AECOM

Final
Remedial Investigation Report

Ridgway Training Range, Pennsylvania

Munitions Response Site PAE40-001-R-01
Pennsylvania Army National Guard

Army National Guard

Contract No. W9133L-14-D-0001
Delivery Order No. 0006

June 2019

Prepared for:

Army National Guard
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Project Name:

Remedial Investigation through Decision Document for Six Army National Guard Munitions Response Sites, Ridgway Training Range, Pennsylvania

Site Location:

Ridgway Township, PA

Contract/Delivery Order:

Contract No. W9133L-14-D-0001
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Report Name:

Remedial Investigation Report
Ridgway Training Range, Pennsylvania
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Preparation Date (Month/Year):

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Acronyms and Abbreviations

°F	degrees Fahrenheit
AECOM	AECOM Technical Services, Inc.
ALM	Adult Lead Methodology
ARNG	Army National Guard
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
CDC	Centers for Disease Control and Prevention
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CHE	Chemical Warfare Materiel Hazard Evaluation
CHF	Contamination Hazard Factor
COC	constituent of concern
COI	constituents of interest
COPC	constituent of potential concern
COPEC	constituents of potential ecological concern
CSM	conceptual site model
CWM	Chemical Warfare Materiel
DD	decision document
DoD	Department of Defense
DRM	dose rate models
DQCR	daily quality control report
DU	decision unit
EBS	Environmental Baseline Survey
EHE	Explosive Hazard Evaluation
ELCR	excess lifetime cancer risk
ESV	ecological screening values
EU	exposure units
FS	Feasibility Study
ft	foot/feet
H	high
HHE	Health Hazard Evaluation
HHRA	human health risk assessment
HI	hazard index
IEUBK	Integrated Exposure Uptake Biokinetic
IS	incremental sample(s)
ISM	incremental sampling methodology

ITRC	Interstate Technology & Regulatory Council
L	low
LCS	laboratory control spike
LOD	limit of detection
M	medium
MC	munitions constituents
MEC	munitions and explosives of concern
mg/kg	milligram per kilogram
mg/L	milligrams per liter
mm	millimeter
MMRP	military munitions response program
MPF	Migration Pathway Factor
MRS	munitions response site
MRSPP	Munitions Response Site Prioritization Protocol
MS	matrix spike
MSC	Medium Specific Concentrations
MSD	matrix spike duplicates
ND	non-detect
NDNODS	Non-Department of Defense, Non-Operational Defense Site
NPS	National Park Service
PAARNG	Pennsylvania Army National Guard
PADEP	Pennsylvania Department of Environmental Protection
PADMVA	Pennsylvania Department of Military and Veterans Affairs
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PP	proposed plan
PbB	lead blood
ppm	parts per million
QA	quality assurance
QC	quality control
RF	Receptor Factor
RI	Remedial Investigation
RPD	relative percent difference
RSD	relative standard deviation
SI	Site Inspection
SLERA	screening level ecological risk assessment
SMDP	scientific management decision points

SOP	standard operating procedures
TCLP	toxicity characteristic leaching procedure
UFP-QAPP	Unified Federal Policy - Quality Assurance Project Plan
µg/dL	microgram per deciliter
U.S.	United States
USEPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WETS	Ridgway Weekend Training Site
XRF	X-ray fluorescence

Executive Summary

This Remedial Investigation (RI) Report presents the methodology and results of a study of munitions constituents (MCs) in soil conducted at the small arms range at the Ridgway Training Range Munitions Response Site (MRS) located in Ridgway Township, Elk County, Pennsylvania (PA). This is a Non-Department of Defense, Non-Operational Defense Site (NDNODS) identified by Army Environmental Database Restoration Number PAE40-001-R-01. AECOM Technical Services, Inc. (AECOM) performed the RI under Army National Guard (ARNG) Contract Number W9133L-14-D-0001, Delivery Order No. 0006. This report has been prepared following the United States (U.S.) Environmental Protection Agency (USEPA) Guidance for Conducting RIs and Feasibility Studies (FSs) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA; USEPA, 1988) and the U.S. Army Military Munitions Response Program (MMRP) RI/FS guidance document (U.S. Army, 2009).

Ridgway Training Range was formerly used by the Pennsylvania ARNG (PAARNG) for small-arms, live-fire weapons training between 1987 and 2005. The 0.22-acre Ridgway Training Range layout comprises a mostly enclosed, 25-meter, outdoor baffled, M-16 rifle range. The range includes 12 sheltered firing points, an earthen berm on the western edge of the MRS in the target area, and wooden baffles suspended over the earthen berm and range floor area. The property is currently used as a staging area for equipment associated with a private landscaping company owned by the property owner. To improve drainage at the MRS, the landowner installed a French drain parallel to the berm, and in doing so, moved soil from the Target Berm to a pile near the north sidewall.

Following a 2012 Site Inspection (SI), the range was divided into two parts based on a visual survey to distinguish between the area including the Firing Point, Target Berm, and range floor in between, and the area where no historical firing occurred (PAE40-001-R-01 and PAE40-001-R-23 respectively). No further action was recommended for the 7.78-acre Ridgway Training Range – PA MRS (PAE40-001-R-02) that included the original area where firing never occurred. The SI found elevated levels of small arms MC in surface soil at the Target Berm, and elevated levels of nitroglycerin at the Firing Point. The 0.22-acre MRS was subsequently recommended to move forward to an RI and is the subject of this investigation.

Environmental data were needed to identify the presence, nature, and extent of small arms MC in soil at the Ridgway Training Range MRS, evaluate whether MCs are present at concentrations that could pose a potential risk to human and ecological receptors, and guide further management decisions as to whether remedial action is required. Per the preliminary conceptual site model (CSM) in the Final RI Work Plan/Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP; AECOM, 2017), potentially complete pathways exist for human receptors to come into direct contact with site soils. The landowner and visitors or workers (e.g., construction, commercial/industrial) that the landowner allows on site may be exposed to site soil. As there is no restriction on the land, there is potential that the site could be used for residential purposes in the future. Additionally, a portion of wetland area is present within the MRS, and the Allegheny National Forest borders the western edge of the MRS, representing ecological habitats within and surrounding the Ridgway Training Range. No federally designated critical habitat is located within the MRS. Pennsylvania State-endangered species may be present in the MRS; however, habitat within the MRS is fragmented to the north, east, and south, and the MRS is very small.

This RI compiled and evaluated information and data about the MRS relating to the potential contamination associated with its historical use for small arms training activities conducted at the Ridgway Training Range. The sampling approach was designed to characterize the nature and extent of MC contamination in soil at the Target Berm, Firing Point, and Soil Pile; and MC contamination in sediment at the French Drain Outfall. For data interpretation purposes and for assessing risks, the MRS was divided into four decision units (DUs) – the Target Berm, Firing Point, Soil Pile, and French Drain Outfall – that reflect the four areas of potential contamination as indicated by site history and post-training construction activities (**Figure ES-1**). Field investigation activities included X-Ray fluorescence (XRF) screening and discrete soil sampling the Target Berm to evaluate the lateral extent of MC; and the collection of surface soil samples using incremental sampling methodology (ISM) and discrete sampling of soil and sediment for evaluating human health and ecological risks (**Table ES-1)**. A background reference area adjacent to the MRS that was not affected by historical training activities was also sampled using ISM. Discrete subsurface samples were collected at select areas to determine the vertical extent of MC.

The data collected at the MRS were sufficient to delineate the extent of site-related MC contamination. Exceedances of the human health criterion for lead were observed in XRF screening results at the Target Berm (**Figure ES-2**) and resulted in step-out sampling that expanded the DU boundary to 0.126 acres. The extent of elevated lead concentrations indicates MC transportation by precipitation or via movement of soil by the property owner. The DU extended beyond the enclosed firing range walls and the current extent of the MRS. ISM sample results at the Target Berm indicate that small arms MC are present in soil above human health screening criteria. Four locations at the Target Berm (location #80 #22, #91, and #45) were selected to represent distinct areas at the DU (the Target Berm north of the concrete walls, the Target Berm within the concrete walls, the Target Berm south of the concrete walls, and the range floor within the concrete walls) for discrete subsurface soil sampling based on XRF results exceeding human health criterion for lead. Discrete subsurface sampling at locations #22 and #91 indicated that small arms MC at the Target Berm are present above their risk-based screening levels at the 12 to 18-inches below ground surface (bgs) depth interval and the 24 to 30-inch bgs interval (**Figure ES-3a**), although MC concentrations generally decreased with depth. Deeper samples at these locations could not be collected due to refusal at a gravel layer within the berm. Solid waste characterization parameters (toxicity characteristic leaching procedure [TCLP]) collected from surface soil at grid location #06 exhibited waste characteristics of toxicity for lead (720 milligrams per liter [mg/L]). The TCLP hazardous waste threshold for lead is 5 mg/L. Detected TCLP parameters are shown on **Figure ES-3a**. XRF data showed that lead is migrating from the Target Berm but does not extend into drainage areas to the north and south of the MRS that are intermittently inundated. Additional sediment samples were collected from a drainage ditch south of the MRS to assess the potential transport of MC from the Target Berm to the drainage ditch sediment. Neither sample showed MC concentrations exceeding human health screening criteria. Target Berm sediment sample results are shown on **Figure ES-4**.

The data collected at the Firing Point were sufficient to delineate the extent of MC contamination at the DU. Surface soil samples collected adjacent to the DU from uncovered soil east of the firing positions showed no exceedances for nitroglycerin, indicating that small arms MC is not being transported outside of the MRS (**Figure ES-3b**). Three locations at the Firing Point were selected for discrete subsurface soil sampling based on their proximity to historical firing positions. Nitroglycerin was elevated above human health screening criterion in subsurface samples from all three locations at depths from 12 to 18-inches bgs (**Figure ES-3b**); the 24 to 30-inch bgs interval could not be sampled due to refusal at a gravel layer. Detected TCLP parameters are also shown on **Figure ES-3b**; however, nitroglycerin does not have a federal Toxicity Characteristic level for solid waste. Although nitroglycerin is elevated above human health screening criterion in Firing Point soil, it is not being transported beyond the MRS boundary.

Discrete soil and sediment samples from the Soil Pile DU and French Drain Outfall DU, respectively, were collected to assess the potential spread of MC contamination because of the installation of the French drain parallel to the berm. Discrete soil samples from the Soil Pile DU, created as a result of excavating soils from the base of the Target Berm, showed small arms MC (antimony, copper, and lead) elevated above human health screening criteria (**Figure ES-3c**). MC in the Soil Pile may be transported to the range floor via runoff due to precipitation but is not anticipated to be transported beyond the MRS due to its confining concrete walls. Discrete sediment samples from the French Drain Outfall DU did not exhibit any small arms MC above human health screening criteria, but did exhibit levels of copper and lead elevated above ecological screening criteria. (**Figure ES-4**).

ISM provided high quality data that are an unbiased estimate of the mean concentration of MC in Target Berm and Firing Point soil and suitable for risk screening. Incremental samples (IS) collected from the both DUs showed elevated concentrations of small arms MC (metals and explosives) compared to human health screening criteria (**Table ES-1** and **Figure ES-5**). Discrete samples from soil at the Soil Pile DU exceeded human health screening criteria for respective small arms matrix spike (MS), as expected. Discrete samples from sediment at the French Drain Outfall DU were elevated only above ecological screening criteria for small arms MC. Based on these results, there is evidence of unacceptable risk to human receptors visiting or working at the MRS. Furthermore, MC concentrations exceed human health screening criteria in soil beyond the current extent of the MRS; however, MC concentrations do not exceed human health screening criteria beyond the MRS's immediate surroundings, and exceedances do not reach the wetland east of the MRS. Furthermore, discrete soil sampling data showed MC concentrations elevated at depths of up to 24-30 inches bgs, indicating an elevated risk to maintenance workers (e.g., landscaper).

A site-specific human health risk assessment (HHRA) was conducted to evaluate whether constituents of potential concern (COPCs) attributable to past site activities have the potential to cause adverse health effects to human receptors from exposure to soil and sediment at the MRS.

The following human health on-site receptors were evaluated: outdoor worker, teen trespasser, child and adult visitor, child and adult hypothetical resident, construction worker, and utility worker. The current scenarios represent exposure to site conditions that is assumed to not change in the future (i.e., no land re-development). Receptors are assumed to be exposed to surface soil (0 to 24 inches bgs). The future scenarios are used to address site conditions that have changed due to land re-development. Land re-development results in excavation activities that bring subsurface soil to the surface, and the soils are "mixed" together. Future receptors are exposed to total soil (0 to 36 inches bgs). Soil-related exposure pathways that were evaluated in the HHRA were incidental ingestion and dermal contact with soil. The inhalation exposure pathway was incomplete because the soil chemicals of potential concern did not have inhalation toxicity values.

Potential off-site receptors were not identified for the MRS because site access is restricted via a locked gate. However, an on-site trespasser scenario was evaluated in the HHRA to address potential breaches in site security. On-site and surrounding area vegetation, the concrete wall, and other structures inhibit windblown particulates from leaving the MRS. Also, human health sediment COPCs were not identified in the surface water drainage areas of the French Drain Outfall and Target Berm DUs where surface water leaves the MRS.

Cancer risk and non-cancer hazard calculations were conducted for the soil exposure medium. USEPA's Adult Lead Methodology (ALM) and Integrated Exposure Uptake Biokinetic (IEUBK) models were used to estimate lead blood (PbB) concentrations for receptors exposed to lead in soil.

Table ES-2 identifies the constituents of concern (COCs) that exceeded the Pennsylvania Department of Environmental Protection (PADEP) and risk thresholds in the HHRA (**Appendix F**). The HHRA recommends further evaluation of the soil COCs in an FS for the Ridgway Training Range MRS

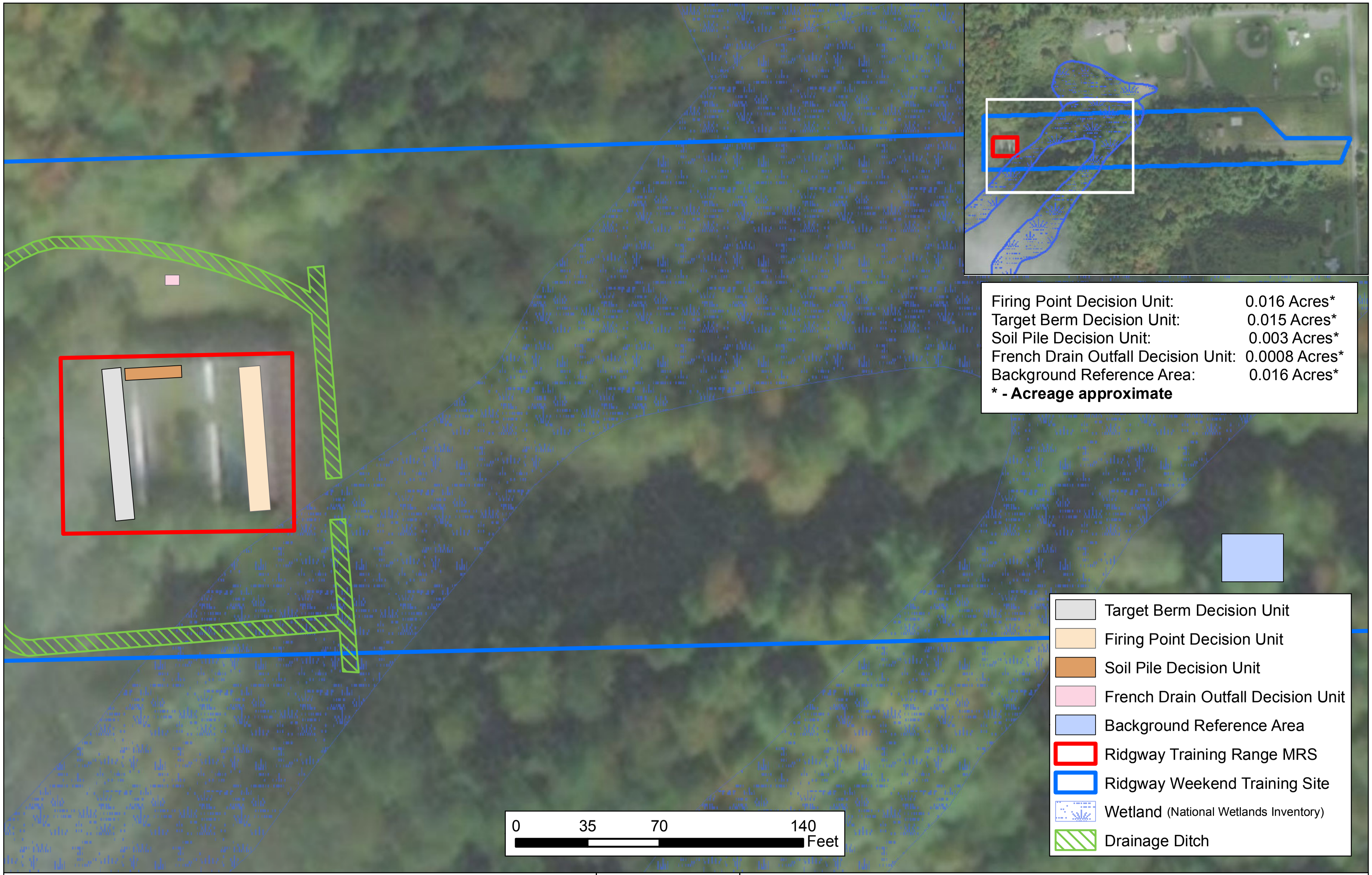
Preferential habitat quality exists in the areas surrounding the MRS (e.g., wetlands), but ecological receptors are anticipated to be minimally exposed to MRS-related MC within or adjacent to the MRS due to forest fragmentation in the surrounding the areas and the relatively small size of the MRS.

Due to MC concentrations in soil at all DUs exceeding ecological screening criteria, a Screening Level Ecological Risk Assessment (SLERA) was conducted. The purpose of the SLERA was to identify the potential risks to ecological receptors exposed to Site-related constituents of interest (COIs) in environmental media at the Site and determine which constituents of potential ecological concern (COPECs), if any, were exerting adverse effects to potential ecological receptor populations. The results of the risk characterization determined the following scientific management decision points (SMDPs):

1. Exposure to COPECs in on-Site soil resulted in substantial impact (*de manifestis*) to both soil invertebrate and terrestrial wildlife populations; action should be taken that can eliminate or reduce exposure to an acceptable level.
2. The potential for adverse effects to the benthic macroinvertebrate community is *de minimus*, and the potential for adverse effects to the aquatic and semi-aquatic wildlife community is *de minimus*.

The results of the SLERA are presented in **Appendix G**.

Based on the results of the RI, the MRS has been sufficiently characterized. The MRS boundary has been revised to include the furthest extent of MC concentration exceedances of human health screening criterion for lead based on XRF data; the revised acreage is 0.27acres (**Figure ES-5**). The presence of unacceptable risks to human health warrants an FS for the Ridgway Training Range MRS. The next step after an FS would be to prepare a proposed plan (PP) to convey this finding to the public, followed by a decision document (DD) to formally conclude work at the MRS.



Firing Point Decision Unit:	0.016 Acres*
Target Berm Decision Unit:	0.015 Acres*
Soil Pile Decision Unit:	0.003 Acres*
French Drain Outfall Decision Unit:	0.0008 Acres*
Background Reference Area:	0.016 Acres*

*** - Acreage approximate**

CLIENT	Army National Guard			
PROJECT	Remedial Investigation through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	11/8/2018
SCALE	1:840	CHK BY	AS	11/8/2018
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	11/8/2018

N

TITLE

Ridgway Training Range MRS RI Approach

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Figure ES-1

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CLIENT	Army National Guard			
PROJECT	Remedial Investigation through Decision Document for Ridgway Training Range			
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SCALE	1:180	CHK BY	AS	11/8/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	11/8/2018

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N

Bold = MC concentration exceeds ecological screening criteria

☐ Sample Grid

🟨 MC Concentration exceeds human health screening criteria

🟥 Ridgway Training Range MRS

▦ Wetland (National Wetlands Inventory)

▨ Drainage Ditch

Note:
ppm = parts per million

TITLE
Target Berm XRF Sample Diagram

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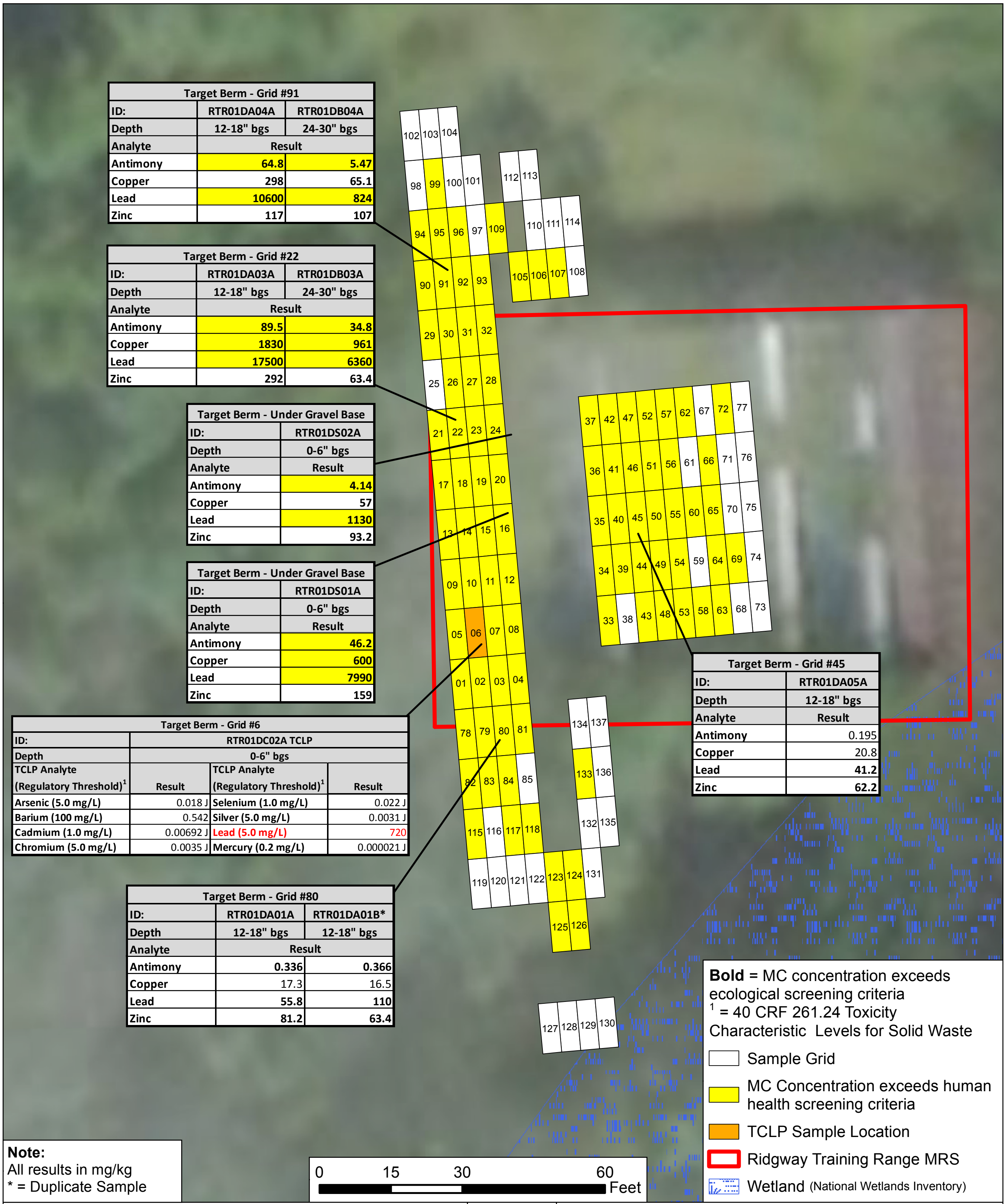
Figure ES-2



Target Berm - Grid #91		
ID:	RTR01DA04A	RTR01DB04A
Depth	12-18" bgs	24-30" bgs
Analyte	Result	
Antimony	**64.8**	**5.47**
Copper	298	65.1
Lead	**10600**	**824**
Zinc	117	107

Target Berm - Grid #22		
ID:	RTR01DA03A	RTR01DB03A
Depth	12-18" bgs	24-30" bgs
Analyte	Result	
Antimony	**89.5**	**34.8**
Copper	**1830**	**961**
Lead	**17500**	**6360**
Zinc	292	63.4

Target Berm - Under Gravel Base	
ID:	RTR01DS02A
Depth	0-6" bgs
Analyte	Result
Antimony	**4.14**
Copper	57
Lead	**1130**
Zinc	93.2

Target Berm - Under Gravel Base	
ID:	RTR01DS01A
Depth	0-6" bgs
Analyte	Result
Antimony	**46.2**
Copper	**600**
Lead	**7990**
Zinc	159

Target Berm - Grid #6			
ID:	RTR01DC02A TCLP		
Depth	0-6" bgs		
TCLP Analyte (Regulatory Threshold)[1]	Result	TCLP Analyte (Regulatory Threshold)[1]	Result
Arsenic (5.0 mg/L)	0.018 J	Selenium (1.0 mg/L)	0.022 J
Barium (100 mg/L)	0.542	Silver (5.0 mg/L)	0.0031 J
Cadmium (1.0 mg/L)	0.00692 J	Lead (5.0 mg/L)	720
Chromium (5.0 mg/L)	0.0035 J	Mercury (0.2 mg/L)	0.000021 J

Target Berm - Grid #80		
ID:	RTR01DA01A	RTR01DA01B*
Depth	12-18" bgs	12-18" bgs
Analyte	Result	
Antimony	**0.336**	**0.366**
Copper	17.3	16.5
Lead	55.8	**110**
Zinc	**81.2**	63.4

Target Berm - Grid #45	
ID:	RTR01DA05A
Depth	12-18" bgs
Analyte	Result
Antimony	0.195
Copper	20.8
Lead	**41.2**
Zinc	**62.2**

Bold = MC concentration exceeds ecological screening criteria

[1] = 40 CRF 261.24 Toxicity Characteristic Levels for Solid Waste

☐ Sample Grid

🟨 MC Concentration exceeds human health screening criteria

🟧 TCLP Sample Location

🟥 Ridgway Training Range MRS

▨ Wetland (National Wetlands Inventory)

Note:
All results in mg/kg
* = Duplicate Sample

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	2/26/2019
SCALE	1:360	CHK BY	JW	2/26/2019
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	2/26/2019

Target Berm Discrete Soil Sample Results

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Figure ES-3A

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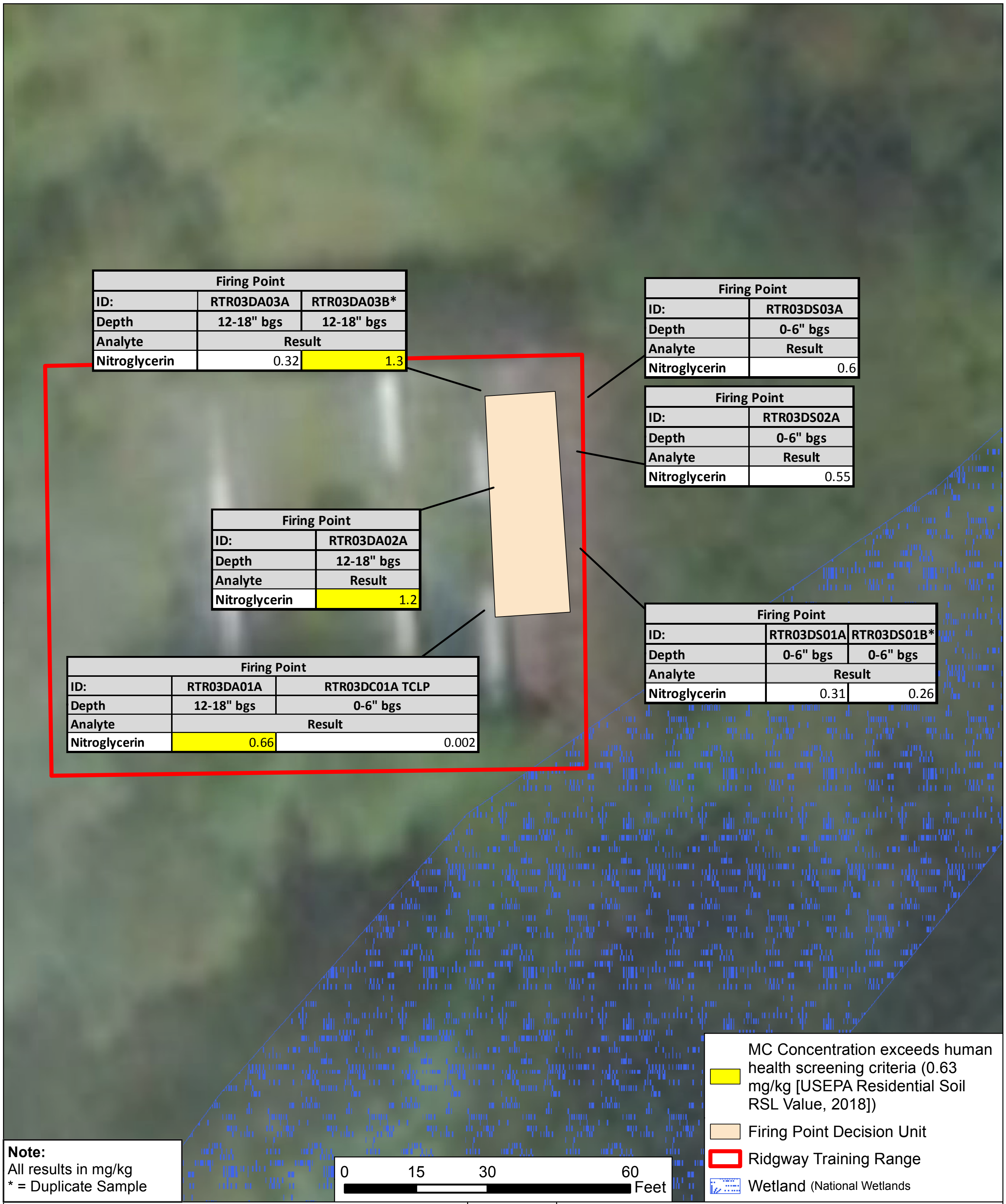

Firing Point		
ID:	RTR03DA03A	RTR03DA03B*
Depth	12-18" bgs	12-18" bgs
Analyte	Result	
Nitroglycerin	0.32	1.3

Firing Point	
ID:	RTR03DS03A
Depth	0-6" bgs
Analyte	Result
Nitroglycerin	0.6

Firing Point	
ID:	RTR03DS02A
Depth	0-6" bgs
Analyte	Result
Nitroglycerin	0.55

Firing Point	
ID:	RTR03DA02A
Depth	12-18" bgs
Analyte	Result
Nitroglycerin	1.2

Firing Point		
ID:	RTR03DS01A	RTR03DS01B*
Depth	0-6" bgs	0-6" bgs
Analyte	Result	
Nitroglycerin	0.31	0.26

Firing Point		
ID:	RTR03DA01A	RTR03DC01A TCLP
Depth	12-18" bgs	0-6" bgs
Analyte	Result	
Nitroglycerin	0.66	0.002

🟨 MC Concentration exceeds human health screening criteria (0.63 mg/kg [USEPA Residential Soil RSL Value, 2018])

▭ Firing Point Decision Unit

🟥 Ridgway Training Range

▨ Wetland (National Wetlands

Note:
All results in mg/kg
* = Duplicate Sample

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	2/26/2019
SCALE	1:360	CHK BY	JW	2/26/2019
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	2/26/2019

Firing Point Discrete Soil Sample Results

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ARMY NATIONAL GUARD

Figure ES-3B

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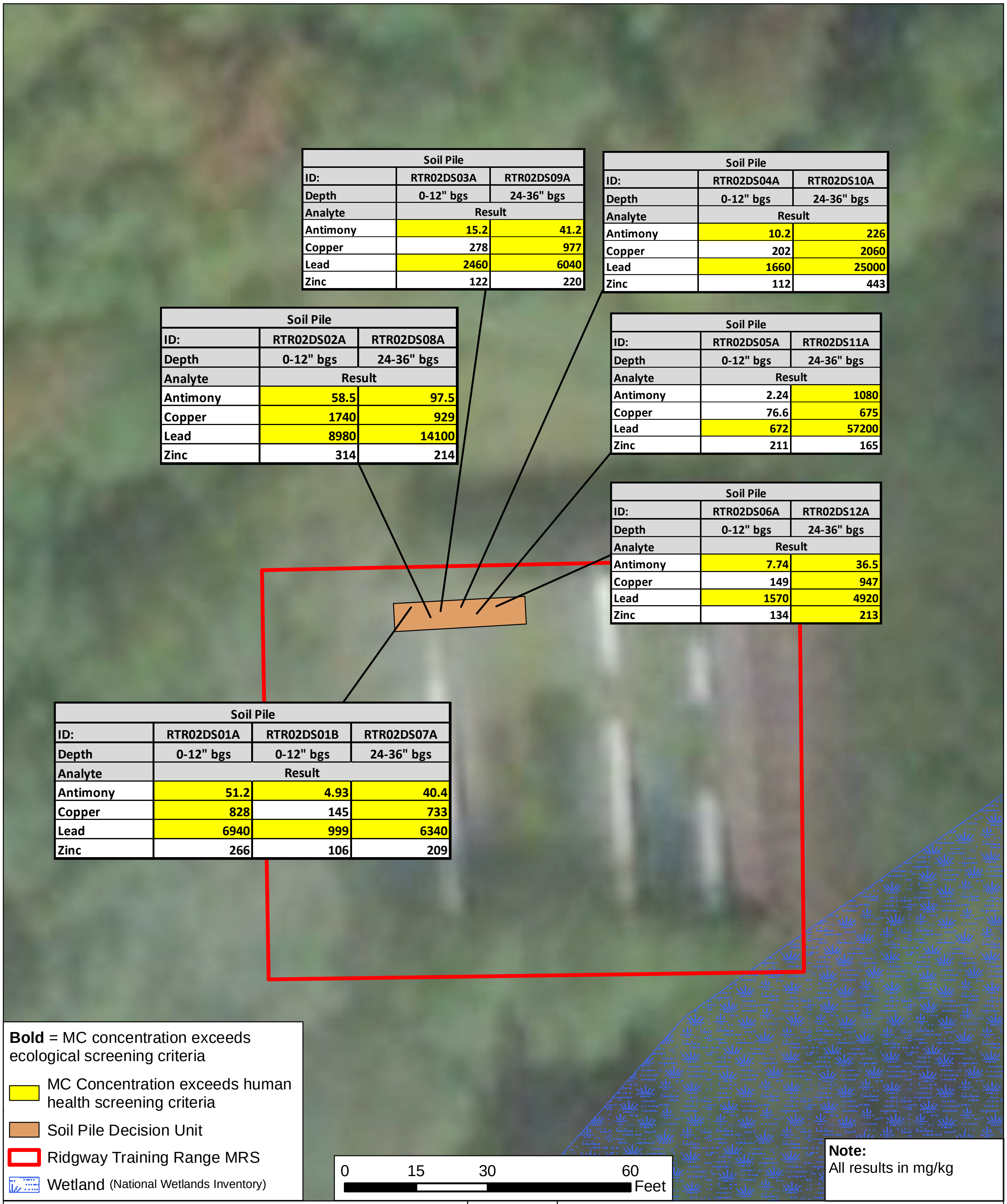

Soil Pile		
ID:	RTR02DS03A	RTR02DS09A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	15.2	41.2
Copper	278	977
Lead	2460	6040
Zinc	122	220

Soil Pile		
ID:	RTR02DS04A	RTR02DS10A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	10.2	226
Copper	202	2060
Lead	1660	25000
Zinc	112	443

Soil Pile		
ID:	RTR02DS02A	RTR02DS08A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	58.5	97.5
Copper	1740	929
Lead	8980	14100
Zinc	314	214

Soil Pile		
ID:	RTR02DS05A	RTR02DS11A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	2.24	1080
Copper	76.6	675
Lead	672	57200
Zinc	211	165

Soil Pile		
ID:	RTR02DS06A	RTR02DS12A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	7.74	36.5
Copper	149	947
Lead	1570	4920
Zinc	134	213

Soil Pile			
ID:	RTR02DS01A	RTR02DS01B	RTR02DS07A
Depth	0-12" bgs	0-12" bgs	24-36" bgs
Analyte	Result		
Antimony	51.2	4.93	40.4
Copper	828	145	733
Lead	6940	999	6340
Zinc	266	106	209

Bold = MC concentration exceeds ecological screening criteria

🟨 MC Concentration exceeds human health screening criteria

🟫 Soil Pile Decision Unit

🟥 Ridgway Training Range MRS

▨ Wetland (National Wetlands Inventory)

Note:
All results in mg/kg

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	10/16/2018
SCALE	1:360	CHK BY	AS	10/16/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	10/16/2018

N

Soil Pile Discrete Soil Sample Results

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Figure ES-3c

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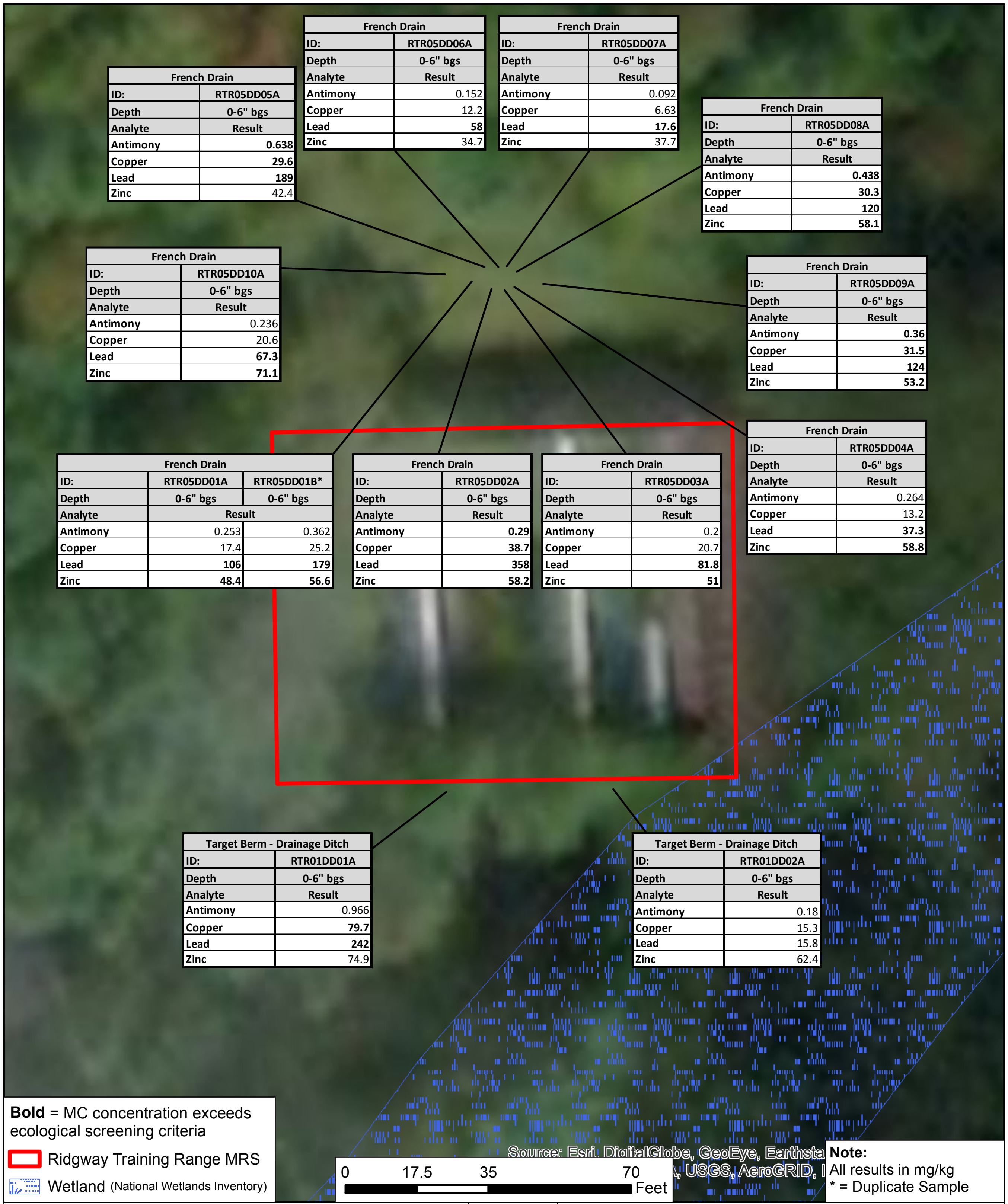

French Drain

ID:	RTR05DD06A
Depth	0-6" bgs
Analyte	Result
Antimony	0.152
Copper	12.2
Lead	**58**
Zinc	34.7

French Drain

ID:	RTR05DD07A
Depth	0-6" bgs
Analyte	Result
Antimony	0.092
Copper	6.63
Lead	**17.6**
Zinc	37.7

French Drain

ID:	RTR05DD05A
Depth	0-6" bgs
Analyte	Result
Antimony	**0.638**
Copper	**29.6**
Lead	**189**
Zinc	42.4

French Drain

ID:	RTR05DD08A
Depth	0-6" bgs
Analyte	Result
Antimony	**0.438**
Copper	**30.3**
Lead	**120**
Zinc	**58.1**

French Drain

ID:	RTR05DD10A
Depth	0-6" bgs
Analyte	Result
Antimony	0.236
Copper	20.6
Lead	**67.3**
Zinc	**71.1**

French Drain

ID:	RTR05DD09A
Depth	0-6" bgs
Analyte	Result
Antimony	**0.36**
Copper	**31.5**
Lead	**124**
Zinc	**53.2**

French Drain

ID:	RTR05DD01A	RTR05DD01B*
Depth	0-6" bgs	0-6" bgs
Analyte	Result	
Antimony	0.253	0.362
Copper	17.4	25.2
Lead	**106**	**179**
Zinc	**48.4**	**56.6**

French Drain

ID:	RTR05DD02A
Depth	0-6" bgs
Analyte	Result
Antimony	**0.29**
Copper	**38.7**
Lead	**358**
Zinc	**58.2**

French Drain

ID:	RTR05DD03A
Depth	0-6" bgs
Analyte	Result
Antimony	0.2
Copper	20.7
Lead	**81.8**
Zinc	**51**

French Drain

ID:	RTR05DD04A
Depth	0-6" bgs
Analyte	Result
Antimony	0.264
Copper	13.2
Lead	**37.3**
Zinc	**58.8**

Target Berm - Drainage Ditch

ID:	RTR01DD01A
Depth	0-6" bgs
Analyte	Result
Antimony	0.966
Copper	**79.7**
Lead	**242**
Zinc	74.9

Target Berm - Drainage Ditch

ID:	RTR01DD02A
Depth	0-6" bgs
Analyte	Result
Antimony	0.18
Copper	15.3
Lead	15.8
Zinc	62.4

Bold = MC concentration exceeds ecological screening criteria

🟥 Ridgway Training Range MRS

▨ Wetland (National Wetlands Inventory)

Source: Esri, DigitalGlobe, GeoEye, Earthsta..., USGS, AeroGRID, I...

Note:
All results in mg/kg
* = Duplicate Sample

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	11/1/2018
SCALE	1:420	CHK BY	JW	11/1/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	11/1/2018

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Discrete Sediment Sample Results

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Figure ES-4

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Table ES-1. Incremental Sampling Results Summary

		Location:	Background Reference											
		Sample ID:	RTR04IS01				RTR04IS02				RTR04IS03			
		Sample Depth (inches bgs):	0-6				0-6				0-6			
		Date Collected:	7/12/2018				7/12/2018				7/12/2018			
Analyte	**Human Health Screening Level**	**Ecological Screening Level**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)														
Antimony	3.1	0.27	0.244	N	J-	m	**0.682**		J-	m	**0.626**		J-	m
Copper	310	28	12		J	s	12.7		J	s	10.5		J	s
Lead	400	11	**59.2**	NA			**81.8**				**82.3**			
Zinc	2,300	46	33.2		J	m	33.5		J	m	23		J	m
Explosives by USEPA SW-846 Method 8330B (mg/kg)														
Nitroglycerin	0.63	13	0.460	ULMM	UJ	l	0.44	UL	UJ	l	0.38	U	UJ	s

		Location:	Target Berm											
		Sample ID:	RTR01IS01				RTR01IS02				RTR01IS03			
		Sample Depth (inches bgs):	0-6				0-6				0-6			
		Date Collected:	7/11/2018				7/11/2018				7/11/2018			
Analyte	**Human Health Screening Level**	**Ecological Screening Level**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)														
Antimony	3.1	0.27	**24.80**	NA	J-	m	**27**		J-	m	**40.1**		J-	m
Copper	310	28	**636**	N*EA	J	s	**481**		J	s	**612**		J	s
Lead	400	11	**5720**	NA			**6180**				**8770**			
Zinc	2,300	46	**158**	NEA	J	m	**149**		J	m	**165**		J	m

		Location:	Firing Point											
		Sample ID:	RTR03IS01				RTR03IS02				RTR03IS03			
		Sample Depth (inches bgs):	0-6				0-6				0-6			
		Date Collected:	7/12/2018				7/12/2018				7/12/2018			
Analyte	**Human Health Screening Level**	**Ecological Screening Level**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Explosives by USEPA SW-846 Method 8330B (mg/kg)														
Nitroglycerin	0.63	13	3.70	L	J	l	4.4	LMM	J	l	**21**	L	J	l

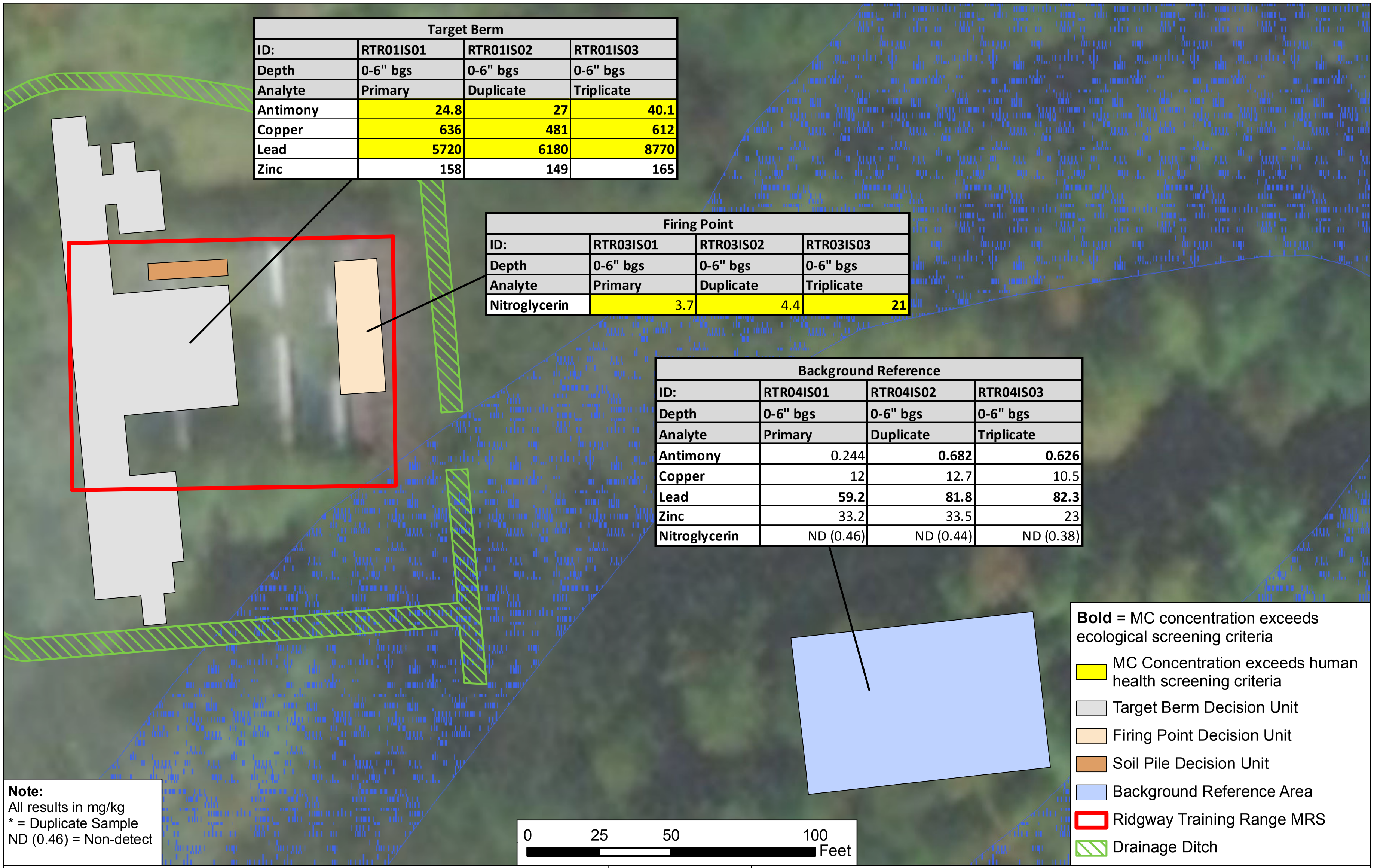
Notes:

Bold = Sample exceeds Ecological Screening Level
🟨 Sample exceeds Human Health Screening Level
bgs = below ground surface
LQ = Laboratory qualifier (LQ flags available in lab report)
VQ = Validiation qualifier
RC = Reason Code
U = non-detect
J = estimated
J- = estimated, negative bias
UJ= non-detect, estimated detection limit
l = LCS recovery failure
m = MS/MSD percent recovery anomaly
s = surrogate failure

Table ES-2. Human Health Risk Assessment Constituents of Concern for Soil

Receptor	Exposure Medium	Constituent of Concern
Target Berm DU		
Child Visitor	Surface Soil	Lead (a, b)
	Total Soil	Lead (a, b)
Outdoor Worker	Surface Soil	Lead (b)
	Total Soil	Lead (b)
Construction/Utility Worker	Surface Soil	Lead (b, c)
Hypothetical Child Resident	Surface Soil	Antimony Lead (b)
	Total Soil	Antimony Lead (b)
Soil Pile DU		
Child Visitor	Surface Soil	Lead (a, b)
	Total Soil	Antimony Lead (a, b)
Construction Worker (c)	Total Soil	Antimony Lead (b, c)
Utility Worker (c)	Total Soil	Lead (b, c)
Outdoor Worker	Surface Soil	Lead (b)
	Total Soil	Lead (b)
Hypothetical Child Resident	Surface Soil	Antimony Lead (b)
	Total Soil	Antimony Lead (b)
Hypothetical Adult Resident	Total Soil	Antimony
Firing Point DU		
Hypothetical Child Resident	Surface Soil	Nitroglycerin

Notes:
(a) IEUBK model results for the hypothetical child resident were also used to be protective of the child visitor at the MRS.
(b) Lead modeling results are based on target PbB threshold of 10 micrograms per deciliter (µg/dL).
(c) If a target PbB threshold of 5 µg/dL was used, then lead would be identified as a surface soil and total soil COC for the construction and utility worker scenarios.



Target Berm			
ID:	RTR01IS01	RTR01IS02	RTR01IS03
Depth	0-6" bgs	0-6" bgs	0-6" bgs
Analyte	Primary	Duplicate	Triplicate
Antimony	**24.8**	**27**	**40.1**
Copper	**636**	**481**	**612**
Lead	**5720**	**6180**	**8770**
Zinc	158	149	165

Firing Point			
ID:	RTR03IS01	RTR03IS02	RTR03IS03
Depth	0-6" bgs	0-6" bgs	0-6" bgs
Analyte	Primary	Duplicate	Triplicate
Nitroglycerin	3.7	4.4	**21**

Background Reference			
ID:	RTR04IS01	RTR04IS02	RTR04IS03
Depth	0-6" bgs	0-6" bgs	0-6" bgs
Analyte	Primary	Duplicate	Triplicate
Antimony	0.244	**0.682**	**0.626**
Copper	12	12.7	10.5
Lead	**59.2**	**81.8**	**82.3**
Zinc	33.2	33.5	23
Nitroglycerin	ND (0.46)	ND (0.44)	ND (0.38)

Note:
All results in mg/kg
* = Duplicate Sample
ND (0.46) = Non-detect

Bold = MC concentration exceeds ecological screening criteria

- 🟨 MC Concentration exceeds human health screening criteria
- ⬜ Target Berm Decision Unit
- ⬜ Firing Point Decision Unit
- 🟧 Soil Pile Decision Unit
- 🟦 Background Reference Area
- 🟥 Ridgway Training Range MRS
- ▨ Drainage Ditch

CLIENT	Army National Guard			
PROJECT	Remedial Investigation through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	11/8/2018
SCALE	1:600	CHK BY	JW	11/8/2018
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	11/8/2018

Ridgway ISM Results

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ARMY NATIONAL GUARD

Figure ES-5

1 Introduction

This Remedial Investigation (RI) report has been prepared in support of the long-term management of the Non-Department of Defense, Non-Operational Defense Site (NDNODS) Ridgway Training Range Munitions Response Site (MRS; Army Environmental Database Restoration Number PAE40-001-R-01), located in Pennsylvania (PA) (**Figure 1-1**).

1.1 Project Authorization

Based on the results of a Site Investigation (SI) (Parsons, 2012), the Army National Guard (ARNG) determined an RI should be conducted at this NDNODS MRS in Pennsylvania under the Military Munitions Response Program (MMRP) Munitions Response Services. The RI is being performed pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986.

Environmental work is being conducted at the MRS by the ARNG Directorate and the PAARNG. This project is being executed by AECOM Technical Services, Inc. (AECOM), under ARNG Contract Number W9133L-14-D-0001, Delivery Order No. 0006, issued 29 September 2016. Under this delivery order, AECOM is responsible for fully executing the RI and related tasks at the Ridgway Training Range MRS.

1.2 Project Purpose and Scope

The overall objectives for the RI of Ridgway Training Range was to collect sufficient information to characterize the nature and extent of munitions constituents (MC) in soil resulting from former PAARNG small arms training activities and to evaluate the associated risks to human health and the environment. The Ridgway Training Range MRS was investigated using several sampling techniques to achieve the project objectives that were specified in the Final RI Work Plan prepared for the Ridgway Training Range (AECOM, 2017).

Soil sampling was performed using incremental and discrete sampling methods in accordance with the RI Work Plan. The information collected during the RI was also used to complete the Munitions Response Site Prioritization Protocol (MRSPP) tables for the MRS to assess the need to evaluate remedial alternatives in an FS and support informed risk management decisions for future remedial decisions.

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	5/30/2017
SCALE	1:126,720	CHK BY	AS	5/30/2017
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	5/30/2017

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Ridgway Training Range MRS Location Map

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Figure 1-1

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1.3 Remedial Investigation Report Organization

Brief descriptions of the document sections and appendices are as follows:

Section 1: Introduction. Describes the authorization, project purpose and scope, and presents the report organization.

Section 2: MRS Description. Presents the MRS background, historical use, and environmental setting; summarizes previous MRS investigations relevant to the RI; and describes current and future land use.

Section 3: Field Investigation Activities. Describes the methodology and procedures followed for the RI field activities.

Section 4: Data Quality Assessment. Discusses the field collection methods and the laboratory analytical techniques for soil samples to determine data usability.

Section 5: Remedial investigation Results. Presents the soil sampling results for the RI.

Section 6: Contaminant Fate and Transport. Discusses migration and contaminant persistence for MC at the MRS.

Section 7: Risk Assessment. Presents the evaluation of the potential of MC to pose a risk to human or ecological receptors.

Section 8: Munitions Response Site Prioritization Protocol. Summarizes the results of the MRSPP modules and score for the MRS.

Section 9: Summary and Conclusions. Provides an overview of the findings of the RI for the MRS.

Section 10: References. Provides the references used to develop this document.

Appendix A: Field Forms

Appendix B: Photographic Record

Appendix C: Data Validation Report

Appendix D: Laboratory Data Analytical Package (on CD)

Appendix E: MRSPP Tables

Appendix F: Human Health Risk Assessment

Appendix G: Screening Level Ecological Risk Assessment

2 Munitions Response Site Description

2.1 Location and Setting

The Ridgway Training Range MRS is a 0.22-acre site located in Ridgeway Township, PA, on the west side of Grant Road, approximately 2 miles northwest of Ridgway Borough and 5 miles southwest of Johnsonburg in Elk County, PA. It is surrounded by the 8-acre former Ridgway Weekend Training Site.

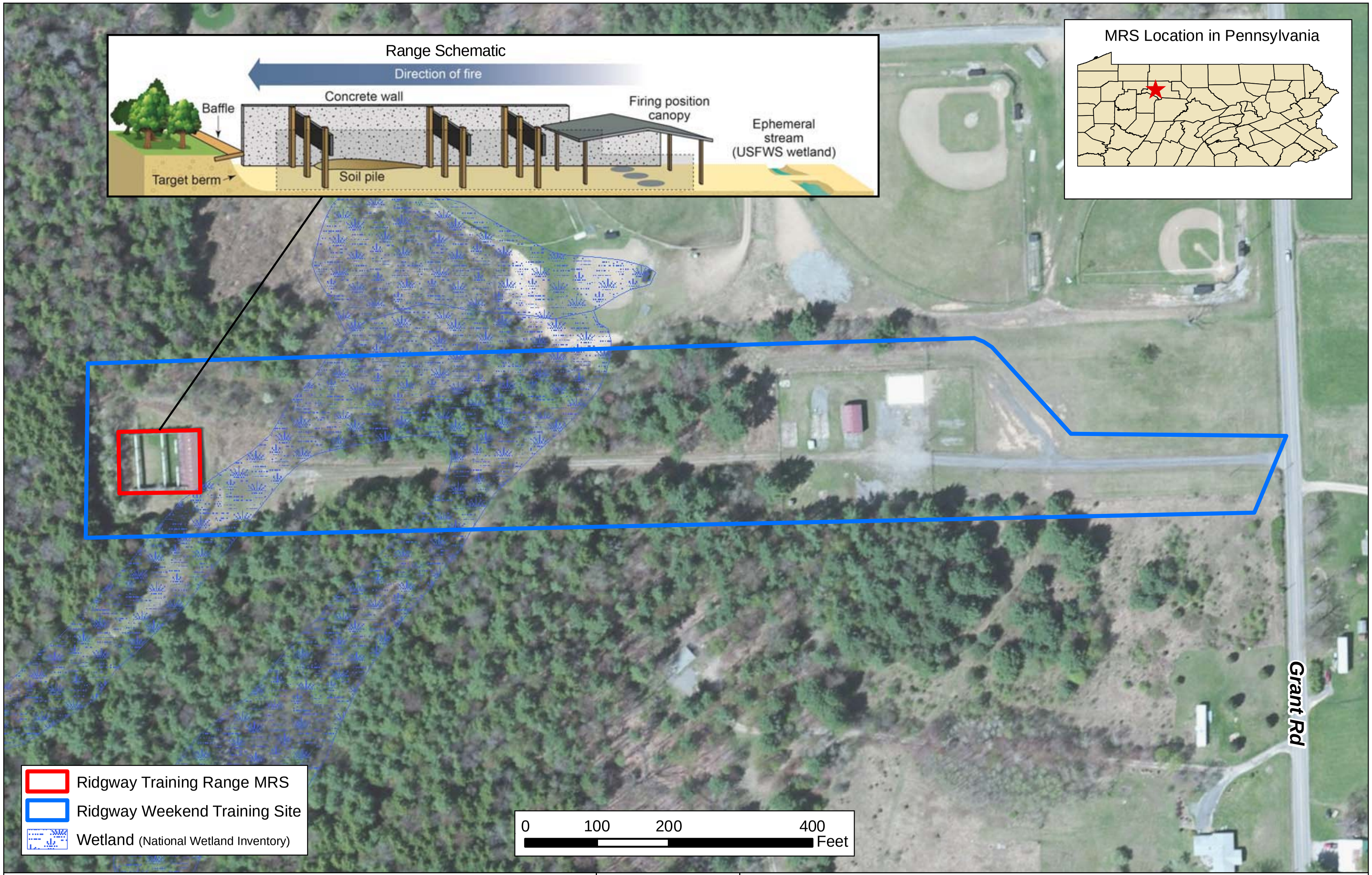
The area surrounding the MRS is predominantly rural; the properties surrounding the MRS include agricultural, mining, residential, and recreational land (Parsons, 2012). Allegheny National Forest borders the western edge of the MRS, with various coniferous trees and some deciduous trees, the most common being birch. A community baseball/athletic field abuts the northern edge of the property. The range is primarily covered in grass, other vegetation, and the structures associated with the former baffled small-arms range. The MRS is located on privately owned property, and access to the range is restricted from public access by a locked gate on two sides of the MRS. The Ridgway Rifle Club, a privately-owned gun club, is located approximately 0.83 miles south of the MRS. The Firing Point at the Ridgway Rifle Club faces west-northwest. Based on the distance from the MRS and the location of and trajectory from firing points, it is not expected that the Ridgway Rifle Club activities would contribute any munitions debris or constituents to the MRS (**Figure 2-1**).

According to the 2012 SI report (Parsons, 2012), PAARNG documentation indicates that the range was constructed in 1987 as a small-arms range with sheltered firing points and a baffle system to control ricochet firing activities. Observations made during the 2012 SI confirmed that the range is a baffled outdoor range that has 15-foot concrete walls on the northern and southern edges of the range. The eastern portion of the MRS contains 12 sheltered firing positions covered by a metal roof; an 8-foot earthen berm is located on the western edge of the MRS. Above the earthen berm is a horizontal wooden baffle supported by large beams installed into the hillside. Within the range, three vertical wooden baffle walls are suspended from the top of the concrete sidewalls and hang down into the range floor area to prevent stray bullets from leaving the range (**Figure 2-1 inset**).

2.2 Historical Use

The NDNODS Ridgway Training Range MRS was used by the PAARNG for small-arms, live-fire weapons training from 1987 to 2005 (Parsons, 2012). Munitions use documentation was not found during the SI, but based on range type, timeframe of range use, and location, AECOM surmised that the following munitions were fired: .22 caliber, .38 caliber, .45 caliber, .50 caliber, 9 millimeter (mm), 5.56mm, and 7.62mm. In 1989, a temporary waiver was granted for one-time firing of 7.62mm machine gun rounds. The extent of the usage is unknown but is expected to be minimal (Earth Resources Technology, 2008).

Live-fire training occurred within the mostly enclosed 25-meter outdoor baffled M-16 rifle range. From 1987 to 1990, the range was used approximately four to five times a year;



CLIENT	Army National Guard			
PROJECT	Remedial Investigation through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	5/30/2017
SCALE	1:2,400	CHK BY	AS	5/30/2017
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community		PM	RG	5/30/2017

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TITLE

Ridgway Training Range MRS Layout

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Figure 2-1

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range use from 1990 to 2001 is unknown. From 2001 to 2005, the range was used approximately two to three times per year. During that period, AECOM estimated that approximately 64,000 small-caliber rounds were expended at the range. The range was last used in November 2005, and small-arms training was discontinued in March of the following year because it no longer met ARNG requirements (PADMVA, 2011). Request for formal closure occurred on 9 September 2011.

The property was originally purchased by the Commonwealth of Pennsylvania from private owners on 26 September 1969 (PADMVA, 2011). A formal request for closure of the range was requested on 9 September 2011. The property was approved for conveyance from the Commonwealth of Pennsylvania (with approval from the Pennsylvania Department of Military and Veterans Affairs [PADMVA]) through Act 56 of 2013 (House Bill 1112). Transfer of the property to a private owner was completed in 2015.

The MRS is currently used as a staging area for equipment associated with a private landscaping company owned by the property owner. To improve drainage in front of the Target Berm at the MRS, the landowner installed a French drain parallel to the berm. In doing so, the top 12 to 18 inches of soil from the foot of the Target Berm were removed and stored in a pile near the north sidewall. The approximate dimensions of the elliptical Soil Pile are 9 feet (ft) wide by 26 ft long by 3 ft high. The approximate conservative volume of the pile is 551 cubic ft of soil. Since the current landowner has owned the property, the range has been used with homemade small arms ammunition, distinct from historic use, which were fired into a trap. This use has stopped and will not occur again until this site is closed under MMRP.

2.3 Environmental Setting

The MRS is located within a fragmented forest that is surrounded on all sides by Ridgway Weekend Training Site (**Figure 2-1**). The area surrounding the MRS is predominantly rural; the properties surrounding the MRS include agricultural, mining, residential, and recreational land (Parsons, 2012). Allegheny National Forest is in close proximity to the western edge of the MRS, with various coniferous trees and some deciduous trees, the most common being birch. A community baseball/athletic field is north of the property. The range is primarily covered in grass, other vegetation, and the structures associated with the former baffled small-arms range.

2.3.1 Climate

The average maximum temperature ranges from 80 degrees Fahrenheit (°F) in July to 32°F in January. The average minimum temperature ranges from 54°F in July to 14°F in January. The average annual rainfall is 44.1 inches, and average annual snowfall is 48 inches. Average precipitation ranges from 4.84 inches in July to 2.4 inches in February (U.S. Climate Data, 2017).

2.3.2 Geology

The MRS is located in the High Plateau section of the Appalachian Plateaus Physiographic Province. The bedrock in the area of the NDNODS Ridgway Training Range MRS consists entirely of sedimentary rocks of Devonian, Mississippian, and Pennsylvanian age, with lithologies ranging from sandstone and conglomerate to shale, coal, and limestone. The site is underlain by the Pennsylvanian Pottsville Formation, predominantly a gray sandstone and conglomerate. The rocks are gently folded, and the site lies less than two miles to the southeast of the axis of the northeast-trending Johnson Run Syncline. The rock strata dip slightly to the northwest of the site (PADMVA, 2011).

2.3.3 Surface Topography

Elk County lies within the Appalachian Plateaus Physiographic Province, and the NDNODS Ridgway Training Range MRS lies within the High Plateau Section of the province. Broad, rounded to flat uplands and deep angular valleys characterize the section. The Ridgway Training Range MRS is located on the western edge of one such upland, and Big Mill Creek lies within the valley immediately to the west of the MRS. The site is essentially flat and at an elevation of approximately 1,680 feet above mean sea level. The site drains toward the southwest (PADMVA, 2011).

2.3.4 Hydrogeology and Hydrology

Principal aquifers are permeable sandstones of the Pennsylvanian age Pottsville Formation. Groundwater recharge is from precipitation that infiltrates to weathered bedrock and fractures in un-weathered bedrock. Groundwater flows vertically through fractures and laterally through permeable sandstone. Typical yields from wells range from 30 to 300 gallons per minute (Trapp and Horn, 1997).

As reported in the 2011 Environmental Baseline Survey (EBS), existing boring logs from wells in the area show depths to bedrock varying from 10 to 33 feet below ground surface (bgs). The static groundwater level in a former on-site well (now permanently sealed) was approximately 30 feet bgs as indicated on the driller’s log. Static groundwater level data from two other wells located north of the range indicate a potentiometric surface sloping to the south, although there is likely a component of groundwater movement to the west, topographically. Groundwater is likely to emerge at the surface along Big Mill Creek, west of the site. Although there are approximately 40 domestic wells within 4 miles of the site, there are no recorded wells downgradient between the site and Big Mill Creek (PADMVA, 2011).

The MRS lies within the Big Mill Creek watershed. Surface water flows southwest off the MRS to Big Mill Creek located in the valley to the west. The EBS reports that any water flowing from the MRS’s berm that can leave the MRS would follow this path to Big Mill Creek (PADMVA, 2011). A surface water feature is located on site approximately 30 ft east of the MRS and flows north to south (per PADMVA, as part of development of the EBS). The surface water feature is a freshwater forested/shrub wetland encompassing approximately 8.73 acres.

The landowner installed a French drain at the base of the berm to assist with drainage at the MRS. The drain daylights about 30 feet north of the north-side wall. During the RI site visit, ponded water was observed at this location. AECOM expects that this water will slowly drain back into the ground. Because water at the MRS tends to drain in a southwesterly direction, any overland flow from this area would drain in the same manner as the rest of the MRS.

2.3.5 Vegetation and Habitat

There are nine terrestrial ecoregions that describe the differing geological and biological communities of Pennsylvania (USEPA, 2010). Some of the features of these ecoregions are unique to the northeastern United States because the landscape is composed of plateau remnants, steep ridges, rounded hills, low mountains, heavily-wooded terrain, and narrow and fertile valleys. The elevations of these ecoregions range from 500 to 4,300 feet. Vegetation communities among these ecoregions include oak (Quercus spp.), hickory (Carya spp.), walnut (Juglans spp.), elms (Ulmus spp.), birches (Betula spp.), ash (Fraxinus spp.), basswood (Tilia spp.), maple (Acer spp.), locust (Robinia spp.), and pine (Pinus spp.) mixed forests (USEPA, 1999). This MRS is found in the Western Allegheny Plateau ecoregion (USEPA, 2010); however, no trees exist within the walled MRS.

Natural wetlands, those that are not impounded or diked, occur in the vicinity of the Ridgway Training Range. A portion of these wetlands falls within the southeast corner of the MRS:

- PFO1 / EM1A – Palustrine, forested and emergent persistent, temporarily flooded
- PEM1A – Palustrine, emergent and persistent, temporarily flooded (USFWS, 2017)

There is no federally designated critical habitat located within the site (USFWS, 2017). However, habitat supporting ecological receptors is present within the MRS. A very small portion of a wetland is present within the MRS.

2.3.6 Ecological Receptors

There is no federally designated critical habitat located within the Ridgway Training Range MRS boundary. Rabbitsfoot (*Quadrula cylindrica cylindrical*) and Northern Long-Eared Bat (*Myotis septentrionalis*) are federally listed threatened species that are listed wherever found, and have the potential to occur in Elk County, Pennsylvania (USFWS, 2018). Rabbitsfoot primarily inhabit small to medium sized streams and some larger rivers, and as such, are highly unlikely to be found within the MRS. Given the limited size of the MRS, it is unlikely that the Northern Long-Eared Bat would be found within the MRS.

2.3.7 Cultural Resources

According to the National Heritage Areas Program, the National Historic Landmarks Program, the National Register of Historic Districts, and the National Register of Historic Places, no nationally-recognized cultural or archaeological resources are listed within the MRS boundary (National Park Service [NPS], 2018).

2.4 Previous Investigations

Prior to official site closure in 2011, a Phase I Qualitative Assessment Report was completed as draft final under the Operational Range Assessment Program in 2007 for the Ridgway Training Range. Based on a review of available documents and observations made during a site visit, the Phase I Assessment recommended that the Ridgway Training Range be carried forward to a Phase II Quantitative Assessment. However, it was officially closed in 2011 and became eligible under the NDNODS MMRP. Two environmental investigations have been completed at Ridgway Training Range since official closure of the MRS in 2011. These include:

- *Ridgway Weekend Training Site & Range, Environmental Baseline Survey Report (PADMVA, 2011)*
- *Final Pennsylvania Site Inspection Report, ARNG MMRP (Parsons, 2012)*

The SI approach included both visual survey and biased soil sampling for MC to evaluate the potential presence of munitions. Parsons performed a 0.66-mile magnetometer-assisted visual survey, collected biased composite and discrete surface soil samples, and collected sediment and surface water samples as part of the 2012 SI. A single .45 caliber bullet and a single 5.56mm casing were observed within the MRS. Slight depressions on the berm were also observed to be especially saturated with subsurface anomalies across from the firing points.

Eight soil samples were collected from the firing line, berm, and ambient areas outside of the MRS; two surface water and two sediment samples were collected from an upstream location as well as a downstream location at the confluence of two on-site creeks. Samples were analyzed for small arms metals (antimony, copper, lead, and zinc) and nitroglycerin. Both lead and antimony concentrations exceeded the human health criteria (PADEP Medium Specific Concentrations [MSCs]) at all seven berm sample locations, while copper exceeded its MSC at two berm sample locations. Nitroglycerin was also detected slightly above its MSC at the firing point. There were no MC detections (metals or explosives) in surface water samples. In sediment, no explosives were detected, small arms MC were all detected below screening criteria, and downstream concentrations were equal to or less than the upstream concentrations.

No historical evidence of munitions and explosives of concern (MEC) has been documented or found at the site. It was determined during the SI that no explosive hazards are present at the MRS. As a result of the baseline survey and SI, the size and shape of the MRS were revised. The revised Ridgway Training Range MRS includes the firing points, Target Berm, and range floor in between (0.22 acres). This MRS (AEDB-R No. PAE40-001-R-01) was recommended to be carried forward to RI/ FS and is the focus of this Work Plan.

2.5 Current and Future Land Use

The surrounding Ridgway Weekend Training Site (WETS) is currently used as a staging area for equipment associated with a private landscaping company owned by the property owner. The area within the MRS concrete walls is currently unused. Since the current landowner has owned the property, the range has been used with homemade small arms ammunition, distinct from historic use, which were fired into a trap. This use has stopped and will not occur again until this project concludes. Future land use is unlikely to significantly change.

2.6 Preliminary Conceptual Site Model

The preliminary conceptual site model (CSM) was generated based on the information and findings presented in the 2012 SI, environmental baseline survey report, and site visit. The CSM describes the potential physical, chemical, and biological processes that may transport contaminants from sources to receptors and provides the basis for evaluating potential risks to human health and the environment.

MC Sources

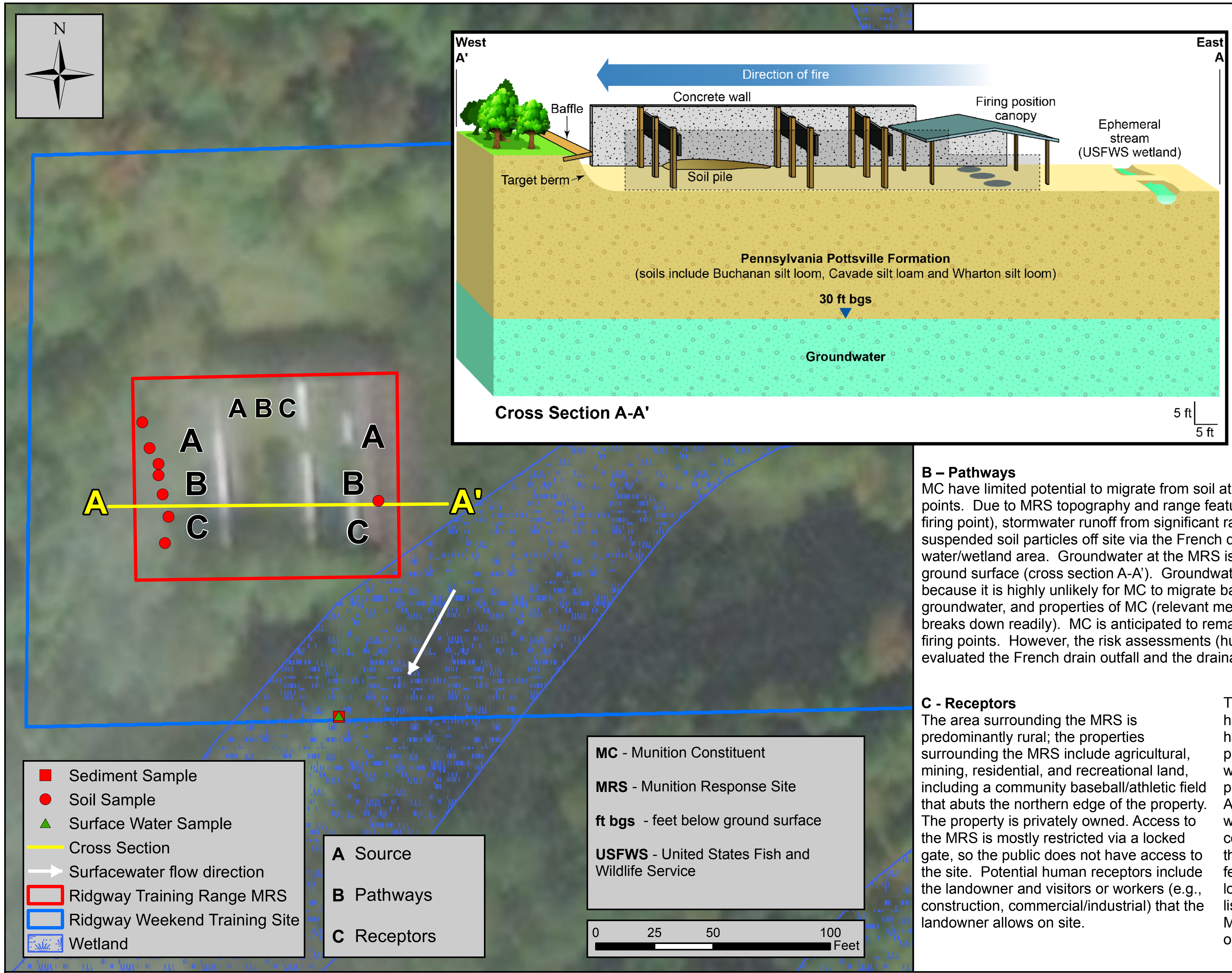
Based on a review of the historical records available, former munitions-related training was limited to small arms (rifles and potentially pistols) at the Ridgway Training Range MRS. The MRS includes a 25-meter outdoor baffled M-16 rifle range with a soil Target Berm. Firing at the former range occurred in a western direction toward the soil Target Berm from the covered Firing Point.

Documentation specifying the exact munitions used at the MRS is unavailable; however, based on range type, timeframe of range use, and location, .22 caliber, .38 caliber, .45 caliber, .50 caliber, 9mm, 5.56mm, and 7.62mm may have been fired (Parsons, 2012). Potential MC from small arms projectiles present within berm soil includes primarily lead and secondarily antimony, copper, and zinc. Nitroglycerin was considered a potential MC at the Firing Point, where it was sampled for and slightly exceeded human health screening criterion during the 2012 SI. MC contamination was also confirmed in surface soil at the Target Berm at concentrations above human health screening criteria during the 2012 SI. No soil samples were taken at the Soil Pile near the northern wall during the same study, as it did not exist at that time.

Pathways

MC deposited in surface soil as a result of firing activities at the MRS has limited potential to migrate from source areas (i.e., Target Berm, Soil Pile, Firing Point). Due to MRS topography and range orientation and the enclosing wall structures, stormwater runoff from significant rain events is unlikely to transport suspended soil particles off site or to wetlands that bisect the southeast corner of the MRS. Dislodged soil particles from the berm are likely to remain at the base of the berm where the gravel area and drain were installed. The gravel increases the infiltration at the base of the berm, increasing deposition in this area. These assumptions were confirmed with surface water and sediment samples collected during the SI and with a visual inspection during the April 2017 site visit with stakeholders. Stormwater runoff from the MRS flows southwest but is mostly encumbered by the concrete range walls. Some erosion was observed during the site visit on the Target Berm where vegetation is sparse, but the MRS walls make MC transport via runoff unlikely. The French drain that was installed post-PAARNG use of the MRS promotes infiltration at the base of berm. The drain daylights north of the MRS where a small ponded area detains excess water and allows for ground infiltration. The water coming off the Target Berm is in short contact time with the soil, so particulates are unlikely to be present at this ponded area; however, the area is considered a potential source area.

Figure 2-2 presents a pictorial diagram of the site including the overland flow direction of stormwater. Transport pathways from soil berms to surface water bodies are incomplete.



MC - Munition Constituent

MRS - Munition Response Site

ft bgs - feet below ground surface

USFWS - United States Fish and Wildlife Service

A Source

B Pathways

C Receptors

Target Berm

A – Sources
Metals MC at the target berm and soil pile as well as nitroglycerin at the firing points as a result of historical small arms training.

Firing Point

B – Pathways
MC have limited potential to migrate from soil at the target berm, soil pile, and firing points. Due to MRS topography and range features (e.g., walled-in MRS, covered firing point), stormwater runoff from significant rain events is unlikely to transport suspended soil particles off site via the French drain outfall or to the nearby surface water/wetland area. Groundwater at the MRS is approximately 30 feet below ground surface (cross section A-A'). Groundwater pathways are incomplete because it is highly unlikely for MC to migrate based on soil type, depth to groundwater, and properties of MC (relevant metals do not migrate far, nitroglycerin breaks down readily). MC is anticipated to remain at the target berm, soil pile, and firing points. However, the risk assessments (human and ecological) have also evaluated the French drain outfall and the drainage area near the target berm.

C - Receptors
The area surrounding the MRS is predominantly rural; the properties surrounding the MRS include agricultural, mining, residential, and recreational land, including a community baseball/athletic field that abuts the northern edge of the property. The property is privately owned. Access to the MRS is mostly restricted via a locked gate, so the public does not have access to the site. Potential human receptors include the landowner and visitors or workers (e.g., construction, commercial/industrial) that the landowner allows on site.

There is no federally-designated critical habitat located within the site. However, habitat supporting ecological receptors is present within the MRS. A tiny portion of a wetland is present within the MRS that could provide habitat for aquatic species. Allegheny National forest borders the western edge of the MRS, with various coniferous trees and some deciduous trees, the most common being birch. Although no federally-designated critical habitat is located within the MRS, there are state-listed endangered species in Pennsylvania. Many of these species will not be found on or near the MRS.

Soil Pile

AECOM
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Figure 2-2
Conceptual Site Model
Ridgway Training Range, Pennsylvania

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Date....................November 2018
Prepared by....................AECOM

Small arms MC have a strong affinity to sorb to soil particles, particularly soils that are rich in organic matter and usually only migrate via physical transport pathways. Because of these chemical properties, they typically do not leach to groundwater except where shallow groundwater exists less than 5 feet bgs. According to Pennsylvania Department of Military and Veterans Affairs (PADMV) data presented in the 2011 EBS, groundwater at the MRS is approximately 30 feet bgs (Cross Section AA' of **Figure 2-2**). Surface water bodies at the MRS do not appear to be groundwater-fed. Therefore, groundwater pathways are incomplete for the Ridgway Training Range MRS.

MC within soil at the MRS is anticipated to remain at the Target Berm, Firing Point, and Soil Pile and not be transported off site. Exposure pathways between MC and receptors are restricted to source areas, which is potentially the soil at the Target Berm, the Firing Point, and the Soil Pile. There is a possibility that particulates from the berm are being transported, via the French drain, to the ponded area to the north of the MRS. Since the drain discharges to a ponded area, it is expected that they would settle in the small detention pond and receptors would only potentially be exposed to sediment in this area.

Receptors

The area surrounding the MRS is predominantly rural; the properties surrounding the MRS include agricultural, mining, residential, and recreational land (Parsons, 2012) (**Figure 2-1**). A community baseball/athletic is north of the property. The property is privately owned and is used as a staging area by a landscaping company. Future use is planned to be the same. Access to the MRS is mostly restricted via a locked gate, so the public does not have access to the site. Potential human receptors include the landowner and visitors or workers (e.g., construction, commercial/industrial) that the landowner allows on site. As there is no restriction on the land, there is potential that the site could be used for residential purposes in the future.

There is no federally designated critical habitat located within the site (USFWS, 2018). However, habitat supporting ecological receptors is present within the MRS. A portion of a wetland is present within the MRS that could provide habitat for aquatic species. Allegheny National Forest borders the western edge of the MRS, with various coniferous trees and some deciduous trees, the most common being birch. Although no federally designated critical habitat is located within the MRS, the species in the following table are listed as State-endangered species. None of these species are known to be present on or near the MRS. However, based on preferred habitat, there is a low likelihood that some could be present. Preferred habitat is listed in the table to help determine the likelihood of each species being present.

Table 2-1. Pennsylvania State-endangered Species

Species	Preferred Habitat/Location in Pennsylvania
American Bittern	Marshes/wetlands
Least Shrew	Prefer non-forested habitat/grassland habitat found mostly in the southern tier counties in the central and eastern part of the State
Black-crowned Night-Heron	Primarily by rivers and creeks, nesting on forested islands or along wooded streams. Largest distribution in Pennsylvania in the southeastern part of the State.

Species	Preferred Habitat/Location in Pennsylvania
Loggerhead Shrike	Prefer short grass pastures with scattered shrubs/trees for nesting and interspersed perching locations for hunting
Blackpoll Warbler	North America's boreal conifer forest. In Pennsylvania, found in and adjacent to isolated forested wetlands dominated by red spruce and eastern hemlock.
Northern Flying Squirrel	Prefer old-growth, boreal forests that contain a heavy coniferous component, moist soils, and lots of downed, woody debris
Black Tern	Leave winter coastal areas for inland prairies and more extensive deep-water marshes or marsh complexes with extensive cattail beds
Peregrine Falcon	Typically found nesting on bridges and tall buildings within cities and cliffs and other open spaces with expansive views.
Common Tern	Nesting habitat is restricted to sandy shorelines and barren islands of large lakes
Sedge Wren	For nesting, require damp meadows or marshes where sedges and grasses are interspersed with small shrubs
Delmarva Fox Squirrel (also federally listed)	Prefer open stands of forests with little understory, often associated with agricultural fields. Most likely found on sites with larger trees, a low percentage of shrubby ground cover, and lower understory density. Reintroduced in southeastern Pennsylvania, where suitable habitat was present.
Short-eared Owl	Inhabit reclaimed strip mines, open, uncut grassy fields, large meadows, airports, and occasionally marshland
Dickcissel	During migration, dickcissels may be found in grassy fields, but most often at bird feeding stations. During the breeding season, they inhabit large grassy fields, such as hayfields or strip-mines recently reclaimed with grass. In winter, dickcissels are found at bird feeding stations near shrubs, thickets or hedgerows. They are fond of alfalfa fields.
Upland Sandpiper	Prefer open areas and short-grass prairies. May be found in large fallow fields, pastures, and grassy areas (greater than 250 acres) with a variety of grasses (shorter and taller).
Great Egret	Typically found feeding in shallow rivers, streams, ponds, lakes, and marshes. Nests are found in adjacent trees or shrubby growth, preferably on islands.
Yellow-bellied Flycatcher	Found in shady coniferous forests and forested wetlands at higher elevations. In Pennsylvania, nests have been found in mossy, poorly drained areas (swamps, bogs, and old beaver ponds) surrounded by extensive northern hardwood forests.
Indiana Bat (also federally listed)	Hibernation sites have stringent requirements, including noticeable airflow and the lowest non-freezing temperatures possible. Sites also usually have some standing or flowing water. Roosts primarily in trees and within ¾ mile of water.
Yellow-crowned Night-Heron	Primarily feeds along small, shallow streams. Nests in brush or trees, usually sycamores, found on islands or along streams. Most nests in recent years are along the Susquehanna River and its tributaries in suburban and urban areas of Cumberland and Dauphin Counties.

Species	Preferred Habitat/Location in Pennsylvania
King Rail	Lives in freshwater and brackish marches, marshy fields, and roadside ditches in eastern North America, primarily along the Atlantic coast. It is a very rare breeder in the few larger marshes remaining in Pennsylvania.
Piping Plover (also federally listed)	Nest on wide, sand to cobble beaches with little vegetation and a long distance to the tree line. The only breeding habitat for piping plovers in Pennsylvania is along the shoreline of Lake Erie at Presque Isle State Park.
Least Bittern	Thrive in dense marshland ecosystems containing cattails and reeds, along the coast and inland, where they feed primarily on small fish, amphibians, insects, and small mammals.

Some preferential habitat quality exists in the areas surrounding the MRS (e.g. wetlands), and ecological receptors are anticipated to be minimally exposed to MC within the MRS or in surrounding areas.

3 Field Investigation Activities

Soil and sediment samples for MC analysis were collected, identified, handled, and documented following the procedures detailed in the *Final Remedial Investigation Work Plan and Unified Federal Policy - Quality Assurance Project Plan* (UFP-QAPP; AECOM, 2017). The sampling approach of the RI was designed to characterize the nature and extent of MC contamination in soil and sediment in areas associated with historical small arms training activities conducted at Ridgway Training Range. The SI (Parsons, 2012) indicated that the groundwater exposure pathway was incomplete for human and ecological receptors due to the depth to groundwater and chemical properties of MC; therefore, groundwater was not sampled during the RI. The sampling design rationale for the MRS was based on historical use, range layout, previous sampling results, and the preliminary CSM. Field forms and a photo log are presented in **Appendix A** and **Appendix B,** respectively).

3.1 Soil and Sediment Sampling Methodology

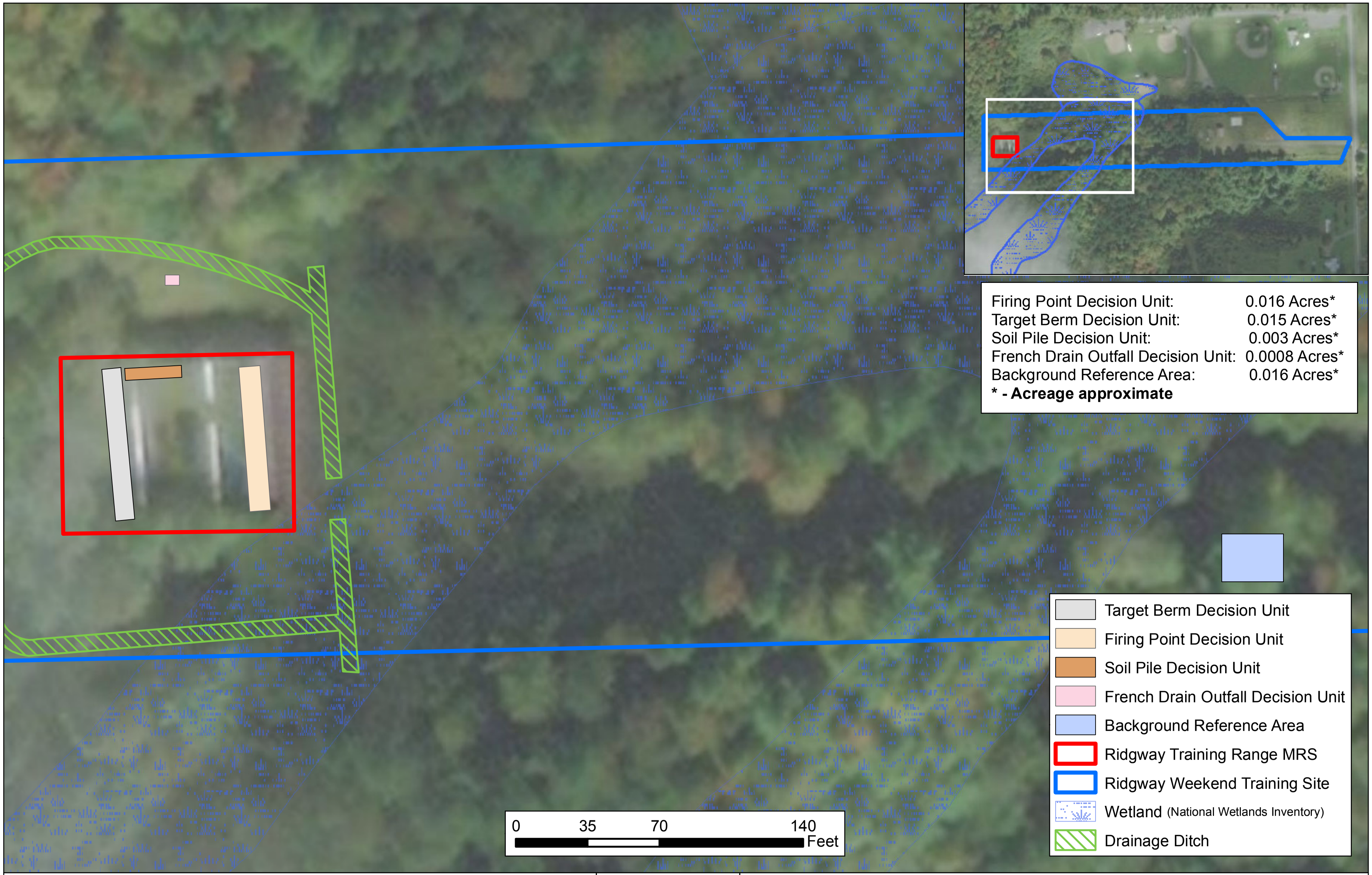
Based on the findings of the SI and site history, the Target Berm (0.015 acres), Firing Point (0.016 acres), Soil Pile (0.003 acres), and French Drain Outfall (0.0008 acres) were identified as individual DUs. **Figure 3-1** presents the location of each initial DU. **Table 3-1** summarizes the analytical samples collected.

A phased approach was used that included assessing the extent of MC contamination in the field using XRF analysis of discrete samples at the Target Berm. The extent of MC established the final size of the Target Berm DU. XRF analysis was not performed at the Firing Point DU because XRF is not a suitable tool for screening nitroglycerin. Soil samples from the Target Berm and Firing Point DUs were collected using an ISM approach because this method provides data useable in assessing risks. Discrete subsurface soil samples were also collected at select locations at the Target Berm and Firing Point. ISM was not used at the French Drain Outfall and Soil Pile DUs due to the small size of the respective DUs. Discrete soil and sediment were collected from the Soil Pile and French Drain Outfall DUs, respectively, and the analytical results were then screened against small arms MC screening criteria for human and ecological health.

3.1.1 X-Ray Fluorescence Screening

The Target Berm initial DU was screened for lead in the field using an Innov-X Alpha A4000 (model number a-200 A) handheld XRF analyzer. A sampling grid was laid out across the Target Berm DU and discrete samples were taken from 0-6 inches bgs at each grid node. An approximate 10 x 4 foot grid was sampled at the Target Berm DU. Soil samples were collected using clean, dedicated disposable sampling spoons, placed in clear plastic zip-top bags, disaggregated/homogenized in the field by mechanical methods prior to analysis, and percent soil moisture was recorded via a handheld analog soil moisture meter. The volume of each XRF sample was approximately 12 cubic inches of soil with weights varying depending on soil moisture content. Coarse material >2 millimeters in diameter, such as pebbles, were removed from the sample to the greatest extent possible before analysis. If soil moisture content exceeded 20%, samples were dried in the field by sunlight before XRF analysis.

Each sample was analyzed by XRF four times, with each analysis performed on a different portion of the sample, following the guidelines of USEPA Method 6200.



Firing Point Decision Unit:	0.016 Acres*
Target Berm Decision Unit:	0.015 Acres*
Soil Pile Decision Unit:	0.003 Acres*
French Drain Outfall Decision Unit:	0.0008 Acres*
Background Reference Area:	0.016 Acres*

*** - Acreage approximate**

- ▭ Target Berm Decision Unit
- ▭ Firing Point Decision Unit
- ▭ Soil Pile Decision Unit
- ▭ French Drain Outfall Decision Unit
- ▭ Background Reference Area
- 🟥 Ridgway Training Range MRS
- 🟦 Ridgway Weekend Training Site
- ▨ Wetland (National Wetlands Inventory)
- ▨ Drainage Ditch

CLIENT	Army National Guard			
PROJECT	Remedial Investigation through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	11/8/2018
SCALE	1:840	CHK BY	AS	11/8/2018
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	11/8/2018

TITLE

Ridgway Training Range MRS RI Approach

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Figure 3-1

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Table 3-1. Summary of RI Samples

Sample Identification	Sample Collection Date	Sample Depth (inches bgs)	Media Type	Analytical Parameters			Comments
				Total Metals[1]	Explosives[2]	TCLP[3]	
INCREMENTAL SAMPLES							
Target Berm							
RTR01IS01	7/11/2018	0 - 6	Soil	X			Primary, used also for MS/MSD
RTR01IS02	7/11/2018	0 - 6	Soil	X			Duplicate
RTR01IS03	7/11/2018	0 - 6	Soil	X			Triplicate
Firing Point							
RTR03IS01	7/12/2018	0 - 6	Soil		X		Primary
RTR03IS02	7/12/2018	0 - 6	Soil		X		Duplicate, used also for MS/MSD
RTR03IS03	7/12/2018	0 - 6	Soil		X		Triplicate
Background Reference							
RTR04IS01	7/12/2018	0 - 6	Soil	X	X		Primary, used also for MS/MSD
RTR04IS02	7/12/2018	0 - 6	Soil	X	X		Duplicate
RTR04IS03	7/12/2018	0 - 6	Soil	X	X		Triplicate
DISCRETE SAMPLES							
Target Berm							
RTR01DA01A	7/12/2018	12 - 18	Soil	X			Collected at XRF sample RTR01X80 location
RTR01DA01B	7/12/2018	12 - 18	Soil	X			Field Duplicate of RTR01DA01A
RTR01DB01A	7/12/2018	24 - 30	Soil	X			Collected at XRF sample RTR01X80 location
RTR01DC02A	7/12/2018	0 - 6	Soil			X	Collected at XRF sample RTR01X06 location
RTR01DA03A	7/12/2018	12 - 18	Soil	X			Collected at XRF sample RTR01X22 location, MS/MSD
RTR01DB03A	7/12/2018	24 - 30	Soil	X			Collected at XRF sample RTR01X22 location
RTR01DA04A	7/12/2018	12 - 18	Soil	X			Collected at XRF sample RTR01X91 location
RTR01DB04A	7/12/2018	24 - 30	Soil	X			Collected at XRF sample RTR01X91 location
RTR01DA05A	7/12/2018	12 - 18	Soil	X			Collected at XRF sample RTR01X45 location
RTR01DS01A	7/12/2018	0 - 6	Soil	X			Collected from beneath gravel east of XRF sample RTR01X12 location
RTR01DS02A	7/12/2018	0 - 6	Soil	X			Collected from beneath gravel east of XRF sample RTR01X24 location
RTR01DD01A	7/12/2018	0 - 6	Sediment	X			Collected from drainage ditch south of XRF sample RTR01X125 location
RTR01DD02A	7/12/2018	0 - 6	Sediment	X			Collected from drainage ditch south of MRS, equidistant between the Firing Point and Target Berm
Soil Pile							
RTR02DS01A	7/9/2018	0 - 12*	Soil	X			Collected from the western half of the Soil Pile
RTR02DS01B	7/9/2018	0 - 12*	Soil	X			Field Duplicate of RTR02DS01A
RTR02DS02A	7/9/2018	0 - 12*	Soil	X		X	Collected from the western half of the Soil Pile
RTR02DS03A	7/9/2018	0 - 12*	Soil	X			Collected from the western half of the Soil Pile
RTR02DS04A	7/9/2018	0 - 12*	Soil	X			Collected from the eastern half of the Soil Pile
RTR02DS05A	7/9/2018	0 - 12*	Soil	X			Collected from the eastern half of the Soil Pile
RTR02DS06A	7/9/2018	0 - 12*	Soil	X			Collected from the eastern half of the Soil Pile
RTR02DS07A	7/9/2018	24 - 36*	Soil	X			Collected from the western half of the Soil Pile
RTR02DS08A	7/9/2018	24 - 36*	Soil	X			Collected from the western half of the Soil Pile
RTR02DS09A	7/9/2018	24 - 36*	Soil	X			Collected from the western half of the Soil Pile
RTR02DS10A	7/9/2018	24 - 36*	Soil	X			Collected from the eastern half of the Soil Pile
RTR02DS11A	7/9/2018	24 - 36*	Soil	X			Collected from the eastern half of the Soil Pile
RTR02DS12A	7/9/2018	24 - 36*	Soil	X			Collected from the eastern half of the Soil Pile
Firing Point							
RTR03DS01A	7/9/2018	0 - 6	Soil		X		Collected east of the Firing Point, one quarter of the distance north bewteen the concret pad and the northern MRS wall
RTR03DS01B	7/9/2018	0 - 6	Soil		X		Field Duplicate of RTR03DS01A
RTR03DS02A	7/9/2018	0 - 6	Soil		X		Collected east of the Firing Point, one half of the distance north bewteen the concret pad and the northern MRS wall
RTR03DS03A	7/9/2018	0 - 6	Soil		X		Collected east of the Firing Point, three quarters of the distance north bewteen the concret pad and the northern MRS wall
RTR03DA01A	7/12/2018	12 - 18	Soil		X		Collected from the covered Firing Point, adjacent to the southern concrete pad, MS/MSD
RTR03DA02A	7/12/2018	12 - 18	Soil		X		Collected from the covered Firing Point, equidistant between the southern concrete pad and northern MRS wall
RTR03DA03A	7/12/2018	12 - 18	Soil		X		Collected from the covered Firing Point, adjacent to the northern MRS wall
RTR03DA03B	7/12/2018	12 - 18	Soil		X		Field Duplicate of RTR03DA03A
RTR03DC01A	7/12/2018	0 - 6	Soil			X	Collected from the covered Firing Point, adjacent to the southern concrete pad, MS/MSD
French Drain							
RTR05DD01A	7/12/2018	0 - 6	Sediment	X			Collected from the southwestern corner of the ponded area , MS/MSD
RTR05DD01B	7/12/2018	0 - 6	Sediment	X			Field Duplicate of RTR05DD01A
RTR05DD02A	7/12/2018	0 - 6	Sediment	X		X	Collected from the southern half of the ponded area
RTR05DD03A	7/12/2018	0 - 6	Sediment	X			Collected from the southern half of the ponded area
RTR05DD04A	7/12/2018	0 - 6	Sediment	X			Collected from the southeastern corner of the ponded area
RTR05DD05A	7/12/2018	0 - 6	Sediment	X			Collected from the northwestern corner of the ponded area
RTR05DD06A	7/12/2018	0 - 6	Sediment	X			Collected from the northern half of the ponded area
RTR05DD07A	7/12/2018	0 - 6	Sediment	X			Collected from the northern half of the ponded area
RTR05DD08A	7/12/2018	0 - 6	Sediment	X			Collected from the northeastern corner of the ponded area
RTR05DD09A	7/12/2018	0 - 6	Sediment	X			Collected 10 feet east of the ponded area
RTR05DD10A	7/12/2018	0 - 6	Sediment	X			Collected 10 feet west of the ponded area
EQUIPMENT BLANK							
RTR03IS00	7/12/2018	--	Water	X	X		

Notes:

[1] - Antimony, Copper, Lead, & Zinc, by USEPA SW-846 Method 6020A

[2] - Nitroglycerin by USEPA SW-846 Method 8330B

[3] - Metals, Reactivity, Flashpoint, & Corrosivity

bgs = below ground surface

MS/MSD = matrix spike/matrix spike duplicate

TCLP = Toxicity Characteristic Leaching Procedure

USEPA = United States Environmental Protection Agency

XRF = X-Ray Fluorescence

* - Soil Pile samples collected from below the soil pile surface, not the ground surface

The concentration of lead (in parts per million [ppm]) and ± error, as reported by the XRF analyzer, was recorded for each analysis (**Appendix A**). Due to the heterogeneous nature of metals distribution in soil matrices, lead results of the four replicates were averaged in the field to represent the final concentration for a single grid node. The highest recorded error of the four replicates was carried forward to represent the maximum potential error associated with any given replicate of the sample. The Target Berm DU boundary was revised based on exceedances of human health screening criterion for lead (400 milligram per kilogram [mg/kg]) observed along the DU boundary. Additional 101 step-out samples were taken along the same grid pattern as the DU until exceedances were no longer observed. This revised boundary was used for incremental sampling at the Target Berm (0.126 acres).

3.1.2 Incremental Soil Sampling

Incremental samples were collected using ISM from the Target Berm, Firing Point, and Background Reference Area DUs (**Figure 3-1**) using a systematic random approach in accordance with the procedures outlined in the UFP-QAPP standard operating procedures (SOPs; AECOM, 2017). XRF screening grids were used at the Target Berm DU to refine the DU boundary. Random numbers were generated in the field, using a random number generator, to select the location of primary, duplicate, and triplicate ISM samples. All incremental samples (IS) were collected in 100 percent triplicate following the technical guidance outlined in the 2012 *Incremental Sampling Methodology* by the Interstate Technology & Regulatory Council (ITRC) Incremental Sampling Methodology Team (2012). The risk screening analysis is performed with the IS sample results.

Prior to IS collection, vegetation and other debris were cleared from the ground surface. Sample increments were collected using an AMS™ 7/8-inch by 33-inch cylindrical stainless steel soil probe. The IS from the Target Berm DU was comprised of 129 evenly spaced increments and the Firing Point DU was comprised of 36 evenly spaced increments. If individual covered wooden firing positions at the Firing Point DU prohibited sampling at any primary, duplicate, or triplicate locations, those samples were collected on the north side, adjacent to that respective firing position. Increments were collected from approximately 0-6 inches bgs (perpendicular to the ground) and composited into individual 10-gallon plastic zipper-lock bags for laboratory analysis of small arms metals.

Although XRF analysis was not necessary at the Firing Point to refine the boundary for ISM, the projected DU boundary was revised based on its former inclusion of a concrete pad area. The concrete pad area, approximately 14 feet by 20 feet, that was originally included in the Firing Point DU was excluded from the final DU boundary because propellant residues containing nitroglycerin that scatter when firing would not enter the soil beneath the concrete pad area. Additionally, the Background Reference Area DU was expanded to include acreage roughly approximate to the average of the Target Berm and Firing Point DUs. As the Target Berm DU expanded based on XRF analysis, the Background Reference Area DU expanded to account for the increase in size at the Target Berm.

In addition to the Target Berm and Firing Point, IS were collected in 100 percent triplicate from a background reference area southeast of the MRS that was not affected by historical training activities (**Figure 3-1**). The area sampled was representative of undisturbed media and of an appropriate size to adequately characterize background concentrations and be comparable to investigative samples.

3.1.3 Discrete Soil Sampling

Discrete samples were collected at each DU for the purposes of vertical and/or lateral delineation of MC (**Figure 3-2**). The vertical extent of contamination was characterized by collecting discrete subsurface soil samples from select areas at the Target Berm where XRF results exceeded the human health screening criterion for lead, and at the Firing Point from areas adjacent to the firing positions. Discrete surface samples were collected at the Firing Point, Soil Pile, and French Drain Outfall DUs to confirm the potential lateral extent of MC contamination in soil and sediment.

At the Target Berm, four locations were selected to represent subsections of the expanded DU: RTR01DA01 (south of the MRS walls), RTR01DA03 (within the MRS walls), RTR01DA04 (north of the MRS walls), and RTR01DA05 (the range floor area). At each location except for RTR01DA05, a discrete sample was collected from two depths: 12-18 inch bgs (DA sample) and 24-30 inches bgs (DB sample). At RTR01DA05 the sample depth of 24-30 inches could not be reached due to refusal at a cobble layer. Each sampling zone was exposed by hand auger and/or shovel, and discrete samples collected with a clean, dedicated, disposable sampling spoon for laboratory analysis of small arms metals. The 24-30 inches bgs samples were held at the laboratory pending the results of the shallow 12-18 inch bgs sample. Of the four discrete sample locations at the Target Berm DU, only samples from locations RTR01DA03 (within the MRS walls) and RTR01DA04 (north of the MRS walls) exceeded the human health screening criterion for lead in the shallow 12-18 inch bgs sample; the deeper 24-30 inch bgs samples were analyzed accordingly. Excess soil was returned to each sampling location at the level removed, and the ground surface returned to original grade. Additionally, a discrete surface soil sample was collected from the Target Berm DU location with the highest XRF lead result (grid #06) for waste characterization analysis (e.g., TCLP).

At the Firing Point DU, three locations were selected for subsurface sampling adjacent to and immediately downrange from the firing positions: RTR03DA01 (southernmost location within the Firing Point DU), RTR03DA02 (central location between the Firing Point concrete pad and northern MRS wall), and RTR03DA03 (northernmost location with the Firing Point DU). At each location, a discrete sample was collected from one depth: 12-18 inch bgs. Across the Firing Point DU, the sample depth of 24-30 inches could not be reached due to refusal at a cobble layer. Each sampling zone was exposed by the same method used at the Target Berm above using a hand auger/shovel and dedicated spoon for laboratory analysis of nitroglycerin. Excess soil was returned to each sampling location at the level removed and the ground surface returned to original grade. Three surface soil samples were also collected east of the covered Firing Point DU with a clean, dedicated, disposable sampling spoon for laboratory analysis of nitroglycerin to determine lateral extent. Additionally, a discrete surface soil sample was collected from surface soil at RTR03DA01 for waste characterization analysis (e.g., TCLP).

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	11/13/2018
SCALE	1:480	CHK BY	JW	11/13/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	11/13/2018

Discrete Sample Locations

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure
3-2

Q:\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 6 SARs\900-Work\GIS\Ridgway\1_MXD\RI\Fig_3-2_Ridgway_Discrete_Sample.mxd

Discrete soil samples were also collected from the Soil Pile DU. The Soil Pile is well defined and above ground, so lateral and vertical extents are already defined. Twelve discrete samples were collected at random locations across the DU pile. Six samples were collected from 0-12 inches below the surface of the Soil Pile, and six samples were collected from 12 inches above ground surface to the ground surface. Each sampling zone was exposed by the same method used at the Target Berm above using a hand auger/shovel and dedicated spoon for laboratory analysis of small arms metals. Additionally, a discrete soil sample was collected from the Soil Pile DU for waste characterization analysis (e.g., TCLP).

3.1.4 Discrete Sediment Sampling

Discrete sediment samples were collected at the French Drain Outfall DU to assess potential MC transport from the Target Berm area. Eight sediment samples were collected from 0-6 inches bgs at random locations within the ponded area where the French Drain daylights. Two additional samples were collected beyond the boundary of the ponded area to confirm extent; one sample was collected ten feet to the east of the ponded area, and one sample was collected ten feet to the west of the ponded area. Additionally, a discrete sediment sample was collected for waste characterization analysis (e.g., TCLP).

Two sediment samples were also collected from a drainage ditch south of the MRS due to the expansion of the Target Berm DU south towards the drainage ditch via step-out sampling. Target Berm DU sediment samples were collected to assess if small arms metals are being transported from the Target Berm area. The drainage ditch runs east-west, parallel to the firing direction, south of the southern MRS wall. One sample was collected from the drainage ditch, adjacent to the southern extent of the Target Berm. The second Target Berm DU sediment sample was collected from the drainage ditch, equidistant between the Target Berm and the confluence of the drainage ditch and a flowing steam east of the MRS.

3.1.5 Sample Identification

Soil and sediment samples collected at the MRS were identified using the procedures detailed in the UFP-QAPP (AECOM, 2017). Using indelible ink, each sample was labeled with a nine- to ten-character sampling code. The sampling code consisted of a three-character site identifier, two-digit DU number, one-to two-character sampling method code, two-digit sample location/type number, and one-character sample replicate code. Each component of the sample code as shown in **Table 3-1** is described in the examples below:

RTR01DA02A and **RTR02IS02**

RTR = Three-character site identifier for the Ridgway Training Range MRS

01 = Decision Unit identifier:

- 01 for the Target Berm DU
- 02 for the Soil Pile DU
- 03 for the Firing Point DU
- 04 for the Background Reference Area
- 05 for the French Drain Outfall DU

DA = One- to two-character sampling method:

- X = discrete XRF surface soil sample
- DA = discrete 12-18 inches bgs subsurface soil sample
- DB = discrete 24-30 inches bgs subsurface soil sample
- DC = discrete 0-6 inches bgs surface sample intended for TCLP analysis
- DS = discrete 0-6 inches bgs surface sample
- DD = discrete sediment sample
- IS = incremental surface soil sample

02 = Sample location/type:

- 01 – 137 for each discrete sample location
- For IS samples only:
    - 00 = equipment blank
    - 01 = primary sample
    - 02 = duplicate sample
    - 03 = triplicate sample

A = Discrete sample replicate:

- A – D for each replicate discrete sample

3.1.6 Decontamination of Sampling Equipment

Personnel donned suitable personal protective equipment to reduce personal exposure as required by the Site Safety and Health Plan (Appendix B of the Final RI Work Plan [AECOM, 2017]). Excess soil on sampling equipment was scraped off at the sampling location. Equipment was rinsed at the sampling location with a spray bottle containing a Liquinox solution or low-sudsing non-phosphate detergent along with distilled water and scrubbed with a bristle brush or similar utensil. The equipment was rinsed with distilled water from a separate spray bottle followed by an analyte-free water rinse. Following decontamination, equipment was placed in a clean plastic zipper-lock bag to prevent contact with contaminated soil and/or surfaces.

3.1.7 Investigative Derived Waste

Soil investigation-derived waste was not generated during the sampling activities completed at the MRS. Rinse water generated from equipment decontamination activities was less than 1-liter in volume per DU and discharged directly to the ground within the MRS per the procedures outlined in the UFP-QAPP (AECOM, 2017).

3.1.8 Quality Assurance / Quality Control

Quality Assurance (QA) / Quality Control (QC) samples collected during the RI consisted of duplicate samples, matrix spike / matrix spike duplicate (MS/MSD) samples, and equipment blanks. QA/QC sampling was conducted in accordance with specifications outlined in the UFP-QAPP.

Duplicates

Duplicate samples were collected at a rate of at least 1 per 10 samples per matrix. Duplicate samples were collected simultaneously from the same source under identical conditions, submitted to the laboratory as indistinguishable samples, and labeled accordingly. Because IS samples were collected in triplicate, duplicate QA/QC samples were unnecessary.

MS/MSD

MS/MSD samples were collected at a rate of 5 percent per mobilization per sample type. Sub-samples were pulled from the parent sample by the analytical laboratory for IS samples. Additional volume was collected for discrete subsurface soil samples from the same location as the parent sample. Labels for the extra volume were the same as the parent sample.

Equipment Blanks

Equipment blanks were collected at a rate of 5 percent per mobilization for samples collected with decontaminated, reusable equipment. Equipment blanks were collected by passing analyte-free deionized water over a decontaminated soil probe into sampling containers.

3.2 Laboratory Analytical Methods

IS and discrete soil samples were submitted to a Department of Defense (DoD) Environmental Laboratory Approval Program-certified laboratory who is also PADEP-certified (Katahdin Analytical Services, Inc.) for all chemical analyses. Each sample was labeled and secured in a shipping cooler filled with ice. Samples were entered on the chain of custody form with the required analyses. Each cooler was sealed with the chain of custody form inside. Custody seals were signed, dated, and placed on opposite corners of the coolers prior to overnight shipment to the analytical laboratory. All laboratory procedures and analyses were conducted in accordance with the UFP-QAPP.

The IS and discrete samples were analyzed by the laboratory for:

- Small arms metals (antimony, copper, lead, and zinc) by USEPA Method SW-846 6020A
- Nitroglycerin by USEPA SW-846 Method 8330B
- TCLP parameters by USEPA Method 1311/6020A/7470A, 1311/8330B, 9012/9034, 9045D, and 1030.

3.3 Data Evaluation Methods

Each sample result was compared directly to the screening criteria (**Section 3.3.1**) for all MC parameters examined. The weight-of-evidence approach used in the assessment helped control decision errors. MC concentrations from all sample results and site conditions were considered to ensure additional information did not provide indications that conclusions may be in error.

All data were reviewed as described in **Section 4** to determine their usability. Sampling locations and field conditions were assessed to ensure all samples were representative of MRS and background area conditions.

3.3.1 Human Health and Ecological Risk Screening Criteria

The human health and ecological risk-based screening levels for soil used for during the RI are presented in **Table 3-2**. Analytical data for this RI were compared to the risk-based screening levels to determine if past small arms training activities resulted in contamination exceeding human health and/or ecological screening levels.

Site-specific Background Reference Area samples were collected and analyzed during this RI for comparison to investigative samples.

Table 3-2. Remedial Investigation Screening Levels

Analyte	Screening Levels			
	Soil Human Health (mg/kg)	Soil Ecological (mg/kg)	Sediment Human Health (mg/kg)	Sediment Ecological (mg/kg)
Antimony	3.1(1)	0.27(2)	880(3)	2(4)
Copper	310(1)	28(2)	81000(3)	31.6(5)
Lead	400(1)	11(2)	5000(3)	35.8(5)
Zinc	2300(1)	46(2)	660000(3)	121(5)
Nitroglycerin	0.63(1)	13(2)	NA	NA

Notes:

(1) USEPA Residential Soil RSL Value (May 2019), protective of a target hazard quotient of 0.1 and a target cancer risk of 1x10-6

(2) USEPA Region 4 Soil Screening Values (Supplemental Guidance for Ecological Risk Assessment, 2015)

(3) Sediment human health screening levels are calculated as PADEP Residential MSCs x 10 (Medium-Specific Concentrations for Inorganic Regulated Substances in Soil, 2016).

(4) EPA Region 3 Biological Technical Assistance Group (BTAG) Freshwater Sediment Screening Benchmarks (USEPA, 2006)

(5) MacDonald et al. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

mg/kg = milligram per kilogram

4 Data Quality Assessment

Field samples were analyzed for small arms metals by SW-846 method 6020A and/or nitroglycerin by SW-846 method 8330B. QA/QC samples were collected to evaluate the field collection methods and the laboratory analytical techniques for soil samples. No deviations from the UFP-QAPP requiring corrective action occurred. The full data validation report is presented in **Appendix C**.

4.1 Data Validation and Verification

The following describes data QC parameters and criteria used during the RI, an analysis of the data in terms of precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) is provided in **Section 4.2**. All laboratory data validation and verification activities were completed by AECOM. As appropriate, the subsections below address the in-field XRF data obtained at Ridgway Training Range MRS

A Tier III Data Validation Report was prepared for each Sample Delivery Group as assigned by the laboratory (**Appendix C**). The validation process used information from the UFP-QAPP (AECOM, 2017) and DoD Quality Systems Manual to define the method quality objectives. Laboratory data were qualified according to protocols defined in the USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data (USEPA, 2017a & 2017b). Issues identified during the data validation process resulted in the application of letter qualifiers to the data. These qualifiers were added to concentrations, when appropriate, to ensure reported concentrations were accurately represented. Usability of data for further analysis was based on review of analytical qualifiers and performed in accordance with the guidelines noted previously. A detailed discussion of anomalies can be found in **Appendix C.**

4.2 Data Usability - PARCCS

This section addresses data usability for both laboratory-generated data and the in-field analyzed XRF data.

Precision

Precision is the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Field sampling precision is measured with the field duplicate relative percent differences; laboratory precision is measured with calibration verification, laboratory control spike (LCS) and MSD relative percent differences, and serial dilution percent differences.

Precision errors may be the result of one or more of the following: field instrument variation, analytical measurement variation, poor sampling technique, sample transport problems, or spatial variation (heterogeneous sample matrices). For example, if poor precision is indicated in both the field and analytical duplicates/replicates, then the laboratory may be the source of error. If poor precision is limited to the field duplicate/replicate results, then the sampling technique, field instrument variation, sample transport, medium heterogeneity, or spatial variability may be the source of error. To identify the cause of imprecision, the field sampling design rationale and sampling techniques were evaluated by the reviewer, and both field and analytical duplicate/replicate sample results were compared.

Calibration verifications are performed routinely to ensure that instrument responses for all calibrated analytes are within established control criteria of +/-20% relative standard deviation (RSD). No calibration verification anomalies were encountered.

Field duplicate pairs were collected to assess the overall sampling and measurement error for this sampling effort. The field duplicate sample was analyzed for the same analytes as the primary field sample. Eight field sample results for copper, lead, and zinc were qualified for field duplicate imprecision. These anomalies are considered minor, the positive and non-detect (ND) associated results were qualified as estimate, and the data should be considered usable as qualified.

Laboratory duplicates were prepared for every inorganic batch to demonstrate the laboratory's ability to detect similar concentrations of unknown quantity in the site matrix media. Laboratory duplicates are separate aliquots of a single field sample that are prepared and analyzed concurrently at the laboratory. The primary purpose of the laboratory duplicate is to check the precision of the laboratory analyst, the sample preparation methodology, and the analytical methodology. As per the UFP-QAPP, laboratory duplicates were to be prepared at a frequency of once per inorganic preparatory batch. Acceptable relative percent differences for laboratory duplicates are specified by the laboratory-specific control limits. The laboratory duplicate performed on field sample RTR02DS01A displayed a relative percent difference (RPD) greater than the laboratory QC limits for antimony at 36.3% and lead at 29.7%. Several zinc and copper field sample results were qualified as estimate due to these anomalies, and the data should be considered usable as qualified. These anomalies are considered minor.

Field triplicates of IS were collected at every DU and background location for laboratory analysis to assess imprecision encountered in the sampling process and heterogeneity of sample media. Acceptable RPDs for discretely collected field duplicates are less than 30 percent. Of the single duplicate pair of discrete samples collected during the RI, RPD varied between analytes. The triplicate performed on incremental field samples RTR03IS01, RTR03IS02, and RTR03IS03 displayed an RSD greater than the upper QC limit of 30% for nitroglycerin at 101%. No field sample results were qualified based on these anomalies; they were previously qualified due to LCSs percent recovery anomalies.

A serial dilution is prepared by the laboratory after digestion for the metals analyses for each preparation batch by creating a 1:5 dilution of a digestate in water. The serial dilution result should be within 10% of the neat digest. A serial dilution displayed percent differences greater than the QC limit of 10% for copper at 13% and zinc at 11%. Several zinc and copper field sample results were qualified as estimate due to these anomalies, and the data should be considered usable as qualified. These anomalies are considered minor.

An MS pair was prepared, analyzed, and reported for all preparation batches. MS pairs were analyzed for every analytical batch to demonstrate the laboratory's ability to detect similar concentrations of a known quantity in site matrix media. No field sample results were qualified based on MS/MSD relative percent difference anomalies.

For XRF screening data, each discrete sample was analyzed four times. Due to the natural variability in the distribution of metals in soil media, replicate concentrations of lead were averaged to represent a given grid's sample concentration. The highest recorded ± error (2-sigma, 95 percent confidence) of the four replicates was used to represent the maximum potential error associated with any given replicate of the sample. The maximum error observed among all sample replicates was ± 613 ppm at Target Berm location RTR01X20. The concentrations at this location were an order of magnitude above the decision criterion (400 mg/kg); therefore, XRF precision is consistent with the data quality objectives.

Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference value. The smaller the difference between the measurement of a parameter and its "true" or expected value, the more accurate the measurement. The more precise or reproducible the result, the more reliable or accurate the result. Accuracy is measured through percent recoveries in the LCS, the matrix spike pairs (MS/MSD), surrogates, and internal standard area counts.

LCS are prepared by addition of known concentrations of each analyte in a matrix free media known to be free of target analytes. LCS were analyzed for every analytical batch to demonstrate that the analytical system was in control during sample preparation and analysis. One LCS performed displayed a percent recovery less than the lower QC limit of 73% for nitroglycerin at 55.6%. These anomalies are considered minor, the positive and ND associated results were qualified as estimate, and the data should be considered usable as qualified.

Matrix spikes are prepared by addition of known concentrations of each analyte in one selected investigative field sample per extraction batch. MSs demonstrate that the analytical system was in control for the matrix being tested. The MS/MSD performed on field samples RTR01IS01, RTR04IS01, and RTR05DD01A displayed percent recoveries outside the QC limits for antimony, copper, and zinc. The field sample results associated with the percent recoveries less than the lower QC limit were positive and qualified as estimate with a likely low bias. Field sample results associated with one negative bias and one positive bias were qualified as estimate with an undetermined bias. One positive field sample result was qualified due to an MS percent recovery greater than the upper QC limit for nitroglycerin. These anomalies are considered minor, the positive and ND associated results were qualified as estimate, and the data should be considered usable as qualified. One ND field sample result was associated with percent recoveries less than 30% was qualified R,m. This is considered a major anomaly, and this data point is not recommended for data use.

LCSs were analyzed for every analytical batch to demonstrate that the analytical system was in control during sample preparation and analysis. All reported percent recoveries were within the accuracy criteria outlined in the UFP-QAPP.

In organic analyses, a surrogate spike is added to every submitted sample and laboratory QC sample prepared in the QC batch. Surrogate spikes are prepared by addition of known concentrations of non-target analytes to all samples in the QC batch. Three positive nitroglycerin results associated with high surrogate percent recoveries were qualified as estimate with a high bias. One ND result associated with a surrogate percent recovery less than the lower control limit was qualified as estimate with a low bias. These anomalies were considered minor and the data should be considered usable as qualified.

For the XRF data, the measured values are presented with a ± error reading. For the Target Berm, the higher lead values (above 1000 ppm) were associated with higher ± errors. In only a few samples with detected concentrations near the 400 ppm action level could the associated error indicate that the true value may or may not exceed the threshold. In these cases (for example, sample RTR01X38, 400 ppm lead with ± 31 ppm error), it was conservatively assumed that the XRF value exceeded 400 ppm.

Representativeness

Representativeness is the measure of the degree to which data accurately and precisely represent a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition. In other words, representativeness is the qualitative measurement that describes how well the analytical data characterizes a specific area of interest. Several factors including selection of appropriate analytical procedures, sampling plan, matrix heterogeneity, and the specific procedures and protocols used to collect, preserve, and transport samples can all influence how representative the analytical results are for a given sampled area. It is imperative that field sampling and collection occurs at appropriately designated locations that accurately represent the area of interest. For example, when sampling for MC, visual observances (small metal fragments or munition debris in surrounding area) in combination with designated sampling depths (e.g., 0-6, 12-24, and 24-30 inches bgs) and appropriate sample collection will help to ensure accurate representation of a specific area of interest. Thus, the sampled soil is known to be located within the MRS, at appropriate step out locations, and background area.

Representativeness qualitatively expresses the degree to which data accurately reflect site conditions. Factors that affect the representativeness of analytical data include appropriate sample population definitions, proper sample collection and preservation techniques, analytical holding times, use of standard analytical methods, and determination of matrix or analyte interferences.

No analytes were detected at concentrations greater than the limit of detection (LOD) in the equipment blank. Therefore, the equipment blank measurement performance criterion was met. Equipment blanks were not collected for discrete or XRF samples since these samples were collected using dedicated, disposable single use spoons.

A method blank is a sample of an analyte-free substance similar to the matrix of interest that is subjected to all of the sample digestion and analytical methodology applied to the samples. The purpose of the method blank is to check for contamination from within the laboratory that might be introduced during sample preparation and analysis that would adversely affect analytical results. Some method blanks displayed detections greater than the LOD for barium, copper, lead, and zinc. The positive associated field sample results for lead and copper in sample RTR03IS00 and for barium in sample RTR02DS02A were less than five times the blank detections and were qualified B. These field sample results should be considered likely false positives.

Laboratories establish a method-specific technical holding time from sampling to preparation or analysis where sample results can be considered valid based on site-specific conditions. All samples must be placed in appropriate containers that are appropriately preserved (as applicable). The holding time for soil from sampling to analysis for SW-846 6020A is six months. Soil samples analyzed for nitroglycerin by SW-846 method 8330B have a holding time of 40 days. Soil samples analyzed for TCLP have a holding time of 28 days for mercury and reactivity. All samples were analyzed within required holding times for their respective method.

XRF analyzers are factory calibrated; field calibration is not appropriate or possible. Calibration checks and analysis of standard reference material were conducted prior to XRF analysis (**Appendix A**). No calibration failures or deviations from expected standard concentrations were observed. Use of the standard sampling protocols at each location ensured representativeness of the medium being sampled (soil) because it allows standardizing sample sizes, reliably achieving the targeted sample depths, and decontamination of samplers was simple, thus minimizing cross contaminating samples.

Field QC samples were collected to assess the representativeness of the data collected. Field duplicates were collected at a rate of 10 percent for all discrete samples. All preservation techniques were followed by the field staff, and all technical and analytical holding times were met by the laboratory. The laboratory used approved standard methods as outlined in the UFP-QAPP for all analyses.

Comparability

Comparability is the degree to which different methods, data sets, and decisions agree or can be represented as similar. Comparability describes the confidence (expressed qualitatively or quantitatively) that two data sets can contribute to a common analysis and interpolation. The results of this study will be used as a benchmark for determining comparability for data collected during any future sampling events using the same or similar sampling and analytical SOPs. It is not anticipated that the data will be compared to past datasets or data using different sampling or analytical SOPs. The data reviewer found that the overall comparability of the dataset was acceptable based on conformance to approved sampling procedures and standard analytical methods.

Data comparability between the background and MRS sampling data is necessary to accurately screen DU concentrations against the background. Comparability was achieved by implementing identical sampling and analytical procedures in both the background area and MRS. Loamy soil types were encountered at the DUs and in the Background Reference Area (see soil sample collection logs, **Appendix A**).

Completeness

Completeness is a quantitative measure of the amount of valid data obtained from a measurement system compared to the amount of data that were expected to be obtained under normal circumstances. Overall completeness is usually expressed as a percentage of usable analytical data. Overall data completeness is greater than 99.9% of the analytical data points collected.

Sensitivity

Sensitivity reflects the ability of the analytical method to discriminate between measurement responses representing different levels and to detect analytes of interest below the level of concern. This goal is achieved by identifying the level of concern, choosing a method with appropriate method detection limit, and ensuring that the laboratory analyzes calibration standards at or below the level of concern. The laboratory was able to achieve the lowest reporting limits based on the analytical methods employed and the sample matrix encountered. For results with detections, the detected concentration was compared to applicable human health and ecological screening levels. For non-detect results, the LOD was compared to applicable human health and ecological screening levels. Based on these criteria, the data reviewer found all data to be of acceptable sensitivity.

Daily calibration checks and analysis of standard reference material ensured that the Innov-X Alpha 4000 XRF analyzer sensitivity did not drift during the mobilization (**Appendix A**). No calibration failures or deviations from expected standard concentrations were observed.

4.2.1 Field Audits/Corrective Actions

No independent field audit was conducted given that the field team was comprised of scientists skilled at the specific sampling methodology and had assisted in preparing the UFP-QAPP and SOPs. Site photographs, standard field forms, and Daily Quality Control Reports (DQCR) show that the proper equipment was being used and QC samples were collected. The DQCRs were submitted daily to the AECOM project manager. Additionally, a Non-Conformance Report was created to address the need for additional sediment sampling from the drainage adjacent to the MRS. These documents appear in **Appendix A**. The AECOM project manager reviewed all field documents for completeness and compliance with the UFP-QAPP.

5 Remedial Investigation Results

This section provides the results of the field investigation at the Ridgway Training Range MRS. Data from the RI combined with previous information were used to further develop the CSM and inform recommendations for future site work. A summary of the field activities conducted for this RI is presented first, followed by XRF sampling results, discrete subsurface sampling results, and ISM sampling results broken out by area. The nature and extent of contamination across the entire MRS is presented last.

All data were validated using the procedures outlined in **Section 4.1**. The data validation report and analytical data package are included in **Appendices C** and **D**. Per the Data Usability Assessment in **Section 4,** all collected data are useable for their intended purpose. Field forms are included in **Appendix A,** and the photo log is included in **Appendix B**.

5.1 Field Activities and Conditions

Following the methods described in **Section 3**, soil and/or sediment samples were collected from the Target Berm, Soil Pile, Firing Point, and French Drain Outfall DUs at the MRS and an adjacent Background Reference Area. Sampling occurred over a one-week period from 8 July through 13 July 2018. Sampling grids were laid out prior to initiating sampling activities following the planned approach presented in the UFP-QAPP. Grid spacing at the Target Berm was 10 feet long by 4 feet wide (129 nodes); Firing Point grids were 6 feet long by 5 feet wide (36 nodes); and Background Reference Area grids were 15 feet long by 10 feet wide (30 nodes). Deviations from planned sampling at the Target Berm and Firing Point DUs were necessary to capture the entire DU areas. DU dimensions during planning were based on estimates. Field measurements necessitated the modification of the DU sampling strategy.

5.2 XRF Screening Results

The Target Berm was screened for lead by handheld XRF prior to ISM sampling to evaluate the lateral extent of MC in soil and refine DU boundaries. Discrete surface soil samples were collected from 0-6 inches bgs along the sampling grid at each DU. Four replicate sample readings were analyzed for each sample; the results were averaged and compared to the human health screening criterion for lead to determine the need for step-out and discrete sampling.

Initially, 32 samples were collected and analyzed for lead by XRF at the Target Berm. All original DU boundary location samples exceeded the human health criterion for lead (400 mg/kg), triggering step-out sampling. An additional 101 samples were collected and analyzed along extended grid nodes until exceedances were no longer observed. In total, 133 samples within and beyond the MRS walls were collected and analyzed to refine the DU boundary. Step-out samples were taken north of the northern MRS wall, east of the Target Berm within the MRS, and south of the southern MRS wall. Lead results ranged from 41 ppm (at grid #130) to 24,543 ppm (at grid #6). XRF analysis was not performed at the Firing Point DU because XRF is not a suitable tool for screening nitroglycerin. Additionally, XRF was not performed at the Soil Pile DU because of anticipated MC contamination in the Soil Pile and its relatively defined extent as an above ground feature. XRF analysis was not performed at the French Drain Outfall DU because XRF analysis is not feasible for wet soils and sediment. A summary of discrete XRF lead results is provided in **Table 5-1** and shown on **Figure 5-1**.

Table 5-1. Summary of Discrete XRF Lead Results – Target Berm

Sample ID	Moisture (%)	Average Lead Result (ppm)	Max Error (+/-)*	Notes
RTR01X01	13	16,486	518	
RTR01X02	20	14,327	413	
RTR01X03	19	15,167	358	
RTR01X04	19	18,071	488	Dried sample before analysis
RTR01X05	13	7,608	188	
RTR01X06	15	24,543	499	
RTR01X07	16	6,843	462	
RTR01X08	11	15,820	478	
RTR01X09	14	13,436	219	
RTR01X10	15	17,020	345	
RTR01X11	18	14,400	409	Dried sample before analysis
RTR01X12	17	3,966	317	
RTR01X13	17	500	31	
RTR01X14	14	11,575	84	
RTR01X15	12	15,603	354	
RTR01X16	14	9,943	312	
RTR01X17	16	12,206	260	
RTR01X18	12	19,016	411	
RTR01X19	14	16,572	528	
RTR01X20	19	10,040	613	
RTR01X21	17	13,003	265	
RTR01X22	16	20,661	493	
RTR01X23	14	8,138	180	
RTR01X24	18	9,965	333	
RTR01X25	16	119	12	
RTR01X26	12	16,236	332	
RTR01X27	16	18,337	478	
RTR01X28	19	6,687	366	
RTR01X29	17	8,829	288	
RTR01X30	16	15,640	400	
RTR01X31	18	13,698	365	
RTR01X32	15	14,375	400	
RTR01X33	18	1,532	53	Dried sample before analysis
RTR01X34	12	3,566	90	Dried sample before analysis
RTR01X35	17	6,938	123	Dried sample before analysis
RTR01X36	15	2,086	89	Dried sample before analysis
RTR01X37	18	4,389	120	Dried sample before analysis
RTR01X38	19	400	31	Dried sample before analysis
RTR01X39	14	5,247	215	Dried sample before analysis
RTR01X40	10	2,381	59	Dried sample before analysis
RTR01X41	19	2,990	67	Dried sample before analysis
RTR01X42	17	4,708	165	Dried sample before analysis
RTR01X43	10	673	44	Dried sample before analysis
RTR01X44	8	868	43	Dried sample before analysis
RTR01X45	14	2,088	83	Dried sample before analysis
RTR01X46	19	2,732	89	Dried sample before analysis
RTR01X47	18	2,402	74	Dried sample before analysis
RTR01X48	16	1,461	76	Dried sample before analysis
RTR01X49	14	2,083	57	Dried sample before analysis
RTR01X50	18	1,280	44	Dried sample before analysis
RTR01X51	19	1,161	50	Dried sample before analysis
RTR01X52	12	465	39	Dried sample before analysis
RTR01X53	18	841	39	Dried sample before analysis
RTR01X54	18	942	35	Dried sample before analysis
RTR01X55	18	1,171	44	Dried sample before analysis
RTR01X56	15	670	36	Dried sample before analysis
RTR01X57	15	1,151	43	Dried sample before analysis
RTR01X58	19	737	31	Dried sample before analysis
RTR01X59	16	338	21	Dried sample before analysis
RTR01X60	15	758	38	Dried sample before analysis
RTR01X61	18	264	17	Dried sample before analysis
RTR01X62	18	428	28	Dried sample before analysis
RTR01X63	15	471	24	Dried sample before analysis
RTR01X64	16	763	34	Dried sample before analysis
RTR01X65	18	717	34	Dried sample before analysis
RTR01X66	15	419	23	

Notes

* = Error: 2-sigma, 95% confidence

🟨 Sample meets or exceeds residential soil RBSL for lead

ppm = parts per million

Table 5-1. Summary of Discrete XRF Lead Results – Target Berm (continued)

Sample ID	Moisture (%)	Average Lead Result (ppm)	Max Error (+/-)*	Notes
RTR01X67	12	328	21	
RTR01X68	12	387	21	
RTR01X69	13	670	34	
RTR01X70	18	394	26	
RTR01X71	18	303	28	
RTR01X72	19	521	31	
RTR01X73	16	303	19	
RTR01X74	17	229	20	
RTR01X75	16	250	19	
RTR01X76	18	231	16	
RTR01X77	12	67	13	
RTR01X78	15	2,466	58	
RTR01X79	15	3,251	87	
RTR01X80	15	12,138	236	
RTR01X81	18	6,387	170	
RTR01X82	18	621	23	Dried sample before analysis
RTR01X83	19	925	26	Dried sample before analysis
RTR01X84	15	1,372	41	Dried sample before analysis
RTR01X85	18	2,255	50	Dried sample before analysis
RTR01X86	16	3,108	85	Duplicate readings of RTR01X82
RTR01X87	15	1,762	49	Duplicate readings of RTR01X83
RTR01X88	15	1,210	45	Duplicate readings of RTR01X84
RTR01X89	16	2,202	61	Duplicate readings of RTR01X85
RTR01X90	18	1,754	144	
RTR01X91	15	2,953	98	
RTR01X92	19	1,485	45	
RTR01X93	18	1,714	43	
RTR01X94	18	715	31	
RTR01X95	19	1,277	45	
RTR01X96	18	959	29	
RTR01X97	19	230	16	Dried sample before analysis
RTR01X98	15	352	19	Dried sample before analysis
RTR01X99	18	487	37	Dried sample before analysis
RTR01X100	18	389	22	
RTR01X101	15	305	15	
RTR01X102	17	215	16	Dried sample before analysis

Sample ID	Moisture (%)	Average Lead Result (ppm)	Max Error (+/-)*	Notes
RTR01X103	17	224	18	Dried sample before analysis
RTR01X104	18	207	17	Dried sample before analysis
RTR01X105	18	863	30	
RTR01X106	20	1,329	42	
RTR01X107	10	746	35	
RTR01X108	18	349	27	
RTR01X109	16	1,752	60	
RTR01X110	17	167	32	
RTR01X111	19	359	29	
RTR01X112	18	49	10	
RTR01X113	19	258	22	
RTR01X114	18	350	21	
RTR01X115	15	739	25	Dried sample before analysis
RTR01X116	10	209	19	Dried sample before analysis
RTR01X117	11	584	26	Dried sample before analysis
RTR01X118	14	1,454	47	Dried sample before analysis
RTR01X119	16	157	15	
RTR01X120	17	120	14	
RTR01X121	14	208	20	
RTR01X122	12	316	21	Dried sample before analysis
RTR01X123	10	3,381	90	Dried sample before analysis
RTR01X124	14	2,903	117	Dried sample before analysis
RTR01X125	19	6,683	164	Dried sample before analysis
RTR01X126	18	780	49	Dried sample before analysis
RTR01X127	16	294	18	
RTR01X128	19	64	10	
RTR01X129	12	61	15	
RTR01X130	18	41	10	
RTR01X131	18	226	26	Dried sample before analysis
RTR01X132	15	86	12	Dried sample before analysis
RTR01X133	18	726	24	Dried sample before analysis
RTR01X134	19	379	17	Dried sample before analysis
RTR01X135	19	82	9	Dried sample before analysis
RTR01X136	18	175	15	Dried sample before analysis
RTR01X137	16	235	13	Dried sample before analysis

Notes
* = Error: 2-sigma, 95% confidence
🟨 Sample exceeds residential soil RBSL for lead
ppm = parts per million

CLIENT	Army National Guard			
PROJECT	Remedial Investigation through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	11/8/2018
SCALE	1:180	CHK BY	AS	11/8/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	11/8/2018

Q:\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 6 SARs\900-Work\GIS\Ridgway\1_MXD\RI\Fig_5-1_Ridgway_XRF_Diagram.mxd

N

Bold = MC concentration exceeds ecological screening criteria

☐ Sample Grid

🟨 MC Concentration exceeds human health screening criteria

🟥 Ridgway Training Range MRS

▨ Wetland (National Wetlands Inventory)

▨ Drainage Ditch

Note:
ppm = parts per million

TITLE

Target Berm XRF Sample Diagram

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Figure 5-1

5.3 Incremental Sampling Results

ISM samples were collected after XRF screening was complete using the revised Target Berm DU boundary. ISM samples were also collected at the Firing Point and Background Reference Area DUs. XRF screening was not needed at the Firing Point or Background Reference Area, but those DUs were revised as described in **Section 3.1.2**. Sample collection logs are included in **Appendix A**. All IS results are summarized in **Table 5-2**, and shown on **Figure 5-2**.

Background Reference Area

An IS was collected from a 0.106 acre Background Reference Area southeast of the MRS within the southwestern portion of the Ridgway Weekend Training Site (**Figure 5-2**). IS were collected in triplicate (RTR04IS01, -02, and -03), with each IS containing 30 increments of equal volume. Soil within the background area was predominantly comprised of silt loam (approximately 60% silt/clay and 40% sand) with organic content and 20% moisture content. No evidence of small arms range impact or debris was observed within the area or samples.

Analytical results showed that nitroglycerin was not detected in any Background IS sample. Antimony ranged from 0.244 to 0.682 mg/kg among triplicate samples. Copper concentrations ranged from 10.5 to 12.7 mg/kg. Lead concentrations ranged from 59.2 to 82.3 mg/kg. Zinc concentrations ranged from 23 mg/kg to 33.5 mg/kg. No results exceeded human health screening criteria (**Table 5-2**). Antimony and lead concentrations exceeded ecological screening criteria.

Target Berm

ISM was applied to the revised Target Berm DU boundary (0.126 acres) established following XRF screening (**Figure 5-2**). IS were collected in triplicate (RTR01IS01, -02, and -03); each IS contained 129 increments of equal volume. Soil at the Target Berm was predominantly a sandy loam (approximately 35% silt/clay, 60% sand, and 5% gravel), with a medium amount organic content (fine roots), and 20% moisture content (**Appendix A**).

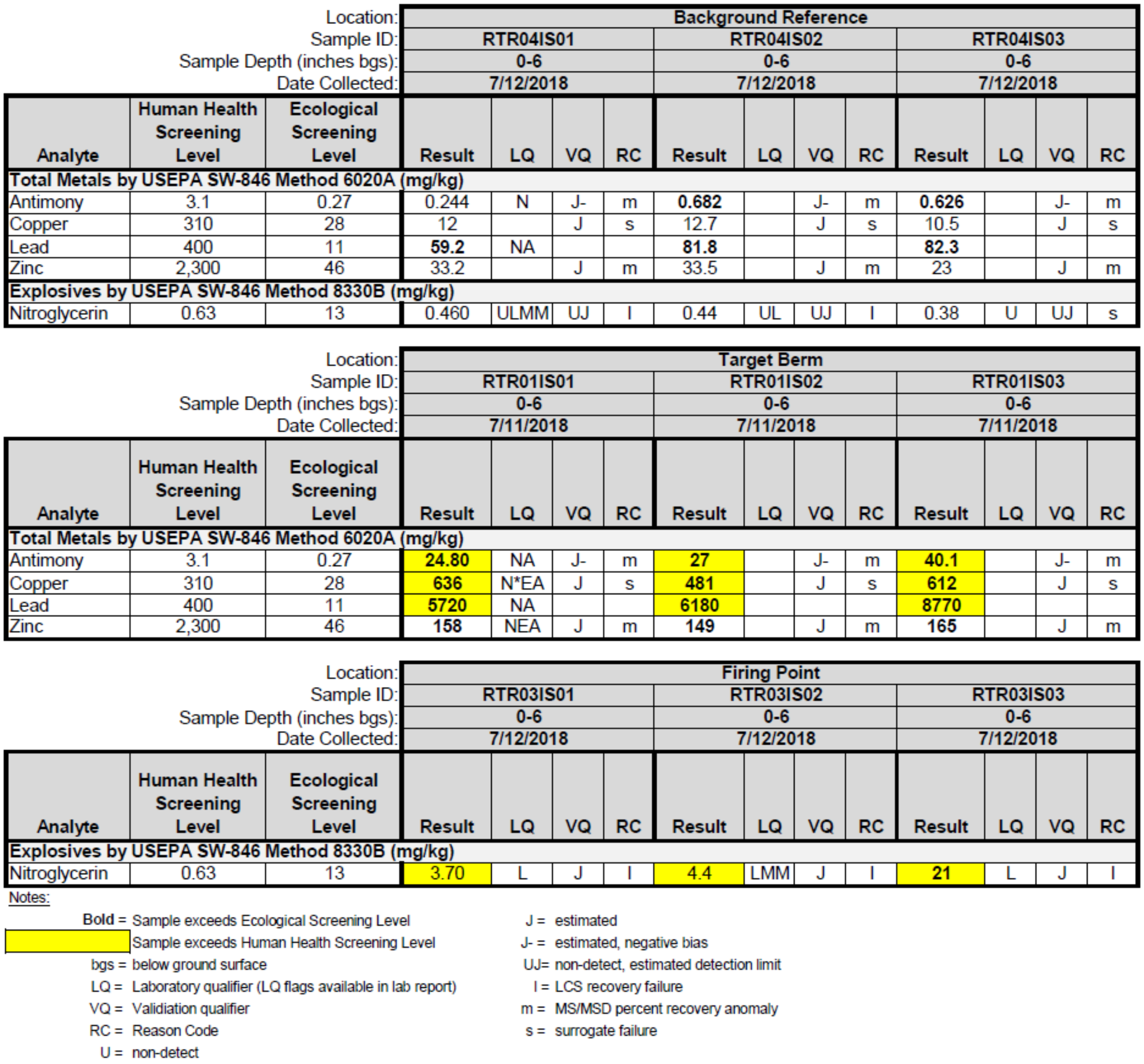
Antimony concentrations at the Target Berm ranged from 24.8 to 40.1 mg/kg. Copper concentrations ranged from 481 to 636 mg/kg. Lead concentrations ranged from 5,720 to 8,770 mg/kg. Zinc concentrations ranged from 149 to 165 mg/kg. All MC concentrations exceeded their respective ecological screening value, and all MC constituents except for zinc exceeded their respective human health screening value. All MC concentrations were elevated above their respective background concentrations (**Table 5-2**).

Firing Point

IS were collected from a 0.016-acre area at the Firing Point DU in triplicate (RTR03IS01, -02, and -03); each IS contained 36 increments of equal volume. Soil at the Firing Point was predominantly loamy/sandy loam (approximately 40% silt/clay, 50% sand, 5% gravel, and 5% cobble), significant amounts of silt, a medium amount of organic content, and 15% moisture content. A 5.56mm casing was observed on the concrete platform adjacent to the firing positions at the covered Firing Point DU.

Nitroglycerin concentrations in soil samples at the Firing Point DU ranged from 3.7 to 21 mg/kg in triplicate samples. All nitroglycerin concentrations exceeded the human health screening criteria for soil. One triplicate sample (RTR03IS03) exceeded the ecological screening criteria for soil. All nitroglycerin concentrations were elevated above background concentrations (**Table 5-2**).

Table 5-2. Incremental Sampling Results Summary



		Location:	Background Reference											
		Sample ID:	RTR04IS01				RTR04IS02				RTR04IS03			
		Sample Depth (inches bgs):	0-6				0-6				0-6			
		Date Collected:	7/12/2018				7/12/2018				7/12/2018			
Analyte	Human Health Screening Level	Ecological Screening Level	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC
Total Metals by USEPA SW-846 Method 6020A (mg/kg)														
Antimony	3.1	0.27	0.244	N	J-	m	**0.682**		J-	m	**0.626**		J-	m
Copper	310	28	12		J	s	12.7		J	s	10.5		J	s
Lead	400	11	**59.2**	NA			**81.8**				**82.3**			
Zinc	2,300	46	33.2		J	m	33.5		J	m	23		J	m
Explosives by USEPA SW-846 Method 8330B (mg/kg)														
Nitroglycerin	0.63	13	0.460	ULMM	UJ	I	0.44	UL	UJ	I	0.38	U	UJ	s

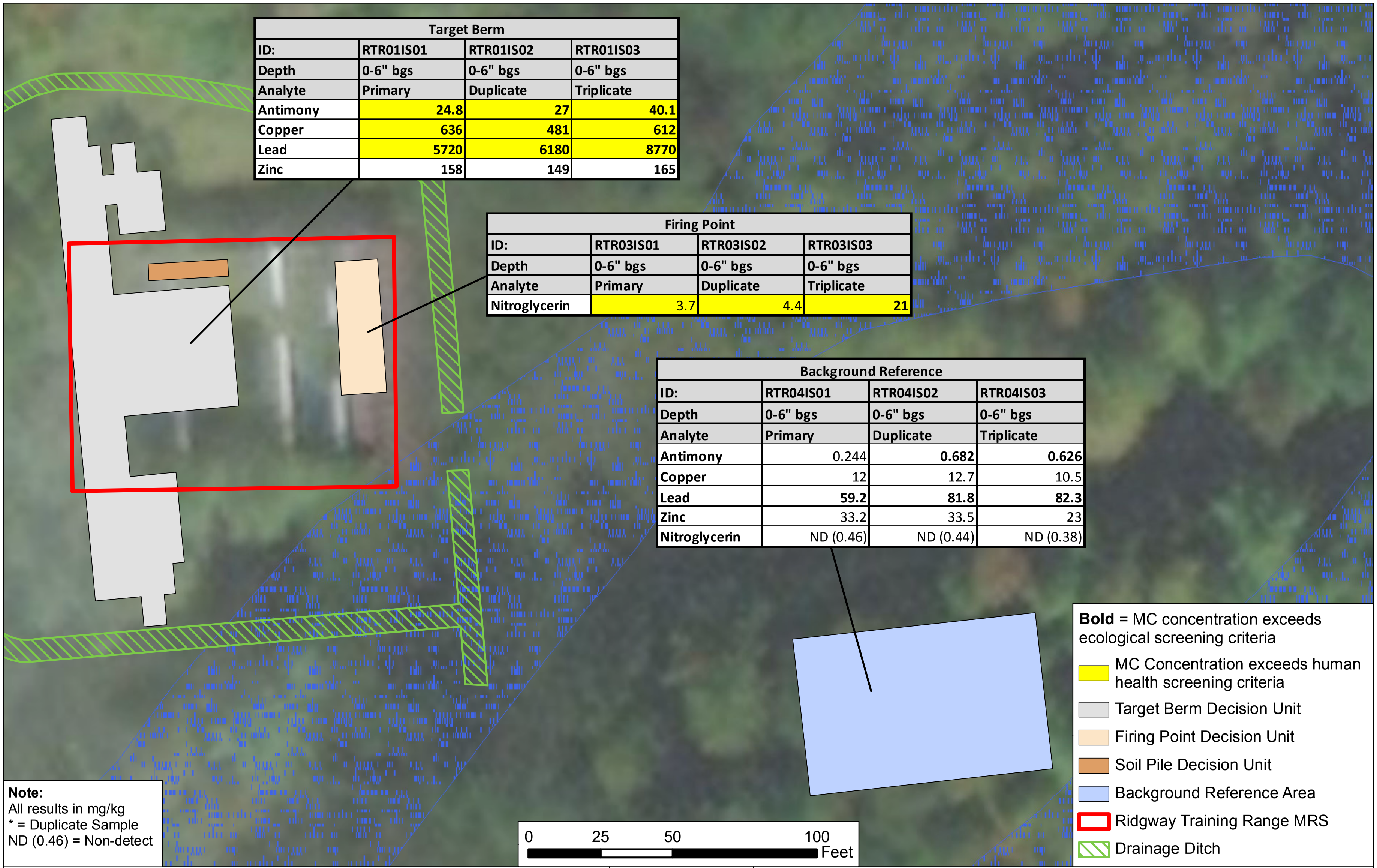
		Location:	Target Berm											
		Sample ID:	RTR01IS01				RTR01IS02				RTR01IS03			
		Sample Depth (inches bgs):	0-6				0-6				0-6			
		Date Collected:	7/11/2018				7/11/2018				7/11/2018			
Analyte	Human Health Screening Level	Ecological Screening Level	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC
Total Metals by USEPA SW-846 Method 6020A (mg/kg)														
Antimony	3.1	0.27	**24.80**	NA	J-	m	**27**		J-	m	**40.1**		J-	m
Copper	310	28	**636**	N*EA	J	s	**481**		J	s	**612**		J	s
Lead	400	11	**5720**	NA			**6180**				**8770**			
Zinc	2,300	46	**158**	NEA	J	m	**149**		J	m	**165**		J	m

		Location:	Firing Point											
		Sample ID:	RTR03IS01				RTR03IS02				RTR03IS03			
		Sample Depth (inches bgs):	0-6				0-6				0-6			
		Date Collected:	7/12/2018				7/12/2018				7/12/2018			
Analyte	Human Health Screening Level	Ecological Screening Level	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC
Explosives by USEPA SW-846 Method 8330B (mg/kg)														
Nitroglycerin	0.63	13	3.70	L	J	I	4.4	LMM	J	I	**21**	L	J	I

Notes:

Bold = Sample exceeds Ecological Screening Level
🟨 Sample exceeds Human Health Screening Level
bgs = below ground surface
LQ = Laboratory qualifier (LQ flags available in lab report)
VQ = Validiation qualifier
RC = Reason Code
U = non-detect

J = estimated
J- = estimated, negative bias
UJ= non-detect, estimated detection limit
I = LCS recovery failure
m = MS/MSD percent recovery anomaly
s = surrogate failure



Target Berm			
ID:	RTR01IS01	RTR01IS02	RTR01IS03
Depth	0-6" bgs	0-6" bgs	0-6" bgs
Analyte	Primary	Duplicate	Triplicate
Antimony	**24.8**	**27**	**40.1**
Copper	**636**	**481**	**612**
Lead	**5720**	**6180**	**8770**
Zinc	158	149	165

Firing Point			
ID:	RTR03IS01	RTR03IS02	RTR03IS03
Depth	0-6" bgs	0-6" bgs	0-6" bgs
Analyte	Primary	Duplicate	Triplicate
Nitroglycerin	3.7	4.4	**21**

Background Reference			
ID:	RTR04IS01	RTR04IS02	RTR04IS03
Depth	0-6" bgs	0-6" bgs	0-6" bgs
Analyte	Primary	Duplicate	Triplicate
Antimony	0.244	**0.682**	**0.626**
Copper	12	12.7	10.5
Lead	**59.2**	**81.8**	**82.3**
Zinc	33.2	33.5	23
Nitroglycerin	ND (0.46)	ND (0.44)	ND (0.38)

Bold = MC concentration exceeds ecological screening criteria

🟨	MC Concentration exceeds human health screening criteria
⬜	Target Berm Decision Unit
🟧	Firing Point Decision Unit
🟫	Soil Pile Decision Unit
🟦	Background Reference Area
🟥	Ridgway Training Range MRS
▨	Drainage Ditch

Note:
All results in mg/kg
* = Duplicate Sample
ND (0.46) = Non-detect

CLIENT	Army National Guard			
PROJECT	Remedial Investigation through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	11/8/2018
SCALE	1:600	CHK BY	JW	11/8/2018
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	11/8/2018

Ridgway ISM Results

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Figure 5-2

5.4 Discrete Sampling Results

Discrete samples were collected from the Target Berm, Soil Pile, Firing Point, and French Drain Outfall DUs. Surface and subsurface samples were collected to assist in delineating the lateral and vertical extent of MC in soil and sediment at the MRS DUs.

Target Berm

At the Target Berm DU, the location with the highest observed concentration of lead in surface soil via XRF analysis was at grid #06 (24,543 ppm lead), located at the southern end of the Target Berm area within the MRS walls (**Figure 5-1**). This location was selected for the collection of a TCLP sample from 0-6 inches bgs (**Figure 5-3a**). No subsurface soil sampling for small arms metals occurred at this location due to refusal at a cobble layer before reaching the 12-18 inches bgs soil layer. Two surface soil samples (RTR01DS01A and RTR01DS02A) were collected from beneath the gravel pad at the base of the Target Berm to confirm the migration of MC from the Target Berm to the range floor, where XRF analysis confirmed lead at concentrations exceeding the human health screening criterion. Both samples showed exceedances to human health screening criteria in small arms MC, confirming the pathway from the Target Berm to the range floor.

Subsurface sample locations at the Target Berm were selected to represent subsections of the expanded DU: RTR01DA01 (south of the MRS walls), RTR01DA03 (within the MRS walls), RTR01DA04 (north of the MRS walls), and RTR01DA05 (the range floor area east of the Target Berm). At each location except for RTR01DA05, a discrete sample was collected from two depths: 12-18 inch bgs (DA sample) and 24-30 inches bgs (DB sample). At RTR01DA05 the sample depth of 24-30 inches could not be reached due to refusal at a cobble layer (**Figure 5-3a**).

Subsurface soil from the 12-18 inches bgs layer at grid #22 (RTR01DA03A) and grid #91 (RTR01DA04A) exceeded the human health criterion for lead (17,500 and 10,600 mg/kg, respectively) and antimony (89.5 and 64.8 mg/kg, respectively). Copper concentrations at grid #22 (1,830 mg/kg) also exceeded the human health criterion. Copper concentrations exceeded their ecological screening levels at grid #91, and zinc concentrations in samples from both grid #22 and grid #91 exceeded the ecological screening criterion for zinc. Analytes detected in subsurface soil from the 24-30 inches bgs layer at grid #22 and grid #91 exceeded human health criterion for lead (6,360 and 824 mg/kg, respectively), and antimony (34.8 and 5.47 mg/kg, respectively). Copper concentrations in subsurface soil from the 24-30 inches bgs layer at grid #22 (961 mg/kg) also exceeded the human health criterion. Copper concentrations exceeded their ecological screening levels in subsurface soil from the 24-30 inches bgs layer at grid #91, and zinc concentrations in subsurface soil from the 24-30 inches bgs layer at both grid #22 and grid #91 exceeded the ecological screening criterion for zinc. No small arms debris (i.e., bullet fragments or casings) were observed in any subsurface samples collected. **Table 5-4** and **Figure 5-3a** present the results of discrete soil sampling at the Target Berm. Sampling at greater depths at grid #22 and grid #91 was prohibited by a cobble layer.

The TCLP sample collected from grid location #6 exhibited waste characteristics of toxicity for lead. The following TCLP metals were detected: arsenic (0.018 mg/L), barium (0.542 mg/L), cadmium (0.00692 mg/L), chromium (0.0035 mg/L), selenium (0.022 mg/L), silver (0.0031 mg/L), lead (720 mg/L), and mercury (0.000021 mg/L). Of these, lead was the only TCLP analyte to exceed its 40 CRF 261.24 Toxicity Characteristic level for solid waste (5.0 mg/L).

Two additional discrete sediment samples were collected from the drainage ditch south of the MRS to assess transport of MC from the southern end of the Target Berm to the drainage ditch sediment (RTR01DD01A and RTR01DD02A). Copper and lead exceeded their ecological screening criteria at concentrations of 79.7 and 242 mg/kg, respectively, in the sample nearest the Target Berm (RTR01DD01A). **Figure 5-4** presents the results of discrete sediment sampling at the Target Berm.

Firing Point

At the Firing Point DU, three locations were selected for subsurface sampling adjacent to and immediately downrange from the firing positions to represent the area most likely to be exposed to MC during training: RTR03DA01 (southernmost location within the Firing Point DU), RTR03DA02 (central location between the Firing Point concrete pad and northern MRS wall), and RTR03DA03 (northernmost location with the Firing Point DU).

Subsurface soil from the 12-18 inch bgs layer exceeded the human health criterion for nitroglycerin in all samples, ranging from 0.66 mg/kg to 1.3 mg/kg. Across the Firing Point DU, the sample depth of 24-30 inches could not be reached due to refusal at a cobble layer. Deeper samples were not collected from the Firing Point DU. A TCLP sample was collected from surface soil (0-6 inches bgs) at RTR03DA01. The sample did not exhibit any waste characteristics of toxicity. Nitroglycerin was ND (less than 0.002 mg/kg) in the surface soil sample. Nitroglycerin does not have a federal Toxicity Characteristic level for solid waste.

Surface soil samples were also collected at the Firing Point to determine the lateral extent of MC in DU soil. Samples were collected from three locations east of the covered Firing Point for laboratory analysis of nitroglycerin: RTR03DS01, RTR03DS02, and RTR03DS03. Nitroglycerin ranged from 0.31 mg/kg to 0.55 mg/kg in surface soil samples. Nitroglycerin did not exceed human health or ecological screening criteria in any sample. No small arms debris (i.e., bullet fragments or casings) were observed in any surface or subsurface samples collected. **Table 5-4** and **Figure 5-3b** present the results of discrete soil sampling at the Firing Point.

Soil Pile

At the Soil Pile, 12 discrete soil samples were collected at random locations across the DU. Six samples were collected from 0-12 inches below the surface of the Soil Pile (RTR02DS01A through RTR02DS06A), and six samples were collected from 12 inches above ground surface to the ground surface (RTR02DS07A through RTR02DS12A). Additionally, a discrete soil sample was collected from RTR02DS02A for waste characterization analysis (e.g., TCLP).

Soil from both layers at the Soil Pile DU exceeded the human health criteria for antimony (maximum concentration of 1080 mg/kg [RTR02DS11A]), copper (maximum concentration of 2060 mg/kg [RTR02DS10A]), and lead (maximum concentration of 57,200 mg/kg [RTR02DS11A]). Zinc concentrations did not exceed human health screening criterion, but did exceed ecological screening criterion (46 mg/kg) with a maximum concentration of 443 mg/kg [RTR02DS10A]. No small arms debris (i.e., bullet fragments or casings) were observed in any samples collected.

The TCLP sample collected from RTR02DS02A exhibited waste characteristics of toxicity for lead. The following TCLP metals were detected: barium (0.43 mg/L), cadmium (0.0019 mg/L), chromium (0.02 mg/L), selenium (0.023 mg/L), silver (0.0018 mg/L), lead (6.46 mg/L), and mercury (0.00005 mg/L). Arsenic and chromium were not detected (ND<0.025mg/L, and ND<0.02 mg/L, respectively). Of the TCLP metals detected, lead was the only analyte to exceed its 40 CRF 261.24 Toxicity Characteristic level for solid waste (5.0 mg/L). **Table 5-4** and **Figure 5-3c** present the results of discrete soil sampling at the Soil Pile.

French Drain

At the French Drain Outfall DU, eight discrete sediment samples were collected at random locations within the ponded outfall area (RTR05DD01 through RTR05DD08). One additional sample was collected approximately ten feet east of the ponded area (RTR05DD09), and one additional sample was collected approximately ten feet west of the ponded area (RTR05DD10). Sediment samples were collected from 0-6 inches bgs. Additionally, a discrete sediment sample was collected from RTR05DD02 for waste characterization analysis (e.g., TCLP).

No sediment samples from the French Drain Outfall DU exhibited MC concentrations exceeding human health screening criteria. Copper concentrations in sample RTR05DD02A (38.7 mg/kg), from within the ponded area, exceeded ecological screening criterion. Lead concentrations in all but one sample (RTR05DD07A) exceeded ecological screening criterion for lead.

The TCLP sample collected from RTR02DS02A was not analyzed due to the lack of human health screening criteria exceedances in French Drain Outfall DU sediment samples. No small arms debris (i.e., bullet fragments or casings) were observed in any samples collected. **Table 5-4** and **Figure 5-4** present the results of discrete sediment sampling at the French Drain Outfall.

Table 5-3. Discrete Soil and Sediment Sample Results

Sample ID:			RTR01DA01A				RTR01DA01B *				RTR01DC02A				RTR01DA03A				RTR01DB03A				RTR01DA04A				RTR01DB04A			
Decision Unit - XRF Location:			Target Berm - #80				Target Berm - #80				Target Berm - #6				Target Berm - #22				Target Berm - #22				Target Berm - #91				Target Berm - #91			
Media:			Soil				Soil				Soil				Soil				Soil				Soil				Soil			
Sample Depth (inches bgs):			12 - 18				12 - 18				0 - 6				12 - 18				24 - 30				12 - 18				24 - 30			
Date Collected:			7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018			
Analyte	**Human Health Screening Level (mg/kg) Soil / Sediment**	**Ecological Screening Level (mg/kg) Soil / Sediment**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																														
Antimony	3.1 / 880	0.27 / 2	**0.336**				**0.366**				--				**89.5**	N*A			**34.8**				**64.8**				**5.47**			
Copper	310 / 81000	28 / 31.6	17.3	B			16.5	B			--				**1830**	N*B			**961**	B			**298**	B			**65.1**	B		
Lead	400 / 5000	11 / 35.8	**55.8**	B	J	f	**110**	B	J	f	--				**17500**	N*BA			**6360**	B			**10600**	B			**824**	B		
Zinc	2300 / 660000	46 / 121	**81.2**				**63.4**				--				**292**	N*A			**189**				**117**				**107**			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																														
Nitroglycerin	0.63 / NA	13 / NA	--				--				--				--				--				--				--			
Toxicity Characteristics Leaching Procedure (various methods)																														
Arsenic (µg/L)	NA	NA	--				--				18	J			--				--				--				--			
Barium (µg/L)	NA	NA	--				--				542				--				--				--				--			
Cadmium (µg/L)	NA	NA	--				--				6.92	J			--				--				--				--			
Chromium (µg/L)	NA	NA	--				--				3.5	J			--				--				--				--			
Selenium (µg/L)	NA	NA	--				--				22	J			--				--				--				--			
Silver (µg/L)	NA	NA	--				--				3.1	J			--				--				--				--			
Lead (µg/L)	NA	NA	--				--				720000				--				--				--				--			
Mercury (µg/L)	NA	NA	--				--				0.021	J			--				--				--				--			
Nitroglycerin	NA	NA	--				--				--				--				--				--				--			

Notes:

* =	Field duplicate
Bold =	Sample exceeds Ecological Screening Level
🟨	Sample exceeds Human Health Screening Level
bgs =	below ground surface
LQ =	laboratory qualifier (LQ flag descriptions available in lab report)
VQ =	validiation qualifier
RC =	reason code
NA =	not applicable
B =	associated blank detection
U =	non-detect
J =	estimated
J- =	estimated, negative bias
d =	MS/MSD imprecision
f =	field duplicate imprecision
m =	MS/MSD percent recovery anomaly
s =	surrogate failure
z =	preparation/method blank anomaly

Table 5-3. Discrete Soil and Sediment Sample Results (continued)

Sample ID:			RTR01DA05A				RTR01DS01A				RTR01DS02A				RTR01DD01A				RTR01DD02A				RTR02DS01A				RTR02DS01B			
Decision Unit - XRF Location:			Target Berm - #45				Target Berm - NA				Target Berm - NA				Target Berm - NA				Target Berm - NA				Soil Pile - NA				Soil Pile - NA			
Media:			Soil				Soil				Soil				Sediment				Sediment				Soil				Soil			
Sample Depth (inches bgs):			12 - 18				0-6				0-6				0-6				0-6				0 - 12				0 - 12			
Date Collected:			7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/9/2018				7/9/2018			
Analyte	Human Health Screening Level (mg/kg) Soil / Sediment	Ecological Screening Level (mg/kg) Soil / Sediment	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																														
Antimony	3.1 / 880	0.27 / 2	0.195				**46.2**				**4.14**				0.966				0.18				**51.2**	N*	J	d	**4.93**		J	d
Copper	310 / 81000	28 / 31.6	20.8	B			**600**				**57**				**79.7**				15.3	B			**828**	NA	J	f	**145**		J	f
Lead	400 / 5000	11 / 35.8	**41.2**	B			**7990**				**1130**				**242**				15.8	B			**6940**	N*A	J	d	**999**		J	d
Zinc	2300 / 660000	46 / 121	**62.2**				**159**				**93.2**				74.9				62.4				**266**	N	J	f	**106**		J	f
Explosives by USEPA SW-846 Method 8330B (mg/kg)																														
Nitroglycerin	0.63 / NA	13 / NA	--				--				--				--				--				--				--			
Toxicity Characteristics Leaching Procedure (various methods)																														
Arsenic (µg/L)	NA	NA	--				--				--				--				--				--				--			
Barium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Cadmium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Chromium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Selenium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Silver (µg/L)	NA	NA	--				--				--				--				--				--				--			
Lead (µg/L)	NA	NA	--				--				--				--				--				--				--			
Mercury (µg/L)	NA	NA	--				--				--				--				--				--				--			
Nitroglycerin	NA	NA	--				--				--				--				--				--				--			

Notes:

* = Field duplicate
Bold = Sample exceeds Ecological Screening Level
🟨 Sample exceeds Human Health Screening Level
bgs = below ground surface
LQ = laboratory qualifier (LQ flag descriptions available in lab report)
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table 5-3. Discrete Soil and Sediment Sample Results (continued)

		Sample ID:	**RTR02DS02A**				**RTR02DS03A**				**RTR02DS04A**				**RTR02DS05A**				**RTR02DS06A**				**RTR02DS07A**				**RTR02DS08A**			
		Decision Unit - XRF Location:	**Soil Pile - NA**				**Soil Pile - NA**				**Soil Pile - NA**				**Soil Pile - NA**				**Soil Pile - NA**				**Soil Pile - NA**				**Soil Pile - NA**			
		Media:	**Soil**				**Soil**				**Soil**				**Soil**				**Soil**				**Soil**				**Soil**			
		Sample Depth (inches bgs):	**0 - 12**				**0 - 12**				**0 - 12**				**0 - 12**				**0 - 12**				**24 - 36**				**24 - 36**			
		Date Collected:	**7/9/2018**				**7/9/2018**				**7/9/2018**				**7/9/2018**				**7/9/2018**				**7/9/2018**				**7/9/2018**			
Analyte	**Human Health Screening Level (mg/kg) Soil / Sediment**	**Ecological Screening Level (mg/kg) Soil / Sediment**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																														
Antimony	3.1 / 880	0.27 / 2	**58.5**		J	d	**15.2**		J	d	**10.2**		J	d	**2.24**		J	d	**7.74**		J	d	**40.4**		J	d	**97.5**		J	d
Copper	310 / 81000	28 / 31.6	**1740**				**278**				**202**				**76.6**				**149**				**733**				**929**			
Lead	400 / 5000	11 / 35.8	**8980**		J	d	**2460**		J	d	**1660**		J	d	**672**		J	d	**1570**		J	d	**6340**		J	d	**14100**		J	d
Zinc	2300 / 660000	46 / 121	**314**				**122**				**112**				**211**				**134**				**209**				**214**			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																														
Nitroglycerin	0.63 / NA	13 / NA	--				--				--				--				--				--				--			
Toxicity Characteristics Leaching Procedure (various methods)																														
Arsenic (µg/L)	NA	NA	25	U			--				--				--				--				--				--			
Barium (µg/L)	NA	NA	430	B	B	z	--				--				--				--				--				--			
Cadmium (µg/L)	NA	NA	1.9	J			--				--				--				--				--				--			
Chromium (µg/L)	NA	NA	20	U			--				--				--				--				--				--			
Selenium (µg/L)	NA	NA	23	J			--				--				--				--				--				--			
Silver (µg/L)	NA	NA	1.8	J			--				--				--				--				--				--			
Lead (µg/L)	NA	NA	6460				--				--				--				--				--				--			
Mercury (µg/L)	NA	NA	0.05	J			--				--				--				--				--				--			
Nitroglycerin	NA	NA	--				--				--				--				--				--				--			

Notes:

* = Field duplicate
Bold = Sample exceeds Ecological Screening Level
🟨 Sample exceeds Human Health Screening Level
bgs = below ground surface
LQ = laboratory qualifier (LQ flag descriptions available in lab report)
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table 5-3. Discrete Soil and Sediment Sample Results (continued)

		Sample ID:	RTR02DS09A				RTR02DS10A				RTR02DS11A				RTR02DS12A				RTR03DS01A				RTR03DS01B				RTR03DS02A			
		Decision Unit - XRF Location:	Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Firing Point - NA				Firing Point - NA				Firing Point - NA			
		Media:	Soil				Soil				Soil				Soil				Soil				Soil				Soil			
		Sample Depth (inches bgs):	24 - 36				24 - 36				24 - 36				24 - 36				0 - 6				0-6				0-6			
		Date Collected:	7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018			
Analyte	**Human Health Screening Level (mg/kg) Soil / Sediment**	**Ecological Screening Level (mg/kg) Soil / Sediment**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																														
Antimony	3.1 / 880	0.27 / 2	**41.2**		J	d	**226**		J	d	**1080**		J	d	**36.5**		J	d	--				--				--			
Copper	310 / 81000	28 / 31.6	**977**				**2060**				**675**				**947**				--				--				--			
Lead	400 / 5000	11 / 35.8	**6040**		J	d	**25000**		J	d	**57200**		J	d	**4920**		J	d	--				--				--			
Zinc	2300 / 660000	46 / 121	**220**				**443**				**165**				**213**				--				--				--			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																														
Nitroglycerin	0.63 / NA	13 / NA	--				--				--				--				0.31	J	J+	s	0.26	J	J+	s	0.55	U		
Toxicity Characteristics Leaching Procedure (various methods)																														
Arsenic (µg/L)	NA	NA	--				--				--				--				--				--				--			
Barium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Cadmium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Chromium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Selenium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Silver (µg/L)	NA	NA	--				--				--				--				--				--				--			
Lead (µg/L)	NA	NA	--				--				--				--				--				--				--			
Mercury (µg/L)	NA	NA	--				--				--				--				--				--				--			
Nitroglycerin	NA	NA	--				--				--				--				--				--				--			

Notes:

* = Field duplicate
Bold = Sample exceeds Ecological Screening Level
🟨 Sample exceeds Human Health Screening Level
bgs = below ground surface
LQ = laboratory qualifier (LQ flag descriptions available in lab report)
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table 5-3. Discrete Soil and Sediment Sample Results (continued)

Sample ID:			RTR03DS03A				RTR03DA01A				RTR03DA02A				RTR03DA03A				RTR03DA03B*				RTR03DC01A				RTR05DD01A			
Decision Unit - XRF Location:			Firing Point - NA				Firing Point - NA				Firing Point - NA				Firing Point - NA				Firing Point - NA				Firing Point - NA				French Drain - NA			
Media:			Soil				Soil				Soil				Soil				Soil				Soil				Sediment			
Sample Depth (inches bgs):			0-6				12 - 18				12 - 18				12 - 18				12 - 18				0-6				0-6			
Date Collected:			7/9/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018			
Analyte	**Human Health Screening Level (mg/kg) Soil / Sediment**	**Ecological Screening Level (mg/kg) Soil / Sediment**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																														
Antimony	3.1 / 880	0.27 / 2	--				--				--				--				--				--				0.253	N		
Copper	310 / 81000	28 / 31.6	--				--				--				--				--				--				17.4	NB		
Lead	400 / 5000	11 / 35.8	--				--				--				--				--				--				**106**	NBA	J	f
Zinc	2300 / 660000	46 / 121	--				--				--				--				--				--				48.4			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																														
Nitroglycerin	0.63 / NA	13 / NA	0.6	U			0.66	JM	J+	m	1.2				0.32	J			1.3		J+	s	0.002	U			--			
Toxicity Characteristics Leaching Procedure (various methods)																														
Arsenic (µg/L)	NA	NA	--				--				--				--				--				--				--			
Barium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Cadmium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Chromium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Selenium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Silver (µg/L)	NA	NA	--				--				--				--				--				--				--			
Lead (µg/L)	NA	NA	--				--				--				--				--				--				--			
Mercury (µg/L)	NA	NA	--				--				--				--				--				--				--			
Nitroglycerin	NA	NA	--				--				--				--				--				0.002	U			--			

Notes:

* = Field duplicate
Bold = Sample exceeds Ecological Screening Level
🟨 Sample exceeds Human Health Screening Level
bgs = below ground surface
LQ = laboratory qualifier (LQ flag descriptions available in lab report)
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table 5-3. Discrete Soil and Sediment Sample Results (continued)

		Sample ID:	RTR05DD01B				RTR05DD02A				RTR05DD03A				RTR05DD04A				RTR05DD05A				RTR05DD06A				RTR05DD07A			
		Decision Unit - XRF Location:	French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA			
		Media:	Sediment				Sediment				Sediment				Sediment				Sediment				Sediment				Sediment			
		Sample Depth (inches bgs):	0-6				0-6				0-6				0-6				0-6				0-6				0-6			
		Date Collected:	7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018			
Analyte	**Human Health Screening Level (mg/kg) Soil / Sediment**	**Ecological Screening Level (mg/kg) Soil / Sediment**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																														
Antimony	3.1 / 880	0.27 / 2	0.362				0.29				0.2				0.264				0.638				0.152				0.092	J		
Copper	310 / 81000	28 / 31.6	25.2	B			**38.7**	B			20.7	B			13.2	B			29.6	B			12.2	B			6.63	B		
Lead	400 / 5000	11 / 35.8	**179**	B	J	f	**358**	B			**81.8**	B			**37.3**	B			**189**	B			**58**	B			17.6	B		
Zinc	2300 / 660000	46 / 121	56.6				58.2				51				58.8				42.4				34.7				37.7			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																														
Nitroglycerin	0.63 / NA	13 / NA	--				--				--				--				--				--				--			
Toxicity Characteristics Leaching Procedure (various methods)																														
Arsenic (µg/L)	NA	NA	--				--				--				--				--				--				--			
Barium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Cadmium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Chromium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Selenium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Silver (µg/L)	NA	NA	--				--				--				--				--				--				--			
Lead (µg/L)	NA	NA	--				--				--				--				--				--				--			
Mercury (µg/L)	NA	NA	--				--				--				--				--				--				--			
Nitroglycerin	NA	NA	--				--				--				--				--				--				--			

Notes:

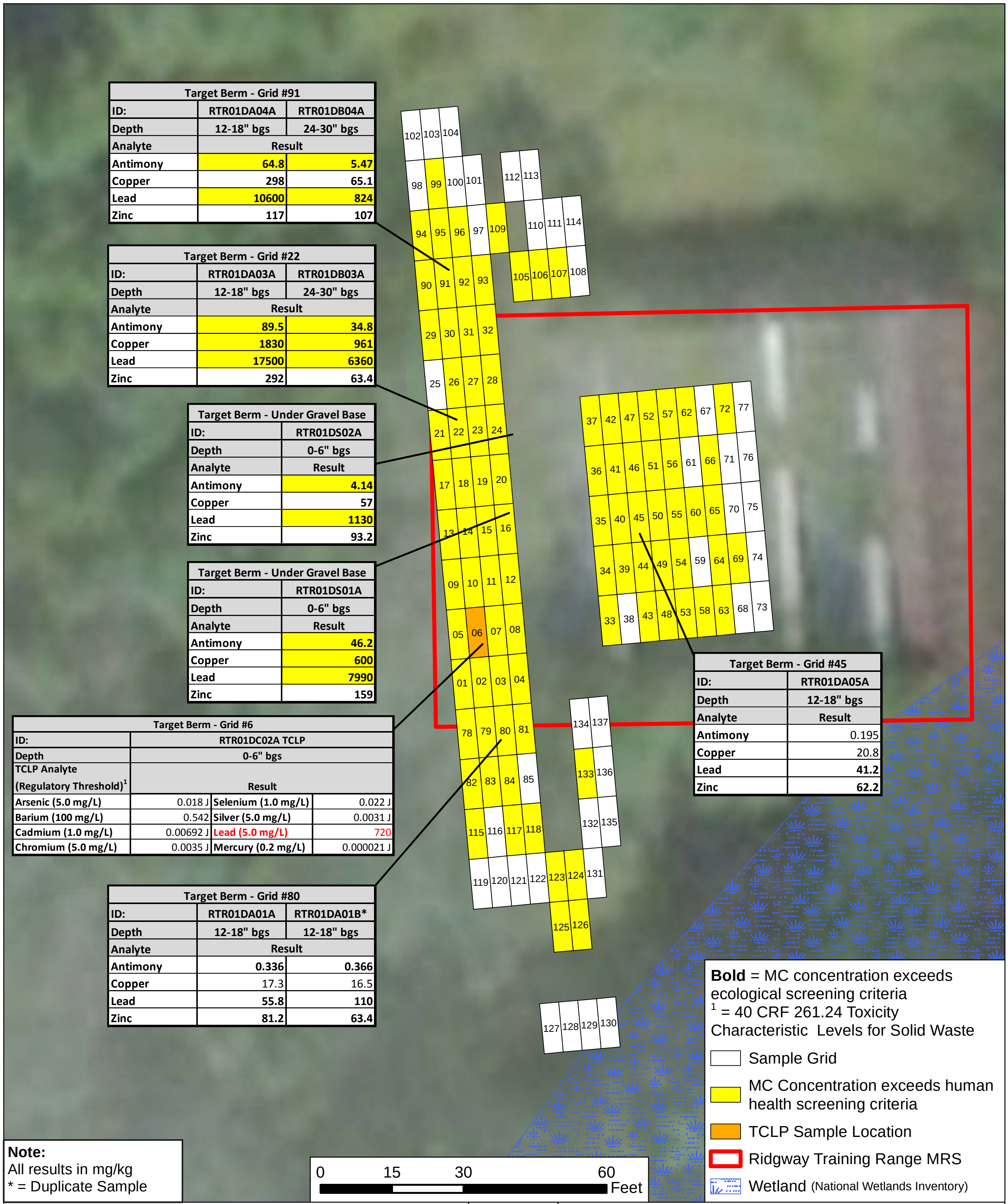
* = Field duplicate
Bold = Sample exceeds Ecological Screening Level
🟨 Sample exceeds Human Health Screening Level
bgs = below ground surface
LQ = laboratory qualifier (LQ flag descriptions available in lab report)
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table 5-3. Discrete Soil and Sediment Sample Results (continued)

Sample ID:			RTR05DD08A				RTR05DD09A				RTR05DD10A			
Decision Unit - XRF Location:			French Drain - NA				French Drain - NA				French Drain - NA			
Media:			Sediment				Sediment				Sediment			
Sample Depth (inches bgs):			0-6				0-6				0-6			
Date Collected:			7/12/2018				7/12/2018				7/12/2018			
Analyte	**Human Health Screening Level (mg/kg) Soil / Sediment**	**Ecological Screening Level (mg/kg) Soil / Sediment**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)														
Antimony	3.1 / 880	0.27 / 2	0.438				0.36				0.236			
Copper	310 / 81000	28 / 31.6	30.3	B			31.5	B			20.6	B		
Lead	400 / 5000	11 / 35.8	**120**	B			**124**	B			**67.3**	B		
Zinc	2300 / 660000	46 / 121	58.1				53.2				71.1			
Explosives by USEPA SW-846 Method 8330B (mg/kg)														
Nitroglycerin	0.63 / NA	13 / NA	--				--				--			
Toxicity Characteristics Leaching Procedure (various methods)														
Arsenic (µg/L)	NA	NA	--				--				--			
Barium (µg/L)	NA	NA	--				--				--			
Cadmium (µg/L)	NA	NA	--				--				--			
Chromium (µg/L)	NA	NA	--				--				--			
Selenium (µg/L)	NA	NA	--				--				--			
Silver (µg/L)	NA	NA	--				--				--			
Lead (µg/L)	NA	NA	--				--				--			
Mercury (µg/L)	NA	NA	--				--				--			
Nitroglycerin	NA	NA	--				--				--			

Notes:

* = Field duplicate
Bold = Sample exceeds Ecological Screening Level
🟨 Sample exceeds Human Health Screening Level
bgs = below ground surface
LQ = laboratory qualifier (LQ flag descriptions available in lab report)
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly



Target Berm - Grid #91		
ID:	RTR01DA04A	RTR01DB04A
Depth	12-18" bgs	24-30" bgs
Analyte	Result	
Antimony	**64.8**	**5.47**
Copper	**298**	**65.1**
Lead	**10600**	**824**
Zinc	**117**	**107**

Target Berm - Grid #22		
ID:	RTR01DA03A	RTR01DB03A
Depth	12-18" bgs	24-30" bgs
Analyte	Result	
Antimony	**89.5**	**34.8**
Copper	**1830**	**961**
Lead	**17500**	**6360**
Zinc	**292**	**63.4**

Target Berm - Under Gravel Base	
ID:	RTR01DS02A
Depth	0-6" bgs
Analyte	Result
Antimony	**4.14**
Copper	**57**
Lead	**1130**
Zinc	**93.2**

Target Berm - Under Gravel Base	
ID:	RTR01DS01A
Depth	0-6" bgs
Analyte	Result
Antimony	**46.2**
Copper	**600**
Lead	**7990**
Zinc	**159**

Target Berm - Grid #6			
ID:	RTR01DC02A TCLP		
Depth	0-6" bgs		
TCLP Analyte (Regulatory Threshold)[1]	Result		
Arsenic (5.0 mg/L)	0.018 J	Selenium (1.0 mg/L)	0.022 J
Barium (100 mg/L)	0.542	Silver (5.0 mg/L)	0.0031 J
Cadmium (1.0 mg/L)	0.00692 J	Lead (5.0 mg/L)	720
Chromium (5.0 mg/L)	0.0035 J	Mercury (0.2 mg/L)	0.000021 J

Target Berm - Grid #80		
ID:	RTR01DA01A	RTR01DA01B*
Depth	12-18" bgs	12-18" bgs
Analyte	Result	
Antimony	**0.336**	**0.366**
Copper	17.3	16.5
Lead	**55.8**	**110**
Zinc	**81.2**	**63.4**

Target Berm - Grid #45	
ID:	RTR01DA05A
Depth	12-18" bgs
Analyte	Result
Antimony	0.195
Copper	20.8
Lead	**41.2**
Zinc	**62.2**

Note:
All results in mg/kg
* = Duplicate Sample

Bold = MC concentration exceeds ecological screening criteria
[1] = 40 CRF 261.24 Toxicity Characteristic Levels for Solid Waste

- ☐ Sample Grid
- 🟨 MC Concentration exceeds human health screening criteria
- 🟧 TCLP Sample Location
- 🟥 Ridgway Training Range MRS
- ▨ Wetland (National Wetlands Inventory)

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	2/21/2019
SCALE	1:360	CHK BY	JW	2/21/2019
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	2/21/2019

Target Berm Discrete Soil Sample Results

AECOM
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Germantown, MD 20876

Figure 5-3A

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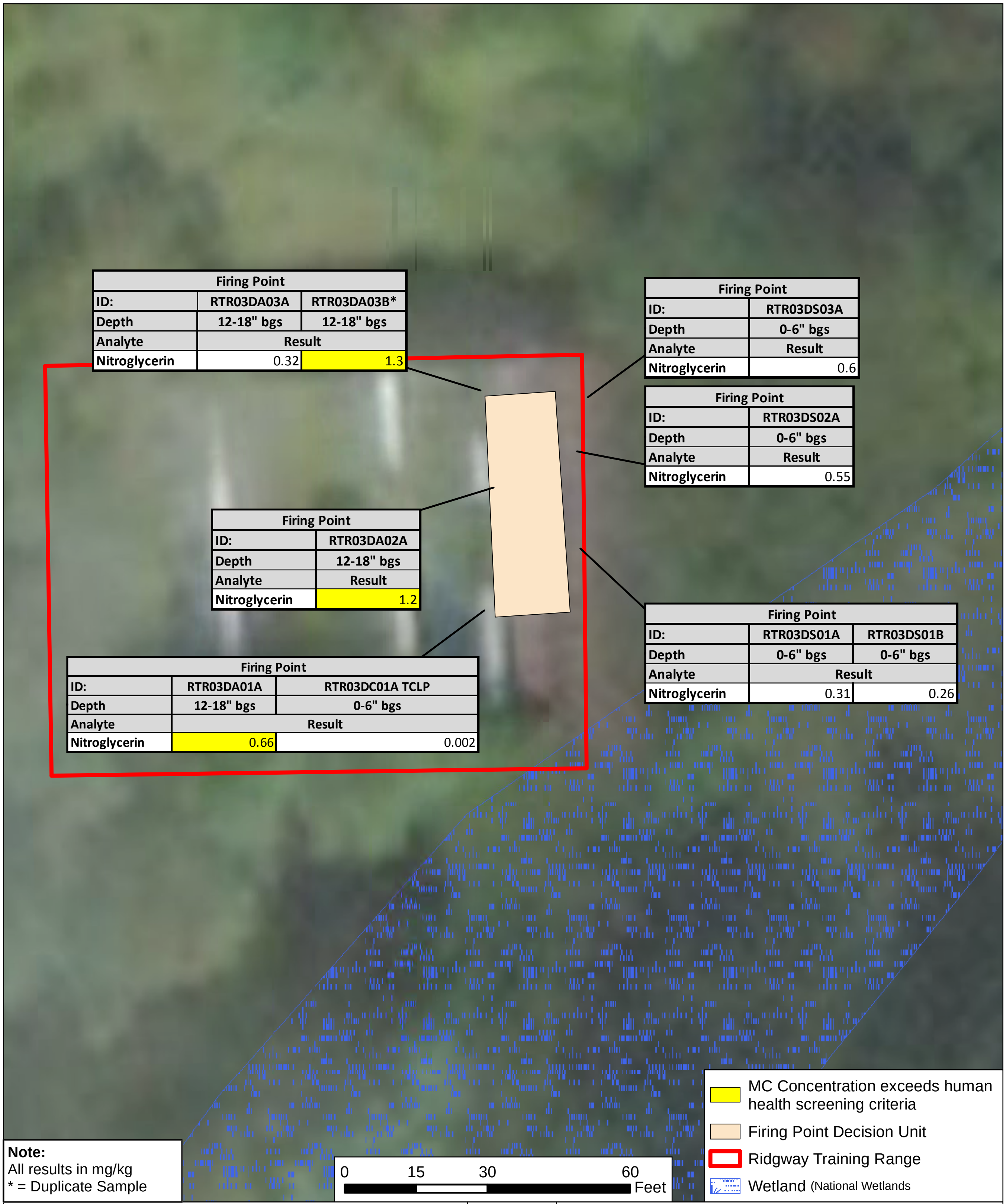

Firing Point		
ID:	**RTR03DA03A**	**RTR03DA03B***
Depth	**12-18" bgs**	**12-18" bgs**
Analyte	**Result**	
Nitroglycerin	0.32	1.3

Firing Point	
ID:	**RTR03DS03A**
Depth	**0-6" bgs**
Analyte	**Result**
Nitroglycerin	0.6

Firing Point	
ID:	**RTR03DS02A**
Depth	**0-6" bgs**
Analyte	**Result**
Nitroglycerin	0.55

Firing Point	
ID:	**RTR03DA02A**
Depth	**12-18" bgs**
Analyte	**Result**
Nitroglycerin	1.2

Firing Point		
ID:	**RTR03DS01A**	**RTR03DS01B**
Depth	**0-6" bgs**	**0-6" bgs**
Analyte	**Result**	
Nitroglycerin	0.31	0.26

Firing Point		
ID:	**RTR03DA01A**	**RTR03DC01A TCLP**
Depth	**12-18" bgs**	**0-6" bgs**
Analyte	**Result**	
Nitroglycerin	0.66	0.002

Note:
All results in mg/kg
* = Duplicate Sample

🟨 MC Concentration exceeds human health screening criteria
▭ Firing Point Decision Unit
🟥 Ridgway Training Range
▨ Wetland (National Wetlands

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	2/21/2019
SCALE	1:360	CHK BY	JW	2/21/2019
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	2/21/2019

Firing Point Discrete Soil Sample Results

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Figure 5-3B

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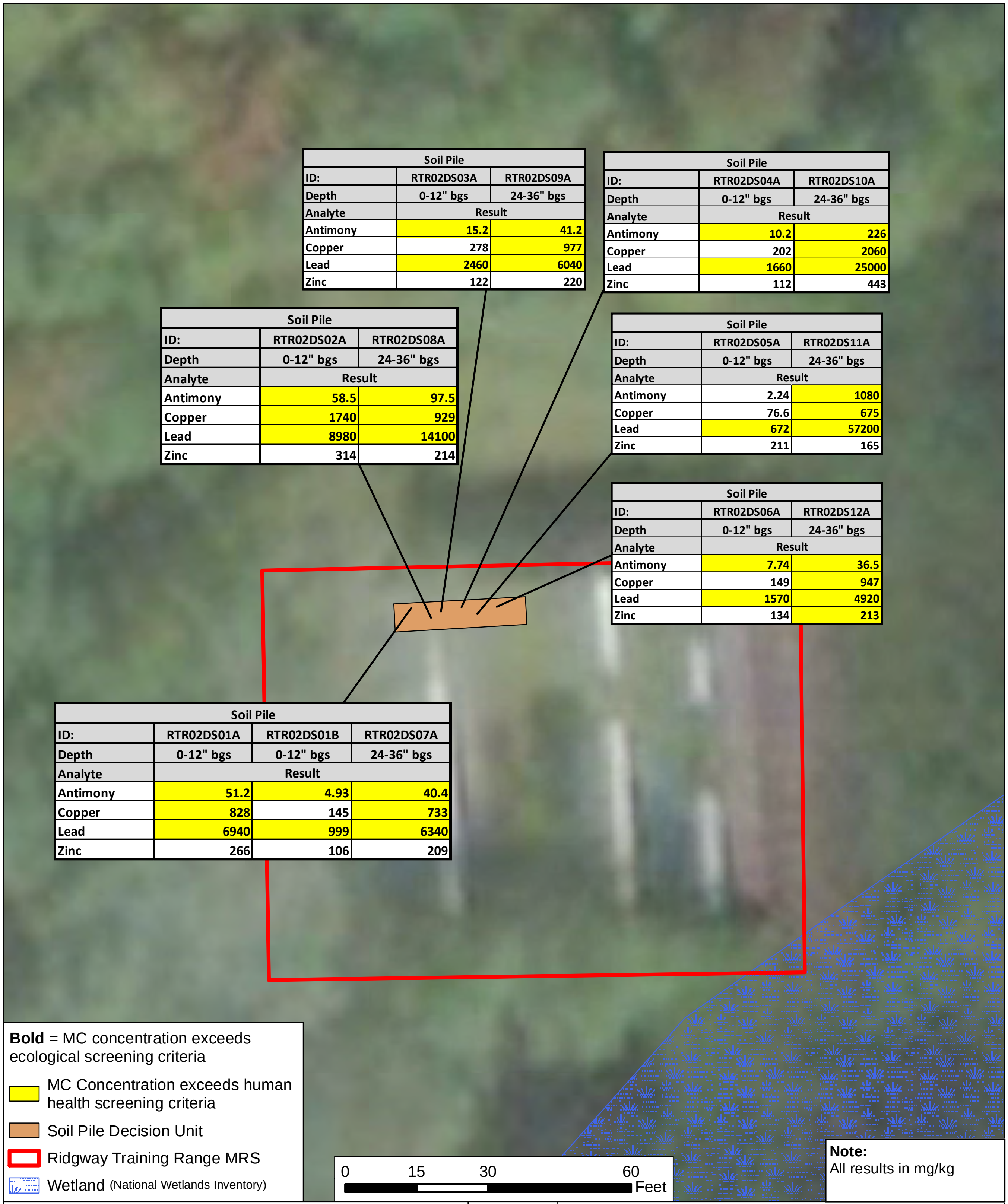

Soil Pile		
ID:	RTR02DS03A	RTR02DS09A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	15.2	41.2
Copper	278	977
Lead	2460	6040
Zinc	122	220

Soil Pile		
ID:	RTR02DS04A	RTR02DS10A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	10.2	226
Copper	202	2060
Lead	1660	25000
Zinc	112	443

Soil Pile		
ID:	RTR02DS02A	RTR02DS08A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	58.5	97.5
Copper	1740	929
Lead	8980	14100
Zinc	314	214

Soil Pile		
ID:	RTR02DS05A	RTR02DS11A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	2.24	1080
Copper	76.6	675
Lead	672	57200
Zinc	211	165

Soil Pile		
ID:	RTR02DS06A	RTR02DS12A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	7.74	36.5
Copper	149	947
Lead	1570	4920
Zinc	134	213

Soil Pile			
ID:	RTR02DS01A	RTR02DS01B	RTR02DS07A
Depth	0-12" bgs	0-12" bgs	24-36" bgs
Analyte	Result		
Antimony	51.2	4.93	40.4
Copper	828	145	733
Lead	6940	999	6340
Zinc	266	106	209

Bold = MC concentration exceeds ecological screening criteria

🟨 MC Concentration exceeds human health screening criteria

🟫 Soil Pile Decision Unit

🟥 Ridgway Training Range MRS

▨ Wetland (National Wetlands Inventory)

Note:
All results in mg/kg

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	10/16/2018
SCALE	1:360	CHK BY	AS	10/16/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	10/16/2018

Soil Pile Discrete Soil Sample Results

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Figure 5-3c

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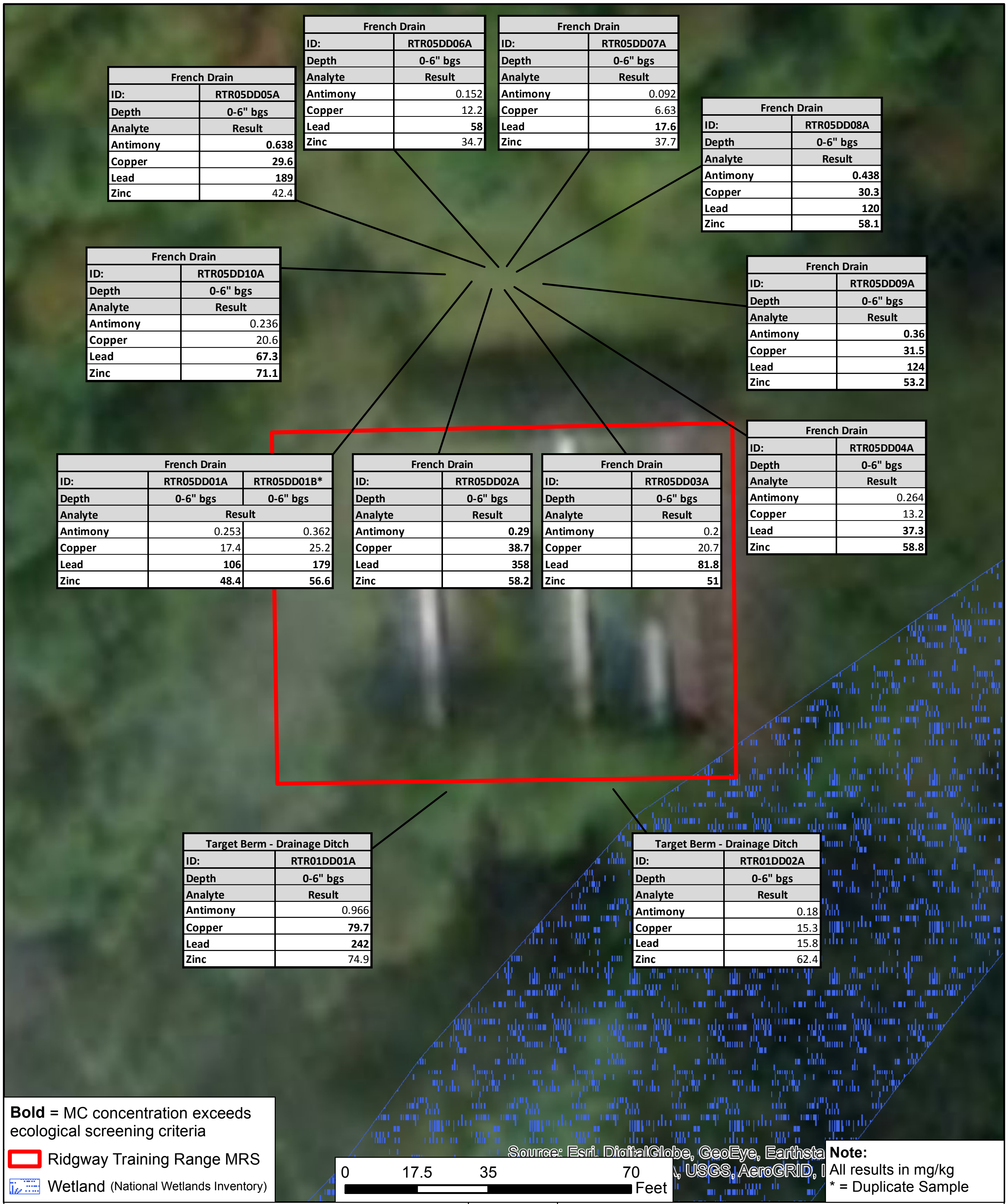

French Drain	
ID:	RTR05DD05A
Depth	0-6" bgs
Analyte	Result
Antimony	**0.638**
Copper	**29.6**
Lead	**189**
Zinc	42.4

French Drain	
ID:	RTR05DD06A
Depth	0-6" bgs
Analyte	Result
Antimony	0.152
Copper	12.2
Lead	**58**
Zinc	34.7

French Drain	
ID:	RTR05DD07A
Depth	0-6" bgs
Analyte	Result
Antimony	0.092
Copper	6.63
Lead	**17.6**
Zinc	37.7

French Drain	
ID:	RTR05DD08A
Depth	0-6" bgs
Analyte	Result
Antimony	**0.438**
Copper	**30.3**
Lead	**120**
Zinc	**58.1**

French Drain	
ID:	RTR05DD10A
Depth	0-6" bgs
Analyte	Result
Antimony	0.236
Copper	20.6
Lead	**67.3**
Zinc	**71.1**

French Drain	
ID:	RTR05DD09A
Depth	0-6" bgs
Analyte	Result
Antimony	**0.36**
Copper	**31.5**
Lead	**124**
Zinc	**53.2**

French Drain		
ID:	RTR05DD01A	RTR05DD01B*
Depth	0-6" bgs	0-6" bgs
Analyte	Result	
Antimony	0.253	0.362
Copper	17.4	25.2
Lead	**106**	**179**
Zinc	**48.4**	**56.6**

French Drain	
ID:	RTR05DD02A
Depth	0-6" bgs
Analyte	Result
Antimony	**0.29**
Copper	**38.7**
Lead	**358**
Zinc	**58.2**

French Drain	
ID:	RTR05DD03A
Depth	0-6" bgs
Analyte	Result
Antimony	0.2
Copper	20.7
Lead	**81.8**
Zinc	**51**

French Drain	
ID:	RTR05DD04A
Depth	0-6" bgs
Analyte	Result
Antimony	0.264
Copper	13.2
Lead	**37.3**
Zinc	**58.8**

Target Berm - Drainage Ditch	
ID:	RTR01DD01A
Depth	0-6" bgs
Analyte	Result
Antimony	0.966
Copper	**79.7**
Lead	**242**
Zinc	74.9

Target Berm - Drainage Ditch	
ID:	RTR01DD02A
Depth	0-6" bgs
Analyte	Result
Antimony	0.18
Copper	15.3
Lead	15.8
Zinc	62.4

Bold = MC concentration exceeds ecological screening criteria

🟥 Ridgway Training Range MRS

▨ Wetland (National Wetlands Inventory)

Note:
All results in mg/kg
* = Duplicate Sample

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	11/1/2018
SCALE	1:420	CHK BY	JW	11/1/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	11/1/2018

Discrete Sediment Sample Results

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Figure 5-4

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6 Contaminant Fate and Transport

This section discusses routes of migration and contaminant persistence for MC at the Ridgway Training Range MRS (PAE40-001-R-01) investigated during this RI. A preliminary CSM presented in **Section 2.6** and **Figure 2-2** included an analysis of the potential routes of migration and potential receptors.

6.1 Contaminant Migration

Small arms MC have been released directly to berm soil during historical small arms training activities through fragmentation and pulverization of bullets on impact. MC appears to have been transported from berm soil downgradient to the east within the MRS boundary on the range floor, and to the north and south of the MRS boundary via movement of soil by the landowner or runoff via precipitation. A drainage ditch downgradient and south of the MRS connects to a freshwater forested/shrub wetland that may potentially receive suspended MC during heavy rainfall. Additionally, the French drain Outfall area becomes inundated during precipitation and flows towards the same wetland.

Potential disturbance of the DU soil is also possible during maintenance (e.g., landscaping) activities that might occur within the MRS in the future. MC in soil at the Soil Pile and Firing Point is expected to remain in place due to the confining MRS walls.

XRF analysis of soil north of the MRS was able to clearly delineate the extent of small arms MC, verifying that impacted soil was not migrating away from source areas (berm soil) north beyond the French Drain Outfall. Furthermore, all MC concentrations in sediment samples from the French Drain Outfall DU were below their respective human health criteria. Although heavy rain may facilitate standing water in the French Drain Outfall area to flow towards the wetland east of the MRS, MC concentrations are below human health screening criteria, and surface water and sediment samples collected during the SI did not indicate the presence of elevated MC in the wetland area.

XRF analysis of soil south of the MRS exceeded the human health criterion for lead in samples abutting the drainage ditch; however, MC concentrations in sediment samples collected from the drainage ditch south of the MRS were below their respective human health criterion. Furthermore, SI samples indicated that MC concentrations in surface water and sediment in the wetland area downgradient from the MRS that confluences with the drainage ditch are below human health and ecological screening criteria (Parsons, 2011).

Nitroglycerin is present in soil at the Firing Point at levels exceeding human health screening criteria, but based on the absence of nitroglycerin exceedances in samples collected east of the Firing Point and the covered nature of the Firing Point, nitroglycerin is not anticipated to migrate beyond the covered DU. Additionally, nitroglycerin photodegrades over time, making the persistence of any nitroglycerin beyond the covered Firing Point extremely unlikely.

Metals and nitroglycerin MC also have the potential to be released to groundwater through leaching and/or infiltration mechanisms where groundwater is shallow (≤ 5 feet bgs). Groundwater at the MRS is approximately 30 feet bgs (Cross Section A-A’, **Figure 2-2**), precluding potential groundwater impacts. Moreover, most lead that is released to the environment is retained in the soil (Evans, 1989). The primary processes influencing the fate of lead in soil include adsorption, ion exchange, precipitation, and complexation with sorbed organic matter. These processes limit the amount of lead that can be transported to surface water or groundwater. Additionally, MC concentrations in the subsurface samples (24-30 inches bgs layer) from the two locations at the Target Berm DU where MC concentrations from the 12-18 inches bgs layer exceeded human health criterion indicated that subsurface impacts decrease with depth.

6.2 Contaminant Persistence

Metals do not readily weather in the environment. Typically, metals in soil form reaction products that become incorporated into soil minerals, precipitate as oxides or hydroxides, or form coatings on minerals (Oak Ridge National Laboratory, 1989). These forms of metals have low mobility in soils. The inherent insolubility of metals, coupled with their related high soil/water partition coefficients, indicate that the metals would be relatively immobile in DU soil and sediment.

7 Risk Assessment

Analytical data generated from ISM samples collected during the RI field investigation were compared with conservative risk-based screening criteria and background reference data, also collected concurrently during the RI, to evaluate whether past small-arms training activities have resulted in contaminant releases exceeding human health or ecological screening criteria. The results of the screening determined whether further risk assessment was necessary.

Each DU was identified as the area over which a receptor is likely to be exposed to potentially contaminated soil within the MRS (exposure area). For this RI, those areas were the Target Berm, the Soil Pile, the Firing Point, and the French Drain Outfall area. The ISM sampling approach used provided a reasonably unbiased and representative estimate of the mean concentrations of MC that receptors would likely be exposed to at the Target Berm and at the Firing Point DUs. ISM sampling was not performed at the Soil Pile or French Drain Outfall DUs due to the small size of the DUs. Discrete samples were collected at the Soil Pile and French Drain Outfall DUs.

As a conservative approach for each DU, the maximum detected concentration of individual small arms MC among the IS triplicates were compared with human health and ecological screening criteria during the RI to determine if an HHRA and/or screening level ecological risk assessment (SLERA) were necessary. The selection of human health and ecological screening criteria used during this RI is presented in **Section 3.3.1** and **Table 3-2**.

Due to small arms MC exceedances of RI screening criteria for human health and ecological health, an HHRA and SLERA were conducted for the MRS. The HHRA and SLERA are presented in sections **7.1** and **7.2**, and **Appendices E** and **F**, respectively.

7.1 Human Health Risk Assessment

The HHRA was conducted as part of the RI to evaluate whether COPCs attributable to past site activities have the potential to cause unacceptable adverse health effects to human receptors at the MRS. Results of the HHRA are used to assess risk management options for the MRS, including possible further actions to address the impacted soils and sediment at the former training range.

The HHRA meets the requirements of CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 as well as the site-specific risk assessment requirements of Act 2 as presented in 25 Pa. Code §250.602(c) and the PADEP 2002 Technical Guidance Manual (PADEP 2002).

The HHRA addressed soil and sediment exposure media only. USEPA residential soil regional screening levels (RSLs; dated May 2018) that are protective of a target cancer risk of 1×10^{-6} (1 in 1,000,000; 1E-06) and a target hazard quotient of 0.1 were used to screen soil and sediment USEPA 2018 and PADEP 2002). The PADEP (2002) guidance recommends using RSLs for site-specific HHRA risk-based screening to address direct contact exposure pathways; this differs from the sediment screening criteria that were used for the RI. Risk-based screening results identified antimony, copper, lead, and nitroglycerin as soil COPCs. Detected concentrations of zinc in soil and sediment were below the residential soil RSL; therefore, zinc was eliminated from further evaluation. Risk-based screening results for sediment were below residential soil RSLs (**Table 5-3**); sediment was eliminated from further evaluation at the Target Berm and French Drain Outfall DU drainage areas.

The Target Berm and Firing Points DU ISM mean concentrations for the metals were compared with the mean concentrations of metals in the Background Reference DU to evaluate whether the metal concentrations were potentially naturally occurring; the site mean concentrations were higher (i.e., at least one order of magnitude higher) than the background mean concentrations, therefore the metals were determined to be site-related.

Potential off-site receptors were not identified for the MRS because site access is restricted via a locked gate. However, an on-site trespasser scenario was evaluated in the HHRA to address potential breaches in security. On-site vegetation, the concrete wall, and other structures inhibit windblown particulates from leaving the MRS; besides, inhalation exposure pathways are incomplete because antimony, copper, and nitroglycerin do not have inhalation toxicity values per the PADEP (2018) on-line toxicity database. Inhalation of lead was handled separately using USEPA's IEUBK and ALM models, where the inhalation of windblown particles exposure pathway was evaluated. Also, sediment COPCs were not identified in the surface water drainage areas of the French Drain Outfall and Target Berm DUs where surface water leaves the MRS.

Figure 7-1 presents the exposure pathway analysis that identifies the soil exposure pathways that were quantified in the HHRA; the HHRA evaluated the following human health on-site receptors: outdoor worker, teen trespasser, child and adult visitor, child and adult hypothetical resident, construction worker, and utility worker. The current scenarios represent exposure to existing site conditions, which are assumed to remain the same in the future (i.e., no land re-development that disturbs the subsurface soil). Current receptors are assumed to be exposed to surface soil (0 to 24 inches bgs). The future scenarios are used to address site conditions that have changed due to land re-development involving excavation activities that bring the subsurface soil to the surface, thus “mixing” the soils together. Future receptors are exposed to total soil (0 to 36 inches bgs).

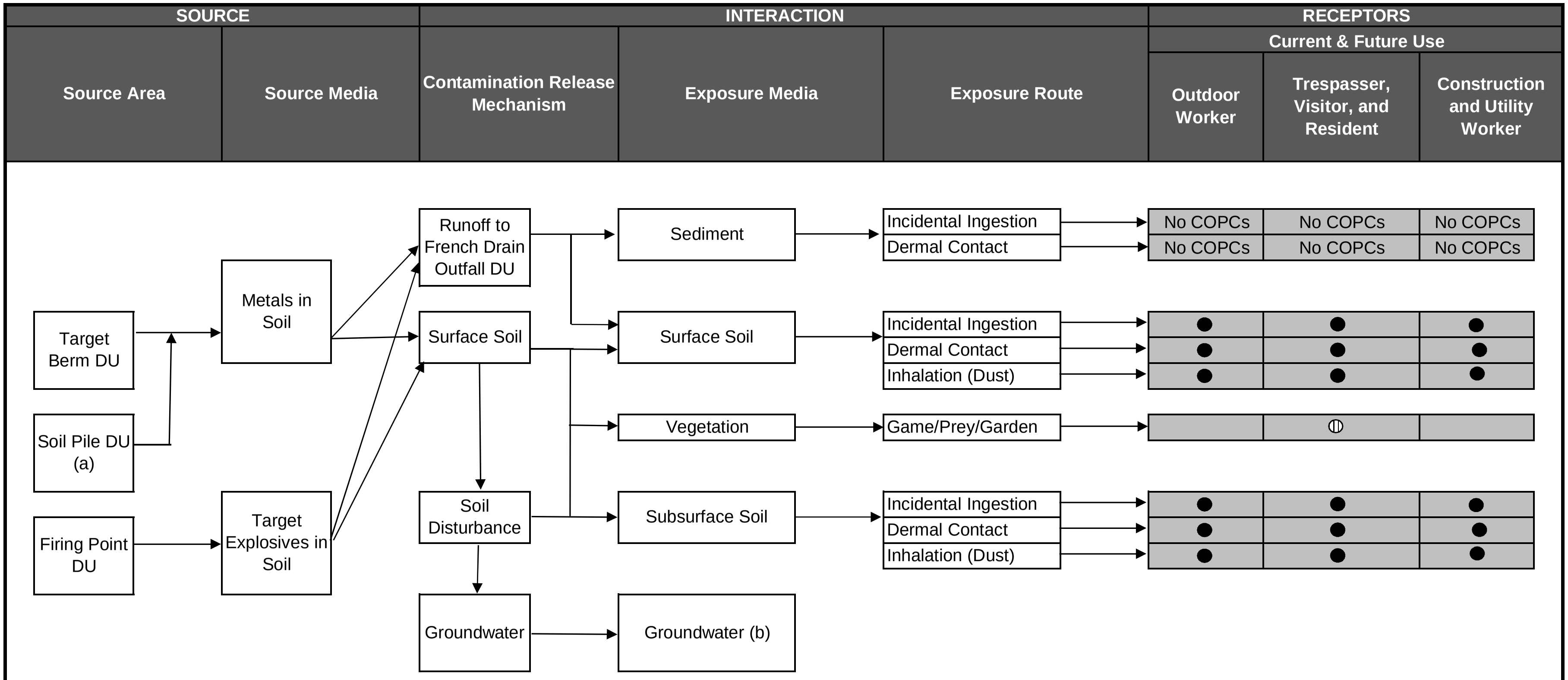
Soil-related exposure pathways that were evaluated in the HHRA include incidental ingestion and dermal contact with soil. The inhalation exposure pathways were identified as incomplete (i.e., antimony, copper, and nitroglycerin do not have inhalation toxicity values).

Cancer risk and non-cancer hazard calculations were conducted for the soil exposure medium. USEPA ALM and IEUBK models were used to estimate (PbB) concentrations for receptors exposed to lead in soil.

The PA Act 2 regulations have established a target cumulative excess lifetime cancer risk (ELCR) (i.e., from all pathways for a single receptor group) of 1×10^{-4} (1 in 10,000; 1E-04) for carcinogenic risks. USEPA (1991) also states that where the cumulative current or future ELCR to an individual is less than 10-4 (1E-04), action generally is not warranted unless there are adverse environmental impacts. Both the Pennsylvania Act 2 regulations and USEPA accept a non-cancer hazard target level, or hazard index (HI), of 1.

Lead exposure was evaluated by comparing the estimated PbB to the USEPA’s target PbB of 10 microgram per deciliter (µg/dL) for the receptor population (USEPA 2016). The Centers for Disease Control and Prevention (CDC) Advisory Committee on Childhood Lead Poisoning

Prevention has revised its recommended target blood lead level to 5 µg/dL (CDC 2012). At the present time, USEPA has not formally adopted this blood lead level and continues to use a target level of 10 µg/dL. However, a sensitivity analysis was performed in the HHRA as part of the lead evaluation to determine how the lead modeling results would change if a target blood lead level of 5 µg/dL were used.



Notes:

COPC - chemical of potential concern; DU - Decision Unit; MC - munition constituent

(a) Landowner created soil pile when installing the french drain on the property.

(b) Depth to groundwater is approximately 30 feet below ground surface; unlikely for MC to migrate based on soil type and depth to groundwater.

Pathway:

● - Complete Pathway

⦶ - Potentially Complete Exposure Pathway (Gardening for current landowner; landowner uses property for storing landscaping equipment and not for personal gardening)

▨ - Incomplete Exposure Pathway (Empty Cell)

No COPCs - Pathway is Potentially Complete (detected concentrations were below risk-based screening levels)

Figure 7-1

Human Health MC Exposure Pathway Analysis

Ridgway Training Range, Remedial Investigation

Ridgway Training Range, Pennsylvania

Table 7-1 identifies the COCs that exceeded the PADEP and USEPA's risk thresholds in the HHRA. The ELCR results for all the on-site receptors were below the target ELCR threshold of 1×10-4 (1E-04). However, antimony and nitroglycerin produced non-cancer HI results above 1 for some of the receptors and DUs. Also, lead was identified as a COC based on the target PbB threshold of 10 µg/dL (**Table 7-1**).

Table 7-1. Human Health Constituents of Concern

Receptor	Scenario Timeframe and Exposure Medium	Constituent of Concern
Target Berm DU		
Child Visitor	Current: Surface Soil	Lead (a, b)
	Future: Total Soil	Lead (a, b)
Outdoor Worker	Current: Surface Soil	Lead (b)
	Future: Total Soil	Lead (b)
Construction/Utility Worker	Current: Surface Soil	Lead (b, c)
Hypothetical Child Resident	Current: Surface Soil	Antimony Lead (b)
	Future: Total Soil	Antimony Lead (b)
Soil Pile DU		
Child Visitor	Current: Surface Soil	Lead (a, b)
	Future: Total Soil	Antimony Lead (a, b)
Construction Worker (c)	Future: Total Soil	Antimony Lead (b, c)
Utility Worker (c)	Future: Total Soil	Lead (b, c)
Outdoor Worker	Current: Surface Soil	Lead (b)
	Future: Total Soil	Lead (b)
Hypothetical Child Resident	Current: Surface Soil	Antimony Lead (b)
	Future: Total Soil	Antimony Lead (b)
Hypothetical Adult Resident	Future: Total Soil	Antimony
Firing Point DU		
Hypothetical Child Resident	Current: Surface Soil	Nitroglycerin

Notes:
(a) IEUBK model results for the hypothetical child resident were also used to be protective of the child visitor at the MRS.
(b) Lead modeling results are based on target PbB threshold of 10 µg/dL.
(c) If a target PbB threshold of 5 µg/dL was used, then lead would be identified as a surface soil and total soil COC for the construction and utility worker scenarios.

The HHRA recommends further evaluation of the soil COCs in an FS for the Ridgway Training Range MRS.

7.2 Ecological Risk Assessment

The purpose of the SLERA was to identify the potential risks to ecological receptors exposed to Site-related COIs in environmental media at the Site and determine which COPECs, if any, were exerting adverse effects to potential ecological receptor populations. The list of COPECs was refined consistent with the initial stage of a Baseline Ecological Risk Assessment (BERA) Step 3 to reduce uncertainty in the SLERA Step 1 and 2 conclusions.

Guided by an ecological CSM, a conservative screening evaluation was conducted to assess potential risks related to on-Site soil and off-Site sediment for soil invertebrates, benthic macroinvertebrates, terrestrial wildlife, and aquatic and semi-aquatic wildlife. If COIs were detected above wildlife-specific benchmarks, dose rate models (DRMs) were prepared to assess potential adverse effects to selected ecological receptors.

Although the Site is small and receptors can freely move between areas, exposure units (EU) were selected based on 1) type of data available (incremental versus discrete); 2) COI source (nitroglycerin vs metals); and 3) DU designation provided in the RI (AECOM, 2018). Receptors with larger ranges and limited substrate intake (e.g. red fox and red-tailed hawk) were evaluated conservatively at a Site-wide level. During BERA Step 3, refinements were made to EU selection and datasets were pooled to assess only Site-wide effects.

After Step 2 of the SLERA, the results of the risk characterization determined the following scientific management decision points (SMDPs):

1. Exposure to COPECs in on-Site soil resulted in substantial impact (*de manifestis*) to both soil invertebrate and terrestrial wildlife populations; action should be taken that can eliminate or reduce exposure to an acceptable level.
    a. Maximum concentrations of nitroglycerin (Firing Point DU) and copper, lead, and zinc (Target Berm and Soil Pile DUs) exceeded ecological screening values (ESVs) protective of soil invertebrates.
    b. Wildlife DRMs indicated that NOAEL TRVs (protective of either mammalian or avian wildlife) were exceeded by maximum concentrations of antimony, copper, lead, and zinc in soil at the Target Berm and Soil Pile DUs and by antimony, copper, and lead for all on-Site soil.
    c. Refinements made in BERA Step 3 would reduce uncertainty in both the direct contact evaluation and DRMs, but, ultimately, COPECs would still exceed benchmarks protective of either soil invertebrates or wildlife.
2. Exposure to COPECs in off-Site sediment indicated that the SLERA should be continued to BERA Step 3 to reduce uncertainty in the evaluation of risk and impact.
    a. Maximum concentrations of copper and lead exceeded ESVs protective of benthic macroinvertebrates in both the French Drain Outfall DU and Drainage Ditch.
    b. Wildlife DRMs indicated that maximum concentrations of copper exceeded NOAEL TRVs protective of mammalian wildlife in all off-Site sediment.

   c. For both the direct contact evaluation and DRMs, exposure estimates will be refined using more representative EPCs and more realistic benchmarks.

Following BERA Step 3 and evaluating uncertainties within the SLERA process, the following SMDPs were made regarding off-Site sediment:

1. The potential for adverse effects to the benthic macroinvertebrate community is *de minimus* due to the following:
   a. Although the refined direct contact evaluation indicated a lead HQ = 1, the median concentration for lead (109 mg/kg) was below the refined ESV.
   b. Small-scale, spatial variability was very high for sediment samples.
   c. Although individuals may experience some adverse effects locally, population level effects are unlikely.
2. The potential for adverse effects to the aquatic and semi-aquatic wildlife community is *de minimus* due to the following:
   a. Refined DRMs indicated no exceedances of TRVs for the little brown bat.

8 Munitions Response Site Prioritization Protocol

This section discusses application of the MRSPP for the Ridgway Training Range MRS (PAE40-001-R-01). The MRSPP was applied in accordance with 32 Code of Federal Regulations (CFR) Part 179 and the guidance provided in the DoD MRSPP Primer (DoD, 2007). The MRSPP worksheet tables for the MRSs are included in **Appendix G**. In 2005, DoD published the MRSPP as a Federal Rule (32 CFR Part 179) to assign a relative risk priority to each defense site in the MMRP Inventory for response activities. These response activities are based on the overall conditions at the MRS, taking into consideration various factors related to explosive safety and environmental hazards. The application of the MRSPP applies to all locations:

- That are or were owned, leased to, or otherwise possessed or used by DoD
- That are known to or are suspected of containing MEC or MC
- That are included in the MMRP Inventory

In assigning a relative priority for response activities, DoD generally considers MRSs posing the greatest hazard as being the highest priority. In the MMRP, the MRSPP priority will be one factor in determining the sequence in which munitions response actions are funded. The following sections are a brief summary of the modules of the MRSPP and the results of the evaluations for the Ridgway Training Range MRS (PAE40-001-R-01).

8.1 Explosive Hazard Evaluation Module

The Explosive Hazard Evaluation (EHE) Module assesses the explosive hazards of a site based on the known or suspected presence of an explosive hazard, including small arms ranges. The EHE Module is composed of three factors, each of which has two to four data elements that are intended to assess the specific conditions at an MRS. Based on site-specific information, each data element is assigned a numeric score, and the sum of these values is the EHE Module score and is used to determine the corresponding EHE Module rating. The data elements are as follows:

- **Explosive Hazard Factor.** Has the data elements Munitions Type and Source of Hazard and constitutes 40 percent of the EHE Module score.
- **Accessibility Factor.** Has the data elements Location of Munitions, Ease of Access, and Status of Property and constitutes 40 percent of the EHE Module score.
- **Receptor Factor.** Has the data elements Population Density, Population Near Hazard, Types of Activities/Structures, and Ecological and/or Cultural Resources and constitutes 20 percent of the EHE Module score.

The Ridgway Training Range MRS (PAE40-001-R-01) received the alternative EHE Module rating of No Known or Suspected Explosive Hazard. This module rating was based on the MRS being a small arms range and no MEC being identified at the MRS during the SI (Parsons, 2012) or RI field work. The MRS contains a block target storage building, a downrange backstop, and a shelter building over twelve firing positions. The firing positions are recessed into the ground surface via culvert type material. Wooden covers enclosed the firing positions, and the range configuration consisted of 12-foot high concrete side and impact walls; a 5.56 mm bullet was observed during RI sampling activities. The EHE Module rating is preliminary and is awaiting stakeholder input. The EHE Module worksheet tables are presented in **Appendix G** and summarized in **Section 8.4**.

8.2 Chemical Warfare Material Hazard Evaluation Module

The Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE) Module provides an evaluation of the chemical hazards associated with the physiological effects of CWM. The CHE Module is used only when CWMs in the form of MEC or MC are known or suspected of being present at an MRS. Like the EHE Module, the CHE Module has three factors, each of which has two to four data elements that are intended to assess the conditions at an MRS. These factors are as follows:

- **CWM Hazard Factor.** Has the data elements CWM Configuration and Sources of CWM and constitutes 40 percent of the CHE score.
- **Accessibility Factor.** Focuses on the potential for receptors to encounter the CWM known or suspected to be present on an MRS. This factor consists of the data elements Location of CWM, Ease of Access, and Status of Property and constitutes 40 percent of the CHE score.
- **Receptor Factor.** Focuses on the human and ecological populations that may be impacted by the presence of CWM. It has the data elements Population Density, Population Near Hazard, Types of Activities/Structures, and Ecological and/or Cultural Resources and constitutes 20 percent of the CHE score.

Similar to the EHE Module, each data element is assigned a numeric value, and the sum of these values is the CHE Module score, which is used to determine the corresponding CHE Module rating. If CWM is not known or suspected, then the CHE Module rating is No Known or Suspected CWM Hazard.

The MRS received the Alternative CHE Module rating of No Known or Suspected CWM Hazard. This was due to the fact that no historical or physical evidence was found during SI or RI activities that indicated CWM is present at the MRS. The worksheet tables are presented in **Appendix G** and summarized in **Section 8.4**.

8.3 Health Hazard Evaluation Module

The Health Hazard Evaluation (HHE) Module provides a consistent DoD-wide approach for evaluating the relative risk to human health and the environment posed by contaminants (i.e., MC) present at an MRS. The module has three factors that are as follows:

- **Contamination Hazard Factor (CHF).** Evaluates potential risk posed by contaminants and contributes a value of High (H), Medium (M), or Low (L) based on Significant, Moderate, or Minimal contaminants present, respectively.
- **Migration Pathway Factor (MPF).** Assesses the potential for MC or incidental contaminants to migrate from an MRS and contributes a value of H, M, or L based on Evident, Potential, or Confined pathways, respectively.

- **Receptor Factor (RF).** Evaluates the presence of receptors that may be exposed and contributes a value of H, M, or L based on Identified, Potential, or Limited receptors, respectively.

The HHE builds on the DoD Relative Risk Site Evaluation framework that is used in the Installation Restoration Program. The CHF, MPF, and RF are based on quantitative evaluation of MC and/or CERCLA hazardous substances and a qualitative evaluation of pathways and human and ecological receptors in surface soil, groundwater, surface water, and sediment. The HHE does not address subsurface soils. In addition, the HHE does not consider air as a pathway, because the risk through this medium from DoD MMRP sites with soil contamination is generally minimal.

The H, M, and L levels for the CHF, MPF, and RF are combined in a matrix to obtain composite three-letter combination levels that integrate considerations of all three factors. The three-letter combination levels are organized by frequency and the combination of the frequencies results in the HHE Module rating.

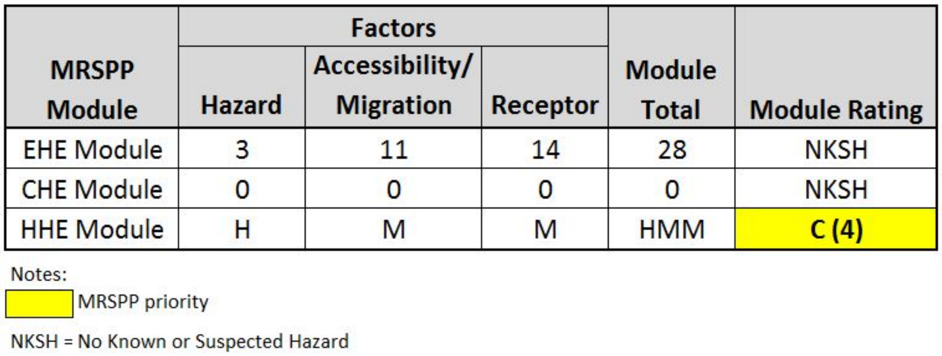
The Ridgway Training Range MRS (PAE40-001-R-01) received the LLM media combination level for sediment/human endpoint, the MHM media combination level for sediment/ecological endpoint, the HMM media combination for surface soil, and the HHE Module Rating of C. The HHE Module rating is based on concentrations of MC in surface soil exceeding respective screening levels. The HHE Module worksheet tables are presented in **Appendix G** and summarized in **Section 8.4**.

8.4 Munitions Response Site Prioritization Protocol Scores

In accordance with the DoD MRSPP Primer (DoD, 2007), the MRS is assigned an MRSPP Priority ranging from 1 to 8. Priority 1 indicates the highest potential hazard and Priority 8 indicates the lowest potential hazard. Only a site with a potential Chemical Warfare Hazard can receive a Priority of 1. The priority is determined by selecting the highest rating from among the EHE, CHE, and HHE Modules. For example, if the EHE rating is 2, the CHE rating is 5, and the HHE rating is 4, the priority assigned would be 2. An alternative rating may be selected for the MRS if it meets the criteria. The priority will be used to determine the future funding sequence of the MRS for further munitions response action.

The overall MRSPP priority for the Ridgway Training Range MRS (PAE40-001-R-01) is assigned a 4. The EHE and CHE, module ratings were each No Known or Suspected Hazard, but the HHE rating was C, indicating an HMM media combination. A summary of the MRSPP scores for each module is provided in **Table 8-1**.

Table 8-1. Munitions Response Site Prioritization Protocol Summary



MRSPP Module	Factors			Module Total	Module Rating
	Hazard	Accessibility/ Migration	Receptor		
EHE Module	3	11	14	28	NKSH
CHE Module	0	0	0	0	NKSH
HHE Module	H	M	M	HMM	**C (4)**

Notes:

🟨 MRSPP priority

NKSH = No Known or Suspected Hazard

9 Summary and Conclusions

This section summarizes results obtained and conclusions reached as a result of the RI activities completed at the Ridgway Training Range MRS (PAE40-001-R-01). The conclusions are general and comparative interpretations of the findings in terms of the general objectives of the RI.

This RI compiled and evaluated information and data for the MRS relating to the potential contamination associated with its historical use for small arms training activities conducted at Ridgway Training Range MRS. The sampling approach was designed to characterize the nature and extent of MC contamination in soil and/or sediment at the Target Berm and Firing Point, and areas where MC contamination could have potentially migrated. For data interpretation purposes and for assessing risks, the MRS was divided into four DUs (the Target Berm, Firing Point, Soil Pile, and French Drain Outfall area) that reflect the source areas of potential contamination as indicated by site history and remaining physical evidence of the target areas, as well as post-use construction by the landowner. Field investigation activities included XRF screening of the Target Berm DU to evaluate the lateral extent of MC, the collection of surface soil samples using ISM at the Target Berm and Firing Point for evaluating risks, and collecting discrete soil and/or sediment samples from all four DUs to delineate lateral and vertical extent of MC contamination.

This information was evaluated and used to interpret the nature and extent of MC, evaluate potential exposures of receptors to MC, complete a risk-based screening for MC, and complete the MRSPP for the MRS.

9.1 Summary of Remedial Investigation Results

Tables 9-1 and **9-2** summarize the results of the human health screening level comparisons to soil and sediment samples collected as part of the Ridgway Training Range MRS RI. **Tables 9-3** and **9-4** summarize the results of the ecological screening level comparisons to soil and sediment samples. The human health and ecological small arms MC screening results identified exceedances in the affected media.

Table 9-1. RI Human Health Screening Summary (ISM)

Analyte	Soil Human Health Screening Level (mg/kg)	Minimum Background Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	
			Target Berm	Firing Point
Metals				
Antimony	3.1	0.244	**40.1**	NA
Copper	310	10.5	**636**	NA
Lead	400	59.2	**8770**	NA
Zinc	2,300	23.0	**165**	NA
Explosives				
Nitroglycerin	0.63	0.38	NA	**4.4**

Notes:

Bold = Exceeds Background

🟨 Exceeds Screening Criteria

Table 9-2. RI Human Health Screening Summary (Discrete)

Analyte	Soil Human Health Screening Level (mg/kg)	Sediment Human Health Screening Level (mg/kg)	Minimum Background Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	
				Soil Pile	French Drain*
Metals					
Antimony	3.1	880	0.244	**1080**	**0.638**
Copper	310	81,000	10.5	**2060**	**38.7**
Lead	400	5,000	59.2	**57200**	**358**
Zinc	2,300	660,000	23.0	**443**	**71.1**

Notes:

Bold = Exceeds Background

🟨 Exceeds Screening Criteria

* Sample media is sediment

Table 9-3. RI Ecological Screening Summary (ISM)

Analyte	Soil Ecological Screening Level (mg/kg)	Minimum Background Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	
			Target Berm	Firing Point
Metals				
Antimony	0.27	0.244	**40.1**	NA
Copper	28	10.5	**636**	NA
Lead	11	59.2	**8770**	NA
Zinc	46	23.0	**165**	NA
Explosives				
Nitroglycerin	0.63	0.38	NA	**4.4**

Notes:

Bold = Exceeds Background

🟨 Exceeds Screening Criteria

Table 9-4. RI Ecological Screening Summary (Discrete)

Analyte	Soil Ecological Screening Level (mg/kg)	Sediment Ecological Screening Level (mg/kg)	Minimum Background Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	
				Soil Pile	French Drain*
Metals					
Antimony	0.27	2	0.244	**1080**	**0.638**
Copper	28	31.6	10.5	**2060**	**38.7**
Lead	11	35.8	59.2	**57200**	**358**
Zinc	46	121	23.0	**443**	**71.1**

Notes:

Bold = Exceeds Background

🟨 Exceeds Screening Criteria

* Sample media is sediment

The data collected at the MRS were sufficient to delineate the extent of site-related MC contamination (antimony, copper, lead, zinc, and nitroglycerin). Exceedances of the human health criterion for lead were observed in XRF screening results at the Target Berm (**Figure 9-1**) and resulted in step-out sampling that extended the DU boundary to 0.126 acres. The extent of elevated lead concentrations indicates MC transportation by movement of soil by the property owner and via potential overland runoff during rain events. The DU extended beyond the enclosed firing range walls and the current extent of the MRS. ISM sample results at the Target Berm indicate that antimony, copper, and lead are present in soil above human health screening criteria. Four locations at the Target Berm (location #80 #22, #91, and #45) were selected to represent distinct areas at the DU for discrete subsurface soil sampling based on XRF results exceeding human health criterion for lead. Discrete subsurface sampling at locations #22 and #91 indicated that antimony, copper, and lead at the Target Berm are present above their risk-based screening levels at the 12 to 18-inches below ground surface (bgs) depth interval and the 24 to 30-inch bgs interval (**Figure 9-2a**), although MC concentrations generally decreased with depth. Deeper samples at these locations could not be collected due to refusal at a gravel layer within the berm. XRF data showed that lead is migrating from the Target Berm, but does not extend into intermittently inundated areas to the north and south of the MRS.

The data collected at the Firing Point were sufficient to delineate the extent of nitroglycerin contamination at the DU. Surface soil samples collected adjacent to the DU from uncovered soil east of the firing positions showed no exceedances for nitroglycerin, indicating that nitroglycerin is not being transported outside of the MRS (**Figure 9-2b**). ISM sample results at the Firing Point indicate that nitroglycerin is present in soil above human health screening criteria. Three locations at the Firing Point selected for discrete subsurface soil sampling showed Nitroglycerin was elevated above human health screening criterion at depths from 12 to 18-inches bgs (**Figure 9-2b**); the 24 to 30-inch bgs interval could not be sampled due to refusal at a gravel layer. Although nitroglycerin is elevated above human health screening criterion in Firing Point soil, it is not being transported beyond the MRS boundary.

Discrete soil and sediment samples from the Soil Pile DU and French Drain Outfall DU, respectively, were collected to assess the potential spread of small arms MC contamination as a result of the installation of the French drain parallel to the Target Berm. Discrete soil samples from the Soil Pile DU showed antimony, copper, and lead elevated above human health screening criteria (**Figure 9-2c**). Small arms MC in the Soil Pile may be transported to the range floor via runoff due to precipitation, but is not anticipated to be transported beyond the MRS due to its confining concrete walls. Discrete sediment samples from the French Drain Outfall DU did not exhibit antimony, copper, lead, or zinc above human health screening criteria, but did exhibit all four analyte levels elevated above ecological screening criteria (**Figure 9-3**).

ISM provided high quality data that are an unbiased estimate of the mean concentration of small arms MC in Target Berm and Firing Point soil and suitable for risk screening. IS collected from the both DUs showed elevated concentrations of small arms MC (metals and explosives, respectively) compared to human health screening criteria (**Table 9-1** and **Figure 9-4**). Soil at the Soil Pile DU exceeded human health screening criteria for antimony, copper, and lead, as expected. Sediment from the French Drain Outfall DU were elevated only above ecological screening criterion for lead. Based on these results, there is evidence of unacceptable risk to human receptors visiting or working at the MRS. Furthermore, small arms MC concentrations exceed human health screening criteria in soil beyond the current extent of the MRS; however, MC concentrations do not exceed human health screening criteria beyond the MRS's immediate surroundings and exceedances do not reach the wetland east of the MRS. Furthermore, discrete soil sampling data showed small arms MC concentrations (metals and explosives) elevated at depths of up to 24-30 inches bgs, indicating an elevated risk to maintenance workers (e.g., landscaper).

The ecological screening criteria for copper and lead was exceeded in sediment at the French Drain Outfall DU. A SLERA was performed to assess ecological risk due to small arms MC at the MRS.

CLIENT	Army National Guard			
PROJECT	Remedial Investigation through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	11/8/2018
SCALE	1:180	CHK BY	AS	11/8/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	11/8/2018

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Bold = MC concentration exceeds ecological screening criteria

☐ Sample Grid

🟨 MC Concentration exceeds human health screening criteria

🟥 Ridgway Training Range MRS

▦ Wetland (National Wetlands Inventory)

▨ Drainage Ditch

Note:
ppm = parts per million

TITLE

Target Berm XRF Sample Diagram

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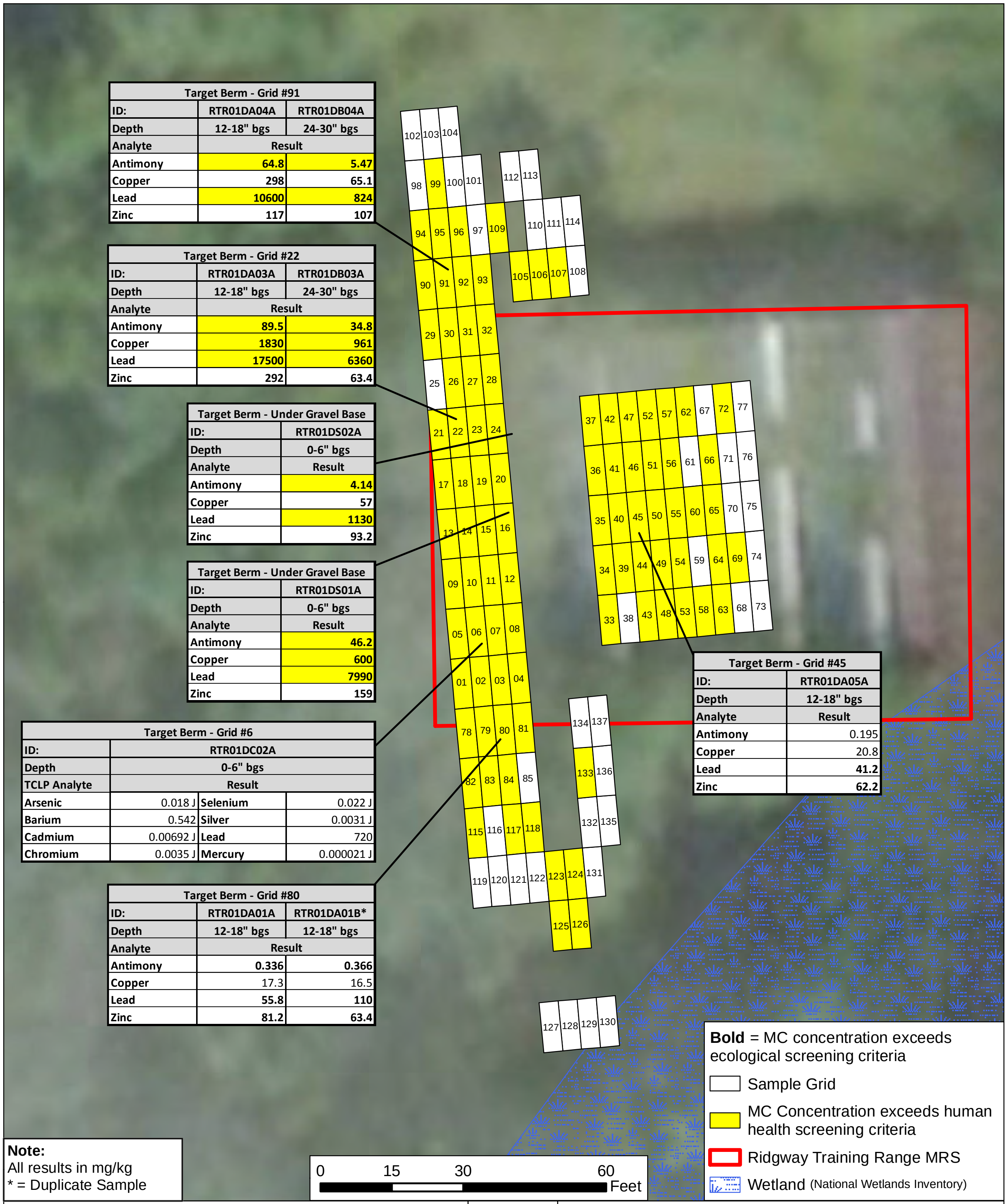
Figure 9-1



Target Berm - Grid #91		
ID:	RTR01DA04A	RTR01DB04A
Depth	12-18" bgs	24-30" bgs
Analyte	Result	
Antimony	**64.8**	**5.47**
Copper	**298**	**65.1**
Lead	**10600**	**824**
Zinc	**117**	**107**

Target Berm - Grid #22		
ID:	RTR01DA03A	RTR01DB03A
Depth	12-18" bgs	24-30" bgs
Analyte	Result	
Antimony	**89.5**	**34.8**
Copper	**1830**	**961**
Lead	**17500**	**6360**
Zinc	**292**	**63.4**

Target Berm - Under Gravel Base	
ID:	RTR01DS02A
Depth	0-6" bgs
Analyte	Result
Antimony	**4.14**
Copper	**57**
Lead	**1130**
Zinc	**93.2**

Target Berm - Under Gravel Base	
ID:	RTR01DS01A
Depth	0-6" bgs
Analyte	Result
Antimony	**46.2**
Copper	**600**
Lead	**7990**
Zinc	**159**

Target Berm - Grid #6			
ID:	RTR01DC02A		
Depth	0-6" bgs		
TCLP Analyte	Result		
Arsenic	0.018 J	Selenium	0.022 J
Barium	0.542	Silver	0.0031 J
Cadmium	0.00692 J	Lead	720
Chromium	0.0035 J	Mercury	0.000021 J

Target Berm - Grid #80		
ID:	RTR01DA01A	RTR01DA01B*
Depth	12-18" bgs	12-18" bgs
Analyte	Result	
Antimony	**0.336**	**0.366**
Copper	17.3	16.5
Lead	**55.8**	**110**
Zinc	**81.2**	**63.4**

Target Berm - Grid #45	
ID:	RTR01DA05A
Depth	12-18" bgs
Analyte	Result
Antimony	0.195
Copper	20.8
Lead	**41.2**
Zinc	**62.2**

Note:
All results in mg/kg
* = Duplicate Sample

Bold = MC concentration exceeds ecological screening criteria

☐ Sample Grid

🟨 MC Concentration exceeds human health screening criteria

🟥 Ridgway Training Range MRS

▨ Wetland (National Wetlands Inventory)

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	10/16/2018
SCALE	1:360	CHK BY	JW	10/16/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	10/16/2018

Target Berm Discrete Soil Sample Results

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Figure 9-2a

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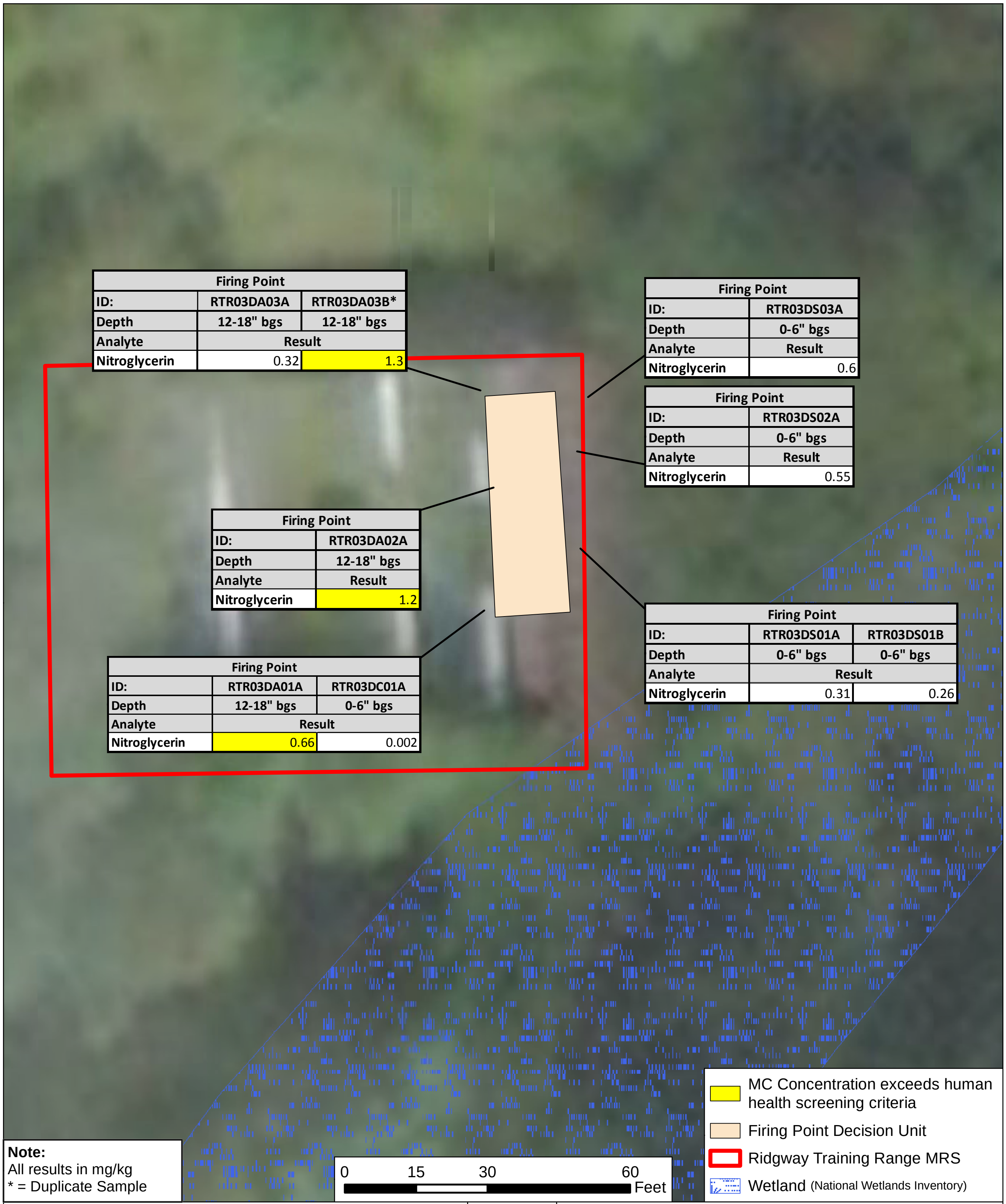

Firing Point		
ID:	RTR03DA03A	RTR03DA03B*
Depth	12-18" bgs	12-18" bgs
Analyte	Result	
Nitroglycerin	0.32	1.3

Firing Point	
ID:	RTR03DS03A
Depth	0-6" bgs
Analyte	Result
Nitroglycerin	0.6

Firing Point	
ID:	RTR03DS02A
Depth	0-6" bgs
Analyte	Result
Nitroglycerin	0.55

Firing Point	
ID:	RTR03DA02A
Depth	12-18" bgs
Analyte	Result
Nitroglycerin	1.2

Firing Point		
ID:	RTR03DS01A	RTR03DS01B
Depth	0-6" bgs	0-6" bgs
Analyte	Result	
Nitroglycerin	0.31	0.26

Firing Point		
ID:	RTR03DA01A	RTR03DC01A
Depth	12-18" bgs	0-6" bgs
Analyte	Result	
Nitroglycerin	0.66	0.002

Note:
All results in mg/kg
* = Duplicate Sample

🟨 MC Concentration exceeds human health screening criteria
🟧 Firing Point Decision Unit
🟥 Ridgway Training Range MRS
▨ Wetland (National Wetlands Inventory)

CLIENT Army National Guard
PROJECT NDNODS Ridgway Training Site
REVISION NO 0 | GIS BY | MS | 10/16/2018
SCALE 1:360 | CHK BY | JW | 10/16/2018
SOURCE ARNG; State of Pennsylvania, ESRI & Partners | PM | RG | 10/16/2018

Firing Point Discrete Soil Sample Results

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Figure 9-2b

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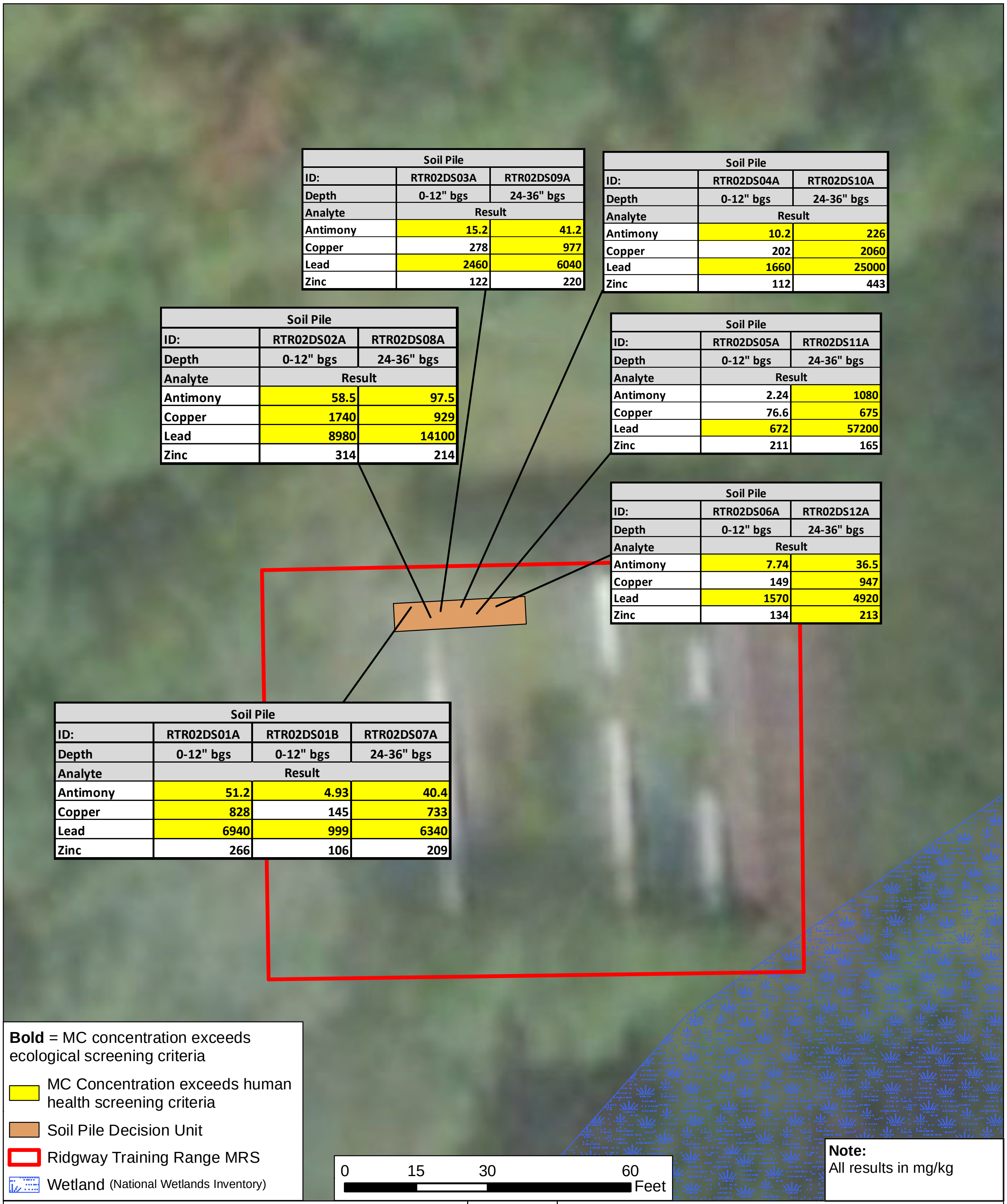

Soil Pile		
ID:	RTR02DS03A	RTR02DS09A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	15.2	41.2
Copper	278	977
Lead	2460	6040
Zinc	122	220

Soil Pile		
ID:	RTR02DS04A	RTR02DS10A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	10.2	226
Copper	202	2060
Lead	1660	25000
Zinc	112	443

Soil Pile		
ID:	RTR02DS02A	RTR02DS08A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	58.5	97.5
Copper	1740	929
Lead	8980	14100
Zinc	314	214

Soil Pile		
ID:	RTR02DS05A	RTR02DS11A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	2.24	1080
Copper	76.6	675
Lead	672	57200
Zinc	211	165

Soil Pile		
ID:	RTR02DS06A	RTR02DS12A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	7.74	36.5
Copper	149	947
Lead	1570	4920
Zinc	134	213

Soil Pile			
ID:	RTR02DS01A	RTR02DS01B	RTR02DS07A
Depth	0-12" bgs	0-12" bgs	24-36" bgs
Analyte	Result		
Antimony	51.2	4.93	40.4
Copper	828	145	733
Lead	6940	999	6340
Zinc	266	106	209

Bold = MC concentration exceeds ecological screening criteria

🟨 MC Concentration exceeds human health screening criteria

🟧 Soil Pile Decision Unit

🟥 Ridgway Training Range MRS

▨ Wetland (National Wetlands Inventory)

Note:
All results in mg/kg

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	10/16/2018
SCALE	1:360	CHK BY	AS	10/16/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	10/16/2018

Soil Pile Discrete Soil Sample Results

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Figure 9-2c

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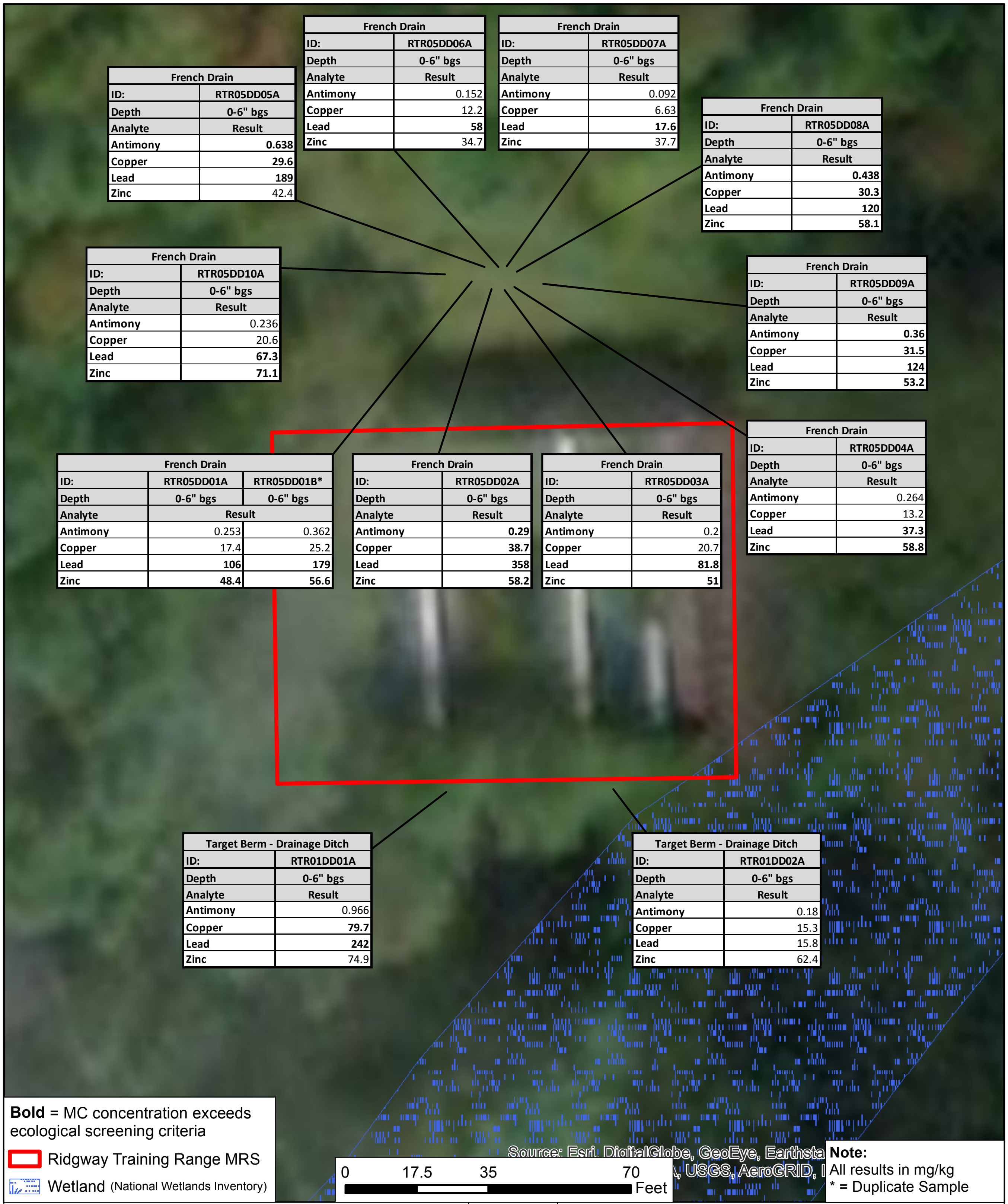

French Drain	
ID:	RTR05DD05A
Depth	0-6" bgs
Analyte	Result
Antimony	**0.638**
Copper	**29.6**
Lead	**189**
Zinc	42.4

French Drain	
ID:	RTR05DD06A
Depth	0-6" bgs
Analyte	Result
Antimony	0.152
Copper	12.2
Lead	**58**
Zinc	34.7

French Drain	
ID:	RTR05DD07A
Depth	0-6" bgs
Analyte	Result
Antimony	0.092
Copper	6.63
Lead	**17.6**
Zinc	37.7

French Drain	
ID:	RTR05DD08A
Depth	0-6" bgs
Analyte	Result
Antimony	**0.438**
Copper	**30.3**
Lead	**120**
Zinc	**58.1**

French Drain	
ID:	RTR05DD10A
Depth	0-6" bgs
Analyte	Result
Antimony	0.236
Copper	20.6
Lead	**67.3**
Zinc	**71.1**

French Drain	
ID:	RTR05DD09A
Depth	0-6" bgs
Analyte	Result
Antimony	**0.36**
Copper	**31.5**
Lead	**124**
Zinc	**53.2**

French Drain		
ID:	RTR05DD01A	RTR05DD01B*
Depth	0-6" bgs	0-6" bgs
Analyte	Result	
Antimony	0.253	0.362
Copper	17.4	25.2
Lead	**106**	**179**
Zinc	**48.4**	**56.6**

French Drain	
ID:	RTR05DD02A
Depth	0-6" bgs
Analyte	Result
Antimony	**0.29**
Copper	**38.7**
Lead	**358**
Zinc	**58.2**

French Drain	
ID:	RTR05DD03A
Depth	0-6" bgs
Analyte	Result
Antimony	0.2
Copper	20.7
Lead	**81.8**
Zinc	**51**

French Drain	
ID:	RTR05DD04A
Depth	0-6" bgs
Analyte	Result
Antimony	0.264
Copper	13.2
Lead	**37.3**
Zinc	**58.8**

Target Berm - Drainage Ditch	
ID:	RTR01DD01A
Depth	0-6" bgs
Analyte	Result
Antimony	0.966
Copper	**79.7**
Lead	**242**
Zinc	74.9

Target Berm - Drainage Ditch	
ID:	RTR01DD02A
Depth	0-6" bgs
Analyte	Result
Antimony	0.18
Copper	15.3
Lead	15.8
Zinc	62.4

Bold = MC concentration exceeds ecological screening criteria

🟥 Ridgway Training Range MRS

▨ Wetland (National Wetlands Inventory)

Source: Esri, DigitalGlobe, GeoEye, Earthsta..., USGS, AeroGRID, I...

Note:
All results in mg/kg
* = Duplicate Sample

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	11/1/2018
SCALE	1:420	CHK BY	JW	11/1/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	11/1/2018

N

Discrete Sediment Sample Results

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Figure 9-3

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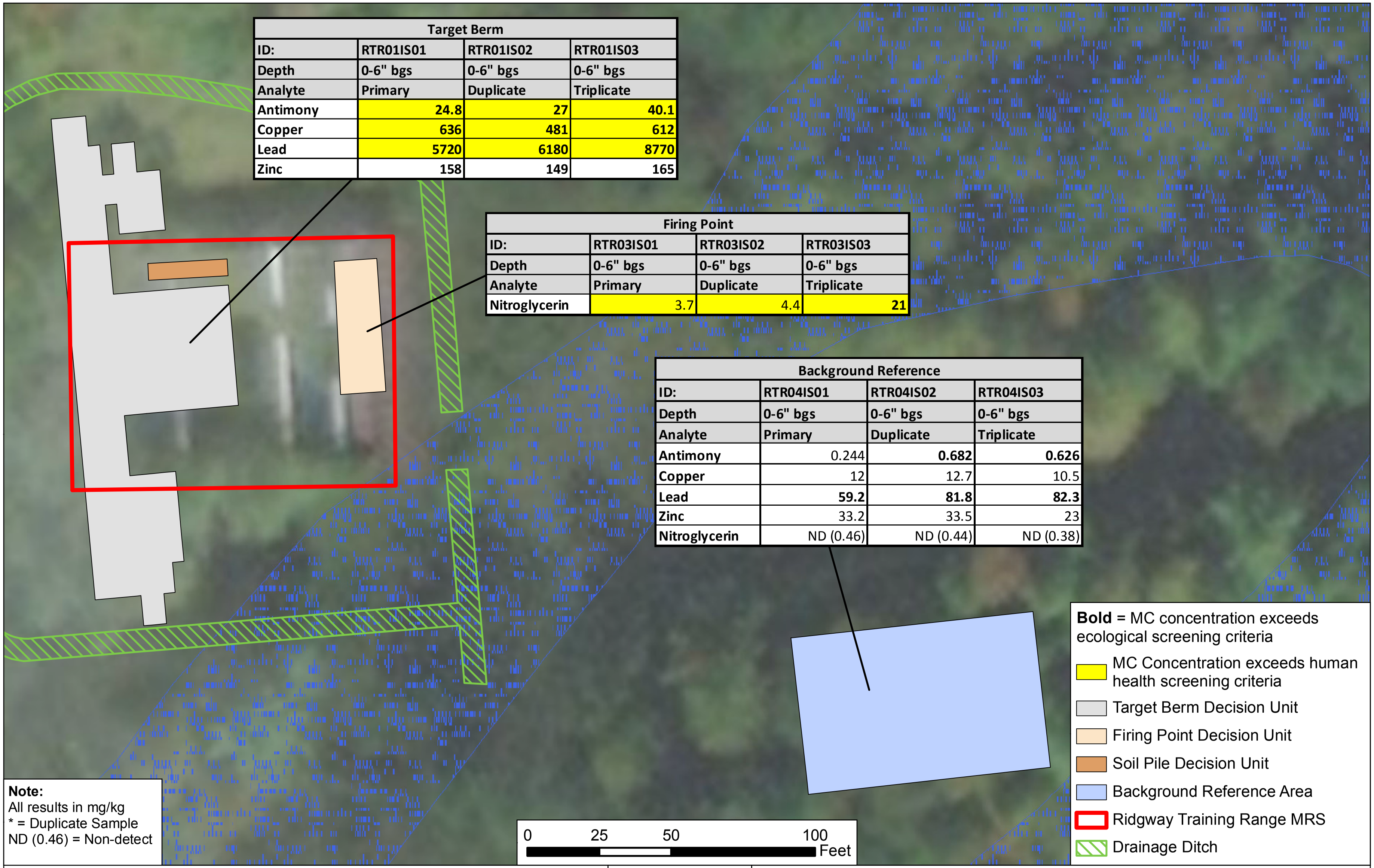

Target Berm			
ID:	RTR01IS01	RTR01IS02	RTR01IS03
Depth	0-6" bgs	0-6" bgs	0-6" bgs
Analyte	Primary	Duplicate	Triplicate
Antimony	**24.8**	**27**	**40.1**
Copper	**636**	**481**	**612**
Lead	**5720**	**6180**	**8770**
Zinc	158	149	165

Firing Point			
ID:	RTR03IS01	RTR03IS02	RTR03IS03
Depth	0-6" bgs	0-6" bgs	0-6" bgs
Analyte	Primary	Duplicate	Triplicate
Nitroglycerin	3.7	4.4	**21**

Background Reference			
ID:	RTR04IS01	RTR04IS02	RTR04IS03
Depth	0-6" bgs	0-6" bgs	0-6" bgs
Analyte	Primary	Duplicate	Triplicate
Antimony	0.244	**0.682**	**0.626**
Copper	12	12.7	10.5
Lead	**59.2**	**81.8**	**82.3**
Zinc	33.2	33.5	23
Nitroglycerin	ND (0.46)	ND (0.44)	ND (0.38)

Note:
All results in mg/kg
* = Duplicate Sample
ND (0.46) = Non-detect

Bold = MC concentration exceeds ecological screening criteria

🟨	MC Concentration exceeds human health screening criteria
⬜	Target Berm Decision Unit
⬜	Firing Point Decision Unit
🟧	Soil Pile Decision Unit
🟦	Background Reference Area
🟥	Ridgway Training Range MRS
▨	Drainage Ditch

CLIENT	Army National Guard			
PROJECT	Remedial Investigation through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	11/8/2018
SCALE	1:600	CHK BY	JW	11/8/2018
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	11/8/2018

Ridgway ISM Results

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Figure 9-4

9.2 Summary of Risk Assessment Results

Analytical results from RI samples showed that small arms MC are present at the Target Berm, Soil Pile, and Firing Point at elevated levels above USEPA RSLs for Residential Soil (USEPA, 2018). MC levels in sediment at the French Drain Outfall are not elevated above USEPA RSLs for Residential Sediment; however, it is elevated above Background concentrations and ecological screening criterion.

Due to MC concentrations in soil at multiple DUs exceeding human health screening criteria, an HHRA was conducted. Cancer risk and non-cancer hazard calculations were conducted for the following scenarios: outdoor worker, teen trespasser, child and adult visitor, child and adult hypothetical resident, construction worker, and utility worker. Also, USEPA's ALM and IEUBK models were used to estimate PbB concentrations from exposure to lead in soil. **Table 9-5** presents the human health COCs for soil that are likely to cause adverse health effects at the MRS.

Since MC concentrations in soil at all DUs exceeding ecological screening criteria, a SLERA was conducted. The purpose of the SLERA was to identify the potential risks to ecological receptors exposed to Site-related COIs in environmental media at the Site and determine which COPECs, if any, were exerting adverse effects to potential ecological receptor populations. The results of the risk characterization determined the following SMDPs:

1. Exposure to COPECs in on-site soil resulted in substantial impact (*de manifestis*) to both soil invertebrate and terrestrial wildlife populations; action should be taken that can eliminate or reduce exposure to an acceptable level.

The potential for adverse effects to the benthic macroinvertebrate community is *de minimus*, and the potential for adverse effects to the aquatic and semi-aquatic wildlife community is *de minimus*.

9.3 Conclusions and Recommendations

Based on the results of the RI, the MRS has been sufficiently characterized. It is recommended that the MRS boundary be revised to include the furthest extent of lead concentration exceedances of its human health screening criterion based on XRF data; the revised acreage is 0.27 acres (**Figure 9-5**). The presence of unacceptable risks to human health warrants an FS for the Ridgway Training Range MRS. The next step after an FS would be to prepare a proposed plan to convey this finding to the public, followed by a decision document to formally conclude work at the MRS.

Table 9-5. Human Health Risk Assessment Constituents of Concern for Soil

Receptor	Exposure Medium	Constituent of Concern
Target Berm DU		
Child Visitor	Surface Soil	Lead (a, b)
	Total Soil	Lead (a, b)
Outdoor Worker	Surface Soil	Lead (b)
	Total Soil	Lead (b)
Construction/Utility Worker	Surface Soil	Lead (b, c)
Hypothetical Child Resident	Surface Soil	Antimony Lead (b)
	Total Soil	Antimony Lead (b)
Soil Pile DU		
Child Visitor	Surface Soil	Lead (a, b)
	Total Soil	Antimony Lead (a, b)
Construction Worker (c)	Total Soil	Antimony Lead (b, c)
Utility Worker (c)	Total Soil	Lead (b, c)
Outdoor Worker	Surface Soil	Lead (b)
	Total Soil	Lead (b)
Hypothetical Child Resident	Surface Soil	Antimony Lead (b)
	Total Soil	Antimony Lead (b)
Hypothetical Adult Resident	Total Soil	Antimony
Firing Point DU		
Hypothetical Child Resident	Surface Soil	Nitroglycerin

Notes:

(a) IEUBK model results for the hypothetical child resident were also used to be protective of the child visitor at the MRS.

(b) Lead modeling results are based on target PbB threshold of 10 µg/dL.

(c) If a target PbB threshold of 5 µg/dL was used, then lead would be identified as a surface soil and total soil COC for the construction and utility worker scenarios.

CLIENT	Army National Guard			
PROJECT	Remedial Investigation through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	10/16/2018
SCALE	1:480	CHK BY	JW	10/16/2018
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	10/16/2018

N

TITLE

Proposed Ridgway MRS Boundary Revision

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Figure 9-5

Q:\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 6 SARs\900-Work\GIS\Ridgway\1_MXD\Ridgway_Revised_MRS_Boundary.mxd

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Appendix A:

Field Forms

Soil Sample Collection Logs

Site ID: __________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 07/11/18
On-Site Personnel: JW, ZN
Log Preparer: ZN
Sample ID: RTR01 IS01

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	35
Sand (0.06 – 2 mm)	60
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	<1
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 3/6
Moisture (%)	20%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Soil Probe

Sample Types

☑ Incremental (always taken Triplicate)– No. of Increments: 133

☐ Discrete – Depth interval: ________

XRF Result: ________

XRF Error: ________

Quality Control Samples

☐ Duplicate ☑ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☐ N/A

Notes:

Target Berm - ISM

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/11/18
On-Site Personnel: JW, ZN
Log Preparer: ZN
Sample ID: RTR01 IS02

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	35
Sand (0.06 – 2 mm)	60
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	<1
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 3/6
Moisture (%)	20%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Soil Probe

Sample Types

☑ Incremental (always taken Triplicate)– No. of Increments: 133

☐ Discrete – Depth interval: ________

XRF Result: ________

XRF Error: ________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Target Berm ISM

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/11/18
On-Site Personnel: JW ZN Log Preparer: ZN
Sample ID: RTR01 IS03

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	35
Sand (0.06 – 2 mm)	60
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	<1
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 3/6
Moisture (%)	20
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Soil Probe

Sample Types

☑ Incremental (always taken Triplicate)– No. of Increments: 133
☐ Discrete – Depth interval:
XRF Result:
XRF Error:

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Target Berm

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/13/18
On-Site Personnel: JW, ZN Log Preparer: ZN
Sample ID: RTR01DA01A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	30
Sand (0.06 – 2 mm)	50
Gravel (2.64 mm)	10
Cobble (64 – 256 mm)	10
Organic Content	[✓ LOW] / MED / HIGH
Color	7.5 YR 4/6
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp. Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 12-18"
XRF Result:
XRF Error:

Quality Control Samples

☑ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☐ N/A

Notes:

Target Berm

DUP: RTR01DA01B

AECOM

Site ID: ________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/13/18
On-Site Personnel: JW, ZN Log Preparer: ZN
Sample ID: RTR01DB01A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	20
Sand (0.06 – 2 mm)	50
Gravel (2.64 mm)	15
Cobble (64 – 256 mm)	15
Organic Content	[✓ LOW] / MED / HIGH
Color	7.5 YR 4/6
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ________
☑ Discrete – Depth interval: 24-30" bgs
XRF Result: ________
XRF Error: ________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☐ N/A

Notes:

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/12/18
On-Site Personnel: JW, ZN Log Preparer: ZN
Sample ID: RTR 01 DC 02A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	35
Sand (0.06 – 2 mm)	60
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	<1
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 3/6
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: __________
☑ Discrete – Depth interval: 0-6" bgs
XRF Result: 24,543 mg/kg
XRF Error: __________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

TCLP- Only

Target Berm

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/12/18
On-Site Personnel: JW, ZN Log Preparer: ZN
Sample ID: RTR01DA03A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	30
Sand (0.06 – 2 mm)	50
Gravel (2.64 mm)	10
Cobble (64 – 256 mm)	10
Organic Content	[✓ LOW] / MED / HIGH
Color	7.5 YR 4/6
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp. Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 12-18"
XRF Result:
XRF Error:

Quality Control Samples

☐ Duplicate ☑ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☐ N/A

Notes:

Target Berm

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA　Date: 7/12/18
On-Site Personnel: JW, ZN　Log Preparer: ZN
Sample ID: RTR01DB03A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	20
Sand (0.06 – 2 mm)	50
Gravel (2.64 mm)	15
Cobble (64 – 256 mm)	15
Organic Content	[✓ LOW] / MED / HIGH
Color	7.5 YR 4/6
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 24-30"
XRF Result:
XRF Error:

Quality Control Samples

☐ Duplicate　☐ MS/MSDs　☐ Field Blank　☐ Equipment Blank　☑ N/A

Notes:

Target Berm

AECOM

Site ID: ______
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/12/18
On-Site Personnel: JW, ZN Log Preparer: ZN
Sample ID: RTR 01 DA04A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	30
Sand (0.06 – 2 mm)	50
Gravel (2.64 mm)	10
Cobble (64 – 256 mm)	10
Organic Content	[✓ LOW] / MED / HIGH
Color	7.5 YR 4/6
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ______
☑ Discrete – Depth interval: 12-18
XRF Result: ______
XRF Error: ______

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Target Berm

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/12/18
On-Site Personnel: JW, ZN Log Preparer: ZN
Sample ID: RTR01DB04A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	20
Sand (0.06 – 2 mm)	50
Gravel (2.64 mm)	15
Cobble (64 – 256 mm)	15
Organic Content	[✓ LOW] / MED / HIGH
Color	7.5 YR 4/6
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ____________
☑ Discrete – Depth interval: 24-30"
XRF Result: ____________
XRF Error: ____________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Target Berm

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/12/18
On-Site Personnel: JV, ZN
Log Preparer: ZN
Sample ID: RTR01 DA 05A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	30
Sand (0.06 – 2 mm)	50
Gravel (2.64 mm)	10
Cobble (64 – 256 mm)	10
Organic Content	[✓ LOW] / MED / HIGH
Color	7.5 YR 4/6
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp. spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 12-18" bgs
XRF Result:
XRF Error:

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Target Berm.

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/12/18
On-Site Personnel: JW, ZN
Log Preparer: ZN
Sample ID: RTR01DS01A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	70
Sand (0.06 – 2 mm)	25
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	7.5 YR 3/2
Moisture (%)	25
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Dip Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 0-6" below cobble
XRF Result:
XRF Error:

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Gravel Area – Target Berm

AECOM

Site ID: ________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/12/18
On-Site Personnel: EW, ZN
Log Preparer: ZN
Sample ID: RTR 01 DS 02A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	70
Sand (0.06 – 2 mm)	25
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	7.5 YR 3/2
Moisture (%)	25
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ________
☑ Discrete – Depth interval: 0–6" below cobble
XRF Result: ________
XRF Error: ________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Gravel Area – Target Berm

Site ID: ________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/12/18
On-Site Personnel: JW, ZN Log Preparer: ZN
Sample ID: RTR-01DD01A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	70
Sand (0.06 – 2 mm)	30
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 5/8
Moisture (%)	50
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ________
☑ Discrete – Depth interval: 0-6"
XRF Result: ________
XRF Error: ________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Drainage Area - South
Sediment

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/12/18
On-Site Personnel: JW, ZN Log Preparer: ZN
Sample ID: RTR01DD02A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	70
Sand (0.06 – 2 mm)	30
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 5/8
Moisture (%)	50
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 0-6"
XRF Result:
XRF Error:

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Drainage Area - South
Sediment

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh
Log Preparer: Zach Neigh
Sample ID: RTR02DS01A (Dup: RTR02DS01B)

Soil Sample Characterization

Grain Size (%)	Sandy Loam
Silt/Clay (<0.06 mm)	35%
Sand (0.06 – 2 mm)	60%
Gravel (2.64 mm)	5%
Cobble (64 – 256 mm)	0% - 1%
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 3/6
Moisture (%)	20%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable Spoon, Hand Auger

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: ~~0-6~~ 0-1' bps (below pile surface)
XRF Result:
XRF Error:

Quality Control Samples

☑ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☐ N/A

Notes:

Soil Pile

Duplicate: RTR02DS01B

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh Log Preparer: Zach Neigh
Sample ID: RTR02DS02A

Soil Sample Characterization

Grain Size (%)	Sandy Loam
Silt/Clay (<0.06 mm)	35%
Sand (0.06 – 2 mm)	60%
Gravel (2.64 mm)	5%
Cobble (64 – 256 mm)	0%
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 3/6
Moisture (%)	20 %
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable Spoon, Hand Auger

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 0-1 bgs
XRF Result:
XRF Error:

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Soil pile

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh Log Preparer: Zach Neigh
Sample ID: RTR02DS03A

Soil Sample Characterization

Grain Size (%)	Sandy Loamy
Silt/Clay (<0.06 mm)	35%
Sand (0.06 – 2 mm)	60%
Gravel (2.64 mm)	5%
Cobble (64 – 256 mm)	0%
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 3/6
Moisture (%)	20 %
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable Spoon, Hand Auger

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 0-1' bgs
XRF Result:
XRF Error:

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Soil pile

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh
Log Preparer: Zach Neigh
Sample ID: RTR02DS04A

Soil Sample Characterization

Grain Size (%)	Sandy Loam
Silt/Clay (<0.06 mm)	35%
Sand (0.06 – 2 mm)	60%
Gravel (2.64 mm)	5%
Cobble (64 – 256 mm)	0%
Organic Content	[✓ LOW] / MED / HIGH
Color	10 YR 3/6
Moisture (%)	32%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable Spoon, Hand Auger

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:

☑ Discrete – Depth interval: 0-1' bgs

XRF Result:

XRF Error:

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Soil pile

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh Log Preparer: Zach Neigh
Sample ID: RTR02DS05A

Soil Sample Characterization

Grain Size (%)	Sand Loam
Silt/Clay (<0.06 mm)	35 %
Sand (0.06 – 2 mm)	60 %
Gravel (2.64 mm)	5%
Cobble (64 – 256 mm)	0 %
Organic Content	[✓ LOW] / MED / HIGH
Color	10 YR 3/6
Moisture (%)	32 %
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable Spoon, Hand Auger

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:

☑ Discrete – Depth interval: 0-1' bgs

XRF Result:

XRF Error:

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Soil Pile

AECOM

Site ID: ________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh
Log Preparer: Zach Neigh
Sample ID: RTR02DS06A

Soil Sample Characterization

Grain Size (%)	Sandy Loam
Silt/Clay (<0.06 mm)	35%
Sand (0.06 – 2 mm)	60%
Gravel (2.64 mm)	5%
Cobble (64 – 256 mm)	0%
Organic Content	[✓ LOW] / MED / HIGH
Color	10 YR 3/6
Moisture (%)	32%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable spoon, Hand Auger

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ________

☑ Discrete – Depth interval: 0-1' bgs

XRF Result: ________

XRF Error: ________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Soil pile

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh Log Preparer: Zach Neigh
Sample ID: RTR02DS07A

Soil Sample Characterization

Grain Size (%)	Sandy Loam
Silt/Clay (<0.06 mm)	35
Sand (0.06 – 2 mm)	60
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	0
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 3/6
Moisture (%)	20%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable Spoon, Hand Auger

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: __________
☑ Discrete – Depth interval: 0-1' ags (above ground surface)
XRF Result: __________
XRF Error: __________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Soil Pile

AECOM

Site ID: ________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh
Log Preparer: Zach Neigh
Sample ID: RTR02DS08A

Soil Sample Characterization

Grain Size (%)	Sandy Loam
Silt/Clay (<0.06 mm)	35
Sand (0.06 – 2 mm)	60
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	0
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 3/6
Moisture (%)	20%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable Spoon, Hand Auger

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ________

☑ Discrete – Depth interval: 0-1' ags

XRF Result: ________

XRF Error: ________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Soil pile

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh Log Preparer: Zach Neigh
Sample ID: RTR 02DS09A

Soil Sample Characterization

Grain Size (%)	Sandy Loam
Silt/Clay (<0.06 mm)	35
Sand (0.06 – 2 mm)	60
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	0
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 3/6
Moisture (%)	20%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable Spoon, Hand Auger

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: __________
☑ Discrete – Depth interval: 0-1' ags
XRF Result: __________
XRF Error: __________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Soil Pile

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh Log Preparer: Zach Neigh
Sample ID: RTR02DS10A

Soil Sample Characterization

Grain Size (%)	Sandy Loam
Silt/Clay (<0.06 mm)	35
Sand (0.06 – 2 mm)	60
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	10 YR 3/6
Moisture (%)	32%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable Spoon, Hand Auger

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 0-1' bgs
XRF Result:
XRF Error:

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Soil pile

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh Log Preparer: Zach Neigh
Sample ID: RTR02DS11A

Soil Sample Characterization

Grain Size (%)	Sandy Loam
Silt/Clay (<0.06 mm)	35
Sand (0.06 – 2 mm)	60
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	10 YR 3/6
Moisture (%)	32%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable Spoon, Hand Auger

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: __________
☑ Discrete – Depth interval: 0-1' ags
XRF Result: __________
XRF Error: __________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Soil pile

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh
Log Preparer: Zach Neigh
Sample ID: RTR02DS12A

Soil Sample Characterization

Grain Size (%)	Sandy Loam
Silt/Clay (<0.06 mm)	35
Sand (0.06 – 2 mm)	60
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	10 YR 3/6
Moisture (%)	32 %
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable spoon, Hand Auger

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ____________
☑ Discrete – Depth interval: 0-1' bgs
XRF Result: ____________
XRF Error: ____________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/13/18
On-Site Personnel: JW, ZN
Log Preparer: ZN
Sample ID: RTR03IS01

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	40
Sand (0.06 – 2 mm)	50
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	5
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 2/4
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Soil Probe

Sample Types

☑ Incremental (always taken Triplicate)– No. of Increments: 36

☐ Discrete – Depth interval: ________

XRF Result: ________

XRF Error: ________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Firing Point.

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/12/18
On-Site Personnel: SW, ZN Log Preparer: ZN
Sample ID: RTR03 IS03

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	40
Sand (0.06 – 2 mm)	50
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	5
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 2/4
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Soil Probe

Sample Types

☑ Incremental (always taken Triplicate)– No. of Increments: 36

☐ Discrete – Depth interval: ____________

XRF Result: ____________

XRF Error: ____________

Quality Control Samples

☐ Duplicate ☑ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☐ N/A

Notes:

Firing Point

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/12/18

On-Site Personnel: JW, ZN
Log Preparer: ZN

Sample ID: RTR03IS03

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	40
Sand (0.06 – 2 mm)	50
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	5
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 3/4
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Soil Probe

Sample Types

☑ Incremental (always taken Triplicate)– No. of Increments: 36

☐ Discrete – Depth interval:

XRF Result:

XRF Error:

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Firing Point

AECOM

Site ID: ________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Nigh
Log Preparer: ZN
Sample ID: RTR03DS01A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	45
Sand (0.06 – 2 mm)	45
Gravel (2.64 mm)	10
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / [✓ HIGH]
Color	7.5YR 2/4
Moisture (%)	18%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: ________

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ________
☑ Discrete – Depth interval: 0-6"
XRF Result: –
XRF Error: –

Quality Control Samples

☑ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☐ N/A

Notes:

Firing Point - Nite only

Dup: RTR03DS01B

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh
Log Preparer: Zach Neigh
Sample ID: RTR03DS02A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	45
Sand (0.06 – 2 mm)	45
Gravel (2.64 mm)	10
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / [✓ HIGH]
Color	7.5 YR 2/4
Moisture (%)	18%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 0-6"
XRF Result: –
XRF Error: –

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Nitroglycerin only

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 07/09/18
On-Site Personnel: Joe Witte, Zach Neigh Log Preparer: Zach Neigh
Sample ID: RTR03 DS03A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	45
Sand (0.06 – 2 mm)	45
Gravel (2.64 mm)	10
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / [✓ HIGH]
Color	7.5 YR 2/4
Moisture (%)	20%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disposable Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ________
☑ Discrete – Depth interval: 0-6"
XRF Result: –
XRF Error: –

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Nitroglycerin only

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/12/18
On-Site Personnel: JLW, ZN
Log Preparer: ZN
Sample ID: RTR 03 DA01 A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	~~46~~ 30
Sand (0.06 – 2 mm)	45
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	20
Organic Content	[✓ LOW] / MED / HIGH
Color	7.5 YR 2/4
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 12-18" bgs
XRF Result:
XRF Error:

Quality Control Samples

☐ Duplicate ☑ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☐ N/A

Notes:

Firing Point

AECOM

Site ID: ____
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/12/18
On-Site Personnel: JW, ZN
Log Preparer: ZN
Sample ID: RTR03 DA02A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	30
Sand (0.06 – 2 mm)	45
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	20
Organic Content	[✓ LOW] / MED / HIGH
Color	7.5 YR 2/1
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ____
☑ Discrete – Depth interval: 12-18"
XRF Result: ____
XRF Error: ____

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Firing Point

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/12/18
On-Site Personnel: JW, ZN
Log Preparer: ZN
Sample ID: RTR03DA03A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	30
Sand (0.06 – 2 mm)	45
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	20
Organic Content	[✓ LOW] / MED / HIGH
Color	7.5 YR 2/4
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ________

☑ Discrete – Depth interval: 12-18" bgs

XRF Result: ________

XRF Error: ________

Quality Control Samples

☑ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☐ N/A

Notes:

Firing Point

DUP: RTR03DA03B

AECOM

Site ID: ________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/13/18
On-Site Personnel: SW, ZN Log Preparer: ZN
Sample ID: RTR03DC01A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	45
Sand (0.06 – 2 mm)	45
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	5
Organic Content	LOW / [✓ MED] / HIGH
Color	7.5 YR 2/4
Moisture (%)	15
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Dip Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ________
☑ Discrete – Depth interval: 0-6"
XRF Result: ________
XRF Error: ________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Firing Point

TCLP only

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA   Date: 7/12/18
On-Site Personnel: JW, ZN   Log Preparer: ZN
Sample ID: RTR05DD01A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	80
Sand (0.06 – 2 mm)	20
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	5 YR 6/10
Moisture (%)	> 50
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp. spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 0-6"
XRF Result:
XRF Error:

Quality Control Samples

☑ Duplicate ☑ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☐ N/A

Notes:

French Drain
Sediment
Dup: RTR05DD01B

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/12/18
On-Site Personnel: JW, ZN
Log Preparer: ZN
Sample ID: RTRC05DD02A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	80
Sand (0.06 – 2 mm)	20
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	5 YR 6/10
Moisture (%)	>50%
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp. Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 0-6"
XRF Result:
XRF Error:

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

French Drain

Sediment

Site ID: ____
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/12/18
On-Site Personnel: SW ZN
Log Preparer: ZN
Sample ID: RTR 05 DD 03A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	80
Sand (0.06 – 2 mm)	20
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	5 YR 6/10
Moisture (%)	>50
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ____
☑ Discrete – Depth interval: 0-6"
XRF Result: ____
XRF Error: ____

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

French Drain

Sediment

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/12/18
On-Site Personnel: JW, ZN Log Preparer: ZN
Sample ID: RTR 05 DD 04A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	80
Sand (0.06 – 2 mm)	20
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	5 YR 6/10
Moisture (%)	> 50
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 0-6
XRF Result:
XRF Error:

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

French Drain
Sediment

AECOM

Site ID: ~~[illegible]~~
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/12/18
On-Site Personnel: SW, ZN
Log Preparer: ZN
Sample ID: RTR05DD05A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	80
Sand (0.06 – 2 mm)	20
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	5 YR 6/10
Moisture (%)	> 50
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp. Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ____

☑ Discrete – Depth interval: 0-6"

XRF Result: ____

XRF Error: ____

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☐ N/A

Notes:

French Drain

Sediment

AECOM

Site ID: __________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/12/18
On-Site Personnel: JW, ZN Log Preparer: ZN
Sample ID: RTR05DD06A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	80
Sand (0.06 – 2 mm)	20
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	5 YR 6/10
Moisture (%)	> 50
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: __________

☑ Discrete – Depth interval: 0-6"

XRF Result: __________

XRF Error: __________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

French Drain

Sediment

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/12/18
On-Site Personnel: JW, ZN Log Preparer: ZN
Sample ID: RTR05 DD07A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	80
Sand (0.06 – 2 mm)	20
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	5 YR 6/10
Moisture (%)	>50
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ____________
☑ Discrete – Depth interval: 0-6"
XRF Result: ____________
XRF Error: ____________

Quality Control Samples

☐Duplicate ☐MS/MSDs ☐Field Blank ☐Equipment Blank ☑N/A

Notes:

French Drain
sediment

AECOM

Site ID: __________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Rigway, PA Date: 7/12/18
On-Site Personnel: JW, ZN Log Preparer: ZN
Sample ID: RTR05DD08

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	80
Sand (0.06 – 2 mm)	20
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	5 YR 6/10
Moisture (%)	≥50
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ________
☑ Discrete – Depth interval: 0-6"
XRF Result: ________
XRF Error: ________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Fresh Drain

Sediment

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/12/18
On-Site Personnel: JW, ZN Log Preparer: ZN
Sample ID: RTR05DD09A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	80
Sand (0.06 – 2 mm)	20
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	5 YR 6/10
Moisture (%)	> 50
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments: ________
☑ Discrete – Depth interval: 0-6"
XRF Result: ________
XRF Error: ________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

French Drain

Sediment

AECOM

Site ID:
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/12/18
On-Site Personnel: JW, ZN
Log Preparer: ZN
Sample ID: RTR05DD10A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	80
Sand (0.06 – 2 mm)	20
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	[✓ LOW] / MED / HIGH
Color	5 YR 6/10
Moisture (%)	>50
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Disp Spoon

Sample Types

☐ Incremental (always taken Triplicate)– No. of Increments:
☑ Discrete – Depth interval: 0-6"

XRF Result:
XRF Error:

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Frech Drain

Sediment

AECOM

Site ID:

Arrival Time: 0700

Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/12/18

On-Site Personnel: SW, ZN Log Preparer: ZN

Sample ID: RTR04IS01

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	60
Sand (0.06 – 2 mm)	40
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / [✓ HIGH]
Color	7.5 YR 1/2
Moisture (%)	20
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Soil Probe

Sample Types

☑ Incremental (always taken Triplicate)– No. of Increments: 30

☐ Discrete – Depth interval:

XRF Result:

XRF Error:

Quality Control Samples

☐ Duplicate ☑ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☐ N/A

Notes:

Background

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA
Date: 7/12/18
On-Site Personnel: SW, ZN
Log Preparer: ZN
Sample ID: RTR 04 IS02

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	60
Sand (0.06 – 2 mm)	40
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / [✓ HIGH]
Color	7.5 YR 1/2
Moisture (%)	20
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Soil Probe

Sample Types

☑ Incremental (always taken Triplicate)– No. of Increments: 30
☐ Discrete – Depth interval: ________
XRF Result: ________
XRF Error: ________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Background

AECOM

Site ID: ____________
Arrival Time: 0700
Departure Time: 1900

Soil Sample Collection Log

Site Name/Location: Ridgway, PA Date: 7/12/18
On-Site Personnel: JW ZN Log Preparer: ZN
Sample ID: RTR04IS03

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	60
Sand (0.06 – 2 mm)	40
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / [✓ HIGH]
Color	7.5 YR 1/2
Moisture (%)	20
Bullets or Bullet Fragments?	YES / [✓ NO]

Sample Collection Tools Used: Soil Probe

Sample Types

☑ Incremental (always taken Triplicate)– No. of Increments: 30

☐ Discrete – Depth interval: ________

XRF Result: ________

XRF Error: ________

Quality Control Samples

☐ Duplicate ☐ MS/MSDs ☐ Field Blank ☐ Equipment Blank ☑ N/A

Notes:

Background.

Soil Sample Collection Logs - XRF Analysis

Sample		XRF Readings				Moisture		
Location	1	2	3	4	AVG	%	Date	initials
KTR01X01	16865	15084	17865	16131	16,486	13	7-8	ZN
error 02	508	382	518	409				
02	12837	15468	13477	15527	14,327	20	7-8	ZN
error 02	264	356	302	413				
03	11869	16268	17384	15140	15,167	19	7-8	ZN
error 03	299	357	358	322				
04	23262	12930	15702	20287	18,071	19	7-8	ZN
error 04	488	257	302	361				
05	6271	6694	8016	9452	7608	13	7-10	dw
error 05	140	188	122	156				
06	19088	24077	27325	27680	24,543	15	7-10	dw
error 06	408	487	499	462				
07	2886	6170	9350	27680	6843	16	7-10	dw
error 07	57	93	176	462				
08	8977	16438	18613	19252	15,820	11	7-8	dw
error 08	302	418	470	478				
09	12150	10994	15601	14999	13,436	14	7-10	dw
error 09	200	213	219	209				
10	16403	19057	16005	16115	17,020	15	7-10	dw
error 10	284	345	220	259				
11	18131	18401	19174	1892	14,400	18	7-10	dw
error 11	355	409	366	341				
14 ~~12~~	4236	3463	4198	3965	11,575	17	7-10	dw
error ~~12~~ 14	84	68	84	79				
13	349	769	438	442	500	18	7-10	dw
error 13	16	31	23	20				
12 ~~14~~	10211	10553	13027	12510	3,966	14	7-8	dw
error ~~14~~ 12	269	232	317	299				
15	11645	15451	16206	19109	15,603	12	7-10	dw
error 15	219	269	281	354				
16	12818	8452	10295	8206	9,943	14	7-8	dw
error 16	287	312	226	203				
17	12264	13461	10646	12451	12,206	16	7-10	dw
error 17	237	230	260	240				
18	20933	17563	18774	18793	19,016	12	7-10	dw
error 18	321	361	411	399				
19	17917	14094	19064	15214	16,572	14	7-10	dw
error 19	327	528	339	388				
20	9859	17116	5819	7365	10,040	19	7-8	dw
error 20	276	613	317	142				
21	13808	12487	13821	11844	13,003	17	7-10	dw
error 21	204	227	265	254				
22	20849	17730	20928	23088	20,661	16	7-10	dw
error 22	364	340	401	493				
23	8125	7930	8002	8495	8,138	14	7-10	dw
error 23	116	168	178	180				
24	9807	9741	11871	8443	9,965	18	7-8	ZN
error 24	233	237	333	181				
25	103	156	106	111	114	16	7-10	dw
error 25	11	12	10	12				
26	16886	15776	16878	15402	16,236	12	7-10	dw
error 26	326	320	382	327				

XRF Analysis

Location	1	2	3	4	AVG	%	Date	initials
27	17603	21921	13344	20481	18,337	16	7-10	JW
error 27	331	478	319	450				
28	7836	3597	9843	5472	6,687	19	7-8	ZN
error 28	191	94	366	138				
29	9322	9262	7503	9228	8,829	17	7-8	JW
error 29	288	239	186	221				
30	16459	16143	14888	15071	15,640	16	7-8	JW
error 30	400	392	374	369				
31	12551	14898	15265	12076	13,698	18	7-8	ZN
error 31	308	347	365	356				
32	13089	14698	15429	14283	14,375	15	7-8	ZN
error 32	331	400	358	344				
33	1228	1811	2047	1043	1,532	18	7-9	ZN
error 33	33	43	53	29				
34	2511	3698	4669	3387	3,566	12	7-9	ZN
error 34	57	66	90	62				
35	7085	5748	8203	6714	6,938	17	7-9	ZN
error 35	102	81	123	116				
36	1713	3456	1336	1838	2,086	15	7-9	JW
error 36	50	89	56	64				
37	4728	4008	4060	4541	4,389	18	7-9	JW
error 37	104	109	103	120				
38	205	619	287	488	400	19	7-9	JW
error 38	24	31	25	25				
39	4034	7374	3749	5831	5,247	14	7-9	ZN
error 39	65	114	215	100				
40	1474	1211	3283	3555	2,381	10	7-9	ZN
error 40	12	32	54	64				
41	3456	2868	2777	2905	2,990	19	7-9	ZN
error 41	67	61	58	51				
42	6725	2218	6658	3230	4,708	17	7-9	JW
error 42	152	69	165	87				
43	768	443	881	599	673	10	7-9	JW
error 43	33	26	41	44				
44	729	812	1015	914	868	8	7-9	JW
error 44	31	32	43	36				
45	310	1762	4376	1902	2,088	14	7-9	JW
error 45	21	64	83	55				
46	3710	3082	1873	2314	2,732	19	7-4	JW
error 46	89	71	55	67				
47	2170	2485	1525	3426	2,402	18	7-9	JW
error 47	58	68	50	74				
48	3371	1122	804	545	1,461	16	7-9	JW
error 48	76	39	34	27				
49	2040	1973	2319	1998	2,083	14	7-10	JW
error 49	57	53	84	57				
50	863	1310	1512	1435	1,280	18	7-10	JW
error 50	30	40	44	40				
51	1055	1076	1317	1195	1,161	19	7-10	JW
error 51	39	35	50	39				
52	151	1068	132	509	465	12	7-10	JW
error 52	13	39	16	24				

XRF Analysis

Location	1	2	3	4	Avg	%	Date	Initials
53	887	969	954	553	841	18	7-10	JW
error 53	32	39	34	25			~~7-10~~	
54	955	1044	887	881	942	18	7-10	JW
error 54	33	35	32	35				
55	1422	743	1083	1435	1,171	18	7-10	JW
error 55	41	24	33	44				
56	672	811	983	211	670	15	7-10	JW
error 56	28	29	36	14				
57	1116	589	1300	1599	1,151	15	7-10	JW
error 57	36	25	42	43				
58	742	855	587	764	737	19	7-10	JW
error 58	28	31	24	28				
59	326	279	407	339	338	16	7-10	JW
error 59	17	17	21	17				
60	1329	612	579	510	758	15	7-10	JW
error 60	38	25	20	23			~~7~~	
61	210	302	258	286	264	18	7-10	JW
error 61	14	17	16	16				
62	777	146	362	427	428	18	7-10	JW
error 62	28	14	16	20				
63	466	345	529	544	471	15	7-10	JW
error 63	22	20	23	24				
64	743	707	607	996	763	16	7-10	JW
error 64	28	29	26	34				
65	637	679	750	801	717	18	7-10	JW
error 65	23	26	27	29				
66	321	437	718	198	419	15	7-10	JW
error 67	18	20	23	15				
68	352	413	379	404	328 387	12	7-10	JW
error 68	20	21	21	20				
69	792	934	409	545	~~387~~ 670	13	7-10	JW
error 69	33	34	23	26				
70	397	367	415	396	~~670~~ 394	18	7-10	JW
error 70	25	22	25	26				
71	379	242	486	106	~~394~~ 303	18	7-10	JW
error 71	22	19	28	17				
72	474	522	627	462	~~303~~ 521	19	7-10	JW
error 72	25	25	31	31				
73	286	303	331	293	~~521~~ 303	16	7-10	JW
error 73	17	16	19	19				
74	193	240	270	214	229	17	7-10	JW
error 74	17	20	20	20				
75	222	241	263	273	250	16	7-10	JW
error 75	19	14	15	16				
76	151	307	234	233	231	18	7-10	JW
error 76	13	16	13	16				
77	64	65	69	69	67	12	7-10	JW
error 78	9	10	10	13				
78	2788	2820	1856	2398	2,466	15	7-10	ZN
error 78	58	56	32	42				
79	3012	3846	5138	1006	3,251	15	7-10	ZN
error 79	58	73	87	32				

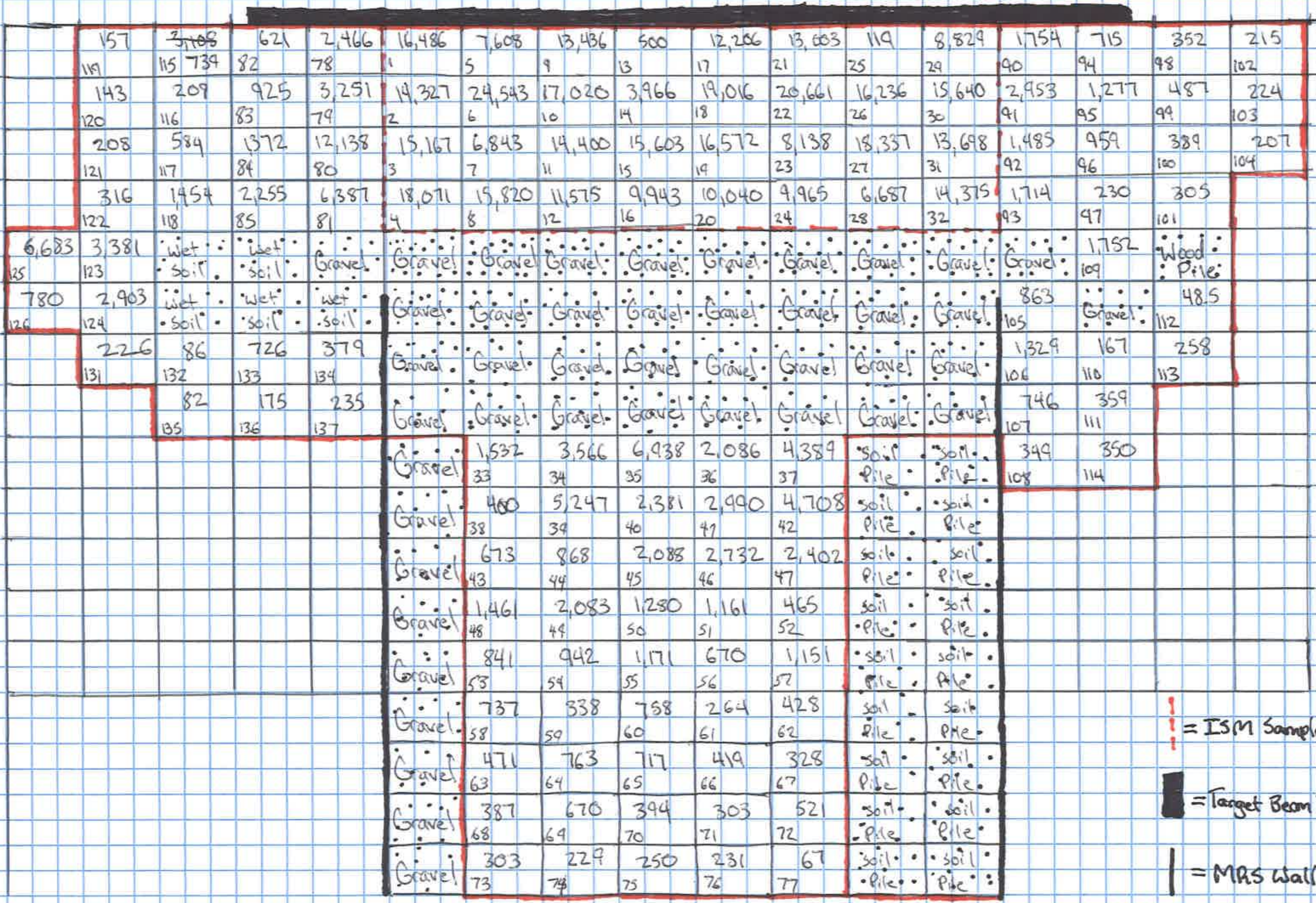
	XRF Analysis					(%)		
Location	1	2	3	4	AVG	Moisture	Date	Initials
80	14869	11122	11282	11279	12,138	15	7-10	ZN
error 80	236	183	184	180				
81	10839	4351	4797	5519	6,387	18	7-10	ZN
error 81	170	79	85	93				
82	694	754	544	492	621	18	7-10	ZN
error 82	20	23	20	20				
83	995	1061	794	851	925	19	7-10	ZN
error 83	26	25	24	25				
84	1162	749	852	2725	1,372	15	7-10	JW
error 84	27	23	23	41				
85	844	1678	1219	2756	2,255	18	7-10	ZN
error 85	24	35	29	50				
86	3996	2529	2859	3048	3,108	16	7-10	JW
error 86	62	53	60	85				
87	1265	1305	2042	2435	1,762	15	7-10	JW
error 87	32	42	49	49				
88	1642	1306	707	1185	1,210	15	7-10	JW
error 88	45	39	30	34				
89	2632	3024	1513	1639	2,202	16	7-10	JW
error 89	60	61	61	42				
90	1637	1854	1614	1909	1,754	18	7-10	ZN
error 90	144	44	37	37				
91	1774	2889	3898	3256	2,953	15	7-10	ZN
error 91	38	68	98	89				
92	1713	1657	2186	2097	1,485	18	7-10	ZN
error 92	45	42	42	40				
93	38	43	31	34	1,714	18	7-10	ZN
error 93	1413	1754	1350	2338				
94	841	865	659	643	715	18	7-10	ZN
error 94	24	31	27	23				
95	1034	1656	788	1631	1,277	19	7-10	ZN
error 95	25	35	23	45				
96	969	905	1107	855	959	18	7-10	ZN
error 96	22	29	27	26				
97	155	386	266	11	230	19	7-10	ZN
error 97	13	16	13	12				
98	514	345	261	289	352	15	7-10	ZN
error 98	19	15	14	13				
99	355	466	480	647	487	18	7-10	ZN
error 99	17	32	24	37				
100	489	357	404	305	389	18	7-10	ZN
error 100	22	17	20	20				
101	305	325	254	335	305	15	7-10	ZN
error 101	14	15	15	13				
102	208	253	222	177	215	17	7-10	ZN
error 102	14	15	16	14				
103	232	298	176	193	224	17	7-10	ZN
error 103	14	18	15	17				
104	295	201	163	168	207	18	7-10	ZN
error 104	17	15	14	14				
105	474	1046	1052	880	863	18	7-10	ZN
error 105	23	30	28	34				

Duplicate rows of 82-85

XRF Analysis

Location	1	2	3	4	AVG.	(%) Moisture	Date	Initials
106	1434	777	1491	1614	1,329	20	7-10	ZN
error 106	42	29	40	38				
107	799	569	805	812	746	10	7-10	JW
error 107	33	30	35	34				
108	401	368	277	350	349	18	7-10	JW
error 108	27	22	17	20				
109	819	2111	2071	2006	1,752	16	7-10	JW
error 109	33	53	55	60				
110	760	658	663	595	167	17	7-10	JW
error 110	32	30	27	26				
111	445	310	312	367	359	19	7-10	JW
error 111	24	21	23	29				
112	57	29	68	40	49	18	7-10	JW
error 112	10	10	10	9				
113	282	305	202	241	258	19	7-10	JW
error 113	17	22	16	15				
114	313	319	426	340	350	18	7-10	JW
error 114	18	21	21	20				
115	762	653	1049	691	739	15	7-10	JW
error 115	~~204~~ 25	~~228~~ 21	~~149~~ 18	~~251~~ 19				
116	209	228	149	251	209	10	7-10	JW
error 116	19	17	14	12				
117	709	449	565	614	584	11	7-10	JW
error 117	26	24	25	31				
118	1877	1530	1184	1240	1,454	14	7-10	JW
error 118	47	45	37	21				
119	151	161	126	188	157	16	7-10	JW
error 119	15	13	13	15		B		
120	203	126	107	135	120	17	7-10	JW
error 120	13	14	10	11				
121	204	180	275	171	208	14	7-10	JW
error 121	20	17	13	12				
122	243	301	312	409	316	12	7-10	JW
error 122	17	21	20	17				
123	3590	3231	3290	3411	3,381	10	7-10	JW
error 123	90	71	88	75				
124	2385	2111	3461	3653	2,903	14	7-10	JW
error 124	60	59	91	117				
125	2570	8688	8751	6721	6,683	19	7-10	JW
error 125	55	161	164	91				
126	352	886	1145	738	780	18	7-10	JW
error 126	20	42	49	30				
127	365	261	277	273	294	16	7-10	JW
error 127	18	13	18	17				
128	68	57	76	54	64	19	7-10	JW
error 128	9	7	10	8				
129	65	49	61	69	61	12	7-10	JW
error 129	10	11	10	15				
130	44	49	61	68	41	18	7-10	JW
error 130	10	10	9	12				
131	336	377	101	84	226	18	7-10	JW
error 131	25	26	9	6				

	XRF Reading							
Location	1	2	3	4	AVG	%	Date	Initials
132	46	71	44	180	86	15	7-10	dW
error 132	5	8	7	12				
133	793	834	535	735	726	18	7-10	dW
error 133	22	24	19	21				
134	546	351	296	323	379	19	7-10	dW
error 134	17	15	14	14				
135	82	82	79	86	82	19	7-10	dW
error 135	8	9	8	8				
136	331	336	349	275	175	18	7-10	dW
error 136	15	14	15	13				
137	185	271	150	95	235	16	7-10	dW
error 137	11	13	11	9				



	157 119	~~3,108~~ 734 115	621 82	2,466 78	16,486 1	7,608 5	13,436 9	500 13	12,286 17	13,603 21	119 25	8,829 29	1754 90	715 94	352 98	215 102
	143 120	209 116	925 83	3,251 79	14,327 2	24,543 6	17,020 10	3,966 14	19,016 18	20,661 22	16,236 26	15,640 30	2,953 91	1,277 95	487 99	224 103
	208 121	584 117	1372 84	12,138 80	15,167 3	6,843 7	14,400 11	15,603 15	16,572 19	8,138 23	18,337 27	13,698 31	1,485 92	959 96	389 100	207 104
	316 122	1454 118	2,255 85	6,387 81	18,071 4	15,820 8	11,575 12	9,943 16	10,040 20	9,965 24	6,687 28	14,375 32	1,714 93	230 97	305 101	
6,683 125	3,381 123	Wet Soil	Wet Soil	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	1,752 109	Wood Pile	
780 126	2,903 124	Wet Soil	Wet Soil	Wet Soil	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	863 105	Gravel	48.5 112	
	226 131	86 132	726 133	379 134	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	1,329 106	167 110	258 113	
		82 135	175 136	235 137	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	746 107	359 111		
					Gravel	1,532 33	3,566 34	6,938 35	2,086 36	4,389 37	Soil Pile	Soil Pile	349 108	350 114		
					Gravel	480 38	5,247 39	2,381 40	2,990 41	4,708 42	Soil Pile	Soil Pile				
					Gravel	673 43	868 44	2,088 45	2,732 46	2,402 47	Soil Pile	Soil Pile				
					Gravel	1,461 48	2,083 49	1,280 50	1,161 51	465 52	Soil Pile	Soil Pile				
					Gravel	841 53	942 54	1,171 55	670 56	1,151 57	Soil Pile	Soil Pile				
					Gravel	737 58	338 59	758 60	264 61	428 62	Soil Pile	Soil Pile				
					Gravel	471 63	763 64	717 65	419 66	328 67	Soil Pile	Soil Pile				
					Gravel	387 68	670 69	394 70	303 71	521 72	Soil Pile	Soil Pile				
					Gravel	303 73	229 74	250 75	231 76	67 77	Soil Pile	Soil Pile				

⁞ = ISM Sample Area

▮ = Target Beam Baffle

| = MRS Wall

⁘ = No ISM Collected

Field Notes

Ridgway Training Range 7-8-2018

1200 - J. Witte onsite, safety walk, photo document site

1300 - Begin gridding ISM locations at Target Berm

1500 - Z. Neigh onsite. Target Berm ISM grid complete. Hold tailgate meeting and safety conversation.

1530 - Begin collecting 0-6" samples from DU grid boundary locations for XRF analysis for lead.

- All DU boundary locations at the Target Berm exceed 400 ppm lead via XRF analysis.

* Gravel lane (20' wide) at base of Target Berm. First step out collected east of gravel lane at grid location 16.

- Transect of soil on range floor east of 16 screened. 8 of 9 samples exceed 400 ppm.
- At least 1 step out on north and south side of Target Berm also exceeds 400 ppm lead. Details on grid figures.

1930 - Consider adding Range Floor as
new DU. Pack up. Sign out.
2000 - Offsite

* Target Beam length = approx. 75' (wall to wall)
Width = approx. 15' (base to baffle)
Grid cells = 10' × 4'
32 increments (before step-outs)
↳ 4 rows, 8 collumns

* XRF succesful standardization
17.3 = 18 (NIST 2709A)
1100 - 1400 = 1230 (NIST 2711A)

J.W.

Scale: 1 square = ______

7-9-2018

0700 - J. Witte, Z. Neigh onsite. Tailgate meeting.

0720 - Begin gridding ISM at Firing Point
Firing Point ~~[illegible]~~ length = approx. 56'
(from concrete pad to wall)
Firing Point width = approx. 20' (fence to gavel)
Grid cells = 6' × 5'
36 increments (4 rows, 9 collumns)

0945 - Move to range floor step-out locations of Target Berm. Continue stepping-out and XRF-analyzing step-out locations.

1030 - Tom Marcs (PAANG) and Margo Wolfgang (PAANG) onsite. Site briefing, site walk, discuss range floor step outs and general concept of ISM. Discussed sediment sampling locations. Resumed XRF analysis of Target Berm step outs.

1300 - Discuss sediment SOPs, strategy with Tom Marcs.

1315 - Tom Marcs & Margo Wolfgang offsite. Begin sampling discrete locations east of Firing Point from 0-6 inches. Three samples collected (RTR03DS01A - 03A) Duplicate taken ~~#~~: RTR03DS01B. 24-hr TAT requested for these samples.

Scale: 1 square = ________

1400 - Began collecting discrete soil samples from the soil pile from 0-1' below top of pile (x6) and ground level to 1' above ground level w/in the pile (x6).
RTRO2DSO1A - RTRO2DSO6A taken from top of pile to 1' depth.
RTRO2DSO7A - RTRO2DS12A taken from 1' above ground to ground.
Duplicate taken (RTRO2DSO1B)
TCLP taken from RTRO2DSO2A.
$ Packed cooler and completed CCC w/ Firing Point and Soil Pile discrete samples
1445 - Z. Neigh offsite to Fedex w/ coolers
J. Witte onsite to continue step outs of Target Beam
1715 - Z. Neigh onsite. Continue step outs. Explore ponding area around MRS. Clean up.
1930 - Offsite.

* XRF succesful standardization
17.3 = ND < 23 (NIST 2709 A)
1100 - 1400 = 1310 (NIST 2711 A)
* Primary/Duplicate/Triplicate sample locations at the Firing Point that fell on wooden firing positions were shifted
Scale: 1 square = north of each respective firing position as necessary.

7-10-2018

0700 - J. Witte, Z. Neigh onsite. Conduct tailgate meeting. Devise strategy for the day.

0730 - Collect XRF samples from range floor step-outs (68-72). Allow samples to dry. Explore potential background DU locations.

0820 - Z. Neigh offsite to purchase more flagging. J. Witte onsite to continue XRF analysis.

0840 - XRF standardization success.

17.3 = ND>20 (NIST 2709A)

1100-1400 = 1351 ± 37 (NIST 2711A)

0945 - ~~Step-outs~~ Dave Connolly (ARNG) onsite. Site walk, tailgate meeting. Continue range floor step outs.

1030 - Range floor step-outs ceased after exceedances ended.

1100 - Rick Weber and Jake More (PADEP) onsite. Tailgate meeting. site walk.

1130 - Continue Target Berm step-outs on north & south side of the MRS walls.

1200 - Troubleshoot XRF analyzer. Continue step-outs.

1445 - Discuss step-out strategy with Jen Li. Formulate step-out approach

Scale: 1 square = ________

Rite in the Rain

that worked around hydric soils at the base of the Target Berm south of the MRS wall.

~~1600~~- Continue step-outs north of MRS wall

1700- End step-outs north of Target Berm once exceedances ceased. Details of step-out locations included on grid.

1715 - Continue step-outs on south side of MRS wall. Last row on Target Berm to the south did not exceed 400ppm, but wet floor soil east of berm/south of wall do. Continued step-outs beyond fence on southern side of MRS - exceedances persisted. Step-out XRF samples taken south of drainage ditch to bound DU. No exceedances observed south of the drainage ditch.

1945 - Clean up. Offsite.

J.W.

Scale: 1 square = ______

7-11-2018

0700 - J. Witte, Z. Neigh onsite. Dailgate meeting. Devise daily strategy.

0800 - Continue step-outs south of the MRS, east of the target berm, for the Target Berm DU
Standardize the XRF - succesful
17.3 = ND > 20 (NIST 2709A)
1100-1400 = 1301 ± 39 (NIST 2711A)

0930 - Complete step outs south of MRS and east of Target Berm. Call Jen Li to discuss sediment sampling in drainage ditch south of the MRS.

1030 - Collect internal XRF samples from Target Berm DU.

1130 - Z. Neigh offsite to purchase more flags
J. Witte onsite to analyze remaining XRF samples.

1245 - Z. Neigh onsite. Grid ISM locations at remaining step out locations.

1530 - Begin collecting ISM samples of the Target Berm DU.

1945 - Complete collecting Target Berm DU ISM

2000 - Offsite after cleanup.
Will continue with Firing Point and background DU ISM collection.

Scale: 1 square = ________

7-12-2018

0700 - Onsite, tailgate meeting

0730 - Began collecting ISM sample from Firing Point. Once complete, began collecting discrete subsurface samples from firing point at 3 locations equidistant from North to South to the west of firing positions. Samples were not collected from 24-30". A 24" depth could not be reached due to a gravel/cobble layer. Multiple attempts made at each location to reach 24-30" failed. A TCLP sample was collected from first Firing Point subsurface sample. This sample location was based on the SI sample location. * J. Witte offsite to purchase ice and extra gloves while Z. Neigh dug.

1045 - Began collecting subsurface samples from the Target Berm. 4 subsurface sample locations sampled. At location ~~one~~ 1, samples collected from both intervals. At location 2, only TCLP sampled from 0-6" (highest XRF). At location 3, both intervals sampled. At location 4, both intervals sampled. At location 5, only 12-18" sampled. Multiple attempts at diff. locations on the Range Floor failed to reach 24-30" based on gravel/cobble layer.

1230 - Began collecting sediment samples from the French Drain outfall.

Scale: 1 square = ________

The ponded area shrank from the first day onsite. Largest observed size was approx. 7ft x 5ft. Size at the time of sampling was approx. 2ft x 3ft. 8 samples collected in ponded area, including one sample for TCLP analysis. One sample collected approx. 10ft east of ponded area where surface water flow may occur during heavy rain. One sample collected approx. 10ft west for same reason. 10 total sediment samples collected from French Drain.

1330 - Two sediment samples collected from drainage ditch south of MRS due to step-outs from Target Berm approaching ditch. One sample collected immediately south of southernmost Target Berm stepouts, between the two locations (east/west). Sample two collected equidistant between sample 1 and where the drainage ditch confluences with flowing water east of the MRS.

1400 - Began gridding ISM locations at background DU. Collected ISM.

1645 - Reviewed sample inventory

1715 - Began collecting GPS locations at areas of interest to bound DUs in figure creation.

1815 - General site cleanup. Packed equip.

-ment into trucks.

~~#~~ 1900 - J. Witte offsite to mobilize to Washington DC, Z. Neigh cont. cleanup.

1930 - Z. Neigh offsite.

*EQB collected between Firing Point ISM & background ISM from Soil Probe.

J.W.

Scale: 1 square = ______

Daily Quality Control Reports

Date: 7-8-18

AECOM Technical Services Inc.
DAILY QUALITY CONTROL REPORT

Report Number: 01
Project Title: Ridgway Training Range
Location: Ridgway, PA
Contract/DO Number:

WEATHER	BRIGHT SUN	[✓ CLEAR]	OVERCAST	RAIN	SNOW
TEMPERATURE	< 32	32 - 50	50 - 70	70-85	>85
WIND	[✓ STILL]	MODERATE	HIGH		
HUMIDITY	DRY	[✓ MODERATE]	HUMID		

Personnel \ Site Visitors On-Site

No.	Name	Hrs.	Affiliation	Location/Description of Work
a.	Joe Witte	8	AECom	Ridgway MRS / XRF, ISM
b.	Zach Neign	5	AECom	" " " " / " " , " "
c.				
d.				
e.				
f.				
g.				

Sampling equipment on site:

Type	Serial Number		Time	Parameter	Standard	Reading
Plastic Spoon	NA	Calibration Verification	1530-1930	NA	NA	NA
XRF	011762		1500	Lead ppm	2109A (173)	20

Field Changes: YES ✗ J.W. NO ✓

If yes, filed Nonconformance and Corrective Action Report number (NCR No.): NA

Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	Conducted tailgate meeting, discussed heat, slips/trips
Work Performed (including sampling)	ISM gridding, XRF analysis
QA Activities	Daily Report ✓ Review of COC NA Track Progress Report against QAPP NA
QC Activities	# Duplicates NA Equipment calibrated complete to standards ✓ # Equipment Blanks NA # MS/MSD NA # Field Blanks NA
Problems Encountered Resolved	DU boundary lead exceedances in every direction
Additional Information	[illegible] J.W. Poison ivy covering portion of Target Berm
Activities Scheduled for the Next Day	XRF, ISM = Target Berm, Firing Point

Contractor Verification: On behalf of the contractor, AECOM, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

Signature

Date 7-8-18

Date: 7-9-18

AECOM Technical Services Inc.
DAILY QUALITY CONTROL REPORT

Report Number: 2
Project Title: Ridgway RI
Location: Ridgway, PA
Contract/DO Number: [illegible]

WEATHER	[✓ BRIGHT SUN]	CLEAR	OVERCAST	RAIN	SNOW
TEMPERATURE	< 32	32 - 50	50 - 70	70-85	>85
WIND	[✓ STILL]	MODERATE	HIGH		
HUMIDITY	DRY	[✓ MODERATE]	HUMID		

Personnel \ Site Visitors On-Site

No.	Name	Hrs.	Affiliation	Location/Description of Work
a.	Joe Witte	12.5	AECOM	Ridgway MRS / ISM, XRF
b.	Zach Neigh	12.5	AECOM	" " " " / " " " "
c.	Tom Marcs	2.5	PAANG	" " " " / Site Visit
d.	Margo Wolfgang	2.5	PAANG	" " " " / " " " "
e.				
f.				
g.				

Sampling equipment on site:

Type	Serial Number		Time	Parameter	Standard	Reading
Plastic Spoon	NA	Calibration Verification	NA	NA	NA	NA
~~Hand Auger~~	~~NA~~		~~NA~~	~~NA~~	—	—
XRF analyzer	011762		0800	NIST 2711A	1100-1400	1310

Field Changes: YES______ NO ✓

If yes, filed Nonconformance and Corrective Action Report number (NCR No.): NA

Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	Conducted tailgate, observed bees at soil pile, observed ticks
Work Performed (including sampling)	XRF analysis, ISM gridding, discrete sampling at Firing Point and Soil Pile
QA Activities	Daily Report ✓ Review of COC ✓ Track Progress Report against QAPP NA
QC Activities	# Duplicates 2 Equipment calibrated complete to standards ✓ # Equipment Blanks 0 # MS/MSD 0 # Field Blanks 0
Problems Encountered Resolved	Resolved to take step outs from Target Berm onto Range Floor as far as necessary. Not treating Range Floor as separate DU
Additional Information	Bees live in soil pile. Ponded water at French Drain sediment connects to water that surrounds the MRS
Activities Scheduled for the Next Day	XRF/ISM of Target Berm step outs. Discrete sediment sampling

Contractor Verification: On behalf of the contractor, AECOM, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

Jo. Witte
Signature

7-9-18
Date

Date: 7-10-2018

AECOM Technical Services Inc.
DAILY QUALITY CONTROL REPORT

Report Number: 3
Project Title: Ridgway RI
Location: Ridgway, PA
Contract/DO Number:

WEATHER	BRIGHT SUN	[✓ CLEAR]	OVERCAST	RAIN	SNOW
TEMPERATURE	< 32	32 - 50	50 - 70	70-85	>85
WIND	STILL	[✓ MODERATE]	HIGH		
HUMIDITY	DRY	[✓ MODERATE]	HUMID		

Personnel \ Site Visitors On-Site

No.	Name	Hrs.	Affiliation	Location/Description of Work
a.	Joe Witte	12.75	AECOM	Ridgway MRS / ISM, XRF
b.	Zach Neigh	12.75	AECOM	" " " " / " ", " "
c.	Dave Connolly	6	ARNG	" " " " / site visit
d.	Rick Weber	0.5	PADEP	" " " " / " " " "
e.	Dale More	0.5	PADEP	" " " " / " " " "
f.				
g.				

Sampling equipment on site:

Type	Serial Number		Time	Parameter	Standard	Reading
Plastic Spoon	NA	**Calibration Verification**	NA	NA	NA	NA
XRF analyzer	011762		0840	NIST 2711A	1100-1400	1351

Field Changes: YES__________ NO ✓

If yes, filed Nonconformance and Corrective Action Report number (NCR No.): NA

Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	Tailgate meeting, observed ticks, falling tree, excessive sun
Work Performed (including sampling)	XRF analysis, ISM gridding
QA Activities	Daily Report ✓ Review of COC NA Track Progress Report against QAPP NA
QC Activities	# Duplicates NA Equipment calibrated complete to standards ✓ # Equipment Blanks NA # MS/MSD NA # Field Blanks NA
Problems Encountered Resolved	Step-out location on southern side of MRS continue into hydric soils. Resolve to step out beyond hydric soil to use XRF.
Additional Information	Continued step outs south of wall / east of berm
Activities Scheduled for the Next Day	XRF/ISM of Target Berm step-outs.

Contractor Verification: On behalf of the contractor, AECOM, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

Signature

Date 7-10-2018

Date: 7-11-2018

AECOM Technical Services Inc.
DAILY QUALITY CONTROL REPORT

Report Number: 4
Project Title: Ridgway RI
Location: Ridgway, PA
Contract/DO Number:

WEATHER	BRIGHT SUN	[✓ CLEAR]	OVERCAST	RAIN	SNOW
TEMPERATURE	< 32	32 - 50	50 - 70	70-85	>85
WIND	STILL	[✓ MODERATE]	HIGH		
HUMIDITY	DRY	[✓ MODERATE]	HUMID		

Personnel \ Site Visitors On-Site

No.	Name	Hrs.	Affiliation	Location/Description of Work
a.	Joe Witte	13	AECOM	Ridgway / ISM, XRF
b.	Zach Neign	13	AECOM	Ridgway / ISM, XRF
c.				
d.				
e.				
f.				
g.				

Sampling equipment on site:

Type	Serial Number	Calibration Verification	Time	Parameter	Standard	Reading
XRF	011762		0800	NIST 2711A	1100 - 1400	1301
Plastic Spoon	NA		NA	NA	NA	NA

Field Changes: YES______ NO ✓

If yes, filed Nonconformance and Corrective Action Report number (NCR No.): NA

Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	Tailgate meeting, sun, heat
Work Performed (including sampling)	XRF, ISM
QA Activities	Daily Report ✓ Review of COC NA Track Progress Report against QAPP NA
QC Activities	# Duplicates NA Equipment calibrated complete to standards XRF # Equipment Blanks NA # MS/MSD 1 # Field Blanks NA
Problems Encountered Resolved	Resolved to add sediment samples to area south of the MRS
Additional Information	Sediment samples ~~feso~~ added to drainage ditch south of MRS.
Activities Scheduled for the Next Day	ISM, discrete samples

Contractor Verification: On behalf of the contractor, AECOM, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

Signature

7-11-2018
Date

Date: 7-12-2018

AECOM Technical Services Inc.
DAILY QUALITY CONTROL REPORT

Report Number: 5
Project Title: Ridgway RI
Location: Ridgway, PA
Contract/DO Number:

WEATHER	BRIGHT SUN	[✓ CLEAR]	OVERCAST	RAIN	SNOW
TEMPERATURE	< 32	32 - 50	50 - 70	70-85	>85
WIND	STILL	[✓ MODERATE]	HIGH		
HUMIDITY	DRY	[✓ MODERATE]	HUMID		

Personnel \ Site Visitors On-Site

No.	Name	Hrs.	Affiliation	Location/Description of Work
a.	Joe Witte	13	AECOM	Ridgway / ISM, discrete
b.	Zach Neigh	13	AECOM	Ridgway / ISM, discrete
c.				
d.				
e.				
f.				
g.				

Sampling equipment on site:

Type	Serial Number	Calibration Verification	Time	Parameter	Standard	Reading
Plastic Spoon	NA		NA	NA	NA	NA

Field Changes: YES______ NO ✓

If yes, filed Nonconformance and Corrective Action Report number (NCR No.): NA

Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	Tailgate briefing
Work Performed (including sampling)	ISM, discrete samples
QA Activities	Daily Report ✓ Review of COC ✓ Track Progress Report against QAPP ✓
QC Activities	# Duplicates ✓ Equipment calibrated complete to standards ✓ XRF # Equipment Blanks ✓ # MS/MSD ✓ # Field Blanks NA
Problems Encountered Resolved	24-30" depth not accessible at the Firing point, nor one location on the range floor for discrete samples due to gravel layer
Additional Information	Background DU acreage increased to average the Target Berm FP DU's.
Activities Scheduled for the Next Day	Travel home. Ship coolers

Contractor Verification: On behalf of the contractor, AECOM, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

Signature

7-12-2018
Date

Nonconformance and Corrective Action Report

Date: 5 July 2018

AECOM Technical Services Inc.
Nonconformance and Corrective Action Report

Report Number: 01
Location: Ridgway Training Range
Project Title: Ridgway Training Range Remedial Investigation
Contract Number: W9133L-14-D-001; DO 0006

Description of Nonconformance and Cause:	The Work Plan and QAPP state that "Enough volume will be collected at each discrete location to be analyzed for waste characterization, and the laboratory will be instructed to hold the extra volume from each sample while MC analysis is performed.Once it is determined which location is the worst-case scenario (i.e., highest concentration), the laboratory will be instructed to run TCLP analysis on that sample." This strategy is inappropriate for waste characterization and Feasibility Study decision making. Waste characterization samples will not be used in the RI report to quantify risk of any kind at the site. Waste characterization samples will only be used to qualitatively inform potential remedial alternative actions in a Feasibility Study.
Proposed Disposition:	AECOM suggests the collection of one waste characterization sample at each DU. At the Target Berm (where XRF is used), the waste characterization sample will be collected from the location with the highest XRF lead result. At all other DUs (where XRF is not used), waste characterization samples will be collected based on field determination. All waste characterization samples will be held at the laboratory and analyzed only if the laboratory results from the respective DU ISM/discrete samples exceed the USEPA RSL for lead (400 ppm). These data will sufficiently characterize waste at the site and inform potential remedial alternative decision making in a potential Feasibility Study. This strategy is consistent with other NDNODS SARs 5 and 6 soil sampling strategies.

Submitted by: Joe Witte
Date: 5 July 2018
Approved by: Gwinn, Rosa Digitally signed by Gwinn, Rosa DN: cn=Gwinn, Rosa, ou=USGRM2 Reason: I am approving this document Date: 2018.07.05 16:25:37 -04'00'

Actual Disposition approved by Project Manager:	Collection of one waste characterization sample at each DU. At the Target Berm, the waste characterization sample will be collected from the location with the highest XRF lead result. At all other DUs, waste characterization samples will be collected based on field determination. All waste characterization samples will be held at the laboratory and analyzed only if the laboratory results from the respective DU ISM/discrete samples exceed the USEPA RSL for lead (400 ppm).
Implementation of Disposition assigned to:	Ridgway Training Range RI field work staff: Joe Witte and Zach Neigh

Completed by: Joe Witte
Date: 5 July 2018
Verified by:
Date: 5 July 2018

Date: 11 July 2018

AECOM Technical Services Inc.
Nonconformance and Corrective Action Report

Report Number: 02

Location: Ridgeway Training Range, PA

Project Title: Ridgeway Training Center Remedial Investigation

Contract Number: W9133L-14-D-001: DO 0006

Description of Nonconformance and Cause:	The Target Berm Decision Unit (DU) has been bounded with step outs to the north and east (on the range floor). Step out sampling has characterized the DU to the south, down to a drainage ditch that runs parallel to the southern range wall. Based on X-Ray Fluorescence (XRF) screening samples, no exceedances of the USEPA RSL for lead (400ppm) were observed beyond the drainage ditch; however, sample screening between the southern range wall and the drainage ditch showed two instances of lead exceedances next to the drainage ditch.
Proposed Disposition:	AECOM suggests additional sampling, specifically collection of up to two discrete sediment samples from the drainage ditch for laboratory analysis of MC metals (Sb, Cu, Pb, Zn). These data will be used to evaluate potential range related impacts to the ditch.

Submitted by: Sarah Stinger

Date: 11 July 2018

Approved by: Laurie Stenberg

Actual Disposition approved by Project Manager:	Collection of up to two discrete sediment samples from the drainage ditch for laboratory analysis of MC metals (Sb, Cu, Pb, Zn). One immediately downgradient from the area of XRF lead exceedances observed and one further downgradient (to the east).
Implementation of Disposition assigned to:	Ridgway Training Range RI field work staff: Joe Witte and Zach Neigh

Completed by: Joe Witte

Date: 11 July 2018

Verified by: Sarah Stinger

Date: 11 July 2018

Appendix B:

Photographic Record

Client Name: Army National Guard	**Site Location:** Ridgway Training Range MRS, Ridgway Township, Pennsylvania	**Project No.** 60519685

Photo No. 1

Location of Photo: Front of the Ridgway Training Range

Description: Covered firing position area pictured, facing northwest

Photo No. 2

Location of Photo: Front of Ridgway Training Range

Description: Drainage ditch east of the covered firing positions at Ridgway Training Range, facing southwest

Photo No. 3

Location of Photo:
Range floor

Description:
A wooden baffle in front of the Target Berm; photo taken from the center of the range floor facing downrange (west)

Photo No. 4

Location of Photo:
Target Berm

Description:
Target Berm downrange on the west end of the MRS, facing north

PHOTOGRAPHIC RECORD

Client Name: Army National Guard	**Site Location:** Ridgway Training Range MRS, Ridgway Township, Pennsylvania	**Project No.** 60519685

Photo No. 5

Location of Photo:
Range floor

Description:
Soil Pile DU on the north side of the range floor between two wooden baffles, facing north

Photo No. 6

Location of Photo:
French Drain DU outfall area

Description:
French Drain outfall north of training range walled area, facing north. Standing water visible

Client Name:	Site Location:	Project No.
Army National Guard	Ridgway Training Range MRS, Ridgway Township, Pennsylvania	60519685

Photo No. 7

Location of Photo:
Covered Firing Position DU

Description:
Incremental sample locations at the Firing Position DU, facing north. White flags = incremental grid nodes; orange flags = primary sample locations; blue flags = duplicate sample locations; yellow flags = triplicate sample locations.

Photo No. 8

Location of Photo:
Background DU

Description:
Incremental sample locations at the Background DU, facing west. White flags = incremental grid nodes; orange flags = primary sample locations; blue flags = duplicate sample locations; yellow flags = triplicate sample locations.

Photo No. 9

Location of Photo: Target Berm DU

Description: Incremental sample locations at the Target Berm DU, facing southwest. White flags = XRF sample locations; orange flags = primary sample locations; blue flags = duplicate sample locations; yellow flags = triplicate sample locations. Gravel at the base of the berm pictured.

Photo No. 10

Location of Photo: Range floor

Description: Incremental sample locations at the Target Berm DU continuing onto the range floor, facing northwest. Pink flags = XRF sample locations; orange flags = primary sample locations; blue flags = duplicate sample locations; red/pink flags = triplicate sample locations

Photo No. 11

Location of Photo: Gravel path on range floor

Description: Gravel path within the walled area of the training range adjacent to the south wall, facing east

Photo No. 12

Location of Photo: Target Berm DU

Description: Incremental sample locations at the Target Berm DU north of the walled training range area, facing northwest

Photo No. 13

Location of Photo:
Target Berm DU

Description:
Gravel area north of the walled area at the base of the Target Berm, facing east

Photo No. 14

Location of Photo:
Target Berm DU

Description:
Incremental sample locations at the Target Berm south of the walled training range area

Client Name: Army National Guard	**Site Location:** Ridgway Training Range MRS, Ridgway Township, Pennsylvania	**Project No.** 60519685

Photo No. 15

Location of Photo: Target Berm DU

Description: Drainage ditch south of the MRS, facing southwest. XRF and incremental sample locations pictured on both sides of the drainage ditch.

Photo No. 16

Location of Photo: French Drain DU

Description: Standing water in the French Drain DU outfall area, facing north. Samples were collected from sediment beneath the standing water.

Photo No. 17

Location of Photo:
Soil Pile DU

Description:
Example soil boring holes where samples were collected from the Soil Pile DU

Photo No. 18

Location of Photo:
Drainage ditch south of the Training Range

Description:
Draining ditch where sediment samples were collected south of the Training Range walled area, facing west

Photo No. 19

Location of Photo:
Target Berm DU

Description:
Several discrete soil samples collected from the Target Berm DU, facing east

Photo No. 20

Location of Photo:
Front of the Ridgway Training Range

Description:
ISM samples RTR01IS01 and RTR01IS03 pictured.

Appendix C:

Data Validation Report (on CD)

Appendix D:

Laboratory Data Analytical Package (on CD)

Appendix E:

Human Health Risk Assessment

AECOM

Final
Human Health Risk Assessment
Ridgway Training Range, Pennsylvania

Munitions Response Site PAE40-001-R-01
Pennsylvania Army National Guard

Army National Guard

Contract No. W9133L-14-D-0001
Delivery Order No. 0006

June 2019

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Project Name:

Remedial Investigation through Decision Document for Six Army National Guard Munitions Response Sites, Ridgway Training Range, Pennsylvania

Site Location:

Ridgway Township, PA

Contract/Delivery Order:

Contract No. W9133L-14-D-0001
Delivery Order No. 0006

Report Name:

Remedial Investigation Report
Ridgway Training Range, Pennsylvania
Munitions Response Site PAE40-001-R-01

Preparation Date (Month/Year):

June 2019

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Acronyms and Abbreviations

AECOM	AECOM Technical Services, Inc.
ALM	Adult Lead Methodology
ARNG	Army National Guard
AT	averaging time
bgs	below ground surface
BW	body weight
CA	constituent concentration in air
cm^2	square centimeters
CDC	Centers for Disease Control and Prevention
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	constituent of concern
COPC	constituent of potential concern
CR	contact rate
CS	soil concentration
CSF	cancer slope factor
CSFd	cancer slope factor, dermal
CSFo	cancer slope factor, oral (ingestion)
CSM	conceptual site model
DABS	dermal absorption fraction
DAD	dermally absorbed dose
DA-event	absorbed dose per event
DoD	Department of Defense
DU	decision unit
EBS	Environmental Baseline Survey
EC	exposure concentration
ED	exposure duration
EF	exposure frequency
ELCR	excess lifetime cancer risk
EPC	exposure point concentration
ET	exposure time
FS	Feasibility Study
GIABS	gastrointestinal absorption factors
HEAST	Health Effects Assessment Summary Table
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IEUBK	Integrated Exposure Uptake Biokinetic
IR	soil ingestion rate
IRIS	Integrated Risk Information System
IS	incremental sample(s)

ISM	incremental sampling methodology
ITRC	Interstate Technology & Regulatory Council
IUR	inhalation unit risk
kg	kilograms
m^3/kg	cubic meters per kilogram
MC	munitions constituents
MEC	munitions and explosives of concern
mg/cm^2-event	milligrams per square centimeters-event
mg/kg	milligram per kilogram
mg/kg-day	milligrams per kilogram-day
$(mg/kg\text{-}day)^{-1}$	1/milligrams per kilogram-day
MMRP	military munitions response program
MRS	munitions response site
ND	non-detect
NDNODS	Non-Department of Defense, Non-Operational Defense Site
ORNL	Oak Ridge National Laboratory
PA	Pennsylvania
PAARNG	Pennsylvania Army National Guard
PADEP	Pennsylvania Department of Environmental Protection
PADMVA	Pennsylvania Department of Military and Veterans Affairs
PbB	lead blood concentration
PEF	particulate emission factor
PPRTV	Provisional Peer Reviewed Toxicity Value
RAGS	Risk Assessment Guidance for Superfund
RBA	relative bioavailability
RfC	reference concentration
RfD	reference dose
RfDd	reference dose, dermal
RfDo	reference dose, oral (ingestion)
RI	Remedial Investigation
RPD	relative percent difference
RSL	regional screening level
SA	skin surface area
SI	Site Inspection
SSAF	soil-to-skin adherence factor
UCL	upper confidence limit
µg/cm^3	micrograms per cubic centimeter
µg/dL	micrograms per deciliter of blood
U.S.	United States
USEPA	United States Environmental Protection Agency
UU/UE	unlimited use and unrestricted exposure

Executive Summary

The Remedial Investigation (RI) report has been prepared in support of the long term management of the Non-Department of Defense (DoD), Non-Operational Defense Site (NDNODS) Ridgway Training Range Munitions Response Site (MRS; Army Environmental Database Restoration Number PAE40-001-R-01), located in Pennsylvania (PA). The Ridgway Training Range MRS is a 0.22-acre site located in Ridgeway Township, Pennsylvania on the west side of Grant Road, approximately 2 miles northwest of Ridgway Borough and 5 miles southwest of Johnsonburg in Elk County, PA.

The Army National Guard (ARNG) determined a RI should be conducted at the MRS under the Military Munitions Response Program (MMRP) Munitions Response Services. The human health risk assessment (HHRA) was conducted as part of the RI to evaluate whether constituents of potential concern (COPCs) attributable to past site activities have the potential to cause adverse health effects to human receptors at the MRS. The RI and HHRA meet the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act of 1986. The HHRA also meets the site-specific risk assessment requirements of Act 2 as presented in 25 Pa. Code §250.602(c) and the Act 2 Technical Guidance Manual [Pennsylvania Department of Environmental Protection (PADEP), 2002].

The Ridgway Training Range MRS was broken into the following Decision Units (DUs): Target Berm, Soil Pile, Firing Point, and French Drain Outfall. Discrete and incremental sampling methodology (ISM) data were collected at the MRS. Discrete soil samples were collected at the Target Berm, Soil Pile, and Firing Point DUs to evaluate the vertical extent of munition constituents (MC). ISM surface soil samples were collected from Target Berm, Firing Point, and Background Reference Area DUs. ISM data were not collected at the Soil Pile and French Drain Outfall DUs due to their small size. Finally, discrete sediment samples were collected from drainage areas at the Target Berm and French Drain Outfall DUs.

Potential off-site receptors were not identified for the MRS because site access is restricted via a locked gate. However, an on-site trespasser scenario was evaluated in the HHRA to address potential breaches in site security. On-site and surrounding area vegetation, the concrete wall, and other structures inhibit windblown particulates from leaving the MRS. Also, sediment COPCs were not identified in the surface water drainage areas of the French Drain Outfall and Target Berm DUs where surface water leaves the MRS.

The HHRA addressed soil and sediment exposure media only. USEPA residential soil regional screening levels (RSLs; dated May 2018) that are protective of a target cancer risk of 1×10^{-6} (one in 1,000,000; 1E-06) and a target hazard quotient of 0.1 were used to screen soil and sediment USEPA 2018 and PADEP 2002). Risk-based screening results identified antimony, copper, lead, and nitroglycerin as soil COPCs. Detected concentrations of zinc in soil and sediment were below the residential soil RSL; therefore zinc was eliminated from further evaluation. Risk-based screening results for sediment were below residential soil RSLs;

sediment was eliminated from further evaluation at the Target Berm and French Drain Outfall DU drainage areas.

The Target Berm and Firing Point DU ISM mean concentrations for the metals were compared with the mean concentrations of metals in the Background Reference Area DU to evaluate whether the metal concentrations were potentially naturally occurring; the site mean concentrations were higher (i.e., at least one order of magnitude higher) than the background mean concentrations therefore the metals were determined to be site-related.

The following human health on-site receptors were evaluated: outdoor worker, teen trespasser, child and adult visitor, child and adult hypothetical resident, construction worker, and utility worker. The current scenarios represent exposure to current site conditions; these conditions are assumed to not change in the future (i.e., no land re-development). Receptors are assumed to be exposed to surface soil (0 to 24 inches below ground surface [bgs]). The future scenarios are used to address site conditions that have changed due to land re-development. Land re-development results in excavation activities that bring subsurface soil to the surface and the soils are “mixed” together. Future receptors are exposed to total soil (0 to 36 inches bgs). Soil-related exposure pathways that were evaluated in the HHRA were incidental ingestion and dermal contact with soil. The inhalation exposure pathway was incomplete because the soil constituents of potential concern did not have inhalation toxicity values.

Cancer risk and non-cancer hazard calculations were conducted for the soil exposure medium. United States Environmental Protection Agency (USEPA) Adult Lead Methodology (ALM) and Integrated Exposure Uptake Biokinetic (IEUBK) models were used to estimate lead blood concentrations (PbB) for receptors exposed to lead in soil.

Table ES-1 identifies the constituents of concern (COCs) that exceeded the PADEP and risk thresholds in the HHRA.

Table ES-1. Human Health Risk Assessment Soil COCs

Receptor	Exposure Medium	Constituent of Concern
Target Berm DU		
Child Visitor	Surface Soil	Lead (a, b)
	Total Soil	Lead (a, b)
Outdoor Worker	Surface Soil	Lead (b)
	Total Soil	Lead (b)
Construction/Utility Worker	Surface Soil	Lead (b, c)
Hypothetical Child Resident	Surface Soil	Antimony Lead (b)
	Total Soil	Antimony Lead (b)
Soil Pile DU		
Child Visitor	Surface Soil	Lead (a, b)
	Total Soil	Antimony Lead (a, b)
Construction Worker (c)	Total Soil	Antimony Lead (b, c)

Receptor	**Exposure Medium**	**Constituent of Concern**
Utility Worker (c)	Total Soil	Lead (b, c)
Outdoor Worker	Surface Soil	Lead (b)
	Total Soil	Lead (b)
Hypothetical Child Resident	Surface Soil	Antimony Lead (b)
	Total Soil	Antimony Lead (b)
Hypothetical Adult Resident	Total Soil	Antimony
Firing Point DU		
Hypothetical Child Resident	Surface Soil	Nitroglycerin

Notes:

(a) IEUBK model results for the hypothetical child resident were also used to be protective of the child visitor at the MRS.

(b) Lead modeling results are based on target PbB threshold of 10 micrograms per deciliter of blood (µg/dL).

(c) If a target PbB threshold of 5 µg/dL was used, then lead would be identified as a surface soil and total soil COC for the construction and utility worker scenarios.

The HHRA recommends further evaluation of the soil COCs in a Feasibility Study (FS) for the Ridgway Training Range MRS.

1 Introduction

This Human Health Risk Assessment (HHRA) was prepared as part of the Remedial Investigation (RI) report in support of the long term management of the Non-Department of Defense (DoD), Non-Operational Defense Site (NDNODS) Ridgway Training Range Munitions Response Site (MRS; Army Environmental Database Restoration Number PAE40-001-R-01), located in Pennsylvania (PA) (**Figure 1-1**).

1.1 Project Authorization

Based on the results of a Site Inspection (SI; Parsons, 2012), the Army National Guard (ARNG) determined a RI and risk assessment should be conducted at a single NDNODS MRS in Pennsylvania under the Military Munitions Response Program (MMRP) Munitions Response Services. The RI is being performed pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986. Also, the HHRA was prepared pursuant to the requirements of Act 2, addressing the site-specific risk assessment requirements as presented in 25 Pa. Code § 250.602(c) and the Act 2 Technical Guidance Manual [Pennsylvania Department of Environmental Protection (PADEP), 2002].

Environmental work is being conducted at the MRS by the ARNG Directorate and the Pennsylvania ARNG (PAARNG). This project is being executed by AECOM Technical Services, Inc. (AECOM), under ARNG Contract Number W9133L-14-D-0001, Delivery Order No. 0006, issued 29 September 2016. Under this delivery order, AECOM is responsible for fully executing the RI and related tasks at the Ridgway Training Range MRS.

1.2 Project Purpose and Scope

The overall objectives for the HHRA of Ridgway Training Range is to conduct a site-specific, quantitative analysis of the MRS under current and future land use scenarios based on the nature of the human health constituents of potential concern (COPCs) detected in environmental media, potential exposure pathways to human receptors, and the degree to which these exposures may pose adverse effects. Results of the HHRA may be used to assess risk management options for the MRS, including possible further actions to address impacted soils and sediment.

A quantitative HHRA was completed as part of the RI to evaluate risks to human health potentially posed by COPCs in the affected media beneath and within the vicinity of the site that cannot be eliminated using screening criteria.

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	MS	5/30/2017
SCALE	1:126,720	CHK BY	AS	5/30/2017
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	5/30/2017

N

Ridgway Training Range Site Location Map

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 1-1

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1.3 Remedial Investigation Report Organization

Brief descriptions of the document sections and appendices are as follows:

Section 1: Introduction. Section describes the authorization, project purpose and scope, and presents the report organization.

Section 2: Site Characterization. Section summarizes the MRS background, historical use, and environmental setting. The conceptual site model developed for the MRS is also presented. The analytical data is reviewed and the human health COPCs are identified.

Section 3: Exposure Assessment. Section identifies the human receptors that may be exposed to site-related COPCs in the affected media and the potential extent of human exposure that may occur under MRS-specific exposure scenarios.

Section 4: Toxicity Assessment. Section describes the relationship between the magnitude of exposure (dose or exposure concentration) and the incidence of adverse health effects associated with the identified COPCs.

Section 5: Risk Characterization. Section describes the nature and magnitude of potential human health risks in comparison with state and federal target risk levels.

Section 6: Uncertainty Analysis. Section discusses the uncertainties associated with each step of the HHRA.

Section 7: Summary and Conclusions. This section provides an overview of the findings of the HHRA for the MRS.

Section 8: References. This section provides the references used to develop this document.

Attachment 1: Sample Data Used in the HHRA

Attachment 2: Exposure Assessment Equations and Exposure Point Concentrations

Attachment 3: Transport and Fate Modeling

Attachment 4: Cancer Risk and Non-Cancer Hazard Calculations

Attachment 5: Uncertainty Assessment Calculations

2 Site Characterization

This Section summarizes the MRS background, historical use, and environmental setting. A conceptual site model (CSM) developed for the MRS is also presented. The evaluation of the analytical data and risk-based screening to identify human health COPCs is described.

2.1 Background Information

The Ridgway Training Range MRS is a 0.22-acre site located in Ridgeway Township, Pennsylvania on the west side of Grant Road, approximately 2 miles northwest of Ridgway Borough and 5 miles southwest of Johnsonburg in Elk County, PA (**Figure 2-1**). It is surrounded by the 8-acre former Ridgway Weekend Training Site.

According to the 2012 SI report (Parsons, 2012), PAARNG documentation indicates that the range was constructed in 1987 as a small-arms range with sheltered firing points and a baffle system to retain firing activities. Observations made during the 2012 SI confirmed that the range is a baffled outdoor range that is surrounded by 15-foot concrete walls on the northern and southern edges of the range. The eastern portion of the MRS contains twelve sheltered firing positions covered by a metal roof; an 8-foot earthen berm is located on the western edge of the MRS. Above the earthen berm is a horizontal wooden baffle supported by large beams installed into the hillside. Within the range, two vertical wooden baffle walls are suspended from the top of the concrete side walls and hang down into the range floor area to prevent stray bullets from leaving the range (**Figure 2-1**). The RI provides a photo log of the MRS in Appendix B.

The NDNODS Ridgway Training Range MRS was used by the PAARNG for small-arms, live-fire weapons training from 1987 to 2005 (Parsons, 2012). Munitions use documentation was not found during the SI, but based on range type, timeframe of range use, and location, AECOM assumes that the following munitions were fired: .22 caliber, .38 caliber, .45 caliber, .50 caliber, 9mm, 5.56mm, and 7.62mm. In 1989, a temporary waiver was granted for one-time firing of 7.62mm machine gun rounds. The extent of the usage is unknown, but is expected to be minimal (Earth Resources Technology, 2008).

Live-fire training occurred within the mostly enclosed 25-meter outdoor baffled M-16 rifle range. From 1987 to 1990, the range was used approximately four to five times a year, but range use from 1990 to 2001 is unknown. From 2001 to 2005, the range was used approximately two to three times a year. During that period, AECOM estimated that approximately 64,000 small-caliber rounds were expended at the range. The range was last used in November 2005 and small-arms training was discontinued in March of the following year because it no longer met ARNG requirements (Pennsylvania Department of Military and Veterans Affairs [PADMVA], 2011). Request for formal closure occurred on September 9, 2011.

No historical evidence of munitions and explosives of concern (MEC) has been documented or found at the site. It was determined during the SI that no explosive hazards are expected at the

MRS. As a result of the baseline survey and SI, the size and shape of the MRS were revised. The revised Ridgway Training Range MRS included only the firing points, target berm, and range floor in between (0.22 acres). This area (AEDB-R No. PAE40-001-R-01) was recommended to be carried forward to RI/Feasibility Study (FS).

Transfer of the property to a private owner was completed in 2015. The MRS is currently used as a staging area for equipment associated with a private landscaping company owned by the property owner. The MRS is primarily covered in grass, other vegetation, and the structures associated with the former baffled small-arms range. The area within the MRS concrete walls is currently unused. Access to the MRS is restricted from public access by a locked gate and walls surrounding the MRS. To improve drainage in front of the target berm at the MRS, the landowner installed a French drain parallel to the berm. In doing so, the top 12 to 18 inches of soil from the foot of the target berm were removed and stored in a pile near the north side wall (i.e., Soil Pile DU). Since the current landowner has owned the property, the range has been used with homemade munitions, distinct from historic use, which were fired into a trap. This use has stopped and will not occur again until this project concludes. Future land use is unlikely to significantly change.

2.2 Surrounding Land Use

The MRS is located within a fragmented forest that is surrounded on all sides by Ridgway Weekend Training Site (**Figure 2-1**). The area surrounding the MRS is predominantly rural; the properties surrounding the MRS include agricultural, mining, residential, and recreational land (Parsons, 2012). Allegheny National Forest borders the western edge of the MRS, with various coniferous trees and some deciduous trees, the most common being birch. A community baseball/athletic field abuts the northern edge of the property.

The Ridgway Rifle Club, a privately owned gun club, is located approximately 0.83 miles south of the MRS. The neighboring Ridgway Rifle Club was founded in 1927 and has remained open since its founding. The club includes small-arms shooting ranges and hosts shooting competitions regularly. Firing points at the Ridgway Rifle Club face west northwest. Based on the distance from the MRS and the location of and trajectory from firing points, it is not expected that the Ridgway Rifle Club activities would contribute any munitions debris or constituents to the MRS.

2.3 Conceptual Site Model

The CSM (**Figure 2-2**) was generated based on the information and findings presented in the 2012 SI, environmental baseline survey report, and site visit. The CSM describes the potential physical, chemical, and biological processes that may transport contaminants from sources to receptors and provides the basis for evaluating potential risks to human health and the environment. A munition constituent (MC) exposure pathway analysis was conducted (**Figure 2-3**) that identifies the potentially complete exposure pathways that were quantified in the HHRA. The exposure scenarios and exposure pathways evaluated in the HHRA are further described in Section 3, Exposure Assessment.

The property is privately owned and is used as a staging area by a landscaping company. Future use is planned to be the same. Access to the MRS is mostly restricted via a locked gate, so the public does not have ready access to the site. However, a trespasser is a possible scenario. Potential human receptors include the landowner, visitors or workers (e.g., construction, utility, and commercial/industrial) that the landowner allows on site. As there is no restriction on the land, there is potential that the site could be used for residential purposes in the future.

2.4 Data Evaluation

The MRS data were broken into the following decision units (DUs): Target Berm, Soil Pile, Firing Point, Background Reference Area and French Drain Outfall (**Figure 2-4**). **Table A1-1 in Attachment 1** lists the samples that were included in the HHRA data set. **Tables A1-2 and A1-3 of Attachment 1** present the analytical data used in the HHRA.

The Ridgway Training Range MRS was broken into the following DUs: Target Berm, Soil Pile, Firing Point, and French Drain. Discrete and incremental sampling methodology (ISM) data were collected at the MRS. Discrete soil samples were collected at the Target Berm, Soil Pile, and Firing Point DUs to evaluate the vertical extent of MC. ISM surface soil samples were collected from Target Berm, Firing Point, and Background Reference Area DUs. ISM data were not collected at the Soil Pile and French Drain Outfall DUs due to their small size. Finally, discrete sediment samples were collected from drainage areas at the Target Berm and French Drain Outfall DUs to determine whether constituent concentrations were leaving the MRS via drainage areas. The Background Reference Area DU data were used to determine whether the metal concentrations were possibly attributed to naturally occurring site conditions. Discrete subsurface samples were collected at select areas to determine the vertical extent of MC (see yellow highlighted samples in **Table A1-1 of Attachment 1**).

Discrete, field duplicate samples were collected in the following DUs: Target Berm, Soil Pile, Firing Point, and the French Drain. Discrete, field duplicate samples, if considered equally representative, are not independent samples. New Jersey Department of Environmental Protection (2014) considers a relative percent difference (RPD) less than 50% to be indicative of representative samples for solid matrices. The RPD between primary and duplicate results for the soil and sediment sample locations are presented in **Table A1-4 of Attachment 1**. Results which were not considered representative were retained as independent samples. The mean of the primary and duplicate was used for samples determined to be representative.

Quality assurance/quality control procedures outlined in AECOM (2018) were used to assess the precision and accuracy of analytical data. No rejected “R”-flagged data were identified and all soil and sediment data were carried forward into the HHRA. “J”-flagged results (estimated values) were treated as detect results. ISM data were used for risk calculations where available. If corresponding biased, discrete surface soil data were available for the DU, then separate risk calculations were conducted and discussed in the uncertainty assessment.

2.4.1 Human Health Risk Screening Criteria

Analytical data were compared to risk-based screening levels to determine if past small arms training activities resulted in contamination exceeding human health screening levels. Site-specific background reference samples were collected and analyzed for comparison purposes.

2.5 Risk-Based Screening

Residential soil regional screening levels (RSLs) that are protective of a target cancer risk of 1E-06 and a target hazard quotient of 0.1 were used to screen the soil and sediment maximum detected concentrations for each DU (United States Environmental Protection Agency [USEPA] 2018a). **Table 2-1** presents the risk-based screening results for each DU and exposure medium.

The surface soil (0 to 24 inches below ground surface [bgs]), subsurface soil (24 to 36 inches bgs), and total soil (i.e., entire soil column, 0 to 36 inches bgs) risk-based screening results for each DU identified antimony, copper, lead and nitroglycerin as soil COPCs. The maximum detected concentrations for zinc were below the residential soil RSL and so zinc was eliminated from further evaluation. The maximum detected concentrations for metals in sediment were below residential soil RSLs at the Target Berm and French Drain Outfall DUs. Therefore, the sediment exposure medium was eliminated from further evaluation. Laboratory detection limits were protective of the USEPA RSLs so no further analysis of non-detections was necessary (AECOM 2017 and 2018).

Because most human health effects data for lead are correlated with concentrations in the blood rather than an external dose, the standard cancer risk and non-cancer hazard approach for evaluating health effects cannot be applied to lead. Lead’s residential soil RSL of 400 milligrams per kilogram (mg/kg) was derived using USEPA’s Integrated Exposure Uptake Biokinetic (IEUBK) model (IEUBKwin v1.1 build 11) (USEPA 2010). The IEUBK model predicts the chance that a typical child (ages 0 to 6 years) would have a lead blood concentration (PbB) exceeding 10 micrograms per deciliter (µg/dL) from background sources (e.g., diet, lead-based paint, drinking water, and indoor dust) as well as an exposure to lead related to the MRS. If all default parameters are used to run the IEUBK model, it produces a soil action level of 400 mg/kg which USEPA has adopted as lead’s residential soil RSL (USEPA 2018a).

USEPA (2010) guidance recommends using the mean concentration for estimating risk from exposure to lead; as shown in **Table 2-1**, the mean soil concentrations for lead at each DU exceeded the soil action level of 400 mg/kg; lead was carried forward as a soil COPC in the HHRA.

In **Table 2-2**, the Background Reference Area DU ISM mean concentrations for the metals and nitroglycerin in surface soil were more than an order of magnitude lower than the ISM mean concentrations at the Target Berm and Firing Point DU. The metals and nitroglycerin in surface soil at the Target Berm and Firing Point DUs are likely site-related COPCs.

Table 2-1. Risk-Based Screening, Summary Statistics and Exposure Point Concentrations for Soil and Sediment

								Summary Statistics			
COPC/ Exposure Media	Detection Frequency	% Detection	Minimum Detection mg/kg	Maximum Detection mg/kg	Maximum Detection Sample Location	Risk-Based Screening Level $^{(1)}$ mg/kg	Constituent of Potential Concern? (Yes/No)	Mean mg/kg	95% UCL $^{(2)}$ mg/kg	95% UCL Type	Selected Exposure Point Concentration $^{(3)}$ mg/kg
Target Berm DU											
Discrete Surface Soil (0 - 6 inches, bgs)											
Total Metals											
Antimony	6/6	100%	0.195	89.5	RTR01DA03A	3.1	Yes	34.2	65.7	N1	65.7
Copper	6/6	100%	16.9	1,830	RTR01DA03A	310	Yes	471	1,049	N1	1,049
Lead	7/7	100%	41.2	17,500	RTR01DA03A	400	Yes	5,347	10,396	N1	5,347
Zinc	6/6	100%	62.2	292	RTR01DA03A	2,300	No	133	203	N1	Not COPC
ISM Surface Soil (0 - 6 inches, bgs)											
Total Metals											
Antimony	3/3	100%	24.8	40.1	RTR01IS03	3.1	Yes	30.6	44.6	N1	40.1
Copper	3/3	100%	481	636	RTR01IS01	310	Yes	576	717	N1	636
Lead	3/3	100%	5,720	8,770	RTR01IS03	400	Yes	6,890	9,662	N1	6,890
Zinc	3/3	100%	149	165	RTR01IS03	2,300	No	157	171	N1	Not COPC
Discrete Subsurface Soil (24 - 30 inches, bgs)											
Total Metals											
Antimony	2/2	100%	5.47	34.8	RTR01DB03A	3.1	Yes	20.1	--	--	34.8
Copper	2/2	100%	65.1	961	RTR01DB03A	310	Yes	513	--	--	961
Lead	2/2	100%	824	6,360	RTR01DB03A	400	Yes	3,592	--	--	3,592
Zinc	2/2	100%	107	189	RTR01DB03A	2,300	No	148	--	--	Not COPC
Discrete Total Soil (0 - 30 inches, bgs)											
Total Metals											
Antimony	8/8	100%	0.195	89.5	RTR01DA03A	3.1	Yes	30.7	53.4	N1	53.4
Copper	8/8	100%	16.9	1,830	RTR01DA03A	310	Yes	481	911	N1	911
Lead	9/9	100%	41.2	17,500	RTR01DA03A	400	Yes	4,957	22,661	G1	4,957
Zinc	8/8	100%	62.2	292	RTR01DA03A	2,300	No	137	187	N1	Not COPC
Discrete Sediment (0 - 6 inches, bgs)											
Total Metals											
Antimony	2/2	100%	0.18	0.966	RTR01DA03A	3.1	No	0.6	--	--	0.966
Copper	2/2	100%	15.3	79.7	RTR01DA03A	310	No	47.5	--	--	79.7
Lead	2/2	100%	15.8	242	RTR01DA03A	400	No	129	--	--	129
Zinc	2/2	100%	62.4	74.9	RTR01DA03A	2,300	No	68.7	--	--	Not COPC
Soil Pile DU											
Discrete Surface Soil (0 - 12 inches, bgs)											
Total Metals											
Antimony	7/7	100%	2.24	58.5	RTR02DS02A	3.1	Yes	21.4	77.7	G1	58.5
Copper	7/7	100%	76.6	1,740	RTR02DS02A	310	Yes	488	1,754	G1	1,740
Lead	7/7	100%	672	8,980	RTR02DS02A	400	Yes	3,326	9,847	G1	3,326
Zinc	7/7	100%	106	314	RTR02DS02A	2,300	No	181	242	N1	Not COPC
Discrete Subsurface Soil (24 - 36 inches, bgs)											

								Summary Statistics			
COPC/ Exposure Media	Detection Frequency	% Detection	Minimum Detection mg/kg	Maximum Detection mg/kg	Maximum Detection Sample Location	Risk-Based Screening Level (1) mg/kg	Constituent of Potential Concern? (Yes/No)	Mean mg/kg	95% UCL (2) mg/kg	95% UCL Type	Selected Exposure Point Concentration (3) mg/kg
Total Metals											
Antimony	6/6	100%	36.5	1,080	RTR02DS11A	3.1	Yes	254	1,790	G1	1,080
Copper	6/6	100%	675	2,060	RTR02DS10A	310	Yes	1,054	1,502	N2	1,502
Lead	6/6	100%	4,920	57,200	RTR02DS11A	400	Yes	18,933	35,573	N1	18,933
Zinc	6/6	100%	165	443	RTR02DS10A	2,300	No	244	332	N2	Not COPC
Discrete Total Soil (0 - 36 inches, bgs)											
Total Metals											
Antimony	13/13	100%	2.24	1,080	RTR02DS11A	3.1	Yes	129	934	NP1	934
Copper	13/13	100%	76.6	2,060	RTR02DS10A	310	Yes	749	1,053	N1	1,053
Lead	13/13	100%	672	57,200	RTR02DS11A	400	Yes	10,529	22,825	G1	10,529
Zinc	13/13	100%	106	443	RTR02DS10A	2,300	No	210	256	N1	Not COPC
Firing Point DU											
Discrete Surface Soil (0 - 18 inches, bgs)											
Semi-Volatile Organic Compounds											
Nitroglycerin	9/9	100%	0.002	1.3	RTR03DA03B	0.63	Yes	0.575	0.844	N1	0.844
ISM Surface Soil (0 - 6 inches, bgs)											
Semi-Volatile Organic Compounds											
Nitroglycerin	3/3	100%	3.7	21	RTR03IS03	0.63	Yes	9.7	26.2	N1	21
Background DU											
ISM Surface Soil (0 - 6 inches, bgs)											
Semi-Volatile Organic Compounds											
Nitroglycerin	3/3	100%	0.38	0.46	RTR04IS01	0.63	No	0.427	0.497	N1	0.46
Total Metals											
Antimony	3/3	100%	0.244	0.682	RTR04IS02	3.1	No	0.517	0.919	N1	0.682
Copper	3/3	100%	10.5	12.7	RTR04IS02	310	No	11.7	13.6	N1	12.7
Lead	3/3	100%	59.2	82.3	RTR04IS03	400	No	74.4	96.7	N1	74.4
Zinc	3/3	100%	23	33.5	RTR04IS02	2,300	No	29.9	40	N1	33.5
French Drain Outfall DU											
Discrete Sediment (0 - 6 inches, bgs)											
Total Metals											
Antimony	10/10	100%	0.092	0.638	RTR05DD05A	3.1	No	0.298	0.388	N1	Not COPC
Copper	10/10	100%	6.63	38.7	RTR05DD02A	310	No	22.5	28.3	N1	Not COPC
Lead	11/11	100%	17.6	358	RTR05DD02A	400	No	122	174	N1	Not COPC
Zinc	10/10	100%	34.7	71.1	RTR05DD10A	2,300	No	51.8	58.1	N1	Not COPC

Notes:

-- = Unable to be determined

bgs = below ground surface

DU = Decision Unit

ISM = Incremental Sampling Methodology

mg/kg = milligrams per kilogram

N/A = Not Available/Applicable

(1) USEPA 2018. Regional Screening Levels (May 2018). Residential RSL was used for soil and sediment that is protective of a target cancer risk of 1E-06 and a target hazard quotient of 0.1.

								Summary Statistics			
COPC/ Exposure Media	**Detection Frequency**	**% Detection**	**Minimum Detection mg/kg**	**Maximum Detection mg/kg**	**Maximum Detection Sample Location**	**Risk-Based Screening Level (1) mg/kg**	**Constituent of Potential Concern? (Yes/No)**	**Mean mg/kg**	**95% UCL (2) mg/kg**	**95% UCL Type**	**Selected Exposure Point Concentration (3) mg/kg**

(2) Determined using USEPA's ProUCL 5.1 software (discrete data) and ITRC UCL calculation method (ISM data).

(3) The maximum detection is selected if no 95% UCL is available or if 95% UCL is greater than the maximum detection. For lead, the mean concentration is used.

UCL Type Code:	
Normal	
95% Student's-t UCL	N1
95% Modified-t UCL	N2
Gamma	
95% Adjusted Gamma UCL	G1
Non-parametric	
99% Chebyshev (Mean, Sd) UCL	NP1

Table 2-2. Background ISM Evaluation

Constituent	Background Reference Area DU ISM Mean Concentration (mg/kg)	Target Berm DU ISM Mean Concentration (mg/kg)	Firing Point DU ISM Mean Concentration (mg/kg)
Antimony	0.517	30.6	NV
Copper	11.7	576	NV
Lead	74.4	6,890	NV
Zinc	29.9	157	NV
Nitroglycerin	0.427	--	9.7

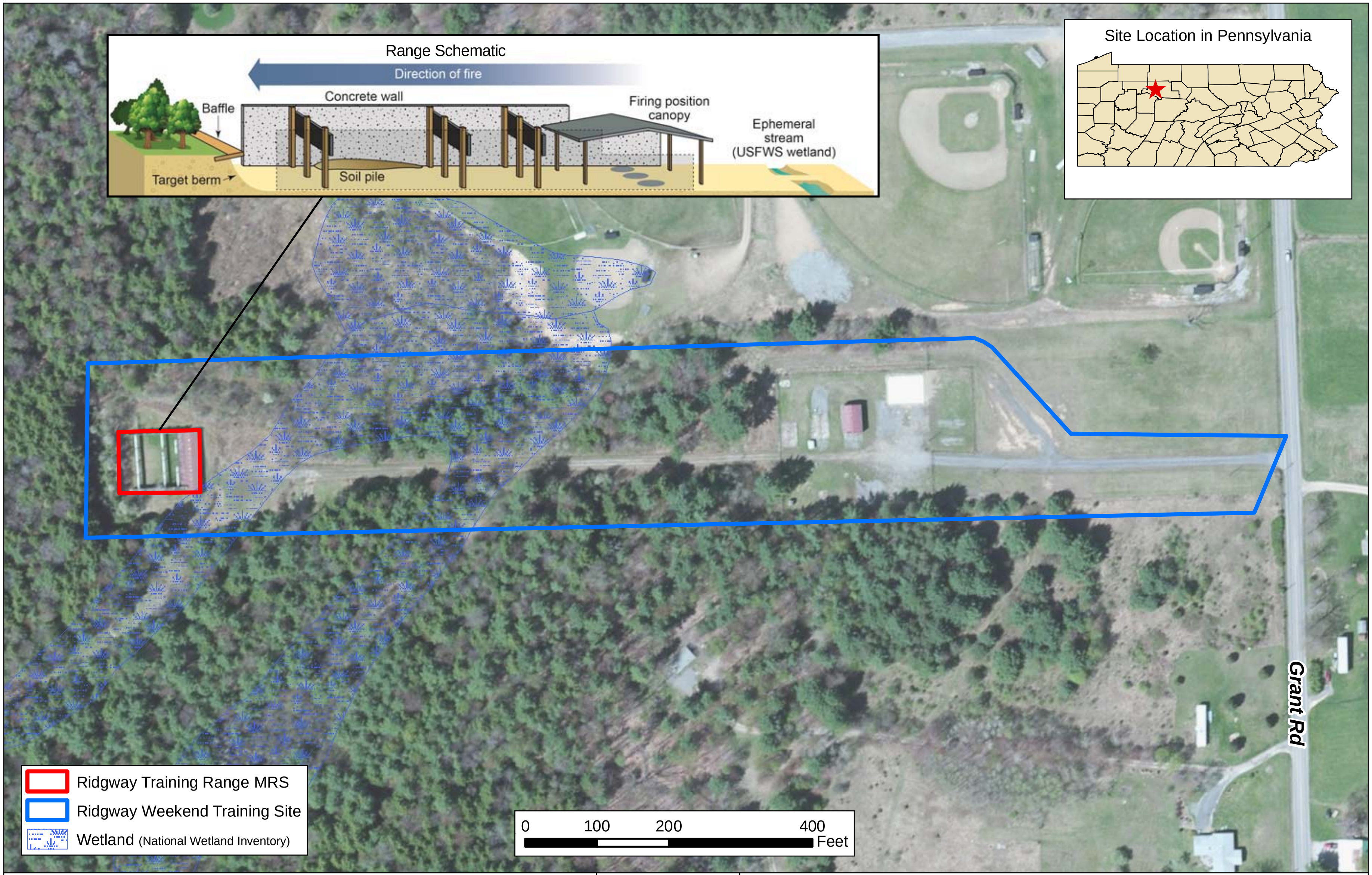
Notes:

DU = Decision Unit; ISM = incremental sampling methodology; mg/kg = milligrams per kilogram; NV = no value

Table 2-3 identifies the soil COPCs at the MRS. Surface soil (0 to 24 inches bgs) and subsurface soil (24 to 36 inches bgs) data were combined to generate total soil data sets for each DU. Exposure to subsurface soil is most likely to occur during excavation activities when subsurface soil is brought to the surface (e.g., utility line repairs, construction trenches, and land redevelopment). Total soil data consist of biased, discrete soil data only.

Table 2-3. Ridgway Training Range COPCs

Exposure Medium	Target Berm DU	Soil Pile DU	Firing Point DU
Surface Soil, 0 to 24 inches bgs	Antimony Copper Lead	Antimony Copper Lead	Nitroglycerin
Total Soil, 0 to 36 inches bgs	Antimony Copper Lead	Antimony Copper Lead	Not applicable



CLIENT	Army National Guard			
PROJECT	Remedial Investigation through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	5/30/2017
SCALE	1:2,400	CHK BY	AS	5/30/2017
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community		PM	RG	5/30/2017

N

TITLE

Ridgway Training Range Site Layout

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-1

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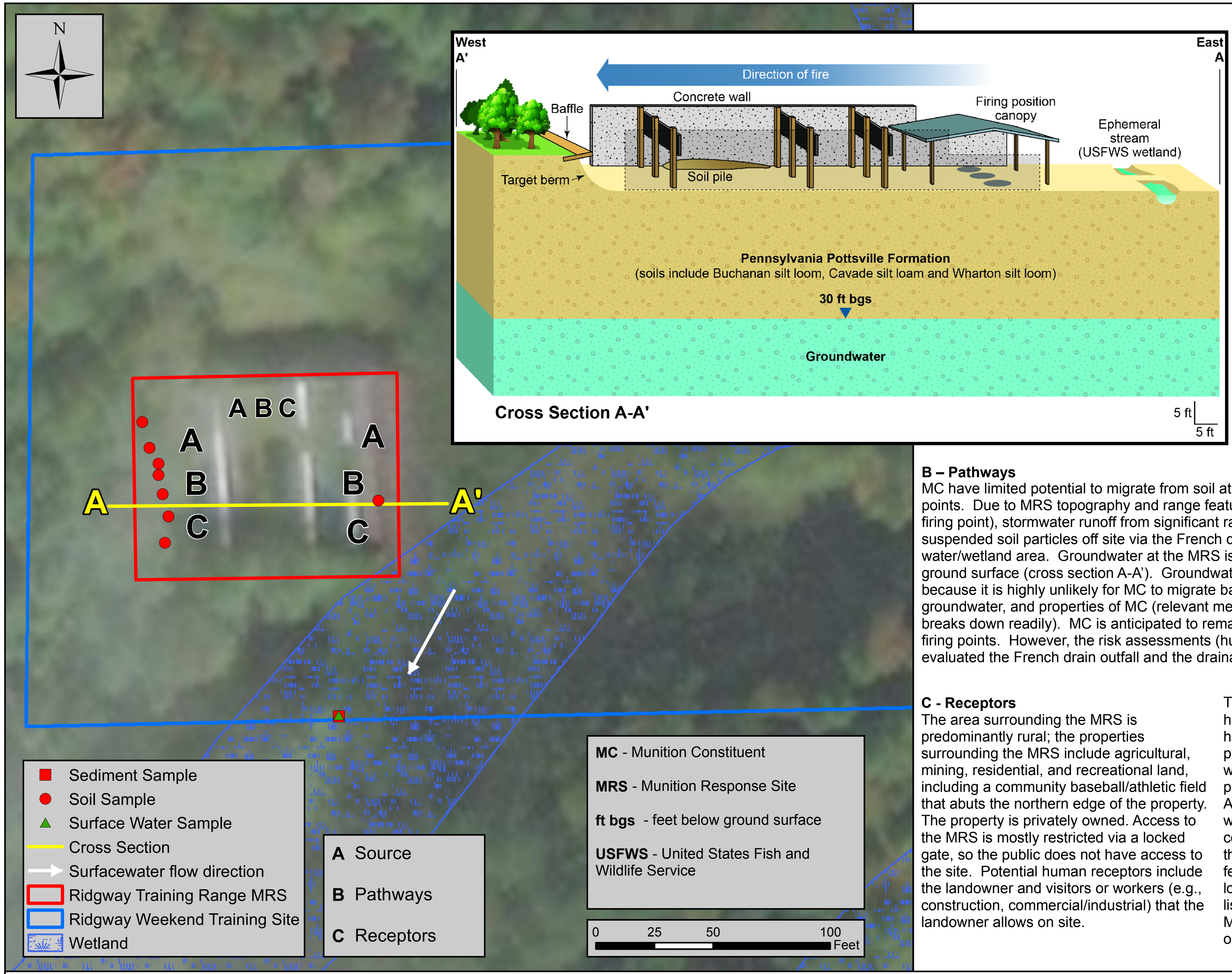

A Source

B Pathways

C Receptors

MC - Munition Constituent

MRS - Munition Response Site

ft bgs - feet below ground surface

USFWS - United States Fish and Wildlife Service

Target Berm

A – Sources
Metals MC at the target berm and soil pile as well as nitroglycerin at the firing points as a result of historical small arms training.

Firing Point

Soil Pile

B – Pathways
MC have limited potential to migrate from soil at the target berm, soil pile, and firing points. Due to MRS topography and range features (e.g., walled-in MRS, covered firing point), stormwater runoff from significant rain events is unlikely to transport suspended soil particles off site via the French drain outfall or to the nearby surface water/wetland area. Groundwater at the MRS is approximately 30 feet below ground surface (cross section A-A'). Groundwater pathways are incomplete because it is highly unlikely for MC to migrate based on soil type, depth to groundwater, and properties of MC (relevant metals do not migrate far, nitroglycerin breaks down readily). MC is anticipated to remain at the target berm, soil pile, and firing points. However, the risk assessments (human and ecological) have also evaluated the French drain outfall and the drainage area near the target berm.

C - Receptors
The area surrounding the MRS is predominantly rural; the properties surrounding the MRS include agricultural, mining, residential, and recreational land, including a community baseball/athletic field that abuts the northern edge of the property. The property is privately owned. Access to the MRS is mostly restricted via a locked gate, so the public does not have access to the site. Potential human receptors include the landowner and visitors or workers (e.g., construction, commercial/industrial) that the landowner allows on site.

There is no federally-designated critical habitat located within the site. However, habitat supporting ecological receptors is present within the MRS. A tiny portion of a wetland is present within the MRS that could provide habitat for aquatic species. Allegheny National forest borders the western edge of the MRS, with various coniferous trees and some deciduous trees, the most common being birch. Although no federally-designated critical habitat is located within the MRS, there are state-listed endangered species in Pennsylvania. Many of these species will not be found on or near the MRS.

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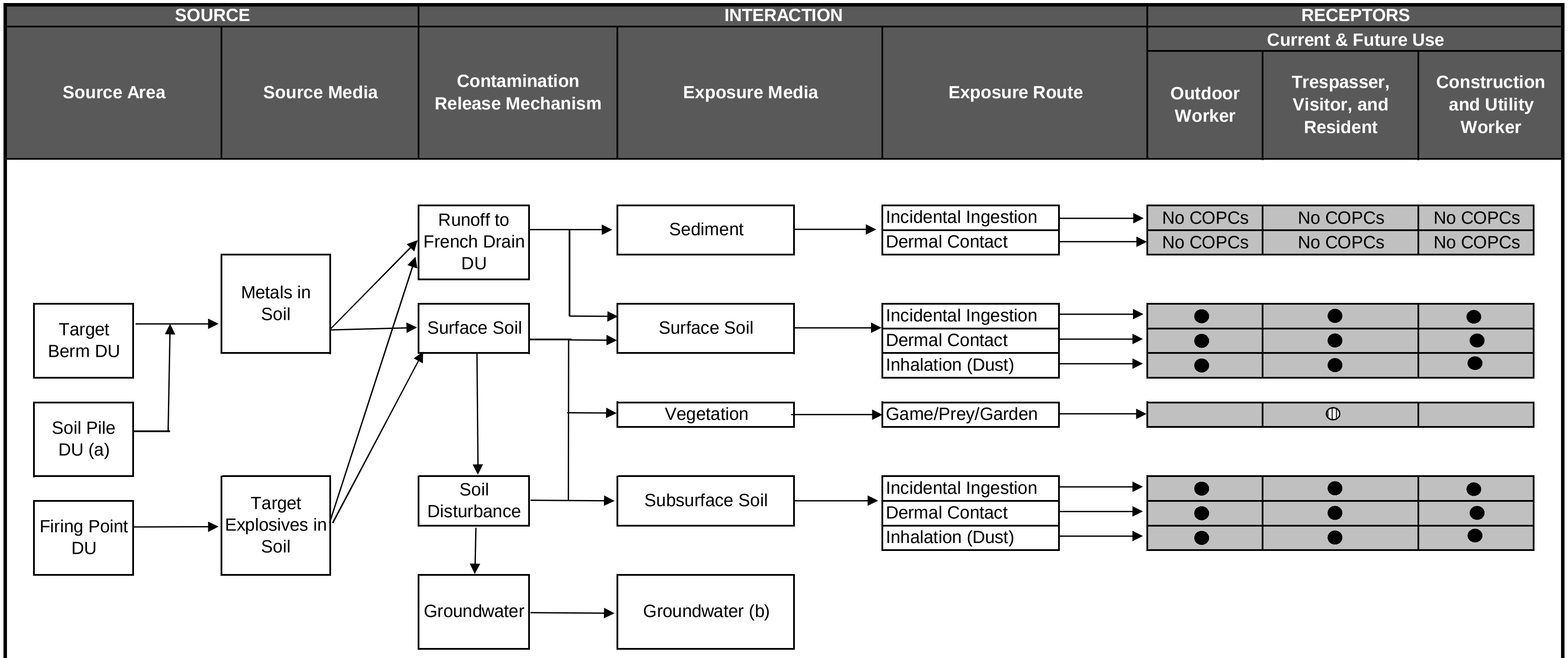
Figure 2-2
Conceptual Site Model
Ridgway Training Range, Pennsylvania

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Date....................November 2018
Prepared by....................AECOM



Notes:

COPC - chemical of potential concern; DU - Decision Unit; MC - munition constituent

(a) Landowner created soil pile when installing the french drain on the property.

(b) Depth to groundwater is approximately 30 feet below ground surface; unlikely for MC to migrate based on soil type and depth to groundwater.

Pathway:

● - Complete Pathway

◐ - Potentially Complete Exposure Pathway (Gardening for current landowner; landowner uses property for storing landscaping equipment and not for personal gardening)

▨ - Incomplete Exposure Pathway (Empty Cell)

No COPCs - Pathway is Potentially Complete (detected concentrations were below risk-based screening levels)

Figure 2-3

Human Health MC Exposure Pathway Analysis

Ridgway Training Range, Remedial Investigation

Ridgway Training Range, Pennsylvania

CLIENT	Army National Guard			
PROJECT	Remedial Investigation through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	8/16/2017
SCALE	1:840	CHK BY	AS	8/16/2017
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community		PM	RG	8/16/2017

TITLE

Ridgway Training Range MRS RI Approach

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Figure 2-4

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3 Exposure Assessment

The HHRA addresses two exposure scenario timeframes: current and future. The current scenarios represent exposure to current site conditions; these conditions are assumed to not change in the future (i.e., no land re-development). Receptors are assumed to be exposed to surface soil (0 to 24 inches bgs). The future scenarios are used to address site conditions that have changed due to land re-development. Land re-development results in excavation activities that bring subsurface soil to the surface and the soils are “mixed” together. Future receptors are exposed to total soil (0 to 36 inches bgs).

3.1 Constituent Intake

Exposure is defined as the contact rate (CR) of an organism with a constituent or physical agent. Intake is exposure normalized for time and body weight (BW) and is expressed in units of milligram (mg) constituent/kilogram (kg) body weight-day (EPA 1989). The HHRA generally focuses on potential impacts of long-term (chronic) exposure to contaminants present at the Site. The measure of chronic exposure is the chronic daily intake (CDI). The CDI is calculated for ingestion pathway.

The general equation (USEPA 1989) for calculating CDI is:

Equation 1:

$$\text{CDI} = (\text{CS} \times \text{CR} \times \text{RBA} \times \text{EF} \times \text{ED})/(\text{BW} \times \text{AT})$$

Where:

CDI = chronic daily intake; the amount of constituent at the exchange boundary (mg/kg body weight-day).

Constituent-specific variable

CS = soil concentration; the representative concentration contacted over the exposure period (mg/kg soil).
RBA = relative bioavailability factor (unitless); concentration that becomes available for distribution to internal target tissues and organs.

Variables that describe the exposed population

CR = contact rate; the amount of contaminated medium contacted per unit time or event (mg/day soil).
EF = exposure frequency (days/year); describes how often exposure occurs.
ED = exposure duration (years); describes how long exposure occurs.
BW = body weight; the average body weight (kilograms [kg]) over the exposure period.

Assessment-determined variable

AT = averaging time; period over which exposure is averaged (days).

Metals can exist in a variety of chemical and physical forms in the environment, and not all forms of a given metal are absorbed to the same extent. The RBA is the fraction of an ingested dose that crosses the gastrointestinal epithelium and becomes available for distribution to internal target tissues and organs (USEPA 2007). **Table A3-3 in Attachment 3** presents the RBAs used in the HHRA. For the Ridgway training range, the default RBA of 1 was used for antimony, copper, and nitroglycerin.

For the dermal exposure pathway, a dermally absorbed dose (DAD) is calculated. The generic equation described above is used with additional constituent- and receptor-specific dermal contact parameters to estimate dermal absorption of the constituent through the skin.

The following equation (USEPA 2004) is used:

Equation 2:

$$DAD = (DA\text{-}event \times EV \times EF \times ED \times SA)/(BW \times AT)$$

Equation 3:

$$DA\text{-}event = (CS \times CF \times SSAF \times DABS)$$

Where:

DAD = dermally absorbed dose; the amount of constituent at the exchange boundary (mg/kg body weight-day).

Constituent-specific variable

CS = soil concentration; the representative concentration contacted over the exposure period (mg/kg soil).

DABS = constituent-specific dermal absorption fraction (unitless)

Variables that describe the exposed population

DA-event = absorbed dose per event; the amount of contaminated medium contacted per unit time or event (mg/centimeter squared-event [mg/cm^2-event]).

EF = exposure frequency (days/year); describes how often exposure occurs.

ED = exposure duration (years); describes how long exposure occurs.

SSAF = soil-to-skin adherence factor (milligrams per square centimeters – event [mg/cm^2-event]); amount of soil that adheres to the skin per unit of skin surface area.

SA = skin surface area, soil contact (square centimeters [cm^2]); amount of skin exposure to the affected media.

BW = body weight; the average body weight (kg) over the exposure period.

Assessment-determined variable

AT = averaging time; period over which exposure is averaged (days).

USEPA’s Office of Research and Development reviewed available experimental data for dermal absorption from contaminated soil and recommended constituent- and class-specific dermal absorption (DABS) fraction which are summarized in Exhibit 3-4 in the USEPA Risk Assessment Guidance for Superfund (RAGS) Part E guidance (USEPA 2004). The recommendations accounted for the uncertainty associated with different soil types, loading rates, constituent concentrations and other conditions that affect how readily a constituent that is adhered to soil particulates may pass through the skin barrier of a potential receptor. The DABS values used in the HHRA are documented in **Table A3-3 of Attachment 3.**

Consistent with USEPA guidance on inhalation exposure (USEPA 2009), exposure by inhalation is evaluated by calculating an adjusted exposure concentration as follows:

Equation 4:

$$EC = (CA \times ET \times EF \times ED)/AT$$

Where:

Constituent-specific variable
EC = exposure concentration (micrograms per cubic meter [$\mu g/m^3$]).
CA = constituent concentration in air ($\mu g/m^3$).

Variables that describe the exposed population
ET = exposure time (hours/day).
EF = exposure frequency (days/year).
ED = exposure duration (years).

Assessment-determined variable
AT = averaging time (ED in years × 365 days/year × 24 hours/day).

The CDI, DAD, and EC equations and exposure parameters that were used for calculating the pathway-specific intakes for each receptor and exposure pathway are provided in **Tables A2-1 through A2-14 in Attachment 2.** Exposure equations and assumptions provided in the Act 2 guidance (PADEP 2002) were used as well as the following USEPA resources: USEPA's standard default exposure parameters (USEPA 2014 and 2015); USEPA's Exposure Factors Handbook (USEPA 2011); USEPA RAGS Human Health Evaluation Manual, Supplemental Guidance for Dermal Risk Assessment (USEPA 2004), and USEPA RAGS Supplemental Guidance for Inhalation Risk Assessment (USEPA 2009). Any site-specific assumptions or values that were used in the calculations are described further below in the exposure scenario descriptions.

3.2 Exposure Scenarios

This section identifies human receptors that may be exposed to site-related human health COPCs in affected media and addresses the potential extent of their exposure under site-specific exposure scenarios. **Figure 2-2** presents the current understanding of the site conditions with respect to known and suspected constituent sources, potential transport mechanisms and migration pathways, and human receptors.

Potential off-site receptors were not identified for the MRS because site access is restricted via a locked gate. However, an on-site trespasser scenario was evaluated in the HHRA to address potential breaches in security. On-site and surrounding area vegetation, the concrete wall, and other structures inhibit windblown particulates from leaving the MRS; also, the inhalation exposure pathways were identified as incomplete because no inhalation toxicity values are available for antimony, copper, and nitroglycerin (PADEP 2018a). Also, sediment COPCs were not identified in the surface water drainage areas of the French Drain and Target Berm DUs where surface water leaves the MRS.

Figure 2-3 identifies the soil exposure pathways that were quantified for each on-site receptor at the MRS. The following on-site receptors were evaluated: outdoor worker, trespasser (teen), visitor (child/adult), hypothetical resident (child/adult), construction worker, and utility worker.

On-Site Outdoor Worker: The on-site outdoor worker spends 180 days per year for 25 years managing and storing landscaping equipment and performing general grounds maintenance at the MRS. This receptor represents the standard default outdoor worker scenario presented in the Act 2 guidance (PADEP 2002). The outdoor worker is assumed to be exposed to surface soil (current) and total soil (future; assuming the land is redeveloped). Soil-related exposure pathways include incidental ingestion, dermal contact, and inhalation of wind-blown particulates from soil. A site-specific particulate emission factor (PEF) of 1.27E+09 cubic meters per kilogram (m^3/kg) was used to estimate the wind-blown particulates in outdoor air; **Attachment 3** describes the calculation of the PEF (USEPA 2002). No volatiles were identified as soil COPCs; therefore the inhalation of vapors emanating from soil is an incomplete exposure pathway.

On-Site Trespasser: The on-site trespasser is a young teen age 6 to 16 years old that spends 24 days per year for 10 years at the MRS climbing the locked gate or fence while visiting the ball fields nearby. **Tables A2-13 and A2-14 in Attachment 2** document the SA (3,749 square centimeters [cm^2]) and BW (44 kg) that were calculated using the USEPA (2011) Exposure Factors Handbook for the trespasser. An SSAF of 0.3 mg/cm^2-event was used for the dermal contact exposure pathway that is protective of a teenager playing soccer in moist field conditions (USEPA 2004). The on-site trespasser is exposed to surface soil (current) and total soil (future; assuming the land is redeveloped). Soil-related exposure pathways include incidental ingestion, dermal contact, and inhalation of wind-blown particulates from soil. A site-specific PEF of 1.27E+09 m^3/kg was used to estimate the wind-blown particulates in outdoor air; **Attachment 3** describes the calculation of the PEF (USEPA 2002). No volatiles were identified as soil COPCs; therefore the inhalation of vapors emanating from soil is an incomplete exposure pathway.

On-Site Visitor (Child/Adult/Lifetime): The on-site visitor is assumed to be an adult and a young child (0 to 6 years) that visits the MRS for 75 days per year for 26 years (Oak Ridge National Laboratory [ORNL] 2018). The on-site visitor is likely to be a friend or family member of the landowner that may occasionally help out with the family business or are just visiting. The on-site visitor is assumed to be exposed to surface soil (current) and total soil (future; following land re-development). Soil-related exposure pathways include incidental ingestion, dermal contact, and inhalation of wind-blown particulates from soil. A site-specific PEF of 1.27E+09 m^3/kg was used to estimate the wind-blown particulates in outdoor air; **Attachment 3** describes the calculation of the PEF (USEPA 2002). No volatiles were identified as soil COPCs; therefore the inhalation of vapors emanating from soil is an incomplete exposure pathway. Potential cancer risk and non-cancer hazard estimates are calculated for the child, adult, and lifetime visitor. The lifetime visitor represents the combined child and adult cancer risk estimates that are normalized over a lifetime of exposure (i.e., USEPA default assumption of 70 years), assuming that the child and adult continue to visit the landowner over the course of their lifetime.

On-Site Hypothetical Resident (Child/Adult/Lifetime): The expected future land use of the park is commercial (i.e., landscaping business). However, the inclusion of a hypothetical future resident (i.e., an adult and young child, 0 to 6 years) was used to conservatively evaluate unlimited use and unrestricted exposure (UU/UE) for future risk management decision-making should the land use change. USEPA standard default residential exposure parameters (i.e., 350 days per year for 26 years) were used (USEPA 2014 and 2015). Soil-related exposure pathways include incidental ingestion, dermal contact, and inhalation of wind-blown particulates from soil. A site-specific PEF of 1.27E+09 m^3/kg was used to estimate the wind-blown particulates in outdoor air; **Attachment 3** describes the calculation of the PEF (USEPA 2002). No volatiles were identified as soil COPCs; therefore the inhalation of vapors emanating from soil is an incomplete exposure pathway. Potential cancer risk and non-cancer hazard estimates are calculated for the child, adult, and lifetime resident. The lifetime resident represents the combined child and adult cancer risk estimates that are normalized over a lifetime of exposure (i.e., USEPA default assumption of 70 years), assuming that the child and adult live at the MRS throughout the course of their lifetime.

On-Site Construction Worker: The construction worker is assumed to be involved in a 3-month-long construction project (i.e., exposure frequency of 60 days per year; 5 days per week × 4 weeks/month × 3 months). Soil-related exposure pathways include incidental ingestion, dermal contact, and inhalation of wind-blown particulates from soil. Excavation activities are likely to produce large amounts of fugitive dust while traveling on unpaved roads and transporting soil. A site-specific unpaved road PEF of 1.07E+07 m^3/kg was used to estimate the wind-blown particulates in outdoor air; **Attachment 3** describes the calculation of the unpaved road PEF (USEPA 2002). No volatiles were identified as soil COPCs; therefore the inhalation of vapors emanating from soil is an incomplete exposure pathway.

On-Site Utility Worker: The utility worker is assumed to be involved short-term excavation activities (e.g., 20 days out of the year to excavate and repair or install a utility line). Soil-related exposure pathways include incidental ingestion, dermal contact, and inhalation of wind-blown particulates from soil. For conservatism, the same site-specific unpaved road PEF of 1.07E+07 m^3/kg was also used for the utility worker to estimate the wind-blown particulates in outdoor air; **Attachment 3** describes the calculation of the unpaved road PEF (USEPA 2002). No volatiles were identified as soil COPCs; therefore the inhalation of vapors emanating from soil is an incomplete exposure pathway.

3.3 Exposure Point Concentration

Table 2-1 provides the exposure point concentrations (EPCs) that were derived for each DU; EPCs are the concentrations of COPCs in the affected medium that a receptor may come into contact. USEPA (1989) recommends using the lower of the maximum detected concentration and the 95% upper confidence limit (UCL) of the mean concentration as the EPC in cases where the DU is reasonably defined. For lead, the mean concentration was used as the EPC (USEPA 2018b).

The discrete soil EPCs were derived using USEPA’s ProUCL Version 5.1 software, which was developed for USEPA, to test the distribution of the datasets (USEPA 2016a). After testing, the program computes a conservative 95% UCL based on the appropriate distribution of the data. For those datasets that do not fit the normal, lognormal, or gamma distributions, several parametric and distribution-free non-parametric methods are available to calculate an appropriate 95% UCL (e.g., bootstrap methods). The ProUCL Version 5.1 program uses several statistical methods to handle datasets with non-detect (ND) results (USEPA 2016a). **Tables A2-15 through A2-18 in Attachment 3** provides the ProUCL output information.

The ISM soil EPCs were derived using the Interstate Technology & Regulatory Council (ITRC) UCL calculation method (ITRC 2012). Three or more ISM samples are needed to calculate a 95% UCL. Because fewer than eight replicate ISM samples are typically collected for a DU, fewer statistical options are available to calculate a UCL compared with the methodology that is used for handling discrete sampling data. The ITRC calculation method calculates two UCLs that accommodate ISM data sets and "bracket" the range of UCLs that may be calculated; the two UCLs are the Student's-t (representing the low end of the range) and Chebyshev (representing the high end of the range). **Table A2-19 in Attachment 3** presents the summary statistics and ITRC UCL calculations for the ISM data (ITRC 2012). However, the calculated ITRC UCLs for the Target Berm, Firing Point and Background Reference Area DUs were higher than the maximum detected concentration of the replicate results. Therefore, the maximum detected concentrations were used as the selected EPCs (**Table 2-1**) (USEPA 1989).

3.4 Lead Evaluation

Attachment 3 presents the exposure parameters used to evaluate lead in soil at the MRS using the Adult Lead Methodology (ALM) model (version dated 14 June 2017) and the IEUBK model (Windows version 1.1, Build 11) (USEPA 2017a and 2010). The goal is to limit the risk to no more than a 5% probability for a fetus of a pregnant female worker (ALM model) or a young child (IEUBK model) to have a PbB that exceeds a target PbB threshold level (USEPA 2010 and 2017a). Two target PbB threshold levels were evaluated in the HHRA: the existing USEPA PbB threshold of 10 µg/dL (USEPA 2010 and 2018a) and the proposed PbB threshold of 5 µg/dL (Centers for Disease Control and Prevention [CDC] 2012 and USEPA 2016b).

The USEPA (2017a) ALM model was used to evaluate potential exposure to lead in soil for the on-site outdoor worker (which is protective of the adult visitor and teen trespasser) and the on-site construction and utility worker. The construction and utility worker scenarios represent short-term exposure scenarios; therefore a “minimum worker scenario” was evaluated using a minimum of 90 days of exposure (i.e., exposure frequency) to predict quasi-steady-state PbB levels from exposure to soils at the DUs because of the limitations of the ALM model (USEPA 2016c). The IEUBK model results are protective of the hypothetical residential scenario; therefore the adult resident was not evaluated separately using the ALM model.

For the ALM model, USEPA (2017b) recommends using a baseline PbB level of 0.6 µg/dL and a geometric standard deviation PbB of 1.8. Also, central tendency values for soil ingestion rates (IRs) and exposure frequency were used; a central tendency soil IRs of 0.05 grams/day was used for the outdoor worker scenario (USEPA 2011 and 2017a) and a higher central tendency IRs of 0.1 grams/day was used for the construction/utility worker scenario (USEPA 2011) to better represent incidental ingestion of higher levels of dust and soil during excavation activities.

The USEPA IEUBK Model for Lead in Children was used to evaluate soil exposure to the hypothetical child resident (USEPA 2010). The IEUBK model default for the mother's blood lead concentration at childbirth was changed from 1.0 to 0.6 µg Pb/dL (USEPA 2017b). Also, USEPA recommended changing the child age range from 0 to 84 months to 12 to 72 months based on recent scientific data provided from the CDC (USEPA 2017c). The IEUBK model was used to estimate PbB levels for the hypothetical child resident which is also protective of the child visitor scenario.

4 Toxicity Assessment

Risk assessments vary for different constituents depending on whether noncarcinogenic or carcinogenic responses are used to assess potential risks. Some COPCs may result in both noncarcinogenic and carcinogenic effects. Toxicity assessment involves determining whether exposures to a constituent can increase the incidence of a specific adverse effect (e.g., cancer, kidney damage) in humans, characterizing the nature and strength of evidence of causation and, if sufficient data are available, quantifying the relationship between the dose of the constituent and the incidence of adverse health effects in the exposed population. Toxicity assessments provide the basis for evaluating what is acceptable exposure and what level of exposure may adversely affect human health.

4.1 Selection of Toxicity Values

USEPA (2003) recommends using the following hierarchy for selecting toxicity values for the HHRA:

Tier 1 – USEPA's Integrated Risk Information System (IRIS) (USEPA 2018c) – The IRIS program supports protection of human health and the environment by identifying and characterizing the health hazards of constituents found in the environment. Each assessment can cover a constituent, a group of related constituents, or a complex mixture. https://www.epa.gov/iris

Tier 2 – USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) (USEPA 2018d) – The Office of Research and Development / National Center for Environmental Assessment / Superfund Health Risk Technical Support Center develops PPRTVs on a constituent-specific basis. https://hhpprtv.ornl.gov/

Tier 3 – Other Toxicity Values – Tier 3 includes additional USEPA and non-USEPA sources of toxicity information. Priority should be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and that have been peer reviewed. Some examples of Tier 3 sources include the following:

- The **PADEP online Land Recycling Program Toxicity Database** (PADEP 2018): http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/CPP/Toxicity
- **Health Effects Assessment Summary Tables (HEAST)** dated July 1997 (USEPA 1997). https://epa-heast.ornl.gov/

Dermal toxicity values are not available in USEPA's IRIS database or other USEPA sources. Therefore, USEPA's RAGS Part E dermal guidance was used for estimating dermal exposure to soil (USEPA 2004). USEPA (2004) recommends adjusting oral toxicity values using gastrointestinal absorption factors (GIABS) to evaluate dermal exposure routes for some constituents. **Table A3-3 in Attachment 3** presents the GIABS values used in the HHRA. The oral-to-dermal adjustment is not required for constituents where 100 percent (i.e., GIABS=1) absorption is assumed (USEPA 2004). A cutoff of 50% gastrointestinal absorption is recommended to reflect the intrinsic variability in the analysis of absorption studies. USEPA (2004) recommends using a GIABS of 15% (GIABS=0.15) for antimony, indicating that the metal is poorly absorbed through the skin and gastrointestinal tract. For the other Ridgway training range COPCs, a default GIABS of 100 percent (GIABS=1) was assumed (USEPA 2004). The following equations were used to derive dermal toxicity values for the MRS:

Equation 5:

$$RfDd = (RfDo \times GIABS)$$

Where:

RfDd = Reference dose, dermal (mg/kg-day)
RfDo = Reference dose, oral (ingestion) (mg/kg-day)
GIABS = Gastrointestinal absorption factor (unitless)

Equation 6:

$$CSFd = (CSFo/GIABS)$$

Where:

CSFd = Cancer slope factor, dermal, 1/milligrams per kilogram-day [(mg/kg-day)$^{-1}$]
CSFo = Cancer slope factor, oral (ingestion) (mg/kg-day)$^{-1}$
GIABS = Gastrointestinal absorption factor (unitless).

4.2 Noncarcinogenic Health Effects

Evaluation of noncarcinogenic effects is based on the assumption that noncarcinogenic toxicological effects of constituents occur only after a threshold dose is achieved. The reference dose (RfD) was used to evaluate ingestion and dermal exposure pathways. The reference concentration (RfC) was used to evaluate the inhalation pathway and the estimates of the threshold dose (or concentration) at which the most sensitive human population may experience an observed adverse effect for that compound. For the Ridgway training range, the none of the soil COPCs have inhalation RfCs available and so the non-cancer inhalation exposure pathway is incomplete.

USEPA defines a chronic RfD as an estimate of a daily exposure level for the human population that is unlikely to result in deleterious effects during a lifetime (i.e., 70 years). A chronic RfD was used to evaluate the potential noncarcinogenic hazards associated with long-term constituent exposures. Chronic toxicity values were used for all the Ridgway training range receptors even though the construction worker and utility worker scenarios are considered subchronic scenarios (i.e., less than 7 years of exposure) (USEPA 1989). Subchronic toxicity values were not used in this HHRA per direction from Ms. Brie Sterling, human health risk assessment reviewer from PADEP (PADEP 2018b).

Table 4-1 documents the non-cancer toxicity values used in this HHRA.

Table 4-1. Non-Cancer Toxicity Values for Ridgway Training Range

COPC	RfDo (mg/kg-day)	GIABS (USEPA 2004) (unitless)	RfDd (mg/kg-day)	Primary Target Organ	Combined Uncertainty/ Modifying Factor	Source
Antimony	0.0004	0.15	0.00006	OT	1000	IRIS; USEPA 2018c
Copper	0.0325	1	0.0325	GI	NA	HEAST 1997
Nitroglycerin	0.0001	1	0.0001	HM	300	PPRTV 2018d

Notes:
COPC = constituent of potential concern; GI = gastrointestinal tract; GIABS = gastrointestinal absorption factor; HEAST = Health Effects Assessment Summary Tables; HM = hematological; IRIS = Integrated Risk Information System; NA = not available; OT = other; PPRTV = Provisional Peer-Reviewed Toxicity Values; RfDo = reference dose, oral; RfDd = reference dose, dermal; USEPA = United States Environmental Protection Agency

The non-cancer toxicity values were cross-checked against the PADEP toxicity database to verify state approval of the values selected from USEPA sources (PADEP 2018b).

4.3 Carcinogenic Health Effects

USEPA (1989) requires that potential carcinogens be evaluated as if minimum threshold doses do not exist. USEPA established a weight-of-evidence approach to evaluate whether a particular constituent is a carcinogen (USEPA 1986). In 2005, USEPA published new guidelines for carcinogenic risk assessment (USEPA 2005). The 2005 guidelines recognize the growing sophistication of research methods; therefore, USEPA is revising the weight-of-evidence classification system. Weighing of the evidence includes addressing both the likelihood of human carcinogenic effects of the agent and the conditions under which such effects may be expressed, to the extent that these are revealed in the toxicological and other biologically important features of the agent. Five standard hazard descriptors are recommended under the 2005 cancer guidance:

- Carcinogenic to Humans
- Likely to be Carcinogenic to Humans
- Suggestive Evidence of Carcinogenic Potential
- Inadequate Information to Assess Carcinogenic Potential
- Not Likely to be Carcinogenic to Humans

The cancer slope factor (CSF) was used to estimate the incremental potential risk from exposure to carcinogenic COPCs. CSFs are developed based on a dose response curve for the carcinogenicity of the specific constituent. In estimating risks posed by potential carcinogens, EPA generally assumes that any exposure level is associated with a finite probability, however minute, of producing a carcinogenic response. This mechanism for carcinogenicity is referred to as non-threshold, because there is theoretically no level of exposure for such a substance that does not pose a small, though finite, probability of producing a carcinogenic response.

The CSF, expressed in units (mg/kg-day)$^{-1}$, is used to convert the CDI or DAD (mg/kg-day) of a constituent from ingestion and dermal exposures, normalized over a lifetime, directly to a potential cancer risk estimate. To evaluate inhalation exposure, the CSF is expressed as an inhalation unit risk (IUR) in units of (µg/m^3)$^{-1}$ and is used to convert the adjusted EC in units of µg/m^3 directly to a potential cancer risk estimate. For the Ridgway training range, none of the soil COPCs have IURs available and so the cancer inhalation exposure pathway is incomplete. Also, only nitroglycerin has carcinogenic toxicity values and is classified as “Likely to be Carcinogenic to Humans” (PPRTV 2018d). The table below presents the oral (ingestion) and dermal cancer toxicity values used for nitroglycerin in the HHRA.

Table 4-2. Cancer Toxicity Values for Ridgway Training Range

COPC	CSFo (mg/kg-day)$^{-1}$	GIABS (USEPA 2004) (unitless)	CSFd (mg/kg-day)$^{-1}$	Weight of Evidence/ Cancer Guideline Description	Source
Nitroglycerin	0.0172	1	0.0172	Likely to be Carcinogenic to Humans	PPRTV 2018d

Notes:
COPC = constituent of potential concern; CSFd = cancer slope factor, dermal; CSFo = cancer slope factor, oral; GIABS = gastrointestinal absorption factor; PPRTV = Provisional Peer-Reviewed Toxicity Values; USEPA = United States Environmental Protection Agency

The cancer toxicity values were cross-checked against the PADEP toxicity database to verify state approval of the values selected from USEPA sources (PADEP 2018b).

5 Risk Characterization

This section integrates the information developed in the exposure assessment and the toxicity assessment into an evaluation of the potential risks associated with exposure to COPCs at each DU. Both the potential cancer risk and non-cancer health hazard were evaluated.

This section also addresses the nature and magnitude of potential human health risks in comparison to state and federal target risk levels for making risk management decisions.

5.1 Target Risk Levels

The Pennsylvania Act 2 regulations have established a target cumulative excess lifetime cancer risk (ELCR) (i.e., from all pathways for a single receptor group) of 1×10^{-4} (1E-04) for carcinogenic risks. USEPA (1991b) also states that where the cumulative current or future ELCR to an individual is less than 10^{-4} (one in 10,000), action generally is not warranted unless there are adverse environmental impacts.

Both the Pennsylvania Act 2 regulations and USEPA accept a noncarcinogenic hazard target level, or hazard index (HI), of 1. For non-cancer hazards, potential adverse health effects cannot be ruled out if the target HI is greater than 1 per target organ endpoint. If the total HI for all target organ endpoints combined exceeds 1, constituents are segregated based on the target organ endpoint, and separate target organ-specific HIs are calculated. Only constituents that act on the same target organ are expected to be additive (USEPA 1989).

Lead exposure was evaluated by comparing the estimated PbB to the USEPA's target PbB of 10 µg/dL for the receptor population (USEPA 2016b). The target PbB is based on potentially adverse neurological effects in children (CDC 1991). The CDC Advisory Committee on Childhood Lead Poisoning Prevention has revised its recommended target blood lead level to 5 µg/dL (CDC 2012). At the present time, USEPA has not formally adopted this blood lead level and continues to use a target level of 10 µg/dL. However, a sensitivity analysis was performed as part of the lead evaluation to determine how the lead modeling results would change if a target blood lead level of 5 µg/dL were used.

In addition, the threshold for lead is to limit the risk to no more than a 5% probability for a young child's or a fetus of a pregnant female worker PbB concentration to exceed the target PbB level in the IEUBK and ALM models, respectively (USEPA, 2010). If the probability of 5% is exceeded, then adverse health effects from exposure to lead are possible for the hypothetical child resident or fetus of the adult female worker.

For each exposure scenario (i.e., receptor and DU) with a potential ELCR/HI above USEPA target levels, Constituent of concern (COC) is defined as COPC that causes the cumulative ELCR to exceed 10^{-4} (1E-04) and/or the target organ endpoint HI to exceed 1, at one significant figure. Lead is identified as a COC if the target PbB of 10 µg/dL and probability of 5% for the receptor population was exceeded.

The potential risks are only estimates and are based on intentionally conservative exposure and toxicity assumptions. Exceedance of any particular risk level does not imply that adverse health effects have already occurred or will occur. The estimates are an indication that additional evaluation or action may be warranted.

5.2 Carcinogenic Risks

The potential ELCR, which is unitless, represents an estimation of an upper bound incremental lifetime probability that an individual may develop cancer as a result of exposure to a potential carcinogen. The potential ELCR is calculated for each constituent and exposure pathway (ingestion and dermal) by multiplying the estimated CDI by the CSF, as follows:

The potential ELCR is calculated for each constituent and exposure pathway (ingestion and dermal) by multiplying the estimated CDI or DAD by the CSF, as follows:

Equation 7:

$$\text{ELCR (unitless)} = \text{CDI (mg/kg-day)} \times \text{CSF (mg/kg-day)}^{-1}$$

Where:

ELCR = Excess lifetime cancer risk (unitless).
CDI = Chronic daily intake (mg/kg-day)
CSFo = Cancer slope factor, oral (ingestion) (mg/kg-day)$^{-1}$

Equation 8:

$$\text{ELCR (unitless)} = \text{DAD (mg/kg-day)} \times \text{CSFd (mg/kg-day)}^{-1}$$

Where:

ELCR = Excess lifetime cancer risk (unitless).
DAD = Dermally absorbed dose (mg/kg-day)
CSFd = Cancer slope factor, dermal (mg/kg-day)$^{-1}$

Potential constituent-specific risks for all constituents associated with a specific pathway are summed to assess exposure to multiple constituents. The pathway-specific risks for all pathways are then summed to determine the estimated total cumulative risk for the exposure scenario. The total cumulative risk estimate assumes that different carcinogens affect the same target organ to produce a cancer response, ignoring potential antagonistic or synergistic effects or disparate effects on different target organs.

Table 5-1 summarizes the ELCR and non-cancer HI results for each DU. **Attachment 4** provides the ELCR and non-cancer HI calculations in USEPA (2001) RAGS Part D Table format.

Table 5-1. Risk Results for the Human Health Risk Assessment

			Current Surface Soil	Future Total Soil	Current/Future Surface Soil		
Decision Unit	**Receptor**	**Attachment 4 Table Reference**	**Non-Cancer Hazard**	**Non-Cancer HI**	**ELCR**	**Non-Cancer Hazard**	**Non-cancer Hazard Driver**
Target Berm	Child Visitor	7-1, 7-9	0.4	0.5	NA	NA	
Target Berm	Adult Visitor	7-2, 7-10	0.04	0.05	NA	NA	
Target Berm	Teen Trespasser	7-3, 7-11	0.03	0.04	NA	NA	
Target Berm	Outdoor Worker	7-4, 7-12	0.05	0.07	NA	NA	
Target Berm	Utility Worker	7-5, 7-13	0.03	0.04	NA	NA	
Target Berm	Construction Worker	7-6, 7-14	0.1	0.1	NA	NA	
Target Berm	Child Resident	7-7, 7-15	**2**	**2**	NA	NA	antimony
Target Berm	Adult Resident	7-8, 7-16	0.2	0.2	NA	NA	
Soil Pile	Child Visitor	7-17, 7-25	0.6	**8**	NA	NA	antimony
Soil Pile	Adult Visitor	7-18, 7-26	0.06	0.8	NA	NA	
Soil Pile	Teen Trespasser	7-19, 7-27	0.05	0.6	NA	NA	
Soil Pile	Outdoor Worker	7-20, 7-28	0.09	1	NA	NA	
Soil Pile	Utility Worker	7-21, 7-29	0.05	0.6	NA	NA	
Soil Pile	Construction Worker	7-22, 7-30	0.2	**2**	NA	NA	antimony
Soil Pile	Child Resident	7-23, 7-31	**3**	**35**	NA	NA	antimony
Soil Pile	Adult Resident	7-24, 7-32	0.3	**4**	NA	NA	antimony
Firing Point	Child Visitor	7-33	NA	NA	1E-07	0.7	
Firing Point	Adult Visitor	7-34	NA	NA	4E-08	0.08	
Firing Point	Lifetime Visitor	7-35	NA	NA	1E-07	NA	
Firing Point	Teen Trespasser	7-36	NA	NA	2E-08	0.07	
Firing Point	Outdoor Worker	7-37	NA	NA	7E-08	0.1	
Firing Point	Utility Worker	7-38	NA	NA	1E-09	0.06	
Firing Point	Construction Worker	7-39	NA	NA	5E-09	0.2	
Firing Point	Child Resident	7-40	NA	NA	5E-07	**3**	nitroglycerin
Firing Point	Adult Resident	7-41	NA	NA	2E-07	0.4	
Firing Point	Lifetime Resident	7-42	NA	NA	7E-07	NA	
Background	Child Visitor	7-43	NA	NA	2E-09	0.02	
Background	Adult Visitor	7-44	NA	NA	8E-10	0.002	
Background	Lifetime Visitor	7-45	NA	NA	3E-09	NA	
Background	Teen Trespasser	7-46	NA	NA	4E-10	0.002	
Background	Outdoor Worker	7-47	NA	NA	2E-09	0.004	
Background	Utility Worker	7-48	NA	NA	3E-11	0.002	
Background	Construction Worker	7-49	NA	NA	1E-10	0.006	
Background	Child Resident	7-50	NA	NA	1E-08	0.1	
Background	Adult Resident	7-51	NA	NA	4E-09	0.01	
Background	Lifetime Resident	7-52	NA	NA	1E-08	NA	

			Current Surface Soil	Future Total Soil	Current/Future Surface Soil		
Decision Unit	Receptor	Attachment 4 Table Reference	Non-Cancer Hazard	Non-Cancer HI	ELCR	Non-Cancer Hazard	Non-cancer Hazard Driver
Target Berm	Child Visitor	7-1, 7-9	0.4	0.5	NA	NA	

Notes:
NA = not applicable
Red Bold Value indicates an exceedance of the target cumulative threshold.

The potential ELCR results are all below the target cumulative ELCR of 1×10^{-4} (1E-04) for carcinogenic risks. Exposure to nitroglycerin in soil is not likely to cause adverse health effects to human receptors at the MRS.

5.3 Noncarcinogenic Risks

To characterize potential noncarcinogenic effects, comparisons were made between projected intakes of substances over a specified time period and toxicity values, primarily RfDs and RfCs. The ratio of exposure to toxicity value is the hazard quotient (HQ). The HQ is calculated for each constituent and exposure pathway (ingestion and dermal) by dividing the CDI by the RfD as follows:

Equation 9:

Non-Cancer HQ (unitless) = CDI (mg/kg-day)/RfDo (mg/kg-day)

Where:

Non-Cancer HQ = Constituent-specific non-cancer hazard quotient (unitless).
CDI = chronic daily intake (mg/kg-day)
RfDo = Reference dose, oral (ingestion) (mg/kg-day)

Equation 10:

Non-Cancer HQ (unitless) = DAD (mg/kg-day)/RfDd (mg/kg-day)

Where:

Non-Cancer HQ = Constituent-specific non-cancer hazard quotient (unitless).
DAD = Dermally absorbed dose (mg/kg-day)
RfDd = Reference dose, dermal (mg/kg-day)

Estimated HQs for noncarcinogenic effects are generated on a constituent-by-constituent basis for each relevant pathway of exposure. The constituent-specific HQs are summed for all constituents associated with a specific pathway to determine the pathway-specific HI. The pathway-specific HIs are then summed to determine the total cumulative non-cancer HI for the exposure scenario.

The HQ is not a statistical probability of a noncarcinogenic effect occurring. If the exposure level is less than the appropriate toxicity value (i.e., the HQ is less than 1), adverse health effects are not likely, even with a lifetime of exposure. Given the uncertainty of factors used in deriving RfDs and RfCs, a HQ greater than 1 may not indicate a higher risk of adverse effect than a HQ of 1 or less. If the cumulative HI for an exposure scenario is greater than 1, the HI is segregated by critical effect and mechanism of action (USEPA 1989). HQs for constituents that affect the same target organ endpoint are summed to derive target organ-specific HIs.

The non-cancer hazard calculations are provided in **Attachment 4** in USEPA RAGS Part D Tables 7 and 9 format (USEPA 2001). **Table 5-1** summarizes the potential non-cancer hazard results for each DU. **Table 5-2** summarizes the non-cancer hazard drivers for the MRS.

Table 5-2. Non-Cancer Risk Drivers for Ridgway Training Range

Decision Unit	Receptor	Scenario Timeframe	Exposure Medium	Non-Cancer HI	Risk Driver
Target Berm	Hypothetical Child Resident	Current	Surface Soil	2	Antimony
		Future	Total Soil	2	Antimony
Soil Pile	Child Visitor	Future	Total Soil	8	Antimony
	Construction Worker	Future	Total Soil	8	Antimony
	Hypothetical Child Resident	Current	Surface Soil	3	Antimony
		Future	Total Soil	35	Antimony
	Hypothetical Adult Resident	Future	Total Soil	4	Antimony
Firing Point	Hypothetical Child Resident	Current/Future	Surface Soil	3	Nitroglycerin

The non-cancer HIs for the Target Berm DU and Soil Pile DU are attributed to incidental ingestion and dermal contact with nitrogen in soil. The landowner is currently using the property as a staging area for equipment associated with a private landscaping company. The hypothetical resident may not be considered a reasonable exposure scenario. The construction worker and child visitor at the Soil Pile DU have non-cancer HIs from exposure to total soil that are above the Act 2 and USEPA target HI threshold of 1. Discrete sample concentrations of antimony in the Soil Pile DU subsurface soil (24 to 36 inches bgs) range from 36.5 mg/kg to 1,080 mg/kg which are higher than the range of concentrations in the surface soil (0 to 24 inches bgs) at 2.24 mg/kg to 58.5 mg/kg (**Table 2-1**); subsurface soil concentrations are driving the risk at the Soil Pile DU. For the Firing Point DU, incidental ingestion of nitroglycerin in surface soil is driving the non-cancer hazard results for the hypothetical child resident. Again the current and future land use is commercial; the hypothetical child resident at the Firing Point DU may not be considered a reasonable exposure scenario.

Non-cancer HI results were also calculated for the Background Reference Area DU for comparison purposes; metals may be present in soil due to minerals (rocks) that break down and release metals into the soil. As shown in **Table 5-1**, the Background Reference Area DU results are an order of magnitude or more lower than the site-related DUs. Background ISM mean concentration comparison (**Table 2-2**) also indicates that metals present in soil at the Target Berm and Soil Pile DUs are likely site-related COPCs.

Antimony is identified as a total soil COC for the child visitor and construction worker scenarios at the Soil Pile DU. If the future land use change should change to residential, antimony is identified as a surface soil and total soil COC for the hypothetical resident at the Target Berm and Soil Pile DUs. If the future land use should change to residential, nitroglycerin is identified as a surface soil COC for the hypothetical child resident at the Firing Point DU.

5.4 Lead Modeling Results

The ALM modeling results are presented in **Tables 5-3 and 5-4** for the on-site outdoor worker and construction/utility worker scenarios, respectively. The ALM model results for the outdoor worker are considered protective of the adult site visitor scenario. **Table 5-5** presents the IEUBK modeling results for the hypothetical child resident; the IEUBK model results are considered protective and representative of the hypothetical child and adult resident scenarios.

For the on-site outdoor worker scenarios, the Target Berm and Soil Pile DU surface soil and total soil results exceed the 5% probability to limit the risk to no more than a 5% probability for a fetus PbB of a pregnant female worker PbB to exceed the target PbB level; As shown in **Table 5-3**, the fetal PbBs also exceed the target PbB thresholds of 5 µg/dL and 10 µg/dL.

For the construction/utility worker scenarios, the 5% probability threshold is exceeded for the Target Berm DU ISM surface soil and Soil Pile DU discrete total soil when a target PbB threshold of 10 µg/dL is assumed; the fetal PbBs also exceed the 10 µg/dL target PbB threshold. When a target PbB threshold of 5 µg/dL is assumed, the surface soil and total soil results for the Target Berm and Soil Pile DUs exceed the target thresholds (5% probability and fetal PbB concentrations).

For the hypothetical child resident, the IEUBK model results exceeded the 5% probability threshold in all cases when the target PbB threshold of 10 µg/dL was assumed. The IEUBK model was not run using the target PbB threshold of 5 µg/dL due to the high probability percentage results when the 10 ug/dL PbB threshold was used.

Assuming a 10 µg/dL PbB threshold, lead is identified as a surface soil and total soil COC for the outdoor worker at the Target Berm and Soil Pile DUs. Lead is also a surface soil COC at the Target Berm DU and a total soil COC for the Soil Pile DU for the construction/utility workers. However, if a 5 µg/dL PbB threshold is assumed for the construction/utility worker evaluation, lead becomes a surface soil and total soil COC for both DUs. The 2017 release of the ALM model lists 5 µg/dL as the model default target PbB level of concern (USEPA 2017a).

Table 5-3. Adult Lead Methodology Results for the On-Site Outdoor Worker Scenario

Decision Unit/Exposure Point	Lead Mean EPC mg/kg	On-Site Outdoor Worker Scenario, ALM Model Results					
		PbB_{adult} PbB of adult worker, geometric mean µg/dL	$PbB_{fetal, 0.95}$ 95th percentile PbB among fetuses of adult workers µg/dL	Probability % Target PbB Threshold, 10 µg/dL	Constituent of Concern? (Yes/No)	Probability % Target PbB Threshold, 5 µg/dL	5 µg/dL Constituent of Concern? (Yes/No)
Target Berm DU, Surface Soil, Discrete	5,347	6.9	**16**	**21%**	**Yes**	**65%**	**Yes**
Target Berm DU, Surface Soil, ISM	6,890	8.8	**21**	**34%**	**Yes**	**78%**	**Yes**
Target Berm DU, Total Soil, Discrete	4,957	6.5	**15**	**18%**	**Yes**	**60%**	**Yes**
Soil Pile DU, Surface Soil, Discrete	3,326	4.5	**11**	**6%**	**Yes**	**37%**	**Yes**
Soil Pile DU, Total Soil, Discrete	10,529	13	**31**	**61%**	**Yes**	**93%**	**Yes**
Background DU, Surface Soil, ISM	74.4	0.7	1.6	0.0001%	No	0.02%	No

Notes:
ALM = Adult Lead Methodology; DU = Decision Unit; EPC = exposure point concentration; ug/dL = micrograms per deciliter; mg/kg milligrams per kilogram; PbB = lead blood concentration

Red bold value = PbB concentration exceeds target PbB threshold

Yes = Probability percent (%) exceeds 5% at the target PbB threshold; No = probability percent (%) equals or is below 5% at the target PbB threshold.

Table 5-4. Adult Lead Methodology Results for the On-Site Construction/Utility Worker Scenario

Decision Unit/Exposure Point	**On-Site Construction/Utility Worker Scenario, ALM Model Results**						
	Lead Mean EPC mg/kg	**PbB_{adult} PbB of adult worker, geometric mean µg/dL**	**$PbB_{fetal, 0.95}$ 95th percentile PbB among fetuses of adult workers µg/dL**	**Probability % Target PbB Threshold, 10 µg/dL**	**10 µg/dL Constituent of Concern? (Yes/No)**	**Probability % Target PbB Threshold, 5 µg/dL**	**5 µg/dL Constituent of Concern? (Yes/No)**
Target Berm DU, Surface Soil, Discrete	5,347	4.3	10	5%	No	**33%**	**Yes**
Target Berm DU, Surface Soil, ISM	6,890	5	**12.6**	**11%**	**Yes**	**47%**	**Yes**
Target Berm DU, Total Soil, Discrete	4,957	4	9.5	4%	No	**29%**	**Yes**
Soil Pile DU, Surface Soil, Discrete	3,326	2.9	6.8	1%	No	**13%**	**Yes**
Soil Pile DU, Total Soil, Discrete	10,529	7.8	**18.5**	**28%**	**Yes**	**72%**	**Yes**
Background DU, Surface Soil, ISM	74.4	0.7	1.5	0.0001%	No	0.01%	No

Notes:

ALM = Adult Lead Methodology; DU = Decision Unit; EPC = exposure point concentration; ug/dL = micrograms per deciliter; mg/kg milligrams per kilogram; PbB = lead blood concentration

Red bold value = PbB concentration exceeds target PbB threshold.

Yes = Probability percent (%) exceeds 5% at the target PbB threshold; No = probability percent (%) equals or is below 5% at the target PbB threshold.

Table 5-5. Integrated Exposure Uptake Biokinetic (IEUBK) Model Results for the Hypothetical Child Resident

Decision Unit/Exposure Point	Lead Mean EPC (mg/kg)	Target PbB Threshold 10 µg/dL Probability %	Target PbB Threshold 5 µg/dL Probabilty %	Constituent of Concern (Yes/No)
Target Berm DU, Discrete SS	5,347	**98.50%**	No run	**Yes**
Target Berm DU, ISM SS	6,890	**99%**	No run	**Yes**
Target Berm DU, Discrete TS	4,957	**98%**	No run	**Yes**
Soil Pile DU, Discrete SS	3,326	**93%**	No run	**Yes**
Soil Pile DU, Discrete TS	10,529	**100%**	No run	**Yes**

Notes:

DU = decision unit; EPC = exposure point concentration; IEUBK = Integrated Exposure Uptake Biokinetic;

ug/dL = micrograms per deciliter; mg/kg = milligrams per kilogram; PbB = lead blood concentration;

Yes = Probability percent (%) exceeds 5% at the target PbB threshold;

No = probability percent (%) equals or is below 5% at the target PbB threshold.

6 Uncertainty Assessment

Uncertainties are inherent in every aspect of a quantitative risk assessment. Certain assumptions are made as part of the risk assessment process, and these assumptions may lead to an over- or underestimation of the actual risks associated with the Site. The assumptions made for this HHRA were conservative, so that an overestimation of the actual risks posed by MRS conditions is more likely.

This section provides information about the key assumptions, their inherent uncertainty and variability, and the impact of this uncertainty and variability on the estimates of potential risk.

6.1 Site Characterization Uncertainties

Source of Uncertainty: Unbiased ISM samples were collected for surface soil at the Target Berm and Background Reference Area DUs in a manner that is representative of exposure at the MRS. However biased discrete soil samples were collected at the Soil Pile and Firing Point DUs.

Effect on Risk/Hazard Estimates: Representative (ISM); Overestimate (Discrete).

Potential Magnitude: Low.

Rationale for Assumptions: Unbiased ISM samples tend to provide better data to derive representative EPCs for evaluating ELCR and/or non-cancer hazards because the data are a composite of randomly collected samples within an area and provide a representative concentration. The discrete samples were collected where contamination was suspected at the MRS and included step out sampling to better define the horizontal extent of contamination. Generally, the ISM results were more consistent but lower than the maximum discrete samples. To reduce the level of uncertainty with the data, the HHRA evaluated both ISM and discrete surface soil data. **Attachment 5** contains the discrete surface soil risk results to support the uncertainty evaluation; the results are summarized in **Table 6-1**.

Table 6-1. Surface Soil Risk Results Using Discrete EPCs

		Current Surface Soil	Future Total Soil	Current/Future Surface Soil	
Decision Unit	**Receptor**	**Non-Cancer Hazard**	**Non-Cancer Hazard**	**Cancer Risk**	**Non-Cancer Hazard**
Target Berm	Child Visitor	0.6	--	--	--
Target Berm	Adult Visitor	0.06	--	--	--
Target Berm	Teen Trespasser	0.05	--	--	--
Target Berm	Outdoor Worker	0.09	--	--	--
Target Berm	Utility Worker	0.05	--	--	--
Target Berm	Construction Worker	0.2	--	--	--
Target Berm	Child Resident	**3**	--	--	--
Target Berm	Adult Resident	0.3	--	--	--
Firing Point	Child Visitor	--	--	4.00E-09	0.03
Firing Point	Adult Visitor	--	--	2.00E-09	0.003

		Current Surface Soil	Future Total Soil	Current/Future Surface Soil	
Decision Unit	Receptor	Non-Cancer Hazard	Non-Cancer Hazard	Cancer Risk	Non-Cancer Hazard
Firing Point	Lifetime Visitor	--	--	6.00E-09	--
Firing Point	Teen Trespasser	--	--	7.00E-10	0.003
Firing Point	Outdoor Worker	--	--	3.00E-09	0.005
Firing Point	Utility Worker	--	--	6.00E-11	0.002
Firing Point	Construction Worker	--	--	2.00E-10	0.008
Firing Point	Child Resident	--	--	2.00E-08	0.1
Firing Point	Adult Resident	--	--	7.00E-09	0.01
Firing Point	Lifetime Resident	--	--	3.00E-08	--

The ISM surface soil results in **Table 5-1** also identified antimony as a COC for the hypothetical child resident at the Target Berm DU (i.e., non-cancer HI exceeded 1). The discrete surface soil results did not identify nitroglycerin as a COC for the child resident at the Firing Point DU. Maximum detected concentration of 21 mg/kg from the ISM replicates was used to estimate surface soil exposure; range of surface soil detections differ for the discrete (0.002 mg/kg to 1.3 mg/kg) and ISM (3.7 mg/kg to 21 mg/kg) data sets. It is unknown if the non-cancer hazards are under- or overestimated.

Source of Uncertainty: If the analytical methods used do not apply to some constituents that are present at the site, risk could be underestimated.

Effect on Risk/Hazard Estimates: Underestimate.

Potential Magnitude: Low.

Rationale for Assumptions: The RI field investigation was designed to address potential MC exposure from historical site-related DoD activities at the MRS. Laboratory analytical methods were specifically selected to evaluate the soil and sediment media for small arms MC constituents. The level of uncertainty is reduced due to the selected methods and quality assurance/quality control procedures that were used to assess the precision and accuracy of analytical data (AECOM 2018).

Source of Uncertainty: The range has been used with homemade munitions, distinct from historic use, which were fired into a trap. However, this use has stopped and will not occur again until this project concludes. Also, to improve drainage at the MRS, the landowner installed a French drain parallel to the berm, and in doing so moved soil from the Target Berm to a pile near the north side wall.

Effect on Risk/Hazard Estimates: Under- or Overestimate.

Potential Magnitude: Unknown.

Rationale for Assumptions: It is unknown how much contamination is attributed to DoD activities or to private use of the range by the current landowner. The French drain installation has potentially impacted the distribution of MC (e.g., soil pile) at the site. The land owner has ceased using the range for the duration of the investigation. It is unknown how these activities have affected of level and distribution of contamination; However, RI field activities have characterized the horizontal and vertical extent of contamination, thus reducing the level of uncertainty.

Source of Uncertainty: Handling of duplicate data in the HHRA data set.

Effect on Risk Hazard Estimates: Representative

Magnitude: Low

Rationale: Primary and duplicate samples were compared for representativeness prior to use in the HHRA. This resulted in some primary/duplicate pairs being averaged or kept independent. The RPD evaluation (**Section 2.4 and Table A1-4 in Attachment 1**) strengthened the EPC calculations for the HHRA; the level of uncertainty associated with the quality of the data used to derive EPCs was reduced.

Source of Uncertainty: Maximum detected concentrations and generic screening levels were used to identify COPCs for the Ridgway training range.

Effect on Risk/Hazard Estimates: Overestimate.

Potential Magnitude: Moderate.

Rationale for Assumptions: PADEP (2002) and USEPA (1989, 2017a) guidance recommends using conservative generic screening levels and maximum detected concentrations for COPC screening. Although the MRS is likely to remain commercial into the future, residential screening levels were used to identify COPCs to be protective of the private, and potentially public use, of the property. Also, the limits of detection were selected to be protective of risk-based screening levels where possible; the laboratory was better able to detect potential concentrations of constituents that may be COPCs at the site.

6.2 Exposure Assessment Uncertainties

Source of Uncertainty: USEPA (1989) recommends using the lower of the 95% UCL of the mean concentration and the maximum detected concentration as the EPC. For the ISM surface soil, maximum detected concentrations were used as the EPCs because they were lower than the calculated UCLs. Also, maximum detected concentrations were used for the Soil Pile DU surface soil risk calculations. The mean concentration was used as the EPC for lead.

Effect on Risk/Hazard Estimates: Overestimate.

Potential Magnitude: Low.

Rationale for Assumptions: Surface soil risk calculations were conducted for the Target Berm DU ISM (maximum detections used for EPCs) and discrete (UCLs used for EPCs) data; the risk conclusions were similar for both data sets. Therefore the level of uncertainty is reduced for the Target Berm DU risk results. ISM data were not collected at the Soil Pile DU. It is unknown if the surface soil results at the Soil Pile DU are overestimated from using biased discrete maximum detected concentrations as the EPCs. **Table 2-1** indicates that the subsurface soil (24 to 36 inches bgs) concentrations for antimony and copper at the Soil Pile DU are higher than the surface soil (0 to 12 inches bgs) concentrations. The total soil risk calculations were derived using UCLs and so the total soil evaluation is likely to be more representative, assuming the Soil Pile DU is disturbed in the future.

Source of Uncertainty: Modeled concentrations were used to estimate concentrations in outdoor air and PbBs. Generally, a higher level of uncertainty is associated with the modeled concentrations rather than the use of measured concentrations.

Effect on Risk/Hazard Estimates: Under- or overestimate.

Potential Magnitude: Low.

Rationale for Assumptions: Conservative model assumptions were used to estimate outdoor air concentrations using site-specific PEFs and PbBs using the ALM and IEUBK lead models. Conservative modeling parameters tend to reduce the likelihood of underestimating the ELCR/non-cancer hazard results as well as receptor PbBs. The risk drivers identified in **Table 5-1 and 6-1** are attributed to the incidental ingestion and dermal contact with soil exposure pathways; inhalation toxicity values were not available for the soil COPCs, so the inhalation of soil particulates in outdoor air exposure pathway was incomplete. Lead was identified as a soil COC for the outdoor worker, construction/utility worker and the hypothetical resident. However, the hypothetical resident is not a likely scenario; future land use is likely to remain commercial.

Source of Uncertainty: Conservative exposure parameters were used to estimate exposure to the potential human receptors at the MRS.

Effect on Risk/Hazard Estimates: Overestimate.

Potential Magnitude: Moderate.

Rationale for Assumptions: Conservative PADEP (2002) and USEPA (2014 and 2015) default exposure parameters were used to estimate exposure to human receptors at the MRS. The site is used as a staging area for landscaping equipment.

6.3 Toxicity Assessment Uncertainties

Source of Uncertainty: USEPA cancer slope factors are considered to be plausible upper bounds of risk at a 95% confidence limit. Therefore, there is a 95% probability that the true cancer risks do not exceed these levels, and that the estimated cancer risks are likely to be much lower (USEPA 2018b).

Effect on Risk/Hazard Estimates: Overestimate.

Potential Magnitude: Moderate.

Rationale for Assumptions: Cancer guidelines state that the use of linearized multistage models and upper bound risk estimates are appropriate, but the lower limit of risk may be as low as zero (USEPA 2018c).

Source of Uncertainty: Reference doses are frequently derived from animal studies that have little quantitative bearing on potential adverse health effects in humans.

Effect on Risk/Hazard Estimates: Overestimate.

Potential Magnitude: Moderate.

Rationale for Assumptions: Since the fate and mechanism of action of a constituent may differ in animals and humans, the effects observed in animals may not be observed in humans, resulting in an overestimation of potential adverse health effects.

Source of Uncertainty: Provisional toxicity data (e.g., PPRTV and HEAST toxicity values) were used to estimate cancer risk and/or non-cancer hazards for copper and nitroglycerin.

Effect on Risk/Hazard Estimates: Under- or overestimate.

Potential Magnitude: Unknown.

Rationale for Assumptions: Provisional toxicity values are still undergoing intensive scientific review and have not been verified by IRIS (USEPA 2018c). It is unknown if the ELCR and/or non-cancer hazards are under- or overestimated. Copper was not identified as a COC, but nitroglycerin was identified as a non-cancer COC for the hypothetical child resident at the Firing Point DU.

Source of Uncertainty: Chronic toxicity data were used to calculate non-cancer hazards for the construction worker scenario, which is a subchronic exposure scenario (3 months of exposure).

Effect on Risk/Hazard Estimates: Overestimate.

Potential Magnitude: Low.

Rationale for Assumptions: The non-cancer hazard results are likely overestimated. However, chronic toxicity data were used for construction worker and utility worker evaluations per direction from PADEP (PADEP 2018b).

6.4 Risk Characterization Uncertainties

Source of Uncertainty: Risk characterization uncertainties include possible synergistic or antagonistic effects of exposure to multiple constituents and applicability of cancer risk estimation methodology to less than lifetime exposure durations.

Effect on Risk/Hazard Estimates: Under- or overestimate.

Potential Magnitude: Low.

Rationale for Assumptions: These uncertainties are generic to the risk assessment process and not specific to the Ridgway training range.

7 Conclusions and Recommendations

The HHRA has fulfilled the objective discussed in Section 1.0, which was to evaluate whether COPCs attributable to past site activities have the potential to cause adverse health effects to human receptors within the area under investigation. Results of the HHRA may be used to develop risk management options for each DU, including possible further actions to address impacted soils sediment where needed. The results are summarized below.

- Risk-based screening results identified antimony, copper, lead, and nitroglycerin as soil COPCs. Zinc was eliminated from further evaluation. ISM surface soil comparison of the Target Berm and Firing Point DU ISM data with the Background Reference Area DU surface soil ISM data indicated that surface soil COPCs are likely site-related. Sediment at the Target Berm and French Drain Outfall DUs was eliminated from further evaluation (i.e., no COPCs).
- Potential off-site receptors were not identified for the MRS because site access is restricted via a locked gate; constituents are not likely to affect groundwater due to its depth (30 feet bgs); and no COPCs were identified in sediment from the French Drain and Target Berm drainage areas that flow off-site.
- Cancer risk and non-cancer hazard calculations were conducted for the soil exposure medium. USEPAALM and IEUBK models were used to evaluate lead in soil. Soil exposure was evaluated for the following on-site receptors: outdoor worker, teen trespasser, child and adult visitor, child and adult hypothetical resident, construction worker, and utility worker.

Table 7-1 identifies the HHRA soil COCs.

Table 7-1. Human Health Risk Assessment Soil COCs

Receptor	Exposure Medium	Constituent of Concern
Target Berm DU		
Child Visitor	Surface Soil	Lead (a, b)
	Total Soil	Lead (a, b)
Outdoor Worker	Surface Soil	Lead (b)
	Total Soil	Lead (b)
Construction/Utility Worker	Surface Soil	Lead (b, c)
Hypothetical Child Resident	Surface Soil	Antimony Lead (b)
	Total Soil	Antimony Lead (b)
Soil Pile DU		
Child Visitor	Surface Soil	Lead (a, b)
	Total Soil	Antimony Lead (a, b)
Construction Worker (c)	Total Soil	Antimony Lead (b, c)
Utility Worker (c)	Total Soil	Lead (b, c)
Outdoor Worker	Surface Soil	Lead (b)

Receptor	Exposure Medium	Constituent of Concern
	Total Soil	Lead [(b)]
Hypothetical Child Resident	Surface Soil	Antimony Lead [(b)]
	Total Soil	Antimony Lead [(b)]
Hypothetical Adult Resident	Total Soil	Antimony
Firing Point DU		
Hypothetical Child Resident	Surface Soil	Nitroglycerin

Notes:

(a) IEUBK model results for the hypothetical child resident were used to be protective of the child visitor and hypothetical adult resident (lifetime exposure) at the MRS.

(b) Lead modeling results are based on target PbB threshold of 10 µg/dL.

(c) If a target PbB threshold of 5 µg/dL was used, then lead would be identified as a surface soil and total soil COC for the construction and utility worker scenarios.

The HHRA recommends further evaluation of the soil COCs in a Feasibility Study for the Ridgway Training Range MRS.

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Attachment 1

Sample Data Used in the HHRA

Table A1-1. Summary of Samples Used in the Human Health Risk Assessment

Sample Identification	Sample Collection Date	Sample Depth (inches bgs)	Media Type	Analytical Parameters		Comments
				Total Metals[1]	Explosives[2]	
INCREMENTAL SAMPLES						
Target Berm DU						
RTR01IS01	7/11/2018	0 - 6	Soil	X		Primary, used also for MS/MSD
RTR01IS02	7/11/2018	0 - 6	Soil	X		Duplicate
RTR01IS03	7/11/2018	0 - 6	Soil	X		Triplicate
Firing Point DU						
RTR03IS01	7/12/2018	0 - 6	Soil		X	Primary
RTR03IS02	7/12/2018	0 - 6	Soil		X	Duplicate, used also for MS/MSD
RTR03IS03	7/12/2018	0 - 6	Soil		X	Triplicate
Background Reference DU						
RTR04IS01	7/12/2018	0 - 6	Soil	X	X	Primary, used also for MS/MSD
RTR04IS02	7/12/2018	0 - 6	Soil	X	X	Duplicate
RTR04IS03	7/12/2018	0 - 6	Soil	X	X	Triplicate
DISCRETE SAMPLES						
Target Berm DU						
RTR01DA01A	7/12/2018	12 - 18	Soil	X		Collected at XRF sample RTR01X80 location
RTR01DA01B	7/12/2018	12 - 18	Soil	X		Field Duplicate of RTR01DA01A
RTR01DB01A	7/12/2018	24 - 30	Soil	X		Collected at XRF sample RTR01X80 location
RTR01DC02A	7/12/2018	0 - 6	Soil			Collected at XRF sample RTR01X06 location
RTR01DA03A	7/12/2018	12 - 18	Soil	X		Collected at XRF sample RTR01X22 location, MS/MSD
RTR01DB03A	7/12/2018	24 - 30	Soil	X		Collected at XRF sample RTR01X22 location
RTR01DA04A	7/12/2018	12 - 18	Soil	X		Collected at XRF sample RTR01X91 location
RTR01DB04A	7/12/2018	24 - 30	Soil	X		Collected at XRF sample RTR01X91 location
RTR01DA05A	7/12/2018	12 - 18	Soil	X		Collected at XRF sample RTR01X45 location
RTR01DS01A	7/12/2018	0 - 6	Soil	X		Collected from beneath gravel east of XRF sample RTR01X12 location
RTR01DS02A	7/12/2018	0 - 6	Soil	X		Collected from beneath gravel east of XRF sample RTR01X24 location
RTR01DD01A	7/12/2018	0 - 6	Sediment	X		Collected from drainage ditch south of XRF sample RTR01X125 location. Eliminated during HHRA risk-based screening.
RTR01DD02A	7/12/2018	0 - 6	Sediment	X		Collected from drainage ditch south of MRS, equidistant between the Firing Point and Target Berm. Eliminated during HHRA risk-based screening.
Soil Pile DU						
RTR02DS01A	7/9/2018	0 - 12*	Soil	X		Collected from the western half of the Soil Pile
RTR02DS01B	7/9/2018	0 - 12*	Soil	X		Field Duplicate of RTR02DS01A
RTR02DS02A	7/9/2018	0 - 12*	Soil	X		Collected from the western half of the Soil Pile
RTR02DS03A	7/9/2018	0 - 12*	Soil	X		Collected from the western half of the Soil Pile
RTR02DS04A	7/9/2018	0 - 12*	Soil	X		Collected from the eastern half of the Soil Pile
RTR02DS05A	7/9/2018	0 - 12*	Soil	X		Collected from the eastern half of the Soil Pile
RTR02DS06A	7/9/2018	0 - 12*	Soil	X		Collected from the eastern half of the Soil Pile
RTR02DS07A	7/9/2018	24 - 36*	Soil	X		Collected from the western half of the Soil Pile
RTR02DS08A	7/9/2018	24 - 36*	Soil	X		Collected from the western half of the Soil Pile
RTR02DS09A	7/9/2018	24 - 36*	Soil	X		Collected from the western half of the Soil Pile
RTR02DS10A	7/9/2018	24 - 36*	Soil	X		Collected from the eastern half of the Soil Pile
RTR02DS11A	7/9/2018	24 - 36*	Soil	X		Collected from the eastern half of the Soil Pile
RTR02DS12A	7/9/2018	24 - 36*	Soil	X		Collected from the eastern half of the Soil Pile
Firing Point DU						
RTR03DS01A	7/9/2018	0 - 6	Soil		X	Collected east of the Firing Point, one quarter of the distance north bewteen the concret pad and the northern MRS wall
RTR03DS01B	7/9/2018	0 - 6	Soil		X	Field Duplicate of RTR03DS01A
RTR03DS02A	7/9/2018	0 - 6	Soil		X	Collected east of the Firing Point, one half of the distance north bewteen the concret pad and the northern MRS wall
RTR03DS03A	7/9/2018	0 - 6	Soil		X	Collected east of the Firing Point, three quarters of the distance north bewteen the concret pad and the northern MRS wall
RTR03DA01A	7/12/2018	12 - 18	Soil		X	Collected from the covered Firing Point, adjacent to the southern concrete pad, MS/MSD
RTR03DA02A	7/12/2018	12 - 18	Soil		X	Collected from the covered Firing Point, equidistant between the southern concrete pad and northern MRS wall
RTR03DA03A	7/12/2018	12 - 18	Soil		X	Collected from the covered Firing Point, adjacent to the northern MRS wall
RTR03DA03B	7/12/2018	12 - 18	Soil		X	Field Duplicate of RTR03DA03A

Table A1-1. Summary of Samples Used in the Human Health Risk Assessment

Sample Identification	Sample Collection Date	Sample Depth (inches bgs)	Media Type	Analytical Parameters		Comments
				Total Metals[1]	Explosives[2]	
RTR03DC01A	7/12/2018	0 - 6	Soil			Collected from the covered Firing Point, adjacent to the southern concrete pad, MS/MSD
French Drain DU: ***NOTE: Sediment was eliminated during HHRA risk-based screening.***						
RTR05DD01A	7/12/2018	0 - 6	Sediment	X		Collected from the southwestern corner of the ponded area , MS/MSD
RTR05DD01B	7/12/2018	0 - 6	Sediment	X		Field Duplicate of RTR05DD01A
RTR05DD02A	7/12/2018	0 - 6	Sediment	X		Collected from the southern half of the ponded area
RTR05DD03A	7/12/2018	0 - 6	Sediment	X		Collected from the southern half of the ponded area
RTR05DD04A	7/12/2018	0 - 6	Sediment	X		Collected from the southeastern corner of the ponded area
RTR05DD05A	7/12/2018	0 - 6	Sediment	X		Collected from the northwestern corner of the ponded area
RTR05DD06A	7/12/2018	0 - 6	Sediment	X		Collected from the northern half of the ponded area
RTR05DD07A	7/12/2018	0 - 6	Sediment	X		Collected from the northern half of the ponded area
RTR05DD08A	7/12/2018	0 - 6	Sediment	X		Collected from the northeastern corner of the ponded area
RTR05DD09A	7/12/2018	0 - 6	Sediment	X		Collected 10 feet east of the ponded area
RTR05DD10A	7/12/2018	0 - 6	Sediment	X		Collected 10 feet west of the ponded area

Notes:

🟨 = Indicates samples used for subsurface soil and total total soil evaluation.

[1] - Antimony, Copper, Lead, & Zinc, by USEPA SW-846 Method 6020A

[2] - Nitroglycerin by USEPA SW-846 Method 8330B

bgs = below ground surface; DU = Decision Unit; HHRA = human health risk assessment.

MS/MSD = matrix spike/matrix spike duplicate

TCLP = Toxicity Characteristic Leaching Procedure

USEPA = United States Environmental Protection Agency

XRF = X-Ray Fluorescence

* - Soil Pile samples collected from below the soil pile surface, not the ground surface

Table A1-2. Incremental Sampling Results Summary

Location:	Background Reference											
Sample ID:	RTR04IS01				RTR04IS02				RTR04IS03			
Sample Depth (inches bgs):	0-6				0-6				0-6			
Date Collected:	7/12/2018				7/12/2018				7/12/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals	**Total Metals by USEPA SW-846 Method 6020A (mg/kg)**											
Antimony	0.244	N	J-	m	0.682		J-	m	0.626		J-	m
Copper	12		J	s	12.7		J	s	10.5		J	s
Lead	59.2	NA			81.8				82.3			
Zinc	33.2		J	m	33.5		J	m	23		J	m
	Explosives by USEPA SW-846 Method 8330B (mg/kg)											
Nitroglycerin	0.460	ULMM	UJ	l	0.44	UL	UJ	l	0.38	U	UJ	s

Location:	Target Berm											
Sample ID:	RTR01IS01				RTR01IS02				RTR01IS03			
Sample Depth (inches bgs):	0-6				0-6				0-6			
Date Collected:	7/11/2018				7/11/2018				7/11/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)												
Antimony	24.80	NA	J-	m	27		J-	m	40.1		J-	m
Copper	636	N*EA	J	s	481		J	s	612		J	s
Lead	5720	NA			6180				8770			
Zinc	158	NEA	J	m	149		J	m	165		J	m

Location:	Firing Point											
Sample ID:	RTR03IS01				RTR03IS02				RTR03IS03			
Sample Depth (inches bgs):	0-6				0-6				0-6			
Date Collected:	7/12/2018				7/12/2018				7/12/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Explosives by USEPA SW-846 Method 8330B (mg/kg)												
Nitroglycerin	3.70	L	J	l	4.4	LMM	J	l	21	L	J	l

Notes:

bgs = below ground surface
LQ = Laboratory qualifier
VQ = Validiation qualifier
RC = Reason Code
U = non-detect
J = estimated
J- = estimated, negative bias
UJ= non-detect, estimated detection limit
l = LCS recovery failure
m = MS/MSD percent recovery anomaly
s = surrogate failure

Table A1-3. Discrete Soil and Sediment Results

Sample ID:	RTR01DA01A				RTR01DA01B *				RTR01DC02A				RTR01DA03A				RTR01DB03A				RTR01DA04A				RTR01DB04A			
Decision Unit - XRF Location:	Target Berm - #80				Target Berm - #80				Target Berm - #6				Target Berm - #22				Target Berm - #22				Target Berm - #91				Target Berm - #91			
Media:	Soil				Soil				Soil				Soil				Soil				Soil				Soil			
Sample Depth (inches bgs):	12 - 18				12 - 18				0 - 6				12 - 18				24 - 30				12 - 18				24 - 30			
Date Collected:	7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																												
Antimony	0.336				0.366				--				89.5	N*A			34.8				64.8				5.47			
Copper	17.3	B			16.5	B			--				1830	N*B			961	B			298	B			65.1	B		
Lead	55.8	B	J	f	110	B	J	f	--				17500	N*BA			6360	B			10600	B			824	B		
Zinc	81.2				63.4				--				292	N*A			189				117				107			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																												
Nitroglycerin	--				--				--				--				--				--				--			

Notes:

* = Field duplicate
bgs = below ground surface
LQ = laboratory qualifier
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table A1-3. Discrete Soil and Sediment Results

Sample ID:	RTR01DA05A				RTR01DS01A				RTR01DS02A				RTR01DD01A				RTR01DD02A				RTR02DS01A				RTR02DS01B			
Decision Unit - XRF Location:	Target Berm - #45				Target Berm - NA				Target Berm - NA				Target Berm - NA				Target Berm - NA				Soil Pile - NA				Soil Pile - NA			
Media:	Soil				Soil				Soil				Sediment				Sediment				Soil				Soil			
Sample Depth (inches bgs):	12 - 18				0-6				0-6				0-6				0-6				0 - 12				0 - 12			
Date Collected:	7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/9/2018				7/9/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-8																												
Antimony	0.195				46.2				4.14				0.966				0.18				51.2	N*	J	d	4.93		J	d
Copper	20.8	B			600				57				79.7				15.3	B			828	NA	J	f	145		J	f
Lead	41.2	B			7990				1130				242				15.8	B			6940	N*A	J	d	999		J	d
Zinc	62.2				159				93.2				74.9				62.4				266	N	J	f	106		J	f
Explosives by USEPA SW-84																												
Nitroglycerin	--				--				--				--				--				--				--			

Notes:

* = Field duplicate
bgs = below ground surface
LQ = laboratory qualifier
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table A1-3. Discrete Soil and Sediment Results

Sample ID:	RTR02DS02A				RTR02DS03A				RTR02DS04A				RTR02DS05A				RTR02DS06A				RTR02DS07A				RTR02DS08A			
Decision Unit - XRF Location:	Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA			
Media:	Soil				Soil				Soil				Soil				Soil				Soil				Soil			
Sample Depth (inches bgs):	0 - 12				0 - 12				0 - 12				0 - 12				0 - 12				24 - 36				24 - 36			
Date Collected:	7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-8																												
Antimony	58.5		J	d	15.2		J	d	10.2		J	d	2.24		J	d	7.74		J	d	40.4		J	d	97.5		J	d
Copper	1740				278				202				76.6				149				733				929			
Lead	8980		J	d	2460		J	d	1660		J	d	672		J	d	1570		J	d	6340		J	d	14100		J	d
Zinc	314				122				112				211				134				209				214			
Explosives by USEPA SW-84																												
Nitroglycerin	--				--				--				--				--				--				--			

Notes:

* =	Field duplicate
bgs =	below ground surface
LQ =	laboratory qualifier
VQ =	validiation qualifier
RC =	reason code
NA =	not applicable
B =	associated blank detection
U =	non-detect
J =	estimated
J- =	estimated, negative bias
d =	MS/MSD imprecision
f =	field duplicate imprecision
m =	MS/MSD percent recovery anomaly
s =	surrogate failure
z =	preparation/method blank anomaly

Table A1-3. Discrete Soil and Sediment Results

Sample ID:	RTR02DS09A				RTR02DS10A				RTR02DS11A				RTR02DS12A				RTR03DS01A				RTR03DS01B				RTR03DS02A			
Decision Unit - XRF Location:	Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Firing Point - NA				Firing Point - NA				Firing Point - NA			
Media:	Soil				Soil				Soil				Soil				Soil				Soil				Soil			
Sample Depth (inches bgs):	24 - 36				24 - 36				24 - 36				24 - 36				0 - 6				0-6				0-6			
Date Collected:	7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-8																												
Antimony	41.2		J	d	226		J	d	1080		J	d	36.5		J	d	--				--				--			
Copper	977				2060				675				947				--				--				--			
Lead	6040		J	d	25000		J	d	57200		J	d	4920		J	d	--				--				--			
Zinc	220				443				165				213				--				--				--			
Explosives by USEPA SW-84																												
Nitroglycerin	--				--				--				--				0.31	J	J+	s	0.26	J	J+	s	0.55	U		

Notes:

* = Field duplicate
bgs = below ground surface
LQ = laboratory qualifier
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table A1-3. Discrete Soil and Sediment Results

Sample ID:	RTR03DS03A				RTR03DA01A				RTR03DA02A				RTR03DA03A				RTR03DA03B*				RTR03DC01A				RTR05DD01A			
Decision Unit - XRF Location:	Firing Point - NA				Firing Point - NA				Firing Point - NA				Firing Point - NA				Firing Point - NA				Firing Point - NA				French Drain - NA			
Media:	Soil				Soil				Soil				Soil				Soil				Soil				Sediment			
Sample Depth (inches bgs):	0-6				12 - 18				12 - 18				12 - 18				12 - 18				0-6				0-6			
Date Collected:	7/9/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-8																												
Antimony	--				--				--				--				--				--				0.253	N		
Copper	--				--				--				--				--				--				17.4	NB		
Lead	--				--				--				--				--				--				106	NBA	J	f
Zinc	--				--				--				--				--				--				48.4			
Explosives by USEPA SW-84																												
Nitroglycerin	0.6	U			0.66	JM	J+	m	1.2				0.32	J			1.3		J+	s	0.002	U			--			

Notes:

* = Field duplicate
bgs = below ground surface
LQ = laboratory qualifier
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table A1-3. Discrete Soil and Sediment Results

Sample ID:	RTR05DD01B				RTR05DD02A				RTR05DD03A				RTR05DD04A				RTR05DD05A				RTR05DD06A				RTR05DD07A			
Decision Unit - XRF Location:	French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA			
Media:	Sediment				Sediment				Sediment				Sediment				Sediment				Sediment				Sediment			
Sample Depth (inches bgs):	0-6				0-6				0-6				0-6				0-6				0-6				0-6			
Date Collected:	7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018			
Analyte	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC
Total Metals by USEPA SW-8																												
Antimony	0.362				0.29				0.2				0.264				0.638				0.152				0.092	J		
Copper	25.2	B			38.7	B			20.7	B			13.2	B			29.6	B			12.2	B			6.63	B		
Lead	179	B	J	f	358	B			81.8	B			37.3	B			189	B			58	B			17.6	B		
Zinc	56.6				58.2				51				58.8				42.4				34.7				37.7			
Explosives by USEPA SW-84																												
Nitroglycerin	--				--				--				--				--				--				--			

Notes:

* =	Field duplicate
bgs =	below ground surface
LQ =	laboratory qualifier
VQ =	validiation qualifier
RC =	reason code
NA =	not applicable
B =	associated blank detection
U =	non-detect
J =	estimated
J- =	estimated, negative bias
d =	MS/MSD imprecision
f =	field duplicate imprecision
m =	MS/MSD percent recovery anomaly
s =	surrogate failure
z =	preparation/method blank anomaly

Table A1-3. Discrete Soil and Sediment Results

Sample ID:	RTR05DD08A				RTR05DD09A				RTR05DD10A			
Decision Unit - XRF Location:	French Drain - NA				French Drain - NA				French Drain - NA			
Media:	Sediment				Sediment				Sediment			
Sample Depth (inches bgs):	0-6				0-6				0-6			
Date Collected:	7/12/2018				7/12/2018				7/12/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-8												
Antimony	0.438				0.36				0.236			
Copper	30.3	B			31.5	B			20.6	B		
Lead	120	B			124	B			67.3	B		
Zinc	58.1				53.2				71.1			
Explosives by USEPA SW-84												
Nitroglycerin	--				--				--			

Notes:

* = Field duplicate
bgs = below ground surface
LQ = laboratory qualifier
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table A1-4. Relative Percent Difference Calculations for Parent/Duplicate Samples

$$\text{RPD (\%)} = \text{abs}\left(\frac{\text{primary - duplicate}}{\text{mean (primary, duplicate)}}\right)\times 100$$

Constituent	Result (mg/kg)		Mean (mg/kg)	RPD (%)	Representative?	Mean (mg/kg)
	Primary	Duplicate				
Target Berm DU (RTR01DA01A/B), 12-18 inches, bgs						
Antimony	0.336	0.366	0.351	9%	Yes	0.351
Copper	17.3	16.5	16.9	5%	Yes	16.9
Lead	56	110	82.9	65%	No	Retain Both
Zinc	81.2	63.4	72.3	25%	Yes	72.3
Soil Pile DU (RTR02DS01A/B), 0-12 inches, bgs						
Antimony	51.2	4.93	28.1	165%	No	Retain Both
Copper	828	145	487	140%	No	Retain Both
Lead	6,940	999	3970	150%	No	Retain Both
Zinc	266	106	186	86%	No	Retain Both
Firing Point DU (RTR03DA01A/B), 0-6 inches, bgs						
Nitroglycerin	0.31	0.26	0.285	18%	Yes	0.285
Firing Point DU (RTR03DA03A/B), 12-18 inches, bgs						
Nitroglycerin	0.32	1.3	0.810	121%	No	Retain Both
French Drain DU (RTR05DD01A/B), 0-6 inches, bgs						
Antimony	0.253	0.362	0.308	35%	Yes	0.308
Copper	17.4	25.2	21.3	37%	Yes	21.3
Lead	106	179	143	51%	No	Retain Both
Zinc	48.4	56.6	52.5	16%	Yes	52.5

Notes:

bgs = below ground surface; DU = Decision Unit; mg/kg = milligrams per kilogram; RPD = relative percent difference
A relative percent difference (RPD) that is less than 50% is indicative of a representative sample for a solid matrix.

Attachment 2

Exposure Assessment Equations and Exposure Point Concentrations

Table A2-1
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Current/Future On-Site Resident (Child/Adult), Ingestion and Dermal Contact with Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	On-Site Resident	Child	Surface Soil	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**Non-Mutagenic Constituents**
			(Current)	IR-SO	Ingestion Rate of Soil	200		mg/day	USEPA, 2011	Chronic Daily Intake (CDI) (mg/kg-day) =
				EF-SO	Exposure Frequency, Soil	350		days/year	USEPA, 1991	CS x IR-SO x RBA x EF-SO x ED x CF3 x
			Total Soil	ED	Exposure Duration	6		years	Act 2	1/BW x 1/AT
			(Future)	ED_{0-2}	Exposure Duration. 0-2 years	2		years	USEPA, 2005a	
				$ADAF_{0-2}$	Age depend. adjust. factor, 0-2 years	10		unitless	USEPA, 2005a	**Mutagenic Constituents**
				ED_{2-6}	Exposure Duration, 2-6 years	4		years	USEPA, 2005a	Chronic Daily Intake (CDI) (mg/kg-day) =
				$ADAF_{2-6}$	Age depend. adjust. factor, 2-6 years	3		unitless	USEPA, 2005a	CS x IR-SO x RBA x EF-SO x CF3 x
				CF3	Conversion Factor 3	0.000001		kg/mg	--	$[(ED_{0-2} \times ADAF_{0-2}) + (ED_{2-6} \times ADAF_{2-6})]$
				RBA	Relative Bioavailability Factor	1, 0.6	(a)	unitless	USEPA, 2007	x 1/BW x 1/AT
				BW	Body Weight	15		kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	CDI (Lifetime) (mg/kg-day) = (CDI [child] + CDI [adult])
				AT-N	Averaging Time (Non-Cancer)	2190		days	ED x 365 days/year	
		Adult	Surface Soil	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**Non-Mutagenic Constituents**
			(Current)	IR-SO	Ingestion Rate of Soil	100		mg/day	USEPA, 1991	Chronic Daily Intake (CDI) (mg/kg-day) =
				EF-SO	Exposure Frequency, Soil	350		days/year	USEPA, 1991	CS x IR-SO x RBA x EF-SO x ED x CF3 x
			Total Soil	ED	Exposure Duration	20		years	USEPA, 2014, 2015	1/BW x 1/AT
			(Future)	ED_{6-16}	Exposure Duration, 6-16 years	10		years	USEPA, 2005a	
				$ADAF_{6-16}$	Age depend. adjust. factor, 6-16 years	3		unitless	USEPA, 2005a	**Mutagenic Constituents**
				ED_{16-26}	Exposure Duration, 16-26 years	10		years	USEPA, 2005a	Chronic Daily Intake (CDI) (mg/kg-day) =
				$ADAF_{16-26}$	Age depend. adjust. factor, 16-26 years	1		unitless	USEPA, 2005a	CS x IR-SO x RBA x EF-SO x CF3 x
				CF3	Conversion Factor 3	0.000001		kg/mg	--	$[(ED_{6-16} \times ADAF_{6-16}) + (ED_{16-26} \times ADAF_{16-26})]$
				RBA	Relative Bioavailability Factor	1, 0.6	(a)	unitless	USEPA, 2007	x 1/BW x 1/AT
				BW	Body Weight	80		kg	USEPA, 2014, 2015	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	CDI (Lifetime) (mg/kg-day) = (CDI [child] + CDI [adult])
				AT-N	Averaging Time (Non-Cancer)	7300		days	ED x 365 days/year	

Table A2-1
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Current/Future On-Site Resident (Child/Adult), Ingestion and Dermal Contact with Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	On-Site Resident	Child	Surface Soil	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**Non-Mutagenic Constituents**
			(Current)	DABS	Absorption Factor, dermal	Chemical Specific	(a)	--	USEPA, 2004	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				SA	Skin Surface Area, Soil Contact	2373	(b)	cm2	USEPA, 2014, 2015	DA-event x EF-SO x EV x ED x SA x 1/BW x 1/AT
			Total Soil	SA_{0-2}	Skin Surface Area, Soil Contact, 0-2 years	2373	(b)	cm2	USEPA, 2014, 2015	
			(Future)	SA_{2-6}	Skin Surface Area, Soil Contact, 2-6 years	2373	(b)	cm2	USEPA, 2014, 2015	**Where:**
				SSAF	Soil to Skin Adherence Factor	0.2	(c)	mg/cm2-event	USEPA, 2014, 2015	Absorbed Dose per event (DA-event)
				EF-SO	Exposure Frequency, Soil	350		days/year	USEPA, 1991	(mg/cm2-event) = CS x CF3 x SSAF x DABS
				EV	Event Frequency	1		events/day	USEPA, 2004	
				ED	Exposure Duration	6		years	Act 2	**Mutagenic Constituents**
				ED_{0-2}	Exposure Duration. 0-2 years	2		years	USEPA, 2005a	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				$ADAF_{0-2}$	Age depend. adjust. factor, 0-2 years	10		unitless	USEPA, 2005a	DA-event x EF-SO x EV x [(ED_{0-2} x $ADAF_{0-2}$ x SA_{0-2}) +
				ED_{2-6}	Exposure Duration, 2-6 years	4		years	USEPA, 2005a	(ED_{2-6} x $ADAF_{2-6}$ x SA_{2-6})]
				$ADAF_{2-6}$	Age depend. adjust. factor, 2-6 years	3		unitless	USEPA, 2005a	1/BW x 1/AT
				CF3	Conversion Factor 3	0.000001		kg/mg	--	
				BW	Body Weight	15		kg	USEPA, 1991	DAD (Lifetime) (mg/kg-day) = (DAD [child] + DAD [adult])
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	2190		days	ED x 365 days/year	
		Adult	Surface Soil	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**Non-Mutagenic Constituents**
			(Current)	DABS	Absorption Factor, dermal	Chemical Specific	(a)	--	USEPA, 2004	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				SA	Skin Surface Area, Soil Contact	6032	(d)	cm2	USEPA, 2014, 2015	DA-event x EF-SO x EV x ED x SA x 1/BW x 1/AT
			Total Soil	SA_{6-16}	Skin Surface Area, Soil Contact, 6-16 years	6032	(d)	cm2	USEPA, 2014, 2015	
			(Future)	SA_{16-26}	Skin Surface Area, Soil Contact, 16-26 years	6032	(d)	cm2	USEPA, 2014, 2015	**Where:**
				SSAF	Soil to Skin Adherence Factor	0.07	(e)	mg/cm2-event	USEPA, 2014, 2015	Absorbed Dose per event (DA-event)
				EF-SO	Exposure Frequency, Soil	350		days/year	USEPA, 1991	(mg/cm2-event) = CS x CF3 x SSAF x DABS
				EV	Event Frequency	1		events/day	USEPA, 2004	
				ED	Exposure Duration	20		years	USEPA, 2014, 2015	**Mutagenic Constituents**
				ED_{6-16}	Exposure Duration, 6-16 years	10		years	USEPA, 2005a	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				$ADAF_{6-16}$	Age depend. adjust. factor, 6-16 years	3		unitless	USEPA, 2005a	DA-event x EF-SO x EV x [(ED_{6-16} x $ADAF_{6-16}$ x SA_{6-16}) +
				ED_{16-26}	Exposure Duration, 16-26 years	10		years	USEPA, 2005a	(ED_{16-26} x $ADAF_{16-26}$ x SA_{16-26})]
				$ADAF_{16-26}$	Age depend. adjust. factor, 16-26 years	1		unitless	USEPA, 2005a	1/BW x 1/AT
				CF3	Conversion Factor 3	0.000001		kg/mg	--	

Table A2-1
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Current/Future On-Site Resident (Child/Adult), Ingestion and Dermal Contact with Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
				BW	Body Weight	80		kg	USEPA, 2014, 2015	DAD (Lifetime) (mg/kg-day) = (DAD [child] + DAD [adult])
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	7300		days	ED x 365 days/year	

Notes:

(a) Chemical-specific parameters are provided in Attachment A4.

(b) The child SA and SA_{2-6} is the weighted average of mean skin surface area values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years).

(c) SSAF value represents a 50th percentile value for a child playing in wet soil. Value derived from Exhibit 3-3 of USEPA Dermal Guidance, Part E of RAGs (USEPA, 2004).

(d) The adult SA and SA_{16-26} represents the weighted average of mean values for head, hands, forearms, and lower legs (male and female, 21+ years old).

(e) SSAF represents the 95th percentile value for residential adult gardeners. Value found in Exhibit 3-3 of USEPA dermal guidance, Part E of RAGs (USEPA, 2004).

Act 2	Pennsylvania Land Recycling and Environmental Remediation Standards Act of 1995 and Title 25 Chapter 250 guidelines.
USEPA, 1991	Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance Standard Default Exposure Factors: Interim Final. March. OSWER 9285.6-03.
USEPA, 2004	Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment, Final, July, EPA/540/R/99/005.
USEPA, 2005a	Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum, EPA, Washington, DC. 20460, EPA/630/R-03/003F. March.
USEPA, 2007	Guidance for Evaluating the Oral Bioavailability of Metals in Soils for Use in Human Health Risk Assessment. OSWER 9285.8-80. May.
USEPA, 2011	Exposure Factors Handbook: 2011 Edition. EPA/600/R-09/052F. September. http://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252
USEPA, 2014	Human Health Evaluation Manual, Update of Standard Default Exposure Factors. OSWER-Directive-9200-1-120
USEPA, 2015	"Frequently Asked Questions (FAQS) About Update of Standard Default Exposure Factors" dated September 14, 2015. https://rais.ornl.gov/documents/FAQs-ExpF-Directive2.pdf

Table A2-2
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Current/Future On-Site Resident (Child/Adult), Inhalation of Wind-blown Dust in Outdoor Air from Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Outdoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	On-Site Resident	Child	Inhalation of Windblown Dust in Outdoor Air	EC	Exposure Concentration	Site-Specific		µg/m3	--	**Non-Mutagenic Constituents**
				CA	Chemical Concentration in Air	Site-Specific		µg/m3	--	Exposure Concentration (EC) (µg/m^3) =
				PEF	Particulate Emissions Factor	Site-Specific	(a)	m3/kg	USEPA, 2002	CA x EF-SO x ET x ED x 1/AT x
				CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	1/(24 hours/day)
				ET	Exposure Time	2	(b)	hr/day	USEPA, 2011	
				EF-SO	Exposure Frequency, Soil	350		days/year	USEPA, 1991	**Where:**
				ED	Exposure Duration	6		years	Act 2	CA = (CS/PEF) x CF5
				ED$_{0-2}$	Exposure Duration. 0-2 years	2		years	USEPA, 2005a	
				ADAF$_{0-2}$	Age depend. adjust. factor, 0-2 years	10		unitless	USEPA, 2005a	**Mutagenic Constituents**
				ED$_{2-6}$	Exposure Duration, 2-6 years	4		years	USEPA, 2005a	Exposure Concentration (EC) (µg/m^3) =
				ADAF$_{2-6}$	Age depend. adjust. factor, 2-6 years	3		unitless	USEPA, 2005a	CA x ET x EF-SO x [(ED$_{0-2}$ x ADAF$_{0-2}$) +
				CF5	Conversion Factor 5	1000		µg/mg	--	(ED$_{2-6}$ x ADAF$_{2-6}$)]
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	x 1/AT x 1/(24 hours/day)
				AT-N	Averaging Time (Non-Cancer)	2190		days	ED x 365 days/year	
										EC (Lifetime) (µg/m^3) = (EC [child] + EC [adult])
		Adult	Inhalation of Windblown Dust in Outdoor Air	EC	Exposure Concentration	Site-Specific		µg/m3	--	**Non-Mutagenic Constituents**
				CA	Chemical Concentration in Air	Site-Specific		µg/m3	--	Exposure Concentration (EC) (µg/m^3) =
				PEF	Particulate Emissions Factor	Site-Specific	(a)	m3/kg	USEPA, 2002	CA x ET x EF-SO x ED x 1/AT x
				CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	1/(24 hours/day)
				ET	Exposure Time	2	(b)	hr/day	USEPA, 2011	
				EF-SO	Exposure Frequency, Soil	350		days/year	USEPA, 1991	**Where:**
				ED	Exposure Duration	20		years	USEPA, 2014, 2015	CA = (CS/PEF) x CF5
				ED$_{6-16}$	Exposure Duration, 6-16 years	10		years	USEPA, 2005a	
				ADAF$_{6-16}$	Age depend. adjust. factor, 6-16 years	3		unitless	USEPA, 2005a	**Mutagenic Constituents**
				ED$_{16-26}$	Exposure Duration, 16-26 years	10		years	USEPA, 2005a	Exposure Concentration (EC) (µg/m^3) =
				ADAF$_{16-26}$	Age depend. adjust. factor, 16-26 years	1		unitless	USEPA, 2005a	CA x ET x EF-SO x [(ED$_{6-16}$ x ADAF$_{6-16}$) +
				CF5	Conversion Factor 5	1000		µg/mg	--	(ED$_{16-26}$ x ADAF$_{16-26}$)]
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	x 1/AT x 1/(24 hours/day)
				AT-N	Averaging Time (Non-Cancer)	7300		days	ED x 365 days/year	
										EC (Lifetime) (µg/m^3) = (EC [child] + EC [adult])

Table A2-2
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Current/Future On-Site Resident (Child/Adult), Inhalation of Wind-blown Dust in Outdoor Air from Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Outdoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name

Notes:

(a) Inhalation of particulates from soils is assumed using a site-specific PEF. No volatiles were identified as chemicals of potential concern (See Attachment A4 for PEF derivation).

(b) The 95th percentile value for the child playing on dirt (120 minutes/day) while the adult supervises the play activities, Table ES-1, 2011 Exposure Factors Handbook.

Act 2	Pennsylvania Land Recycling and Environmental Remediation Standards Act of 1995 and Title 25 Chapter 250 guidelines.
USEPA, 2002	Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December. OSWER 9355.4-24
USEPA, 2005a	Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum, EPA, Washington, DC. 20460, EPA/630/R-03/003F. March.
USEPA, 1991	Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance Standard Default Exposure Factors: Interim Final. March. OSWER 9285.6-03.
USEPA, 2011	Exposure Factors Handbook: 2011 Edition. EPA/600/R-09/052F. September. http://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252
USEPA, 2014	Human Health Evaluation Manual, Update of Standard Default Exposure Factors. OSWER-Directive-9200-1-120
USEPA, 2015	"Frequently Asked Questions (FAQS) About Update of Standard Default Exposure Factors" dated September 14, 2015. https://rais.ornl.gov/documents/FAQs-ExpF-Directive2.pdf

Table A2-3
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Current/Future On-Site Visitor (Child/Adult), Ingestion and Dermal Contact with Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	On-Site Visitor	Child	Surface Soil	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**Non-Mutagenic Constituents**
			(Current)	IR-SO	Ingestion Rate of Soil	200		mg/day	USEPA, 2011	Chronic Daily Intake (CDI) (mg/kg-day) =
				EF-SO	Exposure Frequency, Soil	75		days/year	ORNL, 2018	CS x IR-SO x RBA x EF-SO x ED x CF3 x
			Total Soil	ED	Exposure Duration	6		years	Act 2	1/BW x 1/AT
			(Future)	ED_{0-2}	Exposure Duration. 0-2 years	2		years	USEPA, 2005a	
				$ADAF_{0-2}$	Age depend. adjust. factor, 0-2 years	10		unitless	USEPA, 2005a	**Mutagenic Constituents**
				ED_{2-6}	Exposure Duration, 2-6 years	4		years	USEPA, 2005a	Chronic Daily Intake (CDI) (mg/kg-day) =
				$ADAF_{2-6}$	Age depend. adjust. factor, 2-6 years	3		unitless	USEPA, 2005a	CS x IR-SO x RBA x EF-SO x CF3 x
				CF3	Conversion Factor 3	0.000001		kg/mg	--	$[(ED_{0-2} \times ADAF_{0-2}) + (ED_{2-6} \times ADAF_{2-6})]$
				RBA	Relative Bioavailability Factor	1, 0.6	(a)	unitless	USEPA, 2007	x 1/BW x 1/AT
				BW	Body Weight	15		kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	CDI (Lifetime) (mg/kg-day) = (CDI [child] + CDI [adult])
				AT-N	Averaging Time (Non-Cancer)	2190		days	ED x 365 days/year	
		Adult	Surface Soil	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**Non-Mutagenic Constituents**
			(Current)	IR-SO	Ingestion Rate of Soil	100		mg/day	USEPA, 1991	Chronic Daily Intake (CDI) (mg/kg-day) =
				EF-SO	Exposure Frequency, Soil	75		days/year	ORNL, 2018	CS x IR-SO x RBA x EF-SO x ED x CF3 x
			Total Soil	ED	Exposure Duration	20		years	USEPA, 2014, 2015	1/BW x 1/AT
			(Future)	ED_{6-16}	Exposure Duration, 6-16 years	10		years	USEPA, 2005a	
				$ADAF_{6-16}$	Age depend. adjust. factor, 6-16 years	3		unitless	USEPA, 2005a	**Mutagenic Constituents**
				ED_{16-26}	Exposure Duration, 16-26 years	10		years	USEPA, 2005a	Chronic Daily Intake (CDI) (mg/kg-day) =
				$ADAF_{16-26}$	Age depend. adjust. factor, 16-26 years	1		unitless	USEPA, 2005a	CS x IR-SO x RBA x EF-SO x CF3 x
				CF3	Conversion Factor 3	0.000001		kg/mg	--	$[(ED_{6-16} \times ADAF_{6-16}) + (ED_{16-26} \times ADAF_{16-26})]$
				RBA	Relative Bioavailability Factor	1, 0.6	(a)	unitless	USEPA, 2007	x 1/BW x 1/AT
				BW	Body Weight	80		kg	USEPA, 2014, 2015	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	CDI (Lifetime) (mg/kg-day) = (CDI [child] + CDI [adult])
				AT-N	Averaging Time (Non-Cancer)	7300		days	ED x 365 days/year	

Table A2-3
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Current/Future On-Site Visitor (Child/Adult), Ingestion and Dermal Contact with Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	On-Site Visitor	Child	Surface Soil	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**Non-Mutagenic Constituents**
			(Current)	DABS	Absorption Factor, dermal	Chemical Specific	(a)	--	USEPA, 2004	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				SA	Skin Surface Area, Soil Contact	2373	(b)	cm2	USEPA, 2014, 2015	DA-event x EF-SO x EV x ED x SA x 1/BW x 1/AT
			Total Soil	SA_{0-2}	Skin Surface Area, Soil Contact, 0-2 years	2373	(b)	cm2	USEPA, 2014, 2015	
			(Future)	SA_{2-6}	Skin Surface Area, Soil Contact, 2-6 years	2373	(b)	cm2	USEPA, 2014, 2015	**Where:**
				SSAF	Soil to Skin Adherence Factor	0.2	(c)	mg/cm2-event	USEPA, 2014, 2015	Absorbed Dose per event (DA-event)
				EF-SO	Exposure Frequency, Soil	75		days/year	ORNL, 2018	(mg/cm2-event) = CS x CF3 x SSAF x DABS
				EV	Event Frequency	1		events/day	USEPA, 2004	
				ED	Exposure Duration	6		years	Act 2	**Mutagenic Constituents**
				ED_{0-2}	Exposure Duration. 0-2 years	2		years	USEPA, 2005a	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				$ADAF_{0-2}$	Age depend. adjust. factor, 0-2 years	10		unitless	USEPA, 2005a	DA-event x EF-SO x EV x [(ED_{0-2} x $ADAF_{0-2}$ x SA_{0-2}) +
				ED_{2-6}	Exposure Duration, 2-6 years	4		years	USEPA, 2005a	(ED_{2-6} x $ADAF_{2-6}$ x SA_{2-6})]
				$ADAF_{2-6}$	Age depend. adjust. factor, 2-6 years	3		unitless	USEPA, 2005a	1/BW x 1/AT
				CF3	Conversion Factor 3	0.000001		kg/mg	--	
				BW	Body Weight	15		kg	USEPA, 1991	DAD (Lifetime) (mg/kg-day) = (DAD [child] + DAD [adult])
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	2190		days	ED x 365 days/year	
		Adult	Surface Soil	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**Non-Mutagenic Constituents**
			(Current)	DABS	Absorption Factor, dermal	Chemical Specific	(a)	--	USEPA, 2004	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				SA	Skin Surface Area, Soil Contact	6032	(d)	cm2	USEPA, 2014, 2015	DA-event x EF-SO x EV x ED x SA x 1/BW x 1/AT
			Total Soil	SA_{6-16}	Skin Surface Area, Soil Contact, 6-16 years	6032	(d)	cm2	USEPA, 2014, 2015	
			(Future)	SA_{16-26}	Skin Surface Area, Soil Contact, 16-26 years	6032	(d)	cm2	USEPA, 2014, 2015	**Where:**
				SSAF	Soil to Skin Adherence Factor	0.07	(e)	mg/cm2-event	USEPA, 2014, 2015	Absorbed Dose per event (DA-event)
				EF-SO	Exposure Frequency, Soil	75		days/year	ORNL, 2018	(mg/cm2-event) = CS x CF3 x SSAF x DABS
				EV	Event Frequency	1		events/day	USEPA, 2004	
				ED	Exposure Duration	20		years	USEPA, 2014, 2015	**Mutagenic Constituents**
				ED_{6-16}	Exposure Duration, 6-16 years	10		years	USEPA, 2005a	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				$ADAF_{6-16}$	Age depend. adjust. factor, 6-16 years	3		unitless	USEPA, 2005a	DA-event x EF-SO x EV x [(ED_{6-16} x $ADAF_{6-16}$ x SA_{6-16}) +

Table A2-3

Values Used for Daily Intake Calculations

Reasonable Maximum Exposure: Current/Future On-Site Visitor (Child/Adult), Ingestion and Dermal Contact with Soil

Ridgway Training Range, Pennsylvania

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
				ED_{16-26}	Exposure Duration, 16-26 years	10		years	USEPA, 2005a	(ED_{16-26} x $ADAF_{16-26}$ x SA_{16-26})]
				$ADAF_{16-26}$	Age depend. adjust. factor, 16-26 years	1		unitless	USEPA, 2005a	1/BW x 1/AT
				CF3	Conversion Factor 3	0.000001		kg/mg	--	
				BW	Body Weight	80		kg	USEPA, 2014, 2015	DAD (Lifetime) (mg/kg-day) = (DAD [child] + DAD [adult])
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	7300		days	ED x 365 days/year	

Notes:

(a) Chemical-specific parameters are provided in Attachment A4.

(b) The child SA and SA_{2-6} are the weighted averages of mean skin surface area values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years).

(c) SSAF value represents a 50th percentile value for a child playing in wet soil. Value derived from Exhibit 3-3 of USEPA Dermal Guidance, Part E of RAGs (USEPA, 2004).

(d) The adult SA and SA_{16-26} represent the weighted average of mean values for head, hands, forearms, and lower legs (male and female, 21+ years old).

(e) SSAF represents the 95th percentile value for residential adult gardeners. Value found in Exhibit 3-3 of USEPA dermal guidance, Part E of RAGs (USEPA, 2004).

Act 2	Pennsylvania Land Recycling and Environmental Remediation Standards Act of 1995 and Title 25 Chapter 250 guidelines.
ORNL, 2018	RAIS Preliminary Remediation Goals (PRGs) for Chemicals User's Guide. https://rais.ornl.gov/tools/rais_chemical_prg_guide.html
USEPA, 1991	Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance Standard Default Exposure Factors: Interim Final. March. OSWER 9285.6-03.
USEPA, 2004	Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment, Final, July, EPA/540/R/99/005.
USEPA, 2005a	Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum, EPA, Washington, DC. 20460, EPA/630/R-03/003F. March.
USEPA, 2007	Guidance for Evaluating the Oral Bioavailability of Metals in Soils for Use in Human Health Risk Assessment. OSWER 9285.8-80. May.
USEPA, 2011	Exposure Factors Handbook: 2011 Edition. EPA/600/R-09/052F. September. http://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252
USEPA, 2014	Human Health Evaluation Manual, Update of Standard Default Exposure Factors. OSWER-Directive-9200-1-120
USEPA, 2015	"Frequently Asked Questions (FAQS) About Update of Standard Default Exposure Factors" dated September 14, 2015. https://rais.ornl.gov/documents/FAQs-ExpF-Directive2.pdf

Table A2-4

Values Used for Daily Intake Calculations

Reasonable Maximum Exposure: Current/Future On-Site Recreator or Visitor (Child/Adult), Inhalation of Wind-blown Dust in Outdoor Air from Soil

Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Outdoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	On-Site Recreator or Visitor	Child	Inhalation of Windblown Dust in Outdoor Air	EC	Exposure Concentration	Calculated		µg/m3	--	**Non-Mutagenic Constituents**
				CA	Chemical Concentration in Air	Site-Specific		µg/m3	--	Exposure Concentration (EC) (µg/m^3) =
				PEF	Particulate Emissions Factor	Site-Specific	(a)	m3/kg	USEPA, 2002	CA x EF-SO x ET x ED x 1/AT x
				CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	1/(24 hours/day)
				ET	Exposure Time	2	(b)	hr/day	USEPA, 2011	
				EF-SO	Exposure Frequency, Soil	75		days/year	ORNL, 2018	**Where:**
				ED	Exposure Duration	6		years	Act 2	CA = (CS/PEF) x CF5
				ED$_{0-2}$	Exposure Duration. 0-2 years	2		years	USEPA, 2005a	
				ADAF$_{0-2}$	Age depend. adjust. factor, 0-2 years	10		unitless	USEPA, 2005a	**Mutagenic Constituents**
				ED$_{2-6}$	Exposure Duration, 2-6 years	4		years	USEPA, 2005a	Exposure Concentration (EC) (µg/m^3) =
				ADAF$_{2-6}$	Age depend. adjust. factor, 2-6 years	3		unitless	USEPA, 2005a	CA x ET x EF-SO x [(ED$_{0-2}$ x ADAF$_{0-2}$) +
				CF5	Conversion Factor 5	1000		µg/mg	--	(ED$_{2-6}$ x ADAF$_{2-6}$)]
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	x 1/AT x 1/(24 hours/day)
				AT-N	Averaging Time (Non-Cancer)	2190		days	ED x 365 days/year	
										EC (Lifetime) (µg/m^3) = (EC [child] + EC [adult])
		Adult	Inhalation of Windblown Dust in Outdoor Air	EC	Exposure Concentration	Site-Specific		µg/m3	--	**Non-Mutagenic Constituents**
				CA	Chemical Concentration in Air	Site-Specific		µg/m3	--	Exposure Concentration (EC) (µg/m^3) =
				PEF	Particulate Emissions Factor	Site-Specific	(a)	m3/kg	USEPA, 2002	CA x ET x EF-SO x ED x 1/AT x
				CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	1/(24 hours/day)
				ET	Exposure Time	2	(b)	hr/day	USEPA, 2011	
				EF-SO	Exposure Frequency, Soil	75		days/year	ORNL, 2018	**Where:**
				ED	Exposure Duration	20		years	USEPA, 2014, 2015	CA = (CS/PEF) x CF5
				ED$_{6-16}$	Exposure Duration, 6-16 years	10		years	USEPA, 2005a	
				ADAF$_{6-16}$	Age depend. adjust. factor, 6-16 years	3		unitless	USEPA, 2005a	**Mutagenic Constituents**
				ED$_{16-26}$	Exposure Duration, 16-26 years	10		years	USEPA, 2005a	Exposure Concentration (EC) (µg/m^3) =
				ADAF$_{16-26}$	Age depend. adjust. factor, 16-26 years	1		unitless	USEPA, 2005a	CA x ET x EF-SO x [(ED$_{6-16}$ x ADAF$_{6-16}$) +
				CF5	Conversion Factor 5	1000		µg/mg	--	(ED$_{16-26}$ x ADAF$_{16-26}$)]
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	x 1/AT x 1/(24 hours/day)
				AT-N	Averaging Time (Non-Cancer)	7300		days	ED x 365 days/year	
										EC (Lifetime) (µg/m^3) = (EC [child] + EC [adult])

Table A2-4

Values Used for Daily Intake Calculations

Reasonable Maximum Exposure: Current/Future On-Site Recreator or Visitor (Child/Adult), Inhalation of Wind-blown Dust in Outdoor Air from Soil

Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Outdoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name

Notes:

(a) Inhalation of particulates from soils is assumed using a site-specific PEF. No volatiles were identified as chemicals of potential concern (See Attachment A4 for PEF derivation).

(b) The 95th percentile value for the child playing on dirt (120 minutes/day) while the adult supervises the play activities, Table ES-1, 2011 Exposure Factors Handbook.

Act 2	Pennsylvania Land Recycling and Environmental Remediation Standards Act of 1995 and Title 25 Chapter 250 guidelines.
ORNL, 2018	RAIS Preliminary Remediation Goals (PRGs) for Chemicals User's Guide. https://rais.ornl.gov/tools/rais_chemical_prg_guide.html
USEPA, 2002	Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December. OSWER 9355.4-24
USEPA, 2005a	Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum, EPA, Washington, DC. 20460, EPA/630/R-03/003F. March.
USEPA, 2011	Exposure Factors Handbook: 2011 Edition. EPA/600/R-09/052F. September. http://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252
USEPA, 2014	Human Health Evaluation Manual, Update of Standard Default Exposure Factors. OSWER-Directive-9200-1-120
USEPA, 2015	"Frequently Asked Questions (FAQS) About Update of Standard Default Exposure Factors" dated September 14, 2015. https://rais.ornl.gov/documents/FAQs-ExpF-Directive2.pdf

Table A2-5
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Current/Future On-Site Teen Trespasser, Ingestion and Dermal Contact with Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	On-Site Teen Trespasser	Teen	Surface Soil (Current)	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**Non-Mutagenic Constituents** Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-SO x RBA x EF-SO x ED x CF3 x 1/BW x 1/AT
				IR-SO	Ingestion Rate of Soil	100		mg/day	USEPA, 2011	
				EF-SO	Exposure Frequency, Soil	24	(a)	days/year	See notes below	
			Total Soil (Future)	ED	Exposure Duration	10	(a)	years	See notes below	
				ED$_{6-16}$	Exposure Duration, 6-16 years	10		years	USEPA, 2005a	
				ADAF$_{6-16}$	Age depend. adjust. factor, 6-16 years	3		unitless	USEPA, 2005a	**Mutagenic Constituents** Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-SO x EF-SO x (ED$_{6-16}$ x ADAF$_{6-16}$) x CF3 x RBA x 1/BW x 1/AT
				CF3	Conversion Factor 3	0.000001		kg/mg	--	
				RBA	Relative Bioavailability Factor	1, 0.6	(b)	unitless	USEPA, 2007	
				BW	Body Weight	44	(c)	kg	USEPA, 2011	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	3650		days	ED x 365 days/year	
Dermal	On-Site Teen Trespasser	Teen	Surface Soil (Current)	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**Non-Mutagenic Constituents** Dermally Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF-SO x EV x ED x SA x 1/BW x 1/AT
				DABS	Absorption Factor, dermal	Chemical Specific	(b)	--	USEPA, 2004	
				SA	Skin Surface Area, Soil Contact	3749	(d)	cm2	USEPA, 2011	
			Total Soil (Future)	SA$_{6-16}$	Skin Surface Area, Soil Contact, 6-16 years	3749	(d)	cm2	USEPA, 2011	
				SSAF	Soil to Skin Adherence Factor	0.3	(e)	mg/cm2-event	USEPA, 2004	**Where:** Absorbed Dose per event (DA-event) (mg/cm2-event) = CS x CF3 x SSAF x DABS
				EF-SO	Exposure Frequency, Soil	24	(a)	days/year	See notes below	
				EV	Event Frequency	1		events/day	USEPA, 2004	
				ED	Exposure Duration	10	(a)	years	See notes below	
				ED$_{6-16}$	Exposure Duration, 6-16 years	10		years	USEPA, 2005a	**Mutagenic Constituents** Dermally Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF-SO x EV x (ED$_{6-16}$ x ADAF$_{6-16}$ x SA$_{6-16}$) x 1/BW x 1/AT
				ADAF$_{6-16}$	Age depend. adjust. factor, 6-16 years	3		unitless	USEPA, 2005a	
				CF3	Conversion Factor 3	0.000001		kg/mg	--	
				BW	Body Weight	44	(c)	kg	USEPA, 2011	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	3650		days	ED x 365 days/year	

Notes:

(a) The teen trespasser is ages 6 -16 years old who plays in the wooded area, streams, and secluded areas 6 days per month, 4 months per year (EF = 24 days/year) for 4 hours/event (ET = 4 hours/day).

(b) Chemical-specific parameters are provided in Attachment A4.

(c) The average of the mean body weights for children ages 6 to < 11 years and 11 to <16 years old, Table ES-1 of the 2011 Exposure Factors Handbook (EFH). See Table A3-13 for the calculations.

(d) The teen SA and SA$_{6-16}$ represent the weighted average of the head, forearms, hands, and lower legs. Table 7-2 of the 2011 Exposure Factors Handbook (EFH). See Table A3-14 for the calculations.

(e) SSAF value represents a 95th percentile value for a teen soccer player in moist field conditions. Value derived from Exhibit 3-3 of USEPA Dermal Guidance, Part E of RAGS (USEPA, 2004).

Table A2-5
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Current/Future On-Site Teen Trespasser, Ingestion and Dermal Contact with Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name

Act 2	Pennsylvania Land Recycling and Environmental Remediation Standards Act of 1995 and Title 25 Chapter 250 guidelines.
USEPA, 2004	Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment, Final, July, EPA/540/R/99/005.
USEPA, 2005a	Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum, EPA, Washington, DC. 20460, EPA/630/R-03/003F. March.
USEPA, 2007	Guidance for Evaluating the Oral Bioavailability of Metals in Soils for Use in Human Health Risk Assessment. OSWER 9285.8-80. May.
USEPA, 2011	Exposure Factors Handbook: 2011 Edition. EPA/600/R-09/052F. September. http://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252

Table A2-6
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Current/Future On-Site Teen Trespasser, Inhalation of Wind-blown Dust in Outdoor Air from Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Outdoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	On-Site Teen Trespasser	Teen	Inhalation of Windblown Dust in Outdoor Air	EC	Exposure Concentration	Calculated		µg/m3	--	**Non-Mutagenic Constituents**
				CA	Chemical Concentration in Air	Site-Specific		µg/m3	--	Exposure Concentration (EC) (µg/m^3) =
				PEF	Particulate Emissions Factor	Site-Specific	(a)	m3/kg	USEPA, 2002	CA x ET x EF-SO x ED x 1/AT x
				CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	1/(24 hours/day)
				ET	Exposure Time	4	(b)	hr/day	See notes below	
				EF-SO	Exposure Frequency, Soil	24	(b)	days/year	See notes below	**Where:**
				ED	Exposure Duration	10	(b)	years	See notes below	CA = (CS/PEF) x CF5
				ED_{6-16}	Exposure Duration, 6-16 years	10		years	USEPA, 2005a	
				$ADAF_{6-16}$	Age depend. adjust. factor, 6-16 years	3		unitless	USEPA, 2005a	**Mutagenic Constituents**
				CF5	Conversion Factor 5	1000		µg/mg	--	Exposure Concentration (EC) (µg/m^3) =
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	CA x ET x EF-SO x ED_{6-16} x $ADAF_{6-16}$ x 1/AT x
				AT-N	Averaging Time (Non-Cancer)	3650		days	ED x 365 days/year	1/(24 hours/day)

Notes:

(a) Inhalation of particulates from soils is assumed using a site-specific PEF. No volatiles were identified as chemicals of potential concern (See Attachment A4 for PEF derivation).

(b) The teen trespasser is ages 6 -16 years old who plays in the wooded area, streams, and secluded areas 6 days per month, 4 months per year (EF = 24 days/year) for 4 hours/event (ET = 4 hours/day).

Act 2	Pennsylvania Land Recycling and Environmental Remediation Standards Act of 1995 and Title 25 Chapter 250 guidelines.
USEPA, 2002	Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December. OSWER 9355.4-24
USEPA, 2005a	Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum, EPA, Washington, DC. 20460, EPA/630/R-03/003F. March.

Table A2-7
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Current/Future On-Site Outdoor Worker, Ingestion and Dermal Contact with Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	On-Site Outdoor Worker	Adult	Surface Soil (Current)	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**All Constituents**
				IR-SO	Ingestion Rate of Soil	50		mg/day	Act 2	Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-SO x RBA x EF-SO x ED x CF3 x 1/BW x 1/AT
				EF-SO	Exposure Frequency, Soil	180		days/year	Act 2	
			Total Soil (Future)	ED	Exposure Duration	25		years	Act 2	
				CF3	Conversion Factor 3	0.000001		kg/mg	--	
				RBA	Relative Bioavailability Factor	1, 0.6	(a)	unitless	USEPA, 2007	
				BW	Body Weight	80		kg	USEPA, 2014, 2015	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	9125		days	ED x 365 days/year	
Dermal	On-Site Outdoor Worker	Adult	Surface Soil (Current)	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**All Constituents**
				DABS	Absorption Factor, dermal	Chemical Specific	(a)	--	USEPA, 2004	Dermally Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF-SO x EV x ED x SA x 1/BW x 1/AT
				SA	Skin Surface Area, Soil Contact	3527	(b)	cm2	USEPA, 2014, 2015	
			Total Soil (Future)	SSAF	Soil to Skin Adherence Factor	0.12	(c)	mg/cm2-event	USEPA, 2014, 2015	
				EF-SO	Exposure Frequency, Soil	180		days/year	Act 2	**Where:**
				EV	Event Frequency	1		events/day	USEPA, 2004	Absorbed Dose per event (DA-event) (mg/cm2-event) = CS x CF3 x SSAF x DABS
				ED	Exposure Duration	25		years	Act 2	
				CF3	Conversion Factor 3	0.000001		kg/mg	--	
				BW	Body Weight	80		kg	USEPA, 2014, 2015	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	9125		days	ED x 365 days/year	

Notes:

(a) Chemical-specific parameters are provided in Attachment A4.

(b) SA represents the weighted average of mean values for head, hands, and forearms (male and female, 21+ years old).

(c) SSAF represents the arithmetic mean of weighted average body parts specific (hands, forearms, and face) mean adherence factors for adult commercial/industrial activities.

Act 2	Pennsylvania Land Recycling and Environmental Remediation Standards Act of 1995 and Title 25 Chapter 250 guidelines.
USEPA, 2004	Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment, Final, July, EPA/540/R/99/005.
USEPA, 2007	Guidance for Evaluating the Oral Bioavailability of Metals in Soils for Use in Human Health Risk Assessment. OSWER 9285.8-80. May.
USEPA, 2014	Human Health Evaluation Manual, Update of Standard Default Exposure Factors. OSWER-Directive-9200-1-120
USEPA, 2015	"Frequently Asked Questions (FAQS) About Update of Standard Default Exposure Factors" dated September 14, 2015. https://rais.ornl.gov/documents/FAQs-ExpF-Directive2.pdf

Table A2-8
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Current/Future On-Site Outdoor Worker, Inhalation of Wind-blown Dust in Outdoor Air from Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Outdoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	On-Site Outdoor Worker	Adult	Inhalation of Windblown Dust in Outdoor Air	EC	Exposure Concentration	Calculated		µg/m3	--	**All Constituents**
				CA	Chemical Concentration in Air	Site-Specific		µg/m3	--	Exposure Concentration (EC) (µg/m^3) =
				PEF	Particulate Emissions Factor	Site-Specific	(a)	m3/kg	USEPA, 2002	CA x ET x EF-SO x ED x 1/AT x
				CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	1/(24 hours/day)
				ET	Exposure Time	8		hr/day	Act 2	
				EF-SO	Exposure Frequency, Soil	180		days/year	Act 2	**Where:**
				ED	Exposure Duration	25		years	Act 2	CA = (CS/PEF) x CF5
				CF5	Conversion Factor 5	1000		µg/mg	--	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	9125		days	ED x 365 days/year	

Notes:

(a) Inhalation of particulates from soils is assumed using a site-specific PEF. No volatiles were identified as chemicals of potential concern (See Attachment A4 for PEF derivation).

Act 2	Pennsylvania Land Recycling and Environmental Remediation Standards Act of 1995 and Title 25 Chapter 250 guidelines.
USEPA, 2002	Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December. OSWER 9355.4-24

Table A2-9
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Future On-Site Utility Worker, Ingestion and Dermal Contact with Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Medium:	Soil
Exposure Medium:	Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	On-Site Utility Worker	Adult	Total Soil	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**All Constituents**
				IR-SO	Ingestion Rate of Soil	330		mg/day	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg-day) =
				EF-SO	Exposure Frequency, Soil	20	(a)	days/year	ORNL, 2018	CS x IR-SO x RBA x EF-SO x ED x CF3 x
				ED	Exposure Duration	1		years	USEPA, 1991	1/BW x 1/AT
				CF3	Conversion Factor 3	0.000001		kg/mg	--	
				RBA	Relative Bioavailability Factor	1, 0.6	(b)	unitless	USEPA, 2007	
				BW	Body Weight	80		kg	USEPA, 2014, 2015	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	365		days	ED x 365 days/year	
Dermal	On-Site Utility Worker	Adult	Total Soil	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**All Constituents**
				DABS	Absorption Factor, dermal	Chemical Specific	(b)	--	USEPA, 2004	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				SA	Skin Surface Area, Soil Contact	3527	(c)	cm2	USEPA, 2014, 2015	DA-event x EF-SO x EV x ED x SA x 1/BW x 1/AT
				SSAF	Soil to Skin Adherence Factor	0.2	(d)	mg/cm2-event	USEPA, 2004	
				EF-SO	Exposure Frequency, Soil	20	(a)	days/year	ORNL, 2018	**Where:**
				EV	Event Frequency	1		events/day	USEPA, 2004	Absorbed Dose per event (DA-event)
				ED	Exposure Duration	1		years	USEPA, 1991	(mg/cm2-event) = CS x CF3 x SSAF x DABS
				CF3	Conversion Factor 3	0.000001		kg/mg	--	
				BW	Body Weight	80		kg	USEPA, 2014, 2015	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	365		days	ED x 365 days/year	

Notes:

(a) It is assumed that utility line work would take 20 days out of the year, working typical 8 hour day shifts.

(b) Chemical-specific parameters are provided in Attachment A4.

(c) SA represents the weighted average of mean values for head, hands, and forearms (male and female, 21+ years old).

(d) SSAF represents the arithmetic mean adherence factor for adult commercial/industrial activities, specifically for a utility worker. Value derived from Exhibit 3-3 of USEPA Dermal Guidance, Part E of RAGS (USEPA, 2004).

Act 2	Pennsylvania Land Recycling and Environmental Remediation Standards Act of 1995 and Title 25 Chapter 250 guidelines.
ORNL, 2018	RAIS Preliminary Remediation Goals (PRGs) for Chemicals User's Guide. https://rais.ornl.gov/tools/rais_chemical_prg_guide.html
USEPA, 1991	Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance Standard Default Exposure Factors: Interim Final. March. OSWER 9285.6-03.
USEPA, 2002	Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December. OSWER 9355.4-24
USEPA, 2004	Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment, Final, July, EPA/540/R/99/005.
USEPA, 2007	Guidance for Evaluating the Oral Bioavailability of Metals in Soils for Use in Human Health Risk Assessment. OSWER 9285.8-80. May.
USEPA, 2014	Human Health Evaluation Manual, Update of Standard Default Exposure Factors. OSWER-Directive-9200-1-120
USEPA, 2015	"Frequently Asked Questions (FAQS) About Update of Standard Default Exposure Factors" dated September 14, 2015. https://rais.ornl.gov/documents/FAQs-ExpF-Directive2.pdf

Table A2-10
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Future On-Site Utility Worker, Inhalation of Wind-blown Dust in Outdoor Air from Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Medium:	Soil
Exposure Medium:	Outdoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	On-Site Utility Worker	Adult	Inhalation of Windblown Dust in Outdoor Air	EC	Exposure Concentration	Calculated		µg/m3	--	**All Constituents**
				CA	Chemical Concentration in Air	Site-Specific		µg/m3	--	Exposure Concentration (EC) (µg/m^3) =
				PEF	Particulate Emissions Factor	Site-Specific	(a)	m3/kg	USEPA, 2002	CA x ET x EF-SO x ED x 1/AT x
				CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	1/(24 hours/day)
				ET	Exposure Time	8	(b)	hr/day	USEPA, 2014, 2015	
				EF-SO	Exposure Frequency, Soil	20	(b)	days/year	ORNL, 2018	**Where:**
				ED	Exposure Duration	1		years	USEPA, 1991	CA = (CS/PEF) x CF5
				CF5	Conversion Factor 5	1000		µg/mg	--	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	365		days	ED x 365 days/year	

Notes:

(a) Inhalation of particulates from soils is assumed using a site-specific PEF. No volatiles were identified as chemicals of potential concern (See Attachment A4 for PEF derivation).
(b) It is assumed that utility line work would take 20 days out of the year, working typical 8 hour day shifts.

Act 2	Pennsylvania Land Recycling and Environmental Remediation Standards Act of 1995 and Title 25 Chapter 250 guidelines.
USEPA, 2002	Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December. OSWER 9355.4-24
ORNL, 2018	RAIS Preliminary Remediation Goals (PRGs) for Chemicals User's Guide. https://rais.ornl.gov/tools/rais_chemical_prg_guide.html
USEPA, 1991	Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance Standard Default Exposure Factors: Interim Final. March. OSWER 9285.6-03.
USEPA, 2002	Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December. OSWER 9355.4-24
USEPA, 2014	Human Health Evaluation Manual, Update of Standard Default Exposure Factors. OSWER-Directive-9200-1-120
USEPA, 2015	"Frequently Asked Questions (FAQS) About Update of Standard Default Exposure Factors" dated September 14, 2015. https://rais.ornl.gov/documents/FAQs-ExpF-Directive2.pdf

Table A2-11
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Future On-Site Constuction Worker, Ingestion and Dermal Contact with Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	On-Site Construction Worker	Adult	Total Soil	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**All Constituents** Chronic Daily Intake (CDI) (mg/kg-day) = CS x IR-SO x RBA x EF-SO x ED x CF3 x 1/BW x 1/AT
				IR-SO	Ingestion Rate of Soil	330		mg/day	USEPA, 2002	
				EF-SO	Exposure Frequency, Soil	60		days/year	Proj Judgment	
				ED	Exposure Duration	1		years	USEPA, 2002	
				CF3	Conversion Factor 3	0.000001		kg/mg	--	
				RBA	Relative Bioavailability Factor	1, 0.6	(b)	unitless	USEPA, 2007	
				BW	Body Weight	80		kg	USEPA, 2014, 2015	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	365		days	ED x 365 days/year	
Dermal	On-Site Construction Worker	Adult	Total Soil	CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	**All Constituents** Dermally Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF-SO x EV x ED x SA x 1/BW x 1/AT **Where:** Absorbed Dose per event (DA-event) (mg/cm2-event) = CS x CF3 x SSAF x DABS
				DABS	Absorption Factor, dermal	Chemical Specific	(b)	--	USEPA, 2004	
				SA	Skin Surface Area, Soil Contact	3527	(c)	cm2	USEPA, 2014, 2015	
				SSAF	Soil to Skin Adherence Factor	0.3	(d)	mg/cm2-event	USEPA, 2004	
				EF-SO	Exposure Frequency, Soil	60		days/year	Proj Judgment	
				EV	Event Frequency	1		events/day	USEPA, 2004	
				ED	Exposure Duration	1		years	USEPA, 2002	
				CF3	Conversion Factor 3	0.000001		kg/mg	--	
				BW	Body Weight	80		kg	USEPA, 2014, 2015	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	365		days	ED x 365 days/year	

Notes:

(a) It is assumed that excavation activities are likely to take 3 months (5 days/week x 4 weeks/month x 3 months/year) at this site which is less than a quarter acre in size.

(b) Chemical-specific parameters are provided in Attachment A4.

(c) SA represents the weighted average of mean values for head, hands, and forearms (male and female, 21+ years old).

(d) SSAF represents the 95th percentile adherence factor for adult commercial/industrial activities, specifically for the construction worker. Value derived from Exhibit 3-3 of USEPA Dermal Guidance, Part E of RAGS (USEPA, 2004).

Act 2	Pennsylvania Land Recycling and Environmental Remediation Standards Act of 1995 and Title 25 Chapter 250 guidelines.
USEPA, 2002	Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December. OSWER 9355.4-24
USEPA, 2004	Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment, Final, July, EPA/540/R/99/005.
USEPA, 2007	Guidance for Evaluating the Oral Bioavailability of Metals in Soils for Use in Human Health Risk Assessment. OSWER 9285.8-80. May.
USEPA, 2014	Human Health Evaluation Manual, Update of Standard Default Exposure Factors. OSWER-Directive-9200-1-120
USEPA, 2015	"Frequently Asked Questions (FAQS) About Update of Standard Default Exposure Factors" dated September 14, 2015. https://rais.ornl.gov/documents/FAQs-ExpF-Directive2.pdf

Table A2-12
Values Used for Daily Intake Calculations
Reasonable Maximum Exposure: Future On-Site Construction Worker, Inhalation of Wind-blown Dust in Outdoor Air from Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Outdoor Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Note	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	On-Site Utility Worker	Adult	Inhalation of Windblown Dust in Outdoor Air	EC	Exposure Concentration	Calculated		µg/m3	--	**All Constituents** Exposure Concentration (EC) ($\mu g/m^3$) = CA x ET x EF-SO x ED x 1/AT x 1/(24 hours/day) **Where:** CA = (CS/PEF) x CF5
				CA	Chemical Concentration in Air	Site-Specific		µg/m3	--	
				PEF	Particulate Emissions Factor	Site-Specific	(a)	m3/kg	USEPA, 2002	
				CS	Chemical Concentration in Soil	Site-Specific		mg/kg	--	
				ET	Exposure Time	8		hr/day	Act 2	
				EF-SO	Exposure Frequency, Soil	60	(b)	days/year	Proj Judgment	
				ED	Exposure Duration	1		years	USEPA, 2002	
				CF5	Conversion Factor 5	1000		µg/mg	--	
				AT-C	Averaging Time (Cancer)	25550		days	Act 2	
				AT-N	Averaging Time (Non-Cancer)	365		days	ED x 365 days/year	

Notes:

(a) Inhalation of particulates from soils is assumed using a site-specific PEF. No volatiles were identified as chemicals of potential concern (See Attachment A4 for PEF derivation).

(b) It is assumed that excavation activities are likely to take 3 months (5 days/week x 4 weeks/month x 3 months/year) at this site which is less than a quarter acre in size.

Act 2	Pennsylvania Land Recycling and Environmental Remediation Standards Act of 1995 and Title 25 Chapter 250 guidelines.
USEPA, 2002	Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December. OSWER 9355.4-24

Table A2-13
Values Used for Body Weight Calculations
Teen Trespasser Body Weight Calculations
Ridgway Training Range, Pennsylvania

Receptor Age Range (Years):		10	
Age Group	**Mean Body Weight (kg)**	**Time Weight Factor (1) (%)**	**Adjusted Body Weight (kg)**
6 to <11 years	31.8	0.5	16
11 to <16 years	56.8	0.5	28
	Body Weight (BW) Total (kg):		44

Notes:

Source: USEPA, 2011. Exposure Factors Handbook: 2011 Edition. EPA/ 600/ R-090/052F, September 2011.

Table ES-1. Summary of Exposure Factor Recommendations, Chapter 8, Body Weight, page xvii

(1) Time-weight factor is derived by dividing the age group timeframe (years) by the receptor age range (years; yellow-highlighted cell).

Table A2-14
Values Used for Skin Surface Areas Calculations for Teen Trespasser
Exposure Media: Soil
Ridgway Training Range, Pennsylvania

							Receptor Age Range (Years):	10	Youth (6-16 years)
	Mean Surface Area by Body Part [9] (USEPA, 2011; Table 7-2, Page 7-6)							Time-Weight Factor [(1)] (%)	Soil [(2)] 6-16 years
Age Group	**Head cm^2**	**Arms cm^2**	**Forearms cm^2**	**Hands cm^2**	**Legs cm^2**	**Lower Legs cm^2**	**Feet cm^2**		
6 to <11 years	660	1510	680	510	3110	1244	730	0.50	1547
11 to <16 years	730	2270	1022	720	4830	1932	1050	0.50	2202
16 to <21 years	760	2690	1211	830	5430	2172	1120	-	-
							Skin Surface Area (SA) Totals (cm2):		**3749**

Notes

- = not applicable; cm^2 = square centimeters; SA = skin surface area; USEPA = U.S. Environmental Protection Agency

Sources: USEPA, 2011. Exposure Factors Handbook: 2011 Edition. EPA/ 600/ R-090/052F, September 2011.

Surface area values from USEPA (2011) were converted into cm^2 by multiplying the skin surface areas (m^2) by a conversion factor of 10,000 cm^2/m^2.

(1) Time-weight factor is derived by dividing the age group timeframe (years) by the receptor age range (years; yellow-highlighted cell).

(2) For soil exposure, the weighted mean values for head, forearms, hands and lower legs are used.

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	ProUCL 5.110/27/2018 10:45:30 AM		
From File	ProUCLInput_KLgw2.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Target Berm Antimony Surface Soil			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	1
Minimum	0.195	Mean	34.2
Maximum	89.5	Median	25.17
SD	38.33	Std. Error of Mean	15.65
Coefficient of Variation	1.121	Skewness	0.502
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.854	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.284	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	65.73	95% Adjusted-CLT UCL (Chen-1995)	63.36
		95% Modified-t UCL (Johnson-1978)	66.26
Gamma GOF Test			
A-D Test Statistic	0.47	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.264	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.353	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.397	k star (bias corrected MLE)	0.31
Theta hat (MLE)	86.13	Theta star (bias corrected MLE)	110.4
nu hat (MLE)	4.765	nu star (bias corrected)	3.716
MLE Mean (bias corrected)	34.2	MLE Sd (bias corrected)	61.46
		Approximate Chi Square Value (0.05)	0.613
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	0.29
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	207.4	95% Adjusted Gamma UCL (use when n<50)	438.1
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.852	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.264	**Lilliefors Lognormal GOF Test**	

5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.635	Mean of logged Data	1.873
Maximum of Logged Data	4.494	SD of logged Data	2.721
Assuming Lognormal Distribution			
95% H-UCL	79518617	90% Chebyshev (MVUE) UCL	238.2
95% Chebyshev (MVUE) UCL	315.7	97.5% Chebyshev (MVUE) UCL	423.3
99% Chebyshev (MVUE) UCL	634.6		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	59.93	95% Jackknife UCL	65.73
95% Standard Bootstrap UCL	57.47	95% Bootstrap-t UCL	67.9
95% Hall's Bootstrap UCL	52.94	95% Percentile Bootstrap UCL	59.17
95% BCA Bootstrap UCL	59.82		
90% Chebyshev(Mean, Sd) UCL	81.14	95% Chebyshev(Mean, Sd) UCL	102.4
97.5% Chebyshev(Mean, Sd) UCL	131.9	99% Chebyshev(Mean, Sd) UCL	189.9
Suggested UCL to Use			
95% Student's-t UCL	65.73		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Target Berm Copper Surface Soil			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	1
Minimum	16.9	Mean	470.5
Maximum	1830	Median	177.5
SD	703.4	Std. Error of Mean	287.2
Coefficient of Variation	1.495	Skewness	1.944
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.736	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.264	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1049	95% Adjusted-CLT UCL (Chen-1995)	1186
		95% Modified-t UCL (Johnson-1978)	1087

Table A2-15: ProUCL 5.1 Output for Target Berm DU

Gamma GOF Test			
A-D Test Statistic	0.331	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.735	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.234	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.348	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.512	k star (bias corrected MLE)	0.367
Theta hat (MLE)	918.3	Theta star (bias corrected MLE)	1281
nu hat (MLE)	6.148	nu star (bias corrected)	4.407
MLE Mean (bias corrected)	470.5	MLE Sd (bias corrected)	776.3
		Approximate Chi Square Value (0.05)	0.889
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	0.452
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2333	95% Adjusted Gamma UCL (use when n<50)	4587
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.924	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.177	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.827	Mean of logged Data	4.919
Maximum of Logged Data	7.512	SD of logged Data	1.908
Assuming Lognormal Distribution			
95% H-UCL	452817	90% Chebyshev (MVUE) UCL	1523
95% Chebyshev (MVUE) UCL	1988	97.5% Chebyshev (MVUE) UCL	2634
99% Chebyshev (MVUE) UCL	3904		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	942.8	95% Jackknife UCL	1049
95% Standard Bootstrap UCL	898.9	95% Bootstrap-t UCL	2969
95% Hall's Bootstrap UCL	3315	95% Percentile Bootstrap UCL	936.8
95% BCA Bootstrap UCL	1118		
90% Chebyshev(Mean, Sd) UCL	1332	95% Chebyshev(Mean, Sd) UCL	1722
97.5% Chebyshev(Mean, Sd) UCL	2264	99% Chebyshev(Mean, Sd) UCL	3328
Suggested UCL to Use			
95% Student's-t UCL	1049		
When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test			
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Target Berm Lead Surface Soil			

Table A2-15: ProUCL 5.1 Output for Target Berm DU

General Statistics			
Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	41.2	Mean	5347
Maximum	17500	Median	1130
SD	6875	Std. Error of Mean	2599
Coefficient of Variation	1.286	Skewness	1.036
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.813	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.302	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.304	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	10396	95% Adjusted-CLT UCL (Chen-1995)	10708
		95% Modified-t UCL (Johnson-1978)	10566
Gamma GOF Test			
A-D Test Statistic	0.488	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.773	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.244	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.37	k star (bias corrected MLE)	0.307
Theta hat (MLE)	14434	Theta star (bias corrected MLE)	17422
nu hat (MLE)	5.186	nu star (bias corrected)	4.297
MLE Mean (bias corrected)	5347	MLE Sd (bias corrected)	9651
		Approximate Chi Square Value (0.05)	0.842
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	0.478
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	27275	95% Adjusted Gamma UCL (use when n<50)	48049
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.86	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.228	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.718	Mean of logged Data	6.786
Maximum of Logged Data	9.77	SD of logged Data	2.625
Assuming Lognormal Distribution			
95% H-UCL	3.243E+8	90% Chebyshev (MVUE) UCL	30995
95% Chebyshev (MVUE) UCL	40990	97.5% Chebyshev (MVUE) UCL	54863
99% Chebyshev (MVUE) UCL	82115		

Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	9621	95% Jackknife UCL	10396
95% Standard Bootstrap UCL	9320	95% Bootstrap-t UCL	14439
95% Hall's Bootstrap UCL	8948	95% Percentile Bootstrap UCL	9797
95% BCA Bootstrap UCL	9947		
90% Chebyshev(Mean, Sd) UCL	13143	95% Chebyshev(Mean, Sd) UCL	16674
97.5% Chebyshev(Mean, Sd) UCL	21575	99% Chebyshev(Mean, Sd) UCL	31203
Suggested UCL to Use			
95% Student's-t UCL	10396		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Target Berm Zinc Surface Soil			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	1
Minimum	62.2	Mean	132.6
Maximum	292	Median	105.1
SD	85.43	Std. Error of Mean	34.88
Coefficient of Variation	0.644	Skewness	1.652
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.831	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.239	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	202.9	95% Adjusted-CLT UCL (Chen-1995)	215.1
		95% Modified-t UCL (Johnson-1978)	206.8
Gamma GOF Test			
A-D Test Statistic	0.321	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.701	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.188	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.334	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.602	k star (bias corrected MLE)	1.912
Theta hat (MLE)	36.81	Theta star (bias corrected MLE)	69.35
nu hat (MLE)	43.23	nu star (bias corrected)	22.95
MLE Mean (bias corrected)	132.6	MLE Sd (bias corrected)	95.9

		Approximate Chi Square Value (0.05)	13.05
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	10.46
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	233.2	95% Adjusted Gamma UCL (use when n<50)	290.9
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.153	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.13	Mean of logged Data	4.742
Maximum of Logged Data	5.677	SD of logged Data	0.568
Assuming Lognormal Distribution			
95% H-UCL	274.7	90% Chebyshev (MVUE) UCL	221.6
95% Chebyshev (MVUE) UCL	262.7	97.5% Chebyshev (MVUE) UCL	319.8
99% Chebyshev (MVUE) UCL	431.9		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	190	95% Jackknife UCL	202.9
95% Standard Bootstrap UCL	184.1	95% Bootstrap-t UCL	292.4
95% Hall's Bootstrap UCL	460.9	95% Percentile Bootstrap UCL	187.2
95% BCA Bootstrap UCL	204.5		
90% Chebyshev(Mean, Sd) UCL	237.2	95% Chebyshev(Mean, Sd) UCL	284.6
97.5% Chebyshev(Mean, Sd) UCL	350.4	99% Chebyshev(Mean, Sd) UCL	479.6
Suggested UCL to Use			
95% Student's-t UCL	202.9		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Target Berm Antimony Total Soil			
General Statistics			
Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	1
Minimum	0.195	Mean	30.68
Maximum	89.5	Median	20.14
SD	33.96	Std. Error of Mean	12.01
Coefficient of Variation	1.107	Skewness	0.759
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.862	**Shapiro Wilk GOF Test**	

5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.271	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	53.43	95% Adjusted-CLT UCL (Chen-1995)	53.87
		95% Modified-t UCL (Johnson-1978)	53.96
Gamma GOF Test			
A-D Test Statistic	0.386	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.768	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.217	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.31	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.471	k star (bias corrected MLE)	0.377
Theta hat (MLE)	65.21	Theta star (bias corrected MLE)	81.3
nu hat (MLE)	7.528	nu star (bias corrected)	6.038
MLE Mean (bias corrected)	30.68	MLE Sd (bias corrected)	49.94
		Approximate Chi Square Value (0.05)	1.66
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	1.146
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	111.6	95% Adjusted Gamma UCL (use when n<50)	161.6
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.875	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.234	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.635	Mean of logged Data	2.061
Maximum of Logged Data	4.494	SD of logged Data	2.378
Assuming Lognormal Distribution			
95% H-UCL	86798	90% Chebyshev (MVUE) UCL	197.8
95% Chebyshev (MVUE) UCL	260.2	97.5% Chebyshev (MVUE) UCL	346.8
99% Chebyshev (MVUE) UCL	517		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	50.43	95% Jackknife UCL	53.43
95% Standard Bootstrap UCL	48.98	95% Bootstrap-t UCL	61.64
95% Hall's Bootstrap UCL	52.62	95% Percentile Bootstrap UCL	49.9
95% BCA Bootstrap UCL	51.33		
90% Chebyshev(Mean, Sd) UCL	66.7	95% Chebyshev(Mean, Sd) UCL	83.01
97.5% Chebyshev(Mean, Sd) UCL	105.7	99% Chebyshev(Mean, Sd) UCL	150.1
Suggested UCL to Use			
95% Student's-t UCL	53.43		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			

Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Target Berm Copper Total Soil			
General Statistics			
Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	1
Minimum	16.9	Mean	481.1
Maximum	1830	Median	181.6
SD	641.2	Std. Error of Mean	226.7
Coefficient of Variation	1.333	Skewness	1.6
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.784	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.242	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	910.6	95% Adjusted-CLT UCL (Chen-1995)	991
		95% Modified-t UCL (Johnson-1978)	932
Gamma GOF Test			
A-D Test Statistic	0.354	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.244	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.308	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.564	k star (bias corrected MLE)	0.436
Theta hat (MLE)	853.7	Theta star (bias corrected MLE)	1105
nu hat (MLE)	9.017	nu star (bias corrected)	6.969
MLE Mean (bias corrected)	481.1	MLE Sd (bias corrected)	729
		Approximate Chi Square Value (0.05)	2.154
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	1.542
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1557	95% Adjusted Gamma UCL (use when n<50)	2174
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.923	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.191	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.827	Mean of logged Data	5.069

Maximum of Logged Data	7.512	SD of logged Data	1.788
Assuming Lognormal Distribution			
95% H-UCL	33183	90% Chebyshev (MVUE) UCL	1565
95% Chebyshev (MVUE) UCL	2026	97.5% Chebyshev (MVUE) UCL	2666
99% Chebyshev (MVUE) UCL	3924		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	854	95% Jackknife UCL	910.6
95% Standard Bootstrap UCL	833.9	95% Bootstrap-t UCL	1531
95% Hall's Bootstrap UCL	2327	95% Percentile Bootstrap UCL	858.5
95% BCA Bootstrap UCL	968		
90% Chebyshev(Mean, Sd) UCL	1161	95% Chebyshev(Mean, Sd) UCL	1469
97.5% Chebyshev(Mean, Sd) UCL	1897	99% Chebyshev(Mean, Sd) UCL	2737
Suggested UCL to Use			
95% Student's-t UCL	910.6		
When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test			
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Target Berm Lead Total Soil			
General Statistics			
Total Number of Observations	9	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	41.2	Mean	4957
Maximum	17500	Median	1130
SD	6162	Std. Error of Mean	2054
Coefficient of Variation	1.243	Skewness	1.173
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.82	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.288	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.274	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	8776	95% Adjusted-CLT UCL (Chen-1995)	9193
		95% Modified-t UCL (Johnson-1978)	8910
Gamma GOF Test			
A-D Test Statistic	0.41	**Anderson-Darling Gamma GOF Test**	

5% A-D Critical Value	0.783	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.194	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.297	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.43	k star (bias corrected MLE)	0.361
Theta hat (MLE)	11522	Theta star (bias corrected MLE)	13735
nu hat (MLE)	7.744	nu star (bias corrected)	6.496
MLE Mean (bias corrected)	4957	MLE Sd (bias corrected)	8251
		Approximate Chi Square Value (0.05)	1.898
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	1.421
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	16962	95% Adjusted Gamma UCL (use when n<50)	22661
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.886	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.216	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.718	Mean of logged Data	6.997
Maximum of Logged Data	9.77	SD of logged Data	2.368
Assuming Lognormal Distribution			
95% H-UCL	4794800	90% Chebyshev (MVUE) UCL	28402
95% Chebyshev (MVUE) UCL	37314	97.5% Chebyshev (MVUE) UCL	49683
99% Chebyshev (MVUE) UCL	73980		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	8335	95% Jackknife UCL	8776
95% Standard Bootstrap UCL	8078	95% Bootstrap-t UCL	10997
95% Hall's Bootstrap UCL	9295	95% Percentile Bootstrap UCL	8262
95% BCA Bootstrap UCL	9100		
90% Chebyshev(Mean, Sd) UCL	11119	95% Chebyshev(Mean, Sd) UCL	13910
97.5% Chebyshev(Mean, Sd) UCL	17784	99% Chebyshev(Mean, Sd) UCL	25393
Suggested UCL to Use			
95% Adjusted Gamma UCL	22661		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Target Berm Zinc Total Soil			
General Statistics			
Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	1

Minimum	62.2	Mean	136.5
Maximum	292	Median	112
SD	75.79	Std. Error of Mean	26.8
Coefficient of Variation	0.555	Skewness	1.37
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.879	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.226	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	187.2	95% Adjusted-CLT UCL (Chen-1995)	194.4
		95% Modified-t UCL (Johnson-1978)	189.4
Gamma GOF Test			
A-D Test Statistic	0.241	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.719	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.184	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.326	k star (bias corrected MLE)	2.787
Theta hat (MLE)	31.54	Theta star (bias corrected MLE)	48.96
nu hat (MLE)	69.22	nu star (bias corrected)	44.59
MLE Mean (bias corrected)	136.5	MLE Sd (bias corrected)	81.74
		Approximate Chi Square Value (0.05)	30.28
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	27.33
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	201	95% Adjusted Gamma UCL (use when n<50)	222.7
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.972	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.151	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.13	Mean of logged Data	4.796
Maximum of Logged Data	5.677	SD of logged Data	0.513
Assuming Lognormal Distribution			
95% H-UCL	218.8	90% Chebyshev (MVUE) UCL	210.2
95% Chebyshev (MVUE) UCL	243.9	97.5% Chebyshev (MVUE) UCL	290.8
99% Chebyshev (MVUE) UCL	382.9		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			

Table A2-15: ProUCL 5.1 Output for Target Berm DU

Nonparametric Distribution Free UCLs			
95% CLT UCL	180.5	95% Jackknife UCL	187.2
95% Standard Bootstrap UCL	178.5	95% Bootstrap-t UCL	227.6
95% Hall's Bootstrap UCL	332.3	95% Percentile Bootstrap UCL	183.7
95% BCA Bootstrap UCL	187.8		
90% Chebyshev(Mean, Sd) UCL	216.9	95% Chebyshev(Mean, Sd) UCL	253.3
97.5% Chebyshev(Mean, Sd) UCL	303.8	99% Chebyshev(Mean, Sd) UCL	403.1
Suggested UCL to Use			
95% Student's-t UCL	187.2		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	ProUCL 5.110/27/2018 10:46:32 AM		
From File	ProUCLInput_KLgw2_a.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Soil Pile Antimony Surface Soil			
General Statistics			
Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	2.24	Mean	21.43
Maximum	58.5	Median	10.2
SD	23.29	Std. Error of Mean	8.801
Coefficient of Variation	1.087	Skewness	1.137
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.773	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.32	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.304	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	38.53	95% Adjusted-CLT UCL (Chen-1995)	39.95
		95% Modified-t UCL (Johnson-1978)	39.16
Gamma GOF Test			
A-D Test Statistic	0.406	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.727	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.209	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.32	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.019	k star (bias corrected MLE)	0.677
Theta hat (MLE)	21.03	Theta star (bias corrected MLE)	31.63
nu hat (MLE)	14.26	nu star (bias corrected)	9.485
MLE Mean (bias corrected)	21.43	MLE Sd (bias corrected)	26.04
		Approximate Chi Square Value (0.05)	3.622
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	2.617
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	56.11	95% Adjusted Gamma UCL (use when n<50)	77.67
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.172	**Lilliefors Lognormal GOF Test**	

5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.806	Mean of logged Data	2.5
Maximum of Logged Data	4.069	SD of logged Data	1.19
Assuming Lognormal Distribution			
95% H-UCL	194.5	90% Chebyshev (MVUE) UCL	50.35
95% Chebyshev (MVUE) UCL	63.43	97.5% Chebyshev (MVUE) UCL	81.59
99% Chebyshev (MVUE) UCL	117.3		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	35.91	95% Jackknife UCL	38.53
95% Standard Bootstrap UCL	35.04	95% Bootstrap-t UCL	89.46
95% Hall's Bootstrap UCL	152.8	95% Percentile Bootstrap UCL	35.39
95% BCA Bootstrap UCL	37.1		
90% Chebyshev(Mean, Sd) UCL	47.83	95% Chebyshev(Mean, Sd) UCL	59.79
97.5% Chebyshev(Mean, Sd) UCL	76.39	99% Chebyshev(Mean, Sd) UCL	109
Suggested UCL to Use			
95% Adjusted Gamma UCL	77.67		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Soil Pile Copper Surface Soil			
General Statistics			
Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	76.6	Mean	488.4
Maximum	1740	Median	202
SD	607	Std. Error of Mean	229.4
Coefficient of Variation	1.243	Skewness	1.896
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.72	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.35	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.304	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	934.2	95% Adjusted-CLT UCL (Chen-1995)	1041

		95% Modified-t UCL (Johnson-1978)	961.6
Gamma GOF Test			
A-D Test Statistic	0.566	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.727	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.286	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.319	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.032	k star (bias corrected MLE)	0.685
Theta hat (MLE)	473.3	Theta star (bias corrected MLE)	713.1
nu hat (MLE)	14.45	nu star (bias corrected)	9.588
MLE Mean (bias corrected)	488.4	MLE Sd (bias corrected)	590.1
		Approximate Chi Square Value (0.05)	3.686
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	2.669
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	1270	95% Adjusted Gamma UCL (use when n<50)	1754
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.921	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.217	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.339	Mean of logged Data	5.634
Maximum of Logged Data	7.462	SD of logged Data	1.09
Assuming Lognormal Distribution			
95% H-UCL	2946	90% Chebyshev (MVUE) UCL	1012
95% Chebyshev (MVUE) UCL	1266	97.5% Chebyshev (MVUE) UCL	1618
99% Chebyshev (MVUE) UCL	2309		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	865.8	95% Jackknife UCL	934.2
95% Standard Bootstrap UCL	831.4	95% Bootstrap-t UCL	3231
95% Hall's Bootstrap UCL	3042	95% Percentile Bootstrap UCL	863.9
95% BCA Bootstrap UCL	1032		
90% Chebyshev(Mean, Sd) UCL	1177	95% Chebyshev(Mean, Sd) UCL	1488
97.5% Chebyshev(Mean, Sd) UCL	1921	99% Chebyshev(Mean, Sd) UCL	2771
Suggested UCL to Use			
95% Adjusted Gamma UCL	1754		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Soil Pile Lead Surface Soil			

Table A2-16: ProUCL 5.1 Output for Soil Pile DU

General Statistics			
Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	672	Mean	3326
Maximum	8980	Median	1660
SD	3268	Std. Error of Mean	1235
Coefficient of Variation	0.983	Skewness	1.243
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.787	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.319	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.304	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	5726	95% Adjusted-CLT UCL (Chen-1995)	5978
		95% Modified-t UCL (Johnson-1978)	5823
Gamma GOF Test			
A-D Test Statistic	0.473	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.723	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.239	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.318	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.384	k star (bias corrected MLE)	0.886
Theta hat (MLE)	2403	Theta star (bias corrected MLE)	3753
nu hat (MLE)	19.38	nu star (bias corrected)	12.41
MLE Mean (bias corrected)	3326	MLE Sd (bias corrected)	3533
		Approximate Chi Square Value (0.05)	5.495
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	4.19
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	7508	95% Adjusted Gamma UCL (use when n<50)	9847
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.928	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.191	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.51	Mean of logged Data	7.707
Maximum of Logged Data	9.103	SD of logged Data	0.96
Assuming Lognormal Distribution			
95% H-UCL	14379	90% Chebyshev (MVUE) UCL	6790
95% Chebyshev (MVUE) UCL	8397	97.5% Chebyshev (MVUE) UCL	10627
99% Chebyshev (MVUE) UCL	15008		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	5358	95% Jackknife UCL	5726
95% Standard Bootstrap UCL	5187	95% Bootstrap-t UCL	13046
95% Hall's Bootstrap UCL	20667	95% Percentile Bootstrap UCL	5267
95% BCA Bootstrap UCL	5582		
90% Chebyshev(Mean, Sd) UCL	7032	95% Chebyshev(Mean, Sd) UCL	8711
97.5% Chebyshev(Mean, Sd) UCL	11041	99% Chebyshev(Mean, Sd) UCL	15617

Suggested UCL to Use

95% Adjusted Gamma UCL	9847		

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Soil Pile Zinc Surface Soil

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	106	Mean	180.7
Maximum	314	Median	134
SD	83.56	Std. Error of Mean	31.58
Coefficient of Variation	0.462	Skewness	0.788

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.851	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.283	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	242.1	95% Adjusted-CLT UCL (Chen-1995)	242.7
		95% Modified-t UCL (Johnson-1978)	243.6

Gamma GOF Test

A-D Test Statistic	0.525	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.71	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.281	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.313	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.901	k star (bias corrected MLE)	3.467

Theta hat (MLE)	30.63	Theta star (bias corrected MLE)	52.12
nu hat (MLE)	82.61	nu star (bias corrected)	48.54
MLE Mean (bias corrected)	180.7	MLE Sd (bias corrected)	97.05
		Approximate Chi Square Value (0.05)	33.55
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	29.83
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	261.5	95% Adjusted Gamma UCL (use when n<50)	294.1
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.872	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.255	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.663	Mean of logged Data	5.11
Maximum of Logged Data	5.749	SD of logged Data	0.444
Assuming Lognormal Distribution			
95% H-UCL	279.8	90% Chebyshev (MVUE) UCL	271.1
95% Chebyshev (MVUE) UCL	312.4	97.5% Chebyshev (MVUE) UCL	369.6
99% Chebyshev (MVUE) UCL	482		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	232.7	95% Jackknife UCL	242.1
95% Standard Bootstrap UCL	228.7	95% Bootstrap-t UCL	289.5
95% Hall's Bootstrap UCL	233.1	95% Percentile Bootstrap UCL	232.4
95% BCA Bootstrap UCL	237.1		
90% Chebyshev(Mean, Sd) UCL	275.5	95% Chebyshev(Mean, Sd) UCL	318.4
97.5% Chebyshev(Mean, Sd) UCL	377.9	99% Chebyshev(Mean, Sd) UCL	494.9
Suggested UCL to Use			
95% Student's-t UCL	242.1		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Soil Pile Antimony Subsurface Soil			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	7
Minimum	36.5	Mean	253.6
Maximum	1080	Median	69.35
SD	411.3	Std. Error of Mean	167.9
Coefficient of Variation	1.622	Skewness	2.29
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			

Normal GOF Test			
Shapiro Wilk Test Statistic	0.627	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.36	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	591.9	95% Adjusted-CLT UCL (Chen-1995)	697.5
		95% Modified-t UCL (Johnson-1978)	618.1
Gamma GOF Test			
A-D Test Statistic	0.707	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.271	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.345	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.696	k star (bias corrected MLE)	0.459
Theta hat (MLE)	364.4	Theta star (bias corrected MLE)	552.4
nu hat (MLE)	8.351	nu star (bias corrected)	5.509
MLE Mean (bias corrected)	253.6	MLE Sd (bias corrected)	374.3
		Approximate Chi Square Value (0.05)	1.394
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	0.781
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	1002	95% Adjusted Gamma UCL (use when n<50)	1790
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.839	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.261	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.597	Mean of logged Data	4.667
Maximum of Logged Data	6.985	SD of logged Data	1.336
Assuming Lognormal Distribution			
95% H-UCL	6145	90% Chebyshev (MVUE) UCL	538.4
95% Chebyshev (MVUE) UCL	687.3	97.5% Chebyshev (MVUE) UCL	893.9
99% Chebyshev (MVUE) UCL	1300		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	529.8	95% Jackknife UCL	591.9
95% Standard Bootstrap UCL	505.5	95% Bootstrap-t UCL	2943
95% Hall's Bootstrap UCL	2052	95% Percentile Bootstrap UCL	569.1
95% BCA Bootstrap UCL	631.6		
90% Chebyshev(Mean, Sd) UCL	757.3	95% Chebyshev(Mean, Sd) UCL	985.5
97.5% Chebyshev(Mean, Sd) UCL	1302	99% Chebyshev(Mean, Sd) UCL	1924
Suggested UCL to Use			

95% Adjusted Gamma UCL	1790		
Recommended UCL exceeds the maximum observation			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Soil Pile Copper Subsurface Soil			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	7
Minimum	675	Mean	1054
Maximum	2060	Median	938
SD	508.3	Std. Error of Mean	207.5
Coefficient of Variation	0.482	Skewness	2.122
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.715	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.393	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1472	95% Adjusted-CLT UCL (Chen-1995)	1587
		95% Modified-t UCL (Johnson-1978)	1502
Gamma GOF Test			
A-D Test Statistic	0.711	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.698	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.36	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.333	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.904	k star (bias corrected MLE)	3.563
Theta hat (MLE)	152.6	Theta star (bias corrected MLE)	295.7
nu hat (MLE)	82.84	nu star (bias corrected)	42.75
MLE Mean (bias corrected)	1054	MLE Sd (bias corrected)	558.1
		Approximate Chi Square Value (0.05)	28.76
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	24.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1566	95% Adjusted Gamma UCL (use when n<50)	1824
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.821	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.335	**Lilliefors Lognormal GOF Test**	

5% Lilliefors Critical Value	0.325	Data Not Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.515	Mean of logged Data	6.886
Maximum of Logged Data	7.63	SD of logged Data	0.395
Assuming Lognormal Distribution			
95% H-UCL	1617	90% Chebyshev (MVUE) UCL	1547
95% Chebyshev (MVUE) UCL	1776	97.5% Chebyshev (MVUE) UCL	2093
99% Chebyshev (MVUE) UCL	2715		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1395	95% Jackknife UCL	1472
95% Standard Bootstrap UCL	1363	95% Bootstrap-t UCL	2079
95% Hall's Bootstrap UCL	3038	95% Percentile Bootstrap UCL	1429
95% BCA Bootstrap UCL	1509		
90% Chebyshev(Mean, Sd) UCL	1676	95% Chebyshev(Mean, Sd) UCL	1958
97.5% Chebyshev(Mean, Sd) UCL	2349	99% Chebyshev(Mean, Sd) UCL	3118
Suggested UCL to Use			
95% Student's-t UCL	1472	or 95% Modified-t UCL	1502
or 95% H-UCL	1617		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
ProUCL computes and outputs H-statistic based UCLs for historical reasons only.			
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.			
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.			
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.			
Siol Pile Lead Subsurface Soil			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	7
Minimum	4920	Mean	18933
Maximum	57200	Median	10220
SD	20227	Std. Error of Mean	8258
Coefficient of Variation	1.068	Skewness	1.785
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.767	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.261	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	35573	95% Adjusted-CLT UCL (Chen-1995)	38948
		95% Modified-t UCL (Johnson-1978)	36576
Gamma GOF Test			
A-D Test Statistic	0.463	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.71	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.278	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.339	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.344	k star (bias corrected MLE)	0.783
Theta hat (MLE)	14082	Theta star (bias corrected MLE)	24169
nu hat (MLE)	16.13	nu star (bias corrected)	9.4
MLE Mean (bias corrected)	18933	MLE Sd (bias corrected)	21392
		Approximate Chi Square Value (0.05)	3.571
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	2.401
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	49847	95% Adjusted Gamma UCL (use when n<50)	74122
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.897	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.259	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.501	Mean of logged Data	9.433
Maximum of Logged Data	10.95	SD of logged Data	0.966
Assuming Lognormal Distribution			
95% H-UCL	112093	90% Chebyshev (MVUE) UCL	39146
95% Chebyshev (MVUE) UCL	48690	97.5% Chebyshev (MVUE) UCL	61938
99% Chebyshev (MVUE) UCL	87959		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	32516	95% Jackknife UCL	35573
95% Standard Bootstrap UCL	31387	95% Bootstrap-t UCL	87513
95% Hall's Bootstrap UCL	100268	95% Percentile Bootstrap UCL	32963
95% BCA Bootstrap UCL	36123		
90% Chebyshev(Mean, Sd) UCL	43707	95% Chebyshev(Mean, Sd) UCL	54928
97.5% Chebyshev(Mean, Sd) UCL	70503	99% Chebyshev(Mean, Sd) UCL	101097
Suggested UCL to Use			
95% Student's-t UCL	35573		
When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test			
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Soil Pile Zinc Subsurface Soil			
General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	7
Minimum	165	Mean	244
Maximum	443	Median	213.5
SD	99.5	Std. Error of Mean	40.62
Coefficient of Variation	0.408	Skewness	2.215
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.669	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.429	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	325.9	95% Adjusted-CLT UCL (Chen-1995)	350.1
		95% Modified-t UCL (Johnson-1978)	332
Gamma GOF Test			
A-D Test Statistic	0.974	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.698	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.415	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.333	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	9.531	k star (bias corrected MLE)	4.877
Theta hat (MLE)	25.6	Theta star (bias corrected MLE)	50.04
nu hat (MLE)	114.4	nu star (bias corrected)	58.52
MLE Mean (bias corrected)	244	MLE Sd (bias corrected)	110.5
		Approximate Chi Square Value (0.05)	41.93
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	36.92
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	340.5	95% Adjusted Gamma UCL (use when n<50)	386.7
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.752	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.393	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.325	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.106	Mean of logged Data	5.444
Maximum of Logged Data	6.094	SD of logged Data	0.335

Assuming Lognormal Distribution			
95% H-UCL	344.9	90% Chebyshev (MVUE) UCL	341.8
95% Chebyshev (MVUE) UCL	386.9	97.5% Chebyshev (MVUE) UCL	449.4
99% Chebyshev (MVUE) UCL	572.3		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	310.8	95% Jackknife UCL	325.9
95% Standard Bootstrap UCL	304.1	95% Bootstrap-t UCL	965.6
95% Hall's Bootstrap UCL	712.9	95% Percentile Bootstrap UCL	320
95% BCA Bootstrap UCL	330.3		
90% Chebyshev(Mean, Sd) UCL	365.9	95% Chebyshev(Mean, Sd) UCL	421.1
97.5% Chebyshev(Mean, Sd) UCL	497.7	99% Chebyshev(Mean, Sd) UCL	648.2
Suggested UCL to Use			
95% Student's-t UCL	325.9	or 95% Modified-t UCL	332
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Soil Pile Antimony Total Soil			
General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	2.24	Mean	128.6
Maximum	1080	Median	40.4
SD	292	Std. Error of Mean	80.99
Coefficient of Variation	2.271	Skewness	3.364
Normal GOF Test			
Shapiro Wilk Test Statistic	0.459	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.389	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.234	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	272.9	95% Adjusted-CLT UCL (Chen-1995)	342.5
		95% Modified-t UCL (Johnson-1978)	285.5
Gamma GOF Test			
A-D Test Statistic	0.893	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.795	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.258	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.251	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.472	k star (bias corrected MLE)	0.415
Theta hat (MLE)	272.3	Theta star (bias corrected MLE)	310.1
nu hat (MLE)	12.28	nu star (bias corrected)	10.78

MLE Mean (bias corrected)	128.6	MLE Sd (bias corrected)	199.7
		Approximate Chi Square Value (0.05)	4.435
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	3.871
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	312.6	95% Adjusted Gamma UCL (use when n<50)	358
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.973	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.139	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.234	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.806	Mean of logged Data	3.5
Maximum of Logged Data	6.985	SD of logged Data	1.648
Assuming Lognormal Distribution			
95% H-UCL	885.2	90% Chebyshev (MVUE) UCL	267.1
95% Chebyshev (MVUE) UCL	340.2	97.5% Chebyshev (MVUE) UCL	441.7
99% Chebyshev (MVUE) UCL	641.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	261.8	95% Jackknife UCL	272.9
95% Standard Bootstrap UCL	257.5	95% Bootstrap-t UCL	1169
95% Hall's Bootstrap UCL	800.6	95% Percentile Bootstrap UCL	278.5
95% BCA Bootstrap UCL	375.6		
90% Chebyshev(Mean, Sd) UCL	371.5	95% Chebyshev(Mean, Sd) UCL	481.6
97.5% Chebyshev(Mean, Sd) UCL	634.3	99% Chebyshev(Mean, Sd) UCL	934.4
Suggested UCL to Use			
99% Chebyshev (Mean, Sd) UCL	934.4		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Soil Pile Copper Total Soil			
General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	76.6	Mean	749.2
Maximum	2060	Median	733
SD	614.7	Std. Error of Mean	170.5
Coefficient of Variation	0.82	Skewness	0.95
Normal GOF Test			
Shapiro Wilk Test Statistic	0.882	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.202	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.234	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Table A2-16: ProUCL 5.1 Output for Soil Pile DU

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1053	95% Adjusted-CLT UCL (Chen-1995)	1078
		95% Modified-t UCL (Johnson-1978)	1061
Gamma GOF Test			
A-D Test Statistic	0.446	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.183	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.241	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.37	k star (bias corrected MLE)	1.105
Theta hat (MLE)	546.9	Theta star (bias corrected MLE)	678
nu hat (MLE)	35.62	nu star (bias corrected)	28.73
MLE Mean (bias corrected)	749.2	MLE Sd (bias corrected)	712.7
		Approximate Chi Square Value (0.05)	17.5
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	16.26
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1230	95% Adjusted Gamma UCL (use when n<50)	1324
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.23	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.234	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.339	Mean of logged Data	6.212
Maximum of Logged Data	7.63	SD of logged Data	1.04
Assuming Lognormal Distribution			
95% H-UCL	2054	90% Chebyshev (MVUE) UCL	1564
95% Chebyshev (MVUE) UCL	1906	97.5% Chebyshev (MVUE) UCL	2381
99% Chebyshev (MVUE) UCL	3315		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1030	95% Jackknife UCL	1053
95% Standard Bootstrap UCL	1020	95% Bootstrap-t UCL	1139
95% Hall's Bootstrap UCL	1227	95% Percentile Bootstrap UCL	1023
95% BCA Bootstrap UCL	1085		
90% Chebyshev(Mean, Sd) UCL	1261	95% Chebyshev(Mean, Sd) UCL	1492
97.5% Chebyshev(Mean, Sd) UCL	1814	99% Chebyshev(Mean, Sd) UCL	2446
Suggested UCL to Use			
95% Student's-t UCL	1053		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Table A2-16: ProUCL 5.1 Output for Soil Pile DU

Soil Pile Lead Total Soil			
General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	672	Mean	10529
Maximum	57200	Median	6040
SD	15537	Std. Error of Mean	4309
Coefficient of Variation	1.476	Skewness	2.641
Normal GOF Test			
Shapiro Wilk Test Statistic	0.642	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.309	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.234	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	18210	95% Adjusted-CLT UCL (Chen-1995)	20990
		95% Modified-t UCL (Johnson-1978)	18736
Gamma GOF Test			
A-D Test Statistic	0.452	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.769	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.174	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.245	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.784	k star (bias corrected MLE)	0.655
Theta hat (MLE)	13424	Theta star (bias corrected MLE)	16084
nu hat (MLE)	20.39	nu star (bias corrected)	17.02
MLE Mean (bias corrected)	10529	MLE Sd (bias corrected)	13014
		Approximate Chi Square Value (0.05)	8.687
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	7.852
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	20630	95% Adjusted Gamma UCL (use when n<50)	22825
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.115	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.234	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.51	Mean of logged Data	8.503
Maximum of Logged Data	10.95	SD of logged Data	1.285
Assuming Lognormal Distribution			
95% H-UCL	39286	90% Chebyshev (MVUE) UCL	22190
95% Chebyshev (MVUE) UCL	27627	97.5% Chebyshev (MVUE) UCL	35173
99% Chebyshev (MVUE) UCL	49996		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			

Nonparametric Distribution Free UCLs			
95% CLT UCL	17617	95% Jackknife UCL	18210
95% Standard Bootstrap UCL	17424	95% Bootstrap-t UCL	33536
95% Hall's Bootstrap UCL	47654	95% Percentile Bootstrap UCL	17811
95% BCA Bootstrap UCL	21982		
90% Chebyshev(Mean, Sd) UCL	23457	95% Chebyshev(Mean, Sd) UCL	29313
97.5% Chebyshev(Mean, Sd) UCL	37440	99% Chebyshev(Mean, Sd) UCL	53405
Suggested UCL to Use			
95% Adjusted Gamma UCL	22825		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Soil Pile Zinc Total Soil			
General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	106	Mean	209.9
Maximum	443	Median	211
SD	93.24	Std. Error of Mean	25.86
Coefficient of Variation	0.444	Skewness	1.3
Normal GOF Test			
Shapiro Wilk Test Statistic	0.879	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.226	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.234	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	256	95% Adjusted-CLT UCL (Chen-1995)	262.4
		95% Modified-t UCL (Johnson-1978)	257.6
Gamma GOF Test			
A-D Test Statistic	0.391	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.735	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.17	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.237	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.201	k star (bias corrected MLE)	4.821
Theta hat (MLE)	33.85	Theta star (bias corrected MLE)	43.54
nu hat (MLE)	161.2	nu star (bias corrected)	125.4
MLE Mean (bias corrected)	209.9	MLE Sd (bias corrected)	95.61
		Approximate Chi Square Value (0.05)	100.5
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	97.32
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	261.9	95% Adjusted Gamma UCL (use when n<50)	270.4
Lognormal GOF Test			

Shapiro Wilk Test Statistic	0.946	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.19	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.234	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.663	Mean of logged Data	5.264
Maximum of Logged Data	6.094	SD of logged Data	0.419
Assuming Lognormal Distribution			
95% H-UCL	269.4	90% Chebyshev (MVUE) UCL	283.8
95% Chebyshev (MVUE) UCL	317.5	97.5% Chebyshev (MVUE) UCL	364.3
99% Chebyshev (MVUE) UCL	456.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	252.5	95% Jackknife UCL	256
95% Standard Bootstrap UCL	250.2	95% Bootstrap-t UCL	270.6
95% Hall's Bootstrap UCL	302.6	95% Percentile Bootstrap UCL	254.7
95% BCA Bootstrap UCL	260.5		
90% Chebyshev(Mean, Sd) UCL	287.5	95% Chebyshev(Mean, Sd) UCL	322.6
97.5% Chebyshev(Mean, Sd) UCL	371.4	99% Chebyshev(Mean, Sd) UCL	467.2
Suggested UCL to Use			
95% Student's-t UCL	256		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Table A2-17: ProUCL 5.1 Output for Firing Point DU

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	ProUCL 5.110/27/2018 10:47:58 AM		
From File	ProUCLInput_KLgw2_b.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Firing Point Nitroglycerin Surface Soil			
General Statistics			
Total Number of Observations	9	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	0.002	Mean	0.575
Maximum	1.3	Median	0.55
SD	0.433	Std. Error of Mean	0.144
Coefficient of Variation	0.753	Skewness	0.72
Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use			
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.			
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).			
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1			
Normal GOF Test			
Shapiro Wilk Test Statistic	0.911	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.2	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.844	95% Adjusted-CLT UCL (Chen-1995)	0.85
		95% Modified-t UCL (Johnson-1978)	0.85
Gamma GOF Test			
A-D Test Statistic	0.687	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.28	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.288	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.872	k star (bias corrected MLE)	0.655
Theta hat (MLE)	0.66	Theta star (bias corrected MLE)	0.878
nu hat (MLE)	15.69	nu star (bias corrected)	11.8
MLE Mean (bias corrected)	0.575	MLE Sd (bias corrected)	0.711
		Approximate Chi Square Value (0.05)	5.093
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	4.203
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.332	95% Adjusted Gamma UCL (use when n<50)	1.614
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.671	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.364	**Lilliefors Lognormal GOF Test**	

Table A2-17: ProUCL 5.1 Output for Firing Point DU

5% Lilliefors Critical Value	0.274	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-6.215	Mean of logged Data	-1.226
Maximum of Logged Data	0.262	SD of logged Data	1.958
Assuming Lognormal Distribution			
95% H-UCL	96.3	90% Chebyshev (MVUE) UCL	3.848
95% Chebyshev (MVUE) UCL	5.001	97.5% Chebyshev (MVUE) UCL	6.602
99% Chebyshev (MVUE) UCL	9.748		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.813	95% Jackknife UCL	0.844
95% Standard Bootstrap UCL	0.792	95% Bootstrap-t UCL	0.965
95% Hall's Bootstrap UCL	1.114	95% Percentile Bootstrap UCL	0.806
95% BCA Bootstrap UCL	0.835		
90% Chebyshev(Mean, Sd) UCL	1.008	95% Chebyshev(Mean, Sd) UCL	1.205
97.5% Chebyshev(Mean, Sd) UCL	1.477	99% Chebyshev(Mean, Sd) UCL	2.012
Suggested UCL to Use			
95% Student's-t UCL	0.844		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	ProUCL 5.110/27/2018 10:49:56 AM		
From File	ProUCLInput_KLgw2_d.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
French Drain Antimony Sediment			
General Statistics			
Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	1
Minimum	0.092	Mean	0.298
Maximum	0.638	Median	0.277
SD	0.155	Std. Error of Mean	0.0492
Coefficient of Variation	0.522	Skewness	1.084
Normal GOF Test			
Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.174	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.388	95% Adjusted-CLT UCL (Chen-1995)	0.397
		95% Modified-t UCL (Johnson-1978)	0.391
Gamma GOF Test			
A-D Test Statistic	0.133	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.729	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.108	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.268	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.147	k star (bias corrected MLE)	2.97
Theta hat (MLE)	0.0718	Theta star (bias corrected MLE)	0.1
nu hat (MLE)	82.94	nu star (bias corrected)	59.39
MLE Mean (bias corrected)	0.298	MLE Sd (bias corrected)	0.173
		Approximate Chi Square Value (0.05)	42.67
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	40.22
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.414	95% Adjusted Gamma UCL (use when n<50)	0.44
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.986	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.122	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.386	Mean of logged Data	-1.337

Maximum of Logged Data	-0.449	SD of logged Data	0.545
Assuming Lognormal Distribution			
95% H-UCL	0.461	90% Chebyshev (MVUE) UCL	0.458
95% Chebyshev (MVUE) UCL	0.529	97.5% Chebyshev (MVUE) UCL	0.629
99% Chebyshev (MVUE) UCL	0.824		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.379	95% Jackknife UCL	0.388
95% Standard Bootstrap UCL	0.374	95% Bootstrap-t UCL	0.421
95% Hall's Bootstrap UCL	0.522	95% Percentile Bootstrap UCL	0.38
95% BCA Bootstrap UCL	0.402		
90% Chebyshev(Mean, Sd) UCL	0.445	95% Chebyshev(Mean, Sd) UCL	0.512
97.5% Chebyshev(Mean, Sd) UCL	0.605	99% Chebyshev(Mean, Sd) UCL	0.787
Suggested UCL to Use			
95% Student's-t UCL	0.388		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
French Drain Copper Sediment			
General Statistics			
Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	1
Minimum	6.63	Mean	22.47
Maximum	38.7	Median	21
SD	10.04	Std. Error of Mean	3.175
Coefficient of Variation	0.447	Skewness	-0.00302
Normal GOF Test			
Shapiro Wilk Test Statistic	0.962	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.161	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	28.29	95% Adjusted-CLT UCL (Chen-1995)	27.69
		95% Modified-t UCL (Johnson-1978)	28.29
Gamma GOF Test			
A-D Test Statistic	0.334	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.729	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.19	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.268	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.581	k star (bias corrected MLE)	3.273
Theta hat (MLE)	4.906	Theta star (bias corrected MLE)	6.866

nu hat (MLE)	91.62	nu star (bias corrected)	65.47
MLE Mean (bias corrected)	22.47	MLE Sd (bias corrected)	12.42
		Approximate Chi Square Value (0.05)	47.85
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	45.24
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	30.75	95% Adjusted Gamma UCL (use when n<50)	32.52
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.219	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.892	Mean of logged Data	2.999
Maximum of Logged Data	3.656	SD of logged Data	0.539
Assuming Lognormal Distribution			
95% H-UCL	34.91	90% Chebyshev (MVUE) UCL	34.74
95% Chebyshev (MVUE) UCL	40.13	97.5% Chebyshev (MVUE) UCL	47.61
99% Chebyshev (MVUE) UCL	62.31		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	27.7	95% Jackknife UCL	28.29
95% Standard Bootstrap UCL	27.37	95% Bootstrap-t UCL	28.35
95% Hall's Bootstrap UCL	27.57	95% Percentile Bootstrap UCL	27.44
95% BCA Bootstrap UCL	27.56		
90% Chebyshev(Mean, Sd) UCL	32	95% Chebyshev(Mean, Sd) UCL	36.31
97.5% Chebyshev(Mean, Sd) UCL	42.3	99% Chebyshev(Mean, Sd) UCL	54.07
Suggested UCL to Use			
95% Student's-t UCL	28.29		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			
French Drain Lead Sediment			
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	0
Minimum	17.6	Mean	121.6
Maximum	358	Median	106
SD	95.12	Std. Error of Mean	28.68
Coefficient of Variation	0.782	Skewness	1.632
Normal GOF Test			
Shapiro Wilk Test Statistic	0.861	**Shapiro Wilk GOF Test**	

Table A2-18: ProUCL 5.1 Output for French Dran DU

5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.217	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.251	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	173.6	95% Adjusted-CLT UCL (Chen-1995)	183.9
		95% Modified-t UCL (Johnson-1978)	176
Gamma GOF Test			
A-D Test Statistic	0.148	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.122	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.259	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.942	k star (bias corrected MLE)	1.473
Theta hat (MLE)	62.64	Theta star (bias corrected MLE)	82.59
nu hat (MLE)	42.72	nu star (bias corrected)	32.4
MLE Mean (bias corrected)	121.6	MLE Sd (bias corrected)	100.2
		Approximate Chi Square Value (0.05)	20.39
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	18.85
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	193.3	95% Adjusted Gamma UCL (use when n<50)	209.1
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.981	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.113	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.251	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.868	Mean of logged Data	4.522
Maximum of Logged Data	5.881	SD of logged Data	0.828
Assuming Lognormal Distribution			
95% H-UCL	261.8	90% Chebyshev (MVUE) UCL	222.6
95% Chebyshev (MVUE) UCL	266.9	97.5% Chebyshev (MVUE) UCL	328.5
99% Chebyshev (MVUE) UCL	449.3		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	168.8	95% Jackknife UCL	173.6
95% Standard Bootstrap UCL	167.3	95% Bootstrap-t UCL	204.4
95% Hall's Bootstrap UCL	384.4	95% Percentile Bootstrap UCL	168.7
95% BCA Bootstrap UCL	176.1		
90% Chebyshev(Mean, Sd) UCL	207.7	95% Chebyshev(Mean, Sd) UCL	246.6
97.5% Chebyshev(Mean, Sd) UCL	300.7	99% Chebyshev(Mean, Sd) UCL	407
Suggested UCL to Use			
95% Student's-t UCL	173.6		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			

Table A2-18: ProUCL 5.1 Output for French Dran DU

Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
French Drain Zinc Sediment			
General Statistics			
Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	1
Minimum	34.7	Mean	51.77
Maximum	71.1	Median	52.85
SD	10.98	Std. Error of Mean	3.472
Coefficient of Variation	0.212	Skewness	-0.0514
Normal GOF Test			
Shapiro Wilk Test Statistic	0.951	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.172	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	58.13	95% Adjusted-CLT UCL (Chen-1995)	57.42
		95% Modified-t UCL (Johnson-1978)	58.12
Gamma GOF Test			
A-D Test Statistic	0.377	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.198	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	23.58	k star (bias corrected MLE)	16.57
Theta hat (MLE)	2.196	Theta star (bias corrected MLE)	3.124
nu hat (MLE)	471.5	nu star (bias corrected)	331.4
MLE Mean (bias corrected)	51.77	MLE Sd (bias corrected)	12.72
		Approximate Chi Square Value (0.05)	290.2
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	283.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	59.12	95% Adjusted Gamma UCL (use when n<50)	60.51
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.935	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.211	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.547	Mean of logged Data	3.925
Maximum of Logged Data	4.264	SD of logged Data	0.221
Assuming Lognormal Distribution			
95% H-UCL	59.75	90% Chebyshev (MVUE) UCL	62.72
95% Chebyshev (MVUE) UCL	67.67	97.5% Chebyshev (MVUE) UCL	74.54

99% Chebyshev (MVUE) UCL	88.03		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	57.48	95% Jackknife UCL	58.13
95% Standard Bootstrap UCL	57.27	95% Bootstrap-t UCL	57.78
95% Hall's Bootstrap UCL	57.84	95% Percentile Bootstrap UCL	57.12
95% BCA Bootstrap UCL	57.14		
90% Chebyshev(Mean, Sd) UCL	62.19	95% Chebyshev(Mean, Sd) UCL	66.9
97.5% Chebyshev(Mean, Sd) UCL	73.45	99% Chebyshev(Mean, Sd) UCL	86.31
Suggested UCL to Use			
95% Student's-t UCL	58.13		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.			

Table A2-19: ISM Calculator Results for 1-Sided Upper Confidence Limit (UCL) for the Mean

	TARGET BERM DU					FIRING POINT DU
Sample ID	**Antimony**	**Copper**	**Lead**	**Zinc**	**Sample ID**	**Nitroglycerin**
RTR01IS01, Units mg/kg	24.8	636	5720	158	RTR03IS01, Units mg/kg	3.7
RTR01IS02, Units mg/kg	27	481	6180	149	RTR03IS02, Units mg/kg	4.4
RTR01IS03, Units mg/kg	40.1	612	8770	165	RTR03IS03, Units mg/kg	21
Arithmetic Mean	30.6	576	6890	157	Arithmetic Mean	9.7
Standard Deviation	8.27	83.4	1644	8.02	Standard Deviation	9.79
CV = SD / mean	0.27	0.145	0.239	0.051	CV = SD / mean	1.01
count (r)	3	3	3	3	count (r)	3
alpha (95% = 0.05)	0.05	0.05	0.05	0.05	alpha (95% = 0.05)	0.05
t(alpha, df=r-1)	2.92	2.92	2.92	2.92	t(alpha, df=r-1)	2.92
Student's t UCL	44.6	717	9662	171	Student's t UCL	26.2
Chebychev UCL	51.5	786	11028	178	Chebychev UCL	34.3

	BACKGROUND DU				
Sample ID	**Antimony**	**Copper**	**Lead**	**Zinc**	**Nitroglycerin**
RTR04IS01, Units mg/kg	0.244	12	59.2	33.2	0.46
RTR04IS02, Units mg/kg	0.682	12.7	81.8	33.5	0.44
RTR04IS03, Units mg/kg	0.626	10.5	82.3	23	0.38
Arithmetic Mean	0.517	11.7	74.4	29.9	0.427
Standard Deviation	0.238	1.12	13.2	5.98	0.042
CV = SD / mean	0.461	0.096	0.177	0.200	0.098
count (r)	3	3	3	3	3
alpha (95% = 0.05)	0.05	0.05	0.05	0.05	0.05
t(alpha, df=r-1)	2.92	2.92	2.92	2.92	2.92
Student's t UCL	0.919	13.6	96.7	40.0	0.497
Chebychev UCL	1.12	14.6	108	44.9	0.531

Notes:
CV = Coefficient of Variation; DU = Decision Unit; ITRC = Interstate Technology & Regulatory Council; mg/kg = milligrams per kilogram; SD = Standard Deviation; UCL = Upper Confidence Limit

Source: ITRC 2012. Incremental Sampling Methodology, February 2012. https://www.itrcweb.org/ISM-1/4_2_2_UCL_Calculation_Method.html

Attachment 3

Transport and Fate Modeling

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ACRONYMS AND ABBREVIATIONS

ALM	Adult Lead Methodology
BKSF	biokinetic slope factor
CDC	Centers of Disease Control and Prevention
COPC	constituent of potential concern
DABS	dermal absorption factor
DU	decision unit
EPC	exposure point concentration
GIABS	gastrointestinal factor
GSD	geometric standard deviation
HHRA	human health risk assessment
IEUBK	Integrated Exposure Uptake Biokinetic
IR	ingestion rate
IRIS	Integrated Risk Information System
ISM	incremental sampling methodology
m^3/kg	meters cubed per kilogram
µg/dL	micrograms per deciliter
mg/kg	milligrams per kilogram
NHANES	National Health and Nutrition Examination Survey
OLEM	Office of Land and Emergency Management
PbB	blood lead concentration
PEF	particulate emission factor
RAGS	Risk Assessment Guidance for Superfund
RBA	relative bioavailability absorption factor
USEPA	United States Environmental Protection Agency

INTRODUCTION

Environmental transport and fate models are needed when data for constituent concentrations in certain exposure media and/or at certain exposure locations are not available. A transport and fate model may be a simple cross-media transfer calculation (e.g., volatilization from soil) or complex mathematical simulation. This attachment describes the methods and models for evaluating generation of dust from soil. No volatiles were identified as constituents of potential concern (COPCs), therefore soil-to-outdoor air volatilization factors were not needed for the human health risk assessment (HHRA) calculations. Also, this Attachment documents the constituent-specific parameters used to estimate dermal exposure to soil. Finally, lead was identified as a soil COPC for soil; residential and worker exposure to lead in soil was modeled.

Modeling the environmental transport and fate of constituents requires the use of simplified assumptions to simulate the environment. In reality, migration, dispersion, uptake, and degradation of constituents in environmental media involve many complex processes that are not always accurately represented in models. Although the use of models does introduce a source of uncertainty into the overall risk calculations, models are useful tools for developing a general understanding of constituent movement in the environment, which allows the quantitative evaluation of some exposure pathways that would otherwise be limited to a qualitative or descriptive evaluation. The uncertainties associated with modeling environmental transport and fate is discussed in the uncertainty assessment in the HHRA report.

GENERATION OF DUST FROM SOIL

In addition to direct exposure to soil contaminants, human receptors (e.g., the recreational user, outdoor worker, resident, trespasser, utility worker, and construction worker) may be exposed to windblown dust from soils. U.S. Environmental Protection Agency (USEPA) *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (“Supplemental Guidance”; USEPA 2002a) provides the methodology for deriving a particulate emissions factor (PEF) to evaluate this exposure pathway.

The PEF relates the concentration of the constituent in soil with the concentration of dust particles in the air. The PEF is a representation of an annual average emission rate based on wind erosion that should be compared with chronic health criteria. However, it is not appropriate for evaluating the potential for more acute exposures. Table A3-1 presents the equation for deriving the PEF for the receptors listed above (USEPA 2002a). The Ridgway Training Range is roughly 0.22 acre. The area used in the PEF calculation was 0.5 acre which is the model default; any area smaller than 0.5 acre would distort the PEF calculations (USEPA 1996 and 2002a). The former range is primarily covered in grass, other vegetation, and the structures associated with the historic baffled small-arms range; for conservatism, the model default of 50% vegetative site cover was assumed. The vegetation present is likely to 1) prevent soil particulates from being eroded and suspended in air and 2) hinder transported particulates from settling on the ground surface.

The "Supplemental Guidance" recommends using the PEF equation presented in Table A3-1 for residential and commercial/industrial scenarios (USEPA 2002a). Therefore a site-specific PEF of 1.27E+09 cubic meters per kilogram (m^3/kg) was used for the on-site visitor, resident, trespasser, and outdoor worker scenarios. This PEF is appropriate for assessing exposure to wind-blown particulates under a non-excavation scenario.

The "Supplemental Guidance" provides a separate PEF equation for a construction or utility worker scenarios because it is likely that more dust will be generated during excavation activities for utility line repair or construction project (USEPA 2002a). It was assumed that the excavation occurred during a 3-month long time period (i.e., 5 days/week × 4 weeks/month × 3 months/year). The inhalation-of-fugitive-dust pathway analysis suggests that the most significant contribution to exposure comes from disturbance of surface soil by traffic on unpaved roads (USEPA 2002a). Should heavy construction be conducted on the former range, USEPA's "Supplemental Guidance" may be used to derive a separate PEF equation using as much site-specific data as possible (number of hauling trucks, length of unpaved roadway, etc.) to assess fugitive dust exposure for the future construction worker (USEPA 2002a). USEPA default values for equation constants and areal extent were used to derive a construction worker specific dispersion factor (Q_{sr}) 23.02 g/m^2-s per kg/m^3 and assumed a fleet of standard construction equipment (i.e. employee vehicles, full-size pickup trucks, backhoe, bulldozer, and excavator). An unpaved road PEF of 1.07E+07 m^3/kg was calculated for the site as presented in Table A3-2 and used as the PEF for the on-site construction and utility worker scenarios.

DERMAL CONTACT WITH SOIL

Metals can exist in a variety of chemical and physical forms in the environment, and not all forms of a given metal are absorbed to the same extent. The relative bioavailability factor (RBA) is the fraction of an ingested dose that crosses the gastrointestinal epithelium and becomes available for distribution to internal target tissues and organs (USEPA 2007). Table A3-3 presents the RBAs used in the HHRA. For the Ridgway training range, the default RBA of 1 was used for antimony, copper, and nitroglycerin.

USEPA's Office of Research and Development reviewed available experimental data for dermal absorption from contaminated soil and recommended constituent- and class-specific dermal absorption (DABS) factors which are summarized in Exhibit 3-4 in the USEPA *Risk Assessment Guidance for Superfund* (RAGS) Part E guidance (USEPA 2004). The recommendations accounted for the uncertainty associated with different soil types, loading rates, constituent concentrations and other conditions that affect how readily a constituent that is adhered to soil particulates may pass through the skin barrier of a potential receptor. The DABS values used in the HHRA are documented in Table A3-3.

Dermal toxicity values are not available in USEPA's Integrated Risk Information System (IRIS) or other USEPA sources. Therefore, USEPA's RAGS Part E dermal guidance was used for estimating dermal exposure to soil (USEPA 2004). USEPA (2004) recommends adjusting oral toxicity values using gastrointestinal absorption factors (GIABS) to evaluate dermal exposure routes for some constituents. Table A3-3 presents the GIABS values used in the HHRA. The oral-to-dermal adjustment is not required for constituents where 100 percent (i.e., GIABS=1) absorption is assumed (USEPA 2004). A cutoff of 50% gastrointestinal absorption is recommended to reflect the intrinsic variability in the analysis of absorption studies. USEPA (2004) recommends using a GIABS of 15% (GIABS=0.15) for antimony, indicating that the metal is poorly absorbed through the skin and gastrointestinal tract. For the other Ridgway training range COPCs, a default GIABS of 100 percent (GIABS=1) was assumed.

LEAD MODELING

Because most human health effects data for lead are correlated with concentrations in the blood rather than an external dose, the standard cancer risk and non-cancer hazard approach for evaluating health effects cannot be applied to lead.

The Centers for Disease Control and Prevention (CDC) estimates that about a half million US children (ages 1-5) have blood lead levels above 5 micrograms per deciliter (µg/dL); CDC has adopted a blood lead concentration (PbB) threshold of 5 µg/dL or lower to be protective of children (CDC, 2015). The new toxicity information however has not been fully incorporated into USEPA methodologies for evaluating the exposure of children or adults to lead (USEPA 2018a). The HHRA used the existing USEPA PbB threshold of 10 µg/dL (USEPA 2010) and evaluated the PbB threshold of 5 µg/dL in the uncertainty assessment. The goal is to limit the risk to no more than a 5% probability for a young child's or a fetus of a pregnant female worker PbB concentration to exceed the target PbB level in the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) and Adult Lead Methodology (ALM) models, respectively (USEPA 2010 and 2017a). If the probability of 5% is exceeded, then adverse health effects from exposure to lead are possible for the hypothetical child resident or the fetus of the adult female worker.

USEPA's ALM model (version date 6/14/17) was used to estimate risk from exposure to lead in soil for the non-residential adult receptors (USEPA 2017a). Tables A3-4 and A3-5 document the parameter values used in the ALM modeling for the outdoor worker and construction/utility worker scenarios. The baseline PbB is intended to represent the best estimate of a reasonable central value of PbB in women of child-bearing age who are not exposed to lead-contaminated non-residential soil or dust at a site. The USEPA (2017b) Office of Land and Emergency Management (OLEM) Directive recommends using a default baseline value of 0.6 micrograms per deciliter (µg/dL) based on the most recent six years of PbB data (2009-2014) from the National Health and Nutrition Examination Survey (NHANES) representing women 17-45 years of age; therefore, a baseline PbB level of 0.6 µg/dL was used in the ALM model (USEPA, 2017a,b). The USEPA OLEM Directive (2017b) also recommends using a geometric standard deviation PbB of 1.8.

The ALM guidance recommends using central tendency values for soil ingestion and exposure frequency (USEPA 2010). A central tendency soil ingestion rate (IRs) of 0.05 grams/day was used for the outdoor worker calculations and is also the ALM model default value (USEPA 2011 and 2017a). For the construction/utility worker ALM calculations, a higher central tendency IRs of 0.1 grams/day was used (USEPA 2011) was to better represent digging activities for the two scenarios. USEPA recommends using the mean concentration as the exposure point concentration (EPC) in the lead models (USEPA 2018b).

USEPA's target threshold for lead is to limit the risk to no more than a 5 percent chance fetuses exposed to lead would exceed a PbB of 5 µg/dL (USEPA 2010). As shown in Table A3-4 and A3-5, the probability threshold of no more than 5 percent was exceeded for every decision unit (DU) and soil EPC for the outdoor worker scenario for both target PbB thresholds (5 and 10 µg/dL), except for the Background Reference Area DU incremental sampling methodology (ISM) where the surface soil EPC is below the USEPA residential soil action level of 400 mg/kg. Assuming a target PbB threshold of 10 µg/dL, the construction/utility worker results were above 5 percent probability for the Target Berm DU ISM surface soil and Soil Pile discrete total soil EPCs. Similar to the outdoor worker results, the construction/utility worker results were above the target 5 percent probability when a target PbB threshold of 5 µg/dL was assumed. It should be noted that the target PbB threshold of 5 µg/dL is considered the ALM model default PbB threshold (USEPA 2017a). Tables A3-6 and A3-7 summarize the ALM model results for the on-site outdoor worker and construction/utility worker scenario, respectively.

The IEUBK Model (Windows version 1.1, Build 11) consists of four modules (exposure, uptake, biokinetics, and variability) that mathematically and statistically link environmental lead exposure to PbB for a population of children (USEPA 2002b, 2010). USEPA's IEUBK Model was used to assess potential risks for the following scenario for children ages 12 to 72 months (USEPA 2017c). The USEPA IEUBK model predicts the chance that a typical child (ages 0 to 6 years) would have a PbB exceeding the target PbB threshold from background sources (e.g., diet, lead-based paint, drinking water, and indoor dust) as well as exposure to lead in soil at the site.

Table A3-8 presents the parameter values used in the IEUBK Model. Similar to the ALM results, the IEUBK probability results exceeded 5 percent for every DU and soil medium, except for the Background Reference Area DU ISM surface soil EPC which is below the USEPA residential soil action level of 400 mg/kg. The IEUBK model exceeded the probability threshold of 5 percent at a target PbB threshold of 10 µg/dL; therefore the model was not run using 5 µg/dL since adverse health effects were already noted at the higher target PbB threshold of 10 µg/dL.

For the on-site outdoor worker scenario, the Target Berm and Soil Pile DU surface soil and total soil results exceed the 5% probability to limit the risk to no more than a 5% probability for a fetus PbB of a pregnant female worker PbB to exceed the target PbB level; As shown in Table A3-6, the fetal PbBs also exceed the target PbB thresholds of 5 µg/dL and 10 µg/dL. Outdoor worker results are protective of the adult visitor; therefore adverse health effects from exposure to lead in soils are possible for the outdoor worker and the adult visitor.

For the construction/utility worker scenarios, the 5% probability threshold is exceeded for the Target Berm DU ISM surface soil and Soil Pile DU discrete total soil when a target PbB threshold of 10 µg/dL is assumed; the fetal PbBs also exceed the 10 µg/dL target PbB threshold (Table A3-7). When a target PbB threshold of 5 µg/dL is assumed, the surface soil and total soil results for the Target Berm and Soil Pile DUs exceed the target thresholds (5% probability and fetal PbB concentrations).

For the hypothetical child resident, the IEUBK model results exceeded the 5% probability threshold in all cases when the target PbB threshold of 10 µg/dL was assumed (Table A3-8). The IEUBK model was not run using the target PbB threshold of 5 µg/dL due to the high probability percentage results when the 10 ug/dL PbB threshold was used. The hypothetical child resident results are protective of the child visitor scenario; therefore adverse health effects from exposure to lead in soils for the hypothetical child resident and child visitor are possible at the MRS.

Assuming a 10 µg/dL PbB threshold, lead is identified as a surface soil and total soil COC for the outdoor worker at the Target Berm and Soil Pile DUs. Lead is also a surface soil COC at the Target Berm DU and a total soil COC for the Soil Pile DU for the construction/utility workers. However, if a 5 µg/dL PbB threshold is assumed for the construction/utility worker evaluation, lead becomes a surface soil and total soil COC for both DUs. The 2017 release of the ALM model lists 5 µg/dL as the model default target PbB level of concern (USEPA 2017a).

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USEPA 2018b. Lead at Superfund Sites: Frequent Questions from Risk Assessors on the Integrated Exposure Uptake Biokinetic (IEUBK) Model. Last Updated 7 September 2018. https://www.epa.gov/superfund/lead-superfund-sites-frequent-questions-risk-assessors-integrated-exposure-uptake

Tables

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Table A3-1. Site-Specific Particulate Emission Factor Calculations for Non-Excavation Scenarios

1) General Form for Calculating Receptor and Pathway-Specific Dispersion Factors (Q/C) (USEPA, 2002a)

$$Q/C_{wind} = A * \exp[(\ln A_{site} - B)^2 / C]$$

Values	Parameter	Parameter Description
14.0111	A	Constant for Philadelphia (PHL); Climate Zone 8 (unitless)
19.6154	B	Constant for Philadelphia (PHL); Climate Zone 8 (unitless)
225.3397	C	Constant for Philadelphia (PHL); Climate Zone 8 (unitless)
0.5	A_{site}	Areal extent of the site or contamination (acres) (1)
87.37	Q/C_{wind}	Inverse of mean concentration at center of 0.5-acre-square source (g/m^2-s per kg/m^3)

2) Derivation of the Particulate Emission Factor (PEF) (USEPA 2002a)

$$PEF = \frac{Q/C_{wind} * 3{,}600 s/h}{0.036 * (1-V) * (U_m/U_t)^3 * F(x)}$$

Values	Parameter	Parameter Description
87.37	Q/C_{wind}	Inverse of mean concentration at center of 0.5-acre-square source (g/m^2-s per kg/m^3)
0.5	V	Fraction of vegetative cover (unitless)
4.69	Um	Mean annual wind speed (m/s) (USEPA, 2002a)
11.32	Ut	Equivalent threshold value of wind speed at 7m (m/s)
0.194	F(x)	Function dependent on Um/Ut derived from Cowherd et al. 1985 (unitless)
1.27E+09	PEF	Particulate emission factor (m^3/kg)

Notes:

(1) Selected to represent most conservative scenario allowed by the model (0.5 acres).

References:

USEPA. 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24. December 2002a.

Table A3-2. Site-Specific Particulate Emissions Factor Calculations for Excavation Scenarios

1) General Form for Calculating Construction Worker Dispersion Factor (Q/Csr) (USEPA 2002a)

$$Q/C_{sr} = A \times \exp[(\ln A_{site} - B)^2 / C]$$

Values	Parameters	Parameter Description
12.9351	A	Constant (unitless)
5.7383	B	Constant (unitless)
71.7711	C	Constant (unitless)
0.5	A_{site}	Areal extent of the site or contamination (acres)
23.02	Q/C_{sr}	Inverse of mean concentration at center of 0.5-acre-square source (g/m^2-s per kg/m^3)

2) Derivation of the Particulate Emission Factor Construction Scenario (USEPA 2002a)

$$PEF_{sc} = Q/C_{sr} \times 1/F_D \times \frac{T \times A_R}{556 \times (W / 3)^{0.4} \times [(365 \text{ days/year} - p) / 365 \text{ days/year}] \times [SUM (VKT)]}$$

Values	Parameters	Parameter Description
calc, site specific	PEF_{sc}	Unpaved road particulate emission factor (m^3/kg)
site specific	Q/C_{sr}	Inverse of 1-h average air concentration along a straight road segment bisecting a 0.5-acre square site (g/m^2-s per kg/m^3)
0.185	F_D	Dispersion correction factor (unitless)
5184000	T	Total time over which construction occurs (s)
274	A_R	Surface area of contaminated road segment (m^2), Equation: LR × WR × 0.092903 m^2/ft^2
148	L_R	Length of road segment (ft)
20	W_R	Width of road segment (ft)
4.7	W	Mean vehicle weight (tons)
140	p	Number of days with at least 0.01 inches of precipitation (days/year) (Exhibit 5-2; USEPA 2002a)
4.05E+01	SUM (VKT)	Sum of fleet vehicle kilometers traveled during the exposure duration (km)

Site-Specific Assumptions for Construction Site:

Values	Parameters	Parameter Description
T =	5184000	Assume 3-month construction project working (5 days/week x 4 weeks/month x 3 months/year)
A_R =	274	Assume standard road width of 6.09 m
W =	4.7	Assume 10 two-ton cars + 2 ten-ton trucks + 1 ten-ton backhoe + 1 ten-ton bulldozer + 1 ten-ton excavator
SUM (VKT) =	4.05E+01	Assume travel length of road once per day, for length of project, where: = No of fleet vehicles x length of road (km/day) x construction period (days)
PEF_{sc}	1.07E+07	Unpaved road particulate emission factor (m^3/kg)

References:

USEPA. 2002a. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24. December 2002.

Table A3-3. Dermal Absorption Factors and Gastrointestinal Absorptions Factors

Constituent of Potential Concern	Relative Bioavailability Factor (RBA) (unitless)	Dermal Absorption Factor (DABS) (unitless)	Gastrointestinal Absorption Factor (GIABS) (unitless)
Antimony	1	0.01	0.15
Copper	1	0.01	1
Nitroglycerin	1	0.1	1

Notes:

Source for RBAs: (USEPA 2007)

Source for DABS and GIABS: (USEPA 2004)

Table A3-4. Calculation of Blood Lead Concentrations (PbBs) and Risk for the Outdoor Worker Scenario

Variable	Description of Variable	Parameter Source	Units	Target Berm DU, Surface Soil, Discrete	Target Berm DU, Surface Soil, ISM	Target Berm DU, Total Soil, Discrete	Soil Pile DU, Surface Soil, Discrete	Soil Pile DU, Total Soil, Discrete	Background DU, Surface Soil, ISM
PbS	Soil lead concentration, DU-specific	DU-specific	mg/kg	5,347	6,890	4,957	3,326	10,529	74.4
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	(a)	--	0.9	0.9	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	(a)	µg/dL per µg/day	0.4	0.4	0.4	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	(a)	--	1.8	1.8	1.8	1.8	1.8	1.8
PbB_0	Baseline PbB	(a)	µg/dL	0.6	0.6	0.6	0.6	0.6	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	(a, b)	g/day	0.050	0.050	0.050	0.050	0.050	0.050
$AF_{S, D}$	Absorption fraction (same for soil and dust)	(a)	--	0.12	0.12	0.12	0.12	0.12	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	(c)	days/yr	180	180	180	180	180	180
$AT_{S, D}$	Averaging time (same for soil and dust)	(a)	days/yr	365	365	365	365	365	365
PbB_{adult}	PbB of adult worker, geometric mean	calculated	µg/dL	6.9	8.8	6.5	4.5	13.1	0.7
$PbB_{fetal,\ 0.95}$	95th percentile PbB among fetuses of adult workers	calculated	µg/dL	16.4	20.7	15.3	10.7	30.9	1.6
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	(a)	µg/dL	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**calculated**	**%**	**21%**	**34%**	**18%**	**6%**	**61%**	**0.0001%**
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	(a)	µg/dL	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**calculated**	**%**	**65%**	**78%**	**60%**	**37%**	**93%**	**0.02%**

Notes:

ALM Model Version Date is 06/14/2017

ALM = Adult Lead Methodology; DU = Decision Unit; g = grams; ISM = incremental sampling methodology; µg = micrograms; µg/dL = micrograms per deciliter; PbB = blood lead concentration

(a) Model default and recommended OLEM Directive value (USEPA 2017a,b)

(b) A central tendency soil ingestion rate (IRs) of 0.05 grams/day is used for the adult workers (USEPA 2011); it is also the ALM default value (USEPA 2017a).

(c) PADEP Outdoor Worker default exposure frequency.

Table A3-5. Calculation of Blood Lead Concentrations (PbBs) and Risk for the Construction and Utility Worker Scenarios

Variable	Description of Variable	Parameter Source	Units	Target Berm DU, Surface Soil, Discrete	Target Berm DU, Surface Soil, ISM	Target Berm DU, Total Soil, Discrete	Soil Pile DU, Surface Soil, Discrete	Soil Pile DU, Total Soil, Discrete	Background DU, Surface Soil, ISM
PbS	Soil lead concentration, DU-specific	DU-specific	mg/kg	5,347	6,890	4,957	3,326	10,529	74.4
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	(a)	--	0.9	0.9	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	(a)	µg/dL per µg/day	0.4	0.4	0.4	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	(a)	--	1.8	1.8	1.8	1.8	1.8	1.8
PbB_0	Baseline PbB	(a)	µg/dL	0.6	0.6	0.6	0.6	0.6	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	(b)	g/day	0.10	0.10	0.10	0.10	0.10	0.10
$AF_{S, D}$	Absorption fraction (same for soil and dust)	(a)	--	0.12	0.12	0.12	0.12	0.12	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	(c, d)	days/yr	1	1	1	1	1	1
$AT_{S, D}$	Averaging time (same for soil and dust)	(c, d)	days/yr	7	7	7	7	7	7
PbB_{adult}	PbB of adult worker, geometric mean	calculated	µg/dL	4.3	5.3	4.0	2.9	7.8	0.7
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	calculated	µg/dL	10.1	12.6	9.5	6.8	18.5	1.5
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	(a)	µg/dL	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**calculated**	**%**	**5%**	**11%**	**4%**	**1%**	**28%**	**0.0001%**
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	(a)	µg/dL	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**calculated**	**%**	**33%**	**47%**	**29%**	**13%**	**72%**	**0.01%**

Notes:

ALM Model Version Date is 06/14/2017

ALM = Adult Lead Methodology; DU = Decision Unit; g = grams; ISM = incremental sampling methodology; µg = micrograms; µg/dL = micrograms per deciliter; PbB = blood lead concentration

(a) Model default and recommended Office of Land and Emergency Management Directive 9285.6-56 value (USEPA 2017a,b)

(b) A higher central tendency soil ingestion rate (IRs) of 0.10 grams/day was used to represent exposure during excavation activities (USEPA 2011).

(c) A minimum exposure frequency for soil and dust exposure ($EF_{S,D}$) of 13 days per year is used; three months is considered to be the model's minimum exposure to produce a quasi-steady-state PbB concentration using the following equation (USEPA 2016): $EF_{S,D}$ (days/year) = 1 day/week x 4.3 weeks/month x 3 months/year

(d) USEPA (2003) guidance recommends that the averaging time ($AT_{S,D}$) not be annualized for intermittent exposure scenarios so that a quasi-steady state PbB concentration (minimum of 3 months) can be achieved using the following equation: $AT_{S,D}$ (days/year) = 7 days/week x 4.3 weeks/month x 3 months/year

In the model's EF/AT relationship, the conversion factors of 4.3 weeks/month and 3 months/year drop out of the calculation resulting in an $EF_{S,D}$ of 1 day/year and an $AT_{S,D}$ of 7 days/year.

Table A3-6. Adult Lead Methodology Model Results for the On-Site Worker Scenario

On-Site Outdoor Worker Scenario, ALM Model Results							
Decision Unit/Exposure Point	Lead Mean EPC	PbB_{adult}	$PbB_{fetal, 0.95}$	Probability %	10 μg/dL	Probability %	5 μg/dL
		PbB of adult worker, geometric mean	95th percentile PbB among fetuses of adult workers	Target PbB Threshold, 10 μg/dL	Constituent of Concern? (Yes/No)	Target PbB Threshold, 5 μg/dL	Constituent of Concern? (Yes/No)
	mg/kg	μg/dL	μg/dL				
Target Berm DU, Surface Soil, Discrete	5,347	6.9	16	21%	**Yes**	65%	**Yes**
Target Berm DU, Surface Soil, ISM	6,890	8.8	21	34%	**Yes**	78%	**Yes**
Target Berm DU, Total Soil, Discrete	4,957	6.5	15	18%	**Yes**	60%	**Yes**
Soil Pile DU, Surface Soil, Discrete	3,326	4.5	11	6%	**Yes**	37%	**Yes**
Soil Pile DU, Total Soil, Discrete	10,529	13	31	61%	**Yes**	93%	**Yes**
Background DU, Surface Soil, ISM	74.4	0.7	1.6	0.0001%	No	0.02%	No

Notes:
ALM = Adult Lead Methodology; DU = Decision Unit; EPC = exposure point concentration; ug/dL = micrograms per deciliter; mg/kg milligrams per kilogram; PbB = blood lead concentration

Yes = Probability percent (%) exceeds 5% at the target PbB threshold; No = probability percent (%) equals or is below 5% at the target PbB threshold.

Table A3-7. Adult Lead Methodology Model Results for the On-Site Construction/Utility Worker Scenario

On-Site Construction/Utility Worker Scenario, ALM Model Results							
Decision Unit/Exposure Point	**Lead Mean EPC mg/kg**	**PbB_{adult}**	**$PbB_{fetal, 0.95}$**	**Probability %**	**10 µg/dL**	**Probability %**	**5 µg/dL**
		PbB of adult worker, geometric mean µg/dL	**95th percentile PbB among fetuses of adult workers µg/dL**	**Target PbB Threshold, 10 µg/dL**	**Constituent of Concern? (Yes/No)**	**Target PbB Threshold, 5 µg/dL**	**Constituent of Concern? (Yes/No)**
Target Berm DU, Surface Soil, Discrete	5,347	4.3	10	5%	No	33%	**Yes**
Target Berm DU, Surface Soil, ISM	6,890	5	12.6	11%	**Yes**	47%	**Yes**
Target Berm DU, Total Soil, Discrete	4,957	4.0	9.5	4%	No	29%	**Yes**
Soil Pile DU, Surface Soil, Discrete	3,326	2.9	6.8	1%	No	13%	**Yes**
Soil Pile DU, Total Soil, Discrete	10,529	7.8	18.5	28%	**Yes**	72%	**Yes**
Background DU, Surface Soil, ISM	74.4	0.7	1.5	0.0001%	No	0.01%	No

Notes:
ALM = Adult Lead Methodology; DU = Decision Unit; EPC = exposure point concentration; ug/dL = micrograms per deciliter; mg/kg milligrams per kilogram; PbB = blood lead concentration

Yes = Probability percent (%) exceeds 5% at the target PbB threshold; No = probability percent (%) equals or is below 5% at the target PbB threshold.

Table A3-8. Integrated Exposure Uptake Biokinetic (IEUBK) Model Results for Child Resident, Lead in Soil

Lead Site-Specific Soil Concentrations for the Child Resident Scenario				
Area	**EPC**	**10 μg/dL PbB**	**5 μg/dL PbB**	**COC?**
Ridgway Training Range	**Mean (mg/kg)**	**Probability %**	**Probability %**	**(Yes/No)**
Target Berm DU, Discrete SS	5,347	98.5%	No run	Yes
Target Berm DU, ISM SS	6,890	99%	No run	Yes
Target Berm DU, Discrete TS	4,957	98%	No run	Yes
Soil Pile DU, Discrete SS	3,326	93%	No run	Yes
Soil Pile DU, Discrete TS	10,529	100%	No run	Yes

IEUBK Model Parameters			**Value**		**Units**
Indoor air lead concentration (% of outdoor)			30	[a]	%
AIR (by year)					
Air Concentration					
	Age (years) =	0 - 7	0.10	[a]	μg/m^3
Time Outdoors					
	Age (years) =	0 - 1	1	[a]	hours/day
		1 - 2	2	[a]	hours/day
		2 - 3	3	[a]	hours/day
		3 - 7	4	[a]	hours/day
Ventilation Rate					
	Age (years) =	0 - 1	2	[a]	m^3/day
		1 - 2	3	[a]	m^3/day
		2 - 5	5	[a]	m^3/day
		5 - 7	7	[a]	m^3/day
Lung Absorption			32	[a]	%

Table A3-8. Integrated Exposure Uptake Biokinetic (IEUBK) Model Results for Child Resident, Lead in Soil Cont.

DIET (by year)					
Dietary Lead Intake					
	Age (years) =	0 - 1	2.26	[a]	µg Pb/day
		1 - 2	1.96	[a]	µg Pb/day
		2 - 3	2.13	[a]	µg Pb/day
		3 - 4	2.04	[a]	µg Pb/day
		4 - 5	1.95	[a]	µg Pb/day
		5 - 6	2.05	[a]	µg Pb/day
		6 - 7	2.22	[a]	µg Pb/day
ALTERNATE DIET SOURCES (by food class)					
Concentration:					
		home-grown fruits	0	[a]	µg Pb/g
		home-grown vegetables	0	[a]	µg Pb/g
		fish from fishing	0	[a]	µg Pb/g
		game animals from hunting	0	[a]	µg Pb/g
Percent of food class:					
		home-grown fruits	0	[a]	%
		home-grown vegetables	0	[a]	%
		fish from fishing	0	[a]	%
		game animals from hunting	0	[a]	%

Table A3-8. Integrated Exposure Uptake Biokinetic (IEUBK) Model Results for Child Resident, Lead in Soil Cont.

DRINKING WATER					
Lead Concentration in drinking water			4	[a]	µg/L
Ingestion rate:					
	Age (years) =	0 - 1	0.20	[a]	L/day
		1 - 2	0.50	[a]	L/day
		2 - 3	0.52	[a]	L/day
		3 - 4	0.53	[a]	L/day
		4 - 5	0.55	[a]	L/day
		5 - 6	0.58	[a]	L/day
		6 - 7	0.59	[a]	L/day
SOIL/DUST INGESTION					
Concentration:			Soil		
		soil	200	[a]	µg/g
		dust	200	[a]	µg/g
Soil/dust ingestion weighting factor (% soil)			45	[a]	%
Soil/dust ingestion:					
	Age (years) =	0 - 1	0.085	[a]	g/day
		1 - 4	0.135	[a]	g/day
		4 - 5	0.100	[a]	g/day
		5 - 6	0.090	[a]	g/day
		6 - 7	0.085	[a]	g/day
SOIL/DUST MULTIPLE SOURCE ANALYSIS					
Fraction of indoor dust lead attributable to soil			0.70	[a]	unitless
Ratio of dust lead concentration to outdoor air lead concentration			100	[a]	µg Pb/g dust per µg Pb/m^3 air

Table A3-8. Integrated Exposure Uptake Biokinetic (IEUBK) Model Results for Child Resident, Lead in Soil Cont.

BIOAVAILABILITY FOR GUT ABSORPTION PATHWAYS				
Total lead absorption (at low intake):		Surface Soil		
	diet	50	[a]	%
	drinking water	50	[a]	%
	soil	30	[a]	%
	dust	30	[a]	%
	alternate source	0	[c]	%
BIOAVAILABILITY FOR GUT ABSORPTION PATHWAYS (continued)				
Fraction of total net absorption at low intake rate that is attributable to non-saturable (passive) processes		0.2	[a]	unitless
ALTERNATE SOURCES OF LEAD				
Total lead intake:		Soil		
Age (years) =	0 - 7	0	[a]	µg/day
MATERNAL-TO-NEWBORN LEAD EXPOSURE				
Mothers blood lead concentration at childbirth		0.6	[d]	µg/dL
PLOTTING AND RISK ESTIMATION				
Geometric standard deviation (GSD) for blood lead		1.6	[a]	unitless
Blood lead level of concern		10	[b]	µg/dL
COMPUTATION OPTIONS				
Iteration time step for numerical integration		4	[a]	hours

Notes:

-

[1] Young child = 0 - 7 years of age (0 - 84 months)

[a] USEPA 2010 IEUBK model default value.

[b] The same PbB threshold used to derive USEPA's (2018a) Regional Screening Level 400 mg/kg

[c] USEPA (2017b) mother's blood lead concentration of 0.6 in childbirth (µg Pb/dL) was used.

L/day = liters per day

µg/m^3 = micrograms per cubic meter

COC = constituent of concern

DU = Decision Unit

µg/dL = micrograms per deciliter
µg/g = micrograms per gram
mg/kg = milligrams per kilogram

ISM = Incremental Sampling Methodology
SS = Surface Soil
TS = Total Soil

References:

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USEPA. 2007. User's Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK). Office of Superfund Remediation and Technology Innovation. EPA-540-K-01-005. OSWER #9285.7-42. May.

USEPA 2010. Integrated Exposure Uptake Biokinetic Model for Lead in Children, Windows®version (IEUBKwin v1.1 build 11) 32-bit version Office of Superfund Remediation and Technology Innovation, United States Environmental Protection Agency.

USEPA. 2017b. Transmittal of Update to the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters. OLEM Directive 9285.6-56. May 17, 2017

USEPA. 2017c. Transmittal of Update for the Default Age Range in the IEUBK Model. OLEM Directive 9200.2-177. 15 November 2017.

Attachment 4

Cancer Risk and Non-Cancer Hazard Calculations

Table 7-1
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Visitor (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	9.42E-06	mg/kg-day	--	--	--	1.10E-04	mg/kg-day	4.00E-04	mg/kg-day	0.3
				Copper	6.36E+02	mg/kg	1.49E-04	mg/kg-day	--	--	--	1.74E-03	mg/kg-day	3.25E-02	mg/kg-day	0.05
			Exp. Route Total								--					0.3
			Dermal													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	2.23E-07	mg/kg-day	--	--	--	2.61E-06	mg/kg-day	6.00E-05	mg/kg-day	0.04
				Copper	6.36E+02	mg/kg	3.54E-06	mg/kg-day	--	--	--	4.13E-05	mg/kg-day	3.25E-02	mg/kg-day	0.001
			Exp. Route Total								--					0.04
		Exp. Point Total									--					0.4
	Exp. Medium Total										--					0.4
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	3.17E-05	µg/m³	4.65E-08	µg/m³	--	--	--	5.41E-07	µg/m³	--	--	--
				Copper	5.02E-04	µg/m³	7.38E-07	µg/m³	--	--	--	8.59E-06	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.4
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**0.4**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-2
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Visitor (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	2.94E-06	mg/kg-day	--	--	--	1.03E-05	mg/kg-day	4.00E-04	mg/kg-day	0.03
				Copper	6.36E+02	mg/kg	4.67E-05	mg/kg-day	--	--	--	1.63E-04	mg/kg-day	3.25E-02	mg/kg-day	0.005
			Exp. Route Total								--					0.03
			Dermal													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	1.24E-07	mg/kg-day	--	--	--	4.33E-07	mg/kg-day	6.00E-05	mg/kg-day	0.007
				Copper	6.36E+02	mg/kg	1.97E-06	mg/kg-day	--	--	--	6.87E-06	mg/kg-day	3.25E-02	mg/kg-day	0.0002
			Exp. Route Total								--					0.007
		Exp. Point Total									--					0.04
	Exp. Medium Total										--					0.04
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	3.17E-05	µg/m³	1.55E-07	µg/m³	--	--	--	5.41E-07	µg/m³	--	--	--
				Copper	5.02E-04	µg/m³	2.46E-06	µg/m³	--	--	--	8.59E-06	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.04
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**0.04**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-3
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Trespasser (Teen) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	8.54E-07	mg/kg-day	--	--	--	5.97E-06	mg/kg-day	4.00E-04	mg/kg-day	0.01
				Copper	6.36E+02	mg/kg	1.35E-05	mg/kg-day	--	--	--	9.48E-05	mg/kg-day	3.25E-02	mg/kg-day	0.003
			Exp. Route Total								--					0.02
			Dermal													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	9.62E-08	mg/kg-day	--	--	--	6.74E-07	mg/kg-day	6.00E-05	mg/kg-day	0.01
				Copper	6.36E+02	mg/kg	1.53E-06	mg/kg-day	--	--	--	1.07E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0003
			Exp. Route Total								--					0.01
		Exp. Point Total									--					0.03
	Exp. Medium Total										--					0.03
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	3.17E-05	µg/m³	4.97E-08	µg/m³	--	--	--	3.48E-07	µg/m³	--	--	--
				Copper	5.02E-04	µg/m³	7.88E-07	µg/m³	--	--	--	5.52E-06	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.03
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**0.03**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-4
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Commerical/ Industrial Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk $^{(1)}$	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient $^{(1)}$
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	4.41E-06	mg/kg-day	--	--	--	1.24E-05	mg/kg-day	4.00E-04	mg/kg-day	0.03
				Copper	6.36E+02	mg/kg	7.00E-05	mg/kg-day	--	--	--	1.96E-04	mg/kg-day	3.25E-02	mg/kg-day	0.006
			Exp. Route Total								--					0.04
			Dermal													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	3.74E-07	mg/kg-day	--	--	--	1.05E-06	mg/kg-day	6.00E-05	mg/kg-day	0.02
				Copper	6.36E+02	mg/kg	5.93E-06	mg/kg-day	--	--	--	1.66E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0005
			Exp. Route Total								--					0.02
		Exp. Point Total									--					0.05
	Exp. Medium Total										--					0.05
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	3.17E-05	μg/m³	1.86E-06	μg/m³	--	--	--	5.19E-06	μg/m³	--	--	--
				Copper	5.02E-04	μg/m³	2.95E-05	μg/m³	--	--	--	8.24E-05	μg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.05
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	0.05

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-5
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Utility Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	1.30E-07	mg/kg-day	--	--	--	9.06E-06	mg/kg-day	4.00E-04	mg/kg-day	0.02
				Copper	6.36E+02	mg/kg	2.05E-06	mg/kg-day	--	--	--	1.44E-04	mg/kg-day	3.25E-02	mg/kg-day	0.004
			Exp. Route Total								--					0.03
			Dermal													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	2.77E-09	mg/kg-day	--	--	--	1.94E-07	mg/kg-day	6.00E-05	mg/kg-day	0.003
				Copper	6.36E+02	mg/kg	4.39E-08	mg/kg-day	--	--	--	3.07E-06	mg/kg-day	3.25E-02	mg/kg-day	0.00009
			Exp. Route Total								--					0.003
		Exp. Point Total									--					0.03
	Exp. Medium Total										--					0.03
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	3.17E-05	µg/m³	8.26E-09	µg/m³	--	--	--	5.79E-07	µg/m³	--	--	--
				Copper	5.02E-04	µg/m³	1.31E-07	µg/m³	--	--	--	9.19E-06	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.03
										Total of Receptor Risks Across All Media	**--**				**Total of Receptor Hazards Across All Media**	**0.03**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-6
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Construction Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [(1)]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [(1)]
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	3.89E-07	mg/kg-day	--	--	--	2.72E-05	mg/kg-day	4.00E-04	mg/kg-day	0.07
				Copper	6.36E+02	mg/kg	6.16E-06	mg/kg-day	--	--	--	4.31E-04	mg/kg-day	3.25E-02	mg/kg-day	0.01
			Exp. Route Total								--					0.08
			Dermal													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	1.25E-08	mg/kg-day	--	--	--	8.70E-07	mg/kg-day	6.00E-05	mg/kg-day	0.01
				Copper	6.36E+02	mg/kg	1.98E-07	mg/kg-day	--	--	--	1.38E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0004
			Exp. Route Total								--					0.01
		Exp. Point Total									--					0.1
	Exp. Medium Total										--					0.1
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	3.17E-05	µg/m³	2.48E-08	µg/m³	--	--	--	1.74E-06	µg/m³	--	--	--
				Copper	5.02E-04	µg/m³	3.93E-07	µg/m³	--	--	--	2.75E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.1
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	0.1

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-7
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Resident (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	4.41E-05	mg/kg-day	--	--	--	5.13E-04	mg/kg-day	4.00E-04	mg/kg-day	1
				Copper	6.36E+02	mg/kg	7.00E-04	mg/kg-day	--	--	--	8.14E-03	mg/kg-day	3.25E-02	mg/kg-day	0.3
			Exp. Route Total								--					2
			Dermal													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	1.04E-06	mg/kg-day	--	--	--	1.22E-05	mg/kg-day	6.00E-05	mg/kg-day	0.2
				Copper	6.36E+02	mg/kg	1.65E-05	mg/kg-day	--	--	--	1.93E-04	mg/kg-day	3.25E-02	mg/kg-day	0.006
			Exp. Route Total								--					0.2
		Exp. Point Total									--					2
	Exp. Medium Total										--					2
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	3.17E-05	µg/m³	2.17E-07	µg/m³	--	--	--	2.53E-06	µg/m³	--	--	--
				Copper	5.02E-04	µg/m³	3.44E-06	µg/m³	--	--	--	4.01E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					2
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**2**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-8
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Resident (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	1.37E-05	mg/kg-day	--	--	--	4.81E-05	mg/kg-day	4.00E-04	mg/kg-day	0.1
				Copper	6.36E+02	mg/kg	2.18E-04	mg/kg-day	--	--	--	7.63E-04	mg/kg-day	3.25E-02	mg/kg-day	0.02
			Exp. Route Total								--					0.1
			Dermal													
				Metals (Total)												
				Antimony	4.01E+01	mg/kg	5.81E-07	mg/kg-day	--	--	--	2.03E-06	mg/kg-day	6.00E-05	mg/kg-day	0.03
				Copper	6.36E+02	mg/kg	9.22E-06	mg/kg-day	--	--	--	3.22E-05	mg/kg-day	3.25E-02	mg/kg-day	0.001
			Exp. Route Total								--					0.03
		Exp. Point Total									--					0.2
	Exp. Medium Total										--					0.2
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	3.17E-05	µg/m^3	7.22E-07	µg/m^3	--	--	--	2.53E-06	µg/m^3	--	--	--
				Copper	5.02E-04	µg/m^3	1.14E-05	µg/m^3	--	--	--	4.01E-05	µg/m^3	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.2
										Total of Receptor Risks Across All Media	**--**				**Total of Receptor Hazards Across All Media**	**0.2**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-9
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Future On-Site Visitor (Child) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	1.25E-05	mg/kg-day	--	--	--	1.46E-04	mg/kg-day	4.00E-04	mg/kg-day	0.4
				Copper	9.11E+02	mg/kg	2.14E-04	mg/kg-day	--	--	--	2.50E-03	mg/kg-day	3.25E-02	mg/kg-day	0.08
			Exp. Route Total								--					0.4
			Dermal													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	2.97E-07	mg/kg-day	--	--	--	3.47E-06	mg/kg-day	6.00E-05	mg/kg-day	0.06
				Copper	9.11E+02	mg/kg	5.07E-06	mg/kg-day	--	--	--	5.92E-05	mg/kg-day	3.25E-02	mg/kg-day	0.002
			Exp. Route Total								--					0.06
		Exp. Point Total									--					0.5
	Exp. Medium Total										--					0.5
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.22E-05	µg/m³	6.20E-08	µg/m³	--	--	--	7.21E-07	µg/m³	--	--	--
				Copper	7.19E-04	µg/m³	1.06E-06	µg/m³	--	--	--	1.23E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.5
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	0.5

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-10
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Future On-Site Visitor (Adult) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	3.92E-06	mg/kg-day	--	--	--	1.37E-05	mg/kg-day	4.00E-04	mg/kg-day	0.03
				Copper	9.11E+02	mg/kg	6.69E-05	mg/kg-day	--	--	--	2.34E-04	mg/kg-day	3.25E-02	mg/kg-day	0.007
			Exp. Route Total								--					0.04
			Dermal													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	1.66E-07	mg/kg-day	--	--	--	5.77E-07	mg/kg-day	6.00E-05	mg/kg-day	0.01
				Copper	9.11E+02	mg/kg	2.82E-06	mg/kg-day	--	--	--	9.84E-06	mg/kg-day	3.25E-02	mg/kg-day	0.0003
			Exp. Route Total								--					0.01
		Exp. Point Total									--					0.05
	Exp. Medium Total										--					0.05
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.22E-05	μg/m³	2.06E-07	μg/m³	--	--	--	7.21E-07	μg/m³	--	--	--
				Copper	7.19E-04	μg/m³	3.52E-06	μg/m³	--	--	--	1.23E-05	μg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.05
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	**0.05**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-11
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Future On-Site Trespasser (Teen) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	1.14E-06	mg/kg-day	--	--	--	7.96E-06	mg/kg-day	4.00E-04	mg/kg-day	0.02
				Copper	9.11E+02	mg/kg	1.94E-05	mg/kg-day	--	--	--	1.36E-04	mg/kg-day	3.25E-02	mg/kg-day	0.004
			Exp. Route Total								--					0.02
			Dermal													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	1.28E-07	mg/kg-day	--	--	--	8.97E-07	mg/kg-day	6.00E-05	mg/kg-day	0.01
				Copper	9.11E+02	mg/kg	2.19E-06	mg/kg-day	--	--	--	1.53E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0005
			Exp. Route Total								--					0.02
		Exp. Point Total									--					0.04
	Exp. Medium Total										--					0.04
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.22E-05	µg/m³	6.62E-08	µg/m³	--	--	--	4.64E-07	µg/m³	--	--	--
				Copper	7.19E-04	µg/m³	1.13E-06	µg/m³	--	--	--	7.91E-06	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.04
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**0.04**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-12
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Future On-Site Commerical/ Industrial Worker - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [1]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [1]
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	5.87E-06	mg/kg-day	--	--	--	1.64E-05	mg/kg-day	4.00E-04	mg/kg-day	0.04
				Copper	9.11E+02	mg/kg	1.00E-04	mg/kg-day	--	--	--	2.81E-04	mg/kg-day	3.25E-02	mg/kg-day	0.009
			Exp. Route Total								--					0.05
			Dermal													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	4.98E-07	mg/kg-day	--	--	--	1.39E-06	mg/kg-day	6.00E-05	mg/kg-day	0.02
				Copper	9.11E+02	mg/kg	8.49E-06	mg/kg-day	--	--	--	2.38E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0007
			Exp. Route Total								--					0.02
		Exp. Point Total									--					0.07
	Exp. Medium Total										--					0.07
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.22E-05	µg/m^3	2.47E-06	µg/m^3	--	--	--	6.91E-06	µg/m^3	--	--	--
				Copper	7.19E-04	µg/m^3	4.22E-05	µg/m^3	--	--	--	1.18E-04	µg/m^3	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.07
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**0.07**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-13
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Future On-Site Utility Worker - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk $^{(1)}$	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient $^{(1)}$
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	1.72E-07	mg/kg-day	--	--	--	1.21E-05	mg/kg-day	4.00E-04	mg/kg-day	0.03
				Copper	9.11E+02	mg/kg	2.94E-06	mg/kg-day	--	--	--	2.06E-04	mg/kg-day	3.25E-02	mg/kg-day	0.006
			Exp. Route Total								--					0.04
			Dermal													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	3.68E-09	mg/kg-day	--	--	--	2.58E-07	mg/kg-day	6.00E-05	mg/kg-day	0.004
				Copper	9.11E+02	mg/kg	6.29E-08	mg/kg-day	--	--	--	4.40E-06	mg/kg-day	3.25E-02	mg/kg-day	0.0001
			Exp. Route Total								--					0.004
		Exp. Point Total									--					0.04
	Exp. Medium Total										--					0.04
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.22E-05	μg/m^3	1.10E-08	μg/m^3	--	--	--	7.72E-07	μg/m^3	--	--	--
				Copper	7.19E-04	μg/m^3	1.88E-07	μg/m^3	--	--	--	1.32E-05	μg/m^3	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.04
Notes:										**Total of Receptor Risks Across All Media**	**--**				**Total of Receptor Hazards Across All Media**	**0.04**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-14
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Future On-Site Construction Worker - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [1]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [1]
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	5.17E-07	mg/kg-day	--	--	--	3.62E-05	mg/kg-day	4.00E-04	mg/kg-day	0.09
				Copper	9.11E+02	mg/kg	8.83E-06	mg/kg-day	--	--	--	6.18E-04	mg/kg-day	3.25E-02	mg/kg-day	0.02
			Exp. Route Total								--					0.1
			Dermal													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	1.66E-08	mg/kg-day	--	--	--	1.16E-06	mg/kg-day	6.00E-05	mg/kg-day	0.02
				Copper	9.11E+02	mg/kg	2.83E-07	mg/kg-day	--	--	--	1.98E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0006
			Exp. Route Total								--					0.02
		Exp. Point Total									--					0.1
	Exp. Medium Total										--					0.1
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.22E-05	µg/m³	3.30E-08	µg/m³	--	--	--	2.31E-06	µg/m³	--	--	--
				Copper	7.19E-04	µg/m³	5.63E-07	µg/m³	--	--	--	3.94E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.1
										Total of Receptor Risks Across All Media	**--**				**Total of Receptor Hazards Across All Media**	**0.1**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-15
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Future On-Site Resident (Child) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk $^{(1)}$	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient $^{(1)}$
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	5.87E-05	mg/kg-day	--	--	--	6.84E-04	mg/kg-day	4.00E-04	mg/kg-day	2
				Copper	9.11E+02	mg/kg	1.00E-03	mg/kg-day	--	--	--	1.17E-02	mg/kg-day	3.25E-02	mg/kg-day	0.4
			Exp. Route Total								--					2
			Dermal													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	1.39E-06	mg/kg-day	--	--	--	1.62E-05	mg/kg-day	6.00E-05	mg/kg-day	0.3
				Copper	9.11E+02	mg/kg	2.37E-05	mg/kg-day	--	--	--	2.76E-04	mg/kg-day	3.25E-02	mg/kg-day	0.008
			Exp. Route Total								--					0.3
		Exp. Point Total									--					2
	Exp. Medium Total										--					2
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.22E-05	µg/m³	2.89E-07	µg/m³	--	--	--	3.37E-06	µg/m³	--	--	--
				Copper	7.19E-04	µg/m³	4.93E-06	µg/m³	--	--	--	5.75E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					2
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	2

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-16
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Future On-Site Resident (Adult) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [(1)]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [(1)]
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	1.83E-05	mg/kg-day	--	--	--	6.41E-05	mg/kg-day	4.00E-04	mg/kg-day	0.2
				Copper	9.11E+02	mg/kg	3.12E-04	mg/kg-day	--	--	--	1.09E-03	mg/kg-day	3.25E-02	mg/kg-day	0.03
			Exp. Route Total								--					0.2
			Dermal													
				Metals (Total)												
				Antimony	5.34E+01	mg/kg	7.74E-07	mg/kg-day	--	--	--	2.70E-06	mg/kg-day	6.00E-05	mg/kg-day	0.05
				Copper	9.11E+02	mg/kg	1.32E-05	mg/kg-day	--	--	--	4.61E-05	mg/kg-day	3.25E-02	mg/kg-day	0.001
			Exp. Route Total								--					0.05
		Exp. Point Total									--					0.2
	Exp. Medium Total										--					0.2
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.22E-05	µg/m³	9.61E-07	µg/m³	--	--	--	3.37E-06	µg/m³	--	--	--
				Copper	7.19E-04	µg/m³	1.64E-05	µg/m³	--	--	--	5.75E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.2
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**0.2**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-17
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Visitor (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	1.37E-05	mg/kg-day	--	--	--	1.60E-04	mg/kg-day	4.00E-04	mg/kg-day	0.4
				Copper	1.74E+03	mg/kg	4.09E-04	mg/kg-day	--	--	--	4.77E-03	mg/kg-day	3.25E-02	mg/kg-day	0.1
			Exp. Route Total								--					0.5
			Dermal													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	3.26E-07	mg/kg-day	--	--	--	3.80E-06	mg/kg-day	6.00E-05	mg/kg-day	0.06
				Copper	1.74E+03	mg/kg	9.69E-06	mg/kg-day	--	--	--	1.13E-04	mg/kg-day	3.25E-02	mg/kg-day	0.003
			Exp. Route Total								--					0.07
		Exp. Point Total									--					0.6
	Exp. Medium Total										--					0.6
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.62E-05	µg/m³	6.79E-08	µg/m³	--	--	--	7.90E-07	µg/m³	--	--	--
				Copper	1.37E-03	µg/m³	2.02E-06	µg/m³	--	--	--	2.35E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.6
										Total of Receptor Risks Across All Media	**--**				**Total of Receptor Hazards Across All Media**	**0.6**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-18
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Visitor (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	4.29E-06	mg/kg-day	--	--	--	1.50E-05	mg/kg-day	4.00E-04	mg/kg-day	0.04
				Copper	1.74E+03	mg/kg	1.28E-04	mg/kg-day	--	--	--	4.47E-04	mg/kg-day	3.25E-02	mg/kg-day	0.01
			Exp. Route Total								--					0.05
			Dermal													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	1.81E-07	mg/kg-day	--	--	--	6.32E-07	mg/kg-day	6.00E-05	mg/kg-day	0.01
				Copper	1.74E+03	mg/kg	5.39E-06	mg/kg-day	--	--	--	1.88E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0006
			Exp. Route Total								--					0.01
		Exp. Point Total									--					0.06
	Exp. Medium Total										--					0.06
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.62E-05	µg/m^3	2.26E-07	µg/m^3	--	--	--	7.90E-07	µg/m^3	--	--	--
				Copper	1.37E-03	µg/m^3	6.72E-06	µg/m^3	--	--	--	2.35E-05	µg/m^3	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.06
										Total of Receptor Risks Across All Media	**--**				**Total of Receptor Hazards Across All Media**	**0.06**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-19
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Trespasser (Teen) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk $^{(1)}$	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient $^{(1)}$
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	1.25E-06	mg/kg-day	--	--	--	8.72E-06	mg/kg-day	4.00E-04	mg/kg-day	0.02
				Copper	1.74E+03	mg/kg	3.71E-05	mg/kg-day	--	--	--	2.59E-04	mg/kg-day	3.25E-02	mg/kg-day	0.008
			Exp. Route Total								--					0.03
			Dermal													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	1.40E-07	mg/kg-day	--	--	--	9.83E-07	mg/kg-day	6.00E-05	mg/kg-day	0.02
				Copper	1.74E+03	mg/kg	4.18E-06	mg/kg-day	--	--	--	2.92E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0009
			Exp. Route Total								--					0.02
		Exp. Point Total									--					0.05
	Exp. Medium Total										--					0.05
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.62E-05	µg/m³	7.25E-08	µg/m³	--	--	--	5.08E-07	µg/m³	--	--	--
				Copper	1.37E-03	µg/m³	2.16E-06	µg/m³	--	--	--	1.51E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.05
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**0.05**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-20
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Commerical/ Industrial Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	**Exposure Medium**	**Exposure Point**	**Exposure Route**	**Chemical of Potential Concern**	**EPC**		**Cancer Risk Calculations**					**Non-Cancer Hazard Calculations**				
					Value	**Units**	**Intake/Exposure Concentration**		**CSF/Unit Risk**		**Cancer Risk [1]**	**Intake/Exposure Concentration**		**RfD/RfC**		**Hazard Quotient [1]**
							Value	**Units**	**Value**	**Units**		**Value**	**Units**	**Value**	**Units**	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	6.44E-06	mg/kg-day	--	--	--	1.80E-05	mg/kg-day	4.00E-04	mg/kg-day	0.05
				Copper	1.74E+03	mg/kg	1.91E-04	mg/kg-day	--	--	--	5.36E-04	mg/kg-day	3.25E-02	mg/kg-day	0.02
			Exp. Route Total								--					0.06
			Dermal													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	5.45E-07	mg/kg-day	--	--	--	1.53E-06	mg/kg-day	6.00E-05	mg/kg-day	0.03
				Copper	1.74E+03	mg/kg	1.62E-05	mg/kg-day	--	--	--	4.54E-05	mg/kg-day	3.25E-02	mg/kg-day	0.001
			Exp. Route Total								--					0.03
		Exp. Point Total									--					0.09
	Exp. Medium Total										--					0.09
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.62E-05	µg/m^3	2.71E-06	µg/m^3	--	--	--	7.58E-06	µg/m^3	--	--	--
				Copper	1.37E-03	µg/m^3	8.06E-05	µg/m^3	--	--	--	2.25E-04	µg/m^3	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.09
										Total of Receptor Risks Across All Media	**--**				**Total of Receptor Hazards Across All Media**	**0.09**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-21
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Utility Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	1.89E-07	mg/kg-day	--	--	--	1.32E-05	mg/kg-day	4.00E-04	mg/kg-day	0.03
				Copper	1.74E+03	mg/kg	5.62E-06	mg/kg-day	--	--	--	3.93E-04	mg/kg-day	3.25E-02	mg/kg-day	0.01
			Exp. Route Total								--					0.05
			Dermal													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	4.04E-09	mg/kg-day	--	--	--	2.83E-07	mg/kg-day	6.00E-05	mg/kg-day	0.005
				Copper	1.74E+03	mg/kg	1.20E-07	mg/kg-day	--	--	--	8.40E-06	mg/kg-day	3.25E-02	mg/kg-day	0.0003
			Exp. Route Total								--					0.005
		Exp. Point Total									--					0.05
	Exp. Medium Total										--					0.05
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.62E-05	µg/m³	1.21E-08	µg/m³	--	--	--	8.45E-07	µg/m³	--	--	--
				Copper	1.37E-03	µg/m³	3.59E-07	µg/m³	--	--	--	2.51E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.05
										Total of Receptor Risks Across All Media	**--**				**Total of Receptor Hazards Across All Media**	**0.05**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-22
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Construction Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	5.67E-07	mg/kg-day	--	--	--	3.97E-05	mg/kg-day	4.00E-04	mg/kg-day	0.1
				Copper	1.74E+03	mg/kg	1.69E-05	mg/kg-day	--	--	--	1.18E-03	mg/kg-day	3.25E-02	mg/kg-day	0.04
			Exp. Route Total								--					0.1
			Dermal													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	1.82E-08	mg/kg-day	--	--	--	1.27E-06	mg/kg-day	6.00E-05	mg/kg-day	0.02
				Copper	1.74E+03	mg/kg	5.41E-07	mg/kg-day	--	--	--	3.78E-05	mg/kg-day	3.25E-02	mg/kg-day	0.001
			Exp. Route Total								--					0.02
		Exp. Point Total									--					0.2
	Exp. Medium Total										--					0.2
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.62E-05	µg/m³	3.62E-08	µg/m³	--	--	--	2.53E-06	µg/m³	--	--	--
				Copper	1.37E-03	µg/m³	1.08E-06	µg/m³	--	--	--	7.53E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.2
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**0.2**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-23
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Resident (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [1]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [1]
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	6.44E-05	mg/kg-day	--	--	--	7.49E-04	mg/kg-day	4.00E-04	mg/kg-day	2
				Copper	1.74E+03	mg/kg	1.91E-03	mg/kg-day	--	--	--	2.23E-02	mg/kg-day	3.25E-02	mg/kg-day	0.7
			Exp. Route Total								--					3
			Dermal													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	1.52E-06	mg/kg-day	--	--	--	1.77E-05	mg/kg-day	6.00E-05	mg/kg-day	0.3
				Copper	1.74E+03	mg/kg	4.52E-05	mg/kg-day	--	--	--	5.27E-04	mg/kg-day	3.25E-02	mg/kg-day	0.02
			Exp. Route Total								--					0.3
		Exp. Point Total									--					3
	Exp. Medium Total										--					3
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.62E-05	µg/m³	3.16E-07	µg/m³	--	--	--	3.69E-06	µg/m³	--	--	--
				Copper	1.37E-03	µg/m³	9.41E-06	µg/m³	--	--	--	1.10E-04	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					3
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	3

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-24
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Resident (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	2.00E-05	mg/kg-day	--	--	--	7.02E-05	mg/kg-day	4.00E-04	mg/kg-day	0.2
				Copper	1.74E+03	mg/kg	5.95E-04	mg/kg-day	--	--	--	2.09E-03	mg/kg-day	3.25E-02	mg/kg-day	0.06
			Exp. Route Total								--					0.2
			Dermal													
				Metals (Total)												
				Antimony	5.85E+01	mg/kg	8.48E-07	mg/kg-day	--	--	--	2.96E-06	mg/kg-day	6.00E-05	mg/kg-day	0.05
				Copper	1.74E+03	mg/kg	2.52E-05	mg/kg-day	--	--	--	8.80E-05	mg/kg-day	3.25E-02	mg/kg-day	0.003
			Exp. Route Total								--					0.05
		Exp. Point Total									--					0.3
	Exp. Medium Total										--					0.3
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	4.62E-05	$\mu g/m^3$	1.05E-06	$\mu g/m^3$	--	--	--	3.69E-06	$\mu g/m^3$	--	--	--
				Copper	1.37E-03	$\mu g/m^3$	3.13E-05	$\mu g/m^3$	--	--	--	1.10E-04	$\mu g/m^3$	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.3
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**0.3**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-25
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Visitor (Child) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	2.19E-04	mg/kg-day	--	--	--	2.56E-03	mg/kg-day	4.00E-04	mg/kg-day	6
				Copper	1.05E+03	mg/kg	2.47E-04	mg/kg-day	--	--	--	2.89E-03	mg/kg-day	3.25E-02	mg/kg-day	0.09
			Exp. Route Total								--					6
			Dermal													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	5.20E-06	mg/kg-day	--	--	--	6.07E-05	mg/kg-day	6.00E-05	mg/kg-day	1
				Copper	1.05E+03	mg/kg	5.87E-06	mg/kg-day	--	--	--	6.84E-05	mg/kg-day	3.25E-02	mg/kg-day	0.002
			Exp. Route Total								--					1
		Exp. Point Total									--					8
	Exp. Medium Total										--					8
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	7.37E-04	µg/m³	1.08E-06	µg/m³	--	--	--	1.26E-05	µg/m³	--	--	--
				Copper	8.31E-04	µg/m³	1.22E-06	µg/m³	--	--	--	1.42E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					8
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	8

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-26
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Visitor (Adult) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	6.86E-05	mg/kg-day	--	--	--	2.40E-04	mg/kg-day	4.00E-04	mg/kg-day	0.6
				Copper	1.05E+03	mg/kg	7.73E-05	mg/kg-day	--	--	--	2.71E-04	mg/kg-day	3.25E-02	mg/kg-day	0.008
			Exp. Route Total								--					0.6
			Dermal													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	2.90E-06	mg/kg-day	--	--	--	1.01E-05	mg/kg-day	6.00E-05	mg/kg-day	0.2
				Copper	1.05E+03	mg/kg	3.26E-06	mg/kg-day	--	--	--	1.14E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0003
			Exp. Route Total								--					0.2
		Exp. Point Total									--					0.8
	Exp. Medium Total										--					0.8
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	7.37E-04	µg/m³	3.61E-06	µg/m³	--	--	--	1.26E-05	µg/m³	--	--	--
				Copper	8.31E-04	µg/m³	4.07E-06	µg/m³	--	--	--	1.42E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.8
										Total of Receptor Risks Across All Media	**--**				**Total of Receptor Hazards Across All Media**	**0.8**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-27
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Trespasser (Teen) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	1.99E-05	mg/kg-day	--	--	--	1.39E-04	mg/kg-day	4.00E-04	mg/kg-day	0.3
				Copper	1.05E+03	mg/kg	2.24E-05	mg/kg-day	--	--	--	1.57E-04	mg/kg-day	3.25E-02	mg/kg-day	0.005
			Exp. Route Total								--					0.4
			Dermal													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	2.24E-06	mg/kg-day	--	--	--	1.57E-05	mg/kg-day	6.00E-05	mg/kg-day	0.3
				Copper	1.05E+03	mg/kg	2.53E-06	mg/kg-day	--	--	--	1.77E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0005
			Exp. Route Total								--					0.3
		Exp. Point Total									--					0.6
	Exp. Medium Total										--					0.6
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	7.37E-04	µg/m³	1.16E-06	µg/m³	--	--	--	8.11E-06	µg/m³	--	--	--
				Copper	8.31E-04	µg/m³	1.31E-06	µg/m³	--	--	--	9.15E-06	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.6
										Total of Receptor Risks Across All Media	**--**				**Total of Receptor Hazards Across All Media**	**0.6**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-28
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Commerical/ Industrial Worker - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	1.03E-04	mg/kg-day	--	--	--	2.88E-04	mg/kg-day	4.00E-04	mg/kg-day	0.7
				Copper	1.05E+03	mg/kg	1.16E-04	mg/kg-day	--	--	--	3.24E-04	mg/kg-day	3.25E-02	mg/kg-day	0.01
			Exp. Route Total								--					0.7
			Dermal													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	8.70E-06	mg/kg-day	--	--	--	2.44E-05	mg/kg-day	6.00E-05	mg/kg-day	0.4
				Copper	1.05E+03	mg/kg	9.81E-06	mg/kg-day	--	--	--	2.75E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0008
			Exp. Route Total								--					0.4
		Exp. Point Total									--					1
	Exp. Medium Total										--					1
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	7.37E-04	µg/m³	4.33E-05	µg/m³	--	--	--	1.21E-04	µg/m³	--	--	--
				Copper	8.31E-04	µg/m³	4.88E-05	µg/m³	--	--	--	1.36E-04	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					1
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	1

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-29
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Utility Worker - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	3.02E-06	mg/kg-day	--	--	--	2.11E-04	mg/kg-day	4.00E-04	mg/kg-day	0.5
				Copper	1.05E+03	mg/kg	3.40E-06	mg/kg-day	--	--	--	2.38E-04	mg/kg-day	3.25E-02	mg/kg-day	0.007
			Exp. Route Total								--					0.5
			Dermal													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	6.44E-08	mg/kg-day	--	--	--	4.51E-06	mg/kg-day	6.00E-05	mg/kg-day	0.08
				Copper	1.05E+03	mg/kg	7.27E-08	mg/kg-day	--	--	--	5.09E-06	mg/kg-day	3.25E-02	mg/kg-day	0.0002
			Exp. Route Total								--					0.08
		Exp. Point Total									--					0.6
	Exp. Medium Total										--					0.6
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	7.37E-04	µg/m³	1.92E-07	µg/m³	--	--	--	1.35E-05	µg/m³	--	--	--
				Copper	8.31E-04	µg/m³	2.17E-07	µg/m³	--	--	--	1.52E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.6
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**0.6**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-30
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Construction Worker - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk $^{(1)}$	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient $^{(1)}$
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	9.05E-06	mg/kg-day	--	--	--	6.33E-04	mg/kg-day	4.00E-04	mg/kg-day	2
				Copper	1.05E+03	mg/kg	1.02E-05	mg/kg-day	--	--	--	7.14E-04	mg/kg-day	3.25E-02	mg/kg-day	0.02
			Exp. Route Total								--					2
			Dermal													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	2.90E-07	mg/kg-day	--	--	--	2.03E-05	mg/kg-day	6.00E-05	mg/kg-day	0.3
				Copper	1.05E+03	mg/kg	3.27E-07	mg/kg-day	--	--	--	2.29E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0007
			Exp. Route Total								--					0.3
		Exp. Point Total									--					2
	Exp. Medium Total										--					2
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	7.37E-04	µg/m³	5.77E-07	µg/m³	--	--	--	4.04E-05	µg/m³	--	--	--
				Copper	8.31E-04	µg/m³	6.51E-07	µg/m³	--	--	--	4.56E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					2
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	2

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-31
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Resident (Child) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [(1)]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [(1)]
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	1.03E-03	mg/kg-day	--	--	--	1.20E-02	mg/kg-day	4.00E-04	mg/kg-day	30
				Copper	1.05E+03	mg/kg	1.16E-03	mg/kg-day	--	--	--	1.35E-02	mg/kg-day	3.25E-02	mg/kg-day	0.4
			Exp. Route Total								--					30
			Dermal													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	2.43E-05	mg/kg-day	--	--	--	2.83E-04	mg/kg-day	6.00E-05	mg/kg-day	5
				Copper	1.05E+03	mg/kg	2.74E-05	mg/kg-day	--	--	--	3.19E-04	mg/kg-day	3.25E-02	mg/kg-day	0.01
			Exp. Route Total								--					5
		Exp. Point Total									--					35
	Exp. Medium Total										--					35
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	7.37E-04	µg/m³	5.05E-06	µg/m³	--	--	--	5.89E-05	µg/m³	--	--	--
				Copper	8.31E-04	µg/m³	5.70E-06	µg/m³	--	--	--	6.64E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					35
										Total of Receptor Risks Across All Media	**--**				**Total of Receptor Hazards Across All Media**	**35**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-32
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Visitor (Child) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Total Soil	Total Soil	Ingestion													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	3.19E-04	mg/kg-day	--	--	--	1.12E-03	mg/kg-day	4.00E-04	mg/kg-day	3
				Copper	1.05E+03	mg/kg	3.60E-04	mg/kg-day	--	--	--	1.26E-03	mg/kg-day	3.25E-02	mg/kg-day	0.04
			Exp. Route Total								--					3
			Dermal													
				Metals (Total)												
				Antimony	9.34E+02	mg/kg	1.35E-05	mg/kg-day	--	--	--	4.73E-05	mg/kg-day	6.00E-05	mg/kg-day	0.8
				Copper	1.05E+03	mg/kg	1.53E-05	mg/kg-day	--	--	--	5.33E-05	mg/kg-day	3.25E-02	mg/kg-day	0.002
			Exp. Route Total								--					0.8
		Exp. Point Total									--					4
	Exp. Medium Total										--					4
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	7.37E-04	µg/m³	1.68E-05	µg/m³	--	--	--	5.89E-05	µg/m³	--	--	--
				Copper	8.31E-04	µg/m³	1.90E-05	µg/m³	--	--	--	6.64E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					4
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	4

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-33
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	2.10E+01	mg/kg	4.94E-06	mg/kg-day	1.72E-02	1/(mg/kg-day)	8E-08	5.75E-05	mg/kg-day	1.00E-04	mg/kg-day	0.6
			Exp. Route Total								8E-08					0.6
			Dermal	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	2.10E+01	mg/kg	1.17E-06	mg/kg-day	1.72E-02	1/(mg/kg-day)	2E-08	1.37E-05	mg/kg-day	1.00E-04	mg/kg-day	0.1
			Exp. Route Total								2E-08					0.1
		Exp. Point Total									1E-07					0.7
	Exp. Medium Total										1E-07					0.7
	Outdoor Air	Particulates above Site	Inhalation	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	1.66E-05	µg/m³	2.44E-08	µg/m³	--	--	--	2.84E-07	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											1E-07					0.7
										Total of Receptor Risks Across All Media	**1E-07**				Total of Receptor Hazards Across All Media	**0.7**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 34
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	2.10E+01	mg/kg	1.54E-06	mg/kg-day	1.72E-02	1/(mg/kg-day)	3E-08	5.40E-06	mg/kg-day	1.00E-04	mg/kg-day	0.05
			Exp. Route Total								3E-08					0.05
			Dermal	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	2.10E+01	mg/kg	6.51E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	1E-08	2.27E-06	mg/kg-day	1.00E-04	mg/kg-day	0.02
			Exp. Route Total								1E-08					0.02
		Exp. Point Total									4E-08					0.08
	Exp. Medium Total										4E-08					0.08
	Outdoor Air	Particulates above Site	Inhalation	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	1.66E-05	µg/m³	8.11E-08	µg/m³	--	--	--	2.84E-07	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											4E-08					0.08
										Total of Receptor Risks Across All Media	**4E-08**				**Total of Receptor Hazards Across All Media**	**0.08**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 35
Calculation of Chemical Cancer Risks (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Lifetime) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Lifetime

Medium	**Exposure Medium**	**Exposure Point**	**Exposure Route**	**Chemical of Potential Concern**	**EPC**		**Cancer Risk Calculations**					**Non-Cancer Hazard Calculations**				
							Intake/Exposure Concentration		**CSF/Unit Risk**		**Cancer Risk [1]**	**Intake/Exposure Concentration**		**RfD/RfC**		**Hazard Quotient [1]**
					Value	**Units**	**Value**	**Units**	**Value**	**Units**		**Value**	**Units**	**Value**	**Units**	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	6.47E-06	mg/kg-day	1.72E-02	1/(mg/kg-day)	1E-07	--	--	--	--	--
			Exp. Route Total								1E-07					--
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	1.82E-06	mg/kg-day	1.72E-02	1/(mg/kg-day)	3E-08	--	--	--	--	--
			Exp. Route Total								3E-08					--
		Exp. Point Total									1E-07					--
	Exp. Medium Total										1E-07					--
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	1.66E-05	µg/m³	1.05E-07	µg/m³	--	--	--	--	--	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											1E-07					--
										Total of Receptor Risks Across All Media	**1E-07**				**Total of Receptor Hazards Across All Media**	**--**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 36
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Trespasser (Teen) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe: Current/Future
Receptor Population: On-Site Trespasser
Receptor Age: Teen

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	4.47E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	8E-09	3.13E-06	mg/kg-day	1.00E-04	mg/kg-day	0.03
			Exp. Route Total								8E-09					0.03
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	5.04E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	9E-09	3.53E-06	mg/kg-day	1.00E-04	mg/kg-day	0.04
			Exp. Route Total								9E-09					0.04
		Exp. Point Total									2E-08					0.07
	Exp. Medium Total										2E-08					0.07
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	1.66E-05	µg/m³	2.60E-08	µg/m³	--	--	--	1.82E-07	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											2E-08					0.07
										Total of Receptor Risks Across All Media	**2E-08**				Total of Receptor Hazards Across All Media	**0.07**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 37
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Commerical/ Industrial Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [1]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [1]
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	2.31E-06	mg/kg-day	1.72E-02	1/(mg/kg-day)	4E-08	6.47E-06	mg/kg-day	1.00E-04	mg/kg-day	0.06
			Exp. Route Total								4E-08					0.06
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	1.96E-06	mg/kg-day	1.72E-02	1/(mg/kg-day)	3E-08	5.48E-06	mg/kg-day	1.00E-04	mg/kg-day	0.05
			Exp. Route Total								3E-08					0.05
		Exp. Point Total									7E-08					0.1
	Exp. Medium Total										7E-08					0.1
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	1.66E-05	µg/m³	9.73E-07	µg/m³	--	--	--	2.72E-06	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											7E-08					0.1
										Total of Receptor Risks Across All Media	**7E-08**				**Total of Receptor Hazards Across All Media**	**0.1**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 38
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Utility Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk $^{(1)}$	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient $^{(1)}$
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	6.78E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	1E-09	4.75E-06	mg/kg-day	1.00E-04	mg/kg-day	0.05
			Exp. Route Total								1E-09					0.05
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	1.45E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	2E-10	1.01E-06	mg/kg-day	1.00E-04	mg/kg-day	0.01
			Exp. Route Total								2E-10					0.01
		Exp. Point Total									1E-09					0.06
	Exp. Medium Total										1E-09					0.06
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	1.66E-05	µg/m³	4.33E-09	µg/m³	--	--	--	3.03E-07	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											1E-09					0.06
										Total of Receptor Risks Across All Media	**1E-09**				**Total of Receptor Hazards Across All Media**	**0.06**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 39
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Construction Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [(1)]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [(1)]
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	2.03E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	4E-09	1.42E-05	mg/kg-day	1.00E-04	mg/kg-day	0.1
			Exp. Route Total								4E-09					0.1
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	6.53E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	1E-09	4.56E-06	mg/kg-day	1.00E-04	mg/kg-day	0.05
			Exp. Route Total								1E-09					0.05
		Exp. Point Total									5E-09					0.2
	Exp. Medium Total										5E-09					0.2
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	1.66E-05	µg/m³	1.30E-08	µg/m³	--	--	--	9.09E-07	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											5E-09					0.2
										Total of Receptor Risks Across All Media	**5E-09**				**Total of Receptor Hazards Across All Media**	**0.2**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 40
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	2.31E-05	mg/kg-day	1.72E-02	1/(mg/kg-day)	4E-07	2.69E-04	mg/kg-day	1.00E-04	mg/kg-day	3
			Exp. Route Total								4E-07					3
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	5.46E-06	mg/kg-day	1.72E-02	1/(mg/kg-day)	9E-08	6.36E-05	mg/kg-day	1.00E-04	mg/kg-day	0.6
			Exp. Route Total								9E-08					0.6
		Exp. Point Total									5E-07					3
	Exp. Medium Total										5E-07					3
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	1.66E-05	µg/m³	1.14E-07	µg/m³	--	--	--	1.32E-06	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											5E-07					3
Notes:										**Total of Receptor Risks Across All Media**	**5E-07**				**Total of Receptor Hazards Across All Media**	**3**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 41
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk $^{(1)}$	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient $^{(1)}$
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	7.18E-06	mg/kg-day	1.72E-02	1/(mg/kg-day)	1E-07	2.52E-05	mg/kg-day	1.00E-04	mg/kg-day	0.3
			Exp. Route Total								1E-07					0.3
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	2.10E+01	mg/kg	3.05E-06	mg/kg-day	1.72E-02	1/(mg/kg-day)	5E-08	1.06E-05	mg/kg-day	1.00E-04	mg/kg-day	0.1
			Exp. Route Total								5E-08					0.1
		Exp. Point Total									2E-07					0.4
	Exp. Medium Total										2E-07					0.4
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	1.66E-05	µg/m³	3.78E-07	µg/m³	--	--	--	1.32E-06	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											2E-07					0.4
										Total of Receptor Risks Across All Media	**2E-07**				**Total of Receptor Hazards Across All Media**	**0.4**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 42
Calculation of Chemical Cancer Risks (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Lifetime) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Lifetime

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk $^{(1)}$	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient $^{(1)}$
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	2.10E+01	mg/kg	3.02E-05	mg/kg-day	1.72E-02	1/(mg/kg-day)	5E-07	--	--	--	--	--
			Exp. Route Total								5E-07					--
			Dermal	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	2.10E+01	mg/kg	8.51E-06	mg/kg-day	1.72E-02	1/(mg/kg-day)	1E-07	--	--	--	--	--
			Exp. Route Total								1E-07					--
		Exp. Point Total									7E-07					--
	Exp. Medium Total										7E-07					--
	Outdoor Air	Particulates above Site	Inhalation	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	1.66E-05	µg/m³	4.92E-07	µg/m³	--	--	--	--	--	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											7E-07					--
										Total of Receptor Risks Across All Media	**7E-07**				**Total of Receptor Hazards Across All Media**	**--**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 43
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Background)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	1.08E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	2E-09	1.26E-06	mg/kg-day	1.00E-04	mg/kg-day	0.01
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	1.60E-07	mg/kg-day	--	--	--	1.87E-06	mg/kg-day	4.00E-04	mg/kg-day	0.005
				Copper	1.27E+01	mg/kg	2.98E-06	mg/kg-day	--	--	--	3.48E-05	mg/kg-day	3.25E-02	mg/kg-day	0.001
			Exp. Route Total								2E-09					0.02
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	2.56E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	4E-10	2.99E-07	mg/kg-day	1.00E-04	mg/kg-day	0.003
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	3.80E-09	mg/kg-day	--	--	--	4.43E-08	mg/kg-day	6.00E-05	mg/kg-day	0.0007
				Copper	1.27E+01	mg/kg	7.07E-08	mg/kg-day	--	--	--	8.26E-07	mg/kg-day	3.25E-02	mg/kg-day	0.00003
			Exp. Route Total								4E-10					0.004
		Exp. Point Total									2E-09					0.02
	Exp. Medium Total										2E-09					0.02
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	3.63E-07	µg/m³	5.34E-10	µg/m³	--	--	--	6.21E-09	µg/m³	--	--	--
				Metals (Total)												
				Antimony	5.38E-07	µg/m³	7.92E-10	µg/m³	--	--	--	9.21E-09	µg/m³	--	--	--
				Copper	1.00E-05	µg/m³	1.47E-08	µg/m³	--	--	--	1.71E-07	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											2E-09					0.02
										Total of Receptor Risks Across All Media	**2E-09**				**Total of Receptor Hazards Across All Media**	**0.02**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 44
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Background)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	3.38E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	6E-10	1.18E-07	mg/kg-day	1.00E-04	mg/kg-day	0.001
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	5.01E-08	mg/kg-day	--	--	--	1.75E-07	mg/kg-day	4.00E-04	mg/kg-day	0.0004
				Copper	1.27E+01	mg/kg	9.32E-07	mg/kg-day	--	--	--	3.26E-06	mg/kg-day	3.25E-02	mg/kg-day	0.0001
			Exp. Route Total								6E-10					0.002
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	1.43E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	2E-10	4.97E-08	mg/kg-day	1.00E-04	mg/kg-day	0.0005
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	2.11E-09	mg/kg-day	--	--	--	7.37E-09	mg/kg-day	6.00E-05	mg/kg-day	0.0001
				Copper	1.27E+01	mg/kg	3.94E-08	mg/kg-day	--	--	--	1.37E-07	mg/kg-day	3.25E-02	mg/kg-day	0.000004
			Exp. Route Total								2E-10					0.0006
		Exp. Point Total									8E-10					0.002
	Exp. Medium Total										8E-10					0.002
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	3.63E-07	µg/m³	1.78E-09	µg/m³	--	--	--	6.21E-09	µg/m³	--	--	--
				Metals (Total)												
				Antimony	5.38E-07	µg/m³	2.63E-09	µg/m³	--	--	--	9.21E-09	µg/m³	--	--	--
				Copper	1.00E-05	µg/m³	4.90E-08	µg/m³	--	--	--	1.71E-07	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											8E-10					0.002
										Total of Receptor Risks Across All Media	**8E-10**				Total of Receptor Hazards Across All Media	**0.002**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 45
Calculation of Chemical Cancer Risks (Background)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Lifetime) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Lifetime

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [(1)]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [(1)]
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	1.42E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	2E-09	--	--	--	--	--
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	2.10E-07	mg/kg-day	--	--	--	--	--	--	--	--
				Copper	1.27E+01	mg/kg	3.91E-06	mg/kg-day	--	--	--	--	--	--	--	--
			Exp. Route Total								2E-09					--
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	3.99E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	7E-10	--	--	--	--	--
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	5.91E-09	mg/kg-day	--	--	--	--	--	--	--	--
				Copper	1.27E+01	mg/kg	1.10E-07	mg/kg-day	--	--	--	--	--	--	--	--
			Exp. Route Total								7E-10					--
		Exp. Point Total									3E-09					--
	Exp. Medium Total										3E-09					--
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	3.63E-07	µg/m³	2.31E-09	µg/m³	--	--	--	--	--	--	--	--
				Metals (Total)												
				Antimony	5.38E-07	µg/m³	3.42E-09	µg/m³	--	--	--	--	--	--	--	--
				Copper	1.00E-05	µg/m³	6.38E-08	µg/m³	--	--	--	--	--	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											3E-09					--
										Total of Receptor Risks Across All Media	**3E-09**				Total of Receptor Hazards Across All Media	**--**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 46
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Background)
Reasonable Maximum Exposure
Current/Future On-Site Trespasser (Teen) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	9.80E-09	mg/kg-day	1.72E-02	1/(mg/kg-day)	2E-10	6.85E-08	mg/kg-day	1.00E-04	mg/kg-day	0.0007
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	1.45E-08	mg/kg-day	--	--	--	1.02E-07	mg/kg-day	4.00E-04	mg/kg-day	0.0003
				Copper	1.27E+01	mg/kg	2.71E-07	mg/kg-day	--	--	--	1.89E-06	mg/kg-day	3.25E-02	mg/kg-day	0.00006
			Exp. Route Total								2E-10					0.001
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	1.10E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	2E-10	7.73E-08	mg/kg-day	1.00E-04	mg/kg-day	0.0008
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	1.64E-09	mg/kg-day	--	--	--	1.15E-08	mg/kg-day	6.00E-05	mg/kg-day	0.0002
				Copper	1.27E+01	mg/kg	3.05E-08	mg/kg-day	--	--	--	2.13E-07	mg/kg-day	3.25E-02	mg/kg-day	0.000007
			Exp. Route Total								2E-10					0.001
		Exp. Point Total									4E-10					0.002
	Exp. Medium Total										4E-10					0.002
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	3.63E-07	µg/m³	5.70E-10	µg/m³	--	--	--	4.00E-09	µg/m³	--	--	--
				Metals (Total)												
				Antimony	5.38E-07	µg/m³	8.45E-10	µg/m³	--	--	--	5.92E-09	µg/m³	--	--	--
				Copper	1.00E-05	µg/m³	1.57E-08	µg/m³	--	--	--	1.10E-07	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											4E-10					0.002
										Total of Receptor Risks Across All Media	**4E-10**				**Total of Receptor Hazards Across All Media**	**0.002**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 47
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Background)
Reasonable Maximum Exposure
Current/Future On-Site Commerical/ Industrial Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	5.06E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	9E-10	1.42E-07	mg/kg-day	1.00E-04	mg/kg-day	0.001
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	7.50E-08	mg/kg-day	--	--	--	2.10E-07	mg/kg-day	4.00E-04	mg/kg-day	0.0005
				Copper	1.27E+01	mg/kg	1.40E-06	mg/kg-day	--	--	--	3.91E-06	mg/kg-day	3.25E-02	mg/kg-day	0.0001
			Exp. Route Total								9E-10					0.002
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	4.29E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	7E-10	1.20E-07	mg/kg-day	1.00E-04	mg/kg-day	0.001
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	6.36E-09	mg/kg-day	--	--	--	1.78E-08	mg/kg-day	6.00E-05	mg/kg-day	0.0003
				Copper	1.27E+01	mg/kg	1.18E-07	mg/kg-day	--	--	--	3.31E-07	mg/kg-day	3.25E-02	mg/kg-day	0.00001
			Exp. Route Total								7E-10					0.002
		Exp. Point Total									2E-09					0.004
	Exp. Medium Total										2E-09					0.004
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	3.63E-07	µg/m³	2.13E-08	µg/m³	--	--	--	5.96E-08	µg/m³	--	--	--
				Metals (Total)												
				Antimony	5.38E-07	µg/m³	3.16E-08	µg/m³	--	--	--	8.83E-08	µg/m³	--	--	--
				Copper	1.00E-05	µg/m³	5.89E-07	µg/m³	--	--	--	1.64E-06	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											2E-09					0.004
										Total of Receptor Risks Across All Media	**2E-09**				**Total of Receptor Hazards Across All Media**	**0.004**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 48
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Background)
Reasonable Maximum Exposure
Current/Future On-Site Utility Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	1.49E-09	mg/kg-day	1.72E-02	1/(mg/kg-day)	3E-11	1.04E-07	mg/kg-day	1.00E-04	mg/kg-day	0.001
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	2.20E-09	mg/kg-day	--	--	--	1.54E-07	mg/kg-day	4.00E-04	mg/kg-day	0.0004
				Copper	1.27E+01	mg/kg	4.10E-08	mg/kg-day	--	--	--	2.87E-06	mg/kg-day	3.25E-02	mg/kg-day	0.00009
			Exp. Route Total								3E-11					0.002
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	3.17E-10	mg/kg-day	1.72E-02	1/(mg/kg-day)	5E-12	2.22E-08	mg/kg-day	1.00E-04	mg/kg-day	0.0002
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	4.71E-11	mg/kg-day	--	--	--	3.29E-09	mg/kg-day	6.00E-05	mg/kg-day	0.00005
				Copper	1.27E+01	mg/kg	8.76E-10	mg/kg-day	--	--	--	6.13E-08	mg/kg-day	3.25E-02	mg/kg-day	0.000002
			Exp. Route Total								5E-12					0.0003
		Exp. Point Total									3E-11					0.002
	Exp. Medium Total										3E-11					0.002
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	3.63E-07	µg/m³	9.48E-11	µg/m³	--	--	--	6.65E-09	µg/m³	--	--	--
				Metals (Total)												
				Antimony	5.38E-07	µg/m³	1.41E-10	µg/m³	--	--	--	9.85E-09	µg/m³	--	--	--
				Copper	1.00E-05	µg/m³	2.62E-09	µg/m³	--	--	--	1.84E-07	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											3E-11					0.002
										Total of Receptor Risks Across All Media	**3E-11**				Total of Receptor Hazards Across All Media	**0.002**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 49
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Background)
Reasonable Maximum Exposure
Current/Future On-Site Construction Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [1]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [1]
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	4.46E-09	mg/kg-day	1.72E-02	1/(mg/kg-day)	8E-11	3.12E-07	mg/kg-day	1.00E-04	mg/kg-day	0.003
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	6.61E-09	mg/kg-day	--	--	--	4.62E-07	mg/kg-day	4.00E-04	mg/kg-day	0.001
				Copper	1.27E+01	mg/kg	1.23E-07	mg/kg-day	--	--	--	8.61E-06	mg/kg-day	3.25E-02	mg/kg-day	0.0003
			Exp. Route Total								8E-11					0.005
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	1.43E-09	mg/kg-day	1.72E-02	1/(mg/kg-day)	2E-11	9.98E-08	mg/kg-day	1.00E-04	mg/kg-day	0.001
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	2.12E-10	mg/kg-day	--	--	--	1.48E-08	mg/kg-day	6.00E-05	mg/kg-day	0.0002
				Copper	1.27E+01	mg/kg	3.95E-09	mg/kg-day	--	--	--	2.76E-07	mg/kg-day	3.25E-02	mg/kg-day	0.000008
			Exp. Route Total								2E-11					0.001
		Exp. Point Total									1E-10					0.006
	Exp. Medium Total										1E-10					0.006
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	3.63E-07	µg/m³	2.84E-10	µg/m³	--	--	--	1.99E-08	µg/m³	--	--	--
				Metals (Total)												
				Antimony	5.38E-07	µg/m³	4.22E-10	µg/m³	--	--	--	2.95E-08	µg/m³	--	--	--
				Copper	1.00E-05	µg/m³	7.85E-09	µg/m³	--	--	--	5.50E-07	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											1E-10					0.006
										Total of Receptor Risks Across All Media	**1E-10**				**Total of Receptor Hazards Across All Media**	**0.006**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 50
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Background)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk $^{(1)}$	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient $^{(1)}$
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	5.06E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	9E-09	5.89E-06	mg/kg-day	1.00E-04	mg/kg-day	0.06
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	7.50E-07	mg/kg-day	--	--	--	8.73E-06	mg/kg-day	4.00E-04	mg/kg-day	0.02
				Copper	1.27E+01	mg/kg	1.40E-05	mg/kg-day	--	--	--	1.63E-04	mg/kg-day	3.25E-02	mg/kg-day	0.005
			Exp. Route Total								9E-09					0.09
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	1.20E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	2E-09	1.39E-06	mg/kg-day	1.00E-04	mg/kg-day	0.01
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	1.77E-08	mg/kg-day	--	--	--	2.07E-07	mg/kg-day	6.00E-05	mg/kg-day	0.003
				Copper	1.27E+01	mg/kg	3.30E-07	mg/kg-day	--	--	--	3.85E-06	mg/kg-day	3.25E-02	mg/kg-day	0.0001
			Exp. Route Total								2E-09					0.02
		Exp. Point Total									1E-08					0.1
	Exp. Medium Total										1E-08					0.1
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	3.63E-07	µg/m³	2.49E-09	µg/m³	--	--	--	2.90E-08	µg/m³	--	--	--
				Metals (Total)												
				Antimony	5.38E-07	µg/m³	3.69E-09	µg/m³	--	--	--	4.30E-08	µg/m³	--	--	--
				Copper	1.00E-05	µg/m³	6.87E-08	µg/m³	--	--	--	8.01E-07	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											1E-08					0.1
										Total of Receptor Risks Across All Media	**1E-08**				**Total of Receptor Hazards Across All Media**	**0.1**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 51
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Background)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	1.57E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	3E-09	5.52E-07	mg/kg-day	1.00E-04	mg/kg-day	0.006
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	2.33E-07	mg/kg-day	--	--	--	8.18E-07	mg/kg-day	4.00E-04	mg/kg-day	0.002
				Copper	1.27E+01	mg/kg	4.34E-06	mg/kg-day	--	--	--	1.52E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0005
			Exp. Route Total								3E-09					0.008
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	6.67E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	1E-09	2.33E-07	mg/kg-day	1.00E-04	mg/kg-day	0.002
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	9.89E-09	mg/kg-day	--	--	--	3.45E-08	mg/kg-day	6.00E-05	mg/kg-day	0.0006
				Copper	1.27E+01	mg/kg	1.84E-07	mg/kg-day	--	--	--	6.43E-07	mg/kg-day	3.25E-02	mg/kg-day	0.00002
			Exp. Route Total								1E-09					0.003
		Exp. Point Total									4E-09					0.01
	Exp. Medium Total										4E-09					0.01
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	3.63E-07	µg/m³	8.28E-09	µg/m³	--	--	--	2.90E-08	µg/m³	--	--	--
				Metals (Total)												
				Antimony	5.38E-07	µg/m³	1.23E-08	µg/m³	--	--	--	4.30E-08	µg/m³	--	--	--
				Copper	1.00E-05	µg/m³	2.29E-07	µg/m³	--	--	--	8.01E-07	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											4E-09					0.01
										Total of Receptor Risks Across All Media	**4E-09**				**Total of Receptor Hazards Across All Media**	**0.01**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 52
Calculation of Chemical Cancer Risks (Background)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Lifetime) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Lifetime

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	6.62E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	1E-08	--	--	--	--	--
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	9.82E-07	mg/kg-day	--	--	--	--	--	--	--	--
				Copper	1.27E+01	mg/kg	1.83E-05	mg/kg-day	--	--	--	--	--	--	--	--
			Exp. Route Total								1E-08					--
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	4.60E-01	mg/kg	1.86E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	3E-09	--	--	--	--	--
				Metals (Total)												
				Antimony	6.82E-01	mg/kg	2.76E-08	mg/kg-day	--	--	--	--	--	--	--	--
				Copper	1.27E+01	mg/kg	5.14E-07	mg/kg-day	--	--	--	--	--	--	--	--
			Exp. Route Total								3E-09					--
		Exp. Point Total									1E-08					--
	Exp. Medium Total										1E-08					--
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	3.63E-07	μg/m³	1.08E-08	μg/m³	--	--	--	--	--	--	--	--
				Metals (Total)												
				Antimony	5.38E-07	μg/m³	1.60E-08	μg/m³	--	--	--	--	--	--	--	--
				Copper	1.00E-05	μg/m³	2.98E-07	μg/m³	--	--	--	--	--	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											1E-08					--
										Total of Receptor Risks Across All Media	**1E-08**				Total of Receptor Hazards Across All Media	**--**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-1
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Visitor (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.3	0.04	--	0.3
			Copper	--	--	--	--	GI	0.05	0.001	--	0.05
			Chemical Total	**--**	**--**	**--**	**--**		**0.3**	**0.04**	**--**	**0.4**
		Exposure Point Total					**--**					**0.4**
	Exposure Medium Total						**--**					**0.4**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.4**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.4**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-2
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Visitor (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.03	0.007	--	0.03
			Copper	--	--	--	--	GI	0.005	0.0002	--	0.005
			Chemical Total	**--**	**--**	**--**	**--**		**0.03**	**0.007**	**--**	**0.04**
		Exposure Point Total					**--**					**0.04**
	Exposure Medium Total						**--**					**0.04**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.04**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**0.04**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-3
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Trespasser (Teen) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.01	0.01	--	0.03
			Copper	--	--	--	--	GI	0.003	0.0003	--	0.003
			Chemical Total	**--**	**--**	**--**	**--**		**0.02**	**0.01**	**--**	**0.03**
		Exposure Point Total					**--**					**0.03**
	Exposure Medium Total						**--**					**0.03**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.03**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.03**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-4
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Commerical/ Industrial Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [(1)]				Non-Carcinogenic Hazard Quotient [(1)]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.03	0.02	--	0.05
			Copper	--	--	--	--	GI	0.006	0.0005	--	0.007
			Chemical Total	**--**	**--**	**--**	**--**		**0.04**	**0.02**	**--**	**0.05**
		Exposure Point Total					**--**					**0.05**
	Exposure Medium Total						**--**					**0.05**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.05**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**0.05**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-5
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Utility Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.02	0.003	--	0.03
			Copper	--	--	--	--	GI	0.004	0.00009	--	0.005
			Chemical Total	**--**	**--**	**--**	**--**		**0.03**	**0.003**	**--**	**0.03**
		Exposure Point Total					**--**					**0.03**
	Exposure Medium Total						**--**					**0.03**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.03**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.03**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-6
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Construction Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.07	0.01	--	0.08
			Copper	--	--	--	--	GI	0.01	0.0004	--	0.01
			Chemical Total	**--**	**--**	**--**	**--**		**0.08**	**0.01**	**--**	**0.1**
		Exposure Point Total					**--**					**0.1**
	Exposure Medium Total						**--**					**0.1**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.1**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.1**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-7
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Resident (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	1	0.2	--	1
			Copper	--	--	--	--	GI	0.3	0.006	--	0.3
			Chemical Total	**--**	**--**	**--**	**--**		**2**	**0.2**	**--**	**2**
		Exposure Point Total					**--**					**2**
	Exposure Medium Total						**--**					**2**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**2**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**2**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Total Gastrointestinal (GI) HI across All Media =	**0.3**
Total Other (OT) HI across All Media =	**1**

Table 9-8
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Resident (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.1	0.03	--	0.2
			Copper	--	--	--	--	GI	0.02	0.001	--	0.02
			Chemical Total	**--**	**--**	**--**	**--**		**0.1**	**0.03**	**--**	**0.2**
		Exposure Point Total					**--**					**0.2**
	Exposure Medium Total						**--**					**0.2**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.2**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.2**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-9
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Future On-Site Visitor (Child) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.4	0.06	--	0.4
			Copper	--	--	--	--	GI	0.08	0.002	--	0.08
			Chemical Total	**--**	**--**	**--**	**--**		**0.4**	**0.06**	**--**	**0.5**
		Exposure Point Total					**--**					**0.5**
	Exposure Medium Total						**--**					**0.5**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.5**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.5**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-10
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Future On-Site Visitor (Adult) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.03	0.01	--	0.04
			Copper	--	--	--	--	GI	0.007	0.0003	--	0.008
			Chemical Total	**--**	**--**	**--**	**--**		**0.04**	**0.01**	**--**	**0.05**
		Exposure Point Total					**--**					**0.05**
	Exposure Medium Total						**--**					**0.05**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.05**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**0.05**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-11
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Future On-Site Trespasser (Teen) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [(1)]				Non-Carcinogenic Hazard Quotient [(1)]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.02	0.01	--	0.03
			Copper	--	--	--	--	GI	0.004	0.0005	--	0.005
			Chemical Total	**--**	**--**	**--**	**--**		**0.02**	**0.02**	**--**	**0.04**
		Exposure Point Total					**--**					**0.04**
	Exposure Medium Total						**--**					**0.04**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.04**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.04**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-12
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Future On-Site Commerical/ Industrial Worker - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.04	0.02	--	0.06
			Copper	--	--	--	--	GI	0.009	0.0007	--	0.009
			Chemical Total	**--**	**--**	**--**	**--**		**0.05**	**0.02**	**--**	**0.07**
		Exposure Point Total					**--**					**0.07**
	Exposure Medium Total						**--**					**0.07**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.07**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.07**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-13
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Future On-Site Utility Worker - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [(1)]				Non-Carcinogenic Hazard Quotient [(1)]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.03	0.004	--	0.03
			Copper	--	--	--	--	GI	0.006	0.0001	--	0.006
			Chemical Total	**--**	**--**	**--**	**--**		**0.04**	**0.004**	**--**	**0.04**
		Exposure Point Total					**--**					**0.04**
	Exposure Medium Total						**--**					**0.04**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.04**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.04**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-14
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Future On-Site Construction Worker - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.09	0.02	--	0.1
			Copper	--	--	--	--	GI	0.02	0.0006	--	0.02
			Chemical Total	**--**	**--**	**--**	**--**		**0.1**	**0.02**	**--**	**0.1**
		Exposure Point Total					**--**					**0.1**
	Exposure Medium Total						**--**					**0.1**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.1**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**0.1**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-15
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Future On-Site Resident (Child) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil	**Metals (Total)**									
			Antimony	--	--	--	--	OT	2	0.3	--	2
			Copper	--	--	--	--	GI	0.4	0.008	--	0.4
			Chemical Total	**--**	**--**	**--**	**--**		**2**	**0.3**	**--**	**2**
		Exposure Point Total					**--**					**2**
	Exposure Medium Total						**--**					**2**
	Outdoor Air	Particulates above Site	**Metals (Total)**									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**2**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**2**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Total Gastrointestinal (GI) HI across All Media =	**0.4**
Total Other (OT) HI across All Media =	**2**

Table 9-16
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Future On-Site Resident (Adult) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.2	0.05	--	0.2
			Copper	--	--	--	--	GI	0.03	0.001	--	0.04
			Chemical Total	**--**	**--**	**--**	**--**		**0.2**	**0.05**	**--**	**0.2**
		Exposure Point Total					**--**					**0.2**
	Exposure Medium Total						**--**					**0.2**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.2**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.2**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-17
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Visitor (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.4	0.06	--	0.5
			Copper	--	--	--	--	GI	0.1	0.003	--	0.2
			Chemical Total	**--**	**--**	**--**	**--**		**0.5**	**0.07**	**--**	**0.6**
		Exposure Point Total					**--**					**0.6**
	Exposure Medium Total						**--**					**0.6**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.6**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**0.6**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-18
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Trespasser (Teen) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.04	0.01	--	0.05
			Copper	--	--	--	--	GI	0.01	0.0006	--	0.01
			Chemical Total	**--**	**--**	**--**	**--**		**0.05**	**0.01**	**--**	**0.06**
		Exposure Point Total					**--**					**0.06**
	Exposure Medium Total						**--**					**0.06**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.06**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.06**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-19
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Trespasser (Teen) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.02	0.02	--	0.04
			Copper	--	--	--	--	GI	0.008	0.0009	--	0.009
			Chemical Total	**--**	**--**	**--**	**--**		**0.03**	**0.02**	**--**	**0.05**
		Exposure Point Total					**--**					**0.05**
	Exposure Medium Total						**--**					**0.05**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.05**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**0.05**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-20
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Commerical/ Industrial Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.05	0.03	--	0.07
			Copper	--	--	--	--	GI	0.02	0.001	--	0.02
			Chemical Total	**--**	**--**	**--**	**--**		**0.06**	**0.03**	**--**	**0.09**
		Exposure Point Total					**--**					**0.09**
	Exposure Medium Total						**--**					**0.09**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.09**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.09**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-21
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Utility Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [(1)]				Non-Carcinogenic Hazard Quotient [(1)]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.03	0.005	--	0.04
			Copper	--	--	--	--	GI	0.01	0.0003	--	0.01
			Chemical Total	**--**	**--**	**--**	**--**		**0.05**	**0.005**	**--**	**0.05**
		Exposure Point Total					**--**					**0.05**
	Exposure Medium Total						**--**					**0.05**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.05**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.05**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-22
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Construction Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [(1)]				Non-Carcinogenic Hazard Quotient [(1)]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.1	0.02	--	0.1
			Copper	--	--	--	--	GI	0.04	0.001	--	0.04
			Chemical Total	**--**	**--**	**--**	**--**		**0.1**	**0.02**	**--**	**0.2**
		Exposure Point Total					**--**					**0.2**
	Exposure Medium Total						**--**					**0.2**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.2**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.2**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-23
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Resident (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	2	0.3	--	2
			Copper	--	--	--	--	GI	0.7	0.02	--	0.7
			Chemical Total	**--**	**--**	**--**	**--**		**3**	**0.3**	**--**	**3**
		Exposure Point Total					**--**					**3**
	Exposure Medium Total						**--**					**3**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**3**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**3**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Total Gastrointestinal (GI) HI across All Media =	**0.7**
Total Other (OT) HI across All Media =	**2**

Table 9-24
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Current On-Site Visitor (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.2	0.05	--	0.2
			Copper	--	--	--	--	GI	0.06	0.003	--	0.07
			Chemical Total	**--**	**--**	**--**	**--**		**0.2**	**0.05**	**--**	**0.3**
		Exposure Point Total					**--**					**0.3**
	Exposure Medium Total						**--**					**0.3**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.3**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.3**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-25
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Visitor (Adult) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	6	1	--	7
			Copper	--	--	--	--	GI	0.09	0.002	--	0.09
			Chemical Total	--	--	--	--		6	1	--	8
		Exposure Point Total					--					8
	Exposure Medium Total						--					8
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	--	--	--	--		--	--	--	--
		Exposure Point Total					--					--
	Exposure Medium Total						--					--
Medium Total							--					8
						Receptor Risk Total	--				Receptor Hazard Index (HI)	8

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Total Gastrointestinal (GI) HI across All Media =	**0.09**
Total Other (OT) HI across All Media =	**7**

Table 9-26
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Trespasser (Teen) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.6	0.2	--	0.8
			Copper	--	--	--	--	GI	0.008	0.0003	--	0.009
			Chemical Total	**--**	**--**	**--**	**--**		**0.6**	**0.2**	**--**	**0.8**
		Exposure Point Total					**--**					**0.8**
	Exposure Medium Total						**--**					**0.8**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.8**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**0.8**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-27
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Trespasser (Teen) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.3	0.3	--	0.6
			Copper	--	--	--	--	GI	0.005	0.0005	--	0.005
			Chemical Total	**--**	**--**	**--**	**--**		**0.4**	**0.3**	**--**	**0.6**
		Exposure Point Total					**--**					**0.6**
	Exposure Medium Total						**--**					**0.6**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.6**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.6**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-28
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Commerical/ Industrial Worker - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.7	0.4	--	1
			Copper	--	--	--	--	GI	0.01	0.0008	--	0.01
			Chemical Total	**--**	**--**	**--**	**--**		**0.7**	**0.4**	**--**	**1**
		Exposure Point Total					**--**					**1**
	Exposure Medium Total						**--**					**1**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**1**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**1**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-29
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Utility Worker - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [(1)]				Non-Carcinogenic Hazard Quotient [(1)]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.5	0.08	--	0.6
			Copper	--	--	--	--	GI	0.007	0.0002	--	0.007
			Chemical Total	**--**	**--**	**--**	**--**		**0.5**	**0.08**	**--**	**0.6**
		Exposure Point Total					**--**					**0.6**
	Exposure Medium Total						**--**					**0.6**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.6**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.6**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-30
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Construction Worker - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	2	0.3	--	2
			Copper	--	--	--	--	GI	0.02	0.0007	--	0.02
			Chemical Total	--	--	--	--		2	0.3	--	2
		Exposure Point Total					--					2
	Exposure Medium Total						--					2
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	--	--	--	--		--	--	--	--
		Exposure Point Total					--					--
	Exposure Medium Total						--					--
Medium Total							--					2
Notes:						**Receptor Risk Total**	--				**Receptor Hazard Index (HI)**	2

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Total Gastrointestinal (GI) HI across All Media =	**0.02**
Total Other (OT) HI across All Media =	**2**

Table 9-31
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Resident (Child) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	30	5	--	35
			Copper	--	--	--	--	GI	0.4	0.01	--	0.4
			Chemical Total	--	--	--	--		30	5	--	35
		Exposure Point Total					--					35
	Exposure Medium Total						--					35
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	--	--	--	--		--	--	--	--
		Exposure Point Total					--					--
	Exposure Medium Total						--					--
Medium Total							--					35
						Receptor Risk Total	--				Receptor Hazard Index (HI)	35

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Total Gastrointestinal (GI) HI across All Media =	**0.4**
Total Other (OT) HI across All Media =	**35**

Table 9-32
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Soil Pile)
Reasonable Maximum Exposure
Future On-Site Resident (Adult) - Total Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Future
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Total Soil	Total Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	3	0.8	--	4
			Copper	--	--	--	--	GI	0.04	0.002	--	0.04
			Chemical Total	**--**	**--**	**--**	**--**		**3**	**0.8**	**--**	**4**
		Exposure Point Total					**--**					**4**
	Exposure Medium Total						**--**					**4**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**4**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**4**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Total Gastrointestinal (GI) HI across All Media =	**0.04**
Total Other (OT) HI across All Media =	**4**

Table 9 33
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe: Current/Future
Receptor Population: On-Site Visitor
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	8E-08	2E-08	--	1E-07	HM	0.6	0.1	--	0.7
			Chemical Total	**8E-08**	**2E-08**	**--**	**1E-07**		**0.6**	**0.1**	**--**	**0.7**
		Exposure Point Total					**1E-07**					**0.7**
	Exposure Medium Total						**1E-07**					**0.7**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**1E-07**					**0.7**
						Receptor Risk Total	**1E-07**				**Receptor Hazard Index (HI)**	**0.7**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 34
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	3E-08	1E-08	--	4E-08	HM	0.05	0.02	--	0.08
			Chemical Total	**3E-08**	**1E-08**	**--**	**4E-08**		**0.05**	**0.02**	**--**	**0.08**
		Exposure Point Total					**4E-08**					**0.08**
	Exposure Medium Total						**4E-08**					**0.08**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**4E-08**					**0.08**
						Receptor Risk Total	**4E-08**				**Receptor Hazard Index (HI)**	**0.08**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 35
Summary of Chemical Cancer Risks for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Lifetime) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Lifetime

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	1E-07	3E-08	--	1E-07	--	--	--	--	--
			Chemical Total	**1E-07**	**3E-08**	**--**	**1E-07**		**--**	**--**	**--**	**--**
		Exposure Point Total					**1E-07**					**--**
	Exposure Medium Total						**1E-07**					**--**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**1E-07**					**--**
						Receptor Risk Total	**1E-07**				**Receptor Hazard Index (HI)**	**--**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 36
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Trespasser (Teen) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	8E-09	9E-09	--	2E-08	HM	0.03	0.04	--	0.07
			Chemical Total	**8E-09**	**9E-09**	**--**	**2E-08**		**0.03**	**0.04**	**--**	**0.07**
		Exposure Point Total					**2E-08**					**0.07**
	Exposure Medium Total						**2E-08**					**0.07**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**2E-08**					**0.07**
						Receptor Risk Total	**2E-08**				**Receptor Hazard Index (HI)**	**0.07**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 37
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Commerical/ Industrial Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	4E-08	3E-08	--	7E-08	HM	0.06	0.05	--	0.1
			Chemical Total	**4E-08**	**3E-08**	**--**	**7E-08**		**0.06**	**0.05**	**--**	**0.1**
		Exposure Point Total					**7E-08**					**0.1**
	Exposure Medium Total						**7E-08**					**0.1**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**7E-08**					**0.1**
Notes:						**Receptor Risk Total**	**7E-08**				**Receptor Hazard Index (HI)**	**0.1**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 38
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Utility Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	1E-09	2E-10	--	1E-09	HM	0.05	0.01	--	0.06
			Chemical Total	**1E-09**	**2E-10**	**--**	**1E-09**		**0.05**	**0.01**	**--**	**0.06**
		Exposure Point Total					**1E-09**					**0.06**
	Exposure Medium Total						**1E-09**					**0.06**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**1E-09**					**0.06**
						Receptor Risk Total	**1E-09**				**Receptor Hazard Index (HI)**	**0.06**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 39
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Construction Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	4E-09	1E-09	--	5E-09	HM	0.1	0.05	--	0.2
			Chemical Total	**4E-09**	**1E-09**	**--**	**5E-09**		**0.1**	**0.05**	**--**	**0.2**
		Exposure Point Total					**5E-09**					**0.2**
	Exposure Medium Total						**5E-09**					**0.2**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**5E-09**					**0.2**
Notes:						**Receptor Risk Total**	**5E-09**				**Receptor Hazard Index (HI)**	**0.2**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 40
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	4E-07	9E-08	--	5E-07	HM	3	0.6	--	3
			Chemical Total	**4E-07**	**9E-08**	**--**	**5E-07**		3	**0.6**	**--**	3
		Exposure Point Total					**5E-07**					3
	Exposure Medium Total						**5E-07**					3
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**5E-07**					3
						Receptor Risk Total	**5E-07**				**Receptor Hazard Index (HI)**	3

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Total Hematological (HM) HI across All Media =	3

Table 9 41
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [(1)]				Non-Carcinogenic Hazard Quotient [(1)]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	1E-07	5E-08	--	2E-07	HM	0.3	0.1	--	0.4
			Chemical Total	**1E-07**	**5E-08**	**--**	**2E-07**		**0.3**	**0.1**	**--**	**0.4**
		Exposure Point Total					**2E-07**					**0.4**
	Exposure Medium Total						**2E-07**					**0.4**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**2E-07**					**0.4**
						Receptor Risk Total	**2E-07**				**Receptor Hazard Index (HI)**	**0.4**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 42
Summary of Chemical Cancer Risks for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Lifetime) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Lifetime

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [(1)]				Non-Carcinogenic Hazard Quotient [(1)]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	5E-07	1E-07	--	7E-07	--	--	--	--	--
			Chemical Total	**5E-07**	**1E-07**	**--**	**7E-07**		**--**	**--**	**--**	**--**
		Exposure Point Total					**7E-07**					**--**
	Exposure Medium Total						**7E-07**					**--**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**7E-07**					**--**
						Receptor Risk Total	**7E-07**				**Receptor Hazard Index (HI)**	**--**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 43
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Background)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	2E-09	4E-10	--	2E-09	HM	0.01	0.003	--	0.02
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.005	0.0007	--	0.005
			Copper	--	--	--	--	GI	0.001	0.00003	--	0.001
			Chemical Total	**2E-09**	**4E-10**	**--**	**2E-09**		**0.02**	**0.004**	**--**	**0.02**
		Exposure Point Total					**2E-09**					**0.02**
	Exposure Medium Total						**2E-09**					**0.02**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**2E-09**					**0.02**
Notes:						**Receptor Risk Total**	**2E-09**				**Receptor Hazard Index (HI)**	**0.02**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 44
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Background)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [(1)]				Non-Carcinogenic Hazard Quotient [(1)]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	6E-10	2E-10	--	8E-10	HM	0.001	0.0005	--	0.002
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.0004	0.0001	--	0.0006
			Copper	--	--	--	--	GI	0.0001	0.000004	--	0.0001
			Chemical Total	**6E-10**	**2E-10**	**--**	**8E-10**		**0.002**	**0.0006**	**--**	**0.002**
		Exposure Point Total					**8E-10**					**0.002**
	Exposure Medium Total						**8E-10**					**0.002**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**8E-10**					**0.002**
Notes:						**Receptor Risk Total**	**8E-10**				**Receptor Hazard Index (HI)**	**0.002**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 45
Summary of Chemical Cancer Risks for COPCs (Background)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Lifetime) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Lifetime

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	2E-09	7E-10	--	3E-09	--	--	--	--	--
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**2E-09**	**7E-10**	**--**	**3E-09**		**--**	**--**	**--**	**--**
		Exposure Point Total					**3E-09**					**--**
	Exposure Medium Total						**3E-09**					**--**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**3E-09**					**--**
Notes:						**Receptor Risk Total**	**3E-09**				**Receptor Hazard Index (HI)**	**--**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 46
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Background)
Reasonable Maximum Exposure
Current/Future On-Site Trespasser (Teen) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	2E-10	2E-10	--	4E-10	HM	0.0007	0.0008	--	0.001
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.0003	0.0002	--	0.0004
			Copper	--	--	--	--	GI	0.00006	0.000007	--	0.00006
			Chemical Total	**2E-10**	**2E-10**	**--**	**4E-10**		**0.001**	**0.001**	**--**	**0.002**
		Exposure Point Total					**4E-10**					**0.002**
	Exposure Medium Total						**4E-10**					**0.002**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**4E-10**					**0.002**
Notes:						**Receptor Risk Total**	**4E-10**				**Receptor Hazard Index (HI)**	**0.002**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 47
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Background)
Reasonable Maximum Exposure
Current/Future On-Site Commerical/ Industrial Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	9E-10	7E-10	--	2E-09	HM	0.001	0.001	--	0.003
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.0005	0.0003	--	0.0008
			Copper	--	--	--	--	GI	0.0001	0.00001	--	0.0001
			Chemical Total	**9E-10**	**7E-10**	**--**	**2E-09**		**0.002**	**0.002**	**--**	**0.004**
		Exposure Point Total					**2E-09**					**0.004**
	Exposure Medium Total						**2E-09**					**0.004**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**2E-09**					**0.004**
Notes:						**Receptor Risk Total**	**2E-09**				**Receptor Hazard Index (HI)**	**0.004**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 48
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Background)
Reasonable Maximum Exposure
Current/Future On-Site Utility Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	3E-11	5E-12	--	3E-11	HM	0.001	0.0002	--	0.001
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.0004	0.00005	--	0.0004
			Copper	--	--	--	--	GI	0.00009	0.000002	--	0.00009
			Chemical Total	**3E-11**	**5E-12**	**--**	**3E-11**		**0.002**	**0.0003**	**--**	**0.002**
		Exposure Point Total					**3E-11**					**0.002**
	Exposure Medium Total						**3E-11**					**0.002**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**3E-11**					**0.002**
Notes:						**Receptor Risk Total**	**3E-11**				**Receptor Hazard Index (HI)**	**0.002**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 49
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Background)
Reasonable Maximum Exposure
Current/Future On-Site Construction Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	8E-11	2E-11	--	1E-10	HM	0.003	0.001	--	0.004
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.001	0.0002	--	0.001
			Copper	--	--	--	--	GI	0.0003	0.000008	--	0.0003
			Chemical Total	**8E-11**	**2E-11**	**--**	**1E-10**		**0.005**	**0.001**	**--**	**0.006**
		Exposure Point Total					**1E-10**					**0.006**
	Exposure Medium Total						**1E-10**					**0.006**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**1E-10**					**0.006**
Notes:						**Receptor Risk Total**	**1E-10**				**Receptor Hazard Index (HI)**	**0.006**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 50

Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Background)

Reasonable Maximum Exposure

Current/Future On-Site Resident (Child) - Surface Soil

Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	9E-09	2E-09	--	1E-08	HM	0.06	0.01	--	0.07
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.02	0.003	--	0.03
			Copper	--	--	--	--	GI	0.005	0.0001	--	0.005
			Chemical Total	**9E-09**	**2E-09**	**--**	**1E-08**		**0.09**	**0.02**	**--**	**0.1**
		Exposure Point Total					**1E-08**					**0.1**
	Exposure Medium Total						**1E-08**					**0.1**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**1E-08**					**0.1**
Notes:						**Receptor Risk Total**	**1E-08**				**Receptor Hazard Index (HI)**	**0.1**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 51
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Background)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	3E-09	1E-09	--	4E-09	HM	0.006	0.002	--	0.008
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.002	0.0006	--	0.003
			Copper	--	--	--	--	GI	0.0005	0.00002	--	0.0005
			Chemical Total	**3E-09**	**1E-09**	**--**	**4E-09**		**0.008**	**0.003**	**--**	**0.01**
		Exposure Point Total					**4E-09**					**0.01**
	Exposure Medium Total						**4E-09**					**0.01**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**4E-09**					**0.01**
Notes:						**Receptor Risk Total**	**4E-09**				**Receptor Hazard Index (HI)**	**0.01**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 52
Summary of Chemical Cancer Risks for COPCs (Background)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Lifetime) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Lifetime

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	1E-08	3E-09	--	1E-08	--	--	--	--	--
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**1E-08**	**3E-09**	**--**	**1E-08**		**--**	**--**	**--**	**--**
		Exposure Point Total					**1E-08**					**--**
	Exposure Medium Total						**1E-08**					**--**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**1E-08**					**--**
Notes:						**Receptor Risk Total**	**1E-08**				**Receptor Hazard Index (HI)**	**--**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Attachment 5

Uncertainty Assessment Calculations

Table 7-1
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Visitor (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	1.54E-05	mg/kg-day	--	--	--	1.80E-04	mg/kg-day	4.00E-04	mg/kg-day	0.5
				Copper	1.05E+03	mg/kg	2.47E-04	mg/kg-day	--	--	--	2.87E-03	mg/kg-day	3.25E-02	mg/kg-day	0.09
			Exp. Route Total								--					0.5
			Dermal													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	3.66E-07	mg/kg-day	--	--	--	4.27E-06	mg/kg-day	6.00E-05	mg/kg-day	0.07
				Copper	1.05E+03	mg/kg	5.84E-06	mg/kg-day	--	--	--	6.82E-05	mg/kg-day	3.25E-02	mg/kg-day	0.002
			Exp. Route Total								--					0.07
		Exp. Point Total									--					0.6
	Exp. Medium Total										--					0.6
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	5.19E-05	µg/m³	7.63E-08	µg/m³	--	--	--	8.87E-07	µg/m³	--	--	--
				Copper	8.28E-04	µg/m³	1.22E-06	µg/m³	--	--	--	1.42E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.6
									Total of Receptor Risks Across All Media		--			Total of Receptor Hazards Across All Media		0.6

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-2
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Visitor (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	4.82E-06	mg/kg-day	--	--	--	1.69E-05	mg/kg-day	4.00E-04	mg/kg-day	0.04
				Copper	1.05E+03	mg/kg	7.70E-05	mg/kg-day	--	--	--	2.70E-04	mg/kg-day	3.25E-02	mg/kg-day	0.008
			Exp. Route Total								--					0.05
			Dermal													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	2.04E-07	mg/kg-day	--	--	--	7.10E-07	mg/kg-day	6.00E-05	mg/kg-day	0.01
				Copper	1.05E+03	mg/kg	3.25E-06	mg/kg-day	--	--	--	1.13E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0003
			Exp. Route Total								--					0.01
		Exp. Point Total									--					0.06
	Exp. Medium Total										--					0.06
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	5.19E-05	$\mu g/m^3$	2.54E-07	$\mu g/m^3$	--	--	--	8.87E-07	$\mu g/m^3$	--	--	--
				Copper	8.28E-04	$\mu g/m^3$	4.05E-06	$\mu g/m^3$	--	--	--	1.42E-05	$\mu g/m^3$	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.06
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**0.06**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-3
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Trespasser (Teen) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	1.40E-06	mg/kg-day	--	--	--	9.79E-06	mg/kg-day	4.00E-04	mg/kg-day	0.02
				Copper	1.05E+03	mg/kg	2.23E-05	mg/kg-day	--	--	--	1.56E-04	mg/kg-day	3.25E-02	mg/kg-day	0.005
			Exp. Route Total								--					0.03
			Dermal													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	1.58E-07	mg/kg-day	--	--	--	1.10E-06	mg/kg-day	6.00E-05	mg/kg-day	0.02
				Copper	1.05E+03	mg/kg	2.52E-06	mg/kg-day	--	--	--	1.76E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0005
			Exp. Route Total								--					0.02
		Exp. Point Total									--					0.05
	Exp. Medium Total										--					0.05
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	5.19E-05	µg/m^3	8.14E-08	µg/m^3	--	--	--	5.71E-07	µg/m^3	--	--	--
				Copper	8.28E-04	µg/m^3	1.30E-06	µg/m^3	--	--	--	9.11E-06	µg/m^3	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.05
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	0.05

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-4
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Commerical/ Industrial Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [1]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [1]
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	7.23E-06	mg/kg-day	--	--	--	2.02E-05	mg/kg-day	4.00E-04	mg/kg-day	0.05
				Copper	1.05E+03	mg/kg	1.15E-04	mg/kg-day	--	--	--	3.23E-04	mg/kg-day	3.25E-02	mg/kg-day	0.01
			Exp. Route Total								--					0.06
			Dermal													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	6.12E-07	mg/kg-day	--	--	--	1.71E-06	mg/kg-day	6.00E-05	mg/kg-day	0.03
				Copper	1.05E+03	mg/kg	9.78E-06	mg/kg-day	--	--	--	2.74E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0008
			Exp. Route Total								--					0.03
		Exp. Point Total									--					0.09
	Exp. Medium Total										--					0.09
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	5.19E-05	µg/m³	3.05E-06	µg/m³	--	--	--	8.51E-06	µg/m³	--	--	--
				Copper	8.28E-04	µg/m³	4.86E-05	µg/m³	--	--	--	1.36E-04	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.09
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	0.09

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-5
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Utility Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	2.12E-07	mg/kg-day	--	--	--	1.48E-05	mg/kg-day	4.00E-04	mg/kg-day	0.04
				Copper	1.05E+03	mg/kg	3.39E-06	mg/kg-day	--	--	--	2.37E-04	mg/kg-day	3.25E-02	mg/kg-day	0.007
			Exp. Route Total								--					0.04
			Dermal													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	4.53E-09	mg/kg-day	--	--	--	3.17E-07	mg/kg-day	6.00E-05	mg/kg-day	0.005
				Copper	1.05E+03	mg/kg	7.24E-08	mg/kg-day	--	--	--	5.07E-06	mg/kg-day	3.25E-02	mg/kg-day	0.0002
			Exp. Route Total								--					0.005
		Exp. Point Total									--					0.05
	Exp. Medium Total										--					0.05
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	5.19E-05	μg/m^3	1.35E-08	μg/m^3	--	--	--	9.49E-07	μg/m^3	--	--	--
				Copper	8.28E-04	μg/m^3	2.16E-07	μg/m^3	--	--	--	1.52E-05	μg/m^3	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.05
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**0.05**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-6
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Construction Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	6.37E-07	mg/kg-day	--	--	--	4.45E-05	mg/kg-day	4.00E-04	mg/kg-day	0.1
				Copper	1.05E+03	mg/kg	1.02E-05	mg/kg-day	--	--	--	7.11E-04	mg/kg-day	3.25E-02	mg/kg-day	0.02
			Exp. Route Total								--					0.1
			Dermal													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	2.04E-08	mg/kg-day	--	--	--	1.43E-06	mg/kg-day	6.00E-05	mg/kg-day	0.02
				Copper	1.05E+03	mg/kg	3.26E-07	mg/kg-day	--	--	--	2.28E-05	mg/kg-day	3.25E-02	mg/kg-day	0.0007
			Exp. Route Total								--					0.02
		Exp. Point Total									--					0.2
	Exp. Medium Total										--					0.2
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	5.19E-05	μg/m³	4.06E-08	μg/m³	--	--	--	2.84E-06	μg/m³	--	--	--
				Copper	8.28E-04	μg/m³	6.49E-07	μg/m³	--	--	--	4.54E-05	μg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.2
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	0.2

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-7
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Resident (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk $^{(1)}$	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient $^{(1)}$
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	7.23E-05	mg/kg-day	--	--	--	8.41E-04	mg/kg-day	4.00E-04	mg/kg-day	2
				Copper	1.05E+03	mg/kg	1.15E-03	mg/kg-day	--	--	--	1.34E-02	mg/kg-day	3.25E-02	mg/kg-day	0.4
			Exp. Route Total								--					3
			Dermal													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	1.71E-06	mg/kg-day	--	--	--	1.99E-05	mg/kg-day	6.00E-05	mg/kg-day	0.3
				Copper	1.05E+03	mg/kg	2.73E-05	mg/kg-day	--	--	--	3.18E-04	mg/kg-day	3.25E-02	mg/kg-day	0.01
			Exp. Route Total								--					0.3
		Exp. Point Total									--					3
	Exp. Medium Total										--					3
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	5.19E-05	µg/m³	3.55E-07	µg/m³	--	--	--	4.14E-06	µg/m³	--	--	--
				Copper	8.28E-04	µg/m³	5.67E-06	µg/m³	--	--	--	6.62E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					3
										Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	3

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-8
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Target Berm)
Reasonable Maximum Exposure
Current On-Site Resident (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [1]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [1]
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	2.25E-05	mg/kg-day	--	--	--	7.88E-05	mg/kg-day	4.00E-04	mg/kg-day	0.2
				Copper	1.05E+03	mg/kg	3.59E-04	mg/kg-day	--	--	--	1.26E-03	mg/kg-day	3.25E-02	mg/kg-day	0.04
			Exp. Route Total								--					0.2
			Dermal													
				Metals (Total)												
				Antimony	6.57E+01	mg/kg	9.53E-07	mg/kg-day	--	--	--	3.32E-06	mg/kg-day	6.00E-05	mg/kg-day	0.06
				Copper	1.05E+03	mg/kg	1.52E-05	mg/kg-day	--	--	--	5.31E-05	mg/kg-day	3.25E-02	mg/kg-day	0.002
			Exp. Route Total								--					0.06
		Exp. Point Total									--					0.3
	Exp. Medium Total										--					0.3
	Outdoor Air	Particulates above Site	Inhalation													
				Metals (Total)												
				Antimony	5.19E-05	µg/m³	1.18E-06	µg/m³	--	--	--	4.14E-06	µg/m³	--	--	--
				Copper	8.28E-04	µg/m³	1.89E-05	µg/m³	--	--	--	6.62E-05	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											--					0.3
										Total of Receptor Risks Across All Media	**--**				Total of Receptor Hazards Across All Media	**0.3**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7-33
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	1.98E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	3E-09	2.31E-06	mg/kg-day	1.00E-04	mg/kg-day	0.02
			Exp. Route Total								3E-09					0.02
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	4.70E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	8E-10	5.49E-07	mg/kg-day	1.00E-04	mg/kg-day	0.005
			Exp. Route Total								8E-10					0.005
		Exp. Point Total									4E-09					0.03
	Exp. Medium Total										4E-09					0.03
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	6.66E-07	µg/m³	9.80E-10	µg/m³	--	--	--	1.14E-08	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											4E-09					0.03
										Total of Receptor Risks Across All Media	**4E-09**				**Total of Receptor Hazards Across All Media**	**0.03**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 34
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	8.44E-01	mg/kg	6.19E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	1E-09	2.17E-07	mg/kg-day	1.00E-04	mg/kg-day	0.002
			Exp. Route Total								1E-09					0.002
			Dermal	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	8.44E-01	mg/kg	2.62E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	5E-10	9.12E-08	mg/kg-day	1.00E-04	mg/kg-day	0.0009
			Exp. Route Total								5E-10					0.0009
		Exp. Point Total									2E-09					0.003
	Exp. Medium Total										2E-09					0.003
	Outdoor Air	Particulates above Site	Inhalation	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	6.66E-07	µg/m³	3.26E-09	µg/m³	--	--	--	1.14E-08	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											2E-09					0.003
										Total of Receptor Risks Across All Media	**2E-09**				**Total of Receptor Hazards Across All Media**	**0.003**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 35
Calculation of Chemical Cancer Risks (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Lifetime) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Lifetime

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk $^{(1)}$	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient $^{(1)}$
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	2.60E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	4E-09	--	--	--	--	--
			Exp. Route Total								4E-09					--
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	7.32E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	1E-09	--	--	--	--	--
			Exp. Route Total								1E-09					--
		Exp. Point Total									6E-09					--
	Exp. Medium Total										6E-09					--
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	6.66E-07	μg/m³	4.24E-09	μg/m³	--	--	--	--	--	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											6E-09					--
										Total of Receptor Risks Across All Media	**6E-09**				Total of Receptor Hazards Across All Media	**--**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 36
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Trespasser (Teen) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk $^{(1)}$	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient $^{(1)}$
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	1.80E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	3E-10	1.26E-07	mg/kg-day	1.00E-04	mg/kg-day	0.001
			Exp. Route Total								3E-10					0.001
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	2.03E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	3E-10	1.42E-07	mg/kg-day	1.00E-04	mg/kg-day	0.001
			Exp. Route Total								3E-10					0.001
		Exp. Point Total									7E-10					0.003
	Exp. Medium Total										7E-10					0.003
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	6.66E-07	µg/m³	1.05E-09	µg/m³	--	--	--	7.33E-09	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											7E-10					0.003
Notes:										**Total of Receptor Risks Across All Media**	**7E-10**				**Total of Receptor Hazards Across All Media**	**0.003**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 37
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Commerical/ Industrial Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	9.28E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	2E-09	2.60E-07	mg/kg-day	1.00E-04	mg/kg-day	0.003
			Exp. Route Total								2E-09					0.003
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	7.87E-08	mg/kg-day	1.72E-02	1/(mg/kg-day)	1E-09	2.20E-07	mg/kg-day	1.00E-04	mg/kg-day	0.002
			Exp. Route Total								1E-09					0.002
		Exp. Point Total									3E-09					0.005
	Exp. Medium Total										3E-09					0.005
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	6.66E-07	µg/m³	3.91E-08	µg/m³	--	--	--	1.09E-07	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											3E-09					0.005
										Total of Receptor Risks Across All Media	**3E-09**				**Total of Receptor Hazards Across All Media**	**0.005**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 38
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Utility Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	2.73E-09	mg/kg-day	1.72E-02	1/(mg/kg-day)	5E-11	1.91E-07	mg/kg-day	1.00E-04	mg/kg-day	0.002
			Exp. Route Total								5E-11					0.002
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	5.82E-10	mg/kg-day	1.72E-02	1/(mg/kg-day)	1E-11	4.08E-08	mg/kg-day	1.00E-04	mg/kg-day	0.0004
			Exp. Route Total								1E-11					0.0004
		Exp. Point Total									6E-11					0.002
	Exp. Medium Total										6E-11					0.002
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	6.66E-07	μg/m^3	1.74E-10	μg/m^3	--	--	--	1.22E-08	μg/m^3	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											6E-11					0.002
										Total of Receptor Risks Across All Media	**6E-11**				Total of Receptor Hazards Across All Media	**0.002**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 39
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Construction Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [(1)]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [(1)]
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	8.18E-09	mg/kg-day	1.72E-02	1/(mg/kg-day)	1E-10	5.72E-07	mg/kg-day	1.00E-04	mg/kg-day	0.006
			Exp. Route Total								1E-10					0.006
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	2.62E-09	mg/kg-day	1.72E-02	1/(mg/kg-day)	5E-11	1.83E-07	mg/kg-day	1.00E-04	mg/kg-day	0.002
			Exp. Route Total								5E-11					0.002
		Exp. Point Total									2E-10					0.008
	Exp. Medium Total										2E-10					0.008
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	6.66E-07	μg/m³	5.22E-10	μg/m³	--	--	--	3.65E-08	μg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											2E-10					0.008
										Total of Receptor Risks Across All Media	**2E-10**				Total of Receptor Hazards Across All Media	**0.008**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 40
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk [1]	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient [1]
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	8.44E-01	mg/kg	9.28E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	2E-08	1.08E-05	mg/kg-day	1.00E-04	mg/kg-day	0.1
			Exp. Route Total								2E-08					0.1
			Dermal	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	8.44E-01	mg/kg	2.19E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	4E-09	2.56E-06	mg/kg-day	1.00E-04	mg/kg-day	0.03
			Exp. Route Total								4E-09					0.03
		Exp. Point Total									2E-08					0.1
	Exp. Medium Total										2E-08					0.1
	Outdoor Air	Particulates above Site	Inhalation	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	6.66E-07	µg/m³	4.56E-09	µg/m³	--	--	--	5.32E-08	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											2E-08					0.1
										Total of Receptor Risks Across All Media	**2E-08**				**Total of Receptor Hazards Across All Media**	**0.1**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 41
Calculation of Chemical Cancer Risks and Non-Cancer Hazards (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	2.89E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	5E-09	1.01E-06	mg/kg-day	1.00E-04	mg/kg-day	0.01
			Exp. Route Total								5E-09					0.01
			Dermal													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	8.44E-01	mg/kg	1.22E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	2E-09	4.27E-07	mg/kg-day	1.00E-04	mg/kg-day	0.004
			Exp. Route Total								2E-09					0.004
		Exp. Point Total									7E-09					0.01
	Exp. Medium Total										7E-09					0.01
	Outdoor Air	Particulates above Site	Inhalation													
				Semi-volatile Organic Compounds (SVOCs)												
				Nitroglycerin	6.66E-07	µg/m³	1.52E-08	µg/m³	--	--	--	5.32E-08	µg/m³	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											7E-09					0.01
										Total of Receptor Risks Across All Media	**7E-09**				**Total of Receptor Hazards Across All Media**	**0.01**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 7 42
Calculation of Chemical Cancer Risks (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Lifetime) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Lifetime

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk (1)	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient (1)
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil	Ingestion	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	8.44E-01	mg/kg	1.22E-06	mg/kg-day	1.72E-02	1/(mg/kg-day)	2E-08	--	--	--	--	--
			Exp. Route Total								2E-08					--
			Dermal	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	8.44E-01	mg/kg	3.42E-07	mg/kg-day	1.72E-02	1/(mg/kg-day)	6E-09	--	--	--	--	--
			Exp. Route Total								6E-09					--
		Exp. Point Total									3E-08					--
	Exp. Medium Total										3E-08					--
	Outdoor Air	Particulates above Site	Inhalation	**Semi-volatile Organic Compounds (SVOCs)**												
				Nitroglycerin	6.66E-07	µg/m³	1.98E-08	µg/m³	--	--	--	--	--	--	--	--
			Exp. Route Total								--					--
		Exp. Point Total									--					--
	Exp. Medium Total										--					--
Medium Total											3E-08					--
										Total of Receptor Risks Across All Media	**3E-08**				**Total of Receptor Hazards Across All Media**	**--**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-1
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Visitor (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.5	0.07	--	0.5
			Copper	--	--	--	--	GI	0.09	0.002	--	0.09
			Chemical Total	**--**	**--**	**--**	**--**		**0.5**	**0.07**	**--**	**0.6**
		Exposure Point Total					**--**					**0.6**
	Exposure Medium Total						**--**					**0.6**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.6**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.6**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-2
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Visitor (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.04	0.01	--	0.05
			Copper	--	--	--	--	GI	0.008	0.0003	--	0.009
			Chemical Total	**--**	**--**	**--**	**--**		**0.05**	**0.01**	**--**	**0.06**
		Exposure Point Total					**--**					**0.06**
	Exposure Medium Total						**--**					**0.06**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.06**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**0.06**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-3
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Trespasser (Teen) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.02	0.02	--	0.04
			Copper	--	--	--	--	GI	0.005	0.0005	--	0.005
			Chemical Total	**--**	**--**	**--**	**--**		**0.03**	**0.02**	**--**	**0.05**
		Exposure Point Total					**--**					**0.05**
	Exposure Medium Total						**--**					**0.05**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.05**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**0.05**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-4
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Commerical/ Industrial Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.05	0.03	--	0.08
			Copper	--	--	--	--	GI	0.01	0.0008	--	0.01
			Chemical Total	**--**	**--**	**--**	**--**		**0.06**	**0.03**	**--**	**0.09**
		Exposure Point Total					**--**					**0.09**
	Exposure Medium Total						**--**					**0.09**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.09**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**0.09**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-5
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Utility Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [(1)]				Non-Carcinogenic Hazard Quotient [(1)]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.04	0.005	--	0.04
			Copper	--	--	--	--	GI	0.007	0.0002	--	0.007
			Chemical Total	**--**	**--**	**--**	**--**		**0.04**	**0.005**	**--**	**0.05**
		Exposure Point Total					**--**					**0.05**
	Exposure Medium Total						**--**					**0.05**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.05**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.05**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-6
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Construction Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe: Current
Receptor Population: On-Site Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.1	0.02	--	0.1
			Copper	--	--	--	--	GI	0.02	0.0007	--	0.02
			Chemical Total	**--**	**--**	**--**	**--**		**0.1**	**0.02**	**--**	**0.2**
		Exposure Point Total					**--**					**0.2**
	Exposure Medium Total						**--**					**0.2**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.2**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**0.2**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9-7
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Resident (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Resident
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	2	0.3	--	2
			Copper	--	--	--	--	GI	0.4	0.01	--	0.4
			Chemical Total	**--**	**--**	**--**	**--**		**3**	**0.3**	**--**	**3**
		Exposure Point Total					**--**					**3**
	Exposure Medium Total						**--**					**3**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**3**
						Receptor Risk Total	**--**				**Receptor Hazard Index (HI)**	**3**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Total Gastrointestinal (GI) HI across All Media =	**0.4**
Total Other (OT) HI across All Media =	**2**

Table 9-8
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Target Berm)
Reasonable Maximum Exposure
Current On-Site Resident (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Metals (Total)									
			Antimony	--	--	--	--	OT	0.2	0.06	--	0.3
			Copper	--	--	--	--	GI	0.04	0.002	--	0.04
			Chemical Total	**--**	**--**	**--**	**--**		**0.2**	**0.06**	**--**	**0.3**
		Exposure Point Total					**--**					**0.3**
	Exposure Medium Total						**--**					**0.3**
	Outdoor Air	Particulates above Site										
			Metals (Total)									
			Antimony	--	--	--	--	--	--	--	--	--
			Copper	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**--**					**0.3**
Notes:						**Receptor Risk Total**	**--**				**Receptor Hazard Index (HI)**	**0.3**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 33
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	3E-09	8E-10	--	4E-09	HM	0.02	0.005	--	0.03
			Chemical Total	**3E-09**	**8E-10**	**--**	**4E-09**		**0.02**	**0.005**	**--**	**0.03**
		Exposure Point Total					**4E-09**					**0.03**
	Exposure Medium Total						**4E-09**					**0.03**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**4E-09**					**0.03**
Notes:						**Receptor Risk Total**	**4E-09**				**Receptor Hazard Index (HI)**	**0.03**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 34

Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	1E-09	5E-10	--	2E-09	HM	0.002	0.0009	--	0.003
			Chemical Total	**1E-09**	**5E-10**	**--**	**2E-09**		**0.002**	**0.0009**	**--**	**0.003**
		Exposure Point Total					**2E-09**					**0.003**
	Exposure Medium Total						**2E-09**					**0.003**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**2E-09**					**0.003**
Notes:						**Receptor Risk Total**	**2E-09**				**Receptor Hazard Index (HI)**	**0.003**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 35
Summary of Chemical Cancer Risks for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Visitor (Lifetime) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Visitor
Receptor Age:	Lifetime

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [(1)]				Non-Carcinogenic Hazard Quotient [(1)]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	4E-09	1E-09	--	6E-09	--	--	--	--	--
			Chemical Total	**4E-09**	**1E-09**	**--**	**6E-09**		**--**	**--**	**--**	**--**
		Exposure Point Total					**6E-09**					**--**
	Exposure Medium Total						**6E-09**					**--**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**6E-09**					**--**
Notes:						**Receptor Risk Total**	**6E-09**				**Receptor Hazard Index (HI)**	**--**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 36
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Trespasser (Teen) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Trespasser
Receptor Age:	Teen

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	3E-10	3E-10	--	7E-10	HM	0.001	0.001	--	0.003
			Chemical Total	**3E-10**	**3E-10**	**--**	**7E-10**		**0.001**	**0.001**	**--**	**0.003**
		Exposure Point Total					**7E-10**					**0.003**
	Exposure Medium Total						**7E-10**					**0.003**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**7E-10**					**0.003**
Notes:						**Receptor Risk Total**	**7E-10**				**Receptor Hazard Index (HI)**	**0.003**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 37
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Commerical/ Industrial Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Commerical/ Industrial Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [(1)]				Non-Carcinogenic Hazard Quotient [(1)]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	2E-09	1E-09	--	3E-09	HM	0.003	0.002	--	0.005
			Chemical Total	**2E-09**	**1E-09**	**--**	**3E-09**		**0.003**	**0.002**	**--**	**0.005**
		Exposure Point Total					**3E-09**					**0.005**
	Exposure Medium Total						**3E-09**					**0.005**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**3E-09**					**0.005**
Notes:						**Receptor Risk Total**	**3E-09**				**Receptor Hazard Index (HI)**	**0.005**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 38
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Utility Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	5E-11	1E-11	--	6E-11	HM	0.002	0.0004	--	0.002
			Chemical Total	**5E-11**	**1E-11**	**--**	**6E-11**		**0.002**	**0.0004**	**--**	**0.002**
		Exposure Point Total					**6E-11**					**0.002**
	Exposure Medium Total						**6E-11**					**0.002**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**6E-11**					**0.002**
Notes:						**Receptor Risk Total**	**6E-11**				**Receptor Hazard Index (HI)**	**0.002**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 39
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Construction Worker - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Construction Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	1E-10	5E-11	--	2E-10	HM	0.006	0.002	--	0.008
			Chemical Total	**1E-10**	**5E-11**	**--**	**2E-10**		**0.006**	**0.002**	**--**	**0.008**
		Exposure Point Total					**2E-10**					**0.008**
	Exposure Medium Total						**2E-10**					**0.008**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**2E-10**					**0.008**
						Receptor Risk Total	**2E-10**				**Receptor Hazard Index (HI)**	**0.008**

Notes:

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 40
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Child) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe: Current/Future
Receptor Population: On-Site Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [(1)]				Non-Carcinogenic Hazard Quotient [(1)]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	2E-08	4E-09	--	2E-08	HM	0.1	0.03	--	0.1
			Chemical Total	**2E-08**	**4E-09**	**--**	**2E-08**		**0.1**	**0.03**	**--**	**0.1**
		Exposure Point Total					**2E-08**					**0.1**
	Exposure Medium Total						**2E-08**					**0.1**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**2E-08**					**0.1**
Notes:						**Receptor Risk Total**	**2E-08**				**Receptor Hazard Index (HI)**	**0.1**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 41
Summary of Chemical Cancer Risks and Non-Cancer Hazards for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Adult) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk [1]				Non-Carcinogenic Hazard Quotient [1]				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	5E-09	2E-09	--	7E-09	HM	0.01	0.004	--	0.01
			Chemical Total	**5E-09**	**2E-09**	**--**	**7E-09**		**0.01**	**0.004**	**--**	**0.01**
		Exposure Point Total					**7E-09**					**0.01**
	Exposure Medium Total						**7E-09**					**0.01**
	Outdoor Air	Particulates above Site	**Semi-volatile Organic Compounds (SVOCs)**									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**7E-09**					**0.01**
Notes:						**Receptor Risk Total**	**7E-09**				**Receptor Hazard Index (HI)**	**0.01**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Table 9 42
Summary of Chemical Cancer Risks for COPCs (Firing Point)
Reasonable Maximum Exposure
Current/Future On-Site Resident (Lifetime) - Surface Soil
Ridgway Training Range, Pennsylvania

Scenario Timeframe:	Current/Future
Receptor Population:	On-Site Resident
Receptor Age:	Lifetime

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Thresholds: Chemical-specific (1E-06) and Cumulative (1E-04)				Thresholds: Chemical-specific, Target Organ and Cumulative (HQ > 1)				
				Carcinogenic Risk (1)				Non-Carcinogenic Hazard Quotient (1)				
				Ingestion	Dermal	Inhalation	Exposure Routes Total	Primary Target Organs	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Surface Soil										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	2E-08	6E-09	--	3E-08	--	--	--	--	--
			Chemical Total	**2E-08**	**6E-09**	**--**	**3E-08**		**--**	**--**	**--**	**--**
		Exposure Point Total					**3E-08**					**--**
	Exposure Medium Total						**3E-08**					**--**
	Outdoor Air	Particulates above Site										
			Semi-volatile Organic Compounds (SVOCs)									
			Nitroglycerin	--	--	--	--	--	--	--	--	--
			Chemical Total	**--**	**--**	**--**	**--**		**--**	**--**	**--**	**--**
		Exposure Point Total					**--**					**--**
	Exposure Medium Total						**--**					**--**
Medium Total							**3E-08**					**--**
Notes:						**Receptor Risk Total**	**3E-08**				**Receptor Hazard Index (HI)**	**--**

(1) CR and HQs are rounded to one non-zero digit; cumulative totals may be slightly higher or lower depending on degree of rounding.

Appendix F:

Screening Level Ecological Risk Assessment

AECOM

Appendix F
Screening Level Ecological Risk Assessment (SLERA)
Ridgway Training Range, Pennsylvania

Munitions Response Site PAE40-001-R-01
Pennsylvania Army National Guard

Army National Guard

Contract No. W9133L-14-D-0001
Delivery Order No. 0006

June 2019

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NGB-AQ-W9133L
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Acronyms and Abbreviations

%	Percent
ARNG	Army National Guard
AUF	Area Use Factor
BAZ	Biologically Active Zone
BERA	Baseline Ecological Risk Assessment
bgs	Below Ground Surface
Cl^-	Chloride
CO_3^{2-}	Carbonate
COI	Constituent of Interest
COPEC	Constituent of Potential Ecological Concern
DoD	Department of Defense
DRM	Dose Rate Model
DU	Decision Unit
ECSM	Ecological Conceptual Site Model
EDD	Estimated Daily Dose
EPC	Exposure Point Concentration
ERAGS	Ecological Risk Assessment Guidance for Superfund
ESV	Ecological Screening Value
EU	Exposure Unit
ft	Foot or feet
ft^2	Square feet
HQ	Hazard Quotient
K_{ow}	n-octanol/water partitioning coefficient
LOAEL	Lowest Observed Adverse Effects Level
LOEC	Lowest Observed Effects Concentration
log	Base 10 logarithm
mg/kg-day	Milligrams per kilogram per day
mg/L	Milligrams per liter
MRS	Munitions Response Site
NDNODS	Non-Department of Defense, Non-Operational Defense Site
NO_3^-	Nitrate
NOAEL	No Observed Adverse Effects Level
NOEC	No Observed Effects Concentration
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
OH^-	Hydroxide
PA	Pennsylvania
PADEP	Pennsylvania Department of Environmental Protection
PGC	Pennsylvania Game Commission
PO_4^{3-}	Phosphate
RI	Remedial Investigation
RPD	Relative Percent Difference

RSV	Refined Screening Value
SLERA	Screening Level Ecological Risk Assessment
SMDP	Scientific Management Decision Point
SO_4^{2-}	Sulfate
SWI	Sediment-surface water interface
TGM	Technical Guidance Manual
TRV	Toxicity Reference Value
UCL	Upper Confidence Limit
USACHPPM	United States Army Center for Health Promotion and Preventive Medicine
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

Executive Summary

The Screening Level Ecological Risk Assessment (SLERA) was conducted for the Army National Guard (ARNG) located at the Non-Department of Defense, Non-Operational Defense Site (NDNODS) Ridgway Training Range Munitions Response Site (MRS) (Army Environmental Database Restoration Number PAE40-001-R-01), located in Ridgway Township, Pennsylvania (the "Site").

The purpose of the SLERA was to identify the potential risks to ecological receptors exposed to Site-related constituents of interest (COIs) in environmental media at the Site and determine which constituents of potential ecological concern (COPECs), if any, were exerting adverse effects to potential ecological receptor populations. The list of COPECs was refined consistent with the initial stage of a Baseline Ecological Risk Assessment (BERA) Step 3 to reduce uncertainty in the SLERA Step 1 and 2 conclusions.

Guided by an ecological conceptual site model (ECSM), a conservative screening evaluation was conducted to assess potential risks related to on-Site soil and off-Site sediment for soil invertebrates, benthic macroinvertebrates, terrestrial wildlife, and aquatic and semi-aquatic wildlife. If COIs were detected above wildlife-specific benchmarks, dose rate models (DRMs) were prepared to assess potential adverse effects to selected ecological receptors.

Although the Site is small and receptors can freely move between areas, exposure units (EU) were selected based on 1) type of data available (incremental versus discrete); 2) COI source (nitroglycerin vs metals); and 3) decision unit (DU) designation provided in the remedial investigation (RI) (AECOM, 2018). Receptors with larger ranges and limited substrate intake (e.g. red fox and red-tailed hawk) were evaluated conservatively at a Site-wide level. During BERA Step 3, refinements were made to EU selection and datasets were pooled to assess only Site-wide effects.

After Step 2 of the SLERA, the results of the risk characterization determined the following scientific management decision points (SMDPs):

1. Exposure to COPECs in on-Site soil resulted in substantial impact (*de manifestis*) to both soil invertebrate and terrestrial wildlife populations; action should be taken that can eliminate or reduce exposure to an acceptable level.
    a. Maximum concentrations of nitroglycerin (Firing Point DU) and copper, lead, and zinc (Target Berm and Soil Pile DUs) exceeded ecological screening values (ESVs) protective of soil invertebrates.
    b. Wildlife DRMs indicated that no observed adverse effects level (NOAEL) toxicity reference values (TRVs) (protective of either mammalian or avian wildlife) were exceeded by maximum concentrations of antimony, copper, lead, and zinc in soil at the Target Berm and Soil Pile DUs and by antimony, copper, and lead for all on-Site soil.

    c. Refinements made in BERA Step 3 would reduce uncertainty in both the direct contact evaluation and DRMs, but, ultimately, COPECs would still exceed benchmarks protective of either soil invertebrates or wildlife.

2. Exposure to COPECs in off-Site sediment indicated that the SLERA should be continued to BERA Step 3 to reduce uncertainty in the evaluation of risk and impact.
    a. Maximum concentrations of copper and lead exceeded ESVs protective of benthic macroinvertebrates in both the French Drain DU and Drainage Ditch.
    b. Wildlife DRMs indicated that maximum concentrations of copper exceeded NOAEL TRVs protective of mammalian wildlife in all off-Site sediment.
    c. For both the direct contact evaluation and DRMs, exposure estimates will be refined using more representative exposure point concentrations (EPCs) and more realistic benchmarks.

Following BERA Step 3 and evaluating uncertainties within the SLERA process, the following SMDPs were made regarding off-Site sediment:

1. The potential for adverse effects to the benthic macroinvertebrate community is *de minimus* due to the following:
    a. Although the refined direct contact evaluation indicated a lead HQ = 1, the median concentration for lead (109 milligrams per kilogram [mg/kg]) was below the refined ESV.
    b. Small-scale, spatial variability was very high for sediment samples.
    c. Although individuals may experience some adverse effects locally, population level effects are unlikely.
2. The potential for adverse effects to the aquatic and semi-aquatic wildlife community is *de minimus* due to the following:

a. Refined DRMs indicated no exceedances of TRVs for the little brown bat.

1 Introduction

A Screening Level Ecological Risk Assessment (SLERA) was conducted for the Army National Guard (ARNG) located at the Non-Department of Defense, Non-Operational Defense Site (NDNODS) Ridgway Training Range Munitions Response Site (MRS; Army Environmental Database Restoration Number PAE40-001-R-01), located in Ridgway Township, Pennsylvania (PA) (the "Site"; **Figure 1-1**).

The purpose of the SLERA is to identify the potential risks to ecological receptors exposed to Site-related constituents of interest (COIs) in environmental media at the Site. The SLERA was conducted in accordance with the following state and federal guidance:

- Pennsylvania Department of Environmental Protection (PADEP). 2002[1]. Steps 1 and 2 (§IV.H) of the PADEP *Land Recycling Program Technical Guidance Manual (TGM)*; and
- United States Environmental Protection Agency (USEPA). 1997[2]. *Ecological Risk Assessment Guidance for Superfund* (ERAGS).

Potential ecological exposure is evaluated under current conditions using recent analytical data collected in relevant exposure media. The scope of the SLERA includes Steps 1 and 2 of the PADEP and ERAGS guidance. Steps 1 and 2 were used to identify constituents of potential ecological concern (COPECs) in potentially affected environmental media to support a scientific management decision point (SMDP) regarding the need for further risk characterization and/or remediation. The list of COPECs was refined consistent with the initial stage of a Baseline Ecological Risk Assessment (BERA) Step 3 to reduce uncertainty in the SLERA Step 1 and 2 conclusions and to refine the recommendations presented in the report by applying more realistic exposure assumptions. The results of the SLERA and BERA Step 3 COPEC refinement were used to reach one of the following conclusions consistent with PADEP (2002) guidance:

- The ecological risk assessment should be continued to develop a site-specific clean-up goal, or to reduce uncertainty in the evaluation of risk and impact;
- The preliminary screening is adequate to determine that no substantial ecological risk exists, i.e., risks are *de minimis*; or
- There is substantial impact (*de manifestis*). Proceed to remediation that can eliminate or reduce exposure to an acceptable level (Suter, et al., 1995; in PADEP, 2002).

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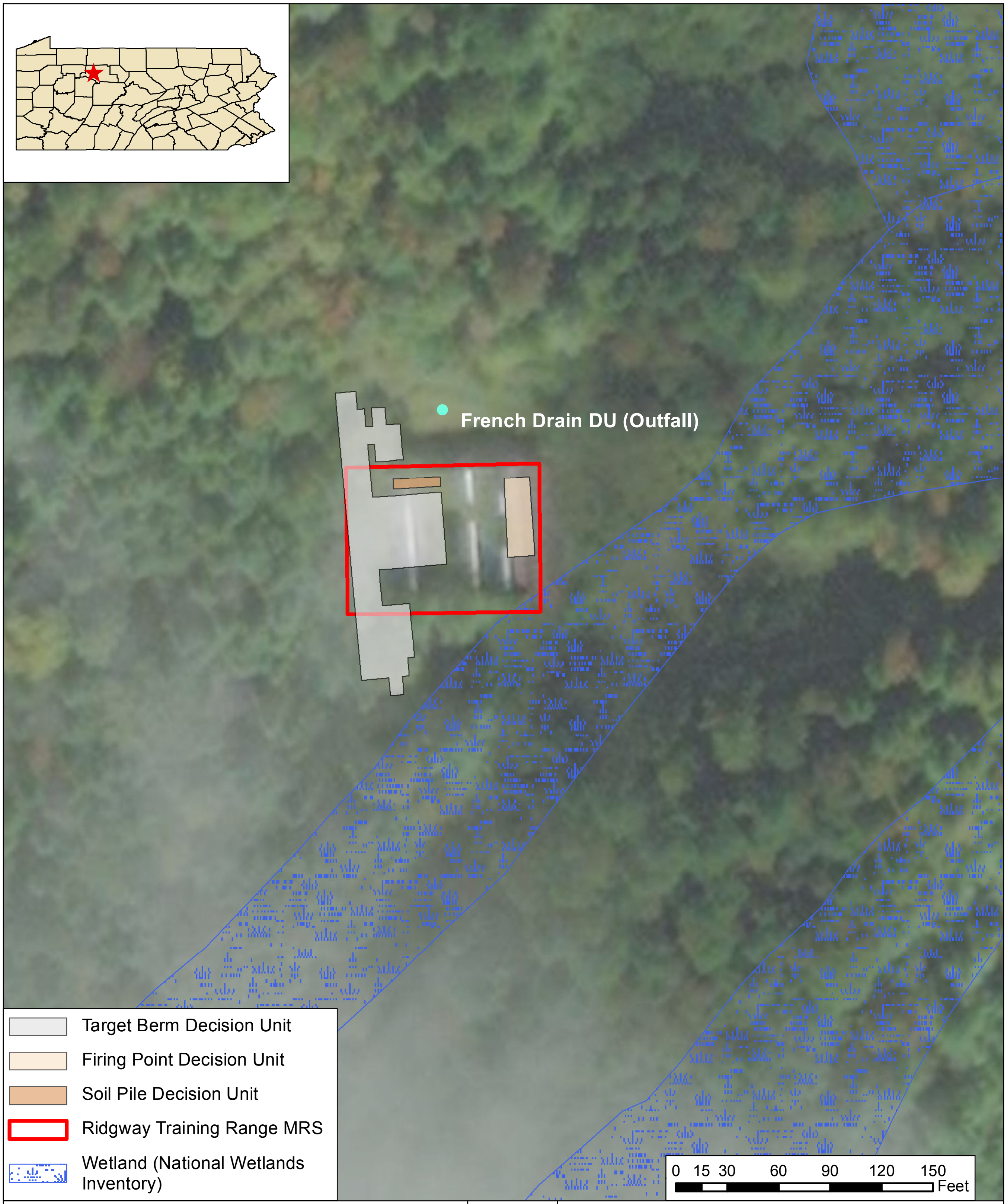
[1] A draft version of the Technical Guidance Manual (TGM) was issued on December 16, 2017. Comments on the draft TGM were presented on August 1, 2018. Because the guidance in the revised TGM has not been formally promulgated, the 2002 TGM was used.

[2] PADEP (2002) recommends the use of USEPA's interim final guidance ERAGS (USEPA, 1997), with some modification, as the process for designing and conducting site-specific ecological risk assessments.



CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	AD	10/31/2018
SCALE	1:1,000	CHK BY	JW	10/31/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	10/31/2018

Site Layout

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

ARMY NATIONAL GUARD

Figure 1-1

\\ursgermantown.us.ie.urs\germantown\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 6 SARs\900-Work\GIS\Ridgway\1_MXD\SLERA\Figure 1-1 Site Layout.mxd

2 Step 1: Screening Level Problem Formulation and Ecological Effects Evaluation

The following fundamental components were evaluated as part of Step 1 of the SLERA preliminary ecological screening assessment:

- Identify ecological setting and potential habitats;
- Identify potential ecological receptors;
- Identify constituents known or suspected to exist at the Site;
- Evaluate potential migration pathways that exist at the Site;
- Characterize fate and transport mechanisms;
- Describe constituent ecotoxicological properties;
- Confirm potentially complete migration pathways and ecological receptors that might exist at the Site;
- Identify assessment and measurement endpoints; and
- Identify conservative ecological screening benchmarks.

2.1 Ecological Setting and Potential Habitats

The ecological setting of the Site was characterized using information from the results of the remedial investigation (RI). This information was supplemented with resources from the United States Fish and Wildlife Service's (USFWS's) National Wetlands Inventory (NWI), Natural Resources Conservation Service (NRCS), and aerial imagery. *Terrestrial and Palustrine Communities of Pennsylvania* (Fike, 1999) was used as a reference to provide a more detailed description of flora within the different habitat types. Soils, terrestrial habitats, wetland habitats, and aquatic habitats present at the Site are summarized below. Site habitat types in relation to decision units (DUs) within the MRS are presented in **Figure 2-1.** Photographs taken during the RI are presented **Attachment A**. Based on a Conservation Planning Report generated for the Site by PA Department of Conservation and Natural Resources, no sensitive areas or habitats of concern have been identified (**Attachment B**).

2.1.1 Soils

Based upon online NRCS soil mapping, the only soil type present at the Site is Cavode silt loam, 0 to 3 percent (%) slopes. NRCS (2018) describes Cavode silt loam as poorly drained, non-hydric soils with very high runoff potential. Cavode silt loams are classified as farmland of statewide importance.

2.1.2 Terrestrial Habitats

The Site is located within the Western Allegheny Plateau ecoregion (USEPA, 2013) and borders the Allegheny National Forest to the west. Within the Site boundary, vegetation is limited primarily to early successional species such as grasses and shrubs. East of the Site boundary is a clear cut area of disturbed soils with minimal vegetation coverage.

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site			
REVISION NO	0	GIS BY	AD	10/31/2018
SCALE	1:500	CHK BY	JW	10/31/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	10/31/2018

N

Site Habitat Map

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 2-1

\\ursgermantown.us.ie.urs\germantown\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 6 SARs\900-Work\GIS\Ridgway\1_MXD\SLERA\Figure 2-1 Site Habitat Map.mxd

The primary habitat type of the Allegheny National Forest is northern hardwood forests. Canopy composition consists primarily of red maple (*Acer rubrum*), black cherry (*Prunus serotina*), American beech (*Fagus grandifolia*), multiple species of birch (*Betula spp.*), northern red oak (*Quercus rubra*), and white ash (*Fraxinus americana*) (Fike, 1999). Coniferous trees can make up to 25% of hardwood forests; portions of hardwood forests with 25-75% conifers are grouped under the sub-class hemlock (white pine)-northern hardwood (Fike, 1999).

Field observations made during the RI indicated the presence of coniferous trees (mostly pine) and birch along the boundary between the Site and the Allegheny National Forest. Although vegetation within the Site boundary is limited to mostly early-successional vegetation, the presence of surrounding forests and rather small size of the Site (about 0.22 acres) suggest that species living in the surrounding habitats could pass through the Site and be exposed to COIs in soil.

2.1.3 Wetland Habitats

Approximately, 4.9 acres of palustrine forested wetlands are present east and southeast of the Site (USFWS, 1983). According to NWI mapping, a very small portion of the wetlands intersect the Site. However, based on field observations made during the RI, the wetlands do not begin until further southeast of the Site boundary. Additionally, the wetlands present were mapped in 1983 using color infrared aerial imagery at a 1:58,000 scale (USFWS, 1983).

2.1.4 Aquatic Habitats

There are no natural aquatic habitats present within the Site boundary, however a drainage ditch extends behind the target berm DU and heads south and then east towards the wetlands (**Figure 2-1**). Observations made during the RI indicate that the ditch is generally dry but will retain less than a foot (ft) of water after rain events. Additionally, there is a culvert located outside the eastern boundary of the Site which feeds into the wetland. The culvert has less than 6 inches of water in the northern portion, but deepens as it approaches the wetland to the south.

Shallow ponding from the French drain DU will extend laterally to cover approximately 28 square feet (ft^2) after a period of rain. Field personnel noted that the next day it had decreased to about 5 ft^2 and eventually fully drained and/or evaporated. During the RI, the pond did not extend into either the drainage ditch or culvert. Elevation is fairly level and varies only a 0-5 ft across the Site. It is not suspected that ponded water from the French drain DU enters the drainage ditch or culvert.

2.2 Potential Ecological Receptors

Potential ecological receptors that may occur at the Site were identified using Site habitat types, observations reported in AECOM (2018), and relevant literature to the greater region (DeGraaf and Rudis, 1986). Species information is summarized in **Table 2-1**. For each ecological receptor identified, the following information is provided:

- Feeding guild;
- Forage method; and
- Breeding substrate.

Table 2-1. Potential Ecological Receptors

Group	Common Name	Genus And Species	Feeding Guild(1)	Forage Method	Breeding Substrate
Amphibians	Eastern American toad	*Bufo a. americanus*	I	Ground ambusher	Water
	Gray treefrog	*Hyla versicolor*	I	Bark ambusher	Water
	Pickerel frog	*Rana palustris*	I	Riparian ambusher	Water
	Red spotted newt	*Notophthalamus viridescens*	I	Water gleaner	Water
	Redback salamander	*Plethodon c. cinereus*	I	Ground gleaner	Terrestrial subsurface
Reptiles	Eastern garter snake	*Thamnophia s. sirtalis*	C	Ground ambusher	Terrestrial subsurface
	Northern black racer	*Coluber c. constrictor*	C	Ground ambusher	Terrestrial subsurface
Birds	American crow	*Corvus brachyrhynchos*	O	Ground gleaner	Tree-branch
	American goldfinch	*Carduelis tristis*	O	Ground gleaner	Shrub
	American redstart	*Setophaga ruticilla*	I	Lower canopy gleaner	Tree-twig
	American robin	*Turdus migratorius*	O	Ground gleaner	Tree-branch
	American woodcock	*Scopolax minor*	I	Ground prober	Ground-herb
	Black-billed cuckoo	*Coccyzus erythropthalmus*	I	Lower canopy gleaner	Tree-branch
	Black-capped chickadee	*Parus atricapillus*	I	Lower canopy gleaner	Tree cavity-crevice
	Blue jay	*Cyanocitta cristata*	O	Ground gleaner	Tree-branch
	Brown creeper	*Certhia americana*	I	Bark gleaner	Tree cavity-crevice
	Brown-headed cowbird	*Molothrus ater*	O	Ground gleaner	Nest parasite
	Cedar waxwing	*Bombycilla cedrorum*	F	Upper canopy gleaner	Tree-twig
	Chestnut-sided warbler	*Dendroica pennsylvania*	I	Lower canopy gleaner	Shrub
	Common grackle	*Quiscalus quiscula*	O	Ground gleaner	Tree-branch
	Dark-eyed junco	*Junco hyemalis*	G	Ground gleaner	Ground-herb
	Downy woodpecker	*Picoides pubescens*	I	Bark gleaner	Tree cavity-crevice

Table 2-1. Potential Ecological Receptors (continued)

Group	Common Name	Genus And Species	Feeding Guild[(1)]	Forage Method	Breeding Substrate
Birds	Field sparrow	*Spizella pusilla*	O	Ground gleaner	Ground-herb
	Grey catbird	*Dumetella carolinensis*	O	Ground gleaner	Shrub
	Hairy woodpecker	*Picoides villosus*	I	Bark gleaner	Tree cavity-crevice
	Indigo bunting	*Passerina cyanea*	I	Lower canopy gleaner	Ground-herb
	Least flycatcher	*Empidonax minimus*	I	Air sallier	Tree branch
	Northern cardinal	*Cardinalis cardinalis*	O	Ground gleaner	Shrub
	Northern flicker	*Colaptes auratus*	I	Ground gleaner	Tree cavity-crevice
	Ovenbird	*Seiurus aurocapilla*	I	Ground gleaner	Ground-herb
	Red-bellied woodpecker	*Melanerpes carolinus*	I	Bark gleaner	Tree cavity-crevice
	Red-eyed vireo	*Vireo olivaceus*	I	Lower canopy gleaner	Tree-branch
	Red-tailed hawk	*Buteo jamaicensis*	C	Ground pouncer	Tree branch
	Ruffed grouse	*Bonasa umbellus*	O	Lower canopy gleaner	Ground-herb
	Scarlet tanager	*Piranga olivacea*	I	Lower canopy gleaner	Tree-branch
	Song sparrow	*Melospiza melodia*	O	Ground gleaner	Ground-herb
	Veery	*Catharus fuscescens*	I	Ground gleaner	Ground-herb
	White-breasted nuthatch	*Sitta carolinesis*	I	Bark gleaner	Tree cavity-crevice
Mammals	Deer mouse	*Peromyscus maniculatus*	O	Ground forager	Terrestrial subsurface
	Eastern chipmunk	*Tamias striatus*	G	Ground forager	Terrestrial subsurface
	Eastern cottontail	*Sylvilagus floridanus*	H	Ground grazer	Ground-herb
	Grey squirrel	*Sciurus carolinensis*	G	Upper canopy forager	Tree cavity-crevice
	Little brown bat	*Myotis lucifugus*	I	Air hawker	Buildings
	Meadow jumping mouse	*Zapus hudsonius*	O	Ground forager	Ground-herb

Table 2-1. Potential Ecological Receptors (continued)

Group	Common Name	Genus And Species	Feeding Guild(1)	Forage Method	Breeding Substrate
Mammals	Meadow Vole	*Microtus pennsylvanicus*	H	Ground grazer	Terrestrial subsurface
	Northern short-tailed shrew	*Blarina brevicauda*	I	Ground gleaner	Terrestrial Subsurface
	Raccoon	*Procyon lotor*	O	Ground forager	Tree Cavity-Crevice
	Red fox	*Vulpes vulpes*	O	Ground forager	Terrestrial subsurface
	Striped skunk	*Mephitis mephitis*	O	Ground forager	Terrestrial subsurface
	Virginia opossum	*Didelphis virginiana*	O	Ground forager	Tree cavity-crevice
	White-footed mouse	*Peromyscus leucopus*	O	Ground forager	Terrestrial subsurface
	White-tailed deer	*Odocoileus virginianus*	H	Ground grazer	Ground-herb
	Woodchuck	*Marmota monax*	H	Ground grazer	Terrestrial Subsurface
	Woodland jumping mouse	*Napaeozapus insignis*	O	Ground forager	Ground-herb

Notes:
(1) C = Carnivore; F = Frugivore; H = Herbivore; I = Insectivore; and O = Omnivore

2.2.1 Commonly Occurring Wildlife

Groups of commonly occurring wildlife include soil and benthic macroinvertebrates, amphibians and reptiles, birds, and mammals. Wildlife likely to be encountered at the Site are briefly discussed below.

2.2.1.1 Terrestrial Receptors

Terrestrial wildlife which may frequent the Site include:

- Soil macroinvertebrates;
    - Common terrestrial soil macroinvertebrates include macrofauna such as earthworms, woodlice, millipedes, and beetles; mesofauna including springtails, mites, and potworms; and microfauna such as nematodes. Soil macroinvertebrates can occupy any portion of the Site with a defined soil layer.
- Amphibians and reptiles;
    - The close proximity to Allegheny National Forest provides habitat for reptiles (such as a garter snake or black racer) which may come onto the Site to feed. The drainage ditch around along the perimeter of the Site provides potential breeding areas for amphibians due to shallow, low-flowing/stagnant water. Toads, salamanders, newts, and tree frogs could make use of these areas temporarily; however, they will predominantly occur in terrestrial areas (damp leaf litter, underneath rocks and logs, or moist crevices within trees).
- Birds; and
    - Birds most likely to be found at the Site would make use of early-successional vegetation and open areas to feed or nesting in the shrubs on the edge of the neighboring forests (robins, finches, and woodcock). Additionally, predatory birds, such as the red-tailed hawk, would use tall canopy trees to hunt small birds and mammals feeding within the Site. Birds which live primarily within forests (ovenbird, various woodpeckers, and grouse) will probably not frequent the Site to feed.
- Mammals.
    - Common forest species such as grey squirrels, chipmunks, and white-tailed deer would likely enter the Site and feed on ground vegetation/shrubs. The fragmented nature of the Site compared to surrounding forests would attract a predator like the red fox which prefers habitat mosaics. Due to the proximity of wetlands and forested areas, the northern short-tailed shrew may potentially use areas within the Site to feed on invertebrates.

2.2.1.2 Aquatic and Semi-Aquatic Receptors

Aquatic and semi-aquatic wildlife which may frequent the Site include:

- Benthic macroinvertebrates;
    - The drainage ditch and potentially impacted areas with temporary ponding (French Drain DU), are most likely to contain only the larvae and juvenile

members of breeding insects. Surface water within these areas is stagnant or very low-flowing.

- Amphibians and reptiles;
  - As mentioned previously, the areas with surface water on the Site are stagnant or low-flowing. Amphibians around the Site would predominantly occupy terrestrial habitats (such as toads and salamanders), and may only use these areas for breeding.
- Birds; and
  - Near the southeast corner of the Site there may exist some habitat for birds that prefer wetlands or swamps. The brown creeper, gray catbird, and veery show some preference towards moist forests and wooded swamps, but generally feed off the ground and bark. Impact to the aquatic and semi-aquatic bird community is expected to be minimal.
- Mammals.
  - Raccoons are ubiquitous omnivores found in almost all areas and could likely be found foraging or feeding along the drainage ditch areas. Raccoons are opportunistic and will eat almost anything and may come into contact with potentially impacted sediments while feeding. Although little brown bats primarily roost in caves, they will seek out temporary roosts close to water bodies. Little brown bats will hawk over water areas and consume flying insects (DeGraaf and Rudis, 1986).

2.2.2 Rare, Threatened, and Endangered Species

Within the Site, there are no federally designated critical habitats (USFWS, 2018), and, as previously reported, no sensitive areas or critical habitats were identified using state resources (**Attachment B**).

However, USFWS (2018) does indicate that rabbitsfoot (*Quadrula cylindrical cylindrical*), a type of clam, and the Northern long-eared bat (*Myotis septentrionalis*) are threatened species wherever they occur. Rabbitsfoot require flowing water in medium-sized streams and would not be found in the stagnant/low-flow drainage ditches around the Site. The Northern long-eared bat prefers forested areas catching prey in-flight and may glean stationary insects from the surface of water bodies (USFWS, 2018). Given the characteristics of the Site, the Northern long-eared bat may be found in the adjacent Allegheny National Forest, but likely would not occupy the Site. The Site would be more preferred by other bats such as the little brown bat which hawks flying insects over small streams.

For the threatened and endangered State species (Pennsylvania Game Commission [PGC], 2018), a review of Site conditions was conducted for species that occupy habitats some-what similar to those found near and around the Site.

- Marshes and forested wetlands;
  - The American bittern (*Botarus lentiginosus*), sedge wren (*Cistothorus platensis*), and yellow-bellied flycatcher (*Empidonax flaviventris*) are state-endangered

species which require swamps or marshes for nesting. The former two species require wet areas with accompanying sedges and grasses, which are not present at the Site. The yellow-bellied flycatcher prefers forested wetlands at higher elevations, which may be similar to the wetlands located south of the Site. However, the yellow-bellied flycatcher generally requires old-growth, boreal forests which are not located near the Site and historical populations are associated with former spruce forests in the North and Pocono Mountains of eastern Pennsylvania (PGC, 2018).

- Grassland and shrub;
    - The least shrew (*Cyptotis parva*) and logger-head shrike (*Lanius ludovicianus*) are state-endangered species which prefer grassland/shrub habitats. These habitats are present at the Site in the form of early-successional vegetation. However, this vegetation is from previous clear-cutting and not a regional trend. These species have primarily been found in southern Pennsylvania (PGC, 2018) where this habitat occurs on a regional level.
    - The northern harrier (*Circus cyaneus*) is a state-threatened species which has breeding populations located in Elk County. However, the northern harrier prefers open wetland, grassland, and farmland (PGC, 2018) and is not likely to occur at the Site.
- Boreal forests;
    - Both the northern flying squirrel (*Glaucomys sabrinus macrotis*) and blackpoll warbler (*Setophaga striata*) are state-endangered species which occur in boreal forests. While boreal forests were once wide-spread throughout the state, clear-cutting in the early 20th century has eliminated most of these habitats. Currently the Pocono Mountains in eastern Pennsylvania (PGC, 2018) are the only areas which would sustain populations of these species.
- Cliffs;
    - The peregrine falcon (*Falco peregrinus*) is a state-endangered species that prefers dwelling on cliffs, generally near water, to stalk prey. Peregrine falcons have also used bridges and large buildings as substitutes for natural features. There are no areas within or near the Site which would provide suitable habitat.
- Caves.
    - The Indiana bat (*Myotis sodalis*) is currently limited to only 18 hibernation sites within the state, primarily limestone caves (PGC, 2018). At least one of these sites is located within Elk County. The Indiana bat is, also, a federally protected species. When conducting a review of federally protected areas, none were identified in the vicinity of the Site. During a 2006 inventory of natural heritage areas, no protected areas were identified for the Indiana bat within or near Ridgway Township (Elk County Planning Commission, 2006).

2.3 Potential Source Areas and Constituents of Interest

Potential COIs at the Site include metals (antimony, copper, lead, and zinc) and nitroglycerin. The potential sources are related to both direct releases to soil and indirect releases to off-Site sediment. The source areas at the Site are related to the DUs established in the RI (AECOM, 2018) and presented in **Figure 1-1**. A list of the source areas and related COIs are summarized below:

- Firing Point DU (on-Site soil);
    - Nitroglycerin
- Target Berm DU (on-Site soil);
    - Metals
- Soil Pile DU (on-Site soil);
    - Metals
- French Drain DU (off-Site sediment); and
    - Metals
- Off-Site Drainage Ditch (off-Site sediment).
    - Metals

2.4 Identification and Evaluation of Migration Pathways

For the screening–level problem formulation, an ecological conceptual site model (ECSM) was developed to identify the migration and exposure pathways of Site constituents in environmental media to ecological receptors. Conceptual models for ecological risk assessments are developed from information about stressors, potential exposure, and predicted effects on an ecological entity (the assessment endpoint). Conceptual models consist of two components:

- A set of risk hypotheses that describe predicted relationships among source/stressor, exposure, and assessment endpoint response, along with the rationale for their selection; and
- A diagram that illustrates the relationships presented in the risk hypotheses.

As illustrated in **Figure 2-2**, the ECSM includes the following components:

- Potential source areas;
- Migration pathways (including potential pathways);
- Exposure media; and
- Exposure pathways (complete and incomplete) for each potential ecological receptor, which may include:
    - Direct contact/absorption;
    - Direct or incidental ingestion of substrate and surface water; and
    - Ingestion of prey items.

The evaluation and identification of potential complete migration pathways is one of the primary goals of the SLERA (USEPA, 1997). Identifying complete migration pathways before the effects evaluation is conducted allows the SLERA to focus on only those Site related compounds to which ecological receptors are potentially exposed.

As defined, a "migration pathway" is the pathway by which a constituent travels from a source to receptors. A pathway can involve multiple media such as erosion of soil to drainage ditch sediments, or volatilization to the atmosphere. The term "complete migration pathway" indicates that a constituent is actually reaching ecological receptors, or may potentially do so in the near future.

Historical direct releases to soil and subsequent erosion and transport to off-Site drainage areas represent the primary release mechanisms at the Site. Complete migration pathways include:

- Erosion of Site soils.
    - Although the vertical gradient across the Site is only a few feet, drainage does occur towards the southwest (AECOM, 2018). Mechanisms that may have transported impacted soils from the Site include erosion via overland flow. Heavy metals at or near the soil surface potentially enter overland flow through dissolution and desorption. The transport of metals in soil via overland flow likely occurs during periods of heavy precipitation and spring snowmelt runoff.

2.5 Fate and Transport Characteristics

This sub-section discusses constituent fate and transport processes in potentially affected media.

2.5.1 Soils

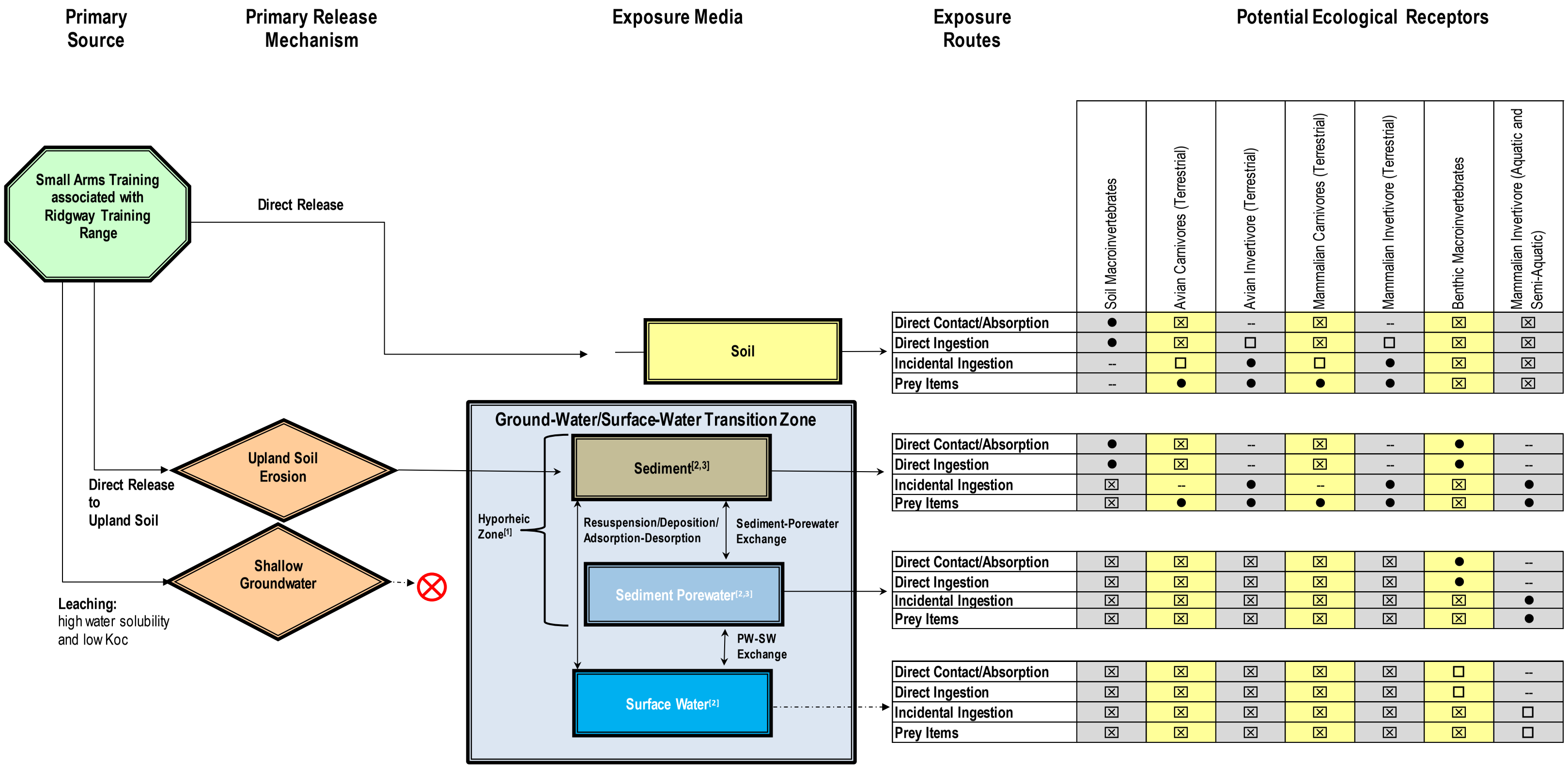
Site-related COIs detected in soils include metals (antimony, copper, lead, and zinc) and nitroglycerin. Water solubility strongly affects organic constituents leaching potential and environmental fate. Generally, constituents with a water solubility of greater than 30 milligrams/liter (mg/L) exhibit an increasing tendency to leach into groundwater (USEPA, 1997) and soil porewater.

The fate and transport of a metal in soil depends significantly on the chemical form and speciation of the metal (USEPA, 1992). In general, the tendency for nitroglycerin to partition into soils is strongly dependent on the amount of organic matter in soils (Allen et al., 2015). Due to shallow location of soil COIs within the substrate and deep groundwater at the Site, transport via groundwater is not expected. As a result, the transport of COIs will occur with the erosion of surface soils via overland flow. Based on surface topography, erosion should be fairly limited in most portions of the Site.

2.5.2 Sediment

Currently exposure to COIs is limited to 1) sediments around the French drain DU which have been influenced from sediment/surface water draining from beneath the target berm and then

Figure 2-2. Site Ecological Conceptual Site Model



	Soil Macroinvertebrates	Avian Carnivores (Terrestrial)	Avian Invertivore (Terrestrial)	Mammalian Carnivores (Terrestrial)	Mammalian Invertivore (Terrestrial)	Benthic Macroinvertebrates	Mammalian Invertivore (Aquatic and Semi-Aquatic)
Direct Contact/Absorption	●	☒	--	☒	--	☒	☒
Direct Ingestion	●	☒	☐	☒	☐	☒	☒
Incidental Ingestion	--	☐	●	☐	●	☒	☒
Prey Items	--	●	●	●	●	☒	☒
Direct Contact/Absorption	●	☒	--	☒	--	●	--
Direct Ingestion	●	☒	--	☒	--	●	--
Incidental Ingestion	☒	--	●	--	●	☒	●
Prey Items	☒	●	●	●	●	☒	●
Direct Contact/Absorption	☒	☒	☒	☒	☒	●	--
Direct Ingestion	☒	☒	☒	☒	☒	●	--
Incidental Ingestion	☒	☒	☒	☒	☒	☒	●
Prey Items	☒	☒	☒	☒	☒	☒	●
Direct Contact/Absorption	☒	☒	☒	☒	☒	☐	--
Direct Ingestion	☒	☒	☒	☒	☒	☐	--
Incidental Ingestion	☒	☒	☒	☒	☒	☒	☐
Prey Items	☒	☒	☒	☒	☒	☒	☐

Notes:

[1] USEPA (2008). The hyporheic zone is defined as a "latticework of underground habitats through the sediments associated with the interstitial waters in the substrate beneath and adjacent to moving surface-waters".

[2] The drainage areas currently receives no groundwater discharge and only retain limited surface water. Flow is stagnant/low and do not drain into any larger surface water body.

[3] Due to availability of Site-specific data, impact to aquatic and semi-aquatic wildlife will be assessed through sediment data.

LEGEND:

⟶	CONTAMINANT MIGRATION PATHWAY
-·-·-→	POTENTIAL CONTAMINANT MIGRATION PATHWAY
●	POTENTIAL COMPLETE PRIMARY EXPOSURE PATHWAY
☐	EXPOSURE PATHWAY IS COMPLETE AND INSIGNIFICANT
--	SIGNIFICANCE OF EXPOSURE PATHWAY IS UNCERTAIN
☒	INCOMPLETE EXPOSURE PATHWAY

ponding around the drain and 2) soil which has been potentially transported from the Site into the off-Site drainage ditch south of the MRS.

Metals are the only COIs detected in on- and off-Site sediments. The release of metals from solid phases to liquid phases, i.e., overlying water or sediment porewater, governs the bioavailability and toxicity of metals. As a result, the bioavailability and toxicity of metals in sediments is associated with the exchangeable fraction of metals in sediment porewater rather than the bulk sediment total metal concentration (USEPA, 2007a; USEPA, 2005; and Ankley et al., 1996).

The majority of metals in porewater are complexed by colloids, and do not exist as freely dissolved metal-ion complexes (Burgess et al., 1996). Therefore, metals concentrations measured in filtered porewater samples more accurately represent the dissolved fraction of metals, which is bioavailable and can be incorporated into the tissues of benthic invertebrates (USEPA, 2005).

In sediment, metals are subjected to biogeochemical processes and conditions that influence their partitioning, including the redox state of sediment and pH of the interstitial water. The microbial degradation of organic matter influences redox conditions across the sediment-surface water interface (SWI) (Baker, 1994; Stumm and Morgan, 1981; in Charriau et al., 2011). Generally, metal mobility increases at low pH and decreases as pH increases, at which point greater sorption occurs (USEPA, 2007a).

2.5.3 Biota

Bioaccumulation represents the potential for a constituent to accumulate in the tissues of an organism. In those instances where bioaccumulation exceeds the ability of an organism to metabolize those constituents, toxic effects can potentially be observed. Wildlife ingesting prey with body burdens of lipophilic compounds may also experience adverse effects when accumulation reaches a threshold level. The purpose of evaluating bioaccumulation potential is to describe the potential of constituents to bioaccumulate in tissues and potentially exert a toxic effect and/or expose upper trophic wildlife receptors through ingestion pathways.

The partitioning of organics into organisms depends on the hydrophobicity of the compound which is expressed by the base 10 logarithm (log) n-octanol/water partitioning coefficient (log K_{ow}). This represents the partitioning of the organic compound between an octanol and water phase. COPEC bioaccumulation can be estimated based on log K_{ow}. Generally, bioaccumulation is likely to occur with persistent and very hydrophobic chemicals including those chemicals with log K_{ow} values that range from 5 to 8 (Hoffman et al., 1995). Nitroglycerin has a log K_{ow} of 1.62 (Hansch et al., 1995) and is not expected to bioaccumulate.

Heavy metals identified at the Site are known to bioaccumulate, but not biomagnify (USEPA, 2000). In contrast, mercury (including methylmercury) both bioaccumulates and biomagnifies. The implications of biomagnification are that even a low concentration of a metal in environmental media or diet items can result in a high enough dosage that adverse effects for birds and mammals may potentially be observed. Metals, such as lead, can bioaccumulate to a point where the concentrations may become a significant source of dietary metal to their predators.

2.6 Ecotoxicological Profiles

This section summarizes the general ecotoxicological effects associated with Site-related constituents including nitroglycerin and metals (antimony, copper, lead, and zinc).

2.6.1 Nitroglycerin

Wildlife toxicity assessments for nitroglycerin are limited primarily to mammalian effects with limited evidence of adverse effects in avian populations (United States Army Center for Health Promotion and Preventive Medicine [USACHPPM], 2007). Toxicity of nitroglycerin has been observed primarily through oral ingestion. Adverse chronic effects observed for mammals have included hematological, hepatic, and body weight changes (USACHPPM, 2007). Generational studies have shown offspring to be impacted from poor nutrition and feeding rates of nursing female rats (USACHPPM, 2007).

2.6.2 Metals

The toxicity of metals depends on the solubility and bioavailability of the particular metal. It is assumed that the water soluble fraction in soil exhibits the greatest potential for adverse ecological risk because it is directly available for uptake by organisms.

The bioavailability and toxicity of Site-related metals in soil are influenced by soil physiochemical characteristics, including the quantity and type of organic carbon. For these reasons, the concentration of a metal in bulk soil does not represent its bioavailability or potential for toxicity (Allen and Janssen, 2006; Thakali et al., 2006a and 2006b). Rather, the bioavailable and toxic form of metals is found in the soil solution (Thakali et al., 2006a and 2006b). Metals exist in the soil solution as either free (uncomplexed) metal ions in soluble complexes with inorganic or organic ligands, or associated with mobile inorganic and organic colloidal material. Common inorganic ligands are sulfate (SO_4^{2-}), chloride (Cl^-), hydroxide (OH^-), phosphate (PO_4^{3-}), nitrate (NO_3^-), and carbonate (CO_3^{2-}). Common organic ligands include low molecular weight aliphatic, aromatic, and amino acids and soluble constituents of fulvic acids.

2.7 Exposure Routes and Receptors Not Evaluated

This section provides the rationale for exposure routes and receptors not selected for further evaluation.

2.7.1 Groundwater

- Based on previous site investigations, there is no evidence that groundwater is interacting with subsurface soil impacted by previous Site activities. The static water level in a former on-site well (now permanently sealed) was approximately 30 ft below ground surface (bgs) as indicated on the driller’s log (reported in AECOM, 2018).

2.7.2 Surface Water

- Within the MRS, there are no surface water features. Surface water flow across the Site is fairly limited due to minimal topographic variation. Beneath the target berm, there is a drainage pipe, which transports water north of the Site. This water ponds during rain events around the French drain DU, but disappears within days.
- Off-Site, there is a drainage ditch which borders to the west and south and a culvert along the eastern boundary. Water within these features are shallow and have limited flow.
- Impacts to the benthic macroinvertebrate community will be evaluated using sediment data. These drainage areas and ponding around the French drain DU could provide viable habitat for breeding invertebrate communities and organisms which feed on them.

2.7.3 Terrestrial and Wetland Plants

- In selecting ecological screening values (ESVs) used in the SLERA, plant-based benchmarks were less conservative than other benchmarks used in the SLERA. Plants were indirectly evaluated in the SLERA for all COIs.
- Metals are considered driver constituents at the Site. Vegetation was omitted in the SLERA because the published plant ESVs for metals are derived from exposure to soils dosed with highly-soluble metal salts which do not represent the kind of metals bioavailability experienced in the field. Hence, those ESVs are of limited value in risk-based decision making.
- Of the potential ecological receptors that are present at the Site, plants are not the most sensitive to the potential effects of Site-related COIs (Suter et al., 2000). For example, unlike herbicides, the toxic and bioaccumulative effects of Site-related metals and organics (nitroglycerin) on plants may be mitigated by biotransformation, volatilization, and/or sequestration in root tissues.

2.7.4 Amphibians

- A standardized ecotoxicological methodology has not been established, and currently, there are very few established methods to evaluate the toxicity of chemical stressors for amphibians. Also, existing ecotoxicological methods are unlikely to predict adverse ecotoxicological effects in support of the SLERA (Johnson et al., 2017).

- Ecotoxicological data for amphibians are limited. The majority of the available ecotoxicological data on amphibians are from acute exposures in aquatic test systems (Johnson et al., 2017). Because of the conservatism in the SLERA, acute ecotoxicological data will not support SLERA assessment and measurement endpoints.

- Surrogate species cannot be used. Definitive comparisons with surrogate species, e.g., fish and amphibians are difficult to achieve because of variability in study design (Birge et al., 2000; Johnson et al., 2017).

- Amphibians will be evaluated indirectly. The proposed conservative screening approach for sediments is intended to be protective of sensitive aquatic organisms.

2.8 Receptors of Concern and Exposure Routes Selected for Evaluation

Based on the evaluation of the chemical and fate and transport characteristics of Site constituents, direct contact exposures to soil are the primary routes of exposure to ecological receptors at the Site. Additionally, wildlife ingestion exposure pathways are also significant due to the potential for Site-related constituents to bioaccumulate from environmental media (i.e., soils into the tissues of prey items).

Selection of potential receptors was driven by the availability of data in potentially affected habitats on the Site. Given that direct contact and dietary exposure to Site-related metals and organics are the primary exposure pathways/routes to ecological receptors, receptors of concern identified for evaluation in the SLERA include the following:

- Terrestrial Receptors and
    - Soil macroinvertebrate community
    - Mammalian invertivore: Short-tailed shrew (*Blarina brevicauda*)
    - Mammalian carnivore: Red fox (*Vulpes vulpes*)
    - Avian invertivore: American robin (*Turdus migratorious*)
    - Avian carnivore: Red-tailed hawk (*Buteo jamaicensis*)
- Aquatic and Semi-Aquatic Receptors.
    - Benthic macroinvertebrate community
    - Mammalian invertivore: Little brown bat (*Myotis lucifugis*)

Summaries of exposure pathways and rationale for selected sensitive receptor groups are presented in the following sub-sections.

2.8.1 Soil Macroinvertebrates

Soil invertebrates are the most susceptible to the effects of Site-related constituents because of their sedentary nature and direct exposure to terrestrial soil. As a result of this exposure, soil invertebrates are sensitive to both acute and chronic changes in soil quality. Exposure routes for soil invertebrates include:

- Direct contact/absorption within the biologically active zone (BAZ); and
- Direct/incidental ingestion.

Soil invertebrates such as earthworms can incorporate Site-related constituents into their tissues through feeding in soil and leaf litter, in addition to burrowing in affected soils. Because earthworms and other soil invertebrates are relatively immobile, these species can potentially be exposed to a maximum constituent concentration in soil during the course of their lifetime (Suter et al., 1995).

For soil invertebrates, most exposure occurs within the BAZ, which operationally extends to a depth of approximately 1 (USEPA, 2015ab) to 2 ft bgs (USEPA, 2018; Efroymson et al., 1996). Soil invertebrates, however, penetrate and exploit the surface soil layer to varying depths, which results in varying degrees of exposure. For example, epigeic species such as arthropods can be found at the surface layer in leaf litter. Whereas epi-endogeic species such as the European earthworm (*Lumbricus rubellus*), primarily reside near or at the surface, create horizontal burrows to feed and reproduce, and are found at soil depths of approximately 8 inches (Sackett et al. 2012). Anecic earthworm species such as the common earthworm *L. terrestris* create permanent vertical burrows in soil, which contain leaf litter and soil mixed from different depths of the profile, and can extend to depths of 6.5 ft (Scharenbroch and Johnston, 2011). *L. terrestris* will feed on leaves on the soil surface that they drag into the burrows.

For these reasons, exposure pathways to soil invertebrates are considered to be complete within the 0-2 ft interval.

2.8.2 Benthic Macroinvertebrates

The erosion of Site soils to downgradient drainage ditch and French Drain DU sediment has been determined to be complete. Exposure routes for benthic macroinvertebrates include:

- Direct contact/absorption within the BAZ; and
- Direct/incidental ingestion.

Benthic macroinvertebrates were selected as the representative ecological receptors for aquatic habitats. Benthic macroinvertebrates are generally sedentary and susceptible to adverse changes in sediment and sediment porewater quality. Additionally, USEPA (2008) indicates that benthic and epibenthic communities, e.g., invertebrate larvae, worms, fish and bivalves spend part or all of their life cycle in contact with the sediments and groundwater that comprise the groundwater-surface water transitional zone.

For benthic macroinvertebrates, exposure occurs within the BAZ, which operationally extends from the SWI to a depth of approximately 0.5 ft (6 inches) for freshwater sediment (USEPA, 2001). Hence, for the purposes of the conservative screening-level evaluation, the BAZ is considered to extend to 0.5 ft below the SWI, i.e., within the groundwater-surface water transitional zone.

Based on availability of habitat near the Site, the benthic macroinvertebrate community is most likely represented by egg and larval stages of flying invertebrates which nest in shallow sediments.

2.8.3 Birds and Mammals

Exposure routes for birds and mammals include:

- Ingestion of prey items; and
- Incidental ingestion of soil/sediment.

Exposure for these species occurs primarily within the 0-2 ft soil interval. Although a significant proportion of the biological activity occurs within the top 0-12 inches, fossorial mammals can be encountered at depths reaching 2 ft (USEPA, 2018). Terrestrial ecological receptors selected for the exposure evaluation are discussed in the following subsections.

2.8.3.1 Short-tailed Shrew

The short-tailed shrew occupies a range of habitat types including wetlands and uplands and is reported to occur in both forested and open habitats (Sample and Suter, 1994). Short-tailed shrews are active on the surface, in leaf litter, and below the ground surface. A well-developed leaf litter layer protects shrews from moisture and temperature extremes. Earthworms are reported to be the most important food item. Millipedes, slugs, snails, and insect larvae are also important prey items.

Shrew will also prey on vertebrates when other food is not available and have shown sensitivity to bioaccumulative chemicals (USEPA, 1993). Additionally, the shrew is a common prey item for owls, raptors, fox, and other carnivores (USEPA, 1993). The short-tailed shrew is expected to occupy all areas of the Site with a complete exposure pathway to surface soil.

2.8.3.2 Red Fox

Foxes prefer a habitat mosaic over homogeneous forested stands or open areas. The red fox is characterized as an old field or edge-species since it is commonly found in areas of forests interspersed with fields, cropland and/or grasslands. The fox has a wide dietary range but is predominantly carnivorous feeding mainly on rabbits and mice (USEPA, 1993). Lesser amounts of mammals, birds, snakes, invertebrates, and plant material are consumed.

Due to the break in habitat type the Site provides relative to the surrounding forests, the Site would be an ideal location for the red fox to feed on small mammals. Due to its large range (407 hectares; average of male and female from Sample and Suter [1994]), the red fox will be assessed conservatively at a Site-wide level.

2.8.3.3 American Robin

American robins can be found in closed canopy forests, woodlands, fields, and residential areas. During the summer, they are most commonly observed foraging in cleared areas with short-stature herbs. The diet of the American robin includes fruits and insects. The diet varies seasonally such that invertebrates dominate the diet in the spring, whereas fruits dominate in the fall/winter (USEPA, 1993).

The American robin could potentially occupy all areas at the Site and is susceptible to localized impacts in soil. The American robin will be initially evaluated using an entirely invertebrate diet to conservatively estimate the impact of COIs in soil.

2.8.3.4 Red-tailed Hawk

Red-tailed hawks occupy a wide variety of open to semi-open habitats including coniferous, deciduous and mixed woodlands, woodland edges, grasslands, parklands, and agricultural fields with scattered trees (USEPA, 1993). Red-tailed hawks primarily consume small mammals such as meadow voles and short-tailed shrews, but also consume birds, reptiles, and some insects.

The red-tailed hawk could potentially feed in any part of the Site. The forests surrounding the Site provide ample locations for nesting or perching and access to a variety of habitat areas. Due to its large range (233 hectares [Sample and Suter, 1994]), the red-tailed hawk will be assessed conservatively at a Site-wide level.

2.8.3.5 Little Brown Bat

The little brown bat roost in caves, buildings, and hollow trees which can maintain constant temperature and higher relative humidity (DeGraaf and Rudis, 1986) and is abundant throughout forests of the United States (Bat Conservation International; 2018). The feeding range for bat colonies are extensive and not-well defined (DeGraaf and Rudis, 1986 and Sample and Suter, 1994); however, bats have been observed to use temporary roosts and feed up to six miles from their home roost (Washington Department of Fish and Wildlife, 2018).

Although little brown bats live and reproduce in terrestrial habitats, they often feed on aquatic flying insects and will skim small streams for food and may consume up to its own body weight during breeding (Chesapeake Bay Program, 2018). The little brown bat will be used as a model receptor for all potential bat species due to prevalence within the region of study and availability of literature and resources.

The little brown bat could potentially feed over any part of the Site, but will be most attracted to the off-Site drainage ditch and French Drain DU where breeding flying insects will lay their eggs in sediment and subsequently hatch and become an abundant food source. Due to its large feeding range, the little brown bat will be assessed conservatively at a Site-wide level.

2.9 Assessment and Measurement Endpoints

An assessment endpoint is an explicit expression of the environmental value that is to be protected. Because of the nature of potential contaminants and the receptors of concern (invertebrates, birds, and mammals), a general assessment endpoint of maintenance of upland, terrestrial community composition is selected.

Measurement endpoints are the measurable ecological characteristics that are related to the assessment endpoints. Measurement endpoints were selected based on their direct relationship to the maintenance of the respective receptor populations. Hence, potential adverse effects on survival, reproduction, and growth are selected as the measurement endpoints. The assessment endpoint(s) and their associated measurement endpoint for the representative receptors are shown below:

Assessment Endpoint(s)	Measurement Endpoint
Invertebrate Community	
Survival, growth, and reproduction of the soil invertebrate community.	Comparison of COI concentrations in soil to ecotoxicity benchmarks for soil invertebrates.

Assessment Endpoint(s)	Measurement Endpoint
Survival, growth, and reproduction of the benthic macroinvertebrate community.	Comparison of COI concentrations in sediment to ecotoxicity benchmarks for benthic macroinvertebrates.
Avian Community	
Survival, growth, and reproduction of the avian invertivore community.	Comparison of modeled daily doses to a toxicity reference value (TRV).
Survival, growth, and reproduction of the avian carnivore community.	Comparison of modeled daily dose to a TRV.
Mammalian Community	
Survival, growth, and reproduction of the mammalian invertivore community.	Comparison of modeled daily doses to a TRV.
Survival, growth, and reproduction of the mammalian omnivore community.	Comparison of modeled daily doses to a TRV.
Survival, growth, and reproduction of the mammalian carnivore community.	Comparison of modeled daily doses to a TRV.

2.10 Ecological Screening Benchmarks

The maximum concentrations of Site-related constituents were compared to their respective chronic ESVs to identify COPECs. The screening-level effects evaluation establishes constituent exposure concentrations that represent thresholds for adverse effects. The following sections discuss the conservative screening criteria established for the selection of COPECs and additional receptor-specific ecotoxicological data that may be used in exposure estimation and risk characterization. Benchmarks representing no observed effects concentrations (NOECs) were used preferentially. ESVs are presented in **Table 2-2**.

Table 2-2. Ecological Screening Values

COI	Soil ESVs (mg/kg)				Sediment ESVs (mg/kg)(1)	
	Direct Contact		Wildlife			
Antimony	78	a	0.27	a	2	b
Copper	80	a	28	a	31.6	b
Lead	1,700	a	11	a	35.8	b
Zinc	120	a	46	a	121	b
Nitroglycerin	13	a	70	a	Not Evaluated	--

Notes:

COI = Constituent of Interest; ESV = Ecological Screening Value; mg/kg = milligram per kilogram

(1) ESVs presented for sediment are the same for both benthic invertebrates and wildlife.

(a) USEPA. 2018. Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft. Scientific Support Section Superfund Division EPA Region 4.

(b) USEPA. 2006. Freshwater Sediment Benchmarks. EPA Region 3 BTAG. URL: http://www.epa.gov/reg3hscd/risk/eco/btag/sbv/fw/screenbench.htm

3 Step 2: Screening Level Exposure Estimate

This section describes the methodology used to conduct screening-level exposure estimates and risk calculations for selected receptor categories, consistent with SLERA Step 2 of ERAGS (USEPA, 1997). This phase of the SLERA uses the results of the screening-level problem formulation and Ecological Effects Evaluation in Step 1 to estimate exposure and characterize risk. This section:

- Identifies exposure units (EUs);
- Describes the data used to characterize ecological exposure;
- Presents the exposure estimate methodology;
- Describes the risk characterization process;
- Specifies the criteria for COPEC selection; and
- Presents the SMDP.

3.1 Exposure Units

The EU is a location within which an exposed ecological receptor can reasonably be assumed to move at random and where contact with an environmental medium is equally likely at all points within the EU.

Although the Site is small and receptors can freely move between areas, EUs were selected based on 1) type of data available (incremental versus discrete); 2) COI source (nitroglycerin vs metals); and 3) DU designation provided in the RI (AECOM, 2018). Receptors with larger ranges and limited substrate intake (e.g. red fox and red-tailed hawk) were evaluated conservatively at a Site-wide level, since they are unlikely to be restricted by these designations.

The EUs chosen and applicable ecological receptors are listed below:

- Target Berm DU (on-Site);
    - Soil macroinvertebrates
    - Short-tailed shrew
    - American robin
- Firing Point DU (on-Site);
    - Soil macroinvertebrates
    - Short-tailed shrew
    - American robin
- Soil Pile DU (on-Site);
    - Soil macroinvertebrates
    - Short-tailed shrew
    - American robin
- On-Site Soil;

    - Red fox
    - Red-tailed hawk
- French Drain DU (off-Site)
    - Benthic macroinvertebrates
- Drainage Ditch (off-Site); and
    - Benthic macroinvertebrates
- Off-Site Sediment.
    - Little brown bat

3.2 Data Used to Characterize Ecological Exposure

The soil and sediment data used in the SLERA are representative of the nature and extent of on-Site COIs and potential off-Site impact. **Attachment C** presents the data used to evaluate potential ecological receptors. **Figure 3-1** shows the locations of samples used in this SLERA. Quality assurance/quality control procedures outlined in AECOM (2018) were used to assess the precision and accuracy of analytical data.

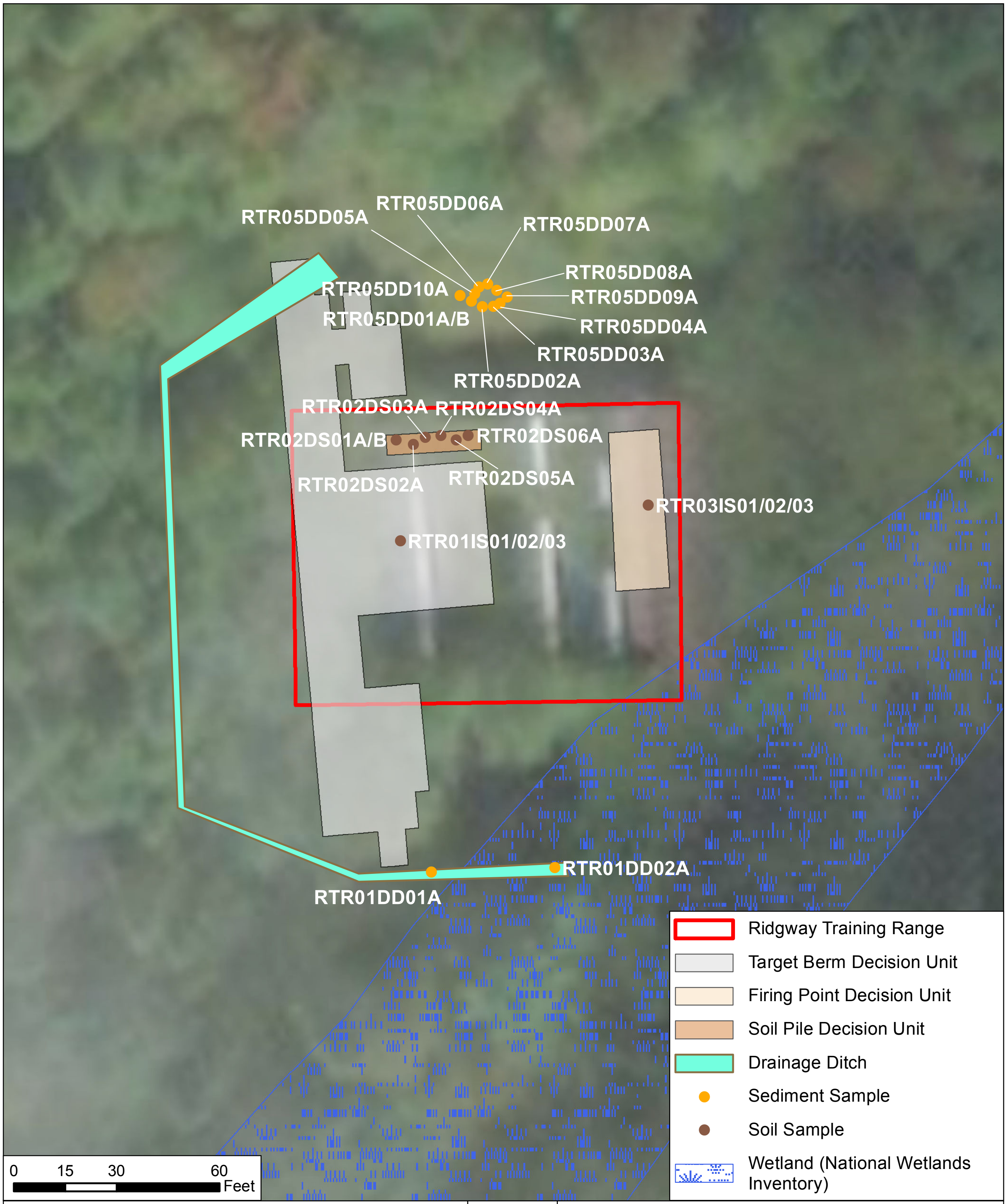
For the Target Berm and Firing Point DUs, incremental samples were collected and analyzed in triplicate to provide representative exposure point concentrations (EPCs) for these areas. Biased, discrete samples were also collected for the purposes of source delineation. Discrete samples will only be used at EUs without incremental samples (Soil Pile DU, French Drain DU, and off-Site drainage ditch). Discrete samples used in support of source delineation will be discussed in **Section 5.0 Uncertainty Analysis**.

A discrete, field duplicate sample was collected in the Soil Pile DU and the French Drain DU. Discrete, field duplicate samples, if considered equally representative, are not independent samples. New Jersey Department of Environmental Protection (2014) considers a relative percent difference (RPD) less than 50% to be indicative of representative samples for solid matrices. The RPD between primary and duplicate results for the soil and sediment sample locations are presented below. The RPD was calculated by:

$$\text{RPD (\%)} = \text{abs}\left(\frac{\text{primary - duplicate}}{\text{mean (primary, duplicate)}}\right) \times 100$$

Results which were not considered representative were retained as independent samples. The mean of the primary and duplicate was used for samples determined to be representative.

COI	**Result (mg/kg)**		**RPD (%)**	**Representative?**	**Mean**
	Primary	Duplicate			
Soil Pile DU (RTR02DS01A/B)					
Antimony	51.2	4.93	165	No	Retain Both
Copper	828	145	140	No	Retain Both
Lead	6,940	999	150	No	Retain Both
Zinc	266	106	86	No	Retain Both
French Drain DU (RTR05DD01A/B)					
Antimony	0.253	0.362	35	Yes	0.308



CLIENT Army National Guard

PROJECT NDNODS Ridgway Training Site

REVISION NO	0	GIS BY	AD	10/31/2018
SCALE	1:500	CHK BY	JW	10/31/2018
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	10/31/2018

Sample Locations

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 3-1

\\ursgermantown.us.ie.urs\germantown\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 6 SARs\900-Work\GIS\Ridgway\1_MXD\SLERA\Figure 3-1 Sample Locations.mxd

COI	**Result (mg/kg)**		**RPD (%)**	**Representative?**	**Mean**
	Primary	Duplicate			
Copper	17.4	25.2	37	Yes	21.3
Lead	106	179	51	No	Retain Both
Zinc	48.4	56.6	16	Yes	52.5

3.3 Exposure Estimate Methodology and Risk Characterization

The preliminary exposure estimate presents the most conservative exposure scenario based on the most conservative exposure assumptions. Maximum concentrations were used to evaluate exposure. This approach addresses wildlife with small home ranges and sedentary organisms, e.g., earthworms.

3.3.1 Exposure Estimate Methodology

Preliminary exposure assumptions are presented below for each receptor category:

- Direct Contact Evaluation (Soil Invertebrates);
    - A direct contact evaluation compares maximum COI concentrations measured in soil to conservative direct contact ESVs known to be protective of soil macroinvertebrates.
- Direct Contact Evaluation (Benthic Macroinvertebrates);
    - A direct contact evaluation compares maximum COI concentrations measured in sediment to conservative direct contact ESVs known to be protective of aquatic organisms exposed to sediment in the off-Site drainage ditch and French Drain DU.
- Preliminary Wildlife Screening (Birds and Mammals); and
    - For both terrestrial and aquatic/semi-aquatic receptors, maximum COI concentrations in both soil and sediment will be compared to ESVs protective of wildlife. Exceedances of ESVs protective of wildlife will require additional modeling to estimate the potential risk for each receptor.
- Dose Rate Modeling (Birds and Mammals).
    - A dose rate model (DRM) was used to generate a total estimated daily dose (EDD_{total}) experienced by each selected receptor. EDD_{total} was compared with a TRV to assess the potential for ecological risk. EDD_{total} consists of the sum of doses obtained from diet (EDD_{diet}), along with the incidental ingestion of the substrate, i.e., soil ($EDD_{substrate}$). The total estimated daily dose (EDD_{total}) experienced by each selected receptor was calculated as the sum of the doses obtained from these routes of exposure. The contribution of surface water for this SLERA was considered negligible with prey items consisting of each receptors primary source of dietary water.

  - Dietary composition for wildlife receptors was assumed to consist of 100% of the most contaminated prey item. Wildlife DRMs based on maximum detected COI concentrations assumed an area use factor (AUF) of 100%; this represents the worst-case exposure scenario for wildlife, and assumes that receptors continuously forage at the maximum COI concentration in each EU.
  - EDD_{total} for each constituent was compared to conservative TRVs for that constituent. TRVs constitute threshold effects concentrations derived from published toxicity test data. Two TRVs were used including the No Observable Adverse Effect (NOAEL) and the Lowest Observable Adverse Effect Level (LOAEL). The NOAEL and LOAEL are daily dose levels normalized to the body weight of the test animals, e.g., milligrams of chemical per kilogram body weight per day (mg/kg-day). The NOAEL represents the highest value within the same endpoint as the LOAEL, e.g., reproduction.
  - Additional details of DRMs and wildlife TRVs used in the SLERA are presented in **Attachment D**.

3.3.2 Risk Characterization Methodology

Potential risks associated with the ecological exposure estimates are expressed as a hazard quotient (HQ), which represents the ratio of the EPC to the ESV for direct contact pathways or the calculated EDD to the TRV for wildlife ingestion pathways:

Based on the magnitude of the HQs, potential risks may be interpreted as follows:

- A HQ less than 1 based on a NOEC or NOAEL indicates that potential risk is not expected because the estimated exposure has not been demonstrated to cause adverse ecological effects (USEPA, 1997);
- A HQ greater than 1 based on a NOAEL, but an HQ less than 1 based on a LOAEL, indicates some potential for risk and further refinements should be made to reduce uncertainty; and
- A HQ equal to or greater than 1 based on a low observable effects concentration (LOEC) or LOAEL generally indicates a potential for risk because estimated exposure exceeds a known threshold of effects.

This decision criterion reflects the abundance of caution adopted for the SLERA and Step 3 evaluations.

3.3.3 Risk Characterization Summary

The preliminary exposure estimate results for all receptors are summarized in the sections below. **Table 3-1 and Table 3-2** present the direct contact evaluation and preliminary wildlife screening of soil and sediment COIs, respectively, at all EUs. **Table 3-3** summarizes the dose rate model results for soil and sediment COPECs for all relevant receptors at all applicable EUs. Full DRM results, explanation of model parameters, and wildlife TRVs can be found in **Attachment D**.

Table 3-1. Direct Contact Evaluation and Preliminary Wildlife Screening (Soil)

COI	**Sample Count**	**Detect Freq. (%)**	**Min. Detect (mg/kg)**	**Max. Detect (mg/kg)**	**Location of Max (depth in. bgs.)**	**ESV$^{(1)}$ (mg/kg)**		**Direct Contact**		**Proceed to Wildlife DRM?**
						DC	Wild	HQ	COPEC	
Firing Point DU										
Nitroglycerin	3	100	3.70	21	RTR03IS03 (0-6)	13	70	2	**Yes**	No
Target Berm DU										
Antimony	3	100	24.8	40.1	RTR01IS03 (0-6)	78	0.27	<1	No	**Yes**
Copper	3	100	481	636	RTR01IS01 (0-6)	80	28	8	**Yes**	**Yes**
Lead	3	100	5,720	8,770	RTR01IS03 (0-6)	1,700	11	5	**Yes**	**Yes**
Zinc	3	100	149	165	RTR01IS03 (0-6)	120	46	1	**Yes**	**Yes**
Soil Pile DU										
Antimony	7	100	2.24	58.5	RTR02DS02A (0-12)	78	0.27	<1	No	**Yes**
Copper	7	100	76.6	1,740	RTR02DS02A (0-12)	80	28	22	**Yes**	**Yes**
Lead	7	100	672	8,980	RTR02DS02A (0-12)	1,700	11	5	**Yes**	**Yes**
Zinc	7	100	106	314	RTR02DS02A (0-12)	120	46	3	**Yes**	**Yes**

Notes:

% = Percent; COI = Constituent of Interest; DC = Direct Contact; DRM = Dose Rate Model; DU = Decision Unit; Freq. = Frequency; HQ = Hazard Quotient; in. bgs. = inches below ground surface; Max. = Maximum; mg/kg = milligram per kilogram; Min. = Minimum; Wild = Wildlife

(1) Sources for ESVs are presented in **Table 2-1**.

Table 3-2. Direct Contact Evaluation and Preliminary Wildlife Screening (Sediment)

COI	Sample Count	Detect Freq. (%)	Min. Detect (mg/kg)	Max. Detect (mg/kg)	Location of Max (depth in. bgs.)	ESV$^{(1)}$ (mg/kg)		Direct Contact		Proceed to Wildlife DRM?
						DC	Wild	HQ	COPEC	
French Drain DU										
Antimony	10	100	0.092	0.638	RTR05DD05A (0-6)	2	2	<1	No	No
Copper	10	100	6.63	38.7	RTR05DD02A (0-6)	31.6	31.6	1	**Yes**	**Yes**
Lead	11	100	17.6	358	RTR05DD02A (0-6)	35.8	35.8	10	**Yes**	**Yes**
Zinc	10	100	34.7	71.1	RTR05DD10A (0-6)	121	121	<1	No	No
Drainage Ditch										
Antimony	2	100	0.18	0.966	RTR01DD01A (0-6)	2	2	<1	No	No
Copper	2	100	15.3	79.7	RTR01DD01A (0-6)	31.6	31.6	3	**Yes**	**Yes**
Lead	2	100	15.8	242	RTR01DD01A (0-6)	35.8	35.8	7	**Yes**	**Yes**
Zinc	2	100	62.4	74.9	RTR01DD01A (0-6)	121	121	<1	No	No

Notes:

% = Percent; COI = Constituent of Interest; DC = Direct Contact; DRM = Dose Rate Model; DU = Decision Unit; Freq. = Frequency; HQ = Hazard Quotient; in. bgs. = inches below ground surface; Max. = Maximum; mg/kg = milligram per kilogram; Min. = Minimum; Wild = Wildlife

(1) Sources for ESVs are presented in **Table 2-1**.

Table 3-3. Wildlife Dose Rate Model Summary

COI	**Short-tailed Shrew HQ**		**Red Fox HQ**		**American Robin HQ**		**Red-tailed Hawk HQ**		**Little Brown Bat HQ**	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Target Berm DU										
Antimony	**94**	<1	--	--	(a)	--	--	--	--	--
Copper	**1**	<1	--	--	**4**	<1	--	--	--	--
Lead	**44**	**1**	--	--	**200**	**7**	--	--	--	--
Zinc	<1	--	--	--	**1**	--	--	--	--	--
Soil Pile DU										
Antimony	**137**	<1	--	--	(a)	--	--	--	--	--
Copper	**2**	<1	--	--	**8**	**2**	--	--	--	--
Lead	**44**	**1**	--	--	**205**	**7**	--	--	--	--
Zinc	**1**	--	--	--	**1**	--	--	--	--	--
Site-Wide (Soil)										
Antimony	--	--	**1**	<1	--	--	(a)	--	--	--
Copper	--	--	<1	<1	--	--	**2**	<1	--	--
Lead	--	--	**3**	<1	--	--	**28**	**1**	--	--
Zinc	--	--	<1	--	--	--	<1	--	--	--
Site-Wide (Sediment)										
Copper	--	--	--	--	--	--	--	--	**4**	<1
Lead	--	--	--	--	--	--	--	--	<1	<1

Notes:

Bold indicates an exceedance of wildlife TRV; -- = Not Evaluated; COI = Constituent of Interest; DU = Decision Unit; HQ = Hazard Quotient; LOAEL = Lowest Observed Adverse Effects Level; NOAEL = No Observed Adverse Effects Level

(a) As indicated in USEPA (2007b), insufficient data to derive a TRV for avian receptors.

3.3.3.1 Soil Macroinvertebrates

Based on the comparison of maximum COI concentrations the following soil, direct contact COPECs were identified:

- Firing Point DU;
    - Nitroglycerin
- Target Berm DU; and
    - Copper
    - Lead
    - Zinc
- Soil Pile DU.
    - Copper
    - Lead
    - Zinc

3.3.3.2 Benthic Macroinvertebrates

Based on the comparison of maximum COI concentrations the following sediment, direct contact COPECs were identified:

- French Drain DU; and
    - Copper
    - Lead
- Drainage Ditch.
    - Copper
    - Lead

3.3.3.3 Birds and Mammals

Based on the comparison of maximum COI concentrations the following wildlife COPECs were identified:

- Target Berm DU;
    - Antimony (Short-tailed shrew)
    - Copper (Short-tailed shrew and American robin)
    - Lead (Short-tailed shrew and American robin)
    - Zinc (American robin)
- Soil Pile DU;
    - Antimony (Short-tailed shrew)
    - Copper (Short-tailed shrew and American robin)
    - Lead (Short-tailed shrew and American robin)
    - Zinc (Short-tailed shrew and American robin)

- On-Site Soil; and
    - Antimony (Red fox)
    - Copper (Red-tailed hawk)
    - Lead (Red fox and red-tailed hawk)
- Off-Site Sediment.
    - Copper (Little brown bat)

3.4 Scientific Management Decision Point

The SMDP is a determination made at the culmination of the SLERA process that states whether there is sufficient information to make a decision regarding risk management strategies (USEPA, 1997). The SMDP rendered at the end of the preliminary risk calculation will not set a clean-up goal. As previously discussed, one of the following conclusions will be reached:

- The ecological risk assessment should be continued to develop a site-specific clean-up goal, or to reduce uncertainty in the evaluation of risk and impact;
- The preliminary screening is adequate to determine that ecological risks are negligible, i.e., *de minimis*; or
- There is substantial impact (*de manifestis*). Proceed to remediation that can eliminate or reduce exposure to an acceptable level (Suter et al., 1995; in PADEP, 2002).

The following sections summarize the SMDPs for each medium and receptor(s) if applicable.

3.4.1 On-Site Soil

The risk characterization supports the following SMDP for exposure to Site-related constituents in soil:

- There is substantial impact (*de manifestis*). Proceed to remediation that can eliminate or reduce exposure to an acceptable level (Suter et al., 1995; in PADEP, 2002).

Individual SMDPs and rationale for the risk characterization of on-Site soil are presented below:

- Soil invertebrates and
    - Maximum concentrations of nitroglycerin (Firing Point DU) and copper, lead, and zinc (Target Berm and Soil Pile DUs) exceeded ESVs protective of soil invertebrates.
    - Further refinements made to the direct contact evaluation (e.g., refined EPC) will reduce uncertainty, but will still exceed benchmarks protective of soil invertebrates.
- Terrestrial wildlife.
    - Wildlife DRMs indicated that NOAEL TRVs (protective of either mammalian or avian wildlife) were exceeded by maximum concentrations of antimony, copper,

lead, and zinc in soil at Target Berm and Soil Pile DUs and by antimony, copper, and lead for all on-Site soil.

  - Additionally, exposure estimates for the shrew and robin exceeded LOAEL TRVs. Further refinements to DRMs may reduce uncertainty further, however, are unlikely to eliminate unacceptable risk.

3.4.2 Off-Site Sediment

The risk characterization supports the following SMDP for exposure to Site-related constituents in sediment:

- The preliminary screening has determined that the SLERA should be continued to BERA Step 3 to reduce uncertainty in the evaluation of risk and impact.

Further evaluation of the direct contact exposure pathways to benthic macroinvertebrates, in addition to food-web mediated exposure for aquatic/semi-aquatic wildlife, is conducted in BERA Step 3. Individual SMDPs are presented below:

- Benthic macroinvertebrates and
  - Maximum concentrations of copper and lead exceeded ESVs protective of benthic macroinvertebrates in both the French Drain DU and Drainage Ditch. Exposure estimates will be refined using more representative EPCs and more realistic ESVs.
- Aquatic/semi-aquatic wildlife.
  - Wildlife DRMs indicated that maximum concentrations of copper exceeded NOAEL TRVs protective of mammalian wildlife in all off-Site sediment. Exposure estimates will be refined using more representative EPCs and more realistic TRVs.

4 Step 3: Constituents of Potential Ecological Concern Refinement

SLERA Steps 1 and 2 were used to select COPECs and evaluate ecological risk under a conservative, “worst-case” scenario. Steps 1 and 2 were also used to identify which constituents can be eliminated from further consideration and those that should be evaluated further.

Because of the conservative assumptions used during Steps 1 and 2, some of the COPECs retained for BERA Step 3 COPEC refinement might pose negligible risk. By conducting a refined exposure evaluation, Step 3 can reduce the list of COPECs and determine if there are COPECs that truly warrant further evaluation with a BERA and/or remediation. Furthermore, Step 3 can focus on the potential risk drivers and portions of the Site where the likelihood of adverse ecological effects is greatest.

The BERA Step 3 refinements included:

- Refined direct contact evaluation for benthic macroinvertebrates and
- Refined DRM for little brown bat.

4.1 Refined Direct Contact Evaluation for Benthic Macroinvertebrates

Step 3 direct contact evaluation refinements for the benthic macroinvertebrate are discussed below.

- Refined EPC and
  - The French Drain DU and Drainage Ditch datasets were combined to provide a representative EPC for the Site. Both areas receive surface water runoff with eroded soil from the same source (Target Berm and Soil Pile DUs).
    - Combining the datasets will help reduce the high variability observed in both datasets on a small spatial scale. The range of values observed from both datasets is comparable.
  - The upper confidence limit (UCL) of the mean was used as a refined EPC. The 95% UCLs were calculated with ProUCL 5.1 (USEPA, 2016). The ProUCL output is included with **Attachment E**.
- Refined ESV
  - Refined sediment ESVs were selected for copper and lead from USEPA Region 4 guidance. Refined ESVs were chosen based on LOAEL-based effects (USEPA, 2018).

4.2 Refined Dose Rate Model Evaluation

Step 3 DRM refinements for the little brown bat are discussed below.

- Refined EPC and

    - The French Drain DU and Drainage Ditch datasets were combined to provide a representative EPC for the Site. Both areas receive surface water runoff with eroded soil from the same source (Target Berm and Soil Pile DUs).
        - Combining the datasets will help reduce the high variability observed in both datasets on a small spatial scale. The range of values observed from both datasets is comparable.
    - The UCL of the mean was used as a refined EPC. The 95% UCLs were calculated with ProUCL 5.1 (USEPA, 2016). The ProUCL output is included with **Attachment E**.
- Refined TRV
    - NOAEL TRVs used to assess impact to mammalian wildlife were refined using less conservative selection criteria. Discussion of TRV refinements is included in **Attachment D**.

4.3 Refined Risk Characterization and Scientific Management Decision Point

The refined exposure estimates represent a more realistic exposure scenario based on the comparisons of 95% UCL COPEC concentrations to refined direct contact ESVs, DRM assumptions, and TRVs. A refined characterization of potential risks is presented below based on these exposure assumptions to focus the list of COPECs and exposure pathways that may warrant further evaluation.

The preliminary characterization of potential risks and refined SMDPs are summarized below by receptor category:

- Benthic macroinvertebrate community and
    - The refined direct contact evaluation (**Table 4-1**) indicated a lead HQ = 1
    - Median concentration for lead (109 mg/kg) was below the refined ESV
    - Small-scale, spatial variability was very high for sediment samples
    - Although individuals may experience some adverse effects locally, population level effects are unlikely
    - The potential for adverse effects of Site-related COPECs in sediment towards benthic macroinvertebrate populations is *de minimis.*
- Aquatic and semi-aquatic wildlife.
    - Refined DRMs indicated a refined copper NOAEL HQ < 1 for the little brown bat
    - The potential for adverse effects of Site-related COPECs in sediment towards aquatic and semi-aquatic wildlife populations is *de minimis*.

Table 4-1. Refined Direct Contact Evaluation (Sediment)

COPEC	Sample Count	Detect Freq. (%)	95% UCL (mg/kg)	RSV$^{(1)}$	Refined HQ
Off-Site Sediment					
Copper	12	100	36.56	149	<1
Lead	13	100	171.4	128	**1**

Notes:

% = Percent; COPEC = Constituent of Potential Ecological Concern; Freq. = Frequency; HQ = Hazard Quotient; mg/kg = milligram per kilogram; UCL = Upper Confidence Limit

(1) USEPA. 2018. Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft. Scientific Support Section Superfund Division EPA Region 4.

5 Uncertainty Analysis

An uncertainty analysis was performed to identify assumptions and procedures that may result in uncertainty in the estimation of exposure or the characterization of risk. Uncertainty in the SLERA is assessed with respect to the following:

- Effects and exposure assessment and
- Risk characterization.

Assumptions and other factors that tend to overestimate, underestimate, or have an unknown effect on the findings of the primary phases of the SLERA are presented and discussed in the following sections.

5.1 Exposure and Effects Assessment

Sources of uncertainty associated with the effects and exposure assessment made in the SLERA are listed below:

- Exposure unit selection;
    - Magnitude – low to moderate (overestimate)
    - Rationale – during selection of exposure units, the Site was broken into very small units (<<0.1 acres) to group similar data types (discrete versus incremental) and source areas (metals vs explosives). Even the most localized wildlife receptors (shrew and robin) have larger ranges than the total Site area and would likely move freely across the Site while feeding. This had minimal impact on the final conclusions, and was re-evaluated in Step 3 for the refined direct contact evaluation for benthic macroinvertebrates.
- Evaluating different data types; and
    - Magnitude – minimal (underestimate)
    - Rationale – the RI collected both incremental and discrete samples for the Firing Point and Target Berm DUs. Incremental samples were preferred for the SLERA since they are a composite of randomly collected sub-samples within an area and provide a representative concentration. The incremental results were more consistent but lower than the maximum discrete samples. The discrete samples were biased and intended to define the extent of source areas. Ultimately, this had no impact on the risk characterization since impacts requiring action were identified for soil.
- Handling of duplicate data.
    - Magnitude – minimal (under/overestimate)
    - Rationale – primary and duplicate samples were compared for representativeness prior to use in the SLERA. This resulted in some primary/duplicate pairs being averaged or kept independent. None of the maximum concentrations were from a sample location with duplicate data. The only impact to the SLERA was averaging/retaining results for copper and lead, respectively, during UCL calculations.

5.2 Risk Characterization

Sources of uncertainty associated with the risk characterization made in the ERA are listed below:

- Synergistic and Antagonistic Effects;
    - Magnitude – minimal (under/overestimate)
    - Rationale – exposures to ecological receptors at the Site involve more than one type of contaminant. This raises the possibility that synergistic or antagonistic interactions might occur. However, data are generally not adequate to permit any quantitative adjustment in toxicity values or risk calculations based on interactions between different compounds. If it is the case that any of the COPECs act by a similar mode of action, total risks could have been higher than estimated. Conversely, if the COPECs act antagonistically, total risks could have been lower than estimated.
- Application of Hazard Quotients; and
    - Magnitude – minimal (overestimate)
    - Rationale – the application of hazard quotients to quantify potential ecological risk has certain limitations although the USEPA recommends this approach for the screening-level risk calculation. One of the advantages is that the procedure intentionally overestimates risks to "ensure that potential ecological threats are not overlooked" (USEPA, 1997). However, the HQ method does limit the information obtained because it provides only a single point of comparison for the exposure-response relationship.
- Incomplete Characterization.
    - Magnitude – low (under/overestimate)
    - Given the use of conservative assumptions regarding exposure and potential toxicological effects, there is minimal uncertainty that the potential ecological risks towards ecological receptors from Site-related constituents went undetected in the SLERA process. Conversely, there is the probability for a false positive (that is, overestimating risk when risk is not present).

5.3 Summary of Uncertainty

In general, conservative estimates or assumptions were made for most parameters associated with ecological exposures and effects in SLERA Steps 1 and 2. Realistic refinements were made during BERA Step 3 COPEC refinement to reduce uncertainty in the final conclusions. Therefore, confidence is high that the conclusions regarding the potential for adverse ecological harm are adequately conservative to quantify potential risks to soil macroinvertebrates, benthic macroinvertebrates, birds, and mammals.

6 Conclusions and Recommendations

The overall objective of the SLERA was to determine whether potentially adverse ecological effects are occurring, or may occur, due to Site-related constituents in soil and sediment. Potential for risks were evaluated by screening in a SLERA framework that identified a limited number of COPECs. The evaluations for these COPECs were further refined in the context of BERA Step 3 of the ERAGS.

The results of the SLERA, BERA Step 3 COPEC refinement, and the consideration of the uncertainties present in the evaluation support the following conclusions for the Site:

Acceptable Risk

- The potential for adverse effects to the benthic macroinvertebrate community is *de minimus* due to the following:
    - Although the refined direct contact evaluation indicated a lead HQ = 1, the median concentration for lead (109 mg/kg) was below the refined ESV.
    - Small-scale, spatial variability was very high for sediment samples.
    - Although individuals may experience some adverse effects locally, population level effects are unlikely.
- The potential for adverse effects to the aquatic and semi-aquatic wildlife community is *de minimus* due to the following:
    - Refined DRMs indicated refined COPEC NOAEL HQs < 1 for the little brown bat.

Unacceptable Risk

- The potential for adverse effects to the soil invertebrate community is *de manifestis* due to the following:
    - Maximum concentrations of nitroglycerin (Firing Point DU) and copper, lead, and zinc (Target Berm and Soil Pile DUs) exceeded ESVs protective of soil invertebrates.
    - Further refinements made to the direct contact evaluation (e.g., refined EPC) will reduce uncertainty, but will still exceed benchmarks protective of soil invertebrates.
- The potential for adverse effects to the terrestrial wildlife community is *de manifestis* due to the following:
    - Wildlife DRMs indicated that maximum concentrations of antimony, copper, lead, and zinc exceeded NOAEL TRVs protective of mammalian wildlife in soil at both the Target Berm and Soil Pile DUs. Antimony, copper, and lead exceeded NOAEL TRVs for all on-Site soil.
    - Additionally, exposure estimates for the shrew and robin exceeded LOAEL TRVs. Further refinements to DRMs may reduce uncertainty further, however, are unlikely to eliminate unacceptable risk.

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Attachment A

Photographic Log

Client Name:	Site Location:	Project No.
Army National Guard	Ridgway Training Range MRS, Ridgway Township, Pennsylvania	60519685

Photo No. 1

Location of Photo:
Front of the Ridgway Training Range

Description:
Covered firing position area pictured, facing northwest

Photo No. 2

Location of Photo:
Front of Ridgway Training Range

Description:
Drainage ditch east of the covered firing positions at Ridgway Training Range, facing southwest

Client Name: Army National Guard	**Site Location:** Ridgway Training Range MRS, Ridgway Township, Pennsylvania	**Project No.** 60519685

Photo No. 3

Location of Photo:
Target Berm

Description:
Target Berm downrange on the west end of the MRS, facing north

Photo No. 4

Location of Photo:
Range floor

Description:
Soil Pile DU on the north side of the range floor between two wooden baffles, facing north

PHOTOGRAPHIC RECORD

Client Name:	**Site Location:**	**Project No.**
Army National Guard	Ridgway Training Range MRS, Ridgway Township, Pennsylvania	60519685

Photo No. 5

Location of Photo:
French Drain DU outfall area

Description:
French Drain outfall north of training range walled area, facing north. Standing water visible

Photo No. 6

Location of Photo:
Target Berm DU

Description:
Incremental sample locations at the Target Berm DU, facing southwest. White flags = XRF sample locations; orange flags = primary sample locations; blue flags = duplicate sample locations; yellow flags = triplicate sample locations. Gravel at the base of the berm pictured.

PHOTOGRAPHIC RECORD

Client Name: Army National Guard	**Site Location:** Ridgway Training Range MRS, Ridgway Township, Pennsylvania	**Project No.** 60519685

Photo No. 7

Location of Photo:
Target Berm DU

Description:
Drainage ditch south of the MRS, facing southwest. XRF and incremental sample locations pictured on both sides of the drainage ditch.

Photo No. 8

Location of Photo:
French Drain DU

Description:
Standing water in the French Drain DU outfall area, facing north. Samples were collected from sediment beneath the standing water.

Attachment B

PA Department of Conservation and Natural Resources Conservation Planning Report

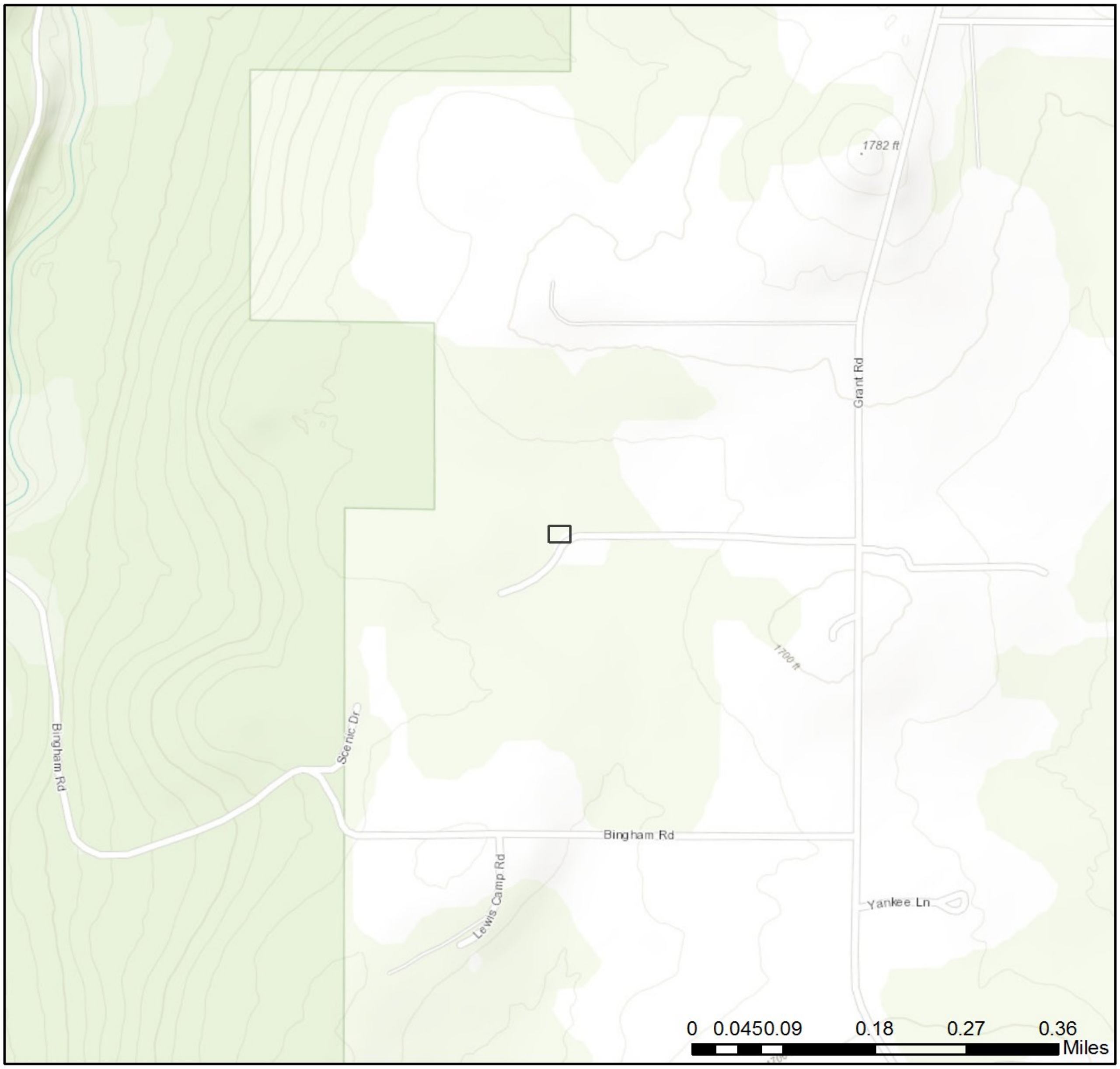
Introduction

This Conservation Planning Report compiles names, descriptions, maps, locations, measurements, links and references for Natural Heritage Areas (core and supporting habitats), Important Bird Areas, State Lands, and agency designated water resources that are coincident with an area of interest defined by the user of the Pennsylvania Conservation Explorer tool. For an overview and additional details, please be sure to visit the website at www.naturalheritage.state.pa.us and download the applicable County Natural Heritage Inventory report(s).

Site Area: 0.22 acres
County(s): Elk
Township/Municipality(s): RIDGWAY
Quadrangle Name(s): PORTLAND MILLS
Watersheds HUC 8: Clarion
Watersheds HUC 12: Big Mill Creek
Decimal Degrees: 41.453208 N, -78.776556 W
Degrees Minutes Seconds: 41° 27' 11.5476" N, 78° 46' 35.6029" W

No conservation planning areas of interest have been detected.

SLERA - Ridgway Training Range



☐ Project Boundary

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo,

For additional information about the Pennsylvania Natural Heritage Program, visit the website at www.naturalheritage.state.pa.us or you can email your questions and comments to RA-HeritageReview@pa.gov.

Attachment C

Sample Data Evaluated

Table 1. Summary of Samples Used in the SLERA

Sample Identification	Sample Collection Date	Sample Depth (inches bgs)	Media Type	Analytical Parameters		Comments
				Total Metals[1]	Explosives[2]	
INCREMENTAL SAMPLES						
Target Berm						
RTR01IS01	7/11/2018	0 - 6	Soil	X		Primary, used also for MS/MSD
RTR01IS02	7/11/2018	0 - 6	Soil	X		Duplicate
RTR01IS03	7/11/2018	0 - 6	Soil	X		Triplicate
Firing Point						
RTR03IS01	7/12/2018	0 - 6	Soil		X	Primary
RTR03IS02	7/12/2018	0 - 6	Soil		X	Duplicate, used also for MS/MSD
RTR03IS03	7/12/2018	0 - 6	Soil		X	Triplicate
DISCRETE SAMPLES						
Target Berm						
RTR01DD01A	7/12/2018	0 - 6	Sediment	X		Collected from drainage ditch south of XRF sample RTR01X125 location
RTR01DD02A	7/12/2018	0 - 6	Sediment	X		Collected from drainage ditch south of MRS, equidistant between the Firing Point and Target Berm
Soil Pile						
RTR02DS01A	7/9/2018	0 - 12*	Soil	X		Collected from the western half of the Soil Pile
RTR02DS01B	7/9/2018	0 - 12*	Soil	X		Field Duplicate of RTR02DS01A
RTR02DS02A	7/9/2018	0 - 12*	Soil	X		Collected from the western half of the Soil Pile
RTR02DS03A	7/9/2018	0 - 12*	Soil	X		Collected from the western half of the Soil Pile
RTR02DS04A	7/9/2018	0 - 12*	Soil	X		Collected from the eastern half of the Soil Pile
RTR02DS05A	7/9/2018	0 - 12*	Soil	X		Collected from the eastern half of the Soil Pile
RTR02DS06A	7/9/2018	0 - 12*	Soil	X		Collected from the eastern half of the Soil Pile
French Drain						
RTR05DD01A	7/12/2018	0 - 6	Sediment	X		Collected from the southwestern corner of the ponded area , MS/MSD
RTR05DD01B	7/12/2018	0 - 6	Sediment	X		Field Duplicate of RTR05DD01A
RTR05DD02A	7/12/2018	0 - 6	Sediment	X		Collected from the southern half of the ponded area
RTR05DD03A	7/12/2018	0 - 6	Sediment	X		Collected from the southern half of the ponded area
RTR05DD04A	7/12/2018	0 - 6	Sediment	X		Collected from the southeastern corner of the ponded area
RTR05DD05A	7/12/2018	0 - 6	Sediment	X		Collected from the northwestern corner of the ponded area
RTR05DD06A	7/12/2018	0 - 6	Sediment	X		Collected from the northern half of the ponded area
RTR05DD07A	7/12/2018	0 - 6	Sediment	X		Collected from the northern half of the ponded area
RTR05DD08A	7/12/2018	0 - 6	Sediment	X		Collected from the northeastern corner of the ponded area
RTR05DD09A	7/12/2018	0 - 6	Sediment	X		Collected 10 feet east of the ponded area
RTR05DD10A	7/12/2018	0 - 6	Sediment	X		Collected 10 feet west of the ponded area

Notes:

[1] - Antimony, Copper, Lead, & Zinc, by USEPA SW-846 Method 6020A

[2] - Nitroglycerin by USEPA SW-846 Method 8330B

bgs = below ground surface

MS/MSD = matrix spike/matrix spike duplicate

USEPA = United States Environmental Protection Agency

* - Soil Pile samples collected from below the soil pile surface, not the ground surface

Table 2. Incremental Sampling Results Summary

	Target Berm											
	RTR01IS01				RTR01IS02				RTR01IS03			
	0-6				0-6				0-6			
	7/11/2018				7/11/2018				7/11/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)												
Antimony	24.80	NA	J-	m	27		J-	m	40.1		J-	m
Copper	636	N*EA	J	s	481		J	s	612		J	s
Lead	5720	NA			6180				8770			
Zinc	158	NEA	J	m	149		J	m	165		J	m

	Firing Point											
	RTR03IS01				RTR03IS02				RTR03IS03			
	0-6				0-6				0-6			
	7/12/2018				7/12/2018				7/12/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Explosives by USEPA SW-846 Method 8330B (mg/kg)												
Nitroglycerin	3.70	L	J	l	4.4	LMM	J	l	21	L	J	l

Notes:

bgs = below ground surface
LQ = Laboratory qualifier
VQ = Validiation qualifier
RC = Reason Code
U = non-detect
J = estimated
J- = estimated, negative bias
l = LCS recovery failure
m = MS/MSD percent recovery anomaly
s = surrogate failure

Table 3. Discrete Soil and Sediment Results

Sample ID:	RTR01DD01A				RTR01DD02A				RTR02DS01A				RTR02DS01B				RTR02DS02A			
Decision Unit:	Target Berm - NA				Target Berm - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA			
Media:	Sediment				Sediment				Soil				Soil				Soil			
Sample Depth (inches bgs):	0-6				0-6				0 - 12				0 - 12				0 - 12			
Date Collected:	7/12/2018				7/12/2018				7/9/2018				7/9/2018				7/9/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																				
Antimony	0.966				0.18				51.2	N*	J	d	4.93		J	d	58.5		J	d
Copper	79.7				15.3	B			828	NA	J	f	145		J	f	1740			
Lead	242				15.8	B			6940	N*A	J	d	999		J	d	8980		J	d
Zinc	74.9				62.4				266	N	J	f	106		J	f	314			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																				
Nitroglycerin	--				--				--				--				--			

Notes:

* = Field duplicate
bgs = below ground surface
LQ = laboratory qualifier
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table 3. Discrete Soil and Sediment Results

Sample ID:	RTR02DS03A				RTR02DS04A				RTR02DS05A				RTR02DS06A				RTR05DD01A			
Decision Unit:	Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				French Drain - NA			
Media:	Soil				Soil				Soil				Soil				Sediment			
Sample Depth (inches bgs):	0 - 12				0 - 12				0 - 12				0 - 12				0-6			
Date Collected:	7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/12/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																				
Antimony	15.2		J	d	10.2		J	d	2.24		J	d	7.74		J	d	0.253	N		
Copper	278				202				76.6				149				17.4	NB		
Lead	2460		J	d	1660		J	d	672		J	d	1570		J	d	106	NBA	J	f
Zinc	122				112				211				134				48.4			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																				
Nitroglycerin	--				--				--				--				--			

Notes:

* = Field duplicate
bgs = below ground surface
LQ = laboratory qualifier
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table 3. Discrete Soil and Sediment Results

Sample ID:	RTR05DD01B				RTR05DD02A				RTR05DD03A				RTR05DD04A				RTR05DD05A			
Decision Unit:	French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA			
Media:	Sediment				Sediment				Sediment				Sediment				Sediment			
Sample Depth (inches bgs):	0-6				0-6				0-6				0-6				0-6			
Date Collected:	7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																				
Antimony	0.362				0.29				0.2				0.264				0.638			
Copper	25.2	B			38.7	B			20.7	B			13.2	B			29.6	B		
Lead	179	B	J	f	358	B			81.8	B			37.3	B			189	B		
Zinc	56.6				58.2				51				58.8				42.4			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																				
Nitroglycerin	--				--				--				--				--			

Notes:

* = Field duplicate
bgs = below ground surface
LQ = laboratory qualifier
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table 3. Discrete Soil and Sediment Results

Sample ID:	RTR05DD06A				RTR05DD07A				RTR05DD08A				RTR05DD09A				RTR05DD10A			
Decision Unit:	French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA			
Media:	Sediment				Sediment				Sediment				Sediment				Sediment			
Sample Depth (inches bgs):	0-6				0-6				0-6				0-6				0-6			
Date Collected:	7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018			
Analyte	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																				
Antimony	0.152				0.092	J			0.438				0.36				0.236			
Copper	12.2	B			6.63	B			30.3	B			31.5	B			20.6	B		
Lead	58	B			17.6	B			120	B			124	B			67.3	B		
Zinc	34.7				37.7				58.1				53.2				71.1			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																				
Nitroglycerin	--				--				--				--				--			

Notes:
* = Field duplicate
bgs = below ground surface
LQ = laboratory qualifier
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Attachment D

Dose Rate Models, Toxicity Reference Values, and Step 3 Refinements

Table of Contents

Tables

ACRONYMS AND ABBREVIATIONS

AUF	Area Use Factor
BAF	Bioaccumulation Factor
BERA	Baseline Ecological Risk Assessment
BSAF	Biota Sediment Accumulation Factor
COPEC	Chemical of Potential Ecological Concern
DRM	Dose Rate Model
dw	dry weight
EA	Exposure Area
EDD	Estimated Daily Dose
EPC	Exposure Point Concentration
ESV	Ecological Screening Value
ha	hectares
HQ	Hazard Quotient
kg	kilogram
LOAEL	Lowest Observed Adverse Effects Level
mg	milligram
NOAEL	No Observed Adverse Effects Level
SLERA	Screening Level Ecological Risk Assessment
TRV	Toxicity Reference Value
UCL	Upper Confidence Limit
USEPA	United State Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
%	Percent

1. Introduction

The purpose of this attachment is to present the approach that was used to develop dose rate models (DRMs) to evaluate exposures to terrestrial wildlife receptors during the screening level ecological risk assessment (SLERA) and refinements made during baseline ecological risk assessment (BERA) Step 3.

The following sections provide a detailed description of the development of species-specific exposure parameters, soil bioaccumulation factors (BAFs), biota sediment accumulation factors (BSAFs), area use factors (AUFs), wildlife toxicity reference values (TRVs), simplified food web modeling, and refinements made during BERA Step 3.

The following tables accompany this memo:

- **Tables 1 and 2** present life history parameters and body weights;
- **Tables 3 and 4** presents terrestrial BAFs and estimated concentrations in prey items;
- **Table 5** presents aquatic BSAFs and estimated concentrations in prey items;
- **Table 6** presents the selected wildlife TRVs;
- **Tables 7 through 10** present the DRM outputs for selected wildlife;
- **Table 11** presents refinements made to estimated prey concentrations;
- **Table 12** presents refinements made to wildlife TRVs; and
- **Table 13** presents the refined DRM outputs for selected wildlife.

2. Modeling Approach

Wildlife ingestion pathways were evaluated by considering the trophic transfer of constituents from soil and sediment through the food web to the selected receptors of concern. Wildlife dose modeling incorporates conservative site-specific parameters and assumptions regarding exposure to prevent underestimating potential risk associated with site COPECs, receptors, and the potential interactions between chemical stressors and biota. Hence, the SLERA uses the maximum concentration and assumes that receptors forage exclusively within the exposure area (EA) at the location of the maximum concentration.

Wildlife receptors evaluated in the SLERA include:

- Terrestrial Receptors and
    - Mammalian invertivore: Short-tailed shrew (*Blarina brevicauda*)
    - Mammalian carnivore: Red fox (*Vulpes vulpes*)
    - Avian invertivore: American robin (*Turdus migratorious*)
    - Avian carnivore: Red-tailed hawk (*Buteo jamaicensis*)
- Aquatic and Semi-Aquatic Receptors.
    - Mammalian invertivore: Little brown bat (*Myotis lucifugis*)

Simplified food web DRMs were used to calculate estimated daily doses (EDDs) of constituents that selected receptor groups experience through exposure to surface soil in terrestrial habitats. The EDD represents the dose of a chemical that an individual member of a receptor population would receive if the individual foraged solely within the area used to develop the EPC. The EDDs were then compared to no observed adverse effect level (NOAEL) and lowest observed adverse effect level (LOAEL) TRVs to assess the potential for adverse effects.

The simplified food web DRM considers the primary routes of exposure to wildlife receptors as the direct ingestion of prey and the incidental ingestion of media. Concentrations of chemicals in prey were expressed as a function of chemical concentrations in soil using BAFs and sediment using BSAFs. The following sections provide descriptions of each of the elements associated with the development of exposures and risks to selected wildlife receptors, including dose model equations, AUFs, and estimates of bioaccumulation, e.g., BAFs and BSAFs.

2.1 Dose Rate Model

This section describes the simplified food web DRM developed to calculate EDDs from chemical concentrations in soil and sediment. The total EDD (EDD_{total}) experienced by each selected receptor was expressed as the sum of the doses obtained from the three primary routes of exposure:

$$EDD_{total} = EDD_{diet} + EDD_{substrate} + EDD_{surfacewater}$$

The total dose from surface water ($EDD_{surfacewater}$) was considered negligible. It was assumed that wildlife receptors receive the majority of their dietary water intake from consumption of prey items.

The total dose from each route of exposure was calculated individually as follows:

Dietary Dose

$$EDD_{diet} = \frac{IR_{diet} * \sum_{i=1}^{n}(B[S]AF * C_S * DF_i) * AUF_i}{BW}$$

where:

EDD_{diet} = Dose of constituent obtained from the diet (milligram [mg] constituent/kilogram [kg] receptor body weight-day);

n = Number of contaminated food types;

IR_{diet} = Ingestion rate of food (kg food ingested/day, dry weight [dw]);

B[S]AF = Soil BAFs or sediment BSAFs specific to prey type and constituent (kg substrate/kg food, dw);

C_s = Concentration of constituent in soil (mg constituent/kg soil, dw);

DF_i = Dietary fraction of food item *i* (proportion of food type in the diet). In accordance with USEPA (1997) guidance, the exposure calculations will be based upon an exclusive diet consisting of 100 percent (%) of the most contaminated dietary component. Food items can include plants, soil invertebrates, and small mammals;

AUF_i = The proportion of time that an individual receptor *i* is expected to contact contaminated environmental media as determined with home range size. This will be expressed as an area use factor for receptor *i* (AUF_i). The area use factor accounts for the size of the Site relative to the size of the home range for receptor *i*. *AUFi* will be defaulted to 1.0, which assumes that the receptor spends 100% of its time on the Site; and

BW = Body weight of the receptor, wet weight (kg)

Substrate Dose

$$EDD_{substrate} = \frac{IR_S \times C_S \times AUF}{BW}$$

where:

$EDD_{substrate}$ = Dose of constituent obtained from incidental ingestion of soil (mg constituent/kg receptor body weight-day)

IR_s = Incidental ingestion rate of soil (kg soil ingested per day, dw)

C_s = Concentration of constituent in soil (mg constituent/kg soil, dw)

AUF = Area use factor includes, when appropriate, seasonal and area use rates. AUF will be defaulted to 1.0.

BW = Body weight of the receptor, wet weight (kg)

The receptor dose of COPECs from dietary and incidental substrate ingestion was modeled using dw parameters to avoid introducing unnecessary uncertainty into the model by converting parameters from dw to wet weight based on approximate moisture contents of dietary items. Food ingestion rates, substrate ingestion rates, and substrate-to-biota accumulation rates were expressed on a dw basis.

3. Model Parameters

The DRM includes parameters relating to receptor-specific exposure factors, bioaccumulation factors, and area use factors. The following section describes the estimation of these parameters and the major assumptions used.

3.1 Receptor-Specific Exposure Parameters

Exposure parameters used to determine the EDD for each receptor included body weight (kg, wet weight), home range, food ingestion rate (kg dry weight/day), incidental substrate ingestion rate (kg dry weight/day), dietary composition, and AUF (**Tables 1 and 2**). Details are provided below:

- Body Weight;

  Body weights were obtained from available literature. The values used in their derivation (as provided by the source) are presented below:

Receptor	Body Weight (kg, wet weight)	Source	Source Notes
American robin	0.077	Sample and Suter (1994)	Dunning, 1984
Red-tailed hawk	1.13	Sample and Suter (1994)	Dunning, 1984
Red fox	4.5	Sample and Suter (1994)	4.5 kg mean ♂+♀ for both Illinois and Iowa Storm et al. 1976
Short-tailed shrew	0.015	Sample and Suter (1994)	0.015 ± 0.00078 kg New Hampshire (field) Schlessinger & Potter, 1974
Little brown bat	0.0075	Sample and Suter (1994)	Gould, 1955

- Home Range;

  Home ranges were obtained from available literature and are presented below in hectares (ha):

American robin	=	0.42 ha	(Sample and Suter, 1994)
Red-shouldered hawk	=	233 ha	(Sample and Suter, 1994)
Red fox	=	407 ha	(Sample and Suter, 1994)
Short-tailed shrew	=	0.39 ha	(Sample and Suter, 1994)
Little brown bat	=	N/A	None available in literature

- Food Ingestion Rate;

  Food ingestion rates (IR_{food}) for selected wildlife receptors were based on allometric regressions of feeding rates versus body mass for over 170 species of mammals and birds (Nagy, 2001), as follows:

Receptor	Category	Equation	IR_{food} (kg /day, dw)
American robin	Avian Invertivore	$0.540*(BW\ [kg] * 1000\ [g/kg])^{0.705} * 0.001\ (kg/g)$	0.012
Red-tailed hawk	Avian Carnivore	$0.849*(BW\ [kg] * 1000\ [g/kg])^{0.663} * 0.001\ (kg/g)$	0.0898
Red fox	Mammalian Carnivore	$0.153*(BW\ [kg] * 1000\ [g/kg])^{0.834} * 0.001\ (kg/g)$	0.170
Short-tailed shrew	Mammalian Invertivore	$0.373*(BW\ [kg] * 1000\ [g/kg])^{0.622} * 0.001\ (kg/g)$	0.002
Little brown bat	Mammalian Invertivore	$0.373*(BW\ [kg] * 1000\ [g/kg])^{0.622} * 0.001\ (kg/g)$	0.0013

- Incidental Substrate Ingestion Rate;

  Incidental substrate ingestion rates for soil are represented by multiplying the rate of food intake (IR_{food}) by the fraction of substrate in dry intake (USEPA, 2007). Substrate (as a % of dry intake) for each receptor was obtained from available literature and are listed below:

Receptor	Substrate (as % of Dry Intake)	$IR_{substrate}$ (kg /day, dw)	Source	Source Notes
American robin	10.4%	0.00120	Beyer et al. (1994)	Based on a soil consumption rate for a woodcock of 10.4%
Red-tailed hawk	5.7%	0.00512	USEPA (2007)	Based on 90th percentile of Monte Carlo Simulation (n = 100,000)
Red fox	2.8%	0.00477	Beyer et al. (1994)	N/A
Short-tailed shrew	3.0%	0.00006	USEPA (2007)	Based on 90th percentile of Monte Carlo Simulation (n = 100,000)
Little brown bat	0%	0	Sample and Suter (1994)	Negligible due to feeding behavior (aerial hawk)

- Dietary Composition; and

  Dietary composition was assumed to be 100% of the food item most sensitive to Site COPECs:

  American robin = Invertebrates (USEPA, 1993)

Red-shouldered hawk = Small mammals (DeGraaf and Rudis, 1992)

Red fox = Small mammals (USEPA, 1993)

Short-tailed shrew = Invertebrates (USEPA, 1993)

Little brown bat = Invertebrates (Sample and Suter, 1994)

- Area Use Factor

  The AUF accounts for the proportion of time that an organism spends in an area of concern during the time period of possible exposure. This factor is generally calculated as the ratio of the size of the EA to the home range of each receptor, but may also include considerations of temporal use of the EA such as seasonality. The AUF provides a more realistic estimate of exposure since it incorporates a more realistic assumption that reduces the overall uncertainty of the risk assessment, while retaining the conservative nature of the model. An AUF of 100% was used to calculate the EDD for each wildlife receptor in order to provide the most conservative exposure estimation.

4. Exposure Point Concentrations

Wildlife exposures were evaluated using the maximum COPEC concentration as an EPC. This was done to represent a conservative estimate of risk that assumes receptors are continuously exposed to maximum COPEC concentrations in media throughout their life span. This section presents the methods used to estimate COPEC concentrations in prey items based on the COPEC EPC.

4.1 Soil and Sediment Bioaccumulation Factors

B(S)AFs provide quantitative indicators of the tendency for a chemical to partition into biological organisms relative to the concentrations present in environmental exposure media. Site-specific measurements of tissue concentrations are the best data to reduce uncertainty in estimating EPCs in dietary components. However, the collection of tissue for all dietary components is not practical in most screening-level ecological risk assessments. Therefore, B(S)AFs or models must be applied, and a level of uncertainty in estimated concentrations must be accepted.

BAFs represent observed or predicted ratios between chemical concentrations in prey and soil:

$$C_p = B(S)AF \times C_s$$

where:

C_p = Chemical concentration predicted in prey (mg chemical/kg prey, dw);

B(s)AF = Soil BAFs and sediment BSAFs specific to prey type and constituent (kg substrate/kg food, dw); and

C_s = Concentration of constituent in soil or sediment (mg constituent/kg soil or sediment, dw).

The methodologies and resources used to derive soil BAFs and estimated concentrations in prey items are presented in **Tables 3 and 4** and outlined below:

- Terrestrial Plants;

  Herbivores were not evaluated in this SLERA since, for Site COPECs, assuming 100% invertebrate diet is more conservative and protective of herbivores. However, plant BAFs were required to assess bioaccumulation of antimony for small mammals (USEPA, 2007).

  Consistent with USEPA Eco-SSL guidance (USEPA, 2005), the concentrations of metals in plants were estimated using the recommended applications of plant bioaccumulation models developed by Efroymson et al. (2001) and supplemented using data compiled in Bechtel-Jacobs (1998a) and USEPA (2007). The model used is presented below.

  $$\ln(tissue) = B0 + B1(\ln[soil])$$

  Parameters in the above equation are included in Tables 3 and 4.

- Soil Invertebrates; and

  Consistent with USEPA Eco-SSL guidance (USEPA, 2005), the concentrations of metals (copper, lead, and zinc) in soil invertebrates were estimated using the recommended applications of earthworm bioaccumulation models developed by Sample et al. (1998a) and as presented below.

$$\ln(tissue) = B0 + B1(\ln[soil])$$

Parameters in the above equation are included in Tables 3 and 4. USEPA (2007) recommends a BAF of 1 for antimony.

- Small Mammals

  Consistent with USEPA Eco-SSL guidance (USEPA, 2005), the concentrations of metals (copper, lead, and zinc) in small mammals were estimated using the recommended applications of earthworm bioaccumulation models developed by Sample et al. (1998b) and as presented below.

  $$\ln(tissue) = B0 + B1(\ln[soil])$$

  Parameters in the above equation are included in Tables 3 and 4. For antimony, USEPA (2007) suggests using a diet-to-beef model presented in Baes et al. (1984), where:

  $$\text{BAF}_{\text{soil-to-beef}} = \text{BAF}_{\text{soil-to-diet (plant)}} \text{ x } 50_{\text{ (cattle food intake)}} \text{ x } 0.001_{\text{ (diet-to-biota factor)}}$$

The methodologies and resources used to derive sediment BSAFs and estimated concentrations in prey items are presented in **Table 5** and outlined below:

- Benthic Invertebrates

  The concentrations of metals in benthic invertebrates were estimated using the recommended applications of biota sediment accumulation models developed by Bechtel-Jacobs (1998b). For lead, Bechtel-Jacobs (1998b) recommended using the median BSAF for non-depurated invertebrates (0.066). For copper, the BSAF was modeled using an upper prediction limit formula develop by Dowdy and Wearden (1983) and presented in Appendix A of Bechtel-Jacobs (1998b).

5. Toxicity Reference Values

Assigning a level of likelihood to risk for birds and mammals was achieved with wildlife TRVs, which constitute threshold effects concentrations derived from published toxicity test data. They are used to estimate the nature and magnitude of effects that a chemical may potentially have on a receptor.

Two TRVs were used including the NOAEL and the LOAEL. The NOAEL and LOAEL are daily dose levels normalized to the body weight of the test animals, e.g., milligrams of chemical per kilogram body weight per day (mg/kg bw-day). USEPA (1997) considers the NOAEL to be the most conservative, and hence, preferred benchmark. Where available, recommended NOAELs that reflect reproduction, growth, and survival endpoints were used, in addition to LOAELs.

Chronic effects levels were included preferentially, and TRVs with reproductive, growth or survival endpoints were considered for selection. These endpoints were favored because effects to these endpoints have a clear impact on the fitness of the organism.

For the Site COPECs (metals), TRVs were selected following guidance in USEPA (2005) and using the applicable Eco-SSL guidance document (accessed via https://www.epa.gov/risk/ecological-soil-screening-level-eco-ssl-guidance-and-documents).

NOAEL TRVs were selected using the following methodology 1) if the NOAEL geometric mean (preferably based reproduction, growth, and survival effect groups) is lower than the lowest bounded LOAEL use the NOAEL geometric mean or otherwise 2) select the highest bounded NOAEL lower than the lowest bounded LOAEL.

If the second option outlined above, the NOAEL geometric mean TRV was retained as a LOAEL TRV. Otherwise, LOAEL TRVs were not selected for the initial DRMs. Selected TRVs for avian and mammalian wildlife are presented in **Table 6**.

6. Modeling Refinements

Based on the results in **Tables 7 through 10** and as discussed in the SLERA, BERA Step 3 was used to determine if the COPECs identified with SLERA Step 2 truly warrant further evaluation. Receptors carried forward to the Step 3 DRM refinement include:

- Mammalian invertivore: Little brown bat (*Myotis lucifugis*)

Components of Step 3 DRM and risk characterization refinements included exposure point concentrations (EPCs) and NOAEL TRVs.

6.1 Refined Modeling Parameters

Consistent with USEPA (1997), parameters used in the DRMs were based on conservative assumptions in order to estimate Reasonable Maximum Exposure (RME). The RME approach, used in the initial steps of the SLERA, is defined by USEPA (1992) as the “highest exposure that could reasonably be expected to occur for a given exposure pathway at a site”. Because the use of the maximum concentration in the exposure assessment provides an unrealistically conservative estimate of exposure.

Refinements were made for receptors which had a NOAEL HQ greater than 1. The refinements made to modeling parameters are provided in **Tables 11 and 12** and **Table 13** provides the refined DRM output. Refinements made in BERA Step 3 are summarized below:

- Refined EPC;

  Tthe 95% upper confidence limit (UCL) of the arithmetic mean was used to reduce uncertainty associated with using the MDC and remain more protective than using the arithmetic mean concentration. As discussed by USEPA (1992), the 95% UCL provides reasonable confidence that the true site arithmetic mean will not be underestimated. The calculation of the UCL was conducted with ProUCL Version 5.1.002 (Singh and Maichle, 2016).

- Refinement of TRVs; and

  The NOAEL geometric mean was selected as the NOAEL TRV for use in the Step 3 refined DRMs. The use of the geometric mean provides a representative estimate of a NOAEL observed for reproduction, growth, and survival effect groups in all studies selected in the development of the Eco-SSLs.

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Tables

Table 1
Life History Parameters and Ingestion Rates (Terrestrial)
Screening Level Ecological Risk Assessment
Ridgway Training Range, Pennsylvania

Representative Species			Home Range	Home Range Reference	Screening Level Area Use Factor (AUF)	Body Weight (kg wet weight)	Dietary Composition				Ingestion Rates					
											Food		Substrate			
Common Name	Scientific Name	Food-web classification					Plant Material	Invertebrates	Small Mammals	References	kg dry weight/day	Reference	% of Dry Intake	kg dry weight/day	Comment	Reference
Avian Receptors																
American robin	*Turdus migratorius*	Small soil probing invertivore	0.42 ha	Sample and Suter (1994)	1	0.077		100%		USEPA (1993)	0.012	Nagy (2001)[a]	10.4%	0.00120		Beyer et al. (1994)[b]
Red-tailed hawk	*Buteo jamaicensis*	Avian carnivore	233 ha	Sample and Suter (1994)	1	1.13			100%	USEPA (1993)	0.0898	Nagy (2001)[c]	5.7%	0.00512		USEPA (2007)
Mammalian Receptors																
Short-tailed shrew	*Blarina brevicauda*	Terrestrial invertivore	0.39 ha	Sample and Suter (1994)	1	0.015		100%		USEPA (1993)	0.002	Nagy (2001)[d]	3.0%	0.00006		USEPA (2007)
Red fox	*Vulpes vulpes*	Medium terrestrial carnivore	407 ha	Sample and Suter (1994)	1	4.5			100%	USEPA (1993)	0.170	Nagy (2001)[e]	2.8%	0.00477		Beyer et al. (1994)

Notes:

ha = hectare; kg = kilogram; % = percent

(a) Estimated food ingestion rate (kg/day dry weight) for insectivorous birds = (0.540*[Body Weight in kg*1000]^0.705)/1000

(b) Estimated based on a soil consumption rate of woodcock of 10.4% (Beyer et al. 1994).

(c) Estimated food ingestion rate (kg/day dry weight) for carnivorous birds = (0.849*[Body Weight in kg*1000]^0.663)/1000

(d) Estimated food ingestion rate (kg/day dry weight) for mammalian insectivores = (0.373*[Body Weight in kg*1000]^0.622)/1000

(e) Estimated food ingestion rate (kg/day dry weight) for mammalian carnivores = (0.153*[Body Weight in kg*1000]^0.834)/1000

Table 2
Life History Parameters and Ingestion Rates (Aquatic and Semi-Aquatic)
Screening Level Ecological Risk Assessment
Ridgway Training Range, Pennsylvania

Representative Species			Home Range	Home Range Reference	Area Use Factor (AUF)	Body Weight (kg wet weight)	Dietary Composition			Ingestion Rates				
Common Name	Scientific Name	Food-web classification					Invertebrates	Fish	References	Food		Substrate		
										kg dry weight/day	Reference	% of Dry Intake	kg dry weight/day	Reference
Mammalian Receptors														
Little brown bat	*Myotis lucifugus*	Aerial insectivore	N/A	--	1	0.0075	100%		Sample and Suter (1994)	0.0013	Nagy (2001)^a	0%	0	Sample and Suter (1994)

Notes:

ha = hectare; kg = kilogram; km = kilometers; N/A = Not Available; % = percent

(a) Estimated food ingestion rate (kg/day dry weight) for mammalian insectivores = (0.373*[Body Weight in kg*1000]^0.622)/1000

Table 3
Soil Bioaccumulation Factors and Estimated Concentrations in Prey Items (Target Berm DU)
Screening Level Ecological Risk Assessment
Ridgway Training Range, Pennsylvania

Analyte	log K_{ow}	Maximum Soil Exposure Point Concentration (mg/kg, dry weight)	Estimated Concentrations in Dietary Items of Terrestrial Receptors (mg/kg, dry weight)								
			Terrestrial Plants			Soil Invertebrates			Small Mammals		
			Bioaccumulation Factor (BAF)	Estimated Concentration	BAF Reference	Bioaccumulation Factor (BAF)	Estimated Concentration	BAF Reference	Bioaccumulation Factor (BAF)	Estimated Concentration	BAF Reference
Metals											
Antimony	N/A	40.1	Regression[a]	1.25	USEPA (2007)	1	40.1	USEPA (2007)	Modeling[c]	0.06	USEPA (2007)
Copper	N/A	636	Regression[a]	24.2	Bechtel-Jacobs (1998)	Regression[b]	28.5	Sample et al. (1998a)	Regression[d]	19.6	Sample et al. (1998b)
Lead	N/A	8770	Regression[a]	42.7	Bechtel-Jacobs (1998)	Regression[b]	1267	Sample et al. (1998a)	Regression[d]	59.8	Sample et al. (1998b)
Zinc	N/A	165	Regression[a]	84.7	Bechtel-Jacobs (1998)	Regression[b]	457	Sample et al. (1998a)	Regression[d]	112.6	Sample et al. (1998b)

Notes:

kg = kilogram; K_{ow} = n-octanol/water partitioning coefficient; log = base-10; mg = milligram

(a) Plant tissue concentrations (mg/kg dry weight) calculated based on regression models, where ln([tissue]) = B0 + B1(ln[soil]). Slopes (B1) and intercepts (B0) are as follows:

Chemical	BO	B1	Data Source for Model
Antimony	-3.233	0.937	USEPA (2007)
Copper	0.67	0.39	Bechtel-Jacobs (1998)
Lead	-1.33	0.56	Bechtel-Jacobs (1998)
Zinc	1.58	0.56	Bechtel-Jacobs (1998)

(b) Soil invertebrate tissue concentrations (mg/kg dry weight) calculated based on regression models, where ln([tissue]) = B0 + B1(ln[soil]). Slopes (B1) and intercepts (B0) are as follows:

Chemical	BO	B1	Data Source for Model
Copper	1.67	0.26	Sample et al. (1998a)
Lead	-0.21	0.81	Sample et al. (1998a)
Zinc	4.44	0.33	Sample et al. (1998a)

(c) USEPA (2007) suggests using a diet-to-beef model presented in Baes et al. (1984), where $BAF_{\text{soil-to-beef}} = BAF_{\text{soil-to-diet (plant)}}$ x 50 (cattle food intake) x 0.001 (diet-to-biota factor)

(d) Small mammal tissue concentrations (mg/kg dry weight) calculated based on regression models, where ln([tissue]) = B0 + B1(ln[soil]). Slopes (B1) and intercepts (B0) are as follows:

Chemical	BO	B1	Data Source for Model
Copper	2.042	0.1444	Sample et al. (1998b)
Lead	0.0761	0.4422	Sample et al. (1998b)
Zinc	4.3632	0.0706	Sample et al. (1998b)

References:

Baes, C.F., R. Sharp, A. Sjoreen and R. Shor. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. Prepared by ORNL for U.S. Dept. of Energy. 150 pp.

Bechtel Jacobs Company LLC. 1998. Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants. Bechtel Jacobs Company LLC, Oak Ridge, TN. BJC/OR-133

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, G.W. Suter, II, and T.L. Ashwood. 1998a. Development and Validation of Bioaccumulation Models for Earthworms. Oak Ridge National Laboratory, Oak Ridge TN. 93 pp. ES/ER/TM-220.

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, and G.W. Suter, II. 1998b. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory, Oak Ridge TN. 89 pp. ES/ER/TM-219.

U.S. Environmental Protection Agency (USEPA). 2007. Guidance for Developing Ecological Soil Screening Levels. Office of Solid Waste and Emergency Response, Washington, D.C. November. OSWER Directive 92857-55.

Table 4
Soil Bioaccumulation Factors and Estimated Concentrations in Prey Items (Soil Pile DU)
Screening Level Ecological Risk Assessment
Ridgway Training Range, Pennsylvania

Analyte	log K_{ow}	Maximum Soil Exposure Point Concentration (mg/kg, dry weight)	Estimated Concentrations in Dietary Items of Terrestrial Receptors (mg/kg, dry weight)								
			Terrestrial Plants			Soil Invertebrates			Small Mammals		
			Bioaccumulation Factor (BAF)	Estimated Concentration	BAF Reference	Bioaccumulation Factor (BAF)	Estimated Concentration	BAF Reference	Bioaccumulation Factor (BAF)	Estimated Concentration	BAF Reference
Metals											
Antimony	N/A	58.5	Regression[a]	1.79	USEPA (2007)	1	58.5	USEPA (2007)	Modeling[c]	0.09	USEPA (2007)
Copper	N/A	1740	Regression[a]	35.9	Bechtel-Jacobs (1998)	Regression[b]	37.0	Sample et al. (1998a)	Regression[d]	22.6	Sample et al. (1998b)
Lead	N/A	8980	Regression[a]	43.3	Bechtel-Jacobs (1998)	Regression[b]	1291	Sample et al. (1998a)	Regression[d]	60.4	Sample et al. (1998b)
Zinc	N/A	314	Regression[a]	121.5	Bechtel-Jacobs (1998)	Regression[b]	565	Sample et al. (1998a)	Regression[d]	117.8	Sample et al. (1998b)

Notes:

kg = kilogram; K_{ow} = n-octanol/water partitioning coefficient; log = base-10; mg = milligram

(a) Plant tissue concentrations (mg/kg dry weight) calculated based on regression models, where ln([tissue]) = B0 + B1(ln[soil]). Slopes (B1) and intercepts (B0) are as follows:

Chemical	BO	B1	Data Source for Model
Antimony	-3.233	0.937	USEPA (2007)
Copper	0.67	0.39	Bechtel-Jacobs (1998)
Lead	-1.33	0.56	Bechtel-Jacobs (1998)
Zinc	1.58	0.56	Bechtel-Jacobs (1998)

(b) Soil invertebrate tissue concentrations (mg/kg dry weight) calculated based on regression models, where ln([tissue]) = B0 + B1(ln[soil]). Slopes (B1) and intercepts (B0) are as follows:

Chemical	BO	B1	Data Source for Model
Copper	1.67	0.26	Sample et al. (1998a)
Lead	-0.21	0.81	Sample et al. (1998a)
Zinc	4.44	0.33	Sample et al. (1998a)

(c) USEPA (2007) suggests using a diet-to-beef model presented in Baes et al. (1984), where $BAF_{\text{soil-to-beef}} = BAF_{\text{soil-to-diet (plant)}}$ x 50 (cattle food intake) x 0.001 (diet-to-biota factor)

(d) Small mammal tissue concentrations (mg/kg dry weight) calculated based on regression models, where ln([tissue]) = B0 + B1(ln[soil]). Slopes (B1) and intercepts (B0) are as follows:

Chemical	BO	B1	Data Source for Model
Copper	2.042	0.1444	Sample et al. (1998b)
Lead	0.0761	0.4422	Sample et al. (1998b)
Zinc	4.3632	0.0706	Sample et al. (1998b)

References:

Baes, C.F., R. Sharp, A. Sjoreen and R. Shor. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. Prepared by ORNL for U.S. Dept. of Energy. 150 pp.

Bechtel Jacobs Company LLC. 1998. Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants. Bechtel Jacobs Company LLC, Oak Ridge, TN. BJC/OR-133

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, G.W. Suter, II, and T.L. Ashwood. 1998a. Development and Validation of Bioaccumulation Models for Earthworms. Oak Ridge National Laboratory, Oak Ridge TN. 93 pp. ES/ER/TM-220.

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, and G.W. Suter, II. 1998b. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory, Oak Ridge TN. 89 pp. ES/ER/TM-219.

U.S. Environmental Protection Agency (USEPA). 2007. Guidance for Developing Ecological Soil Screening Levels. Office of Solid Waste and Emergency Response, Washington, D.C. November. OSWER Directive 92857-55.

Table 5
Biota Sediment Accumulation Factors and Estimated Concentrations in Prey Items (Site-Wide)
Screening Level Ecological Risk Assessment
Ridgway Training Range, Pennsylvania

Analyte	log K_{ow}	Maximum Sediment Concentration (mg/kg, dry weight)	Normalized BSAF (kg 0C/kg lipid)	Estimated Concentrations in Dietary Items of Aquatic Receptors (mg/kg, dry weight)		
				Aquatic Life Stage Benthic Invertebrates		
				Site-Specific BSAF	Estimated Concentration	BSAF Reference
Metals						
Copper	N/A	79.7	N/A	95% UPL	132	Bechtel-Jacobs (1998)[a]
Lead	N/A	358	N/A	0.066	23.6	Bechtel-Jacobs (1998)[b]

Notes:

BSAF = biota sediment accumulation factor; kg = kilogram; K_{ow} = n-octanol/water partitioning coefficient; log = base-10; mg = milligram

N/A = log K_{ow} and normalized BSAF were not available/applicable for metals

(a) 95% upper prediction limit (UPL) of regressions calculated by Bechtel-Jacobs (1998); calculated according to Appendix A in Bechtel-Jacobs (1998)

(b) Median BSAF for non-depurated invertebrates determined by Bechtel-Jacobs (1998)

References:

Bechtel Jacobs Company LLC. 1998. Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation. Bechtel Jacobs Company LLC, Oak Ridge, TN. BJC/OR-112

Table 6
Toxicity Reference Values
Screening Level Ecological Risk Assessment
Ridgway Training Range, Pennsylvania

Analyte	Avian Receptors				Mammalian Receptors			
	Chronic NOAEL (mg/kg-bw/d)	Source	Chronic LOAEL (mg/kg-bw/d)	Source	Chronic NOAEL (mg/kg-bw/d)	Source	Chronic LOAEL (mg/kg-bw/d)	Source
Metals								
Antimony	N/A	USEPA Eco-SSL; Insufficient data to derive a TRV	N/A	--	0.059	USEPA Eco-SSL; Highest bounded NOAEL lower than the lowest bounded LOAEL	13.3	USEPA Eco-SSL; Geometric Mean (NOAEL)
Copper	4.05	USEPA Eco-SSL; Highest bounded NOAEL lower than the lowest bounded LOAEL	18.5	USEPA Eco-SSL; Geometric Mean (NOAEL)	5.60	USEPA Eco-SSL; Highest bounded NOAEL lower than the lowest bounded LOAEL	25.0	USEPA Eco-SSL; Geometric Mean (NOAEL)
Lead	1.63	USEPA Eco-SSL; Highest bounded NOAEL lower than the lowest bounded LOAEL	44.6	USEPA Eco-SSL; Geometric Mean (NOAEL)	4.7	USEPA Eco-SSL; Highest bounded NOAEL lower than the lowest bounded LOAEL	186.4	USEPA Eco-SSL; Geometric Mean (NOAEL)
Zinc	66.1	USEPA Eco-SSL; Geometric Mean (NOAEL)	N/A	--	75.4	USEPA Eco-SSL; Geometric Mean (NOAEL)	N/A	--

Notes:

-- Appropriate data are not available from published literature to derive NOAEL and LOAEL values.

bw/d = body weight per day; kg = kilogram; LOAEL = Lowest Observable Adverse Effect Level; mg = milligram; NOAEL = No Observable Adverse Effect Level; TRV = toxicity reference value

References:

USEPA Eco-SSLs available at https://www.epa.gov/risk/ecological-soil-screening-level-eco-ssl-guidance-and-documents

Table 7
Dose Rate Model Output (Target Berm DU)
Screening Level Ecological Risk Assessment
Ridgway Training Range, Pennsylvania

Analyte	Maximum Soil Exposure Point Concentration (mg/kg, dry weight)	Short-tailed Shrew (mg/kg bw-day)						TRV (mg/kg bw-dw)			
		Diet				Substrate	Total Dose[c]	TRV$_{NOAEL}$	HQ$_{NOAEL}$	TRV$_{LOAEL}$	HQ$_{LOAEL}$
		Plant Material	Invertebrates	Small Mammals	Dose$_{diet}$[a]	Dose$_{substrate}$[b]					
Metals											
Antimony	40.1	0	5.37	0	5.37	0.161	5.54	0.059	**94**	13.3	<1
Copper	636	0	3.81	0	3.81	2.56	6.37	5.6	**1**	25	<1
Lead	8770	0	170	0	170	35.3	205	4.7	**44**	186.4	**1**
Zinc	165	0	61.3	0	61.3	0.663	61.9	75.4	<1	N/A	--

Analyte	Maximum Soil Exposure Point Concentration (mg/kg, dry weight)	American Robin (mg/kg bw-day)						TRV (mg/kg bw-dw)			
		Diet				Substrate	Total Dose[c]	TRV$_{NOAEL}$	HQ$_{NOAEL}$	TRV$_{LOAEL}$	HQ$_{LOAEL}$
		Plant Material	Invertebrates	Small Mammals	Dose$_{diet}$[a]	Dose$_{substrate}$[b]					
Metals											
Antimony	40.1	0	6.01	0	6.01	0.625	6.64	N/A	--	N/A	--
Copper	636	0	4.27	0	4.27	9.92	14.2	4.05	**4**	18.5	<1
Lead	8770	0	190	0	190	137	327	1.63	**200**	44.6	**7**
Zinc	165	0	68.5	0	68.5	2.57	71.1	66.1	**1**	N/A	--

Notes:

bw/d = body weight per day; kg = kilogram; LOAEL = Lowest Observable Adverse Effect Level; mg = milligram; NOAEL = No Observable Adverse Effect Level; TRV = toxicity reference value

(a) Dietary dose calculated as:

$$EDD_{diet} = \frac{IR_{diet} \times \sum(BAF \times C_{soil} \times DF_i) \times AUF}{BW}$$

(b) Substrate dose calculated as:

$$EDD_{substrate} = \frac{IR_{substrate} \times C_{substrate} \times AUF}{BW}$$

(c) Total dose calculated as:

$$EDD_{total} = EDD_{diet} + EDD_{substrate}$$

Where:

EDDdiet = Dose of COPC obtained from the diet (mg COPC/kg receptor body weight-day)
IRdiet = Ingestion rate of food (kg food ingested per day, dry weight)
BAF = Bioaccumulation factor (BAF) specific to prey type and COPC (kg substrate/kg food, dry weight)
Csoil = COPC concentration in soil (mg COPC/kg soil, dry weight)
DFi = Dietary fraction of food item i
AUF = Area use factor accounts for receptor home range
BW = Body weight of the receptor, wet weight
EDDsubstrate = Dose of COPC obtained from substrate (mg COPC/kg receptor body weight-day)
IRsubstrate = Incidental Ingestion rate of substrate (kg substrate ingested per day, dry weight)
Csubstrate = COPC concentration in substrate (mg COPC/kg substrate, dry weight)

Table 8
Dose Rate Model Output (Soil Pile DU)
Screening Level Ecological Risk Assessment
Ridgway Training Range, Pennsylvania

Analyte	Maximum Soil Exposure Point Concentration (mg/kg, dry weight)	Short-tailed Shrew (mg/kg bw-day)						TRV (mg/kg bw-dw)			
		Diet				Substrate	Total Dose^{c}	TRV$_{NOAEL}$	HQ$_{NOAEL}$	TRV$_{LOAEL}$	HQ$_{LOAEL}$
		Plant Material	Invertebrates	Small Mammals	Dose$_{diet}^{a}$	Dose$_{substrate}^{b}$					
Metals											
Antimony	58.5	0	7.84	0	7.84	0.235	8.07	0.059	**137**	13.3	<1
Copper	1740	0	4.95	0	4.95	7.00	11.9	5.6	**2**	25	<1
Lead	8980	0	173	0	173	36.1	209	4.7	**44**	186.4	**1**
Zinc	314	0	75.8	0	75.8	1.26	77.0	75.4	**1**	N/A	--

Analyte	Maximum Soil Exposure Point Concentration (mg/kg, dry weight)	American Robin (mg/kg bw-day)						TRV (mg/kg bw-dw)			
		Diet				Substrate	Total Dose^{c}	TRV$_{NOAEL}$	HQ$_{NOAEL}$	TRV$_{LOAEL}$	HQ$_{LOAEL}$
		Plant Material	Invertebrates	Small Mammals	Dose$_{diet}^{a}$	Dose$_{substrate}^{b}$					
Metals											
Antimony	58.5	0	8.77	0	8.77	0.912	9.68	N/A	--	N/A	--
Copper	1740	0	5.54	0	5.54	27.1	32.7	4.05	**8**	18.5	**2**
Lead	8980	0	194	0	194	140	334	1.63	**205**	44.6	**7**
Zinc	314	0	84.7	0	84.7	4.90	89.6	66.1	**1**	N/A	--

Notes:

bw/d = body weight per day; kg = kilogram; LOAEL = Lowest Observable Adverse Effect Level; mg = milligram; NOAEL = No Observable Adverse Effect Level; TRV = toxicity reference value

(a) Dietary dose calculated as:

$$EDD_{diet} = \frac{IR_{diet} \times \sum(BAF \times C_{soil} \times DF_{i}) \times AUF}{BW}$$

(b) Substrate dose calculated as:

$$EDD_{substrate} = \frac{IR_{substrate} \times C_{substrate} \times AUF}{BW}$$

(c) Total dose calculated as:

$$EDD_{total} = EDD_{diet} + EDD_{substrate}$$

Where:

EDDdiet = Dose of COPC obtained from the diet (mg COPC/kg receptor body weight-day)
IRdiet = Ingestion rate of food (kg food ingested per day, dry weight)
BAF = Bioaccumulation factor (BAF) specific to prey type and COPC (kg substrate/kg food, dry weight)
Csoil = COPC concentration in soil (mg COPC/kg soil, dry weight)
DFi = Dietary fraction of food item i
AUF = Area use factor accounts for receptor home range
BW = Body weight of the receptor, wet weight
EDDsubstrate = Dose of COPC obtained from substrate (mg COPC/kg receptor body weight-day)
IRsubstrate = Incidental Ingestion rate of substrate (kg substrate ingested per day, dry weight)
Csubstrate = COPC concentration in substrate (mg COPC/kg substrate, dry weight)

Table 9
Dose Rate Model Output (Site-Wide Soil)
Screening Level Ecological Risk Assessment
Ridgway Training Range, Pennsylvania

Analyte	Maximum Soil Exposure Point Concentration (mg/kg, dry weight)$^{(1)}$	Red Fox (mg/kg bw-day)						TRV (mg/kg bw-dw)			
		Diet				Substrate	Total Dose^{c}	TRV$_{NOAEL}$	HQ$_{NOAEL}$	TRV$_{LOAEL}$	HQ$_{LOAEL}$
		Plant Material	Invertebrates	Small Mammals	Dose$_{diet}$^{a}	Dose$_{substrate}$^{b}					
Metals											
Antimony	58.5	0	0	0.003	0.003	0.062	0.065	0.059	**1**	13.3	<1
Copper	1740	0	0	0.857	0.857	1.84	2.70	5.6	<1	25	<1
Lead	8980	0	0	2.29	2.29	9.52	11.8	4.7	**3**	186.4	<1
Zinc	314	0	0	4.46	4.46	0.333	4.79	75.4	<1	N/A	--

Analyte	Maximum Soil Exposure Point Concentration (mg/kg, dry weight)$^{(1)}$	Red-tailed Hawk (mg/kg bw-day)						TRV (mg/kg bw-dw)			
		Diet				Substrate	Total Dose^{c}	TRV$_{NOAEL}$	HQ$_{NOAEL}$	TRV$_{LOAEL}$	HQ$_{LOAEL}$
		Plant Material	Invertebrates	Small Mammals	Dose$_{diet}$^{a}	Dose$_{substrate}$^{b}					
Metals											
Antimony	58.5	0	0	0.007	0.007	0.265	0.272	N/A	--	N/A	--
Copper	1740	0	0	1.80	1.80	7.88	9.68	4.05	**2**	18.5	<1
Lead	8980	0	0	4.80	4.80	40.7	45.5	1.63	**28**	44.6	**1**
Zinc	314	0	0	9.36	9.36	1.42	10.8	66.1	<1	N/A	--

Notes:

(1) Site-Wide exposure point concentrations represent the maximum concentration encountered at the Site.

bw/d = body weight per day; kg = kilogram; LOAEL = Lowest Observable Adverse Effect Level; mg = milligram; NOAEL = No Observable Adverse Effect Level; TRV = toxicity reference value

(a) Dietary dose calculated as:

$$EDD_{diet} = \frac{IR_{diet} \times \sum(BAF \times C_{soil} \times DF_i) \times AUF}{BW}$$

(b) Substrate dose calculated as:

$$EDD_{substrate} = \frac{IR_{substrate} \times C_{substrate} \times AUF}{BW}$$

(c) Total dose calculated as:

$$EDD_{total} = EDD_{diet} + EDD_{substrate}$$

Where:

EDDdiet = Dose of COPC obtained from the diet (mg COPC/kg receptor body weight-day)
IRdiet = Ingestion rate of food (kg food ingested per day, dry weight)
BAF = Bioaccumulation factor (BAF) specific to prey type and COPC (kg substrate/kg food, dry weight)
Csoil = COPC concentration in soil (mg COPC/kg soil, dry weight)
DFi = Dietary fraction of food item i
AUF = Area use factor accounts for receptor home range
BW = Body weight of the receptor, wet weight
EDDsubstrate = Dose of COPC obtained from substrate (mg COPC/kg receptor body weight-day)
IRsubstrate = Incidental Ingestion rate of substrate (kg substrate ingested per day, dry weight)
Csubstrate = COPC concentration in substrate (mg COPC/kg substrate, dry weight)

Table 10
Dose Rate Model Output (Site-Wide Sediment)
Screening Level Ecological Risk Assessment
Ridgway Training Range, Pennsylvania

Analyte	Maximum Sediment Exposure Point Concentration (mg/kg, dry weight)$^{(1)}$	Little brown bat (mg/kg bw-day)					TRV (mg/kg bw-day)			
		Diet			Substrate	Total Dose^{c}	TRV_{NOAEL}	HQ_{NOAEL}	TRV_{LOAEL}	HQ_{LOAEL}
		Invertebrates	Fish	$Dose_{diet}$^{a}	$Dose_{substrate}$^{b}					
Metals										
Copper	79.7	22.9	0	22.9	0	22.9	5.6	**4**	25	<1
Lead	358	4.11	0	4.11	0	4.11	4.7	<1	186.4	<1

Notes:

(1) Site-Wide exposure point concentrations represent the maximum concentration encountered at the Site.

bw/d = body weight per day; kg = kilogram; LOAEL = Lowest Observable Adverse Effect Level; mg = milligram; NOAEL = No Observable Adverse Effect Level; TRV = toxicity reference value

(a) Dietary dose calculated as:

$$ADD_{diet} = \frac{IR_{diet} \times \sum(B[S]AF \times C_{substrate} \times DF_i) \times AUF}{BW}$$

(b) Substrate dose calculated as:

$$ADD_{substrate} = \frac{IR_{substrate} \times C_{substrate} \times AUF}{BW}$$

(c) Total dose calculated as:

$$ADD_{total} = ADD_{diet} + ADD_{water} + ADD_{substrate}$$

Where:

ADD_{diet} = Dose of COPC obtained from the diet (mg COPC/kg receptor body weight-day)

IR_{diet} = Ingestion rate of food (kg food ingested per day, dry weight)

B(S)AF = Bioaccumulation factor (BAF) or biota-sediment accumulation factor (BSAF), specific to prey type and COPC (kg substrate/kg food, dry weight)

DF_i = Dietary fraction of food item *i*

AUF = Area use factor accounts for receptor home range

BW = Body weight of the receptor, wet weight

$ADD_{substrate}$ = Dose of COPC obtained from substrate (mg COPC/kg receptor body weight-day)

$IR_{substrate}$ = Incidental Ingestion rate of substrate (kg substrate ingested per day, dry weight)

$C_{substrate}$ = COPC concentration in substrate (mg COPC/kg substrate, dry weight)

Table 11
Biota Sediment Accumulation Factors and Refined Estimated Concentrations in Prey Items (Site-Wide)
Screening Level Ecological Risk Assessment
Ridgway Training Range, Pennsylvania

Analyte	log K_{ow}	95% UCL Sediment Concentration (mg/kg, dry weight)	Normalized BSAF (kg 0C/kg lipid)	Estimated Concentrations in Dietary Items of Aquatic Receptors (mg/kg, dry weight)		
				Aquatic Life Stage Benthic Invertebrates		
				Site-Specific BSAF	Estimated Concentration	BSAF Reference
Metals						
Copper	N/A	36.56	N/A	95% UPL	106	Bechtel-Jacobs (1998)[a]

Notes:

Red text indicates a Step 3 refinement

BSAF = biota sediment accumulation factor; kg = kilogram; K_{ow} = n-octanol/water partitioning coefficient; log = base-10; mg = milligram; 95% UCL = 95 Percent Upper Confidence Limit

N/A = log K_{ow} and normalized BSAF were not available/applicable for metals

(a) 95% upper prediction limit (UPL) of regressions calculated by Bechtel-Jacobs (1998); calculated according to Appendix A in Bechtel-Jacobs (1998)

References:

Bechtel Jacobs Company LLC. 1998. Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation. Bechtel Jacobs Company LLC, Oak Ridge, TN. BJC/OR-112

Table 12
Refined Toxicity Reference Values
Screening Level Ecological Risk Assessment
Ridgway Training Range, Pennsylvania

Analyte	Avian Receptors				Mammalian Receptors			
	Chronic NOAEL (mg/kg-bw/d)	Source	Chronic LOAEL (mg/kg-bw/d)	Source	Chronic NOAEL (mg/kg-bw/d)	Source	Chronic LOAEL (mg/kg-bw/d)	Source
Metals								
Copper	4.05	USEPA Eco-SSL; Highest bounded NOAEL lower than the lowest bounded LOAEL	18.5	USEPA Eco-SSL; Geometric Mean (NOAEL)	25	USEPA Eco-SSL; Geometric Mean (NOAEL)	None Selected	N/A

Notes:

-- Appropriate data are not available from published literature to derive NOAEL and LOAEL values.

Red text indicates a Step 3 refinement

bw/d = body weight per day; kg = kilogram; LOAEL = Lowest Observable Adverse Effect Level; mg = milligram; NOAEL = No Observable Adverse Effect Level; TRV = toxicity reference value

References:

USEPA Eco-SSLs available at https://www.epa.gov/risk/ecological-soil-screening-level-eco-ssl-guidance-and-documents

Table 13
Refined Dose Rate Model Output (Site-Wide Sediment)
Screening Level Ecological Risk Assessment
Ridgway Training Range, Pennsylvania

Analyte	95% UCL Sediment Exposure Point Concentration (mg/kg, dry weight)(1)	Little brown bat (mg/kg bw-day)					TRV (mg/kg bw-day)			
		Diet			Substrate	Total Dose[c]	TRV_{NOAEL}	HQ_{NOAEL}	TRV_{LOAEL}	HQ_{LOAEL}
		Invertebrates	Fish	$Dose_{diet}$[a]	$Dose_{substrate}$[b]					
Metals										
Copper	36.56	18.5	0	18.5	0	18.5	25	<1	None Selected	--

Notes:

Red text indicates a Step 3 refinement

bw/d = body weight per day; kg = kilogram; LOAEL = Lowest Observable Adverse Effect Level; mg = milligram; NOAEL = No Observable Adverse Effect Level; TRV = toxicity reference value; 95% UCL = 95 Percent Upper Confidence Limit

(a) Dietary dose calculated as:

$$ADD_{diet} = \frac{IR_{diet} \times \sum(B[S]AF \times C_{substrate} \times DF_i) \times AUF}{BW}$$

(b) Substrate dose calculated as:

$$ADD_{substrate} = \frac{IR_{substrate} \times C_{substrate} \times AUF}{BW}$$

(c) Total dose calculated as:

$$ADD_{total} = ADD_{diet} + ADD_{water} + ADD_{substrate}$$

Where:

ADD_{diet} = Dose of COPC obtained from the diet (mg COPC/kg receptor body weight-day)

IR_{diet} = Ingestion rate of food (kg food ingested per day, dry weight)

B(S)AF = Bioaccumulation factor (BAF) or biota-sediment accumulation factor (BSAF), specific to prey type and COPC (kg substrate/kg food, dry weight)

DF_i = Dietary fraction of food item *i*

AUF = Area use factor accounts for receptor home range

BW = Body weight of the receptor, wet weight

$ADD_{substrate}$ = Dose of COPC obtained from substrate (mg COPC/kg receptor body weight-day)

$IR_{substrate}$ = Incidental Ingestion rate of substrate (kg substrate ingested per day, dry weight)

$C_{substrate}$ = COPC concentration in substrate (mg COPC/kg substrate, dry weight)

Attachment E

ProUCL Output

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.110/31/2018 11:08:29 AM
From File	SLERA_Ridgway_ProUCL_Input.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Conc (copper (sed, mg/kg))

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	0
Minimum	6.63	Mean	26.64
Maximum	79.7	Median	21
SD	19.13	Std. Error of Mean	5.522
Coefficient of Variation	0.718	Skewness	2.116

Normal GOF Test

Shapiro Wilk Test Statistic	0.789	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.233	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.243	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	36.56	95% Adjusted-CLT UCL (Chen-1995)	39.33
		95% Modified-t UCL (Johnson-1978)	37.12

Gamma GOF Test

A-D Test Statistic	0.32	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.147	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.248	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.773	k star (bias corrected MLE)	2.135
Theta hat (MLE)	9.61	Theta star (bias corrected MLE)	12.48
nu hat (MLE)	66.54	nu star (bias corrected)	51.24
MLE Mean (bias corrected)	26.64	MLE Sd (bias corrected)	18.24
		Approximate Chi Square Value (0.05)	35.8
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	33.84

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	38.13	95% Adjusted Gamma UCL (use when n<50)	40.34

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.110/31/2018 11:08:29 AM
From File	SLERA_Ridgway_ProUCL_Input.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.125	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.892	Mean of logged Data	3.092
Maximum of Logged Data	4.378	SD of logged Data	0.638

Assuming Lognormal Distribution

95% H-UCL	42.21	90% Chebyshev (MVUE) UCL	41.62
95% Chebyshev (MVUE) UCL	48.49	97.5% Chebyshev (MVUE) UCL	58.02
99% Chebyshev (MVUE) UCL	76.74		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	35.73	95% Jackknife UCL	36.56
95% Standard Bootstrap UCL	35.39	95% Bootstrap-t UCL	44.42
95% Hall's Bootstrap UCL	78.06	95% Percentile Bootstrap UCL	35.68
95% BCA Bootstrap UCL	39.3		
90% Chebyshev(Mean, Sd) UCL	43.21	95% Chebyshev(Mean, Sd) UCL	50.71
97.5% Chebyshev(Mean, Sd) UCL	61.13	99% Chebyshev(Mean, Sd) UCL	81.59

Suggested UCL to Use

95% Student's-t UCL	36.56

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.110/31/2018 11:08:29 AM
From File	SLERA_Ridgway_ProUCL_Input.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Conc (lead (sed, mg/kg))

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	15.8	Mean	122.8
Maximum	358	Median	106
SD	98.38	Std. Error of Mean	27.29
Coefficient of Variation	0.801	Skewness	1.206

Normal GOF Test

Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.187	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	171.4	95% Adjusted-CLT UCL (Chen-1995)	177.4
		95% Modified-t UCL (Johnson-1978)	172.9

Gamma GOF Test

A-D Test Statistic	0.146	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0943	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.241	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.577	k star (bias corrected MLE)	1.264
Theta hat (MLE)	77.83	Theta star (bias corrected MLE)	97.08
nu hat (MLE)	41.01	nu star (bias corrected)	32.88
MLE Mean (bias corrected)	122.8	MLE Sd (bias corrected)	109.2
		Approximate Chi Square Value (0.05)	20.77
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	19.41

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	194.3	95% Adjusted Gamma UCL (use when n<50)	208

UCL Statistics for Data Sets with Non-Detects

```
                    User Selected Options
           Date/Time of Computation   ProUCL 5.110/31/2018 11:08:29 AM
                          From File   SLERA_Ridgway_ProUCL_Input.xls
                     Full Precision   OFF
             Confidence Coefficient   95%
    Number of Bootstrap Operations    2000

                                        Lognormal GOF Test
               Shapiro Wilk Test Statistic   0.953          Shapiro Wilk Lognormal GOF Test
           5% Shapiro Wilk Critical Value    0.866     Data appear Lognormal at 5% Significance Level
                 Lilliefors Test Statistic   0.123           Lilliefors Lognormal GOF Test
             5% Lilliefors Critical Value    0.234     Data appear Lognormal at 5% Significance Level
                              Data appear Lognormal at 5% Significance Level

                                        Lognormal Statistics
                  Minimum of Logged Data     2.76                            Mean of logged Data   4.461
                  Maximum of Logged Data     5.881                             SD of logged Data   0.951

                                   Assuming Lognormal Distribution
                             95% H-UCL   290.6                       90% Chebyshev (MVUE) UCL   240.2
              95% Chebyshev (MVUE) UCL   290.1                     97.5% Chebyshev (MVUE) UCL   359.4
              99% Chebyshev (MVUE) UCL   495.6

                               Nonparametric Distribution Free UCL Statistics
                       Data appear to follow a Discernible Distribution at 5% Significance Level

                                  Nonparametric Distribution Free UCLs
                           95% CLT UCL   167.6                                95% Jackknife UCL   171.4
             95% Standard Bootstrap UCL  167.1                              95% Bootstrap-t UCL   188.7
                95% Hall's Bootstrap UCL 196.8                     95% Percentile Bootstrap UCL   167.9
                  95% BCA Bootstrap UCL  175.2
           90% Chebyshev(Mean, Sd) UCL   204.6                    95% Chebyshev(Mean, Sd) UCL   241.7
         97.5% Chebyshev(Mean, Sd) UCL   293.2                    99% Chebyshev(Mean, Sd) UCL   394.2

                                          Suggested UCL to Use
                     95% Student's-t UCL   171.4

        Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
                                Recommendations are based upon data size, data distribution, and skewness.
           These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
      However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.
```

Appendix G:

Munitions Response Site Prioritization Protocol Tables

Table A

MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: Ridgway Training Range (PAE40-001-R-01)

Component: Army National Guard Directorate

Installation/Property Name: JFHQ Pennsylvania

Location (City, County, State): Ridgway Township, Elk County, Pennsylvania

Site Name/Project Name (Project No.): Ridgway Training Range Remedial Investigation

Date Information Entered/Updated: 11 October 2018

Point of Contact (Name/Phone): Dave Connolly (ARNG), (703)607-7589

Project Phase (check only one):

☐ PA	☐ SI	☑ RI	☐ FS	☐ RD
☐ RA-C	☐ RIP	☐ RA-O	☐ RC	☐ LTM

Media Evaluated (check all that apply):

☐ Groundwater	☑ Sediment (human receptor)
☑ Surface soil	☐ Surface Water (ecological receptor)
☑ Sediment (ecological receptor)	☐ Surface Water (human receptor)

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM, or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

*The NDNODS Ridgway Training Range MRS is a 0.22-acre site used by the PAARNG for live-fire weapons training from 1987 to 2005. Weapons training was conducted within the enclosed 25 Meter Outdoor Baffle M-16 Rifle Range. Support structures on the range included a block target storage building, a downrange backstop, and a shelter building over the 12 firing positions protecting the soldiers from the weather. The firing points were recessed into the ground surface via culvert type material. Wooden covers enclosed the firing positions. The range configuration consisted of 12-foot high concrete side and impact walls (original construction). Documentation specifying the exact munitions used was not found; however, based on range type, timeframe of range use, and location, AECOM surmised that the following munitions were fired: .22 caliber, .38 caliber, .45 caliber, .50 caliber, 9 millimeter (mm), 5.56mm, and 7.62mm. (*continued next page)

Transfer of the property to a private owner was completed in 2015. To improve drainage in front of the target berm at the MRS, the landowner installed a French drain parallel to the berm. Soil excavated during construction of the berm is stored in a pile within the MRS walls.

Description of Pathways for Human and Ecological Receptors:

MC within soil at the MRS is anticipated to remain at the Target Berm, Firing Point, Soil Pile, and French Drain Outfall and not be transported off site. Exposure pathways between MC and receptors are restricted to source areas, which is potentially the soil at the Target Berm, the Firing Point, and the Soil Pile, and sediment at the French Drain Outfall. Particulates from the berm are being transported, via the French drain, to the ponded area (French Drain Outfall) to the north of the MRS. Since the drain discharges to a ponded area, it is expected that particulates settle in the small detention pond and receptors are only potentially exposed to sediment in this area. A drainage ditch south of the MRS abuts the southern end of the Target Berm which extends beyond the southern MRS wall, and there is potential for runoff to enter the drainage ditch; however, sample data indicates that MC are not being transported throughout the drainage ditch. The drainage ditch is intermittently inundated, but potentially confluences with a wetland in the southeast portion of the MRS when flowing. The MRS walls prevent soil particles from the Target berm within the MRS walls from being transported off-site to the east. Evidence of erosion is present on the center of the Target Berm, but the MRS walls prevent soil particles from the center of the Target Berm from being transported off-site to the east. MC deposited in the Soil Pile have limited potential to migrate due to the pile's location within the MRS walls.

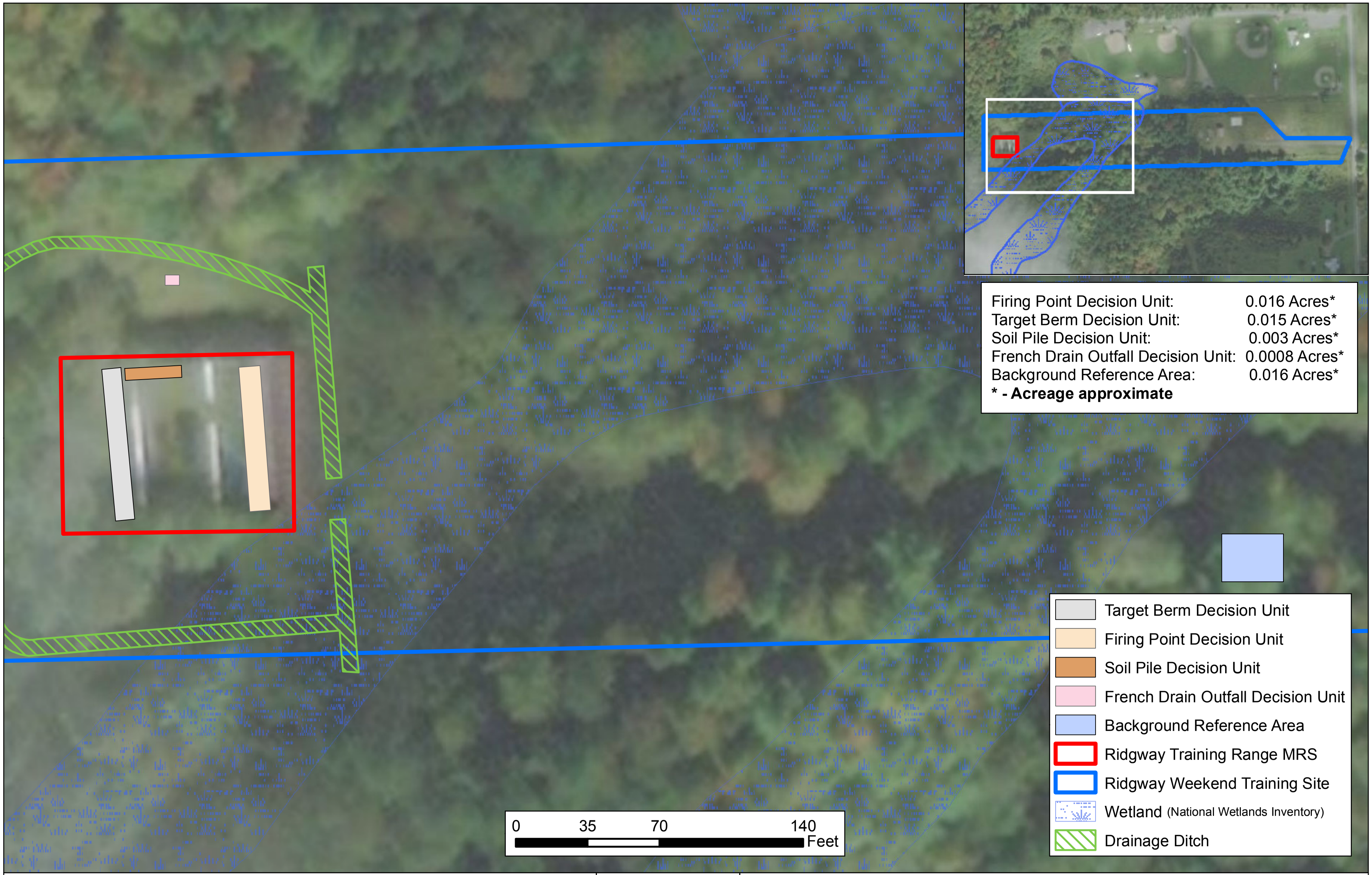
Antimony, copper, lead, and zinc have a strong affinity to sorb to soil particles, particularly soils that are rich in organic matter, and usually only migrate via physical transport pathways. Because of these chemical properties, they typically do not leach to groundwater except where shallow groundwater exists less than 5 feet below ground surface (bgs). According to the 2011 Environmental Baseline Survey, existing boring logs from wells in the area show depths to bedrock varying from 10 to 33 feet (see Cross Section A-A′ of ***Figure 10-1*** *of the UFP-QAPP [AECOM, 2017]). Therefore, groundwater pathways are incomplete for the Ridgway Training Range MRS. Because explosives (e.g. nitroglycerin) are organic compounds, they also are subject to biological or chemical degradation over time, which results in these compounds being less persistent in the environment than MC metals.*

MC may be transported to the ponded area where the French drain daylights and the drainage ditch south of the MRS. Exposure pathways between MC and receptors are restricted to source areas, which are the Target Berm, Firing Point, and Soil Pile, as well as the French Drain Outfall and the drainage ditch south of the MRS.

Description of Receptors (Human and Ecological):

*The area surrounding the MRS is predominantly rural; the properties surrounding the MRS include agricultural, mining, residential, and recreational land (****Figure 2-1*** *of the RI Report). A community baseball/athletic is north of the property. The property is privately owned, and the property is used as a staging area by a landscaping company. Future use is planned to be the same. Access to the MRS is mostly restricted via a locked gate, so the public does not have access to the site. Potential human receptors include the landowner and visitors or workers (e.g., construction, commercial/industrial) that the landowner allows on site. As there is no restriction on the land, there is potential that the site could be used for residential purposes in the future.*

There is no federally designated critical habitat located within the site; however, habitat supporting ecological receptors is present within the MRS. A portion of a wetland is present within the MRS that could provide habitat for aquatic species, and some preferential habitat quality exists in the areas surrounding the MRS. Although no federally designated critical habitat is located within the MRS, Pennsylvania State-endangered species have the potential to exist at or in the vicinity of the MRS. Many of these species will not be found on or near the MRS; a list of species and their preferred habitat is listed in Table 2-1 of the RI report to help determine the likelihood of each species being present.



Firing Point Decision Unit:	0.016 Acres*
Target Berm Decision Unit:	0.015 Acres*
Soil Pile Decision Unit:	0.003 Acres*
French Drain Outfall Decision Unit:	0.0008 Acres*
Background Reference Area:	0.016 Acres*

*** - Acreage approximate**

CLIENT	Army National Guard			
PROJECT	Remedial Investigation through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	11/8/2018
SCALE	1:840	CHK BY	AS	11/8/2018
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	11/8/2018

N

TITLE

Ridgway Training Range MRS RI Approach

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure ES-1

Q:\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 6 SARs\900-Work\GIS\Ridgway\1_MXD\RI\Fig_3-1_Ridgway_RI_Approach.mxd

Table 1

EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms *practice munitions, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	• UXO that are considered most likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). • Hand grenades containing energetic filler. • Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30

High explosive (used or damaged)	• UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive."
	• DMM containing a high-explosive filler that have:
	  • Been damaged by burning or detonation
	  • Deteriorated to the point of instability.
		25

Pyrotechnic (used or damaged)	• UXO containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades).
	• DMM containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades) that have:
	  • Been damaged by burning or detonation
	  • Deteriorated to the point of instability.
		20

High explosive (unused)	• DMM containing a high-explosive filler that:
	  • Have not been damaged by burning or detonation
	  • Are not deteriorated to the point of instability.
		15

Propellant	• UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor).
	• DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are:
	  • Damaged by burning or detonation
	  • Deteriorated to the point of instability.
		15

Bulk secondary high explosives, pyrotechnics, or propellant	• DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). • DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	10

Pyrotechnic (not used or damaged)	• DMM containing a pyrotechnic filler (i.e., red phosphorus), other than white phosphorus filler, that:
	  • Have not been damaged by burning or detonation
	  • Are not deteriorated to the point of instability.
		10

Practice	• UXO that are practice munitions that are not associated with a sensitive fuze.
	• DMM that are practice munitions that are not associated with a sensitive fuze and that have not:
	  • Been damaged by burning or detonation
	  • Deteriorated to the point of instability.
		5

Riot control	• UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	• Used munitions or DMM that are categorized as small arms ammunition. (Physical evidence or historical evidence that no other types of munitions [e.g., grenades, subcaliber training rockets, demolition charges] were used or are present on the MRS is required for selection of this category.)	[✓ **2**]
Evidence of no munitions	• Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
MUNITIONS TYPE	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	2

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided.

The 2012 SI report reported there was no evidence of MEC at this MRS (RI report, Section 2.2.2). During the RI, no evidence of MEC was observed at this site; a 5.56mm caliber bullet was observed during RI field work on the ground surface at the Firing Point; no evidence of munitions was observed at the Target Berm, Soil Pile, or French drain area.

Table 2

EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the scores that correspond with **all** the sources of explosive hazards known or suspected to be present at the MRS.

Note: The terms *former range, practice munitions, small arms range, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Former range	- The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include impact or target areas and associated buffer and safety zones.	10
Former munitions treatment (i.e., OB/OD) unit	- The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	- The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	6
Former maneuver area	- The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	- The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	5
Former industrial operating facilities	- The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	- The MRS is a firing point, where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	- The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	- The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	2
Former small arms range	- The MRS is a former military range where only small arms ammunition was used. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present to place an MRS into this category.)	[✓ **1**]
Evidence of no munitions	- Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

During the RI, no evidence of MEC was observed at this MRS a 5.56mm caliber bullet was observed during RI field work on the ground surface at the Firing Point; no evidence of munitions was observed at the Target Berm, Soil Pile, or French drain area.

Table 3

EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the scores that correspond with **all** the locations where munitions are known or suspected to be present at the MRS.

Note: The terms *confirmed, surface, subsurface, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	• Physical evidence indicates that there are UXO or DMM on the surface of the MRS. • Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report that an incident or accident that involved UXO or DMM occurred) indicates there are UXO or DMM on the surface of the MRS.	25
Confirmed subsurface, active	• Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. • Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	20
Confirmed subsurface, stable	• Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. • Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	15
Suspected (physical evidence)	• There is physical evidence (e.g., munitions debris such as fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	10
Suspected (historical evidence)	• There is historical evidence indicating that UXO or DMM may be present at the MRS.	5
Subsurface, physical constraint	• There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	2
Small arms (regardless of location)	• The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present at the MRS to place an MRS into this category.)	**1**
Evidence of no munitions	• Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of Munitions*** classifications in the space provided.

During the RI, no evidence of MEC was observed at this site; a 5.56mm caliber bullet was observed during RI field work on the ground surface at the Firing Point (RI report, Section 5.3); no evidence of munitions was observed at the Target Berm, Soil Pile, or French drain area. Analytical results from the RI showed elevated levels of small arms metals MC in the Target Berm, Soil Pile, and French Drain soil and sediment compared to background and elevated levels of nitroglycerin in the Firing Point soil compared to background (RI report, Section 5).

Table 4

EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	- There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	- There is a barrier preventing access to parts of the MRS, but not the entire MRS.	8
Barrier to MRS access is complete but not monitored	- There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	**5**
Barrier to MRS access is complete and monitored	- There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

Access to the MRS is restricted via a locked gate (RI report, Section 2.3).

Table 5

EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	• The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies. • The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	**5**
Scheduled for transfer from DoD control	• The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	• The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

The MRS is a NDNODS Site that contains one parcel of land. The MRS is entirely privately owned by Steve Lawrie (RI report, Section 2.2).

Table 6

EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.

Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	• There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	• There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	3
< 100 persons per square mile	• There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	[✓ **1**]
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

The MRS is a small 0.22-acre tract of land that is surrounded by predominantly rural areas. According to the 2010 US Census for Pennsylvania, the Ridgway Township has a population density of 29.0 per square mile.

Table 7

EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	• There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	**5**
16 to 25 inhabited structures	• There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	• There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	• There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	• There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	• There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

The MRS is a small 0.22-acre tract of uninhabited land that is comprised of that does not contain any habitable structures. More than 26 inhabited structures are located within a two-mile radius of the MRS.

Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	**5**
Parks and recreational areas	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	4
Agricultural, forestry	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	• There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

The MRS is currently used for the staging of landscaping equipment. Land uses of properties surrounding the site include recreational, agricultural, residential, and mining. Located on the site's northern boundary is a community baseball/athletic field (RI Report, Section 2.1).

Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	• There are both ecological and cultural resources present on the MRS.	5
Ecological resources present	• There are ecological resources present on the MRS.	3
Cultural resources present	• There are cultural resources present on the MRS.	[✓ **3**]
No ecological or cultural resources present	• There are no ecological resources or cultural resources present on the MRS.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

There are no known cultural resources located within the MRS. There are no documented occurrences of federally listed threatened and endangered species or federally-designated critical habitat on the MRS. A portion of a wetland is located within the MRS, providing habitat for aquatic species (RI Report, Section 2.1; RI Report ***Figure 2-1****).*

Table 10

Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	2	**3**
Source of Hazard	Table 2	1	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	1	**11**
Ease of Access	Table 4	5	
Status of Property	Table 5	5	
Receptor Factor Data Elements			
Population Density	Table 6	1	**14**
Population Near Hazard	Table 7	5	
Types of Activities/Structures	Table 8	5	
Ecological and/or Cultural Resources	Table 9	3	
EHE MODULE TOTAL			**28**

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	**G**
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	**No Known or Suspected Explosive Hazard**

As small arms are the only munitions known to have been used on the MRS, small arms do not present a unique explosive hazard [Army Guidance SAIE (ESOH) Memorandum February 2009], therefore the MRS does not present a unique explosive hazard. Accordingly, the EHE module has been rated “No Known or Suspected Explosive Hazard”.

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond with **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS are: • CWM that are UXO (i.e., CWM/UXO) • Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	• The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	• The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS are: • Non-explosively configured CWM/DMM either damaged or undamaged • Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	• The CWM/DMM known or suspected of being present at the MRS are CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	12
CAIS (chemical agent identification sets)	• CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	10
Evidence of no CWM	• Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	<u>**0**</u>
CWM CONFIGURATION	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

The 2012 SI and Historical Records Review determined that there was no evidence of MEC or CWM at the MRS (RI report, Section 2.4).

Tables 12 through 19 are Intentionally Omitted According to Army Guidance

Table 20

Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	0	0
Sources of CWM	Table 12	0	
Accessibility Factor Data Elements			
Location of CWM	Table 13	0	0
Ease of Access	Table 14	0	
Status of Property	Table 15	0	
Receptor Factor Data Elements			
Population Density	Table 16	0	0
Population Near Hazard	Table 17	0	
Types of Activities/Structures	Table 18	0	
Ecological and/or Cultural Resources	Table 19	0	
CHE MODULE TOTAL			**0**

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	**No Known or Suspected CWM Hazard**

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's groundwater and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional groundwater contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
Media Not Evaluated			

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		

$$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$$

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the groundwater is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in groundwater has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the groundwater to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater receptors at the MRS.

Classification	Description	Value
Identified	There is a threatened water supply well downgradient of the source and the groundwater is a current source of drinking water or source of water for other beneficial uses such as irrigation/agriculture (equivalent to Class I or IIA aquifer).	H
Potential	There is no threatened water supply well downgradient of the source and the groundwater is currently or potentially usable for drinking water, irrigation, or agriculture (equivalent to Class I, IIA, or IIB aquifer).	M
Limited	There is no potentially threatened water supply well downgradient of the source and the groundwater is not considered a potential source of drinking water and is of limited beneficial use (equivalent to Class IIIA or IIIB aquifer, or where perched aquifer exists only).	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Groundwater MC Hazard ☐

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
Media Not Evaluated			

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)		
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

$$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$$

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L

MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L

RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Human Endpoint) MC Hazard ☐

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Antimony	0.966	880	0.00109
Copper	79.7	81000	0.00098
Lead	358	5000	0.0716
Zinc	74.9	660000	0.00011
CHF Scale	**CHF Value**	**Sum The Ratios**	0.0826
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		

$$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$$

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right maximum value = H).	L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	**M**

No Known or Suspected Sediment (Human Endpoint) MC Hazard ☑

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
Media Not Evaluated			

CHF Scale	CHF Value	Sum the Ratios	
CHF > 100	H (High)		
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

$$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$$

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L

MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L

RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Ecological Endpoint) MC Hazard ☐

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

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Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Antimony	0.966	2	0.483
Copper	79.7	31.6	2.522
Lead	358	35.8	10
Zinc	74.9	121	0.619
CHF Scale	**CHF Value**	**Sum the Ratios**	13.624
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		

$$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$$

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	**M**

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	**H**

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	**M**

No Known or Suspected Sediment (Ecological Endpoint) MC Hazard ☐

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface soil contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
Antimony	1080	3.1	348.38
Copper	2060	310	6.64
Lead	57200	400	143
Zinc	443	2,300	0.19
Nitroglycerin	4.4	0.63	6.98

CHF Scale	**CHF Value**	**Sum the Ratios**	505.19
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	**H**

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface soil is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface soil has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	**M**
Confined	Information indicates a low potential for contaminant migration from the source via the surface soil to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	**M**

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface soil to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface soil to which contamination has moved or can move.	**M**
Limited	Little or no potential for receptors to have access to surface soil to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	**M**

No Known or Suspected Surface Soil MC Hazard ☐

Tables 27 is Intentionally Omitted
According to Army Guidance

Table 28

Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard**, **Migration Pathway**, and **Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the **HHE Ratings** provided below, determine each media's rating (A–G) and record the letter in the corresponding **Media Rating** box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)					
Surface Water/Human Endpoint (Table 22)					
Sediment/Human Endpoint (Table 23)	L	L	M	L-L-M	F
Surface Water/Ecological Endpoint (Table 24)					
Sediment/Ecological Endpoint (Table 25)	M	H	M	M-H-M	C
Surface Soil (Table 26)	H	M	M	H-M-M	C

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the **HHE Module Rating** box.

Note:

An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING **C**

HHE Ratings (for reference only)

Combination	Rating
HHH	A
HHM	B
HHL	**C**
HMM	
HML	D
MMM	
HLL	E
MML	
MLL	F
LLL	G

Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected MC Hazard

Table 29

MRS Priority

DIRECTIONS: In the chart below, circle the letter **rating** for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical **priority** for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the **MRS Priority or Alternative MRS Rating** at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	**C**	**4**
D	5	E	5	D	5
E	6	F	6	E	6
F	7	G	7	F	7
G	**8**			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		**No Known or Suspected CWM Hazard**		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				**4**	