AECOM

Final
Remedial Investigation Report
Williston Local Training Area
Munitions Response Site, North Dakota

Munitions Response Site NDHQ-008-R-01

Army National Guard

Contract No. W9133L-14-D-0001
Delivery Order No. 0008

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Prepared for:
Army National Guard
NGB-AQ-W9133L
111 South George Mason Drive
Building 2, 4th Floor
Arlington, VA 22204-1373

Prepared by:
AECOM
12420 Milestone Center Drive
Suite 150
Germantown
MD, 20876
USA

T: +1 (301) 820 3000
F: +1 (301) 820 3009
aecom.com

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Acronyms and Abbreviations

AECOM	AECOM Technical Services, Inc.
ARNG	Army National Guard
asl	above sea level
bgs	below ground surface
CD	Compact Disc
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CHE	Chemical Warfare Materiel Hazard Evaluation
CHF	Contamination Hazard Factor
CSM	conceptual site model
Cu	copper
CWM	Chemical Warfare Materiel
DoD	Department of Defense
DU	decision unit
DQCR	daily quality control report
EA	EA Engineering, Science, and Technology
EHE	Explosive Hazard Evaluation
ERT	Earth Resources Technology, Inc.
FS	Feasibility Study
H	high
HHE	Health Hazard Evaluation
IS	incremental sample(s)
ISM	incremental sampling methodology
ITRC	Interstate Technology and Regulatory Council
J	represents data flagged as an estimate
L	low
LCS	laboratory control spike
LOD	limit of detection
LOQ	limit of quantitation
LTA	Local Training Area
M	medium
MC	munitions constituents
MEC	munitions and explosives of concern
mg/kg	milligram per kilogram
MMRP	military munitions response program
MPF	Migration Pathway Factor
MRS	munitions response site
MRSPP	Munitions Response Site Prioritization Protocol
MS	matrix spike
MSD	matrix spike duplicates
NDARNG	North Dakota Army National Guard

NOAA	National Oceanic and Atmospheric Association
ORAP	Operational Range Assessment Program
PA	Preliminary Assessment
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
Pb	lead
ppm	parts per million
QA	quality assurance
QC	quality control
RF	Receptor Factor
RI	Remedial Investigation
RPD	relative percent difference
RSD	relative standard deviation
Sb	antimony
SOP	Standard Operating Procedure
TCLP	toxicity characteristic leaching procedure
U	represents a data flag as non-detect
UFP-QAPP	Unified Federal Policy - Quality Assurance Project Plan
U.S.	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
XRF	X-ray fluorescence
Zn	zinc

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 Williston Local Training Area (LTA) Munitions Response Site (MRS) located in Williston, North Dakota, identified by Army Environmental Database Restoration Number NDHQ-008-R-01. AECOM Technical Services, Inc. (AECOM) performed the RI under Army National Guard (ARNG) Contract Number W9133L-14-D-0001, Delivery Order No. 0008. 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). Based on the results of this RI, discussed in detail below, the MRS has been sufficiently characterized and no unacceptable risks were found. No Action is recommended for the entirety of the MRS.

Williston LTA MRS was a former small arms range on property leased from the U.S. Army Corps of Engineers (USACE) in 1959 by the North Dakota Army National Guard (NDARNG) for use as a training area. The firing range was operational between 1960 and 2002 and was used for small arms qualification and instructional firing purposes. The 0.52-acre MRS is located in the southwest corner of the 344.5-acre Williston LTA. Within the MRS is the former firing point of a 25-meter zero range, a target berm, a “duck pond” behind the berm, and the down-range floor area of the natural backstop hills. Prior to construction of the berm, the surrounding hills were used as a backstop to targets used during training. Targets were reportedly set up in the northern end of the coulee. Firing occurred towards the north, away from Lake Sakakawea, from 12 firing points into the target berm and hillside backstop.

Environmental data were needed to identify the presence, nature, and extent of small arms metals MC in soil at the Williston LTA MRS, evaluate whether MCs are present at concentrations that could pose a potential risk to receptors, and guide further management decisions as to whether remedial action is required. Per the preliminary conceptual site model in the Final RI Work Plan/Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP; AECOM, 2018), 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, natural backstop area, and constructed pond) beyond the Williston LTA MRS boundary. Due to MRS topography and range orientation, stormwater runoff from significant rain events is unlikely to transport suspended soil particles off site (UFP-QAPP; AECOM, 2018). No sensitive ecological habitats (i.e., wetlands) are present within the MRS, but native and non-native grassland, forbs, and marsh area habitats occur within the Williston LTA. Additionally, no federally or State listed species are known to occupy the MRS. Due to the steeply sloping and rugged topography of the MRS, its remote location within a coulee formation, and scrub brush vegetation present, the habitat at the Williston LTA MRS is considered to be generally poor. These conditions make the habitat at the Williston LTA MRS not suitable for ecological receptors to inhabit the area on a full-time basis. Based on this analysis of habitat and the absence of sensitive ecological species, it is unlikely there is an elevated exposure risk to ecological receptors at the MRS. The exposure pathways are considered incomplete for ecological receptors.

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 Williston LTA. The sampling approach was designed to characterize the nature and extent of MC contamination in the Williston LTA MRS firing range area. For data interpretation purposes and for assessing risks, the MRS was divided into three decision units (DUs) – Target Berm, Backstop Area, and Constructed Pond – that reflect the three areas of potential contamination as indicated by site history and remaining physical evidence (**Figure ES-1**). Each DU encompasses the entirety of the range feature being investigated; DUs extend beyond the MRS boundary in order to capture the actual dimensions of the range features potentially affected by range activities. Sampling was not conducted on the surrounding hillsides of the coulee due to safety concerns related to the steepness of the slopes. Field investigation activities included X-Ray fluorescence (XRF) screening of the Target Berm and Backstop Area to evaluate the lateral extent of MC (lead is of particular interest) and the collection of surface soil samples using incremental sampling methodology (ISM) to determine a representative exposure point concentration for evaluating risks. XRF was not conducted on the Constructed Pond, as it was believed the soil would be too moist for reliable results. 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 not collected at the Target Berm or Backstop Area, as no shallow soil XRF values exceeded the human health screening criteria for lead. Subsurface samples were, however, taken at random locations within the Constructed Pond to determine the vertical extent of the MC. The discrete samples taken at the Constructed Pond were analyzed for both metals and explosives MC, as a one-time use of 6 to 8 cratering charges (approximately 300 to 400 pounds of explosives) were used to construct the pond.

The data collected at the MRS were sufficient to delineate the extent of site-related MC contamination. No step-out sampling was necessary to extend the DU boundaries. XRF data showed that metals MC are not migrating from source locations at the Target Berm or Backstop Area DUs (**Figure ES-2** and **ES-3**). Two locations for discrete subsurface soil sampling (locations #11 and #22) were randomly selected at the Constructed Pond, as XRF was not useable to determine surface MC concentrations due to high soil moisture. Discrete subsurface sampling at both locations indicated that metals MC at the Constructed Pond are below their risk-based screening levels at the 12 to 18 inches below ground surface (bgs) depth interval, so further analysis was not needed for the 24 to 30-inch bgs interval (**Figure ES-4**). Because no laboratory analysis of ISM samples from any DU showed lead above the human health screening criteria, no respective discrete contingency samples were analyzed for solid waste characterization parameters (toxicity characteristic leaching procedure).

ISM provided high quality data that are an unbiased estimate of the mean concentration of MC in the Target Berm, Backstop, and Constructed Pond soil and are suitable for risk screening. Incremental Samples collected from the Backstop Area and Constructed Pond DUs showed only slightly elevated concentrations of small arms metals MC compared to background (**Table ES-1** and **Figure ES-5**). At the Target Berm, MC metals were notably higher than background

CLIENT	Army National Guard				
PROJECT	RI through DD for Williston LTA, ND MRS				
REVISION NO	0	GIS BY	MS	2/1/2019	
SCALE	1:1,080	CHK BY	JW	2/1/2019	
SOURCE	ARNG; State of North Dakota, ESRI & Partners	PM	LS	2/1/2019	

N

Remedial Investigation Decision Units

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ARMY NATIONAL GUARD

Figure ES-1

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CLIENT	Army National Guard			
PROJECT	RI through DD for Williston LTA, ND MRS			
REVISION NO	0	GIS BY	MS	12/13/2018
SCALE	1:300	CHK BY	JL	12/13/2018
SOURCE	ARNG; State of North Dakota, ESRI & Partners	PM	LS	12/13/2018

Target Berm XRF Results

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Figure ES-2

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CLIENT	Army National Guard				
PROJECT	RI through DD for Williston LTA, ND MRS				
REVISION NO	0	GIS BY	MS	12/13/2018	
SCALE	1:480	CHK BY	JL	12/13/2018	
SOURCE ARNG; State of North Dakota, ESRI & Partners		PM	LS	12/13/2018	

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Backstop Area XRF Results

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Figure ES-3

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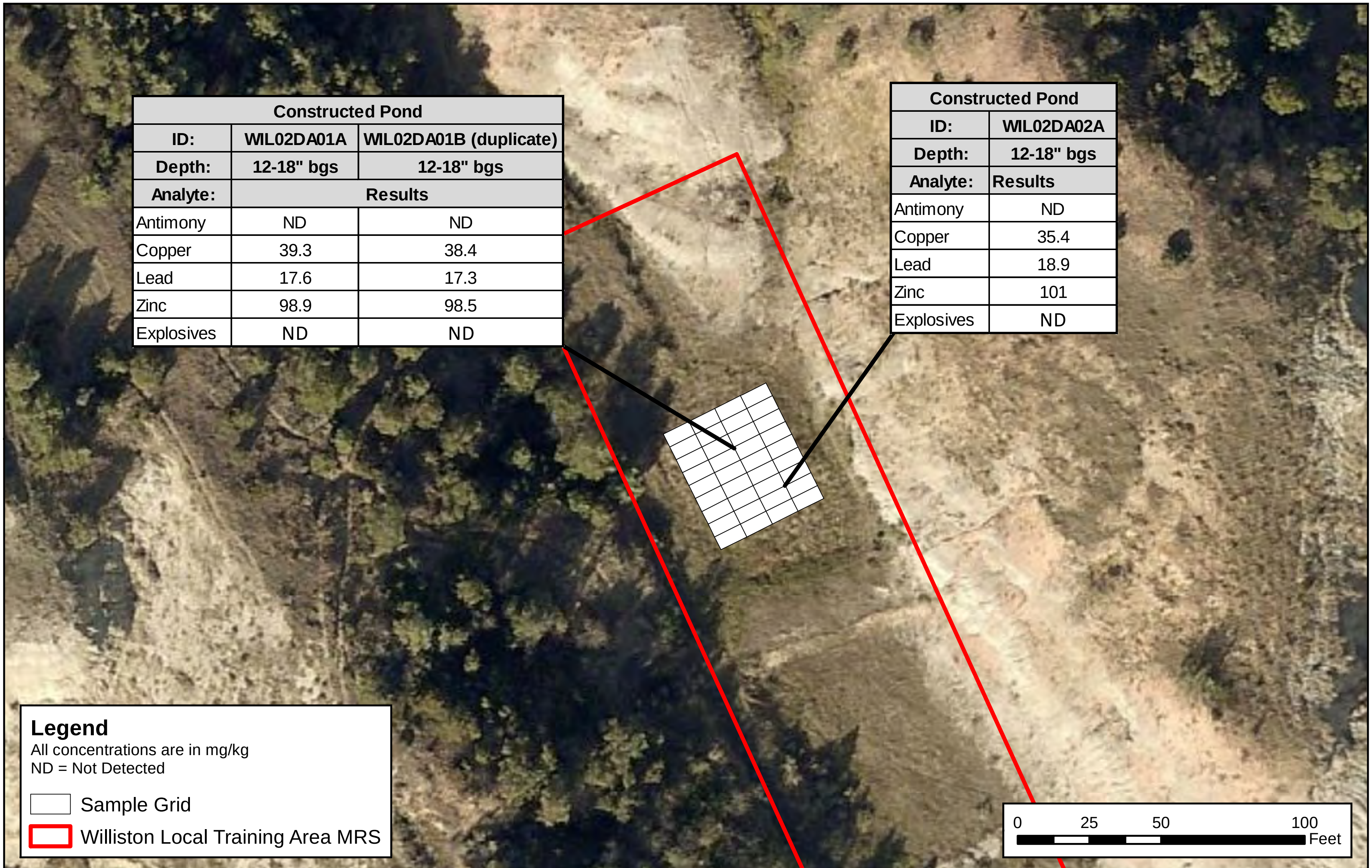

Constructed Pond		
ID:	WIL02DA01A	WIL02DA01B (duplicate)
Depth:	12-18" bgs	12-18" bgs
Analyte:	Results	
Antimony	ND	ND
Copper	39.3	38.4
Lead	17.6	17.3
Zinc	98.9	98.5
Explosives	ND	ND

Constructed Pond	
ID:	WIL02DA02A
Depth:	12-18" bgs
Analyte:	Results
Antimony	ND
Copper	35.4
Lead	18.9
Zinc	101
Explosives	ND

CLIENT	Army National Guard			
PROJECT	RI through DD for Williston LTA, ND MRS			
REVISION NO	0	GIS BY	MS	12/20/2018
SCALE	1:600	CHK BY	JL	12/20/2018
SOURCE	ARNG; State of North Dakota, ESRI & Partners	PM	LS	12/20/2018

Discrete Subsurface Soil 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:		WIL04IS01				WIL04IS02				WIL04IS03			
Sample Depth (inches bgs):		0-6				0-6				0-6			
Date Collected:		8/15/2018				8/15/2018				8/15/2018			
Analyte	**Human Health Screening Level**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020B (mg/kg)													
Antimony	31	0.379	U	UJ	m	0.387	U	UJ	m	0.386	U	UJ	m
Copper	310	14.9		J+	m	14.4		J+	m	15.4		J+	m
Lead	400	7.11				6.66				7.26			
Zinc	2,300	56.4				51.1				56.5			

Location:		Target Berm											
Sample ID:		WIL01IS01				WIL01IS02				WIL01IS03			
Sample Depth (inches bgs):		0-6				0-6				0-6			
Date Collected:		8/14/2018				8/14/2018				8/14/2018			
Analyte	**Human Health Screening Level**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020B (mg/kg)													
Antimony	31	0.422	U	UJ	m	0.427	U	UJ	m	0.383	U	UJ	m
Copper	3,100	23.8				21		J+	m	24.3			
Lead	400	46.5				63.5				69.1			
Zinc	2,300	67.3				61.2				64.5			

Location:		Backstop Area											
Sample ID:		WIL03IS01				WIL03IS02				WIL03IS03			
Sample Depth (inches bgs):		0-6				0-6				0-6			
Date Collected:		8/14/2018				8/14/2018				8/14/2018			
Analyte	**Human Health Screening Level**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020B (mg/kg)													
Antimony	31	0.417	U	UJ	m	0.423	U	UJ	m	0.564	U	UJ	m
Copper	3,100	27.3				23.1				35.7			
Lead	400	14.7				14.3				22.7			
Zinc	23,000	72.9				66.9				81.7			

Notes:

Sample exceeds Human Health Screening Level

bgs = below ground surface
LQ = Laboratory Qualifier
VQ = Validation Qualifier
RC = Reason Code

U = Non-Detect
J+ = Estimated, positive bias
m = MS/MSD percent recovery anomaly
UJ = analyte was not detected at level ≥ DL
UQ = Non-detect, associated non-compliant QC result

Table ES-1. Incremental Sampling Results Summary (cont.)

	Location:	Constructed Pond DU											
	Sample ID:	WIL02IS01				WIL02IS02				WIL02IS03			
	Sample Depth (inches bgs):	0-6				0-6				0-6			
	Date Collected:	8/16/2018				8/16/2018				8/16/2018			
Analyte	**Human Health Screening Level**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020B (mg/kg)													
Antimony	31	0.469	U	UJ	m	0.453	U	UJ	m	0.468	U	UJ	m
Copper	3,100	38.4				33.9				35.6			
Lead	400	15.9				15.1				15.7			
Zinc	23,000	88.5				77.4				81.4			
Explosives by USEPA SW-846 Method 8330B													
1,3,5-Trinitrobenzene	220	0.099	U			0.0952	U			0.1	U		
1,3-Dinitrobenzene	63	0.099	U			0.0952	U			0.1	U		
2,4,6-Trinitrotoluene	3.6	0.099	U			0.0952	U			0.1	U		
2,4-Dinitrotoluene	13	0.099	U			0.0952	U			0.1	U		
2,6-Dinitrotoluene	1.9	0.099	U			0.0952	U			0.1	U		
2-Amino-4,6-dinitrotoluene	15	0.099	U			0.0952	U			0.1	U		
2-Nitrotoluene	7	0.099	U			0.0952	U			0.1	U		
3,5-Dinitroaniline	NA	0.099	U			0.0952	U			0.1	U		
3-Nitrotoluene	63	0.149	U			0.143	U			0.15	U		
4-Amino-2,6-dinitrotoluene	15	0.099	U			0.0952	U			0.1	U		
4-Nitrotoluene	25	0.099	UQ			0.0952	UQ			0.1	UQ		
HMX	390	0.099	U			0.0952	U			0.1	U		
Nitrobenzene	13	0.099	U			0.0952	U			0.1	U		
Nitroglycerin	63	0.099	U			0.0952	U			0.1	U		
PETN	13	0.149	U			0.143	U			0.15	U		
RDX	23	0.099	U			0.0952	U			0.1	U		
Tetryl	16	0.099	U			0.0952	U			0.1	U		

Notes:

Sample exceeds Human Health Screening Level

bgs = below ground surface

LQ = Laboratory Qualifier

VQ = Validation Qualifier

RC = Reason Code

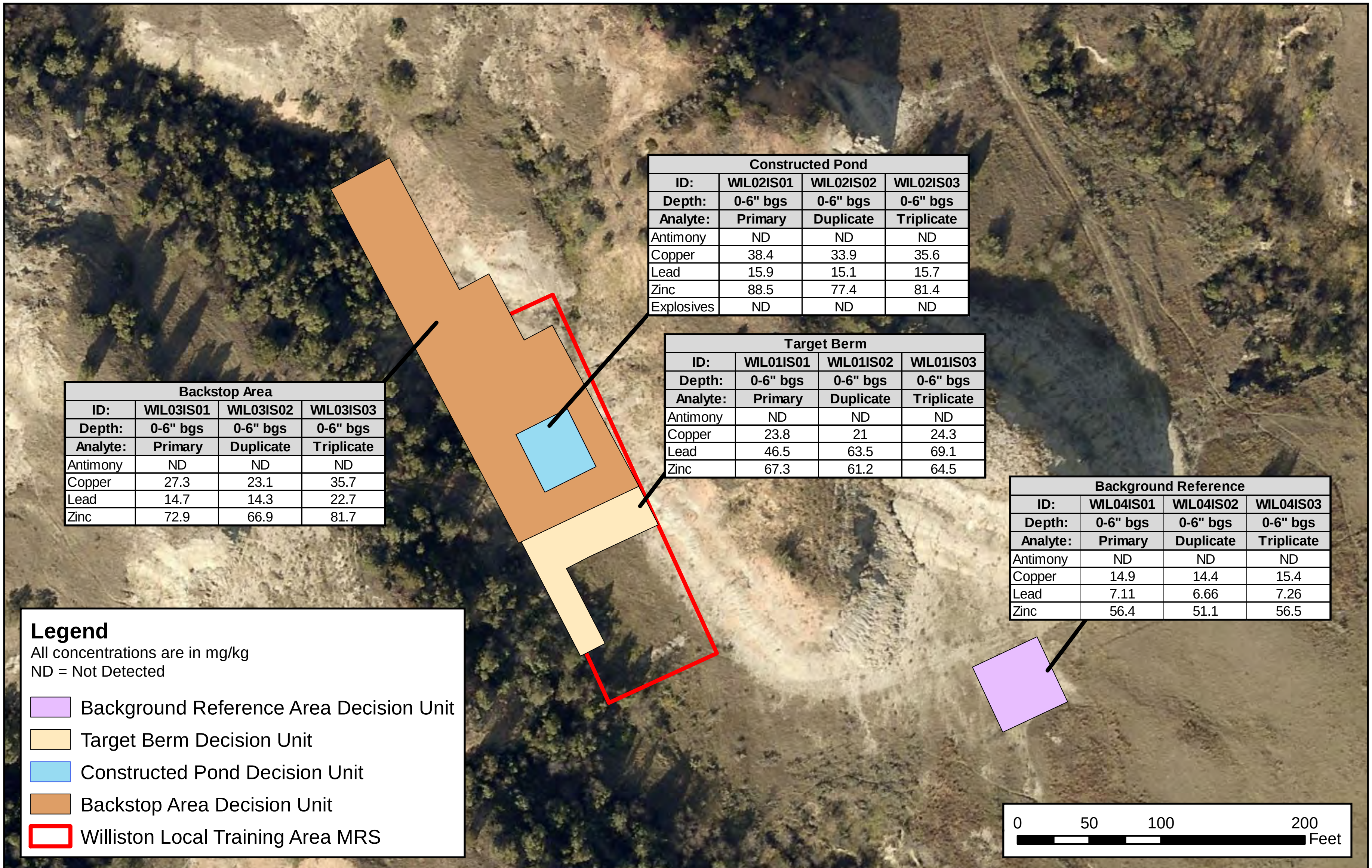
U = Non-Detect

J+ = Estimated, positive bias

m = MS/MSD percent recovery anomaly

UJ = analyte was not detected at level ≥ DL

UQ = Non-detect, associated non-compliant QC result



Constructed Pond			
ID:	**WIL02IS01**	**WIL02IS02**	**WIL02IS03**
Depth:	**0-6" bgs**	**0-6" bgs**	**0-6" bgs**
Analyte:	**Primary**	**Duplicate**	**Triplicate**
Antimony	ND	ND	ND
Copper	38.4	33.9	35.6
Lead	15.9	15.1	15.7
Zinc	88.5	77.4	81.4
Explosives	ND	ND	ND

Target Berm			
ID:	**WIL01IS01**	**WIL01IS02**	**WIL01IS03**
Depth:	**0-6" bgs**	**0-6" bgs**	**0-6" bgs**
Analyte:	**Primary**	**Duplicate**	**Triplicate**
Antimony	ND	ND	ND
Copper	23.8	21	24.3
Lead	46.5	63.5	69.1
Zinc	67.3	61.2	64.5

Backstop Area			
ID:	**WIL03IS01**	**WIL03IS02**	**WIL03IS03**
Depth:	**0-6" bgs**	**0-6" bgs**	**0-6" bgs**
Analyte:	**Primary**	**Duplicate**	**Triplicate**
Antimony	ND	ND	ND
Copper	27.3	23.1	35.7
Lead	14.7	14.3	22.7
Zinc	72.9	66.9	81.7

Background Reference			
ID:	**WIL04IS01**	**WIL04IS02**	**WIL04IS03**
Depth:	**0-6" bgs**	**0-6" bgs**	**0-6" bgs**
Analyte:	**Primary**	**Duplicate**	**Triplicate**
Antimony	ND	ND	ND
Copper	14.9	14.4	15.4
Lead	7.11	6.66	7.26
Zinc	56.4	51.1	56.5

CLIENT	Army National Guard			
PROJECT	RI through DD for Williston LTA, ND MRS			
REVISION NO	0	GIS BY	MS	12/19/2018
SCALE	1:1,200	CHK BY	JL	12/19/2018
SOURCE	ARNG; State of North Dakota, ESRI & Partners	PM	LS	12/19/2018

Incremental Sampling Results

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Figure ES-5

Q:\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 5 SARs\900-Work\GIS\ND_Williston\MXD\RI_Figures\Fig_5-3_Williston_LTA_Incremental_Sampling_Results.mxd levels indicating some effect from historical training on DU soil; however, no analyte exceeded its respective human health criterion. Based on these results, there is no evidence of unacceptable risk to human receptors visiting the Target Berm, Backstop Area, or Constructed Pond.

Based on the results of the RI, the MRS has been sufficiently characterized. Based on the lack of unacceptable risks, an FS is not warranted at the Williston LTA MRS. No Action is recommended for the entirety of the 0.52-acre MRS (**Figure ES-6**). The next step 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.

CLIENT Army National Guard				
PROJECT RI through DD for Williston LTA, ND MRS				
REVISION NO	0	GIS BY	MS	11/12/2018
SCALE	1:960	CHK BY	JL	11/12/2018
SOURCE	ARNG; State of North Dakota, ESRI & Partners	PM	LS	11/12/2018

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Proposed MRS Recommendation

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Figure ES-6

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1 Introduction

This Remedial Investigation (RI) report has been prepared in support of the long-term management of the small arms range that comprises the Williston Local Training Area (LTA) Munitions Response Site (MRS) located in Williston, North Dakota; Army Environmental Database Restoration Number NDHQ-008-R-01 (**Figure 1-1**).

1.1 Project Authorization

Based on the results of sampling conducted during a Preliminary Assessment (PA) performed by the North Dakota Army National Guard (NDARNG) (NDARNG, 2013), the Army National Guard (ARNG) determined a RI should be conducted at the Williston LTA small arms range in North Dakota 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 NDARNG. This project is being executed by AECOM Technical Services, Inc. (AECOM), under ARNG Contract Number W9133L-14-D-0001, Delivery Order No. 0008, issued 29 September 2016. Under this delivery order, AECOM is responsible for fully executing the RI and related tasks at the Williston LTA MRS.

1.2 Project Purpose and Scope

The overall objectives for the RI of Williston LTA MRS were to collect sufficient information to characterize the nature and extent of munitions constituents (MC) in soil resulting from former NDARNG small arms training activities and to evaluate the associated risks to human health and the environment. The MRS was investigated using several sampling techniques to achieve the project objectives that were specified in the Final RI Work Plan prepared for the Williston LTA MRS (AECOM, 2018).

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 a Feasibility Study (FS), and support informed risk management decisions for future remedial decisions.

1.3 Remedial Investigation Report Organization

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

Section 1: Introduction. This section describes the authorization, project purpose and scope, and presents the report organization.

CLIENT	Army National Guard			
PROJECT	RI through DD for Williston LTA, ND MRS			
REVISION NO	0	GIS BY	MS	12/19/2018
SCALE	1:190,080	CHK BY	JL	12/19/2018
SOURCE	ARNG; State of North Dakota, ESRI & Partners	PM	LS	12/19/2018

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Williston Local Training Area MRS Location

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Figure 1-1

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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: MC Risk Screening. Presents the evaluation of the potential for MC to pose a risk to human 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. This section provides the references used to develop this document.

Appendix A: Field Forms

Appendix B: Photographic Record

Appendix C: Data Validation Report (on compact disc [CD])

Appendix D: Laboratory Data Analytical Package (on CD)

Appendix E: MRSPP Tables

2 Munitions Response Site Description

2.1 Location and Setting

The Williston LTA MRS is located in the remote area of Williams County, North Dakota, approximately 21 miles east of the city of Williston, and roughly 630 feet northwest of the northern shore of Lake Sakakawea, a dammed lake along the Missouri River (**Figure 1-1**).

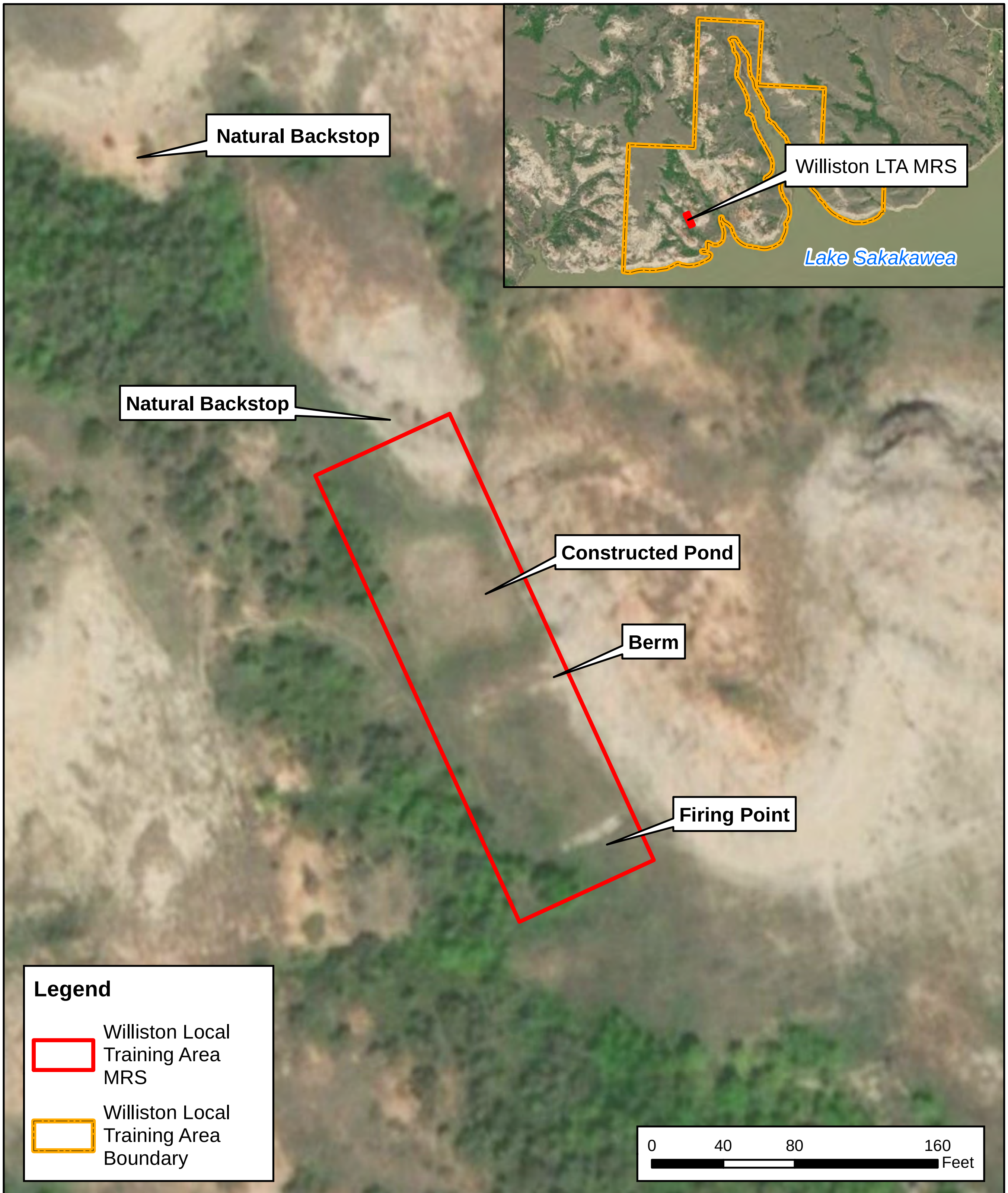
The MRS is a predominantly grassland area containing rugged terrain with mixed grass prairie and woody draws with rolling prairie and badlands topography. The 0.52-acre MRS is located in a coulee within the southwest corner of the larger 344.5-acre former Williston LTA and consists of a 25-meter zero small arms range. In addition to a constructed pond (now dry), range related features that remain at the MRS include a target berm and a natural backstop area that is comprised of the coulee walls (**Figure 2-1**).

2.2 Historical Use

Historical records show that the Williston LTA property is federally owned and administered by the United States (U.S.) Army Corps of Engineers (USACE)-Omaha District and has been co-leased to NDARNG and the Cattle Grazing Association. NDARNG has leased the Williston LTA from the USACE since 1959 for use as a training area. The firing range within the LTA was operational between 1960 and 2002 and was used by the NDARNG for small arms qualification and instructional firing purposes. In approximately 1991, an earthen target berm reinforced with railroad ties was reportedly constructed (EA Engineering, Science, and Technology [EA], 1993). Prior to construction of the berm, the surrounding hills were used as a backstop to targets used during training. The steep hillsides continued to serve as additional backstop following berm construction. Targets were reportedly set up in the northern end of the coulee. Firing occurred towards the north, away from Lake Sakakawea, from 12 firing points into the target berm and hillside backstop (**Figure 2-1**).

Munitions usage data is not available for training activities at the Williston LTA MRS range. However, it is known that training was limited to small-caliber ammunition. Operations reportedly included zero and familiarization fire with M1, M14, and M16 rifles, M9 and M1911 pistols, and M2 (plastic training ammunition), M60, and M249 machine guns (NDARNG, 2012). In 1999 a number of installations replaced traditional bullets with lead-free tungsten composite rounds; however, to the best knowledge of NDARNG range personnel, there has been no use of tungsten-containing munitions at the Williston LTA (Earth Resources Technology, Inc. [ERT], 2008).

Range operations ceased in 2002 and official closure was obtained in 2012 (NDARNG, 2013). According to NDARNG personnel, approximately 5,000 live-fire small arms rounds were used per training event, on an annual basis. Over the 43-year history of the small arms range (1959-2002), it is estimated that 215,000 small arms rounds were expended at the MRS (ERT, 2008). In addition, there was a one-time use of 6 to 8 cratering charges (approximately 300 to 400



CLIENT	Army National Guard			
PROJECT	RI through DD for Williston LTA, ND MRS			
REVISION NO	0	GIS BY	MS	11/12/2018
SCALE	1:960	CHK BY	JL	11/12/2018
SOURCE	ARNG; State of North Dakota, ESRI & Partners	PM	LS	11/12/2018

Williston LTA MRS Layout

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Figure 2-1

Q:\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 5 SARs\900-Work\GIS\ND_Williston\MXD\RI_Figures\Fig_2-1_Williston_LTA_Site_Layout.mxd pounds of explosives) in 1998 to construct a small "duck pond" at USACE's request. All charges were verified to have detonated.

Since range closure, NDARNG has removed all buildings and structures and has terminated electrical hookups associated with the former range. NDARNG has also removed the railroad ties that supported the earthen target berm in 2012 and properly disposed of them following waste characterization (NDARNG, 2013).

2.3 Environmental Setting

The MRS is located within an area of rugged terrain in northwestern North Dakota that is characterized by rolling prairies, woody draws, and badlands. The northern shore of Lake Sakakawea is located approximately 630 feet to the southeast of the Williston LTA MRS. The area is extremely remote, has poorly maintained entrance roads and interior trails, and has restricted access by fence and locked gate; access is possible by boat from Lake Sakakawea. With the exception of a cattle farm located 3.5 miles to the west and Lund's Landing marina and lodge 2 miles to the east, the nearest residence to the MRS is approximately 7 miles away.

2.3.1 Climate

The climate at Williston LTA MRS is classified as sub-humid and continental, with warm summers, occasional droughts, and long, cold winters with low precipitation. The long-term average annual temperature is 44 degrees Fahrenheit (°F) for the Williston, North Dakota area. Summertime (June through August) temperatures range from an average low of 55°F at night to an average high of 83°F during the daytime. Temperatures during the remaining part of the year range from an average low of 5.5°F in December to an average high of 75°F in September (National Oceanic and Atmospheric Association [NOAA], 2017).

The Williston area is characteristically dry; the average annual rainfall total is only 15 inches. June is the rainiest month with an average of 2.6 inches and January the driest with less than one inch on average. The majority of precipitation occurs as snowfall from November through mid-April and as rain from mid-April through October. Winter snowstorms can occur from September through May with the harshest conditions occurring December through March (NOAA, 2017). Tornadoes are associated with thunderstorm conditions and can occur May through September, but most commonly occur in June through August.

The percent relative humidity for the region averages between 59 percent and 80 percent (North Dakota Agricultural Weather Network). The annual wind speed is approximately 8.6 miles per hour (NOAA, 2017). The average mean lake evapotranspiration is approximately 33 inches per year (Shjeflo, 1968).

2.3.2 Geology

Williams County lies within the center of the structural and sedimentary Williston Basin, a glaciated section of the Missouri Plateau of the Great Plains Province. The Williston LTA MRS is underlain by five dominant soil series: Williams-Zahl, Armor Williams-Zahl, Armor-Zahl-Cabba, Bradenburg-Channery, and the Cabba-Badland. These upland soils were glacially derived and developed under the prairie vegetation with permanent grass cover and have slopes typically between 3 and 70 percent and a pH ranging between 7.0 – 7.2 (Natural Resources Conservation Service, 2007). These soils are susceptible to wind erosion if exposed which can be observed around the backstop area and coulee walls.

Glacial drifts underlie the majority of Williams County with the exception of the area surrounding the Missouri River. The glacial deposits underlying Williston LTA are typically a few feet deep and commonly include till, sand, gravel, and a combination of clay and silt. Directly beneath the glacial sediments at Williston LTA lies the Tertiary Butte Formation comprised of alternating beds of somber-colored clays, silts, and sands (Freers, 1970).

Williston LTA is located within the lower tertiary aquifer of the Northern Great Plains aquifer system. It comprises alternating beds of sandstone, siltstone, claystone, and lignite, and can be around 300 feet thick (U.S. Geological Survey, 2007).

2.3.3 Surface Topography

The Williston LTA is situated within the Nesson Valley, primarily characterized by rolling grassland prairies and badlands inundated with inlets and bays (finger draws) that drain directly into Lake Sakakawea. Topographic relief of the training area changes drastically from 2,204 feet above sea level (asl) near the shore to 2,362 feet asl 150-170 feet away from the shore. The remaining portion of the training area experiences further topographic relief (approximately 78 feet) with the maximum elevation achieved in the northeast portion of the range at 2,554 feet asl (Sedivec et al., 2007).

2.3.4 Hydrogeology and Hydrology

Williston LTA MRS is located in the Lake Sakakawea watershed, which is a part of the Missouri River Basin that drains approximately 4,407 miles of streams and rivers. Lake Sakakawea has an approximate maximum storage capacity of 23.8 million acre-feet and a normal surface area of 307,000 acres. Four intermittent drainages have been documented at the LTA (Sedivec et al., 2007); however, aerial imagery and topographic maps identify only a single stream. Roughly ninety percent of the LTA’s surface water is thought to be drained by one of the four documented intermittent drainages, downgradient into Lake Sakakawea. The single identifiable drainage originates north of the LTA boundary and drains to the lake. Approximately one acre of wetlands located along the riparian zone and shoreline of the lake occurs both on and off the leased LTA area. The wetlands extent is directly influenced by the fluctuating water levels of the lake; however, there are no wetland areas that occur within the MRS (U.S. Fish and Wildlife Service [USFWS], 2017a). Approximately four miles east is White Tail Bay, and three miles south is Tobacco Garden Bay, two designated recreational areas collocated within Lake Sakakawea.

Groundwater is assumed to flow south towards Lake Sakakawea from the MRS and is also a source of recharge for the lake. Information pertaining to the depth of groundwater at the former range is limited; however, the water table can be as shallow as one to two feet near the finger draws close to the lake shore. A groundwater well, that has since been decommissioned and abandoned, was formerly located near the south-central area east of the small arms range. When in use, this well was used for non-potable water supply only. Data for this well is scarce, but according to data presented in the 2008 Qualitative Assessment Report (ERT, 2008); groundwater at the MRS is approximately 80 feet below ground surface (bgs). Groundwater use within four miles of the LTA includes: 13 wells used for domestic water sources and nine wells used for irrigation purposes to the east and a single groundwater well used for irrigation purposes to the north of the LTA.

2.3.5 Vegetation and Habitat

The Williston LTA MRS is largely situated within the mixed grass prairie community of North Dakota, which includes upland, midland, lowland, and woody draw vegetation. Typically, these communities are comprised of both native prairie and introduced grasses intermixed with forbs. The rugged terrain and topographic relief also contribute to the type of vegetation found in the area.

Upland prairie vegetation occurs on the hilltops of the training area and generally has a high tolerance for dry conditions. Typical grass-like species found in this community include: western wheatgrass (*Pascopyrumn smithii*), blue grama (*Bouteloua gracilis*), needle-leaf sedge (*Carex duriuscula*), prairie sandreed (*Calamovilfa longifolia*), threadleaf sedge (*Carex filifolia*), and prairie junegrass (*Koeleria macrantha*), plains muhly (*Muhlenbergia cuspidate*), and needle-and-thread (*Hesperostipa comata*). Additionally, various seasonal forbs are found in the area.

Midland prairie vegetation occurs on the hillsides of the training area. Typically, this community is more vegetated than the upland prairie community due to moist soil conditions. In addition to the above referenced grass-like species commonly found in the upland prairie areas, little bluestem (*Shizachyrium scoparium*), porcupine grass (*Hesperostipa curtiseta*), and green needlegrass (*Nasella viridula*) can be found. Various seasonal forbs can also be found in this area.

The lowland prairie community is found near the wetlands areas, the lake, and at the bottom of drainage ways within Williston LTA. Common plant species typically found in these areas include various grass and grass-like plants such as slender wheatgrass (*Elymus trachycaulus*), big bluestem (*Andropogon geradii*), Baltic rush (*Juncus balticus*), Kentucky bluegrass (*Poa pratensis*), prairie dropseed (*Sporobolus heterolepis*), and wedgegrass (*Sphenopholis obtusata*). Various seasonal forbs can also be found in this community.

Woodland draws occur in the drainage ways found in the midland prairie communities adjacent to the hillsides toward the outlet at Williston LTA. Similar to the midland prairie, moist soils dominate the area and have a high density of plant species. Common grassy species found in this community are the same as those typically identified in the lowland community.

2.3.6 Ecological Receptors

There are seven federally listed threatened and endangered wildlife species that have the potential to occur in Williams County, North Dakota including the Whooping Crane (*Grus Americana*), Pallid sturgeon (*Scaphirhynchus albus*), Interior least tern (*Sterna antillarum*), Piping plover (*Charadrius melodus*), Northern long-eared bat (*Myotis septentrionalis*), Red knot (*Calidris canutus rufa*), and the Gray wolf (*Canis lupus*) (USFWS, 2017b). While the Bald eagle (*Haliaeetus leucocephalus*) has been de-listed from the national endangered list, the species is still protected under the Bald and Golden Eagle Act and the Migratory Bird Treaty Act.

Specifically, the Whooping crane and Interior least tern have the potential to be located at the Williston LTA for short periods of time. USACE completed annual breeding surveys for the Interior least tern and there have been no reported sightings during these surveys. Central North Dakota is located within the spring and fall migration pathway for the Whooping Crane; however, they have never been sighted in the Williston LTA area (Sedivec et al., 2007).

The Piping plover can be found on the shores of Lake Sakakawea in Williams County. Shorelines of the Lake can provide critical habitat for the nesting Piping plover; however, the shoreline is directly affected by the expansion of vegetation from the mainland. During surveys conducted by USACE, there were no sightings of breeding pairs in the area of Williston LTA (Sedivec et al., 2007). The Piping plover has designated critical habitat in Williams County; however, no federally or State listed species have been identified as occupying the MRS. The remaining aforementioned species have not been identified on or surrounding Williston LTA.

Because the land is co-leased by a cattle grazing association, cattle are present within the LTA. The land within the MRS boundary is generally not supportive of grazing due to steeply sloping topography and scrub brush vegetation present so cattle pass through the MRS transiently.

2.3.7 Cultural Resources

No nationally-recognized cultural or archaeological resources are listed within the MRS boundary. The greater area has historically been inhabited by American Indian Tribes, with potential cultural or archaeological resources existing within the boundary of Williston LTA. However, evidence of archaeological resources was not observed during RI field work within the MRS.

2.4 Previous Investigations

Three environmental investigations have been completed at Williston LTA MRS. These include:

- Preliminary Assessment Narrative Report, Garrison Dam and Lake Sakakawea, Riverdale, North Dakota (EA, 1993)
- Operational Range Assessment Program (ORAP), Phase I Quantitative Assessment Report, Williston Local Training Area, Williston North Dakota (ERT, 2008)
- Preliminary Assessment, Williston Local Training Area, North Dakota, (NDARNG, 2013)

2.4.1 Preliminary Assessment Narrative Report (EA, 1993)

A desktop PA Narrative Report was completed in 1993 for what was then called the NDARNG Company B Firing Range. The range was still operational at the time of the report and data collection included personnel interviews and desktop research. A site visit was not conducted due to inclement weather causing roads to be impassable. The narrative detailed the history of the site, based on personal communications with the ND Guardsmen, and estimated that 1.9 tons of lead and 0.9 tons of copper alloy had been deposited at the range, as a result of weapons training, since it began operation in 1960. Other groups had used the maneuver and training area, including the Williston Police Department, who set up targets to practice shooting while moving. An estimate of only 15 pounds of lead was contributed to the site from police department training activities. The PA narrative concluded that there was no evidence of lead or copper migrating from the range; lead slugs and copper alloy were embedded in the soils of the berm and hillside backstops. Since the range was used by NDARNG for an additional 9 years following the 1993 report, the MC weight estimates reported are likely lower than the present day. Furthermore, estimates within the report may be incorrect due to the application of inaccurate facts and assumptions in weapons type used (i.e., NDARNG did not field the M16 rifle until the early 1970s).

2.4.2 ORAP Phase I Assessment (ERT, 2008)

A Phase I Assessment was completed for the entirety of the Williston LTA in 2008. Data collection efforts made during the Phase I Assessment included Department of Defense and installation-specific data repository and database research, personnel interviews, and a site visit. The primary sources of MC identified during the Phase I Assessment included the firing points and impact areas of the inactive MRS. The assessment concluded that there is no pathway available for potential MC to migrate off-range due to environmental factors such as soil characteristics, distance to off-range areas, and the presence of vegetative cover. The Phase I Assessment categorized the Williston LTA small arms range MRS as “Unlikely” under the ORAP. This categorization refers to ranges where, based upon a review of readily available information, there is sufficient evidence to show that there are no known releases or source-receptor interactions that could present an unacceptable risk to human health or the environment.

2.4.3 Preliminary Assessment, Williston LTA (NDARNG, 2013)

The 2013 PA (NDARNG, 2013) documented that the NDARNG began the process of returning the Williston LTA property to USACE control through the lease termination process in 2011 (ERT, 2008). Range area cleanup was noted as a requirement of lease termination. The NDARNG Environmental Office conducted reconnaissance and sampling of the range in August 2011. Discrete surface soil samples were taken from the target berm and a background reference area and analyzed for metals. Concentrations of lead in berm soil ranged from 53.4 to 6,940 milligrams per kilogram (mg/kg), while background soil had a lead concentration of 5.74 mg/kg. Material from the railroad ties supporting the target berm was also sampled for waste characterization parameters in 2012 (NDARNG, 2013). Railroad ties were subsequently removed and disposed of at an appropriate waste disposal facility.

2.5 Current and Future Land Use

At the time of reporting, the Williston LTA is owned by the USACE and co-leased to the NDARNG and the Cattle Grazing Association. The NDARNG is no longer using the land for training and is in the process of terminating their lease to return the property to the USACE. The Williston LTA MRS small arms range was officially closed in 2012 and is no longer operational.

Access to the MRS is restricted by fence and locked gate; access is possible by boat from Lake Sakakawea. Recreational users of the lake occasionally trespass onto LTA property for recreational purposes (i.e., sightseeing/hiking). LTA land is actively used and managed by a cattle grazing association that co-leases the land. Anticipated future land use is unlikely to significantly change due to the topography of the land and its remote location.

2.6 Preliminary Conceptual Site Model

The preliminary conceptual site model (CSM) was generated based on the information and findings presented in the 1993 PA Narrative Report, 2008 Phase I Quantitative Assessment Report, the 2013 PA, 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, pistols, and machine guns) at the Williston LTA MRS. Active training occurred between 1960 and 2002 for small arms qualification and instructional firing purposes (NDARNG, 2013). The range is located in a coulee, surrounded to the north, east, and west by steep, rugged hills. The hills surrounding the range acted as a natural backstop during active training (EA, 1993). The MRS includes a 25-meter target berm, which is still extant within the MRS. A raised side berm extends from the target berm up-range towards the firing point. Firing at the former range occurred in a northwesterly direction, away from Lake Sakakawea, from 12 firing points toward the target berm and natural backstop. Additionally, 6 to 8 cratering charges (approximately 300 to 400 pounds of explosives) were used in 1998 to construct a small “duck pond” behind the target berm at USACE request (NDARNG, 2013). The pond is currently filled in with cattails, silted in considerably, and only wet seasonally. Topography and the silted-in condition of the pond indicate it may be a location where surficial soil particles suspended in stormwater accumulate from the surrounding steep hills.

Munitions expenditure data are not available for the training activities at the Williston LTA MRS; however, it is known that training was limited to small-caliber ammunition. It is estimated that 215,000 small arms rounds were expended at the small arms range (ERT, 2008). Potential MC present within target berm soil, natural backstop area soil, and constructed pond soil as a result of small arms projectiles are primarily lead (Pb), and secondarily antimony (Sb), copper (Cu), and zinc (Zn). Metals MC contamination was confirmed in surface soil at the target berm at concentrations above human health screening criteria during NDARNG sampling conducted in 2011. Due to the limited coverage of the MRS during the 2011 investigation, metals MC may also be present in natural backstop area soil and constructed pond soil. Although the natural backstop area is not within the boundaries of the MRS, observations made during the site visit indicate that MC may be present in soil in this area. Additionally, although all charges used to construct the pond were verified to have detonated, residual explosives MC may have been left behind in soil at the pond.

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, natural backstop area, and constructed pond) beyond the Williston LTA boundary. Due to MRS topography and range orientation, stormwater runoff from significant rain events is unlikely to transport suspended soil particles off site. This was confirmed during the September 2017 site visit with stakeholders. Stormwater runoff from the steep hills surrounding the range flows radially inward towards the coulee floor and constructed pond. Over time, the pond has silted in considerably with eroded soil from the surrounding hillsides and coulee floor. The target berm and constructed pond effectively separate the coulee floor from soils beyond the MRS boundary. No evidence of erosion or gullies was observed during the site visit on either the berm face or leading from or around the berm. **Figure 2-2** presents a pictorial diagram of the site including the overland flow direction of stormwater. The constructed pond holds standing water only seasonally during rainy periods. Transport pathways from soil in source areas to surface water bodies are incomplete.

Metals 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 data presented in the 2008 Qualitative Assessment Report (ERT, 2008), groundwater at the MRS is approximately 80 feet bgs (Cross Section A-A' of **Figure 2-2**). Therefore, groundwater pathways are incomplete for the Williston LTA MRS.

MC within target berm, natural backstop, and constructed pond soil is anticipated to remain within source areas and/or soils on the coulee floor, and not be transported off site. Bulk/coarse bullets are embedded in berm and backstop soil; due to their weight, it is unlikely for them to be transported off-site via overland flow. Exposure pathways between MC and receptors are restricted to the target berm, constructed pond, and backstop areas.

Receptors

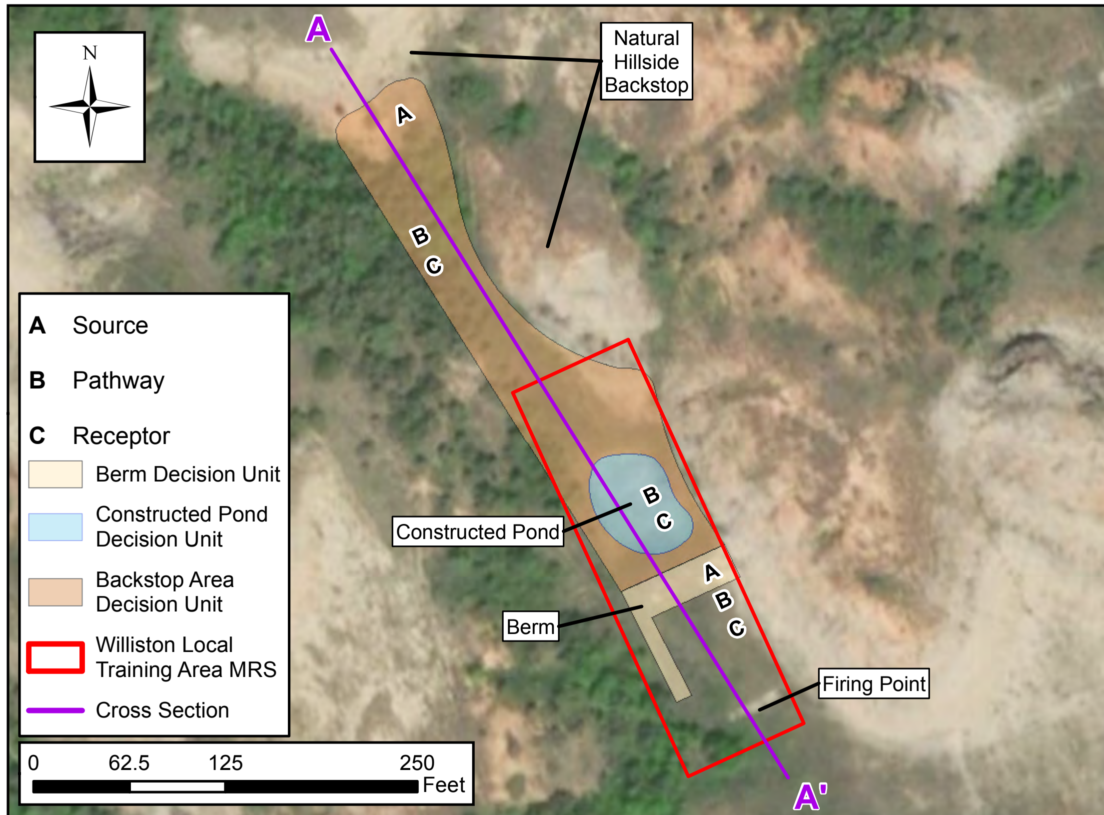
Lake Sakakawea is located south of the MRS. The property is remotely located and federally owned by the USACE, with access to the site restricted by a fence and locked gate. Human receptors may visit the Williston LTA (including the MRS) for sightseeing, hiking, or boating activities from Lake Sakakawea. Currently, an impassible culvert prevents direct vehicle access to the MRS, however it was drivable in the past. The Williston LTA is co-leased by a cattle grazing association. Workers may visit the MRS to conduct activities associated with cattle grazing.

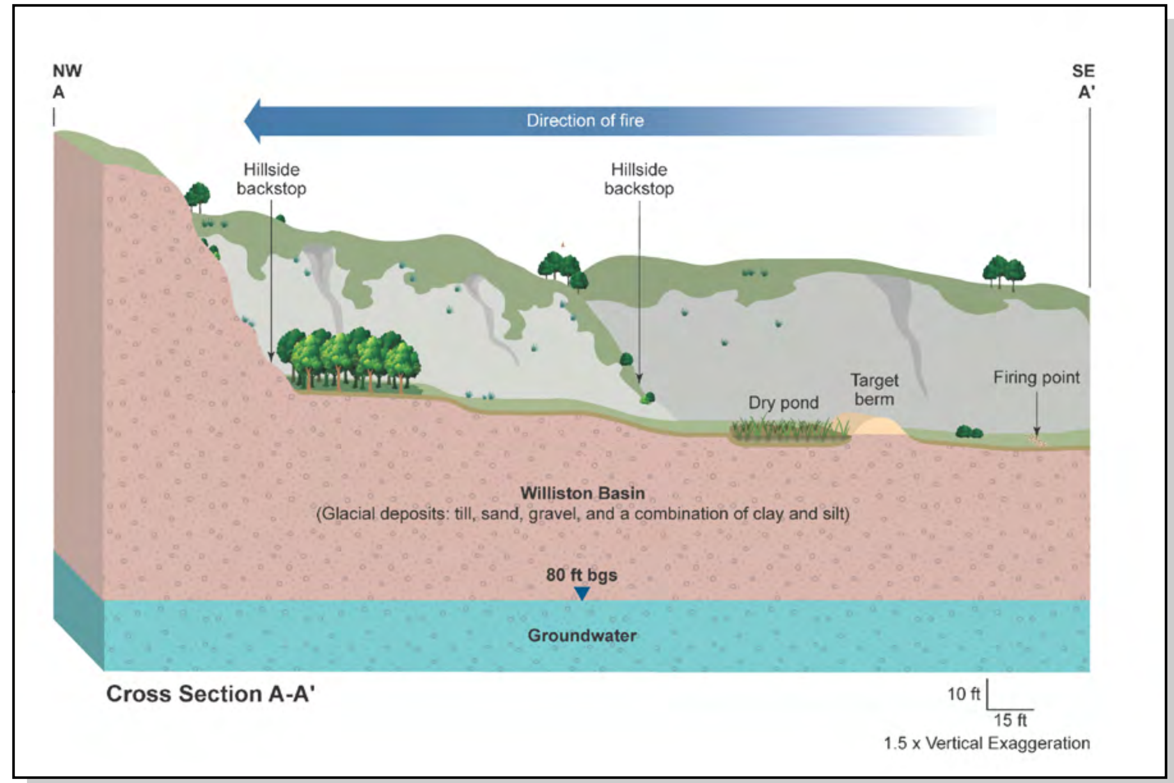
No sensitive ecological habitats (i.e., wetlands) are present within the MRS, but native and non-native grassland, forbs, and marsh area habitats occur within the Williston LTA. The habitat within the MRS, specifically within the vicinity of the firing range, is greatly influenced by the rugged, and steep topographic relief of the surrounding hillsides. The firing range and associated DUs are situated in a coulee that is populated with scrub brush and grassland prairie vegetation. Heavy erosion and infill affect the surrounding slopes, especially in the Constructed Pond and Backstop Area, which receive eroded sediments from the surrounding hillsides. Surface run-off and stormwater flow radially inwards toward the coulee floor. Because of this, habitat quality is considered relatively poor. These conditions, in conjunction with the small footprint of the MRS (0.52-acres), make the habitat at the Williston LTA MRS not suitable for ecological receptors to inhabit the area on a full-time basis.

The Interior Least Tern (*Sterna antillarum*), Whooping Crane (*Grus americana*), Pallid Sturgeon (*Scaphirhynchus albus*), and Gray Wolf (*Canis lupus*) are federal and State endangered species that potentially occur within Williams County. The Piping Plover (*Charadrius melodus*) is a federal and State threatened species with designated critical habitat in Williams County, however, no federally or State listed species have been identified as occupying the MRS. Additionally, no sensitive ecological species or evidence of burrowing animals were observed at the MRS during the site visit or RI field work. Soil within the Constructed Pond DU is comprised of hard dense clay that desiccates surficially during dry periods and no evidence of organismal inhabitance has been observed. Although the land is co-leased and used for cattle grazing, lead is not known to be significantly bioaccumulative (unlike mercury, for example) within terrestrial food chains (ATSDR, 2007). Cattle pass through the MRS transiently because the land within the MRS boundary is not supportive of grazing due to steeply sloping topography and scrub brush vegetation. Cattle are not a potential receptor at the MRS.

Based on this analysis of habitat and no known sensitive ecological species inhabiting the MRS, it is unlikely there is an elevated exposure risk to ecological receptors at the MRS.

Figure 2-3 depicts the preliminary CSM diagram that illustrates potential source to receptor exposure pathways for the MRS.





A – Sources
Particulate metals, particularly lead, and bulk bullets/projectiles in soil on the target berm and natural hillside backstops as a result of historical small arms training.

B – Pathways
Metals MC have limited potential to migrate from soil at the target berm, or natural hillside backstops (Source areas: "A" on map to left) beyond range boundaries. Due to topography and range orientation, stormwater runoff from hillside backstop areas flows towards the "Dry Pond" impoundment behind the earthen berm. Groundwater at the MRS is approximately 80 feet below ground surface (Cross section A-A'). Groundwater pathways are incomplete since metals are highly unlikely to leach from soil in source areas to deep groundwater. MC within MRS soil is anticipated to collect and remain in the target berm, dry pond and backstop areas, and not migrate off-site. Bulk/coarse bullets are embedded in berm and backstop soil; due to their weight, it is unlikely for them to be transported off-site via overland flow.

C - Receptors
The MRS is located within a coulee, surrounded on three sides by steep, rugged hills. Human receptors may recreationally visit the MRS for sightseeing, hiking, or boating activities from Lake Sakakawea. Workers may also visit the MRS to conduct activities associated with the Cattle Grazing Association.

No sensitive ecological habitats (i.e., wetlands) are present within the MRS, but native and non-native grassland, forbs, and marsh area habitats occur within the Williston LTA. The dry pond is poor habitat due to infilling from erosion of the surrounding hillsides. The Interior Least Tern (Sterna antillarum), Whooping Crane (Grus americana), Pallid Sturgeon (Scaphirhynchus albus), and Gray Wolf (Canis lupus) are federal and State endangered species that potentially occur within Williams County. The Piping Plover (Picoides borealis) is a federal and State threatened species with designated critical habitat in Williams County, however, no federally or State listed species have been identified as occupying the MRS.

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Figure 2-2
Preliminary Conceptual Site Model
Williston Local Training Area, North Dakota

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

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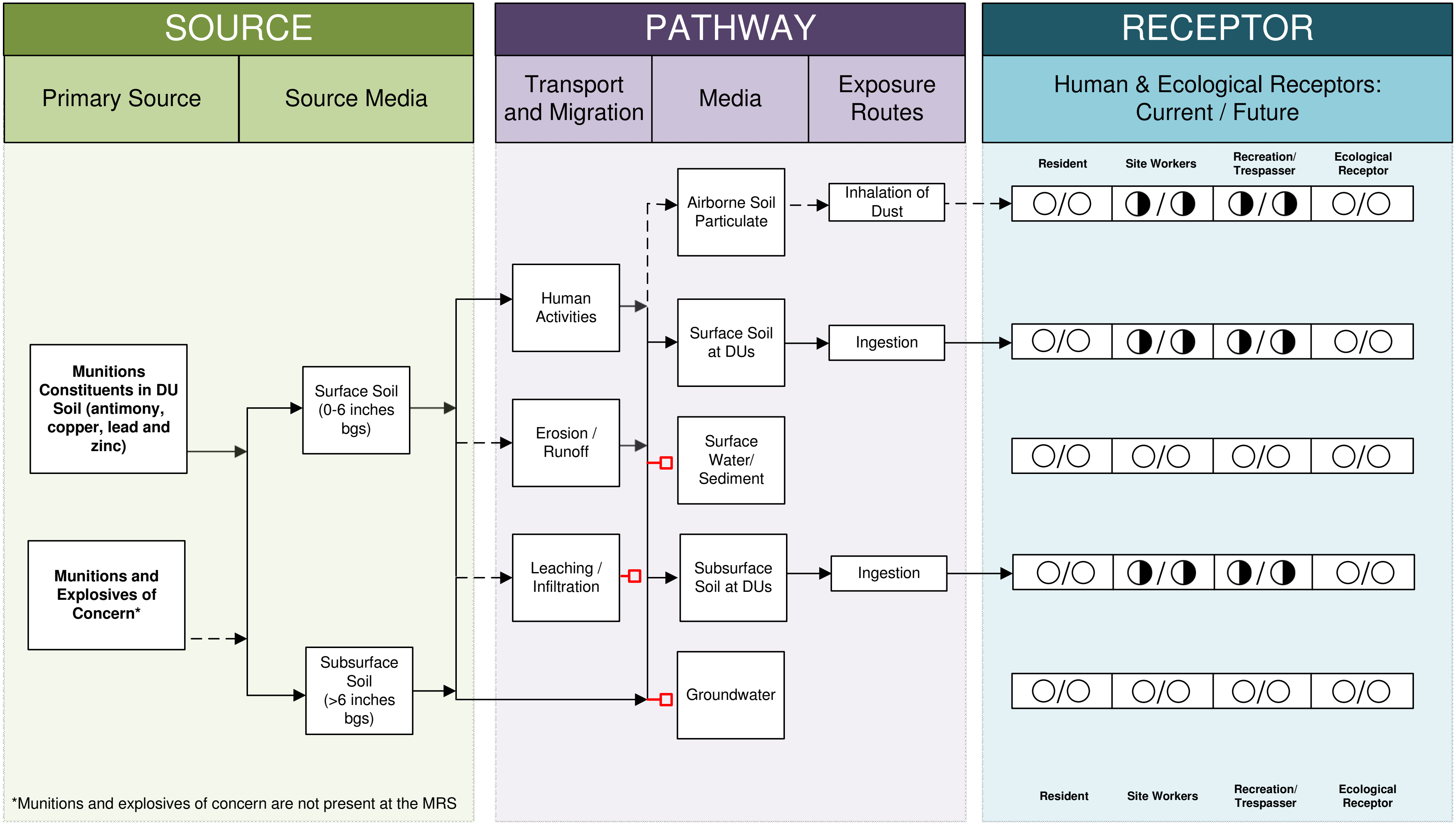


LEGEND

Flow-Chart Stops

Flow-Chart Continues

Partial / Possible Flow

Incomplete Pathway

Potentially Complete Pathway

Complete Pathway

Figure 2-3
Preliminary Conceptual Site Model Diagram
Williston LTA MRS, North Dakota

3 Field Investigation Activities

MC samples 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, 2018). The sampling approach of the RI was designed to characterize the nature and extent of MC contamination in soil at the Target Berm, Backstop Area, and Constructed pond that are associated with historical small arms training activities conducted at Williston LTA MRS. The ORAP Phase I Assessment (ERT, 2008) found that there is no pathway available for potential MC to migrate off-range due to environmental factors such as soil characteristics, distance to off-range areas, and presence of vegetation. Data presented in the Phase I Assessment (ERT, 2008) also indicated that groundwater at the MRS is approximately 80 feet bgs; 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.

Although historical use of the MRS was solely as a small arms range, unexploded ordnance avoidance was provided by the USACE during all intrusive field activities due to the potential use of limited pyrotechnics within the greater LTA.

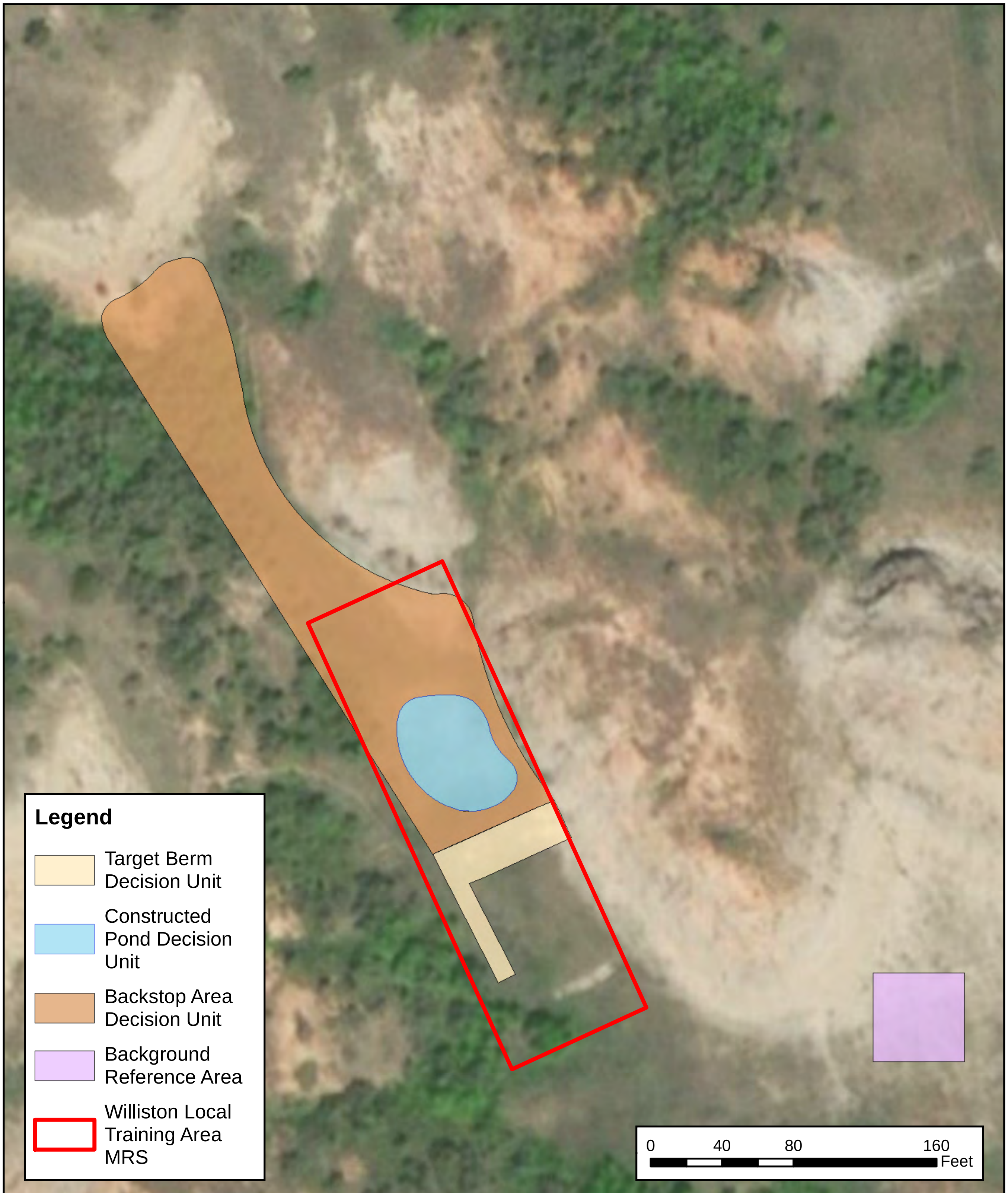
3.1 Soil Sampling Methodology

A phased approach was used that included assessing the extent of MC contamination in the field using XRF analysis of discrete samples in accordance with the Work Plan/UFP-QAPP. XRF data were used to help determine the final size of the decision units (DUs). XRF analysis was not conducted at the Constructed Pond DU due to the anticipated high moisture content of soil. Soil samples from each DU were collected using an incremental sampling methodology (ISM) approach because this method provides a representative exposure point concentration for evaluating risks. Discrete subsurface soil samples were also collected at random locations within the Constructed Pond DU.

Based on the findings of the 2013 PA, the 2008 Phase I report, and site history, three distinct DUs have been identified as associated with the former firing range: the Target Berm (0.053 acres), Constructed Pond (0.073 acres), and the Backstop Area (0.43 acres). Each DU encompasses the entirety of the range feature being investigated; DUs extend beyond the MRS boundary in order to capture the actual dimensions of the range features potentially affected by range activities. Due to the steepness of the slopes of the hillside backstops, the Backstop Area DU encompasses the depositional areas at the base of the hills. Sampling was not conducted on the surrounding hillsides of the coulee due to safety concerns related to the steepness of the slopes. **Figure 3-1** presents the location of each initial DU as illustrated in the RI UFP-QAPP. **Table 3-1** summarizes the soil samples collected.

3.1.1 X-Ray Fluorescence Screening

The Backstop Area and Target Berm were screened for lead in the field using an Olympus DELTA Professional (DPO-2000) handheld XRF analyzer. A grid was laid out across both DUs,



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SOURCE	ARNG; State of North Dakota, ESRI & Partners	PM	LS	2/1/2019

Initial Remedial Investigation Units

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

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	
INCREMENTAL SAMPLES						
Target Berm						
WIL01IS01	8/14/2018	0 - 6	Soil	X		Primary, used also for MS/MSD
WIL01IS02	8/14/2018	0 - 6	Soil	X		Duplicate
WIL01IS03	8/14/2018	0 - 6	Soil	X		Triplicate
Constructed Pond						
WIL02IS01	8/14/2018	0 - 6	Soil	X	X	Primary
WIL02IS02	8/14/2018	0 - 6	Soil	X	X	Duplicate
WIL02IS03	8/14/2018	0 - 6	Soil	X	X	Triplicate
Backstop Area						
WIL03IS01	8/14/2018	0 - 6	Soil	X		Primary
WIL03IS02	8/14/2018	0 - 6	Soil	X		Duplicate
WIL03IS03	8/14/2018	0 - 6	Soil	X		Triplicate
Background Reference						
WIL04IS01	8/15/2018	0 - 6	Soil	X		Primary
WIL04IS02	8/15/2018	0 - 6	Soil	X		Duplicate
WIL04IS03	8/15/2018	0 - 6	Soil	X		Triplicate
DISCRETE SAMPLES						
WIL02DA01A	8/16/2018	12 - 18	Soil	X	X	Sample taken at grid node #22
WIL02DA01B	8/16/2018	12 - 18	Soil	X	X	Field Duplicate of WIL02DA01A
WIL02BA02A	8/16/2018	12 - 18	Soil	X	X	Sample taken at grid node #11; MS/MSD
EQUIPMENT BLANK						
WIL03IS00	8/15/2018	--	Water	X		

Notes:

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

bgs = below ground surface

MS/MSD = matrix spike/matrix spike duplicate

USEPA = United States Environmental Protection Agency and discrete samples were taken from 0-6 inches bgs at each grid node. An approximate 10 x 10 foot grid (39 samples) was sampled at the Target Berm DU. The Backstop Area DU was sampled on an approximate 26 x 23 foot grid (30 samples). 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 recorded. An analog soil moisture meter was used in the field to estimate soil moisture content. Coarse material >2 millimeters in diameter, such as pebbles or organic matter were removed from the sample before analysis and recorded in the field notes (**Appendix A**).

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. The concentration of lead (in parts per million [ppm] which is equivalent to mg/kg) and ± error, as reported by the XRF analyzer, was recorded for each analysis. 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.

No DU boundaries were revised because there were no exceedances of the human health screening criterion for lead (400 mg/kg). Step-out sampling was not necessary at any DU thus the size and shape of the initial DUs were unchanged.

3.1.2 Incremental Soil Sampling

Incremental samples (IS) were collected from each DU using a systematic random approach, using XRF screening grids, and in accordance with the procedures outlined the UFP-QAPP standard operating procedures (SOPs; AECOM, 2018). Random numbers were generated in the field, using a random number generator, to select the location of primary, duplicate, and triplicate ISM samples. All 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 (ITRC, 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 a standard cylindrical stainless steel soil probe. The IS from the Target Berm DU was comprised of 39 evenly spaced increments, the Backstop Area DU was comprised of 30 evenly spaced increments, and the Constructed Pond DU (an approximate 5 x 10-foot grid) was comprised of 36 evenly spaced increments. Increments were collected from approximately 0-6 inches bgs and composited into individual 10-gallon plastic zipper-lock bags for laboratory analysis of small arms metals; IS from the Constructed Pond DU were also analyzed for explosives.

In addition to the three designated DUs, IS were collected in 100 percent triplicate from a background reference area adjacent to 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. The Background DU was sampled on an approximate 8.3 x 10-foot grid (30 samples).

3.1.3 Discrete Subsurface Soil Sampling

Discrete subsurface soil samples were collected from the Constructed Pond DU to determine the vertical extent of potential MC contamination. Subsurface sampling was not conducted at the Target Berm DU or the Backstop Area DU because surface soil XRF results found no exceedances of the human health screening criterion for lead, per the UFP-QAPP (AECOM, 2018). Because the soil at the Constructed Pond DU was too moist to obtain reliable XRF results, two locations (grid nodes #22 and #11) were randomly selected for discrete subsurface soil sampling. At each location, a discrete sample was collected from two depths: 12-18 inch bgs (DA sample) and 24-30 inches bgs (DB sample). Each sampling zone was exposed by hand auger, and discrete samples collected with a clean, dedicated, disposable sampling spoon for laboratory analysis of small arms metals and explosives. The 24-30 inches bgs samples were held at the laboratory pending the results of the shallower 12-18 inch bgs sample. Both locations did not exceed the human health screening criterion for lead in the shallow 12-18 inch bgs sample, so the deeper 24-30 inch bgs samples were not analyzed per the data quality objectives outlined in the UFP-QAPP. Excess soil was returned to each sampling location at the level removed, and the ground surface returned to flush.

Additionally, a discrete surface soil sample was collected from each investigative DU at the grid node location where the highest XRF lead result was observed or co-located with a discrete subsurface sample at the Constructed Pond DU. These discrete surface soil samples were held at the laboratory for waste characterization analysis (e.g., toxicity characteristic leaching procedure [TCLP]) pending the results of the IS. No IS results exceeded the human health criterion for lead. Per the data quality objectives within the UFP-QAPP, TCLP samples were not analyzed since IS sample results did not exceed human health screening criteria.

3.1.4 Sample Identification

Soil samples collected at the MRS were identified using the procedures detailed in the UFP-QAPP (AECOM, 2018). 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:

WIL01DA02A and **WIL02IS02**

WIL = Three-character site identifier for the Williston LTA MRS

01 = DU identifier:

- 01 for the Target Berm DU
- 02 for the Constructed Pond DU

- 03 for the Backstop Area DU
- 04 for the Background incremental sample

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
- IS = incremental surface soil sample

02 = Sample location/type:

- 01 – 39 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
- E for TCLP sample at an XRF location

3.1.5 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, 2018]). Excess soil on 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.

3.1.6 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, 2018).

3.1.7 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. 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 rate of 5 percent per mobilization. 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 North Dakota State Department of Health accredited (GCAL Analytical Laboratories, LLC) 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 analyzed by the laboratory for:

- Small arms metals (antimony, copper, lead, and zinc) by USEPA Method SW-846 6020B
- Explosives (Constructed Pond DU) by USEPA Method 8330B/MET-004, MET-021

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 Risk Screening Criteria

The human health risk-based screening levels for soil used 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 or "duck pond" construction resulted in contamination exceeding human health screening levels. Based on the analysis of habitat and no known sensitive ecological species inhabiting the MRS (**Section 2.6**), it is unlikely there is an elevated exposure risk to ecological receptors at the MRS; the exposure pathways are considered incomplete (**Figure 2-3**).

Site-specific background reference samples were collected and analyzed during this RI for comparison to investigative samples. Explosives are not naturally occurring; therefore, background samples were analyzed for target small arms metals only.

Table 3-2. Remedial Investigation Screening Levels

Analyte	Screening Levels	
	Soil Human Health (mg/kg)	Source
Total Metals by USEPA SW-846 Method 6020B (mg/kg)		
Antimony	31	RSL
Copper	3,100	
Lead	400	
Zinc	23,000	
Explosives by USEPA SW-846 Method 8330B[1]		
1,3,5-Trinitrobenzene	220	RSL
1,3-Dinitrobenzene	63	
2,4,6-Trinitrotoluene	4	
2,4-Dinitrotoluene	13	
2,6-Dinitrotoluene	2	
2-Amino-4,6-dinitrotoluene	15	
2-Nitrotoluene	7	
3,5-Dinitroaniline	NA	
3-Nitrotoluene	63	
4-Amino-2,6-dinitrotoluene	15	
4-Nitrotoluene	25	
HMX	390	
Nitrobenzene	13	
Nitroglycerin	63	
PETN	13	
RDX	23	
Tetryl	16	

Notes:
[1] - Analyzed at Constructed Pond DU only
mg/kg = milligram per kilogram
RSL = Regional Screening Level (Residential)

4 Data Quality Assessment

Field samples were analyzed for small arms metals by SW-846 method 6020B, and explosives by SW-846 8330B (Constructed Pond DU only). 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 project chemist Naoum Tavantzis. As appropriate, the subsections below address the in-field XRF data obtained at Williston LTA MRS.

A Stage 2b 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, 2018) 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.

<u>Holding Time Requirements</u>

Samples are only representative of the area they were taken from for a specific length of time before sample preparation or analysis must begin. All samples must be placed in appropriate containers that are appropriately preserved (as applicable). The holding time for soil from sampling to analysis for metals by SW-846 6020B is six months, while samples analyzed for explosives have a technical holding time of 14 days. All samples were analyzed within required holding times for their respective method. Several non-detect field sample results were re-extracted after the technical holding time of 14 days had expired due to percent recoveries in the laboratory control spike pair less than the lower QC limits. These results were qualified “UJ”, meaning the analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise. The re-extracted results were not recommended for data use. However, it should be noted that while these results were not recommended for data use, they were not rejected and were a confirmation of the non-detect explosives results in the initial extraction.

<u>Calibration Criteria</u>

All laboratory analyses require that a multi-point calibration be prepared to cover the appropriate concentration range based on the intended application and prior to establishing the linear dynamic range. For explosives analysis, the initial calibration must meet criteria outlined in the UFP-QAPP of relative standard deviations less than 15%, or regressions with $r^2 \geq 0.99$, followed by calibration verification at frequencies listed in the UFP-QAPP. For the metals analysis, a daily instrument tune and multi-point calibration are required along with calibration verifications as outlined in the UFP-QAPP. All calibration criteria were met for explosives and metals analysis.

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.

Laboratory Method Blank

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 preparation 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. During metals analysis, one method blank displayed a detection greater than the limit of detection (LOD) for zinc. Field sample results were greater than five times the concentration found in the blank; no data qualifying action was required.

Equipment Blank

As per the UFP-QAPP, equipment blanks were to be collected at rate of 5 percent, with measurement performance criterion stating that all detections would be less than the LOD. With the four primary investigative samples and eight additional field duplicate and triplicate IS analyzed, one equipment blank (WIL03IS00) was collected for a rate of 8.33 percent. The equipment blank was collected as discussed in **Section 3.1.7** and analyzed for small arms metals. The equipment blank displayed detections greater than the detection limit, but less than the LOD. The associated field sample results were positive and greater than five times the concentrations found in the blank. Equipment blanks were not collected for discrete or XRF samples since these samples were collected using disposable single use spoons.

Laboratory Duplicate Samples

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 (RPDs) for laboratory duplicates are specified by the laboratory-specific control limits. All laboratory duplicates prepared were within QC limits.

Field Duplicates/Field Triplicates

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 RPD/ relative standard deviations (RSDs), also known as coefficient of variation for discretely and incrementally collected field duplicates and triplicates are less than 30 percent. Of the single duplicate pair of discrete samples collected during the RI, all field duplicate results were within QC limits. No anomalies were encountered in the field triplicates. Acceptable RSDs between triplicates are less than 30 percent. Percent RSD ranged from 1.58 percent to 22.5 percent. Percent RSD is calculated by dividing the standard deviation of the triplicates by the mean.

Laboratory Control Spike (LCS) Samples

A laboratory control spike (LCS) is an interference-free matrix spiked with known concentrations of specific analytes of interest. This analysis determines if the laboratory procedure is working within the established control limits. Similar to the method blank, an LCS is carried through the complete preparation and analytical procedure, utilizing recoveries of spiked analytes to determine accuracy. An LCS pair is to be performed at a minimum of once per preparation batch or one per twenty field samples. All field samples displayed LCS percent recoveries within the established control limits for metals analysis. During the explosives analysis, discrete field samples WIL02DA01A, WIL02DA02A, and WIL02DA01B had results qualified “UJ” due to low LCS recoveries. These field samples were re-extracted with LCS percent recoveries that were either within control limits, or displayed recoveries greater than the upper QC limits, with the exception of tetryl. Since successful recoveries of the LCS was shown in the subsequent extraction, it was determined this was not a systemic problem with the laboratory extraction process, and instead an anomalous issue with this one extraction batch. Field samples WIL02DA01A, WIL02DA02A, and WIL02DA01B displayed 0% recoveries for the explosive tetryl in the initial and re-extracted results, which resulted in field sample results being qualified “R”. Meaning the sample results are unusable and rejected due to serious deficiencies in meeting QC criteria; the analyte may or may not be present in the sample. However, tetryl decomposes readily in moist, sunlit conditions and is therefore not expected to persist in the environment of the Constructed Pond. Furthermore, tetryl was used mostly during World War I and World War II and is no longer manufactured or used in the U.S.; the timing of the use of explosives to construct the “duck pond” is outside of this active timeframe of use (ATSDR, 1995). For these reasons, the compound would not be expected to be present at the MRS.

Matrix Spike/Matrix Spike Duplicates

An MS/MSD is a separate aliquot of a specified field sample that is spiked with known concentrations of analytes of interest at the laboratory. It is analyzed to determine if the laboratory procedure is working within the established control limits and if matrix interference is present. Percent recoveries of the spiked analytes are evaluated to determine accuracy within a given matrix. Comparison of the MS to the MSD will yield a precision measurement, or RPD, in a given matrix. A MS/MSD sample is to be collected at a rate of 5 percent and for each sample matrix. For the explosives analyses, the MS performed on field sample WIL02DA02A displayed a percent recovery less than the lower QC limit of 74% for HMX at 61%. The associated parent sample result was non-detect and was qualified “UJ,m.” In addition, the matrix spike pairs performed on field sample WIL02DA02A displayed several RPDs greater than the QC laboratory QC limit of 20%. The associated parent sample results were non-detect, so no data qualifying action was required. For the metals analyses, field samples WIL02DA02A and WIL01IS02 displayed percent recoveries less than the lower QC limits for antimony and WIL01IS02 displayed a percent recovery in the MS greater than the upper QC limit for copper. The post-digestion spikes performed on these parent samples displayed percent recoveries within laboratory QC limits. The field sample results associated with the positive bias were positive and were qualified “J+” meaning that the result is an estimated quantity, but the result may be biased high. The field sample results associated with the negative biases were non-detect and were qualified “UJ”.

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 of agreement among repeated measurements of the same characteristic on the same sample or on separate samples collected as close as possible in time and place. Field sampling precision is measured with the field duplicate relative percent differences; laboratory precision is measured with calibration verification, laboratory control spike and matrix spike duplicate relative percent differences, dual column precision analysis, 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). To identify the cause of imprecision, the field sampling design rationale and sampling techniques will be evaluated by the reviewer, and both field and analytical duplicate/replicate sample results will be compared. 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.

Calibration verifications are performed routinely to ensure that instrument responses for all calibrated analytes are within established control criteria. No calibration verification anomalies were encountered.

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. Of the laboratory duplicates performed, all were within the precision criteria outlined in the UFP-QAPP. The laboratory control spike pairs in the explosives analysis displayed several RPD anomalies, but the associated field sample results were non-detect, so no data qualifying action was taken.

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 the MS pair RPD anomalies because the positive associated field sample results were previously qualified due to MS/MSD percent recovery anomalies.

A serial dilution is a sample aliquot that is subjected to a multiple or series of dilution steps. Serial dilutions are run at specific dilutions (usually 1:5) to determine whether any significant chemical or physical interference exist due to sample matrix effects. The serial dilution performed on field sample WIL02DA02A displayed a percent difference greater than the QC limit of 10% for zinc, at 10.9%. These anomalies are considered minor, the positive associated results were qualified as estimated, and the data should be considered usable as qualified.

IS field triplicates and discrete field duplicates were collected to assess the overall sampling and measurement error for this sampling effort. Relative percent difference of 30% was used to evaluate the field duplicate precision for discrete samples and a relative standard deviation of 30 percent was used to evaluate the field triplicate precision for all results that displayed concentrations (or sample averages for ISM triplicate samples) greater than five times the limit of quantitation (LOQ). If sample results for field duplicates or sample average results for field triplicates displayed concentrations less than five times the LOQ, a control limit of a difference two times the LOQ for field duplicates or average deviation less than two times the LOQ for field triplicates. All reported results were within the precision criteria outlined in the UFP-QAPP.

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 ± 7 ppm at Target Berm locations WIL01X11 and WIL01X21. Concentrations at both locations were below the decision criterion (400 mg/kg) given the ± error. At two locations at both the Target Berm and Backstop Area DUs, three additional replicates were analyzed to calculate percent RSDs using all seven XRF readings at the four locations. Acceptable RSDs between replicates is less than or equal to 20 percent. Three of the four samples were within the acceptable limit, ranging from 6 percent to 12 percent. One sample from the Target Berm exhibited an RSD of 42 percent, indicating heterogeneous distribution of lead within the soil matrix of the sample. Precision was controlled for by using the average of replicate results for each sample. XRF precision is consistent with the data quality objectives.

Accuracy

Accuracy is a measure of confidence in a measurement. 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 laboratory control spikes, the matrix spike pairs, and surrogates.

LCS are prepared by addition of known concentrations of each analyte in a matrix free media known to be free of target analytes. LCS pairs were prepared for every quality control batch to demonstrate the ability of the laboratory to detect similar concentrations of a known quantity in matrix free media. An LCS pair is to be performed at a minimum of once per preparation batch or one per twenty field samples. All field samples displayed LCS percent recoveries within the established control limits for metals analyses. During the explosives analysis, field samples WIL02DA01A, WIL02DA02A, and WIL02DA01B had several results qualified “UJ” due to low LCS recoveries in the initial preparation and re-extraction. In addition, these same field samples displayed 0% recoveries for tetryl, which is a poor performer, and this resulted in field sample results being qualified “R” in the initial preparation and re-extraction. Tetryl is likely not present in site media for the reasons discussed in **Section 4.1**.

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. For the explosives analyses, the MS performed on field sample WIL02DA02A displayed a percent recovery less than the lower QC limit for HMX. The associated parent sample result was non-detect and was qualified “UJ,m”. A re-extraction of the parent sample was performed, however, that result was not recommended for use by the data reviewer, and the parent sample was retained for use. For the metals analyses, field samples WIL02DA02A and WIL01IS02 displayed percent recoveries less than the lower QC limit for antimony, and WIL01IS02 displayed a percent recovery in the MS greater than the upper QC limit for copper. The post-digestion spikes performed on these parent samples displayed percent recoveries within laboratory QC limits, so the positive field sample results were qualified “J+”. The field sample results associated with the negative biases were non-detect and were qualified “UJ”.

For the XRF data, the measured values are presented with a ± error reading. For this project, the ± error rarely exceeded 3 ppm at the Backstop Area. Nearly all sample detections were less than 30 ppm with the exception of WIL03X18, which had a detection of 118.5 and a ± error of 5 ppm. For the Target Berm, samples WIL01X21 and WIL01X11 exhibited both the highest concentrations of lead observed by XRF and the largest associated error values (242.3 ± 7 ppm and 235.6 ± 7 ppm respectively). No XRF sample concentrations were close enough to the action level of 400 ppm lead that the associated error would indicate the true value would likely exceed the threshold.

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.

As described in **Section 3.1** of this report and in the UFP-QAPP, the MRS - for data interpretation purposes - was divided into three DUs that reflect the three areas of potential contamination as indicated by site history and remaining physical evidence of the target areas. Thus, uniform distribution of MC across the MRS was considered unlikely and subdividing the MRS appropriate. Samples from within each DU are considered representative of their DU and satisfactorily define the DU extent. Based on the XRF screenings, no step-outs were needed at any DU and the three DU boundaries were delineated appropriately and satisfactorily. Samples collected from the background area are considered representative of baseline conditions because it is in a location unaffected by site activities and is of similar land use. The number of discrete samples was based on professional judgment and designed to be sufficiently spaced to delineate the distribution of metals MC in soil at the DU. The numbers and uniform spacing of ISM increments adhered to the UFP-QAPP requirements and were sufficiently large that the analytical results represent the DUs with confidence.

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, with the exception of the re-extracted explosives results that were not recommended for data use. It should be noted that while these results were not recommended for data use, they were not rejected and were a confirmation of the non-detect explosives results in the initial extraction. The laboratory used approved standard methods as outlined in the UFP-QAPP for all analyses.

An equipment blank was also collected for all matrices where decontamination was required during field sampling. The measurement performance criterion of no analyte being greater than the LOD was met; no field sample results were qualified due to this blank detection.

Laboratory blanks (method blanks and calibration blanks) are extracted and analyzed by the laboratory as a negative control to see if there are possible false positives (or false negatives) in matrix-free QC samples. One method blank displayed a detection for zinc greater than the LOD. Associated field sample results were greater than five times the concentration found in the blank; no data qualifying action was required.

Incremental field samples submitted for metals analysis were dried, sieved, and ground by the laboratory during sample preparation. Because samples were ground, it is possible that non-bioavailable metals were included in the metals results due to the pulverization of the soil matrix. These results could, therefore, be considered as potentially biased high.

Comparability

Comparability refers to the equivalency of sets of data or 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. Comparability is achieved through the use of standard or similar techniques as those required when analyzing representative samples. Comparable data sets must contain the same variables of interest and must utilize values that can be converted into a common unit of measurement. For example, if reporting limits for target analytes are significantly different between separate methods, the methods may not be comparable. It can be difficult, and possibly inaccurate, to use data from multiple methods in order to draw inferences on the data or make comparisons. For this reason, it is important to always use caution when combining data sets. Standard field sampling and typical laboratory protocols were used in this investigation and the data reviewer has found all data to be comparably acceptable.

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. The soil types at the three DUs and in the background area were similar (see soil sample collection logs, **Appendix A**).

Soil samples were collected over a four-day period. A brief period of rain and lightning occurred during the evening of the first day of site work; however, the densely packed soil and semi-arid conditions prevented the soil from becoming saturated. Soil moistures were relatively similar in all sampled areas for the Target Berm and Backstop Area, while the discrete Constructed Pond samples had between 70 – 90% moisture. Soil sent to the laboratory was analyzed on a dry-weight basis. Soil moisture content at the Target Berm and Backstop Area was low enough to allow XRF to be useable but too high within the Constructed Pond (as anticipated).

Completeness

Completeness is a quantitative measure that is used to evaluate the number of valid analytical data points obtained in comparison to the amount of data points that were expected to be obtained under normal circumstances. Overall completeness is usually expressed as a percentage of usable analytical data. During the course of an investigation, completeness goals are specified for various sample matrices and analyses. These goals are used to estimate the minimum amount of analytical data that will be required to support the conclusions of the investigator. To set a completeness goal of 100 percent means to collect, analyze, and yield analytical data for every sample put forth in the agreed upon sampling plan. Overall completeness goals are generally set below 100 percent to account for losses such as unplanned sampling issues (groundwater well will not regenerate enough for sampling, inclement weather, breakdown of equipment, samples broken in transit, etc.) or to account for quality issues that would affect data usability. Percent completeness per soil parameter is as follows: Explosives by SW-846 8330B at 97.1% (due to "R" qualified tetryl data); Total Metals by SW-846 6020B at 100%. Overall completeness was 98.6%.

With the exception of tetryl analysis, no field samples were rejected, and all data are considered usable, as qualified; therefore, total completeness for laboratory and XRF data is 100 percent.

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. All analytical results displayed acceptable sensitivity.

The LOD for lead established by the manufacturer of the DELTA Professional (DPO-2000) XRF analyzer is 5 ppm for complex (real-world) media (Olympus Scientific Solutions Americas Corp., 2014). The LOD is sensitive enough to determine whether samples did or did not exceed the decision criteria used for XRF screening data (400 ppm lead). Daily calibration checks and analysis of standard reference material ensured that 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 who had assisted in preparing the UFP-QAPP and SOPs. Additionally, the site photographs, standard field forms, and Daily Quality Control Reports (DQCR) show that the proper equipment was being used and QC samples collected. These documents appear in **Appendix A** and **B**. The DQCRs were submitted daily to the AECOM project manager. 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 Williston LTA 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 organized 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 **Appendix 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 photo log in **Appendix B**.

5.1 Field Activities and Conditions

Adhering to the methods described in **Section 3**, soil samples were collected at the Target Berm area, Constructed Pond, Backstop Area, and an adjacent background reference area. Sampling occurred over a four day period, from 13 August through 16 August 2018. Sampling grids were laid out prior to initiating sampling activities following the planned approach presented in the UFP-QAPP. Minor variations to grid spacing and DU shape were required to adjust for topographic constraints and real-world conditions within the MRS area. Grid spacing at the Target Berm was 10 feet long by 10 feet wide (39 nodes); Constructed Pond grids were 5 feet long by 10 feet wide (36 nodes); Backstop Area grids were 23 feet long by 26 feet wide (30 nodes); and background reference grids were 8.3 feet long by 10 feet wide (30 nodes). No deviations from planned sampling locations were necessary at either DU.

5.2 XRF Screening Results

The Target Berm and Backstop Area were screened for lead by handheld XRF (the Constructed Pond was not screened per the UFP-QAPP, because the soil was too moist for reliable results) 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. Additional replicate readings were taken on four samples within roughly ± 100 ppm of the action level (400 ppm lead) for in-field QC precision measurements (RSD; **Section 4.2**).

Target Berm

A total of 39 samples were collected and analyzed for lead by XRF at the Target Berm. No DU samples exceeded the human health criterion for lead (400 mg/kg). Refinement of the DU boundary and discrete subsurface soil sampling were not necessary per the UFP-QAPP. The original DU boundary was carried forward for ISM sampling. Average lead results ranged from

11 ppm at grid #08 to a maximum 242 ppm at grid #21. A summary of discrete XRF lead results is provided in **Table 5-1** and shown in **Figure 5-1**.

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

Sample ID	Moisture (%)	Average Lead Result (ppm)	Max Error (+/-)*
WIL01X01	0	15	2
WIL01X02	5	15	2
WIL01X03	0	42	4
WIL01X04	0	51	3
WIL01X05	0	57	5
WIL01X06	0	62	5
WIL01X07	0	55	4
WIL01X08	0	11	2
WIL01X09	5	19	3
WIL01X10	0	27	3
WIL01X11	0	236	7
WIL01X12	0	21	3
WIL01X13	0	165	5
WIL01X14	0	38	3
WIL01X15	0	85	4
WIL01X16	0	39	3
WIL01X17	0	16	2
WIL01X18	5	22	3
WIL01X19	0	27	3
WIL01X20	5	71	4

Sample ID	Moisture (%)	Average Lead Result (ppm)	Max Error (+/-)*
WIL01X21	0	242	7
WIL01X22	0	63	4
WIL01X23	0	85	4
WIL01X24	0	26	3
WIL01X25	0	19	3
WIL01X26	0	21	3
WIL01X27	0	93	4
WIL01X28	5	19	3
WIL01X29	0	72	4
WIL01X30	0	19	3
WIL01X31	0	76	4
WIL01X32	0	21	3
WIL01X33	0	28	3
WIL01X34	5	24	3
WIL01X35	0	17	3
WIL01X36	0	46	3
WIL01X37	0	14	2
WIL01X38	0	15	3
WIL01X39	0	14	2

Notes

* = Error: 2-sigma, 95% confidence

Sample exceeds residential soil RBSL for lead

ppm = parts per million

Backstop Area

Thirty discrete samples were collected and analyzed for lead by XRF at the Backstop Area. No samples exceeded the human health criterion for lead. Evidence of spent bullets were observed at the base of coulee walls in the Backstop Area; however, no bullets or bullet fragments were observed in XRF samples. Average lead results ranged from 12 ppm at grid #30 to a maximum 119 ppm at grid #18. Refinement of the DU boundary and discrete subsurface soil sampling were not necessary per the UFP-QAPP. The original DU boundary was carried forward for ISM sampling. A summary of discrete XRF lead results is provided in **Table 5-2** and shown in **Figure 5-2**.

CLIENT	Army National Guard			
PROJECT	RI through DD for Williston LTA, ND MRS			
REVISION NO	0	GIS BY	MS	12/13/2018
SCALE	1:300	CHK BY	JL	12/13/2018
SOURCE	ARNG; State of North Dakota, ESRI & Partners	PM	LS	12/13/2018

N

Target Berm XRF Results

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Figure 5-1

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Table 5-2. Summary of Discrete XRF Lead Results in Surface Soil – Backstop Area

Sample ID	Moisture (%)	Average Lead Result (ppm)	Max Error (+/-)*
WIL03X01	0	15	2
WIL03X02	0	13	2
WIL03X03	0	18	3
WIL03X04	0	17	3
WIL03X05	0	26	3
WIL03X06	10	19	3
WIL03X07	0	26	3
WIL03X08	0	24	3
WIL03X09	5	28	3
WIL03X10	0	15	2
WIL03X11	0	19	3
WIL03X12	0	16	3
WIL03X13	0	16	5
WIL03X14	0	15	2
WIL03X15	0	15	2
WIL03X16	0	14	2
WIL03X17	0	17	3
WIL03X18	0	119	5
WIL03X19	0	20	4
WIL03X20	0	18	3
WIL03X21	0	19	3
WIL03X22	0	24	3
WIL03X23	0	15	2
WIL03X24	5	23	3
WIL03X25	0	19	3
WIL03X26	0	17	2
WIL03X27	0	15	2
WIL03X28	0	13	2
WIL03X29	0	13	2
WIL03X30	0	12	2

Notes

* = Error: 2-sigma, 95% confidence

Sample exceeds residential soil RBSL for lead

ppm = parts per million

CLIENT	Army National Guard			
PROJECT	RI through DD for Williston LTA, ND MRS			
REVISION NO	0	GIS BY	MS	12/13/2018
SCALE	1:480	CHK BY	JL	12/13/2018
SOURCE ARNG; State of North Dakota, ESRI & Partners		PM	LS	12/13/2018

Backstop Area XRF Results

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Figure
5-2

Q:\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 5 SARs\900-Work\GIS\ND_Williston\MXD\RI_Figures\Fig_5-2_Williston_LTA_Backstop_Area_XRF_Results.mxd

5.3 Incremental Sampling Results

IS were collected after XRF screening was complete using the initial DU boundary established for the Target Berm, Constructed Pond, and Backstop Area. XRF screening was not needed in the background reference area; IS were collected in the established area as described in **Section 3.1.2**. Sample collection logs are included in **Appendix A**. All IS results are summarized in **Table 5-3**, and **Figure 5-3**.

<u>Background Reference</u>

IS were collected from a 0.06-acre area within a background reference location (**Figure 5-3**). IS samples were collected in triplicate (WIL04IS01, -02, and -03), with each IS containing 30 increments of equal volume. Soil within the background area was predominantly comprised of sandy silt that contained small amounts of organic material and little moisture. No evidence of small arms range impact or debris was observed within the area or samples.

Analytical results showed that antimony was not detected in any Background IS. Copper ranged from 14.4 to 15.4 mg/kg among triplicate samples (J+ flagged). Lead concentrations ranged from 6.66 to 7.26 mg/kg. Zinc concentrations ranging from 51.1 to 56.5 mg/kg. No result exceeded human health screening criteria (**Table 5-3**).

<u>Target Berm</u>

ISM was applied to the initial Target Berm DU boundary (0.09 acres) following XRF screening (**Figure 5-3**). IS were collected in triplicate (WIL01IS01, -02, and -03); each IS contained 39 increments of equal volume. Soil within the DU was predominantly a clayey silt with minor amounts of sand and gravel, low to medium amount organic content (fine roots), and a low moisture content (**Appendix A**).

Analytical results showed that antimony was not detected in any Target Berm IS sample. Copper concentrations ranged from 21 (J+ flagged) to 24.3 mg/kg. The highest concentration of lead was recorded from sample WIL01IS03 at 69.1 mg/kg. Zinc concentrations for Target Berm IS ranged from 61.2 mg/kg to a maximum concentration of 67.3 mg/kg. No analyte exceeded human health screening criteria (**Table 5-3**).

<u>Constructed Pond</u>

IS were collected from a 0.04-acre area at the Constructed Pond in triplicate (WIL02IS01, -02, and -03); each IS contained 36 increments of equal volume. Soil in the Constructed Pond was densely packed silty clay, with low amounts organic material and high moisture content.

IS collected from the Constructed Pond were analyzed for target small arms metals as well as explosives. Explosives MC and antimony were not detected in any IS sample. Copper, lead, and zinc concentrations were similar in concentration range as the Backstop Area DU. Copper values ranged from 33.9 mg/kg to 38.4 mg/kg among triplicates; lead concentrations showed little variability, ranging from 15.1 mg/kg to 15.9 mg/kg; and levels of zinc ranged from 77.4 to 88.5 mg/kg. No results exceeded the human health screening levels (**Table 5-3**).

Table 5-3. Incremental Sampling Results Summary

Location:		Background Reference											
Sample ID:		WIL04IS01				WIL04IS02				WIL04IS03			
Sample Depth (inches bgs):		0-6				0-6				0-6			
Date Collected:		8/15/2018				8/15/2018				8/15/2018			
Analyte	**Human Health Screening Level**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020B (mg/kg)													
Antimony	31	0.379	U	UJ	m	0.387	U	UJ	m	0.386	U	UJ	m
Copper	310	14.9		J+	m	14.4		J+	m	15.4		J+	m
Lead	400	7.11				6.66				7.26			
Zinc	2,300	56.4				51.1				56.5			

Location:		Target Berm											
Sample ID:		WIL01IS01				WIL01IS02				WIL01IS03			
Sample Depth (inches bgs):		0-6				0-6				0-6			
Date Collected:		8/14/2018				8/14/2018				8/14/2018			
Analyte	**Human Health Screening Level**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020B (mg/kg)													
Antimony	31	0.422	U	UJ	m	0.427	U	UJ	m	0.383	U	UJ	m
Copper	3,100	23.8				21		J+	m	24.3			
Lead	400	46.5				63.5				69.1			
Zinc	2,300	67.3				61.2				64.5			

Location:		Backstop Area											
Sample ID:		WIL03IS01				WIL03IS02				WIL03IS03			
Sample Depth (inches bgs):		0-6				0-6				0-6			
Date Collected:		8/14/2018				8/14/2018				8/14/2018			
Analyte	**Human Health Screening Level**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020B (mg/kg)													
Antimony	31	0.417	U	UJ	m	0.423	U	UJ	m	0.564	U	UJ	m
Copper	3,100	27.3				23.1				35.7			
Lead	400	14.7				14.3				22.7			
Zinc	23,000	72.9				66.9				81.7			

Notes:

Sample exceeds Human Health Screening Level

bgs = below ground surface — U = Non-Detect

LQ = Laboratory Qualifier — J+ = Estimated, positive bias

VQ = Validation Qualifier — m = MS/MSD percent recovery anomaly

RC = Reason Code — UJ = analyte was not detected at level ≥ DL

UQ = Non-detect, associated non-compliant QC result

Table 5-3. Incremental Sampling Results Summary (cont.)

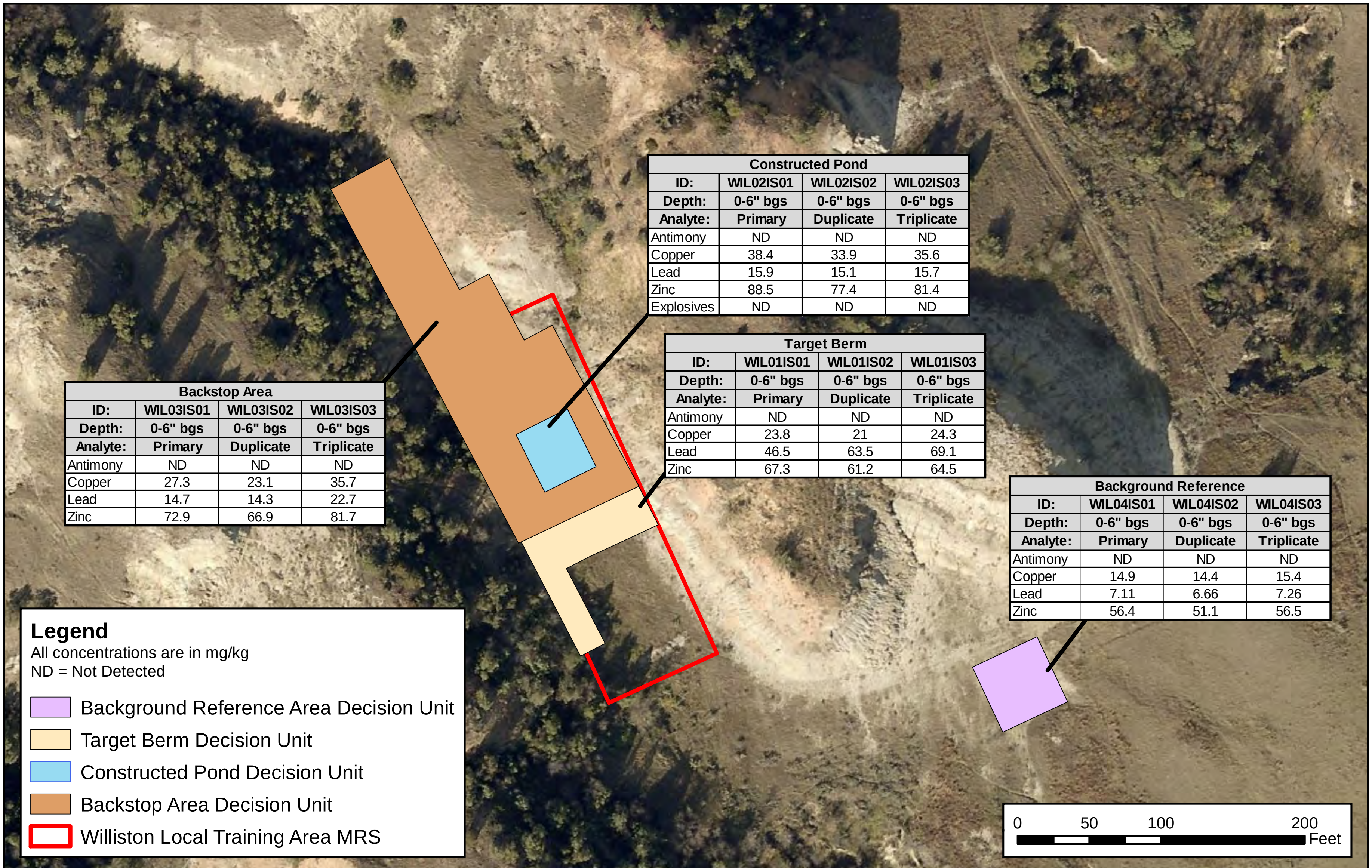
	Location:	Constructed Pond DU											
	Sample ID:	WIL02IS01				WIL02IS02				WIL02IS03			
	Sample Depth (inches bgs):	0-6				0-6				0-6			
	Date Collected:	8/16/2018				8/16/2018				8/16/2018			
Analyte	**Human Health Screening Level**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020B (mg/kg)													
Antimony	31	0.469	U	UJ	m	0.453	U	UJ	m	0.468	U	UJ	m
Copper	3,100	38.4				33.9				35.6			
Lead	400	15.9				15.1				15.7			
Zinc	23,000	88.5				77.4				81.4			
Explosives by USEPA SW-846 Method 8330B													
1,3,5-Trinitrobenzene	220	0.099	U			0.0952	U			0.1	U		
1,3-Dinitrobenzene	63	0.099	U			0.0952	U			0.1	U		
2,4,6-Trinitrotoluene	3.6	0.099	U			0.0952	U			0.1	U		
2,4-Dinitrotoluene	13	0.099	U			0.0952	U			0.1	U		
2,6-Dinitrotoluene	1.9	0.099	U			0.0952	U			0.1	U		
2-Amino-4,6-dinitrotoluene	15	0.099	U			0.0952	U			0.1	U		
2-Nitrotoluene	7	0.099	U			0.0952	U			0.1	U		
3,5-Dinitroaniline	NA	0.099	U			0.0952	U			0.1	U		
3-Nitrotoluene	63	0.149	U			0.143	U			0.15	U		
4-Amino-2,6-dinitrotoluene	15	0.099	U			0.0952	U			0.1	U		
4-Nitrotoluene	25	0.099	UQ			0.0952	UQ			0.1	UQ		
HMX	390	0.099	U			0.0952	U			0.1	U		
Nitrobenzene	13	0.099	U			0.0952	U			0.1	U		
Nitroglycerin	63	0.099	U			0.0952	U			0.1	U		
PETN	13	0.149	U			0.143	U			0.15	U		
RDX	23	0.099	U			0.0952	U			0.1	U		
Tetryl	16	0.099	U			0.0952	U			0.1	U		

Notes:

Sample exceeds Human Health Screening Level

bgs = below ground surface
LQ = Laboratory Qualifier
VQ = Validation Qualifier
RC = Reason Code

U = Non-Detect
J+ = Estimated, positive bias
m = MS/MSD percent recovery anomaly
UJ = analyte was not detected at level ≥ DL
UQ = Non-detect, associated non-compliant QC result



Constructed Pond			
ID:	WIL02IS01	WIL02IS02	WIL02IS03
Depth:	0-6" bgs	0-6" bgs	0-6" bgs
Analyte:	Primary	Duplicate	Triplicate
Antimony	ND	ND	ND
Copper	38.4	33.9	35.6
Lead	15.9	15.1	15.7
Zinc	88.5	77.4	81.4
Explosives	ND	ND	ND

Target Berm			
ID:	WIL01IS01	WIL01IS02	WIL01IS03
Depth:	0-6" bgs	0-6" bgs	0-6" bgs
Analyte:	Primary	Duplicate	Triplicate
Antimony	ND	ND	ND
Copper	23.8	21	24.3
Lead	46.5	63.5	69.1
Zinc	67.3	61.2	64.5

Backstop Area			
ID:	WIL03IS01	WIL03IS02	WIL03IS03
Depth:	0-6" bgs	0-6" bgs	0-6" bgs
Analyte:	Primary	Duplicate	Triplicate
Antimony	ND	ND	ND
Copper	27.3	23.1	35.7
Lead	14.7	14.3	22.7
Zinc	72.9	66.9	81.7

Background Reference			
ID:	WIL04IS01	WIL04IS02	WIL04IS03
Depth:	0-6" bgs	0-6" bgs	0-6" bgs
Analyte:	Primary	Duplicate	Triplicate
Antimony	ND	ND	ND
Copper	14.9	14.4	15.4
Lead	7.11	6.66	7.26
Zinc	56.4	51.1	56.5

CLIENT	Army National Guard			
PROJECT	RI through DD for Williston LTA, ND MRS			
REVISION NO	0	GIS BY	MS	12/19/2018
SCALE	1:1,200	CHK BY	JL	12/19/2018
SOURCE	ARNG; State of North Dakota, ESRI & Partners	PM	LS	12/19/2018

N

Incremental Sampling Results

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Figure 5-3

Q:\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 5 SARs\900-Work\GIS\ND_Williston\MXD\RI_Figures\Fig_5-3_Williston_LTA_Incremental_Sampling_Results.mxd

<u>Backstop Area</u>
ISM was applied to the initial Backstop Area DU boundary (0.4 acres) following XRF screening (**Figure 5-3**). IS were collected in triplicate (WIL03IS01, -02, and -03); each IS contained 30 increments of equal volume. Soil within the DU was predominantly a clayey silt with minor amounts of sand, medium amount organic content (fine roots and grass), and a low moisture content (**Appendix A**).

Analytical results showed that antimony was not detected in any Backstop Area IS. Copper concentrations ranged from 23.1 to 35.7 mg/kg. The highest concentration of lead was recorded from sample WIL03IS03 at 22.7 mg/kg. Zinc concentrations for Backstop Area IS ranged from 66.9 mg/kg to a maximum concentration of 81.7 mg/kg among triplicates. No analyte exceeded its respective human health screening criterion (**Table 5-3**).

5.4 Discrete Sampling Results

Because XRF use was not viable at the Constructed Pond DU due to soil moisture content, discrete samples were collected from two randomly selected locations (grid #11 and grid #22) within the DU (**Figure 5-4**). These locations were selected for subsurface soil sampling (12-18 and 24-30 inches bgs) for target small arms metals and explosives MC, and contingency surface soil (0-6 inches bgs) sampling for TCLP. Subsurface samples were not collected from the Target Berm or Backstop Area DUs because lead was not found to exceed the human health screening criterion for lead in any XRF results; however, contingency TCLP samples were collected from each DU from surface soil at the locations exhibiting the highest lead by XRF result. Analysis of all contingency TCLP samples and subsurface 24-30 inches bgs samples were held at the laboratory pending laboratory results. Because no ISM results exceeded human health screening criteria, TCLP samples were not required to be analyzed by the laboratory per the UFP-QAPP.

At the Constructed Pond DU, subsurface soil from the 12-18 inches bgs layer at grid #11 (WIL01DA01A and duplicate sample WIL01DA01B) and grid #22 (WIL01DA02A) did not exceed the human health screening criteria for any analyte. Lead concentrations ranged from 17.3 mg/kg in the duplicate sample (WIL01DA01B) to 18.9 mg/kg in the parent sample (WIL01DA01A). Antimony was not detected in any sample. Because the human health screening criteria were not exceeded in any sample from the 12-18-inch bgs level, deeper samples from 24-30 inches bgs were not required to be analyzed by the laboratory per the UFP-QAPP. No small arms debris (i.e., bullet fragments or casings) were observed in any subsurface samples collected. **Table 5-4** and **Figure 5-4** present the results of discrete soil sampling.

Table 5-4. Discrete Subsurface Soil Sampling Results

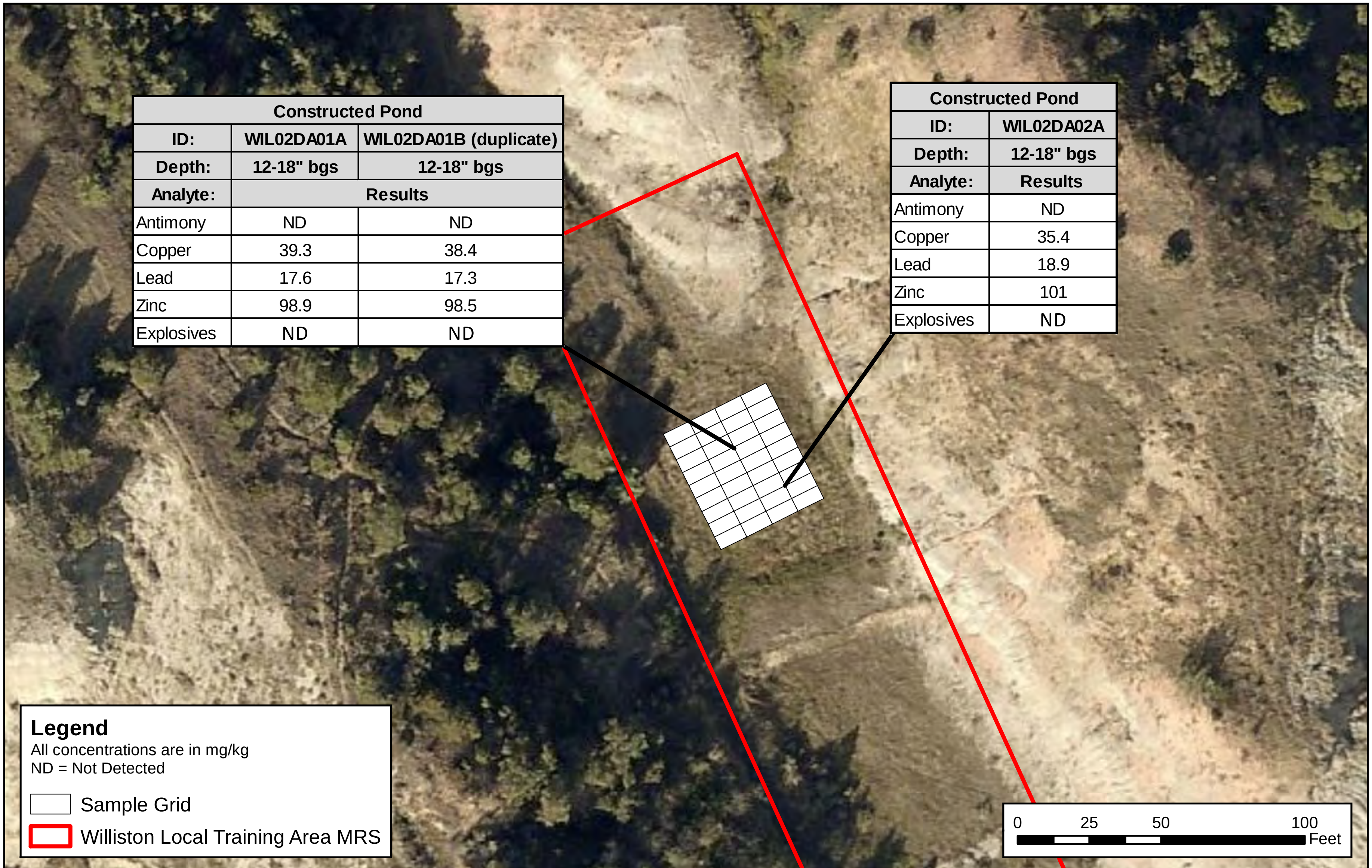
Location:		Constructed Pond DU											
Sample ID:		WIL02DA01A				WIL02DA01B (duplicate)				WIL02DA02A			
Sample Depth (inches bgs):		12-18				12-18				12-18			
Date Collected:		8/16/2018				8/16/2018				8/16/2018			
Analyte	Human Health Screening Level	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC
846 Method 6020B (mg/kg)													
Antimony	31	0.490	U	UJ	m	0.535	U	UJ	m	0.574	U	UJ	m
Copper	3,100	39.3				38.4				35.4			
Lead	400	17.6				17.3				18.9			
Zinc	23,000	98.9		J	s	98.5		J	s	101		J	s
Explosives by USEPA SW-846 Method 8330B													
1,3,5-Trinitrobenzene	220	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQ	UJ	I
1,3-Dinitrobenzene	63	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQ	UJ	I
2,4,6-Trinitrotoluene	4	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQ	UJ	I
2,4-Dinitrotoluene	13	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQ	UJ	I
2,6-Dinitrotoluene	2	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQ	UJ	I
2-Amino-4,6-dinitrotoluene	15	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQ	UJ	I
2-Nitrotoluene	7	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQJ	UJ	I
3,5-Dinitroaniline	NA	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQ	UJ	I
3-Nitrotoluene	63	0.143	UQ	UJ	I	0.15	UQ	UJ	I	0.146	UQ	UJ	I
4-Amino-2,6-dinitrotoluene	15	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQ	UJ	I
4-Nitrotoluene	25	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQJ	UJ	I
HMX	390	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQ	UJ	I
Nitrobenzene	13	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQ	UJ	I
Nitroglycerin	63	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQ	UJ	I
PETN	13	0.143	UQ	UJ	I	0.15	UQ	UJ	I	0.146	UQ	UJ	I
RDX	23	0.0952	UQ	UJ	I	0.1	UQ	UJ	I	0.0971	UQ	UJ	I
Tetryl	16	0.0952	UQ	R	I	0.1	UQ	R	I	0.0971	UQJ	R	I

Notes:

Sample exceeds Human Health Screening Level

bgs = below ground surface
LQ = Laboratory Qualifier
VQ = Validation Qualifier
RC = Reason Code
NA = Not Applicable
U = Non-Detect
UQ = Non-detect, associated non-compliant QC result

J = Estimated
m = MS/MSD percent recovery anomaly
UJ = analyte was not detected at level ≥ DL
s = surrogate failure
I = LCS recovery failure
R = Analyte may or may not be present
UQJ = Non-detect, associated non-compliant QC result, no detected at level > DL



Constructed Pond		
ID:	**WIL02DA01A**	**WIL02DA01B (duplicate)**
Depth:	**12-18" bgs**	**12-18" bgs**
Analyte:	**Results**	
Antimony	ND	ND
Copper	39.3	38.4
Lead	17.6	17.3
Zinc	98.9	98.5
Explosives	ND	ND

Constructed Pond	
ID:	**WIL02DA02A**
Depth:	**12-18" bgs**
Analyte:	**Results**
Antimony	ND
Copper	35.4
Lead	18.9
Zinc	101
Explosives	ND

CLIENT	Army National Guard			
PROJECT	RI through DD for Williston LTA, ND MRS			
REVISION NO	0	GIS BY	MS	12/20/2018
SCALE	1:600	CHK BY	JL	12/20/2018
SOURCE	ARNG; State of North Dakota, ESRI & Partners	PM	LS	12/20/2018

N

Discrete Subsurface Soil Sample Results

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Figure 5-4

Q:\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 5 SARs\900-Work\GIS\ND_Williston\MXD\RI_Figures\Fig_5-4_Williston_LTA_Discrete_Sampling_Results.mxd

6 Contaminant Fate and Transport

This section discusses routes of migration and contaminant persistence for MC at the Williston LTA MRS (NDHQ-008-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. This section updates the preliminary CSM based on RI results.

6.1 Contaminant Migration

Metals MC may have been released directly to berm soil during historical small arms training activities through fragmentation and pulverization of bullets on impact. However, MC deposited in surface soil as a result of firing activities at the MRS has limited potential to migrate from source areas (Target Berm, Constructed Pond, Backstop Area) beyond the Williston LTA MRS boundary. Furthermore, no MC analytes were found during the RI that exceeded human health screening criteria. Due to MRS topography and range orientation, stormwater runoff from significant rain events is unlikely to transport suspended soil particles off-site. The firing range is located within a coulee, and stormwater runoff from the surrounding steep hills flows radially inward towards the coulee floor (Constructed Pond and Backstop Area). With the exception of the steep coulee walls, the majority of the MRS and DUs are vegetated with grasses and shrubs and therefore reducing the likelihood of overland transport. XRF analysis of the Target Berm and Backstop Area was able to clearly delineate the extent of metals MC, verifying that impacted soil was not migrating away from source areas or MRS boundaries at concentrations that would pose a risk to human health. Significant disturbance of soil within the DU is possible, but unlikely during human activities that occur in the MRS boundary (i.e., site workers associated with cattle grazing activities and trespassers).

Metals MC also has the potential to be released to groundwater through leaching and/or infiltration mechanisms where groundwater is shallow (≤ 5 feet bgs). However, historical well data and topographic relief indicate that groundwater at the MRS is approximately 80 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), as metals MC have a strong affinity to sorb to soil particles. 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. Furthermore, MC concentrations within surface soil were below human screening levels for all samples collected across the DUs. The subsurface samples collected during this RI at two locations within the Constructed Pond DU showed that subsurface MC concentrations are nearly identical to surface soil concentrations, with no increase in metals MC with depth, suggesting that any contamination is contained to the surface soils and is not leaching into groundwater and off-site.

Metals MC is not migrating from any DU defined during this RI.

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.

7 MC Risk Screening

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. The results of the screening were used to support risk management decisions at the MRS.

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, Constructed Pond, and Backstop Area.

As a conservative approach for each DU area, the maximum detected concentration of individual small arms metals among the IS triplicates was compared with conservative risk-based human health screening criteria to identify chemicals of potential concern. The selection of screening criteria used during this RI is presented in **Section 3.3.1** and **Table 3-2**.

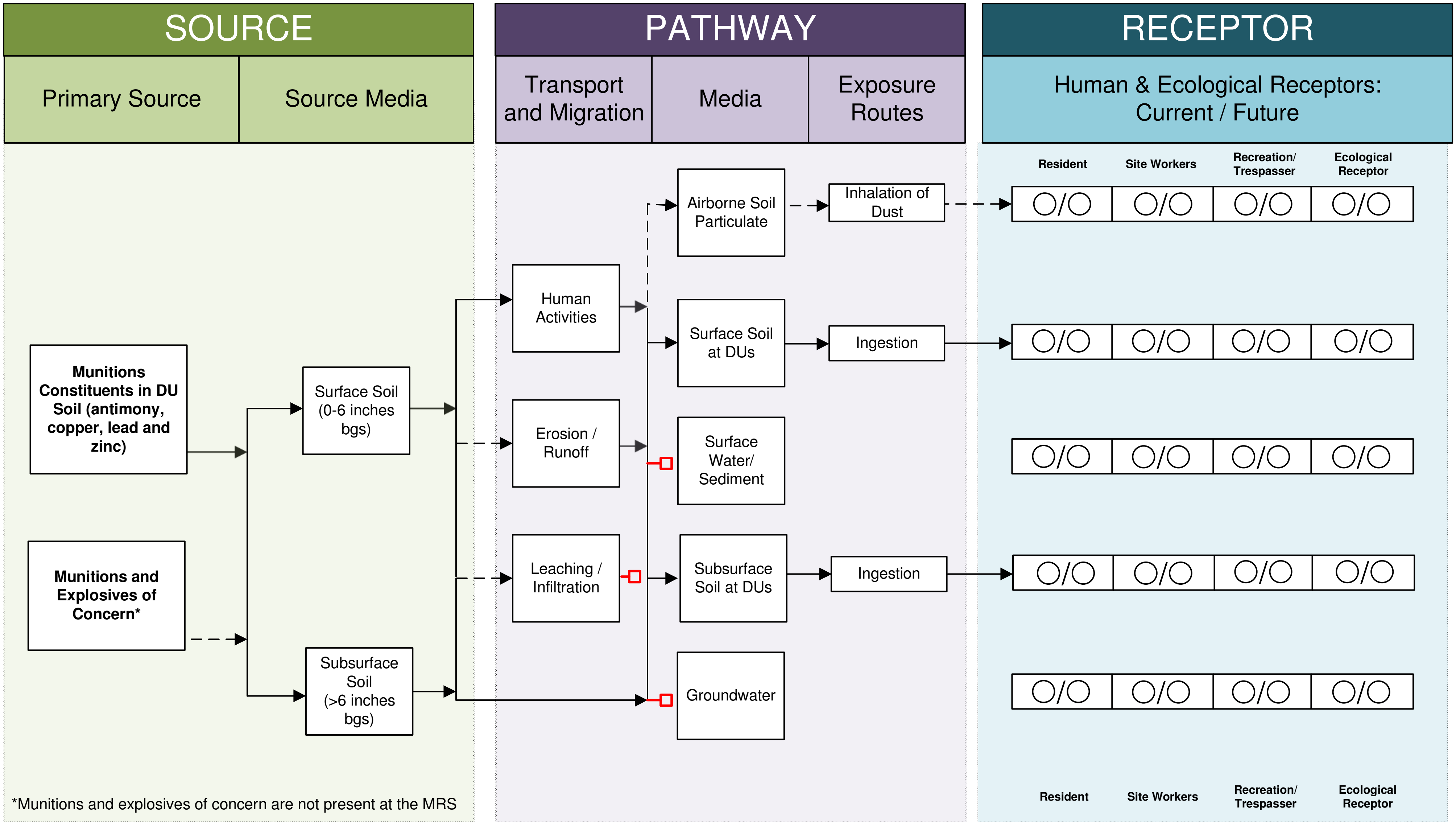
The preliminary CSM discussed in **Section 2.6** and presented in **Figure 2-3** for the Williston LTA MRS was updated based on results of the risk screening and fate and transport analysis. Pathway completeness is based on the presence of an elevated risk to the receptor that would drive an action. Pathways are considered complete where the risk screening indicates elevated risk to the receptor; if the risk screening concludes there is no elevated risk, the pathway is incomplete. Source to receptor exposure pathways are summarized and updated in the revised CSM diagram shown on **Figure 7-1**.

As discussed in the CSM presented in **Section 2.6**, based on the analysis of habitat and no known sensitive ecological species inhabiting the MRS, it is unlikely there is an elevated exposure risk to ecological receptors at the MRS. The exposure pathways are considered incomplete (**Figure 2-3**) and screening was therefore not performed.

7.1 Human Health Risk Screening Results

Analytical results showed that small arms metals, with the exception of antimony, are present at all three DUs at levels above Background concentrations. The maximum concentrations of copper, lead, and zinc are two to three times greater at each DU than their respective minimum background concentrations, except for lead at the Target Berm DU which was ten times greater than background. However, no analyte exceeded USEPA Regional Human Health Screening Levels for Residential Soil (USEPA, 2018). Antimony was not detected in any ISM sample from the Background area or any of the three DUs. The maximum concentration of lead, copper, and zinc observed in ISM samples were at least one order of magnitude below their respective screening levels for each DU. Because explosives were not detected in any of the samples collected at the Constructed Pond DU, screening was not necessary.

Table 7-1 summarizes the results of the screening level comparisons. Based on the results of the human health risk-based screening analysis, there is no evidence to suggest any elevated



LEGEND

Flow-Chart Stops

Flow-Chart Continues

Partial / Possible Flow

Incomplete Pathway

Potentially Complete Pathway

Complete Pathway

Figure 7-1
Revised Conceptual Site Model Diagram
Williston LTA MRS, North Dakota

risk to human receptors visiting the Target Berm, Constructed Pond, or Backstop Area DUs. **Figure 7-1** reflects the results of the risk-based screening analysis for the Williston LTA MRS.

Table 7-1. Human Health Risk Screening Summary

Analyte	Health Screening Level (mg/kg)	Minimum Background Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)		
			Target Berm	Backstop Area	Constructed Pond
Total Metals by USEPA SW-846 Method 6020B (mg/kg)					
Antimony	31	ND	ND	ND	ND
Copper	3,100	14.4	**24.3**	**35.7**	**38.4**
Lead	400	6.66	**69.1**	**22.7**	**15.9**
Zinc	23,000	51.1	**67.3**	**81.7**	**88.5**

Notes:

Bold = Exceeds Background ND = Analyte Not Detected

Exceeds Screening Criteria

8 Munitions Response Site Prioritization Protocol

This section discusses application of the MRSPP for the Williston LTA MRS (NDHQ-008-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 E**. 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 munitions and explosives of concern (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 previous MRSPP was completed in 2012 and resulted in the following module priority scores which correspond to an overall priority rating of 5.

- Explosive Hazard Evaluation (EHE) Module: 6
- Chemical Warfare Material (CWM) Hazard Evaluation (CHE) Module: No Known or Suspected CWM Hazard
- Health Hazard Evaluation (HHE) Module: 5

The following sections are a brief summary of the modules of the MRSPP and the results of the evaluations for the Williston LTA MRS (NDHQ-008-R-01) updated as a part of the RI.

8.1 Explosive Hazard Evaluation Module

The 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, which 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 Williston LTA MRS (NDHQ-008-R-01) received the alternative EHE Module rating of No Longer Required. This module rating was based on the MRS being a small arms range and no MEC being identified at the MRS during the NDARNG PA (NDARNG, 2013) or the RI field work. The MRS contains the target berm of a former small arms range; bullet fragments were observed during RI sampling activities at the base of the backstop walls. The EHE Module worksheet tables are presented in **Appendix E** and summarized in **Section 8.4**.

8.2 Chemical Warfare Material Hazard Evaluation Module

The CHE Module provides an evaluation of the chemical hazards associated with the physiological effects of CWM. The CHE Module is used only when CWM 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 PA or RI activities that indicated CWM was present at the MRS. The worksheet tables are presented in **Appendix E** and summarized in **Section 8.4**.

8.3 Health Hazard Evaluation Module

The 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 level 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 level 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 level 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 MC 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 Williston LTA MRS (NDHQ-008-R-01) received the LLL media combination level for surface soil and the alternative HHE Module Rating of No Known or Suspected MC Hazard. The HHE Module rating is based on concentrations of MC in surface soil not exceeding respective screening levels. The HHE Module worksheet tables are presented in **Appendix E** 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 Williston LTA MRS (NDHQ-008-R-01) is assigned the alternative rating of No Longer Required. The EHE Module rating selected was No Longer Required; the CHE Module rating selected was No Known or Suspected CWM Hazard, and HHE Module rating selected was No Known or Suspected MC Hazard. These module ratings correspond to the alternative MRSPP priority rating of No Longer Required. A summary of the MRSPP scores for each module is provided in **Table 8-1**.

Table 8-1. Munitions Response Site Priority Summary

MRSPP Module	Factors			Module Total	Module Rating	MRS Priority
	Hazard	Accessibility/ Migration	Receptor			
EHE Module	3	9	9	21	NLR	**NLR**
CHE Module	0	0	0	0	NKSH	
HHE Module	L	L	L	LLL	NKSH	

Notes:
NLR = No Longer Required
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 Williston LTA MRS (NDHQ-008-R-01). The conclusions provide general and comparative interpretations of the findings in terms of the general objectives of the MMRP.

9.1 Summary of Remedial Investigation Activities

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 Williston LTA MRS. The sampling approach was designed to characterize the nature and extent of MC contamination in soil at the Target Berm, Constructed Pond, and Backstop Area. For data interpretation purposes and for assessing risks, the MRS was divided into three DUs (Target Berm, Constructed Pond, and Backstop Area) that reflect the three areas of potential contamination as indicated by site history and remaining physical evidence of the target areas and backstop. Field investigation activities included XRF screening of the Target Berm DU and the Backstop Area DU, to evaluate the lateral extent of MC, and the collection of surface soil samples using ISM to determine a representative exposure point concertation for evaluating risks. XRF screening was not conducted on the Constructed Pond DU because soil was too moist for reliable results. Discrete subsurface sampling was also conducted at the Constructed Pond DU at select areas to determine the vertical extent of MC.

This information was evaluated and used to interpret 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.

9.2 Summary of Remedial Investigation Results

The data collected at the MRS were sufficient to delineate the extent of site-related MC contamination. No exceedances of the human health criterion for lead were observed in XRF screening results at the Target Berm (**Table 5-1**) or Backstop Area (**Table 5-2**). No step-out sampling was necessary for either DU (**Figure 5-1** and **5-2**), and discrete subsurface samples were not analyzed. XRF screening was not conducted on the Constructed Pond DU because the soil was too moist for reliable results, and the DU was surrounded by the Backstop Area DU. XRF data showed that metals MC are not migrating at levels above the human health criteria from source locations at the Target Berm and Backstop Area.

Two locations for discrete subsurface soil sampling (location #11 and #22) were randomly selected within the Constructed Pond DU (**Section 5.4** and **Table 5-4**). Discrete subsurface sampling at both locations indicated that metals MC were not present above their human health screening criteria in the 12-18 inches bgs stratum; explosives MC were not detected in any sample. Analysis of the 24-30 inches bgs stratum was not necessary because no concentrations of MC exceeded their respective health screening criteria.

The vertical extent of MC in soil at the MRS was delineated. XRF data and subsurface sampling showed that MC is contained within the first 0-12 inches of soil and is not migrating to deeper stratum.

ISM, as applied to the DUs during this RI, provided high quality data that are an unbiased estimate of the mean concentration of MC in soil from range features. ISM data are suitable for risk screening as there is a high degree of confidence in the representativeness of the data.

IS collected from each of the three DUs showed elevated concentrations of copper, lead, and zinc compared to background (**Table 5-3** and **Figure 5-3**). However, no detected analyte exceeded its respective USEPA Regional Human Health Screening Levels for Residential Soil (USEPA, 2018) (**Section 7.1**). Antimony was not detected in any IS sample and explosives were not detected in samples from the Constructed Pond DU. All analytical results for IS showed that concentrations of metals MC were at least one to three orders of magnitude below their respective human health screening levels. Based on these results, there is no evidence of unacceptable risk to human receptors visiting the Target Berm, Constructed Pond, or Backstop Area.

9.3 Conclusions and Recommendations

Based on the results of the RI, the MRS has been sufficiently characterized. Based on the lack of unacceptable risks, an FS is not warranted at the Williston LTA MRS. No Action is recommended for the entirety of 0.52-acre MRS (**Figure 9-1**). The next step 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.

CLIENT Army National Guard				
PROJECT RI through DD for Williston LTA, ND MRS				
REVISION NO 0	GIS BY	MS	11/12/2018	
SCALE 1:960	CHK BY	JL	11/12/2018	
SOURCE ARNG; State of North Dakota, ESRI & Partners	PM	LS	11/12/2018	

N

Proposed MRS Recommendation

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Figure 9-1

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10 References

AECOM, 2018. *Final Remedial Investigation Work Plan and UFP-QAPP*. June.

ATSDR (Agency for Toxic Substances and Disease Registry). 2007. Toxicological Profile for Lead, U.S. Department of Health and Human Services. August 2007.

ATSDR. 1995. Public Health Statement, Tetryl, CAS#: 479-45-8, U.S. Department of Health and Human Services. June 1995.

DoD. 2007. *Munitions Response Site Prioritization Protocol (MRSPP) Primer*. June 2007.

EA Engineering, Science, and Technology, 1993. Final Preliminary Assessment Narrative Report Garrison Dam and Lake Sakakawea Riverdale, North Dakota. 1993.

Earth Resources Technology, Inc., 2008. Final Operational Range Assessment Program Phase I Qualitative Assessment Report, Williston Local Training Area, Williston, North Dakota. April 2008.

Evans, L.J. 1981. Chemistry of Metal Retention, Environmental Science Technology, 23:1046-1056.

Interstate Technology Regulatory Council (ITRC). 2012. *Incremental Sampling Methodology*. Technical and Regulatory Guidance. February.

Freers, Theodore, R., 1970. *Geology and Ground Water Resources of Williams County, North Dakota*. 1970.

National Oceanic and Atmospheric Administration (NOAA), 2017. Climate Data Online. https://www.ncdc.noaa.gov/cdo-web/. (Accessed November 2017).

Natural Resources Conservation Service (NRCS), 2007. Custom Soil Resource Report for Williams County, North Dakota, http://www.nrcs.usda.gov. (Accessed October 2007).

North Dakota Agricultural Weather Network. https://ndawn.ndsu.nodak.edu/. (Accessed November 2017).

North Dakota Army National Guard, 2012. Memorandum Through ARNG-TRS, Branch Chief (ARNG-TRS-S/LTC Trygve Trosper), 111 S George Mason Drive, Arlington VA 22204-1382. Subject: Closing of 0.47 Operational Range Acres within Williston Training Area, Williston, North Dakota. 17 February 2012.

North Dakota Army National Guard, 2013. Preliminary Assessment Williston Local Training Area, North Dakota. 29 April 2013.

North Dakota Army National Guard, 2013. Readiness Operations Personnel Interviews. 29 April 2007 by ERT, Inc.

Oak Ridge National Laboratory. 1989. *The Installation and Restoration Program Toxicology Guide*. Harry G. Armstrong Aerospace Medical Research Laboratory. Air Force Systems Command. Volumes I through IV.

Olympus Scientific Solutions Americas Corp. (2014). *DELTA Handheld XRF, Limits of Detections (LODs) for Geochemical Analyzers*. http://northernani.com/wp-content/uploads/2014/08/Mining_LOD_DELTA_Professional.pdf.

Sedivec, Kevin K. and Barker, William T., North Dakota State University, Animal Range Sciences Department, 2007. Integrated Natural Resources Management Plan, Williston Local Training Area. 2007.

Shjeflo, Jelmer B., 1968. Evapotranspiration and the Water Budget of Prairie Potholes in North Dakota. Geological Survey Professional Paper 585-B. 1968.

U.S. Army. 2009. *Final Military Munitions Response Program, Munitions Response Remedial Investigation/Feasibility Study Guidance*. November 2009.

U.S. Census Bureau, 2017. http://www.factfinder.census.gov. (Accessed November 2017). http://quickfacts.census.gov. (Accessed November 2017).

U.S. Fish and Wildlife Service (USFWS), 2017a. National Wetlands Inventory: Wetlands Mapper. http://www.fws.gov/wetlands/Data/mapper.html. (Accessed November 2017).

USFWS, 2017b. Environmental Conservation Online System (ECOS). https://ecos.fws.gov/ecp0/reports/species-by-current-range-county?fips=38105. (Accessed November 2017).

U.S. Geological Survey, 2007. Groundwater Atlas of the U.S., California, Nevada, North Dakota, and South Dakota. http://capp.water.usgs.gov. (Accessed November 2007).

U.S. Environmental Protection Agency (USEPA), 2018. *Regional Screening Level (RSL) Table and User's Guide Dated November 2018*. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

USEPA, 2017a. *National Functional Guidelines for Inorganic Superfund Methods Data Review (ISM02.4)*, January 2017, EPA-540-R-2017-001.

USEPA, 2017b. *National Functional Guidelines for Organic Superfund Methods Data Review (SOM02.4)*, January 2017, EPA-540-R-2017-002.

USEPA, 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. Office of Solid Waste and Emergency and Remedial Response, OSWER Directive 9234.1-01. August.

Appendix A

Field Forms

Soil Sample
Collection Logs

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 1230
Departure Time: 1415

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/14/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: J.Li

Sample ID: WIL01IS01

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	90
Sand (0.06 – 2 mm)	5
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	2.5Y-8/2
Moisture (%)	5%
Bullets or Bullet Fragments?	YES / NO

Sample Collection Tools Used: Soil probe

Sample Types

☒ Incremental (always taken Triplicate) – No. of Increments: 39

☐ Discrete – Depth interval: ________

XRF Result: ________

XRF Error: ________

Quality Control Samples

Duplicate MS/MSDs Field Blank Equipment Blank N/A

Notes:

Sample Time: 1340

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 1230
Departure Time: 1415

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/14/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JL

Sample ID: WIL01IS02

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	95%
Sand (0.06 – 2 mm)	5
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	2.5Y-8/2 Tan/lt. brown
Moisture (%)	0%
Bullets or Bullet Fragments?	YES / NO

Sample Collection Tools Used: Soil probe

Sample Types

☒ Incremental (always taken Triplicate) – No. of Increments: 39

☐ Discrete – Depth interval: ______

XRF Result: ______

XRF Error: ______

Quality Control Samples

Duplicate MS/MSDs Field Blank Equipment Blank N/A

Notes:

Sample Time: 1350

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 1230
Departure Time: 1415

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/14/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JL

Sample ID: WIL01IS03

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	90
Sand (0.06 – 2 mm)	5
Gravel (2.64 mm)	5
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	2.54-8/2
Moisture (%)	0%
Bullets or Bullet Fragments?	YES / NO

Sample Collection Tools Used: Soil probe

Sample Types

☒ Incremental (always taken Triplicate) – No. of Increments: 39

☐ Discrete – Depth interval: ________

XRF Result: ________

XRF Error: ________

Quality Control Samples

Duplicate MS/MSDs Field Blank Equipment Blank N/A

Notes: Sample Time - 1400

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 1630
Departure Time: 1400

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/15/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JC

Sample ID: WILØ2ISØ1

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	100
Sand (0.06 – 2 mm)	0
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	2.54-8/2
Moisture (%)	10%
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:

Sample Time: 1200

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 1030
Departure Time: 1400

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/15/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JL

Sample ID: WIL02IS02

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	100%
Sand (0.06 – 2 mm)	0
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	2.5Y - 7/2
Moisture (%)	20%
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:

Sample Time: 1210

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 1030
Departure Time: 1400

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/15/13

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JL

Sample ID: WIL02IS03

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	100%
Sand (0.06 – 2 mm)	0
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	2.5Y-8/2
Moisture (%)	30%
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:

Sample Time: 1220

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 1430
Departure Time: 1610

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/14/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JL

Sample ID: WIL Ø3 IS Ø1

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	90%
Sand (0.06 – 2 mm)	5%
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	2.5Y - 7/2
Moisture (%)	0%
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:

Sample Time: 1600

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 1430
Departure Time: 1610

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/14/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JL

Sample ID: WIL03IS02

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	95%
Sand (0.06 – 2 mm)	5
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	2.5Y - 7/2
Moisture (%)	00/6
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: Sample Time: 1605

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 1430
Departure Time: 1610

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/14/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JL

Sample ID: WIL03IS03

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	100%
Sand (0.06 – 2 mm)	0
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	2.5Y - 7/2
Moisture (%)	0%
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:

Sample Time: 1610

Ice Water leaked into bag during transport of sample

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 1440
Departure Time: 1615

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/15/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JL

Sample ID: WIL04IS01

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	85
Sand (0.06 – 2 mm)	15
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	7.5B-7/2
Moisture (%)	0%
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: Sample Time = 1600

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 1440
Departure Time: 1615

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/15/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: ______

Sample ID: WILΦ4ISΦ2

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	85
Sand (0.06 – 2 mm)	15
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	~~0%~~ 2.5Y - 8/4
Moisture (%)	0%
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: Sample Time: 1605

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 1440
Departure Time: 1615

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/15/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JC

Sample ID: WIL04IS03

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	85
Sand (0.06 – 2 mm)	15
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	5.0Y-8/2
Moisture (%)	0%
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: Sample Time: 1610

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 0900
Departure Time: 1100

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/16/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JC

Sample ID: WILΦ2DAΦ1A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	100%
Sand (0.06 – 2 mm)	0
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	7.5Y - 7/2 Dark grey brown
Moisture (%)	
Bullets or Bullet Fragments?	YES / NO

Sample Collection Tools Used: Disposable

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:

Duplicate = WILΦ2DAΦ1B, Sample Time = 0935

Sample Time = 0930

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 0900
Departure Time: 1100

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/16/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JL

Sample ID: WIL02DB01A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	100%
Sand (0.06 – 2 mm)	0
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	2.5Y-7/2 Dark grayish brown
Moisture (%)	
Bullets or Bullet Fragments?	YES / NO

Sample Collection Tools Used: Disposable

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:

Sample Time: 0950

Analysis contingent on WIL02DA01A results

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 0900
Departure Time: 1100

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/16/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JL

Sample ID: WILØ2DAØ2A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	100%
Sand (0.06 – 2 mm)	0
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	2.5Y-7/2 Dark grey brown
Moisture (%)	
Bullets or Bullet Fragments?	YES / NO

Sample Collection Tools Used: Disposable

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:

Sample Time: 1020

AECOM

Site ID: Williston LTA MRS, ND
Arrival Time: 0900
Departure Time: 1100

Soil Sample Collection Log

Site Name/Location: Williston LTA MRS, North Dakota Date: 8/16/18

On-Site Personnel: J. Li, J. Witte, L. Councell Log Preparer: JL

Sample ID: WILØ2DBØ2A

Soil Sample Characterization

Grain Size (%)	
Silt/Clay (<0.06 mm)	100%
Sand (0.06 – 2 mm)	0
Gravel (2.64 mm)	0
Cobble (64 – 256 mm)	0
Organic Content	LOW / MED / HIGH
Color	2.5Y-7/2 Dark grey brown
Moisture (%)	
Bullets or Bullet Fragments?	YES / NO

Sample Collection Tools Used: Disposable

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:

Sample Time: 1030

Analysis Contingent on WILØ2DAØ2A results

Soil Sample Collection Logs - XRF Analysis

Soil Sample Collection Log
XRF Analysis
Williston LTA MRS, ND

Location: Berm (DU 01)

ID			Date/ Initials	% Moist.	Lead (PPM)	Error (±)	Comments
WIL01X	01	A	8/13/18 JW	0%	17	2	
WIL01X	01	B			19	2	
WIL01X	01	C			11	2	
WIL01X	01	D			13	2	
WIL01X	02	A	8/14/18 JW	5%	12	2	
WIL01X	02	B			16	2	
WIL01X	02	C			15	2	
WIL01X	02	D			16	2	
WIL01X	03	A	8/14/18 JL	0%	31	3	
WIL01X	03	B			28	3	
WIL01X	03	C			76	4	
WIL01X	03	D			31	3	
WIL01X	04	A	8/14/18 JL	0%	57	3	
WIL01X	04	B			49	3	
WIL01X	04	C			50	3	
WIL01X	04	D			48	3	
WIL01X	05	A	8/14/18	0%	40	3	
WIL01X	05	B			125	5	
WIL01X	05	C	JW		31	3	
WIL01X	05	D			33	3	
WIL01X	06	A	8/14/18 JW	0%	42	3	
WIL01X	06	B			41	3	
WIL01X	06	C			122	5	
WIL01X	06	D			42	3	

Soil Sample Collection Log
XRF Analysis
Williston LTA MRS, ND

Location: Berm (DU 01) - cont.

ID			Date/ Initials	% Moist.	Lead (PPM)	Error (±)	Comments
WIL01X	7	A	8/14/18 JW	0%	37	3	
WIL01X	7	B			57	3	
WIL01X	7	C			79	4	
WIL01X	7	D			45	3	
WIL01X	8	A	8/14/18 JW	0%	ND<6	—	
WIL01X	8	B			14	2	
WIL01X	8	C			11	2	
WIL01X	8	D			8	2	
WIL01X	9	A	8/13/18 jw	5%	17	3	
WIL01X	9	B			20	2	
WIL01X	9	C			16	3	
WIL01X	9	D			21	3	
WIL01X	10	A	8/14/18 JL		29	3	
WIL01X	10	B			26	3	
WIL01X	10	C			25	3	
WIL01X	10	D			27	3	
WIL01X	11	A	8/14/18 JW	0%	247	6	Precision Replicates: 8/15/18, 0%
WIL01X	11	B			322	7	E: 164 ±5
WIL01X	11	C			111	4	F: 403 ±8
WIL01X	11	D			215	6	G: 187 ±5
WIL01X	12	A	8/14/18 JL		21	3	
WIL01X	12	B			17	3	
WIL01X	12	C			22	3	
WIL01X	12	D			23	3	

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Soil Sample Collection Log
XRF Analysis
Williston LTA MRS, ND

Location: Berm (DU 01) - cont.

ID			Date/ Initials	% Moist.	Lead (PPM)	Error (±)	Comments
WIL01X	13	A	8/14/18 JL	0%	159	5	Precision Replicates
WIL01X	13	B			181	5	E: 152 ppm +/- 5
WIL01X	13	C			163	5	F: 168 ppm +/- 5
WIL01X	13	D			161	5	G: 172 ppm +/- 5
WIL01X	14	A	8/14/18 JL	0%	32	3	
WIL01X	14	B			42	3	
WIL01X	14	C			39	3	
WIL01X	14	D			40	3	
WIL01X	15	A	8/14/18 JW	0%	85	4	
WIL01X	15	B			74	4	
WIL01X	15	C			86	4	
WIL01X	15	D			93	4	
WIL01X	16	A	8/14/18 JW	0%	49	3	
WIL01X	16	B			39	3	
WIL01X	16	C			30	3	
WIL01X	16	D			37	3	
WIL01X	17	A	8/13/18 JW	0%	17	2	
WIL01X	17	B			16	2	
WIL01X	17	C			17	2	
WIL01X	17	D			15	2	
WIL01X	18	A	8/13/18 JW	5%	20	3	
WIL01X	18	B			21	3	
WIL01X	18	C			19	2	
WIL01X	18	D			26	3	

Soil Sample Collection Log
XRF Analysis
Williston LTA MRS, ND

Location: Berm (DU 01) - cont.

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ID			Date/ Initials	% Moist.	Lead (PPM)	Error (±)	Comments
WIL01X	19	A	8/13/18 JW	0%	24	3	
WIL01X	19	B			29	3	
WIL01X	19	C			27	3	
WIL01X	19	D			29	3	
WIL01X	20	A	8/13/18 JW	5%	60	3	
WIL01X	20	B			73	4	
WIL01X	20	C			82	4	
WIL01X	20	D			67	4	
WIL01X	21	A	8/13/18 JW	0%	193	6	
WIL01X	21	B			225	6	
WIL01X	21	C			282	7	
WIL01X	21	D			269	7	
WIL01X	22	A	8/13/18 JW	5%	66	4	
WIL01X	22	B			59	4	
WIL01X	22	C			65	4	
WIL01X	22	D			61	4	
WIL01X	23	A	8/13/18 JW	0%	72	4	
WIL01X	23	B			91	4	
WIL01X	23	C			101	4	
WIL01X	23	D			75	4	
WIL01X	24	A	8/13/18 JW	0%	24	3	
WIL01X	24	B			32	3	
WIL01X	24	C			24	3	
WIL01X	24	D			24	3	

Soil Sample Collection Log
XRF Analysis
Williston LTA MRS, ND

Location: Berm (DU 01) - cont.

ID			Date/ Initials	% Moist.	Lead (PPM)	Error (±)	Comments
WIL01X	25	A	8/13/18 JW	0%	19	2	
WIL01X	25	B			19	2	
WIL01X	25	C			24	3	
WIL01X	25	D			15	2	
WIL01X	26	A	8/13/18 JW	0%	25	3	
WIL01X	26	B			19	3	
WIL01X	26	C			20	3	
WIL01X	26	D			19	2	
WIL01X	27	A	8/13/18 JW	0%	101	4	
WIL01X	27	B			81	4	
WIL01X	27	C			95	4	
WIL01X	27	D			95	4	
WIL01X	28	A	8/13/18 JW	5%	21	3	
WIL01X	28	B			16	2	
WIL01X	28	C			24	3	
WIL01X	28	D			13	2	
WIL01X	29	A	8/13/18 JW	0%	79	4	
WIL01X	29	B			65	4	
WIL01X	29	C			70	4	
WIL01X	29	D			72	4	
WIL01X	30	A	8/13/18 JW	0%	19	3	
WIL01X	30	B			25	3	
WIL01X	30	C			17	2	
WIL01X	30	D			14	2	

Soil Sample Collection Log
XRF Analysis
Williston LTA MRS, ND

Location: Berm (DU 01) - cont.

ID			Date/ Initials	% Moist.	Lead (PPM)	Error (±)	Comments
WIL01X	31	A	8/13/18 JW	0%	63	4	
WIL01X	31	B			96	4	
WIL01X	31	C			79	4	
WIL01X	31	D			67	4	
WIL01X	32	A	8/13/18 JW	0%	17	2	
WIL01X	32	B			27	3	
WIL01X	32	C			20	2	
WIL01X	32	D			19	2	
WIL01X	33	A	8/13/18 JW	0%	25	3	
WIL01X	33	B			24	3	
WIL01X	33	C			36	3	
WIL01X	33	D			25	3	
WIL01X	34	A	8/13/18 JW	0%	35	3	
WIL01X	34	B			19	3	
WIL01X	34	C			21	3	
WIL01X	34	D			20	3	
Step-Out Sampling							
WIL01X	35	A	8/13/18 JW	5%	18	2	
WIL01X	35	B			21	3	
WIL01X	35	C			7	2	
WIL01X	35	D			21	3	
WIL01X	36	A	8/14/18 JL	0%	48	3	
WIL01X	36	B			41	3	
WIL01X	36	C			15	3	
WIL01X	36	D			51	3	

Soil Sample Collection Log
XRF Analysis
Williston LTA MRS, ND

Location: Berm (DU 01) - cont.

ID			Date/ Initials	% Moist.	Lead (PPM)	Error (±)	Comments
WIL01X	37	A	8/14/18 JW	0%	10	2	
WIL01X	37	B			13	2	
WIL01X	37	C			11	2	
WIL01X	37	D			20	2	
WIL01X	38	A	8/14/18 JW	0%	19	3	
WIL01X	38	B			13	2	
WIL01X	38	C			15	2	
WIL01X	38	D			14	2	
WIL01X	39	A	8/13/18 JW	0%	15	2	
WIL01X	39	B			16	2	
WIL01X	39	C			11	2	
WIL01X	39	D			14	2	
WIL01X	40	A					
WIL01X	40	B					
WIL01X	40	C					
WIL01X	40	D					
WIL01X	41	A					
WIL01X	41	B					
WIL01X	41	C					
WIL01X	41	D					
WIL01X	42	A					
WIL01X	42	B					
WIL01X	42	C					
WIL01X	42	D					

Soil Sample Collection Log
XRF Analysis
Williston LTA MRS, ND

Location: Backstop Area (DU 03)

ID			Date/ Initials	% Moist.	Lead (PPM)	Error (±)	Comments
WIL03X	01	A	LC		15	2	
WIL03X	01	B	8/15/18	0	13	2	
WIL03X	01	C			17	2	
WIL03X	01	D			15	2	
WIL03X	02	A	LC		16	2	
WIL03X	02	B		0	11	2	
WIL03X	02	C	8/15/18		12	2	
WIL03X	02	D			12	2	
WIL03X	03	A	8/15/18		19	2	Precision Replicates
WIL03X	03	B			17	3	E: 15, +/- 2
WIL03X	03	C	JL		17	2	F: 13, +/- 2
WIL03X	03	D			17	3	G: 16, +/- 2
WIL03X	04	A	LC		15	2	
WIL03X	04	B	8/15/18	0	17	3	
WIL03X	04	C			19	3	
WIL03X	04	D			18	3	
WIL03X	05	A	8/14/18		13.7	1.4	
WIL03X	05	B		0%	19	2	
WIL03X	05	C	JW		41	3	
WIL03X	05	D			30	2	
WIL03X	06	A			19	2	
WIL03X	06	B	8/15/16	10	17	2	
WIL03X	06	C	JC		24	3	
WIL03X	06	D			14	2	

Soil Sample Collection Log
XRF Analysis
Williston LTA MRS, ND

Location: Backstop Area (DU 03) - cont.

ID			Date/ Initials	% Moist.	Lead (PPM)	Error (±)	Comments
WIL03X	7	A	LC 8/15/18	0	29	3	
WIL03X	7	B			27	3	
WIL03X	7	C			22	2	
WIL03X	7	D			26	3	
WIL03X	8	A	LC 8/15/18	0	22	3	
WIL03X	8	B			24	3	
WIL03X	8	C			23	3	
WIL03X	8	D			28	3	
WIL03X	9	A	8/15/18 LC	5	25	3	
WIL03X	9	B			28	3	
WIL03X	9	C			25	3	
WIL03X	9	D			34	3	
WIL03X	10	A	8/14/18 JW	0%	15	2	
WIL03X	10	B			13	2	
WIL03X	10	C			17	2	
WIL03X	10	D			15	2	
WIL03X	11	A	LC 8/15/18	0	21	3	
WIL03X	11	B			19	2	
WIL03X	11	C			18	2	
WIL03X	11	D			17	2	
WIL03X	12	A	8/14/18 JW	0%	13	2	
WIL03X	12	B			17	2	
WIL03X	12	C			21	3	
WIL03X	12	D			13	2	

Soil Sample Collection Log
XRF Analysis
Williston LTA MRS, ND

Location: Backstop Area (DU 03) - cont.

ID			Date/ Initials	% Moist.	Lead (PPM)	Error (±)	Comments
WIL03X	13	A	LC 8/15/18	0	11	2	
WIL03X	13	B			19	3	
WIL03X	13	C			17	5	
WIL03X	13	D			16	2	
WIL03X	14	A	LC 8/15/18	0	16	2	
WIL03X	14	B			13	2	
WIL03X	14	C			15	2	
WIL03X	14	D			14	2	
WIL03X	15	A	LC 8/15/18	0	16	2	
WIL03X	15	B			13	2	
WIL03X	15	C			12	2	
WIL03X	15	D			17	2	
WIL03X	16	A	LC 8/15/18	0	15	2	
WIL03X	16	B			11	2	
WIL03X	16	C			13	2	
WIL03X	16	D			15	2	
WIL03X	17	A	LC 8/15/18	0	14	2	
WIL03X	17	B			17	2	
WIL03X	17	C			19	3	
WIL03X	17	D			17	3	
WIL03X	18	A	LC 8/15/18	0	92	4	
WIL03X	18	B			110	5	
WIL03X	18	C			127	5	
WIL03X	18	D			145	5	

Soil Sample Collection Log
XRF Analysis
Williston LTA MRS, ND

Location: Backstop Area (DU 03) - cont.

ID			Date/ Initials	% Moist.	Lead (PPM)	Error (±)	Comments
WIL03X	19	A	8/15/18 JC	0%	~~24~~ 13	~~3~~ 4	
WIL03X	19	B			22	3	
WIL03X	19	C			21	3	
WIL03X	19	D			24	3	
WIL03X	20	A	8/13/18 JL	0%	19	3	
WIL03X	20	B			17	2	
WIL03X	20	C			14	2	
WIL03X	20	D			20	3	
WIL03X	21	A	8/13/18 JL	0%	18	3	
WIL03X	21	B			20	3	
WIL03X	21	C			18	3	
WIL03X	21	D			20	3	
WIL03X	22	A	8/13/18 JL		30	3	
WIL03X	22	B			19	3	
WIL03X	22	C			22	3	
WIL03X	22	D			25	3	
WIL03X	23	A	8/13/18 JL	0%	15	2	
WIL03X	23	B			16	2	
WIL03X	23	C			15	2	
WIL03X	23	D			13	2	
WIL03X	24	A	8/13/18 JL	5%	22	3	took additional replicate readings for precision measurements
WIL03X	24	B			23	3	
WIL03X	24	C			24	3	
WIL03X	24	D			26	3	
	24	E			24	3	
	24	F			21	3	

Soil Sample Collection Log
XRF Analysis
Williston LTA MRS, ND

Location: Backstop Area (DU 03) - cont.

ID			Date/ Initials	% Moist.	Lead (PPM)	Error (±)	Comments
WIL03X	25	A	8/13/18 JL	0%	17	3	
WIL03X	25	B			17	2	
WIL03X	25	C			19	3	
WIL03X	25	D			21	3	
WIL03X	26	A	8/13/18 JL	6%	17	2	
WIL03X	26	B			19	2	
WIL03X	26	C			15	2	
WIL03X	26	D			16	2	
WIL03X	27	A	8/13/18 JL	0%	16	2	
WIL03X	27	B			10	2	
WIL03X	27	C			15	2	
WIL03X	27	D			19	2	
WIL03X	28	A	8/13/18 JL	0%	15	2	
WIL03X	28	B			12	2	
WIL03X	28	C			10	2	
WIL03X	28	D			13	2	
WIL03X	29	A	8/13/18 JL	0%	13	2	~~ND~~ JL
WIL03X	29	B			15	2	JL
WIL03X	29	C			8	2	
WIL03X	29	D			15	2	
WIL03X	30	A	8/13/18 JL	0%	11	2	
WIL03X	30	B			12	2	
WIL03X	30	C			14	2	
WIL03X	30	D			11	2	

Field Notes

Williston CTA MRS, ND 8/13/18

Onsite : 0800

Weather : high 70's, cloudy w/ rain

AECOM : JL, JW, LC ; USACE : S. Sawyer

ARNG : S. Herda ; see DTM for add. visitors

Scope : Grid DU's + Collect + Analyze XRF Samp

0810 : H&S meeting

0820 : Scope the site / site walk

0850 : Begin Gridding

1000 : Finish main grids for Backstop area DU (DU Ø3)

Topography + site features required adjusting gridding to 30 grids for representativeness + safety reasons

- JW + LC continue gridding DUs
- JL begin collecting XRF samp.

1210 : Break for lunch + hydration

1230 : JW + LC continue collecting XRF

JL begin analyzing XRF samp.

XRF unit : Olympus Delta Innov X system

S/N : 510125 ; 3-beams, 15sec ea.

Cal check Passed ; Blank : ND (<4.5)

SRM 2711A (1400 ppm Pb) = 1370 ppm Pb +/- 18

Scale: 1 square = __________

Rite in the Rain

Williston LTA (cont.) 8/13/18

1440: SRM check - Blank = ND (<5.1 ppm)
SRM 0711A = 1359 ppm +/- 18 ppm
1500: JL + LC continue collecting XRF samp.
JW to analyze XRF samp.
1630: Finish collecting XRF samples
1645: Begin gridding increment locations
1700: Stop work for the day - severe storms w/ lightening moving in to site - poor road conditions too risky in rain.
• Mob off site

Decision Unit Notes: Gridding of DU's adjusted in the field to account for topography limitations & site features to the following dimensions & increments:

DU01 - Target Berm: 39 grids, 10 x 10 ft

DU02 - Constructed Pond: 3~~6~~ grids, 10 x 5 ft

DU03 - Backstop Area: 30 grids, 23 x 26 ft

1800: Arrive @ hotel - debrief & twilight talk

Scale: 1 square =

Williston LTA MRS, ND 8/14/18

Onsite: 0735

Weather: low 80's, Sunny

AECOM: JL, JW, LC; USACE: S. Sawyer

ARNG: S. Herda - see DTM for visitors

Scope: · Assess site road access for safety
· Grid Increments, Analyze XRF,
Begin ISM sampling

0740: · Tailgate to discuss roads
· Drive in to site & stopped at each culvert (3 total) to assess/photograph/flag as necessary/spot vehicles as they passed over
· Determined the first 2 culverts are safely passable using spotters, but the 3rd was not.
· Parked vehicles at 3rd culvert, packed backpacks w/ essential equip. & walked the remaining distance to the MRS

0840: · Onsite at the MRS

0905: Begin flagging Increment locations

1100: · Finish flagging " "
for Target Berm and Backstop area
· Break for hydration

Scale: 1 square = ______

Rite in the Rain

Williston LTA (cont.) 8/14/18

1130: Prep for ISM sampling @ Target Berm
1200: Lunch Break
1230: Begin ISM samp. @ Target Berm
1340: WIL01IS01 - Primary
1350: WIL01IS02 - Duplicate
1400: WIL01IS03 - Triplicate
~~1400~~ Sample Times
Note decontaminated soil probes prior to collecting samples
1415: Hydration break and decontaminate soil probes
1430: JW + LC begin collecting ISM Sample from Backstop Area
1600: WIL03IS01 - Primary
1605: WIL03IS02 - Duplicate
1610: WIL03IS03 - Triplicate
~~JC~~ Sample Times = ~~1610~~
1435: JL begin XRF Analysis
Cal Check Passed
SRM Blank = ND (<41.6 ppm Pb)
SRM 2711A (1400 ppm Pb) = 1461 ppm Pb, +/- 18 ppm
1610: Finish collecting ISM @ Backstop
1620: Remove Increment flags from DU01 and DU03

Scale: 1 square = ______

Williston LTA (cont.) 8/14/18

1720: XRF check - SRM Blank = ND (<4.8)
SRM 2711A (1400 ppm Pb) = 1336, +/- 17

1730: · Samples placed on ice
· De mob site - use spotter @ narrow culvert crossing

1830: Arrive @ Hotel

Scale: 1 square = ______________

Rite in the Rain

Williston LTA MRS, ND 8/15/18

Onsite: 0730

Weather: high 80's, full sun

AECom: JL, JW, LC; USACE: S. Sawyer

ARNG: S. Herda

Scope: ISM Gridding & Sampling, XRF Analysis, Discrete Sampling

0800: H&S Meeting

0820: Pack & hike to site

0840: Begin XRF Analysis

Cal Check - Passed

SRM Blank: ND (<4.9)

SRM 2711A (1400ppm Pb): 1417, +/- 18ppm

- Begin gridding Increment locations @ Pond DU

1000: S. Herda off site, finish increment gridding of Pond DU

1020: Decon soil probes

1030: Begin ISM Sampling Constructed Pond DU

- soil is dense, sticky, silty clay making sampling slow.

Sample times follow →

→

Scale: 1 square = ______________

Williston LTA (cont) 8/15/18

1200: WILØ2ISØ1 - Primary
1210: WILØ2ISØ2 - Duplicate
1220: WILØ2ISØ3 - Triplicate
1240: XRF Cal Check - Passed
SRM Blank: ND (<5.1)
SRM 2711A (1400 ppm Pb): 1433 ppm Pb, +/- 18
: Finish XRF analysis
1300: Break for lunch + cool down
1400: Finish ISM @ Constructed Pond DU
1420: Decon Soil Probes
1440: Grid + collect ISM sample from 1st Background Reference Area
1600: WILØ4ISØ1 - Primary
1605: WILØ4ISØ2 - Duplicate
1610: WILØ4ISØ3 - Triplicate
1615: Finish ISM samp of Background Area
Samples on ice
1630: Pack Cars
1700: off site
1740: Arrive @ Hotel

Scale: 1 square = ______

Rite in the Rain

Williston LTAMRS, ND 8/16/18

onsite: 0730

Weather: Low 90's, sunny / hazey

AEcom: JL, JW, LC, USACE: S. Sawyer

Scope: Discrete Sampling, GPS DUs,
Site clean up

0800: H&S Meeting

0810: Decon soil probes for EQ BLK
Equipment Blank: WILØ3ISØØ
Time: 0820

0900: Begin Discrete Sampling
XRF Cal Check = Passed
SRM Blank = ND (<4.9)
SRM 2711A (1400 ppm Pb) = 1397, +/- 18

Constructed Pond Discrete Samples:
Location #22:

0-6" ms WILØ2X22E, Time: 0920, TCLP
12-18" WILØ2DAØ1A, Time: 0930, Metals, Explo.
12-18" WILØ2DAØ1B, Time: 0935, Metals, Explo. Dup.
24-30" WILØ2DBØ1A, Time: 0950, Metals, Explo.
↳ Hold pending DA sample analysis

Scale: 1 square = ____________

Location #22 @ Constructed Pond, 12"-18" bgs

12-18" bgs
XRF : A 11 ppm Pb, +/- 2 ; moisture : 70%
B 13 " , +/- 2
C 13 " , +/- 2
D 13 " , +/- 2

24"-30" bgs
A 13 ppm Pb, +/- 2 ; moisture : 70%
B 14 " , +/- 2
C 15 " , +/- 2
D 12 " , +/- 2

Location # 11 @ Constructed Pond

ms/msD

12-18" WILØ2DAØ2A, Time: 1020, metals, Explo
24-30" WILØ2DBØ2A, Time: 1030, metals, Explo
↳ Hold Pending Analysis of DA

XRF :

12"-18" bgs
A - 12 ppm Pb, +/- 2 ; moisture : 80%
B - 11 ppm Pb, +/- 2
C - 14 " , +/- 2
D - 15 " , +/- 3

24"-30" bgs
A - 11 " , +/- 2 ; moisture : 90%
B 12 " , +/- 2
C 18 " , +/- 2
D 15 " , +/- 2

Scale: 1 square = ____________

Rite in the Rain

1100: Collect TCLP from Backstop Area
grid # 18
0-6" WIL Ø3 X 18 E, Time: 1100 , TCLP
1115: Collect TCLP from Target Berm
grid # 21
WIL Ø1 X 21 E, Time: 1115 , TCLP
1130: XRF Cal Check: Passed
SRM Blank: ND (<5.1)
SRM 2711 A (1400 ppm Pb): 1427 ± 18
1135: Collect GPS for DU Boundaries

error ↓

DU01-39: N 48°09'00.278" W 103°10'05.728" 26 m.
DU01-21 (Tclp): N 48°09'00.077" W 103°10'06.268" 27 m.
DU01-18: N 48°08'59.930" W 103°10'06.569" 26 m.
DU01-36: N 48°08'59.431" W 103°10'06.085" 26 m.
DU01-35: N 48°08'59.361" W 103°10'06.231" 27 m.
DU01-01: N 48°09'00.023" W 103°10'06.901" 27 m.
DU01-37: N 48°09'00.422" W 103°10'05.831" 28 m.

DU02-36: N 48°09'00.445" W 103°10'06.683" 29 m.
DU02-33: N 48°09'00.804 W 103°10'07.072" 34 m.
Tclp DU02-22: N 48°09'00.721 W 103°10'06.799" 30 m.
DU02-25: N 48°09'00.446 W 103°10'06.766 31 m.
discrete DU02-11: N 48°09'00.604 W 103°10'06.541 26 m.
DU02-01: N 48°09'00.549 W 103°10'06.322 26 m.

Scale: 1 square = ____________

			error
DU03-01:	N 48° 09' 00.570"	W 103° 10' 06.047"	33 M.
DU03-20:	N 48° 09' 00.183"	W 103° 10' 06.987"	29 M.
DU03-24:	N 48° 09' 01.151"	W 103° 10' 07.672"	32 M.
DU03-30:	N 48° 09' 02.491"	W 103° 10' 08.849	31 M.
DU03-19:	N 48° 09' 02.670	W 103° 10' 08.548	31 M.
RCV? DU03-18:	N 48° 09' 02.368	W 103° 10' 08.423	28 M.
DU03-15:	N 48° 09' 01.677	W 103° 10' 07.872	25 M.
DU03-10:	N 48° 09' 01.783	W 103° 10' 07.591	24 M.
DU03-8:	N 48° 09' 01.422	W 103° 10' 07.149	24 M.
DU03-5:	N 48° 09' 01.542	W 103° 10' 06.886	24 M.
DU04-1:	N 48° 08' 59.074	W 103° 10' 01.383	26 M.
DU04-4:	N 48° 08' 59.415	W 103° 10' 01.658	25 M.
DU04-3:	N 48° 08' 59.260	W 103° 10' 02.174	24 M.
DU04-2:	N 48° 08' 58.898	W 103° 10' 01.915	26 M.

1230: Site Recon + Clean up

1300: Recon + clean up complete

- various kinds of bullets observed along the base and sides of the first butte in the backstop in notable quantity. Sporadic bullets observed along face of the furthest butte in the backstop.

Scale: 1 square = ____________

Rite in the Rain

1400: Samples on ice, cars packed,
All personel off site + Lunch
1540: @ Hotel, organize samples for
shippment on Friday + QC COC, +
Replinish ice
1800: End

Scale: 1 square =

Daily Quality Control Reports

Date: 8/13/18

AECOM Technical Services Inc.
DAILY QUALITY CONTROL REPORT

Report Number: 1
Project Title: Williston LTA MRS RI-DD
Location: Williston, ND
Contract/DO Number: W9133L-14-D-0001/ 0008

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.	Jennifer Li		AECOM	Field Team Leader & Safety Officer
b.	Joe Witte		AECOM	Field Team Member
c.	Luke Councell		AECOM	Field Team Member
d.	Milton Scott Sawyer		USACE – Omaha	UXO Clearance
e.				
f.				
g.				

Sampling equipment on site:

Type	Serial Number		Time	Parameter	Standard	Reading
XRF Analyzer	510125	Calibration Verification	1230	Pb	SRM2711A	1370 +/- 18
					1400 ppm	
					Blank	ND (<4.5)

Field Changes: YES________ NO X

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

Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	Poor roads, weather safety, uneven terrain slip trip falls
Work Performed (including sampling)	Gridded DU's, collected XRF samples & analyzed
QA Activities	Daily Report X Review of COC N/A Track Progress Report against QAPP X
QC Activities	# Duplicates N/A 5% Precision XRF measurement Equipment calibrated complete to standards yes # Equipment Blanks N/A # MS/MSD N/A # Field Blanks N/A
Problems Encountered Resolved	Unpaved roads & culverts in poor condition. Will reassess in am, condense cars, and hike in if needed.
Additional Information	De mobed from site @ 1700 due to severe storm moving into area.
Activities Scheduled for the Next Day	Increment Gridding, continue XRF analysis, begin ISM sample collection.

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: [signature]

Date: 8/13/18

Date: 8/14/18

AECOM Technical Services Inc.
DAILY QUALITY CONTROL REPORT

Report Number: 2
Project Title: Williston LTA MRS RI-DD
Location: Williston, ND
Contract/DO Number: W9133L-14-D-0001/ 0008

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.	Jennifer Li		AECOM	Field Team Leader & Safety Officer
b.	Joe Witte		AECOM	Field Team Member
c.	Luke Councell		AECOM	Field Team Member
d.	Milton Scott Sawyer		USACE – Omaha	UXO Clearance
e.				
f.				
g.				

Sampling equipment on site:

Type	Serial Number		Time	Parameter	Standard	Reading
XRF Analyzer	510125	Calibration Verification	1435	Pb-SRM	1400ppmPb	1416ppm
				2711A		
				blank	0ppmPb	ND(<4.6)

+/- 18ppm

Field Changes: YES______ NO X

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

Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	Impassable culverts, sun safety & hydration, wild life hazards ie, bees & wasps
Work Performed (including sampling)	Increment location Gridding, Analyze XRF samples, ISM sampling, Scope Culverts
QA Activities	Daily Report ✓ Review of COC NA ✓ Track Progress Report against QAPP ✓
QC Activities	# Duplicates ISM 100% Triplicate Equipment calibrated complete to standards ✓ # Equipment Blanks 0 # MS/MSD 1 # Field Blanks N/A
Problems Encountered Resolved	Road over culverts very poor. Used spotters & did not pass if unsafe
Additional Information	Collected XRF Precision Measurements
Activities Scheduled for the Next Day	ISM sampling, XRF analysis, Increment gridding @ DU02 & Background.

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 8/14/18

Date: 8/15/18

AECOM Technical Services Inc.
DAILY QUALITY CONTROL REPORT

Report Number: 3
Project Title: Williston LTA MRS RI-DD
Location: Williston, ND
Contract/DO Number: W9133L-14-D-0001/ 0008

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.	Jennifer Li		AECOM	Field Team Leader & Safety Officer
b.	Joe Witte		AECOM	Field Team Member
c.	Luke Councell		AECOM	Field Team Member
d.	Milton Scott Sawyer		USACE – Omaha	UXO Clearance
e.				
f.				
g.				

Sampling equipment on site:

Type	Serial Number		Time	Parameter	Standard	Reading
XRF Analyzer	510125	Calibration Verification	0840	Pb - SRM 2711A	1400 ppm Pb	1417, +/-18 ppm
				Blank	0 ppm Pb	ND (<4.9)

Field Changes: YES____ NO X

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

Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	Bee + wasp risks, sun + heat safety, risk of Complacency + pacing work.
Work Performed (including sampling)	Increment location Gridding, ISM Samp Collection Discrete Sampling
QA Activities	Daily Report X Review of COC X Track Progress Report against QAPP X
QC Activities	# Duplicates ISM 100% Trip. Equipment calibrated complete to standards ✓ # Equipment Blanks 0 # MS/MSD 0 # Field Blanks 0
Problems Encountered Resolved	Constructed Pond soil dense sticky silty clay made Sampling slow - used buddy system sampling
Additional Information	None.
Activities Scheduled for the Next Day	Discrete Sampling, GPS DUs, Site clean up.

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 8/15/18

Date: 8/16/18

AECOM Technical Services Inc.

DAILY QUALITY CONTROL REPORT

Report Number: 4
Project Title: Williston LTA MRS RI-DD
Location: Williston, ND
Contract/DO Number: W9133L-14-D-0001/ 0008

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.	Jennifer Li		AECOM	Field Team Leader & Safety Officer
b.	Joe Witte		AECOM	Field Team Member
c.	Luke Councell		AECOM	Field Team Member
d.	Milton Scott Sawyer		USACE – Omaha	UXO Clearance
e.				
f.				
g.				

Sampling equipment on site:

Type	Serial Number		Time	Parameter	Standard	Reading
XRF Analyzer	510125	Calibration Verification	0900	Pb - SRM	1400 ppm Pb	1397 +/- 18
				2711A		
				Blank	0 ppm Pb	ND (<4.9)

Field Changes: YES______ NO X

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

Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	Poor air quality, last day complainsency risks, change in task type
Work Performed (including sampling)	Discrete Sampling, GPS DU boundaries, Site recon & clean up
QA Activities	Daily Report ✓ Review of COC ✓ Track Progress Report against QAPP ✓
QC Activities	# Duplicates 1 Equipment calibrated complete to standards ✓ # Equipment Blanks 1 # MS/MSD 1 # Field Blanks N/A
Problems Encountered Resolved	None.
Additional Information	None.
Activities Scheduled for the Next Day	Ship samples + Equipment.

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 [signature] Date 8/16/18

Appendix B

Photographic Record

AECOM

PHOTOGRAPHIC RECORD

Client Name: Army National Guard	**Site Location:** Williston Local Training Area MRS, Williston, North Dakota	**Project No.** 60520956

Photo No. 1	
Location of Photo: Standing at southeastern corner of the Target Berm, looking northwest. **Date Taken:** 8/14/2018	
Description: Flagged incremental sampling locations at the Target Berm Decision Unit (DU). Flags: Pink = primary Blue = duplicate Yellow = triplicate	

Photo No. 2	
Location of Photo: Standing on north side of Constructed Pond, facing south. **Date Taken:** 8/13/2018	
Description: Constructed Pond DU. Flagged primary incremental sampling locations visible in center of photograph.	

PHOTOGRAPHIC RECORD

Client Name:	Site Location:	Project No.
Army National Guard	Williston Local Training Area MRS, Williston, North Dakota	60520956

Photo No. 3

Location of Photo:
Center of Backstop Area DU facing northwest.

Date Taken:
8/14/2018

Description:
Backstop Area DU looking northwest

Photo No. 4

Location of Photo:
Standing at former firing line, facing north towards MRS.

Date Taken:
8/14/2018

Description:
View from firing line, facing former target berm. Natural buttes used as range backstops visible in background.

AECOM

PHOTOGRAPHIC RECORD

Client Name: Army National Guard	**Site Location:** Williston Local Training Area MRS, Williston, North Dakota	**Project No.** 60520956

Photo No. 5

Location of Photo: Standing within Backstop Area DU facing east towards southernmost backstop butte..

Date Taken: 8/14/2018

Description: Southernmost backstop butte. Steep eroded hillsides visible with scrub vegetation.

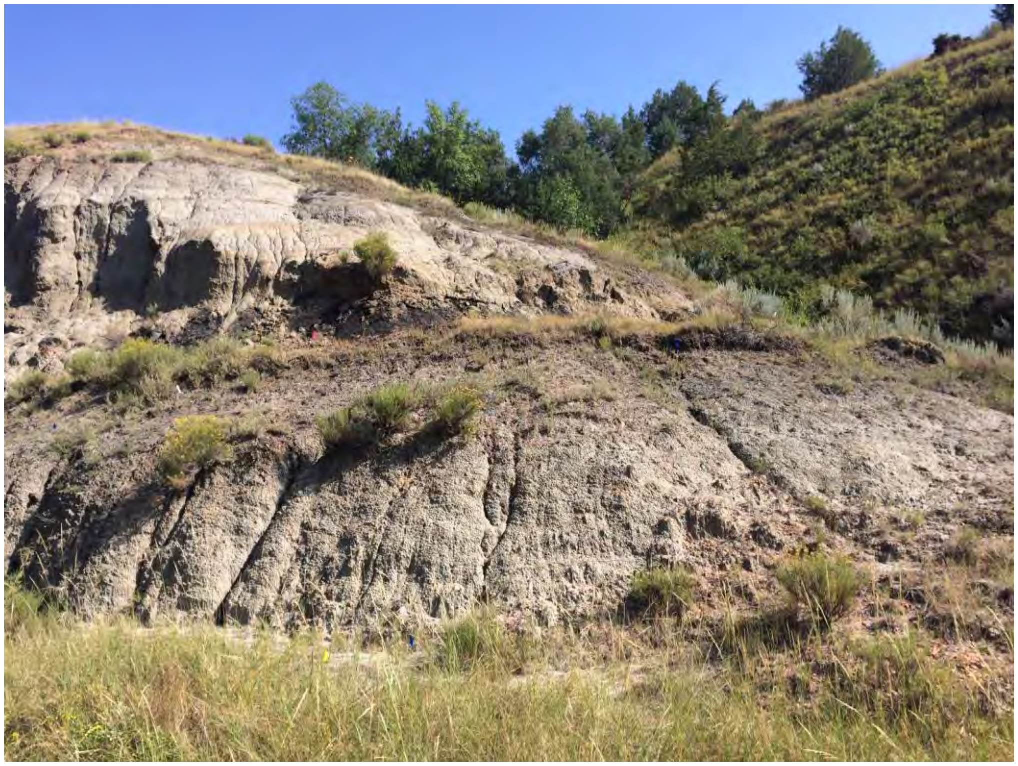


Photo No. 6

Location of Photo: Base of western side of southernmost backstop butte.

Date Taken: 8/16/2018

Description: Bullet and plastic practice round fragments at the base of the western side of southernmost backstop butte within a small erosion channel.

AECOM	PHOTOGRAPHIC RECORD	
Client Name: Army National Guard	**Site Location:** Williston Local Training Area MRS, Williston, North Dakota	**Project No.** 60520956

Photo No. 7

Location of Photo:
Standing on top of southernmost butte facing south towards Lake Sakakawea

Date Taken:
8/16/2018

Description:
View of Constructed Pond and top of Target Berm from the top of the southernmost butte facing south.

Photo No. 8

Location of Photo:
Constructed Pond DU

Date Taken:
8/15/2018

Description:
Incremental sampling, collection of triplicate sample.

Client Name:	Site Location:	Project No.
Army National Guard	Williston Local Training Area MRS, Williston, North Dakota	60520956

Photo No. 9

Location of Photo:
Constructed Pond DU

Date Taken:
8/15/2018

Description:
Incremental sampling, collection of duplicate sample for sample ID: WIL02IS02.

Photo No. 10

Location of Photo:
Standing at northwest corner of the Background Reference Area facing southeast.

Date Taken:
8/15/2018

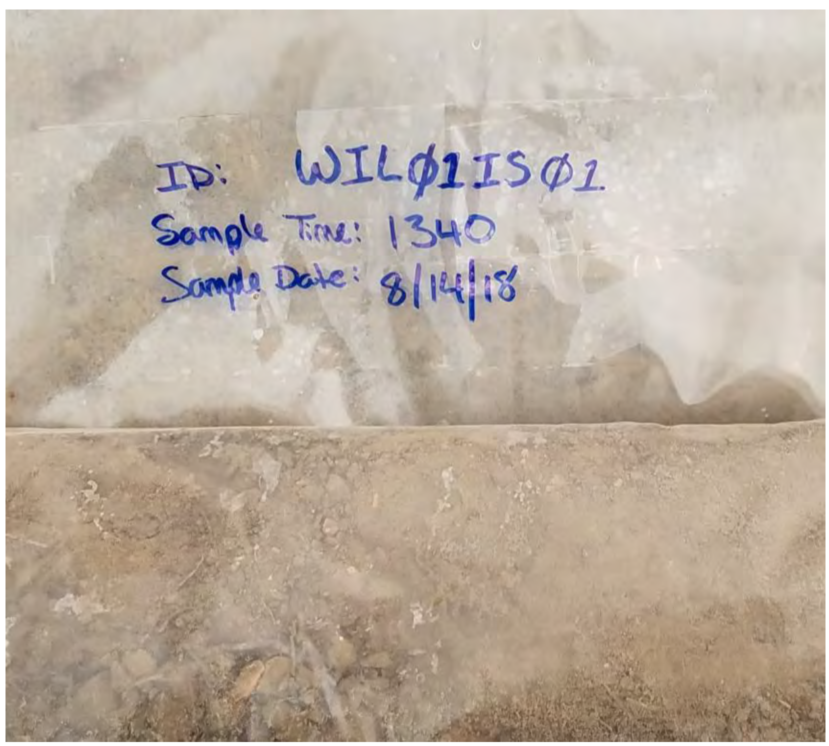
Description:
Flagged incremental sampling locations at the Background Reference Area.
Flags:
Pink = primary
Blue = duplicate
Yellow = triplicate.

AECOM

PHOTOGRAPHIC RECORD

Client Name: Army National Guard	**Site Location:** Williston Local Training Area MRS, Williston, North Dakota	**Project No.** 60520956

Photo No. 11	
Location of Photo: Sampling tent set up at former firing point **Date Taken:** 8/15/2018	
Description: Analyzing a surface soil sample by XRF.	

Photo No. 12	
Location of Photo: Target Berm **Date Taken:** 8/16/2018	
Description: Incremental sample WIL01IS01	

AECOM	PHOTOGRAPHIC RECORD	
Client Name: Army National Guard	**Site Location:** Williston Local Training Area MRS, Williston, North Dakota	**Project No.** 60520956

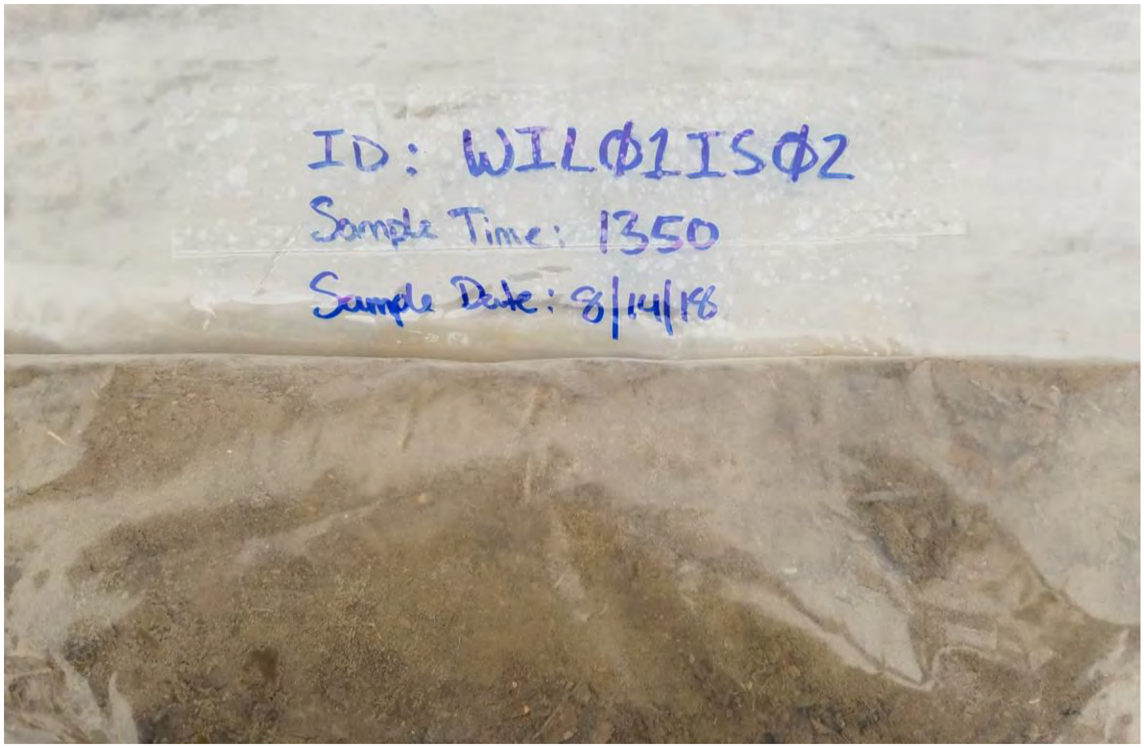
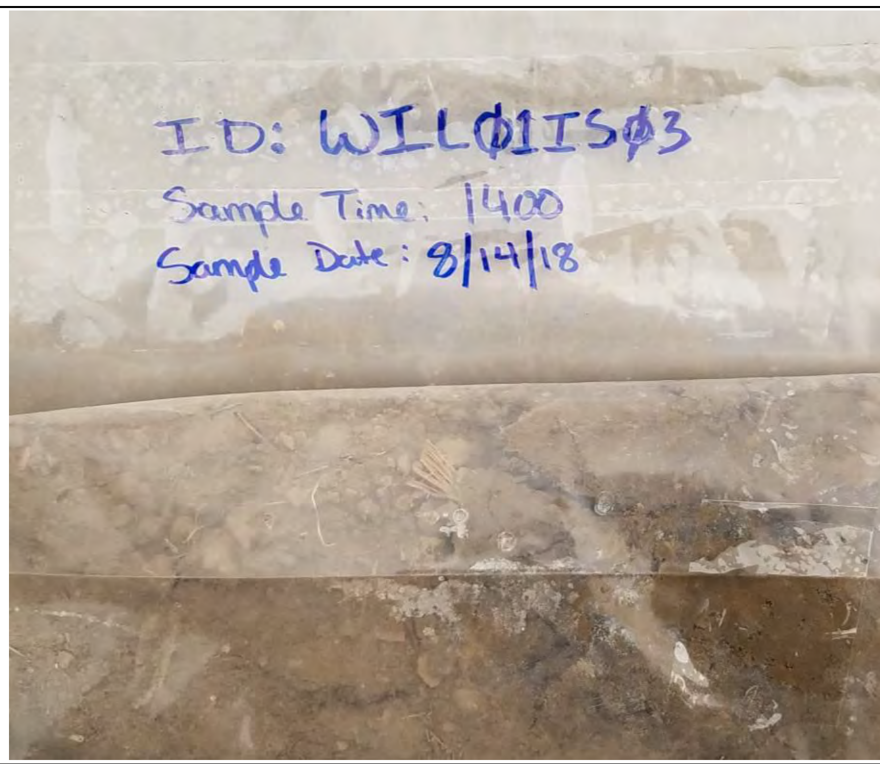
Photo No. 13	
Location of Photo: Target Berm **Date Taken:** 8/16/2018	
Description: Incremental sample WIL01IS02.	

Photo No. 14	
Location of Photo: Target Berm **Date Taken:** 8/16/2018	
Description: Incremental sample WIL01IS03.	

AECOM	PHOTOGRAPHIC RECORD	
Client Name: Army National Guard	**Site Location:** Williston Local Training Area MRS, Williston, North Dakota	**Project No.** 60520956

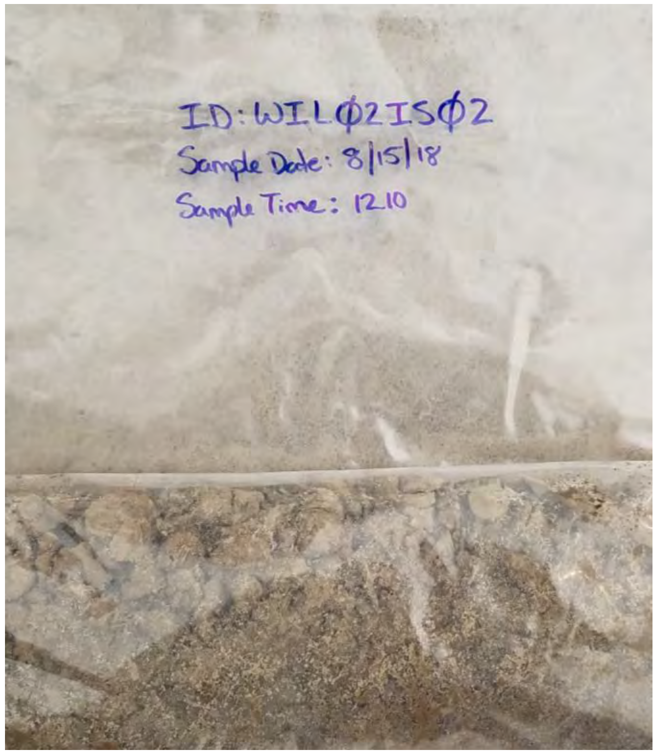
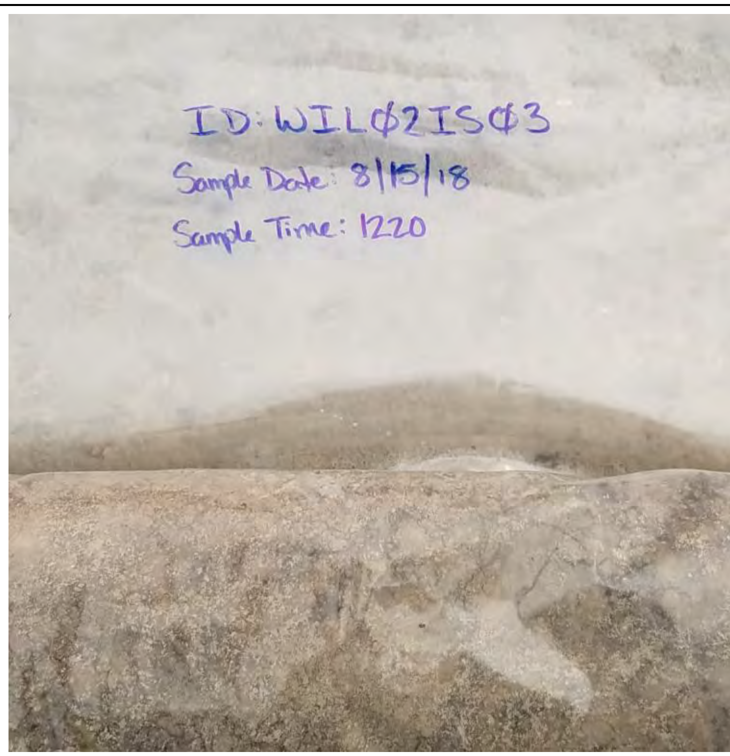
Photo No. 15	
Location of Photo: Constructed Pond **Date Taken:** 8/16/2018	
Description: Incremental sample WIL02IS02.	

Photo No. 16	
Location of Photo: Constructed Pond **Date Taken:** 8/16/2018	
Description: Incremental sample WIL02IS03.	

PHOTOGRAPHIC RECORD

Client Name:	Site Location:	Project No.
Army National Guard	Williston Local Training Area MRS, Williston, North Dakota	60520956

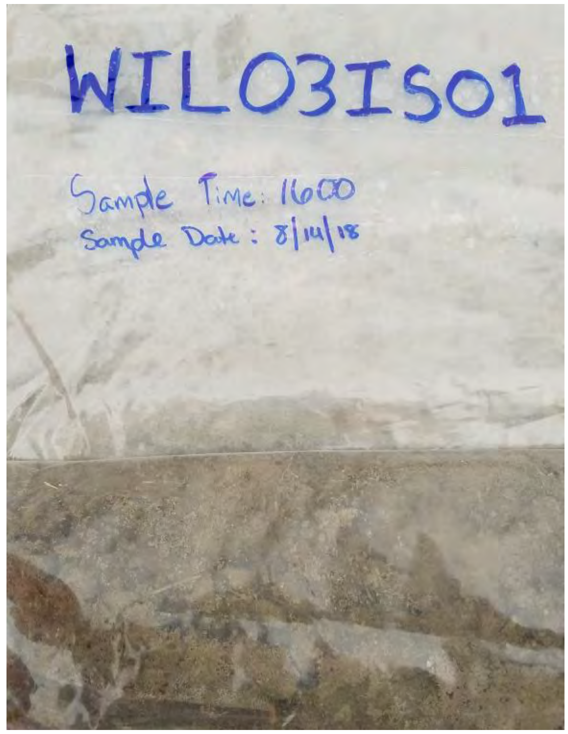
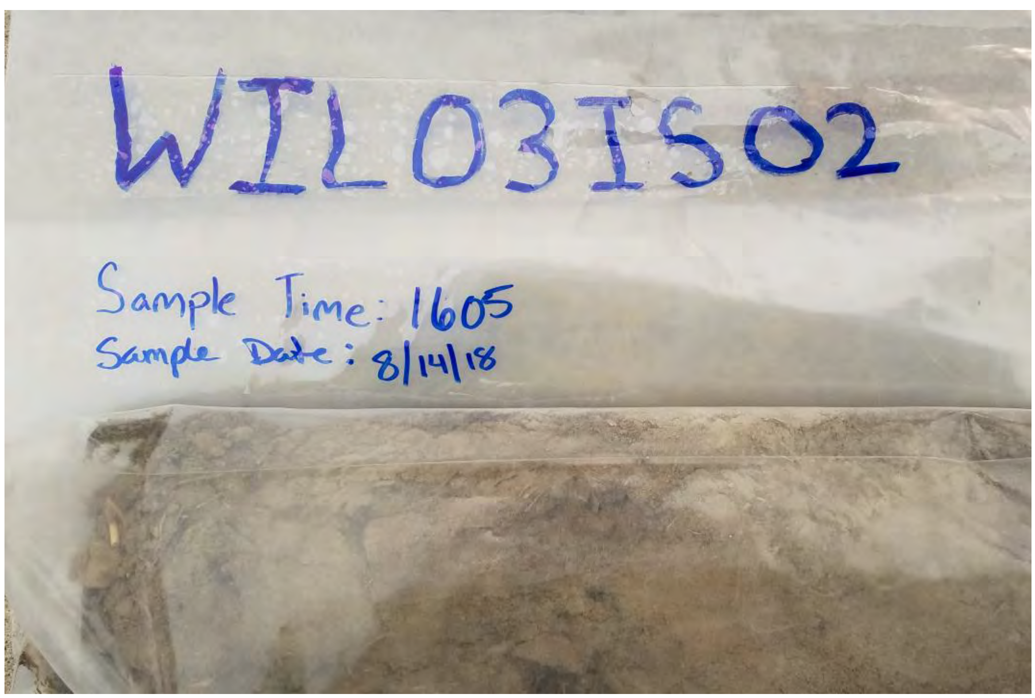
Photo No. 17	
Location of Photo: Backstop Area **Date Taken:** 8/16/2018	
Description: Incremental sample WIL03IS01.	

Photo No. 18	
Location of Photo: Backstop Area **Date Taken:** 8/16/2018	
Description: Incremental sample WIL03IS02.	

AECOM

PHOTOGRAPHIC RECORD

Client Name:	Site Location:	Project No.
Army National Guard	Williston Local Training Area MRS, Williston, North Dakota	60520956

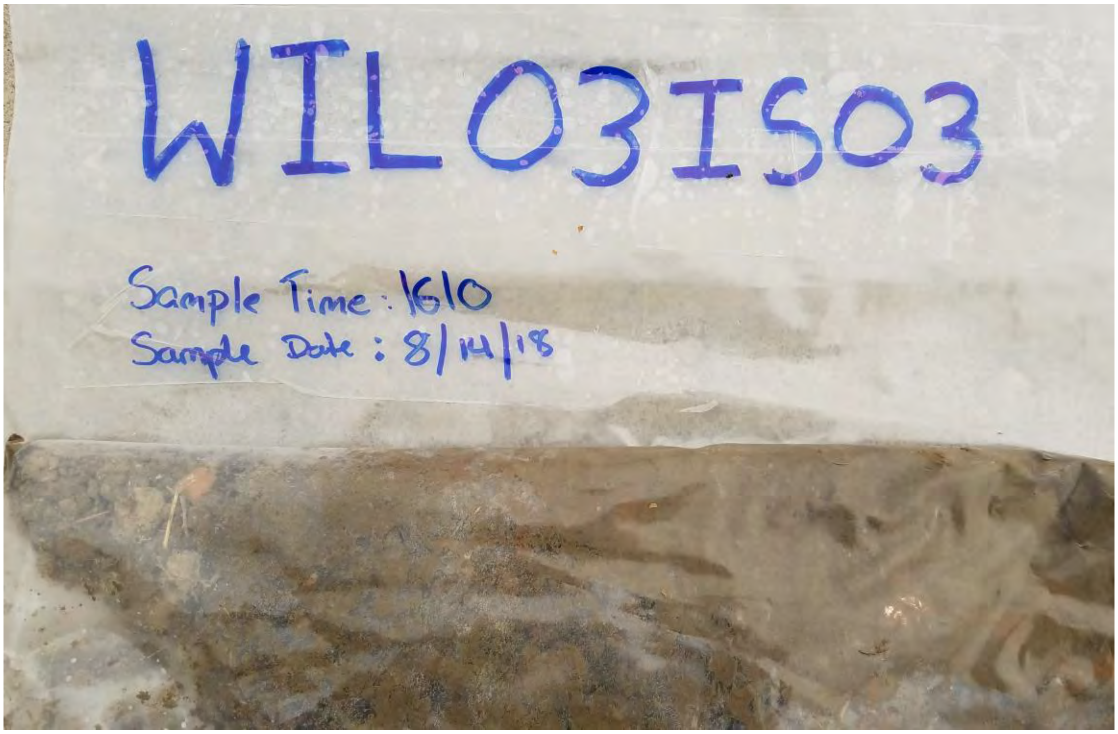
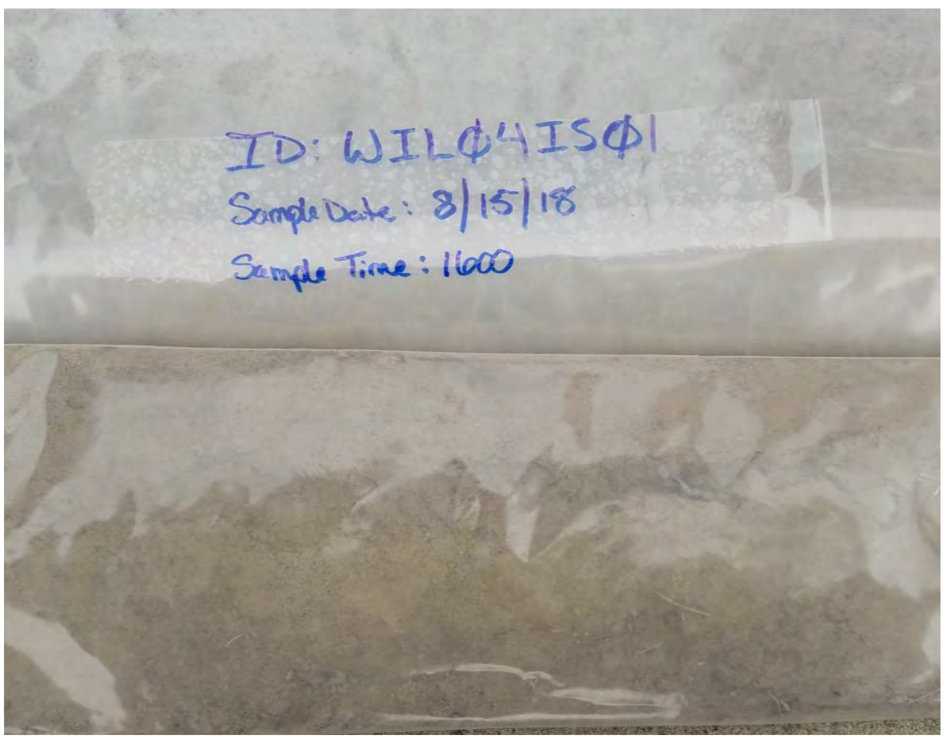
Photo No. 19	
Location of Photo: Backstop Area **Date Taken:** 8/16/2018	
Description: Incremental sample WIL03IS03.	

Photo No. 20	
Location of Photo: Background Reference Area **Date Taken:** 8/16/2018	
Description: Incremental sample WIL04IS01.	

AECOM	**PHOTOGRAPHIC RECORD**

Client Name:	**Site Location:**	**Project No.**
Army National Guard	Williston Local Training Area MRS, Williston, North Dakota	60520956

Photo No. 21

Location of Photo: Background Reference Area

Date Taken: 8/16/2018

Description: Incremental sample WIL04IS02.

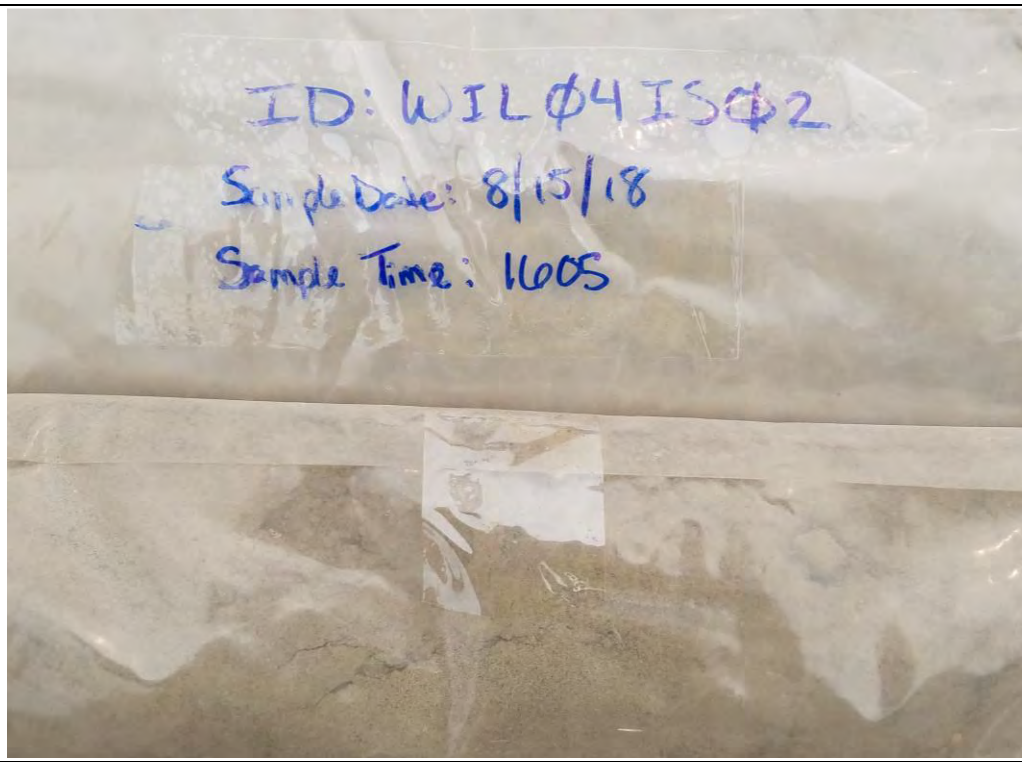
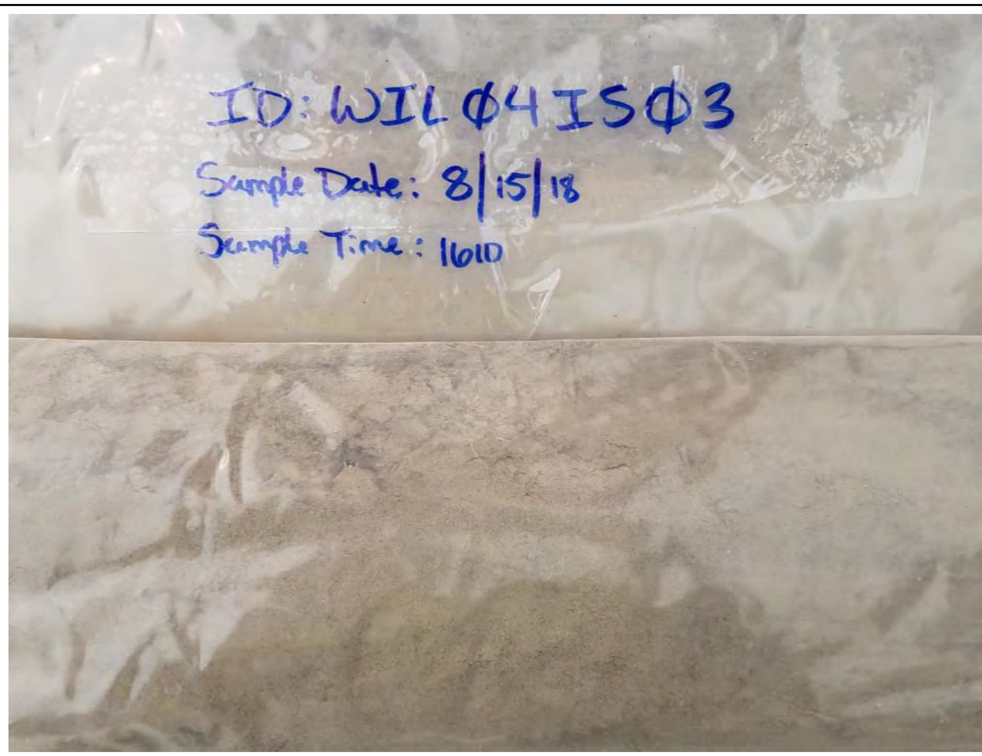


Photo No. 22

Location of Photo: Background Reference Area

Date Taken: 8/16/2018

Description: Incremental sample WIL04IS03.



Appendix C

Data Validation Report
(on CD)

Appendix D

Laboratory Data Analytical Package (on CD)

Appendix E

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: Williston LTA MRS (NDHQ-008-R-01)

Component: US Army National Guard

Installation/Property Name: Williston LTA MRS

Location (City, County, State): Williston, Williams County, North Dakota

Site Name/Project Name (Project No.): Williston LTA MRS Remedial Investigation

Date Information Entered/Updated: 3 December 2018

Point of Contact (Name/Phone): Stephen Herda (NDARNG), (701)333-2070

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 Williston LTA MRS is a former small arms range that was operational between 1960 and 2002 and was used primarily by the NDARNG for small arms qualification and instructional firing purposes. The former range was used exclusively for small arms training. Munitions debris previously identified at the range indicated that small arms munitions, including .30, .32, and .45 caliber bullets, as well as M1, M14, and M16 rifles were fired (NDARNG, 2013). Small arms metals MC (antimony, copper, lead, and zinc) are potentially present in the firing range soil (Target Berm, Constructed Pond, and Backstop area).

(continued next page)

Description of Pathways for Human and Ecological Receptors:

MC deposited in surface soil as a result of firing activities at the MRS has limited potential to migrate from source areas (i.e., soil at Target Berm, Constructed Pond, and Backstop). Due to MRS topography and range orientation, stormwater runoff from significant rain events is unlikely to transport suspended soil particles off site. This was confirmed during the September 2017 Site Visit with stakeholders. The range is located in a coulee, surrounded to the north, east, and west by steep, rugged hills. Stormwater runoff from the steep hills flows radially inward towards the coulee floor. The Target Berm and Constructed Pond effectively separate the coulee floor from soils beyond the MRS Boundary. (see Cross Section A-A′ of Figure 10-1 of the UFP-QAPP [AECOM, 2018])). No evidence of erosion or gullies was observed during the site visit on either berm face or leading from or around the berm. Transport pathways from soil berms to surface water bodies are incomplete.

Metals 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 below ground surface (bgs). According to ND Department of Natural Resources data presented in the 2013 NDARNG PA, groundwater at the MRS is approximately 80 feet bgs (see Cross Section A-A′ of Figure 10-1 of the UFP-QAPP [AECOM, 2018]). Therefore, groundwater pathways are incomplete for the Williston LTA MRS.

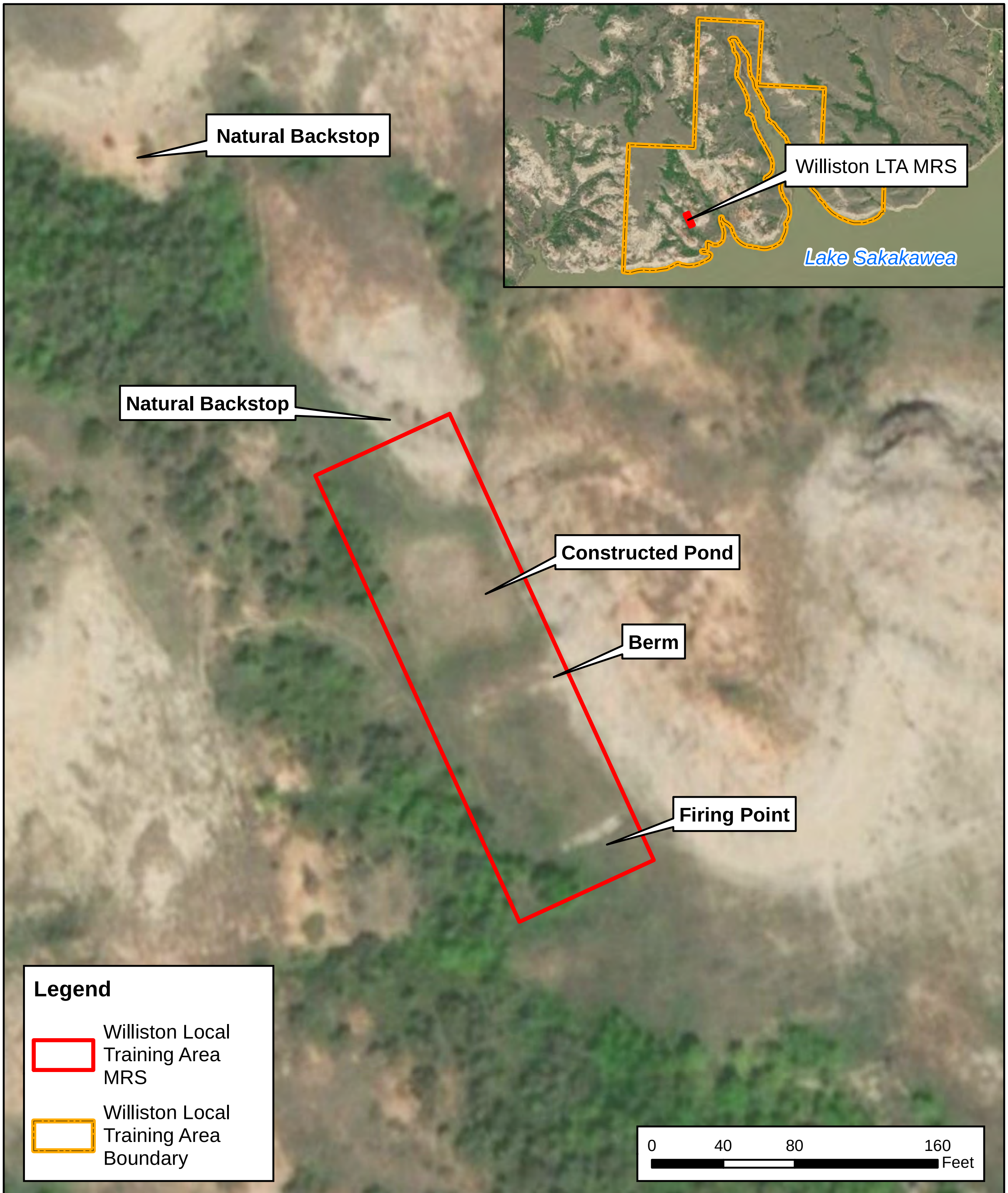
A one-time use of explosives was used in 1998 to create the "Constructed Pond" thus there is a possibility that residual explosives MC could remain. The pond is located behind the Target Berm and The pond is currently filled in with cattails, silted in considerably, and only wet seasonally. MC within pond soil is anticipated to remain within the pond and not be transported off site.

MC within berm soil is anticipated to remain at the source area and/or the coulee floor, and not be transported off site. Exposure pathways between MC and receptors are restricted to the Target Berm, Constructed Pond, and Backstop area.

Description of Receptors (Human and Ecological):

The MRS is remotely located and federally owned by the US Army Corps of Engineers (USACE), with access to the site restricted by a fence and locked gate (Figure 2-1 of RI Report). Boat access is available from Lake Sakakawea, which is located to the south of the MRS. Human receptors may visit the MRS for recreational purposes, such as sightseeing or hiking/exercise, or boating activities from Lake Sakakawea. However, an impassible culvert prevents direct vehicle access to the MRS. The Williston LTA MRS is co-leased by a cattle grazing association. Workers may visit the MRS to conduct activities associated with cattle grazing.

No sensitive ecological habitats (i.e., wetlands) are present within the MRS, but native and non-native grassland, forbs, and marsh area habitats occur within the Williston LTA. The Constructed Pond is poor habitat due to infilling and erosion of the surrounding hillsides. Lund's Landing – a boating marina – lies 3 miles to the east, and Lewis and Clark State Park and the North Tabaco Garden State Game Management Area lay 2 and 4 miles to the west, respectively. The Interior Least Tern (Sterna antillarum), Whooping Crane (Grus americana), Pallid Sturgeon (Scaphirhynchus albus), and Gray Wolf (Canis lupus) are federal and State endangered species that potentially occur within Williams County. The Piping Plover (Charadrius melodus) is a federal and State threatened species with designated critical habitat in Williams County, however, no federally or State listed species have been identified as occupying the MRS. Due to poor habitat quality, ecological receptors are anticipated to be minimally exposed to MC within the MRS.



Williston LTA MRS Layout

CLIENT	Army National Guard			
PROJECT	RI through DD for Williston LTA, ND MRS			
REVISION NO	0	GIS BY	MS	11/12/2018
SCALE	1:960	CHK BY	JL	11/12/2018
SOURCE	ARNG; State of North Dakota, ESRI & Partners	PM	LS	11/12/2018

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Q:\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 5 SARs\900-Work\GIS\ND_Williston\MXD\RI_Figures\Fig_2-1_Williston_LTA_Site_Layout.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 2013 NDARNG PA report reported that the former firing range was used for small arms munitions and training activities. Small caliber arms from M1911 and M9 pistols, to M1, M14, and M16 rifles were used. In addition, there was a one-time use of 6 to 8 cratering charges (approximately 300 to 400 pound of explosives) in 1998 to construct a small "duck pond" at the USACE's request. All charges were verified to have detonated.

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.)	**<u>1</u>**
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 site; a large amount of military and non-military bullet fragments and spent casings were observed during RI field work in surface soil (0-6 inches bgs) at the Target Berm, Constructed Pond, and Backstop Area (RI report, Section 5).

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 large amount of military and non-military bullet fragments and spent casings were observed during RI field work in surface soil (0-6 inches bgs) at the Target Berm, Constructed Pond, and Backstop Area (RI report, Section 5). Analytical results from the RI showed elevated levels of small arms metals MC in the Target Berm, Constructed Pond, and Backstop Area (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).	8

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

The MRS is located in a very remote area and access from public roads is restricted by fence and locked gate. However, the MRS can be accessed by boat from Lake Sakakawea. The MRS area is co-leased with a cattle grazing association and thus workers and ranchers have access (Section 2.3 of the RI Report).

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).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

The MRS is owned by the United States Army Corps of Engineers (USACE) and leased to the North Dakota Army National Guard (NDARNG). The NDARNG is in the process of terminating the lease and returning the property to the USACE.

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.	**<u>1</u>**
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 0.52 acre MRS is located in the southwest corner of the 344.5 acre Williston LTA, in a remote location surrounded by rugged steep hills and grassland prairie vegetation. According to the 2018 US Census report, the town of Williston which is 21 miles away has a population of 25,586 people. The actual Williston LTA has <100 people 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).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

The 0.52 acre MRS is located in the southwest corner of the 344.5 acre Williston LTA, in a remote location surrounded by rugged steep hills and grassland prairie vegetation. There are roughly 1-5 inhabited buildings located within 2 miles of the MRS boundary.

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).	4

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

The MRS can be accessed from Lake Sakakawea and has paths for sightseeing, hiking, and other outdoors activities. The land is also co-leased with a cattle grazing association (RI report Section 2.3) and is transiently used for cattle grazing. There are no other land use types or structures within the MRS. Within a two-mile radius of the MRS, there is only one boat marina, Lund's Landing, that can be used for boating activities (RI report Section 2.3).

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.

The MRS does not contain any sensitive ecological species or habitat (RI report, Section 2.3.6). Several American Indian Tribes have historically inhabited the Williston LTA area. The USACE reports it will coordinate with the Tribes and ND State Historic Preservation Office in efforts to prevent loss of any cultural or archaeological resources that may exist within the boundary of Williston LTA (RI report, Section 2.3.7).

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.

The alternative rating of No Longer Required was selected because the MRS is a small arms range and RI activities confirmed no potential UXO during the site visit and field activities, all explosives were ND in soil analysis.

	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	9
Ease of Access	Table 4	8	
Status of Property	Table 5	0	
Receptor Factor Data Elements			
Population Density	Table 6	1	9
Population Near Hazard	Table 7	1	
Types of Activities/Structures	Table 8	4	
Ecological and/or Cultural Resources	Table 9	3	
EHE MODULE TOTAL			21

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 Longer Required

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: • Nonexplosively 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.	**0**
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 2013 PA and Historical Records Review determined that there was no evidence of MEC or CWM at the site (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)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

$$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$$

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)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
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).		

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
Media Not Evaluated			
CHF Scale	**CHF Value**	**Sum The Ratios**	
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**	$CHF = \sum \frac{[\text{Maximum Concentration of Contaminant}]}{[\text{Comparison Value for Contaminant}]}$	
2 > CHF	**L (Low)**		
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 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).	

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).	

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)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
2 > CHF	**L (Low)**		
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.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Media Not Evaluated			

CHF Scale	CHF Value	Sum the Ratios	
CHF > 100	H (High)		
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

$CHF = \sum$ [Maximum Concentration of 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 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).	

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).	

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	0.427	31	0.0148
Copper	38.4	3,100	0.012
Lead	69.1	400	0.17
Zinc	88.5	23,000	0.0038
Explosives MC	Not detected	NA	NA
CHF Scale	**CHF Value**	**Sum the Ratios**	0.201
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 (Low)

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).	L

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).	L

No Known or Suspected Surface Soil MC Hazard ☒

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Only use this table if there are more than five contaminants in any given medium present at the MRS. This is a supplemental table designed to hold information about contaminants that do not fit in the previous tables. Indicate the **media** in which these contaminants are present. Then record all **contaminants**, their **maximum concentrations** and their **comparison values** (from Appendix B of the Primer) in the table below. Calculate and record the **ratio** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** for each medium on the appropriate media-specific tables.

Note: Do not add ratios from different media.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio

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)					
Surface Water/Ecological Endpoint (Table 24)					
Sediment/Ecological Endpoint (Table 25)					
Surface Soil (Table 26 and 27)	L	L	L	L-L-L	G

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	G

HHE Ratings (for reference only)

Combination	Rating
HHH	A
HHM	B
HHL	C
HMM	C
HML	D
MMM	D
HLL	E
MML	E
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				**No Longer Required**	