Comprehensive Long-term Environmental Action Navy

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Phase III Soils RCRA Facility Investigation Solid Waste Management Unit 7 Addendum for X-Ray Fluorescence Field Measurement and Soil Sampling for Select Metals at the Old Pistol Range

Naval Surface Warfare Center Crane Division

Crane, Indiana

September 2005

NAVFAC
Naval Facilities Engineering Command

Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

TETRA TECH NUS, Inc.

DEPARTMENT OF THE NAVY
CRANE DIVISION
NAVAL SURFACE WARFARE CENTER
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IN REPLY REFER TO:
5090/S4.7.1
Ser RP3/5155
5 MAY 2005

U.S. Environmental Protection Agency, Region V
Waste, Pesticides, & Toxics Division
Waste Management Branch
Corrective Action Section
77 West Jackson Blvd.
Chicago, IL 60604

Dear Mr. Ramanauskas:

Crane Division, Naval Surface Warfare Center submits the Draft Phase III Soils RCRA Facility Investigation (RFI) Sampling Addendum Report for the Old Pistol Range (OPR), Solid Waste Management Unit 7. The report is provided for your review and comment as enclosure (1). The permit required Certification Statement is provided as enclosure (2).

If you require any further information, my point of contact is Mr. Thomas J. Brent, Code RP3-TB, at 812-854-6160, email thomas.brent@navy.mil.

Sincerely,

James M. Hunsicker
JAMES M. HUNSICKER
Manager, Environmental Protection
By direction of the Commanding Officer

Enclosures: 1. Draft Phase III Soils RFI OPR Addendum Report
2. Certification Statement

Copy to:
ADMINISTRATIVE RECORD
SOUTHNAVFACENGCOM (Code ES31) (w/o encl)
IDEM (Doug Griffin)
TTNUS (Ralph Basinski) (w/o encl)

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

James M. Hunsucker

SIGNATURE

Manager, Environmental Protection — 5/05/05

TITLE — DATE

080203/P

PHASE III SOILS
RCRA FACILITY INVESTIGATION
SOLID WASTE MANAGEMENT UNIT 7
ADDENDUM FOR X-RAY FLUORESCENCE FIELD MEASUREMENT AND SOIL SAMPLING FOR SELECT METALS AT THE OLD PISTOL RANGE

NAVAL SURFACE WARFARE CENTER
CRANE DIVISION
CRANE, INDIANA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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Southern Division
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September 2005

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EXECUTIVE SUMMARY

Tetra Tech NUS, Inc. (TtNUS) prepared a document entitled Phase III Soils RCRA Facility Investigation for SWMU 7 [Old Rifle Range (ORR)] at Crane, IN (TtNUS, 2002), which was reviewed by the USEPA. In conjunction with that report, this Old Pistol Range (OPR) Soil Addendum discusses the results and recommendations associated with additional work requested by USEPA Region 5. The following describes the sequence of events leading to the preparation of this addendum and other potential activities in the future.

Draft Old Rifle Range (ORR) Phase III Soils RFI Report - November 2002

The objective of the ORR RFI was to provide data on select metal, polycyclic aromatic hydrocarbon (PAH), energetic material and heptachlor epoxide concentrations in NSWC Crane soils at the ORR (SWMU 7), which contains active and inactive portions. The scope of the RFI was to delineate the extent of soil contamination greater than risk-based target levels (RBTLs) and background concentrations for the previously identified contaminants of concern (COCs) at the ORR. Section 1 presented a detailed discussion of site operations and conditions. Soil sampling and analyses were conducted at SWMU 7 (at both the ORR and OPR) between 2001 and 2002. The actions described in the following sections needed to be completed before the final version of the ORR RFI could be completed (September, 2005).

Voluntary Interim Measure (ORR) - October 2003

Based on conclusions and recommendations developed in the draft version of the ORR RFI Report (November 2002), the Navy conducted a Voluntary Interim Measure (VIM) in the summer of 2003 to excavate a limited amount of soil containing high concentrations of 2,4,6-trinitrotoluene (TNT). The high concentrations observed at two locations (soil borings [SB]16 at 9,900 ppm and SB47 at 940 ppm) were driving approximately 95% of the calculated risk for the site presented in the draft report. Completion of the VIM resulted in significantly lower TNT concentrations and associated reductions in risk for the site. The VIM Letter Report and After Action Report are provided in Appendix I of the ORR RFI Report. Section 4 of the final ORR RFI Report was modified to reflect the lower risks resulting from this targeted excavation.

EPA Approval – June 2004

After review of the draft versions of both of the reports discussed above, Mr. Peter Ramanauskas (USEPA Region 5 Environmental Scientist) indicated in a letter dated June 17, 2004 that the Phase III Soils RFI Report covering the ORR was acceptable as is, although he indicated additional investigative work was required at the Old Pistol Range (OPR) located to the north of the ORR portion of the SWMU.

This was partially based on potential metals contamination in soil (primarily lead) as described in a previous U.S. Army Corps of Engineers report.

Old Pistol Range (OPR) Soil Addendum Report (X-ray Fluorescence) – April 2005

This Old Pistol Range (OPR) Soil Addendum Report summarizes work that TtNUS conducted to investigate the berms and firing lanes at the OPR to address the requirements outlined by EPA. Surface and subsurface soil samples were collected for select metals analysis by both X-ray fluorescence and a fixed-base laboratory for the purposes of characterizing the vertical and horizontal extent of potential metals contamination and to conduct human health and ecological risk screening assessments. A draft OPR Soil Addendum Report covering the investigation, conclusions and recommendations was prepared in April, 2005. EPA reviewed this draft report and indicated that it could also be finalized. This final OPR Soil Addendum Report (September, 2005) is not an attachment or appendix to the final ORR RFI, but rather a stand-alone document that is part of a set of documents covering RFI activities at this SWMU.

Old Rifle Range (ORR) Recent Observations - August 2005

The Navy recently uncovered late-40s to early-50s vintage aerial photographs and drawings. Aerial photography clearly showed the evidence of a semi-circular shaped trap range and evidence of an additional small pistol range within the ORR. This small pistol range and trap range are also indicated on an October 13,1947 drawing. Both of these areas are within the boundary of the ORR portion of the SWMU (not in the area of the OPR to the North). Following a site visit made on August 3, 2005 with EPA, the Navy, and TtNUS, it was decided that another phase of soil investigation (RFI Addendum 2) will be necessary to evaluate these recent observations. Another stand-alone document that will become part of the set of documents covering RFI activities at this SWMU will be produced following completion of any future investigations based on these recent observations.

1.0 INTRODUCTION

Tetra Tech NUS, Inc. (TtNUS) prepared a document entitled Phase III Soils RCRA Facility Investigation for SWMU 7 [Old Rifle Range (ORR)] at Crane, IN (TtNUS, 2002), which was reviewed by the USEPA. This Old Pistol Range (OPR) Soil Addendum Report discusses the results and recommendations associated with additional work requested by USEPA Region 5.

1.1 EPA TELECONFERENCE JUNE 29, 2004

The USEPA requested that additional investigation be conducted at the OPR which is located adjacent to the ORR. A telecon with the USEPA, the Navy and TtNUS was conducted on June 29, 2004 to discuss the proposed investigation. The following lists the persons present during the conference call followed by the proposed Objectives and Scope agreed upon for the investigation.

Attendees

Navy

Bill Gates (Remedial Project Manager – Southdiv)

Tom Brent (NSWC Crane Environmental Project Manager)

USEPA

Peter Ramanauskas (Project Manager)

Mario Mangino - Toxicologist

Greg Czajkowski – Environmental Scientist

Allen Debus - Chemist

TtNUS

Roger Clark (Task Order Manager [TOM])

Leeann Sinagoga (Human Health Risk Assessor)

Aaron Bernhardt (Ecological Risk Assessor)

Mark Francis (Deputy TOM)

1.2 OBJECTIVES AND SCOPE

The following objectives and scope were agreed upon for the requested additional investigation during the telecon with the USEPA, the Navy and TtNUS on June 29, 2004.

- The overall approach for this additional work, including the risk assessments should be similar to what was done for the Landfarm assessments (i.e., stream-lined QAPP and Report formats).

- For ecological risks, make any changes as necessary to benchmarks based on June 9, 2004 technical meeting with Navy, TtNUS, USEPA, and IDEM.

- The QAPP should have tables comparing screening levels to MDLs, similar to other QAPPs.

- X-Ray Fluorescence (XRF) methodology is suggested for field analysis of soils. The field screening samples will be complimented with fixed-base confirmatory lab samples. The fixed-based analysis should be done on 10 to 20 percent of the samples; a minimum of 10 samples should be analyzed by the fixed-based laboratory. The samples for fixed-based analysis should include a range of concentrations (not all biased to the high side or low side). The analytical program will include 5 metals:

  - lead
  - antimony
  - copper
  - tin
  - zinc

- TtNUS will propose the type of XRF unit and methodology for the field screening. The QAPP should define the acceptable level of correlation between XRF data and fixed-based data to determine if the screening data can be used in the risk assessment. If the correlation is good, USEPA indicated that the screening data can be used in the risk assessment. If the correlation is not good, fixed-based data will be used. All soil samples will be shipped to the laboratory so that the samples will be available for analysis, if needed.

- A short work plan addendum will be prepared specifying the objectives and scope of the soil sampling program, field screening analytical methods, fixed-base lab methods, risk-based target levels, detection limits for both field screening and fixed-base lab, and quality assurance samples.

- The QAPP should discuss in detail how the samples will be prepared (i.e., placed in plastic bag, dried, etc.). Large bullet fragments should be removed from the sample before analysis by XRF or fixed-based lab. Any fragments removed should be noted in the field notebook.

- Samples in the berm areas will be collected from the following depths: 0 to 3 inches, 3 to 6 inches, 6 to 12 inches, and 12 to 24 inches. Samples outside the berm areas will be collected at 0 to 3 inches and 3 to 6 inches. In both cases, additional samples will be taken at depth if necessary to determine the vertical extent of contamination. Discrete samples will be collected within the berm areas. However, a grid will be established for samples collected outside the berm areas (e.g., the range floor and surrounding area). Composite samples will be collected from sub areas established by the grid (no more than 5 sub-samples will collected to construct the composite for a sub-area of the grid). While the work plan will establish an initial grid for investigation of areas outside the berms, the grid may be expanded in the field as necessary to establish the horizontal extent of contamination. The approach will be similar to that used to collect samples for the RFI Report already submitted to EPA.

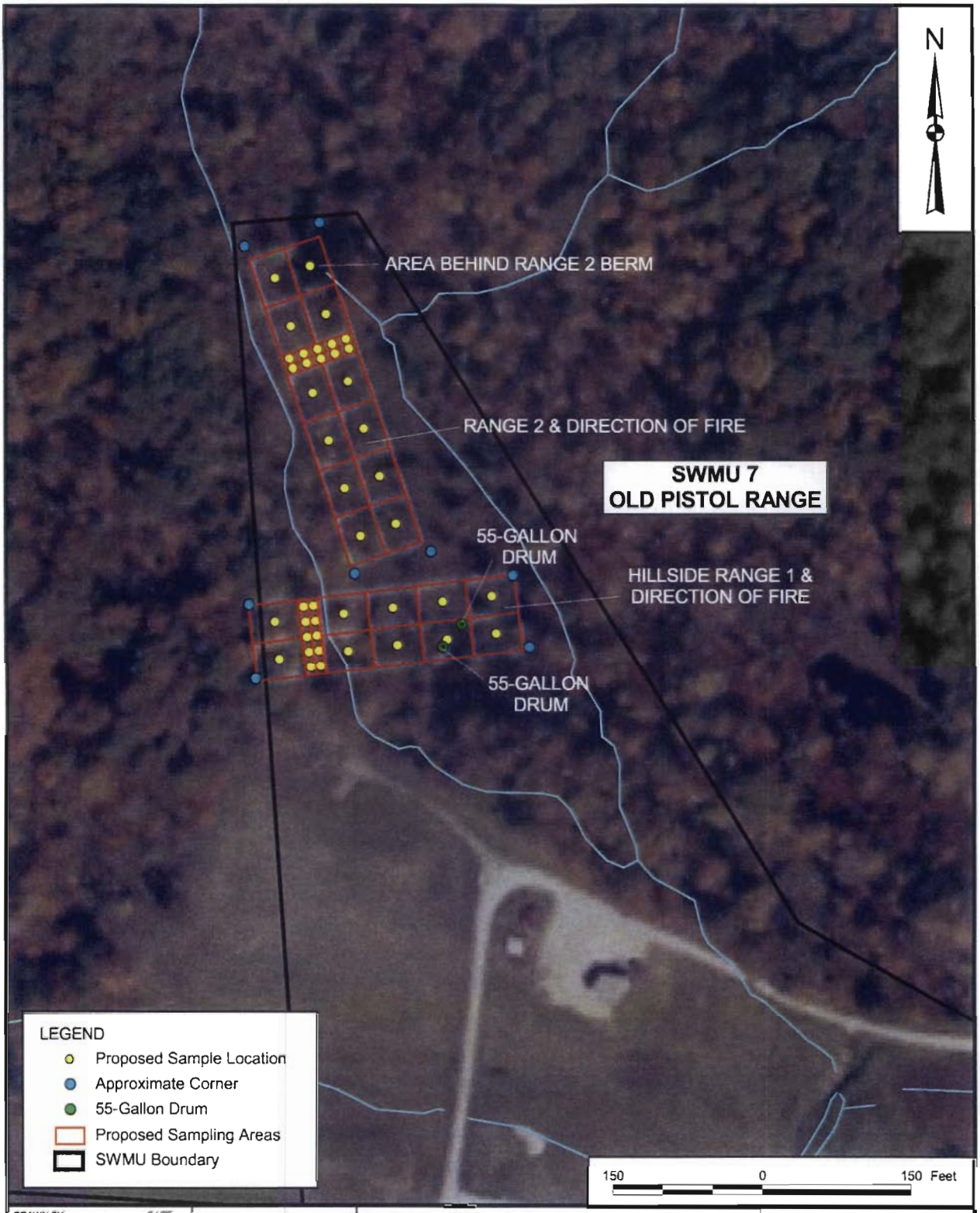
- The lower of the human health and ecological screening levels will be used to evaluate soil samples collected from 0 to 6 inches. Only human health screening levels will be used to evaluate soil samples collected from deeper than 6 inches because 6 inches is the biologically active zone for ecological receptors. Background levels will be used to evaluate the data if the screening levels are less than the base-wide background numbers.

1.3 BACKGROUND INFORMATION

This section presents a brief history of the OPR and the chain of events leading to the requested additional investigation. It should be noted that SWMU 7 consists of two adjoining sites; the ORR which is the larger and historically more active firing range (also used for ammunition burning) and the OPR which is a smaller firing range that was used less frequently. Currently the ORR is maintained (grass mowing and unimproved roadway maintenance, plus occasional ammunition burning) whereas the OPR has been allowed to revegetate.

Historical operations conducted at the OPR consisted of small arms firing within two discrete areas. These areas are illustrated in Figure 1-1. The first area identified as Hillside Range 1 consists of an open field (currently overgrown with volunteer shrubs and native trees) and an adjoining hillside. Reportedly, small arms shooters positioned themselves in the area close to the 55-gallon drum identified in Figure 1-1 and shot toward metal-framed targets located to the west. The backstop for the bullets was a hillside a few tens of feet west of the targets. The second shooting area referred to as Range 2 is located immediately north of Hillside Range 1. This area is also relatively flat and is currently overgrown with volunteer shrubs and native trees. The shooting area was oriented south to north. The backstop for the bullets was a manmade earthen berm located approximately 150 feet north of Hillside Range 1.

Soil sampling and analyses were conducted at SWMU 7 (at both the ORR and OPR) between 2001 and 2002. Results of this investigation were presented in a Phase III Soils RFI Report (TtNUS, August 2002). Based on results of this investigation, one area of concern was identified; TNT soil exceedances at a very localized area. The recommendation from this report was that the Navy should conduct a Voluntary Interim Measure (VIM) for the excavation and removal of a limited amount of TNT contaminated soil at the ORR. The USEPA and the Navy agreed to this approach and the VIM was implemented. A summary report of this VIM was prepared as the Voluntary Interim Measure Letter Report for TNT Contamination Removal at Solid Waste Management Unit 7 (Old Rifle Range) Naval Surface Warfare Center Crane (TtNUS, 2003). The USEPA reviewed the Phase III Soils RFI Report (TtNUS, 2002) and the VIM Report (TtNUS, 2003). Mr. Peter Ramanauskas (USEPA Region 5 Environmental Scientist) indicated in a correspondence dated June 17, 2004 that the Phase III Soils RFI Report covering the ORR was acceptable as is although additional investigative work was required at the OPR. This was partially based on potential metals contamination in soil (primarily lead and other ammunition-related metals) as described in a previous U.S. Army Corps of Engineers report. The additional investigative work described herein is in response to these requests by the USEPA.



DRAWN BY	DATE
C. FOSTER	3/14/05
CHECKED BY	DATE
M. FRANCIS	3/14/05
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	

GENERALIZED LAYOUT OF HISTORICAL OPERATIONS AND FIRING RANGES
SWMU 7 - OLD PISTOL RANGE
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

CONTRACT NUMBER	
3961 CTO 160	
APPROVED BY	DATE
M. FRANCIS	9/03/04
APPROVED BY	DATE
R. CLARK	9/03/04
DRAWING NO.	REV
FIGURE 1 - 1	1

P:\GIS\NSWC_CRANE\7829.APR SWMU 7 (OLD PISTOL RANGE)-RANGE LOCATIONS LAYOUT 4/25/05 CF

2.0 FIELD INVESTIGATION ACTIVITIES

The following field investigation activities were conducted to address the requirements outlined by EPA. Surface and subsurface soil samples were collected during this investigation for select metals analysis for the purposes of characterizing the vertical and horizontal extent of potential metals contamination at the Old Pistol Range (OPR) and to conduct a human health and ecological risk screening assessment.

2.1 SOIL SAMPLING LOCATIONS, RATIONALE AND ANALYTICAL PROTOCOL

The following sections describe the sampling locations, rationale for the sampling analytical program, analyses performed, and QA samples collected at the OPR. As requested by EPA, the activities referred to were accomplished in accordance with the previous site QAPP entitled SWMU 7 Phase III Soils RFI QAPP, Naval Surface Warfare Center, Crane, Indiana, October, 2000 (TtNUS, 2000) and the Addendum to that issued immediately prior to this field work (TtNUS, 2005).

Sampling Locations

Soil sampling locations at the OPR were selected as follows. The OPR was divided into two areas as shown in Figure 1-1: Hillside Range 1 and Range 2. Each area was gridded off in the field using a tape measure and pin flags to aid in locating sampling points. Figures 2-1 and 2-2 illustrate the sampling grid and sample locations for the Hillside Range 1 and Range 2 respectively. Figure 2-3 illustrates the sampling grid and sample locations for the Hillside Range 1 and Range 2 berms. Samples labeled "07XSS" are discrete surface soil grab samples, while samples labeled "07XCP" are composite samples made up by combining soil from four randomly selected grab sample locations. The "X" in the sample name denotes that these samples were collected as part of a field effort using XRF instrumentation.

The sampling rationale for Hillside Range 1 (see Figure 2-1) assumed a firing lane of 200 feet followed by an impact berm (the hillside across the creek) which is roughly perpendicular to the ground surface. The impact berm is assumed to be approximately 20 feet high, followed uphill by an "overspray area" of an additional 50 feet. Therefore for Hillside Range 1, it was assumed that the total area potentially impacted by range activities was approximately 75 feet wide by 270 feet long [the impact berm (hillside) is estimated to be 20 feet high]. A grid was manually marked in the field to aid in sample collection. The grid was established by first marking the corners of the area. This area was then divided lengthwise into two sub areas of 35.5 feet wide by 270 feet long. The two sub areas were then subdivided lengthwise on 50 foot intervals (starting on either side of the impact berm area) into 10 grid cells as illustrated in Figure 2-1. Each grid cell was further divided into 10 equal sub areas. Prior to conducting the field investigation,

four soil sampling locations were identified within each grid cell by random selection using a uniform random number generator [Microsoft Excel 97 SR-2 (h)]. This soil sampling design constitutes a stratified random design [as was used in the evaluation of SWMU 1/12 (Mustard Gas Burial Ground) during a recent NSWC Crane investigation]. Figures 2-1 and 2-2 illustrate the random pattern of proposed and actual sample locations collected in the field. The berm area was divided in half lengthwise and further subdivided into 5 equal sub areas for a total of 10 sampling areas. The grid of sample locations for the berm is shown on Figure 2-3. Sample locations were marked in the field at the centers of each grid cell. Using this grid spacing plan, a total of 50 surface locations were marked for sample collection (40 sample locations within the firing lanes and 10 sample locations within the berm).

For Range 2 (see Figure 2-2), it was assumed that the area potentially impacted by range activities was approximately 75 feet wide by 300 feet long plus the impact berm, estimated to have a footprint of about 20 feet long x 75 feet wide. Therefore the grid was established in the field by first marking the corners of the area. This area was then divided lengthwise into two sub areas of 35.5 feet wide by 320 feet long. The two sub areas were then subdivided lengthwise on 50 foot intervals (starting on either side of the impact berm area) into 12 grid cells as illustrated in Figure 2-2. As was the case for Hillside Range 1, prior to conducting the field investigation, four soil sampling locations were identified within each grid cell by random selection using a uniform random number generator [Microsoft Excel 97 SR-2 (h)]. This soil sampling design constitutes a stratified random design [as was used in the evaluation of SWMU 1/12 (Mustard Gas Burial Ground) during a recent NSWC Crane investigation]. The berm area was divided in half lengthwise and further subdivided into 5 equal sub areas for a total of 10 sampling areas. The grid of sample locations for the berm is shown on Figure 2-3. Sample locations were marked in the field at the centers of each grid cell. Using this grid spacing, a total of 58 surface locations were marked for sample collection (48 sample locations within the firing lanes and 10 sample locations within the berm).

Sampling Depths

The soil sampling depths for each of the two areas used the same general format. Soil samples collected from the floors of the firing ranges were collected from two depths; 0 to 3" and 3 to 6" below ground surface (bgs). Soil samples collected from the berms were collected from four depths; 0 to 3", 3 to 6", 6 to 12" and 12 to 24".

Discrete samples were collected within each grid cell of the berm areas. However, a grid was established for samples collected outside the berm areas (e.g., the range floor and surrounding area) and composite samples were collected from sub areas established by the grid. Four discrete samples were collected from each randomly selected sub area and composited into one sample for analysis. As an example, at

Hillside Range 1, ten (10) sub areas were gridded off and four (4) discrete soil samples were collected at a specific depth within each sub area. One composite sample was generated from the four samples collected at each sub area for a total of 10 samples used for field XRF measurement and select laboratory analyses as described earlier. This procedure was used for each depth required.

Because of the shallow depths and unconsolidated nature of the samples collected, subsurface soil sampling was performed using a hand auger. Bedrock was not encountered during sampling activities. Excess soil cuttings from the borings were placed back in the borehole.

The following summarizes the numbers of samples collected and the types of analyses performed. The XRF samples were field analyzed using Method SW846 6200.

XRF Field Measurement and Laboratory Sample Summary Table

Hillside Range 1				
Firing Lane	**Firing Lane XRF Samples**	**Hillside Berm**	**Berm XRF Samples**	**Total Number of XRF and Laboratory Samples**
10 cells x 2 depths (0-3", 3-6")	20	10 cells x 4 depths (0-3", 3-6", 6-12", 12-24")	40	60 XRF samples. 5 of these samples were submitted for fixed-base lab analyses + 1 duplicate (6 total).

Range 2				
Firing Lane	**Firing Lane XRF Samples**	**Berm**	**Berm XRF Samples**	**Total Number of XRF and Laboratory Samples**
12 cells x 2 depths (0-3", 3-6")	24	10 cells x 4 depths (0-3", 3-6", 6-12", 12-24")	40	64 XRF samples. 5 of these samples were submitted for fixed-base lab analyses + 1 duplicate (6 total).

Total XRF Analyses (Field Measurements) = 124 samples + 5 duplicates
Total Fixed-Base Laboratory Analyses = 10 samples + 2 duplicates

Analytical Protocol

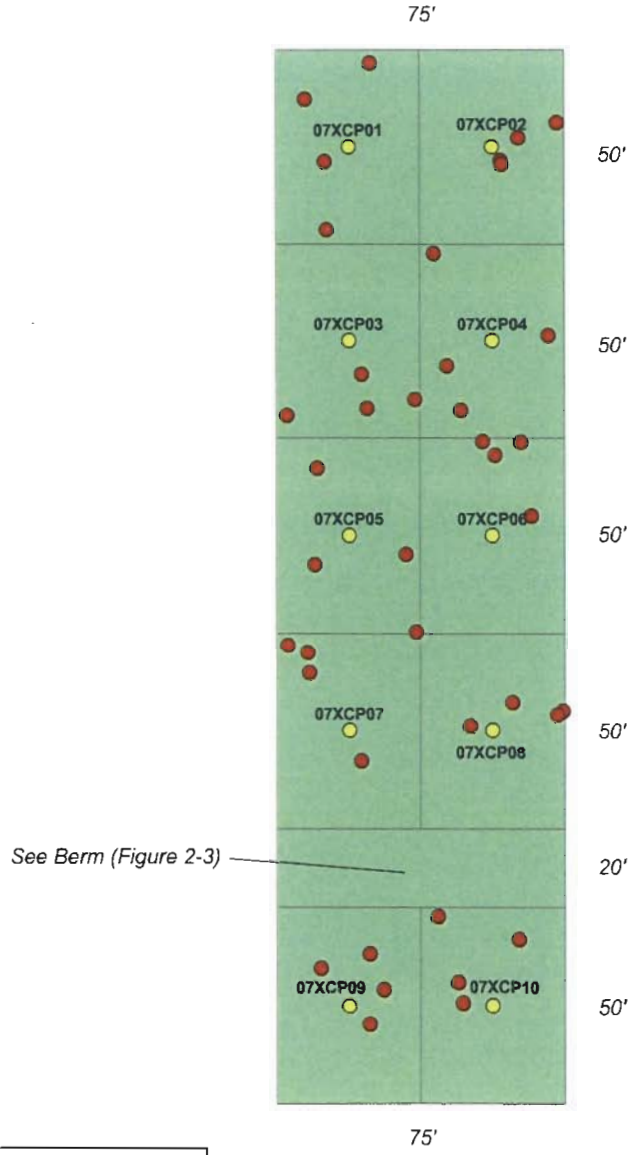
A total of 124 samples (20 composite samples from the OPR Hillside Range 1 firing lane, 40 discrete samples from the OPR Hillside Range 1 berm, 24 composite samples from the OPR Range 2 firing lane and 40 discrete samples from the OPR (Range 2 berm) were analyzed for antimony, lead, copper, tin and zinc using field portable XRF instrumentation.

Samples collected were placed into sandwich style sealable plastic bags for field XRF analyses and 8-ounce glass jars for fixed-base analyses and labeled with the location identity. Prior to the sample placement in the bags and glass jars, debris, rocks, and pebbles were removed. During this activity, the sample was homogenized and examined to ensure no bullets or shot were present in the sample that could skew the results.

Prior to field analysis, the sample was further homogenized and flattened using a rolling pin. This process aided in identification and subsequent removal of rocks, pebbles, and debris. This preparation also permitted the flattening of the sample to allow full contact with the probe window of the XRF instrument. The sample was then analyzed at three different points and the results were recorded for averaging.

Prior to sample analysis, the instrument was allowed to warm up for a period of time recommended by the manufacturer. The instrument was then calibrated according to the manufacturer's specifications before sample analysis occurred. On-going calibration verifications were conducted in accordance with the QAPP Addendum (TtNUS, 2005).

As shown in the XRF and Laboratory Sample Summary Table, 10 samples were selected for confirmatory analyses at a fixed-base laboratory. (Note that all samples were sent to the laboratory in case analyses might be required at a later date.) Samples selected for confirmatory analyses were selected from a range of concentrations (low, medium, high). A correlation value of 65 percent (i.e., r=0.65) was considered acceptable for using the XRF data in the human health and ecological screening evaluations. Actual correlation values achieved are described in Section 3.



LEGEND

- Center of Sample Area
- Proposed Sample Location
- Sample Area

50 0 50 Feet

DRAWN BY	DATE			CONTRACT NUMBER
A. JANOCHA	9/02/04		HILLSIDE RANGE 1	3961 CTO 160
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R. CLARK	9/08/04		NAVAL SURFACE WARFARE CENTER	M. FRANCIS / 9/03/04
COST/SCHEDULE-AREA			CRANE, INDIANA	APPROVED BY / DATE
				R. CLARK / 9/03/04
SCALE				DRAWING NO. / REV
AS NOTED				FIGURE 2 - 1 / 1

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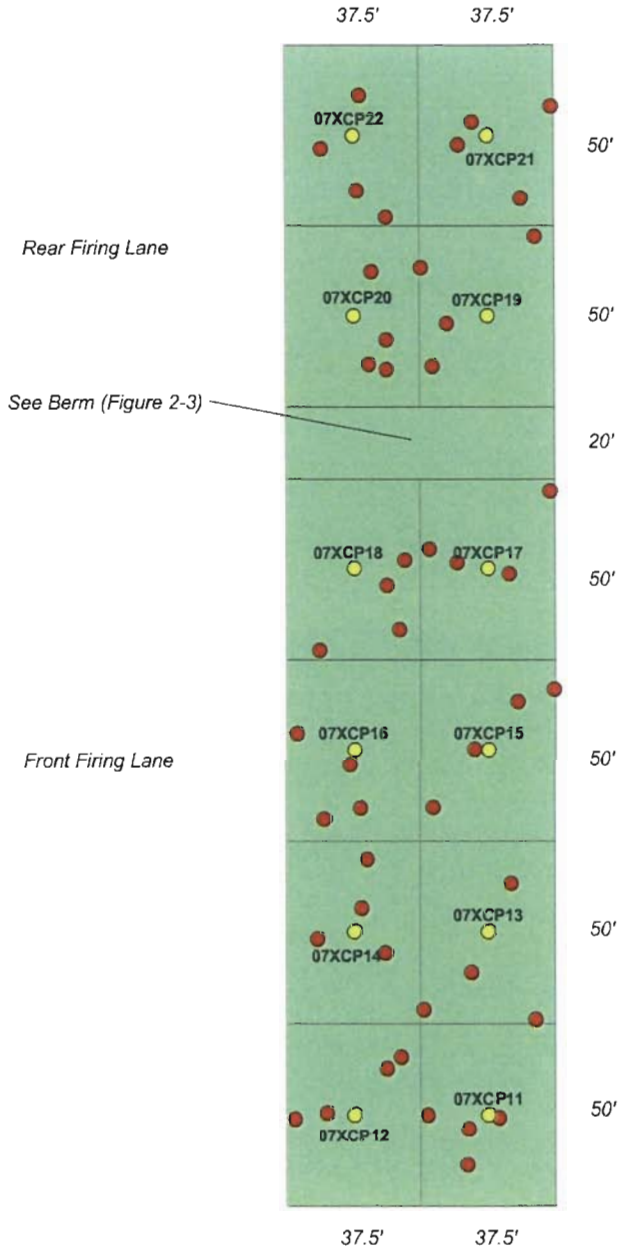


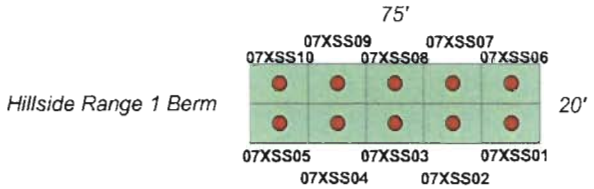
LEGEND

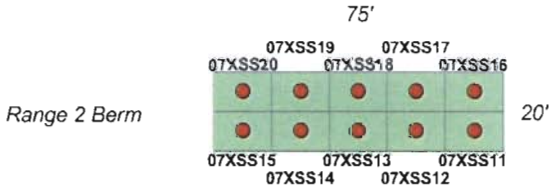
- Center of Sample Area
- Proposed Sample Location
- Sample Area

50 0 50 Feet

DRAWN BY A. JANOCHA	DATE 9/02/04	RANGE 2 SWMU 7 - OLD PISTOL RANGE NAVAL SURFACE WARFARE CENTER CRANE, INDIANA	CONTRACT NUMBER 3961 CTO 160
CHECKED BY R. CLARK	DATE 9/08/04		APPROVED BY M. FRANCIS — DATE 9/03/04
COST/SCHEDULE-AREA			APPROVED BY R. CLARK — DATE 9/03/04
SCALE AS NOTED			DRAWING NO. FIGURE 2 - 2 — REV 1

P:\GIS\NSWC_CRANE\7829.APR SWMU 7 RANGE 2 SAMPLE LAYOUT 4/25/05 CF





LEGEND
- Proposed Sample Location
- Sample Area

50 0 50 Feet

DRAWN BY A. JANOCHA	DATE 9/02/04	HILLSIDE RANGE 1 & RANGE 2 BERMS SWMU 7 - OLD PISTOL RANGE NAVAL SURFACE WARFARE CENTER CRANE, INDIANA	CONTRACT NUMBER 3961 CTO 160
CHECKED BY R. CLARK	DATE 9/08/04		APPROVED BY M. FRANCIS — DATE 9/03/04
COST/SCHEDULE-AREA			APPROVED BY R. CLARK — DATE 9/03/04
SCALE AS NOTED			DRAWING NO. FIGURE 2 - 3 — REV 1

P:\GIS\NSWC_CRANE\7829.APR SWMU 7 BERMS SAMPLE LAYOUT 4/25/05 CF

3.0 SOIL SAMPLING RESULTS

This section presents the results of data collected by TtNUS in December 2004 to fill the data gap request from EPA for the 5 metals of concern at the OPR.

In the following discussions, all references to soil background concentrations for metals refer to the mean background concentration for the appropriate soil group data set as determined in the Base-wide Background Soil Investigation for NSWC Crane (TtNUS, 2001). Background soil comparisons considered the soil sample depositional area, grain size and depth as outlined in that study.

Appendix A provides a printout of all of the data collected for the OPR for this investigation. In addition to providing all of the laboratory data, this table provides the individual XRF readings (labeled "A", "B", and "C") along with the calculated XRF average using those three values. Tables, figures and text provided in the remainder of this section discuss subsets of these data in greater detail. Where XRF data is discussed, the value referred to is the average of the three individual readings obtained.

Appendix B provides copies of multiple sample log sheets with the numbers of bullets listed in parentheses on left hand side of those samples from which bullets were removed.

3.1 XRF FIELD MEASUREMENT VERSUS LABORATORY RESULT COMPARISONS

A critical objective of this investigation was to be able to substantiate that XRF results for the metals of potential concern could be used in place of (or in some cases, in addition to) laboratory results. As discussed earlier, a correlation value of 65 percent (i.e., r=0.65) was considered acceptable for using the XRF data in the human health and ecological screening evaluations. Calculated correlation coefficients for the 5 metals of potential concern; antimony, copper, lead, tin, and zinc are shown in Table 3-1. As shown in that table, correlation coefficients for antimony, copper, lead, and zinc were all acceptable (r greater than 65%). Tin did not have a correlation value in the acceptable range (-0.249) however, this was caused by the fact that all of the laboratory tin results were non-detectable. In view of this lack of correlation for tin results, as outlined in the QAPP Addendum, the laboratory results (all non-detects) will be the values used for human health and ecological screening evaluations. Scatter plots for these 5 metals are shown in Figures 3-1 through 3-5.

3.2 OLD PISTOL RANGE RESULTS COMPARED TO HUMAN HEALTH SCREENING LEVELS

Table 3-2 presents XRF and laboratory data (location name ends with "lab") at the OPR compared to the applicable human health screening level provided in the QAPP Addendum (TtNUS, 2005). Figures 2-1 through 2-3 show the sample locations and nomenclature at the OPR.

Several observations can be noted from evaluating the data in Table 3-2:

- Exceedances of human health screening levels at Hillside Range 1 are limited to 3 metals (antimony, copper, and lead) at the following 6 locations:

  - 07XSS02
  - 07XSS03
  - 07XSS04
  - 07XSS05
  - 07XSS07
  - 07XSS08

- Exceedances of human health screening levels at Range 2 are limited to 2 metals (antimony and lead) at 3 locations:

  - 07XSS13
  - 07XSS16
  - 07XSS17

- All of these locations are in the berms – the firing lanes themselves have no exceedances.

- There were no exceedances at 12" to 24".

- There were no exceedances for tin or zinc at any location or any depth.

Using the data provided above, Section 4.0 presents the results of the human health risk screening evaluation (HHRSE) for these metals detected in surface and subsurface soil samples at the OPR. Information on the selection of chemicals of potential concern (COPCs), exposure assessment, characterization of estimated potential human health risks, uncertainty analyses, and summary and conclusions for the risk screening are provided in that section.

3.3 OLD PISTOL RANGE RESULTS COMPARED TO ECOLOGICAL SCREENING LEVELS

Table 3-3 presents XRF and laboratory data (location name ends with "lab") at the OPR compared to the applicable ecological screening level provided in the QAPP Addendum (TtNUS, 2005). Figures 2-1 through 2-3 show the sample locations and nomenclature at the OPR.

Several observations can be noted from evaluating the data in Table 3-3:

- Exceedances of ecological screening levels at Hillside Range 1 were noted for every metal in at least one sample location. Antimony had the fewest exceedances and the tin exceedances are based on XRF values. As stated previously, the non-detect laboratory values will be used for tin as there was no correlation supporting the use of XRF data.

- Exceedances of ecological screening levels at Range 2 were noted for every metal in at least one sample location. Antimony had the fewest exceedances and the tin exceedances are based on XRF values. As stated previously, the non-detect laboratory values will be used for tin as there was no correlation supporting the use of XRF data.

Using the data provided above, Section 5.0 presents the results of the ecological risk screening evaluation (ERSE) for these metals detected in surface and subsurface soil samples at the OPR.

3.4 OLD PISTOL RANGE ECOLOGICAL SCREENING LEVELS COMPARED TO BASE-WIDE BACKGROUND

Table 3-4 presents mean soil background concentrations for metals in the appropriate soil group data set as determined in the Base-wide Background Soil Investigation for NSWC Crane (TtNUS, 2001). Background soil comparisons considered the soil sample depositional area, grain size and depth as outlined in that study. OPR soils are classified as Soil Group 3.

The individual values for each soil sample collected for each of the 5 metals of potential concern in this investigation are provided in the table. The average of these is also presented using ½ of the detection limit in the calculation for non-detected results. The end of the table also provides a comparison of the screening values for human health and ecological compared to the average Soil Group 3 background concentration for each of these metals. As shown in this portion of the table and as specified in the QAPP Addendum, average background values for antimony, copper and zinc should be used for

ecological screening rather than the screening values originally presented in the QAPP as they are higher than the screening values specified.

Using the data provided above, Section 5.0 also presents the results of the ERSE for these metals taking into account representative background concentrations at the Base.

TABLE 3-1

CORRELATION COEFFICIENTS
SWMU 7 - OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

LOCATION	Description	DEPTH	sb_xrf_r	sb_xrf_q	sb_lab_r	sb_lab_q	cu_xrf_r	cu_xrf_q	cu_lab_r	cu_lab_q	pb_xrf_r	pb_xrf_q	pb_lab_r	pb_lab_q	tin_xrf_r	tin_xrf_q	tin_lab_r	tin_lab_q	zn_xrf_r	zn_xrf_q	zn_lab_r	zn_lab_q
07XCP06	Hillside Range 1 Firing Lane	0" to 3"	80	U	0.61	U	48		75.4	J	18.67		25.2	J	58.33		0.94	U	137.67		207	J
07XSS03	Hillside Range 1 Berm	0" to 3"	96.33	U	30.8	J	1004		897	J	6194.33		6870	J	70.67		1.4	U	231		262	J
07XSS07	Hillside Range 1 Berm	0" to 3"	89	U	2.8	J	48		49	J	360		396	J	63.67	U	0.77	U	60		78.9	J
07XCP16	Range 2 Firing Lane (North South)	0" to 3"	78.67	U	0.46	U	21.67	U	28	J	17		19.4	J	55.67	U	0.97	U	45.33		65.3	J
07XSS13	Range 2 Berm (North South)	0" to 3"	81.67	U	4.3	J	32.33		33.3	J	308.67		475	J	58	U	0.68	U	50.67		83.2	J
07XSS17	Range 2 Berm (North South)	0" to 3"	94	U	50.6	J	82.67		87.6	J	3194		10200	J	66.67	U	1.2	U	62		70.9	J
07XSS04	Hillside Range 1 Berm	3" to 6"	102.67	U	24.6	J	1411.33		1550	J	2086.67		3650	J	77.33		0.77	U	506		533	J
07XSS04-D	Hillside Range 1 Berm	3" to 6"	100.33	U	37.3	J	1755		1640	J	2065		4330	J	85		0.8	U	443.33		615	J
07XSS17	Range 2 Berm (North South)	3" to 6"	95.33	U	39.9	J	112		88	J	2302		2590	J	68	U	1.1	U	70		107	J
07XSS03	Hillside Range 1 Berm	6" to 12"	97	U	16.8	J	1269.67		1340	J	1309.33		3920	J	70.33		0.66	U	293.33		428	J
07XSS03-D	Hillside Range 1 Berm	6" to 12"	96.67	U	10	J	865.33		484	J	1076.33		1330	J	86.67		0.7	U	334.67		409	J
07XSS17	Range 2 Berm (North South)	6" to 12"	88	U	11.9	J	33		27.5	J	464.33		922	J	80.67		0.76	U	54.67		71	J
			ANTIMONY				COPPER				LEAD				TIN				ZINC			
	Correlation Coefficient "r" =		0.686				0.980				0.801				-0.249				0.979			

*** 1/2 Nondetect concentration used for statistics and graphical analysis

TABLE 3-2

HUMAN HEALTH SCREENING COMPARISONS
NSWC CRANE
CRANE, INDIANA

Location	Description	ANTIMONY		COPPER		LEAD		TIN		ZINC	
All Results (mg/kg)	Human Health Screening Level [1]	3.1		310		400		4700		2300	
		0 to 3"									
07XCP01	Hillside Range 1 Firing Lane	77.33	U	22.67		18		55.33	U	49.67	
07XCP02	Hillside Range 1 Firing Lane	75	U	29.33		22		53.33	U	50.67	
07XCP03	Hillside Range 1 Firing Lane	77.67	U	44.67		23.33		55.33	U	127	
07XCP04	Hillside Range 1 Firing Lane	80.67	U	52.67		34		57.33	U	199	
07XCP05	Hillside Range 1 Firing Lane	83.33	U	31		56		59.33	U	43.33	
07XCP06	Hillside Range 1 Firing Lane	80	U	48		18.67		58.33		137.67	
07XCP06-lab	Hillside Range 1 Firing Lane	0.61	U	75.4	J	25.2	J	0.94	U	207	J
07XCP07	Hillside Range 1 Firing Lane	80	U	24		53		59		40.67	
07XCP08	Hillside Range 1 Firing Lane	79.67	U	24.33		35		67.33		50	
07XCP09	Hillside Range 1 Firing Lane	77.67	U	59.33		135.33		58		47.33	
07XCP09-D	Hillside Range 1 Firing Lane	76.67	U	34		100		54.33	U	41.67	
07XCP10	Hillside Range 1 Firing Lane	80	U	23.67		19.33		57	U	61	
07XSS01	Hillside Range 1 Berm	82.67	U	35		48.67		58.67	U	43	
07XSS02	Hillside Range 1 Berm	88.33	U	607.67		2695.33		62.67	U	121.33	
07XSS03	Hillside Range 1 Berm	96.33	U	1004		6194.33		70.67		231	
07XSS03-lab	Hillside Range 1 Berm	30.8	J	897	J	6870	J	1.4	U	262	J
07XSS03-D	Hillside Range 1 Berm	NA		NA		NA		NA		NA	
07XSS03-D-lab	Hillside Range 1 Berm	NA		NA		NA		NA		NA	
07XSS04	Hillside Range 1 Berm	84.67	U	540.67		2695.33		64.67		181	
07XSS04-lab	Hillside Range 1 Berm	NA		NA		NA		NA		NA	
07XSS04-D	Hillside Range 1 Berm	NA		NA		NA		NA		NA	
07XSS04-D-lab	Hillside Range 1 Berm	NA		NA		NA		NA		NA	
07XSS05	Hillside Range 1 Berm	87	U	335.33		1414.33		62	U	135.67	
07XSS06	Hillside Range 1 Berm	78.67	U	31		137		55.67	U	59.67	
07XSS07	Hillside Range 1 Berm	89	U	48		360		63.67	U	60	
07XSS07-lab	Hillside Range 1 Berm	2.8	J	49	J	396	J	0.77	U	78.9	J
07XSS08	Hillside Range 1 Berm	86.33	U	76.67		476.67		61.67	U	60.67	
07XSS09	Hillside Range 1 Berm	83.67	U	44		109.67		59.67	U	63.67	
07XSS10	Hillside Range 1 Berm	89.67	U	34.33		26.33		63.33	U	61.33	
07XCP11	Range 2 Firing Lane (North South)	87.33	U	40		25		64		87	
07XCP12	Range 2 Firing Lane (North South)	80.33	U	23.67		36.33		93		97.67	
07XCP13	Range 2 Firing Lane (North South)	77	U	21.33	U	18.67		55	U	40	
07XCP14	Range 2 Firing Lane (North South)	77.33	U	21	U	14.33		60		32.67	
07XCP15	Range 2 Firing Lane (North South)	80.67	U	21.67	U	26		57.67	U	59	
07XCP15-D	Range 2 Firing Lane (North South)	84.33	U	25.67		27		60	U	56.33	
07XCP16	Range 2 Firing Lane (North South)	78.67	U	21.67	U	17		55.67	U	45.33	
07XCP16-lab	Range 2 Firing Lane (North South)	0.46	U	28	J	19.4	J	0.97	U	65.3	J
07XCP17	Range 2 Firing Lane (North South)	86	U	26		29.33		71.67		45	
07XCP18	Range 2 Firing Lane (North South)	86	U	35.67		22		61	U	55	
07XCP19	Range 2 Firing Lane (North South)	81.33	U	23.67		20.67		58	U	40.67	
07XCP20	Range 2 Firing Lane (North South)	85	U	28.33		25.67		61.33	U	45.67	
07XCP21	Range 2 Firing Lane (North South)	86.67	U	28.67		28.33		76		53	
07XCP22	Range 2 Firing Lane (North South)	80.67	U	22.67		18.33		57.33	U	43.67	
07XSS11	Range 2 Berm (North South)	78.67	U	35.33		240		58.67		58.67	
07XSS12	Range 2 Berm (North South)	81.67	U	33.33		267		57.67	U	50.67	
07XSS13	Range 2 Berm (North South)	81.67	U	32.33		308.67		58	U	50.67	
07XSS13-lab	Range 2 Berm (North South)	4.3	J	33.3	J	475	J	0.68	U	83.2	J
07XSS13-D	Range 2 Berm (North South)	NA		NA		NA		NA		NA	
07XSS14	Range 2 Berm (North South)	85.67	U	29		149.33		62		47.67	
07XSS15	Range 2 Berm (North South)	83.33	U	31.33		62		59.33	U	58.33	
07XSS16	Range 2 Berm (North South)	84.33	U	56.67		977.33		60	U	48.67	
07XSS17	Range 2 Berm (North South)	94	U	82.67		3194		66.67	U	62	
07XSS17-lab	Range 2 Berm (North South)	50.6	J	87.6	J	10200	J	1.2	U	70.9	J
07XSS18	Range 2 Berm (North South)	89	U	33.33		98.67		63.33	U	62.67	
07XSS19	Range 2 Berm (North South)	88.67	U	51		129.33		64.33		69.33	
07XSS20	Range 2 Berm (North South)	91.67	U	44.33		85.33		65.33	U	57	

ANTIMONY		COPPER		LEAD		TIN		ZINC	
3.1		310		400		4700		2300	
3" to 6"									
89.33	U	23.67	U	22.67		64	U	41.33	
83	U	31.67		25.33		59.33	U	44.67	
83	U	75		18.33		59.33	U	196	
83.33	U	86.33		30.67		60.67		336.67	
90	U	30.67		34.33		64	U	47.33	
80.33	U	103.67		26.67		56.67	U	219.67	
NA		NA		NA		NA		NA	
87.67	U	24.33		50.67		74.67		40	
83.33	U	23	U	55.33		59	U	40.33	
87	U	28		42.67		71.33		50	
NA		NA		NA		NA		NA	
96.67	U	30		56.67		68.67	U	39	
92	U	25.67	U	30.33		77.33		44.67	
88	U	455.33		1594.33		70		105.33	
98.33	U	1268.33		3118		70.33	U	284.33	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
102.67	U	1411.33		2086.67		77.33		506	
24.6	J	1550	J	3650	J	0.77	U	533	J
100.33	U	1755		2365		85		443.33	
37.3	J	1640	J	4330	J	0.8	U	615	J
92	U	1059.33		2490		73.33		222.33	
87.33	U	24.67	U	56		60.33	U	56.33	
85.33	U	53		383		63.33		40.67	
NA		NA		NA		NA		NA	
91.33	U	57.33		225		68.67		51.33	
84.67	U	40.33		84		96.67		55.67	
91.33	U	24.67	U	45		72.33		49	
94.33	U	33		22.33		84		69	
85	U	23	U	27.67		63.67		59	
81.33	U	21.33	U	19.67		58	U	42	
85.33	U	22.33	U	17.33		71.67		46.33	
84	U	22.67	U	23.33		62.67		48.67	
NA		NA		NA		NA		NA	
86.33	U	23.33	U	21.67		61.33	U	52.33	
NA		NA		NA		NA		NA	
93.33	U	25	U	22.67		66.33	U	52.33	
89.33	U	28.33		23.67		76.33		53.67	
84.33	U	22	U	19.67		56.33		48	
87.33	U	25.33		27		62	U	56	
101	U	28.67	U	27.67		71.33	U	54.67	
86	U	23.67	U	21.67		61	U	43.67	
85	U	23	U	63.33		60.33	U	43.67	
86.67	U	24.67		140		61.33	U	53.33	
84.33	U	28.67		106		56.33	U	52.33	
NA		NA		NA		NA		NA	
86.67	U	24.33	U	91.33		58	U	46.67	
90.33	U	25.67		63		64.33	U	57.67	
87	U	25.67		66.33		61.67	U	58.67	
89	U	39.33		303.67		63	U	50	
95.33	U	112		2302		68	U	70	
39.9	J	88	J	2590	J	1.1	U	107	J
91.33	U	29.33		64.67		65	U	62	
93.33	U	29.67		88.33		67		60.33	
93	U	42.33		54		66.33	U	62.67	

ANTIMONY		COPPER		LEAD		TIN		ZINC	
3.1		310		400		4700		2300	
6" to 12"									
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
92	U	24.33	U	31.33		65	U	41.67	
93	U	62.33		322.67		66	U	50	
97	U	1269.67		1309.33		70.33		293.33	
16.8	J	1340	J	3920	J	0.66	U	428	J
96.67	U	865.33		1076.33		86.67		334.67	
10	J	484	J	1330	J	0.7	U	409	J
95	U	365.67		59		85.67		60	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
95.33	U	848.67		2571		79		215.67	
88.33	U	24	U	33.33		62.67	U	40.67	
95.33	U	653.67		1348		86.67		95	
NA		NA		NA		NA		NA	
101.33	U	35.67		139.67		85.33		57.33	
87.67	U	42.67		46.33		62.67	U	59	
95	U	26	U	23.67		68	U	54.67	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
84.33	U	23.33	U	30.33		65.67		49	
88	U	24.33	U	65.67		62.33	U	47.33	
91	U	25.33	U	27.33		64	U	52.67	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
92	U	25.67		36.33		76.33		53.67	
90.33	U	24.33	U	24		65.33	U	56	
88	U	25.67		30		62.33	U	50	
88	U	33		464.33		80.67		54.67	
11.9	J	27.5	J	922	J	0.76	U	71	J
92.33	U	25.33	U	20		65.67	U	52	
103	U	35.67		24		84		63.67	
100.33	U	27	U	24.33		78.67		63.33	

ANTIMONY		COPPER		LEAD		TIN		ZINC	
3.1		310		400		4700		2300	
12" to 24"									
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
99	U	27.67	U	17.67		68.67	U	50.67	
95	U	25.67	U	35.67		69		46	
91.33	U	63		125.67		73.33		59	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
90.67	U	29		14		64.33	U	44.33	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
88.67	U	97.33		131.67		63	U	57.67	
85	U	24	U	25.67		60.33	U	42.33	
89.67	U	58.33		189		64.67		50.67	
NA		NA		NA		NA		NA	
85.67	U	23.33	U	14.67		60.33	U	33	
83.67	U	22.33	U	15.33		59.33	U	44	
88.67	U	24	U	13.67		67.67		44.33	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
86.33	U	26.67		52		67.33		54.33	
86.67	U	26		20.67		62.67	U	51.33	
89	U	24	U	23.33		59.67	U	57	
NA		NA		NA		NA		NA	
NA		NA		NA		NA		NA	
100.33	U	27.33	U	22		70.67	U	68	
95	U	26	U	18.67		68	U	55.67	
89.67	U	28.33		22.33		63.67	U	48.33	
95	U	26	U	64.67		67.67	U	52.67	
NA		NA		NA		NA		NA	
93	U	25.33	U	20.33		81		52.33	
90.67	U	24.67	U	17.67		67		46	
97.67	U	29.67		26.67		71		51	

1 Human health screening levels provided are the USEPA Region 9 PRGs divided by a factor of 10, with the exception of lead, which is not divided by 10.

TABLE 3-3

ECOLOGICAL SCREENING COMPARISONS
NSWC CRANE
CRANE, INDIANA

Location	Description	ANTIMONY		COPPER		LEAD		TIN		ZINC		ANTIMONY		COPPER		LEAD		TIN		ZINC	
All Results (mg/kg)	Ecological Screening Level [2]	0.29		5.4		16		7.62		6.62		0.29		5.4		16		7.62		6.62	
		0 to 3"										3" to 6"									
07XCP01	Hillside Range 1 Firing Lane	77.33	U	22.67		18		55.33	U	49.67		89.33	U	23.67	U	22.67		64	U	41.33	
07XCP02	Hillside Range 1 Firing Lane	75	U	29.33		22		53.33	U	50.67		83	U	31.67		25.33		59.33	U	44.67	
07XCP03	Hillside Range 1 Firing Lane	77.67	U	44.67		23.33		55.33	U	127		83	U	75		18.33		59.33	U	196	
07XCP04	Hillside Range 1 Firing Lane	80.67	U	52.67		34		57.33	U	199		83.33	U	86.33		30.67		60.67		336.67	
07XCP05	Hillside Range 1 Firing Lane	83.33	U	31		56		59.33	U	43.33		90	U	30.67		34.33		64	U	47.33	
07XCP06	Hillside Range 1 Firing Lane	80	U	48		18.67		58.33		137.67		80.33	U	103.67		26.67		56.67	U	219.67	
07XCP06-lab	Hillside Range 1 Firing Lane	0.61	U	75.4	J	25.2	J	0.94	U	207	J	NA		NA		NA		NA		NA	
07XCP07	Hillside Range 1 Firing Lane	80	U	24		53		59		40.67		87.67	U	24.33		50.67		74.67		40	
07XCP08	Hillside Range 1 Firing Lane	79.67	U	24.33		35		67.33		50		83.33	U	23	U	55.33		59	U	40.33	
07XCP09	Hillside Range 1 Firing Lane	77.67	U	59.33		135.33		58		47.33		87	U	28		42.67		71.33		50	
07XCP09-D	Hillside Range 1 Firing Lane	76.67	U	34		100		54.33	U	41.67		NA		NA		NA		NA		NA	
07XCP10	Hillside Range 1 Firing Lane	80	U	23.67		19.33		57	U	61		96.67	U	30		56.67		68.67	U	39	
07XSS01	Hillside Range 1 Berm	82.67	U	35		48.67		58.67	U	43		92	U	25.67	U	30.33		77.33		44.67	
07XSS02	Hillside Range 1 Berm	88.33	U	607.67		2625.33		62.67	U	121.33		88	U	465.33		1594.33		70		105.33	
07XSS03	Hillside Range 1 Berm	96.33	U	1004		6194.33		70.67		231		98.33	U	1268.33		3118		70.33	U	284.33	
07XSS03-lab	Hillside Range 1 Berm	30.8	J	897	J	6870	J	1.4	U	262	J	NA		NA		NA		NA		NA	
07XSS04	Hillside Range 1 Berm	84.67	U	540.67		2695.33		64.67		181		102.67	U	1411.33		2086.67		77.33		506	
07XSS04-lab	Hillside Range 1 Berm	NA		NA		NA		NA		NA		24.6	J	1550	J	3650	J	0.77	U	533	J
07XSS04-D	Hillside Range 1 Berm	NA		NA		NA		NA		NA		100.33	U	1755		2065		85		443.33	
07XSS04-D-lab	Hillside Range 1 Berm	NA		NA		NA		NA		NA		37.3	J	1640	J	4330	J	0.8	U	615	J
07XSS05	Hillside Range 1 Berm	87	U	335.33		1414.33		62	U	135.67		92	U	1059.33		2490		73.33		222.33	
07XSS06	Hillside Range 1 Berm	78.67	U	31		137		55.67	U	59.67		87.33	U	24.67	U	56		60.33	U	56.33	
07XSS07	Hillside Range 1 Berm	89	U	48		360		63.67	U	60		85.33	U	53		583		63.33		40.67	
07XSS07-lab	Hillside Range 1 Berm	2.8	J	49	J	396	J	0.77	U	78.9	J	NA		NA		NA		NA		NA	
07XSS08	Hillside Range 1 Berm	86.33	U	76.67		476.67		61.67	U	60.67		91.33	U	57.33		225		68.67		51.33	
07XSS09	Hillside Range 1 Berm	83.67	U	44		109.67		59.67	U	63.67		84.67	U	40.33		84		96.67		55.67	
07XSS10	Hillside Range 1 Berm	89.67	U	34.33		26.33		63.33	U	61.33		91.33	U	24.67	U	45		72.33		49	
07XCP11	Range 2 Firing Lane (North South)	87.33	U	40		25		64		87		94.33	U	33		22.33		84		69	
07XCP12	Range 2 Firing Lane (North South)	80.33	U	23.67		36.33		93		97.67		85	U	23	U	27.67		63.67		59	
07XCP13	Range 2 Firing Lane (North South)	77	U	21.33	U	18.67		55	U	40		81.33	U	21.33	U	19.67		58	U	42	
07XCP14	Range 2 Firing Lane (North South)	77.33	U	21	U	14.33		60		32.67		85.33	U	22.33	U	17.33		71.67		46.33	
07XCP15	Range 2 Firing Lane (North South)	80.67	U	21.67	U	26		57.67	U	59		84	U	22.67	U	23.33		62.67		48.67	
07XCP15-D	Range 2 Firing Lane (North South)	84.33	U	25.67		27		60	U	56.33		NA		NA		NA		NA		NA	
07XCP16	Range 2 Firing Lane (North South)	78.67	U	21.67	U	17		55.67	U	45.33		86.33	U	23.33	U	21.67		61.33	U	52.33	
07XCP16-lab	Range 2 Firing Lane (North South)	0.46	U	28	J	19.4	J	0.97	U	65.3	J	NA		NA		NA		NA		NA	
07XCP17	Range 2 Firing Lane (North South)	86	U	26		29.33		71.67		45		93.33	U	25	U	22.67		66.33	U	52.33	
07XCP18	Range 2 Firing Lane (North South)	86	U	35.67		22		61	U	55		89.33	U	28.33		23.67		76.33		53.67	
07XCP19	Range 2 Firing Lane (North South)	81.33	U	23.67		20.67		58	U	40.67		84.33	U	22	U	19.67		56.33		48	
07XCP20	Range 2 Firing Lane (North South)	85	U	28.33		25.67		61.33	U	45.67		87.33	U	25.33		27		62	U	56	
07XCP21	Range 2 Firing Lane (North South)	86.67	U	28.67		28.33		76		53		101	U	28.67	U	27.67		71.33	U	54.67	
07XCP22	Range 2 Firing Lane (North South)	80.67	U	22.67		18.33		57.33	U	43.67		86	U	23.67	U	21.67		61	U	43.67	
07XSS11	Range 2 Berm (North South)	78.67	U	35.33		240		58.67		58.67		85	U	23	U	63.33		60.33	U	43.67	
07XSS12	Range 2 Berm (North South)	81.67	U	33.33		267		57.67	U	50.67		86.67	U	24.67		140		61.33	U	53.33	
07XSS13	Range 2 Berm (North South)	81.67	U	32.33		308.67		58	U	50.67		84.33	U	28.67		106		56.33	U	52.33	
07XSS13-lab	Range 2 Berm (North South)	4.3	J	33.3	J	475	J	0.68	U	83.2	J	NA		NA		NA		NA		NA	
07XSS13-D	Range 2 Berm (North South)	NA		NA		NA		NA		NA		86.67	U	24.33	U	91.33		58	U	46.67	
07XSS14	Range 2 Berm (North South)	85.67	U	29		149.33		62		47.67		90.33	U	25.67		63		64.33	U	57.67	
07XSS15	Range 2 Berm (North South)	83.33	U	31.33		62		59.33	U	58.33		87	U	25.67		66.33		61.67	U	58.67	
07XSS16	Range 2 Berm (North South)	84.33	U	56.67		977.33		60	U	48.67		89	U	39.33		303.67		63	U	50	
07XSS17	Range 2 Berm (North South)	94	U	82.67		3194		66.67	U	62		95.33	U	112		2302		68	U	70	
07XSS17-lab	Range 2 Berm (North South)	50.6	J	87.6	J	10200	J	1.2	U	70.9	J	39.9	J	88	J	2590	J	1.1	U	107	J
07XSS18	Range 2 Berm (North South)	89	U	33.33		98.67		63.33	U	62.67		91.33	U	29.33		64.67		65	U	62	
07XSS19	Range 2 Berm (North South)	88.67	U	51		129.33		64.33		69.33		93.33	U	29.67		88.33		67		60.33	
07XSS20	Range 2 Berm (North South)	91.67	U	44.33		85.33		65.33	U	57		93	U	42.33		54		66.33	U	62.67	

2 Ecological screening levels provided are either USEPA Ecological Soil Screening Levels or USEPA Region 5 Ecological Screening Levels. Applicable only down to 6"

TABLE 3-4

OPR BACKGROUND METALS FOR SOIL GROUP 3
NSWC CRANE
CRANE, INDIANA

Background Sample	Background Sample Parameter	Lab Result	Lab Qualifier	Units	Value to use (NDs at 1/2)
BG1SBA0101	ANTIMONY	0.53	U	MG/KG	0.265
BG1SBA0401	ANTIMONY	0.37	U	MG/KG	0.185
BG1SBP0401	ANTIMONY	0.72	U	MG/KG	0.36
BG1SBP0601-MAX	ANTIMONY	0.61	U	MG/KG	0.305
BG1SBP0701	ANTIMONY	0.26	U	MG/KG	0.13
BG1SBP0801	ANTIMONY	1.8	U	MG/KG	0.9
BG1SBP0901	ANTIMONY	3.2	U	MG/KG	1.6
BG3SBA0101-MAX	ANTIMONY	1.1	U	MG/KG	0.55
BG3SBA0301	ANTIMONY	0.71	U	MG/KG	0.355
BG3SBA0501	ANTIMONY	0.41	U	MG/KG	0.205
BG3SBM0201	ANTIMONY	0.38	U	MG/KG	0.19
BG3SBM0401	ANTIMONY	5.6	J	MG/KG	5.6
BG3SBM0601	ANTIMONY	0.44	U	MG/KG	0.22
BG3SBM0701	ANTIMONY	1.4	J	MG/KG	1.4
BG3SBM0801	ANTIMONY	0.36	U	MG/KG	0.18
Average Antimony					**0.83**
BG1SBA0101	COPPER	9.8		MG/KG	9.8
BG1SBA0401	COPPER	8.8		MG/KG	8.8
BG1SBP0401	COPPER	9.8		MG/KG	9.8
BG1SBP0601-MAX	COPPER	12.2		MG/KG	12.2
BG1SBP0701	COPPER	5.4		MG/KG	5.4
BG1SBP0801	COPPER	17.1		MG/KG	17.1
BG1SBP0901	COPPER	9.4		MG/KG	9.4
BG3SBA0101-MAX	COPPER	6.5		MG/KG	6.5
BG3SBA0301	COPPER	8	J	MG/KG	8
BG3SBA0501	COPPER	7.5		MG/KG	7.5
BG3SBM0201	COPPER	7.6		MG/KG	7.6
BG3SBM0401	COPPER	8.1	J	MG/KG	8.1
BG3SBM0601	COPPER	7.6		MG/KG	7.6
BG3SBM0701	COPPER	7.1	J	MG/KG	7.1
BG3SBM0801	COPPER	7.9	J	MG/KG	7.9
Average Copper					**8.9**
BG1SBA0101	LEAD	21.5	J	MG/KG	21.5
BG1SBA0401	LEAD	9.4	J	MG/KG	9.4
BG1SBP0401	LEAD	13.6	J	MG/KG	13.6
BG1SBP0601-MAX	LEAD	14.3	J	MG/KG	14.3
BG1SBP0701	LEAD	10.7	J	MG/KG	10.7
BG1SBP0801	LEAD	13.8	J	MG/KG	13.8
BG1SBP0901	LEAD	13.7	J	MG/KG	13.7
BG3SBA0101-MAX	LEAD	13.1	J	MG/KG	13.1
BG3SBA0301	LEAD	19	J	MG/KG	19
BG3SBA0501	LEAD	12.3	J	MG/KG	12.3
BG3SBM0201	LEAD	16.6	J	MG/KG	16.6
BG3SBM0401	LEAD	14.2	J	MG/KG	14.2
BG3SBM0601	LEAD	17.8	J	MG/KG	17.8
BG3SBM0701	LEAD	20.6	J	MG/KG	20.6
BG3SBM0801	LEAD	14.3	J	MG/KG	14.3
Average Lead					**15.0**

TABLE 3-4

OPR BACKGROUND METALS FOR SOIL GROUP 3
NSWC CRANE
CRANE, INDIANA

Background Sample	Background Sample Parameter	Lab Result	Lab Qualifier	Units	Value to use (NDs at 1/2)
BG1SBA0101	TIN	0.63	U	MG/KG	0.315
BG1SBA0401	TIN	0.53	U	MG/KG	0.265
BG1SBP0401	TIN	0.67	U	MG/KG	0.335
BG1SBP0601-MAX	TIN	0.77	U	MG/KG	0.385
BG1SBP0701	TIN	0.51	U	MG/KG	0.255
BG1SBP0801	TIN	0.8	U	MG/KG	0.4
BG1SBP0901	TIN	0.6	U	MG/KG	0.3
BG3SBA0101-MAX	TIN	0.66	U	MG/KG	0.33
BG3SBA0301	TIN	0.82	U	MG/KG	0.41
BG3SBA0501	TIN	0.56	U	MG/KG	0.28
BG3SBM0201	TIN	0.65	U	MG/KG	0.325
BG3SBM0401	TIN	0.59	U	MG/KG	0.295
BG3SBM0601	TIN	1.2	U	MG/KG	0.6
BG3SBM0701	TIN	1.2	U	MG/KG	0.6
BG3SBM0801	TIN	0.52	U	MG/KG	0.26
Average Tin					**0.36**
BG1SBA0101	ZINC	37.6	J	MG/KG	37.6
BG1SBA0401	ZINC	24.4	J	MG/KG	24.4
BG1SBP0401	ZINC	41.4	J	MG/KG	41.4
BG1SBP0601-MAX	ZINC	43.1	J	MG/KG	43.1
BG1SBP0701	ZINC	32.7	J	MG/KG	32.7
BG1SBP0801	ZINC	52.6	J	MG/KG	52.6
BG1SBP0901	ZINC	36.2	J	MG/KG	36.2
BG3SBA0101-MAX	ZINC	34.1	J	MG/KG	34.1
BG3SBA0301	ZINC	37.7	J	MG/KG	37.7
BG3SBA0501	ZINC	30.2	U	MG/KG	15.1
BG3SBM0201	ZINC	35.1	J	MG/KG	35.1
BG3SBM0401	ZINC	37.2	J	MG/KG	37.2
BG3SBM0601	ZINC	40.2	J	MG/KG	40.2
BG3SBM0701	ZINC	60.2	J	MG/KG	60.2
BG3SBM0801	ZINC	28.1	J	MG/KG	28.1
Average Zinc					**37.0**
	ANTIMONY	COPPER	LEAD	TIN	ZINC
Background Average	**0.83**	**8.9**	**15.0**	**0.36**	**37.0**
HHRA	3.1	310	400	4700	2300
	ANTIMONY	COPPER	LEAD	TIN	ZINC
Background Average	**0.83**	**8.9**	**15.0**	**0.36**	**37.0**
ERA Screening Level	0.29	5.4	16	7.62	6.62

Green-shaded cells = appropriate screening level taking background concentrations into effect

FIGURE 3-1
SCATTERPLOT ANTIMONY
XRF vs LAB
SWMU 7 - OLD PISTOL RANGE

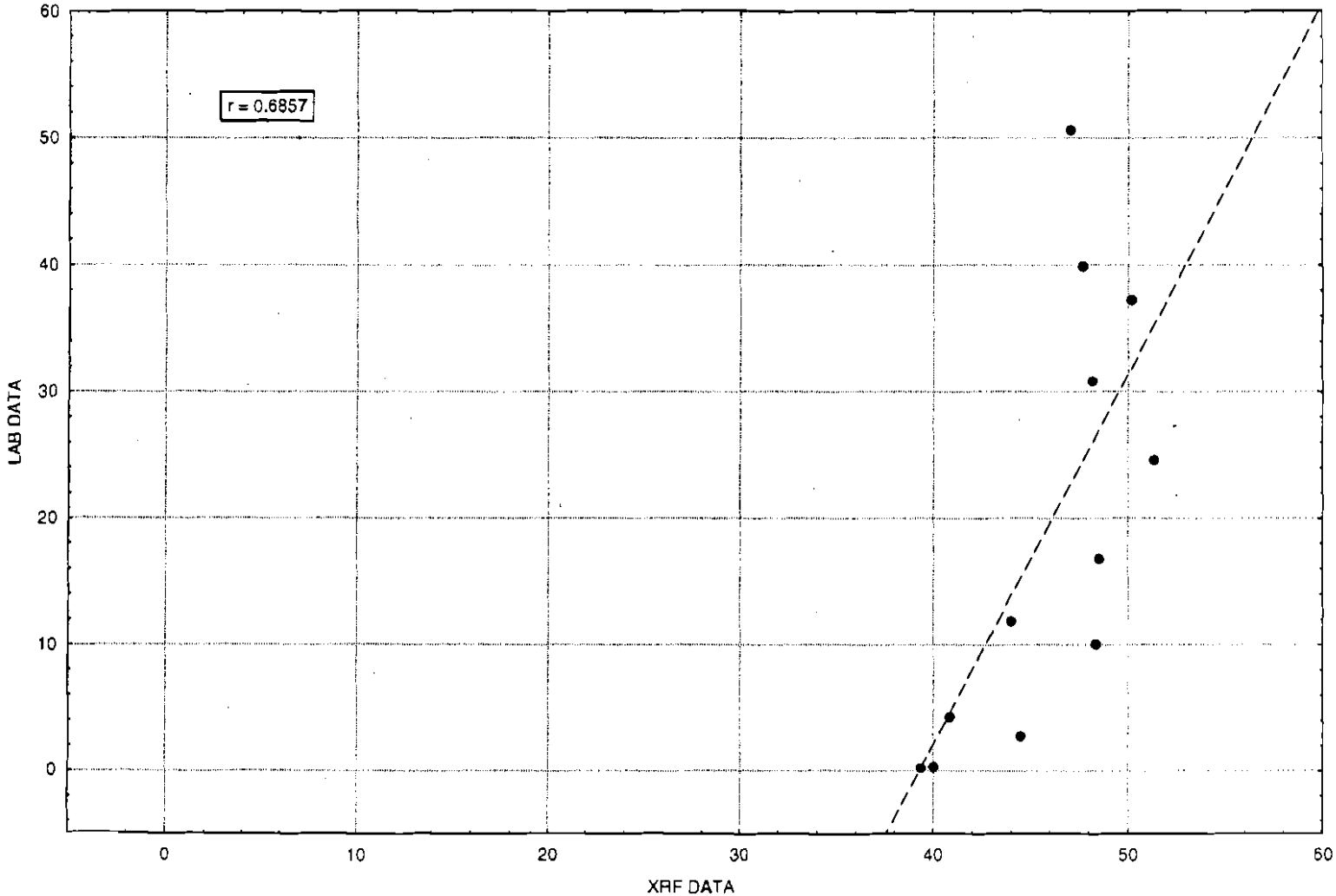


FIGURE 3-2
SCATTERPLOT COPPER
XRF vs LAB
SWMU 7 - OLD PISTOL RANGE

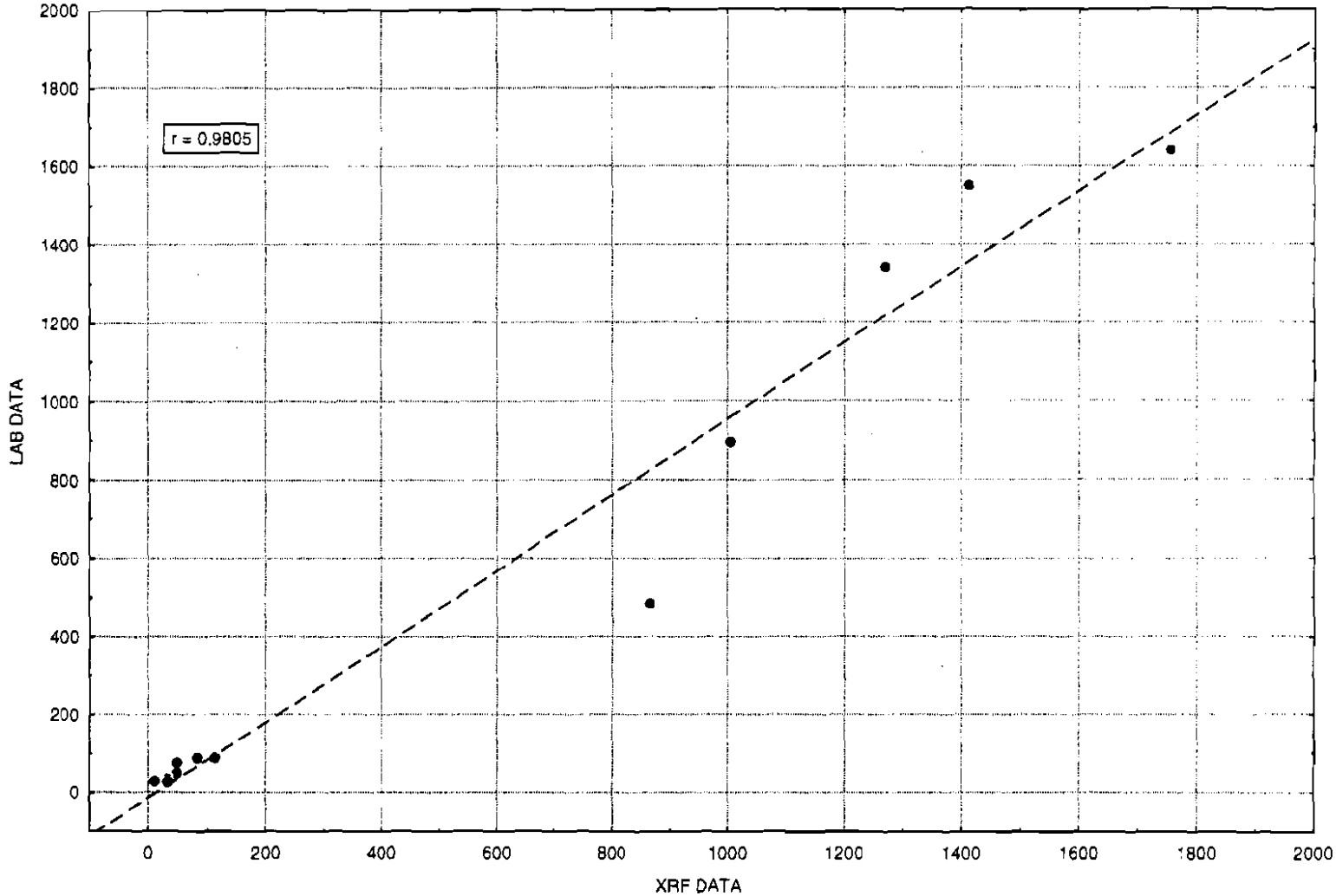


FIGURE 3-3
SCATTERPLOT LEAD
XRF vs LAB
SWMU 7 - OLD PISTOL RANGE

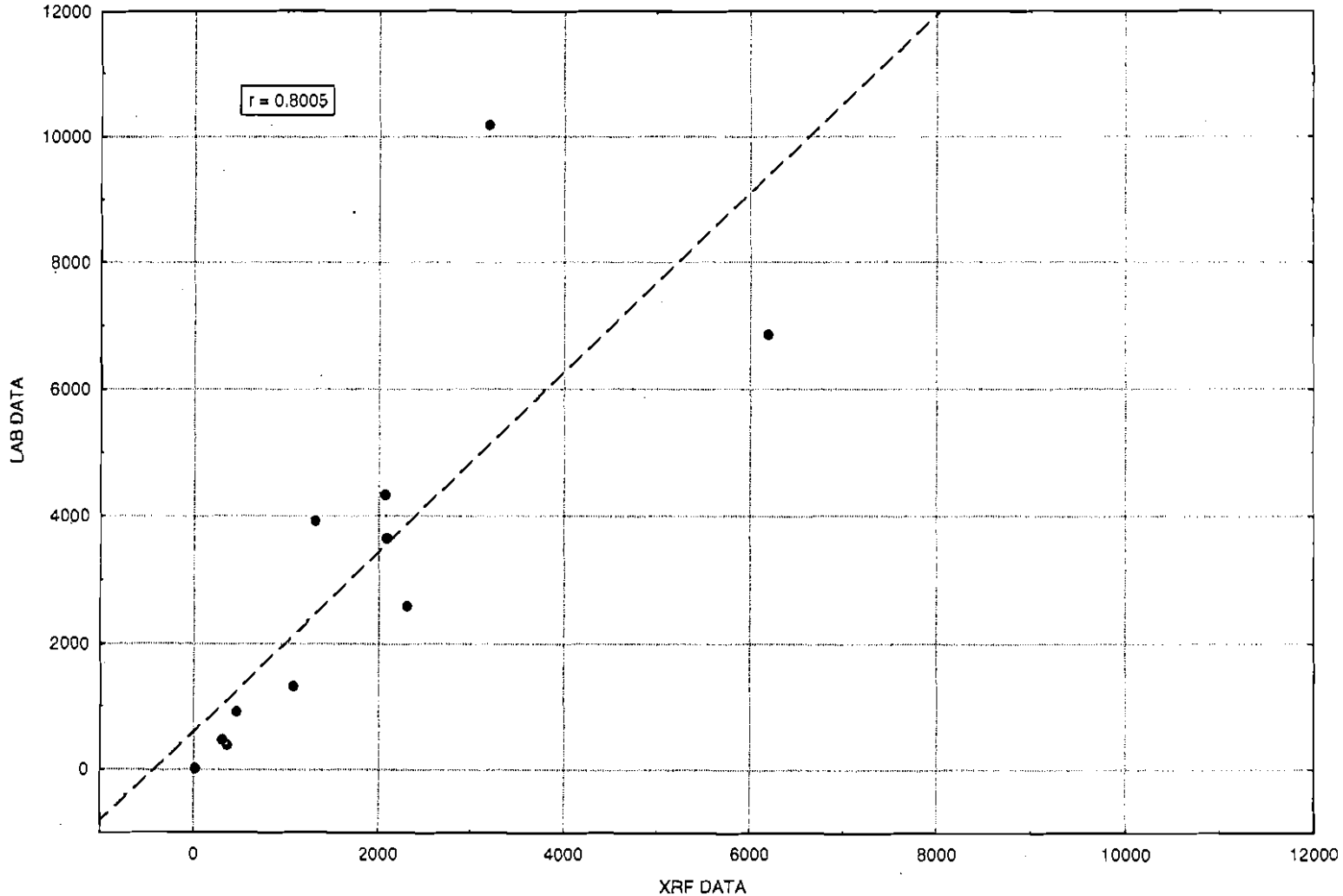


FIGURE 3-4
SCATTERPLOT TIN
XRF vs LAB
SWMU 7 - OLD PISTOL RANGE

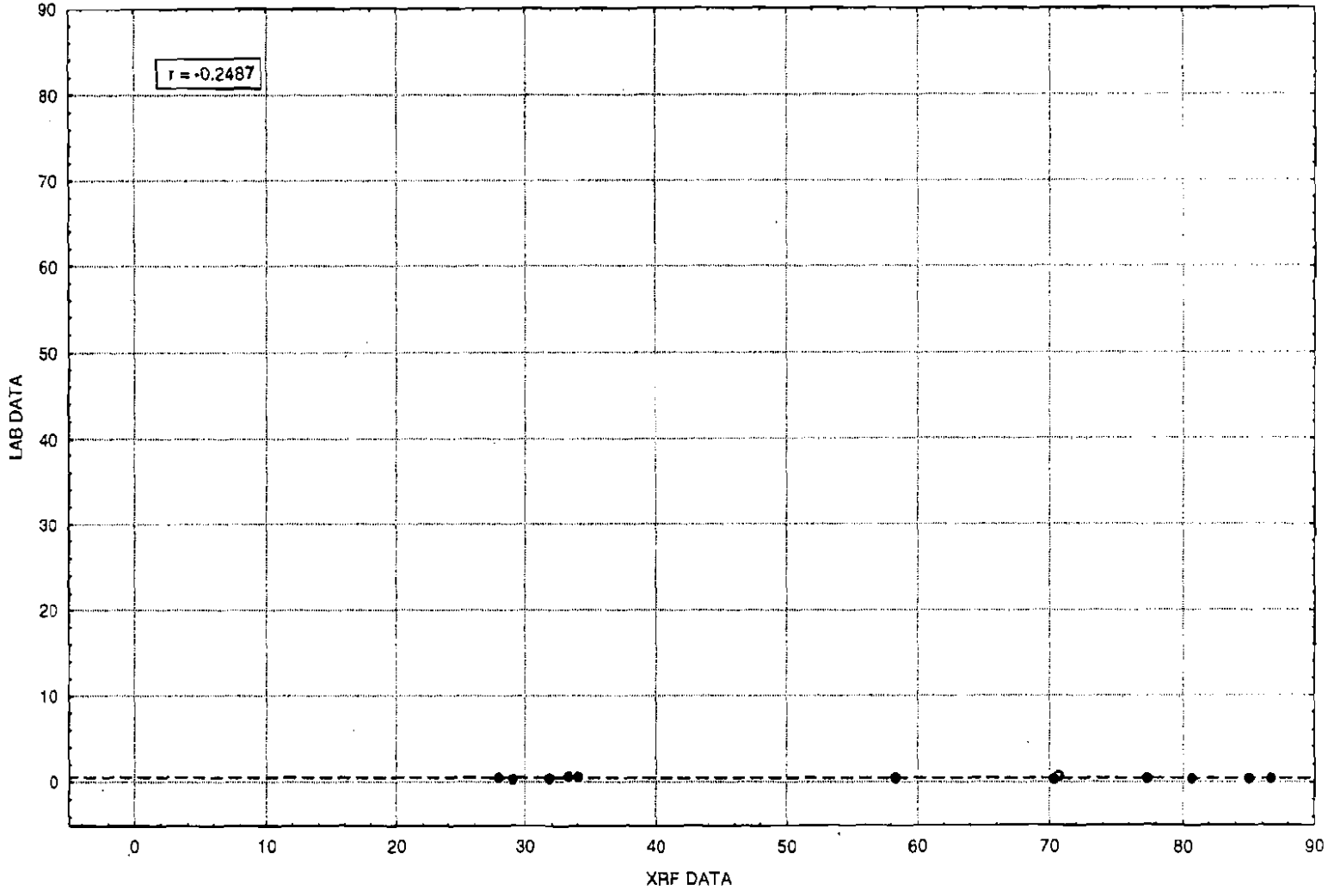
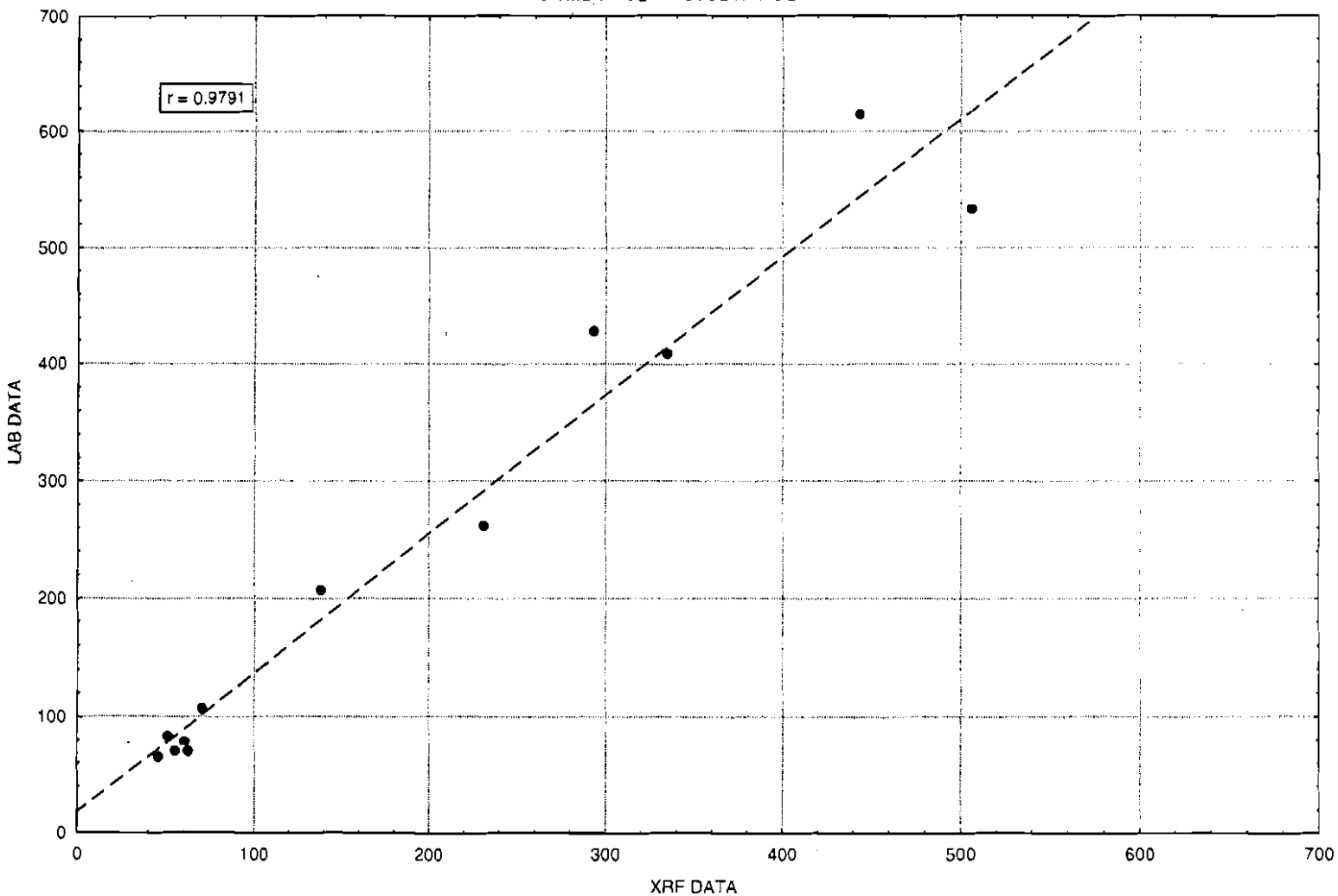


FIGURE 3-5
SCATTERPLOT ZINC
XRF vs LAB
SWMU 7 - OLD PISTOL RANGE



4.0 HUMAN HEALTH RISK SCREENING EVALUATION

This section presents the results of the Human Health Risk Screening Evaluation (HHRSE) of chemical concentrations detected in soils (0 to 24 inches below ground surface [bgs]) collected at the Old Pistol Range (OPR) in 2004. As detailed in Section 3, soil samples were collected at Hillside Range 1 and Range 2 and were analyzed for antimony, copper, lead, tin, and zinc using XRF field screening technology; a subset of the samples were also submitted to a fixed-base laboratory for analysis. Based on the data evaluation presented in Section 3, all available XRF and fixed-base laboratory data for copper, lead, and zinc are evaluated in this risk assessment. However, only the fixed-base laboratory data for antimony and tin are considered in the evaluation because a reasonable correlation between the XRF data and the fixed-base laboratory data could not be demonstrated for these metals. This is primarily because all of the fixed-base laboratory data for tin and much of the fixed-based laboratory data for antimony were non-detect results. Additionally, all of the XRF data for antimony and much of the XRF data for tin were non-detect results. Basic descriptive statistics (i.e. concentration range detected, frequency of detection, arithmetic mean, etc.) for the target analytes (antimony, copper, lead, tin and zinc) are presented in Tables 4-1 through 4-8 for the soils collected at various depths (0-6 inches, 6 to 12 inches, 12 to 24 inches) at the Hillside Range 1 and Range 2 berms and firing lanes.

Information on the selection of chemicals of potential concern, exposure assessment, characterization of estimated potential human health risks, uncertainty analysis, and summary and conclusions for the risk screening are contained in Sections 4.1, 4.2, 4.3, 4.4, and 4.5, respectively.

4.1 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Chemicals of potential concern (COPCs) are the target analytes detected in an environmental media that are selected for evaluation in a risk assessment. Antimony and copper were selected as COPCs because, as summarized in Table 3-2, the maximum detected soil concentrations exceed one-tenth the U.S.EPA Region 9 preliminary remediation goals (PRGs) established for these non-carcinogenic chemicals. The PRGs are chemical concentrations corresponding to fixed levels of risk (i.e., a Hazard Quotient (HQ) of 1 for non-carcinogenic chemicals or a lifetime cancer risk of 1E-06 for carcinogenic chemicals). One-tenth the PRG is typically recommended by U.S.EPA Region 5 as the COPC screening criteria for non-carcinogenic compounds to account for the potential cumulative effects of multiple compounds affecting the same target organ. Zinc and tin were not selected as COPCs because the maximum detected concentrations of these non-carcinogenic chemicals do not exceed one-tenth the U.S.EPA Region 9 PRG.

Lead was selected as a COPC because the maximum detected concentration exceeds the U.S.EPA OSWER screening level of 400 mg/kg (U.S. EPA, 1994). Guidance from the Office of Prevention, Pesticides, and Toxic Substances (OPPTS) and the OSWER recommends 400 mg/kg as a screening level for lead-contaminated soil in a residential setting, where children are frequently present (USEPA, 1994). OPPTS also identifies 2,000 to 5,000 mg/kg as an appropriate range for areas where contact with soil by children in a residential setting is less frequent. Guidance from the USEPA Technical Review Workgroup (TRW) for Lead indicates that "a reasonable screening level for lead in soils at commercial/industrial (i.e., non-residential) sites is 800 mg/kg" for a typical non-contact intensive worker (USEPA, 2004).

Antimony, copper, and/or lead were detected at concentrations exceeding the COPC screening levels in the berm soil samples collected from the 0 to 12 inch interval at both ranges. Consequently, data sets for samples collected from this depth interval in the berms are evaluated in this risk assessment. None of the target analytes were detected in soils from the firing lanes or in soils greater than 12 inches bgs at concentrations exceeding the COPC screening levels.

4.2 EXPOSURE ASSESSMENT

This section presents the exposure assessment for the OPR at SWMU 7. Receptors evaluated in the risk assessment are identified. The methodology used to determine the exposure point concentration (i.e., the concentration to which a receptor is exposed) is presented.

As described in more detail in Section 1, the OPR is located in the central portion of NSWC Crane and is an un-maintained area less than 3 acres in size. The site is overgrown and is bound to the south by the ORR. The areas to the west, north, and east are forested. Topographically the site is relatively flat except for the hillside berm area. The elevation across the OPR varies from approximately 510 feet AMSL in the south to 525 feet AMSL to the north, east, and west. The OPR is located in a floodplain formed from a tributary stream channel of Turkey Creek. Surface water drainage from the area flows to the east. Depth to groundwater is less than 10 feet below ground surface.

The base does not have any current plans to develop the OPR at SWMU 7. Consequently, under current and anticipated future land use, the following receptors are the most likely individuals to be exposed to COPCs in soils at the site.

- Base personnel engaged in site maintenance activities (cutting grass, etc.).
- Trespassers.

These receptors may be exposed to COPCs in soils at the ranges via direct contact (i.e., incidental ingestion, dermal contact) or via inhalation of airborne soil particulates from the site. However, for the purposes of this risk screening, this exposure assessment will assume that a hypothetical future resident or typical industrial worker may be exposed to the COPCs in the soils. The exposure assessment assumptions (e.g., soil ingestion rates, etc) are those specified in the calculation of the Region 9 PRGs for the hypothetical future resident and the typical industrial worker. (The exposure assessment methodology for the Region 9 PRGs is presented in Attachment A.)

The exposure point concentration (EPC) is the COPC concentration to which the receptor is exposed. Per U.S.EPA guidance, the arithmetic mean concentration is recommended as the EPC for lead and the 95 percent upper confidence limit (UCL) on the arithmetic mean is recommended for other chemicals. If a soil data set evaluated in this risk assessment contains fewer than 10 samples (e.g., the soil data sets for antimony), the EPC is defined as the maximum detected concentration (with the exception of lead). If a soil data set evaluated in the risk assessment contains greater than 10 samples, the 95 percent upper confidence limit (UCL) on the arithmetic mean, which is based on the distribution of the data set, is selected as the EPC (with the exception of lead). EPCs are calculated following USEPA's Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (USEPA, 2002) and using the U.S.EPA Pro-UCL software.

4.3 RISK CHARACTERIZATION

The risk characterization of antimony and copper concentrations in soils is conducted using the simple risk-ratio technique described in the following paragraphs. The risk characterization for lead is conducted by a qualitative comparison of arithmetic mean lead concentrations in soils to the aforementioned EPA risk benchmarks (400 mg/kg and 800 mg/kg for the residential and industrial land use scenarios, respectively.)

The risk characterization of antimony and copper concentrations detected in OPR soils are presented in Tables 4-9 through 4-16. Non-cancer risk estimates were developed for the hypothetical future resident and typical industrial worker using the EPC concentrations calculated for COPC concentrations in soils (as described above), and available Region 9 PRGs. As noted previously, the EPA Region 9 PRGs for antimony and copper (selected as COPCs) represent a Hazard Index of 1 (i.e., the no adverse effect concentration) for non-carcinogens. Thus, risk estimates were developed using a simple ratio-ing technique:

$$\frac{\text{EPA Region 9 PRG}}{\text{EPC for COPC}} = \frac{\text{Hazard Index of 1 or Cancer Risk Estimate of 1E - 06}}{\text{?? Hazard Index or Cancer risk Estimate}}$$

Risk estimates (hazard indices) for the hypothetical future resident and the typical industrial worker exposed to antimony and copper are summarized below:

AREA	***HAZARD INDEX RESIDENTIAL***	***HAZARD INDEX INDUSTRIAL***
Hillside Range 1 Berm 0 – 6" soils	Antimony – 0.99 Copper – 0.46 Total – 1.4	Antimony– 0.075 Copper – 0.034 Total – 0.11
Hillside Range 1 Berm 6-12" soils	Antimony– 0.54 Copper – 0.38 Total – 0.92	Antimony – 0.041 Copper – 0.028 Total – 0.069
Range 2 Berm 0 – 6" soils	Antimony – 1.6 Copper – 0.015 Total – 1.6	Antimony – 0.12 Copper – 0.0012 Total – 0.12
Range 2 Berm 6-12" soils	Antimony – 0.38 Copper – 0.0079 Total – 0.39	Antimony– 0.029 Copper - 0.0006 Total – 0.03

The total hazard indices calculated for the typical industrial worker are all less than one indicating that adverse non-carcinogenic health effects are not anticipated under the conditions established for the exposure assessment. The total hazard indices calculated for the hypothetical future resident exposed to antimony in the 0 to 6 inch surface soils in the berms equal or marginally exceed the EPA benchmark of 1. The non-cancer risk estimates for antimony are likely over-estimated because, as previously indicated, the maximum detected concentration for antimony was evaluated as the EPC. However, as discussed below, lead concentrations detected in the 0 to 6 inch soil samples collected from the berms also exceed U.S.EPA benchmarks.

Arithmetic mean lead concentrations for the berm soil samples collected within the 0 to 24 inch depth interval are summarized below:

AREA	***MAXIMUM CONCENTRATION (mg/kg)***(1)(2)	***95 % UCL (mg/kg)***(2)	***ARITHMETIC MEAN (mg/kg)***(2)
Hillside Range 1 Berm 0-6 inches bgs	***6530***	***2380***	***1280***

AREA	***MAXIMUM CONCENTRATION (mg/kg)***[1][2]	***95 % UCL (mg/kg)***[2]	***ARITHMETIC MEAN (mg/kg)***[2]
Hillside Range 1 Berm 6-12 inches bgs	***2610***	***2160***	719
Hillside Range 1 Berm 12-24 inches bgs	189	116	58.3
Hillside Range 1 Firing Lane 0-6 inches bgs	135	48.8	39.1
Range 2 Berm 0-6 inches bgs	***6700***	***4030***	625
Range 2 Berm 6-12 inches bgs	693	387	97.5
Range 2 Berm 12-24 inches bgs	64.7	38.1	28.8
Range 2 Firing Lane 0-6 inches bgs	36.3	24.9	23.2

1 The location of the maximum concentration is provided in Tables 4-1 through 4-6.
2 Bold-Italicized values exceed benchmarks for both residential and industrial land use scenarios. Underlined values exceed residential, but not industrial benchmarks.

Arithmetic mean lead concentrations in the Hillside Range 1 berm soils at 0 to 0.5 ft bgs exceed U.S.EPA benchmarks for both the residential and industrial land use scenarios (400 mg/kg and 800 mg/kg, respectively). Arithmetic mean lead concentrations in the Hillside Range 1 berm soils at 0.5 to 1 ft bgs and Range 2 berm soils at 0 to 0.5 ft. bgs interval exceed the U.S.EPA benchmark for residential land use scenario. The maximum detected lead concentrations in the Hillside Range 1 and Range 2 berm soils are approximately 8 times the U.S.EPA benchmark for industrial land use and approximately 16 times the U.S.EPA benchmark for residential land use. The maximum concentrations in the Hillside Range 1 and Range 2 firing lane samples do not exceed U.S.EPA benchmarks for receptor exposure to lead in soils assuming residential or industrial land use.

4.4 UNCERTAINTY ANALYSIS

The following significant sources of uncertainty should be considered when interpreting the results of this HHRSE of the 2004 analytical results for antimony, copper, lead, tin, and zinc:

- The fixed-base lab data only for antimony and tin were evaluated in the risk analysis. The XRF data for tin and antimony were not evaluated because, as discussed in Section 3, a reasonable correlation between the XRF data and the fixed-base lab data could not be demonstrated for these metals. This is primarily because all of the fixed-base lab data for tin and much of the fixed-based lab data for antimony were non-detect results. Additionally, all of the XRF data for antimony and much of the XRF data for tin were non-detect results. This is not considered a significant source of uncertainty for the risk evaluation because several of the samples targeted for fixed-base lab analysis for antimony and tin were collected from areas demonstrating the highest lead contamination (based on XRF analysis). These areas are also the areas likely to demonstrate elevated antimony and tin concentrations. More importantly, both fixed-base and XRF data indicate that lead is the primary contaminant of concern. The correlation between the XRF data for lead and fixed-base lab data is reasonable (see Section 3, correlation coefficient = 0.8). Consequently, the spatial distribution of metals contamination at the OPR is adequately demonstrated using the available data (fixed-base ***and*** XRF) for lead.

- As noted above, positive detections were reported for tin for some soil samples based on the XRF analysis. However, these results should be considered false positives because although tin was detected in some XRF samples from locations targeted for both XRF and fixed-base lab analysis, tin was not detected in any of the fixed-base lab samples from these same locations. The detection limits for the fixed-base lab samples were an order of magnitude lower than the detection limits reported for the XRF samples.

- As detailed in Section 3, three instrument readings were collected for each soil sample analyzed in the field using XRF technology. The final reading reported in this assessment for a sample location is the average of those readings (positive and/or non-detect instrument readings) for each sample. Conservatively, non-detect results were not divided by a factor of two before the average soil concentration was calculated for a location. Consequently, final readings that are based on a combination of individual positive detections and non-detect results (e.g., one positive instrument reading and two non-detect readings) may be biased high.

- This risk evaluation focuses on shallow soil samples (i.e., 0 to 24 inches bgs) specifically collected from the berms and firing lanes of Hillside Range 1 and Range 2 in 2004 and analyzed for antimony, copper, lead, tin, and zinc. However, a previous HHRSE (TtNUS, 2002) presented a risk characterization of three polyaromatic hydrocarbons (PAHs), two energetics (2,4,6-trinitrotoluene,

2,6-dinitrotoluene), and three metals (arsenic, beryllium, and manganese) detected in shallow and subsurface soils from sampling locations more widely dispersed across the site. The November 2002 HHRSE concluded that risk estimates developed the future typical worker or resident hypothetically exposed the concentrations of these analytes in the shallow soils at the OPR do not exceed the EPA benchmarks typically used to determine the need for environmental remediation. The risk characterization results for the previous November HHRSE do not impact risk characterization results and conclusions presented in this assessment (and vice versa). None of the COPCs evaluated in this assessment are carcinogens. Consequently, the cumulative cancer risk estimates presented in the November 2002 HHRSE for the shallow soils do not change. The non-cancer risk estimates presented in the November 2002 HHRSE for shallow soils are based on arsenic concentrations in the shallow soils; the hazard indices do not exceed 0.5.

- Using the entire concentration range for computing correlation of XRF to laboratory results for lead (see Figure 3-3), it appears that a few fixed-base laboratory results greater than 1,000 mg/kg could be skewing predicted concentrations (based on the reported XRF concentrations), especially at low concentrations. If the correlation plot for lead was used to estimate laboratory concentrations from XRF data, the minimum value that could be obtained would be approximately 600 mg/kg. this results in significant uncertainty in the use of XRF lead data below 1,000 mg/kg. Therefore, it may be prudent to consider the correlation for the low concentration range (i.e., <1,000 mg/kg), where laboratory and XRF agreement was very good, to be different than the high range where the agreement was less robust. This could yield different conclusions regarding the depth of soil that exceeds certain cleanup goals than if the entire range of the correlation plot is used. Also, the uncertainty indicated by the correlation plot for lead in this case suggests that should confirmation samples be collected, they should be analyzed at fixed-base laboratory.

4.5 SUMMARY AND CONCLUSIONS

Antimony, copper, and lead were detected in soils at concentrations exceeding screening levels typically recommended by EPA Region 5 to select chemicals of potential concern for human health risk assessment. Two human receptors (the hypothetical future resident and typical industrial worker) were evaluated for health risks potentially resulting from exposure to these metals. Non-cancer risk estimates for antimony equal or marginally exceed the EPA non-carcinogenic benchmark (a hazard index of 1) when the hypothetical future resident exposure to shallow soils (i.e., 0 to 6 inches bgs) in the berms is evaluated; the hazard indices for copper do not exceed 1. The non-cancer risk estimates calculated for antimony and copper do not exceed 1 when the typical industrial worker is evaluated. Arithmetic mean lead concentrations calculated for soil samples from the 0-to-6 inch interval at the Hillside Range 1 berm

exceed the U.S.EPA benchmarks for industrial and residential land use (i.e., 800 mg/kg and 400 mg/kg, respectively). Arithmetic mean lead concentrations calculated for soil samples from the 6-to-12 inch interval at the Hillside Range 1 berm and the 0-to-6 inch interval at Range 2 berm only exceed the U.S.EPA benchmarks for residential use (i.e., 400 mg/kg). However, localized lead concentrations in these soils also exceed the U.S.EPA benchmark for worker exposure to lead by a factor of approximately 3 or more. Arithmetic mean lead concentrations for deeper berm soils or soils in the firing lane of either range do not exceed U.S.EPA benchmarks for exposure to lead.

TABLE 4-1

SUMMARY OF DESCRIPTIVE STATISTICS
HILLSIDE RANGE 1 BERM SURFACE SOIL (0 - 6")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter	Range of Detections	Frequency of Detection	Range of Nondetects	Arithmetic Mean Concentration	Average of Positive Detects	Location of Maximum Detect	Region 9 PRG (1)	# Detections > PRG	Ecological COPC Screening Level (2)	# Detections > Eco COPC Screening Level	Exposure Point Concentration (3)
Inorganics (mg/kg)											
ANTIMONY	2.8 J - 30.8 J	3/3	---	19.4	19.4	07XSS03	31	0	0.29	3	---
COPPER	31 - 1481 J	17/20	24.7 - 25.7	358	419	07XSS04	3100	0	5.4	17	1413
LEAD	26.3 - 6532 J	20/20	---	1277	1277	07XSS03	400	10	16	20	2380
TIN	---	0/3	0.77 - 1.4	0.49	---	---	47000	0	7.62	0	---
ZINC	40.7 - 520 J	20/20	---	124	124	07XSS04	23000	0	6.62	20	240

1) U.S.EPA Region 9 Preliminary Remediation Goal (PRG), November 2004.
2) These are the agreed upon NSWC Crane COPC selection criteria for ecological risk assessment (see Tables 5-1 through 5-4).
3) Calculated using U.S.EPA Pro-UCL software (See Attachment A).

Note: Data for samples analyzed using both XRF and laboratory techniques were averaged before descriptive statistics were calculated.

TABLE 4-2

SUMMARY OF DESCRIPTIVE STATISTICS
HILLSIDE RANGE 1 BERM SHALLOW SUBSURFACE SOIL (6 - 12")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter	Range of Detections	Frequency of Detection	Range of Nondetects	Arithmetic Mean Concentration	Average of Positive Detects	Location of Maximum Detect	Region 9 PRG (1)	# Detections > PRG	Ecological COPC Screening Level (2)	# Detections > Eco COPC Screening Level	Exposure Point Concentration (3)
Inorganics (mg/kg)											
ANTIMONY	16.8 J	1/1	---	16.8	16.8	07XSS03	31	0	0.29	1	---
COPPER	35.7 - 1304 J	7/10	24 - 26	335	473	07XSS03	3100	0	5.4	7	1168
LEAD	23.7 - 2615 J	10/10	---	719	719	07XSS03	400	3	16	10	2155
TIN	---	0/1	0.66	0.33	---	---	47000	0	7.62	0	---
ZINC	40.7 - 361 J	10/10	---	103	103	07XSS03	23000	0	6.62	10	247

1) U.S.EPA Region 9 Preliminary Remediation Goal (PRG), November 2004.
2) These are the agreed upon NSWC Crane COPC selection criteria for ecological risk assessment (see Tables 5-1 through 5-4).
3) Calculated using U.S.EPA Pro-UCL software (See Attachment A).

Note: Data for samples analyzed using both XRF and laboratory techniques were averaged before descriptive statistics were calculated.

TABLE 4-3

SUMMARY OF DESCRIPTIVE STATISTICS
HILLSIDE RANGE 1 BERM DEEP SUBSURFACE SOIL (1 - 2 FT)
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter	Range of Detections	Frequency of Detection	Range of Nondetects	Arithmetic Mean Concentration	Average of Positive Detects	Location of Maximum Detect	Region 9 PRG [1]	# Detections > PRG	Ecological COPC Screening Level [2]	# Detections > Eco COPC Screening Level	Exposure Point Concentration [3]
Inorganics (mg/kg)											
COPPER	29 - 97.3	4/10	22.3 - 27.7	32.1	61.9	07XSS05	3100	0	5.4	4	73.9
LEAD	13.7 - 189	10/10	---	58.3	58.3	07XSS07	400	0	16	6	116
ZINC	33 - 59	10/10	---	47.2	47.2	07XSS03	23000	0	6.62	10	51.6

1) U.S.EPA Region 9 Preliminary Remediation Goal (PRG), November 2004.
2) These are the agreed upon NSWC Crane COPC selection criteria for ecological risk assessment (see Tables 5-1 through 5-4).
3) Calculated using U.S.EPA Pro-UCL software (See Attachment A).

Note: Data for samples analyzed using both XRF and laboratory techniques were averaged before descriptive statistics were calculated.

TABLE 4-4

SUMMARY OF DESCRIPTIVE STATISTICS
HILLSIDE RANGE 1 FIRING LANE SURFACE SOIL (0 - 6")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter	Range of Detections	Frequency of Detection	Range of Nondetects	Arithmatic Maan Concentration	Average of Positive Detects	Location of Maximum Detect	Region 9 PRG (1)	# Detections > PRG	Ecological COPC Screening Level (2)	# Detections > Eco COPC Screening Level	Exposure Point Concentration (3)
Inorganics (mg/kg)											
ANTIMONY	---	0/1	0.61	0.31	---	---	31	---	0.29	---	---
COPPER	22.7 - 104	18/20	23 - 23.7	40.3	43.5	07XCP06	3100	0	5.4	18	51.2
LEAD	18 - 135	20/20	---	39.1	39.1	07XCP09	400	0	16	20	48.8
TIN	---	0/1	0.94	0.47	---	---	47000	---	7.62	---	---
ZINC	39 - 337	20/20	---	94.8	94.8	07XCP04	23000	0	6.62	20	177

1) U.S.EPA Region 9 Preliminary Remediation Goal (PRG), November 2004.
2) These are the agreed upon NSWC Crane COPC selection criteria for ecological risk assessment (see Tables 5-1 through 5-4).
3) Calculated using U.S.EPA Pro-UCL software (See Attachment A).

Note: Data for samples analyzed using both XRF and laboratory techniques were averaged before descriptive statistics were calculated.

TABLE 4-5

SUMMARY OF DESCRIPTIVE STATISTICS
RANGE 2 BERM SURFACE SOIL (0 - 6")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter	Range of Detections	Frequency of Detection	Range of Nondetects	Arithmetic Mean Concentration	Averags of Positive Detects	Location of Maximum Detect	Region 9 PRG (1)	# Detections > PRG	Ecological COPC Screening Level (2)	# Detections > Eco COPC Screening Level	Exposure Point Concentration (3)
Inorganics (mg/kg)											
ANTIMONY	4.3 J - 50.6 J	3/3	---	31.6	31.6	07XSS17	31	2	0.29	3	---
COPPER	24.7 - 100 J	19/20	23	39.5	40.9	07XSS17	3100	0	5.4	19	47.7
LEAD	54 - 6697 J	20/20	---	625	625	07XSS17	400	3	16	20	4029
TIN	---	0/3	0.68 - 1.2	0.50	---	---	47000	0	7.62	0	---
ZINC	43.7 - 88.5 J	20/20	---	58.8	58.8	07XSS17	23000	0	6.62	20	62.6

1) U.S.EPA Region 9 Preliminary Remediation Goal (PRG), November 2004.
2) These are the agreed upon NSWC Crane COPC selection criteria for ecological risk assessment (see Tables 5-1 through 5-4).
3) Calculated using U.S.EPA Pro-UCL software (See Attachment A).

Note: Data for samples analyzed using both XRF and laboratory techniques were averaged before descriptive statistics were calculated.

TABLE 4-6

SUMMARY OF DESCRIPTIVE STATISTICS
RANGE 2 BERM SHALLOW SUBSURFACE SOIL (6 - 12")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter	Range of Detections	Frequency of Detection	Range of Nondetects	Arithmetic Mean Concentration	Average of Positive Detects	Location of Maximum Detect	Region 9 PRG (1)	# Detections > PRG	Ecological COPC Screening Level (2)	# Detections > Eco COPC Screening Level	Exposure Point Concentration (3)
Inorganics (mg/kg)											
ANTIMONY	11.9 J	1/1	---	11.9	11.9	07XSS17	31	0	0.29	1	---
COPPER	25.7 - 35.7	4/10	23.3 - 27	19.2	29.3	07XSS19	3100	0	5.4	4	24.5
LEAD	20 - 693 J	10/10	---	97.5	97.5	07XSS17	400	1	16	10	387
TIN	---	0/1	0.76	0.38	---	---	47000	0	7.62	0	---
ZINC	47.3 - 63.7	10/10	---	55.1	55.1	07XSS19	23000	0	6.62	10	58.6

1) U.S.EPA Region 9 Preliminary Remediation Goal (PRG), November 2004.
2) These are the agreed upon NSWC Crane COPC selection criteria for ecological risk assessment (see Tables 5-1 through 5-4).
3) Calculated using U.S.EPA Pro-UCL software (See Attachment A).

Note: Data for samples analyzed using both XRF and laboratory techniques were averaged before descriptive statistics were calculated.

TABLE 4-7

SUMMARY OF DESCRIPTIVE STATISTICS
RANGE 2 BERM DEEP SUBSURFACE SOIL (1 - 2 FT)
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter	Range of Detections	Frequency of Detection	Range of Nondetects	Arithmetic Mean Concentration	Average of Positive Detecta	Location of Maximum Detect	Region 9 PRG (1)	# Detections > PRG	Ecological COPC Screening Level (2)	# Detections > Eco COPC Screening Level	Exposure Point Concentration (3)
Inorganics (mg/kg)											
COPPER	26 - 29.7	4/10	24 - 27.3	18.7	27.7	07XSS20	3100	0	5.4	4	23.2
LEAD	17.7 - 64.7	10/10	---	28.8	28.8	07XSS17	400	0	16	10	38.1
ZINC	48 - 68	10/10	---	53.9	53.9	07XSS14	23000	0	6.62	10	57.3

1) U.S.EPA Region 9 Preliminary Remediation Goal (PRG), November 2004.
2) These are the agreed upon NSWC Crane COPC selection criteria for ecological risk assessment (see Tables 5-1 through 5-4).
3) Calculated using U.S.EPA Pro-UCL software (See Attachment A).

Note: Data for samples analyzed using both XRF and laboratory techniques were averaged before descriptive statistics were calculated.

TABLE 4-8
SUMMARY OF DESCRIPTIVE STATISTICS
RANGE 2 FIRING LANE SURFACE SOIL (0 - 6")
OLD PISTOL RANGE
NSWC CRANE, CRANE, INDIANA

Parameter	Range of Detections	Frequency of Detection	Range of Nondetects	Arithmetic Mean Concentration	Average of Positive Detects	Location of Maximum Detect	Region 9 PRG [1]	# Detections > PRG	Ecological COPC Screening Level [2]	# Detections > Eco COPC Screening Level	Exposure Point Concentration [3]
Inorganics (mg/kg)											
ANTIMONY	---	0/1	0.46	0.23	---	---	31	0	0.29	0	---
COPPER	19.4 - 40	12/24	21 - 28.7	19.7	27.9	07XCP11	3100	0	5.4	12	23.0
LEAD	14.3 - 36.3	24/24	---	23.2	23.2	07XCP12	400	0	16	23	24.9
TIN	---	0/1	0.97	0.49	---	---	47000	0	7.6	0	---
ZINC	32.7 - 97.7	24/24	---	53.3	53.3	07XCP12	23000	0	6.6	24	58.4

1) U.S.EPA Region 9 Preliminary Remediation Goal (PRG), November 2004.
2) These are the agreed upon NSWC Crane COPC selection criteria for ecological risk assessment (see Tables 5-1 through 5-4).
3) Calculated using U.S.EPA Pro-UCL software (See Attachment A).

Note: Data for samples analyzed using both XRF and laboratory techniques were averaged before descriptive statistics were calculated.

TABLE 4-9

SUMMARY OF RESIDENTIAL HUMAN HEALTH RISKS AND HAZARDS FOR HILLSIDE RANGE 1 BERM
SURFACE SOIL (0-6")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter[4]	Exposure Point Concentration	Incremental Lifetime Carcinogenic Risk (ILCR)		Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		PRG - Residential[1]	Estimated ILCR	Primary Target Organs[2]	PRG - Residential[1,3]	Estimated HQ
0-6"	(mg/kg)	(mg/kg)			(mg/kg)	
Antimony	30.8 [5]	NA	NA	Blood	3.1E+01	9.9E-01
Copper	1410 [6]	NA	NA	Gastrointestinal	3.1E+03	4.5E-01
Lead	1280 [7]	NA	NA	CNS	4.0E+02	[8]
		Total Carcinogenic Risk	NA		Total HI	1.4E+00

Target Organ HIs

Total Blood HI =	9.9E-01
Total Gastrointestinal HI =	4.5E-01

Footnotes:

1 - Region IX - Preliminary Remediation Goals (PRGs) Tables, October 2004.
2 - Primary Target Organs - Integrated Risk Information System (IRIS).
3 - PRG is shaded if EPC exceeds 1/10th the PRG.
4 - Analyte name is shaded if EPC is greater than the carcinogenic and/or 1/10th the noncarcinogenic PRG.
5 - The maximum concentration was used because there is an insufficient number of samples to calculate statistics.
6 - 99% Chebyshev UCL.
7 - Arithmetic Mean.
8 - Lead is evaluated qualitatively in Section 4.

Abbreviations:

EPC = Exposure Point Concentration
CNS = Central Nervous System
HI = Hazard Index
HQ = Hazard Quotient
ILCR = Incremental Lifetime Cancer Risk
NA = Not Applicable - these COPCs are not carcinogens
PRG = Preliminary Remediation Goal
UCL = Upper Confidence Level

TABLE 4-10

SUMMARY OF INDUSTRIAL HUMAN HEALTH RISKS AND HAZARDS FOR HILLSIDE RANGE 1 BERM
SURFACE SOIL (0-6")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter[4]	Exposure Point Concentration	Incremental Lifetime Carcinogenic Risk (ILCR)		Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		PRG - Industrial[1]	Estimated ILCR	Primary Target Organs[2]	PRG - Industrial[1,3]	Estimated HQ
0-6"	(mg/kg)	(mg/kg)			(mg/kg)	
Antimony	30.8 [5]	NA	NA	Blood	4.1E+02	7.5E-02
Copper	1410 [6]	NA	NA	Gastrointestinal	4.1E+04	3.4E-02
Lead	1280 [7]	NA	NA	CNS	8.0E+02	[8]
		Total Carcinogenic Risk	NA		Total HI	1.1E-01

Target Organ HIs

Total Blood HI =	7.5E-02
Total Gastrointestinal HI =	3.4E-02

Footnotes:

1 - Region IX - Preliminary Remediation Goals (PRGs) Tables, October 2004.
2 - Primary Target Organs - Integrated Risk Information System (IRIS).
3 - PRG is shaded if EPC exceeds 1/10th the PRG.
4 - Analyte name is shaded if EPC is greater than the carcinogenic and/or 1/10th the noncarcinogenic PRG.
5 - The maximum concentration was used because there is an insufficient number of samples to calculate statistics.
6 - 99% Chebyshev UCL.
7 - Arithmetic Mean.
8 - Lead is evaluated qualitatively in Section 4.

Abbreviations:

EPC = Exposure Point Concentration
CNS = Central Nervous System
HI = Hazard Index
HQ = Hazard Quotient
ILCR = Incremental Lifetime Cancer Risk
NA = Not Applicable - these COPCs are not carcinogens
PRG = Preliminary Remediation Goal
UCL = Upper Confidence Level

TABLE 4-11

SUMMARY OF RESIDENTIAL HUMAN HEALTH RISKS AND HAZARDS FOR HILLSIDE RANGE 1 BERM
SUBSURFACE SOIL (6-12")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter[4]	Exposure Point Concentration	Incremental Lifetime Carcinogenic Risk (ILCR)		Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		PRG - Residential[1]	Estimated ILCR	Primary Target Organs[2]	PRG - Residential[1,3]	Estimated HQ
6-12"	(mg/kg)	(mg/kg)			(mg/kg)	
Antimony	16.8 [5]	NA	NA	Blood	3.1E+01	5.4E-01
Copper	1170 [6]	NA	NA	Gastrointestinal	3.1E+03	3.8E-01
Lead	719 [7]	NA	NA	CNS	4.0E+02	[8]
		Total Carcinogenic Risk	NA		Total HI	9.2E-01

Target Organ HIs

Total Blood HI =	5.4E-01
Total Gastrointestinal HI =	3.8E-01

Footnotes:
1 - Region IX - Preliminary Remediation Goals (PRGs) Tables, October 2004.
2 - Primary Target Organs - Integrated Risk Information System (IRIS).
3 - PRG is shaded if EPC exceeds 1/10th the PRG.
4 - Analyte name is shaded if EPC is greater than the carcinogenic and/or 1/10th the noncarcinogenic PRG.
5 - The maximum concentration was used because there is an insufficient number of samples to calculate statistics.
6 - Adjusted Gamma 95% UCL.
7 - Arithmetic Mean.
8 - Lead is evaluated qualitatively in Section 4.

Abbreviations:
EPC = Exposure Point Concentration
CNS = Central Nervous System
HI = Hazard Index
HQ = Hazard Quotient
ILCR = Incremental Lifetime Cancer Risk
NA = Not Applicable - these COPCs are not carcinogens
PRG = Preliminary Remediation Goal
UCL = Upper Confidence Level

TABLE 4-12

SUMMARY OF INDUSTRIAL HUMAN HEALTH RISKS AND HAZARDS FOR HILLSIDE RANGE 1 BERM
SUBSURFACE SOIL (6-12")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter[4]	Exposure Point Concentration	Incremental Lifetime Carcinogenic Risk (ILCR)		Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		PRG - Industrial[1]	Estimated ILCR	Primary Target Organs[2]	PRG - Industrial[1,3]	Estimated HQ
6-12"	(mg/kg)	(mg/kg)			(mg/kg)	
Antimony	16.8 [5]	NA	NA	Blood	4.1E+02	4.1E-02
Copper	1170 [6]	NA	NA	Gastrointestinal	4.1E+04	2.9E-02
Lead	719 [7]	NA	NA	CNS	8.0E+02	[8]
		Total Carcinogenic Risk	NA		Total HI	7.0E-02

Target Organ HIs

Total Blood HI =	4.1E-02
Total Gastrointestinal HI =	2.9E-02

Footnotes:

1 - Region IX - Preliminary Remediation Goals (PRGs) Tables, October 2004.
2 - Primary Target Organs - Integrated Risk Information System (IRIS).
3 - PRG is shaded if EPC exceeds 1/10th the PRG.
4 - Analyte name is shaded if EPC is greater than the carcinogenic and/or 1/10th the noncarcinogenic PRG.
5 - The maximum concentration was used because there is an insufficient number of samples to calculate statistics.
6 - Adjusted Gamma 95% UCL.
7 - Arithmetic Mean.
8 - Lead is evaluated qualitatively in Section 4.

Abbreviations:

EPC = Exposure Point Concentration
CNS = Central Nervous System
HI = Hazard Index
HQ = Hazard Quotient
ILCR = Incremental Lifetime Cancer Risk
NA = Not Applicable - these COPCs are not carcinogens
PRG = Preliminary Remediation Goal
UCL = Upper Confidence Level

TABLE 4-13

SUMMARY OF RESIDENTIAL HUMAN HEALTH RISKS AND HAZARDS FOR RANGE 2 BERM
SURFACE SOIL (0-6")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter[4]	Exposure Point Concentration	Incremental Lifetime Carcinogenic Risk (ILCR)		Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		PRG - Residential[1]	Estimated ILCR	Primary Target Organs[2]	PRG - Residential[1,3]	Estimated HQ
0-6"	(mg/kg)	(mg/kg)			(mg/kg)	
Antimony	50.6 [5]	NA	NA	Blood	3.1E+01	1.6E+00
Copper	47.7 [6]	NA	NA	Gastrointestinal	3.1E+03	1.5E-02
Lead	625 [7]	NA	NA	CNS	4.0E+02	[8]
		Total Carcinogenic Risk	NA		Total HI	1.6E+00

Target Organ HIs

Total Blood HI =	1.6E+00
Total Gastrointestinal HI =	1.5E-02

Footnotes:
1 - Region IX - Preliminary Remediation Goals (PRGs) Tables, October 2004.
2 - Primary Target Organs - Integrated Risk Information System (IRIS).
3 - PRG is shaded if EPC exceeds 1/10th the PRG.
4 - Analyte name is shaded if EPC is greater than the carcinogenic and/or 1/10th the noncarcinogenic PRG.
5 - The maximum concentration was used because there is an insufficient number of samples to calculate statistics.
6 - Approximate Gamma 95% UCL.
7 - Arithmetic Mean.
8 - Lead is evaluated qualitatively in Section 4.

Abbreviations:
EPC = Exposure Point Concentration
CNS = Central Nervous System
HI = Hazard Index
HQ = Hazard Quotient
ILCR = Incremental Lifetime Cancer Risk
NA = Not Applicable - these COPCs are not carcinogens
PRG = Preliminary Remediation Goal
UCL = Upper Confidence Level

TABLE 4-14

SUMMARY OF INDUSTRIAL HUMAN HEALTH RISKS AND HAZARDS FOR RANGE 2 BERM
SURFACE SOIL (0-6")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter[4]	Exposure Point Concentration	Incremental Lifetime Carcinogenic Risk (ILCR)		Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		PRG - Industrial[1]	Estimated ILCR	Primary Target Organs[2]	PRG - Industrial[1,3]	Estimated HQ
0-6"	(mg/kg)	(mg/kg)			(mg/kg)	
Antimony	50.6 [5]	NA	NA	Blood	4.1E+02	1.2E-01
Copper	47.7 [6]	NA	NA	Gastrointestinal	4.1E+04	1.2E-03
Lead	625 [7]	NA	NA	CNS	8.0E+02	[8]
		Total Carcinogenic Risk	NA		Total HI	1.2E-01

Target Organ HIs

Total Blood HI =	1.2E-01
Total Gastrointestinal HI =	1.2E-03

Footnotes:
1 - Region IX - Preliminary Remediation Goals (PRGs) Tables, October 2004.
2 - Primary Target Organs - Integrated Risk Information System (IRIS).
3 - PRG is shaded if EPC exceeds 1/10th the PRG.
4 - Analyte name is shaded if EPC is greater than the carcinogenic and/or 1/10th the noncarcinogenic PRG.
5 - The maximum concentration was used because there is an insufficient number of samples to calculate statistics.
6 - Approximate Gamma 95% UCL.
7 - Arithmetic Mean.
8 - Lead is evaluated qualitatively in Section 4.

Abbreviations:
EPC = Exposure Point Concentration
CNS = Central Nervous System
HI = Hazard Index
HQ = Hazard Quotient
ILCR = Incremental Lifetime Cancer Risk
NA = Not Applicable - these COPCs are not carcinogens
PRG = Preliminary Remediation Goal
UCL = Upper Confidence Level

TABLE 4-15

SUMMARY OF RESIDENTIAL HUMAN HEALTH RISKS AND HAZARDS FOR RANGE 2 BERM
SUBSURFACE SOIL (6-12")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter[4]	Exposure Point Concentration	Incremental Lifetime Carcinogenic Risk (ILCR)		Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		PRG - Residential[1]	Estimated ILCR	Primary Target Organs[2]	PRG - Residential[1,3]	Estimated HQ
6-12"	(mg/kg)	(mg/kg)			(mg/kg)	
Antimony	11.9 [5]	NA	NA	Blood	3.1E+01	3.8E-01
Copper	24.5 [6]	NA	NA	Gastrointestinal	3.1E+03	7.9E-03
Lead	97.5 [7]	NA	NA	CNS	4.0E+02	[8]
		Total Carcinogenic Risk	NA		Total HI	3.9E-01

Target Organ HIs

Total Blood HI =	3.8E-01
Total Gastrointestinal HI =	7.9E-03

Footnotes:
1 - Region IX - Preliminary Remediation Goals (PRGs) Tables, October 2004.
2 - Primary Target Organs - Integrated Risk Information System (IRIS).
3 - PRG is shaded if EPC exceeds 1/10th the PRG.
4 - Analyte name is shaded if EPC is greater than the carcinogenic and/or 1/10th the noncarcinogenic PRG.
5 - The maximum concentration was used because there is an insufficient number of samples to calculate statistics.
6 - Student-t or Modified-t UCL.
7 - Arithmetic Mean.
8 - Lead is evaluated qualitatively in Section 4.

Abbreviations:
EPC = Exposure Point Concentration
CNS = Central Nervous System
HI = Hazard Index
HQ = Hazard Quotient
ILCR = Incremental Lifetime Cancer Risk
NA = Not Applicable - these COPCs are not carcinogens
PRG = Preliminary Remediation Goal
UCL = Upper Confidence Level

TABLE 4-16

SUMMARY OF INDUSTRIAL HUMAN HEALTH RISKS AND HAZARDS FOR RANGE 2 BERM
SUBSURFACE SOIL (6-12")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter[4]	Exposure Point Concentration	Incremental Lifetime Carcinogenic Risk (ILCR)		Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		PRG - Industrial[1]	Estimated ILCR	Primary Target Organs[2]	PRG - Industrial[1,3]	Estimated HQ
6-12"	(mg/kg)	(mg/kg)			(mg/kg)	
Antimony	11.9 [5]	NA	NA	Blood	4.1E+02	2.9E-02
Copper	24.5 [6]	NA	NA	Gastrointestinal	4.1E+04	6.0E-04
Lead	97.5 [7]	NA	NA	CNS	8.0E+02	[8]
		Total Carcinogenic Risk	NA		Total HI	3.0E-02

Target Organ HIs

Total Blood HI =	2.9E-02
Total Gastrointestinal HI =	6.0E-04

Footnotes:

1 - Region IX - Preliminary Remediation Goals (PRGs) Tables, October 2004.
2 - Primary Target Organs - Integrated Risk Information System (IRIS).
3 - PRG is shaded if EPC exceeds 1/10th the PRG.
4 - Analyte name is shaded if EPC is greater than the carcinogenic and/or 1/10th the noncarcinogenic PRG.
5 - The maximum concentration was used because there is an insufficient number of samples to calculate statistics.
6 - Student-t or Modified-t UCL.
7 - Arithmetic Mean.
8 - Lead is evaluated qualitatively in Section 4.

Abbreviations:

EPC = Exposure Point Concentration
CNS = Central Nervous System
HI = Hazard Index
HQ = Hazard Quotient
ILCR = Incremental Lifetime Cancer Risk
NA = Not Applicable - these COPCs are not carcinogens
PRG = Preliminary Remediation Goal
UCL = Upper Confidence Level

ATTACHMENT A-1

SUMMARY OF EXPOSURE POINT CONCENTRATIONS
HILLSIDE RANGE 1 BERM SURFACE SOIL SAMPLES (0 - 6")
OLD PISTOL RANGE
NSWC CRANE
CRANE INDIANA

Chemical	Raw Statistics											Data Distribution	EPA's ProUCL Recommended UCL to Use		Comments
	Frequency of Detection		Mininum Detected	Maximum Detected	Mean of All Samples	Mean of Positive Detects	Median	Standard Deviation	Coefficient of Variation	Skewness	Outlier?				
	Number	Percent													
ANTIMONY	3/3	100%	2.8 J	30.8 J	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)
COPPER	17/20	85%	31	1481 J	358	419	55.2	474	1.3	1.3	- -	Non-parametric	1413	99% Chebyshev(Mean, Std) UCL	- -
LEAD	20/20	100%	26.3	6532 J	1277	1277	427	1681	1.3	1.8	Yes	Gamma	2380	Approximate Gamma 95% UCL	- -
TIN	0/3	0%	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)
ZINC	20/20	100%	40.7	520 J	124	124	62.5	119	0.96	2.3	Yes	Non-parametric	240	95% Chebyshev(Mean, Std) UCL	- -

Bolded and shaded values indicate that frequency of detection is less than 50 percent.
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
The Discordance Outlier test assumes normality after the maximum concentration is removed.
Only one outlier is tested for, the Discordance test does not test for multiple outliers.
B qualified data were evaluated as positive detections.
NA(1) - Not applicable, there are an insufficient number of samples to calculate statistics.
NA(5) - Not applicable, data distribution does not allow the statistic to be calculated.
NA(6) - Chemical was not detected, therefore statistics could not be calculated.

ATTACHMENT A-2

SUMMARY OF EXPOSURE POINT CONCENTRATIONS
HILLSIDE RANGE 1 BERM SHALLOW SUBSURFACE SOIL SAMPLES (6 - 12")
OLD PISTOL RANGE
NSWC CRANE
CRANE INDIANA

Chemical	Raw Statistics												Data Distribution	EPA's ProUCL Recommended UCL to Use Adjusted		Rationale for Adjustment
	Frequency of Detection		Mininum Detected	Maximum Detected	Mean of All Samples	Mean of Positive Detects	Median	Standard Deviation	Coefficient of Variation	Skewness	Outlier?	Distribution				
	Number	Percent														
ANTIMONY	1/1	100%	16.8 J	16.8 J	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	
COPPER	7/10	70%	35.7	1305 J	335	473	52.5	456	1.4	1.3	- -	Gamma	Gamma	1168	Adjusted Gamma 95% UCL	
LEAD	10/10	100%	23.7	2615 J	719	719	99.3	1066	1.5	1.3	- -	Gamma	Gamma	2155	Approximate Gamma 95% UCL	Skewness
[illegible]	[illegible]	[illegible]	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	
ZINC	10/10	100%	40.7	361 J	103	103	58.2	104	1.0	2.1	Yes	Not Gamma	Non-parametric	247	95% Chebyshev(Mean, Std) UCL	

Bolded and shaded values indicate that frequency of detection is less than 50 percent.
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
The Discordance Outlier test assumes normality after the maximum concentration is removed.
Only one outlier is tested for, the Discordance test does not test for multiple outliers.
B qualified data were evaluated as positive detections.
NA(1) - Not applicable, there are an insufficient number of samples to calculate statistics.
NA(5) - Not applicable, data distribution does not allow the statistic to be calculated.
NA(6) - Chemical was not detected, therefore statistics could not be calculated.

ATTACHMENT A-3

SUMMARY OF EXPOSURE POINT CONCENTRATIONS
HILLSIDE RANGE 1 BERM DEEP SUBSURFACE SOIL SAMPLES (1 - 2 FT)
OLD PISTOL RANGE
NSWC CRANE
CRANE INDIANA

Chemical	Raw Statistics											Data Distribution	EPA's ProUCL Recommended UCL to Use		Comments
	Frequency of Detection		Mininum Detected	Maximum Detected	Mean of All Samples	Mean of Positive Detects	Median	Standard Deviation	Coefficient of Variation	Skewness	Outlier?				
	Number	Percent													
COPPER	**4/10**	**40%**	**20.1**	**97.33**	**32.1**	**61.0**	**43.3**	**30.3**	**0.94**	**1.4**	**--**	**Non-parametric**	**73.9**	**95% Chebyshev(Mean, Std) UCL**	**--**
LEAD	10/10	100%	13.7	189	58.3	58.3	21.7	64.9	1.1	1.3	--	Gamma	116	Approximate Gamma 95% UCL	--
ZINC	10/10	100%	33	59	47.2	47.2	45.2	7.6	0.16	-0.058	--	Normal	51.6	Student-t	--

Bolded and shaded values indicate that frequency of detection is less than 50 percent.
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
The Discordance Outlier test assumes normality after the maximum concentration is removed.
Only one outlier is tested for, the Discordance test does not test for multiple outliers.
B qualified data were evaluated as positive detections.
NA(5) - Not applicable, data distribution does not allow the statistic to be calculated.

ATTACHMENT A-4

SUMMARY OF EXPOSURE POINT CONCENTRATIONS
HILLSIDE RANGE 1 FIRING LANE SURFACE SOIL SAMPLES (0 - 6")
OLD PISTOL RANGE
NSWC CRANE
CRANE INDIANA

Chemical	Raw Statistics											Data Distribution	EPA's ProUCL Recommended UCL to Use		Comments
	Frequency of Detection		Mininum Detected	Maximum Detected	Mean of All Samples	Mean of Positive Detects	Median	Standard Deviation	Coefficient of Variation	Skewness	Outlier?				
	Number	Percent													
ANTIMONY	0/1	0%	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)
COPPER	18/20	90%	22.7	104	40.3	43.5	30.3	25.1	0.62	1.2	- -	Gamma	51.2	Approximate Gamma 95% UCL	- -
LEAD	20/20	100%	18	135	39.1	39.1	32.3	26.5	0.68	2.7	Yes	Gamma	48.8	Approximate Gamma 95% UCL	- -
TIN	0/1	0%	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)
ZINC	20/20	100%	39	337	94.8	94.8	49.8	84.6	0.89	1.7	Yes	Non-parametric	177	95% Chebyshev(Mean, Std) UCL	- -

Bolded and shaded values indicate that frequency of detection is less than 50 percent.
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
The Discordance Outlier test assumes normality after the maximum concentration is removed.
Only one outlier is tested for, the Discordance test does not test for multiple outliers.
B qualified data were evaluated as positive detections.
NA(5) - Not applicable, data distribution does not allow the statistic to be calculated.
NA(6) - Chemical was not detected, therefore statistics could not be calculated.

ATTACHMENT A-5

SUMMARY OF EXPOSURE POINT CONCENTRATIONS
RANGE 2 BERM SURFACE SOIL SAMPLES (0 - 6")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Chemical	Raw Statistics											Data Distribution	EPA's ProUCL Recommended UCL to Use		Comments
	Frequency of Detection		Mininum Detected	Maximum Detected	Mean of All Samples	Mean of Positive Detects	Median	Standard Deviation	Coefficient of Variation	Skewness	Outlier?				
	Number	Percent													
ANTIMONY	3/3	100%	4.3 J	50.6 J	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)
COPPER	19/20	95%	24.7	100 J	39.5	40.9	33.1	20.8	0.53	1.9	Yes	Gamma	47.7	Approximate Gamma 95% UCL	- -
LEAD	20/20	100%	54	6697 J	625	625	118	1530	2.4	3.7	Yes	Non-parametric	4029	99% Chebyshev(Mean, Std) UCL	- -
TIN	0/3	0%	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)
ZINC	20/20	100%	43.7	88.5 J	58.8	58.8	58.5	9.83	0.17	1.3	Yes	Normal	62.6	Student-t	- -

Bolded and shaded values indicate that frequency of detection is less than 50 percent.
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
The Discordance Outlier test assumes normality after the maximum concentration is removed.
Only one outlier is tested for, the Discordance test does not test for multiple outliers.
B qualified data were evaluated as positive detections.
NA(1) - Not applicable, there are an insufficient number of samples to calculate statistics.
NA(5) - Not applicable, data distribution does not allow the statistic to be calculated.
NA(6) - Chemical was not detected, therefore statistics could not be calculated.

ATTACHMENT A-6

SUMMARY OF EXPOSURE POINT CONCENTRATIONS
RANGE 2 BERM SHALLOW SUBSURFACE SOIL SAMPLES (6 - 12")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Chemical	Raw Statistics											Data Distribution	EPA's ProUCL Recommended UCL to Use Adjusted		Rationale for Adjustment
	Frequency of Detection		Mininum Detected	Maximum Detected	Mean of All Samples	Mean of Positive Detects	Median	Standard Deviation	Coefficient of Variation	Skewness	Outlier?				
	Number	Percent													
ANTIMONY	1/1	100%	11.9 J	11.9 J	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	
COPPER	4/10	40%	25.9	35.9	10.3	25.9	[illegible]	[illegible]	0.48	0.82	- -	Non-parametric	24.5	Student-t for Modified-t UCL	
LEAD	10/10	100%	20	693 J	97.5	97.5	28.7	210	2.2	3.1	Yes	Non-parametric	387	95% Chebyshev(Mean, Std) UCL	Mean, Outlier
TIN	0/10	0%	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	
ZINC	10/10	100%	47.3	63.7	55.1	55.1	53.2	6.2	0.11	0.49	- -	Normal	58.6	Student-t	

Bolded and shaded values indicate that frequency of detection is less than 50 percent.
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
The Discordance Outlier test assumes normality after the maximum concentration is removed.
Only one outlier is tested for, the Discordance test does not test for multiple outliers.
Max(1) - Recommended UCL exceeds the maximum observation, consider using 95% or 97.5% Chebyshev (Mean, Sd) UCL.
B qualified data were evaluated as positive detections.
NA(1) - Not applicable, there are an insufficient number of samples to calculate statistics.
NA(5) - Not applicable, data distribution does not allow the statistic to be calculated.
NA(6) - Chemical was not detected, therefore statistics could not be calculated.

ATTACHMENT A-7

SUMMARY OF EXPOSURE POINT CONCENTRATIONS
RANGE 2 BERM DEEP SUBSURFACE SOIL SAMPLES (1 - 2 FT)
OLD PISTOL RANGE
NSWC CRANE
CRANE INDIANA

Chemical	Raw Statistics											Data Distribution	EPA's ProUCL Recommended UCL to Use		Comments
	Frequency of Detection		Mininum Detected	Maximum Detected	Mean of All Samples	Mean of Positive Detects	Median	Standard Deviation	Coefficient of Variation	Skewness	Outlier?				
	Number	Percent													
COPPER	4/10	40%	26	59.6	18.7	27.7	13.3	24.5	0.84	0.53	-	Non-parametric	23.2	Student-t or Modified-t UCL	- -
LEAD	10/10	100%	17.7	64.7	28.8	28.8	22.2	16.0	0.56	1.8	Yes	Non-parametric	38.1	Student-t or Modified-t UCL	- -
ZINC	10/10	100%	48	68	53.9	53.9	52.5	5.7	0.11	1.8	Yes	Gamma	57.3	Approximate Gamma 95% UCL	- -

Bolded and shaded values indicate that frequency of detection is less than 50 percent.
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
The Discordance Outlier test assumes normality after the maximum concentration is removed.
Only one outlier is tested for, the Discordance test does not test for multiple outliers.
B qualified data were evaluated as positive detections.
NA(5) - Not applicable, data distribution does not allow the statistic to be calculated.

ATTACHMENT A-8

SUMMARY OF EXPOSURE POINT CONCENTRATIONS
RANGE 2 FIRING LANE SURFACE SOIL SAMPLES (0 - 6")
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Chemical	Raw Statistics											Data Distribution	EPA's ProUCL Recommended UCL to Use		Comments
	Frequency of Detection		Mininum Detected	Maximum Detected	Mean of All Samples	Mean of Positive Detects	Median	Standard Deviation	Coefficient of Variation	Skewness	Outlier?				
	Number	Percent													
ANTIMONY	0/1	0%	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)
COPPER	12/24	50%	19.4	40	19.7	27.9	16.9	9.34	0.47	0.61	- -	Non-parametric	23	Student-t or Modified-t UCL	- -
LEAD	24/24	100%	14.3	36.3	23.2	23.2	22.5	4.8	0.21	0.66	Yes	Normal	24.9	Student-t	- -
TIN	0/1	0%	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)	NA(6)
ZINC	24/24	100%	32.7	97.7	53.3	53.3	52.3	14.3	0.27	1.8	Yes	Lognormal	58.4	Student's-t, modified-t or H-UCL	- -

Bolded and shaded values indicate that frequency of detection is less than 50 percent.
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
The Discordance Outlier test assumes normality after the maximum concentration is removed.
Only one outlier is tested for, the Discordance test does not test for multiple outliers.
B qualified data were evaluated as positive detections.
NA(5) - Not applicable, data distribution does not allow the statistic to be calculated.
NA(6) - Chemical was not detected, therefore statistics could not be calculated.

5.0 ECOLOGICAL RISK SCREENING EVALUATION

This section presents the results of an ecological risk screening evaluation (ERSE) of chemical concentrations detected in soils (0 to 6 inches bgs) collected at the OPR in 2004. As detailed in Section 3, soil samples were collected at Hillside Range 1 and Range 2 and were analyzed for antimony, copper, lead, tin, and zinc using XRF field screening technology; a subset of the samples were also submitted to a fixed-base lab for analysis. Based on the data evaluation presented in Section 3, all available XRF and fixed-base lab data for copper, lead, and zinc are evaluated in this risk assessment. However, only the fixed-base lab data for antimony and tin are considered in the evaluation because a reasonable correlation was not demonstrated for the XRF versus fixed-base lab data for antimony and tin. Basic descriptive statistics (i.e. concentration range detected, frequency of detection, arithmetic mean, etc.) for the target analytes (antimony, copper, lead, tin and zinc) are presented in Tables 4-1 through 4-8 for the soils collected at various depths (0-6 inches, 6 to 12 inches, 12 to 24 inches) at the Hillside Range 1 and Range 2 berms and firing lanes. However, per instructions from U.S. EPA Region 5 only soils in the 0 to 6 inch bgs depth interval are evaluated in this ERSE.

This ERSE is limited to a comparison of maximum and arithmetic mean metals concentrations to ecological screening benchmarks typically used in ecological risk assessments prepared for regulatory review within EPA Region 5. It includes the limited food chain modeling calculations presented in Attachment 5-A. (Attachment 5-A provides the methodology used to conduct the food chain modeling and the resultant ecological effects quotients (EEQs) for the Meadow Vole, the Short-tailed Shrew, the American Woodcock, and Bobwhite Quail). The objective of this assessment is to determine if select metals concentrations in the OPR soils are significant enough to warrant further ecological evaluation (i.e., do chemicals of potential concern exist?). A brief site description and discussion of potential ecological receptors of concern and exposure pathways is presented in Sections 5.1 and 5.2, respectively. The analytical results for the soil samples collected at the OPR are presented in Section 3. The comparison of maximum and arithmetic mean metals concentrations to the aforementioned ecological screening benchmarks is presented in Section 5.3. An uncertainty assessment is presented in Section 5.4. Summary and conclusions are presented in Section 5.5.

5.1 SITE DESCRIPTION

As described in more detail in Section 1, the OPR is located in the central portion of NSWC Crane and is an un-maintained area less than 3 acres in size. The site is overgrown and is bound to the south by the ORR. The areas to the west, north, and east are forested. Topographically the site is relatively flat

except for the hillside berm area. The elevation across the OPR varies from approximately 510 feet AMSL in the south to 525 feet AMSL to the north, east, and west. The OPR is located in a floodplain formed from a tributary stream channel of Turkey Creek. Surface water drainage from the area flows to the east.

5.2 POTENTIAL ECOLOGICAL RECEPTORS AND EXPOSURE PATHWAYS

Based on the description of the site found in Section 1, ecological receptors could be directly exposed to chemicals in the surface soils at the OPR (i.e., plants and soil invertebrates), or indirectly via the food chain (i.e., through the ingestion of plants and invertebrates). The primary ecological receptors of concern are:

- Soil invertebrates
- Soil vegetation
- Small insectivorous mammals
- Small herbivorous

Large herbivorous mammals may visit and graze at the site; however, the firing ranges and berms at the OPR are a half an acre or less each, which is a very small percentage of the territory needed to maintain such animals, or the larger omnivores, or predatory animals and birds. Also, although small insectivorous and herbivorous mammals and birds may consume some food items from the firing ranges and berms, the home range of most small mammals and birds is much larger than 0.5 acres.

5.3 ECOLOGICAL SCREENING

The risk screening summarized in Tables 5-1 through 5-4 was performed by comparing maximum and arithmetic mean metals concentrations in the 0 to 6 inch depth interval to the following ecological screening benchmarks for surface soil:

- ***EPA Region 5 Ecological Screening Levels (ESLs) for Ecological Receptors*** – These levels were developed to protect soil invertebrates, plants, and terrestrial wildlife from exposure to chemical concentrations in the soil (U.S. EPA, 1999). The lower of the screening values to protect each of the above endpoints was selected as the ESLs.

- ***Federal EPA Ecological Soil Screening Levels (Eco SSLs)*** - The Eco SSLs were developed for invertebrates, plants, mammals, and birds for each chemical for which adequate data were available.

For some chemicals, adequate data were only available to develop Eco SSL values for some of the receptors.

- ***Oak Ridge National Laboratory Benchmarks (ORNL)*** – The Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision (Efroymson et al., 1997a) and the Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision (Efroymson, et al., 1997b) were developed by the Oak Ridge National Laboratory (ORNL). These benchmarks were intended to be used as screening values, and as such, may be overly conservative. They are based on a 20 percent reduction in growth, reproduction, or activity (for invertebrates) or growth and yield (for plants) as the threshold for significant effects (Efroymson R.A. et al., 1997a, b).

- ***Canadian Soil Quality Guidelines (CSQG)*** - The Canadian Soil Quality Guidelines were developed by the Canadian Council of Ministers of the Environment (CCME, 1997). They are derived using toxicological data to determine the threshold level for key receptors (CCME, 1997). The values are calculated for four land uses: agricultural, residential/parkland, commercial, and industrial. Exposure from direct soil contact is used to derive guidelines for the residential/parkland, commercial, and industrial land uses (CCME, 1997). However, the soil guidelines for the agricultural land use incorporate direct soil contact as well as soil and food ingestion (CCME, 1997).

The U.S. EPA Region 5 ESLs and federal U.S. EPA wildlife Eco SSLs are the most conservative screening levels presented in these tables and are considered the initial chemical of potential concern (COPC) screening levels for this assessment. However, an exceedance of these screening levels is not necessarily indicative of a potential for ecological risk at a site because:

- The screening levels generally represent the lowest screening levels found in the literature for any receptor and are not always applicable to site-specific receptors and conditions, and

- The ESLs and the Eco SSLs for wildlife are often less than base-specific background concentrations. For example, the arithmetic mean antimony (0.83 mg/kg), copper (8.9 mg/kg), lead (15 mg/kg), and zinc (37 mg/kg) background concentrations presented in Table 3-4 exceed the ESLs presented in Tables 5-1 through 5-4. The arithmetic mean lead concentration presented in Table 3-4 (15 mg/kg) approximates the U.S. EPA Eco SSL for wildlife of 16 mg/kg.

The key is to determine the degree of the exceedance and compare the value to the potential ecological impact of the exceedance. Alternative benchmarks defined above (Eco SSLs for plants and invertebrates, the Canadian SQG, and the ORNL benchmarks for plants and earthworms) provide further perspective on the exceedances of the COPC screening levels.

As summarized in Table 3-3, antimony, copper, lead, and zinc were detected at the OPR soils and are considered potential chemicals of concern for the OPR soils. However, tin was not detected in the fixed-base laboratory samples collected at the OPR as described in the QAPP Addendum for this investigation and is therefore not considered a potential chemical of concern for the site. The following paragraphs discuss each of the metals exceeding the EPA Region 5 ESLs and U.S. EPA Eco SSLs for wildlife, the alternative benchmarks (i.e., the Eco SSLs for plants and invertebrates, Canadian SQG, and ORNL values), and background concentrations.

Antimony was detected in all six fixed-base lab samples collected from the berms at Hillside Range 1 and Range 2 at concentrations ranging from 2.8 mg/kg to 50.6 mg/kg. (As noted previously, fixed-base lab data only are used in this risk assessment based on the data evaluation presented in Section 3.) Four of the six reported detections exceed the background soil concentration range for Soil Group 3 background soils ($C_{maximum}$ = 5.6 mg/kg). These detections also exceed the Eco SSLs (wildlife, 0.29 mg/kg) and the ORNL value for plants (5 mg/kg) but not the Eco SSL for protection of invertebrates (78 mg/kg). Antimony was not detected in any of the soil samples collected from the firing lanes at Hillside Range 1 or Range 2. The surface area contaminated is the berm areas which are each approximately 20 feet wide by 75 feet long. Consequently, the potential for adverse ecological impact is limited by the size of these berm areas. Conservatively, antimony is selected as a potential chemical of concern. However, remedial decisions for the OPR are likely to be dictated by lead, the predominant site contaminant.

All **copper** detections reported for the soil samples collected within the 0 to 6 inch depth interval exceed the background soil concentration range ($C_{maximum}$ = 17.1 mg/kg). However, as summarized in Table 3-3, the copper concentrations reported for samples collected from the firing lanes of the ranges are often less than 2 times the maximum background copper concentration. Copper was detected in all 0 to 3 inch berm soil and most of the 3 to 6 inch berm soil samples at concentrations exceeding the EPA Region 5 ESL (5.4 mg/kg). Most of the analytical results for the soil samples collected from the Hillside Range 1 firing lane exceed the ESL; however, only 3 of 12 results reported for the 3 to 6 inch samples from the Range 2 firing lane exceed the ESL. The arithmetic mean copper concentration in the Hillside Range 1 berm soil samples (358 mg/kg) exceeds the alternative benchmarks in Table 5-1. However, few detections in the Range 2 berm soils samples or in the firing lane soil samples from Hillside Range 1 or Range 2 exceed

the alternative benchmarks. Additionally, the arithmetic mean concentrations for these three data sets (i.e., the Range 2 berm and the Hillside Range 1 and Range 2 firing lanes; Tables 5-2, 5-3, and 5-4) also do not exceed the alternative benchmarks. Consequently, with the exception of the Hillside Range 1 berm area, there is limited potential for adverse ecological impact. As noted above for antimony, the size of the berm areas (20 feet wide by 75 feet long) further limits the potential for adverse impact. None of the food-chain model EEQs developed for copper exceeds 1. Copper is selected as a potential chemical of concern for the OPR soils. However, remedial decisions for the OPR are likely to be dictated by the lead, the predominant site contaminant.

Lead was detected in all 0 to 3 inch and 3 to 6 inch berm and firing lane soil samples collected at the OPR at concentrations exceeding the EPA Region 5 ESL. Most detections also exceed the background soil concentration range and the U.S. EPA Eco SSL for wildlife. Several detections and the arithmetic mean concentrations reported for the berm areas also exceed one or more of the alternative benchmarks by an order of magnitude. No detections reported for the Range 2 firing lane samples exceed the U.S. EPA Eco SSL for plants or invertebrates, the Canadian SQG, or the ORNL values for plants and invertebrates. Few detections reported for the Hillside Range 1 firing lane surface soil samples exceed these benchmarks and the arithmetic mean concentrations for the two firing lane data sets (Tables 5-2 and 5-4) also do not exceed these alternative benchmarks. While the food-chain model EEQ developed for average lead concentrations in the Hillside Range 1 berm surface soils exceed 1 for the American woodcock (EEQ, NOAEL case = 1.3), none of the food-chain model EEQs developed for average lead concentrations in the Range 2 berm and Hillside Range 1 and Range 2 firing lane surface soils exceed one. Lead is selected as a potential chemical of concern for the OPR soils and is the primary contaminant of concern at this site.

Zinc was detected in all 0 to 3 inch and 3 to 6 inch berm and firing lane soil samples collected at the OPR at concentrations exceeding the EPA Region 5 ESL. However, in contrast to copper and lead, many of the detections reported were within the background soil concentration range (15.1 to 60.2 mg/kg). None of the berm or firing lane surface soil samples for Range 2 exceed the SQG or the ORNL benchmark for earthworms. Although fifty percent of the berm samples and some firing lane soil samples for Hillside Range 1 exceed the SQG or the ORNL benchmarks for earthworms, the arithmetic mean zinc concentration for surface soil samples collected at the Hillside Range 1 firing lane do not exceed the SQG or the ORNL benchmark for earthworms. Several detections reported for the Hillside Range 1 and Range 2 soil samples also exceed the ORNL benchmark for plants. However, this benchmark (50 mg/kg) is within the background concentration range for zinc (15.1 – 60.2 mg/kg) and is, consequently, of somewhat limited value as an alternative screening benchmark. Also, the SQG was developed to protect plants as well as invertebrates. The food-chain modeling EEQs developed for average zinc

concentrations in berm or firing lane surface soil samples do not exceed one. Zinc is selected as a potential chemical of concern. However, as noted for antimony and copper, remedial decisions are likely to be made with regard to lead, the predominant site contaminant.

5.4 UNCERTAINTY ANALYSIS

The following significant sources of uncertainty should be considered when interpreting the results of this ERSE of the 2004 analytical results for antimony, copper, lead, tin, and zinc:

- This risk evaluation focuses on shallow soil samples (i.e., 0 to 6 inches bgs) specifically collected from the berms and firing lanes of Hillside Range 1 and Range 2 in 2004 and analyzed for antimony, copper, lead, tin, and zinc. However, analytical data also exists for three polyaromatic hydrocarbons (PAHs), two energetics (2,4,6-trinitrotoluene, 2,6-dinitrotoluene), and three metals (arsenic, beryllium, and manganese) detected in surface soils collected in 2002 from OPR sampling locations more widely dispersed across the site. These results do not impact the screening level evaluation and conclusions presented in this assessment. The maximum concentrations reported for benzo(a)pyrene, benzo(a)anthracene, and benzo(a)fluoranthene do not exceed 0.025 mg/kg and are orders of magnitude less than current EPA Region 5 ESLs for these chemicals which exceed 1 mg/kg. The maximum arsenic concentration (12.8 mg/kg) exceeds the current EPA Region 5 ESL (5.7 mg/kg) and the ORNL value for plants (10 mg/kg) but is less than the SQG (19 mg/kg) and ORNL value for invertebrates (60 mg/kg). The maximum detected beryllium concentration (1.3 mg/kg) marginally exceeds the EPA Region 5 ESLs (1.06 mg/kg) but not the available Eco SSL (36 mg/kg) or ORNL benchmark for plants (10 mg/kg). Manganese was not detected in the OPR soils at concentrations exceeding background concentrations (TtNUS, 2002). The reader is referred to Phase III Soils RCRA Facility Investigation Solid Waste Management Unit 7 (Old Rifle Range) (TtNUS, 2002) for a detailed discussion of the result of the 2002 soil investigation.

5.5 SUMMARY AND CONCLUSIONS

Lead is the predominant site contaminant in the surface soils of the berms and firing lanes at the OPR. The arithmetic mean lead concentrations in the surface soils (0 to 6 inches bgs) of the Range 1 berm (1280 mg/kg) and the Range 2 berm (625 mg/kg) exceed the COPC screening levels and most alternative benchmarks presented in this assessment. In contrast, none of the detections reported for the Range 2 firing lane surface soil samples and a limited number of detections reported for the Hillside Range 1 firing lane surface soil samples exceed the alternative benchmarks. The results of a food-chain modeling evaluation also indicate that lead concentrations in the firing lanes at Hillside Range 1 and

Range 2 are unlikely to adversely impact ecological receptors. The risk assessment results for antimony, copper, and zinc are similar to those presented for lead and suggest that metals concentrations for surface soils in the berm areas have the potential to adversely impact ecological receptors; however, these receptors are unlikely to be impacted by metal concentrations in the firing lane areas of either firing range.

TABLE 5-1

EXCEEDANCES OF ECOLOGICAL CRITERIA FOR HILLSIDE RANGE 1 BERM (0-6" SOIL INTERVAL)
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter	Minimum Detection	Maximum Detection	Average of All Results	Frequency of Detection	COPC Selection Criteria[1]	# Exceed	Region 5 ESL	# Exceed	USEPA Eco SSL						Canadian SQG	# Exceed	ORNL			
									Plant	# Exceed	Invertebrate	# Exceed	Wildlife	# Exceed			Plant	# Exceed	Earthworm	# Exceed
Inorganics (mg/kg)																				
Antimony	2.8	30.8	19.4	3/3	0.29 [2]	3	0.142	3	---	---	78	0	0.29	3	---	---	5	2	---	---
Copper	31	1480	358	17/20	5.4 [3]	17	5.4	17	---	---	---	---	---	---	63	9	100	8	60	9
Lead	26.3	6530	1280	20/20	16 [2]	20	0.0537	20	115	13	1700	6	16	20	300	11	50	16	500	9
Zinc	40.7	520	124	20/20	6.62 [3]	20	6.62	20	---	---	---	---	---	---	200	4	50	16	100	8

Footnotes:
1 - These are the agreed upon NSWC Crane COPC selection criteria for ecological risk assessment.
2 - Based on the lowest USEPA Eco SSL value.
3 - Based on the Region 5 ESL.

Acronyms:
ESL = Ecological Screening Level
USEPA = United States Environmental Protection Agency
SSL = Soil Screening Level
SQG = Soil Quality Guideline
ORNL = Oak Ridge National Laboratory

TABLE 5-2

EXCEEDANCES OF ECOLOGICAL CRITERIA FOR HILLSIDE RANGE 1 FIRING LANE (0-6" SOIL INTERVAL)
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter	Minimum Detection	Maximum Detection	Average of All Results	Frequency of Detection	COPC Selection Criteria[1]	# Exceed	Region 5 ESL	# Exceed	USEPA Eco SSL						Canadian SQG	# Exceed	ORNL			
									Plant	# Exceed	Invertebrate	# Exceed	Wildlife	# Exceed			Plant	# Exceed	Earthworm	# Exceed
Inorganics (mg/kg)																				
Antimony	ND	ND	0.305	0/1	0.29 [2]	0	0.142	0	---	---	78	0	0.29	0	---	---	5	0	---	---
Copper	22.7	104	40.3	18/20	5.4 [3]	18	5.4	18	---	---	---	---	---	---	63	3	100	1	60	4
Lead	18	135	39.1	20/20	16 [2]	20	0.0537	20	115	1	1700	0	16	20	300	0	50	7	500	0
Zinc	39	337	94.8	20/20	6.62 [3]	20	6.62	20	---	---	---	---	---	---	200	2	50	8	100	6

Footnotes:
1 - These are the agreed upon NSWC Crane COPC selection criteria for ecological risk assessment.
2 - Based on the lowest USEPA Eco SSL value.
3 - Based on the Region 5 ESL.

Acronyms:
ESL = Ecological Screening Level
USEPA = United States Environmental Protection Agency
SSL = Soil Screening Level
SQG = Soil Quality Guideline
ORNL = Oak Ridge National Laboratory
ND = Not Detected

TABLE 5-3

EXCEEDANCES OF ECOLOGICAL CRITERIA FOR RANGE 2 BERM (0-6" SOIL INTERVAL)
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter	Minimum Detection	Maximum Detection	Average of All Results	Frequency of Detection	COPC Selection Criteria[1]	# Exceed	Region 5 ESL	# Exceed	USEPA Eco SSL						Canadian SQG	# Exceed	ORNL			
									Plant	# Exceed	Invertebrate	# Exceed	Wildlife	# Exceed			Plant	# Exceed	Earthworm	# Exceed
Inorganics (mg/kg)																				
Antimony	4.3	50.6	31.6	3/3	0.29 [2]	3	0.142	3	---	---	78	0	0.29	3	---	---	5	2	---	---
Copper	24.7	100	39.5	19/20	5.4 [3]	19	5.4	19	---	---	---	---	---	---	-63	2	100	0	60	2
Lead	54	6700	625	20/20	16 [2]	20	0.0537	20	115	10	1700	2	16	20	300	5	50	20	500	3
Zinc	43.7	88.5	58.8	20/20	6.62 [3]	20	6.62	20	---	---	---	---	---	---	200	0	50	16	100	0

Footnotes:
1 - These are the agreed upon NSWC Crane COPC selection criteria for ecological risk assessment.
2 - Based on the lowest USEPA Eco SSL value.
3 - Based on the Region 5 ESL.

Acronyms:
ESL = Ecological Screening Level
USEPA = United States Environmental Protection Agency
SSL = Soil Screening Level
SQG = Soil Quality Guideline
ORNL = Oak Ridge National Laboratory

TABLE 5-4

EXCEEDANCES OF ECOLOGICAL CRITERIA FOR RANGE 2 FIRING LANE (0-6" SOIL INTERVAL)
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Parameter	Minimum Detection	Maximum Detection	Average of All Results	Frequency of Detection	COPC Selection Criteria[1]	# Exceed	Region 5 ESL	# Exceed	USEPA Eco SSL						Canadian SQG	# Exceed	ORNL			
									Plant	# Exceed	Invertebrate	# Exceed	Wildlife	# Exceed			Plant	# Exceed	Earthworm	# Exceed
Inorganics (mg/kg)																				
Antimony	ND	ND	0.23	0/1	0.29 [2]	0	0.142	0	---	---	78	0	0.29	0	---	---	5	0	---	---
Copper	19.4	40	19.7	12/24	5.4 [3]	12	5.4	12	---	---	---	---	---	---	63	0	100	0	60	0
Lead	14.3	36.3	23.2	24/24	16 [2]	23	0.0537	24	115	0	1700	0	16	23	300	0	50	0	500	0
Zinc	32.7	97.7	53.3	24/24	6.62 [3]	24	6.62	24	---	---	---	---	---	---	200	0	50	13	100	0

Footnotes:
1 - These are the agreed upon NSWC Crane COPC selection criteria for ecological risk assessment.
2 - Based on the lowest USEPA Eco SSL value.
3 - Based on the Region 5 ESL.

Acronyms:
ESL = Ecological Screening Level
USEPA = United States Environmental Protection Agency
SSL = Soil Screening Level
SQG = Soil Quality Guideline
ORNL = Oak Ridge National Laboratory
ND = Not Detected

ATTACHMENT 5-A

ATTACHMENT 5-A

A food chain model was used to evaluate risks to terrestrial wildlife via ingestion of soil, vegetation, and invertebrates at the Old Pistol Range (OPR). Food chain modeling was conducted only on the chemicals that are considered bioaccumulative [according to the list of important bioaccumulative chemicals from USEPA (2000)]. If a chemical was not considered bioaccumulative, it was not carried through the food chain model.

Representative species were used as surrogates to conduct the food chain modeling. The meadow vole was used as a surrogate for herbivorous mammals, the short-tailed shrew was used as a surrogate for insectivorous mammals, the bobwhite quail was used as a surrogate for herbivorous birds, and the American woodcock was used as a surrogate for insectivorous birds.

Risks to terrestrial wildlife from exposure to COPCs in the soil were determined by estimating the chronic daily intake (CDI) and comparing it to toxicity reference values (TRVs) representing acceptable daily doses in mg/kg/day. The TRVs were developed from no-observed-adverse-effect-levels (NOAELs) and lowest-observed-adverse-effect-levels (LOAELs) obtained from wildlife studies, when available. The TRVs came from the ORNL Toxicological Benchmarks for Wildlife: 1996 Revision (Sample, et al., 1996).

For avian species, the NOAEL (or LOAEL) for the test species was used as the NOAEL (or LOAEL) for the surrogate species in accordance with Sample et al. (1996) or other sources that were used. For mammalian species, the NOAEL (or LOAEL) from one species was adjusted to a NOAEL (or LOAEL) for the surrogate species using the following modified body weight scaling equation (from Sample et al., 1996):

$$NOAEL_w = NOAEL_t * (bw_t / bw_w)$$

Where: $NOAEL_w$ = no-observed-adverse-effect level for the surrogate wildlife species
$NOAEL_t$ = no-observed-adverse-effect level for the test species
bw_t = body weight of the test species
bw_w = body weight of the surrogate test species

Intake of COPCs by wildlife exposed to contaminated soil was estimated as a daily dose (in mg/kg/day) using the following equations based on exposure parameters for the surrogate species.

$$\text{Dose, surface soil (mg/kg - day)} = \frac{(SC * SI)}{BW}$$

$$\text{Dose, food (mg/kg - day)} = \frac{(FC * FI)}{BW}$$

$$\text{Total CDI (mg/kg - day)} = [\text{Dose (surface soil)} + \text{Dose (food)}] * H$$

Where:

	FI	= Food ingestion rate (kg/day)
	FC	= Food concentration (mg/kg)
	BW	= Body weight (kg)
	SI	= Incidental soil ingestion rate (kg/day)
	SC	= Soil concentration (mg/kg)
	H	= Home Range/Contaminated Area

The metal concentration of prey items for the insectivorous and herbivorous species is calculated using the following equation:

$$FC = SC * BAF$$

Where:

	FC	= Contaminant concentration in food (e.g., earthworms or vegetation, mg/kg)
	SC	= Contaminant concentration in surface soil (mg/kg)
	BAF	= Soil to plant or soil to invertebrate bioaccumulation factor (unitless)

Only the average concentrations and average exposure parameters were used for the calculations. Also, because the contaminated area (less than 0.5 acre for each firing lane and less than 0.05 acre for the berms) is small compared to the home ranges of the affected species, area use factors (AUFs) were used to adjust the contaminant doses. For the Hillside Range 1 and Range 2 Berm areas, an AUF of 5% was used for mammals and an AUF of 2.5% was used for birds. For the Hillside Range 1 and Range 2 Firing Lane areas, an AUF of 50% was used for mammals and an AUF of 25% was used for birds. The AUFs of 2.5% and 25% for birds in the berms and firing lanes, respectively, are conservative values based on the large home range of most insectivorous and herbivorous birds.

An EEQ approach was used to characterize the risk to terrestrial receptors. This approach characterizes the potential effects by comparing exposure concentration with the effects data. An EEQ of greater than 1.0 is considered indicative of a potential risk. The EEQ is not an expression of probability, and the meaning of values greater than 1.0 must be interpreted in light of attendant uncertainties in risk management.

The EEQ for the terrestrial wildlife model was calculated as follows:

$$EEQ = \frac{\text{Total CDI}}{\text{TRV}}$$

Where:	EEQ	= Ecological effects quotient (unitless)
	Total CDI	= Total daily intake dose (mg/kg-day)
	TRV	= Toxicity reference value (NOAEL or LOAEL) (mg/kg-day)

The food chain model calculations that were conducted are included in Attachment 5-A-1. Pages 1 through 4 of Attachment 5-A-1 show the calculations for the Hillside Range 1 Berm. Pages 5 through 8 of Attachment 5-A-1 show the calculations for the Hillside Range 1 Firing Lane. Pages 9 through 12 of Attachment 5-A-1 show the calculations for the Range 2 Berm. Pages 13 through 16 of Attachment 5-A-1 show the calculations for the Range 2 Firing Lane. The summaries of results for the food chain model are included in Attachment 5-A-2. Pages 1 through 4 of Attachment 5-A-2 show the summary tables for Hillside Range 1 Berm, Hillside Range 1 Firing Lane, Range 2 Berm, and Range 2 Firing Lane, respectively.

ATTACHMENT 5-A-1

MEADOW VOLE RAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - HILLSIDE RANGE 1 BERM
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to veg.)	Vegetation Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Dose (mg/kg/day) from: Vegetation	Total Dose (mg/kg/day)	Dose (AUF = 5%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	3.58E+02	1.24E-01	4.44E+01	8.37E-01	4.33E+00	5.16E+00	2.58E-01	3.20E+02	4.13E+02	8.08E-04	6.25E-04
LEAD	1.28E+03	3.89E-02	4.97E+01	2.99E+00	4.84E+00	7.83E+00	3.91E-01	7.64E+01	7.64E+02	5.12E-03	5.12E-04
ZINC	1.24E+02	3.66E-01	4.54E+01	2.90E-01	4.42E+00	4.71E+00	2.36E-01	1.53E+03	3.06E+03	1.54E-04	7.71E-05

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	3.663E-02	kg
Food Ingestion Rate = (If)	3.570E-03	kg/day
Water Ingestion Rate = (Iw)	6.400E-03	L/day
Soil Ingestion Rate = (Is)	8.568E-05	kg/day
Home Range = (HR)	1.640E-01	acres
Contaminated Area = (CA)	Assume equal to home range	

H=HR/CA (Assume = to 1 for maximum exposure)

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (vegetation) = (Cv * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (vegetation)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Cv = Contaminant conc. in vegetation (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

SHORT-TAILED SHREW - AVERAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - HILLSIDE RANGE 1 BERM
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to inv.)	Invertebrate Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Dose (mg/kg/day) from: Inverts.	Total Dose (mg/kg/day)	Dose (AUF = 5%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	3.58E+02	5.15E-01	1.84E+02	4.55E+00	1.80E+01	2.26E+01	1.13E+00	6.94E+02	8.97E+02	1.62E-03	1.26E-03
LEAD	1.28E+03	2.66E-01	3.40E+02	1.62E+01	3.32E+01	4.94E+01	2.47E+00	1.66E+02	1.66E+03	1.49E-02	1.49E-03
ZINC	1.24E+02	3.20E+00	3.97E+02	1.57E+00	3.88E+01	4.03E+01	2.02E+00	3.32E+03	6.64E+03	6.08E-04	3.04E-04

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	1.687E-02	kg
Food Ingestion Rate = (If)	1.648E-03	kg/day
Water Ingestion Rate = (Iw)	3.800E-03	L/day
Soil Ingestion Rate = (Is)	2.142E-04	kg/day
Home Range = (HR)	9.700E-01	acres
Contaminated Area = (CA)	Assume equal to home range	

H=HR/CA (Assume = to 1 for maximum exposure)

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (invertebrates) = (Ci * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (invertebrates)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Ci = Contaminant conc. in soil invertebrates (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

BOBWHITE QUAI ERAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - HILLSIDE RANGE 1 BERM
NSWC CRANE, INOIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to veg.)	Vegetation Concentretion (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Vegetation	Total Dose (mg/kg/day)	Dose (AUF = 2.5%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	3.58E+02	1.24E-01	4.44E+01	7.16E-01	1.08E+00	1.80E+00	4.50E-02	4.70E+01	6.17E+01	9.58E-04	7.29E-04
LEAD	1.28E+03	3.89E-02	4.97E+01	2.56E+00	1.21E+00	3.77E+00	9.42E-02	1.13E+00	1.13E+01	8.34E-02	8.34E-03
ZINC	1.24E+02	3.66E-01	4.54E+01	2.48E-01	1.11E+00	1.36E+00	3.39E-02	1.45E+01	1.31E+02	2.34E-03	2.59E-04

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	1.770E-01	kg
Food Ingestion Rate = (If)	4.320E-03	kg/day
Water Ingestion Rate = (Iw)	1.840E-02	L/day
Soil Ingestion Rate = (Is)	3.542E-04	kg/day
Home Range = (HR)	2.860E+01	acres
Contaminated Area = (CA)	Assume equal to home range	

H=HR/CA (Assume = to 1 for maximum exposure)

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (vegetation) = (Cv * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (vegetation)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Cv = Contaminant conc. in vegetation (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

AMERICAN WOODCOCK - AVERAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - HILLSIDE RANGE 1 BERM
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to inv.)	Invertebrate Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Dose (mg/kg/day) from: Inverts.	Total Dose (mg/kg/day)	Dose (AUF = 2.5%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	3.58E+02	5.15E-01	1.84E+02	3.19E+00	2.46E+01	2.78E+01	6.94E-01	4.70E+01	6.17E+01	1.48E-02	1.12E-02
LEAD	1.28E+03	2.66E-01	3.40E+02	1.14E+01	4.53E+01	5.67E+01	1.42E+00	1.13E+00	1.13E+01	1.25E+00	1.25E-01
ZINC	1.24E+02	3.20E+00	3.97E+02	1.10E+00	5.29E+01	5.40E+01	1.35E+00	1.45E+01	1.31E+02	9.32E-02	1.03E-02

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	1.895E-01	kg
Food Ingestion Rate = (If)	2.526E-02	kg/day
Water Ingestion Rate = (Iw)	1.900E-02	L/day
Soil Ingestion Rate = (Is)	1.688E-03	kg/day
Home Range = (HR)	6.133E+01	acres
Contaminated Area = (CA)	Assume equal to home range	

H=HR/CA (Assume = to 1 for maximum exposure)

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (invertebrates) = (Ci * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (invertebrates)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Ci = Contaminant conc. in soil invertebrates (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

MEADOW VOLE RAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - HILLSIDE RANGE 1 FIRING LANE
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to veg.)	Vegetation Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Vegetation	Total Dose (mg/kg/day)	Dose (AUF = 50%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	4.03E+01	1.24E-01	5.00E+00	9.43E-02	4.87E-01	5.81E-01	2.91E-01	3.20E+02	4.13E+02	9.09E-04	7.03E-04
LEAD	3.91E+01	3.89E-02	1.52E+00	9.15E-02	1.48E-01	2.40E-01	1.20E-01	7.64E+01	7.64E+02	1.57E-03	1.57E-04
ZINC	9.48E+01	3.66E-01	3.47E+01	2.22E-01	3.38E+00	3.60E+00	1.80E+00	1.53E+03	3.06E+03	1.18E-03	5.89E-04

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	3.663E-02	kg
Food Ingestion Rate = (If)	3.570E-03	kg/day
Water Ingestion Rate = (Iw)	6.400E-03	L/day
Soil Ingestion Rate = (Is)	8.568E-05	kg/day
Home Range = (HR)	1.640E-01	acres
Contaminated Area = (CA)	Assume equal to home range	

H=HR/CA (Assume = to 1 for maximum exposure)

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (vegetation) = (Cv * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (vegetation)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Cv = Contaminant conc. in vegetation (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

SHORT-TAILED SHREW - AVERAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - HILLSIDE RANGE 1 FIRING LANE
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentretion (mg/kg)	Biotransfer Factor (soil to inv.)	Invertebrate Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Dose (mg/kg/day) from: Inverts.	Total Dose (mg/kg/day)	Dose (AUF = 50%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	4.03E+01	5.15E-01	2.08E+01	5.12E-01	2.03E+00	2.54E+00	1.27E+00	6.94E+02	8.97E+02	1.83E-03	1.41E-03
LEAD	3.91E+01	2.66E-01	1.04E+01	4.97E-01	1.02E+00	1.51E+00	7.56E-01	1.66E+02	1.66E+03	4.56E-03	4.56E-04
ZINC	9.48E+01	3.20E+00	3.03E+02	1.20E+00	2.96E+01	3.08E+01	1.54E+01	3.32E+03	6.64E+03	4.65E-03	2.32E-03

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	1.687E-02	kg
Food Ingestion Rate = (If)	1.648E-03	kg/day
Water Ingestion Rate = (Iw)	3.800E-03	L/day
Soil Ingestion Rate = (Is)	2.142E-04	kg/day
Home Range = (HR)	9.700E-01	acres
Contaminated Area = (CA)	Assume equal to home range	
H=HR/CA (Assume = to 1 for maximum exposure)		

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (invertebrates) = (Ci * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (invertebrates)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Ci = Contaminant conc. in soil invertebrates (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

BOBWHITE QUAIL ERAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - HILLSIDE RANGE 1 FIRING LANE
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to veg.)	Vegetation Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Vegetation	Total Dose (mg/kg/day)	Dose (AUF = 25%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	4.03E+01	1.24E-01	5.00E+00	8.07E-02	1.22E-01	2.03E-01	5.07E-02	4.70E+01	6.17E+01	1.08E-03	8.21E-04
LEAD	3.91E+01	3.89E-02	1.52E+00	7.83E-02	3.71E-02	1.15E-01	2.88E-02	1.13E+00	1.13E+01	2.55E-02	2.55E-03
ZINC	9.48E+01	3.66E-01	3.47E+01	1.90E-01	8.47E-01	1.04E+00	2.59E-01	1.45E+01	1.31E+02	1.79E-02	1.98E-03

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	1.770E-01	kg
Food Ingestion Rate = (If)	4.320E-03	kg/day
Water Ingestion Rate = (Iw)	1.840E-02	L/day
Soil Ingestion Rate = (Is)	3.542E-04	kg/day
Home Range = (HR)	2.860E+01	acres
Contaminated Area = (CA)	Assume equal to home range	
H=HR/CA (Assume = to 1 for maximum exposure)		

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (vegetation) = (Cv * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (vegetation)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Cv = Contaminant conc. in vegetation (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

AMERICAN WOODCOCK - AVERAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - HILLSIDE RANGE 1 FIRING LANE
NSWC CRANE, INDIANA

Perameter	Avg Soil Concentretion (mg/kg)	Biotransfer Fsctor (soil to Inv.)	Invertebrate Concentration (mg/kg)	Doee (mg/kg/day) from: Surface Soil	Inverts.	Total Dose (mg/kg/day)	Dose (AUF = 25%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	4.03E+01	5.15E-01	2.08E+01	3.59E-01	2.77E+00	3.13E+00	7.81E-01	4.70E+01	6.17E+01	1.66E-02	1.27E-02
LEAD	3.91E+01	2.66E-01	1.04E+01	3.48E-01	1.39E+00	1.73E+00	4.34E-01	1.13E+00	1.13E+01	3.84E-01	3.84E-02
ZINC	9.48E+01	3.20E+00	3.03E+02	8.44E-01	4.05E+01	4.13E+01	1.03E+01	1.45E+01	1.31E+02	7.13E-01	7.89E-02

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	1.895E-01	kg
Food Ingestion Rate = (If)	2.526E-02	kg/day
Water Ingestion Rate = (Iw)	1.900E-02	L/day
Soil Ingestion Rate = (Is)	1.688E-03	kg/day
Home Range = (HR)	6.133E+01	acres
Contaminated Area = (CA)	Assume equal to home range	
H=HR/CA (Assume = to 1 for maximum exposure)		

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (invertebrates) = (Ci * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (invertebrates)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Ci = Contaminant conc. in soil invertebrates (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

MEADOW VOLE · RAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - RANGE 2 BERM
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to veg.)	Vegetation Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Dose (mg/kg/day) from: Vegetation	Total Dose (mg/kg/day)	Dose (AUF = 5%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	3.95E+01	1.24E-01	4.90E+00	9.24E-02	4.77E-01	5.70E-01	2.85E-02	3.20E+02	4.13E+02	8.91E-05	6.89E-05
LEAD	6.25E+02	3.89E-02	2.43E+01	1.46E+00	2.37E+00	3.83E+00	1.92E-01	7.64E+01	7.64E+02	2.51E-03	2.51E-04
ZINC	8.85E+01	3.66E-01	3.24E+01	2.07E-01	3.16E+00	3.36E+00	1.68E-01	1.53E+03	3.06E+03	1.10E-04	5.50E-05

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	3.663E-02	kg
Food Ingestion Rate = (If)	3.570E-03	kg/day
Water Ingestion Rate = (Iw)	6.400E-03	L/day
Soil Ingestion Rate = (Is)	8.568E-05	kg/day
Home Range = (HR)	1.640E-01	acres
Contaminated Area = (CA)	Assume equal to home range	
H=HR/CA (Assume = to 1 for maximum exposure)		

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (vegetation) = (Cv * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (vegetation)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Cv = Contaminant conc. in vegetation (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

SHORT-TAILED SHREW - AVERAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - RANGE 2 BERM
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to inv.)	Invertebrate Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Dose (mg/kg/day) from: Inverts.	Total Dose (mg/kg/day)	Dose (AUF = 5%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	3.95E+01	5.15E-01	2.03E+01	5.02E-01	1.99E+00	2.49E+00	1.24E-01	6.94E+02	8.97E+02	1.79E-04	1.39E-04
LEAD	6.25E+02	2.66E-01	1.66E+02	7.94E+00	1.62E+01	2.42E+01	1.21E+00	1.66E+02	1.66E+03	7.28E-03	7.28E-04
ZINC	8.85E+01	3.20E+00	2.83E+02	1.12E+00	2.77E+01	2.88E+01	1.44E+00	3.32E+03	6.64E+03	4.34E-04	2.17E-04

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	1.687E-02	kg
Food Ingestion Rate = (If)	1.648E-03	kg/day
Water Ingestion Rate = (Iw)	3.800E-03	L/day
Soil Ingestion Rate = (Is)	2.142E-04	kg/day
Home Range = (HR)	9.700E-01	acres
Contaminated Area = (CA)	Assume equal to home range	
H=HR/CA (Assume = to 1 for maximum exposure)		

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (invertebrates) = (Ci * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (invertebrates)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Ci = Contaminant conc. in soil invertebrates (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

BOBWHITE QUAIL .RAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - RANGE 2 BERM
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to veg.)	Vegetation Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Vegetation	Total Dose (mg/kg/day)	Dose (AUF = 2.5%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	3.95E+01	1.24E-01	4.90E+00	7.91E-02	1.20E-01	1.99E-01	4.96E-03	4.70E+01	6.17E+01	1.06E-04	8.04E-05
LEAD	6.25E+02	3.89E-02	2.43E+01	1.25E+00	5.93E-01	1.84E+00	4.61E-02	1.13E+00	1.13E+01	4.08E-02	4.08E-03
ZINC	8.85E+01	3.66E-01	3.24E+01	1.77E-01	7.91E-01	9.68E-01	2.42E-02	1.45E+01	1.31E+02	1.67E-03	1.85E-04

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	1.770E-01	kg
Food Ingestion Rate = (If)	4.320E-03	kg/day
Water Ingestion Rate = (Iw)	1.840E-02	L/day
Soil Ingestion Rate = (Is)	3.542E-04	kg/day
Home Range = (HR)	2.860E+01	acres
Contaminated Area = (CA)	Assume equal to home range	
H=HR/CA (Assume = to 1 for maximum exposure)		

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (vegetation) = (Cv * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (vegetation)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Cv = Contaminant conc. in vegetation (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

AMERICAN WOODCOCK - AVERAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - RANGE 2 BERM
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to inv.)	Invertebrate Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Dose (mg/kg/day) from: Inverts.	Total Dose (mg/kg/day)	Dose (AUF = 2.5%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	3.95E+01	5.15E-01	2.03E+01	3.52E-01	2.71E+00	3.06E+00	7.66E-02	4.70E+01	6.17E+01	1.63E-03	1.24E-03
LEAD	6.25E+02	2.66E-01	1.66E+02	5.57E+00	2.22E+01	2.77E+01	6.93E-01	1.13E+00	1.13E+01	6.14E-01	6.14E-02
ZINC	8.85E+01	3.20E+00	2.83E+02	7.88E-01	3.78E+01	3.86E+01	9.64E-01	1.45E+01	1.31E+02	6.65E-02	7.36E-03

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	1.895E-01	kg
Food Ingestion Rate = (If)	2.526E-02	kg/day
Water Ingestion Rate = (Iw)	1.900E-02	L/day
Soil Ingestion Rate = (Is)	1.688E-03	kg/day
Home Range = (HR)	6.133E+01	acres
Contaminated Area = (CA)	Assume equal to home range	

H=HR/CA (Assume = to 1 for maximum exposure)

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (invertebrates) = (Ci * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (invertebrates)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Ci = Contaminant conc. in soil invertebrates (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

MEADOW VOLE :RAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - RANGE 2 FIRING LANE
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to veg.)	Vegetation Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Vegetation	Total Dose (mg/kg/day)	Dose (AUF = 50%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	1.97E+01	1.24E-01	2.44E+00	4.61E-02	2.38E-01	2.84E-01	1.42E-01	3.20E+02	4.13E+02	4.44E-04	3.44E-04
LEAD	2.32E+01	3.89E-02	9.02E-01	5.43E-02	8.80E-02	1.42E-01	7.11E-02	7.64E+01	7.64E+02	9.30E-04	9.30E-05
ZINC	5.33E+01	3.66E-01	1.95E+01	1.25E-01	1.90E+00	2.03E+00	1.01E+00	1.53E+03	3.06E+03	6.63E-04	3.31E-04

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	3.663E-02	kg
Food Ingestion Rate = (If)	3.570E-03	kg/day
Water Ingestion Rate = (Iw)	6.400E-03	L/day
Soil Ingestion Rate = (Is)	8.568E-05	kg/day
Home Range = (HR)	1.640E-01	acres
Contaminated Area = (CA)	Assume equal to home range	

H=HR/CA (Assume = to 1 for maximum exposure)

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (vegetation) = (Cv * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (vegetation)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Cv = Contaminant conc. in vegetation (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

SHORT-TAILED SHREW - AVERAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - RANGE 2 FIRING LANE
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to inv.)	Invertebrate Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Dose (mg/kg/day) from: Inverts.	Total Dose (mg/kg/day)	Dose (AUF = 50%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	1.97E+01	5.15E-01	1.01E+01	2.50E-01	9.91E-01	1.24E+00	6.21E-01	6.94E+02	8.97E+02	8.94E-04	6.92E-04
LEAD	2.32E+01	2.66E-01	6.17E+00	2.95E-01	6.03E-01	8.97E-01	4.49E-01	1.66E+02	1.66E+03	2.70E-03	2.70E-04
ZINC	5.33E+01	3.20E+00	1.71E+02	6.77E-01	1.67E+01	1.73E+01	8.67E+00	3.32E+03	6.64E+03	2.61E-03	1.31E-03

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	1.687E-02	kg
Food Ingestion Rate = (If)	1.648E-03	kg/day
Water Ingestion Rate = (Iw)	3.800E-03	L/day
Soil Ingestion Rate = (Is)	2.142E-04	kg/day
Home Range = (HR)	9.700E-01	acres
Contaminated Area = (CA)	Assume equal to home range	
H=HR/CA (Assume = to 1 for maximum exposure)		

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (invertebrates) = (Ci * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (invertebrates)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Ci = Contaminant conc. in soil invertebrates (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

BOBWHITE QUAIL AVERAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - RANGE 2 FIRING LANE
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to veg.)	Vegetation Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Dose (mg/kg/day) from: Vegetation	Total Dose (mg/kg/day)	Dose (AUF = 25%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	1.97E+01	1.24E-01	2.44E+00	3.94E-02	5.96E-02	9.90E-02	2.48E-02	4.70E+01	6.17E+01	5.27E-04	4.01E-04
LEAD	2.32E+01	3.89E-02	9.02E-01	4.64E-02	2.20E-02	6.85E-02	1.71E-02	1.13E+00	1.13E+01	1.51E-02	1.51E-03
ZINC	5.33E+01	3.66E-01	1.95E+01	1.07E-01	4.76E-01	5.83E-01	1.46E-01	1.45E+01	1.31E+02	1.01E-02	1.11E-03

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	1.770E-01	kg
Food Ingestion Rate = (If)	4.320E-03	kg/day
Water Ingestion Rate = (Iw)	1.840E-02	L/day
Soil Ingestion Rate = (Is)	3.542E-04	kg/day
Home Range = (HR)	2.860E+01	acres
Contaminated Area = (CA)	Assume equal to home range	
H=HR/CA (Assume = to 1 for maximum exposure)		

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (vegetation) = (Cv * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (vegetation)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Cv = Contaminant conc. in vegetation (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

AMERICAN WOODCOCK - AVERAGE INPUTS
TERRESTRIAL WILDLIFE MODEL ECOLOGICAL EFFECTS QUOTIENT CALCULATION
OLD PISTOL RANGE - RANGE 2 FIRING LANE
NSWC CRANE, INDIANA

Parameter	Avg Soil Concentration (mg/kg)	Biotransfer Factor (soil to Inv.)	Invertebrate Concentration (mg/kg)	Dose (mg/kg/day) from: Surface Soil	Dose (mg/kg/day) from: Inverts.	Total Dose (mg/kg/day)	Dose (AUF = 25%) (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	NOAEL EEQ	LOAEL EEQ
Inorganics											
COPPER	1.97E+01	5.15E-01	1.01E+01	1.75E-01	1.35E+00	1.53E+00	3.82E-01	4.70E+01	6.17E+01	8.13E-03	6.19E-03
LEAD	2.32E+01	2.66E-01	6.17E+00	2.07E-01	8.23E-01	1.03E+00	2.57E-01	1.13E+00	1.13E+01	2.28E-01	2.28E-02
ZINC	5.33E+01	3.20E+00	1.71E+02	4.75E-01	2.27E+01	2.32E+01	5.81E+00	1.45E+01	1.31E+02	4.01E-01	4.43E-02

Cells are shaded if the EEQ is greater than 1.0.

Body Weight = (BW)	1.895E-01	kg
Food Ingestion Rate = (If)	2.526E-02	kg/day
Water Ingestion Rate = (Iw)	1.900E-02	L/day
Soil Ingestion Rate = (Is)	1.688E-03	kg/day
Home Range = (HR)	6.133E+01	acres
Contaminated Area = (CA)	Assume equal to home range	
H=HR/CA (Assume = to 1 for maximum exposure)		

Dose (surface soil) = (Cs * Is)(H)/BW
Dose (invertebrates) = (Ci * If)(H)/BW
Total Dose = Dose (surface soil) + Dose (invertebrates)

Definitions:
EEQ = Ecological Effects Quotient
NOAEL = No Observed Adverse Effects Level
LOAEL = Lowest Observed Adverse Effects Level
Cs = Contaminant concentration in soil
Ci = Contaminant conc. in soil invertebrates (=soil conc. * Biotransfer Factor)
AUF = Area Use Factor

ATTACHMENT 5-A-2

TERRESTRIAL WILDLIFE MODEL-AVERAGE CONCENTRATIONS, AVERAGE BAF, AND AVERAGE EXPOSURE PARAMETERS
SURFACE SOIL (0-6")
OLD PISTOL RANGE - HILLSIDE RANGE 1 BERM
NSWC CRANE, INDIANA

Parameter	Meadow Vole[1]		Short-Tailed Shrew[1]		American Woodcock[2]		Bobwhite Quail[2]	
	NOAEL EEQ	LOAEL EEQ	NOAEL EEQ	LOAEL EEQ	NOAEL EEQ	LOAEL EEQ	NOAEL EEQ	LOAEL EEQ
Inorganics								
COPPER	8.1E-04	6.2E-04	1.6E-03	1.3E-03	1.5E-02	1.1E-02	9.6E-04	7.3E-04
LEAD	5.1E-03	5.1E-04	1.5E-02	1.5E-03	1.3E+00	1.3E-01	8.3E-02	8.3E-03
ZINC	1.5E-04	7.7E-05	6.1E-04	3.0E-04	9.3E-02	1.0E-02	2.3E-03	2.6E-04

Notes:
- Cells are shaded if the EEQ is greater than 1.0
1 - An Area Use Factor of 5% was used.
2 - An Area Use Factor of 2.5% was used.

Acronyms:
EEQ - Ecological Effects Quotient
LOAEL - Lowest Observed Adverse Effects Concentration
NOAEL - No Observed Adverse Effects Concentration

TERRESTRIAL WILDLIFE MODEL-AVERAGE CONCENTRATIONS, AVERAGE BAF, AND AVERAGE EXPOSURE PARAMETERS
SURFACE SOIL (0-6")
OLD PISTOL RANGE - HILLSIDE RANGE 1 FIRING LANE
NSWC CRANE, INDIANA

	Meadow Vole[1]		Short-Tailed Shrew[1]		American Woodcock[2]		Bobwhite Quail[2]	
Parameter	**NOAEL EEQ**	**LOAEL EEQ**	**NOAEL EEQ**	**LOAEL EEQ**	**NOAEL EEQ**	**LOAEL EEQ**	**NOAEL EEQ**	**LOAEL EEQ**
Inorganics								
COPPER	9.1E-04	7.0E-04	1.8E-03	1.4E-03	1.7E-02	1.3E-02	1.1E-03	8.2E-04
LEAD	1.6E-03	1.6E-04	4.6E-03	4.6E-04	3.8E-01	3.8E-02	2.6E-02	2.6E-03
ZINC	1.2E-03	5.9E-04	4.6E-03	2.3E-03	7.1E-01	7.9E-02	1.8E-02	2.0E-03

Notes:
- Cells are shaded if the EEQ is greater than 1.0
1 - An Area Use Factor of 50% was used.
2 - An Area Use Factor of 25% was used.

Acronyms:
EEQ - Ecological Effects Quotient
LOAEL - Lowest Observed Adverse Effects Concentration
NOAEL - No Observed Adverse Effects Concentration

TERRESTRIAL WILDLIFE MODEL-AVERAGE CONCENTRATIONS, AVERAGE BAF, AND AVERAGE EXPOSURE PARAMETERS
SURFACE SOIL (0-6")
OLD PISTOL RANGE - RANGE 2 BERM
NSWC CRANE, INDIANA

Parameter	Meadow Vole[1]		Short-Tailed Shrew[1]		American Woodcock[2]		Bobwhite Quail[2]	
	NOAEL EEQ	LOAEL EEQ	NOAEL EEQ	LOAEL EEQ	NOAEL EEQ	LOAEL EEQ	NOAEL EEQ	LOAEL EEQ
Inorganics								
COPPER	8.9E-05	6.9E-05	1.8E-04	1.4E-04	1.6E-03	1.2E-03	1.1E-04	8.0E-05
LEAD	2.5E-03	2.5E-04	7.3E-03	7.3E-04	6.1E-01	6.1E-02	4.1E-02	4.1E-03
ZINC	1.1E-04	5.5E-05	4.3E-04	2.2E-04	6.7E-02	7.4E-03	1.7E-03	1.8E-04

Notes:
- Cells are shaded if the EEQ is greater than 1.0
1 - An Area Use Factor of 5% was used.
2 - An Area Use Factor of 2.5% was used.

Acronyms:
EEQ - Ecological Effects Quotient
LOAEL - Lowest Observed Adverse Effects Concentration
NOAEL - No Observed Adverse Effects Concentration

TERRESTRIAL WILDLIFE MODEL-AVERAGE CONCENTRATIONS, AVERAGE BAF, AND AVERAGE EXPOSURE PARAMETERS
SURFACE SOIL (0-6")
OLD PISTOL RANGE - RANGE 2 FIRING LANE
NSWC CRANE, INDIANA

Parameter	Meadow Vole[1]		Short-Tailed Shrew[1]		American Woodcock[2]		Bobwhite Quail[2]	
	NOAEL EEQ	LOAEL EEQ	NOAEL EEQ	LOAEL EEQ	NOAEL EEQ	LOAEL EEQ	NOAEL EEQ	LOAEL EEQ
Inorganics								
COPPER	4.4E-04	3.4E-04	8.9E-04	6.9E-04	8.1E-03	6.2E-03	5.3E-04	4.0E-04
LEAD	9.3E-04	9.3E-05	2.7E-03	2.7E-04	2.3E-01	2.3E-02	1.5E-02	1.5E-03
ZINC	6.6E-04	3.3E-04	2.6E-03	1.3E-03	4.0E-01	4.4E-02	1.0E-02	1.1E-03

Notes:
- Cells are shaded if the EEQ is greater than 1.0
1 - An Area Use Factor of 50% was used.
2 - An Area Use Factor of 25% was used.

Acronyms:
EEQ - Ecological Effects Quotient
LOAEL - Lowest Observed Adverse Effects Concentration
NOAEL - No Observed Adverse Effects Concentration

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APPENDIX A

HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA

APPENDIX A

HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP01	07XCP01	07XCP01	07XCP01	07XCP01	07XCP01	07XCP01	07XCP01
Sample ID	07XCP010003	07XCP010003A	07XCP010003B	07XCP010003C	07XCP010306	07XCP010306A	07XCP010306B	07XCP010306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	77.33 U	78 U	76 U	78 U	89.33 U	85 U	88 U	95 U
COPPER	22.67	22 U	21 U	25	23.67 U	23 U	23 U	25 U
LEAD	18	20	17	17	22.67	20	25	23
TIN	55.33 U	56 U	54 U	56 U	64 U	61 U	63 U	68 U
ZINC	49.67	46	51	52	41.33	36	35	53
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP02	07XCP02	07XCP02	07XCP02	07XCP02	07XCP02	07XCP02	07XCP02
Sample ID	07XCP020003	07XCP020003A	07XCP020003B	07XCP020003C	07XCP020306	07XCP020306A	07XCP020306B	07XCP020306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	75 U	74 U	74 U	77 U	83 U	84 U	82 U	83 U
COPPER	29.33	22 U	23	43	31.67	41	31	23 U
LEAD	22	23	23	20	25.33	30	25	21
TIN	53.33 U	53 U	53 U	54 U	59.33 U	60 U	59 U	59 U
ZINC	50.67	50	45	57	44.67	51	43	40
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP03	07XCP03	07XCP03	07XCP03	07XCP03	07XCP03	07XCP03	07XCP03
Sample ID	07XCP030003	07XCP030003A	07XCP030003B	07XCP030003C	07XCP030306	07XCP030306A	07XCP030306B	07XCP030306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	77.67 U	77 U	79 U	77 U	83 U	80 U	83 U	86 U
COPPER	44.67	38	30	66	75	52	124	49
LEAD	23.33	25	23	22	18.33	19	23	13
TIN	55.33 U	55 U	56 U	55 U	59.33 U	57 U	59 U	62 U
ZINC	127	94	132	155	196	174	322	92
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP04	07XCP04	07XCP04	07XCP04	07XCP04	07XCP04	07XCP04	07XCP04
Sample ID	07XCP040003	07XCP040003A	07XCP040003B	07XCP040003C	07XCP040306	07XCP040306A	07XCP040306B	07XCP040306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	80.67 U	78 U	85 U	79 U	83.33 U	84 U	84 U	82 U
COPPER	52.67	46	39	73	86.33	73	79	107
LEAD	34	32	33	37	30.67	26	29	37
TIN	57.33 U	55 U	60 U	57 U	60.67	59 U	61	62
ZINC	199	230	169	198	336.67	263	226	521
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP05	07XCP05	07XCP05	07XCP05	07XCP05	07XCP05	07XCP05	07XCP05
Sample ID	07XCP050003	07XCP050003A	07XCP050003B	07XCP050003C	07XCP050306	07XCP050306A	07XCP050306B	07XCP050306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	83.33 U	87 U	81 U	82 U	90 U	94 U	86 U	90 U
COPPER	31	31	32	30	30.67	45	23 U	24 U
LEAD	56	38	26	104	34.33	35	32	36
TIN	59.33 U	62 U	58 U	58 U	64 U	67 U	61 U	64 U
ZINC	43.33	55	38	37	47.33	60	47	35
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP06	07XCP06	07XCP06	07XCP06	07XCP06	07XCP06	07XCP06	07XCP06
Sample ID	07XCP060003	07XCP060003A	07XCP060003B	07XCP060003C	07XCP060306	07XCP060306A	07XCP060306B	07XCP060306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/10/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	80 U	80 U	78 U	82 U	80.33 U	71 U	82 U	88 U
COPPER	48	79	38	27	103.67	70	131	110
LEAD	18.67	19	15	22	26.67	14	41	25
TIN	58.33	57 U	60	58 U	56.67 U	50 U	58 U	62 U
ZINC	137.67	173	101	139	219.67	163	224	272
Metals (MG/KG)								
ANTIMONY	0.61 U							
COPPER	75.4 J							
LEAD	25.2 J							
TIN	0.94 U							
ZINC	207 J							

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP07	07XCP07	07XCP07	07XCP07	07XCP07	07XCP07	07XCP07	07XCP07
Sample ID	07XCP070003	07XCP070003A	07XCP070003B	07XCP070003C	07XCP070306	07XCP070306A	07XCP070306B	07XCP070306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	80 U	79 U	79 U	82 U	87.67 U	85 U	89 U	89 U
COPPER	24	22 U	27	23 U	24.33	22 U	28	23 U
LEAD	53	94	30	35	50.67	39	75	38
TIN	59	56 U	63	58 U	74.67	60 U	89	75
ZINC	40.67	41	42	39	40	46	43	31
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP08	07XCP08	07XCP08	07XCP08	07XCP08	07XCP08	07XCP08	07XCP08
Sample ID	07XCP080003	07XCP080003A	07XCP080003B	07XCP080003C	07XCP080306	07XCP080306A	07XCP080306B	07XCP080306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	79.67 U	78 U	79 U	82 U	83.33 U	82 U	82 U	86 U
COPPER	24.33	22 U	22 U	29	23 U	22 U	23 U	24 U
LEAD	35	29	32	44	55.33	57	53	56
TIN	67.33	55 U	56 U	91	59 U	58 U	58 U	61 U
ZINC	50	40	50	60	40.33	45	33	43
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP09	07XCP09	07XCP09	07XCP09	07XCP09	07XCP09	07XCP09	07XCP09
Sample ID	07XCP090003	07XCP090003-D	07XCP090003A	07XCP090003A-D	07XCP090003B	07XCP090003B-D	07XCP090003C	07XCP090003C-D
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	77.67 U	76.67 U	76 U	73 U	81 U	82 U	76 U	75 U
COPPER	59.33	34	90	43	32	29	56	30
LEAD	135.33	100	171	107	149	117	86	76
TIN	58	54.33 U	54 U	52 U	57 U	58 U	63	53 U
ZINC	47.33	41.67	37	39	55	58	50	28
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP09	07XCP09	07XCP09	07XCP09	07XCP10	07XCP10	07XCP10	07XCP10
Sample ID	07XCP090306	07XCP090306A	07XCP090306B	07XCP090306C	07XCP100003	07XCP100003A	07XCP100003B	07XCP100003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	87 U	85 U	87 U	89 U	80 U	78 U	84 U	78 U
COPPER	28	24 U	27	33	23.67	22 U	26	23
LEAD	42.67	33	43	52	19.33	21	19	18
TIN	71.33	61 U	90	63 U	57 U	56 U	60 U	55 U
ZINC	50	41	41	68	61	72	51	60
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP10	07XCP10	07XCP10	07XCP10	07XSS01	07XSS01	07XSS01	07XSS01
Sample ID	07XCP100306	07XCP100306A	07XCP100306B	07XCP100306C	07XSS010003	07XSS010003A	07XSS010003B	07XSS010003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	96.67 U	100 U	97 U	93 U	82.67 U	83 U	80 U	85 U
COPPER	30	27 U	33	30	35	33	26	46
LEAD	56.67	35	63	72	48.67	50	51	45
TIN	68.67 U	71 U	69 U	66 U	58.67 U	59 U	57 U	60 U
ZINC	39	44	46	27	43	38	38	53
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS01	07XSS01	07XSS01	07XSS01	07XSS01	07XSS01	07XSS01	07XSS01
Sample ID	07XSS010306	07XSS010306A	07XSS010306B	07XSS010306C	07XSS010612	07XSS010612A	07XSS010612B	07XSS010612C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	92 U	92 U	93 U	91 U	92 U	90 U	95 U	91 U
COPPER	25.67 U	26 U	26 U	25 U	24.33 U	24 U	25 U	24 U
LEAD	30.33	37	29	25	31.33	38	24	32
TIN	77.33	65 U	102	65 U	65 U	64 U	67 U	64 U
ZINC	44.67	53	40	41	41.67	41	41	43
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS01	07XSS01	07XSS01	07XSS01	07XSS02	07XSS02	07XSS02	07XSS02
Sample ID	07XSS011224	07XSS011224A	07XSS011224B	07XSS011224C	07XSS020003	07XSS020003A	07XSS020003B	07XSS020003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	1 - 2	1 - 2	1 - 2	1 - 2	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	99 U	100 U	96 U	101 U	88.33 U	88 U	85 U	92 U
COPPER	27.67 U	27 U	27 U	29 U	607.67	237	424	1162
LEAD	17.67	22	13	18	2625.33	1655	3547	2674
TIN	68.67 U	71 U	68 U	67 U	62.67 U	62 U	61 U	65 U
ZINC	50.67	58	45	49	121.33	94	117	153
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS02	07XSS02	07XSS02	07XSS02	07XSS02	07XSS02	07XSS02	07XSS02
Sample ID	07XSS020306	07XSS020306A	07XSS020306B	07XSS020306C	07XSS020612	07XSS020612A	07XSS020612B	07XSS020612C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	88 U	88 U	85 U	91 U	93 U	96 U	91 U	92 U
COPPER	465.33	658	215	523	62.33	51	78	58
LEAD	1594.33	1448	1428	1907	322.67	252	391	325
TIN	70	84	61 U	65 U	66 U	68 U	65 U	65 U
ZINC	105.33	115	74	127	50	53	49	48
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS02	07XSS02	07XSS02	07XSS02	07XSS03	07XSS03	07XSS03	07XSS03
Sample ID	07XSS021224	07XSS021224A	07XSS021224B	07XSS021224C	07XSS030003	07XSS030003A	07XSS030003B	07XSS030003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	1 - 2	1 - 2	1 - 2	1 - 2	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/11/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	95 U	96 U	93 U	96 U	96.33 U	95 U	94 U	100 U
COPPER	25.67 U	26 U	26 U	25 U	1004	794	898	1320
LEAD	35.67	22	56	29	6194.33	6250	6000	6333
TIN	69	69 U	70	68 U	70.67	74	67 U	71 U
ZINC	46	49	40	49	231	252	224	217
Metals (MG/KG)								
ANTIMONY					30.8 J			
COPPER					897 J			
LEAD					6870 J			
TIN					1.4 U			
ZINC					262 J			

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS03	07XSS03	07XSS03	07XSS03	07XSS03	07XSS03	07XSS03	07XSS03
Sample ID	07XSS030306	07XSS030306A	07XSS030306B	07XSS030306C	07XSS030612	07XSS030612-D	07XSS030612A	07XSS030612A-D
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/11/2004	12/11/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	98.33 U	104 U	96 U	95 U	97 U	96.67 U	96 U	95 U
COPPER	1268.33	1389	1212	1204	1269.67	865.33	985	1014
LEAD	3118	3651	3063	2640	1309.33	1076.33	1505	942
TIN	70.33 U	74 U	69 U	68 U	70.33	86.67	64 U	68 U
ZINC	284.33	309	258	286	293.33	334.67	308	217
Metals (MG/KG)								
ANTIMONY					16.8 J	10 J		
COPPER					1340 J	484 J		
LEAD					3920 J	1330 J		
TIN					0.66 U	0.7 U		
ZINC					428 J	409 J		

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS03	07XSS03	07XSS03	07XSS03	07XSS03	07XSS03	07XSS03	07XSS03
Sample ID	07XSS030612B	07XSS030612B-D	07XSS030612C	07XSS030612C-D	07XSS031224	07XSS031224A	07XSS031224B	07XSS031224C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	1 - 2	1 - 2	1 - 2	1 - 2
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	95 U	97 U	100 U	98 U	91.33 U	90 U	91 U	93 U
COPPER	1296	1117	1528	465	63	101	25 U	63
LEAD	1329	1390	1094	897	125.67	244	24	109
TIN	76	103	71 U	89	73.33	64 U	65 U	91
ZINC	263	356	309	431	59	80	35	62
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS04	07XSS04	07XSS04	07XSS04	07XSS04	07XSS04	07XSS04	07XSS04
Sample ID	07XSS040003	07XSS040003A	07XSS040003B	07XSS040003C	07XSS040306	07XSS040306-D	07XSS040306A	07XSS040306A-D
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/11/2004	12/11/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	84.67 U	83 U	85 U	86 U	102.67 U	100.33 U	104 U	97 U
COPPER	540.67	459	632	531	1411.33	1755	2035	1218
LEAD	2695.33	2418	3214	2454	2086.67	2065	2371	1625
TIN	64.67	72	61 U	61 U	77.33	85	74 U	69 U
ZINC	181	169	203	171	506	443.33	586	366
Metals (MG/KG)								
ANTIMONY					24.6 J	37.3 J		
COPPER					1550 J	1640 J		
LEAD					3650 J	4330 J		
TIN					0.77 U	0.8 U		
ZINC					533 J	615 J		

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS04	07XSS04	07XSS04	07XSS04	07XSS04	07XSS04	07XSS04	07XSS04
Sample ID	07XSS040306B	07XSS040306B-D	07XSS040306C	07XSS040306C-D	07XSS040612	07XSS040612A	07XSS040612B	07XSS040612C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	97 U	95 U	107 U	109 U	95 U	94 U	95 U	96 U
COPPER	881	1251	1318	2796	365.67	122	917	58
LEAD	1998	1296	1891	3274	59	32	81	64
TIN	69 U	108	89	78 U	85.67	87	83	87
ZINC	367	422	565	542	60	42	96	42
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS04	07XSS04	07XSS04	07XSS04	07XSS05	07XSS05	07XSS05	07XSS05
Sample ID	07XSS041224	07XSS041224A	07XSS041224B	07XSS041224C	07XSS050003	07XSS050003A	07XSS050003B	07XSS050003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	1 - 2	1 - 2	1 - 2	1 - 2	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	90.67 U	91 U	88 U	93 U	87 U	77 U	100 U	84 U
COPPER	29	29	28	30	335.33	317	355	334
LEAD	14	14	14	14	1414.33	1389	1442	1412
TIN	64.33 U	65 U	63 U	65 U	62 U	55 U	71 U	60 U
ZINC	44.33	39	49	45	135.67	130	137	140
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS05	07XSS05	07XSS05	07XSS05	07XSS05	07XSS05	07XSS05	07XSS05
Sample ID	07XSS050306	07XSS050306A	07XSS050306B	07XSS050306C	07XSS050612	07XSS050612A	07XSS050612B	07XSS050612C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	92 U	89 U	93 U	94 U	95.33 U	93 U	97 U	96 U
COPPER	1059.33	779	1009	1390	848.67	1218	865	463
LEAD	2490	2386	2398	2686	2571	1823	3878	2012
TIN	73.33	63 U	90	67 U	79	100	69 U	68 U
ZINC	222.33	188	228	251	215.67	209	277	161
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS05	07XSS05	07XSS05	07XSS05	07XSS06	07XSS06	07XSS06	07XSS06
Sample ID	07XSS051224	07XSS051224A	07XSS051224B	07XSS051224C	07XSS060003	07XSS060003A	07XSS060003B	07XSS060003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	1 - 2	1 - 2	1 - 2	1 - 2	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	88.67 U	85 U	92 U	89 U	78.67 U	80 U	80 U	76 U
COPPER	97.33	24 U	214	54	31	26	36	31
LEAD	131.67	41	236	118	137	135	138	138
TIN	63 U	61 U	65 U	63 U	55.67 U	57 U	54 U	56 U
ZINC	57.67	35	94	44	59.67	55	61	63
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS06	07XSS06	07XSS06	07XSS06	07XSS06	07XSS06	07XSS06	07XSS06
Sample ID	07XSS060306	07XSS060306A	07XSS060306B	07XSS060306C	07XSS060612	07XSS060612A	07XSS060612B	07XSS060612C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	87.33 U	84 U	88 U	90 U	88.33 U	92 U	85 U	88 U
COPPER	24.67 U	24 U	25 U	25 U	24 U	26 U	23 U	23 U
LEAD	56	54	56	58	33.33	33	34	33
TIN	60.33 U	60 U	62 U	59 U	62.67 U	66 U	60 U	62 U
ZINC	56.33	50	58	61	40.67	44	38	40
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS06	07XSS06	07XSS06	07XSS06	07XSS07	07XSS07	07XSS07	07XSS07
Sample ID	07XSS061224	07XSS061224A	07XSS061224B	07XSS061224C	07XSS070003	07XSS070003A	07XSS070003B	07XSS070003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	1 - 2	1 - 2	1 - 2	1 - 2	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/11/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	85 U	82 U	87 U	86 U	89 U	86 U	86 U	95 U
COPPER	24 U	23 U	25 U	24 U	48	25 U	73	46
LEAD	25.67	30	21	26	360	332	348	400
TIN	60.33 U	58 U	62 U	61 U	63.67 U	61 U	62 U	68 U
ZINC	42.33	36	48	43	60	48	65	67
Metals (MG/KG)								
ANTIMONY					2.8 J			
COPPER					49 J			
LEAD					396 J			
TIN					0.77 U			
ZINC					78.9 J			

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS07	07XSS07	07XSS07	07XSS07	07XSS07	07XSS07	07XSS07	07XSS07
Sample ID	07XSS070306	07XSS070306A	07XSS070306B	07XSS070306C	07XSS070612	07XSS070612A	07XSS070612B	07XSS070612C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	85.33 U	87 U	84 U	85 U	95.33 U	96 U	92 U	98 U
COPPER	53	54	41	64	653.67	114	140	1707
LEAD	583	225	482	1042	1348	1283	1006	1755
TIN	63.33	69	60 U	61 U	86.67	68 U	123	69 U
ZINC	40.67	38	45	39	95	77	75	133
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS07	07XSS07	07XSS07	07XSS07	07XSS08	07XSS08	07XSS08	07XSS08
Sample ID	07XSS071224	07XSS071224A	07XSS071224B	07XSS071224C	07XSS080003	07XSS080003A	07XSS080003B	07XSS080003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	1 - 2	1 - 2	1 - 2	1 - 2	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	89.67 U	86 U	92 U	91 U	86.33 U	79 U	96 U	84 U
COPPER	58.33	125	25 U	25 U	76.67	69	82	79
LEAD	189	408	104	55	476.67	322	420	688
TIN	64.67	64	65 U	65 U	61.67 U	56 U	69 U	60 U
ZINC	50.67	61	38	53	60.67	51	67	64
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS08	07XSS08	07XSS08	07XSS08	07XSS08	07XSS08	07XSS08	07XSS08
Sample ID	07XSS080306	07XSS080306A	07XSS080306B	07XSS080306C	07XSS080612	07XSS080612A	07XSS080612B	07XSS080612C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	91.33 U	90 U	92 U	92 U	101.33 U	101 U	90 U	113 U
COPPER	57.33	69	38	65	35.67	35	36	36
LEAD	225	310	135	230	139.67	151	124	144
TIN	68.67	75	66 U	65 U	85.33	72 U	103	81 U
ZINC	51.33	57	56	41	57.33	54	50	68
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS08	07XSS08	07XSS08	07XSS08	07XSS09	07XSS09	07XSS09	07XSS09
Sample ID	07XSS081224	07XSS081224A	07XSS081224B	07XSS081224C	07XSS090003	07XSS090003A	07XSS090003B	07XSS090003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	1 - 2	1 - 2	1 - 2	1 - 2	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	85.67 U	86 U	86 U	85 U	83.67 U	86 U	78 U	87 U
COPPER	23.33 U	24 U	23 U	23 U	44	38	50	44
LEAD	14.67	15	12	17	109.67	109	103	117
TIN	60.33 U	61 U	60 U	60 U	59.67 U	61 U	56 U	62 U
ZINC	33	21	32	46	63.67	61	57	73
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS09	07XSS09	07XSS09	07XSS09	07XSS09	07XSS09	07XSS09	07XSS09
Sample ID	07XSS090306	07XSS090306A	07XSS090306B	07XSS090306C	07XSS090612	07XSS090612A	07XSS090612B	07XSS090612C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	84.67 U	83 U	87 U	84 U	87.67 U	86 U	89 U	88 U
COPPER	40.33	32	51	38	42.67	42	61	25 U
LEAD	84	82	88	82	46.33	52	63	24
TIN	96.67	95	98	97	62.67 U	62 U	63 U	63 U
ZINC	55.67	48	60	59	59	55	70	52
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS09	07XSS09	07XSS09	07XSS09	07XSS10	07XSS10	07XSS10	07XSS10
Sample ID	07XSS091224	07XSS091224A	07XSS091224B	07XSS091224C	07XSS100003	07XSS100003A	07XSS100003B	07XSS100003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	1 - 2	1 - 2	1 - 2	1 - 2	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	83.67 U	82 U	84 U	85 U	89.67 U	87 U	93 U	89 U
COPPER	22.33 U	22 U	22 U	23 U	34.33	37	32	34
LEAD	15.33	10 U	25	11 U	26.33	27	26	26
TIN	59.33 U	58 U	60 U	60 U	63.33 U	62 U	66 U	62 U
ZINC	44	39	45	48	61.33	64	60	60
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS10	07XSS10	07XSS10	07XSS10	07XSS10	07XSS10	07XSS10	07XSS10
Sample ID	07XSS100306	07XSS100306A	07XSS100306B	07XSS100306C	07XSS100612	07XSS100612A	07XSS100612B	07XSS100612C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	91.33 U	90 U	93 U	91 U	95 U	96 U	95 U	94 U
COPPER	24.67 U	24 U	26 U	24 U	26 U	26 U	26 U	26 U
LEAD	45	43	47	45	23.67	17	29	25
TIN	72.33	87	66 U	64 U	68 U	68 U	68 U	68 U
ZINC	49	43	55	49	54.67	53	56	55
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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HILLSIDE RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS10	07XSS10	07XSS10	07XSS10
Sample ID	07XSS101224	07XSS101224A	07XSS101224B	07XSS101224C
Matrix	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS
Depth Range	1 - 2	1 - 2	1 - 2	1 - 2
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)				
ANTIMONY	88.67 U	89 U	88 U	89 U
COPPER	24 U	24 U	24 U	24 U
LEAD	13.67	14	11 U	16
TIN	67.67	76	63 U	64 U
ZINC	44.33	49	39	45
Metals (MG/KG)				
ANTIMONY				
COPPER				
LEAD				
TIN				
ZINC				

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP11	07XCP11	07XCP11	07XCP11	07XCP11	07XCP11	07XCP11	07XCP11
Sample ID	07XCP110003	07XCP110003A	07XCP110003B	07XCP110003C	07XCP110306	07XCP110306A	07XCP110306B	07XCP110306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	87.33 U	88 U	86 U	88 U	94.33 U	92 U	95 U	96 U
COPPER	40	36	29	55	33	49	24 U	26 U
LEAD	25	25	21	29	22.33	24	22	21
TIN	64	67	62 U	63 U	84	65 U	118	69 U
ZINC	87	96	81	84	69	54	72	81
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP12	07XCP12	07XCP12	07XCP12	07XCP12	07XCP12	07XCP12	07XCP12
Sample ID	07XCP120003	07XCP120003A	07XCP120003B	07XCP120003C	07XCP120306	07XCP120306A	07XCP120306B	07XCP120306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	80.33 U	78 U	83 U	80 U	85 U	84 U	90 U	81 U
COPPER	23.67	23 U	25	23 U	23 U	23 U	25 U	21 U
LEAD	36.33	42	36	31	27.67	20	36	27
TIN	93	92	134	53 U	63.67	60 U	64 U	67
ZINC	97.67	71	73	149	59	52	66	59
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP13	07XCP13	07XCP13	07XCP13	07XCP13	07XCP13	07XCP13	07XCP13
Sample ID	07XCP130003	07XCP130003A	07XCP130003B	07XCP130003C	07XCP130306	07XCP130306A	07XCP130306B	07XCP130306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	77 U	78 U	79 U	74 U	81.33 U	83 U	82 U	79 U
COPPER	21.33 U	21 U	22 U	21 U	21.33 U	22 U	21 U	21 U
LEAD	18.67	18	18	20	19.67	23	15	21
TIN	55 U	56 U	56 U	53 U	58 U	59 U	59 U	56 U
ZINC	40	39	37	44	42	50	35	41
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP14	07XCP14	07XCP14	07XCP14	07XCP14	07XCP14	07XCP14	07XCP14
Sample ID	07XCP140003	07XCP140003A	07XCP140003B	07XCP140003C	07XCP140306	07XCP140306A	07XCP140306B	07XCP140306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	77.33 U	77 U	78 U	77 U	85.33 U	87 U	86 U	83 U
COPPER	21 U	21 U	21 U	21 U	22.33 U	24 U	22 U	21 U
LEAD	14.33	14	15	14	17.33	17	17	18
TIN	60	66	56 U	58 U	71.67	89	67	59 U
ZINC	32.67	31	35	32	46.33	37	43	59
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP15	07XCP15	07XCP15	07XCP15	07XCP15	07XCP15	07XCP15	07XCP15
Sample ID	07XCP150003	07XCP150003-D	07XCP150003A	07XCP150003A-D	07XCP150003B	07XCP150003B-D	07XCP150003C	07XCP150003C-D
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	80.67 U	84.33 U	81 U	83 U	81 U	83 U	80 U	87 U
COPPER	21.67 U	25.67	21 U	23 U	23 U	23 U	21 U	31
LEAD	26	27	17	27	34	25	27	29
TIN	57.67 U	60 U	58 U	59 U	57 U	59 U	58 U	62 U
ZINC	59	56.33	66	52	51	52	60	65
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP15	07XCP15	07XCP15	07XCP15	07XCP16	07XCP16	07XCP16	07XCP16
Sample ID	07XCP150306	07XCP150306A	07XCP150306B	07XCP150306C	07XCP160003	07XCP160003A	07XCP160003B	07XCP160003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/10/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	84 U	85 U	82 U	85 U	78.67 U	79 U	77 U	80 U
COPPER	22.67 U	22 U	22 U	24 U	21.67 U	22 U	21 U	22 U
LEAD	23.33	12	33	25	17	17	14	20
TIN	62.67	60 U	58 U	70	55.67 U	56 U	55 U	56 U
ZINC	48.67	50	46	50	45.33	42	48	46
Metals (MG/KG)								
ANTIMONY					0.46 U			
COPPER					28 J			
LEAD					19.4 J			
TIN					0.97 U			
ZINC					65.3 J			

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP16	07XCP16	07XCP16	07XCP16	07XCP17	07XCP17	07XCP17	07XCP17
Sample ID	07XCP160306	07XCP160306A	07XCP160306B	07XCP160306C	07XCP170003	07XCP170003A	07XCP170003B	07XCP170003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	86.33 U	99 U	78 U	82 U	86 U	83 U	88 U	87 U
COPPER	23.33 U	26 U	22 U	22 U	26	23 U	29	26
LEAD	21.67	20	22	23	29.33	23	31	34
TIN	61.33 U	70 U	56 U	58 U	71.67	90	63 U	62 U
ZINC	52.33	63	53	41	45	46	43	46
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP17	07XCP17	07XCP17	07XCP17	07XCP18	07XCP18	07XCP18	07XCP18
Sample ID	07XCP170306	07XCP170306A	07XCP170306B	07XCP170306C	07XCP180003	07XCP180003A	07XCP180003B	07XCP180003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	93.33 U	89 U	99 U	92 U	86 U	88 U	87 U	83 U
COPPER	25 U	25 U	25 U	25 U	35.67	29	40	38
LEAD	22.67	23	22	23	22	19	25	22
TIN	66.33 U	63 U	71 U	65 U	61 U	62 U	62 U	59 U
ZINC	52.33	55	52	50	55	53	57	55
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP18	07XCP18	07XCP18	07XCP18	07XCP19	07XCP19	07XCP19	07XCP19
Sample ID	07XCP180306	07XCP180306A	07XCP180306B	07XCP180306C	07XCP190003	07XCP190003A	07XCP190003B	07XCP190003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	89.33 U	94 U	88 U	86 U	81.33 U	81 U	82 U	81 U
COPPER	28.33	38	24 U	23 U	23.67	23 U	24	24 U
LEAD	23.67	23	24	24	20.67	22	20	20
TIN	76.33	105	63 U	61 U	58 U	58 U	58 U	58 U
ZINC	53.67	62	51	48	40.67	30	50	42
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP19	07XCP19	07XCP19	07XCP19	07XCP20	07XCP20	07XCP20	07XCP20
Sample ID	07XCP190306	07XCP190306A	07XCP190306B	07XCP190306C	07XCP200003	07XCP200003A	07XCP200003B	07XCP200003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	84.33 U	81 U	86 U	86 U	85 U	85 U	86 U	84 U
COPPER	22 U	20 U	23 U	23 U	28.33	28	30	27
LEAD	19.67	16	22	21	25.67	23	28	26
TIN	56.33	69	61 U	39 U	61.33 U	61 U	61 U	62 U
ZINC	48	51	45	48	45.67	48	51	38
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP20	07XCP20	07XCP20	07XCP20	07XCP21	07XCP21	07XCP21	07XCP21
Sample ID	07XCP200306	07XCP200306A	07XCP200306B	07XCP200306C	07XCP210003	07XCP210003A	07XCP210003B	07XCP210003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	87.33 U	82 U	93 U	87 U	86.67 U	91 U	89 U	80 U
COPPER	25.33	27	26 U	23 U	28.67	31	32	23 U
LEAD	27	29	25	27	28.33	26	30	29
TIN	62 U	59 U	66 U	61 U	76	94	64 U	70
ZINC	56	54	60	54	53	61	55	43
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP21	07XCP21	07XCP21	07XCP21	07XCP22	07XCP22	07XCP22	07XCP22
Sample ID	07XCP210306	07XCP210306A	07XCP210306B	07XCP210306C	07XCP220003	07XCP220003A	07XCP220003B	07XCP220003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	101 U	96 U	109 U	98 U	80.67 U	76 U	84 U	82 U
COPPER	28.67 U	27 U	31 U	28 U	22.67	23	23 U	22 U
LEAD	27.67	21	34	28	18.33	21	21	13
TIN	71.33 U	68 U	77 U	69 U	57.33 U	54 U	60 U	58 U
ZINC	54.67	52	58	54	43.67	44	43	44
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XCP22	07XCP22	07XCP22	07XCP22	07XSS11	07XSS11	07XSS11	07XSS11
Sample ID	07XCP220306	07XCP220306A	07XCP220306B	07XCP220306C	07XSS110003	07XSS110003A	07XSS110003B	07XSS110003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	86 U	86 U	86 U	86 U	78.67 U	76 U	80 U	80 U
COPPER	23.67 U	24 U	24 U	23 U	35.33	25	44	37
LEAD	21.67	23	21	21	240	252	239	229
TIN	61 U	61 U	61 U	61 U	58.67	54 U	57 U	65
ZINC	43.67	44	44	43	58.67	54	62	60
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS11	07XSS11	07XSS11	07XSS11	07XSS11	07XSS11	07XSS11	07XSS11
Sample ID	07XSS110306	07XSS110306A	07XSS110306B	07XSS110306C	07XSS110612	07XSS110612A	07XSS110612B	07XSS110612C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	85 U	84 U	84 U	87 U	84.33 U	85 U	84 U	84 U
COPPER	23 U	22 U	23 U	24 U	23.33 U	23 U	23 U	24 U
LEAD	63.33	40	102	48	30.33	32	29	30
TIN	60.33 U	60 U	60 U	61 U	65.67	60 U	73	64 U
ZINC	43.67	41	43	47	49	44	53	50
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS11	07XSS11	07XSS11	07XSS11	07XSS12	07XSS12	07XSS12	07XSS12
Sample ID	07XSS111224	07XSS111224A	07XSS111224B	07XSS111224C	07XSS120003	07XSS120003A	07XSS120003B	07XSS120003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	1 - 2	1 - 2	1 - 2	1 - 2	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	86.33 U	87 U	87 U	85 U	81.67 U	83 U	81 U	81 U
COPPER	26.67	32	25 U	23 U	33.33	32	35	33
LEAD	52	99	31	26	267	296	273	232
TIN	67.33	62 U	79	61 U	57.67 U	59 U	57 U	57 U
ZINC	54.33	69	47	47	50.67	41	53	58
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS12	07XSS12	07XSS12	07XSS12	07XSS12	07XSS12	07XSS12	07XSS12
Sample ID	07XSS120306	07XSS120306A	07XSS120306B	07XSS120306C	07XSS120612	07XSS120612A	07XSS120612B	07XSS120612C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	86.67 U	90 U	84 U	86 U	88 U	91 U	87 U	86 U
COPPER	24.67	25 U	23 U	26	24.33 U	25 U	24 U	24 U
LEAD	140	115	141	164	65.67	44	49	104
TIN	61.33 U	64 U	59 U	61 U	62.33 U	65 U	61 U	61 U
ZINC	53.33	49	60	51	47.33	52	52	38
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS12	07XSS12	07XSS12	07XSS12	07XSS13	07XSS13	07XSS13	07XSS13
Sample ID	07XSS121224	07XSS121224A	07XSS121224B	07XSS121224C	07XSS130003	07XSS130003A	07XSS130003B	07XSS130003C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	1 - 2	1 - 2	1 - 2	1 - 2	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/11/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	86.67 U	87 U	87 U	86 U	81.67 U	80 U	81 U	84 U
COPPER	26	25 U	29	24 U	32.33	35	27	35
LEAD	20.67	22	20	20	308.67	222	471	233
TIN	62.67 U	62 U	62 U	64 U	58 U	57 U	58 U	59 U
ZINC	51.33	54	48	52	50.67	44	45	63
Metals (MG/KG)								
ANTIMONY					4.3 J			
COPPER					33.3 J			
LEAD					475 J			
TIN					0.68 U			
ZINC					83.2 J			

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS13	07XSS13	07XSS13	07XSS13	07XSS13	07XSS13	07XSS13	07XSS13
Sample ID	07XSS130306	07XSS130306-D	07XSS130306A	07XSS130306A-D	07XSS130306B	07XSS130306B-D	07XSS130306C	07XSS130306C-D
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	84.33 U	86.67 U	84 U	75 U	82 U	97 U	87 U	88 U
COPPER	28.67	24.33 U	27	22 U	36	27 U	23 U	24 U
LEAD	106	91.33	94	83	111	93	113	98
TIN	56.33 U	58 U	59 U	54 U	59 U	69 U	51 U	51 U
ZINC	52.33	46.67	58	34	46	62	53	44
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

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RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS13	07XSS13	07XSS13	07XSS13	07XSS13	07XSS13	07XSS13	07XSS13
Sample ID	07XSS130612	07XSS130612A	07XSS130612B	07XSS130612C	07XSS131224	07XSS131224A	07XSS131224B	07XSS131224C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	1 - 2	1 - 2	1 - 2	1 - 2
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	91 U	93 U	89 U	91 U	89 U	87 U	90 U	90 U
COPPER	25.33 U	26 U	24 U	26 U	24 U	24 U	24 U	24 U
LEAD	27.33	35	21	26	23.33	16	33	21
TIN	64 U	66 U	63 U	63 U	59.67 U	51 U	64 U	64 U
ZINC	52.67	54	50	54	57	51	56	64
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS14	07XSS14	07XSS14	07XSS14	07XSS14	07XSS14	07XSS14	07XSS14
Sample ID	07XSS140003	07XSS140003A	07XSS140003B	07XSS140003C	07XSS140306	07XSS140306A	07XSS140306B	07XSS140306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	85.67 U	84 U	88 U	85 U	90.33 U	90 U	90 U	91 U
COPPER	29	24 U	39	24 U	25.67	25 U	27	25 U
LEAD	149.33	155	147	146	63	53	78	58
TIN	62	60 U	65	61 U	64.33 U	64 U	64 U	65 U
ZINC	47.67	43	50	50	57.67	51	61	61
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS14	07XSS14	07XSS14	07XSS14	07XSS14	07XSS14	07XSS14	07XSS14
Sample ID	07XSS140612	07XSS140612A	07XSS140612B	07XSS140612C	07XSS141224	07XSS141224A	07XSS141224B	07XSS141224C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	1 - 2	1 - 2	1 - 2	1 - 2
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	92 U	90 U	91 U	95 U	100.33 U	95 U	105 U	101 U
COPPER	25.67	24 U	25 U	28	27.33 U	27 U	29 U	26 U
LEAD	36.33	41	16	52	22	22	20	24
TIN	76.33	64 U	82	83	70.67 U	68 U	75 U	69 U
ZINC	53.67	45	59	57	68	70	66	68
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS15	07XSS15	07XSS15	07XSS15	07XSS15	07XSS15	07XSS15	07XSS15
Sample ID	07XSS150003	07XSS150003A	07XSS150003B	07XSS150003C	07XSS150306	07XSS150306A	07XSS150306B	07XSS150306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	83.33 U	82 U	92 U	76 U	87 U	88 U	87 U	86 U
COPPER	31.33	35	31	28	25.67	30	24 U	23 U
LEAD	62	55	80	51	66.33	72	61	66
TIN	59.33 U	58 U	66 U	54 U	61.67 U	62 U	62 U	61 U
ZINC	58.33	53	71	51	58.67	60	62	54
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS15	07XSS15	07XSS15	07XSS15	07XSS15	07XSS15	07XSS15	07XSS15
Sample ID	07XSS150612	07XSS150612A	07XSS150612B	07XSS150612C	07XSS151224	07XSS151224A	07XSS151224B	07XSS151224C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	1 - 2	1 - 2	1 - 2	1 - 2
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	90.33 U	89 U	92 U	90 U	95 U	94 U	98 U	93 U
COPPER	24.33 U	24 U	25 U	24 U	26 U	25 U	27 U	26 U
LEAD	24	24	24	24	18.67	22	18	16
TIN	65.33 U	64 U	66 U	66 U	68 U	67 U	70 U	67 U
ZINC	56	55	59	54	55.67	56	60	51
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS16	07XSS16	07XSS16	07XSS16	07XSS16	07XSS16	07XSS16	07XSS16
Sample ID	07XSS160003	07XSS160003A	07XSS160003B	07XSS160003C	07XSS160306	07XSS160306A	07XSS160306B	07XSS160306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	84.33 U	86 U	80 U	87 U	89 U	85 U	94 U	88 U
COPPER	56.67	53	58	59	39.33	47	33	38
LEAD	977.33	1062	806	1064	303.67	304	331	276
TIN	60 U	61 U	57 U	62 U	63 U	60 U	67 U	62 U
ZINC	48.67	45	44	57	50	46	57	47
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS16	07XSS16	07XSS16	07XSS16	07XSS16	07XSS16	07XSS16	07XSS16
Sample ID	07XSS160612	07XSS160612A	07XSS160612B	07XSS160612C	07XSS161224	07XSS161224A	07XSS161224B	07XSS161224C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	1 - 2	1 - 2	1 - 2	1 - 2
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	88 U	89 U	86 U	89 U	89.67 U	89 U	87 U	93 U
COPPER	25.67	28	23 U	26	28.33	25 U	23 U	37
LEAD	30	29	27	34	22.33	24	21	22
TIN	62.33 U	63 U	61 U	63 U	63.67 U	63 U	62 U	66 U
ZINC	50	50	45	55	48.33	42	49	54
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS17	07XSS17	07XSS17	07XSS17	07XSS17	07XSS17	07XSS17	07XSS17
Sample ID	07XSS170003	07XSS170003A	07XSS170003B	07XSS170003C	07XSS170306	07XSS170306A	07XSS170306B	07XSS170306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/11/2004	12/12/2004	12/12/2004	12/12/2004	12/11/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	94 U	94 U	101 U	87 U	95.33 U	97 U	97 U	92 U
COPPER	82.67	76	80	92	112	140	121	75
LEAD	3194	3001	3712	2869	2302	2234	2459	2213
TIN	66.67 U	67 U	71 U	62 U	68 U	69 U	69 U	66 U
ZINC	62	45	81	60	70	75	74	61
Metals (MG/KG)								
ANTIMONY	50.6 J				39.9 J			
COPPER	87.6 J				88 J			
LEAD	10200 J				2590 J			
TIN	1.2 U				1.1 U			
ZINC	70.9 J				107 J			

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS17	07XSS17	07XSS17	07XSS17	07XSS17	07XSS17	07XSS17	07XSS17
Sample ID	07XSS170612	07XSS170612A	07XSS170612B	07XSS170612C	07XSS171224	07XSS171224A	07XSS171224B	07XSS171224C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	1 - 2	1 - 2	1 - 2	1 - 2
Sample Date	12/11/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	88 U	90 U	87 U	87 U	95 U	90 U	96 U	99 U
COPPER	33	46	29	24 U	26 U	25 U	26 U	27 U
LEAD	464.33	621	335	437	64.67	41	69	84
TIN	80.67	64 U	116	62 U	67.67 U	64 U	69 U	70 U
ZINC	54.67	51	53	60	52.67	44	59	55
Metals (MG/KG)								
ANTIMONY	11.9 J							
COPPER	27.5 J							
LEAD	922 J							
TIN	0.76 U							
ZINC	71 J							

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS18	07XSS18	07XSS18	07XSS18	07XSS18	07XSS18	07XSS18	07XSS18
Sample ID	07XSS180003	07XSS180003A	07XSS180003B	07XSS180003C	07XSS180306	07XSS180306A	07XSS180306B	07XSS180306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	89 U	91 U	94 U	82 U	91.33 U	91 U	91 U	92 U
COPPER	33.33	41	26 U	33	29.33	31	32	25 U
LEAD	98.67	91	97	108	64.67	65	60	69
TIN	63.33 U	65 U	67 U	58 U	65 U	65 U	65 U	65 U
ZINC	62.67	74	57	57	62	65	59	62
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS18	07XSS18	07XSS18	07XSS18	07XSS18	07XSS18	07XSS18	07XSS18
Sample ID	07XSS180612	07XSS180612A	07XSS180612B	07XSS180612C	07XSS181224	07XSS181224A	07XSS181224B	07XSS181224C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	1 - 2	1 - 2	1 - 2	1 - 2
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	92.33 U	90 U	93 U	94 U	93 U	94 U	92 U	93 U
COPPER	25.33 U	25 U	25 U	26 U	25.33 U	25 U	25 U	26 U
LEAD	20	21	18	21	20.33	22	21	18
TIN	65.67 U	64 U	67 U	66 U	81	67 U	110	66 U
ZINC	52	45	57	54	52.33	59	47	51
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS19	07XSS19	07XSS19	07XSS19	07XSS19	07XSS19	07XSS19	07XSS19
Sample ID	07XSS190003	07XSS190003A	07XSS190003B	07XSS190003C	07XSS190306	07XSS190306A	07XSS190306B	07XSS190306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	88.67 U	94 U	82 U	90 U	93.33 U	90 U	96 U	94 U
COPPER	51	56	53	44	29.67	28	27 U	34
LEAD	129.33	134	128	126	88.33	68	74	123
TIN	64.33	67 U	59 U	67	67	64 U	68 U	69
ZINC	69.33	76	57	75	60.33	56	61	64
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS19	07XSS19	07XSS19	07XSS19	07XSS19	07XSS19	07XSS19	07XSS19
Sample ID	07XSS190612	07XSS190612A	07XSS190612B	07XSS190612C	07XSS191224	07XSS191224A	07XSS191224B	07XSS191224C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	1 - 2	1 - 2	1 - 2	1 - 2
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	103 U	103 U	99 U	107 U	90.67 U	93 U	92 U	87 U
COPPER	35.67	45	29	33	24.67 U	25 U	25 U	24 U
LEAD	24	32	21	19	17.67	14	24	15
TIN	84	107	70 U	75 U	67	66 U	65 U	70
ZINC	63.67	72	49	70	48	56	47	41
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS20	07XSS20	07XSS20	07XSS20	07XSS20	07XSS20	07XSS20	07XSS20
Sample ID	07XSS200003	07XSS200003A	07XSS200003B	07XSS200003C	07XSS200306	07XSS200306A	07XSS200306B	07XSS200306C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0 - 0.25	0 - 0.25	0 - 0.25	0 - 0.25	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	91.67 U	91 U	93 U	91 U	93 U	90 U	98 U	91 U
COPPER	44.33	53	38	42	42.33	25 U	38	64
LEAD	85.33	79	92	85	54	40	69	53
TIN	65.33 U	65 U	66 U	65 U	66.33 U	64 U	70 U	65 U
ZINC	57	52	61	58	62.67	55	65	68
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX A

RANGE 1 AND RANGE 2 XRF AND LABORATORY DATA
OLD PISTOL RANGE
NSWC CRANE
CRANE, INDIANA

Location	07XSS20	07XSS20	07XSS20	07XSS20	07XSS20	07XSS20	07XSS20	07XSS20
Sample ID	07XSS200612	07XSS200612A	07XSS200612B	07XSS200612C	07XSS201224	07XSS201224A	07XSS201224B	07XSS201224C
Matrix	SO	SO	SO	SO	SO	SO	SO	SO
Submatrix	SS	SS	SS	SS	SS	SS	SS	SS
Depth Range	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	1 - 2	1 - 2	1 - 2	1 - 2
Sample Date	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004	12/12/2004
Field Parameters (XRF) (MG/KG)								
ANTIMONY	100.33 U	99 U	98 U	104 U	97.67 U	99 U	95 U	99 U
COPPER	27 U	27 U	25 U	29 U	29.67	27 U	26 U	36
LEAD	24.33	24	22	27	26.67	31	25	24
TIN	78.67	70 U	92	74 U	71	75	67 U	71 U
ZINC	63.33	57	61	72	51	62	47	44
Metals (MG/KG)								
ANTIMONY								
COPPER								
LEAD								
TIN								
ZINC								

APPENDIX B

MULTIPLE SAMPLE LOG SHEETS

(NUMBER OF BULLETS FOUND IN PARENTHESES ON LEFT HAND SIDE)

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [] SEDIMENT
[] SUBSURFACE SOIL [] LAGOON / POND
[] OTHER _____

SIGNATURE(S): Tony Rojahn

SAMPLER (S): T. Rojahn & D. Westerhoff

PROJECT NAME: ____ OLD PISTOL RANGE
PROTECT NUMBER: __ N3961

LOCATION: SWMU 7 - HILLSIDE BERM

	SAMPLE ID	SAMPLE METHOD	DEPTH ~~(ft)~~ (IN)	DATE 2004	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB (C) COMPOSITE	TOTAL No. OF CONTAINERS	ANALYSES: SELECTED METALS: Cu, Pb, Sb, Sn & ZN	FOR ANALYSIS	FOR HOLD	PID READING	SOIL DESCRIPTION
	07X5501 0003	DT	0-3	12/11	0912	L	G	1	1		X		Silt, f. SAND Rock FRAGS, Roots — Moist BRN
	07X5501 0306	DT	3-6	12/11	0913	L	G	1	1		X		CLAY Rock FRAGS Roots — ↓
	07X5501 0612	ST	6-12	12/11	0914	L	G	1	1		X		↓ — Sl Moist YEL ~~YEL~~ BRN
	07X5501 1224	HA	12-24	12/11	0919	L	G	1	1		X		↓ — ↓
	07X5502 0003	DT	0-3	12/11	0924	L	G	1	1		X		Silt, f. SAND Rock FRAGS Roots — Moist BRN
	07X5502 0306	DT	3-6	12/11	0925	L	G	1	1		X		CLAY Rock FRAGS Roots — ↓
	07X5502 0612	ST	6-12	12/11	0926	L	G	1	1		X		CLAY Rock FRAGS — Moist YEL BRN
	07X5502 1224	HA	12-24	12/11	0929	L	G	1	1		X		↓ — ↓
(12)	07X5503 0003	DT	0-3	12/11	0937	L	G	1	1	X			Silt, f. SAND Rock FRAGS Roots — Moist DARK BRN
(1)	07X5503 0306	DT	3-6	12/11	0938	L	G	1	1		X		Clayey Silt Rock FRAGS — Moist BRN
(4)	07X5503 0612	ST	6-12	12/11	0939	L	G	1	1	X			↓ — ↓
(1)	07X5503 1224	HA	12-24	12/11	0950	L	G	1	1		X		CLAY Rock FRAGS — Moist YEL BRN
*	07FD12110401	ST	6-12	12/11	0939	L	G	1	1	X			FROM 07X5503 0612

REMARKS: ST= Stainless Steel Trowel
DT= Disposable Trowel
HA = Hand Auger
(#) # of Bullets

LABORATORY: Laucks Testing Laboratories

COC No.: 4846, 4845

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [] SEDIMENT
[] SUBSURFACE SOIL [] LAGOON / POND
[] OTHER _____

SIGNATURE(S): [signature]

SAMPLER (S): T. Rojahn & D. Westerhoff

PROJECT NAME: ____ OLD PISTOL RANGE
PROTECT NUMBER: _ N3961

LOCATION: SWMU 7 - Hillside Range BERM

	SAMPLE ID	SAMPLE METHOD	DEPTH (IN)	DATE 2004	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB (C) COMPOSITE	TOTAL No. OF CONTAINERS	ANALYSES: SELECTED METALS: Cu, Pb, Sb, Sn & ZN	FOR ANALYSIS	FOR HOLD	PID READING	SOIL DESCRIPTION
(1)	07X5504 0003	DT	0-3	12/11	0954	L	G	1	1		X		Silt + Rock Frags Roots Moist Dark Brn
(20)	07X5504 0306	DT	3-6	12/11	0955	L	G	1	1	X			Clay Numerous Rock Frags Moist Brn
*	07FD12110402	DT	3-6	12/11	0955	L	G	1	1	X			Dup of 07X5504 0306
	07X6504 0612	ST	6-12	12/11	0956	L	G	1	1		X		Clay Rock Frags Moist Yel Brn
	07X5504 1224	HA	12-24	12/11	1005	L	G	1	1		X		↓ ↓
	07X5505 0003	DT	0-3	12/11	1007	L	G	1	1		X		Silt, + Sand Rock Frags Roots Moist Dark Brn
	07X5505 0306	DT	3-6	12/11	1008	L	G	1	1		X		Silt Num Rock Frags Roots ↓
	07X5505 0612	ST	6-12	12/11	1009	L	G	1	1		X		Clay Rock Frags, Roots Moist Brn
	07X5505 1224	HA	12-24	12/11	1012	L	G	1	1		X		↓ Moist Yel Brn
	07X5506 0003	DT	0-3	12/11	1014	L	G	1	1		X		Clayey Silt Rock Frags, Roots Moist Dark Brn
	07X5506 0306	DT	3-6	12/11	1015	L	G	1	1		X		Clay Rock Frags, Roots Moist Brn
	07X5506 0612	ST	6-12	12/11	1016	L	G	1	1		X		Clay Rock Frags, Roots Moist Yel Brn
	07X5506 1224	HA	12-24	12/11	1024	L	G	1	1		X		↓ Moist Black Eye Brn

REMARKS: ST: Stainless Steel Trowel
DT= Disposable Trowel (#) # of Bullets
HA = Hand Auger

LABORATORY: Laucks Testing Laboratories

COC No.: 4846, 4847
0990

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [] SEDIMENT
[] SUBSURFACE SOIL [] LAGOON / POND
[] OTHER _____

SIGNATURE(S): [signature]

SAMPLER (S): T. Rojahn & D. Westerhoff

PROJECT NAME: ____ OLD PISTOL RANGE
PROTECT NUMBER: __ N3961

LOCATION: SWMU 7 - Hillside BERM

SAMPLE ID	SAMPLE METHOD	DEPTH ~~(Ft)~~ (IN)	DATE 2004	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB (C) COMPOSITE	TOTAL No. OF CONTAINERS	ANALYSES: SELECTED METALS: Cu, Pb, Sb, Sn & ZN	FOR ANALYSIS	FOR HOLD	PID READING	SOIL DESCRIPTION
07X5507 0003	DT	0-3	12/11	1026	L	G	1	1	X			Clayey Silt Rock Frags, Roots — Moist Dark BRN
07X5507 0306	DT	3-6	12/11	1027	L	G	1	1		X		↓ ↓
07X5507 0612	ST	6-12	12/11	1028	L	G	1	1		X		↓ Moist BRN
07X5507 1224	HA	12-24	12/11	1031	L	G	1	1		X		Clay Rock Frags, Roots — Moist YEL BRN
07X5508 0003	DT	0-3	12/11	1034	L	G	1	1		X		Clayey Silt Rock Frags, Roots — Moist Dark BRN
07X5508 0306	DT	3-6	12/11	1035	L	G	1	1		X		Clayey Silt Rock Frags, Roots — Moist BRN
07X5508 0612	ST	6-12	12/11	1036	L	G	1	1		X		↓ ↓
07X5508 1224	HA	12-24	12/11	1037	L	G	1	1		X		Clay Rock Frags, Roots — Moist YEL BRN
07X5509 0003	DT	0-3	12/11	1042	L	G	1	1		X		Clayey Silt Rock Frags, Roots — Moist Dark BRN
07X5509 0306	DT	3-6	12/11	1043	L	G	1	1		X		↓ Moist BRN
07X5509 0612	ST	6-12	12/11	1044	L	G	1	1		X		↓ ↓
07X5509 1224	HA	12-24	12/11	1045	L	G	1	1		X		Clay Rock Frags, Roots — Moist YEL BRN
07X5510 0003	DT	0-3	12/11	1047	L	G	1	1		X		Clayey Silt F-C Gravel Roots — Moist Dark BRN

REMARKS:

DT= Disposable Trowel

HA = Hand Auger

LABORATORY:

Laucks Testing Laboratories

COC No.:

4847 & 4848

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [] SEDIMENT
[] SUBSURFACE SOIL [] LAGOON / POND
[] OTHER _____

SIGNATURE(S): Tony Rojahn

SAMPLER (S): T. Rojahn & D. Westerhoff

PROJECT NAME: ____ OLD PISTOL RANGE
PROTECT NUMBER: __ N3961

LOCATION: SWMU 7 - Hillside Range Berm & Range 2 Berm

SAMPLE ID	SAMPLE METHOD	DEPTH (Ft) (In)	DATE	TIME 2004	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB (C) COMPOSITE	TOTAL No. OF CONTAINERS	ANALYSES: SELECTED METALS: Cu, Pb, Sb, Sn & ZN	FOR ANALYSIS	FOR HOLD	PID READING	SOIL DESCRIPTION	
07X5510 0306	DT	3-6	12/11	1048	L	G	1	1		X		Clayey silt F-C Gravel, Roots	Moist Dark BRN
07X5510 0612	ST	6-12	12/11	1049	L	G	1	1		X		Clayey silt T. SAND F-C Gravel, Roots	Moist BRN
07X5510 1224	HA	12-24	12/11	1052	L	G	1	1		X		Clay F-C Gravel, Roots	Moist YEL BRN
07X5511 0003	DT	0-3	12/11	1230	L	G	1	1		X		Clayey silt F-C Gravel, Roots	Moist Dark BRN
07X5511 0306	DT	3-6	12/11	1231	L	G	1	1		X		↓	↓
07X5511 0612	ST	6-12	12/11	1232	L	G	1	1		X		Silt F-C Gravel, Roots	Moist BRN
07X5511 1224	HA	12-24	12/11	1239	L	G	1	1		X		Clayey Silt F-C Gravel, Roots	Moist BRN
07X5512 0003	DT	0-3	12/11	1243	L	G	1	1		X		Clayey Silt F-C Gravel, Roots	V. Moist Dark BRN
07X5512 0306	DT	3-6	12/11	1244	L	G	1	1		X		↓	Moist BRN
07X5512 0612	ST	6-12	12/11	1245	L	G	1	1		X		↓	↓
07X5512 1224	HA	12-24	12/11	1250	L	G	1	1		X		Silt F-C Gravel, Roots	↓
07X5513 0003	DT	0-3	12/11	1255	L	G	1	1	X			Clayey Silt F-C Gravel, Roots	Moist Dark BRN
07X5513 0306	DT	3-6	12/11	1256	L	G	1	1		X		↓	Moist BRN

REMARKS: ST: Stainless Steel Trowel
DT= Disposable Trowel
HA = Hand Auger

LABORATORY: Laucks Testing Laboratories

COC No.: 4848 & 4849

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [] SEDIMENT
[] SUBSURFACE SOIL [] LAGOON / POND
[] OTHER _____

SIGNATURE(S): Terry Rojahn

SAMPLER (S): T. Rojahn & D. Westerhoff

PROJECT NAME: ____ OLD PISTOL RANGE
PROTECT NUMBER: __ N3961

LOCATION: SWMU 7 - RANGE 2 BERM

SAMPLE ID	SAMPLE METHOD	DEPTH (IN)	DATE 2004	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB (C) COMPOSITE	TOTAL No. OF CONTAINERS	ANALYSES: SELECTED METALS: Cu, Pb, Sb, Sn & ZN	FOR ANALYSIS	FOR HOLD	PID READING	SOIL DESCRIPTION
07FD12110403	DT	3-6	12/11	0000	L	G	1	1		X		FROM 07X55130306
07X5513 0612	ST	6-12	12/11	1257	L	G	1	1		X		Clayey Silt F Gravel Roots Moist BRN
07X5513 1224	HA	12-24	12/11	1302	L	G	1	1		X		Silt w/clay F-C Gravel Moist BRN
07X5514 0003	DT	0-3	12/11	1306	L	G	1	1		X		Clayey Silt F-C Gravel, Roots Moist DARK BRN
07X5514 0306	DT	3-6	12/11	1307	L	G	1	1		X		↓ Moist BRN
07X5514 0612	ST	612	12/11	1308	L	G	1	1		X		↓ ↓
07X5514 1224	HA	12-24	12/11	1313	L	G	1	1		X		↓ ↓
07X5515 0003	DT	0-3	12/11	1317	L	G	1	1		X		↓ Moist DARK BRN
07X5515 0306	DT	3-6	12/11	1318	L	G	1	1		X		↓ Moist BRN
07X5515 0612	ST	6-12	12/11	1319	L	G	1	1		X		↓ ↓
07X5515 1224	HA	12-24	12/11	1324	L	G	1	1		X		↓ ↓
07X5516 0003	DT	0-3	12/11	1325	L	G	1	1		X		↓ Moist DARK BRN
07X5516 0306	DT	3-6	12/11	1326	L	G	1	1		X		↓ Moist BRN

REMARKS: STS Stainless Steel Trowel
DT= Disposable Trowel
HA = Hand Auger

LABORATORY: Laucks Testing Laboratories

COC No.: 4849 & 4850

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [] SEDIMENT
[] SUBSURFACE SOIL [] LAGOON / POND
[] OTHER _____

SIGNATURE(S): Ty Rojahn

SAMPLER (S): T. Rojahn & D. Westerhoff

PROJECT NAME: ____ OLD PISTOL RANGE
PROTECT NUMBER: __ N3961

LOCATION: SWMU 7 - RANGE 2 BERM

SAMPLE ID	SAMPLE METHOD	DEPTH (Ft.)	DATE 2004	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB (C) COMPOSITE	TOTAL No. OF CONTAINERS	ANALYSES: SELECTED METALS: Cu, Pb, Sb, Sn & ZN	ANALYSES: FOR ANALYSIS	ANALYSES: FOR HOLD	PID READING	SOIL DESCRIPTION
07X5516 0612	ST	6-12	12/11	1327	L	G	1	1		X	✓	CLAYEY SILT F-C-GRAVEL, Roots Moist BRN
07X5516 1224	HA	12-24	12/11	1329	L	G	1	1		X		↓ Moist BRN
07X5517 0003	DT	0-3	12/11	1331	L	G	1	1	X			↓ Moist DARK BRN
07X5517 0306	DT	3-6	12/11	1332	L	G	1	1	X			↓ ↓
07X5517 0612	ST	6-12	12/11	1333	L	G	1	1	X			↓ Moist BRN
07X5517 1224	HA	12-24	12/11	1335	L	G	1	1		X		↓ ↓
07X5518 0003	DT	0-3	12/11	1337	L	G	1	1		X		↓ Moist DARK BRN
07X5518 0306	DT	3-6	12/11	1338	L	G	1	1		X		↓ ↓
07X5518 0612	ST	6-12	12/11	1339	L	G	1	1		X		↓ Moist BRN
07X5518 1224	HA	12-24	12/11	1341	L	G	1	1		X		↓ ↓
07X5519 0003	DT	0-3	12/11	1343	L	G	1	1		X		↓ Moist DARK BRN
07X5519 0306	DT	3-6	12/11	1344	L	G	1	1		X		↓ Moist BRN
07X5519 0612	ST	6-12	12/11	1345	L	G	1	1		X		↓ ↓

REMARKS: ST- Stainless Steel Trowel
DT= Disposable Trowel
HA = Hand Auger

LABORATORY: Laucks Testing Laboratories

COC No.: 4850 & 0990

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [] SEDIMENT
[] SUBSURFACE SOIL [] LAGOON / POND
[] OTHER _____

SIGNATURE(S): [signature]

SAMPLER (S): T. Rojahn & D. Westerhoff

PROJECT NAME: ____ OLD PISTOL RANGE
PROTECT NUMBER: __ N3961

LOCATION: SWMU 7 - RANGE 2 BERM

SAMPLE ID	SAMPLE METHOD	DEPTH (FL)	DATE 2004	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB (C) COMPOSITE	TOTAL No. OF CONTAINERS	ANALYSES: SELECTED METALS: Cu, Pb, Sb, Sn & ZN	FOR ANALYSIS	FOR HOLD	PID READING	SOIL DESCRIPTION
07X5519 1224	HA	12-24	12/11	1348	L	G	1	1		X		CLAYEY SILT F-G GRAVEL MOIST BRN
07X5520 0003	DT	0-3	12/11	1350	L	G	1	1		X		↓ MOIST DARK BRN
07X5520 0306	DT	3-6	12/11	1351	L	G	1	1		X		↓ MOIST BRN
07X5520 0612	ST	6-12	12/11	1352	L	G	1	1		X		↓ ↓
07X5520 1224	HA	12-24	12/11	1355	L	G	1	1		X		↓ ↓
					L		1	1				
					L		1	1				
					L		1	1				
					L		1	1				
					L		1	1				
					L		1	1				
					L		1	1				
					L		1	1				

REMARKS: ST: STAINLESS STEEL TROWEL
DT= Disposable Trowel
HA = Hand Auger

LABORATORY: Laucks Testing Laboratories

COC No.: 0990

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [] SEDIMENT
[] SUBSURFACE SOIL [] LAGOON / POND
[] OTHER _____

SIGNATURE(S): Tony Rojahn

SAMPLER (S): T. Rojahn & D. Westerhoff

PROJECT NAME: ____ OLD PISTOL RANGE
PROTECT NUMBER: __ N3961

LOCATION: SWMU 7 - Hillside RANGE

SAMPLE ID	SAMPLE METHOD	DEPTH ~~(FT)~~ IN	DATE 2004	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB (C) COMPOSITE	TOTAL No. OF CONTAINERS	ANALYSES: SELECTED METALS: Cu, Pb, Sb, Sn & ZN	FOR ANALYSIS	FOR HOLD	PID READING	SOIL DESCRIPTION
07XCP020003	ST	0-3	12/8	1515	L	C	1	1		X	0.0	Silt, trace sand, Rock Frags, wet YEL. BRN
07XCP020306	ST	3-6	12/8	1530	L	C	1	1		X	0.0	Silt, t. sand (fine) Rock Frags. Roots wet YEL. BRN
07XCP010003	ST	0-3	12/8	1530	L	C	1	1		X	0.0	Silt, t. sand t. Rock, Roots (TR) ~~moist~~ wet YEL. BRN
07XCP010306	ST	3-6	12/8	1533	L	C	1	1		X	0.0	Silt, t. sand Rock Frags, Roots wet YEL BRN
07XCP030003	DT	0-3	12/10	0940	L	C	1	1		X	0.0	Silt, t. sand Rock Frags Trace, Roots moist BRN
07XCP030306	ST	3-6	12/10	0942	L	C	1	1		X	0.0	↓
07XCP040003	DT	0-3	12/10	0950	L	C	1	1		X	0.0	Clayey Silt Rock Frags Trace, Roots moist BRN
07XCP040306	ST	3-6	12/10	0952	L	C	1	1		X	0.0	Clayey Silt Rock Frags, Roots BRN wet
07XCP050003 ~~07XTC~~	DT	0-3	12/10	0953	L	C	1	1		X	0.0	Silt, t. sand t. Rock Frags, Roots moist Dark BRN
07XCP050306	ST	3-6	12/10	0955	L	C	1	1		X	0.0	Silt, t. sand Rock Frags, Roots moist BRN
07XCP060003	DT	0-3	12/10	1000	L	C	1	1	X		0.0	Silt, t. sand Rock Frags, Roots moist Dark BRN
07XCP060306	ST	3-6	12/10	1005	L	C	1	1		X	0.0	↓
07XCP070003	DT	0-3	12/10	1001	L	C	1	1		X	0.0	↓

REMARKS: ST: Stainless Steel Trowel
DT= Disposable Trowel
HA = Hand Auger

LABORATORY: Laucks Testing Laboratories

COC No.: 4840

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [] SEDIMENT
[] SUBSURFACE SOIL [] LAGOON / POND
[] OTHER _____

SIGNATURE(S): [signature]

SAMPLER (S): T. Rojahn & D. Westerhoff

PROJECT NAME: ____ OLD PISTOL RANGE
PROTECT NUMBER: __ N3961

LOCATION: SWMU 7 Hillside Range & RANGE 2

	SAMPLE ID	SAMPLE METHOD	DEPTH (FT) (IN)	DATE 2004	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB (C) COMPOSITE	TOTAL No. OF CONTAINERS	ANALYSES: SELECTED METALS: Cu, Pb, Sb, Sn & ZN	FOR ANALYSIS	FOR HOLD	PID READING	SOIL DESCRIPTION
	07XCP07 0306	ST	3-6	12/10	1003	L	C	1	1		X	0.0	Silt w/t. sand Rock Frags, Roots — Moist Dark BRN
	07XCP08 0003	DT	0-3	12/10	1010	L	C	1	1		X	0.0	Clayey Silt t. sand Rock Frags, Roots — Moist BRN
LSIDE	07XCP08 0306	ST	3-6	12/10	1012	L	C	1	1		X	0.0	↓ ↓
	07XCP09 0003	DT	0-3	12/10	1022	L	C	1	1		X	0.0	Silt w/t. sand Rock Frags, Roots — Moist Dark BRN
*	07FD12100401	DT	0-3	12/10	0000	L	C	1	1		X	0.0	DUP. OF 07XCP09 0003
	07XCP09 0306	ST	3-6	12/10	1024	L	C	1	1		X	0.0	Clayey Silt, t. sand Num. Rock Frags Roots — Moist BRN
	07XCP10 0003	DT	0-3	12/10	1029	L	C	1	1		X	0.0	Clayey Silt t. sand Rock Frags Roots BRN - Moist YEL. BRN
	07XCP10 0306	ST	3-6	12/10	1030	L	C	1	1		X	0.0	↓ — Moist YEL BRN
	07XCP11 0003	DT	0-3	12/10	1045	L	C	1	1		X	0.0	Clayey Silt w/t. sand Rock Frags, Roots — Moist Dark BRN
NGE 2	07XCP11 0306	ST	3-6	12/10	1047	L	C	1	1		X	0.0	Silt, t. sand Rock Frags (Num.), Roots — Moist BRN
	07XCP12 0003	DT	0-3	12/10	1055	L	C	1	1		X	0.0	Silt, t. sand t. Rock Frags, Roots — Moist Dark BRN
	07XCP12 0306	ST	3-6	12/10	1057	L	C	1	1		X	0.0	↓ ↓
	07XCP13 0003	DT	0-3	12/10	1100	L	C	1	1		X	0.0	↓ ↓

REMARKS: ST= Stainless Steel Trowel
DT= Disposable Trowel
HA = Hand Auger

LABORATORY: Laucks Testing Laboratories

COC No.: 4843 & 0990

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [] SEDIMENT
[] SUBSURFACE SOIL [] LAGOON / POND
[] OTHER _____

SIGNATURE(S): Tony Rojahn

SAMPLER (S): T. Rojahn & D. Westerhoff

PROJECT NAME: ____ OLD PISTOL RANGE
PROTECT NUMBER: __ N3961

LOCATION: SWMU7 - RANGE 2

SAMPLE ID	SAMPLE METHOD	DEPTH ~~(ft)~~ (IN)	DATE 2004	TIME	CONCENTRATION (L)OW (H)IGH	(G) GRAB (C) COMPOSITE	TOTAL No. OF CONTAINERS	ANALYSES: SELECTED METALS: Cu, Pb, Sb, Sn & ZN	FOR ANALYSIS	FOR HOLD	PID READING	SOIL DESCRIPTION
07XCP13 0306	ST	3-6	12/10	1102	L	C	1	1		X	0.0	SiH, + SAND + ROCK FRAGS, ROOTS Moist DARK BRN
07XCP14 0003	DT	0-3	12/10	1108	L	C	1	1		X	0.0	SiH + ROCK FRAGS, ROOTS ↓
07XCP14 0306	ST	3-6	12/10	1110	L	C	1	1		X	0.0	SiH, + SAND ROCK FRAGS, ROOTS Moist BRN
07XCP15 0003	DT	0-3	12/10	1115	L	C	1	1		X	0.0	↓ Moist DARK BRN
* 07FD12 100402	DT	0-3	12/10	1115	L	C	1	1		X	0.0	↓ ↓
07CP15 0306	ST	3-6	12/10	1117	L	C	1	1		X	0.0	↓ ↓
07CP16 0003	DT	0-3	12/10	1125	L	C	1	1	X		0.0	↓ ↓
07CP16 0306	ST	3-6	12/10	1128	L	C	1	1		X	0.0	↓ (2 CASINGS) Moist BRN
07CP17 0003	DT	0-3	12/10	1135	L	C	1	1		X	0.0	↓ Moist DARK BRN
07CP17 0306	ST	3-6	12/10	1137	L	C	1	1		X	0.0	↓ Moist BRN
07CP18 0003	DT	0-3	12/10	1140	L	C	1	1		X	0.0	↓ Moist DARK BRN
07CP18 0306	ST	3-6	12/10	~~1144~~ 1144 (TB)	L	C	1	1		X	0.0	↓ ↓
07CP19 0003	DT	0-3	12/10	1146	L	C	1	1		X	0.0	SiH NUM. ROCK FRAGS, ROOTS WET VEL BRN

REMARKS: ST = Stainless Steel Trowel
DT= Disposable Trowel
HA = Hand Auger

LABORATORY: Laucks Testing Laboratories

COC No.: 3843 & 4844
0990

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [] SEDIMENT
[] SUBSURFACE SOIL [] LAGOON / POND
[] OTHER _____

SIGNATURE(S): [signature]

SAMPLER (S): T. Rojahn & D. Westerhoff

PROJECT NAME: ____ OLD PISTOL RANGE
PROTECT NUMBER: __ N3961

LOCATION: SWMU 7 - RANGE 2

SAMPLE ID	SAMPLE METHOD	DEPTH (FT) (IN)	DATE 2004	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB (C) COMPOSITE	TOTAL No. OF CONTAINERS	ANALYSES: SELECTED METALS: Cu, Pb, Sb, Sn & ZN	FOR ANALYSIS	FOR HOLD	PID READING	SOIL DESCRIPTION	
07CP19 0306	ST	3-6	12/10	1141	L	GC	1	1		X	0.0	SILT NUM ROCK FRAGS	WET YEL BRN
07CP20 0003	DT	0-3	12/10	1146	L	GC	1	1		X	0.0	↓	MOIST BRN
07CP20 0306	ST	3-6	12/10	1150	L	GC	1	1		X	0.0	↓	WET YEL BRN
07CP21 0003	DT	0-3	12/10	1150	L	GC	(12) 1	1		X	0.0	SILT T. SAND NUM ROCK FRAGS, ROOTS	V. MOIST BRN
07CP21 0306	ST	3-6	12/10	1152	L	GC	1	1		X	0.0	SILT T. SAND ABUNDANT ROCK FRAGS	WET BRN
07CP22 0003	DT	0-3	12/10	1155	L	GC	1	1		X	0.0	CLAYEY SILT T. SAND ROCK FRAGS, ROOTS	V. MOIST YEL BRN
07CP22 0306	ST	3-6	12/10	1200	L	C	1	1		X	0.0	SILT, T. SAND ROCK FRAGS, ROOTS	WET YEL BRN
					L		1	1					
					L		1	1					
					L		1	1					
					L		1	1					
					L		1	1					
					L		1	1					

REMARKS: ST= STAINLESS STEEL TROWEL
DT= Disposable Trowel
HA = Hand Auger

LABORATORY: Laucks Testing Laboratories

COC No.: 4844 & 4845