RAAP050506\05018

RADFORD ARMY AMMUNITION PLANT, VIRGINIA

NRU Additional Characterization Sampling: Work Instructions

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

Prepared by:
Shaw Environmental, Inc.
2113 Emmorton Park Rd.
Edgewood, MD 21040
Contract No. DACA31-01-F-0085

Final Document

May 2004

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

June 10, 2004

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
New River Unit, Dublin, Va.
Draft revised *NRU Additional Characterization Sampling Work Instructions*
Review of the Army's 5/21/04 response to EPA's 4/21/04 comment letter

Dear Mr. McKenna and Ms. Jake:

The U.S. Environmental Protection Agency (EPA) has reviewed the U.S. Army's (Army's) May 21, 2004 response to EPA's April 21, 2004 letter concerning the Army's draft *NRU Additional Characterization Sampling Work Instructions* for the investigation of the New River Ammunition Storage Depot (NRASD), located in Dublin, Virginia. Based upon that review, EPA finds the Army's response to be acceptable.

Therefore, the Army's May 2004 *NRU Additional Characterization Sampling Work Instructions* can now be considered final. If you have any questions, please feel free to call me at 215-814-3357.

Sincerely,

Robert Thomson, PE
Federal Facilities Branch

cc: Russell Fish, EPA
Leslie Romanchik, VDEQ-RCRA

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

W. Tayloe Murphy, Jr.
Secretary of Natural Resources

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June 3, 2004

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

RE: NRU Additional Characterization Sampling: Work Instructions, Final 2004

Dear Mr. McKenna:

Thank you for providing the Department of Environmental Quality, Office of Remediation Programs, the opportunity to review the responses to staff comments on the referenced document. The responses provided adequately address the staff's comments. We anticipate receiving the final NRU Additional Characterization Sampling in the near future.

If there are questions concerning these comments, please contact me at (804) 698-4192.

Sincerely,

Durwood H. Willis
Federal Facilities Program Manager

cc: Norman Auldridge, VDEQ - WCRO
Robert Thomson, US EPA Region III

ATK
ALLIANT TECHSYSTEMS

Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24143-0100
USA

1.

May 21, 2004

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

Subject: NRU Additional Characterization Sampling: Work Instructions, Final 2004
Radford Army Ammunition Plant
EPA ID# VA1 210020730

Dear Mr. Thomson:

Enclosed is one certified copy of NRU Additional Characterization Sampling: Work Instructions, Final 2004 Radford Army Ammunition Plant for your review and comment or approval. Your additional three copies will be sent under separate cover as well as additional copies to the Virginia Department of Environmental Quality (VDEQ), U.S. Army Environmental Center, U.S. Army Center for Health Promotion and Preventive Medicine. Attached are our responses to your comments dated April 21, 2004 and VDEQ comments dated March 25, 2004.

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, Environmental Manager
Alliant Ammunition and Powder Company LLC

Enclosure

c:

w/o enclosure

Russell Fish, P.E., EPA Region III, 3WC23

w/ enclosure

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04-815-70
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Coordination: J. McKenna

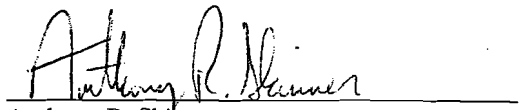
bc: Administrative File
J. McKenna-ACO Staff
Rob Davie-ACO Staff
C. A. Jake
J. J. Redder
Env. File

04-815-70
JMcKenna/JJRedder

Concerning the following:

NRU Additional Characterization Sampling: Work Instructions, Final 2004
April 2004
Radford Army Ammunition Plant

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: 
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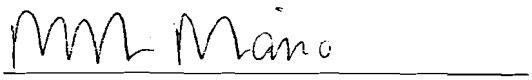
Radford AAP

SIGNATURE: 
PRINTED NAME: Anthony Miano
TITLE: Vice President Operations
Alliant Ammunition and Powder Company, LLC

Response to USEPA Comments dated 21 April 2004
for
Draft NRU Additional Characterization Sampling Work Plan
Dated November 2003

General Comments

EPA Comment 1
Some of the comparisons required by the screening procedure of the Site Screening Process (SSP) for the Radford Army Ammunition Plant (RFAAP [October 26, 2001]) were not conducted. These include the EPA Region 3 soil screening levels (SSLs) and the EPA Region 3 Biological and Technical Assistance Group (BTAG) Ecological Risk Assessment guidelines. Please revise the Work Instructions to compare all the available data to the SSLs and EPA Region 3 BTAG values and revise any conclusion drawn from the current comparisons accordingly. In addition, please clarify if the screening concentrations for non-carcinogens were adjusted to a hazard index (HI) of 0.1, as required, and if not, revise the Work Instructions to use a HI equal to 0.1 for non-carcinogens.

RFAAP Response
This document is not intended to be a complete, stand-alone document. The purpose of the Work Instructions is to provide notice as to additional delineation samples that will be collected as the result of the field investigation for WPA 012 conducted in June 2002. It is appropriate to use industrial, residential RBCs and background concentrations to determine hotspots in need of further delineation. A RI Report will be prepared that will screen data from previous investigations, the WPA 012 field investigation and the currently proposed investigation. The RI report will include a Human Health Risk Assessment (HHRA) and a Screening Level Ecological Risk Assessment (SLERA). At the completion of 2002 WPA 012 activities, data gaps in the extent of contamination at these sites lead to the preparation of these Work Instructions. RFAAP believes that it was inappropriate to complete the risk assessments without the additional delineation included in this document.

RBCs for non-carcinogens have been adjusted to an HI of 0.1. A full explanation of the screening values will be included in the follow up RI report at the conclusion of the proposed sampling.

EPA Comment 2
The Work Instructions figures contain comparisons to "background criteria." However, these background criteria are not listed or properly referenced in the Work Instructions. It is understood that the criteria used are contained in the RFAAP Facility-Wide Background Study Report (December 2001), but, for the benefit of the reviewer and, more importantly, the public, please revise the Work Instructions to include a table listing the site background values.

RFAAP Response
As stated above, the Work Instructions are not intended to be a complete, stand alone document. However, a table and reference to the FWBSR will be added to the report.

EPA Comment 3
The Work Instructions state that x-ray fluorescence (XRF) will be used to screen the soil samples collected in the Northern Burning Ground (NBG) main area and Western Burning Ground (WBG) for lead at a resolution of 20 milligrams per kilogram (mg/kg). The Work Instructions do not provide a reference for (or include) the quality assurance project plan (QAPP) and the Standard Operating Procedures (SOP) for the XRF lead screening. Please provide a reference for (or include) the XRF lead screening QAPP, and SOP within the Work Instructions.

RFAAP Response
An SOP for XRF will be added to the appendix for these Work Instructions. The data is intended to be used solely to guide the placement of confirmation samples. Data from the XRF screening will not be used for risk assessments in the RI Report.

EPA Comment 4
For each area of investigation, the proposed sampling locations do not address all of the areas that previous sampling results indicate detections and in many cases exceedances of various screening criteria. It is not clear how the vertical and horizontal extent of contamination at those areas outside the grid area locations proposed will be determined. Please revise the Work Instructions to discuss how and when the extent of contamination in these areas will be determined.

RFAAP Response
These Work Instructions will supplement the data collected for WPA 012. The sampling strategy is meant to complete delineation of elevated concentrations detected during field sampling in 2002. The issues raised in this comment will be addressed in the RI report.

Specific Comments

EPA Comment 5
Section 1.1.2, Summary of Previous Investigations, page 1-3: The second paragraph in this section states that "volatile organic compounds (VOCs), non-polynuclear aromatic hydrocarbons (PAH), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), herbicides, explosive compounds, and metals are not a concern within the study area." Metals were detected in the pre-RI removal action conducted at the Building Debris Disposal Trench (BDDT) area sampling, and were also detected in the 2002 delta and unnamed creek samples above screening concentrations. Thus, the conclusion as presented cannot be supported at this time. Please revise the Work Instructions to indicate that metals, will be evaluated at the BDDT area at the conclusion of the proposed sampling to determine if there are unacceptable risks associated with the contaminants in site media. Also, clarify if in the statement quoted above "Non-PAH SVOCs" was intended, and not separate listings of PAH and SVOCs. In addition, a cursory review of the Site Characterization Work Plan, Addendum 012 (IT Corp., April 2001), seems to indicate that previous sampling at the BDDT did not include pesticides and herbicides as analytes (pages 1-73 to 1-79). Please clarify if this is correct, and if so, revise the Work Instructions to provide an explanation for the omission of pesticides and herbicides as analytes in samples collected or proposed at the BDDT.

RFAAP Response
Metals will be evaluated in the follow up RI report. Samples collected during the 2002 sampling indicate that metals do not appear to be an issue at the BDDT.

Yes, Non-PAH SVOCs was intended. There should be no comma between "(PAH)" and "semi-volatile". This statement was meant to indicate that the only SVOCs of concern were PAHs.

Sampling for herbicides/pesticides was conducted as part of WPA 012 and results/discussion will occur in the RI report.

EPA Comment 6
Table 1-2 on page 1-8: presents the proposed sampling and analysis at the Building Debris Disposal Trench (BDDT). The table states that surface and subsurface soil samples will be analyzed for polychlorinated biphenyls (PCB). There is no discussion in the accompanying section stating why PCBs are proposed for analysis. This issue should be clarified.

RFAAP Response
RFAAP has specifically requested that samples collected for laboratory analysis as part of this investigation be analyzed for TCL PCBs in addition to the analytes of concern. This will be clarified in the text and discussed in the RI report.

EPA Comment 7
Section 1.1.3.1, Soil Sampling, on page 1-8: states that initially, 12 samples will be collected from the delta where the ditch enters the stream. The section further states that additional samples will be collected where PAH concentrations exceed the adjusted residential risk based concentration. An additional goal of the sampling should be to characterize the area presenting potential ecological risk. The document should clearly state how this characterization will be performed.

RFAAP Response
Proposed sampling is to better delineate areas of concern. A SLERA will be conducted using the combined data from the previous investigations, the WPA 012 investigation and the data to be collected as part of this follow-on investigation to assess the risks to ecological receptors.

EPA Comment 8
Figure 1-3, Building Debris Disposal Trench Surface Water/Sediment and Proposed Sampling Locations: This Figure depicts the 24 proposed grid-sampling locations. Section 1.1.3.1 indicates that an initial 12 samples will be collected, and the remaining samples will be stepped out from the original locations, based upon the results. Please revise Figure 1-3 to differentiate the initial proposed 12 samples from the final 12 sample locations. Also, discuss why no additional sampling outside of the grid area (e.g., the rip rap area) is not proposed, as the results of the previous sampling indicate constituents that are present at concentrations exceeding various screening criteria including background values.

The legend for Figure 1-3 indicates that the values in the shaded cells exceed either the April 2003 EPA Region 3 Residential Risk-Based Concentrations (RBCs) for soil or the 1999 EPA

National Recommended Water Quality Criteria (NRWQC) (chronic) values. Please revise this figure to clearly indicate which values exceed which screening criteria or list these screening values on the figure. Also, it is not clear why the NRWQC values are being used as screening for water samples, since the RFAAP SSP requires use of the tap water RBCs for screening water samples and maximum contaminant levels (MCLs) for groundwater and surface water used as a source of drinking water. If the use of NRWQC is necessary for some reason, please use the most current version of *NRWQC human health criteria matrix calculation* (November 2002) and revise any conclusions drawn from this comparison as appropriate.

RFAAP Response
In response to this comment and similar comments in Comments 11, 13, and 14, only the 12 initial samples will be presented on the figure. Samples have not been proposed for the rip-rap area because this area has been backfilled with clean fill and covered with geotextile membrane and rip-rap. No exposure pathways are present in this area.

RFAAP will use MCLs for screening (NRWQCs will be part of the SLERA).

To insure the clarity of black and white reproduction, the amount of symbols and shading is limited. The sample IDs, the sample symbols and the units indicate which criteria are being used. RFAAP requests that the use of this format be allowed to continue.

Please see RFAAP Response to Comment #20 regarding terminology revisions.

EPA Comment 9
Table 1-4 states that surface and subsurface soil, sediment and fish tissue will be analyzed for PCBs. Information should be provided stating why PCB analysis is being performed, since the data provided indicates low to non-detect PCBs in most upgradient samples. Because PCBs will bioaccumulate in tissue, even when found at low levels in media, PCB analysis in fish tissue should still be performed, even if additional characterization of soil or sediment may not be warranted.

RFAAP Response
RFAAP has specifically requested that samples collected for laboratory analysis as part of this investigation be analyzed for TCL PCBs in additional to the analytes of concern. This will be clarified in the text.

EPA Comment 10
Section 1.2.2, Summary of Previous Investigations, page 1-11: This section states that "VOCs, non-PAH SVOCs, herbicides, explosive compounds, dioxins/furans, and pesticides were detected, but did not exceed residential screening levels; therefore, these compounds are not a concern at the NBG study area." A cursory review of the Site Characterization Work Plan, Addendum 012 (IT Corp., April 2001), seems to indicate that previous sampling at the NBG did not include herbicides as an analyte (pages 1-90 to 1-95). Please clarify if this is correct, and if so, revise the Work Instructions to provide an explanation for the omission of herbicides as an analyte in samples collected or proposed at the NBG.

RFAAP Response

Samples were analyzed for herbicides during the field investigation for WPA 012. A full discussion of results will be presented in the RI report.

EPA Comment 11

Section 1.2.3.1, XRF Screening, page 1-14: This section states that approximately 48 samples will be collected and screened for lead using XRF at the NBG - main area. A review of the historic sampling results for the NBG-main area and the proposed screening locations shown on Figure 1-5 seems to indicate that the depicted sampling locations are the minimum number of samples which will be screened (prior to additional step-out sampling) to determine the NBG-main area extent of lead contamination that is greater than 400 mg/kg in the horizontal plane. It is indicated in the text that initially samples will be collected from 12 locations, but the step-out process is not explained and the locations of these samples are not identified. Please clarify if the screening locations shown on Figure 1-5 are the minimum number of samples to be screened, or revise the Work Instructions to provide a more detailed methodology for the proposed XRF screening process and include a figure containing the minimum number of proposed screening sampling locations. In addition, Figure 1-5 shows 49 anticipated XRF screening locations, instead of 48. Please clarify which is correct and revise the Work Instructions accordingly.

The 49 screening locations depicted on Figure 1-5 cover less than half of the 30 feet (ft) by 42 ft grid area. The area not covered by the screening sampling have not been investigated previously, however, a sample (NBGSD01) located outside of the grid area (north of the Guard Road, near the culvert) indicated constituents exceeding residential RBCs and background values. Please discuss why no samples are proposed between this sampling location and mid-grid location or revise the Work Instructions to propose random sampling locations within the area identified.

RFAAP Response

Forty-eight is the approximate total number of XRF samples anticipated to be collected. As in response to Comment #8, only the initial sample locations will be shown on the figures. The final number of samples required to complete delineation will be determined during the field investigation. SOP 30.7 of the Master Work Plan (MWP) is referenced and discusses grid sampling. The location of step out samples cannot be known until results of the initial samples are processed.

Based on investigations conducted prior to WPA 012, there is no indication that burn activities were conducted in this area. The grid was extended to this area in order to collect samples to verify that burn activities did not occur in this area. Sampling will move from the main burn area in the direction of sample NBGSD01 depending on the results of the XRF screening. The Work Instructions also include two additional samples to be collected from the ditch on the near side of the road to assess this area (Section 1.2.3.3).

EPA Comment 12

Section 1.2.3.2, Soil Sampling, page 1-14: This section states that nine confirmation samples and 12 soil samples from three borings will be collected after the x-ray fluorescence (XRF) screening for lead is completed at the NBG - main area. Table 1-3 indicates that 12 surface soil confirmation samples and 9 soil boring samples will be collected. Even though the total number of samples is constant, Table 1-3 seems to indicate that the surface soil samples collected at the

three boring locations will also serve as confirmation samples. Please clarify if this is correct and revise the Work Instructions accordingly.

RFAAP Response
There are 12 surface soil samples proposed. Nine of these samples are confirmation samples from the XRF survey. There are nine subsurface soil and three surface soil samples proposed from the three soil borings. In order to reduce confusion, the "confirmation" will be removed from Table 1-3 in the surface soil subheading.

EPA Comment 13
Figure 1-5, Northern Burning Ground Main Burning Area Proposed Sampling Locations and Results: This Figure shows the proposed location of seven perimeter confirmation sample locations. Since the confirmation sample locations will be chosen at the conclusion of the XRF screening using the procedure discussed in Section 1.2.3.2, showing proposed locations on Figure 1-5 is inappropriate. Please revise Figure 1-5 to remove the proposed confirmation sampling locations.

The legend for this figure indicates that values in the shaded cells exceed either the industrial soil RBC values or the EPA toxicity characteristics leaching procedure (TCLP) criteria. The TCLP comparison of the data does not add any value to the screening process, especially when its exceedance cannot be discriminated from RBC exceedance. Please revise this figure to remove the TCLP comparison and present this comparison in a separate table.

RFAAP Response
Sample locations will be determined in the field based on results from the XRF survey. The maps are intended to give an approximate idea of the number and location of samples. For clarity, confirmation sample locations will be removed from the figures. All available lead data was presented in order to provide a complete sampling picture. TCLP data was not intended and will not be used for screening or contamination assessments. TCLP screening adds qualitative data that can aid in addressing data needs.

EPA Comment 14
Section 1.3.3.1, XRF Screening, pages 1-21 to 1-24: This section states that approximately 50 samples will be collected and screened for lead using XRF at the WBG. A review of the historic sampling results for the WBG and the proposed screening locations shown on Figure 1-7 seems to indicate that the depicted sampling locations are the minimum number of samples which will be screened (prior to additional step-out sampling) to determine the WBG extent of lead contamination that is greater than 400 mg/kg in the horizontal plane. Please clarify if this is correct, or revise the Work Instructions to provide a more detailed methodology for the proposed XRF screening process and include a figure containing the minimum number of proposed screening sampling locations.

RFAAP Response
Fifty samples is an estimation of the number of samples that will be required to delineate areas of elevated constituents. Samples shown on the Figure 1-7 are intended to present the likely locations where these samples will be collected. However, as previously discussed, only the initial sampling locations will be presented in the figures. XRF results

from the initial samples (closest to identified hotspots) will be used to determine subsequent locations.

EPA Comment 15

Section 1.3.3.1, XRF Screening, on page 1-21 states that surface soil samples for x-ray flourescence (XRF) screening will be collected from a square grid pattern with an 18 foot spacing between grid line intersections. Justification should be provided for this sampling approach. Collecting samples in a grid is acceptable where no preferential flow path is expected. Where preferential flow paths are present, grid sampling can overlook these pathways. If preferential flow paths to the pond and/or depositional areas are present, these areas should be sampled, regardless of where they fall on the grid.

RFAAP Response

The grid is intended to provide a starting point for the locations of samples and is discussed in SOP 30.7 of the MWP. Text will be clarified to indicate that samples will be biased towards drainage pathways (and other indications of contamination, if noted).

EPA Comment 16

Figure 1-7, Western Burning Ground Main Soil Boring and Proposed Sampling Locations: This figure depicts 14 of 15 samples collected along the dirt road (location of cross section A - A') as confirmation samples. Section 1.3.3.1 describes all 15 sample locations as soil borings. Please clarify which is correct and revise the Work Instructions accordingly. In addition, Figure 1-7 depicts 5 samples collected in the unnamed pond as soil borings. Section 1.3.3.1 did not describe any sediment borings to be placed within the unnamed pond. Please address these discrepancies and revise the Work Instructions accordingly. In addition, discuss why no additional sampling outside of the grid area (e.g., along the unlined drainage ditch and the bermed area) are not proposed, as the results of the previous sampling indicate constituents that are present at concentrations exceeding various screening criteria including background values.

RFAAP Response

The symbols for the confirmation sediment samples and the soil borings are switched in the legend. In addition, the fifteenth sample near the unpaved road is also a boring. The figure will be corrected. Data analysis from WPA 12 indicated that no additional sampling was necessary in the bermed area. Additional sampling in the unlined ditch is discussed in comment No. 17.

EPA Comment 17

Figure 1-7 presents the proposed sampling locations for the Western Burning Ground (WBG). The figure shows elevated metals in the unlined drainage ditch northwest of the WBG (Sample WBGSBB25A). Because the goal of this work plan is to characterize migration pathways to the unnamed pond, additional samples in the ditch and pond downgradient of this sample should be collected.

RFAAP Response

Three additional surface soil samples will be collected in the unlined drainage ditch. One sample will be collected upgradient of sample WBGSB25 and the WBG. Two soil samples will be collected between sample WBGSB25 and the unnamed pond. A sediment sample will be collected from the unnamed pond at the confluence of the ditch and the pond. Samples will be analyzed for metals and PAHs.

EPA Comment 18

Section 1.3.3.3, Fish Tissue/Bioaccumulation Study, on page 1-24 states that fish samples (fillets) will be collected from the WBG pond and analyzed to further evaluate the potential for adverse effects to humans from the consumption of fish associated with the pond. A similar statement appears on page 1-25, stating that potential risks from the consumption of fish will be evaluated for child and adult fishers. This is inconsistent with the statement on pages 1-18 and 1-19 that the tissue sampling is being performed to assess aquatic organism health. BTAG recommends that fish tissue be used to assess risk to fish populations using critical body residues and to piscivorous birds and mammals using food chain modeling. Because piscivorous birds and mammals eat whole fish and not fillets, whole body fish should be analyzed.

RFAAP Response

Regulators from the Commonwealth of Virginia have made this comment as well. Whole body fish will also be analyzed.

EPA Comment 19

Section 1.3.3.3, Fish Tissue/Bioaccumulation Study, on page 1-25: states that an analysis consistent with EPA guidance was conducted to assess the sample size required to provide sufficient power to detect the difference between tissue concentrations and screening values. Based on this analysis, 14 water column fish (largemouth bass) and 14 bottom dwelling fish (brown bullhead) should be collected from the pond. The section states that because this quantity is likely to significantly impact the remaining population of fish in the pond, seven of each species will be collected. No information is presented to support that collecting 14 of each species would impact the remaining population. It is unlikely that collecting this many fish from a pond with a healthy fish population would have a significant impact on fish populations in the pond. Therefore, EPA BTAG recommends that 14 fish of each species be collected as determined by EPA guidance.

RFAAP Response

Fourteen fish from each species will be collected, in accordance with EPA guidance.

Minor Comments

EPA Comment 20

The Work Instructions seem to change from single sided pages to double sided pages, although the page numbering does seem to include all pages, even those that are blank and inserted figures (which contain no page numbers). This method of page numbering makes it difficult follow and/or reference the Work Instructions, and leaves the reviewer to believe that pages are missing from the document. In future revisions of the Work Instructions, please maintain a consistent page numbering system with either single or double sided pages.

RFAAP Response

In order to reduce the number of single sided pages within the report, the oversized figures in map pockets will be moved to the rear of the report and called "Exhibits" rather than "Figures". The term "Figures" will be used to refer to 8½" x 11" figures within the body of the report.

Response to VDEQ Comments dated 25 March 2004
for
Draft NRU Additional Characterization Sampling Work Plan
Dated November 2003

VDEQ Comment 1
Page 1-8 & Figure 1-3: as illustrated in Figure 1-3, there is a distance of approximately 90 feet of the BDDT that will not be sampled. The last sample collected from the trench, DTSB45, recorded a benzo(a) pyrene level of 1300 ug/kg, which exceeds the industrial screening level. It would be beneficial to collect a sample in the 90 foot stretch of trench that has not been investigated. Rather than collected a sample from the outlying area, please add one surface soil sample between DTSB45 and the first proposed sample collection point.

RFAAP Response
Samples will be collected in the 90 foot stretch of trench that has not been investigated. The final number of samples will be determined by the results of initial samples. Figure 1-3 has been revised to show the sampling grid extending to the last soil sample collected in the trench (DTSB45). The figure has also been revised to present the locations of only the 12 initial samples. The text has been revised to clarify that samples will be collected in the trench area as guided by initial sample results.

VDEQ Comment 2
Section 1.1.3, page 1-18: this section state that "the results of previous investigation are shown on Figure1-6." However, WPA 12 Figure 1.13-1 indicates that surface water and sediment samples were to be collected in and around the unnamed creek and Wiggins Spring: WBGSW08, WBGSD08, WBGSW09, WBGSD09, WBGSW13, WBGSD13 & 14 respectively. If these samples did not have any detections, please reference this in the report. If there were detections, please illustrate them in Figure 1-6. Furthermore, please illustrate the area from which the perchlorate sample was collected.

RFAAP Response
An additional exhibit (Exhibit 7) has been added to the Work Instructions showing exceedances at the requested sample locations and proposed surface water sampling locations to confirm the perchlorate detection at sample location WBGSW14.

VDEQ Comment 3
Section 1.1.3, page 1-18: this section states that samples will be collected to identify any ecological adverse effects on organisms inhabiting the unnamed pond and assess aquatic organism health. Section 1.3.3.3 states that fish fillets will be used for a bioaccumulation study. Although using fillets can be applied to adverse effects through human consumption, in order to assess aquatic organism health whole fish samples must be used.

RFAAP Response
The text has been revised to include whole fish analysis as well as fish fillets.

Rec'd ENV 4-27-04

c: Jake
Reder
McKenna
ENV file

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

04-44

April 21, 2004

In reply
Refer to 3HS13

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

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C.A. Jake
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Re: Radford Army Ammunition Plant
New River Ammunition Storage Depot, Dublin, Va.
Review of Army draft *NRU Additional Characterization Sampling Work Plan*

Dear Mr. McKenna and Ms. Jake:

The U.S. Environmental Protection Agency (EPA) has reviewed the Army's November, 2003 draft *NRU Additional Characterization Sampling Work Instructions* Plan for the investigation of New River Ammunition Storage Depot (NRASD). Outlined below, please find EPA's comments based upon that review:

GENERAL COMMENTS

1. Some of the comparisons required by the screening procedure of the *Site Screening Process* (SSP) for the Radford Army Ammunition Plant (RFAAP [October 26, 2001]) were not conducted. These include the EPA Region 3 soil screening levels (SSLs) and the EPA Region 3 Biological and Technical

Assistance Group (BTAG) Ecological Risk Assessment guidelines. Please revise the Work Instructions to compare all the available data to the SSLs and EPA Region 3 BTAG values and revise any conclusion drawn from the current comparisons accordingly. In addition, please clarify if the screening concentrations for non-carcinogens were adjusted to a hazard index (HI) of 0.1, as required, and if not, revise the Work Instructions to use a HI equal to 0.1 for non-carcinogens.

2. The Work Instructions figures contain comparisons to "background criteria." However, these background criteria are not listed or properly referenced in the Work Instructions. It is understood that the criteria used are contained in the RFAAP *Facility-Wide Background Study Report (December 2001)*, but, for the benefit of the reviewer and, more importantly, the public, please revise the Work Instructions to include a table listing the site background values.

3. The Work Instructions state that x-ray fluorescence (XRF) will be used to screen the soil samples collected in the Northern Burning Ground (NBG) main area and Western burning Ground (WBG) for lead at a resolution of 20 milligrams per kilogram (mg/kg). The Work Instructions do not provide a reference for (or include) the quality assurance project plan (QAPP) and the Standard Operating Procedures (SOP) for the XRF lead screening. Please provide a reference for (or include) the XRF lead screening QAPP, and SOP within the Work Instructions.

4. For each area of investigation, the proposed sampling locations do not address all of the areas that previous sampling results indicate detections and in many cases exceedances of various screening criteria. It is not clear how the vertical and horizontal extent of contamination at those areas outside the grid area locations proposed will be determined. Please revise the Work Instructions to discuss how and when the extent of contamination in these areas will be determined.

SPECIFIC COMMENTS

5. **Section 1.1.2, Summary of Previous Investigations, page 1-3:** The second paragraph in this section states that "volatile organic compounds (VOCs), non-polynuclear aromatic hydrocarbons (PAH), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), herbicides, explosive compounds, and metals are not a concern within the study area." Metals were detected in the pre-RI removal action conducted at the Building Debris Disposal Trench (BDDT) area sampling, and were also detected in the 2002 delta and unnamed creek samples above screening concentrations. Thus, the conclusion as presented cannot be supported at this time. Please revise the Work Instructions to indicate that metals, will be evaluated at the BDDT area at the conclusion of the proposed sampling to determine if there are unacceptable risks associated with the contaminants in site media. Also, clarify if in the statement quoted above "Non-PAH SVOCs" was intended, and not separate listings of PAH and SVOCs. In addition, a cursory review of the Site Characterization Work

Plan, Addendum 012 (IT Corp., April 2001), seems to indicate that previous sampling at the BDDT did not include pesticides and herbicides as analytes (pages 1-73 to 1-79). Please clarify if this is correct, and if so, revise the Work Instructions to provide an explanation for the omission of pesticides and herbicides as analytes in samples collected or proposed at the BDDT.

6. **Table 1-2 on page 1-8** presents the proposed sampling and analysis at the Building Debris Disposal Trench (BDDT). The table states that surface and subsurface soil samples will be analyzed for polychlorinated biphenyls (PCB). There is no discussion in the accompanying section stating why PCBs are proposed for analysis. This issue should be clarified.

7. **Section 1.1.3.1, Soil Sampling, on page 1-8** states that initially, 12 samples will be collected from the delta where the ditch enters the stream. The section further states that additional samples will be collected where PAH concentrations exceed the adjusted residential risk based concentration. An additional goal of the sampling should be to characterize the area presenting potential ecological risk. The document should clearly state how this characterization will be performed.

8. **Figure 1-3, Building Debris Disposal Trench Surface Water/Sediment and Proposed Sampling Locations**: This Figure depicts the 24 proposed grid-sampling locations. Section 1.1.3.1 indicates that an initial 12 samples will be collected, and the remaining samples will be stepped out from the original locations, based upon the results. Please revise Figure 1-3 to differentiate the initial proposed 12 samples from the final 12 sample locations. Also, discuss why no additional sampling outside of the grid area (e.g., the rip rap area) is not proposed, as the results of the previous sampling indicate constituents that are present at concentrations exceeding various screening criteria including background values.

   The legend for Figure 1-3 indicates that the values in the shaded cells exceed either the April 2003 EPA Region 3 Residential Risk-Based Concentrations (RBCs) for soil or the 1999 EPA National Recommended Water Quality Criteria (NRWQC) (chronic) values. Please revise this figure to clearly indicate which values exceed which screening criteria or list these screening values on the figure. Also, it is not clear why the NRWQC values are being used as screening for water samples, since the RFAAP SSP requires use of the tap water RBCs for screening water samples and maximum contaminant levels (MCLs) for groundwater and surface water used as a source of drinking water. If the use of NRWQC is necessary for some reason, please use the most current version of *NRWQC human health criteria matrix calculation* (November 2002) and revise any conclusions drawn from this comparison as appropriate.

9. **Table 1-4** states that surface and subsurface soil, sediment and fish tissue will be analyzed for PCBs. Information should be provided stating why PCB analysis is being performed, since the data provided indicates low to non-detect PCBs in most upgradient samples. Because PCBs will bioaccumulate in tissue, even when found at low levels in media, PCB analysis in fish tissue should still be

performed, even if additional characterization of soil or sediment may not be warranted.

10. **Section 1.2.2, Summary of Previous Investigations, page 1-11:** This section states that "VOCs, non-PAH SVOCs, herbicides, explosive compounds, dioxins/furans, and pesticides were detected, but did not exceed residential screening levels; therefore, these compounds are not a concern at the NBG study area." A cursory review of the Site Characterization Work Plan, Addendum 012 (IT Corp., April 2001), seems to indicate that previous sampling at the NBG did not include herbicides as an analyte (pages 1-90 to 1-95). Please clarify if this is correct, and if so, revise the Work Instructions to provide an explanation for the omission of herbicides as an analyte in samples collected or proposed at the NBG.

11. **Section 1.2.3.1, XRF Screening, page 1-14:** This section states that approximately 48 samples will be collected and screened for lead using XRF at the NBG - main area. A review of the historic sampling results for the NBG-main area and the proposed screening locations shown on Figure 1-5 seems to indicate that the depicted sampling locations are the minimum number of samples which will be screened (prior to additional step-out sampling) to determine the NBG-main area extent of lead contamination that is greater than 400 mg/kg in the horizontal plane. It is indicated in the text that initially samples will be collected from 12 locations, but the step-out process is not explained and the locations of these samples are not identified. Please clarify if the screening locations shown on Figure 1-5 are the minimum number of samples to be screened, or revise the Work Instructions to provide a more detailed methodology for the proposed XRF screening process and include a figure containing the minimum number of proposed screening sampling locations. In addition, Figure 1-5 shows 49 anticipated XRF screening locations, instead of 48. Please clarify which is correct and revise the Work Instructions accordingly.

    The 49 screening locations depicted on Figure 1-5 cover less than half of the 30 feet (ft) by 42 ft grid area. The area not covered by the screening sampling have not been investigated previously, however, a sample (NBGSD01) located outside of the grid area (north of the Guard Road, near the culvert) indicated constituents exceeding residential RBCs and background values. Please discuss why no samples are proposed between this sampling location and mid-grid location or revise the Work Instructions to propose random sampling locations within the area identified.

12. **Section 1.2.3.2, Soil Sampling, page 1-14:** This section states that nine confirmation samples and 12 soil samples from three borings will be collected after the x-ray fluorescence (XRF) screening for lead is completed at the NBG - main area. Table 1-3 indicates that 12 surface soil confirmation samples and 9 soil boring samples will be collected. Even though the total number of samples is constant, Table 1-3 seems to indicate that the surface soil samples collected at the three boring locations will also serve as confirmation samples. Please clarify if this is correct and revise the Work Instructions accordingly.

13. **Figure 1-5, Northern Burning Ground Main Burning Area Proposed Sampling Locations and Results:** This Figure shows the proposed location of seven perimeter confirmation sample locations. Since the confirmation sample locations will be chosen at the conclusion of the XRF screening using the procedure discussed in Section 1.2.3.2, showing proposed locations on Figure 1-5 is inappropriate. Please revise Figure 1-5 to remove the proposed confirmation sampling locations.

    The legend for this figure indicates that values in the shaded cells exceed either the industrial soil RBC values or the EPA toxicity characteristics leaching procedure (TCLP) criteria. The TCLP comparison of the data does not add any value to the screening process, especially when its exceedance cannot be discriminated from RBC exceedance. Please revise this figure to remove the TCLP comparison and present this comparison in a separate table.

14. **Section 1.3.3.1, XRF Screening, pages 1-21 to 1-24:** This section states that approximately 50 samples will be collected and screened for lead using XRF at the WBG. A review of the historic sampling results for the WBG and the proposed screening locations shown on Figure 1-7 seems to indicate that the depicted sampling locations are the minimum number of samples which will be screened (prior to additional step-out sampling) to determine the WBG extent of lead contamination that is greater than 400 mg/kg in the horizontal plane. Please clarify if this is correct, or revise the Work Instructions to provide a more detailed methodology for the proposed XRF screening process and include a figure containing the minimum number of proposed screening sampling locations.

15. **Section 1.3.3.1, XRF Screening, on page 1-21** states that surface soil samples for x-ray flourescence (XRF) screening will be collected from a square grid pattern with an 18 foot spacing between grid line intersections. Justification should be provided for this sampling approach. Collecting samples in a grid is acceptable where no preferential flow path is expected. Where preferential flow paths are present, grid sampling can overlook these pathways. If preferential flow paths to the pond and/or depositional areas are present, these areas should be sampled, regardless of where they fall on the grid.

16. **Figure 1-7, Western Burning Ground Main Soil Boring and Proposed Sampling Locations:** This figure depicts 14 of 15 samples collected along the dirt road (location of cross section A - A') as confirmation samples. Section 1.3.3.1 describes all 15 sample locations as soil borings. Please clarify which is correct and revise the Work Instructions accordingly. In addition, Figure 1-7 depicts 5 samples collected in the unnamed pond as soil borings. Section 1.3.3.1 did not describe any sediment borings to be placed within the unnamed pond. Please address these discrepancies and revise the Work Instructions accordingly. In addition, discuss why no additional sampling outside of the grid area (e.g., along the unlined drainage ditch and the bermed area) are not proposed, as the results of the previous sampling indicate constituents that are

present at concentrations exceeding various screening criteria including background values.

17. **Figure 1-7** presents the proposed sampling locations for the Western Burning Ground (WBG). The figure shows elevated metals in the unlined drainage ditch northwest of the WBG (Sample WBGSBB25A). Because the goal of this work plan is to characterize migration pathways to the unnamed pond, additional samples in the ditch and pond downgradient of this sample should be collected.

18. **Section 1.3.3.3, Fish Tissue/Bioaccumulation Study, on page 1-24** states that fish samples (fillets) will be collected from the WBG pond and analyzed to further evaluate the potential for adverse effects to humans from the consumption of fish associated with the pond. A similar statement appears on page 1-25, stating that potential risks from the consumption of fish will be evaluated for child and adult fishers. This is inconsistent with the statement on pages 1-18 and 1-19 that the tissue sampling is being performed to assess aquatic organism health. BTAG recommends that fish tissue be used to assess risk to fish populations using critical body residues and to piscivorous birds and mammals using food chain modeling. Because piscivorous birds and mammals eat whole fish and not fillets, whole body fish should be analyzed.

19. **Section 1.3.3.3, Fish Tissue/Bioaccumulation Study, on page 1-25** states that an analysis consistent with EPA guidance was conducted to assess the sample size required to provide sufficient power to detect the difference between tissue concentrations and screening values. Based on this analysis, 14 water column fish (largemouth bass) and 14 bottom dwelling fish (brown bullhead) should be collected from the pond. The section states that because this quantity is likely to significantly impact the remaining population of fish in the pond, seven of each species will be collected. No information is presented to support that collecting 14 of each species would impact the remaining population. It is unlikely that collecting this many fish from a pond with a healthy fish population would have a significant impact on fish populations in the pond. Therefore, EPA BTAG recommends that 14 fish of each species be collected as determined by EPA guidance.

MINOR COMMENTS, WORK INSTRUCTIONS

20. The Work Instructions seem to change from single sided pages to double sided pages, although the page numbering does seem to include all pages, even those that are blank and inserted figures (which contain no page numbers). This method of page numbering makes it difficult follow and/or reference the Work Instructions, and leaves the reviewer to believe that pages are missing from the document. In future revisions of the Work Instructions, please maintain a consistent page numbering system with either single or double sided pages.

This concludes EPA's review of the Army's November, 2003 draft *NRU Additional Characterization Sampling Work Instructions* Plan for the investigation of the NRASD. If you have any questions, please call me at 215-814-3357.

Sincerely,

Robert Thomson

Robert Thomson, PE
Federal Facilities Branch

cc: Mark Leeper, VDEQ-CERCLA

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

DIVISION OF WASTE PROGRAM COORDINATION
OFFICE OF REMEDIATION PROGRAMS

MEMORANDUM

TO: Jim McKenna

FROM: Mark Leeper

DATE: 25 March 2004

SUBJECT: DRAFT Comments for NRU Additional Characterization Sampling Work Instructions

This office has reviewed the previously mentioned document and offers the following comments:

1. Page 1-8 & Figure 1-3 - as illustrated in Figure 1-3, there is a distance of approximately 90 feet of the BDDT that will not be sampled. The last sample collected from the trench, DTSB45, recorded a benzo(a) pyrene level of 1300 ug/kg, which exceeds the industrial screening level. It would be beneficial to collect a sample in the 90 foot stretch of trench that has not been investigated. Rather than collected a sample from the outlying area, please add one surface soil sample between DTSB45 and the first proposed sample collection point.

2. Section 1.1.3, page 1-18 – this section state that "the results of previous investigation are shown on Figure1-6." However, WPA 12 Figure 1.13-1 indicates that surface water and sediment samples were to be collected in and around the unnamed creek and Wiggins Spring: WBGSW08,WBGSD08, WBGSW09, WBGSD09, WBGSW13, WBGSD13 & 14 respectively. If these samples did not have any detections, please reference this in the report. If there were detections, please illustrate them in Figure 1-6. Furthermore, please illustrate the area from which the perchlorate sample was collected.

3. Section 1.1.3, page 1-18 – this section states that samples will be collected to identify any ecological adverse effects on organisms inhabiting the unnamed pond and assess aquatic organism health. Section 1.3.3.3 states that fish fillets will be used for a bioaccumulation study. Although using fillets can be applied to adverse effects through human consumption, in order to assess aquatic organism health whole fish samples must be used.

ATK
ALLIANT TECHSYSTEMS

Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24143-0100
USA

January 27, 2004

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

Subject: NRU Additional Characterization Sampling: Work Instructions
Draft Document, November 2003
Radford Army Ammunition Plant
EPA ID# VA1 210020730

Dear Mr. Thomson:

Enclosed is one certified copy of NRU Additional Characterization Sampling: Work Instructions Draft Document, November 2003 Radford Army Ammunition Plant (RFAAP) for your review and comment or approval.

The data gap analysis (i.e. basis for these instructions) was discussed with you during your September 25, 2003 site visit to the New River Unit (NRU). As agreed during this meeting, this work is to be accomplished in accordance with the procedures in Work Plan Addendum 12 that were used for performing the original NRU sampling work. Therefore the subject work instructions are in lieu of preparing and submitting a new work plan addendum.

Per your recommendation RFAAP attempted to contact Biological Toxicity Assessment Group (BTAG) informally and sent Sections 1.1 and 1.3 of these instructions to the BTAG on December 22, 2003 to get their feedback prior to a formal submittal. Since that time RFAAP attempted several more times to discuss these instructions with the BTAG. First contact with the BTAG was made on January 12, 2004 and the BTAG indicated they were going to follow a formal route of 30-day review and issue comments. Therefore we are formally submitting the subject work instructions for action by the EPA and Virginia Department of Environmental Quality (VDEQ). Note the data gap analysis was discussed with Mr. Mark Leeper, VDEQ on November 6, 2003 during a separate NRU site visit.

Your additional three copies will be sent under separate cover as well as additional copies to the VDEQ, U.S. Army Environmental Center, U.S. Army Center for Health Promotion and Preventive Medicine. 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

w/o enclosure

c: Russell Fish, P.E., EPA Region III

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bc: Administrative File
J. McKenna, ACO Staff
Rob Davie-ACO Staff
C. A. Jake
J. J. Redder
Env. File

04-815-11
JMcKenna/JJRedder

Concerning the following:

NRU Additional Characterization Sampling: Work Instructions
Draft Document, November 2003
Radford Army Ammunition Plant

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: Anthony R. Skinner
PRINTED NAME: Anthony R. Skinner
TITLE: LTC, CM, Commanding
Radford AAP

SIGNATURE: Anthony Miano
PRINTED NAME: Anthony Miano
TITLE: Vice President Operations
Alliant Ammunition and Powder Company, LLC

04-815-11
JMcKenna/JJRedder

RADFORD ARMY AMMUNITION PLANT, VIRGINIA

NRU Additional Characterization Sampling: Work Instructions

Prepared for:
USACE, Baltimore District
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Prepared by:
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Contract No. DACA31-01-F-0085

Final Document

May 2004

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LIST OF ACRONYMS AND ABBREVIATIONS

BDDT ..... Building Debris Disposal Trench
CFR ..... Code of Federal Regulations
ft bgs ..... feet below ground surface
ft msl ..... feet above mean sea level
FS ..... Feasibility Study
FWBSR ..... Facility-Wide Background Study Report
GPS ..... Global Positioning System
HHRA ..... Human Health Risk Assessment
IDM ..... Investigative-derived Materials
MCL ..... Maximum Contaminant Level
MHSP ..... Master Health and Safety Plan
MMA ..... Main Manufacturing Area
MQAP ..... Master Quality Assurance Plan
MWP ..... Master Work Plan
NBG ..... Northern Burning Ground
NRU ..... New River Unit
PAH ..... Polynuclear Aromatic Hydrocarbon
PCB ..... Polychlorinated Biphenyl
RBC ..... Risk Based Concentration
RFAAP ..... Radford Army Ammunition Plant
SLERA ..... Screening Level Ecological Risk Assessment
SSL ..... Soil Screening Level
SVOC ..... Semivolatile Organic Compound
TAL ..... Target Analyte List
TCL ..... Target Compound List
USACE ..... U.S. Army Corps of Engineers
USEPA ..... U.S. Environmental Protection Agency
VDEQ ..... Virginia Department of Environmental Quality
VOC ..... Volatile Organic Compound
WBG ..... Western Burning Ground
XRF ..... X-ray Fluorescence

EXECUTIVE SUMMARY

Shaw Environmental, Inc. (Shaw) was tasked by the U.S. Army Corps of Engineers (USACE), Baltimore District, to perform characterization activities at the New River Unit (NRU), in accordance with Contract No. DACA31-94-D-0064, Delivery Order 0013. The additional characterization activities were documented in Work Plan Addendum (WPA) 012 (IT, 2002) to Radford Army Ammunition Plant's (RFAAP) Master Work Plan (MWP) (URS, 2003). Field investigation and sample collection occurred during June and July 2002.

During the analysis of chemical data generated from WPA 012, additional data gaps were identified at three sites at the NRU. The three sites requiring additional delineation sampling are the Building Debris Disposal Trench (BDDT), the Northern Burning Ground (NBG), and the Western Burning Ground (WBG).

Additional sampling for polyaromatic hydrocarbons (PAHs) is required at the BDDT to delineate the extent of PAHs in the "delta" area where the BDDT meets an unnamed creek that flows through the NRU.

The extent of lead-containing soil was not fully bound at the NBG during the WPA 012 investigation. The site will be characterized with a field x-ray fluorescence (XRF) unit capable of detecting lead in soil to 20 mg/kg. Confirmation samples will be collected and submitted to a laboratory for target analyte list (TAL) metals analysis once the extent of lead has been bound using the XRF. Two sediment samples will also be collected from the ditch along the road north of the NBG and analyzed for TAL metals.

Elevated concentrations of lead were detected in near shore sediment in the unnamed pond downslope from the WBG. XRF analysis for lead will be performed on sediment samples to delineate the extent of lead-impacted sediment in the pond. A fish tissue study to assess bioaccumulation of WBG constituents in the unnamed pond will also be conducted. XRF analysis will be performed on soil samples from the slope and drainage swale leading from the former burning area to the unnamed pond and from the dirt road to identify potential migration pathways to the pond. Surface and subsurface soil samples will be collected from the dirt road and from both sides of the road and will be analyzed for lead to define the extent of an ash/soil layer identified during previous investigations.

Additionally, perchlorate was detected in surface water from the unnamed creek where it first enters the NRU. Although not directly associated with the WBG, two surface water samples will be collected along the first 100 feet of the creek where it enters the NRU to confirm the detection of perchlorate in surface water.

These work instructions are intended to be used in conjunction with WPA 012 and the MWP and do not duplicate information that is contained within those documents. Investigative activities will be conducted in accordance with the MWP, the Master Quality Assurance Plan (MQAP), Master Health and Safety Plan (MHSP) (URS, 2003), and WPA 012.

1.0 WORK INSTRUCTIONS

These Work Instructions are intended to guide the collection of supplemental data at three sites in the New River Unit (NRU) under Work Plan Addendum 012 (WPA) (IT, 2002). One of the objectives of WPA 012 was to sufficiently characterize the sites at the NRU to conduct a Feasibility Study (FS) for potential remedial alternatives, if appropriate. An analysis of the data collected during the field investigation for WPA 012 indicated that additional sampling and analysis would be required to fulfill this objective. Analysis of the data included a comparison to adjusted USEPA Region III soil risk based concentrations (RBCs) for soil and sediment, facility-wide background values (IT, 2001) for soil and sediment inorganic concentrations, and maximum contaminant levels (MCLs) for surface water samples. The facility-wide point estimates for background soil are presented in **Table 1-1**.

Table 1-1
Facility-Wide Point Estimates for Background Soil

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

These Work Instructions are intended to fill these additional data gaps so that the objectives of WPA 012 can be met. The three sites are the Building Debris Disposal Trench (BDDT), the Northern Burning Ground (NBG), and the Western Burning Ground (WBG).

Sampling will be conducted in accordance with RFAAP's Master Work Plan (MWP) (URS, 2003) and WPA 012. **Table 1-2** provides cross references between the applicable sections in the MWP, WPA 012, and the SOPs that will be used to complete these Work Instructions.

Table 1-2
Work Elements Referenced in the Master Work Plan and Addendum 012

Introduction	2.0	1.1	NA
Installation Setting and Site Descriptions	2.0	1.10.1 (BDDT) 1.12.1 (NBG) 1.13.1 (WBG)	NA
Summaries of Previous Investigations	NA	1.10.2 (BDDT) 1.12.2 (NBG) 1.13.2 (WBG)	NA
Soil Sampling/XRF Screening			
Field Logbooks	NA		10.1
Sample Logbooks	NA		10.2
Chain-of Custody	NA		10.4
Surface Soil Sampling	5.2		30.1
Subsurface Soil Sampling	5.2		30.1
Lead Check Soil Screening Kit	5.2		30.11
Screening for Metals via XRF Spectrometry	NA	App. A, SOP 30.13*	NA
Sample Labels	5.1		50.1
Sample Packaging	5.1		50.2
Investigative Derived Material	5.13		70.1
Decontamination	5.12		80.1
Sediment Sampling		NA	
Field Logbooks	NA		10.1
Sample Logbooks	NA		10.2
Chain-of Custody	NA		10.4
Sediment Sampling	5.4		30.4
Benthic Macroinvertebrate Sampling	5.4		30.5
Sample Labels	5.1		50.1
Sample Packaging	5.1		50.2
Investigative Derived Material	5.13		70.1
Decontamination	5.12		80.1
Surface Water Sampling		NA	
Field Logbooks	NA		10.1
Sample Logbooks	NA		10.2
Chain-of Custody	NA		10.4
Surface Water Sampling	5.3		30.3
Sample Labels	5.1		50.1
Sample Packaging	5.1		50.2
Bioaccumulation Tests	NA	NA	NA

* SOP 30.13 is included in the back of these Work Instructions

Quality Assurance/Quality Control

Quality Assurance/Quality Control procedures will follow those specified in the Master Quality Assurance Plan (URS, 2003) and in *Section 2.0 – Quality Assurance Plan Addendum* of WPA 012.

Health and Safety

Health and Safety procedures, including monitoring and personal protection levels, will follow those specified in the Master Health and Safety Plan (URS, 2003) and in *Section 3.0 – Health and Safety Plan Addendum* of WPA 012.

1.1 BUILDING DEBRIS DISPOSAL TRENCH

1.1.1 Site Description and History

The BDDT is located in the southern portion of the NRU (**Figure 1-1**). The trench was formerly an ephemeral unlined natural drainage channel that had eroded into the clay surficial soil. The trench has been incorporated into the storm water drainage system at the NRU. A culvert diverts storm water runoff underneath A Avenue into the trench. The trench then channels surface water runoff down the length of the ditch to the unnamed creek at the base of the BDDT. There is a delta of sediment eroded from the ditch at the base of the ditch where it meets the unnamed creek. **Exhibit 1** presents the salient features at the site. "Exhibits" are located at the end of this document. The natural depression formed by the trench was previously utilized for the disposal of miscellaneous building debris derived from the demolition of various NRU structures. Building debris consisted of concrete, wood, and rusted and deteriorated 5 gallon containers of a tarry substance believed to be roofing tar. The debris has been removed and the trench is now lined with a geotextile membrane and covered with rip-rap, preventing further deposition of trench sediment in the delta.

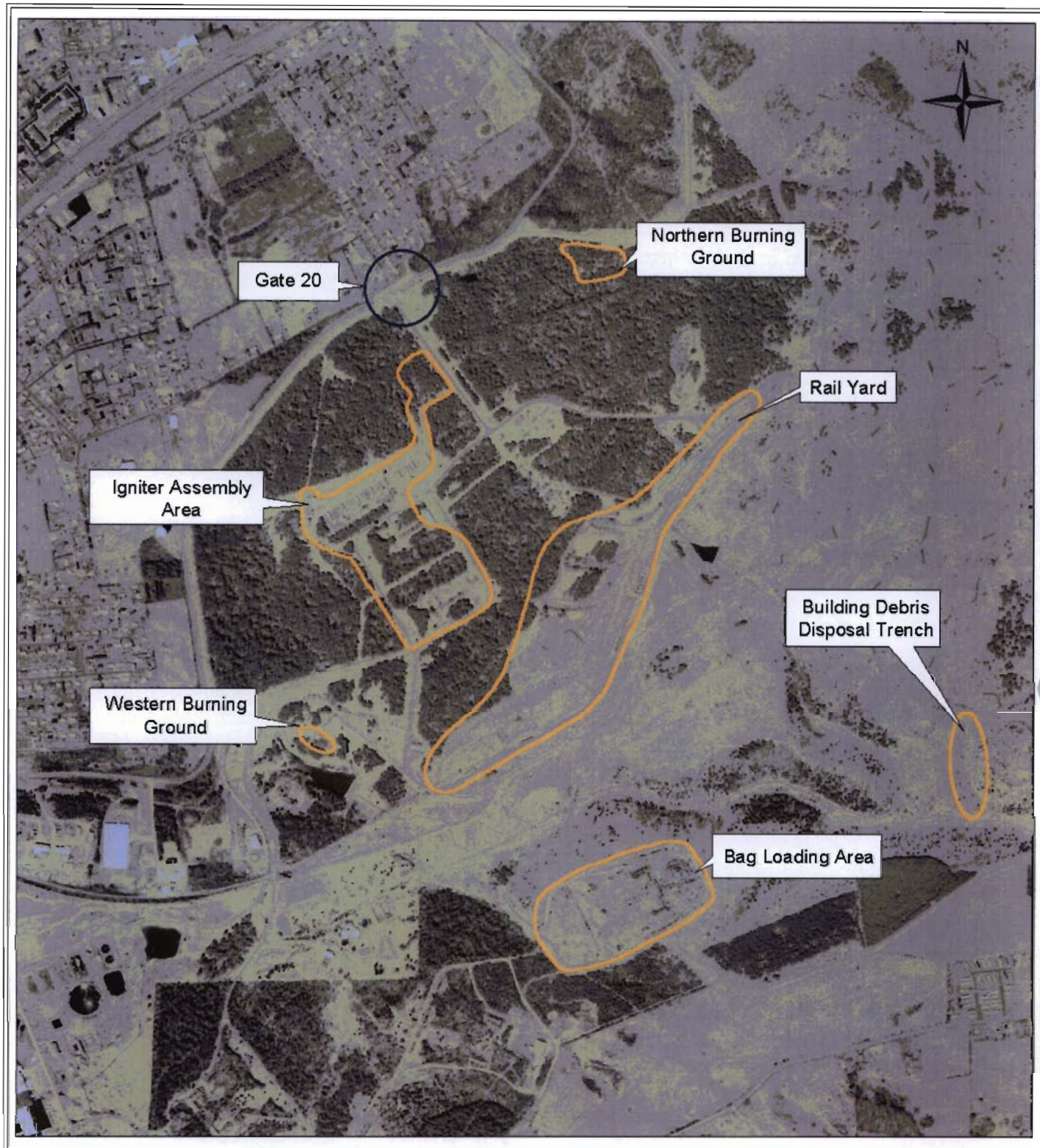
1.1.2 Summary of Previous Investigations

The primary constituents with elevated concentrations at the BDDT were PAHs associated with the disposal of roofing tar drums in the trench. The 1998 RI mitigated future impacts by removing the debris, including the drums, and visibly stained soil from the trench and delta areas. Migration of residual constituents present in the trench after the RI sampling effort is limited by the emplacement of a geotextile membrane and rip-rap.

Based on the results of the 2002 samples, in conjunction with the previously collected data at the site, volatile organic compounds (VOCs), non-polynuclear aromatic hydrocarbon (PAH), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), herbicides, explosive compounds, and metals are not a concern at the BDDT study area. PAHs are present in surface soil in the delta area. Results from the sediment and surface water samples indicate that the delta area acted as an accumulation point for the PAH compounds and these compounds no longer reach the creek in sufficient concentrations to negatively impact the creek.

Residual PAHs from the trench have been prevented from further migration by the geotextile membrane and the rip-rap. The delta area downgradient from the trench was impacted by PAHs prior to the emplacement of lining material in the trench and could potentially be a secondary source area contributing to the creek. The delta area acted as a collection point for trench constituents during normal conditions. Extremely heavy rain events, however, could potentially transport PAH-contaminated soil into the unnamed creek.

Results from the 2002 Investigation indicate that PAHs are confined to surface soil (0-6 inches) in this area, minimizing the volume of impacted soil. Additional sampling is required to delineate the horizontal extent of impacted soil in the delta area. These work instructions are intended to supplement the existing data collected at the BDDT to complete the delineation of PAHs in surface soil at the delta area and confirm that PAHs are not migrating through the soil column.



LEGEND

NRU Sites

Installation Gate

Aerial photograph from U.S. ACE
1:24,000 USGS Topographic Quadrangle

200 0 200 400 Feet

RADFORD AAP		Figure 1-1
PREPARED BY: SC	TASK NO:	Aerial Photograph of the NRU
CHECKED BY: TL	FILE NAME: RFAAP-NRU.apr	
DATE: 04-07-03		

1.1.3 Proposed Activities

The proposed activities at the BDDT are intended to assess the horizontal and vertical extent of elevated PAHs in the delta area at the downslope end of the BDDT, where it intersects with the unnamed creek. A summary of the proposed sampling is presented in **Table 1-3.**

Table 1-3
Proposed Sampling and Analysis
Building Debris Disposal Trench

Surface Soil	24	TCL PAHs, TCL PCBs*	Characterize the lateral extent of PAHs in delta area
Subsurface Soil	5	TCL PAHs, TCL PCBs*	Confirm PAHs attenuate rapidly with depth

* Based on concern for the potential of PCBs to enter the NRU watershed, samples collected and analyzed for PAHs will also be analyzed for PCBs. This is considered a conservative approach since previous sampling has not indicated elevated PCB concentrations at the BDDT.

1.1.3.1 Soil Sampling

Additional surface soil samples for PAH analysis will be collected on a grid with 30 ft spacing between intersections of grid lines (**Exhibit 2**). The grid area encompasses an area approximately 270 by 240 ft area on the north bank of the unnamed creek. A total of 24 surface soil samples will be collected in a two step approach. Initially, 12 samples will be collected within and near the perimeter of the delta. These samples will be submitted for low level PAH analysis with a 72 hour turn-around time. Results from the first set of samples will be used to guide the placement of the second set of samples. These samples will be stepped out from the original set at locations where PAHs are reported at concentrations greater than the adjusted residential RBCs. Samples will be collected in the delta and parts of the trench not covered by rip rap, as guided by initial sample results.

Results from the 2002 investigation indicate that PAHs are confined to surface soil in the delta area. To confirm this conclusion, subsurface soil samples will be collected at five of the surface soil locations where the highest concentrations of PAHs are reported. Collecting the subsurface soil samples beneath the highest PAH concentrations in surface soil will provide an indication of the greatest vertical extent of PAHs in soil. Subsurface soil samples will be collected using a hand auger from 1-3 ft bgs and analyzed for low-level PAHs.

If preliminary chemical results indicate specific "hot spot" areas of elevated PAH concentrations, test pitting may be employed rather than hand augering to collect subsurface soil samples for analysis.

1.2 NORTHERN BURNING GROUND

1.2.1 Site Description and History

The NBG is located in the northern portion of the NRU, east of Gate 20, along Guard Road (**Figure 1-1**). The approximate area of investigation at the burning ground is 200 ft long by 120 ft wide. A dirt road follows the outer perimeter of the NBG and defines the outermost boundary of the site. The NBG is currently heavily wooded and appears to have been in limited use as a burning ground. There are no structures associated with the site and burning activities took place on the ground. Soil reworking, such as berms, is not evident at the site. Actual burning appears

to have been conducted in a small area at the center of the site, although visible evidence of burning is no longer apparent. Site features and the results of previous sampling efforts are shown on **Exhibit 3.**

1.2.2 Summary of Previous Investigations

Evaluating the combined chemical dataset from the NBG investigations, the chemical parameters of concern are:

- ***PCBs.*** Aroclor-1254 in surface soil; and,
- ***Metals.*** Lead, chromium, and arsenic in surface soil.

VOCs, non-PAH SVOCs, herbicides, explosive compounds, dioxin/furans, and pesticides were detected, but did not exceed residential screening levels; therefore, these compounds are not a concern at the NBG study area. One PAH [benzo(a)pyrene] was detected at a concentration greater than its residential screening level, but below its industrial screening level. This exceedance was reported in a sample from the drainage ditch near the paved road. The absence of this compound in burning area soil and its presence near the road suggests that the benzo(a)pyrene is associated with the asphalt pavement rather than the burning ground.

Areas outside the main burn area of the NBG do not appear to have been impacted by burning operations at the site. Samples from a low area adjacent to the NBG and from the access road area south of the burn area did not have concentrations of metals or PCBs above residential screening levels, except for two arsenic concentrations slightly above background (IT, 2001) (and the industrial screening level). The lack of other metals exceedances in this area would indicate that the elevated arsenic concentrations are not related to burning activities. The sediment sample collected from the surface water drainage leading from the site contained no residential screening level exceedances, indicating that migration of metals and PCBs from the site by surface water transport is limited.

In the main burn area, lead, chromium, arsenic, iron, and Aroclor-1254 were detected above their respective industrial screening criteria in burn area surface soil. Although some of the 2002 Investigation sample locations were selected to bound the extent of burn operations, samples from these locations had metal industrial criteria exceedances, indicating that the full horizontal extent of burning operations has not been characterized.

1.2.3 Proposed Activities

Proposed activities at the NBG are intended to bound the horizontal and vertical extent of elevated metals within the main burning area. Concentrations of lead were generally higher than other metals. Because lead is present more consistently and at higher concentrations within the main burning area, it has been selected as an indicator metal to define the extent of contamination. The objective of these work instructions is to delineate lead concentrations greater than the residential screening level (400 mg/kg). To accomplish this objective, soil samples will be field screened for lead using X-ray fluorescence (XRF), and confirmation samples will be collected at the extent of lead as bound by the XRF sampling. The confirmation samples will be analyzed at an offsite laboratory for TAL metals. Subsurface soil samples will be collected at three subsurface intervals to assess the vertical mobility and extent of lead in the subsurface. A summary of the proposed samples is presented in **Table 1-4.**

Table 1-4
Proposed Sampling and Analysis
Northern Burning Ground

Surface Soil – XRF	48[1]	Lead (XRF)	Define extent of lead in surface soil
Surface Soil	12	TAL Metals, TCL PCBs[2]	Confirm extent of lead as defined by XRF and collect surface soil at boring locations
Subsurface Soil	9	TAL Metals, TCL PCBs[2]	Confirm extent of lead in subsurface soil
Sediment	2	TAL Metals, TCL PCBs[2]	Confirm that drainage ditch along the road is not a migration pathway for NBG contaminants.

[1] XRF sample numbers are approximate. Final number of samples will be based on field results.
[2] Based on concern for the potential of PCBs to be present in soil or drainage pathways at the NBG, samples collected and analyzed for TAL metals will also be analyzed for PCBs. This is considered a conservative approach since previous sampling has not indicated elevated PCB concentrations at the NBG.

1.2.3.1 XRF Screening

XRF analysis provides a field analytical method for analysis of lead in soil. XRF is capable of detecting lead in soil down to 20 mg/kg. By obtaining real-time data for lead concentrations, new sample locations can be guided by results from previous samples. A 30 ft by 42 ft grid will be superimposed over the site with grid line intersections at 3 ft intervals (**Exhibit 4**). Initially, samples will be collected from 12 locations around the perimeter of elevated lead defined by previous samples. Approximately 12 samples can be collected and analyzed by XRF in a day. Samples will be collected, stepping outward along grid lines, until sample concentrations are below the residential screening level of 400 mg/kg. It is assumed that approximately 48 XRF samples will be collected at the NBG.

1.2.3.2 Soil Sampling

Once the extent of soil with lead concentrations greater than 400 mg/kg has been delineated through XRF analysis, nine confirmation surface soil samples will be collected and analyzed at an offsite laboratory for TAL metals. One confirmation sample will be collected in each direction (N, NE, E, SE, S, SW, N and NW) at XRF locations where lead is detected at a concentration less than 400 mg/kg. An extra confirmation sample will be collected at the discretion of the field team leader. In addition to the confirmation samples; twelve samples will be collected from soil borings near the center of the main burning area to assess the vertical extent of elevated lead in soil. Four samples will be collected from each of three soil boring locations (**Exhibit 4**). Soil borings will be advanced using a hand auger. Samples will be collected at the surface (0-0.5 ft bgs), 1-3 ft bgs, 3-5 ft bgs, and 5-7 ft bgs. Previous subsurface samples have shown that elevated concentrations are primarily in the top 1 ft of soil; however, lead was detected at a concentration of 903 mg/kg in the 3-5 ft interval in boring NBGSB11. Sampling to 5-7 ft bgs at three locations will indicate whether this elevated concentration at depth is an artifact of borehole collapse.

1.2.3.3 Sediment Sampling

Two sediment samples will be collected from the drainage ditch between the NBG and the paved road to the north (Guard Road). The ditch is dry except during heavy rain events. A sample was collected in 2002 from below a culvert that drains under the paved road. Results from this

sample indicated that constituents from the NBG are not being transported under the road in the drainage system. The two proposed sediment samples will be collected from the ditch prior to the culvert to assess whether this portion of the ditch has been impacted.

1.3 WESTERN BURNING GROUND

1.3.1 Site Description and History

The WBG is located in the western portion of the NRU, west of the RY and south of the IAA (**Figure 1-1**). The WBG was used as a burning ground to decontaminate explosives-contaminated material. The site is no longer active. The main burn area was approximately 170 ft long by 100 ft wide and is surrounded on three sides by an approximately 4 ft high earthen berm. A dirt road runs parallel to the open (unbermed) side, leading north to the main road and south to the top of a steep slope above an unnamed pond. The pond was constructed during the early 1990s and is fed by Wiggins Spring, a natural spring located at the head of the pond. The pond also collects runoff from the boundary road and from off the Installation through a series of storm water culverts. The pond drains via a constant level drain into the unnamed creek south of the WBG. A site map and the results of previous investigations are shown on **Exhibit 5**.

1.3.2 Summary of Previous Investigations

Based on the chemical results of environmental samples collected in the WBG study area, the extent of contamination can be defined by metals, specifically arsenic, iron, and lead in surface soil; arsenic and lead in subsurface soil; and chromium and lead in sediment. Because soil was removed from the main burn area during previous sampling/test pitting, the main burn area is no longer a concern. The major areas of concern are the unpaved road leading from the former burning ground to the unnamed pond and the unnamed pond itself.

Because of the elevated lead concentrations in both soil and sediment detected during the 2002 Investigation, additional investigative activities are required to fully delineate the extent of metals in the unnamed pond and along the slope and drainage swale leading from the burning ground to the pond.

Perchlorate was detected during the 2002 Investigation in one surface water sample collected from the unnamed creek where it first enters the NRU. Additional sampling is proposed within the first 100 feet of the creek where it enters the NRU to confirm the detection of perchlorate.

1.3.3 Proposed Activities

Similarly to the NBG, lead was detected at elevated levels along with other TAL metals, including chromium, arsenic, and zinc. Since lead is present at the highest concentrations and is present most consistently, it will be used to define the extent of contamination at the site. Proposed activities at the WBG include additional soil, sediment, and surface water sampling to:

- bound the extent of elevated lead detected in the unnamed pond downslope of the burning area;
- identify the extent of elevated lead in soil under the dirt road leading from the burn area to the unnamed pond;
- assess potential migration routes to the pond from the burning area by assessing the soil from the slope and unlined drainage swale leading to the unnamed pond;
- assess the unlined drainage ditch to the southwest of the WBG as a secondary migration pathway; and,

- confirm the detection of perchlorate in surface water from the unnamed creek where it first enters the NRU.

Ecological samples will also be collected to identify adverse effects on organisms inhabiting the unnamed pond. Specifically, samples will be collected to assess aquatic organism health through fish bioaccumulation measurements. A summary of the proposed samples is presented in **Table 1-5**.

Table 1-5
Proposed Sampling and Analysis
Western Burning Ground

Surface Soil – XRF	50[1]	Lead (XRF)	Define extent of lead in surface soil; identify migration pathways.
Subsurface Soil – XRF	25[1]	Lead (XRF)	Define extent of lead in subsurface soil.
Sediment– XRF	20[1]	Lead (XRF)	Define extent of lead in sediment in the unnamed pond.
Surface Soil	18	TAL Metals, TCL PCBs[2], PAHs (3 samples)	Confirm extent of lead as defined by XRF.
Subsurface Soil	10	TAL Metals, TCL PCBs[2]	Confirm extent of lead as defined by XRF.
Sediment	6	TAL Metals, TCL PCBs[2], PAHs (1 sample)	Confirm extent of lead as defined by XRF.
Surface Water	2	Perchlorate	Confirm previous detection of perchlorate in the unnamed creek where it first enters the NRU.
Fish Tissue – Bioaccumulation	14/14	TAL Metals, TCL PCBs, Lipids	Evaluate levels of metals and PCBs in fish tissue in the unnamed pond.

[1] XRF sample numbers are approximate. Final number of samples will be based on field results.
[2] Based on concern for the potential of PCBs to enter the WBG watershed, samples collected and analyzed for TAL metals will also be analyzed for PCBs. This is considered a conservative approach since previous sampling has not indicated elevated PCB concentrations at the WBG.

1.3.3.1 XRF Screening

XRF field screening will be done on surface and subsurface soil and sediment. Surface soil samples for XRF screening will be collected from a square grid pattern with an 18 ft spacing between grid line intersections (**Exhibit 6**). The grid is 270 ft by 270 ft and approximately half of the grid extends over the unnamed pond and will be used to collect sediment samples from the pond.

Sixteen surface soil samples will be collected initially from the slope leading from the WBG to the unnamed pond. These samples will be collected below the end of the dirt access road and from the slope and drainage swale southeast of the road to identify potential migration pathways between the former burning area and the pond. Samples will be biased, as necessary, towards drainage pathways, accumulation areas, or other indications of contamination. Additional XRF samples will be collected from grid intersections to bound the extent of lead (if encountered) in this area to a concentration of 400 mg/kg.

Fifteen surface soil samples and 15 subsurface soil samples will be collected from five borings through the unnamed road and five borings on each side of the road. Borings will be continued

down the road toward the pond until lead is no longer detected at elevated levels (i.e., screening levels) in the samples. The subsurface soil sample from each boring will be collected from the layer of ash/soil found beneath the roadbed material. If the ash/soil is not encountered in a boring, the sample depth will be based on the closest boring where the ash/soil layer was identified. Confirmation samples will be collected at locations where the lead concentrations are less than 400 mg/kg.

Ten sediment samples will be collected for XRF screening. These samples will be collected from the same grid as the soil samples where it extends over the pond. The initial ten samples will be collected near 2002 Investigation sample WBGSD10 and are designed to indicate the extent of lead-impacted sediment in the pond. Additional XRF sediment samples will be collected based on the results of the initial samples.

1.3.3.2 Confirmation Sampling

Confirmation samples will be collected from surface and subsurface soil and sediment after the extent of lead at concentrations greater than 400 mg/kg has been established through the XRF field screening. The confirmation samples will be analyzed for TAL metals. A sufficient number of samples will be collected to ensure that the extent of elevated concentrations of lead can be delineated with validated analytical data from a laboratory. It is estimated that five sediment samples, fifteen surface soil samples, and ten subsurface soil samples will be required to complete the delineation.

A surface water sample (WBGSW14) was collected from the unnamed creek where it first enters the NRU (**Exhibit 7**). This sample had the sole detection of perchlorate (1.71 ug/L) at the NRU. Indications are that this compound is coming into the NRU from offsite. Although not directly associated with the WBG, two additional surface water samples will be collected from the first 100 feet of the creek where it enters the NRU to confirm the detection of perchlorate in surface water.

1.3.3.3 Unlined Drainage Ditch Characterization

Three additional surface soil samples will be collected in the unlined drainage ditch. One sample will be collected upgradient of sample WBGSB25 and the WBG. The other two soil samples will be collected between sample WBGSB25 and the unnamed pond. A sediment sample will be collected from the unnamed pond at the confluence of the ditch and the pond. Samples will be analyzed for TAL metals, TCL PCBs, and PAHs (sediment).

1.3.3.4 Fish Tissue/Bioaccumulation Study

Fish samples (both whole body and fillets) will be collected from the WBG pond and analyzed to further evaluate the potential for adverse effects to humans and environmental receptors from the consumption of fish associated with the pond. Due to the small size of the pond, no particular area will be singled out for collection; instead, collection will be attempted throughout the pond in order to obtain representative samples.

In accordance with USEPA guidance (USEPA, 1995), the most important criteria for selecting target species is that they are consumed by humans and have recreational fishing value. Currently, the WBG pond is believed to provide habitat for a few fish species, with rainbow trout (*Oncorhynchus mykiss*), largemouth bass (*Micropterus salmoides*), and brown bullhead catfish (*Ameiurus nebulosus*) being the species likely to meet this criteria. Trout and bass have been stocked in the pond in the past for recreational fishing. Trout and bass are predatory and likely to bioaccumulate the target compounds of interest and are recommended freshwater ecosystem

target species (USEPA, 1995). Catfish are bottom-feeders, so are likely to be exposed to and accumulate target compounds if present in sediments. A sampling of both bottom dwellers (e.g., catfish) and water-column dwellers (e.g., trout, bass) will be attempted. However, if catfish cannot be found in sufficient quantities in the pond, water column dwellers will be substituted. In the event that rainbow trout, largemouth bass, and brown bullhead catfish are not present, other edible species present in the pond will be considered for sampling. For example, bluegill sunfish (*Lepomis macrochirus*), common carp (*Cyprinus carpio*), and white suckers (*Catostomus commersoni*) likely inhabit the pond. These species are edible and have been listed as target species in some national studies (USEPA, 1995).

Description of Work. Fish will be collected from the WBG pond by electroshocking using approved methods (Murphy and Willis, 1996). Typical electroshocking units can be easily mounted and operated from small, stable watercraft. The electroshocking unit will be deployed off the bow of the boat using a T-boom with two electrodes. The depth of the electrodes can be manipulated to effectively adjust for shallow- or deep-water conditions. The electroshocking unit operates by sending a current through the water that stuns the fish causing them to rise to the surface for collection. Effective distance (radially from probe) will vary; however, the anticipated effective distance is expected to be 6-8 ft.

Both whole body and fillets will be analyzed. Half of the fish will be filleted to obtain the tissue samples. The fillet size must be large enough for analysis (approximately 73 grams). If smaller fish must be collected due to limited selection, fillets from multiple fish may be combined in order to produce composite samples large enough for analysis. If composite samples must be produced, attempts will be made to combine fish of similar size within a composite sample according to USEPA guidance (USEPA, 1995).

The number of replicate samples collected from the pond will be designed to provide sufficient power to detect exceedances of a target value. In order to assess the appropriate number of fish to collect, it is necessary to know the variance of chemical concentrations in target species tissues. At present, there is no information available concerning target compound levels in fish tissues at the WBG pond. Accordingly, an analysis consistent with USEPA guidance (USEPA, 1995) was conducted to assess the sample size required to provide sufficient power to detect the difference between tissue concentrations and screening values. Based on this methodology, 14 water column dweller fish (largemouth bass) and 14 bottom dweller fish (brown bullhead catfish) should be collected from the pond. This target sample size would provide sufficient power (90%) to detect exceedance of a screening value assuming a coefficient of variation in the target compound concentrations in the fish population of 50% and setting the minimum detectable difference between the mean tissue concentration and the screening value to 50% (USEPA, 1995).

Each sample will be analyzed for TAL metals, Target Compound List (TCL) PCBs, and lipids according to USEPA-approved methodologies (USEPA; 1986, 1995) by a qualified laboratory.

Data Management, Interpretation, and Analysis. The fish fillet data collected during this investigation will be used to evaluate the potential risks from consumption of fish caught in the WBG pond to recreational child and adult fishers. Fish tissue data will be grouped and data from both fish species will be combined. If adequate fish tissue data is unavailable, literature-based models will be used to estimate fish tissue concentrations. One potential model is presented in Sample et al. (1996). This model estimates whole body fish tissue concentrations using bioaccumulation factors. Appropriate adjustments will be made to estimate fillet concentrations

from these whole body concentrations. The model selected for fish tissue estimation will depend on the constituents of potential concern (COPCs) identified. COPCs will be identified by comparing maximum chemical concentrations within each grouping to USEPA Region III RBCs for fish. Intake doses of adult and child fish consumption will be quantified, and relevant toxicity criteria will be identified for each COPC. During the risk characterization, the exposure intake and toxicity values will be integrated to estimate potential carcinogenic and noncarcinogenic health effects (USEPA, 1989). The results of the risk characterization will include estimates of the upper-bound individual cancer risk and hazard index associated with exposure via fish consumption from the WBG pond.

2.0 REFERENCES

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IT Corporation (IT), 2002. *Radford Army Ammunition Plant, Master Work Plan Addendum 012.* Final document. September 2002. Delivery Order No. 0013, Contract No. DACA31–94–D–0064.

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U.S. Environmental Protection Agency (USEPA), 1995. *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories.* Volume I: Fish Sampling and Analysis. 2nd Edition. Washington, D.C.: USEPA Office of Water.

U.S. Environmental Protection Agency (USEPA), 1986. *Bioaccumulation Monitoring Guidance: Volume 4, Analytical Methods for USEPA Priority Pollutants and 301 (h) Pesticides in Tissue from Estuarine and Marine Organisms.* TetraTech, Office of Marine and Estuarine Protection.

Appendix A
Standard Operating Procedure for XRF Screening

STANDARD OPERATING PROCEDURE 30.13
SCREENING FOR METALS VIA X-RAY FLUORESCENCE (XRF) SPECTROMETRY

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide general guidance for the analysis of samples using X-Ray Fluorescence (XRF) methods. XRF can be used to screen for a variety of metals (**Attachment 1**) in environmental sample matrices that include soil, air filters, solid surfaces, materials including dried filter papers, and to screen for lead-based paint. The XRF technique has been accepted by the U.S. Environmental Protection Agency (EPA) for screening of samples during investigative and remediation actions and is published in USEPA SW-846 as Method 6200.

This procedure is applicable to efforts where metals are to be assessed using XRF methods. It is intended to act primarily as a guideline for the use and applicable Quality Control (QC) requirements of this technique. This procedure is not intended to replace the applicable manufacturer's information/procedures or those in SW-846, and it also does not present expanded detail on sample preparation. XRF is a surface analysis technique and as such, higher confidence data is achieved when solid samples, especially soil samples, are homogenized and reduced to consistent particle-size mixtures by drying, grinding, and sieving.

2.0 MATERIALS

- NITON Model XL-703 XRF system;
- Applicable source (Cd-109, Am-241);
- Filter holder assembly;
- System blank;
- Energy blank;
- System reference material (SRM);
- Sample cup; and,
- Field logbook and log sheets.

3.0 PRECAUTIONS

- XRF instruments contain radioactive source(s), and the electron beam is hazardous. Do not remove shielding or disassemble instruments beyond the user maintenance dictated in the instrument manual.
- Never place a hand or other body part in the path of the detector, and always operate it either with its shield closed or with the sensor window held tight against a surface; do not look directly at the beam.
- Some systems utilize cryogenic cooling systems, and appropriate precautions should be taken during operation.
- These instruments are regulated radioactive sources and require licensing and specific radioactive licensee procedures for use. In several states, some units, especially those containing Cd109 sources, are considered controlled sources and subject to state radioactive regulations including specific training for persons using the instrument, posting of radioactive safety procedures, isolation of work areas, and issuance of state radioactive licenses and permits. The Commonwealth of Virginia allows

the use of Niton Corporation's Radioactive Materials License. The Virginia State Department of Health must be informed (804-786-5932) that a "generally licensed source" is being used. Personnel using this type of instrument for the first time must attend the manufacturer's Safety Training course or be trained by a certified representative. Manufacturers will not send instruments containing radioactive sources to a project site without a competent person as required by their Specific License and General License with an Agreement State where analysis will be performed. The Commonwealth of Virginia requires the instrument to be shipped to the site directly. For additional information or assistance in dealing with licensing and/or shipment issues, contact the manufacturer, or leasing agent.

4.0 PROCEDURE

4.1 GENERAL INFORMATION

Method sensitivity is a function of the count time. Consult the manufacturer's manual to establish a count time that provides the needed sensitivity while allowing for sample throughput efficiency. Typical count times are 60 to 180 seconds.

Soil samples will be analyzed by using *ex situ* methods. *Ex situ* analysis involves thorough drying, grinding, mixing, and sieving of the sample, placing it into a sample cup for introduction to the instrument, and collecting data. Soil samples are analyzed by placing the sample cup into the manufacturer's holder and read by the instrument. The average of two readings should be calculated for each result.

XRF instruments are essentially semi-quantitative screening instruments and in most instances provide non-definitive screening data that must be confirmed by definitive methods. In well defined remedial actions governed by detailed approved plans, XRF has been used as a confirmatory tool. Use of the method for confirmatory purposes requires site-specific calibration over multiple points, regular QC checks, adjustments of the site-specific curve/Definitive method relationship via split sample analysis, and defined confidence windows for grey-area data.

4.2 GENERAL OPERATION

4.2.1 **Record** data onto a log sheet using the XRF Calibration Log (**Attachment 2**) and XRF Sample Collection Log (**Attachment 3**).

4.2.2 Allow the instrument to warm-up for 15 to 30 minutes before use.

4.2.3 **Perform** manufacturer-specified background (scatter) and internal self-calibration checks using the supplied materials. The XRF Calibration Log should be **completed daily** to record the date, time, sample no., leakage current (Pa), and resolution (eV). If the resolution reads above 900 eV or the leakage current is above 160 milliamps, the detector is not performing adequately. If the system fails the background check, **clean** the window and repeat. Do not use an instrument that fails either the background check or internal calibration criteria. **Contact** the manufacturer if the instrument does not pass calibration.

4.2.4 Prior to analyzing samples, **analyze** each of the required QC samples to include SRM and blanks and **compare** to the project criteria. Do not proceed to project samples until QC meets criteria. QC samples in sample cups should be **tilted** to **remix** the contents before analysis.

4.2.5 For *ex situ* samples, **place** approximately 5-10 grams of soil on a drying pan or tin and **place** in 103°C oven for 2-4 hours.

4.2.6 Using a 60 mesh sieve, **sift** out any coarse material. **Mix and grind** the sample using a mortar and pestle until a fine consistency is reached.

4.2.7 **Fill** each sample cup with the soil matrix. **Analyze** in duplicate and **average** the results. Higher confidence data from soils in sample cups is achieved if each cup is analyzed in duplicate.

4.2.8 **Tilt** the cup to **remix** the material between each analysis. **Report** the result as the average of the two values, provided they differ by less than 20%. If they differ by more than 20%, sample preparation methods should be reviewed.

4.2.9 **Analyze** a calibration check standard (SRM) and instrument blank after every ten sample analyses, following an extended down period, and at the end of the analysis day/shift.

4.3 QUALITY CONTROL

QC requirements include analysis of blanks (instrument, method), calibration checks (SRMs or known value samples), and replicate samples. Blanks should be less than the instrument detection limits in **Attachment 1.** Instrument blank is clean sand or lithium carbonate. The SRM and continuing calibration should be ±20% D of certified value.

Confirmatory use requires more extensive QC efforts. A site-specific calibration should be performed by split analyzing prepared samples in duplicate by XRF and off-site definitive methods. The results are used to develop a site-specific XRF/Definitive method correlation and calibration curve. Daily QC should include the analysis of blanks, at least three of the site-specific calibration standards bracketing the expected concentration ranges, replicates, and a check sample or SRM. The correlation should be verified and if necessary adjusted on a defined sample analysis or time frequency.

5.0 REFERENCES

Field Portable X-ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment, Method 6200, Revision 0, 1998, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, SW-846, Third Edition, January.

Instrument Manual for Spectrace Model 9000 XRF, TN Technologies.

Instrument Manual for Niton 700 Series Systems, Niton Inc.

Attachment 1
List of XRF Analytes and Instrument Detection Limits[a]

Element	Typical Reporting Limits for Each Radioactive Source (mg/kg)	
	Cd-109	Am-241
Sulfur		
Chlorine		
Potassium		
Calcium		
Titanium		
Chromium	260	
Manganese	205	
Iron	110	
Cobalt	100	
Nickel	65	
Copper	45	
Zinc	35	
Mercury	30	
Arsenic	25	
Selenium	15	
Lead	15	
Rubidium	5	
Strontium	4	
Zirconium	3	
Molybdenum	4	
Cadmium		50
Tin		85
Antimony		45
Barium		30
Silver		9

[a] Typically achievable in a clean, silica sand matrix. Actual sample detection limits will be higher due to the sample matrix interferences.

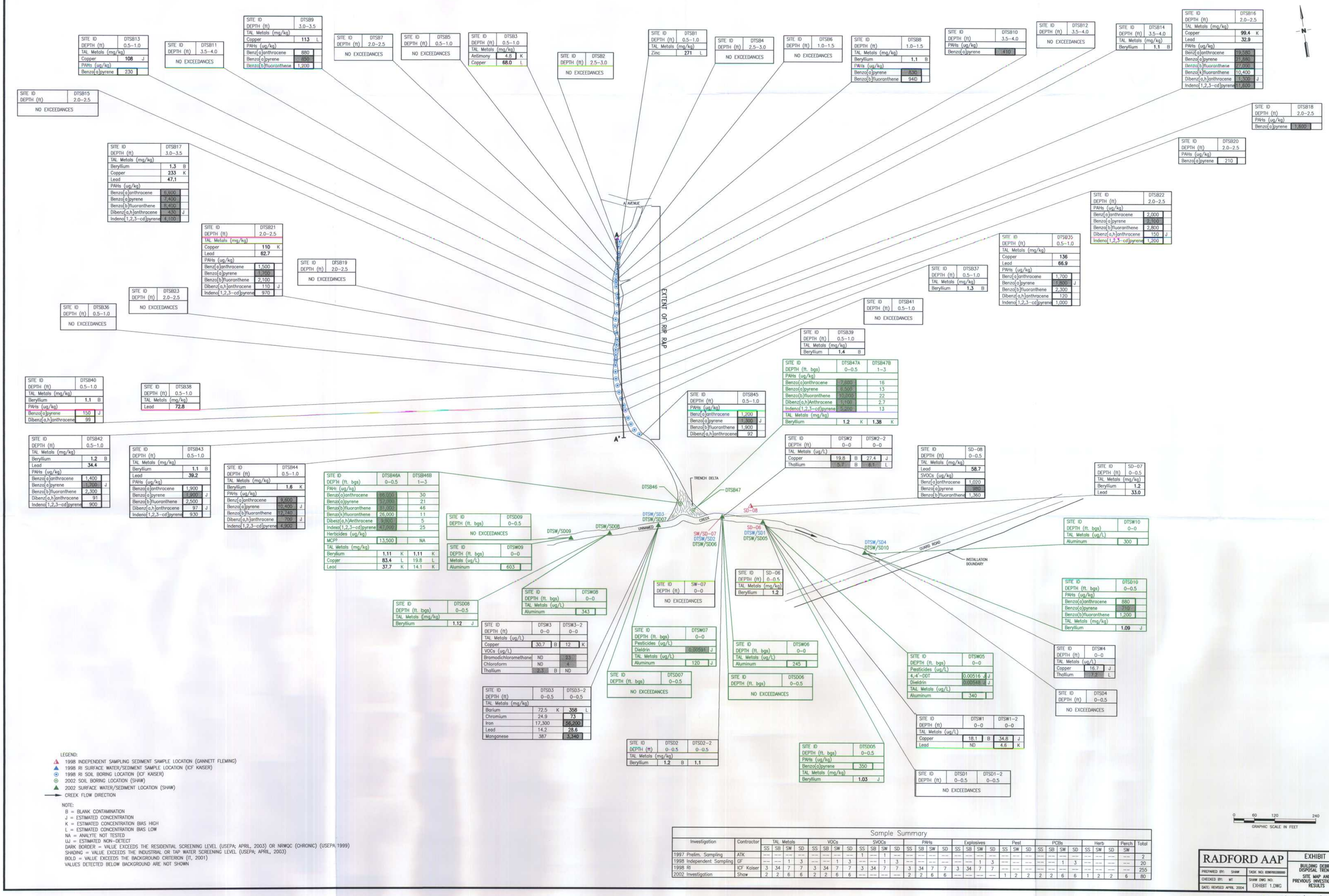
Attachment 2
XRF Calibration Log

XRF Model Number:		XRF Serial Number:		
Date	Time	Sample No.	Instrument Self-Calibration	
			Leakage Current (Pa)	Resolution (eV)

Notes: If the Resolution reads above 900 eV, contact Niton Corporation.
If leakage current is above 160 milliamps, the detector is not performing adequately.

Attachment 3
XRF Sample Collection Log

Client:		XRF Model:		XRF Serial Number:					
Site:		Samplers:		Parameters/Readings (ppm)					
Date	Time	Sample No.	Media	Arsenic	Chromium	Copper	Iron	Lead	Remarks



SITE ID	DTSB13
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Copper	108 J
PAHs (ug/kg)	
Benzo[a]pyrene	230

SITE ID	DTSB11
DEPTH (ft)	3.5–4.0
NO EXCEEDANCES	

SITE ID	DTSB9
DEPTH (ft)	3.0–3.5
TAL Metals (mg/kg)	
Copper	113 L
PAHs (ug/kg)	
Benz[a]anthracene	880
Benzo[a]pyrene	850
Benzo[b]fluoranthene	1,200

SITE ID	DTSB7
DEPTH (ft)	2.0–2.5
NO EXCEEDANCES	

SITE ID	DTSB5
DEPTH (ft)	0.5–1.0
NO EXCEEDANCES	

SITE ID	DTSB3
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Antimony	4.8 K
Copper	68.0 L

SITE ID	DTSB2
DEPTH (ft)	2.5–3.0
NO EXCEEDANCES	

SITE ID	DTSB1
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Zinc	271 L

SITE ID	DTSB4
DEPTH (ft)	2.5–3.0
NO EXCEEDANCES	

SITE ID	DTSB6
DEPTH (ft)	1.0–1.5
NO EXCEEDANCES	

SITE ID	DTSB8
DEPTH (ft)	1.0–1.5
TAL Metals (mg/kg)	
Beryllium	1.1 B
PAHs (ug/kg)	
Benzo[a]pyrene	830
Benzo[b]fluoranthene	940

SITE ID	DTSB10
DEPTH (ft)	3.5–4.0
PAHs (ug/kg)	
Benzo[a]pyrene	410

SITE ID	DTSB12
DEPTH (ft)	3.5–4.0
NO EXCEEDANCES	

SITE ID	DTSB14
DEPTH (ft)	3.5–4.0
TAL Metals (mg/kg)	
Beryllium	1.1 B

SITE ID	DTSB16
DEPTH (ft)	2.0–2.5
TAL Metals (mg/kg)	
Copper	99.4 K
Lead	32.9
PAHs (ug/kg)	
Benz[a]anthracene	19,580
Benzo[a]pyrene	25,880
Benzo[b]fluoranthene	27,000
Benzo[k]fluoranthene	10,400
Dibenz[a,h]anthracene	1,300 J
Indeno[1,2,3-cd]pyrene	11,800

SITE ID	DTSB15
DEPTH (ft)	2.0–2.5
NO EXCEEDANCES	

SITE ID	DTSB18
DEPTH (ft)	2.0–2.5
PAHs (ug/kg)	
Benzo[a]pyrene	1,600

SITE ID	DTSB20
DEPTH (ft)	2.0–2.5
PAHs (ug/kg)	
Benzo[a]pyrene	210

SITE ID	DTSB17
DEPTH (ft)	3.0–3.5
TAL Metals (mg/kg)	
Beryllium	1.3 B
Copper	233 K
Lead	47.1
PAHs (ug/kg)	
Benzo[a]anthracene	6,800
Benzo[a]pyrene	7,400
Benzo[b]fluoranthene	8,400
Dibenz[a,h]anthracene	430 J
Indeno[1,2,3-cd]pyrene	4,100

SITE ID	DTSB22
DEPTH (ft)	2.0–2.5
PAHs (ug/kg)	
Benz[a]anthracene	2,000
Benzo[a]pyrene	2,300
Benzo[b]fluoranthene	2,800
Dibenz[a,h]anthracene	150 J
Indeno[1,2,3-cd]pyrene	1,200

SITE ID	DTSB21
DEPTH (ft)	2.0–2.5
TAL Metals (mg/kg)	
Copper	110 K
Lead	82.7
PAHs (ug/kg)	
Benz[a]anthracene	1,500
Benzo[a]pyrene	1,700
Benzo[b]fluoranthene	2,100
Dibenz[a,h]anthracene	110 J
Indeno[1,2,3-cd]pyrene	970

SITE ID	DTSB19
DEPTH (ft)	2.0–2.5
NO EXCEEDANCES	

SITE ID	DTSB35
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Copper	136
Lead	66.9
PAHs (ug/kg)	
Benz[a]anthracene	1,700
Benzo[a]pyrene	1,800 J
Benzo[b]fluoranthene	2,300
Dibenz[a,h]anthracene	120
Indeno[1,2,3-cd]pyrene	1,000

SITE ID	DTSB37
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Beryllium	1.3 B

SITE ID	DTSB23
DEPTH (ft)	2.0–2.5
NO EXCEEDANCES	

SITE ID	DTSB36
DEPTH (ft)	0.5–1.0
NO EXCEEDANCES	

SITE ID	DTSB41
DEPTH (ft)	0.5–1.0
NO EXCEEDANCES	

SITE ID	DTSB39
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Beryllium	1.4 B

SITE ID	DTSB40
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Beryllium	1.1 B
PAHs (ug/kg)	
Benzo[a]pyrene	150 J
Dibenz[a,h]anthracene	99

SITE ID	DTSB38
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Lead	72.8

SITE ID	DTSB45
DEPTH (ft)	0.5–1.0
PAHs (ug/kg)	
Benz[a]anthracene	1,200
Benzo[a]pyrene	1,300 J
Benzo[b]fluoranthene	1,900
Dibenz[a,h]anthracene	92

SITE ID	DTSB47A	DTSB47B
DEPTH (ft. bgs)	0–0.5	1–3
PAHs (ug/kg)		
Benzo(a)anthracene	7,880	16
Benzo(a)pyrene	8,500	13
Benzo(b)fluoranthene	10,000	22
Dibenz(a,h)Anthracene	1,100	2.7
Indeno(1,2,3-cd)pyrene	5,260	13
TAL Metals (mg/kg)		
Beryllium	1.2 K	1.38 K

SITE ID	DTSB42
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Beryllium	1.2 B
Lead	34.4
PAHs (ug/kg)	
Benzo[a]anthracene	1,400
Benzo[a]pyrene	1,700 J
Benzo[b]fluoranthene	2,300
Dibenz[a,h]anthracene	91
Indeno[1,2,3-cd]pyrene	900

SITE ID	DTSB43
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Beryllium	1.1 B
Lead	39.2
PAHs (ug/kg)	
Benzo[a]anthracene	1,900
Benzo[a]pyrene	1,900 J
Benzo[b]fluoranthene	2,500
Dibenz[a,h]Anthracene	97 J
Indeno[1,2,3-cd]pyrene	930

SITE ID	DTSB44
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Beryllium	1.6 K
PAHs (ug/kg)	
Benz[a]anthracene	9,600
Benzo[a]pyrene	10,400 J
Benzo[b]fluoranthene	12,740
Dibenz[a,h]anthracene	700 J
Indeno[1,2,3-cd]pyrene	4,900

SITE ID	DTSB46A	DTSB46B
DEPTH (ft. bgs)	0–0.5	1–3
PAHs (ug/kg)		
Benzo(a)anthracene	66,000	30
Benzo(a)pyrene	57,000	21
Benzo(b)fluoranthene	83,000	46
Benzo(k)fluoranthene	26,000	11
Dibenz(a,h)Anthracene	9,200	5
Indeno(1,2,3-cd)pyrene	47,000	25
Herbicides (ug/kg)		
MCPP	13,500	NA
TAL Metals (mg/kg)		
Beryllium	1.11 K	1.11 K
Copper	83.4 L	19.8 L
Lead	37.7 K	14.1 K

SITE ID	DTSD09
DEPTH (ft. bgs)	0–0.5
NO EXCEEDANCES	

SITE ID	DTSW09
DEPTH (ft. bgs)	0–0
Metals (ug/L)	
Aluminum	603

SITE ID	DTSW2	DTSW2-2
DEPTH (ft)	0–0	0–0
TAL Metals (ug/L)		
Copper	19.8 B	27.4 J
Thallium	5.7 B	6.1 L

SITE ID	SD-08
DEPTH (ft)	0–0.5
TAL Metals (mg/kg)	
Lead	58.7
SVOCs (ug/kg)	
Benz[a]anthracene	1,020
Benzo[a]pyrene	980
Benzo[b]fluoranthene	1,360

SITE ID	SD-07
DEPTH (ft)	0–0.5
TAL Metals (mg/kg)	
Beryllium	1.2
Lead	33.0

SITE ID	DTSW10
DEPTH (ft. bgs)	0–0
TAL Metals (ug/L)	
Aluminum	300

SITE ID	DTSW08
DEPTH (ft. bgs)	0–0
TAL Metals (ug/L)	
Aluminum	343

SITE ID	DTSD08
DEPTH (ft. bgs)	0–0.5
TAL Metals (mg/kg)	
Beryllium	1.12 J

SITE ID	DTSW3	DTSW3-2
DEPTH (ft)	0–0	0–0
TAL Metals (ug/L)		
Copper	30.7 B	12 K
VOCs (ug/L)		
Bromodichloromethane	ND	2.3
Chloroform	ND	4
Thallium	2.3 B	ND

SITE ID	SW-07
DEPTH (ft)	0–0
NO EXCEEDANCES	

SITE ID	SD-06
DEPTH (ft)	0–0.5
TAL Metals (mg/kg)	
Beryllium	1.2

SITE ID	DTSW07
DEPTH (ft. bgs)	0–0
Pesticides (ug/L)	
Dieldrin	0.00591 J
TAL Metals (ug/L)	
Aluminum	120 J

SITE ID	DTSW06
DEPTH (ft. bgs)	0–0
TAL Metals (ug/L)	
Aluminum	245

SITE ID	DTSD10
DEPTH (ft. bgs)	0–0.5
PAHs (ug/kg)	
Benzo(a)anthracene	880
Benzo(a)pyrene	719
Benzo(b)fluoranthene	1,200
TAL Metals (mg/kg)	
Beryllium	1.09 J

SITE ID	DTSW4
DEPTH (ft)	0–0
TAL Metals (ug/L)	
Copper	16.7 J
Thallium	7.2 L

SITE ID	DTSW05
DEPTH (ft. bgs)	0–0
Pesticides (ug/L)	
4,4'-DDT	0.00516 J J
Dieldrin	0.00548 J J
TAL Metals (ug/L)	
Aluminum	340

SITE ID	DTSD07
DEPTH (ft. bgs)	0–0.5
NO EXCEEDANCES	

SITE ID	DTSD06
DEPTH (ft. bgs)	0–0.5
NO EXCEEDANCES	

SITE ID	DTSD4
DEPTH (ft)	0–0.5
NO EXCEEDANCES	

SITE ID	DTSD3	DTSD3-2
DEPTH (ft)	0–0.5	0–0.5
TAL Metals (mg/kg)		
Barium	72.5 K	358 L
Chromium	24.9	73
Iron	17,300	56,200
Lead	14.2	28.6
Manganese	387	3,340

SITE ID	DTSW1	DTSW1-2
DEPTH (ft)	0–0	0–0
TAL Metals (ug/L)		
Copper	18.1 B	34.8 J
Lead	ND	4.6 K

SITE ID	DTSD2	DTSD2-2
DEPTH (ft)	0–0.5	0–0.5
TAL Metals (mg/kg)		
Beryllium	1.2 B	1.1

SITE ID	DTSD05
DEPTH (ft. bgs)	0–0.5
PAHs (ug/kg)	
Benzo(a)pyrene	350
TAL Metals (mg/kg)	
Beryllium	1.03 J

SITE ID	DTSD1	DTSD1-2
DEPTH (ft)	0–0.5	0–0.5
NO EXCEEDANCES		

LEGEND:
- 1998 INDEPENDENT SAMPLING SEDIMENT SAMPLE LOCATION (CANNETT FLEMING)
- 1998 RI SURFACE WATER/SEDIMENT SAMPLE LOCATION (ICF KAISER)
- 1998 RI SOIL BORING LOCATION (ICF KAISER)
- 2002 SOIL BORING LOCATION (SHAW)
- 2002 SURFACE WATER/SEDIMENT LOCATION (SHAW)
- CREEK FLOW DIRECTION

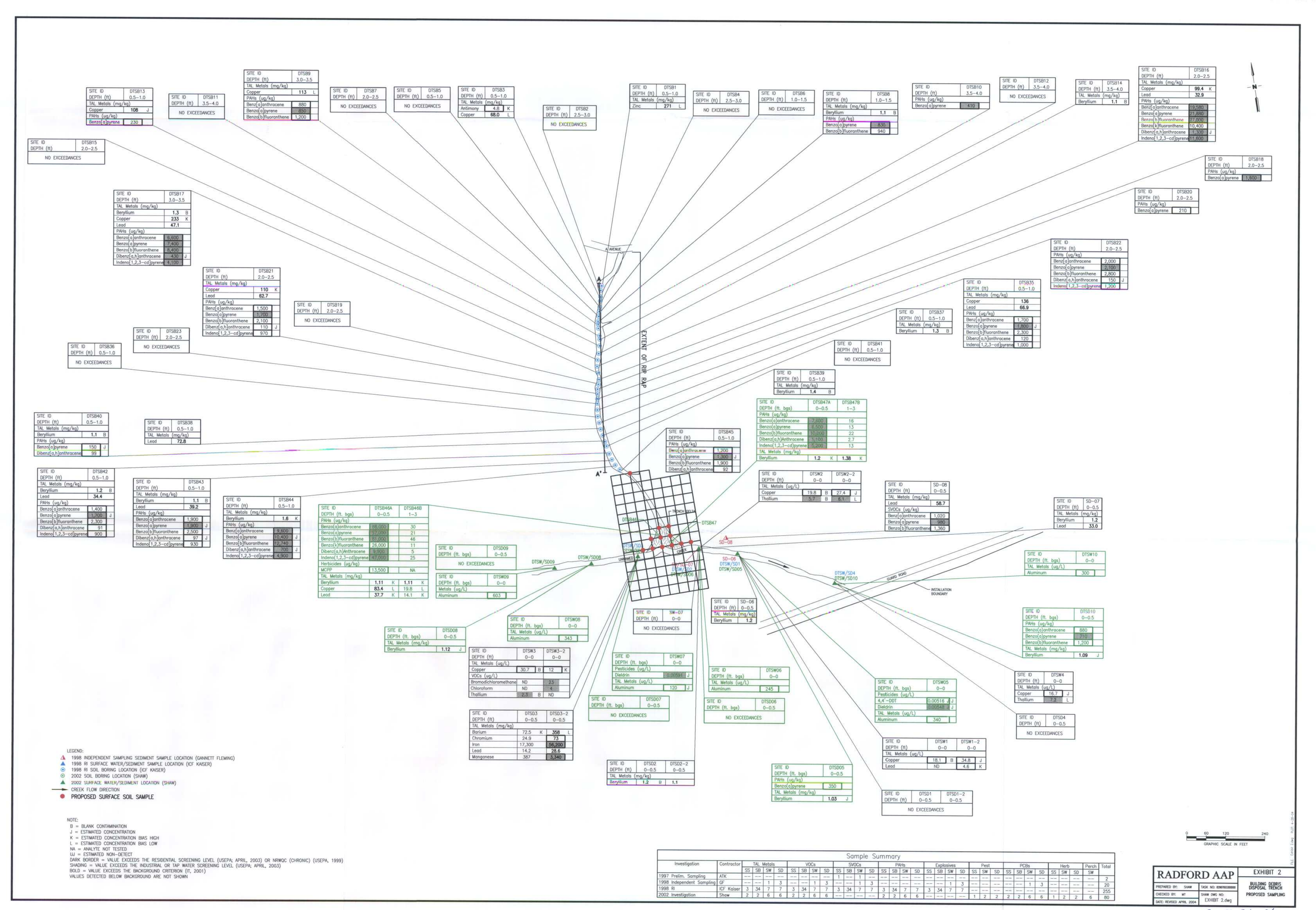
NOTE:
- B = BLANK CONTAMINATION
- J = ESTIMATED CONCENTRATION
- K = ESTIMATED CONCENTRATION BIAS HIGH
- L = ESTIMATED CONCENTRATION BIAS LOW
- NA = ANALYTE NOT TESTED
- UJ = ESTIMATED NON-DETECT
- DARK BORDER = VALUE EXCEEDS THE RESIDENTIAL SCREENING LEVEL (USEPA; APRIL, 2003) OR NRWQC (CHRONIC) (USEPA 1999)
- SHADING = VALUE EXCEEDS THE INDUSTRIAL OR TAP WATER SCREENING LEVEL (USEPA; APRIL, 2003)
- BOLD = VALUE EXCEEDS THE BACKGROUND CRITERION (IT, 2001)
- VALUES DETECTED BELOW BACKGROUND ARE NOT SHOWN

Sample Summary

Investigation	Contractor	TAL Metals				VOCs				SVOCs				PAHs				Explosives				Pest				PCBs				Herb				Perch	Total
		SS	SB	SW	SD	SS	SB	SW	SD	SS	SB	SW	SD	SS	SB	SW	SD	SS	SB	SW	SD	SS	SB	SW	SD	SS	SB	SW	SD	SS	SB	SW	SD	SW	
1997 Prelim. Sampling	ATK	---	---	---	---	---	---	---	---	1	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2
1998 Independent Sampling	GF	---	---	1	3	---	---	1	3	---	---	1	3	---	---	---	---	---	---	1	3	---	---	---	---	---	---	1	3	---	---	---	---	---	20
1998 RI	ICF Kaiser	3	34	7	7	3	34	7	7	3	34	7	7	3	34	7	7	3	34	7	7	---	---	---	---	---	---	---	---	---	---	---	---	---	255
2002 Investigation	Shaw	2	2	6	6	2	2	6	6	---	---	---	---	2	2	6	6	---	---	---	---	1	2	2	2	2	2	6	6	1	2	2	6	---	80

RADFORD AAP	EXHIBIT 1
PREPARED BY: SHAW	TASK NO: 8286150330000
CHECKED BY: MT	SHAW DWG NO: EXHIBIT 1.DWG
DATE: REVISED APRIL 2004	BUILDING DEBRIS DISPOSAL TRENCH SITE MAP AND PREVIOUS INVESTIGATION RESULTS

05018\84-1/1



SITE ID	DTSB13
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Copper	**108** J
PAHs (ug/kg)	
Benzo[a]pyrene	230

SITE ID	DTSB11
DEPTH (ft)	3.5–4.0
NO EXCEEDANCES	

SITE ID	DTSB9
DEPTH (ft)	3.0–3.5
TAL Metals (mg/kg)	
Copper	**113** L
PAHs (ug/kg)	
Benz[a]anthracene	880
Benzo[a]pyrene	850
Benzo[b]fluoranthene	1,200

SITE ID	DTSB7
DEPTH (ft)	2.0–2.5
NO EXCEEDANCES	

SITE ID	DTSB5
DEPTH (ft)	0.5–1.0
NO EXCEEDANCES	

SITE ID	DTSB3
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Antimony	**4.8** K
Copper	**68.0** L

SITE ID	DTSB2
DEPTH (ft)	2.5–3.0
NO EXCEEDANCES	

SITE ID	DTSB1
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Zinc	**271** L

SITE ID	DTSB4
DEPTH (ft)	2.5–3.0
NO EXCEEDANCES	

SITE ID	DTSB6
DEPTH (ft)	1.0–1.5
NO EXCEEDANCES	

SITE ID	DTSB8
DEPTH (ft)	1.0–1.5
TAL Metals (mg/kg)	
Beryllium	**1.1** B
PAHs (ug/kg)	
Benzo[a]pyrene	830
Benzo[b]fluoranthene	940

SITE ID	DTSB10
DEPTH (ft)	3.5–4.0
PAHs (ug/kg)	
Benzo[a]pyrene	410

SITE ID	DTSB12
DEPTH (ft)	3.5–4.0
NO EXCEEDANCES	

SITE ID	DTSB14
DEPTH (ft)	3.5–4.0
TAL Metals (mg/kg)	
Beryllium	**1.1** B

SITE ID	DTSB16
DEPTH (ft)	2.0–2.5
TAL Metals (mg/kg)	
Copper	**99.4** K
Lead	**32.9**
PAHs (ug/kg)	
Benz[a]anthracene	10,580
Benzo[a]pyrene	24,890
Benzo[b]fluoranthene	27,000
Benzo[k]fluoranthene	10,400
Dibenz[a,h]anthracene	1,300 J
Indeno[1,2,3-cd]pyrene	11,600

SITE ID	DTSB15
DEPTH (ft)	2.0–2.5
NO EXCEEDANCES	

SITE ID	DTSB18
DEPTH (ft)	2.0–2.5
PAHs (ug/kg)	
Benzo[a]pyrene	1,600

SITE ID	DTSB17
DEPTH (ft)	3.0–3.5
TAL Metals (mg/kg)	
Beryllium	**1.3** B
Copper	**233** K
Lead	**47.1**
PAHs (ug/kg)	
Benzo[a]anthracene	6,600
Benzo[a]pyrene	7,400
Benzo[b]fluoranthene	8,400
Dibenz[a,h]anthracene	430 J
Indeno[1,2,3-cd]pyrene	4,100

SITE ID	DTSB20
DEPTH (ft)	2.0–2.5
PAHs (ug/kg)	
Benzo[a]pyrene	210

SITE ID	DTSB22
DEPTH (ft)	2.0–2.5
PAHs (ug/kg)	
Benz[a]anthracene	2,000
Benzo[a]pyrene	2,100
Benzo[b]fluoranthene	2,800
Dibenz[a,h]anthracene	150 J
Indeno[1,2,3-cd]pyrene	1,200

SITE ID	DTSB21
DEPTH (ft)	2.0–2.5
TAL Metals (mg/kg)	
Copper	**110** K
Lead	**82.7**
PAHs (ug/kg)	
Benz[a]anthracene	1,500
Benzo[a]pyrene	1,700
Benzo[b]fluoranthene	2,100
Dibenz[a,h]anthracene	110 J
Indeno[1,2,3-cd]pyrene	970

SITE ID	DTSB19
DEPTH (ft)	2.0–2.5
NO EXCEEDANCES	

SITE ID	DTSB35
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Copper	**136**
Lead	**66.9**
PAHs (ug/kg)	
Benz[a]anthracene	1,700
Benzo[a]pyrene	1,800 J
Benzo[b]fluoranthene	2,300
Dibenz[a,h]anthracene	120
Indeno[1,2,3-cd]pyrene	1,000

SITE ID	DTSB37
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Beryllium	**1.3** B

SITE ID	DTSB23
DEPTH (ft)	2.0–2.5
NO EXCEEDANCES	

SITE ID	DTSB36
DEPTH (ft)	0.5–1.0
NO EXCEEDANCES	

SITE ID	DTSB41
DEPTH (ft)	0.5–1.0
NO EXCEEDANCES	

SITE ID	DTSB39
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Beryllium	**1.4** B

SITE ID	DTSB40
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Beryllium	**1.1** B
PAHs (ug/kg)	
Benzo[a]pyrene	150 J
Dibenz[a,h]anthracene	99

SITE ID	DTSB38
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Lead	**72.8**

SITE ID	DTSB45
DEPTH (ft)	0.5–1.0
PAHs (ug/kg)	
Benz[a]anthracene	1,200
Benzo[a]pyrene	1,300 J
Benzo[b]fluoranthene	1,900
Dibenz[a,h]anthracene	92

SITE ID	DTSB47A	DTSB47B
DEPTH (ft. bgs)	0–0.5	1–3
PAHs (ug/kg)		
Benzo(a)anthracene	7,600	16
Benzo(a)pyrene	8,500	13
Benzo(b)fluoranthene	10,000	22
Dibenz(a,h)Anthracene	1,100	2.7
Indeno(1,2,3-cd)pyrene	5,200	13
TAL Metals (mg/kg)		
Beryllium	**1.2** K	**1.38** K

SITE ID	DTSB42
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Beryllium	**1.2** B
Lead	**34.4**
PAHs (ug/kg)	
Benzo[a]anthracene	1,400
Benzo[a]pyrene	1,700 J
Benzo[b]fluoranthene	2,300
Dibenz[a,h]anthracene	91
Indeno[1,2,3-cd]pyrene	900

SITE ID	DTSB43
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Beryllium	**1.1** B
Lead	**39.2**
PAHs (ug/kg)	
Benzo[a]anthracene	1,900
Benzo[a]pyrene	1,900 J
Benzo[b]fluoranthene	2,500
Dibenz[a,h]anthracene	97 J
Indeno[1,2,3-cd]pyrene	930

SITE ID	DTSB44
DEPTH (ft)	0.5–1.0
TAL Metals (mg/kg)	
Beryllium	**1.6** K
PAHs (ug/kg)	
Benz[a]anthracene	9,600
Benzo[a]pyrene	10,400 J
Benzo[b]fluoranthene	12,740
Dibenz[a,h]anthracene	700 J
Indeno[1,2,3-cd]pyrene	4,900

SITE ID	DTSB46A	DTSB46B
DEPTH (ft. bgs)	0–0.5	1–3
PAHs (ug/kg)		
Benzo(a)anthracene	88,000	30
Benzo(a)pyrene	97,000	21
Benzo(b)fluoranthene	81,000	46
Benzo(k)fluoranthene	26,000	11
Dibenz(a,h)Anthracene	9,300	5
Indeno(1,2,3-cd)pyrene	47,000	25
Herbicides (ug/kg)		
MCPP	13,500	NA
TAL Metals (mg/kg)		
Beryllium	**1.11** K	**1.11** K
Copper	**83.4** L	19.8 L
Lead	**37.7** K	14.1 K

SITE ID	DTSD09
DEPTH (ft. bgs)	0–0.5
NO EXCEEDANCES	

SITE ID	DTSW09
DEPTH (ft. bgs)	0–0
Metals (ug/L)	
Aluminum	603

SITE ID	DTSW2	DTSW2-2
DEPTH (ft)	0–0	0–0
TAL Metals (ug/L)		
Copper	19.8 B	27.4 J
Thallium	5.7 B	6.1 L

SITE ID	SD-08
DEPTH (ft)	0–0.5
TAL Metals (mg/kg)	
Lead	**58.7**
SVOCs (ug/kg)	
Benz[a]anthracene	1,020
Benzo[a]pyrene	980
Benzo[b]fluoranthene	1,360

SITE ID	SD-07
DEPTH (ft)	0–0.5
TAL Metals (mg/kg)	
Beryllium	**1.2**
Lead	**33.0**

SITE ID	DTSW10
DEPTH (ft. bgs)	0–0
TAL Metals (ug/L)	
Aluminum	300

SITE ID	DTSD10
DEPTH (ft. bgs)	0–0.5
PAHs (ug/kg)	
Benzo(a)anthracene	880
Benzo(a)pyrene	710
Benzo(b)fluoranthene	1,200
TAL Metals (mg/kg)	
Beryllium	**1.09** J

SITE ID	SW-07
DEPTH (ft)	0–0
NO EXCEEDANCES	

SITE ID	SD-06
DEPTH (ft)	0–0.5
TAL Metals (mg/kg)	
Beryllium	**1.2**

SITE ID	DTSW08
DEPTH (ft. bgs)	0–0
TAL Metals (ug/L)	
Aluminum	343

SITE ID	DTSD08
DEPTH (ft. bgs)	0–0.5
TAL Metals (mg/kg)	
Beryllium	**1.12** J

SITE ID	DTSW3	DTSW3-2
DEPTH (ft)	0–0	0–0
TAL Metals (ug/L)		
Copper	30.7 B	12 K
VOCs (ug/L)		
Bromodichloromethane	ND	23
Chloroform	ND	4
Thallium	2.3 B	ND

SITE ID	DTSW07
DEPTH (ft. bgs)	0–0
Pesticides (ug/L)	
Dieldrin	0.00591 J
TAL Metals (ug/L)	
Aluminum	120 J

SITE ID	DTSW06
DEPTH (ft. bgs)	0–0
TAL Metals (ug/L)	
Aluminum	245

SITE ID	DTSW05
DEPTH (ft. bgs)	0–0
Pesticides (ug/L)	
4,4'-DDT	0.00516 J J
Dieldrin	0.00548 J J
TAL Metals (ug/L)	
Aluminum	340

SITE ID	DTSW4
DEPTH (ft)	0–0
TAL Metals (ug/L)	
Copper	16.7 J
Thallium	7.2 L

SITE ID	DTSD07
DEPTH (ft. bgs)	0–0.5
NO EXCEEDANCES	

SITE ID	DTSD06
DEPTH (ft. bgs)	0–0.5
NO EXCEEDANCES	

SITE ID	DTSD4
DEPTH (ft)	0–0.5
NO EXCEEDANCES	

SITE ID	DTSD3	DTSD3-2
DEPTH (ft)	0–0.5	0–0.5
TAL Metals (mg/kg)		
Barium	72.5 K	**358** L
Chromium	24.9	**73**
Iron	17,300	**56,200**
Lead	14.2	**28.6**
Manganese	387	**3,340**

SITE ID	DTSW1	DTSW1-2
DEPTH (ft)	0–0	0–0
TAL Metals (ug/L)		
Copper	18.1 B	34.8 J
Lead	ND	4.6 K

SITE ID	DTSD2	DTSD2-2
DEPTH (ft)	0–0.5	0–0.5
TAL Metals (mg/kg)		
Beryllium	**1.2** B	**1.1**

SITE ID	DTSD05
DEPTH (ft. bgs)	0–0.5
PAHs (ug/kg)	
Benzo(a)pyrene	350
TAL Metals (mg/kg)	
Beryllium	**1.03** J

SITE ID	DTSD1	DTSD1-2
DEPTH (ft)	0–0.5	0–0.5
NO EXCEEDANCES		

LEGEND:
- 1998 INDEPENDENT SAMPLING SEDIMENT SAMPLE LOCATION (GANNETT FLEMING)
- 1998 RI SURFACE WATER/SEDIMENT SAMPLE LOCATION (ICF KAISER)
- 1998 RI SOIL BORING LOCATION (ICF KAISER)
- 2002 SOIL BORING LOCATION (SHAW)
- 2002 SURFACE WATER/SEDIMENT LOCATION (SHAW)
- CREEK FLOW DIRECTION
- **PROPOSED SURFACE SOIL SAMPLE**

NOTE:
B = BLANK CONTAMINATION
J = ESTIMATED CONCENTRATION
K = ESTIMATED CONCENTRATION BIAS HIGH
L = ESTIMATED CONCENTRATION BIAS LOW
NA = ANALYTE NOT TESTED
UJ = ESTIMATED NON-DETECT
DARK BORDER = VALUE EXCEEDS THE RESIDENTIAL SCREENING LEVEL (USEPA; APRIL, 2003) OR NRWQC (CHRONIC) (USEPA, 1999)
SHADING = VALUE EXCEEDS THE INDUSTRIAL OR TAP WATER SCREENING LEVEL (USEPA; APRIL, 2003)
BOLD = VALUE EXCEEDS THE BACKGROUND CRITERION (IT, 2001)
VALUES DETECTED BELOW BACKGROUND ARE NOT SHOWN

Sample Summary

Investigation	Contractor	TAL Metals				VOCs				SVOCs				PAHs				Explosives				Pest			PCBs				Herb			Perch	Total
		SS	SB	SW	SD	SS	SB	SW	SD	SS	SB	SW	SD	SS	SB	SW	SD	SS	SB	SW	SD	SW	SD	SS	SB	SW	SD	SS	SW	SD	SW	
1997 Prelim. Sampling	ATK	---	---	---	---	---	---	---	---	1	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2
1998 Independent Sampling	GF	---	---	1	3	---	---	1	3	---	---	1	3	---	---	---	---	---	---	1	3	---	---	---	---	1	3	---	---	---	---	20
1998 RI	ICF Kaiser	3	34	7	7	3	34	7	7	3	34	7	7	3	34	7	7	3	34	7	7	---	---	---	---	---	---	---	---	---	---	255
2002 Investigation	Shaw	2	2	6	6	2	2	6	6	---	---	---	---	2	2	6	6	---	---	---	---	1	2	2	2	2	6	6	1	2	2	6	80

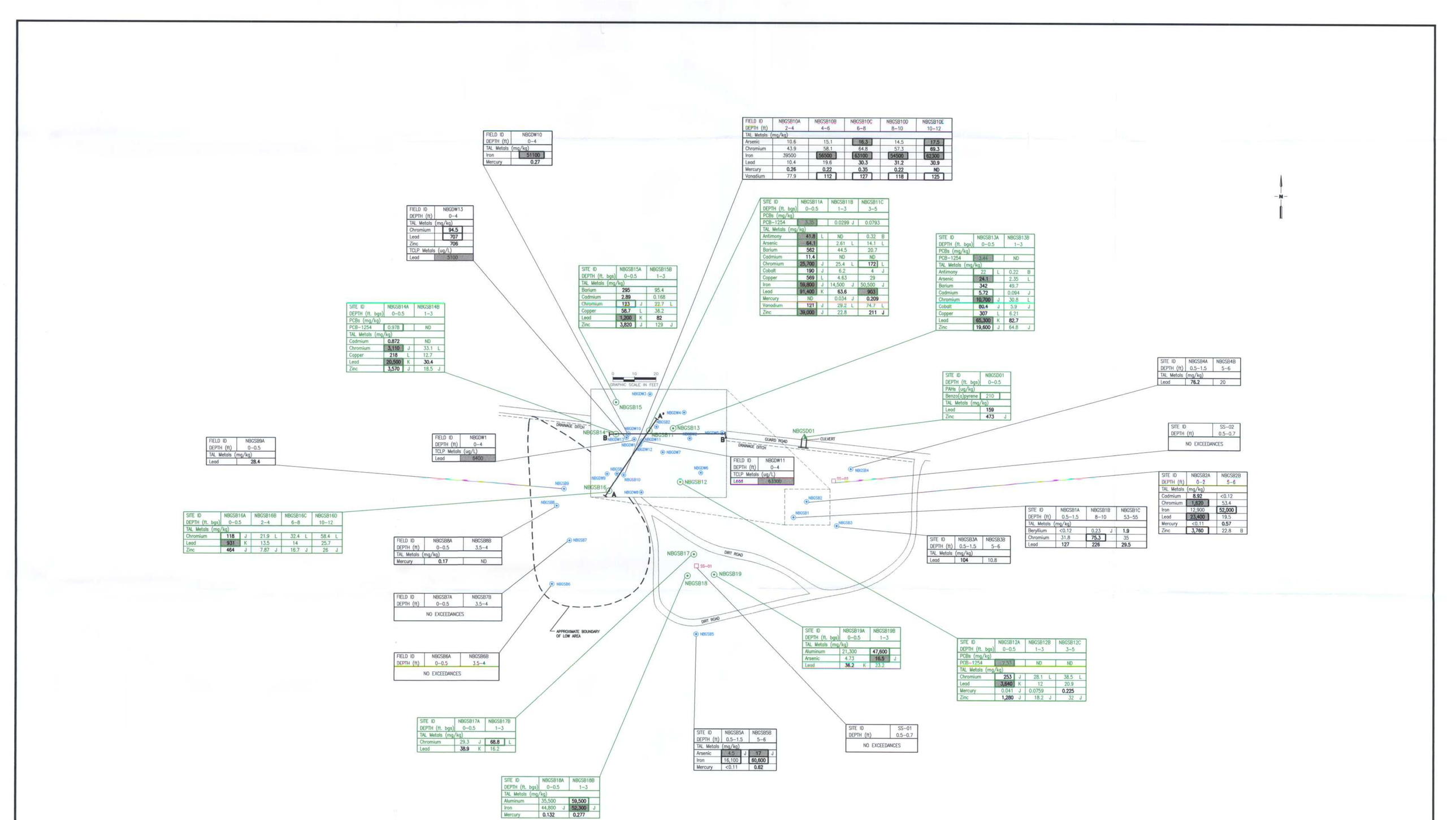
RADFORD AAP

EXHIBIT 2

BUILDING DEBRIS DISPOSAL TRENCH
PROPOSED SAMPLING

PREPARED BY: SHAW	TASK NO: 8296705320000
CHECKED BY: MT	SHAW DWG NO: EXHIBIT 2.dwg
DATE: REVISED APRIL 2004	

05018\84_2/8



LEGEND:

- 1998/1999 RI SOIL BORING LOCATION (ICF KAISER)
- 1997 INDEPENDENT SAMPLING SURFACE SOIL SAMPLE (GANNETT FLEMING)
- 2002 SOIL BORING LOCATION (SHAW)
- 2002 SURFACE SOIL LOCATION (SHAW)
- 2002 SEDIMENT LOCATION (SHAW)

NOTE:

B = BLANK CONTAMINATION
J = ESTIMATED CONCENTRATION
K = ESTIMATED CONCENTRATION BIAS HIGH
L = ESTIMATED CONCENTRATION BIAS LOW
UJ = ESTIMATED NON-DETECT
DARK BORDER = VALUE EXCEEDS THE RESIDENTIAL SCREENING LEVEL (USEPA; APRIL, 2003)
SHADING = VALUE EXCEEDS THE INDUSTRIAL SCREENING LEVEL (USEPA; APRIL, 2003) OR TCLP CRITERIA (USEPA 40 CFR 261.4)
BOLD = VALUE EXCEEDS THE BACKGROUND CRITERION (IT, 2001)
VALUES DETECTED BELOW BACKGROUND ARE NOT SHOWN

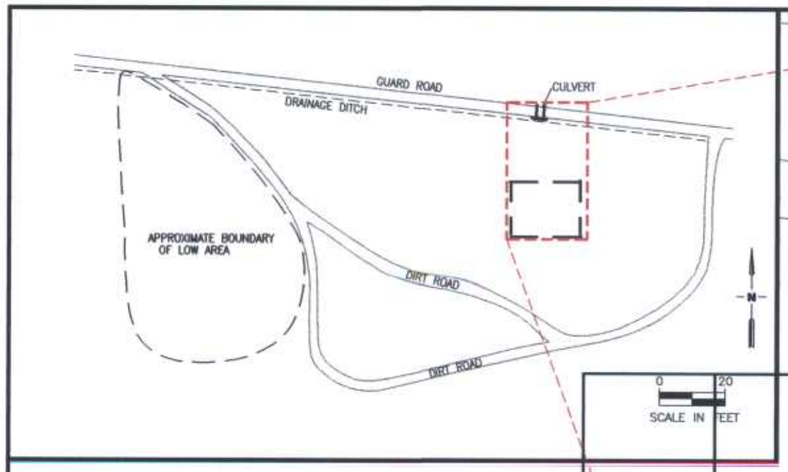
Sample Summary

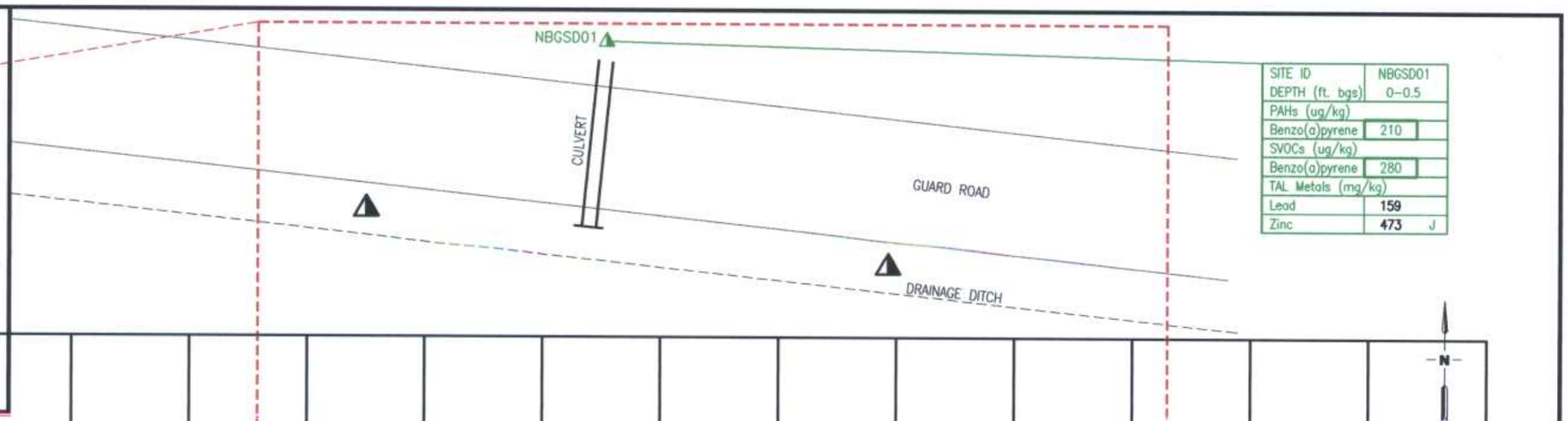
Investigation	Contractor	TAL Metals			Cyanide	VOCs			SVOCs			PAHs			Explosives			Pest		PCBs			Herb		Dioxins/Furans			TCLP Metals			Total
		SS	SB	SD	SS	SS	SB	SD	SS	SB	SD	SS	SB	SD	SS	SB	SD	SS	SD	SS	SB	SD	SS	SD	SS	SB	SD	SS	SB	SD	
1997 Independent Sampling	GF	2	---	---	2	2	---	---	2	---	---	---	---	---	1	---	---	---	---	2	---	---	---	---	---	---	---	---	---	---	11
1998 RI	ICF Kaiser	4	7	---	---	4	7	---	4	7	---	---	---	---	4	7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	44
1999 RI	ICF Kaiser	4	11	---	---	4	10	---	4	9	---	4	8	---	4	8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	74
2002 Investigation	Shaw	9	13	1	---	3	3	1	---	---	1	---	---	1	---	---	1	3	1	9	13	1	3	1	9	13	1	2	2	6	97

0 30 60 120
SCALE IN FEET

RADFORD AAP	EXHIBIT 3
PREPARED BY: SHAW	TASK NO: 0206780370000
CHECKED BY: MT	SHAW DWG NO. Exhibit 3.DWG
DATE: REVISED APRIL 2004	NORTHERN BURNING GROUND SITE MAP AND PREVIOUS INVESTIGATION RESULTS

05018\84-3/78





SITE ID	NBGSD01
DEPTH (ft. bgs)	0–0.5
PAHs (ug/kg)	
Benzo(a)pyrene	210
SVOCs (ug/kg)	
Benzo(a)pyrene	280
TAL Metals (mg/kg)	
Lead	159
Zinc	473 J

SITE ID	NBGSB15A	NBGSB15B
DEPTH (ft. bgs)	0–0.5	1–3
TAL Metals (mg/kg)		
Barium	295	95.4
Cadmium	2.89	0.368
Chromium	123 J	22.7 L
Copper	58.7 L	36.2
Lead	1,200 K	82
Zinc	3,820 J	129 J

SITE ID	NBGSB11A	NBGSB11B	NBGSB11C
DEPTH (ft. bgs)	0–0.5	1–3	3–5
PCBs (mg/kg)			
PCB–1254	3.35	0.0299 J	0.0793
TAL Metals (mg/kg)			
Antimony	41.8 L	ND	0.32 B
Arsenic	64.1	2.61 L	14.1 L
Barium	562	44.5	20.7
Cadmium	11.4	ND	ND
Chromium	25,700 J	25.4 L	72 L
Cobalt	190 J	6.2	4 J
Copper	569 L	4.63	29
Iron	59,800 J	14,500 J	50,300 J
Lead	91,400 K	63.6	903
Mercury	ND	0.034 J	0.209
Vanadium	121 J	29.2 L	74.7 L
Zinc	39,000 J	22.8	211 J

SITE ID	NBGSB14A	NBGSB14B
DEPTH (ft. bgs)	0–0.5	1–3
PCBs (mg/kg)		
PCB–1254	0.978	ND
TAL Metals (mg/kg)		
Cadmium	0.872	ND
Chromium	3,110 J	34.1 L
Copper	218 L	12.7
Lead	20,500 K	30.4
Zinc	3,570 J	118.5 J

FIELD ID	NBGDW10
DEPTH (ft)	0–4
TAL Metals (mg/kg)	
Iron	51100
Mercury	0.27

SITE ID	NBGSB2A	NBGSB2B
DEPTH (ft)	0–2	5–6
TAL Metals (mg/kg)		
Cadmium	8.92	<0.12
Chromium	1,620	53.4
Iron	12,900	52,000
Lead	23,400	19.5
Mercury	<0.11	0.57
Zinc	3,760	22.8 B

SITE ID	NBGSB13A	NBGSB13B
DEPTH (ft. bgs)	0–0.5	1–3
PCBs (mg/kg)		
PCB–1254	3.44	ND
TAL Metals (mg/kg)		
Antimony	22 L	0.22 B
Arsenic	24.1	2.35 L
Barium	342	49.7
Cadmium	5.72	0.094 J
Chromium	10,700 J	30.8 L
Cobalt	80.4 J	5.9 J
Copper	307 L	6.21
Lead	65,300 K	82.7
Zinc	19,600 J	64.8 J

FIELD ID	NBGDW13
DEPTH (ft)	0–4
TAL Metals (mg/kg)	
Chromium	94.5
Lead	707
Zinc	706
TCLP Metals (ug/L)	
Lead	5100

FIELD ID	NBGDW1
DEPTH (ft)	0–4
TCLP Metals (ug/L)	
Lead	6400

FIELD ID	NBGDW11
DEPTH (ft)	0–4
TCLP Metals (ug/L)	
Lead	65300

SITE ID	NBGSB1A	NBGSB1B	NBGSB1C
DEPTH (ft)	0.5–1.5	8–10	53–55
TAL Metals (mg/kg)			
Beryllium	<0.12	0.23 J	1.9
Chromium	31.8	75.3	35
Lead	127	226	29.5

SITE ID	NBGSB12A	NBGSB12B	NBGSB12C
DEPTH (ft. bgs)	0–0.5	1–3	3–5
PCBs (mg/kg)			
PCB–1254	2.53	ND	ND
TAL Metals (mg/kg)			
Chromium	253 J	28.1 L	38.5 L
Lead	3,640 K	12	20.9
Mercury	0.041 J	0.0759	0.225
Zinc	1,280 J	18.2 J	32 J

SITE ID	NBGSB16A	NBGSB16B	NBGSB16C	NBGSB16D
DEPTH (ft. bgs)	0–0.5	2–4	6–8	10–12
TAL Metals (mg/kg)				
Chromium	118 J	21.9 L	32.4 L	58.4 L
Lead	931 K	13.5	14	25.7
Zinc	464 J	7.87 J	16.7 J	26 J

FIELD ID	NBGSB10A	NBGSB10B	NBGSB10C	NBGSB10D	NBGSB10E
DEPTH (ft)	2–4	4–6	6–8	8–10	10–12
TAL Metals (mg/kg)					
Arsenic	10.6	15.1	16.3	14.5	17.5
Chromium	43.9	58.1	64.8	57.3	69.3
Iron	39500	56500	63100	54500	62300
Lead	10.4	19.6	30.3	31.2	30.9
Mercury	0.26	0.22	0.35	0.22	0.15
Vanadium	77.9	112	127	118	125

NBGDW3
NBGSB15
NBGDW4
NBGSB14
NBGDW10
NBGSB11
NBGSB13
NBGDW5
NBGDW13
NBGDW1
NBGDW11
NBGDW12
NBGDW2
NBGDW7
NBGDW9
NBGSB1
NBGSB10
NBGDW6
NBGSB12
NBGSB16
NBGDW8

LEGEND:

- 1998/1999 RI SOIL BORING LOCATION (ICF KAISER)
- 2002 SOIL BORING LOCATION (SHAW)
- 2002 SOIL BORING LOCATION (SHAW)
- MAIN BURNING AREA
- PROPOSED XRF SAMPLE
- PROPOSED BORING
- PROPOSED BORING

NOTE:

B = BLANK CONTAMINATION
J = ESTIMATED CONCENTRATION
K = ESTIMATED CONCENTRATION BIAS HIGH
L = ESTIMATED CONCENTRATION BIAS LOW
DARK BORDER = VALUE EXCEEDS THE RESIDENTIAL SCREENING LEVEL (USEPA; APRIL, 2003)
SHADING = VALUE EXCEEDS THE INDUSTRIAL SCREENING LEVEL (USEPA; APRIL, 2003) OR TCLP CRITERIA (USEPA 40 CFR 261.4)
BOLD = VALUE EXCEEDS THE BACKGROUND CRITERION (IT, 2001)
VALUES DETECTED BELOW BACKGROUND ARE NOT SHOWN

0 3 6
SCALE IN FEET

PLOT: 4-28-04
FILE: Exhibit 4.dwg

RADFORD AAP

EXHIBIT 4

NORTHERN BURNING GROUND

PROPOSED SAMPLING

PREPARED BY: SHAW	TASK NO: 829870057000000
CHECKED BY: MT	SHAW DWG NO: Exhibit 4.DWG
DATE REVISED APRIL 2004	

05018\84-4/8

SITE ID	DTSW4
DEPTH (ft)	0–0
TAL Metals (ug/L)	
Aluminum	232 B
Copper	20.2 K

FIELD ID	WBGSD4
DEPTH (ft)	0–0.5
NO EXCEEDANCES	

FIELD ID	WBGSB21	WBGSB21A
DEPTH (ft)	0–2	2–4
NO EXCEEDANCES		

FIELD ID	WBGSB18	WBGSB18A
DEPTH (ft)	0–2	2–4
NO EXCEEDANCES		

FIELD ID	WBGSB15	WBGSB15A
DEPTH (ft)	0–2	2–4
TAL Metals (mg/kg)		
Mercury	<0.1	0.14 K

SAMPLE ID	WBGSB25A	WBGSB25B	WBGSB25C
DEPTH (ft. bgs)	0–0.5	2–4	6–8
PAHs (ug/kg)			
Benzo(a)anthracene	970	ND	ND
Benzo(a)pyrene	1,100	ND	ND
Benzo(b)fluoranthene	1,800	ND	ND
Dibenz(a,h)Anthracene	220	ND	ND
Indeno(1,2,3-cd)pyrene	1,100	ND	ND
TAL Metals (mg/kg)			
Beryllium	0.6 L	ND	3.25 J
Chromium	69.6	20.8 L	62.3 L
Lead	259	19.3	30.5
Zinc	449	24 J	35.1 J

FIELD ID	WBGSB14	WBGSB14A
DEPTH (ft)	0–2	2–4
TAL Metals (mg/kg)		
Lead	33.3	21.3

FIELD ID	WBGSB12
DEPTH (ft)	0–4
TAL Metals (mg/kg)	
Mercury	0.2

FIELD ID	WBGSB20	WBGSB20A
DEPTH (ft)	0–2	2–4
TAL Metals (mg/kg)		
Beryllium	1.1 B	0.66 B
Lead	28.9	23.6
Mercury	0.16 K	0.18 K

SAMPLE ID	WBGSB24A	WBGSB24B	WBGSB24C
DEPTH (ft. bgs)	0–0.5	2–4	6–8
PAHs (ug/kg)			
Benzo(a)pyrene	540	6	ND
Benzo(b)fluoranthene	970	1.3	ND
Dibenz(a,h)Anthracene	130	1.3 J J	ND
TAL Metals (mg/kg)			
Lead	79.1	23.3	33.1

SITE ID	WBGSD12
DEPTH (ft. bgs)	0–0.5
TAL Metals (mg/kg)	
Lead	28.5

SAMPLE ID	WBGSB23A	WBGSB23B	WBGSB23C
DEPTH (ft. bgs)	0–0.5	2–4	4–5
TAL Metals (mg/kg)			
Aluminum	23,900	24,100	41,600
Beryllium	0.75 L	1.09 J	1.55 J
Lead	26.9 J	21.5	18.1

FIELD ID	WBGSB17	WBGSB17A
DEPTH (ft)	0–2	2–4
TAL Metals (mg/kg)		
Lead	26.9	26.9

FIELD ID	WBGSW5
DEPTH (ft)	0–0
TAL Metals (ug/L)	
Arsenic	8.6 B
Lead	4 B

FIELD ID	WBGSD5	WBGSD5-2
DEPTH (ft)	0–0.5	0–0.5
TAL Metals (mg/kg)		
Chromium	39.3	96.9
Lead	347 J	899
Zinc	104 K	209

FIELD ID	WBGSB19	WBGSB19A
DEPTH (ft)	0–2	2–4
NO EXCEEDANCES		

FIELD ID	WBGSB16	WBGSB16A
DEPTH (ft)	0–2	2–4
TAL Metals (mg/kg)		
Lead	44.4	25.3

FIELD ID	WBGBC1A	WBGBC1B
DEPTH (ft)	0–2	5–7
TAL Metals (mg/kg)		
Aluminum	27,900	46,500
Beryllium	0.83 B	2.5
Lead	33.2	18.6
Mercury	0.19	0.12
Zinc	414	59.5

SITE ID	WBGSD11
DEPTH (ft. bgs)	0–0.5
TAL Metals (mg/kg)	
Lead	29.4

SITE ID	WBGSW10
DEPTH (ft. bgs)	0–0
VOCs (ug/L)	
Chloroform	1.1
TAL Metals (ug/L)	
Aluminum	304
Lead	28.9

SITE ID	WBGSD10
DEPTH (ft. bgs)	0–0.5
TAL Metals (mg/kg)	
Antimony	3.1 L
Beryllium	2.27
Cadmium	2.7
Chromium	15,400
Cobalt	84.1
Copper	188 J
Lead	109,000
Zinc	17,300

SITE ID	SW-02
DEPTH (ft)	0–0
TAL Metals (ug/L)	
Vanadium	75

SITE ID	SD-02
DEPTH (ft)	0–0.5
TAL Metals (mg/kg)	
Copper	85.1
Lead	36.6

SAMPLE ID	WBGSB22A	WBGSB22B	WBGSB22C
DEPTH (ft. bgs)	0–0.5	2–4	6–8
PAHs (ug/kg)			
Benzo(a)pyrene	1.7	330	2.9
SVOCs (ug/kg)			
Dibenz(a,h)Anthracene	ND	170 J	ND
PCBs (mg/kg)			
PCB-1254	ND	0.875	ND
TAL Metals (mg/kg)			
Antimony	ND	4.26 L	ND
Arsenic	7.53 L	29 L	7.54 L
Barium	26.9	295	147
Cadmium	ND	2.95	ND
Chromium	30.3	256 L	56.6 L
Copper	16.4	174	32.5
Iron	26,300	61,800 J	36,100 J
Lead	25.3 J	965	86.5
Zinc	36.3	1,510 J	50 J

FIELD ID	WBGSB10A
DEPTH (ft)	0–2
TAL Metals (mg/kg)	
Mercury	0.21 K

FIELD ID	WBGSB11A
DEPTH (ft)	0–2
NO EXCEEDANCES	

FIELD ID	WBGSB6A
DEPTH (ft)	0–2
NO EXCEEDANCES	

FIELD ID	WBGSB7A
DEPTH (ft)	0–2
NO EXCEEDANCES	

FIELD ID	WBGSB8A
DEPTH (ft)	0–2
TAL Metals (mg/kg)	
Arsenic	17.1
Cadmium	0.74
Lead	79.4 J
Zinc	381 K

FIELD ID	WBGSB13	WBGSB13A
DEPTH (ft)	0–2	2–4
TAL Metals (mg/kg)		
Beryllium	0.59 B	1.3 B

FIELD ID	WBGSB9A
DEPTH (ft)	0–2
TAL Metals (mg/kg)	
Lead	43.6 J
Mercury	0.21 K

FIELD ID	WBGSW6
DEPTH (ft)	0–0
TAL Metals (ug/L)	
Aluminum	91.8 B
Arsenic	10.4 K

FIELD ID	WBGSD6
DEPTH (ft)	0–0.5
TAL Metals (mg/kg)	
Lead	29.5 J

UNNAMED POND

UNLINED DRAINAGE DITCH

UNLINED DRAINAGE SWALE

1999 RI TEST PIT AREA

PINE TREES

MOUND

SLOPE

BERM

TOE OF BERM

DIRT ROAD

ASPHALT ROAD

FORMER BURN CAGE (NOT TO SCALE)

TO POND

APPROXIMATE POND BOUNDARY

LEGEND

- 1999 RI SOIL BORING (ICF KAISER)
- 1999 QUALITATIVE SOIL BORING (ICF KAISER)
- 2002 SOIL BORING LOCATION (SHAW)
- 1997 SURFACE WATER/SEDIMENT SAMPLE LOCATION (GANNETT FLEMING)
- 1998/1999 RI SURFACE WATER/SEDIMENT SAMPLE LOCATION (ICF KAISER)
- 2002 SURFACE WATER/SEDIMENT LOCATION (SHAW)
- 2002 SEDIMENT LOCATION (SHAW)
- CREEK FLOW DIRECTION

NOTE:

B = BLANK CONTAMINATION
J = ESTIMATED CONCENTRATION
K = ESTIMATED CONCENTRATION BIAS HIGH
L = ESTIMATED CONCENTRATION BIAS LOW
ND = NOT DETECTED
UJ = ESTIMATED NON-DETECT
DARK BORDER = VALUE EXCEEDS THE RESIDENTIAL SCREENING LEVEL (USEPA; APRIL, 2003)
SHADING = VALUE EXCEEDS THE INDUSTRIAL SCREENING LEVEL (USEPA; APRIL, 2003)
BOLD = VALUE EXCEEDS THE BACKGROUND CRITERION (IT, 2001)
VALUES DETECTED BELOW BACKGROUND ARE NOT SHOWN

0 9 18 36
SCALE IN FEET

RADFORD AAP	EXHIBIT 5
PREPARED BY: SHAW	TASK NO: 8396783800000
CHECKED BY: MT	SHAW DWG NO: Exhibit 5.dwg
DATE: REVISED APRIL 2004	WESTERN BURNING GROUND
	SITE MAP AND PREVIOUS INVESTIGATION RESULTS

05018\84-9/8

SITE ID	DTSW4
DEPTH (ft)	0–0
TAL Metals (ug/L)	
Aluminum	232 B
Copper	20.2 K

FIELD ID	WBGSD4
DEPTH (ft)	0–0.5
NO EXCEEDANCES	

FIELD ID	WBGSB21	WBGSB21A
DEPTH (ft)	0–2	2–4
NO EXCEEDANCES		

FIELD ID	WBGSB18	WBGSB18A
DEPTH (ft)	0–2	2–4
NO EXCEEDANCES		

FIELD ID	WBGSB15	WBGSB15A
DEPTH (ft)	0–2	2–4
TAL Metals (mg/kg)		
Mercury	<0.1	**0.14** K

SAMPLE ID	WBGSB25A	WBGSB25B	WBGSB25C
DEPTH (ft. bgs)	0–0.5	2–4	6–8
PAHs (ug/kg)			
Benzo(a)anthracene	970	ND	ND
Benzo(a)pyrene	3,100	ND	ND
Benzo(b)fluoranthene	1,800	ND	ND
Dibenz(a,h)Anthracene	220	ND	ND
Indeno(1,2,3-cd)pyrene	1,100	ND	ND
TAL Metals (mg/kg)			
Beryllium	0.6 L	ND	**3.25** J
Chromium	**69.6**	20.8 L	62.3 L
Lead	**259**	19.3	**30.5**
Zinc	**449**	24 J	35.1 J

FIELD ID	WBGSB14	WBGSB14A
DEPTH (ft)	0–2	2–4
TAL Metals (mg/kg)		
Lead	**33.3**	21.3

FIELD ID	WBGSB12
DEPTH (ft)	0–4
TAL Metals (mg/kg)	
Mercury	**0.2**

FIELD ID	WBGSB20	WBGSB20A
DEPTH (ft)	0–2	2–4
TAL Metals (mg/kg)		
Beryllium	**1.1** B	0.66 B
Lead	**28.9**	23.6
Mercury	**0.16** K	**0.18** K

SAMPLE ID	WBGSB24A	WBGSB24B	WBGSB24C
DEPTH (ft. bgs)	0–0.5	2–4	6–8
PAHs (ug/kg)			
Benzo(a)pyrene	2,540	6	ND
Benzo(b)fluoranthene	970	13	ND
Dibenz(a,h)Anthracene	130	1.3 J J	ND
TAL Metals (mg/kg)			
Lead	**79.1**	23.3	**33.1**

FIELD ID	WBGSB17	WBGSB17A
DEPTH (ft)	0–2	2–4
TAL Metals (mg/kg)		
Lead	**26.9**	**26.9**

SITE ID	WBGSD12
DEPTH (ft. bgs)	0–0.5
TAL Metals (mg/kg)	
Lead	**28.5**

FIELD ID	WBGSW5
DEPTH (ft)	0–0
TAL Metals (ug/L)	
Arsenic	8.6 B
Lead	4 B

SAMPLE ID	WBGSB23A	WBGSB23B	WBGSB23C
DEPTH (ft. bgs)	0–0.5	2–4	4–5
TAL Metals (mg/kg)			
Aluminum	23,900	24,100	**41,600**
Beryllium	0.75 L	**1.09** J	**1.55** J
Lead	**26.9** J	21.5	18.1

FIELD ID	WBGSD5	WBGSD5-2
DEPTH (ft)	0–0.5	0–0.5
TAL Metals (mg/kg)		
Chromium	39.3	**96.9**
Lead	**347** J	**899**
Zinc	104 K	**209**

FIELD ID	WBGSB19	WBGSB 9A
DEPTH (ft)	0–2	2–4
NO EXCEEDANCES		

FIELD ID	WBGSB16	WBGSB16A
DEPTH (ft)	0–2	2–4
TAL Metals (mg/kg)		
Lead	**44.4**	25.3

SITE ID	WBGSD11
DEPTH (ft. bgs)	0–0.5
TAL Metals (mg/kg)	
Lead	**29.4**

FIELD ID	WBGBC1A	WBGBC1B
DEPTH (ft)	0–2	5–7
TAL Metals (mg/kg)		
Aluminum	27,900	**46,500**
Beryllium	0.83 B	**2.5**
Lead	**33.2**	18.6
Mercury	**0.19**	0.12
Zinc	**414**	59.5

SITE ID	WBGSW10
DEPTH (ft. bgs)	0–0
VOCs (ug/L)	
Chloroform	1.5
TAL Metals (ug/L)	
Aluminum	304
Lead	28.9

SITE ID	WBGSD10
DEPTH (ft. bgs)	0–0.5
TAL Metals (mg/kg)	
Antimony	3.1 L
Beryllium	**2.27**
Cadmium	**2.7**
Chromium	**15,400**
Cobalt	**84.1**
Copper	**188** J
Lead	**109,000**
Zinc	**17,300**

SITE ID	SW-02
DEPTH (ft)	0–0
TAL Metals (ug/L)	
Vanadium	75

SITE ID	SD-02
DEPTH (ft)	0–0.5
TAL Metals (mg/kg)	
Copper	**88.1**
Lead	**34.5**

SAMPLE ID	WBGSB22A	WBGSB22B	WBGSB22C
DEPTH (ft. bgs)	0–0.5	2–4	6–8
PAHs (ug/kg)			
Benzo(a)pyrene	1.7	330	2.9
SVOCs (ug/kg)			
Dibenz(a,h)Anthracene	ND	170 J	ND
PCBs (mg/kg)			
PCB-1254	ND	0.875	ND
TAL Metals (mg/kg)			
Antimony	ND	4.26 L	ND
Arsenic	7.53 L	**29** L	7.54 L
Barium	26.9	**295**	47
Cadmium	ND	**2.95**	ND
Chromium	30.3	**256** L	54.6 L
Copper	16.4	**174**	32.5
Iron	26,300	**61,800** J	36,100 J
Lead	25.3 J	**965**	**86.5**
Zinc	36.3	**1,510** J	50 J

FIELD ID	WBGSB10A
DEPTH (ft)	0–2
TAL Metals (mg/kg)	
Mercury	**0.21** K

FIELD ID	WBGSB11A
DEPTH (ft)	0–2
NO EXCEEDANCES	

FIELD ID	WBGSB6A
DEPTH (ft)	0–2
NO EXCEEDANCES	

FIELD ID	WBGSB7A
DEPTH (ft)	0–2
NO EXCEEDANCES	

FIELD ID	WBGSB8A
DEPTH (ft)	0–2
TAL Metals (mg/kg)	
Arsenic	**17.1**
Cadmium	**0.74**
Lead	**79.4** J
Zinc	**381** K

FIELD ID	WBGSW6
DEPTH (ft)	0–0
TAL Metals (ug/L)	
Aluminum	91.8 B
Arsenic	10.4 K

FIELD ID	WBGSD6
DEPTH (ft)	0–0.5
TAL Metals (mg/kg)	
Lead	**28.5** J

FIELD ID	WBGSB13	WBGSB13A
DEPTH (ft)	0–2	2–4
TAL Metals (mg/kg)		
Beryllium	0.59 B	1.3 B

FIELD ID	WBGSB9A
DEPTH (ft)	0–2
TAL Metals (mg/kg)	
Lead	**43.6** J
Mercury	**0.21** K

UNNAMED POND

UNLINED DRAINAGE DITCH

UNLINED DRAINAGE SWALE

1999 RI TEST PIT AREA

PINE TREES

MOUND

SLOPE

BERM

TOE OF BERM

DIRT ROAD

ASPHALT ROAD

FORMER BURN CAGE (NOT TO SCALE)

TO POND

APPROXIMATE POND BOUNDARY

LEGEND

- 1999 RI SOIL BORING (ICF KAISER)
- 1999 QUALITATIVE SOIL BORING (ICF KAISER)
- 2002 SOIL BORING LOCATION (SHAW)
- 1997 SURFACE WATER/SEDIMENT SAMPLE LOCATION (GANNETT FLEMING)
- 1998/1999 RI SURFACE WATER/SEDIMENT SAMPLE LOCATION (ICF KAISER)
- 2002 SURFACE WATER/SEDIMENT LOCATION (SHAW)
- 2002 SEDIMENT LOCATION (SHAW)
- CREEK FLOW DIRECTION
- PROPOSED XRF SAMPLE
- PROPOSED BORING
- PROPOSED SEDIMENT SAMPLE
- PROPOSED SURFACE SOIL SAMPLE

NOTE:

B = BLANK CONTAMINATION
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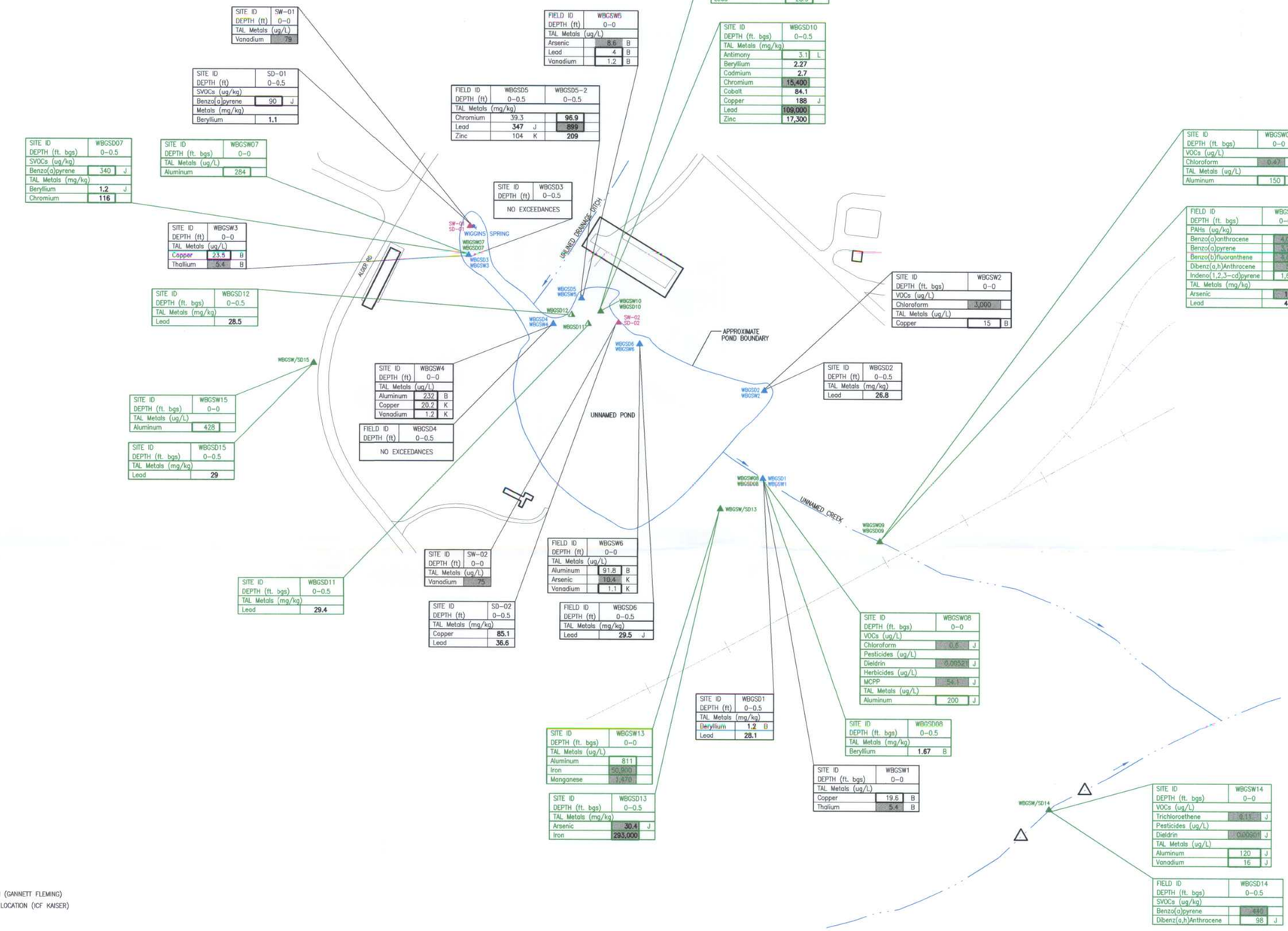
DARK BORDER = VALUE EXCEEDS THE RESIDENTIAL SCREENING LEVEL (USEPA; APRIL, 2003)
SHADING = VALUE EXCEEDS THE INDUSTRIAL SCREENING LEVEL (USEPA; APRIL, 2003)
BOLD = VALUE EXCEEDS THE BACKGROUND CRITERION (TT, 2001)
VALUES DETECTED BELOW BACKGROUND ARE NOT SHOWN

0 9 18 36
SCALE IN FEET

RADFORD AAP	EXHIBIT 6
PREPARED BY: SHAW	TASK NO. 826078100000
CHECKED BY: MT	SHAW DWG NO. Exhibit 6.dwg
DATE: REVISED APRIL 2004	WESTERN BURNING GROUND PROPOSED SAMPLING

05018\84 - 6/8



LEGEND

- 1997 SURFACE WATER/ SEDIMENT SAMPLE LOCATION (GANNETT FLEMING)
- 1998/1999 RI SURFACE WATER/ SEDIMENT SAMPLE LOCATION (ICF KAISER)
- 2002 SURFACE WATER/SEDIMENT LOCATION (SHAW)
- 2002 SEDIMENT LOCATION (SHAW)
- CREEK FLOW DIRECTION
- △ PROPOSED SURFACE WATER SAMPLE

NOTE:

B = BLANK CONTAMINATION
J = ESTIMATED CONCENTRATION
K = ESTIMATED CONCENTRATION BIAS HIGH
ND = NOT DETECTED
UJ = ESTIMATED NON-DETECT
DARK BORDER = VALUE EXCEEDS THE RESIDENTIAL SCREENNG LEVEL (USEPA; OCTOBER, 2003) OR NRWQC (CHRONIC) (USEPA, 1999)
SHADING = VALUE EXCEEDS THE INDUSTRIAL OR TAP WATER SCREENING LEVEL (USEPA; OCTOBER, 2003)
BOLD = VALUE EXCEEDS THE BACKGROUND CRITERION (IT, 2001)
VALUES DETECTED BELOW BACKGROUND ARE NOT SHOWN

Sample Summary

Investigation	Contractor	TAL Metals				Cyanide			VOCs				SVOCs				PAHs				Explosives				Pest			PCBs				Herb			Dioxins/Furans				TCLP Metals				Perch	Total
		SS	SB	SW	SD	SS	SW	SD	SS	SB	SW	SD	SS	SB	SW	SD	SS	SB	SW	SD	SS	SB	SW	SD	SS	SW	SD	SS	SB	SW	SD	SS	SW	SD	SS	SB	SW	SD	SS	SB	SW	SD	SW	
1997 Independent Sampling	GF	3	---	2	2	3	2	2	3	---	2	2	3	---	2	2	---	---	---	---	1	---	2	1	---	---	---	3	---	2	2	---	---	---	3	---	---	---	---	---	---	---	---	42
1998 RI	ICF Kaiser	1	7	3	3	---	---	---	1	7	3	3	1	7	3	3	---	---	1	---	1	7	3	3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	57
1999 RI	ICF Kaiser	6	66	3	4	---	---	---	---	6	---	---	5	53	3	3	---	6	---	---	---	6	---	---	---	---	---	---	---	---	---	---	---	---	---	1	7	---	---	---	---	3	179
2002 Investigation	Shaw	4	8	7	9	---	---	---	4	8	7	9	4	8	7	9	4	8	7	9	4	8	4	6	4	5	5	5	8	7	9	4	5	5	4	8	4	6	---	---	---	---	7	214

0 60 120 240
SCALE IN FEET

RADFORD AAP	EXHIBIT 7
PREPARED BY: SHAW	TASK NO: 626070530000
CHECKED BY: MT	SHAW DWG NO: Exhibit 7.dwg
DATE: REVISED APRIL 2004	WESTERN BURNING GROUND
	SURFACE WATER/SEDIMENT RESULTS AND PROPOSED SURFACE WATER SAMPLING LOCATIONS

05018\84-7/7