 0.12	5.55
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	15.552455	7.729086	23928.0424	40.269046	3595.480836	886.296585	0.162904	8.563799
Std. Dev. - ln transformed data	0.848774	0.817336	0.569745	0.702228	1.264664	0.970916	0.796578	0.759641
H value	2.279627	2.244416	2.001284	2.124294	2.799588	2.421391	2.221475	2.18343
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	18.268603	10.082374	25257.77476	31.400935	4006.315655	1192.50219	0.100065	9.754979
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	12.240904	7.407939	22900	17.867035	1216.703482	701.987915	< 0.12	9.007939
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	35.524756	15.300448	46798.6187	119.93554	11581.50724	2026.07226	0.583396	18.245718
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	59.224125	31.872899	62093.21998	89.332031	15654.89962	4202.44837	0.31086	29.321726
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	19.329561	11.373066	23711.96884	219.158595	7545.096508	1326.702899	1.2	10.773389
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Surface Soil Data (Table 4-11)
Radford Army Ammunition Plant

Statistics	POTASSIUM	SELENIUM	SILVER	SODIUM	THALLIUM	VANADIUM	ZINC
No. of data points	28	28	28	28	28	28	28
No. of detects	22	2	1	1	4	28	28
Frequency of detects	78.57%	7.14%	3.57%	3.57%	14.29%	100.00%	100.00%
Minimum of detects	166	0.64	N/A	N/A	1.3	12.2	7.1
Maximum of detects	2350	0.77	4.3	124	2.1	101	216
Minimum of nondetects	< 557	< 0.56	< 0.56	< 110	< 1.1	N/A	N/A
Maximum of nondetects	< 752	< 1.2	< 2.4	< 752	< 1.2	N/A	N/A
Arithmetic Mean (Gilbert 1987, Eq 4.3)	643.142857	0.33625	0.656964	140.160714	0.7625	33.889286	41.210714
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	586.363793	0.121576	0.73728	117.339098	0.469165	17.780729	40.242297
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.911716	0.361565	1.122253	0.837175	0.615298	0.524671	0.976501
Geometric Mean (Gilbert 1987, Eq 13.1)	467.015515	0.322541	0.531835	102.124914	0.683561	30.113272	30.588143
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	2.17177	1.302809	1.709065	2.179983	1.514938	1.644242	2.140806
Shapiro-Wilk Coefficient (95%)	0.924	0.924	0.924	0.924	0.924	0.924	0.924
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	0.759	0.484	0.373	0.673	0.466	0.832	0.665
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	0.908	0.532	0.717	0.674	0.506	0.939	0.975
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution [a]	LQ	U	U	U	U	L	L
Median (Gilbert 1987, Eq 13.15 & 13.16)	355	< 0.585	< 1.1	< 120	< 1.2	33.8	29.7
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	831.888192	0.375384	0.894288	177.931135	0.91352	39.612746	54.164355
Std. Dev. - ln transformed data	0.775543	0.264523	0.535946	0.779317	0.415374	0.49728	0.761183
H value	2.199809	1.783197	1.972554	2.203697	1.878531	1.93996	2.185018
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	876.051028	0.365766	0.752505	192.553456	0.865884	41.028487	56.28311
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	586.113565	< 0.6	< 1.2	123.409044	< 1.2	38.581809	39.511357
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	1961.757754	0.609651	2.31496	404.032878	1.817558	73.874589	131.707592
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	2671.519868	0.584694	1.775024	589.175923	1.739597	92.134412	169.416454
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	1395.157939	0.77	4.3	< 590.876868	2.1	38.862178	57.812306
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

[a] Key for distribution type

L = Passed lognormal distribution test.
L* = Passed both normal and lognormal distribution tests, but lognormal distribution was a better fit.
LQ = Lognormal distribution assumed since it was close to passing lognormal distribution test.
N = Passed normal distribution test.
N* = Passed both normal and lognormal distribution tests, but normal distribution was a better fit.
NQ = Normal distribution assumed since it was close to passing normal distribution test.
U = Distribution undefined (nonparametric).

EPA April 1992, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance.
Gilbert 1987, Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York.

Statistical Output for Subsurface Soil Data (Table 4-12)
Radford Army Ammunition Plant

Statistics	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM
No. of data points	51	24	51	51	51	51	51	51
No. of detects	51	0	48	39	25	12	40	51
Frequency of detects	100.00%	0.00%	94.12%	76.47%	49.02%	23.53%	78.43%	100.00%
Minimum of detects	6130	N/A	1.2	25.2	0.78	0.57	120	10.8
Maximum of detects	47900	N/A	35.9	164	5.4	2.5	25700	75.8
Minimum of nondetects	N/A	< 0.67	< 1.1	< 23	< 0.55	< 0.55	< 110	N/A
Maximum of nondetects	N/A	< 9	< 1.3	< 27.3	< 0.68	< 1.3	< 682	N/A
Arithmetic Mean (Gilbert 1987, Eq 4.3)	17846.86275	2.64375	5.512745	51.960784	1.03	0.53	1223.794118	30.94902
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	9724.188293	1.655111	6.325977	40.154506	1.147605	0.46723	3610.720907	12.075585
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.544868	0.626047	1.147518	0.772785	1.11418	0.881566	2.950432	0.390177
Geometric Mean (Gilbert 1987, Eq 13.1)	15695.19339	1.743857	3.673959	38.910123	0.663042	0.426633	485.029926	28.672735
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	1.659203	3.052581	2.389528	2.20864	2.467649	1.793104	3.209802	1.500442
Shapiro-Wilk Coefficient (95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia Coefficient (EPA April 1992, 95%)	0.954	N/A	0.954	0.954	0.954	0.954	0.954	0.954
Shapiro-Francia calc. - Normal (EPA April 1992)	0.874	N/A	0.618	0.85	0.669	0.568	0.231	0.929
Shapiro-Francia calc. - Lognormal (EPA April 1992)	0.992	N/A	0.947	0.949	0.85	0.717	0.933	0.962
Distribution [a]	L	N/A	LQ	LQ	U	U	LQ	L
Median (Gilbert 1987, Eq 13.15 & 13.16)	15300	< 7.25	3.4	42.6	< 0.68	< 0.62	520	30.1
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	20128.87398	3.222778	6.997286	61.383991	1.299313	0.639647	2071.135348	33.782842
Std. Dev. - ln transformed data	0.506337	1.115987	0.871096	0.792377	0.903266	0.583948	1.166209	0.405759
H value	1.880436	2.668707	2.17883	2.105368	2.209266	1.934764	2.488165	1.816628
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	20413.48241	6.048558	7.022274	67.431392	1.322128	0.593597	1443.170719	34.553564
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	18124.29493	< 7.452942	3.887382	47.44953	0.956215	< 0.66	621.621475	33.6
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	37885.49756	6.465401	18.548686	134.707174	3.39487	1.492821	8664.406692	55.833177
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	44556.76996	22.940738	22.116783	199.159467	4.265007	1.421214	5363.745774	66.16126
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	21396.46447	< 7.300264	13.738132	71.612067	1.3	0.886181	5283.736478	34.85732
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Subsurface Soil Data (Table 4-12)
Radford Army Ammunition Plant

Statistics	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL
No. of data points	51	51	51	51	51	51	51	51
No. of detects	37	51	51	51	48	51	16	46
Frequency of detects	72.55%	100.00%	100.00%	100.00%	94.12%	100.00%	31.37%	90.20%
Minimum of detects	6.2	1.6	14300	2.1	139	16.7	0.038	4.8
Maximum of detects	130	38.7	67700	256	58100	1760	0.27	94.2
Minimum of nondetects	< 5.7	N/A	N/A	N/A	< 110	N/A	< 0.037	< 4.6
Maximum of nondetects	< 6.6	N/A	N/A	N/A	< 629	N/A	< 0.14	< 4.8
Arithmetic Mean (Gilbert 1987, Eq 4.3)	20.186275	15.296078	31717.64706	19.739216	7877.480392	354.817647	0.076353	19.016667
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	26.779035	10.193389	9751.219532	39.106644	14871.18642	327.070423	0.050005	17.142718
CV - Normal (Gilbert 1987, Sec 4.4.4)	1.326596	0.666405	0.307438	1.981165	1.88781	0.921799	0.654919	0.901458
Geometric Mean (Gilbert 1987, Eq 13.1)	11.259934	11.321729	30236.37374	11.943455	1904.726254	221.734789	0.064113	13.197511
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	2.879291	2.398796	1.376103	2.197441	5.587546	2.966064	1.814514	2.47063
Shapiro-Wilk Coefficient (95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia Coefficient (EPA April 1992, 95%)	0.954	0.954	0.954	0.954	0.954	0.954	0.954	0.954
Shapiro-Francia calc. - Normal (EPA April 1992)	0.618	0.953	0.933	0.301	0.542	0.823	0.762	0.79
Shapiro-Francia calc. - Lognormal (EPA April 1992)	0.939	0.94	0.954	0.839	0.969	0.962	0.898	0.981
Distribution [a]	LQ	NQ	L	U	L	L	U	L
Median (Gilbert 1987, Eq 13.15 & 13.16)	12.2	12.3	32300	10.2	1780	262	< 0.12	14.8
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	26.47061	17.688199	34006.00181	28.916517	11367.35671	431.572473	0.088088	23.039612
Std. Dev. - ln transformed data	1.057544	0.874967	0.319256	0.787293	1.72054	1.087236	0.595818	0.904473
H value	2.369068	2.182469	1.771013	2.100945	3.162409	2.401611	1.943073	2.210473
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	28.071829	21.748912	34465.8257	20.573797	18064.50043	579.282807	0.090186	26.359
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	14.011677	19.34671	34986.44239	12.524295	3169.529953	365.116774	< 0.128738	18.436912
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	75.369832	36.301596	51811.98515	100.326278	38522.53424	1028.811667	0.179398	54.342665
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	99.537215	68.701286	58377.82271	60.494885	66013.25737	2083.801516	0.218864	85.104176
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	31.270517	21.3	34681.39737	33.998575	42713.9838	503.903331	0.124274	26.351247
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Subsurface Soil Data (Table 4-12)
Radford Army Ammunition Plant

Statistics	POTASSIUM	SELENIUM	SILVER	SODIUM	THALLIUM	VANADIUM	ZINC
No. of data points	51	51	51	51	51	51	51
No. of detects	45	0	0	5	12	51	51
Frequency of detects	88.24%	0.00%	0.00%	9.80%	23.53%	100.00%	100.00%
Minimum of detects	123	N/A	N/A	114	1.4	22	4.7
Maximum of detects	10900	N/A	N/A	151	5	114	598
Minimum of nondetects	< 586	< 0.55	< 0.56	< 110	< 1.1	N/A	N/A
Maximum of nondetects	< 682	< 3.6	< 2.6	< 750	< 1.4	N/A	N/A
Arithmetic Mean (Gilbert 1987, Eq 4.3)	1959.039216	0.460686	0.550686	147.343137	1.107843	53.945098	62.703922
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	2477.751605	0.40461	0.227119	116.803788	1.00982	18.44754	103.880678
CV - Normal (Gilbert 1987, Sec 4.4.4)	1.264779	0.878276	0.412429	0.792733	0.911519	0.341969	1.656685
Geometric Mean (Gilbert 1987, Eq 13.1)	1016.588222	0.379368	0.511751	109.511753	0.853795	50.856251	33.839535
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	3.178316	1.695118	1.466104	2.132231	1.907791	1.423729	2.744177
Shapiro-Wilk Coefficient (95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia Coefficient (EPA April 1992, 95%)	0.954	0.954	0.954	0.954	0.954	0.954	0.954
Shapiro-Francia calc. - Normal (EPA April 1992)	0.699	0.462	0.755	0.728	0.589	0.964	0.47
Shapiro-Francia calc. - Lognormal (EPA April 1992)	0.979	0.563	0.851	0.755	0.659	0.983	0.957
Distribution [a]	L	U	U	U	U	L*	L
Median (Gilbert 1987, Eq 13.15 & 13.16)	861	< 0.61	< 1.2	< 130	< 1.2	52.3	30.4
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	2540.502349	0.555638	0.603985	174.753914	1.344821	58.27425	87.081984
Std. Dev. - ln transformed data	1.156351	0.527753	0.382609	0.757169	0.645946	0.353279	1.009481
H value	2.477361	1.895427	1.803957	2.074737	1.982298	1.788705	2.316391
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	2974.739032	0.502319	0.60707	182.152951	1.260669	59.191148	78.401974
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	1386.214746	< 0.62	< 1.2	121.864424	< 1.3	60.208857	37.460267
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	7064.941949	1.294466	1.01871	388.040703	3.18878	91.959943	276.770834
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	11015.96553	1.125572	1.125835	521.302111	3.231792	105.320215	270.931967
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	3704.818414	< 3.022863	< 1.2	< 608.851594	2.602242	62.42377	80.153223
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

[a] Key for distribution type

L = Passed lognormal distribution test.
L* = Passed both normal and lognormal distribution tests, but lognormal distribution was a better fit.
LQ = Lognormal distribution assumed since it was close to passing lognormal distribution test.
N = Passed normal distribution test.
N* = Passed both normal and lognormal distribution tests, but normal distribution was a better fit.
NQ = Normal distribution assumed since it was close to passing normal distribution test.
U = Distribution undefined (nonparametric).

EPA April 1992, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance.
Gilbert 1987, Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York.

Statistical Output for Surface Soil Data - MMA (Table 4-13)
Radford Army Ammunition Plant

Statistics	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM	COBALT
No. of data points	12	9	12	12	12	12	12	12	12
No. of detects	12	0	12	10	5	2	8	12	7
Frequency of detects	100.00%	0.00%	100.00%	83.33%	41.67%	16.67%	66.67%	100.00%	58.33%
Minimum of detects	3700	N/A	1.5	39.9	0.72	0.67	116	8.7	6.5
Maximum of detects	15400	N/A	10.2	174	1.1	0.82	7340	27	16.1
Minimum of nondetects	N/A	< 6.7	N/A	< 22.3	< 0.56	< 0.56	< 557	N/A	< 5.6
Maximum of nondetects	N/A	< 9	N/A	< 23.4	< 0.61	< 0.64	< 609	N/A	< 6.1
Arithmetic Mean (Gilbert 1987, Eq 4.3)	8179.166667	3.666667	3.458333	92.054167	0.545417	0.369167	1292.25	17.283333	7.7125
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	3647.087152	0.34821	2.640061	54.232846	0.331433	0.178883	2016.411354	6.868748	4.876713
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.4459	0.094966	0.763391	0.589141	0.607669	0.48456	1.560388	0.39742	0.632313
Geometric Mean (Gilbert 1987, Eq 13.1)	7480.085537	3.653195	2.869807	69.013464	0.461788	0.342706	632.018571	15.98009	6.211731
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	1.554564	1.093209	1.792792	2.570031	1.811573	1.441014	3.212319	1.525284	2.041035
Estimated Mean - Lognormal (Eq 13.7)	8244.702219	3.667731	3.402944	107.747667	0.550948	0.366358	1248.696376	17.469595	8.012078
Estimated Std. Dev. - Lognormal (Eq 13.8)	3821.929669	0.327509	2.168456	129.18579	0.358509	0.138441	2127.735592	7.716504	6.527075
Shapiro-Wilk Coefficient (95%)	0.859	N/A	0.859	0.859	0.859	0.859	0.859	0.859	0.859
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	0.915	N/A	0.7	0.941	0.759	0.55	0.591	0.906	0.865
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	0.955	N/A	0.846	0.817	0.742	0.586	0.923	0.909	0.827
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution [a]	L*	N/A	LQ	N	U	U	L	L*	N
Median (Gilbert 1987, Eq 13.15 & 13.16)	6730	< 7.1	2.45	106.55	< 0.6	< 0.59	392	17.05	7.3
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	10069.91499	3.882504	4.827012	120.169936	0.71724	0.461905	2337.612021	20.844277	10.24072
Std. Dev. - ln transformed data	0.441195	0.089117	0.583774	0.943918	0.594196	0.365347	1.166993	0.422181	0.713457
H value	2.073375	1.822	2.249906	2.815735	2.263454	1.991693	3.231619	2.051508	2.434993
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	10863.2142	3.884446	5.056412	240.124038	0.826461	0.456236	3893.011903	22.682715	13.527907
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	15400	< 9	10.2	174	1.1	0.82	7340	27	16.1
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	18157.59712	4.722438	10.681541	240.435233	1.452216	0.858591	6809.151466	36.076227	21.055187
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	25011.96603	4.786532	14.174591	913.114123	2.34684	0.931188	15395.21886	50.725592	43.748547
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	15400	< 9	10.2	174	1.1	0.82	7340	27	16.1
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Surface Soil Data - MMA (Table 4-13)
Radford Army Ammunition Plant

Statistics	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL	POTASSIUM	SELENIUM
No. of data points	12	12	12	12	12	12	12	12	12
No. of detects	11	12	12	9	12	2	7	6	0
Frequency of detects	91.67%	100.00%	100.00%	75.00%	100.00%	16.67%	58.33%	50.00%	0.00%
Minimum of detects	2.2	7250	9.4	158	43	0.07	4.6	174	N/A
Maximum of detects	13.6	23800	225	5930	1910	1.2	13.5	1430	N/A
Minimum of nondetects	N/A	N/A	N/A	< 563	N/A	< 0.037	< 4.4	< 557	< 0.56
Maximum of nondetects	< 1.1	N/A	N/A	< 609	N/A	< 0.12	< 4.9	< 752	< 0.75
Arithmetic Mean (Gilbert 1987, Eq 4.3)	7.820833	14755	33.675	1525.208333	615.366667	0.132042	6.695833	566.583333	0.300417
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	4.621563	6308.329991	61.342957	1710.242599	490.804326	0.336876	4.697072	462.702429	0.026668
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.59093	0.427538	1.821617	1.121317	0.79758	2.551286	0.701492	0.816654	0.08877
Geometric Mean (Gilbert 1987, Eq 13.1)	5.931507	13429.69496	17.900477	832.874966	431.096925	0.041159	5.147891	435.230896	0.299433
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	2.561955	1.593814	2.493808	3.307836	2.776557	3.264777	2.181048	2.065184	1.0861
Estimated Mean - Lognormal (Eq 13.7)	9.233175	14970.87757	27.1765	1703.50518	726.159339	0.082881	6.977114	566.143961	0.300456
Estimated Std. Dev. - Lognormal (Eq 13.8)	11.014615	7375.164448	31.044683	3039.398816	984.302793	0.144864	6.382939	470.974071	0.024858
Shapiro-Wilk Coefficient (95%)	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	N/A
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	0.906	0.892	0.436	0.79	0.857	0.373	0.814	0.742	N/A
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	0.826	0.874	0.661	0.925	0.903	0.677	0.816	0.844	N/A
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution [a]	N	N*	U	L	L	U	U	LQ	N/A
Median (Gilbert 1987, Eq 13.15 & 13.16)	6.65	15350	13.65	904.5	536.5	< 0.0465	4.9	< 600.5	< 0.585
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	10.216776	18025.40838	65.476843	2411.844215	869.812864	0.306687	9.130922	806.46075	0.314242
Std. Dev. - ln transformed data	0.940771	0.46613	0.913811	1.196294	1.021212	1.183191	0.779805	0.72522	0.082593
H value	2.810164	2.102049	2.762445	3.287174	2.955217	3.262331	2.538496	2.453343	1.775
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	20.489537	20116.41329	58.176048	5575.372414	1803.890695	0.265398	12.673168	968.066703	0.314035
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	13.6	23800	225	5930	1910	1.2	13.5	1430	< 0.75
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	20.46543	32014.59086	201.509331	6204.432085	1958.207302	1.053735	19.547021	1832.537179	0.37338
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	77.806626	48076.79296	218.113217	21981.22807	7047.073865	1.048012	43.472762	3165.535173	0.375353
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	13.6	23800	225	5930	1910	1.2	13.5	1430	< 0.75
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Surface Soil Data - MMA (Table 4-13)
Radford Army Ammunition Plant

Statistics	SILVER	SODIUM	THALLIUM	VANADIUM	ZINC
No. of data points	12	12	12	12	12
No. of detects	1	1	4	12	12
Frequency of detects	8.33%	8.33%	33.33%	100.00%	100.00%
Minimum of detects	N/A	N/A	1.3	14.7	10
Maximum of detects	4.3	124	2.1	43.6	216
Minimum of nondetects	< 0.56	< 120	< 1.1	N/A	N/A
Maximum of nondetects	< 1.2	< 752	< 1.2	N/A	N/A
Arithmetic Mean (Gilbert 1987, Eq 4.3)	0.70375	249.125	1	28.283333	55.783333
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	1.138815	105.453593	0.657129	10.247202	56.832239
CV - Normal (Gilbert 1987, Sec 4.4.4)	1.61821	0.423296	0.657129	0.362305	1.018803
Geometric Mean (Gilbert 1987, Eq 13.1)	0.443204	215.204264	0.84338	26.407366	37.831572
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	2.162503	1.923136	1.786744	1.491859	2.50922
Estimated Mean - Lognormal (Eq 13.7)	0.596725	266.511561	0.998093	28.607023	57.761256
Estimated Std. Dev. - Lognormal (Eq 13.8)	0.537968	194.692941	0.631676	11.916898	66.641552
Shapiro-Wilk Coefficient (95%)	0.859	0.859	0.859	0.859	0.859
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	0.409	0.775	0.675	0.908	0.739
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	0.624	0.683	0.693	0.881	0.954
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A
Distribution [a]	U	U	U	N*	L
Median (Gilbert 1987, Eq 13.15 & 13.16)	< 0.63	< 582	< 1.2	30.25	44.95
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	1.294143	303.794986	1.340673	33.595759	85.246698
Std. Dev. - ln transformed data	0.771267	0.653957	0.580395	0.400023	0.919972
H value	2.525176	2.348159	2.245513	2.026027	2.77335
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	1.073495	423.442191	1.478527	36.525636	124.660711
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	4.3	124	2.1	43.6	216
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	3.819549	537.64603	2.797904	56.319678	211.276338
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	3.656332	1287.95945	4.127296	78.894091	468.805239
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	4.3	< 752	2.1	43.6	216
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

[a] Key for distribution type
L = Passed lognormal distribution test.
L* = Passed both normal and lognormal distribution tests, but lognormal distribution was a better fit.
LQ = Lognormal distribution assumed since it was close to passing lognormal distribution test.
N = Passed normal distribution test.
N* = Passed both normal and lognormal distribution tests, but normal distribution was a better fit.
NQ = Normal distribution assumed since it was close to passing normal distribution test.
U = Distribution undefined (nonparametric).

EPA April 1992, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance.
Gilbert 1987, Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York.

Statistical Output for Surface Soil Data - NRU (Table 4-14)
Radford Army Ammunition Plant

Statistics	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM	COBALT	COPPER
No. of data points	16	5	16	16	16	16	16	16	16	16
No. of detects	16	0	16	14	10	0	15	16	13	15
Frequency of detects	100.00%	0.00%	100.00%	87.50%	62.50%	0.00%	93.75%	100.00%	81.25%	93.75%
Minimum of detects	3620	N/A	1.6	23.4	0.61	N/A	238	6.3	5.9	2.9
Maximum of detects	20100	N/A	9.3	109	1.5	N/A	1810	53.3	45.4	11.6
Minimum of nondetects	N/A	< 0.69	N/A	< 23	< 0.57	< 0.55	N/A	N/A	< 5.7	N/A
Maximum of nondetects	N/A	< 0.73	N/A	< 23	< 0.59	< 1.2	< 120	N/A	< 5.9	< 1.1
Arithmetic Mean (Gilbert 1987, Eq 4.3)	8390.625	0.353	3.9375	47.1438	0.656875	0.310313	827.125	23.95	15.5938	5.446875
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	4814.07585	0.009083	2.134127	26.8538	0.369034	0.077706	458.5749	11.986437	12.1467	3.090494
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.573745	0.025731	0.542001	0.56962	0.561803	0.250412	0.55442	0.500478	0.77895	0.567389
Geometric Mean (Gilbert 1987, Eq 13.1)	7348.73738	0.352907	3.496385	39.4811	0.563719	0.304344	662.3478	20.815954	11.3842	4.510109
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	1.674682	1.025956	1.634406	1.92555	1.787156	1.201167	2.279489	1.793945	2.38527	2.055463
Shapiro-Wilk Coefficient (95%)	0.887	N/A	0.887	0.887	0.887	N/A	0.887	0.887	0.887	0.887
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	0.846	N/A	0.862	0.95	0.882	N/A	0.983	0.93	0.891	0.914
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	0.944	N/A	0.971	0.945	0.868	N/A	0.854	0.914	0.945	0.862
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution [a]	L	N/A	L	N*	NQ	N/A	N	N*	L*	N
Median (Gilbert 1987, Eq 13.15 & 13.16)	6505	< 0.7	3.5	43.2	0.63	< 0.58	816.5	25.8	11.6	4.85
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	10500.4552	0.36166	4.872809	58.9128	0.818609	0.344368	1028.101	29.203209	20.9172	6.801324
Std. Dev. - ln transformed data	0.515623	0.025625	0.491279	0.65521	0.580625	0.183293	0.823951	0.584417	0.86931	0.720501
H value	2.067185	2.035	2.041628	2.22626	2.138688	1.790477	2.446011	2.142859	2.51043	2.307062
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	11052.6836	0.362349	5.11094	71.3145	0.919421	0.336868	1564.953	34.118493	29.1823	8.980639
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	20100	< 0.73	9.3	109	1.5	< 1.2	1810	53.3	45.4	11.6
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	20536.5384	0.391239	9.321904	114.896	1.587948	0.506365	1984.109	54.19178	46.2399	13.24419
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	26989.4327	0.393109	12.07609	206.216	2.439319	0.483285	5295.54	90.940316	102.055	27.77527
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	20100	< 0.73	9.3	109	1.5	< 1.2	1810	53.3	45.4	11.6
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Surface Soil Data - NRU (Table 4-14)
Radford Army Ammunition Plant

Statistics	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL	POTASSIUM	SELENIUM
No. of data points	16	16	16	16	16	16	16	16
No. of detects	16	16	16	16	1	10	16	2
Frequency of detects	100.00%	100.00%	100.00%	100.00%	6.25%	62.50%	100.00%	12.50%
Minimum of detects	7470	8.9	259	91.7	N/A	4.6	166	0.64
Maximum of detects	63000	76.7	20400	2040	0.13	18.1	2350	0.77
Minimum of nondetects	N/A	N/A	N/A	N/A	< 0.11	< 4.6	N/A	< 0.56
Maximum of nondetects	N/A	N/A	N/A	N/A	< 0.12	< 4.8	N/A	< 1.2
Arithmetic Mean (Gilbert 1987, Eq 4.3)	24121.875	21.925	2813.5625	756.29375	0.063125	7.1344	700.5625	0.363125
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	13575.04437	15.94363	5292.851695	666.370173	0.01797	5.4015	673.552272	0.15584
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.562769	0.72719	1.881192	0.8811	0.284671	0.7571	0.961445	0.429165
Geometric Mean (Gilbert 1987, Eq 13.1)	20797.58445	18.811404	974.401306	507.905481	0.061616	5.4393	492.368207	0.341034
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	1.787753	1.688044	3.851179	2.609191	1.224806	2.1576	2.294828	1.399994
Shapiro-Wilk Coefficient (95%)	0.887	0.887	0.887	0.887	0.887	0.887	0.887	0.887
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	0.866	0.653	0.544	0.828	0.361	0.832	0.756	0.56
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	0.925	0.92	0.86	0.952	0.409	0.872	0.929	0.579
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution [a]	L	L	LQ	L	U	LQ	L	U
Median (Gilbert 1987, Eq 13.15 & 13.16)	23600	17.55	741	470	< 0.12	5.9	402	< 0.585
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	30071.3114	28.912499	5133.222289	1048.338981	0.071001	9.5017	995.755377	0.431424
Std. Dev. - ln transformed data	0.580959	0.52357	1.348379	0.95904	0.202782	0.769	0.830658	0.336468
H value	2.139055	2.075927	3.28018	2.642561	1.801975	2.3711	2.455534	1.901269
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	33935.40003	28.564391	7577.067463	1547.71312	0.069119	11.706	1177.175597	0.425712
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	63000	76.7	20400	2040	0.13	18.1	2350	0.77
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	58371.71194	62.150778	16167.42733	2437.545696	0.108463	20.762	2399.934881	0.75631
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	90070.9399	70.487181	29254.37259	5709.884893	0.102774	37.858	4003.707793	0.79703
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	63000	76.7	20400	2040	0.13	18.1	2350	0.77
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Surface Soil Data - NRU (Table 4-14)
Radford Army Ammunition Plant

Statistics	SILVER	SODIUM	THALLIUM	VANADIUM	ZINC
No. of data points	16	16	16	16	16
No. of detects	0	0	0	16	16
Frequency of detects	0.00%	0.00%	0.00%	100.00%	100.00%
Minimum of detects	N/A	N/A	N/A	12.2	7.1
Maximum of detects	N/A	N/A	N/A	101	56.3
Minimum of nondetects	< 1.1	< 110	< 1.1	N/A	N/A
Maximum of nondetects	< 2.4	< 120	< 1.2	N/A	N/A
Arithmetic Mean (Gilbert 1987, Eq 4.3)	0.621875	58.4375	0.584375	38.09375	30.28125
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	0.155958	2.393568	0.023936	21.167821	15.782742
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.250787	0.040959	0.040959	0.555677	0.521205
Geometric Mean (Gilbert 1987, Eq 13.1)	0.609757	58.39052	0.583905	33.230172	26.081175
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	1.203385	1.042533	1.042533	1.735026	1.820638
Shapiro-Wilk Coefficient (95%)	N/A	N/A	N/A	0.887	0.887
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	0.845	0.929
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	0.938	0.943
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A
Distribution [a]	N/A	N/A	N/A	L	L*
Median (Gilbert 1987, Eq 13.15 & 13.16)	< 1.2	< 120	< 1.2	38.9	28.2
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	0.690226	59.48651	0.594865	47.370817	37.198238
Std. Dev. - ln transformed data	0.185139	0.041654	0.041654	0.551022	0.599187
H value	1.791529	1.743	1.743	2.106125	2.159106
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	0.67576	59.54705	0.595471	52.191344	43.587059
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	< 2.4	< 120	< 1.2	101	56.3
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	1.015357	64.47647	0.644765	91.500161	70.101109
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	0.972787	64.86092	0.648609	133.444807	118.269107
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	< 2.4	< 120	< 1.2	101	56.3
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

[a] Key for distribution type

L = Passed lognormal distribution test.
L* = Passed both normal and lognormal distribution tests, but lognormal distribution was a better fit.
LQ = Lognormal distribution assumed since it was close to passing lognormal distribution test.
N = Passed normal distribution test.
N* = Passed both normal and lognormal distribution tests, but normal distribution was a better fit.
NQ = Normal distribution assumed since it was close to passing normal distribution test.
U = Distribution undefined (nonparametric).

EPA April 1992, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance.
Gilbert 1987, Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York.

Statistical Output for Subsurface Soil Data - MMA (Table 4-15)
Radford Army Ammunition Plant

Statistics	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM	COBALT
No. of data points	22	16	22	22	22	22	22	22	22
No. of detects	22	0	20	19	11	12	13	22	16
Frequency of detects	100.00%	0.00%	90.91%	86.36%	50.00%	54.55%	59.09%	100.00%	72.73%
Minimum of detects	8710	N/A	1.2	25.2	0.79	0.57	120	10.8	6.8
Maximum of detects	47900	N/A	35.9	155	5.3	2.5	2020	75.8	94.3
Minimum of nondetects	N/A	< 6.7	< 1.1	< 24.5	< 0.55	< 0.55	< 110	N/A	< 5.7
Maximum of nondetects	N/A	< 9	< 1.1	< 27.3	< 0.68	< 0.68	< 682	N/A	< 6.3
Arithmetic Mean (Gilbert 1987, Eq 4.3)	21223.18182	3.778125	7.731818	71.504545	1.007045	0.778182	668.113636	32.263636	18.288636
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	10979.56604	0.286338	8.966134	44.530313	1.163782	0.626277	530.043595	13.777779	24.321311
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.517338	0.075788	1.159641	0.622762	1.15564	0.804795	0.793343	0.427037	1.329859
Geometric Mean (Gilbert 1987, Eq 13.1)	19055.45194	3.768276	4.180506	56.070645	0.654964	0.595292	434.757785	29.593359	10.649957
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	1.585743	1.076906	3.204765	2.187386	2.447319	2.079657	2.962452	1.549133	2.780464
Shapiro-Wilk Coefficient (95%)	0.911	N/A	0.911	0.911	0.911	0.911	0.911	0.911	0.911
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	0.828	N/A	0.747	0.939	0.654	0.788	0.878	0.899	0.584
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	0.955	N/A	0.942	0.922	0.847	0.87	0.882	0.951	0.902
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution [a]	L	N/A	L	N*	U	LQ	LQ	L	LQ
Median (Gilbert 1987, Eq 13.15 & 13.16)	19050	< 7.45	3.45	61.5	0.565	0.595	369.5	33.6	12.6
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	25251.18658	3.903616	11.021168	87.841103	1.433995	1.00794	862.567417	37.318204	27.211244
Std. Dev. - ln transformed data	0.461053	0.074092	1.164639	0.782707	0.894993	0.732203	1.086017	0.437695	1.022618
H value	1.948869	1.743	2.77747	2.273286	2.409367	2.215711	2.666457	1.929598	2.576936
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	25782.9594	3.906754	16.684896	112.303693	1.565006	1.108917	1475.017924	39.159383	31.92794
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	21993.65366	< 9	7.206082	90.624858	1.1	0.984416	981.197889	35.650507	16.308374
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	47025.162	4.500556	28.802233	176.150781	3.741934	2.249932	1913.716085	64.641416	75.443717
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	56307.4886	4.542834	64.543091	352.82584	5.365876	3.326678	5579.922077	82.775614	117.76691
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	25703.6745	< 9	17.846461	116.84295	1.3	1.2	1057.648769	35.398824	63.499852
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Subsurface Soil Data - MMA (Table 4-15)
Radford Army Ammunition Plant

Statistics	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL	POTASSIUM
No. of data points	22	22	22	22	22	22	22	22
No. of detects	22	22	22	20	22	10	22	16
Frequency of detects	100.00%	100.00%	100.00%	90.91%	100.00%	45.45%	100.00%	72.73%
Minimum of detects	3.3	14300	5.6	350	39.4	0.038	4.8	474
Maximum of detects	34.4	67700	256	58100	1760	0.27	94.2	10900
Minimum of nondetects	N/A	N/A	N/A	< 586	N/A	< 0.037	N/A	< 586
Maximum of nondetects	N/A	N/A	N/A	< 629	N/A	< 0.12	N/A	< 682
Arithmetic Mean (Gilbert 1987, Eq 4.3)	16.995455	32595.45455	31.327273	7144.886364	428.254545	0.072909	20.404545	1842.863636
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	10.377286	11474.29746	57.696151	14037.86905	402.188178	0.063056	20.556553	2470.281029
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.610592	0.352021	1.841723	1.964744	0.939133	0.864858	1.00745	1.340458
Geometric Mean (Gilbert 1987, Eq 13.1)	13.237078	30741.55688	16.528432	2095.840498	274.638891	0.054034	14.77697	1029.830014
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	2.211357	1.427979	2.504491	4.719954	2.821435	2.185348	2.189487	2.873051
Shapiro-Wilk Coefficient (95%)	0.911	0.911	0.911	0.911	0.911	0.911	0.911	0.911
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	0.92	0.913	0.439	0.524	0.817	0.791	0.671	0.641
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	0.887	0.949	0.8	0.918	0.954	0.938	0.939	0.927
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution ^{a}	N	L*	U	L	L	L	L	L
Median (Gilbert 1987, Eq 13.15 & 13.16)	18.45	33700	12.4	1896	324	< 0.11	17.4	935.5
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	20.802505	36804.95833	52.493899	12294.87164	575.802808	0.096042	27.946	2749.120197
Std. Dev. - ln transformed data	0.793607	0.35626	0.918086	1.551799	1.037245	0.781775	0.783667	1.055375
H value	2.285711	1.867445	2.438921	3.362689	2.597591	2.272224	2.274381	2.623189
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	26.94412	37873.65352	41.064441	21817.29621	846.702347	0.108077	29.638657	3288.48198
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	23.250507	36257.86696	17.7368	5043.450909	574.987224	0.105685	19.579947	1760.405499
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	41.382078	59560.05357	166.913229	40133.87862	1373.396763	0.221091	68.712446	7648.024054
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	85.455626	71010.46112	142.962606	80373.31362	3143.160179	0.339269	93.194442	12299.07316
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	23.27303	35887.20231	256	58100	691.861609	0.154143	35.683507	2966.468299
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Subsurface Soil Data - MMA (Table 4-15)
Radford Army Ammunition Plant

Statistics	SELENIUM	SILVER	SODIUM	THALLIUM	VANADIUM	ZINC
No. of data points	22	22	22	22	22	22
No. of detects	0	0	1	12	22	22
Frequency of detects	0.00%	0.00%	4.55%	54.55%	100.00%	100.00%
Minimum of detects	N/A	N/A	N/A	1.4	27	14.7
Maximum of detects	N/A	N/A	114	5	114	598
Minimum of nondetects	< 0.55	< 0.56	< 110	< 1.1	N/A	N/A
Maximum of nondetects	< 0.75	< 1.2	< 750	< 1.4	N/A	N/A
Arithmetic Mean (Gilbert 1987, Eq 4.3)	0.306136	0.381136	246.931818	1.759091	61.895455	112.381818
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	0.02454	0.113252	114.886103	1.282449	20.36029	144.230545
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.080161	0.297143	0.465254	0.729041	0.328946	1.283398
Geometric Mean (Gilbert 1987, Eq 13.1)	0.30524	0.367231	203.98776	1.322233	58.588227	66.218853
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	1.080636	1.309796	2.082576	2.220132	1.416857	2.684646
Shapiro-Wilk Coefficient (95%)	N/A	N/A	0.911	0.911	0.911	0.911
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	0.728	0.847	0.973	0.646
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	0.661	0.831	0.97	0.942
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A
Distribution [a]	N/A	N/A	U	U	N*	L
Median (Gilbert 1987, Eq 13.15 & 13.16)	< 0.61	< 0.64	< 610.5	1.6	62.6	66.4
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	0.315139	0.422684	289.079365	2.229575	69.364907	165.294777
Std. Dev. - ln transformed data	0.07755	0.269871	0.733606	0.797567	0.348441	0.987549
H value	1.719	1.809272	2.217311	2.290226	1.861893	2.528876
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	0.315196	0.42367	380.73702	2.707368	71.722931	185.966462
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	< 0.62	< 0.70505	< 623.357866	2.371573	71.238828	79.470296
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	0.363806	0.647279	516.914159	4.772846	109.742136	451.323599
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	0.366259	0.692416	1143.711096	8.615853	132.869915	674.320115
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	< 0.626168	< 1.1	< 604.46351	2.613412	72.49142	573.113852
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

[a] Key for distribution type
L = Passed lognormal distribution test.
L* = Passed both normal and lognormal distribution tests, but lognormal distribution was a better fit.
LQ = Lognormal distribution assumed since it was close to passing lognormal distribution test.
N = Passed normal distribution test.
N* = Passed both normal and lognormal distribution tests, but normal distribution was a better fit.
NQ = Normal distribution assumed since it was close to passing normal distribution test.
U = Distribution undefined (nonparametric).

EPA April 1992, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance.
Gilbert 1987, Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York.

Statistical Output for Subsurface Soil Data - NRU (Table 4-16)
Radford Army Ammunition Plant

Statistics	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM
No. of data points	29	8	29	29	29	29	29	29
No. of detects	29	0	28	20	14	0	27	29
Frequency of detects	100.00%	0.00%	96.55%	68.97%	48.28%	0.00%	93.10%	100.00%
Minimum of detects	6130	N/A	1.2	28.5	0.78	N/A	140	13.6
Maximum of detects	33900	N/A	10.7	164	5.4	N/A	25700	50.9
Minimum of nondetects	N/A	< 0.67	N/A	< 23	< 0.56	< 0.56	< 110	N/A
Maximum of nondetects	N/A	< 0.86	< 1.3	< 26	< 0.66	< 1.3	< 120	N/A
Arithmetic Mean (Gilbert 1987, Eq 4.3)	15285.51724	0.375	3.82931	37.134483	1.047414	0.341724	1645.344828	29.951724
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	7917.836369	0.036742	2.088725	29.3984	1.155535	0.102724	4758.521606	10.753326
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.517996	0.09798	0.545457	0.791674	1.103227	0.300606	2.892112	0.359022
Geometric Mean (Gilbert 1987, Eq 13.1)	13547.24294	0.373463	3.33104	29.491036	0.669237	0.33136	527.010267	27.993483
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	1.642752	1.101141	1.752351	1.995391	2.52235	1.260207	3.441588	1.470975
Shapiro-Wilk Coefficient (95%)	0.926	N/A	0.926	0.926	0.926	N/A	0.926	0.926
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	0.889	N/A	0.887	0.699	0.704	N/A	0.322	0.941
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	0.963	N/A	0.96	0.875	0.823	N/A	0.909	0.928
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution [a]	L	N/A	L	U	U	N/A	LQ	N*
Median (Gilbert 1987, Eq 13.15 & 13.16)	12500	< 0.72	3.4	35.4	< 0.66	< 0.61	527	30
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	17786.69808	0.399611	4.489122	46.421201	1.412438	0.374174	3148.523538	33.348613
Std. Dev. - In transformed data	0.496373	0.096347	0.560958	0.69084	0.925191	0.231276	1.235933	0.385925
H value	1.934649	1.849	1.988538	2.106723	2.357473	1.763034	2.746994	1.854279
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	18372.5404	0.401334	4.813522	49.292047	1.550478	0.367604	2148.658203	34.524843
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	16900.50864	< 0.86	4.028789	41.216175	1.063032	< 0.624292	620.287894	32.015666
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	32977.13082	0.492135	8.496357	102.822267	3.629342	0.571251	12277.78551	53.978955
UTL (95%) - Lognormal (Gilbert 1987, In Eq 11.2)	41070.03453	0.507742	11.666134	138.061525	5.288999	0.555556	8339.750504	66.306205
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	20581.47169	< 0.86	4.819896	43.893356	1.681836	< 1.3	25700	31.163921
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Subsurface Soil Data - NRU (Table 4-16)
Radford Army Ammunition Plant

Statistics	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL
No. of data points	29	29	29	29	29	29	29	29
No. of detects	21	29	29	29	28	29	6	24
Frequency of detects	72.41%	100.00%	100.00%	100.00%	96.55%	100.00%	20.69%	82.76%
Minimum of detects	6.2	1.6	17300	2.1	139	16.7	0.11	4.8
Maximum of detects	130	38.7	44200	35.5	51300	931	0.19	51.1
Minimum of nondetects	< 5.7	N/A	N/A	N/A	N/A	N/A	< 0.11	< 4.6
Maximum of nondetects	< 6.6	N/A	N/A	N/A	< 110	N/A	< 0.14	< 4.8
Arithmetic Mean (Gilbert 1987, Eq 4.3)	21.625862	14.006897	31051.72414	10.948276	8433.241379	299.106897	0.078966	17.963793
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	28.843459	10.039349	8365.858366	6.983021	15696.39136	249.516581	0.038298	14.324186
CV - Normal (Gilbert 1987, Sec 4.4.4)	1.333748	0.716743	0.269417	0.637819	1.861252	0.834205	0.484998	0.797392
Geometric Mean (Gilbert 1987, Eq 13.1)	11.745875	10.055833	29858.67654	9.334419	1771.455892	188.510951	0.072995	12.112919
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	3.002179	2.529153	1.341787	1.774341	6.437357	3.046098	1.444263	2.694612
Shapiro-Wilk Coefficient (95%)	0.926	0.926	0.926	0.926	0.926	0.926	0.926	0.926
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	0.656	0.929	0.944	0.803	0.557	0.902	0.592	0.895
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	0.931	0.923	0.911	0.971	0.956	0.928	0.645	0.918
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution [a]	L	N	N	L	L	L	U	LQ
Median (Gilbert 1987, Eq 13.15 & 13.16)	12	11.8	31600	8.7	1780	245	< 0.12	12.7
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	30.737279	17.178246	33694.43152	13.154156	13391.60519	377.927178	0.091064	22.488688
Std. Dev. - ln transformed data	1.099338	0.927885	0.294002	0.573429	1.862118	1.113861	0.367599	0.991254
H value	2.572153	2.360625	1.795861	1.999014	3.650834	2.590743	1.842489	2.434767
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	36.677135	23.396399	34448.80014	13.663775	36244.88219	604.771686	0.088762	31.239033
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	18.558087	16.68586	34672.22786	11.429298	2868.08747	329.894201	< 0.13	23.431841
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	86.073686	36.438817	49744.39807	26.551139	43505.25824	856.626745	0.164539	49.969754
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	136.983989	79.951341	57592.56759	33.615221	113581.2271	2270.982725	0.165962	110.955656
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	38.216759	21.341453	33542.71279	13.8	45575.70089	472.229081	0.168143	29.6
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Subsurface Soil Data - NRU (Table 4-16)
Radford Army Ammunition Plant

Statistics	POTASSIUM	SELENIUM	SILVER	SODIUM	THALLIUM	VANADIUM	ZINC
No. of data points	29	29	29	29	29	29	29
No. of detects	29	0	0	4	0	29	29
Frequency of detects	100.00%	0.00%	0.00%	13.79%	0.00%	100.00%	100.00%
Minimum of detects	123	N/A	N/A	123	N/A	22	4.7
Maximum of detects	10000	N/A	N/A	151	N/A	77.6	69.8
Minimum of nondetects	N/A	< 0.56	< 1.1	< 110	< 1.1	N/A	N/A
Maximum of nondetects	N/A	< 3.6	< 2.6	< 140	< 1.4	N/A	N/A
Arithmetic Mean (Gilbert 1987, Eq 4.3)	2047.172414	0.577931	0.67931	71.793103	0.613793	47.913793	25.017241
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	2523.407632	0.508804	0.206811	27.555631	0.037551	14.472529	16.065003
CV - Normal (Gilbert 1987, Sec 4.4.4)	1.232631	0.880388	0.304443	0.38382	0.061179	0.302053	0.642157
Geometric Mean (Gilbert 1987, Eq 13.1)	1006.656421	0.447393	0.65825	68.316306	0.612703	45.678828	20.334945
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	3.47593	1.922959	1.263281	1.339623	1.062327	1.380843	1.978438
Shapiro-Wilk Coefficient (95%)	0.926	N/A	N/A	0.926	N/A	0.926	0.926
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	0.733	N/A	N/A	0.539	N/A	0.974	0.9
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	0.95	N/A	N/A	0.592	N/A	0.964	0.969
Shapiro-Francia Coefficient (EPA April 1992, 95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Normal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia calc. - Lognormal (EPA April 1992)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution [a]	L	N/A	N/A	U	N/A	N*	L
Median (Gilbert 1987, Eq 13.15 & 13.16)	705	< 0.62	< 1.2	< 120	< 1.2	47.6	20.7
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	2844.296593	0.738658	0.74464	80.497706	0.625655	52.485549	30.092047
Std. Dev. - ln transformed data	1.245862	0.653865	0.233713	0.292388	0.060462	0.322694	0.682308
H value	2.759704	2.071967	1.76431	1.795017	1.704333	1.8136	2.098702
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	4189.080999	0.715684	0.731298	78.734364	0.625895	53.747663	33.640401
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	1642.929805	< 0.66	< 1.24293	< 130	< 1.2	53.257579	29.571719
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	7685.474426	1.714802	1.14141	133.363406	0.697698	80.251211	60.912885
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	16287.35228	1.928378	1.109642	131.296861	0.701328	93.940585	93.399769
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	5975.964191	< 3.022267	< 2.6	150.822603	< 1.3	54.260429	30.13757
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

[a] Key for distribution type

L = Passed lognormal distribution test.
L* = Passed both normal and lognormal distribution tests, but lognormal distribution was a better fit.
LQ = Lognormal distribution assumed since it was close to passing lognormal distribution test.
N = Passed normal distribution test.
N* = Passed both normal and lognormal distribution tests, but normal distribution was a better fit.
NQ = Normal distribution assumed since it was close to passing normal distribution test.
U = Distribution undefined (nonparametric).

EPA April 1992, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance.
Gilbert 1987, Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York.

Statistical Output for Total Soil Data (Table 4-19)
Radford Army Ammunition Plant

Statistics	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM
No. of data points	79	38	79	79	79	79	79	79
No. of detects	79	0	76	63	40	13	63	79
Frequency of detects	100.00%	0.00%	96.20%	79.75%	50.63%	16.46%	79.75%	100.00%
Minimum of detects	3620	N/A	1.2	23.4	0.61	0.62	116	6.3
Maximum of detects	47900	N/A	35.9	174	5.4	2.5	25700	75.8
Minimum of nondetects	N/A	< 0.67	< 1.1	< 22.3	< 0.55	< 0.55	< 110	N/A
Maximum of nondetects	N/A	< 9	< 1.3	< 27.3	< 0.68	< 1.3	< 682	N/A
Arithmetic Mean (Gilbert 1987, Eq 4.3)	14463.16456	2.584605	4.881646	57.075316	0.880823	0.457468	1153.85443	27.455696
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	9384.746837	1.639861	5.316605	42.574795	0.963357	0.39359	2999.854789	12.416808
CV - Normal (Gilbert 1987, Sec 4.4.4)	0.648872	0.634472	1.089101	0.745941	1.093701	0.860365	2.599856	0.452249
Geometric Mean (Gilbert 1987, Eq 13.1)	12026.28318	1.683757	3.503329	42.574262	0.607301	0.382018	537.820195	24.588777
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	1.842899	3.062475	2.15358	2.243669	2.246871	1.670524	3.010069	1.642207
Shapiro-Wilk Coefficient (95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia Coefficient (EPA April 1992, 95%)	0.97	N/A	0.97	0.97	0.97	0.97	0.97	0.97
Shapiro-Francia calc. - Normal (EPA April 1992)	0.858	N/A	0.594	0.884	0.625	0.482	0.251	0.945
Shapiro-Francia calc. - Lognormal (EPA April 1992)	0.993	N/A	0.949	0.954	0.853	0.628	0.95	0.958
Distribution [a]	L	N/A	LQ	LQ	U	U	LQ	LQ
Median (Gilbert 1987, Eq 13.15 & 13.16)	12200	< 7	3.2	45.5	0.61	< 0.61	534	27
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	16220.78679	3.033407	5.877366	65.048937	1.061245	0.531182	1715.682209	29.781178
Std. Dev. - ln transformed data	0.61134	1.119223	0.767132	0.808112	0.809538	0.513137	1.101963	0.496041
H value	1.916097	2.511284	2.032703	2.065728	2.066946	1.852234	2.338579	1.841607
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	16553.47282	4.999974	5.609831	71.292298	1.018577	0.485287	1321.439026	30.838175
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	14155.26995	< 7.357024	3.7	54.217944	0.79	< 0.613106	715.62108	29.862108
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	32927.65396	6.097187	15.342067	140.841226	2.776227	1.231856	7056.068728	51.885765
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	40041.0536	18.511729	15.848027	208.765379	2.986303	1.048447	4701.499409	65.251616
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	16735.05051	< 7	7.348184	63.494993	1.020004	0.686705	1316.944691	30.167755
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Total Soil Data (Table 4-19)
Radford Army Ammunition Plant

Statistics	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL
No. of data points	79	79	79	79	79	79	79	79
No. of detects	57	77	79	79	73	79	19	63
Frequency of detects	72.15%	97.47%	100.00%	100.00%	92.41%	100.00%	24.05%	79.75%
Minimum of detects	5.9	1.6	7250	2.1	139	16.7	0.038	4.6
Maximum of detects	130	38.7	67700	256	58100	2040	1.2	94.2
Minimum of nondetects	< 5.6	< 1.1	N/A	N/A	< 110	N/A	< 0.037	< 4.4
Maximum of nondetects	< 6.6	< 1.1	N/A	N/A	< 629	N/A	< 0.14	< 4.9
Arithmetic Mean (Gilbert 1987, Eq 4.3)	17.361392	12.165823	27602.65823	22.298734	5886.974684	475.706329	0.082133	14.738608
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	22.618565	9.48822	11872.44069	39.80101	12450.67155	465.451471	0.134716	15.194799
CV - Normal (Gilbert 1987, Sec 4.4.4)	1.302808	0.779908	0.430119	1.7849	2.114952	0.978443	1.640225	1.030952
Geometric Mean (Gilbert 1987, Eq 13.1)	10.310094	8.517466	24778.56435	13.924562	1466.582971	290.131123	0.059459	9.559199
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	2.691948	2.543391	1.650048	2.185771	4.979819	3.014271	1.967036	2.604149
Shapiro-Wilk Coefficient (95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia Coefficient (EPA April 1992, 95%)	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Shapiro-Francia calc. - Normal (EPA April 1992)	0.597	0.9	0.958	0.349	0.479	0.799	0.264	0.733
Shapiro-Francia calc. - Lognormal (EPA April 1992)	0.938	0.961	0.928	0.862	0.956	0.971	0.823	0.965
Distribution [a]	LQ	LQ	NQ	U	LQ	L	U	LQ
Median (Gilbert 1987, Eq 13.15 & 13.16)	11.4	9.1	27200	12.5	1080	359	< 0.12	9.8
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	21.59751	13.942824	29826.18818	29.752866	8218.798597	562.878404	0.107363	17.584365
Std. Dev. - ln transformed data	0.990265	0.933498	0.500805	0.781969	1.605393	1.103358	0.676528	0.957106
H value	2.226883	2.174884	1.844316	2.044483	2.888649	2.339985	1.962641	2.196509
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	21.609354	16.571909	31185.81607	22.655696	8994.950703	714.346691	0.086875	19.174239
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	12.624216	11.731054	31193.16197	13.8	2010	449.037019	< 0.12	13.2
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	61.863419	30.833895	50961.68529	100.607221	30383.67095	1391.482098	0.347187	44.634375
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	72.34673	53.451606	66374.42405	64.856521	34520.27386	2543.229288	0.225056	62.841148
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	21.970172	16.270227	31431.00585	26.836532	10521.42082	587.632964	0.13	18.059425
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

Statistical Output for Total Soil Data (Table 4-19)
Radford Army Ammunition Plant

Statistics	POTASSIUM	SELENIUM	SILVER	SODIUM	THALLIUM	VANADIUM	ZINC
No. of data points	79	79	79	79	79	79	79
No. of detects	67	2	1	6	16	79	79
Frequency of detects	84.81%	2.53%	1.27%	7.59%	20.25%	100.00%	100.00%
Minimum of detects	123	0.64	N/A	114	1.3	12.2	4.7
Maximum of detects	10900	0.77	4.3	151	5	114	598
Minimum of nondetects	< 557	< 0.55	< 0.56	< 110	< 1.1	N/A	N/A
Maximum of nondetects	< 752	< 3.6	< 2.6	< 752	< 1.4	N/A	N/A
Arithmetic Mean (Gilbert 1987, Eq 4.3)	1492.64557	0.416582	0.588354	144.797468	0.985443	46.836709	55.086076
Arithmetic Std. Dev (Gilbert 1987, Eq 4.4)	2110.856762	0.337115	0.473124	116.290819	0.87035	20.513455	87.092276
CV - Normal (Gilbert 1987, Sec 4.4.4)	1.414171	0.80924	0.804148	0.803127	0.883207	0.437978	1.581022
Geometric Mean (Gilbert 1987, Eq 13.1)	771.638011	0.358164	0.518781	106.834421	0.789085	42.235808	32.64939
Geometric Std. Dev. (Gilbert 1987, Eq 13.2)	2.998105	1.579355	1.552728	2.140055	1.7895	1.614126	2.522604
Shapiro-Wilk Coefficient (95%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Wilk calc. - Normal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Wilk calc. - Lognormal (Gilbert 1987, Eq 12.3 & 12.4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shapiro-Francia Coefficient (EPA April 1992, 95%)	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Shapiro-Francia calc. - Normal (EPA April 1992)	0.618	0.417	0.369	0.713	0.539	0.967	0.455
Shapiro-Francia calc. - Lognormal (EPA April 1992)	0.959	0.536	0.778	0.732	0.616	0.969	0.961
Distribution [a]	LQ	U	U	U	U	LQ	LQ
Median (Gilbert 1987, Eq 13.15 & 13.16)	618	< 0.61	< 1.2	< 120	< 1.2	43.6	30.2
UCL (95%) - Normal (Gilbert 1987, Eq 11.6)	1887.97736	0.479719	0.676964	166.576993	1.148447	50.678571	71.397152
Std. Dev. - ln transformed data	1.09798	0.457016	0.440013	0.760831	0.581936	0.478794	0.925292
H value	2.334564	1.819987	1.810567	2.0277	1.896403	1.832052	2.167367
UCL (95%) - Lognormal (Gilbert 1987, Eq 13.13)	1884.717518	0.436855	0.625464	169.931114	1.059079	52.311203	62.864439
UCL (95%) - Nonparametric (Gilbert 1987, Eq 13.22)	891.743451	< 0.61	< 1.2	< 140	< 1.2	48.25527	35.524216
UTL (95%) - Normal (Gilbert 1987, Eq 11.2)	5645.756249	1.079856	1.519227	373.599655	2.697857	87.196932	226.440129
UTL (95%) - Lognormal (Gilbert 1987, ln Eq 11.2)	6692.82915	0.880219	1.233003	477.33384	2.479552	108.342218	201.610485
UTL (95%) - Nonparametric (Gilbert 1987, Eq 11.13,p=am)	2100.661192	1.16766	< 1.2	< 585.372922	2.108904	50.829365	61.930684
Units	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG

[a] Key for distribution type

L = Passed lognormal distribution test.
L* = Passed both normal and lognormal distribution tests, but lognormal distribution was a better fit.
LQ = Lognormal distribution assumed since it was close to passing lognormal distribution test.
N = Passed normal distribution test.
N* = Passed both normal and lognormal distribution tests, but normal distribution was a better fit.
NQ = Normal distribution assumed since it was close to passing normal distribution test.
U = Distribution undefined (nonparametric).

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