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26 April 2017

Mae Willkom
Wisconsin DNR
1300 West Clairemont Avenue
Eau Claire, WI 54701

Re: **Feasibility Study Document Submittals**
Volk Field CRTC, Camp Douglas, Wisconsin
Contract W9128F-10-D-0054 Task Order 0009, Modification 2

Ms. Willkom:

Enclosed find the following

1) One unbound copy and one CD - **Final Military Munitions Response Program Feasibility Study Report for Six Munitions Response Sites, Revision 00, Volk Field CRTC, Camp Douglas, Wisconsin**. This Feasibility Study incorporates the following sites:
    - Former Firing-in-Buttress #1 (FR501)
    - Former Rifle Range #1/Machine Gun Range (SR503)
    - Former Rifle Range #5/Range #250 (SR503c)
    - Former Small Arms Range #251 (SR504)
    - Former Small Arms Debris Area (SR506)
    - Potential Civil War Era Impact Area (MU507)

2) One unbound copy of Change Pages (Appendix B) and one complete CD - **Final Feasibility Study Report for Munitions Response Site MU505 Former Mortar/Artillery Impact Area, Revision 00 Volk Field CRTC, Camp Douglas, Wisconsin.** These change pages will replace the cover page (Revision 01) and Appendix B.

Should you have any questions or need additional information, please do not hesitate to contact me at (651) 291-3435 or via email at joshm@baywest.com.

Thank you for your time and assistance.

Josh Miller
Project Manager

cc: Dan Gonnering, Volk Field
James King, NGB
Troy Pfertsh, USACE

Bay West file

Final

Military Munitions Response Program
Feasibility Study Report for
Six Munitions Response Sites

Former Firing-in-Buttress #1 (FR501)
Former Rifle Range #1/Machine Gun Range (SR503)
Former Rifle Range #5/Range #250 (SR503c)
Former Small Arms Range #251 (SR504)
Former Small Arms Debris Area (SR506)
Potential Civil War Era Impact Area (MU507)

Volk Field Combat Readiness Training Center
Camp Douglas, Wisconsin

Contract W9128F-10-D-0054 Task Order 0009
Revision 00, March 2017

Final

Military Munitions Response Program Feasibility Study Report for Six Munitions Response Sites

Former Firing-in-Buttress #1 (FR501)
Former Rifle Range #1/Machine Gun Range (SR503)
Former Rifle Range #5/Range #250 (SR503c)
Former Small Arms Range #251 (SR504)
Former Small Arms Debris Area (SR506)
Potential Civil War Era Impact Area (MU507)

Volk Field CRTC, Wisconsin

Contract W9128F-10-D-0054 Task Order 0009
Revision 00, March 2017

Prepared for:

Air National Guard Bureau
Volk Field CRTC, Wisconsin

Prepared by:

United States Army Corps of Engineers
Omaha District

and

Bay West
5 Empire Drive
St. Paul, Minnesota 55103

EXECUTIVE SUMMARY

The United States (U.S.) Army Corps of Engineers (USACE), Omaha District, contracted with Bay West LLC (Bay West) under the USACE Small Business set-aside Multiple Award Task Order Contract (MATOC) W9128F-10-D-0054, Task Order (TO) 0009, to perform a Feasibility Study (FS) for six Munitions Response Sites (MRSs) at the Volk Field Combat Readiness Training Center (CRTC), Wisconsin.

These MRSs require evaluation in accordance with the Comprehensive Environmental, Response, Compensation, and Liability Act of 1980 (CERCLA) due to potentially unacceptable hazards/risks associated with either munitions and explosives of concern (MEC) or munitions constituents (MC) identified during the remedial investigation (RI). Therefore, this FS has been prepared for the following six MRSs:

- Former Firing-in-Buttress (FIB) #1 (FR501)
- Former Rifle Range #1/Machine Gun Range (SR503)
- Former Rifle Range #5/Range #250 (SR503c)
- Former Small Arms Range #251 (SR504)
- Former Small Arms Debris Area (SR506)
- Potential Civil War Era Impact Area (MU507)

In support of the Military Munitions Response Program (MMRP) at Volk Field CRTC, Bay West prepared this FS Report. The goal of the U.S. Air Force (USAF) MMRP is to make MRSs safe for reuse and to protect human health and the environment in the process. The MMRP addresses issues related to MEC and MC associated with MRSs.

Current Site Conditions

An RI was performed to determine the nature and extent of contamination associated with historic military munitions activities at the MRSs through site characterization and baseline risk/hazard assessment activities. A subsequent interim removal action (IRA) was conducted in 2015 to address concerns identified during the RI for MEC and/or MC in soil at all six MRSs. The Site Specific Final Report for the IRA activities was submitted under separate cover (EA Engineering, Science, and Technology, Inc., PBC [EA], 2016). The current condition of each MRS, based on the results of the RI and IRA, is presented in the following paragraphs.

<u>Former Firing-in-Buttress #1 (FR501)</u>

MEC – All MEC/munitions debris (MD) has been removed from soil as a result of the IRA. Some MD may still be embedded in timbers inside the structure. In addition, MEC could potentially remain below the depth of instrument detection (i.e., 2-4 ft).

MC – Lead in soil is below the U.S. Environmental Protection Agency (USEPA) Regional Screening Level (RSL) and Wisconsin Department of Natural Resources (WDNR) residual contaminant level (RCL) of 400 milligrams per kilogram (mg/kg) for residential soil. However, based on the results of the RI, soil concentrations in the FIB structure exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater.

<u>Former Rifle Range #1/Machine Gun Range (SR503)</u>

MEC – There are no known or suspected MEC hazards at SR503.

MC – Lead in soil remaining on-site after the IRA is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, soil concentrations in the area of the IRA excavation footprint exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater.

Former Rifle Range #5/Range #250 (SR503c)

MEC – MEC and MD were removed in the impact area. Surface sweep completed over the rest of the MRS. However, MEC could potentially remain below the depth of instrument detection (i.e., 2-4 ft).

MC – Lead in soil remaining on-site after the IRA is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, soil concentrations in the area of and to the north of the IRA excavation footprint exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater.

Former Small Arms Range #251 (SR504)

MEC – There are no known or suspected MEC hazards at SR504.

MC – Lead in soil remaining on-site after the IRA is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, soil concentrations in the area of the IRA excavation footprint, as well as additional areas where RI sampling indicated lead concentrations below 400 mg/kg, exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater.

Former Small Arms Debris Area (SR506)

MEC – MEC/MD has been removed, except for the inaccessible portions of the site. In addition, MEC could potentially remain below the depth of instrument detection (i.e., 2-4 ft).

MC – Lead in soil remaining on-site after the IRA is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, soil concentrations in the area of the IRA excavation footprint exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater.

Potential Civil War Impact Area (MU507)

MEC – MEC/MD has been removed, except for the inaccessible portions of the site. In addition, MEC could potentially remain below the depth of instrument detection (i.e., 2-4 ft).

MC – No unacceptable risks have been identified for MC at MU507.

FS Development

The Department of Defense (DoD) established the MMRP to address DoD sites suspected of containing MEC or MC. Under the MMRP, USAF, the lead agency, is conducting environmental response activities at Volk Field CRTC. While Volk Field CRTC is not on the National Priorities List (NPL), pursuant to the DoD Manual 4715.20, Defense Environmental Restoration Program (DERP) Management (DoD, 2012), USAF is conducting MEC response activities in accordance with the DERP statute (10 U.S. Code [USC] 2701 et seq.), CERCLA (42 USC §9620), Executive Orders 12580 and 13016, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] Part 300.430). While MEC does not constitute a CERCLA hazardous substance, pollutant, or contaminant, the DERP statute provides the DoD the authority to respond to releases of MEC/MC, and DoD policy states that such responses shall be conducted in accordance with CERCLA and the NCP.

In addition, lead was detected at five of the six MRSs (FR501, SR503, SR503c, SR504, and SR506) at concentrations greater than the WDNR RCL of 27 mg/kg for lead based on protection of groundwater. While the risk assessments concluded that no unacceptable risks were associated with MC at the MRSs, the WDNR RCLs were established to provide residual contaminant levels for soil cleanup based on protection of groundwater. Because Volk Field CRTC is a non-NPL facility, in accordance with 42 USC Section 9620(a)(4) Volk Field CRTC must also comply with non-discriminatory state response laws. State response laws at Wisconsin Code of Administrative Rules, Chapter NR 292.12 require that response action be implemented when residual contamination exceeds the applicable remediation standards. As such, evaluation of remedial alternatives to address lead in soils is required regardless of whether risk is established.

This FS is being completed under CERCLA in the place of a Remedial Action Options Report (RAOR). Requirements of the RAOR, as described in Wisconsin Code of Administrative Rules, Chapter NR 722, are addressed in this FS. The components of the RAOR not addressed in the FS (i.e., selection of the remedial action alternative) will be addressed in a subsequent Proposed Plan and Record of Decision.

The objective of this FS was to develop, evaluate, and compare remedial action alternatives that meet remedial action objectives (RAOs), allowing the USAF to select appropriate remedies for the MRSs. This FS uses the RI and IRA information to perform a systematic analysis to determine appropriate remedial actions based on current and anticipated future land use. The RAO for the MRSs is to mitigate contact with MEC potentially present at FR501, SR503c, SR506, and MU507; and ensure receptors are not exposed to MC potentially in groundwater at FR501, SR503, SR503c, SR504, and SR506.

The alternatives developed and evaluated for the six MRSs include:

- Alternative 1 – No Action
- Alternative 2 – Land Use Controls (LUCs). LUCs would be implemented to address residual MEC potentially remaining at four of the six MRSs either below the depth of instrument detection and/or in areas inaccessible to remediation due to slopes greater than 30 degrees (FR501, SR503c, SR506, and MU507). LUCs would also be implemented to restrict groundwater use due to residual lead concentrations in soil exceeding protection of groundwater standards at five of the six MRSs (FR501, SR503, SR503c, SR504, and SR506), and these MRSs would remain in the WDNR Geographic Information System Registry for sites with residual contamination. Alternative 2 consists of restricted access, land use and groundwater use restrictions, and excavation construction support. Additional LUCs include education, warning signage, and unexploded ordnance and munitions recognition training.
- Alternative 3 – Soil Excavation and LUCs. Alternative 3 involves the excavation of approximately 9,937 cubic yards (CY) of soil and off-site disposal of soil with concentrations exceeding the WDNR RCL for protection of groundwater (27 mg/kg). Excavation would apply to the five MRSs that contain residual lead in soil exceeding the protection of groundwater standard: FR501, SR503, SR503c, SR504, and SR506. LUCs would be implemented to address residual MEC potentially remaining below the depth of instrument detection and/or in areas inaccessible to remediation due to slopes greater than 30 degrees (FR501, SR503c, SR506, and MU507).

Each alternative was evaluated for the nine NCP criteria applied to CERCLA remedial actions:

- Overall protection of human health and the environment;
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs);
- Long-term effectiveness and permanence;
- Reduction in toxicity, mobility, or volume (TMV) through treatment;
- Short-term effectiveness;
- Implementability;
- WDNR acceptance;
- Community acceptance; and
- Cost.

In addition to the NCP criteria, each alternative was evaluated with respect to the core green and sustainable remediation (GSR) elements of energy, air, water, land use, and materials and waste (WDNR, 2012).

With regard to overall protection of human health and the environment, under all three alternatives, potential MEC would remain in the inaccessible areas of SR506 and MU507 as well as potentially below the depth of instrument detection (i.e., 2-4 ft) at FR501, SR503c, SR506, and MU507. However, LUCs would be implemented under Alternatives 2 and 3 to restrict entry into these areas. Alternative 3 offers the highest level of protection of human health and the environment through removal of soil with residual lead impacts. Alternative 2 uses LUCs to reduce exposure to potential hazards but does not remove residual lead in soil at concentrations exceeding the WDNR RCL of 27 mg/kg for protection of groundwater. The No Action alternative, Alternative 1, consists of leaving the site in its current state and is the least protective. Since soil exceeding the residential standard for lead of 400 mg/kg has already been removed, the potential for risk associated with residual lead concentrations remaining in soil is low. Therefore, Alternative 3 is only slightly more protective than Alternative 2.

Alternative 1 does not comply with the chemical-specific to be considered (TBC) guidance, which is the WDNR RCL of 27 mg/kg for lead based on protection of groundwater. Furthermore, Alternative 1 does not comply with the action-specific ARAR requiring response action for sites with residual contamination. There are no location-specific ARARs associated with Alternative 1. Alternatives 2 and 3 are compliant with the chemical-specific, location-specific and action-specific ARARs.

With respect to long-term effectiveness, Alternative 3 is slightly more effective than Alternative 2. Both alternatives would include LUCs to limit contact with MEC potentially remaining below the depth of instrument detection and/or in areas inaccessible to remediation due to slopes greater than 30 degrees (FR501, SR503c, SR506, and MU507). As a result of previous removal actions, lead concentrations in soil are below the residential cleanup level of 400 mg/kg and do not pose an unacceptable risk for direct contact. Alternative 2 would include LUCs to prevent groundwater use due to the residual risk resulting from soil concentrations greater than the protection of groundwater standard at FR501, SR503, SR503c, SR504, and SR506. However, Alternative 3 would be more effective because soil with lead concentrations greater than the protection of groundwater standard would be excavated and disposed off-site. Alternative 1 would not be effective in the long-term because the hazard for exposure to MEC potentially remaining below the depth of instrument detection (i.e., 2-4 ft) and/or in the inaccessible areas of FR501, SR503c, SR506, and MU507 is not mitigated. Furthermore, there is no action to remove or mitigate potential hazards associated with residual lead in soil.

Alternative 3 would be the most favorable for reduction of TMV since excavation of residual lead-impacted soil would eliminate the potential for migration of lead to groundwater. For Alternatives 2 and 3, as part of the operation and maintenance (O&M) program, visual confirmation of the inaccessible areas and construction support will be performed, and any MEC identified would be treated on-site using conventional MEC destruction techniques (e.g., blow-in-place, consolidated shot). Minimal MEC is anticipated during these activities. Therefore, only a minor reduction in TMV would be achieved. No reduction in the volume of MEC or MC would be provided by Alternative 1.

With regard to short-term effectiveness, Alternative 1 involves the lowest short-term hazards to site workers and the local public as no activities are performed at the MRS in order to implement this alternative. Alternative 2 only entails short-term hazards during the site inspections and during construction support activities in the event subsurface construction or other intrusive activities are planned. For Alternative 3, which would include soil excavation, health and safety requirements would be detailed in work planning documents. Implementing the requirements of the planning documents would ensure the local public and site workers are protected during remedy completion.

Implementability addresses the feasibility of performing a remedial action given field conditions and other factors (e.g., administrative and technical). The three alternatives are all feasible with respect to the technologies involved; LUCs and soil excavation are standard technologies that have been applied with success at Volk Field CRTC and various other DoD installations. However, the excavation proposed for Alternative 3 is labor intensive and translates to the highest difficulty of implementation. Alternative 2 is comparatively easy to implement. By definition, the no action alternative, Alternative 1, is easiest to implement.

Alternative 1 has no capital or O&M cost because no remedial activity would be performed. Alternative 2 has the next lowest life-cycle cost. This alternative combines the lowest capital cost with the ongoing long-term maintenance costs. Alternative 3 has the highest capital costs, while long-term maintenance costs are the same as Alternative 2. The estimated costs for each alternative are listed in **Table ES-1**.

Table ES-1 Estimated Costs for Remedial Alternatives

Alternative Number	Title	Capital Costs	30-Year O&M	Net Present Value
1	No Action	$0	$0	$0
2	LUCs	$18,648	$811,511	$830,159
3	Soil Excavation and LUCs	$2,769,198	$811,511	$3,580,709

The GSR evaluation is not applicable to Alternative 1, since there is no remedial action associated with this alternative. Overall, Alternative 2 is the most sustainable, since this alternative primarily consists of administrative actions. Alternative 3 would have greater impacts than Alternative 2 for energy and air, due to the use of heavy equipment for excavation. Alternative 3 would also require off-site disposal, and therefore would have a greater impact for materials and waste than Alternative 2.

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Acronyms and Abbreviations

°F	degrees Fahrenheit
%	percent
ANG	Air National Guard
ANGB	Air National Guard Base
ARAR	Applicable or Relevant and Appropriate Requirement
Bay West	Bay West LLC
BCY	bank cubic yard
bgs	below ground surface
BIP	blow-in-place
CERCLA	Comprehensive Environmental, Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CHE	Chemical Warfare Materiel Hazard Evaluation
CRTC	Combat Readiness Training Center
CSE	Comprehensive Site Evaluation
CSM	Conceptual Site Model
CWM	Chemical Warfare Materiel
CY	cubic yard
DERP	Defense Environmental Restoration Program
DGM	digital geophysical mapping
DoD	Department of Defense
DPT	direct push technology
EA	EA Engineering, Science, and Technology, Inc., PBC
EBS	environmental baseline study
EHE	Explosive Hazard Evaluation
EOD	explosives ordnance disposal
FIB	firing-in-buttress
FOB	Forward Operating Base
FS	Feasibility Study
ft	foot/feet
GIS	geographic information system
GPS	global positioning system
GRA	General Response Action
GSR	green and sustainable remediation
HE	high explosive
HHE	Health Hazard Evaluation
HHRA	Human Health Risk Assessment
HRR	historical records review
lb	pound
IRA	interim removal action
LCY	loose cubic yard
LUC	Land Use Control
MATOC	Multiple Award Task Order Contract
MC	munitions constituents
MCL	maximum contaminant level
MD	munitions debris
MDAS	material documented as safe
MEC	munitions and explosives of concern
MHAT	Munitions Hazard Assessment Tool
mg/kg	milligrams per kilogram
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	material potentially presenting an explosive hazard
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
NA	not applicable
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	no further action
NMRD	non-munitions related debris
NPL	National Priorities List
O&M	operation and maintenance
OMB	Office of Management and Budget
PRG	preliminary remediation goal
RAO	remedial action objective

RAOR................Remedial Action Options Report
RCL...................residual contaminant level
RCRA................Resource Conservation and Recovery Act
RI ....Remedial Investigation
ROD..................Record of Decision
RRD ....range-related debris
RSL ....Regional Screening Level
SAA...................small arms ammunition
SPLP.................synthetic precipitation leaching procedure
SWPPP.............storm water pollution prevention plan
TBC...................to be considered
TCLP.................toxicity characteristic leaching procedure
TMV ....toxicity, mobility, or volume
TO.....................task order
U.S...................United States
USACE ....United States Army Corps of Engineers
USAF................United States Air Force
USC ....United States Code
USEPA ....United States Environmental Protection Agency
UXO..................unexploded ordnance
WDNR ....Wisconsin Department of Natural Resources
WI ANG ....Wisconsin Air National Guard
WI ARNG..........Wisconsin Army National Guard
XRF ....x-ray fluorescence

1.0 INTRODUCTION

The United States (U.S.) Army Corps of Engineers (USACE), Omaha District, contracted with Bay West, Inc. (Bay West) under the USACE Small Business set-aside Multiple Award Task Order Contract (MATOC) W9128F-10-D-0054, Task Order (TO) 0009 to perform a Feasibility Study (FS) for six Munitions Response Sites (MRSs) at the Volk Field Combat Readiness Training Center (CRTC), Wisconsin (**Figure 1-1**).

A Remedial Investigation (RI; Bay West, 2015a) was initiated in 2012 for 15 MRSs at the Volk Field CRTC in support of the Military Munitions Response Program (MMRP). MRS locations are shown on **Figure 1-2**. Seven MRSs were recommended for No Further Action (NFA), as follows:

- Former Firing-in-Buttress (FIB) #1 (FR501a); areas excluding the FIB structure and berm
- Former FIB #2 (FR502)
- Former Rifle/Small Arms Ranges – Multiple Sites (SR503b)
- Kitchen Dump – C4 Discovery Area (XU508)
- Building 324 Area – Munitions and Explosives of Concern (MEC) Discovery (XU511)
- Petroleum, Oil, and Lubricants Area – MEC Discovery (XU512)
- Former Fire Training Area/Suspected Munitions Burn/Burial Pit (OB513)

The NFA MRSs are not included in this FS but will be addressed in a separate NFA Proposed Plan and Record of Decision (ROD).

Expanded areas associated with one MRS required further investigation, which was performed as an RI Addendum (Bay West, 2015b). The FS for the following MRS has been submitted under separate cover (Bay West, 2016a):

- Former Mortar/Artillery Range (MU505)

Three MRSs require further investigation and therefore are not included in the FS. An RI Work Plan Addendum has been submitted under separate cover (Bay West, 2016b) for the following three MRSs:

- Former Skeet Range #1/Trap Range #1 & #2 (TS509)
- Former Skeet Range #2 (TS510)
- Munitions Storage Area (MRS was not included in the initial 2012 RI)

For the remaining MRSs, potentially unacceptable hazards/risks associated with either MEC or munitions constituents (MC) were identified during the RI. Therefore, this FS has been prepared for the following six MRSs included in the interim removal action (IRA):

- Former FIB #1 (FR501); includes the FIB structure and berm
- Former Rifle Range #1/Machine Gun Range (SR503)
- Former Rifle Range #5/Range #250 (SR503c)
- Former Small Arms Range #251 (SR504)
- Former Small Arms Debris Area (SR506)
- Potential Civil War Era Impact Area (MU507)

An IRA was completed at these six MRSs in 2015 and the Site Specific Final Report for the IRA activities was submitted under separate cover (EA Engineering, Science, and Technology, Inc., PBC [EA], 2016). In support of the MMRP at Volk Field CRTC, Bay West prepared this FS Report. The goal of the U.S. Air Force (USAF) MMRP is to make MRSs safe for reuse and to protect human health and the environment in the process. The MMRP addresses issues related to MEC and MC associated with MRSs.

1.1 Purpose

The Department of Defense (DoD) established the MMRP to address DoD sites suspected of containing MEC or MC. Under the MMRP, the USAF, the lead agency, is conducting environmental response activities at Volk Field CRTC. While Volk Field CRTC is not on the National Priorities List (NPL), pursuant to the DoD Manual 4715.20, Defense Environmental Restoration Program (DERP) Management (DoD, March 2012), USAF is conducting MEC response activities in accordance with the DERP statute (10 U.S. Code [USC] 2701 et seq.); the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 USC §9620); Executive Orders 12580 and 13016; and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] Part 300).

While MEC does not constitute a CERCLA hazardous substance, pollutant, or contaminant, the DERP statute provides the DoD the authority to respond to release of MEC/MC, and DoD policy states such responses will be conducted in accordance with CERCLA and the NCP.

An RI was performed to determine the nature and extent of contamination associated with historic military munitions activities at the MRSs through site characterization and baseline risk/hazard assessment activities. A subsequent IRA was conducted to address concerns identified during the RI for MEC and MC in soil. This FS Report was then developed to address the residual risks/hazards identified during the RI and previous investigations.

The purpose of the FS is to develop, evaluate, and compare remedial action alternatives to meet the remedial action objectives (RAOs), allowing the USAF to select and propose an appropriate remedy for the MRSs in accordance with 40 CFR 300.430(a)(2). This FS Report uses the information obtained during the RI and IRA to perform a systematic analysis to determine appropriate remedial actions based on current and anticipated future land use.

This FS Report was developed from the *Munitions Response Remedial Investigation/Feasibility Study Guidance* (DoD, 2009) and in accordance with U.S. Environmental Protection Agency (USEPA) guidance documents developed for activities performed under CERCLA, as outlined in the NCP.

This FS is being completed under CERCLA in the place of a Remedial Action Options Report (RAOR). Requirements of the RAOR, as described in Wisconsin Code of Administrative Rules, Chapter NR 722, are addressed in this FS. The components of the RAOR not addressed in the FS (i.e., selection of the remedial action alternative) will be addressed in a subsequent Proposed Plan and ROD.

1.2 Project Management

Bay West prepared this FS Report under the USACE Omaha MMRP MATOC W9128F-10-D-0054, TO 0009, Volk Field CRTC.

1.3 Report Organization

This FS Report is organized by the sequence of steps used in the development, screening, and analysis of alternatives as follows:

- **Section 1.0** – Introduction: This section describes the regulatory framework, purpose, and property identification; presents background information; and summarizes the results of the RI, including the RI risk assessment.
- **Section 2.0** – Identification and Screening of Remedial Action Technologies: This section defines RAOs and potential Applicable or Relevant and Appropriate Requirements (ARARs), identifies the range of applicable general response actions

(GRAs) and technologies to address hazards associated with MEC, and provides an initial screening of such GRAs and technologies to assess whether they should be included as part of a remedial alternative.

- **Section 3.0** – Development and Screening of Alternatives: This section presents the various remedial alternatives and includes preliminary screening of alternative effectiveness, implementability, and cost.
- **Section 4.0** – Detailed Analysis of Alternatives: This section presents a detailed evaluation of each remedial alternative developed and retained during the screening process in **Section 3.0**. The evaluation is based on the nine criteria in the NCP: protection to human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume (TMV) through treatment; short-term effectiveness; implementability; cost; state acceptance; and community acceptance.
- **Section 5.0** – Comparative Analysis: This section provides a comparison of the alternatives based on the results of the detailed analysis of alternatives in **Section 4.0**.

The following appendices contain information supporting the FS:

- **Appendix A –** Supporting Site Information for the Feasibility Study: Provides data for individual sites excerpted from previous reports.
- **Appendix B** – Remedial Alternatives Cost Worksheets: Provides backup information for the cost estimates presented in the FS.
- **Appendix C –** Definitions: Provides definitions of terminology used in the FS.

1.4 Installation Description and Mission

The Wisconsin Air National Guard (WI ANG) supporting the CRTC and the 128th Air Control Squadron, WI ANG are based at Volk Field. The mission of the CRTC is to provide a training environment for Air National Guard (ANG) units to enhance combat capabilities by allowing training that is not possible at a unit's home station.

The CRTC approximates a Forward Operating Base (FOB) location and provides a realistic setting for unit Operational Readiness Exercises and Inspections. Additionally, the Volk Field CRTC oversees operations and scheduling of the Hardwood Air-to-Ground Gunnery Range and over 11,000 square miles of special use military training airspace.

Volk Field also supports Camp Williams, consisting of the U.S. Property and Fiscal Office, the 32nd Brigade Headquarters of the WI ANG, and the Combined Support Maintenance Shop.

1.5 Location and Setting

Volk Field CRTC is located approximately 1 mile northeast of the village of Camp Douglas (population 601) in Township 17N and Range 2E along Interstate 90/94 in Juneau County, Wisconsin, approximately 90 miles northwest of Madison, Wisconsin (**Figure 1-1**).

Volk Field CRTC is located in a relatively undeveloped rural area. The village of Camp Douglas is adjacent to the installation to the southwest and the village of Oakdale to the northwest. Vast parcels of land located around the installation are primarily used for agriculture and open land. The city of New Lisbon, located approximately 10 miles southeast of Volk Field CRTC, has an estimated population of 2,343 (U.S. Census, 2010).

Volk Field covers approximately 2,336 acres controlled by the WI ANG. There are approximately 120 military and 70 permanent civilian employees assigned to Volk Field CRTC, with approximately 130 additional employees associated with various tenant units. Real property documents indicate the base contains 143 buildings (WI ANG, 2007).

Camp Williams, located within the southwest portion of Volk Field CRTC, is home to the 32nd Infantry Brigade, Wisconsin Army National Guard (WI ARNG). Camp Williams is also home to the U.S. Property and Fiscal Office for the State of Wisconsin. Camp Williams has 50 structures; there is no fence or physical boundary between Volk Field CRTC and Camp Williams.

The State of Wisconsin owns Volk Field. The property is leased to the Air Force, licensed to the Air National Guard, and the Air National Guard fully controls access to the installation and all MRSs.

1.5.1 Installation History

Volk Field CRTC dates to 1888, when the State Adjutant General, General Chandler Chapman, purchased land for a rifle range and offered it to the state for training. The State Legislature authorized the purchase of 600 acres for a permanent camp and a rifle range, known as the Wisconsin Rifle Range, for the Wisconsin National Guard in 1889. By 1897, the Wisconsin Rifle Range was known as the Wisconsin Military Reservation and was used by infantry, artillery, and cavalry units for a variety of field programs, including simulating combat conditions.

The reservation was renamed Camp Williams in 1927. Construction of the first hard surface runways began in 1935 and expanded during World War II to improve training capabilities. The WI ARNG and WI ANG were formed as part of the DoD reorganization in 1947.

In 1954, the Federal Government leased the field from the State of Wisconsin for use as a permanent field training site. In 1957, the Wisconsin State Legislature renamed the field Volk Field CRTC ANG Base (ANGB) in honor of First Lieutenant Jerome A. Volk, the first WI ANG pilot killed in the Korean War.

During the 1960s, Volk Field CRTC served as a Dispersed Operating Base for the active duty Air Defense Mission in Duluth, Minnesota, with over 200 personnel assigned to the base. In 1970 the unit was re-designated as Detachment 1, 87th Fighter Interceptor Squadron and reported through K.I. Sawyer Air Force Base, Michigan. The detachment was deactivated in 1974, and the WI ANG assumed exclusive control of the base.

In the 1980s, Volk Field ANGB began year-round operations for training the WI ANG, other DoD services, and some foreign allies. In 1988, Volk Field ANGB was chosen to house the ANG training program, and the base was designated as a CRTC in 1990.

1.5.2 Summary of MEC-Related Activities

Significant munitions use has occurred at Volk Field CRTC, including target impacts, small arms, and munitions disposal. As a result of investigations during a Comprehensive Site Evaluation (CSE) Phase II (Sky Research, 2011) and RI (Bay West, 2015a), the six MRSs presented in this FS were carried forward to an IRA. This section summarizes the MEC-related activities associated with the six MRSs.

1.5.2.1 Former Firing-In-Buttress #1 (FR501)

The FIB was identified during the CSE Phase I on a topographic survey map titled *Topographic Survey of Firing Butt East of 932 (Aug, 1973)* (Sky Research, 2011). FIB #1 was constructed in 1956 and ground scarring from the construction activities is evident in 1957 aerial photos.

The aircraft tie down and firing point for the FIB is currently used as the Power Check Pad along Taxiway A. The FIB target facility is located southeast of the aircraft tie down and firing point. The footprint of the former range crosses Madison Boulevard (**Figure 1-3**). The FIB structure is constructed of concrete surrounded by an earthen berm, with the upper portion of the walls and ceiling constructed of wood timbers and with a poured concrete roof.

The primary aircraft using FIB #1 would have been P-51, F-84, F-86, F-100, and A-7 aircraft (WI ANG, 2007). Munitions historically used by these aircraft include 0.50 caliber ammunition and 20 millimeter (mm) projectiles. According to a 2007 Environmental Baseline Study (EBS), the range was reportedly used until the early 1970s and was taken off of the Installation's real property listing as of 1984 (Sky Research, 2011).

The total original area of FR501 MRS was 5.13 acres. Based on the RI results (**Section 1.7**), it was recommended that the MRS be split into FR501, consisting of approximately 1.0 acre encompassing the FIB structure and the associated impact berm, and FR501a, consisting of the remaining 4.13-acre area. Both the original and revised areas of FR501 MRS are shown on **Figure 1-3**. The RI recommended that a removal action be completed for FR501 to reduce the potential explosive hazards and environmental risks, while FR501a does not require any further action.

1.5.2.2 Former Rifle Range #1/Machine Gun Range (SR503)

Former Rifle Range #1 was one of six rifle ranges (Ranges #1 through #6) that were orientated with the firing lines towards the sandstone bluff located on the southeastern portion of the installation and were constructed by the authority of the Adjutant General by 1894. The former rifle ranges were constructed in conjunction with training exercises performed by infantry, artillery, and cavalry units. The footprint of the former ranges has been extensively redeveloped and no evidence of the firing lines remains (Sky Research, 2011).

Over time, other small arms ranges were developed over portions of the footprints of the original rifle ranges. The Machine Gun/Pistol Range, identified on a historic figure titled "The Location of the Rifle and Machine Guns Ranges at Camp Williams" was constructed over the southeastern footprint of former Rifle Range #1 and eastern portion of former Rifle Range #2 sometime in the 1930s (Sky Research, 2011).

Former Rifle Range #1/Machine Gun Range was investigated during the RI as part of the Former Rifle Range/Small Arms Ranges – Multiple Sites (SR503) MRS. Based on RI results, it was recommended that the MRS be further subdivided into the Former Rifle Range #1/Machine Gun Range (SR503), Former Rifle Range #5/Former Range 250 (SR503c), and SR503b representing the remaining portion recommended for administrative closeout. **Figure 1-4** shows the Former Rifle Range #1/Machine Gun Range (SR503) MRS addressed by the FS (total area of 5.67 acres).

1.5.2.3 Former Rifle Range #5/Range #250 (SR503c)

Former Rifle Range #5 was one of six rifle ranges (Ranges #1 through #6) that were orientated with the firing lines towards the sandstone bluff located on the southeastern portion of the installation and were constructed by the authority of the Adjutant General by 1894. The former rifle ranges were constructed in conjunction with training exercises performed by infantry, artillery, and cavalry units. The footprint of the former ranges has been extensively redeveloped and no evidence of the firing lines remains (Sky Research, 2011).

Over time, other small arms ranges were developed over portions of the footprints of the original rifle ranges. Small Arms Range #250 was constructed over portions of the former footprint of Rifle Ranges #4 and #5. Small Arms Range #250 first appears on a March 9, 1943, map entitled *Plat Camp Williams, Camp Douglas, Wisconsin,* prepared for the Office of the Quartermaster by Henry C. Hengels. Small Arms Range #250 was reportedly used until the late 1980s. When Small Arms Range #250 was in use, Volk Field CRTC personnel barricaded Wisconsin Avenue where it cut through the Former Rifle Range #6 (Sky Research, 2011).

Range #250 was used for small arms training by ANG personnel, law enforcement personnel, and at times, Civil War Era re-enactors. Documentation discussing the type or size of munitions used at these ranges was not identified. However, visual observations identified remnants of 40 mm projectiles and extensive small arms debris (Sky Research, 2011).

Figure 1-5 shows the Former Rifle Range #5/Range #250 (SR503c) MRS addressed by the FS (total area of 16.14 acres). A masonry wall and berm that was formerly used for setting rifle range targets runs north-south, located about 200 feet (ft) west and in front of the impact area along a sandstone rock face (**Figure 1-5**). Most of the small arms debris could be found along the surface of a sand deposit at the base of the rock face.

1.5.2.4 Former Small Arms Range #251 (SR504)

Former Small Arms Range #251 was identified in a 2007 EBS (Sky Research, 2011). The range was in use from 1954 until 1999 when the new, active small arms range (Facility #243) was constructed at the southeastern portion of former Small Arms Range #250.

Former Small Arms Range #251 (SR504) was located within the southeastern portion of the footprint of former Rifle Range #3. The sandstone bluff located to the east was used as the target impact area for range activities. No documentation was identified discussing the types of munitions that were used at this range (Sky Research, 2011).

Figure 1-6 shows the Former Small Arms Range #251 (SR504) MRS addressed by the FS (total area of 2.46 acres).

1.5.2.5 Former Small Arms Debris Area (SR506)

A Small Arms Debris Area (**Figure 1-7**) was reported by Volk Field personnel during the CSE Phase I interviews. The ground surface was reported to have a significant amount of small arms projectiles scattered over a small area. No information was available regarding use of the site or the time frame of site activities (HRR; Sky Research, 2011).

This heavily wooded area is contiguous with the former Mortar/Artillery Impact Area; however, no documentation regarding historical munitions activities in this area was identified and no munitions debris (MD) was identified in the CSE Phase II (Sky Research, 2011). Accordingly, the Former Small Arms Debris Area was treated as a separate MRS during the RI.

1.5.2.6 Potential Civil War Era Impact Area (MU507)

A Civil War Era projectile, identified as a Hotchkiss 3-inch gun projectile in the CSE Phase II, was identified in a heavily wooded area of the sandstone bluff. While no documentation specifying the use of this area for artillery training was identified, it is known that artillery training did take place at Volk Field. No discernible features were identified during the historic aerial photograph review (Sky Research, 2011).

Figure 1-8 shows the Potential Civil War Era Impact Area (MU507) MRS addressed by the FS (total area of 8.1 acres).

1.6 Site Physical Characteristics

1.6.1 Climate

The climate at Volk Field CRTC is mild, with monthly mean high temperatures ranging from 25 degrees Fahrenheit (°F) in January to 84°F in July, and monthly mean low temperatures ranging from 6°F in January to 57°F in July. The average annual precipitation is approximately 32.3 inches. The annual mean snowfall is approximately 31.4 inches (Sky Research, 2011).

The frost depth for Volk Field CRTC is 114 inches according to Unified Facilities Criteria 3-301-01. This is considered the maximum depth where frost may occur and the maximum depth where frost-related migration of MEC is possible (DoD, 2011).

1.6.2 Topography

Volk Field is located approximately 1 mile north of the village of Camp Douglas, in Juneau County, Wisconsin. The Base is located in the Central Lowlands physiographic province of the Lake Michigan Basin. The topography is generally flat at an average 905 ft above mean sea level and an elevation change of only 10 ft; however, to the southeast, a large sandstone butte rises approximately 200 ft above the surrounding landscape.

1.6.3 Hydrology

Volk Field is located within the drainage basin of the Lemonweir and Little Lemonweir Rivers. The Lemonweir River flows from northwest to southeast and is located approximately 3,700 ft northeast of the installation boundary. The Little Lemonweir River is approximately 2.5 miles south of the Volk Field boundary and flows from west to east. The Little Lemonweir River joins the Lemonweir River 4.5 miles southeast of Volk Field at the town of New Lisbon.

Storm water runoff from Volk Field is facilitated by a system of ditches that drain toward the south and east and eventually lead to the Lemonweir River or the Little Lemonweir River (Sky Research, 2011).

1.6.4 Geology

Volk Field CRTC is underlain by 130 ft of Pleistocene-age glacially deposited unconsolidated sand, silt, gravel, and minor amounts of clay. The glacial sediments overlay quartz-rich sandstone bedrock included in the Elk Mound Group (WI ANG, 2007). The Elk Mound Group outcrops as a sandstone butte on the southeast part of the installation.

1.6.5 Hydrogeology

Two aquifers that lie beneath Volk Field are the Pleistocene aged glacial deposits and the Cambrian aged Wonewoc Formation. Infiltration to aquifers is by precipitation, snowmelt, and surface water. Shallow groundwater depth is typically 10-15 ft below ground surface (bgs); however, depth fluctuates seasonally. Groundwater beneath the property generally flows in an east-northeasterly direction.

Volk Field maintains four production water wells used to provide a potable water supply. The primary wells are located near Building 319 and Building 28. The well at Building 319 has a depth of 191 ft and draws water at 80 ft depth. The well at Building 28 has a depth of 80 ft and draws water at depths as shallow as 12 ft.

A well located at the top of the bluff serves only Building 323. Depth of the well is unknown. A shallow groundwater well currently exists at the Leadership Reaction Course but is scheduled to be capped and abandoned (WI ANG, 2012).

1.6.6 Wetlands

There are no wetlands areas present within the boundaries of the six MRSs included in this FS.

1.6.7 Soil and Vegetation Types

1.6.7.1 Soil

Seventeen soil classifications occur within Volk Field. Soils are generally deep, sandy, and range from well-to-poorly drained. All soil types found on the base are susceptible to wind and water erosion. Soils have high to moderately rapid permeability. Soils are rarely flooded; only the Newson-Dawson complex and Newson loamy sand are subject to frequent flooding. Slopes range from flat (0-5 percent [%]) across much of the base to 60% at the sandstone bluff.

1.6.7.2 Vegetation

Volk Field vegetation includes open fields, woodlands, and wetlands. Open fields are the dominating vegetation type and consist mostly of non-native species that are actively managed (i.e., mowed or managed as native vegetation restoration areas). The majority of woodlands occur in the southeastern portion of the installation (Sky Research, 2011).

1.6.8 Ecology

Volk Field CRTC vegetation includes open fields, woodlands, and wetlands. Open fields are the dominant vegetation type and consist of actively managed (i.e., mowed or landscaped) non-native species. The majority of woodlands occur in the southeastern portion of the installation.

Ecological receptors could potentially be exposed to MC that may be present in soil in the Volk Field CRTC MRSs. Potential ecological receptors include plants, soil invertebrates, birds, and mammals common to central Wisconsin.

1.7 Previous Site Investigations

The USACE Omaha District contracted with Sky Research, Inc., to conduct CSE Phase I and II investigations at Volk Field CRTC. The CSE Phase I consisted of an HRR to investigate documentation regarding munitions usage. Interviews were conducted with current and former employees at Volk Field that were likely to have first-hand knowledge of historical activities (e.g., explosives ordnance disposal [EOD], civil engineering, etc.), curators of nearby museums, and long-time area residents.

During CSE Phase II activities, the potential presence of MEC and MC were evaluated at each applicable MRS. The Field Team searched for visual evidence of MEC and munitions-related features and categorized these features as 1) Potential MEC, 2) MD, 3) Evidence of MEC activity, or 4) Other. No MC sampling was performed during this phase. The findings of the CSE Phase I and II investigations are presented in the summary of MEC-related activities found in **Section 1.5.2**. Subsequent findings from the RI and IRA are presented below.

Following the CSE Phase II, an RI was performed in 2012. The RI included digital geophysical mapping (DGM) and intrusive investigations to further characterize the nature and extent of MEC, and environmental sampling to evaluate if MC impacts had occurred.

The RI recommended IRA for the six MRSs included in this FS. The IRA was conducted in 2015, and included mag and dig operations to remove surface and subsurface MEC; excavation and sifting to remove MEC and MD, including small arms ammunition (SAA); and removal of lead-contaminated soil (EA, 2016).

Following the IRA, each MRS was assessed using the Munitions Response Site Prioritization Protocol (MRSPP). The National Defense Authorization Act for Fiscal Year 2002 required the Secretary of Defense to develop a protocol for assigning to each defense site a relative priority (i.e., an MRS Score) for response activities and to annually update the MRS Score to reflect new information that became available. The MRSPP consists of three hazard evaluation modules:

- Explosive Hazard Evaluation (EHE) evaluates the potential for explosive hazards;
- Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE) evaluates the potential for CWM hazards; and

- Health Hazard Evaluation (HHE) is used to evaluate the potential human health (both acute and chronic) and environmental hazards posed by MC and any incidental non-munitions-related contaminants.

The module ratings are combined to produce an overall MRSPP priority score ranging from 1 (highest priority) to 8 (lowest priority). An A rating from the EHE or HHE modules would receive a maximum priority of 2 while an A rating from the CHE rating would receive the highest priority of 1. The priority of each MRS is determined by the highest rating in amongst the EHE, CHE, and HHE Modules. The MRSPP scores for the six MRSs included in this FS were updated in August 2016 and are presented in **Table 1-1** below.

Table 1-1 Summary of MRSPP Scores

MRS	EHE	CHE	HHE	Priority
FR501	G	No Known or Suspected Hazard	G	**8**
SR503	G	No Known or Suspected Hazard	G	**8**
SR503c	G	No Known or Suspected Hazard	G	**8**
SR504	G	No Known or Suspected Hazard	G	**8**
SR506	F	No Known or Suspected Hazard	G	**7**
MU507	D	No Known or Suspected Hazard	No Known or Suspected Hazard	**5**

1.7.1 Former Firing-In-Buttress #1 (FR501)

MEC Investigation

During the RI, a surface clearance was performed prior to the DGM and analog surveys. The DGM survey was conducted over approximately 3.16 acres of FIB #1 to identify locations of subsurface anomalies. This included only those areas accessible to the DGM instrumentation. An analog survey was performed during two field events over approximately 1.5 acres of the area extending from the floor to the MRS boundary to address some of the areas that were inaccessible to the DGM equipment. The area directly behind the FIB structure was not surveyed, as no munitions fired into the catch box would penetrate all the way through the structure.

The DGM and analog surveys identified 859 and 324 targets, respectively. The 1,183 targets were intrusively investigated and removed. No MEC were encountered. A total of 48 pounds (lbs) of MD and 447 lbs of non-munitions related debris (NMRD) were recovered from the excavations (Bay West, 2015a). The MD items were predominantly from 20 mm practice training projectiles. Fragments of larger ordnance (e.g., 75 mm projectiles) were scattered across the area, but the pattern did not indicate use as an impact area. Historic records indicate fill material for the construction of training areas was obtained from near the base of the sandstone bluff that was formerly used as an artillery target (Bay West, 2015a). The MD identified at FIB #1 associated with larger ordnance therefore was likely deposited as fill material during the FIB construction.

Nine small test pits were hand excavated inside the FIB structure and the soil from the impact berm was screened for munitions related debris. The impact berm soil was inspected and determined to contain MD from 20 mm high explosive (HE) projectiles (Bay West, 2015a). The soil volume excavated from the test pits and the number of projectile-related MD recovered resulted in an average density of 14.3 projectiles per cubic ft of soil. This was compared to the estimated volume of soil from the impact berm (approximately 400 cubic yards [CY]), resulting in an estimate of 150,000 to 160,000 projectiles potentially remaining in the impact berm soil.

<u>MC Investigation</u>

During the RI, discrete soil samples were collected by scoop or hand auger at 20 locations. Two samples were collected next to the location where planes would have been anchored while using the range. Nine sample locations were located near the FIB structure in the area where projectiles wide of the target would have impacted, and three samples were collected directly in front of the impact berm where undershoots would have impacted. Six samples were collected from the impact berm inside the FIB structure.

Three soil borings were installed along the northern edge of the impact berm at the undershoot locations using direct push technology (DPT). The FIB #1 structure prevented direct access to soil under the impact berm so the DPT rig was placed as close to the structure as possible, and the borings were angled at 45 degrees to collect samples from under the impact berm. Samples were collected from 0-6 inch and 24-48 inch intervals.

The soil samples from the three borings were sent off-site for laboratory analysis of MC-related compounds, including antimony, copper, lead, and zinc. None of the sample concentrations exceeded the USEPA Regional Screening Levels (RSLs) or Wisconsin Department of Natural Resources (WDNR) residual contaminant levels (RCLs) for residential soil, with a maximum detected value of 140 milligrams per kilogram (mg/kg) for lead.

At one of the three soil boring locations (FR501-LS005), all samples from all depths were also analyzed for synthetic precipitation leaching procedure (SPLP) lead. The SPLP lead values slightly exceeded the USEPA Maximum Contaminant Level (MCL) criteria at the 4-ft depth; however, the total lead concentration at this sample location (0.91 mg/kg) did not exceed the WDNR RCL for groundwater protection (i.e., 27 mg/kg for lead). Therefore, leaching to groundwater is not considered to be of concern at FR501 (Bay West, 2015a).

<u>MEC Removal</u>

During the IRA, soil inside of the Former FIB #1 was excavated to grade and sifted to remove all MD, SAA, and debris larger than 5 mm. Sifted soil that was cleared by the unexploded ordnance (UXO) technicians and the UXO quality control specialist was returned to the FIB as backfill. Over 19,265 items were removed from the Former FIB #1 including items classified as MD, SAA, and NMRD, totaling 4,145.5 lbs. The majority of MD recovered were fragments of 20 mm projectiles, consistent with the findings of the RI. All 20 mm projectiles were determined to be target practice rounds; no HE rounds were found (EA, 2016).

During the IRA, it was observed that some 20 mm projectile debris were embedded in the wooden beams in the upper portion of the walls and also in the ceiling inside the FIB structure. It was determined by USACE that this debris could not be removed without also removing the structure and the decision was made to proceed with returning the sifted soil to inside the FIB as backfill (EA, 2016).

A total volume of 605 loose cubic yards (LCY) of soil was excavated, sifted, and backfilled. Approximately 0.3 acres were seeded and mulched as part of site restoration (EA, 2016).

<u>MC Removal</u>

No unacceptable risks associated with MC at FR501 were identified during the RI; therefore, MC was not addressed by the IRA. Prior to backfilling of sifted soil, the floor inside the FIB structure was field screened for lead using x-ray fluorescence (XRF) and results were found to be either non-detect or low (< 20 mg/kg) (EA, 2016).

Current Site Conditions

MEC – All MEC/MD has been removed from soil as a result of the IRA. Some MD may still be embedded in timbers inside the structure. In addition, MEC could potentially remain below the depth of instrument detection (i.e., 2-4 ft).

MC – Lead in soil is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, based on the results of the RI, soil concentrations in the FIB structure exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater (**Appendix A-1**).

1.7.2 Former Rifle Range #1/Machine Gun Range (SR503)

MEC Investigation

During the RI, a visual survey was performed between firing points and target berms. No MEC was identified during the visual survey of the MRS.

MC Investigation

During the RI, soil from 48 locations at the Former Rifle Range #1 Machine Gun Range was screened for lead by XRF. Beginning at the target placement area identified from aerial photographs, the sample locations followed an approximate 50 ft by 50 ft grid moving up the sloped area behind the target placement area. Twelve soil samples representing a range of XRF readings were sent to an off-site laboratory for correlation of field XRF lead values with fixed laboratory analysis. The XRF lead correlation samples were also analyzed for MC-related metals (e.g., antimony, copper, and zinc).

Lead concentrations in ten samples at four locations exceeded the USEPA RSL and WDNR RCL for residential soil (400 mg/kg). One soil sample (FRRMG-LS003-SB01-119) had a lead concentration of 80,000 mg/kg (laboratory result); however, the split duplicate sample collected had a lead concentration of only 630 mg/kg. Antimony was identified at the same location at 970 mg/kg, but in the split duplicate sample the antimony concentration was 0.52 mg/kg. The isolated incident of 80,000 mg/kg lead and 970 mg/kg antimony in one soil sample is most likely attributed to bullet fragments in the sample, resulting in an abnormal spike.

A second sampling event occurred to more accurately delineate the impacted area. Soil samples were collected from 10 locations at six intervals (0-6, 6-12, 12-18, 18-24, 24-36, and 36-48 inches) and analyzed for lead. The 24-36 and 36-48 inch depth samples were submitted to the laboratory, but were not analyzed because there were no lead detections above 400 mg/kg at the 18-24 inch interval.

The location of the 80,000 mg/kg sample result was one of the resampled locations. The lead and antimony concentrations detected at this location during the supplemental RI sampling event were 620 and 0.48 mg/kg respectively. This supports the conclusion that the high values found in the initial sample were most likely due to the presence of bullet fragments in the soil that were not visible during field sampling (Bay West, 2015a).

In the area where the highest lead concentrations were identified with the XRF, four locations (005, 030, 032, and 035) were sampled using DPT to a depth of 8 ft at the following intervals: 0-6, 6-24, 24-48, 48-72, and 72-96 inches. The samples were analyzed for total lead and SPLP lead. The SPLP lead values exceeded the USEPA MCL down to the 2-ft depth at one location (005). At location 030, the SPLP lead levels exceeded the USEPA MCL down to the 6-ft depth. However, SPLP concentrations beneath the 6-ft depth did not exceed the USEPA MCL, and the total concentration was below the USEPA RSL default value for groundwater protection. Combined with the age of release and depth to groundwater (estimated at approximately 16 ft bgs), the threat to groundwater at the MRS is expected to be of limited concern (Bay West, 2015a). In addition, bedrock refusal was met at 28 ft bgs, without encountering groundwater, in an August 2014 attempt to install a temporary well.

<u>MEC Removal</u>

On 13 May 2015, during an initial surface sweep for the IRA, one MD item (projectile fragment) was recovered and removed. The item was included with MD from other MRSs where MD was being recovered (e.g., SR506). The USACE-Omaha Project Manager and Ordnance and Explosives Safety Specialist conducted a follow-up inspection to look for additional MD at SR503. No other MD was found and it was determined that the item was not site-related. In addition, no other MD was found during excavating and sifting for MC removal; SAA debris was removed from SR503 as described below (EA, 2016).

<u>MC Removal</u>

Based on pre-excavation characterization results for the IRA, the volume of lead-contaminated soil to be removed was estimated at 360 bank cubic yards (BCY) (approximately 450 LCY). However, as a result of XRF field screening during excavation, additional soil with lead concentrations above 400 mg/kg was identified, generally at greater depth than previously estimated during pre-excavation characterization, resulting in greater volume being removed for disposal (**Figure 1-4**). Much of the SAA debris, as well as the metal supports for former targets, were found in the subsurface in the area of deeper contamination, coinciding with the apparent location of the former target line. The lateral extent of SAA debris, or area of soil to be sifted, was refined using a metal detector from previous estimates (EA, 2016).

Confirmation samples were collected using five-point composite samples, one for each of 20 approximately 25-ft-by-25-ft grids in the bottom of the excavation. In addition, 20 discrete excavation perimeter samples were collected along sidewalls to confirm lateral extent at or below 400 mg/kg. The analytical results of all confirmation samples were at or below 400 mg/kg total lead. Excavated soil was stabilized and sent off-site for disposal as non-hazardous solid waste at the Madison Prairie Landfill following characterization (EA, 2016).

The lead-contaminated soil excavation areas were backfilled using clean fill from the on-site borrow source (existing berm) following receipt of results from a five-point composite soil sample collected from the borrow area and analyzed for total lead. Results for this borrow source confirmation sample were below the lowest WDNR RCL of 27 mg/kg for lead (based on protection of groundwater). Imported topsoil from a landscaping material supplier was placed as the final lift of backfill material and the original, grassed area that was disturbed by IRA activity was hydro-seeded. All SAA recovered during excavation and sifting at SR503, along with a minor amount from SR504, was placed into a sealed roll-off container and sent off-site to Demil Metals, Inc., for smelting on 24 August 2015. The SAA at SR503 included some organic debris, soil, and rock, adding to the total weight sent off-site (EA, 2016).

The total quantities for IRA activities completed at SR503 are summarized in **Table 1-2** below.

Table 1-2 Summary of MC Removal Quantities at SR503

Material Description	Units	Quantity
Lead contaminated soil (lead > 400 mg/kg), excavated, sifted to remove SAA debris, stabilized, transported, and disposed	LCY	943
	tons	1,728.55
Soil not requiring disposal, outside lead-contaminated soil excavation area (lead ≤ 400 mg/kg), excavated, sifted to remove SAA debris, and used as backfill in same areas	LCY	41
Clean fill from on-site borrow source (berm) used to backfill lead-contaminated excavation areas	CY	762
Imported topsoil placed prior to hydro-seeding	tons	233.57
SAA debris sent off-site for metal recycling, including some organics and rocks	lbs	30,000
Hydro-seeding and mulching of disturbed, original grassed areas	acres	1.4

NOTE: Volumes of excavated and sifted soil in LCY estimated from the measured dimensions of sifted soil piles (approximated as a cone). Soil disposal weight in tons includes amendment added during stabilization and is taken from the weight tickets of trucks hauling stabilized soil from the MRS to the landfill.
Source: EA, 2016

<u>Current Site Conditions</u>

MEC – There are no known or suspected MEC hazards at SR503.

MC – Lead in soil remaining on-site after the IRA is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, soil concentrations in the area of the IRA excavation footprint exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater (**Appendix A-2**).

1.7.3 Former Rifle Range #5/Range #250 (SR503c)

<u>MEC Investigation</u>

An intact 40 mm grenade was identified at Former Range #250 during a site tour performed in conjunction with the RI kickoff meeting. The grenade was brought to the attention of the Volk Field CRTC Safety Office. In turn, the Safety Office requested assistance from the EOD unit at Fort McCoy, Wisconsin. The EOD unit responded and determined the grenade was a M407A1 training grenade. The EOD team performed blow-in-place (BIP) demolition on the grenade.

A visual sweep of the Range #250 area was conducted during the RI between the firing points and the impact area. No additional MEC was identified on the surface, but approximately 80 lbs of MD, primarily expended 40 mm grenades, were recovered.

The impact area was littered with small arms projectiles such that identifying discrete targets was not possible. Therefore, no subsurface investigation was performed, with potential additional 40 mm grenades remaining in the subsurface.

<u>MC Investigation</u>

The Former Rifle Range #5 and Former Range #250 overlap with no discernible border between the two ranges. During the RI, samples were collected at 36 locations (0-6 inches) and screened with XRF. The sample locations at Former Rifle Range #5 fit on a roughly 50-ft-by-50-ft grid, and extend from a small berm where the targets were placed, east to the top of the hill that served as the impact area in the northeast corner of the MRS. However, due to rocky and unstable portions of the hillside, the 50-ft-by-50-ft grid could not be followed precisely in some locations. At one location (SAR250-LS011-SB01-011-PS) the lead concentration (540 mg/kg) was greater than the screening level for residential soil for lead.

The ground at Range #250 was so littered with SAA and MD from 40 mm grenades, only one location (SAR250-LS026-SB01-026-PS) in the primary impact area was considered safe for the collection of samples during the RI. At this location, lead was detected at 1,100 mg/kg, 460 mg/kg, and 400 mg/kg in the 6-12, 6-24, and 24-48 inch intervals, respectively. The 0-6 inch interval was not analyzed for total lead. XRF samples were collected along the perimeter of the impact area to determine if lead was migrating away from the impact area. The results were below the USEPA RSL and WDNR RCL for residential soil (400 mg/kg). The samples were also analyzed for explosives based on the presence of the 40mm MD. However, no explosives were detected in any sample.

Samples were collected at three locations to a depth of 4 ft with sample intervals of 0-0.5, 0.5-2, and 2-4 ft. The samples were analyzed for total lead and SPLP lead. At one location (SAR250-LS017-SB01-017-PS), the SPLP lead values exceed the USEPA MCL down to the 2-ft depth. At location SAR250-LS026-SB01-026-PS (where SPLP lead was detected at 1,900 µg/L in the 0-0.5 ft. interval), the SPLP Lead levels exceed the USEPA MCL down to the 4-ft depth, suggesting that lead has migrated vertically beneath the lead impacted soil. Deeper data (> 4 ft bgs) is typically considered when evaluating the migration to groundwater pathway (WDNR, 2014). Samples below 4 ft were not collected due to the rocky terrain of the impact area and the presence of MD in the impact area. The Former Small Arms Range #250 was in use until 1999. Depth-to-groundwater is expected as approximately 16 ft bgs. Therefore, potential for leaching of lead is possible, though leaching would be limited by the generally low mobility of MC, the age of the release and the depth to groundwater.

<u>MEC Removal</u>

Prior to IRA intrusive activities, a UXO surface sweep was completed by grid and a total of 159 items including MD, range-related debris (RRD), and NMRD totaling 210.7 pounds were recovered. Following the surface sweep and prior to excavation and sifting, the sandstone rock face was cleared of all visible SAA and soil, using an air compressor and vacuum truck. This material was then stockpiled for sifting. Following mechanical excavation of the sand deposit below, soil with residual SAA debris at the bottom of the rock face was removed and sifted by hand (EA, 2016).

During the IRA excavation process (**Figure 1-5**), four munitions items of interest were discovered. The first was an aluminum Civil War reenactment cannon ball, which was vented the same day and determined to be MD. An aluminum reproduction Civil War parrot round was also discovered at SR503c. Members of the 115th WI ANG EOD Unit x-rayed the parrot round and classified it to be MD as well. The weight of these two items totaled approximately 10.5 lbs. Finally, two intact 40 mm M781 projectiles containing orange dye were found. While these do not present an explosive hazard, they were destroyed during the final demolition for the IRA that was conducted at SR503c to dispose of remaining donor explosives (EA, 2016).

Over 2,401 items including MD and SAA were recovered during excavation and sifting totaling 63,564 lbs. The majority of the MD recovered at SR503c were fragments of 40 mm projectiles. No MEC items were found. The SAA at SR503c included some soil and rock, adding to the total weight (EA, 2016).

<u>MC Removal</u>

Based on pre-excavation sampling completed for the IRA, the volume of lead-contaminated soil to be removed was estimated at 500 BCY (approximately 620 LCY). However, as a result of XRF field screening during excavation of the original planned limits, an additional deeper, more laterally extensive layer of soil with lead concentrations above 400 mg/kg was identified. This deeper layer above 400 mg/kg lead was beneath a layer at or below 400 mg/kg lead and generally extended west from the rock face. The discovery of the deeper layer resulted in greater volume being removed for sifting and disposal than estimated prior to excavation (EA, 2016).

Confirmation samples were collected using five-point composite samples, one for each of 77 approximately 25-ft-by-25-ft grids in the bottom of the excavation (excluding those excavated to bedrock). In addition, eight discrete excavation perimeter samples were collected down to excavation depth to confirm lateral extent at or below 400 mg/kg. The analytical results of all confirmation samples were at or below 400 mg/kg total lead, except for one excavation bottom sample (SR503c-DG26-32), where the soil was subsequently excavated down to bedrock to remove all soil > 400 mg/kg. Excavated soil was stabilized and sent off-site for disposal as non-hazardous solid waste at the Madison Prairie Landfill after characterization (EA, 2016).

Stockpiled soil not requiring disposal (at or below 400 mg/kg lead) was placed as backfill within the excavation limits and the original, grassed area that was disturbed by IRA activity was hydroseeded. One area, due to tree cover, was not re-seeded, but was covered with an erosion control blanket (EA, 2016).

The total quantities for IRA activities completed at SR503c are summarized in **Table 1-3** below.

Table 1-3 Summary of MC Removal Quantities at SR503c

Material Description	Units	Quantity
Lead contaminated soil (lead > 400 mg/kg), excavated, sifted to remove MD and SAA debris, stabilized, transported, and disposed	LCY	1,909
	tons	2,524.46
Soil not requiring disposal, outside lead-contaminated soil excavation area (lead ≤ 400 mg/kg), excavated, sifted to remove MD and SAA, and used as backfill in same areas	LCY	1,662
Hydro-seeding and mulching of disturbed, original grassed areas	acres	0.6

NOTE: Volumes of excavated and sifted soil in LCY estimated from the measured dimensions of sifted soil piles (approximated as a cone). Soil disposal weight in tons includes amendment added during stabilization and is taken from the weight tickets of trucks hauling stabilized soil from the MRS to the landfill.
Source: EA, 2016

<u>Current Site Conditions</u>

MEC – MEC and MD were removed in the impact area. Surface sweep completed over the rest of the MRS. However, MEC could potentially remain below the depth of instrument detection (i.e., 2-4 ft).

MC – Lead in soil remaining on-site after the IRA is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, soil concentrations in the area of and to the north of the IRA excavation footprint exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater (**Appendix A-3**).

1.7.4 Former Small Arms Range #251 (SR504)

<u>MEC Investigation</u>

During the RI, a visual survey was performed between firing points and target/impact area. No MEC was identified during the visual survey of the MRS.

<u>MC Investigation</u>

During the RI, 31 locations were sampled based on a 50-ft-by-50-ft grid beginning on the west side at the previous firing line. However, due to problems with the global positioning system (GPS) acquiring satellites and extensive tree growth, not all points were located following the grid. All samples were screened with XRF (Bay West, 2015a). At two locations, lead concentrations exceeded the USEPA RSL and WDNR RCL for residential soil (400 mg/kg). A second sampling event occurred to more accurately delineate the lead impacted area and to evaluate the vertical extent of elevated lead concentrations. Seven samples were collected from the same locations as the first sampling event; however, these seven samples were collected from the 6-12 inch interval. None of these soil sample concentrations exceeded the USEPA RSL and WDNR RCL for residential soil (400 mg/kg). Soil concentrations in the 6-12 inch interval ranged from 6.1 to 200 mg/kg. In addition, eight new sample locations were selected for sampling at 6 inch-intervals to a depth of 48 inches. At these eight new locations samples from the 0-6 inch and 6-12 inch intervals were analyzed in the lab. Soil concentrations in the 0-6 inch interval ranged from 15 to 150 mg/kg. Soil concentrations in the 6-12 inch interval ranged from 2 to 45 mg/kg. Samples from the 12-24 inch, 24-36 inch, and 36-48 inch intervals were submitted to the lab, but were not analyzed because there were no lead detections above screening levels for residential soil at the 6-12 inch interval.

Three sampling locations were chosen for DPT borings based on the XRF results. Borings were drilled to 8 ft bgs and samples were collected for total lead analysis. At one location (SAR251-LS001-SB01-001-PS), lead was detected in the SPLP leachate at a concentration of 26 micrograms per liter (µg/L) (exceeding the MCL of 15 µg/L) in the 2-4 ft interval. At another location (SAR251-LS003-SB01-003-PS), lead was detected in the leachate at 140 µg/L (exceeding the MCL of 15 µg/L) in the 4-6 ft interval. However, total lead concentrations in soil at these sample locations did not exceed the USEPA RSL default value for groundwater protection (i.e., 14 mg/kg lead). Samples collected at the 6-8 ft interval did not contain SPLP lead above the MCL. Based on the age of the release, limited vertical migration of lead, and depth to groundwater (approximately 17 ft), no threat to groundwater from lead in soil is expected at this MRS (Bay West, 2015a).

<u>MEC Removal</u>

Based on the RI findings of no known or suspected MEC hazards, no MEC removal action objectives were developed for SR504 and therefore MEC was not addressed by the IRA (EA, 2016).

<u>MC Removal</u>

Based on pre-excavation characterization results for the IRA, the volume of lead-contaminated soil to be removed was estimated at 35 BCY (approximately 44 LCY). As a result of XRF field screening during excavation, soil below the original 6-inch depth was identified to have lead concentrations above 400 mg/kg, resulting in greater volume being removed for disposal (**Figure 1-6**). The lateral extent of SAA debris, or area of soil to be sifted, was refined using a metal detector from previous estimates (EA, 2016).

Confirmation samples were collected using five-point composite samples, one for each of 4 approximately 25-ft by 25-ft grids in the bottom of the excavation. In addition, 8 discrete excavation perimeter samples were collected along sidewalls to confirm lateral extent ≤ 400 mg/kg. An elevated duplicate perimeter sample result (P14) was reanalyzed. The analytical results of all final confirmation samples were at or below 400 mg/kg total lead. The stabilized soil was sent off-site for disposal as non-hazardous solid waste at the Madison Prairie Landfill after characterization (EA, 2016).

Stockpiled soil not requiring disposal (at or below 400 mg/kg lead) was placed as backfill within the excavation limits and the original, grassed area that was disturbed by IRA activity was hydro-seeded (EA, 2016).

The total quantities for IRA activities completed at SR504 are summarized in **Table 1-4** below.

Table 1-4 Summary of MC Removal Quantities at SR504

Material Description	Units	Quantity
Lead contaminated soil (lead > 400 mg/kg), excavated, sifted to remove SAA debris, stabilized, transported, and disposed	LCY	71
	tons	113.95
Soil not requiring disposal, outside lead-contaminated soil excavation area (lead ≤ 400 mg/kg), excavated, sifted to remove SAA debris, and used as backfill in same areas	LCY	192
SAA debris sent off-site for metal recycling	lbs	8,997
Hydro-seeding and mulching of disturbed, original grassed areas	acres	0.3

NOTE: Volumes of excavated and sifted soil in LCY estimated from the measured dimensions of sifted soil piles (approximated as a cone). Soil disposal weight in tons includes amendment added during stabilization and is taken from the weight tickets of trucks hauling stabilized soil from the MRS to the landfill.
Source: EA, 2016

Current Conditions

MEC – There are no known or suspected MEC hazards at SR504.

MC – Lead in soil remaining on-site after the IRA is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, soil concentrations in the area of the IRA excavation footprint, as well as additional areas where RI sampling indicated lead concentrations below 400 mg/kg, exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater (**Appendix A-4**).

1.7.5 Former Small Arms Debris Area (SR506)

MEC Investigation

The CSE Phase II Report indicated that only SAA debris was present. During the RI a small quantity of SAA debris was identified, collected, and removed from the MRS, while a large amount of MD was identified during the visual survey. The RI was expanded to include a surface clearance and mag and flag survey of the accessible portion of the MRS. The Former Small Arms Debris Area is heavily forested with heavy leaf and duff cover prevalent throughout the MRS. Approximately 0.2 acres (40%) of the 0.48 acre MRS was deemed inaccessible due to steep slopes in excess of 30 degrees.

A total of 684 subsurface anomalies were flagged, which equates to a density of approximately 3,420 anomalies per acre. A total of 69 anomalies (10%) were intrusively investigated. No MEC items were found. However, 295 lbs of MD and 1 lb of NMRD was recovered. The MD was predominately fragments from 75 mm projectiles, but fragments from ordnance ranging from 37 mm up to 155 mm were also recovered. The MD was distributed across the entire MRS with no discernible impact patterns.

MC Investigation

During the RI, two soil samples were collected and analyzed by the lab for MC-related metals. The analyte concentrations in samples from both locations were below the USEPA RSLs and WDNR RCLs for residential soil; however, a duplicate sample (FSADA-LS004-SB01-004-FD) at one location had a concentration of lead that was greater than the USEPA RSL and WDNR

RCL of 400 mg/kg for residential soil. This location had concentrations of 330 mg/kg and 910 mg/kg of lead for the sample and duplicate, respectively. In addition, four soil samples were collected in areas where MD was most evident during the surface sweep. Samples were analyzed for explosives; none were detected.

MEC Removal

MEC removal was completed via mag and dig during the IRA for approximately 0.3 acres out of a total of 0.48 acres that was determined to be safely accessible. The remaining area was determined to be inaccessible due to steep slopes/rocks and footing conditions (**Figure 1-7**). No MEC items were found at SR506. A total of 1,800 items totaling 686 lbs were removed, including MD and NMRD (EA, 2016).

The majority of MD recovered were fragments of 75 mm projectiles, consistent with RI findings. One 3-inch Stokes mortar was recovered, which was confirmed following detonation to be a sand-filled practice item. A soil sample was collected at the demolition location, and the results were non-detect (EA, 2016).

MC Removal

Based on pre-excavation characterization results for the IRA, the volume of lead-contaminated soil to be removed was estimated at 4 BCY. A total of 4 LCY and 3.94 tons of lead-contaminated soil (above 400 mg/kg total lead in soil) was stabilized, removed, transported and disposed of (**Figure 1-7**). Due to its location in a heavily tree-covered area, the excavation area was not re-seeded, but was covered with an erosion control blanket (EA, 2016).

One confirmation sample was collected using a five-point composite sampling approach for the approximate 15-ft-by-15-ft grid in the bottom of the excavation. In addition, four discrete excavation perimeter samples were collected to confirm lateral extent at or below 400 mg/kg. The analytical results of all confirmation samples were at or below 400 mg/kg total lead (EA, 2016).

The excavated and stabilized soil was sent off-site for disposal as non-hazardous solid waste at the Waste Management Landfill in Madison, Wisconsin, following characterization sampling (EA, 2016).

Current Conditions

MEC – MEC/MD has been removed, except for the inaccessible portions of the site. In addition, MEC could potentially remain below the depth of instrument detection (i.e., 2-4 ft).

MC – Lead in soil remaining on-site after the IRA is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, soil concentrations in the area of the IRA excavation footprint exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater (**Appendix A-5**).

1.7.6 Potential Civil War Era Impact Area (MU507)

MEC Investigation

The Potential Civil War Era Impact Area is moderately heavy forest with moderate leaf and duff cover prevalent throughout the MRS. The terrain ranges from relatively flat to very steep. For the purpose of the RI, approximately 0.5 acre of the 8.1 acre MRS was determined inaccessible due to slopes in excess of 30 degrees, including the essentially vertical face of the sandstone bluff. However, the bluff is relatively flat across the top and could be accessed (**Figure 1-8**).

An analog survey was conducted over the accessible area with 5,038 anomalies flagged (approximately 620 anomalies per acre). A total of 504 (10%) anomalies were intrusively investigated. One potential MEC item was identified as an unfired fuzed practice 3-inch Stokes. After demolition, the item was confirmed to be a sand-filled practice round. In addition, 75 lbs of MD and 93 lbs of NMRD were removed from the MRS. The MD included fragments from ordnance items ranging from 75 mm to 155 mm projectiles. SAA debris and small MD items (i.e., grenade spoons) indicate the area was also used for small unit training exercises. The majority of the MD was clustered in distinct bands indicating possible target areas.

<u>MC Investigation</u>

Sixteen soil samples were collected, at an average of two soil samples per acre. Samples were taken at a depth of 0-6 inches using a hand auger. Samples were collected at locations where MD was most evident during the surface sweep (**Appendix A-6**). All samples were analyzed for explosives by USEPA Method 8330A. None of the samples had analyte concentrations that exceeded the USEPA RSL and WDNR RCL for residential soil (EA, 2016).

<u>MEC Removal</u>

Approximately 6.2 acres of the total 8.1 acres was determined to be safely accessible during the IRA, due to steep slopes/rocks and footing conditions in the inaccessible portion (**Figure 1-8**). A total of 3 MEC items were found at MU507 MRS; all three were 2.94-inch Hotchkiss shells. A total of 9,164 items were recovered including MEC, MD, NMRD, and RRD, with a total weight of 1,089 lbs. The MD generally consisted of fragments or components of the MEC items that were recovered. A soil sample was collected at the MEC demolition locations, and all results were below detection limits (EA, 2016).

<u>MC Removal</u>

Based on lack of MC detections and risk found during the RI, no MC removal action objectives were developed for MU507 and therefore MC was not specifically addressed by the IRA, except as described above for post-detonation sampling (EA, 2016).

<u>Current Conditions</u>

MEC – MEC/MD has been removed, except for the inaccessible portions of the site (**Figure 1-8**). In addition, MEC could potentially remain below the depth of instrument detection (i.e., 2-4 ft).

MC – No unacceptable risks have been identified for MC at MU507.

1.8 Munitions and Explosives of Concern and Munitions Constituents Exposure Pathways

<u>1.8.1 Exposure Pathway Analysis</u>

The status of MEC at each site following completion of the IRA is as follows:

- Former FIB #1 (FR501) – All MEC and MD have been removed from soil. Some MD may still be embedded in timbers within the FIB structure. In addition, MEC could potentially remain below the depth of instrument detection (i.e., 2-4 ft).
- Former Rifle Range #1/Machine Gun Range (SR503) – No known or suspected MEC hazard.
- Former Rifle Range #5/Range #250 (SR503c) – MEC and MD were removed in the impact area. Surface sweep completed over the rest of the MRS. However, MEC could potentially remain below the depth of instrument detection (i.e., 2-4 ft).
- Former Small Arms Range #251 (SR504) – No known or suspected MEC hazard.

- Former Small Arms Debris Area (SR506) – MEC/MD has been removed, except for the inaccessible portions of the site. In addition, MEC could potentially remain below the depth of instrument detection (i.e., 2-4 ft).
- Potential Civil War Era Impact Area (MU507) – MEC/MD has been removed, except for the inaccessible portions of the site. In addition, MEC could potentially remain below the depth of instrument detection (i.e., 2-4 ft).

The status of MC at each site following completion of the IRA is as follows:

- Former FIB #1 (FR501) – Lead in soil is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, based on the results of the RI, soil concentrations in the FIB structure exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater.
- Former Rifle Range #1/Machine Gun Range (SR503) – Lead in soil remaining on-site after the IRA is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, soil concentrations in the area of the IRA excavation footprint exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater.
- Former Rifle Range #5/Range #250 (SR503c) – Lead in soil remaining on-site after the IRA is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, soil concentrations in the area of and to the north of the IRA excavation footprint exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater.
- Former Small Arms Range #251 (SR504) – Lead in soil remaining on-site after the IRA is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, soil concentrations in the area of the IRA excavation footprint, as well as additional areas where RI sampling indicated lead concentrations below 400 mg/kg, exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater.
- Former Small Arms Debris Area (SR506) – Lead in soil remaining on-site after the IRA is below the USEPA RSL and WDNR RCL of 400 mg/kg for residential soil. However, soil concentrations in the area of the IRA excavation footprint exceed the WDNR RCL of 27 mg/kg for lead based on protection of groundwater.
- Potential Civil War Era Impact Area (MU507) – No unacceptable risks have been identified for MC at MU507.

Although lead concentrations in soil remain above the WDNR RCL of 27 mg/kg for lead based on protection of groundwater at FR501, SR503, SR503c, SR504, and SR506, it should be noted that the threat to groundwater was determined to be limited based on soil and SPLP analysis conducted during the RI (Bay West, 2015a).

<u>1.8.2 Activity</u>

An activity process appears to have a minimal effect on MEC location at SR506 and MU507, which are the sites that had inaccessible areas where MEC removal could not be completed. Approximately 40% of SR506 was determined to be inaccessible due to steep slopes/rocks and footing conditions. Approximately 20-25% of MU507 was similarly considered inaccessible.

A significant portion of the annual precipitation is in the form of snow and the sandy soil appears to drain well; based on surface observations, surface erosion does not appear to be a significant factor at the MRSs. Based on the site location, frost heave is possible. The frost depth for Volk Field is 114 inches according to Unified Facilities Criteria 3-301-01. This is considered the maximum depth where frost may occur and maximum depth where frost-related migration of

MEC is possible (DoD, 2011). However, the sandy nature of the soil indicates moisture content in the soil at the onset of winter conditions is likely low, thus lowering the potential for swelling in the soil.

1.8.3 Exposure Media and Accessibility

MEC exposure may include surface and subsurface media. The exposure pathway conceptual site model (CSM) for the MRSs is presented in **Figure 1-9**. MEC removal has been completed at FR501, SR503, SR503c, and SR504. No MEC hazard was identified at SR503 and SR504. However, MEC may potentially remain below the depth of instrument detection (i.e., 2-4 ft) at FR501, SR503c, SR506, and MU507. MEC removal has been completed in accessible areas of SR506 and MU507 but may remain in the areas of slopes greater than 30 degrees, which were inaccessible during the removals.

There is a potential for MEC remaining in the subsurface below the depth of instrument detection or in areas that were not accessible for MEC removal. Therefore, intrusive activities (e.g., driving tent stakes, digging a foxhole or other shallow trench, etc.) during training activities could result in potential contact with MEC. Additionally, while no future construction activity is currently planned, any future work could require intrusive activities. Accordingly, the subsurface exposure pathway is considered to be potentially complete.

MC exposure also may include surface and subsurface media, and the exposure pathway CSMs for MC are presented in **Figures 1-10** and **1-11**. Soil exceeding the residential soil standard of 400 mg/kg was removed during the IRA; therefore, there is no remaining hazard for direct contact with soil. However, lead concentrations at five of the six MRSs exceed the WDNR RCL for protection of groundwater (27 mg/kg). Therefore, groundwater is a potentially complete pathway at those MRSs. While groundwater at the MRSs is not currently used, hypothetical future residential land use was evaluated such that unrestricted use could be considered to support NFA decisions if applicable at the MRSs.

1.8.4 Exposure Receptors

Receptors include current and future site workers (e.g., ANG and DoD civilian staff during military training exercises), current and future construction workers (e.g., workers performing intrusive work related to maintenance at the radar tower), current and future recreational users (e.g., joggers, hunters), and unauthorized trespassers.

No residential areas currently exist at Volk Field CRTC and no plans exist to establish residential areas. Temporary lodging facilities (i.e., barracks) are used to house personnel on a short-term basis, typically less than two weeks, during training exercises. However, the potential future resident scenario was evaluated such that unrestricted use could be considered to support NFA decisions if applicable at the MRSs.

Ecological receptor groups identified for the Volk Field CRTC include terrestrial organisms. Potential routes of exposure to ecological receptors include inadvertent ingestion of soil; dermal exposure to surface soils; uptake of contaminants by flora; and ingestion of contaminants in food resources (i.e., prey or flora) by consumers. Bio-uptake may occur by terrestrial ecological receptors. Higher trophic level species may then be exposed during foraging or other activities.

The only federally listed species known to be present at Volk Field is the gray wolf (*Canis lupus*). It is believed Volk Field represents a limited part of their range, and their presence at the installation is as transient creatures. The gray wolf was delisted as a federally listed species in 2012; however, in 2014 the gray wolf was relisted in Wisconsin.

1.8.5 Exposure Conclusions

MEC removal has been completed at FR501, SR503, SR503c, and SR504; therefore, a risk to receptors is not currently present. However, MEC may potentially remain below the depth of instrument detection (i.e., 2-4 ft) at FR501 and SR503c. No MEC hazard was identified at SR503 or SR504. MEC removal could not be completed in the inaccessible portions of SR506 and MU507, and MEC is currently considered a risk to receptors that may have access these areas (**Figure 1-9**). MEC may also potentially remain below the depth of instrument detection at SR506 and MU507.

With regard to MC, lead remains in soil above the WDNR RCL for protection of groundwater (27 mg/kg) at FR501, SR503, SR503c, SR504, and SR506. While MC at this level does not pose an unacceptable risk to current receptors, there is a potential for unacceptable risk for the groundwater pathway under a hypothetical future residential scenario (**Figure 1-10**).

1.9 Summary of Risk/Hazards Associated with MEC and MC

This section discusses the risks associated with MC and hazards associated with MEC at the MRSs. As discussed in **Section 1.7**, residual MEC is potentially present in FR501, SR503c, SR506, and MU507. In addition, lead was detected at five of the six MRSs (FR501, SR503, SR503c, SR504, and SR506) at concentrations greater than the WDNR RCL of 27 mg/kg for lead based on protection of groundwater. The WDNR RCLs were established to provide residual contaminant levels for soil cleanup based on protection of groundwater. Because Volk Field CRTC is a non-NPL facility, in accordance with 42 USC Section 9620(a)(4) Volk Field CRTC must also comply with non-discriminatory state response laws. State response laws at Section 292.11 of the Wisconsin Statutes require that actions be taken to restore the environment to the extent practicable in response to the discharge of a hazardous substance. As such, evaluation of remedial alternative to address lead in soils is required regardless of whether risk is established.

1.9.1 MEC Hazard Tool Assessment Results

Explosive hazard assessment was conducted using the USAF Munitions Hazard Assessment Tool (MHAT). The USAF MHAT addresses human health and safety concerns associated with potential exposure to MEC at the MRS. The baseline MHAT assists in understanding MEC hazards for an MRS if no action is taken and then evaluates the hazard reductions if munitions response alternatives are implemented. Each component is assessed by adding scores assigned to each input factor for each site. The sum of the input factor scores falls within one of four defined ranges, called hazard levels. Each of the four levels reflects site attributes that describe groups of sites and site conditions ranging from the highest to the lowest hazards. The MHAT hazard levels are defined as follows:

- Hazard Level 1 — Sites with the highest hazard potential. There might be instances where an imminent threat to human health exists from MEC.
- Hazard Level 2 — Sites with a high hazard potential. A site with surface MEC or one undergoing intrusive activities such that MEC would be encountered in the subsurface. The site would also have moderate or greater accessibility by the public.
- Hazard Level 3 — Sites with a moderate hazard potential. A site that would be considered safe for the current land use without further munitions responses, although not necessarily suitable for reasonable, anticipated future use. Level 3 areas generally would have restricted access, a low number of contact hours, and typically contain MEC only in the subsurface.

- Hazard Level 4 — Sites with a low hazard potential. A site compatible with current and reasonably anticipated future use. Level 4 sites typically have had a MEC cleanup performed, and contact hours are low.

The MHAT scoring from the RI Report (Bay West, 2015a) is provided in **Table 1-5** below. MHAT scores were presented based on the current conditions at the time of the RI if no further action were taken, as well as assumed conditions after a removal action. Note that for MRS MU507, the no further action hazard level should be assumed for inaccessible areas where MEC removal could not be completed. The USAF MHAT has two alternative ratings that can be assigned based on the site-specific conditions encountered. The ratings are "Munitions Debris Only" for sites where MEC was not encountered but MD was encountered, and "No Known or Suspected MEC Hazard" for sites where neither MEC nor MD was encountered. If an alternative rating is assigned, the remaining calculations in the MHAT workbook are not completed and a MHAT Hazard Level Determination score is not calculated.

Table 1-5 USAF MHAT Hazard Level Determination

MRS	Alternative Rating	No Further Action[1]		Removal Action[2]	
		Hazard Level	Category Score	Hazard Level	Category Score
Former Firing-in-Buttress #1 (FR501)	No known or suspected MEC hazard (only applicable to the area identified as FR501a that excludes the FIB structure and impact berm, see **Figure 1-3**)	2	735	4	500
Former Rifle Range #1/ Machine Gun Range (SR503)	No known or suspected MEC hazard	NA	NA	NA	NA
Former Rifle Range #5/ Range #250 (SR503c)	NA	1	895	4	500
Former Small Arms Range #251 (SR504)	No known or suspected MEC hazard	NA	NA	NA	NA
Former Small Arms Debris Area (SR506)	MD only	NA	NA	NA	NA
Potential Civil War Era Impact Area (MU507)	NA	2	760	4	365

1. *No Further Action score provided at the time of the RI, prior to the IRA*
2. *Removal action completed during 2015 IRA. Note that for MRS MU507, the no further action hazard level should be assumed for inaccessible areas where MEC removal could not be completed.*

NA = Not applicable

1.9.2 Human Health Risk Assessment

The human health risk assessment (HHRA) evaluates the probability and magnitude of potential adverse effects on human health associated with exposure to site-related chemicals in soil at the MRSs. The HHRA was presented in the RI Report, and potentially unacceptable risks for future residential land use were identified due to lead in soil at SR503, SR503c, SR504, and SR506 (Bay West, 2015a). During the subsequent IRA, soil was excavated from these sites to USEPA RSL and WDNR RCL of 400 mg/kg for residential land use. Therefore, the potentially unacceptable risks for future residential land use identified in the HHRA are no longer applicable.

However, soil remaining at these four MRSs, as well as FR501, may contain lead concentrations which exceed the WDNR RCL for protection of groundwater (27 mg/kg). The CSM for the five MRSs that contain residual lead in soil is presented in **Figure 1-10**. No hazards associated with MC have been identified for MU507 (**Figure 1-11**).

1.9.3 Screening Level Ecological Risk Assessment

A screening level ecological risk assessment was completed as part of the RI (Bay West, 2015a), and potential impacts were identified for ecological receptors at SR503 and SR503c, primarily due to the concentrations of lead in soil. Excavation of lead-contaminated soil at SR503 and SR503c was completed during the IRA, thereby reducing the potential impacts. No ecological risks were identified at the remaining MRSs included in this FS.

1.10 Summary

An RI was performed for the six MRSs at Volk Field CRTC: FR501, SR503, SR503c, SR504, SR506, and MU507. The RI was designed to characterize the nature and extent of MEC and MC at the Volk Field CRTC. The RI recommended these MRSs be carried through to the FS to address MEC and MC in soil. An IRA was completed at these sites in 2015 with removal of MEC and lead-contaminated soil.

It should be noted that while soil exceeding the residential cleanup level of 400 mg/kg was removed, residual lead may remain in soil above the WDNR RCL for protection of groundwater (27 mg/kg) at FR501, SR503, SR503c, SR504, and SR506. In addition, MEC/MD could not be cleared from the inaccessible areas of SR506 and MU507, and may remain at depths below the range of instrument detection (i.e., 2-4 ft) at FR501, SR503c, SR506, and MU507.

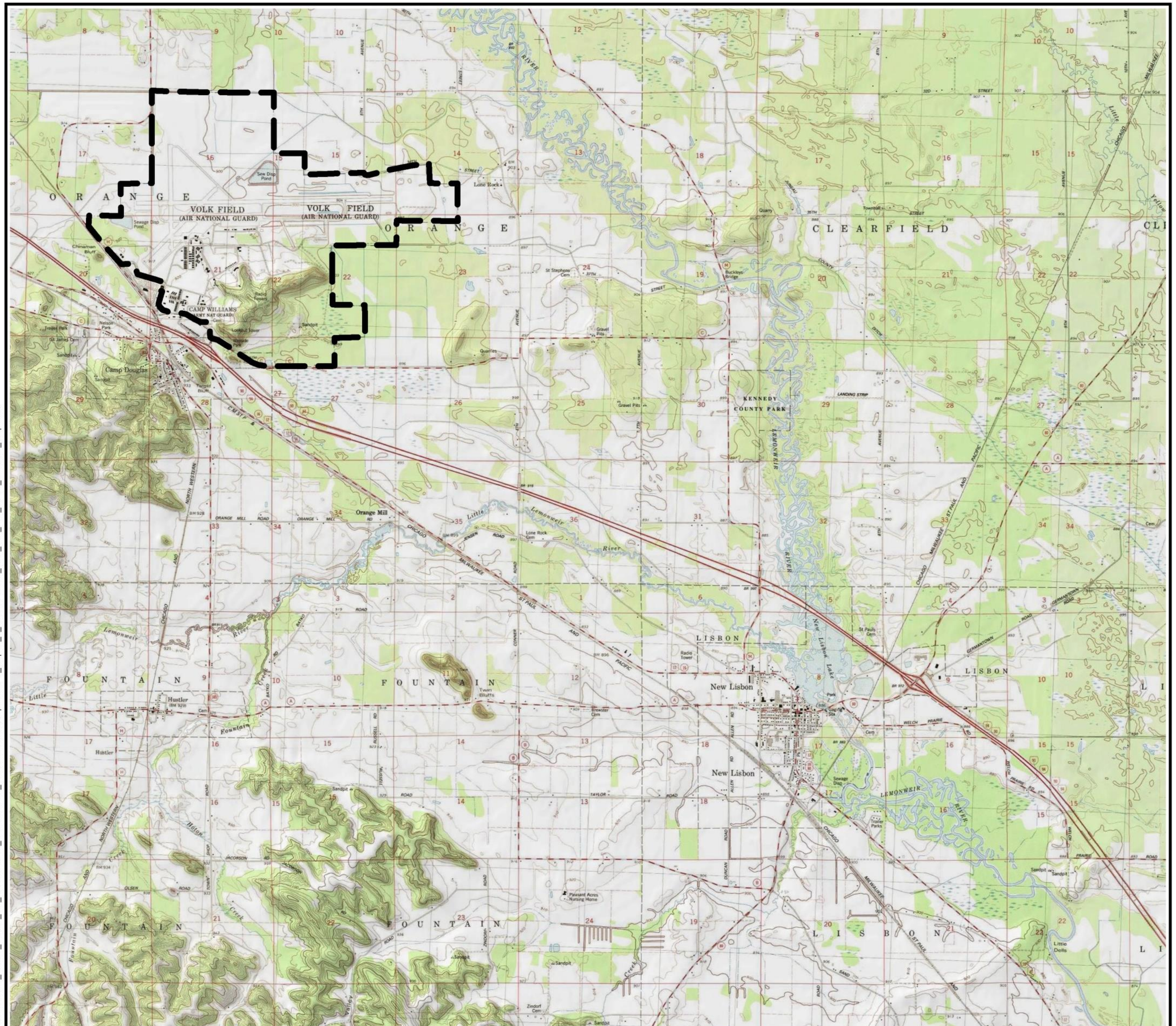

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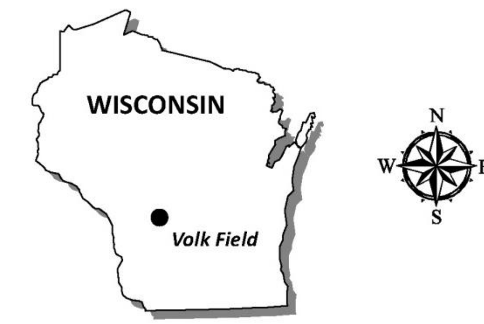
Figure 1-1

Project Location Map

Volk Field CRTC, Wisconsin



Map Projection: NAD 1983 StatePlane Wisconsin South Feet

Bing World Imagery Basemap

0 5,000 10,000 Feet

0 1,000 2,000 Meters

Installation Boundary

US Army Corps of Engineers
Omaha District
Drawn By: MDH
Date Drawn: 3/30/2016

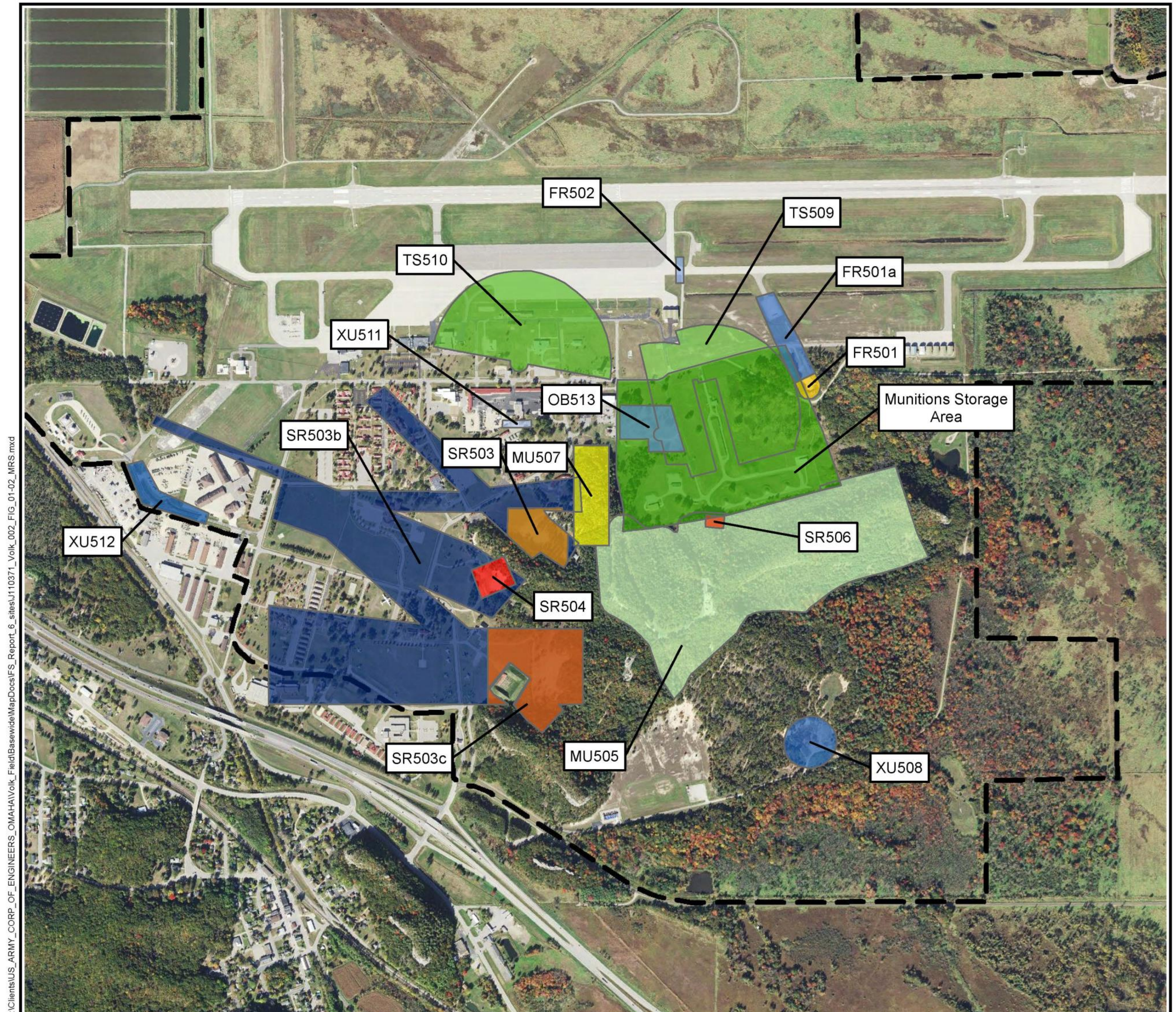
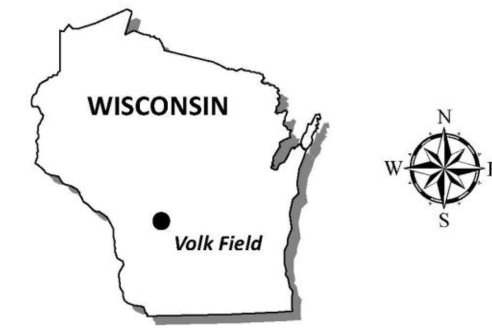


Figure 1-2

MRS Location Map

Volk Field CRTC, Wisconsin



Map Projection: NAD 1983 StatePlane Wisconsin South Feet
Basemap: NAIP Wisconsin 2015 Aerial Imagery

0 1,000 2,000 Feet
0 250 500 Meters

Interim Removal Action Completed (MRS included in this FS)
- Civil War Impact Area, MU507
- Former FIB #1, FR501
- Former Rifle Range #1/Machine Gun Range, SR503
- Former Rifle Range #5/Range #250, SR503c
- Former Small Arms Debris Area, SR506
- Former Small Arms Range #251, SR504

No Further Action (MRS included in NFA FS)
- Building 324 Area - MEC Discovery , XU511
- Firing-in-Buttress #2, FR502
- Former Fire Training Area/Suspected Munitions Burn/Burial Pit, OB513
- Former Firing-in-Buttress #1, FR501a
- Kitchen Dump – C4 Discovery Area , XU508
- POL Area – MEC Discovery, XU512
- Former Rifle/Small Arms Ranges – Multiple Sites , SR503b

Further Action or Investigation Planned
- Munitions Storage Area
- Former Skeet Range #2 , TS510
- Former Skeet Range #1/Trap Range #1 & #2 , TS509
- Former Mortar/Artillery Range , MU505
- Installation Boundary

US Army Corps of Engineers
Omaha District
Drawn By: MDH
Date Drawn: 9/16/2016

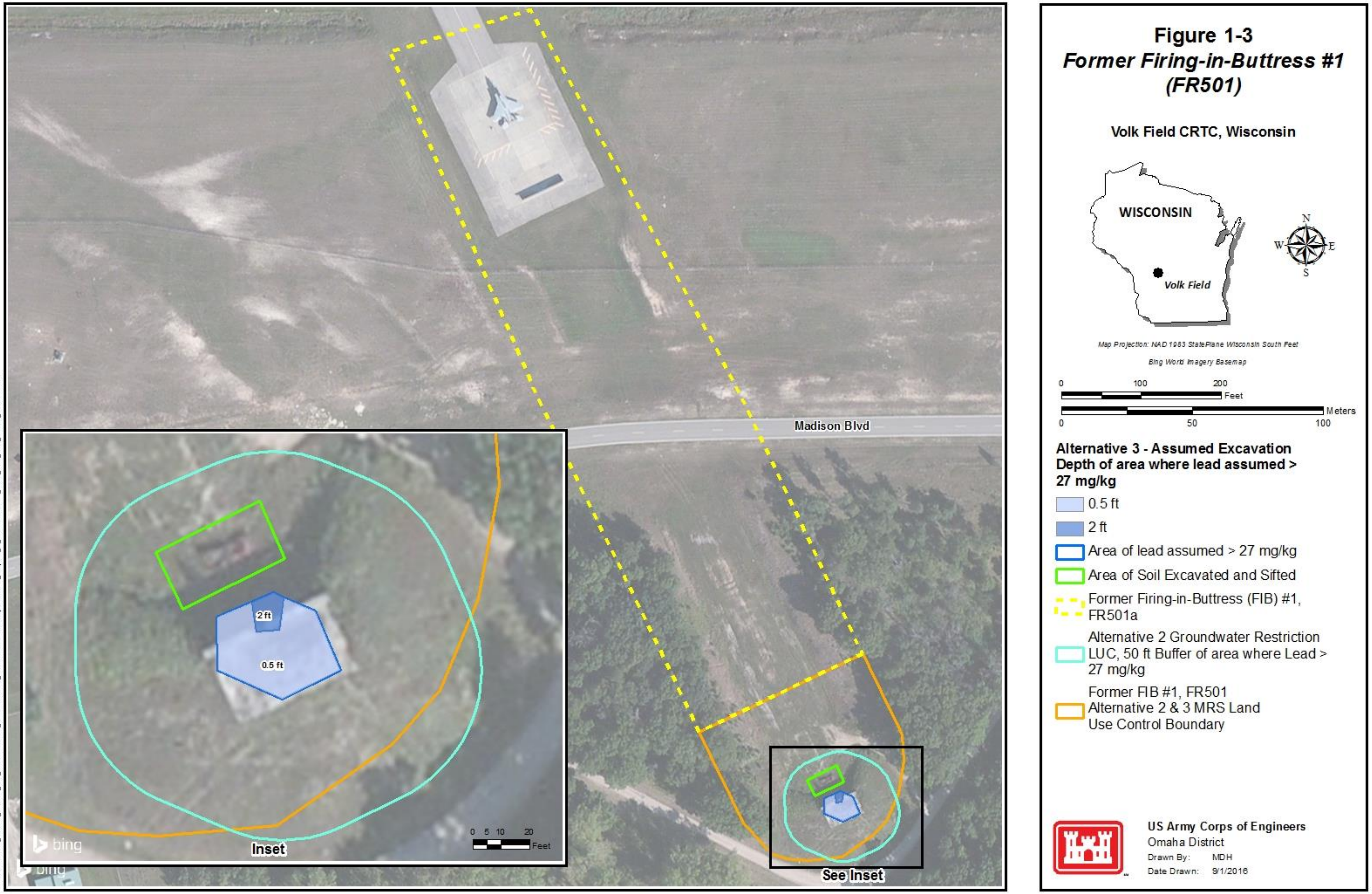


Figure 1-3
Former Firing-in-Buttress #1 (FR501)

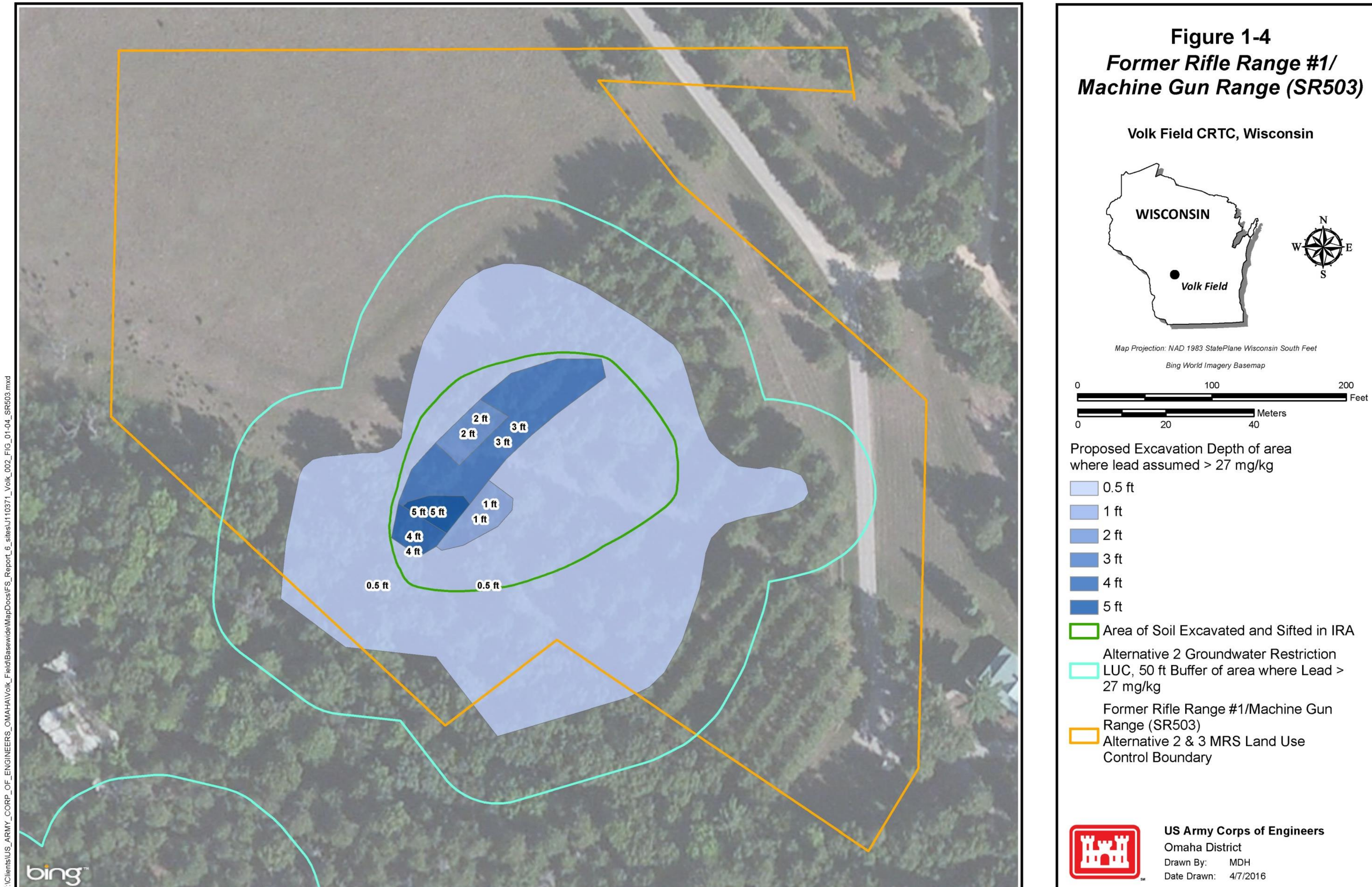


Figure 1-4
Former Rifle Range #1/ Machine Gun Range (SR503)

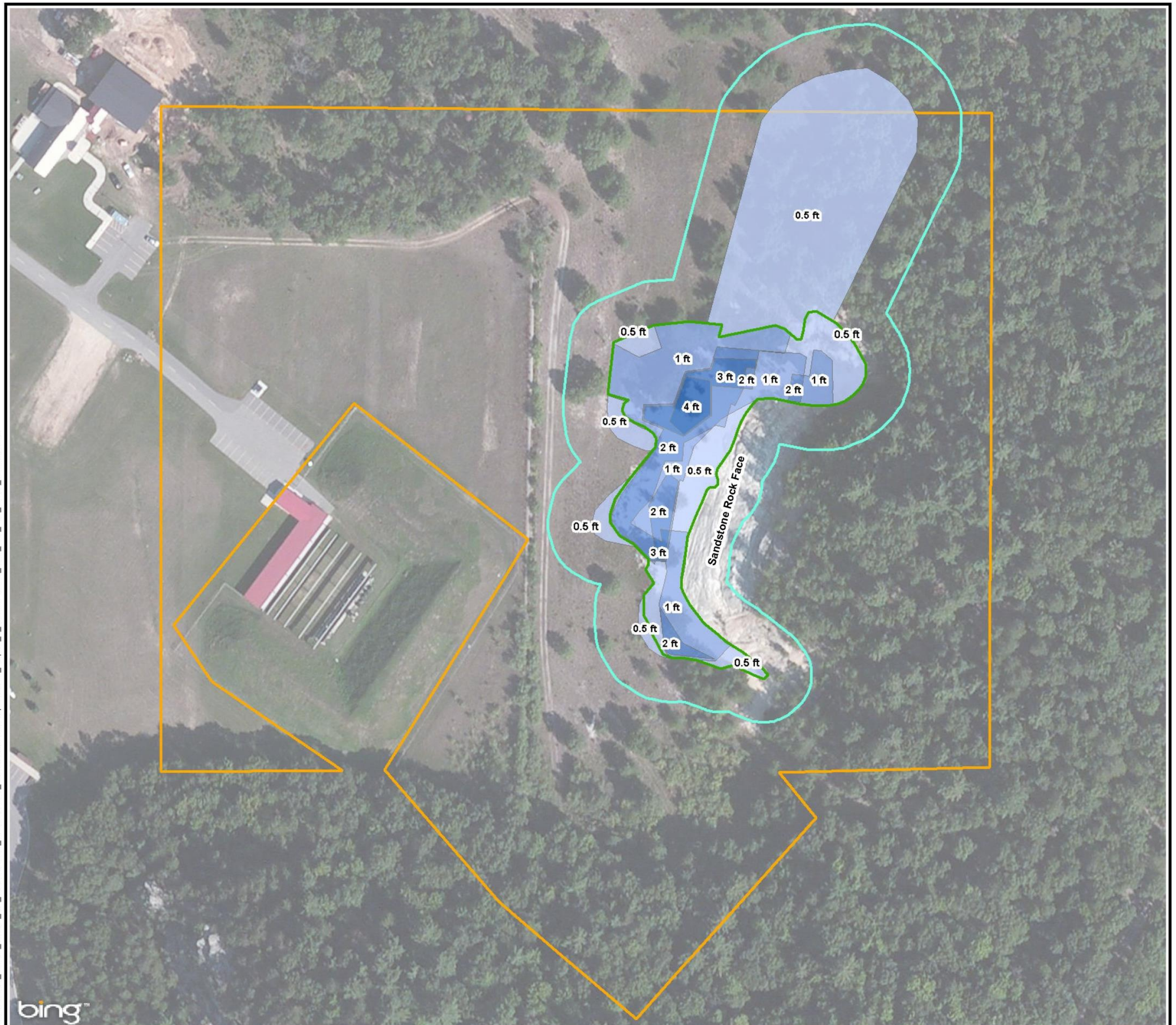


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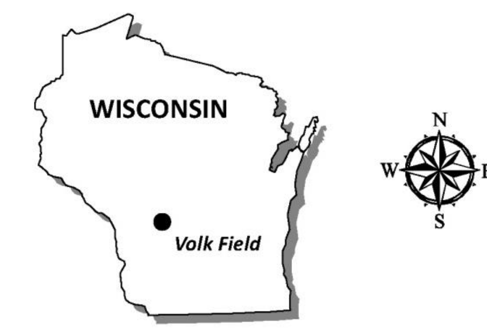
Figure 1-5
Former Rifle Range #5
Range #250 (SR503c)

Volk Field CRTC, Wisconsin



Map Projection: NAD 1983 StatePlane Wisconsin South Feet

Bing World Imagery Basemap

0 100 200 Feet

0 20 40 Meters

Alternative 3 - Assumed Excavation Depth of area where lead assumed > 27 mg/kg

- 0.5 ft
- 1 ft
- 2 ft
- 3 ft
- 4 ft
- 5 ft
- Area of Soil Excavated and Sifted in IRA
- Alternative 2 Groundwater Restriction LUC, 50 ft Buffer of area where Lead > 27 mg/kg
- Former Rifle Range #5/Range #250 (SR503c) Alternative 2 & 3 MRS Land Use Control Boundary

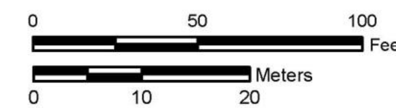
US Army Corps of Engineers
Omaha District
Drawn By: MDH
Date Drawn: 4/8/2016

Figure 1-6
Former Small Arms Range #251 (SR504)

Volk Field CRTC, Wisconsin

Map Projection: NAD 1983 StatePlane Wisconsin South Feet

Bing World Imagery Basemap



Alternative 3 - Assumed Excavation Depth of area where lead assumed > 27 mg/kg

- 0.5 ft
- 1 ft
- Area of Soil Excavated and Sifted in IRA
- Alternative 2 Groundwater Restriction LUC, 50 ft Buffer of area where Lead > 27 mg/kg
- Former Small Arms Range #251 (SR504) Alternative 2 & 3 MRS Land Use Control Boundary

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Omaha District
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Date Drawn: 9/16/2016

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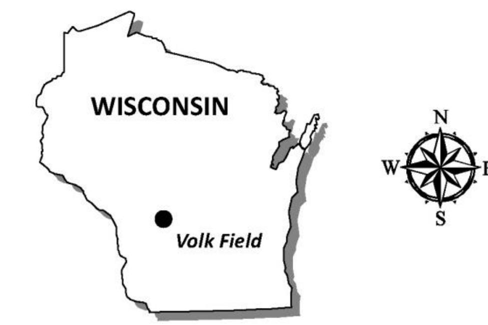
Figure 1-7
Small Arms Debris Area (SR506)

Volk Field CRTC, Wisconsin



Map Projection: NAD 1983 StatePlane Wisconsin South Feet

Bing World Imagery Basemap

0 25 50 Feet

0 5 10 Meters

Alternative 3 - Assumed Excavation Depth of area where lead assumed > 27 mg/kg

- 0.5 ft
- 1 ft
- Inaccessible
- Alternative 2 Groundwater Restriction LUC, 50 ft Buffer of area where Lead > 27 mg/kg
- Small Arms Debris Area (SR506) Alternative 2 & 3 MRS Land Use Control Boundary

US Army Corps of Engineers
Omaha District
Drawn By: MDH
Date Drawn: 4/8/2016

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Figure 1-8
Potential Civil War Era Impact Area (MU507)

Volk Field CRTC, Wisconsin

Map Projection: NAD 1983 StatePlane Wisconsin South Feet

Bing World Imagery Basemap

0 100 200 Feet
0 50 100 Meters

Inaccessable

Potential Civil War Era Impact Area (MU507) Alternative 2 & 3 MRS Land Use Control Boundary

US Army Corps of Engineers
Omaha District
Drawn By: MDH
Date Drawn: 4/7/2016

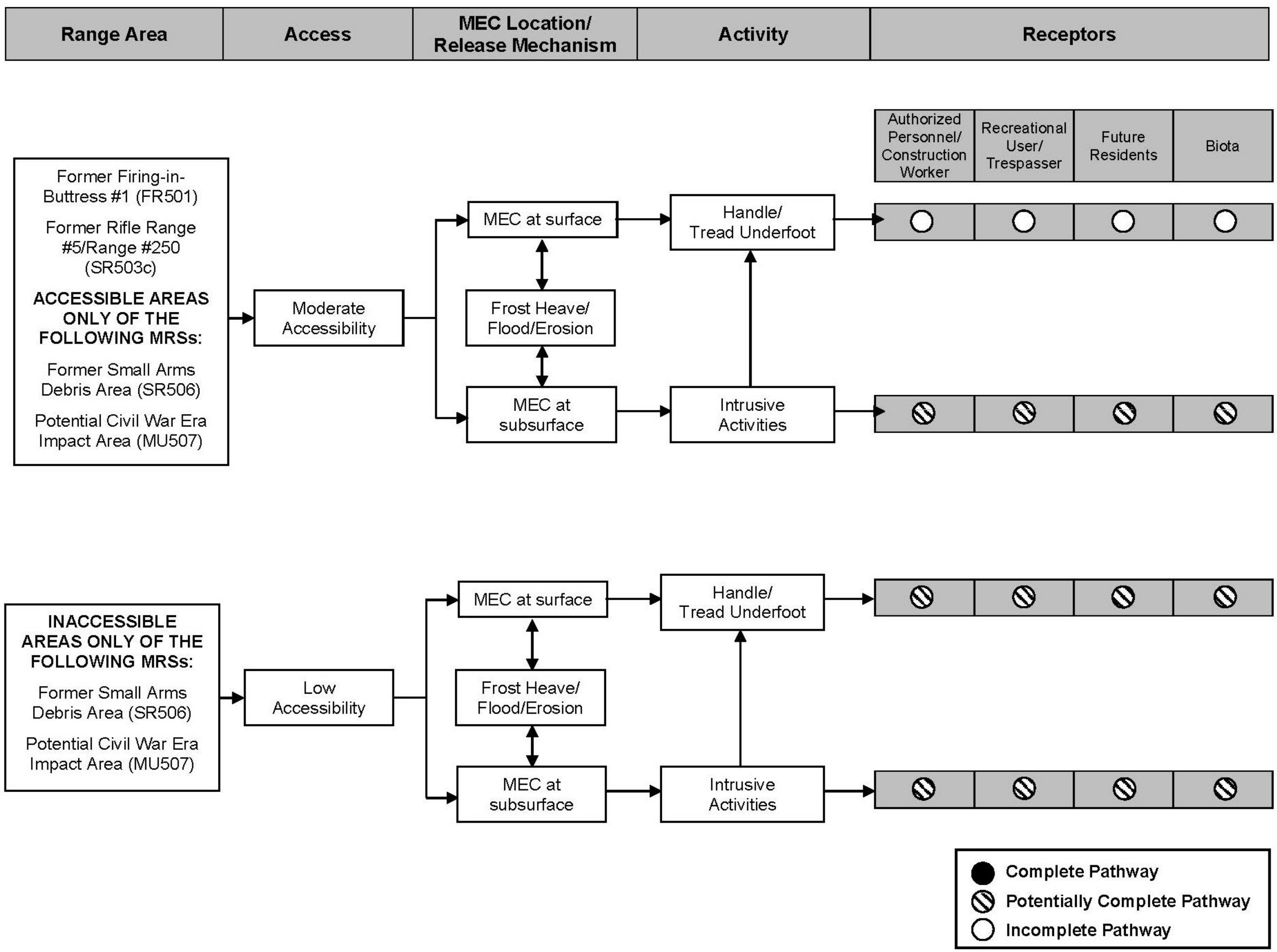

Range Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
Authorized Personnel/ Construction Worker
Recreational User/ Trespasser
Future Residents
Biota
Former Firing-in-Buttress #1 (FR501)
Former Rifle Range #5/Range #250 (SR503c)
ACCESSIBLE AREAS ONLY OF THE FOLLOWING MRSs:
Former Small Arms Debris Area (SR506)
Potential Civil War Era Impact Area (MU507)
Moderate Accessibility
MEC at surface
Frost Heave/ Flood/Erosion
MEC at subsurface
Handle/ Tread Underfoot
Intrusive Activities
INACCESSIBLE AREAS ONLY OF THE FOLLOWING MRSs:
Former Small Arms Debris Area (SR506)
Potential Civil War Era Impact Area (MU507)
Low Accessibility
MEC at surface
Frost Heave/ Flood/Erosion
MEC at subsurface
Handle/ Tread Underfoot
Intrusive Activities
Complete Pathway
Potentially Complete Pathway
Incomplete Pathway

Figure 1-10 Conceptual Site Model Exposure Pathway for MC – MRS with Residual Lead

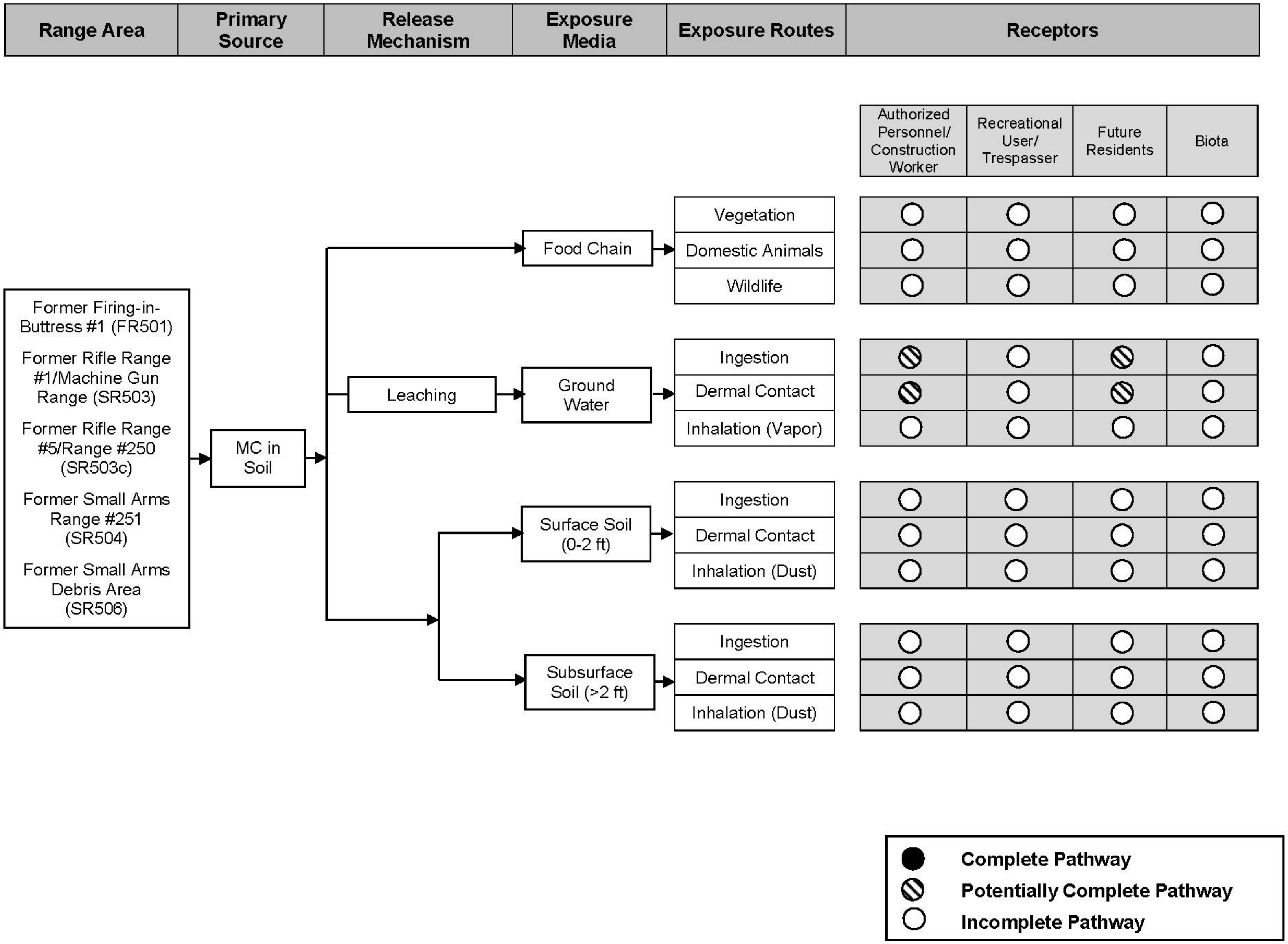
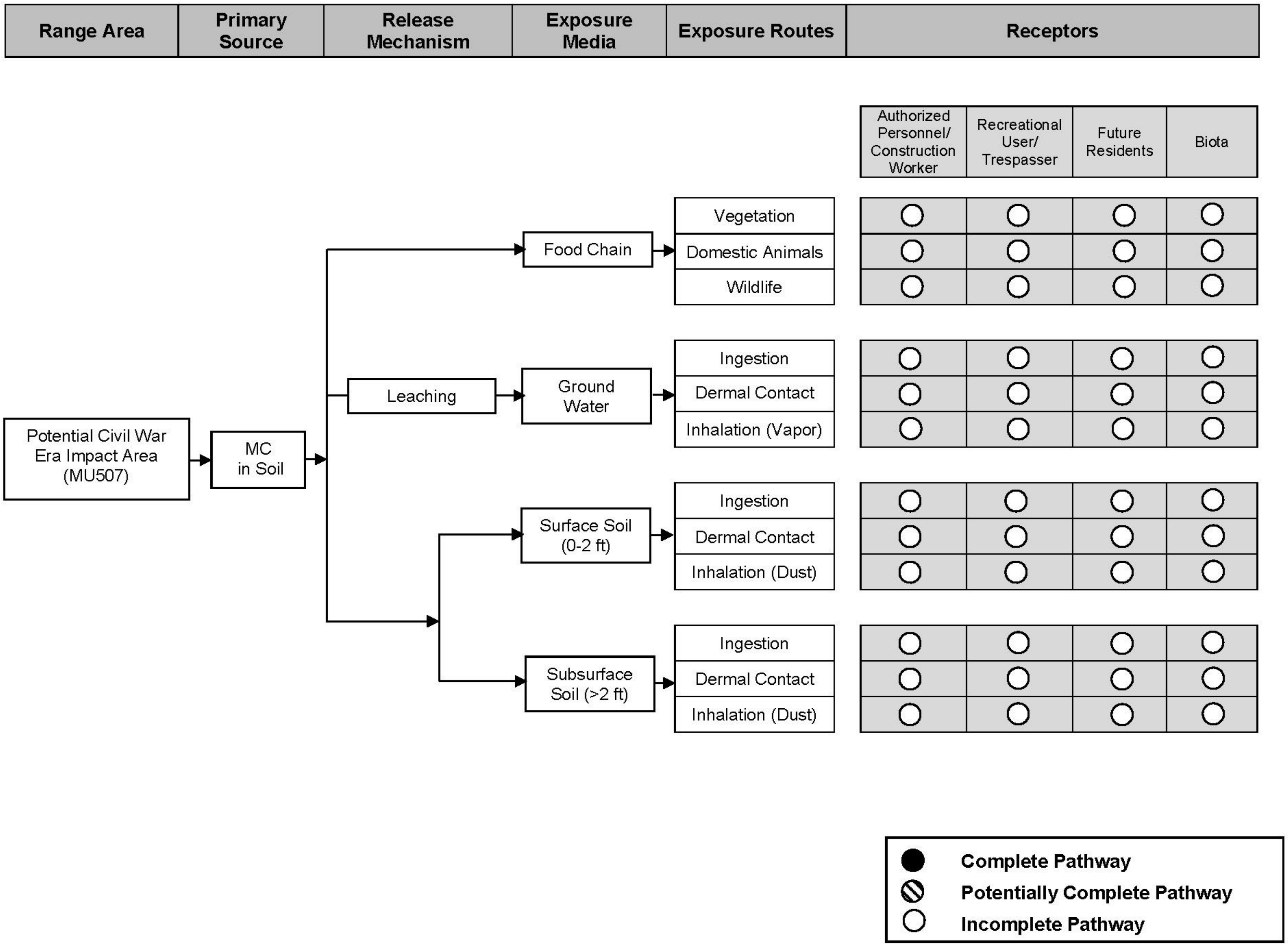


Figure 1-11 Conceptual Site Model Exposure Pathway for MC – No Hazard Identified



2.0 IDENTIFICATION AND SCREENING OF REMEDIAL ACTION TECHNOLOGIES

2.1 Applicable or Relevant and Appropriate Requirements and To Be Considered Information

In accordance with Section 300.400(g) of the NCP, the lead and support agencies will identify requirements applicable to the release or remedial action contemplated based upon an objective determination of whether the requirement specifically addresses a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Remedial actions for releases and threatened releases of hazardous substances and pollutants or contaminants must be selected and carried out in compliance with State and Federal legal requirements. The applicability and/or relevance of an ARAR will depend on the type of response action evaluated. Final ARARs will be presented in the ROD.

The NCP (40 CFR 300.5) defines "applicable" requirements as: "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site." Only those promulgated state standards identified by a state in a timely manner that are substantive and equally or more stringent than federal requirements may be applicable.

The NCP (40 CFR 300.5) further defines "relevant and appropriate" requirements as:

> "Those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing laws that, while not 'applicable' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site."

Like "applicable" requirements, the NCP also provides that only those promulgated state requirements that are identified in a timely manner and are more stringent than corresponding federal requirements may be relevant and appropriate.

USEPA identifies three basic types of ARARs:

- Chemical-specific ARARs are generally health- or risk-based values which, when applied to site-specific conditions, result in numerical values. These values establish the acceptable concentration of a chemical that may be found in, or discharged to, the ambient environment.
- Location-specific ARARs are restrictions placed upon removal activities of hazardous substances solely because they are occurring in a particular place.
- Action-specific ARARs are general technology or activity-based requirements on actions taken with respect to hazardous substances. These requirements are triggered by the particular activities that are selected to accomplish a remedy. Thus, action-specific requirements do not in themselves determine the removal alternative; rather, they indicate how the selected alternative must be achieved.

To be considered (TBC) guidance are guidelines or advisories that are issued by the federal or state government, but which are neither legally binding nor promulgated (USEPA, 1988). However, these guidelines may be used when necessary to ensure protection of public health and the environment, and when they have not been superseded (USEPA, 1988). If no ARARs address a particular circumstance at a CERCLA site, then TBCs can be used to establish remedial guidelines or targets.

Potential ARARs and TBCs to be used in the alternatives evaluation for the six MRSs are presented in **Table 2-1**.

2.2 Remedial Action Objectives

RAOs are developed as target goals for remediation and are used during the analysis and selection of remedial alternatives. RAOs for MC are risk-based, chemical-specific concentrations for the media in which they are found.

RAOs for MEC are defined differently than for chemical compounds, as there are no established risk-based "values" to use for MEC. Preliminary remediation goals (PRGs) are used as the basis for the development of RAOs. The USEPA provides the following definition for MEC PRGs (USEPA, 2005):

> PRGs for a munitions response are the preliminary goals pertaining to the depth of that response action and are used for planning purposes. PRGs are directly related to the specific media that are identified in your CSM as potential pathways for MEC exposure (e.g., vadose zone, river bottom, wetland area). The PRGs for response depths for munitions are a function of the goal of the investigation and the reasonably anticipated land use on the range.

The USACE defines PRGs as follows (USACE, 2005):

> "A PRG for MEC would be a description of a method likely to be protective of the particular exposure pathway(s) identified at the site; e.g., levels of cleanup such as surface removal, removal to depth or the implementation of LUCs [land use controls]."

For both MEC and MC, PRGs are a function of the investigation goal and reasonably anticipated future land use. PRGs may change as more information becomes available (e.g., the actual depth of MEC as well as the anticipated depth at which receptors may contact subsurface soils), environmental conditions, and the complexity and cost of the response required to meet a PRG. Based upon USEPA guidance (USEPA, 1988, 1989), knowledge of the affected media, contaminants of concern, and potential exposure pathways, the following PRGs were developed:

- Prevent direct human contact with MEC in inaccessible areas and subsurface soils.
- Prevent groundwater use where soil concentrations exceed the protection of groundwater standard for lead.
- Comply with chemical-specific, location-specific, and action-specific ARARs and TBC guidance.

The RAOs are developed in the FS based on criteria outlined in Section 300.430(e)(2)(i) of the NCP. RAOs specify the item/contaminants of concern, media of concern, exposure routes and receptors, and an acceptable contaminant level or range of levels for each exposure route. The following RAOs were developed:

- **MEC Items of Concern:** With MEC potentially remaining below the depth of instrument detection and/or within inaccessible areas of FR501, SR503c, SR506, and MU507, it is assumed that the items of concern would be the same as the MEC/MD items identified during the RI and IRA. For FR501, these include 20 mm and 75 mm projectiles. For SR503c, these include 40 mm grenades and 40 mm projectiles. For SR506, these include predominantly 75 mm projectiles, as well as 37-155 mm projectiles and 3-inch

Stokes mortar. For MU507, these include projectiles ranging from 75-155 mm, 3-inch Stokes mortar, and 2.94-inch Hotchkiss shells.

- **Contaminants of Concern:** Lead in soil.
- **Medium of Concern:** Soil for MEC. Soil and potentially groundwater for MC.
- **Exposure Routes and Receptors:** Authorized installation personnel/contractors, recreational users/visitors, trespassers, and biota.
- **PRGs:** Prevent direct human contact with MEC in inaccessible areas and subsurface soils; prevent groundwater use where soil concentrations exceed the protection of groundwater standard for lead; and comply with chemical-specific, location-specific, and action-specific ARARs and TBC guidance.

The RAO for the MRSs is to mitigate contact with MEC potentially present at FR501, SR503c, SR506, and MU507; and ensure receptors are not exposed to MC potentially in groundwater at FR501, SR503, SR503c, SR504, and SR506.

2.3 General Response Actions

Based on the current conditions at the MRSs and the current and future land use scenario, the highest hazard level according to the MHAT methodology is a Hazard Level of 2 (high potential explosive hazard condition; applicable to the areas of MU507 that were inaccessible during the IRA). Based on the potential for MEC in inaccessible areas, the following GRAs are considered in this FS Report for MEC:

- No action
- Land use controls (LUCs)
- Subsurface clearance

The GRAs for MC-impacted soils include:

- No Action
- LUCs
- Removal/disposal

The approximate volume of soil for remediation is 9,937 CY (includes MRSs FR501, SR503, SR503c, SR504, and SR506). Further detail for this estimate is provided in **Section 3.1.3**.

2.4 Identification and Screening of Remedial Technologies

This section identifies the appropriate remedial technologies and process options for each GRA that are appropriate for MEC and MC at the six Volk Field CRTC MRSs included in this FS. The MEC items of concern are provided in **Section 2.2**. Remedial technologies, as used in this FS, refer to general categories of technologies.

Process options, as used in this FS, refer to specific technologies. For example, the “Land Use Controls” general response action includes “Access Restrictions” as a remedial technology, which includes active LUCs such as fencing, warning signs, security patrols, etc., and “Administrative Controls” such as training/awareness programs, deed/zoning restrictions and incorporating the MRS locations and restriction into the installation’s master plans and geographic information system (GIS) databases. Several comprehensive remedial technology types may be identified for each GRA.

The GRAs and remedial technologies to address MEC and MC in soils that were evaluated for the MRSs are presented in **Table 2-2**.

Table 2-1 Summary of Potential State and Federal Applicable or Relevant and Appropriate Requirements

Standard, Requirement, Criteria, or Limitation	Citation	Description	Applicable or Relevant and Appropriate Requirement
Chemical-Specific ARARs and TBCs			
Contaminated Site Management – Soil Remediation Standards	Wisconsin Administrative Code, Chapter NR 720, Procedures for determining residual contaminant levels based on protection of groundwater.	Provides methods for calculation of RCLs for soil cleanup based on protection of groundwater. Site-specific or generic standards may be developed following procedures provided in this citation.	ARAR – Provides promulgated methods to calculate RCLs for MC impacted soils.
Groundwater Quality	Wisconsin Administrative Code, Chapter NR 140	Chemical-specific groundwater quality standards.	ARAR – Establishes groundwater quality standards.
Location-Specific ARARs			
Endangered Species Act of 1973	16 U.S.C. § 1531 et seq	These rules are designed to protect critically imperiled species from extinction as a "consequence of economic growth and development untempered by adequate concern and conservation."	ARAR – The federally listed species known as the gray wolf (*Canis lupus*) may be present at Volk Field CRTC. Volk Field CRTC represents a limited part of their range and their presence at the installation is as transient creatures. Applicable to activities at the MRSs that may impact the gray wolf.
Action-Specific ARARs			
Remedial Action – Sites with Residual Contamination	Wisconsin Statutes, Section 292.12, Sites with residual contamination	Establishes requirements for sites with residual contamination, including database listing, and provides authority to place limitations or controls on sites with residual contamination.	ARAR – Applicable to alternatives that would leave residual contamination.
Laboratory Certification and Registration	Wisconsin Administrative Code, Chapter NR 149	Provides standards for analytical laboratory testing for contaminants during remedial action at impacted sites.	ARAR – Applicable to MC impacted soils.
Solid and Hazardous Waste Management and Facilities Standards	Wisconsin Statutes, Chapter 289 Wisconsin Administrative Code, Chapter NR 500 series and Chapter NR 600 series	Requires management of contaminated soil as a solid or hazardous waste.	ARAR – Applicable if soil is excavated.
Standards for Selecting Remedial Actions	Wisconsin Administrative Code, Chapter NR 722	Establishes standards for identifying and evaluating remedial action options and selecting remedial actions.	ARAR – Applicable to evaluation and selection of remedial actions.

Standard, Requirement, Criteria, or Limitation	Citation	Description	Applicable or Relevant and Appropriate Requirement
Remedial and Interim Action Design, Implementation, Operation, Maintenance, and Monitoring Requirements	Wisconsin Administrative Code, Chapter NR 724	Specifies the requirements for the design, implementation, operation, maintenance, and monitoring of remedial actions and certain types of interim actions.	ARAR – Applicable if active remediation is conducted.
Continuing Obligations Requirements	Wisconsin Administrative Code, Chapter NR 727	Specifies the requirements for management of sites with continuing obligations.	ARAR – Applicable if Wisconsin continuing obligations are used as institutional controls.
Groundwater Protection and Groundwater Quality Standards	Wisconsin Statutes, Chapter 160 Wisconsin Administrative Code, Chapter NR 140	Requires review and approval from WDNR for water supply well construction or reconstruction.	ARAR – Applicable to all sites on the GIS Registry, per Wisconsin Administrative Code Chapter NR 812.
Clean Water Act Storm Water Pollution Prevention Plan (SWPPP) Provisions	40 CFR 122.26	Establishes the requirement for SWPPPs for construction sites that exceed 5 acres in area.	ARAR – A SWPPP may be required if a remedial alternative involves excavation or clearing and grubbing operations that exceed 5 acres.
Resource Conservation and Recovery Act (RCRA), Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR Part 264 Subpart X	Relevant parts relate to the management of MEC that is recovered, including characterization as hazardous waste and requirements for treatment, storage, and transportation. Establishes actions required for the disposal of waste explosives by open burning or open detonation.	ARAR – May be applicable if storage and transportation of recovered military munitions is performed during remedial actions. May also be applicable if disposal of explosives is performed during the remedial actions.
Generation of Hazardous Wastes and Testing of Excavated Materials	40 CFR 261, Subparts A, B, C and D-40 CFR 136, App., Resource Conservation and Recovery Act (RCRA) methods for identification and evaluation of solid and hazardous wastes	Specific requirements for identifying hazardous wastes. Establishes analytical requirements for testing and evaluating solid, hazardous, and water wastes.	ARAR – Applicable to alternatives that include excavation and off-site disposal for MC-impacted soils that require hazardous waste characterization testing prior to soil disposal.

Table 2-2 General Response Actions and Remedial Technologies

GRA	Remedial Technology	Process Options
MEC and MC		
No Action	None	NA
LUCs	Access Restrictions	Fences
		Warning Signs
		Security Patrols
		Permit
		Construction Support
	Continuing Obligations under Section 292.12 of the Wisconsin Statutes	Land Use Restrictions
		Groundwater Use Restrictions
	Educational Programs	Signage
		Public Meetings
		Flyers
		Contractor or School Information Program
	Monitoring	Construction Support
		Enhanced Visual Surveys
MEC		
Surface/Subsurface Clearance	Surface Detection	Visual
		Instrument-Aided Surface Sweep
	Subsurface Detection	Subsurface Analog Detection
		Subsurface Digital Detection
	Excavation	Hand Excavation
		Mechanical Equipment
	Sorting	Mechanized Soil Processing
	Disposal	Blow-in-place
		Consolidated Shot
		Recycling
MC		
Removal	Excavation	Mechanical Equipment
Treatment	In situ Soil Treatment	In situ Soil Treatment
	Ex situ Soil Treatment	Ex situ Soil Treatment
Disposal	Offsite Disposal	Permitted Landfill

Technologies and process option screening consists of presenting and evaluating all possible options that could be used on the site, even those that are not realistically applicable to a specific site. As provided for in the RI/FS guidance, site-specific conditions determine the range of process options available at a given investigation area.

These are “cases where there may be so few realistic options that a screening process is not needed and only a detailed analysis is conducted” (DoD, 2009). The possible remedial technologies are presented in the following sections and **Tables 2-3** through **2-7**. These technologies are divided into four categories: detection, recovery, disposal, and LUCs. In addition, treatment technologies are available for MC-related impacts.

This section contains an evaluation and description of process options for each technology. For technologies with more than one process option, each option is evaluated according to the following criteria.

- Effectiveness – which includes evaluation of the following:
  - Potential effectiveness in handling the estimated areas or volumes of media and in meeting the RAOs.
  - Potential impacts to human health and the environment during the construction and implementation phase.
  - Demonstrated reliability of the process with respect to contaminants and conditions at the site (USEPA, 1988).
- Implementability – which includes both the technical and institutional feasibility of implementing a process option:
  - Technologies passing the initial screen of applicability are screened on the basis of technical feasibility. This criterion means feasibility under site-specific conditions. This evaluation may show that although a technology may be generally appropriate for the MEC or MC of concern, the specific technology may be unworkable or limited due to site-specific conditions.
  - Institutional feasibility emphasizes the institutional aspects of implementability, such as the ability to obtain permits for off-site actions; the availability of treatment, storage, and disposal services (including capacity); and the availability of equipment and skilled workers to implement the technology (USEPA, 1988).
- Cost – This plays a limited role in the screening of process options. Cost is considered a deciding factor only when two alternatives are found to be equally protective. Ranges or approximations of relative capital and operation and maintenance (O&M) costs are used rather than detailed estimates. At this stage in the FS process, the cost analysis is made on the basis of prior experience with technologies, readily available information, and engineering judgment. Each process is evaluated relative to other process options of the same technology type, based on a cost range.

Following selection of the most appropriate process options for each technology type, the process options are combined to form remedial alternatives. The remedial alternatives are discussed in **Sections 3.0** and **4.0**. Each process option for a given technology provides a basis for developing remedial alternatives and evaluating their costs and attributes.

2.4.1 Land Use Controls (MEC and MC)

LUCs are a type of administrative measure developed to protect human health and safety from the presence of hazards, including explosive hazards. They have been retained for alternative development. LUCs as discussed in *Munitions Response Remedial Investigation/Feasibility Study Guidance* (DoD, 2009) include measures such as placing warning signs; fencing the area; adding deed restrictions such as land use, construction support, or monitoring; providing informational programs for the public; and educational programs. They may also include continuing obligations under Section 292.12 of the Wisconsin Statutes. These measures are summarized in **Table 2-3** and discussed below.

2.4.1.1 Access and Administrative Restrictions

Access restrictions are remedial technologies that limit access to the site or restrict land usage. Land use restrictions can be used to reduce the chance of a MEC incident by restricting certain activities from occurring that are likely to pose a hazard. Specifically, the restrictions should prohibit disturbance into any soil or sediment where MEC is known or suspected to exist. Similarly, access restrictions are used to prevent direct contact with MC.

Fences physically restrict or discourage access to a site. The effectiveness of the fence depends on the size, type, and maintenance of the fence. Increased height and barbed wire increase the effectiveness, although a determined person can cross virtually any fence. The main advantage to fencing is that it prevents inadvertent access. While fences are technically feasible for the MRSs, access to the area is already limited by Base security and the installation and maintenance costs are high. Furthermore, fences likely would have limited benefit because there are already few trespassers. Therefore, fencing is removed from further consideration.

Warning signs posted along the perimeter and within the interior of the property provide potential trespassers with immediate awareness of the hazards and land use restrictions. Sign posting is typically completed to inform people that entry is prohibited or that activities within the property are restricted in some manner. Warning signs are a proven technology that is effective, easily implementable, and low cost.

Deed/zoning restrictions are methods of administratively restricting land use. Specific legal approaches to limit or restrict access to property are established generally as proprietary controls and governmental controls. A notice on the deed restriction can be included when transferring property (or in the case of federal to federal reassignments, an “Assignment”). A deed restriction will identify current and projected land use (i.e., recreational), pertinent site conditions related to military munitions use, munitions responses implemented, potentially remaining MEC hazards, if any, and any potential mitigation requirements.

The property is currently managed under the Base General Plan, but if a property transfer occurs in the future, deed restrictions may be necessary. Because the government currently has ownership, deed restrictions would be easy to implement if needed.

LUCs may include continuing obligations under Section 292.12 of the Wisconsin Statutes. Continuing obligations are legal requirements designed to protect public health and the environment in regard to residual contamination that remains on a property. Continuing obligations may include restrictions on land use or groundwater use. Sites with continuing obligations are tracked through the WDNR GIS Registry.

2.4.1.2 Education

Education is a remedial technology that provides information to potential receptors in an effort to alter behavior. The use of education can be an effective strategy to manage and reduce residual hazard from community exposure to MEC. Education can take many forms and can be easily tailored to meet the specific needs of a particular audience, either for users of the site or the surrounding community. Specific information that may be provided includes:

- The history of the site, specifying that the property was used for military training exercises and may contain MEC;
- The locations of potential hazardous areas;
- The potential hazards associated with MEC;
- Types of activities that may be especially hazardous in these areas;
- How to recognize UXO and munitions;
- Ways to avoid encountering UXO and munitions;
- What to do (and what not to do) if UXO or munitions are discovered; and
- Who to call to notify of UXO or munitions.

The following options focus on the particular education approaches that may prove effective in altering behavior and mitigating hazards at Volk Field CRTC.

UXO and munitions recognition safety training is a focused training program targeted at individuals that are authorized to access the MRSs at Volk Field CRTC. UXO and munitions recognition and safety training may be provided to anyone conducting ground disturbance activities (e.g., excavating trenches, repairing underground utilities, etc.) and should include material on what type of UXO and munitions might be located and the procedures to follow if something is located.

UXO and munitions safety recognition safety training may be conducted in local facilities with the USAF providing professionals and experts to conduct UXO and munitions identification and safety lectures. Presentation materials could consist of brochures/fact sheets, videos, and inert items representative of the MEC types possibly located on the MRSs.

This technology would be effective in training authorized personnel entering the MRSs to recognize and avoid MEC hazards. This measure would only be effective for people authorized to access the MRSs (i.e., trespassers would not receive training). This technology is easily implemented and low in cost.

Public meetings or town hall meetings can be held to target either the local population in general, or target individuals or small groups that frequent the area. Meetings can be held to educate the community about the dangers of the MEC that is potentially present at Volk Field CRTC.

Participants could consist of community leaders, representatives from civic associations and businesses from the community, and a representative from USACE, who would serve as a mechanism for facilitating meetings. Public meetings can be highly effective, easy to implement, and low in cost.

Flyers or other printed media can be used to facilitate awareness and understanding. The printed media can be distributed to the community or to individuals granted access to the Base at the Base security gate. The opportunity to disseminate information through the printed media is readily available and can be easily facilitated.

Implementation of education technologies would be developed in coordination with the Community Planning Liaison Officer, and would be incorporated in the Community Involvement Plan for Volk Field.

2.4.1.3 Monitoring

Monitoring is a remedial technology that either oversees activities at the site to make sure personnel are safe, or periodically assesses that conditions at the site are as anticipated when the remedy was selected.

Construction support is a method of protecting people from contact with MEC during various projects where there is the potential to encounter MEC. Prior to any subsurface work including excavation and construction, a review is performed to determine if any potential chemical hazards exist, or if MEC may be present.

Based on the potential hazards, proper procedures are identified and documented. UXO qualified personnel, knowledgeable in the identification of MEC, use various instruments and techniques to ensure that personnel do not come into contact with MEC. This technology is considered to be effective, implementable, and medium cost.

Visual surveys are performed to evaluate whether MEC is exposed at the surface at a future date after MEC removal is performed. It is intended to assess the permanence of the MEC removal. Surface MEC, which is the most accessible, may begin to reappear in areas previously cleared of MEC due to frost heave and erosion, which may expose items from below, and lateral transport from other areas (i.e., water transport in dynamic environments).

Periodic visual surveys can assess whether such mechanisms are occurring, and should be part of CERCLA five-year reviews, if appropriate. This technology is considered to be effective, implementable, and moderate in cost.

2.4.2 Detection (MEC)

Detection involves locating hazardous items (i.e., MEC) in the environment. This can include a broad scale investigation to locate areas where items are densely clustered, or a focused scale investigation to locate individual items. Detection is usually used in conjunction with removal and disposal to meet RAOs, but can also be used to identify areas for containment and/or institutional controls. Detection process options are summarized in **Table 2-4**.

Current state-of-the-art detection methods cannot detect all MEC items. Some technologies can only identify items that are on the surface, and those that can detect buried items have depth limitations. In general, the deeper an item is buried, and the smaller an item is, the harder it is to detect. If an item is small enough or deep enough, it might not be detected and may remain after the removal.

2.4.2.1 Subsurface Analog Detection

Hand-held analog geophysical instruments are used in sweep mode as the instrument is passed back and forth by UXO technicians in well-defined search lanes of typically 5 ft wide or less. Analog instruments emit an audible signal as the instrument is moved past a metallic item. The UXO technician progresses along the search lane and stops when an anomaly is identified. Anomalies are either immediately excavated or flagged for future excavation.

Analog magnetometers detect irregularities (anomalies) in the earth's magnetic field due to the presence of surface and/or subsurface ferrous metallic items. An analog magnetometer emits an audible signal that changes in pitch as the instrument is moved past a metallic item. Due to its effectiveness, simple operation, and availability of hand-held units, magnetometry is the most commonly used technology for locating buried MEC. Detection depth is generally limited to 2-4 ft depending on the type of ordnance. When electromagnetic detectors are utilized, the depth of detection is generally limited to 1-1.5 ft, depending on the type of ordnance. The cost for this option is relatively low.

Analog electromagnetic instruments involve the use of an electromagnetic induction system to transmit electrical current. The system measures either the secondary magnetic field induced in metal objects or the difference between the electrical conductivity of the soil and the object. Because electromagnetic instruments detect non-ferrous as well as ferrous metallic items, they can detect a broader range of munitions items, but will also detect a greater number of other debris items such as aluminum cans and non-ordnance debris (e.g., tools, car parts, etc.). These instruments are readily available and can be easily implemented with medium relative cost.

Analog or digital detection was completed during the RI and IRA throughout accessible areas for the MRSs where MEC was considered a potential concern (MRSs FR501, SR503, SR503c, SR506, and MU507). Further use of subsurface analog detection would not be effective for site clearance, and is not feasible in the areas of the MRSs classified as inaccessible due to steep slopes (SR506 and MU507). However, analog detection is retained to support remedial alternatives that include an intrusive component to address MC.

2.4.2.2 Subsurface Digital Detection

Digital instruments are available in multiple configurations including man-portable, litter carry, cart, and towed array. As opposed to analog instruments, digital instruments log georeferenced sensor data that can be analyzed, processed, and used to identify targets with known location coordinates or to create maps of metallic clutter. Anomalies identified in the data are analyzed to determine the likely mass and depth of the item. Anomalies can be ordered from most likely to least likely to be the size and shape of munitions known to have been used at the site.

With the appropriate quality control, the number of anomalies to investigate may be reduced to create a target anomaly list. Because coordinates are known, the target anomalies can be reacquired and excavated at a later date. Electromagnetic instruments detect non-ferrous as well as ferrous metallic items so that they can detect a broader range of munitions items, but they will also detect a larger number of other debris items such as aluminum cans and non-ordnance debris.

Digital magnetometers work on the same principle as analog magnetometers, detecting irregularities (anomalies) in the earth's magnetic field or the spatial rate of change in the magnetic field. Digital magnetometers may be appropriate at Volk Field CRTC because the majority of items of interest are ferrous. These instruments also provide depth detection within 4 ft or more into the subsurface and provide defensible anomaly discrimination. These instruments are readily available and can be easily implemented with medium relative cost.

Digital electromagnetic instruments work on the same principle as analog electromagnetic instruments, transmitting electrical current and measuring either the secondary magnetic field induced in metal objects or the difference between the electrical conductivity of the soil and the object. Because electromagnetic instruments detect non-ferrous as well as ferrous metallic items, they can detect a broader range of munitions items but will also detect a larger number of other debris items such as aluminum cans and non-ordnance debris.

Digital instruments are available in multiple configurations including man-portable, litter carry, cart, and towed array. At Volk Field CRTC, the cart and towed array configurations are not viable due to the steep slopes and heavy vegetation that exist over most of the impact areas.

The litter carry configuration is viable for some parts of the Volk Field MRSs but may be limited due to the tight spacing the trees in wooded areas (i.e., the digital equipment litter will not fit between the trees). The litter carry configuration would also create potential safety concerns due to the steepness of the slopes (i.e., the weight and unwieldy configuration of the data collection equipment).

The man portable configuration would be viable, but the steepness of the slopes in some area would likely create potential safety concerns due to the weight and unwieldy configuration of the data collection backpack.

Additionally, the overhead canopy in the Volk Field CRTC some MRSs would likely inhibit the ability to obtain, and maintain, GPS signals needed to accurately locate and reacquire anomalies using digital detectors. Anomaly location precision can be improved by employing a static base station located in an unobstructed area and using software to correct drift of the GPS unit and to help fill in data gaps that occur if the canopy prevents continuous GPS signal lock on the data collector. However, this approach increases both the complexity and the cost of field operations.

Digital detection was completed during the RI at FR501. Analog detection was completed during the RI and IRA throughout the remaining accessible areas for the MRSs where MEC was considered a potential concern (MRSs FR501, SR503, SR503c, SR506, and MU507). Further use of subsurface digital detection would not be effective for site clearance, and is not feasible in the areas of the MRSs classified as inaccessible due to steep slopes (SR506 and MU507). Therefore, this technology is not retained for further evaluation.

2.4.3 Removal (MEC)

MEC removal process options are evaluated in **Table 2-5**. Removal technologies involve the movement of hazardous items (e.g., MEC) from the source area to another place either on-site or off-site. Removal is used in conjunction with detection and disposal. If it can be performed safely, removal is usually considered the most effective form of remediation for MEC. If the MEC no longer exist, they cannot present a hazard to receptors. This makes MEC removal the best traditional method of long-term protection.

MEC removal can be performed in a targeted fashion, where individual items are detected, identified, and removed one at a time in a focused manner. Alternatively, bulk removal can be performed in known cluttered areas.

Due to the potential for accidental detonation and the sensitive nature of UXO with armed fuzing, bulk removal technologies may not be appropriate unless adequate precautions (e.g., engineering controls) can be applied. Various MEC removal remedial technologies and process options are discussed below.

MEC excavation refers to the focused, intrusive investigation of a single anomaly that could represent MEC. The metallic item causing the anomaly is left in place with as little disturbance as possible until it is positively identified, and its condition with respect to safety is assessed by qualified UXO technicians. Only then is a decision made to either remove it or, if MEC, to detonate it in place. This technology is appropriate when the items of interest may be fuzed and armed.

2.4.3.1 Manual Excavation

Manual excavation consists of hand digging methods performed by UXO technicians. Manual excavations are usually limited to 4 ft or less. When excavating an anomaly manually, non-essential personnel must be evacuated to the hazardous fragmentation distance. This technology is effective at removing MEC and implementable, although large or entrenched items may be difficult to remove manually.

MEC removal was completed during the IRA throughout accessible areas for the MRSs where MEC was considered a potential concern (MRSs FR501, SR503, SR503c, SR506, and MU507). Further removal is not feasible in the areas of the MRSs classified as inaccessible due to steep slopes (SR506 and MU507). However, manual excavation is retained to support remedial alternatives that include an intrusive component to address MC.

2.4.3.2 Heavy Equipment Excavation

Heavy equipment excavation (e.g., excavators or other earth moving machinery) can be used to excavate an anomaly. When heavy equipment is used, digging progresses to within approximately 1 ft of the anomaly, after which hand digging commences. Equipment used for anomaly excavation typically requires armoring to protect the operator. Remotely operated equipment is available and may be appropriate in some high risk locations. Mechanical excavation, assisted with selective hand digging, has been demonstrated to be administratively feasible and in cases where MEC is deep, has been shown to save time and money in some areas.

Heavy equipment would be very disruptive to the natural environment and wildlife in undeveloped areas of the MRSs, requiring extensive restoration and resulting in a much higher cost (only applicable to areas not previously excavated). Due to the steep slopes and heavily wooded terrain in the inaccessible areas, heavy equipment excavation is not feasible for all areas of the MRSs. However, heavy equipment excavation is retained to support remedial alternatives that include excavation to address MC, in the event that a MEC item is discovered during remedial activities.

2.4.3.3 Mechanical Soil Screening

Mechanical soil screening consists of excavation of soil to the desired depth with subsequent processing through a screening plant to remove MEC, MD, and other debris. As the soil is processed through a screen, UXO technicians monitor the operation and check the screen for MEC and MD. If MEC/MD is recovered, the UXO technicians will take appropriate steps to evaluate, segregate, and dispose of the items. The soil is then returned to the environment.

This process inherently removes and jostles all items before a determination is made that the item is safe to move, so it usually cannot be used when fuzed items are expected, unless the process is carried out either remotely or with engineering controls to protect personnel. Remote operation will raise costs considerably, especially if unintentional detonations occur and damage the equipment. Accordingly, this process may not be appropriate for a site where large MEC items are present.

MEC removal was completed during the IRA throughout accessible areas for the MRSs where MEC was considered a potential concern (MRSs FR501, SR503, SR503c, SR506, and MU507). Further removal is not feasible in the areas of the MRSs classified as inaccessible due to steep slopes (SR506 and MU507). Therefore, mechanical soil screening is not retained.

2.4.4 MEC Disposal

Disposal process options are summarized in **Table 2-6**. Process options for disposal of MEC at Volk Field CRTC include BIP or consolidated demolition shots.

BIP is the most common method of MEC disposal for items found on land. It is the safest method, especially for fuzed items, because it does not require moving or transporting the item. A donor explosive is attached to the item and used to trigger a high order detonation to result in complete destruction. Specific safety controls are developed and are in place to protect the public, the project team, and the environment. The BIP process has been used successfully at Volk Field CRTC. This technology is effective, implementable, and relatively low cost.

Consolidated detonations are controlled detonations of a number of MEC items that are safe to move and transported to a single disposal site, where they are then destroyed. This approach reduces the number of detonations and therefore limits impacts to the environment. It also allows for detonations to occur in areas where conditions are favorable for site control, evacuation, access, and fire control. However, if a site is repeatedly used, it may be considered a disposal area that must be sited. Environmental testing and restoration may be necessary.

Off-site disposal is not considered as a potential MEC disposal method because it poses a significant problem in regards to transportation of MEC, which is not an option on public roads.

However, MD encountered during surface and subsurface clearance may be recycled as metal scrap, provided the DoD inspection, certification, and verification by qualified UXO personnel requirements are met for classification as material documented as safe (MDAS) prior to disposal.

2.4.5 Removal (MC)

Removal options for MC are summarized in **Table 2-7**. Excavation of MC-impacted soil would reduce the long-term potential for human and ecological exposure by removing soils above risk-based PRGs from the environment. MC-impacted source soils would be excavated using conventional earth-moving equipment.

Excavation at FR501 would involve removing soil from within the impact berm structure. The structure roof will limit overhead clearance but the option is implementable with selection of the right size equipment. Soil was previously removed from the same location for sifting and removal of MD. Other MRSs containing lead in soil above the WDNR RCL for protection of groundwater have already had excavations completed during the IRA (MRSs SR503, SR503c, SR504, and SR506) and use of mechanical equipment is possible with limited impact to vegetation and wildlife. Other areas for expanded excavation are more heavily vegetated and may require removal of some trees and underbrush.

Soil removal by mechanical excavation may require the use of dust control and surface runoff measures to ensure worker safety and to protect the general public and the environment. Restoration to replace trees removed during the excavation may be required. These measures have been successfully used at other sites around the country.

2.4.6 Treatment (MC)

2.4.6.1 In situ Soil Treatment

Treatment options for MC are summarized in **Table 2-7**. In situ treatment consists of adding chemical amendments to the soil that react with MC to reduce the toxicity or mobility of the MC compounds. For lead, phosphate compounds are mixed into the soil with a resultant reduction in bioavailability. Bench scale testing is typically required to determine the mixture based on the site-specific soil chemistry and the specific soil amendment planned for use.

In situ treatment is easily performed in open areas with little or no vegetation. In areas with vegetation, removal of trees and underbrush is often necessary to allow access for the application equipment and to facilitate soil mixing. Where trees are present, removal of the subsurface root ball is often required to ensure complete mixing and to prevent damage to the mixing equipment.

The depth of soil mixing required may also limit the implementability. Soil mixing at shallow depths (less than 6 inches) can be easily performed with readily available equipment but availability of specialized equipment needed for deeper soil mixing limits the applicability and increases costs.

In situ treatment does not reduce total lead concentration in soil, and the long-term impacts of the treatment option with respect to lead mobility and toxicity have not been established. Due to these factors, this process option is removed from further consideration.

2.4.6.2 Ex situ Soil Treatment

Ex situ treatment consists of first excavating impacted soil, placing the soil into previously prepared treatment areas (e.g., land farms) and then adding chemical amendments to the soil that react with MC to reduce the toxicity or mobility of the MC compounds. For lead, phosphate compounds are mixed into the soil with a resultant reduction in bioavailability.

Bench scale testing is typically required to determine the mixture based on the site-specific soil chemistry and the specific soil amendment planned for use. After the amendment is applied, samples are collected for analysis to evaluate the effectiveness of the lead stabilization.

Space for land farm construction is available at Volk Field CRTC, with the exception of SR506. However, soil could be transported from SR506 to a land farm constructed at another MRS. Removal of the vegetation during soil placement could be performed and the soil layer thickness controlled to allow use of readily available shallow mixing equipment.

Stabilization treatment for lead does not reduce the total lead concentration in soil, and the long-term impacts of the treatment option with respect to lead mobility and toxicity have not been fully established. The cost of amendments and level of effort to apply and maintain the land farms is also high. Due to these factors, this process option is screened from further consideration for on-site treatment and backfill with treated soil. However, stabilization is a cost-effective approach for treatment of soil prior to disposal, in order to reduce toxicity characteristic leaching procedure (TCLP) concentrations, allowing for classification as non-hazardous waste.

2.4.7 Off-site Disposal (MC)

Disposal options for MC are summarized in **Table 2-7**. Contaminated soil above cleanup criteria would be disposed off-site in accordance with local, state, and federal regulations. Soil would be excavated with standard equipment (e.g., hydraulic excavators) and loaded onto trucks for transport to facilities permitted to accept the waste.

Prior to disposal, samples will be collected to determine if the excavated soil is hazardous. Soils are considered hazardous if they exhibit any characteristic of hazardous waste. Based on the concentrations of lead in excavated soils during the IRA it is possible soils will exhibit the toxicity characteristic for lead, when tested using the TCLP. However, stabilization technology may be used to allow for classification and disposal as non-hazardous waste.

Off-site disposal would use existing permitted and licensed disposal facilities. Off-site disposal would involve the permanent and final placement of the impacted soils in a manner that protects human health and the environment.

Excavation cost is relatively high but similar to the ex situ treatment option. Transport and disposal costs for off-site disposal are moderate and anticipated as less than amendment placement and land farm management costs associated with the ex situ treatment option. This technology is retained for further consideration.

Table 2-3 Land Use Control Technologies

Identified Process Option	Effectiveness L/M/H	Implementability L/M/H	Cost L/M/H	Comments	Retained Yes/No
Access and Administrative Restrictions					
Fencing	H	L	H	Fencing would be effective for restricting access; however, access is already limited by Base security. Costs would be high for installation.	No
Signage	M	M	M	Signage would be effective for alerting users of potential dangers. Assumes that signs are placed in appropriate places for optimal viewing. Moderate effort would be necessary to implement (signs must be installed in a remote area). Cost would be moderate (signs must be monitored and maintained).	Yes
Deed/ Zoning Restrictions	H	L	L	Zoning ordinances would be put in place to prohibit land use inconsistent with remedial alternative. Effectiveness and ease of implementability dependent on governmental agencies. Cost is low.	Yes
Continuing Obligations	H	H	L	Continuing obligations under Section 292.12 of the Wisconsin Statutes may include restrictions on land use or groundwater use. Continuing obligations are tracked through the WDNR GIS Registry.	Yes
Education					
Training	H	H	L	Can target individuals with access to the MRSs. This technology would be effective in training authorized personnel entering the site to recognize and avoid UXO and munitions hazards.	Yes
Public Meetings	H	H	L	Public meetings can be a highly effective means of communication depending on how well they are advertised and attended. They are generally easy to implement and do not have a significant cost.	Yes
Flyers	H	H	L	Flyers via mass mailing or for individuals that may be entering the Volk Field CRTC MRSs can be highly effective in reaching potential individuals that may encounter MEC. Educational handouts may also be strategically provided to other members of the community (hunters, hikers, etc.). Preparing and distributing flyers would be easily implemented; costs associated with preparation and distribution would be low.	Yes
Monitoring					
Construction Support	H	H	M	Construction oversight by qualified health and safety and/or MEC personnel would be an effective means of monitoring for potential MEC during both planning and execution.	Yes
Visual Surveys	H	H	M	Use to assess for changes in site conditions and effectiveness of the remedy selected.	Yes

Notes: H = high M = medium L = low

Table 2-4 MEC Detection Technologies

Identified Process Option	Effectiveness L/M/H	Implementability L/M/H	Cost L/M/H	Comments	Retained Yes/No
Subsurface Detection					
Analog Magnetometer	H	M	L	Maps only ferrous items. Detection depth limited to 2 to 4 ft. MEC clearance was completed in accessible areas of MRSs during the IRA; this technology is retained to support remedial alternatives that include an intrusive component to address MC.	Yes
Analog Electromagnetic Instruments	M	M	L	Maps both ferrous and nonferrous, so will detect non-munitions in the subsurface (the munitions at Volk Field CRTC are predominantly ferrous) increasing the number of targets. However, the depth of detection for electromagnetic instruments is limited compared to magnetometers. MEC clearance was completed in accessible areas of MRSs during the IRA; this technology is retained to support remedial alternatives that include an intrusive component to address MC.	Yes
Digital Magnetometer	H	L	M	Can be digitally analyzed to provide the mass and depth of an anomaly. Effective greater than 4 ft. Locations are recorded and anomalies can be relocated. Due to the trees and topography in inaccessible portions of the MRSs not previously cleared, this process option is not implementable.	No
Digital Electromagnetic Instruments	M	L	M	Maps both ferrous and nonferrous, so will detect non-munitions in the subsurface increasing the number of targets. Due to the trees and topography in inaccessible portions of the MRSs not previously cleared, this process option is not implementable.	No

Notes:
H denotes high
M denotes medium
L denotes low

Table 2-5 MEC Removal Technologies

Identified Process Option	Effectiveness L/M/H	Implementability L/M/H	Cost L/M/H	Comments	Retained Yes/No
Manual Excavation	H	H	L-H	Proven effective at Volk Field CRTC. Easy to implement. MEC removal was completed during the IRA throughout accessible areas. However, manual excavation is retained to support remedial alternatives that include an intrusive component to address MC.	Yes
Excavation by Heavy Equipment	L-M	M	M-H	May be difficult to implement without damage to the vegetation and disrupting wildlife. Difficult to perform on steep slopes and in heavily wooded areas. However, heavy equipment excavation is retained to support remedial alternatives that include excavation to address MC, in the event that a MEC item is discovered during remedial activities.	Yes
Excavation followed by Mechanized Soil Sorting	L-M	M	H	Highly effective at separating MEC/MD from large volumes of excavated soil if mechanical excavation is used. Is more difficult than hand excavation to implement and requires more planning/staging. Soil sorting was previously completed to remove MEC from accessible areas of the MRSs and is not retained.	No

Notes:
H denotes high
M denotes medium
L denotes low

Table 2-6 MEC Disposal Technologies

Identified Process Option	Effectiveness L/M/H	Implementability L/M/H	Cost L/M/H	Comments	Retained Yes/No
BIP	H	H	M	This method has been used effectively on similar sites and was proven effective during the RI/IRA. This is a field-proven technique using transportable materials and equipment.	Yes
Consolidated Demolition Shot	H	H	M	This method may be more cost-effective than BIP if large amounts of MEC are recovered.	Yes
Recycling of MD as Metal Scrap	H	H	L	The majority of MEC items at Volk Field CRTC are metallic so may be disposed of as scrap metal after destruction and certification by UXO personnel as MDAS. This method has been used effectively on similar sites and during the RI/IRA.	Yes

Note(s):
H denotes high
M denotes medium
L denotes low

Table 2-7 MC Removal, Treatment, and Disposal Technologies

Identified Process Option	Effectiveness L/M/H	Implementability L/M/H	Cost L/M/H	Comments	Retained Yes/No
Excavation by Heavy Equipment	H	H	M-H	Effective in reducing potential migration of lead to groundwater by removing soil containing residual lead concentrations above the WDNR RCL for protection of groundwater. Easy to implement with readily available equipment. Will require import of clean fill.	Yes
In situ Soil Treatment	M	L-M	H	Treatment does not reduce the total lead concentration in soil and the long-term impacts of the treatment option with respect to lead mobility and toxicity have not been established. Depth of soil may limit implementability. Costs are high.	No
Ex situ Soil Treatment	M	M	H	Treatment does not reduce the total lead concentration in soil and the long-term impacts of the treatment option with respect to lead mobility and toxicity have not been established. Space is available for construction of land farms, but presence of trees and underbrush will require extensive removal to implement. Overall costs are high. However, stabilization is a cost-effective approach for treatment of soil prior to disposal, and the technology is retained for use in an alternative incorporating off-site disposal.	Yes
Off-Site Disposal	L-M	H	H	Effective in reducing potential exposure by placing material in a controlled facility to limit future exposure. Easy to implement. Overall costs are high but anticipated to be less than in situ or ex situ treatment options.	Yes

Note(s):
H denotes high
M denotes medium
L denotes low

3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

This section discusses how the GRAs and specific process options are combined to develop remedial alternatives for the six MRSs as defined in the *Technical Update Standard Format for Feasibility Study Reports For Military Munitions Response Program* (USACE, 2005). In accordance with the guidance, the following alternatives should be considered:

a. No Action;
b. An alternative that reduces or eliminates TMV of waste;
c. An alternative that considers LUCs;
d. An alternative that does not consider LUCs;
e. Unrestricted use;
f. An alternative that considers an innovative technology;
g. An alternative that considers monitored natural attenuation;
h. Alternatives that provide varying levels of protection; and/or
i. An alternative that considers presumptive remedies.

The requirements for the alternatives listed above can be met either singularly in a specific alternative (i.e., No Action Indicated or Unrestricted Use) or in conjunction with other alternatives (i.e., an alternative that provides varying levels of protection may be inherent to alternatives that do and do not consider LUCs).

The use of monitored natural attenuation applies to sites with MC and is not applicable to the MRSs discussed in this section, as lead cannot be addressed through natural attenuation. Currently, no presumptive remedies are available for MEC. Likewise, innovative technologies were not considered due to the GRAs applicable to MEC.

Three alternatives were developed that represent a reasonable range of treatment and meet the requirements outlined in the *Technical Update Standard Format for Feasibility Study Reports For Military Munitions Response Program* (USACE, 2005). The alternatives are summarized in **Table 3-1** and described in the following sections. Alternatives 1 and 2 are potentially applicable to each of the MRSs. The excavation component of Alternative 3 is potentially applicable to MRSs with residual lead in soil (FR501, SR503, SR503c, SR504, and SR506) while LUCs under Alternative 3 would apply to all MRSs.

Table 3-1 Description of Remedial Action Alternatives

Alternative Number	Description	USACE, 2005 Requirement Fulfilled
1	No Action	A,D
2	Implement LUCs to address MEC below the depth of instrument detection and in areas with slopes greater than 30 degrees that were not accessible during the IRA. LUCs consisting of land use restrictions and construction support through the Volk Field CRTC review process. Additional LUCs consist of monitoring at five year intervals, education, warning signage, restricted access, and training. Restrictions on groundwater use in the form of continuing obligations under Section 292.12 of the Wisconsin Statutes would be implemented for MRSs with residual lead concentrations exceeding the WDNR RCL for protection of groundwater (27 mg/kg).	C,H
3	Excavation of lead-impacted soil to meet the WDNR RCL for protection of groundwater (27 mg/kg). Implement LUCs to address MEC below the depth of instrument detection and in areas with slopes greater than 30 degrees that were not accessible during the IRA.	B,C

A denotes no action.
B denotes alternative that reduces or eliminates toxicity, mobility, or volume of waste.
C denotes alternative that considers LUCs.
D denotes alternative that does not consider LUCs.
H denotes alternatives that provide varying levels of protection.

This section also provides a description of each alternative and the rationale for each alternative. These alternatives are screened for effectiveness, implementability, and cost as follows:

- ***Effectiveness***: The demonstrated ability of component technologies to achieve design goals.
- ***Implementability***: Factors such as safety, constructability, regulatory and public support, compatibility with land use plans and availability of material, equipment, technical expertise, and availability of off-site disposal facilities are considered.
- ***Cost***: Remedial action implementation and O&M costs are evaluated based on order-of-magnitude estimates.

The results of this screening are presented in **Table 3-2**.

3.1 Alternative 1: No Action

The NCP requires a No Action alternative be evaluated to provide a baseline for comparison to other alternatives. This alternative provides no actions to protect human health or the environment at the site. Alternative 1 would result in no further treatment of MC and would not provide LUCs. As this is required per the NCP, no preliminary screening is necessary and this alternative is retained for detailed analysis in **Section 4.0**. Alternative 1 is evaluated for all MRSs.

3.2 Alternative 2: Land Use Controls

Under this alternative, no additional active remediation would be performed at the MRSs. The MRSs would remain at the current status, resulting from previous completion of the IRA in 2015. Hazards remaining at the sites would be managed through LUCs including a review process to provide construction support for any construction or other intrusive activities in addition to land use restrictions at MRSs with MEC potentially remaining below the depth of instrument detection and/or within inaccessible areas (FR501, SR503c, SR506, and MU507). Groundwater use would be restricted for MRSs with residual lead remaining in soil at concentrations exceeding the WDNR RCL for protection of groundwater (FR501, SR503, SR503c, SR504, and SR506) of 27 mg/kg. All six MRSs would be added to the ANG Geobase System, a GIS system that can be utilized for long-term management and tracking of the MRSs.

Alternative 2 would allow for case closure for the MRSs under WDNR guidance for sites with residual contamination (WDNR, 2014). However, the MRSs would be required to remain in the GIS Registry in accordance with the Wisconsin Code of Administrative Rules, chapter NR 726, due to the presence of residual lead contamination exceeding the WDNR RCL for protection of groundwater (MRSs FR501, SR503, SR503c, SR504, and SR506).

Training/awareness programs would be implemented, and the MRSPP Annual Update and annual site inspections would be conducted. In addition, a five-year review would be performed in accordance with the requirements of the NCP.

The LUC alternative focuses on reducing human exposure to MEC and MC by managing the activities occurring at the site. The site would be formally incorporated into the Volk Field CRTC Base General Plan and review process, which includes a review of any construction plans and construction support. The LUC alternative includes access and land use restrictions, construction support requirements, signage and education, site inspections, and five-year reviews as described below. Alternative 2 is evaluated for all MRSs.

- Listing of applicable continuing obligations in the WDNR GIS Registry would be required for MRSs FR501, SR503, SR503c, SR504, and SR506.
- Access Restrictions will be implemented to restrict access to authorized personnel only. These restrictions will be implemented by Volk Field CRTC personnel or authorized contractors.
- Warning Signs would be installed and maintained around the property to warn people of the potential dangers of MEC at the MRSs. For those who must be in the area, signage should help clarify where the MRS boundaries are and help them avoid intruding.
- Use Restrictions would be incorporated into a Base General Plan, or similar style document, and installation GIS. In addition, the restrictions would need to be incorporated into any future real property transfer/sale and would require the acceptance of any new property owner.
- Training/Education regarding the history of the site and its previous use as a military training exercise area would be required for Volk Field CRTC personnel or the public who may use the area; locations of potential hazardous areas; the potential hazards associated with MEC; the types of activities that may be especially hazardous; how to recognize UXO and munitions and how to avoid them; what to do (and what not to do) if UXO or munitions are discovered; and whom to call to notify of potential UXO or munitions.
- MEC Recognition Safety Training would consist of a focused training program targeted at Volk Field CRTC site workers or other individuals authorized to access the MRSs. The training would instruct personnel not to touch anything that looks like UXO, munitions, shrapnel, or any other unidentified material. UXO and munitions recognition safety training would be conducted in local facilities by USAF personnel or contractors retained for this purpose.
- Informational Flyer would be provided to any public entering at the gate that may be using the area for recreational activities such as hunting.

Table 3-2 Remedial Alternative Screening

Identified Remedial Alternative	Effectiveness L/M/H	Implementability L/M/H	Cost L/M/H	Comments	Retained Yes/No
1. **No Action**	L	H	L	Baseline for comparison to other alternatives.	Yes
2. **LUCs** including land use restrictions, and incorporation into the Volk Field CRTC review process for construction support for any intrusive work.	M	H	L	This is a viable remedial alternative since risks are managed; access to the area is restricted and the area is included in the Volk Field CRTC review process under the Base General Plan.	Yes
3. **Soil excavation for protection of groundwater** to meet the WDNR RCL of 27 mg/kg. This alternative includes LUCs to prevent contact with MEC below the depth of instrument detection as well as in areas with slopes greater than 30 degrees that were inaccessible during IRA MEC clearance.	H	L	H	This is a very effective, permanent remedial alternative to remove lead to meet the WDNR RCL for protection of groundwater, which is the most conservative level for cleanup. This alternative could be difficult and costly to implement. Because MEC may remain below the depth of instrument detection or in areas that were inaccessible to remediation during the IRA (i.e., areas with slopes greater than 30 degrees), LUCs will be required.	Yes

Notes:
H denotes high.
M denotes medium.
L denotes low.

- Monitoring of the MRS would be performed to ensure ongoing public safety by overseeing activities at the site to ensure personnel are safe, and by periodically assessing that conditions at the site are as anticipated when the remedy was selected.
- Construction Support would be a requirement for personnel performing intrusive activity within the MRS. This is an ongoing cost that would need to be funded by the entity performing the activity. It would be required through the use of the Base General Plan and the established dig permit process, pursuant to DoD 6055.09-M-V7 (DoD, 2012).
- LUC inspections would be required annually to ensure LUCs remain effective and to assess to what degree MEC is exposed at the surface. Surface and subsurface clearance was performed over accessible areas of the MRSs as part of the RI/IRA. However, there is a possibility that the subsurface MEC could be exposed due to erosion or frost heave. Because the sites have not been actively used for significant military activities for decades, and removal actions have been completed in the accessible areas of the MRSs, future exposure of MEC is considered unlikely. The likelihood is low, but not zero, because MEC has been present since the early 1900s and minimum subsequent exposure of MEC has been observed at Volk Field CRTC. Periodic visual confirmation of the inaccessible areas, to verify that the areas remain inaccessible, would be part of CERCLA five-year reviews (required only in the portions of SR506 and MU507 that were inaccessible during the IRA).

Effectiveness: The LUC alternative would not reduce TMV of MEC or MC, and the hazards would remain at the site. However, LUCs would help to change behavior and reduce the potential for human exposure to MEC. Additionally, groundwater use would be prevented, thereby eliminating potential future exposure to MC.

Access management measures (e.g., warning signs and a dig permit system for subsurface activities) and training of Base personnel would not prevent trespassing but may be reasonably effective in the short- and long-term at limiting access to the MRSs. Documented use restrictions are effective at helping to ensure the current and future land use is compatible with the land use that was the basis for the remedy. UXO and munitions awareness training and informational flyers would be effective at educating people who may have access to the site.

This alternative is effective for MEC because surface and subsurface MEC were removed as part of the RI and IRA from all accessible areas, and a process for identification and clearance of any future subsurface targets is maintained via Volk Field CRTC's review process, where construction support will be required to mitigate potential hazards from subsurface MEC. Construction support would be effective at reducing the MEC hazard posed to construction personnel. This procedure is implementable as it uses proven techniques for LUCs.

This alternative is effective for MC because soil with lead concentrations exceeding risk-based levels for direct contact was removed during the IRA. Restrictions on groundwater use in the form of continuing obligations under Section 292.12 of the Wisconsin Statutes would prevent exposure to groundwater at the site, which is effective to mitigate potential hazards associated with lead remaining in site soil at concentrations above the WDNR RCL for protection of groundwater.

Implementability: LUCs are considered technically and administratively feasible for the Volk Field CRTC MRSs. An estimated timeframe of approximately one year is required for formalizing plans and procedures and approval by the regulators.

Cost: The cost of LUCs is considered low in comparison with other remedial options. However, because this option does not allow for unrestricted use and unlimited exposure, CERCLA five-year reviews would be required, and recurring costs for initiating and maintaining the LUCs would be incurred.

Overall Evaluation: The LUC alternative is retained for detailed analysis in **Section 4.0** because it is effective, implementable, and low cost.

3.3 Alternative 3: Soil Excavation and LUCs

This alternative consists of the removal of soil from MRSs with residual lead remaining in soil (FR501, SR503, SR503c, SR504, and SR506) at concentrations exceeding the WDNR RCL for protection of groundwater (27 mg/kg). This is the most conservative cleanup level for lead, and no further restrictions on use or access would be required for the MRSs related to MC.

However, due to limitations on technology that may have potentially left MEC below the depth of instrument detection (i.e., below 2-4 ft for analog or digital detection) and in areas with steep slopes (more than 30 degrees) that were inaccessible during the IRA, LUCs would still be required post-remedy implementation for FR501, SR503c, SR506, and MU507.

LUCs would be the same as those required for Alternative 2, except that groundwater use restrictions would not be required. The soil excavation components of this alternative are described in the following paragraphs. Excavation would apply only to MRSs with residual lead concentrations exceeding 27 mg/kg in soil (WDNR RCL for protection of groundwater); these MRSs include FR501, SR503, SR503c, SR504, and SR506.

Soil Excavation: Soil excavation would be accomplished with the use of mechanical equipment. Soil excavation would be completed to remove all soil with residual lead concentrations exceeding 27 mg/kg. The area of soil excavation at FR501 is the area of RI soil detections exceeding 27 mg/kg for lead (**Appendix A-1**). For SR503, SR503c, SR504, and SR506, it is assumed that the volume of excavation is approximately the IRA excavation volume, excavation to additional depth where confirmation samples from the bottom of the excavation exceeded 27 mg/kg, plus excavation of additional areas with sidewall confirmation samples or pre-excavation samples exceeding 27 mg/kg for lead (**Appendices A-2** through **A-5** and **Figures 1-3** through **1-7**). Areas excavated and backfilled during the IRA would be excavated again for Alternative 3 and replaced with clean fill. During the IRA, soil with lead concentrations < 400 mg/kg was acceptable for reuse as backfill, since the goal of the IRA was to meet the residential standard for lead of 400 mg/kg. Therefore, soil backfilled in the previous excavations may exceed the protection of groundwater standard for lead of 27 mg/kg.

Vegetation is very limited at FR501 as well as in the areas of previous excavation; however, some vegetation removal would be required in the additional areas (lead concentrations greater than 27 but less than 400 mg/kg) that were not previously excavated, including removal of trees.

Backfill soil from previous excavations at SR503, SR503c, SR504, and SR506 would be excavated and stockpiled for confirmation sampling. Any backfill with lead concentrations exceeding the WDNR RCL for protection of groundwater (27 mg/kg) would require offsite disposal. Any backfill with lead concentrations below 27 mg/kg would be retained on-site for reuse. For cost estimation purposes, it is conservatively assumed that the entire volume of backfill from the IRA excavations would require disposal.

Excavation would then continue horizontally and vertically beyond the original excavation footprint in order to remove soil containing residual lead concentrations greater than 27 mg/kg. Confirmation soil samples would be collected from the excavation bottom and sidewalls to confirm excavation to the target concentration of 27 mg/kg total lead. Soil from the excavation areas would be stockpiled for characterization and disposal. **Table 3-3** presents the estimated volume of soil to be removed during excavation. However, actual volumes for excavation would be determined based on the results of confirmation sampling.

Table 3-3 Estimated Soil Excavation and Disposal Volume

MRS	Excavation of IRA Backfill Material Potentially Containing Residual Lead > 27 mg/kg	Excavation of Additional Areas with Residual Lead > 27 mg/kg	Estimated Volume for Disposal*	
	(CY)	(CY)	(CY)	(tons)
Former Firing-in-Buttress #1 (FR501)	NA	30.6	30.6	45.8
Former Rifle Range #1/ Machine Gun Range (SR503)	943	1,988	2,931	4,396
Former Rifle Range #5/ Range #250 (SR503c)	1,909	3,324	5,233	7,850
Former Small Arms Range #251 (SR504)	71	1,599	1,670	2,505
Former Small Arms Debris Area (SR506)	4	68.1	72.1	108.1
Potential Civil War Era Impact Area (MU507)	NA	NA	NA	NA
Total Estimated Soil Disposal			**9,937**	**14,905**

** For estimation purposes, it was assumed that 1 CY of soil weighs approximately 1.5 tons.*

<u>Soil Disposal:</u> A soil amendment may be used for stabilization, if necessary to ensure TCLP results for soil below the maximum contaminant level (5 micrograms per liter) for lead. After characterization, soil would be properly disposed at a permitted off-site facility. It is anticipated that soil could be disposed as non-hazardous waste by using stabilization amendments if necessary. For conservative cost estimation purposes, it was assumed all of the backfill from the IRA excavation areas may require disposal (due to use of soil containing less than 400 mg/kg lead as backfill; the backfill may exceed the protection of groundwater standard). However, actual volumes for disposal would be determined based on the results of waste characterization sampling.

<u>MEC Disposal:</u> MEC disposal would be performed on all MEC identified. All material potentially presenting an explosive hazard (MPPEH) would go through the MPPEH inspection process and, if determined to potentially be MEC, would be detonated. This would typically consist of BIP detonation or consolidated detonations throughout the MRS rather than establishing a fixed demolition area.

MDAS would not be detonated. MDAS and other debris determined not to be culturally significant would be collected for disposal so that it does not remain in the environment and interfere with future monitoring sweeps.

<u>Effectiveness</u>: This alternative is effective at reducing potential migration of MC to groundwater, thereby reducing the potential TMV, a CERCLA preference. LUCs would be required to manage residual risk from MEC below the depth of instrument detection or in areas that were inaccessible during completion of the IRA.

Implementability: Large-scale excavation is technically difficult but feasible to implement, with an estimated time of approximately 2 years for planning and implementation. The impact to the environment would be minimal as these areas were previously disturbed.

Cost: The cost of excavations is considered high in comparison with other remedial options.

Overall Evaluation: This alternative is retained for detailed analysis in **Section 4.0** because it is the most effective for removal of MC, although it would be more difficult to implement and would have a high cost.

4.0 DETAILED ANALYSIS OF ALTERNATIVES

The NCP (40 CFR 300.430) states that the primary objective of the FS is to "ensure that appropriate remedial alternatives are developed and evaluated," and that "the number and type of alternatives to be analyzed shall be determined at each site, taking into account the scope, characteristics, and complexity of the site problem that is being addressed."

This section presents the detailed analysis of remedial alternatives developed in **Section 3.0** compared to the following nine NCP criteria:

1. Overall Protection of Human Health and the Environment
2. Compliance with ARARs
3. Long-Term Effectiveness and Permanence
4. Reduction in TMV through Short-Term Treatment
5. Short-term Effectiveness
6. Implementability
7. Cost
8. State Acceptance
9. Community Acceptance

The overall protectiveness criteria are associated with particular land use scenarios so that the protectiveness discussion is focused on the reasonable anticipated future land use. The future land use for at Volk Field CRTC is military non-residential use.

4.1 Individual Alternative Analysis – Criteria

This section presents the detailed analysis of alternatives based on criteria 1 through 7 from the NCP (40 CFR 300.430(e)(9)), as listed above. Criteria 8 and 9 will be addressed in the ROD after receipt of comments on the Proposed Plan.

CERCLA requires alternatives be developed for treating principal threats at a site through reductions in TMV. In addition, remedies are required to be permanent and cost-effective. The five balancing factors are weighed against each other to determine which remedies are cost-effective and "permanent" to the maximum extent practicable.

The NCP explains that in general, preferential weight is given to alternatives that offer advantages in terms of the reduction of TMV through treatment and achieve long-term effectiveness and permanence. However, the NCP also recognizes that some contamination problems will not be suitable for treatment and permanent remedies.

The balancing process weighs the proportionality of costs to effectiveness to select one or more remedies that are cost-effective. The final management decision is one that determines which cost-effective remedy offers the best balance of all factors. The modifying criteria for governmental and community acceptance will be addressed in the ROD once comments on the RI Report, FS Report, and Proposed Plan have been received.

4.1.1 Threshold Criteria

Overall Protection of Human Health and the Environment – An alternative must eliminate, reduce, or control potential threats to public health and the environment through treatment or LUCs.

Compliance with ARARs – The alternative must meet federal and state environmental statutes, regulations, and other requirements that pertain to the site or area unless a waiver is justified.

4.1.2 Balancing Criteria

Short-term Effectiveness – Considers the length of time needed to implement an alternative and the risks and hazards the alternative poses to workers, residents, and the environment during implementation.

Long-term Effectiveness and Permanence – Considers the ability of an alternative to maintain protection of human health and the environment over time.

Reduction of TMV through Treatment – Evaluates the use of treatment (for which there is a statutory preference) in the alternative to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

Implementability – Considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services. Technical feasibility considerations include the availability of services, necessary equipment, and skilled workers to implement a particular alternative. Administrative feasibility includes obtaining necessary permits and regulatory approvals for implementation of the alternative.

Cost – The total estimated cost includes both capital cost and the annual operating cost for each alternative. General indirect management and administrative costs are not included for the purpose of alternative comparison. Total estimated present worth is calculated using a discount rate of 1.5% (Office of Management and Budget [OMB], 2016) allowing for comparison on an equal time basis. Further discussions of this and other evaluation criteria for each alternative are provided in the following sections.

4.1.3 Modifying Criteria

State Acceptance – Evaluates technical and administrative issues and concerns that the state may have regarding each alternative. State Acceptance will be addressed in the ROD once comments on the RI Report, FS Report, and Proposed Plan have been received (USEPA, 1989).

Community Acceptance – Evaluates issues and concerns that the public may have regarding each alternative. Community Acceptance will be addressed in the ROD once comments on the RI Report, FS Report, and Proposed Plan have been received (USEPA, 1989).

The following section summarizes the results for each alternative and presents a comparative analysis.

4.2 Individual Alternative Analysis

This section presents the detailed analysis of each remedial alternative for the six MRSs compared with the nine NCP criteria. In addition to the NCP criteria, each alternative was evaluated with respect to the core green and sustainable remediation (GSR) elements identified in the WDNR GSR Manual (WDNR, 2012). The core elements of the GSR evaluation are energy, air, water, land use, and materials and waste.

4.2.1 Alternative 1: No Action

4.2.1.1 Description

Alternative 1 is the No Action remedial alternative. No additional remedial action would take place, and the MRSs would remain at the current status resulting from the IRA completed in 2015. The No Action alternative discussion is limited because it is probable some level of a cleanup action will be selected. However, this alternative is fully evaluated in the event that the No Action alternative is selected. No uncertainties are associated with this alternative, as there are no assumptions that could affect the results of the analysis.

4.2.1.2 Assessment

Threshold Criteria

The threshold criteria are overall protection of human health and the environment and compliance with ARARs. Although surface MEC was removed during the IRA, the No Action alternative is not protective of human health and the environment because it does not mitigate the potential hazard associated with potential MEC in areas of SR506 and MU507 that were inaccessible during the IRA, or subsurface MEC that may potentially remain below the depth of instrument detection (i.e., 2-4 ft) at FR501, SR503c, SR506, and MU507. This alternative does not provide any mechanism for managing the current or future hazard from potential MEC. Additionally, this alternative does not mitigate the potential hazard associated with lead concentrations exceeding the WDNR RCL for protection of groundwater at FR501, SR503, SR503c, SR504, and SR506, and does provide any mechanism for managing the potential risk. Alternative 1 does not comply with chemical-specific TBC which is the WDNR RCL of 27 mg/kg for lead based on protection of groundwater. Furthermore, Alternative 1 does not comply with the action-specific ARAR requiring response action for sites with residual contamination. There are no location-specific ARARs associated with Alternative 1.

Balancing Criteria

The five balancing criteria are: 1) short-term effectiveness, 2) long-term effectiveness, 3) reduction of TMV through treatment, 4) implementability, and 5) cost. There are no changes to short-term risks or hazards because there are no activities associated with this alternative. This alternative does not provide any mechanism to reduce or mitigate the potential hazards associated with MEC or residual lead remaining in soil; therefore, this alternative does not meet the criteria of long-term effectiveness.

This alternative does not provide a permanent solution because MEC potentially remaining below the depth of instrument detection or in the inaccessible areas is not removed and hazards for exposure are not mitigated at FR501, SR503c, SR506, and MU507. Furthermore, there is no action to remove or mitigate potential hazards associated with residual lead in soil above the WDNR RCL for protection of groundwater (27 mg/kg) at FR501, SR503, SR503c, SR504, and SR506. There is no change in TMV since no actions are implemented. The volume of MEC is not reduced and poses a potential health hazard because it remains available for possible encounter in the inaccessible areas, during intrusive activities, or if exposed in the future during natural processes. Similarly, the volume of lead-impacted soil is not reduced and poses a potential health hazard based on default assumptions of migration to groundwater.

Implementability of this alternative is feasible because there are no actions needed to implement. The cost of the No Action alternative is the lowest of any of the alternatives, as the cost for this alternative is zero dollars for remediation because no remediation will occur.

Modifying Criteria

The modifying criteria of state acceptance and community acceptance will be addressed in the ROD once comments on the RI Report, FS Report, and Proposed Plan have been received.

Green and Sustainable Remediation

The GSR evaluation is not applicable to Alternative 1, since there is no remedial action associated with this alternative.

4.2.2 Alternative 2: LUCs

4.2.2.1 Description

Under this alternative, no additional active remediation would be performed at the six MRSs. The MRSs would remain at the current status, consisting of completed removal actions for MEC in accessible areas and excavation of lead to the residential standard of 400 mg/kg during the 2015 IRA. The remaining MEC hazards and potential hazards associated with residual lead in soil would be managed through LUCs including a review process to provide construction support for any construction or other intrusive activities, as well as restrictions on land use and groundwater use in the form of continuing obligations under Section 292.12 of the Wisconsin Statutes.

Alternative 2 would allow for case closure for the MRSs under WDNR guidance for sites with residual contamination (WDNR, 2014). However, the MRSs would be required to remain in the GIS Registry in accordance with the Wisconsin Code of Administrative Rules, chapter NR 726, due to the presence of residual lead contamination exceeding the WDNR RCL for protection of groundwater (MRSs FR501, SR503, SR503c, SR504, and SR506).

The MRSPP Annual Update and site inspections will be completed on an annual basis. In addition, a five-year review will be performed in accordance with the requirements of CERCLA. For the purpose of cost estimation for this FS, a 30-year LUC program continuation period is assumed.

No uncertainties are associated with this alternative because the technologies for the LUCs are proven methods currently in place at Volk Field CRTC and other DoD facilities.

4.2.2.2 Assessment

Threshold Criteria

The threshold criteria are overall protection of human health and the environment and compliance with ARARs. Alternative 2 is protective of human health and the environment because this alternative provides administrative measures and construction support to identify and remove MEC encountered during future intrusive activities or that are exposed at the surface due to erosion, frost heave, or other natural processes at FR501, SR503c, SR506, and MU507; as well as to restrict access to the steeply sloped areas of SR506 and MU507 that were inaccessible for the IRA removal actions. These measures would reduce the hazard associated with the remaining MEC.

Future site usage at the MRSs could possibly include intrusive subsurface projects for the construction of new facilities or utility lines in low slope areas of the MRSs; therefore, the potential for exposure to any remaining subsurface MEC exists. Future use of groundwater at the MRSs is not anticipated, and use would be restricted under Alternative 2.

Alternative 2 is compliant with ARARs as defined in **Section 2.1** and shown in **Table 2-1**.

Balancing Criteria

The five balancing criteria are: 1) short-term effectiveness, 2) long-term effectiveness, 3) reduction of TMV through treatment, 4) implementability, and 5) cost.

Short-term risks are limited since MEC removal has been completed in the accessible areas of the MRSs. LUCs, such as restrictions for recreational land use and construction support for future construction, would be effective at reducing the long-term hazard to MEC for the life of the program. However, because the potential for MEC remains, the long-term hazard is not completely mitigated. Similarly, restrictions on groundwater use in the form of continuing obligations under Section 292.12 of the Wisconsin Statutes would mitigate the potential hazard associated with residual lead concentrations in soil exceeding the WDNR RCL for protection of groundwater. Due to the previous soil remediation completed during the IRA, there are no unacceptable risks remaining due to lead in soil for direct contact with existing or potential future receptors. However, the potential for migration of lead to groundwater in the long term would remain.

This alternative does not provide a permanent solution because MEC and residual lead-impacted soil are not removed. The volume of MEC that may potentially remain in the inaccessible areas or below the depth of instrument detection (i.e., 2-4 ft) is not reduced, remains for possible encounter during intrusive activities, and may be exposed in the future due to natural processes. Thus, MEC continues to pose a potential future health hazard. Furthermore, migration of lead to groundwater remains possible, due to concentrations in soil exceeding the protection of groundwater standard.

This alternative is straightforward to implement. These LUCs are readily available and are proven technologies at other DoD sites. This alternative is less disruptive to the natural setting, including potential exposure by an endangered species, because no excavation activities are included.

The estimated present worth capital cost to implement Alternative 2 is $18,648 with O&M present worth value over 30 years estimated to be $811,511. Total estimated present worth is calculated using a discount rate of 1.5% (OMB, 2016) to allow for comparison on an equal time basis. The total present worth value cost for this alternative is $830,159. Data supporting this cost estimate are presented in **Appendix B**.

The cost of this alternative is relatively low because the only field activities included are the construction support with removal of any MEC and annual LUC inspection. Administrative costs for Alternative 2 include the preparation of a LUC plan, implementation of these activities (e.g., installing signs, education programs, etc.), the MRSPP Annual Update, and five-year CERCLA reviews.

<u>Modifying Criteria</u>

The modifying criteria of state acceptance and community acceptance will be addressed in the ROD once comments on the RI Report, FS Report, and Proposed Plan have been received.

<u>Green and Sustainable Remediation</u>

The GSR evaluation for Alternative 2 is presented in **Table 4-1**. Since Alternative 2 primarily consists of administrative actions, the overall impact of the alternative is low.

Table 4-1 GSR Evaluation for Alternative 2: LUCs

Element	Evaluate Negatives	Evaluate Positives
Energy	Energy (i.e., fuel) will be used for transportation to facilitate the limited field activities associated with this alternative (construction support and LUC inspections).	Overall energy use is low for this alternative. Transportation needs are minimal.
Air	Some air emissions will be generated as fuel is consumed for transportation.	Overall energy use is low for this alternative. Transportation needs are minimal.

Element	Evaluate Negatives	Evaluate Positives
Water	This alternative does not address the potential for future impacts to groundwater from soil concentrations remaining above the WDNR RCL for protection of groundwater.	This alternative does not require water use.
Land Use	Sites with remaining residual lead contamination exceeding the WDNR RCL for protection of groundwater will require listing and tracking in the WDNR GIS Registry. LUCs would be required to mitigate potential MEC hazards due to MEC potentially remaining below the depth of instrument detection (i.e., 2-4 ft) and/or within the inaccessible areas at FR501, SR503c, SR506, and MU507.	Sites have already been remediated for lead to eliminate unacceptable risks for direct contact. MEC has been cleared to the extent practicable. This alternative will not negatively impact site usage under current or reasonably anticipated future land use for military training and support activities.
Materials and Waste	None.	No significant wastes will be generated as a result of this alternative.

4.2.3 Alternative 3: Soil Excavation and LUCs

4.2.3.1 Description

This alternative consists of the removal of soil from MRSs with residual lead remaining in soil (FR501, SR503, SR503c, SR504, and SR506) at concentrations exceeding the WDNR RCL for protection of groundwater (27 mg/kg). This is the most conservative cleanup level for lead, and no further restrictions on use or access would be required for the MRSs related to MC. However, due to limitations on technology that may have potentially left MEC below the depth of instrument detection (i.e., below 2-4 ft) and in areas with steep slopes (more than 30 degrees) that were inaccessible during the IRA, LUCs would still be required post-remedy implementation at FR501, SR503c, SR506, and MU507. LUCs would be the same as those required for Alternative 2, except that groundwater use restrictions would not be required. LUCs would apply to all MRSs.

4.2.3.2 Assessment

Threshold Criteria

The threshold criteria are overall protection of human health and the environment and compliance with ARARs. Alternative 3 meets the threshold criteria of overall protection of human health by removing residual lead exceeding protection of groundwater standards from soil. This alternative offers the highest degree of protection because it would eliminate the potential for groundwater impacts due to lead remaining in soil.

LUCs included in Alternative 3 would be protective of human health and the environment because this alternative provides administrative measures and construction support to identify and remove MEC encountered during future intrusive activities or that are exposed at the surface due to erosion, frost heave, or other natural processes at FR501, SR503c, SR506, and MU507; as well as to restrict access to the steeply sloped areas of SR506 and MU507 that were inaccessible during the IRA. These measures would reduce the hazard associated with the remaining MEC.

Alternative 3 is compliant with ARARs as defined in **Section 2.1** and shown in **Table 2-1**.

Balancing Criteria

The five balancing criteria are: 1) short-term effectiveness, 2) long-term effectiveness, 3) reduction of TMV through treatment, 4) implementability, and 5) cost.

Short-term risks are limited since MEC removal has been completed in the accessible areas of the MRSs, and excavation has previously been implemented successfully at Volk Field CRTC. There is some risk associated with operation of heavy equipment for excavation; however, proper training and equipment will be required to mitigate these risks.

This alternative would be effective over the long-term because all lead impacted soil exceeding the WDNR RCL for protection of groundwater would be removed. Therefore, there would be no long-term risks associated with lead concentrations in soil. TMV would be reduced by eliminating the potential for lead migration to groundwater.

MEC hazards have largely been mitigated by removal action during the IRA. However, the volume of MEC potentially remaining in the inaccessible areas or below the depth of instrument detection (i.e., below 2-4 ft) is not reduced, remains for possible encounter during intrusive activities, and may be exposed in the future due to natural processes. Thus, MEC continues to pose a potential future health hazard.

This alternative is straightforward to implement. These LUCs are readily available and are proven technologies at other DoD sites. Excavation of lead-impacted soil has been successfully implemented previously at four MRSs (SR503, SR503b, SR504, and SR506). It is estimated that it would take approximately two years to complete the planning and excavation phase of Alternative 3. For the purposes of developing a cost estimate for the FS, it is assumed that LUCs would be maintained for 30 years.

The estimated present worth capital cost to implement Alternative 3 is $2,769,198 with O&M present worth value over 30 years estimated to be $811,511. Total estimated present worth is calculated using a discount rate of 1.5% (OMB, 2016) to allow for comparison on an equal time basis. The total present worth value cost for this alternative is $3,580,709. Data supporting this cost estimate are presented in **Appendix B**.

Modifying Criteria

The modifying criteria of state acceptance and community acceptance will be addressed in the ROD once comments on the RI Report, FS Report, and Proposed Plan have been received.

Green and Sustainable Remediation

The GSR evaluation for Alternative 3 is presented in **Table 4-2**. Since Alternative 3 includes operation of heavy equipment for soil excavation, the overall impact of the alternative is moderate.

Table 4-2 GSR Evaluation for Alternative 3: Soil Excavation and LUCs

Element	Evaluate Negatives	Evaluate Positives
Energy	Vehicles and heavy equipment will consume fuel during excavation activities. Additional energy use will include transportation for field personnel and electricity usage in an office trailer during site work.	Excavation work will be organized and sequenced to efficiently complete the excavation activities and minimize travel.

Element	Evaluate Negatives	Evaluate Positives
Air	Some air emissions will be generated as fuel is consumed from vehicle and equipment operation during field activities.	Excavation work will be organized and sequenced to efficiently complete the excavation activities and minimize travel.
Water	Some water may need to be applied during heavy equipment operation to control dust.	The use of water will minimize dust generation during field activities. The required volume of water is expected to be low. This alternative would address the potential for future impacts to groundwater by removing all soil with residual concentrations exceeding the WDNR RCL for protection of groundwater.
Land Use	Land will be disturbed as part of the field activities. LUCs would be required to mitigate potential MEC hazards due to MEC potentially remaining below the depth of instrument detection (i.e., 2-4 ft) and/or within the inaccessible areas at FR501, SR503c, SR506, and MU507.	Site disturbance will be temporary. Soil with residual lead contamination exceeding the WDNR RCL for protection of groundwater will be removed, allowing for removal of restrictions and GIS Registry requirements triggered by residual contamination. MEC has been cleared to the extent practicable. This alternative will not negatively impact site usage under current or reasonably anticipated future land use for military training and support activities.
Materials and Waste	Soil containing lead concentrations greater than 27 mg/kg will require off-site disposal. Some solid waste, or trash, will be disposed of.	All soil will be transported to an appropriate facility in accordance with ARARs. Soil not requiring disposal will be replaced within the excavation.

5.0 COMPARATIVE ANALYSIS

In this section, alternatives are compared to each other with respect to the nine NCP criteria listed in **Section 4.0** and to the overall cost-effectiveness of the risk/hazard reduction offered by the alternatives. In addition to the NCP criteria, each alternative was evaluated with respect to the core GSR elements (WDNR, 2012). A summary of the comparative analysis of the alternatives is provided in **Table 5-1**.

5.1 Overall Protection of Human Health and the Environment

Alternative 3 offers the highest level of protection of human health and the environment. Alternative 2 uses LUCs to reduce exposure to hazards but does not remove residual lead in soil at concentrations exceeding the WDNR RCL of 27 mg/kg for protection of groundwater. The No Action alternative, Alternative 1, consists of leaving the site in its current state. However, soil exceeding the residential standard for lead of 400 mg/kg has already been removed, and the potential for risk associated with residual lead concentrations remaining in soil is low. Therefore, Alternative 3 is only slightly more protective than Alternative 2.

Under all three alternatives, potential MEC would remain below the depth of instrument detection (i.e., 2-4 ft) and/or within the inaccessible areas at FR501, SR503c, SR506, and MU507. However, LUCs would be implemented under Alternatives 2 and 3 to restrict entry into these areas. Alternative 1 does not include any measures to prevent access to areas where MEC may be present or to prevent groundwater use. Therefore, Alternative 1 is the least protective of human health.

Accordingly, the ranking of alternatives for protection of human health and the environment, in order from most favorable to least favorable, is Alternatives 3, 2, and 1.

5.2 Compliance with ARARs

Alternative 1 does not comply with chemical-specific TBC which is the WDNR RCL of 27 mg/kg for lead based on protection of groundwater. Furthermore, Alternative 1 does not comply with the action-specific ARAR requiring response action for sites with residual contamination. There are no location-specific ARARs associated with Alternative 1. Alternatives 2 and 3 are compliant with the ARARs as defined in **Section 2.1** and shown in **Table 2-1**. Alternatives 2 and 3 are therefore equally ranked for compliance with ARARs, while Alternative 1 receives the lowest rank.

5.3 Long-Term Effectiveness and Permanence

With respect to long-term effectiveness, Alternative 3 is slightly more effective than Alternative 2. Both alternatives would include LUCs to limit potential contact with MEC potentially remaining below the depth of instrument detection (i.e., 2-4 ft) and/or within the inaccessible areas (FR501, SR503c, SR506, and MU507). As a result of previous removal actions, lead concentrations in soil are below the residential cleanup level of 400 mg/kg and do not pose an unacceptable risk for direct contact. Alternative 2 would include LUCs to prevent groundwater use due to the residual risk resulting from soil concentrations greater than the protection of groundwater standard. However, Alternative 3 would be more effective because soil with lead concentrations greater than the protection of groundwater standard would be excavated and disposed off-site. Alternative 1 would not be effective in the long-term because the hazard for exposure to MEC potentially remaining below the depth of instrument detection (i.e., 2-4 ft) and/or in the inaccessible areas (FR501, SR503c, SR506, and MU507) is not mitigated. Furthermore, there is no action to remove or mitigate potential hazards associated with residual lead in soil above the WDNR RCL for protection of groundwater (27 mg/kg) at FR501, SR503, SR503c, SR504, and SR506.

Accordingly, the ranking of alternatives for long-term effectiveness and permanence, in order from most favorable to least favorable, is Alternatives 3, 2, and 1.

5.4 Reduction in TMV

Reduction of TMV through treatment refers to the anticipated performance of the remedy or treatment technology. Alternative 3 would be the most favorable since excavation of residual lead-impacted soil would eliminate the potential for migration of lead to groundwater. For Alternatives 2 and 3, construction support will be performed as part of the O&M program, and any MEC identified would be treated on-site using conventional MEC destruction techniques (e.g., BIP, consolidated shot). Minimal MEC is anticipated during these activities. Therefore, only a minor reduction in TMV would be achieved. No reduction in the volume of MEC would be provided by Alternative 1.

Accordingly, the ranking of alternatives for reduction in TMV, in order from most favorable to least favorable, is Alternatives 3, 2, and 1.

5.5 Short-Term Effectiveness

With regard to short-term effectiveness, Alternative 1 involves the lowest short-term hazards to site workers and the local public as no activities are performed at the MRS in order to implement this alternative. Alternative 2 only entails short-term hazards during the LUC inspections and during construction support activities in the event subsurface construction or other intrusive activities are planned. For Alternative 3, which would include soil excavation, health and safety requirements would be detailed in work planning documents. Implementing the requirements of the planning documents will ensure the local public and site workers are protected during remedy completion.

Accordingly, the ranking of alternatives for short-term effectiveness from most favorable to least favorable is Alternatives 1, 2, and 3.

5.6 Implementability

Implementability addresses the feasibility of performing a remedial action given field conditions and other factors (e.g., administrative and technical). The three alternatives are all feasible with respect to their technology; LUCs and soil excavation are standard technologies that have been applied with success at Volk Field CRTC and various other DoD installations. However, the excavation proposed for Alternative 3 is labor intensive and translates to the highest difficulty of implementation. Alternative 2 is comparatively easy to implement. By definition, the no action alternative, Alternative 1, is easiest to implement.

Accordingly, the ranking of alternatives for implementability from most favorable to least favorable is Alternatives 1, 2, and 3.

5.7 Cost

With regard to cost, Alternative 1 has no cost as no activities would be performed. Alternative 2 has the lowest capital cost, with ongoing O&M costs assumed over 30 years. Alternative 3 has the highest capital cost, and the same O&M costs as Alternative 2. Alternative 3 therefore has the highest overall cost. The estimated costs are listed in **Table 5-1**.

Accordingly, the ranking of alternatives for cost, in order from most favorable to least favorable, is Alternatives 1, 2, and 3.

5.8 Green and Sustainable Practices

The core elements of the GSR evaluation are energy, air, water, land use, and materials and waste (WDNR, 2012). The GSR evaluation is not applicable to Alternative 1, since there is no remedial action associated with this alternative. Overall, Alternative 2 would have the lowest impact, since this alternative primarily consists of administrative actions. While Alternative 2 would require listing and tracking in the WDNR GIS Registry due to residual lead concentrations in soil remaining above the WDNR RCL for protection of groundwater, the alternative will not negatively impact site usage under current or reasonably anticipated future land use for military training and support activities. Alternative 3 would have greater impacts than Alternative 2 for energy and air, due to the use of heavy equipment for excavation. Alternative 3 would also require off-site disposal, and therefore would have a greater impact for materials and waste than Alternative 2.

Thus, the GSR ranking of alternatives from most favorable to least favorable is Alternative 2, then Alternative 3. Alternative 1 is not ranked.

Table 5-1 Comparative Analysis of Alternatives

NCP Criteria	Alternative 1 No Action	Alternative 2 LUCs	Alternative 3 Soil Excavation and LUCs
1. Overall Protectiveness			
Direct Contact	No significant reduction in hazards.	Would reduce human contact with MEC potentially remaining below the depth of instrument detection (i.e., 2-4 ft) and/or in the inaccessible areas (FR501, SR503c, SR506, and MU507).	LUCs would reduce human contact with MEC potentially remaining below the depth of instrument detection (i.e., 2-4 ft) and/or in the inaccessible areas (FR501, SR503c, SR506, and MU507).
Protection of Groundwater	No significant reduction in hazards.	LUCs would restrict groundwater use.	Soil containing residual lead concentrations above the WDNR RCL of 27 mg/kg would be removed.
2. Compliance With ARARS/TBC Guidance			
Chemical-Specific ARARs	Does not meet chemical-specific TBC.	Would meet all chemical-specific ARARs.	See Alternative 2.
Location-Specific ARARs	There are no location-specific ARARs.	Would meet all location-specific ARARs.	See Alternative 2.
Action-Specific ARARs	Does not meet action-specific ARAR.	Would meet all action-specific ARARs.	See Alternative 2.
3. Long-Term Effectiveness And Permanence			
Magnitude of Residual Risk (Direct Contact)	Any MEC potentially remaining below the depth of instrument detection (i.e., 2-4 ft) and/or in the inaccessible areas (FR501, SR503c, SR506, and MU507) would not be removed. Lead would remain in soil above the protection of groundwater standard. Existing hazards will remain.	Any MEC potentially remaining below the depth of instrument detection (i.e., 2-4 ft) and/or in the inaccessible areas (FR501, SR503c, SR506, and MU507) would not be removed. Lead would remain in soil above the protection of groundwater standard. However, LUCs would minimize contact with MEC and groundwater. There are no unacceptable risks for direct contact due to lead in soil.	Any MEC potentially remaining below the depth of instrument detection (i.e., 2-4 ft) and/or in the inaccessible areas (FR501, SR503c, SR506, and MU507) would not be removed. However, LUCs would minimize contact with MEC. Soil with lead concentrations exceeding the protection of groundwater standard would be removed.

NCP Criteria	Alternative 1 No Action	Alternative 2 LUCs	Alternative 3 Soil Excavation and LUCs
Adequacy and Reliability of Controls	No controls over contact with MEC remaining at the MRS. No reliability.	LUCs would prevent contact with residual MEC and restrict groundwater use.	LUCs would prevent contact with residual MEC. Reliability of soil removal is high, since all lead-impacted soil would be removed from the site.
Need for 5-Year Review	Review would be required.	See Alternative 1.	See Alternative 1.
4. Reduction In Toxicity, Mobility, Or Volume Through Treatment			
Treatment Process Used	None.	MEC is destroyed through detonation.	See Alternative 2.
Amount Destroyed or Treated	None.	Any MEC identified during construction support would be destroyed. Minimal MEC is anticipated during these activities.	See Alternative 2.
Reduction of Toxicity, Mobility, or Volume	None.	Any residual MEC identified would be destroyed and MDAS disposed off-site. Minimal MEC is anticipated during these activities; therefore, only a minor reduction would be achieved.	See Alternative 2. Furthermore, the excavation of lead-impacted soil would eliminate the potential for migration of lead to groundwater.
Irreversible Treatment	None.	Destruction of MEC is irreversible.	See Alternative 2.
Type and Quantity of Residuals Remaining after Treatment	Residual MEC may remain in previously cleared MRSs below the depth of instrument detection (i.e., 2-4 ft) and/or in the inaccessible areas (FR501, SR503c, SR506, and MU507). Residual lead in soil exceeding the protection of groundwater standard would remain.	See Alternative 1.	Residual MEC may remain in previously cleared MRSs below the depth of instrument detection (i.e., 2-4 ft) and/or in the inaccessible areas (FR501, SR503c, SR506, and MU507). Soil with residual lead contamination would be removed.
Statutory Preference for Treatment	Does not satisfy.	Satisfies.	Satisfies.
5. Short-Term Effectiveness			
Community Protection	Risk to community not increased by remedy implementation.	Temporary increase if MEC is identified/ destroyed. Would be controlled by maintaining exclusion zones and implementing engineering controls during detonations.	See Alternative 2. Also, temporary increase in risk due to heavy equipment excavation would be mitigated by following health and safety procedures.

NCP Criteria	Alternative 1 No Action	Alternative 2 LUCs	Alternative 3 Soil Excavation and LUCs
Worker Protection	No significant risk to workers.	Measures to protect workers from MEC must be taken during intrusive activities. UXO technicians or EOD would be required to perform these activities.	See Alternative 2. Also, temporary increase in risk due to heavy equipment excavation would be mitigated by following health and safety procedures.
Environmental Impacts	Existing conditions unchanged.	No environmental impacts from remedial action.	Destruction of vegetation and wildlife may result. Not anticipated to impact community, habitats or rare, threatened or endangered species significantly.
Time until Action is Complete	Not applicable.	30 years.	1.5 years for excavation; 30 years for LUCs.
6. Implementability			
Ability to Obtain Approvals and Coordinate with other Agencies	No approval necessary.	Approvals and coordination can be obtained.	See Alternative 2.
Availability of Services and Capacities	No services or capacities necessary.	Services or capacities are readily available.	See Alternative 2.
Availability of Equipment, Specialists, and Materials	None required.	Equipment, specialists, and materials are readily available.	See Alternative 2.
Availability of Technologies	None required.	Technologies are readily available.	See Alternative 2.
7. Cost			
Capital Cost	$0	$18,648	$2,769,198
O&M Cost	$0	$811,511	$811,511
30-Year Present Worth Cost at 1.5% Discount Rate	$0	$830,159	$3,580,709
8. Green and Sustainable Practices			
Energy	Not applicable.	Overall energy use is low.	Energy use for heavy equipment operation.
Air	Not applicable.	Overall air emissions are low.	Air emissions due to heavy equipment operation.
Water	Not applicable.	Residual lead in soil exceeds the WDNR RCL for protection of groundwater.	Removes residual lead in soil exceeding the WDNR RCL for protection of groundwater.
Land Use	Not applicable.	No significant impacts to current or reasonably anticipated future land use.	After temporary impacts during excavation, no significant impacts to current or reasonably anticipated future land use.
Materials and Waste	Not applicable.	No significant wastes will be generated as a result of this alternative.	Soil containing lead concentrations greater than 27 mg/kg will require off-site disposal.

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Appendix A

Supporting Site Information for the Feasibility Study

A-1 Supporting Information for Former Firing-in-Buttress #1 (FR501)

A-2 Former Rifle Range #1/Machine Gun Range (SR503)

A-3 Former Rifle Range #5/Range #250 (SR503c)

A-4 Former Small Arms Range #251 (SR504)

A-5 Former Small Arms Debris Area (SR506)

A-6 Potential Civil War Impact Area (MU507)

Appendix A-1

Supporting Information for Former Firing-in-Buttress #1 (FR501)

Source: Bay West, 2015a

Figure 5-3 Firing-In-Buttress #1 (FR501) MC Sampling Locations

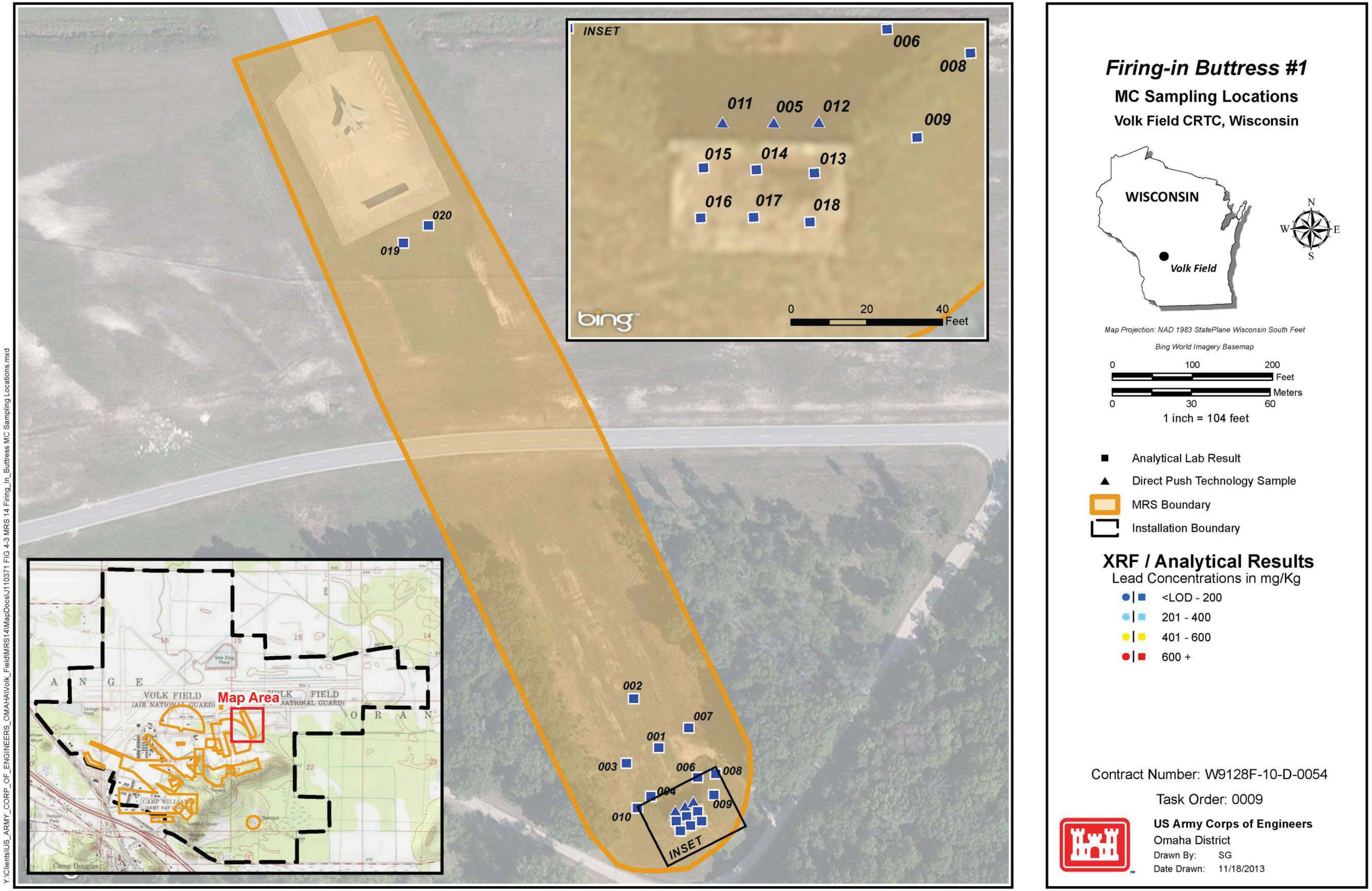


Table 5-2 Sample Results - Firing-In-Buttress #1 (FR501)

Analyte	Sample ID		FR501-LS001-SB02-001-PS					FR501-LS002-SB02-002-PS					FR501-LS003-SB02-003-PS					FR501-LS004-SB02-004-PS				
	Sample Date		11/7/12					11/7/12					11/7/12					11/7/12				
	Sample Depth (ft)		0.5-1					0.5-1					0.5-1					0.5-1				
	i-SL	r-SL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Metals (mg/kg)																						
Antimony	41	3.1	0.6	U		0.38	2	0.62	U		0.4	2.1	0.61	U		0.39	2	0.59	U		0.38	2
Copper	4100	310	3	J Q	J	0.22	5	5.1	J Q	J	0.23	5.2	1.6	J Q	J	0.22	5.1	2.6	J Q	J	0.21	4.9
Lead	800	400	2.9			0.27	0.9	3.4			0.28	0.94	2.8			0.28	0.92	5.5			0.27	0.89
Zinc	31000	2300	7.1	J	J	0.4	8	11			0.41	8.3	64			0.41	8.2	4.3	J	J	0.39	7.9

Analyte	Sample ID		FR501-LS005-SB01-005-PS					FR501-LS005-SB02-005-PS					FR501-LS005-SB02-005-FD					FR501-LS005-SB04-005-PS				
	Sample Date		12/4/12					11/7/12					11/7/12					12/4/12				
	Sample Depth (ft)		0-0.5					0.5-1					0.5-1					0.5-2				
	i-SL	r-SL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Metals (mg/kg)																						
Antimony	41	3.1	0.74	U		0.47	2.5	0.86	J	J	0.42	2.2	0.8	J	J	0.38	2	0.6	U		0.38	2
Copper	4100	310	32	Q		0.27	6.2	12	Q		0.24	5.6	11	Q		0.22	5	51	Q		0.22	5
Lead	800	400	49	J	J	0.33	1.1	16			0.3	1	16			0.27	0.9	75			0.27	0.9
Zinc	31000	2300	11			0.49	9.9	18			0.44	8.9	17			0.4	8	8.7			0.4	8

Analyte	Sample ID		FR501-LS005-SB08-005-PS					FR501-LS006-SB02-006-PS					FR501-LS007-SB02-007-PS					FR501-LS008-SB02-008-PS				
	Sample Date		12/4/12					11/7/12					11/7/12					11/7/12				
	Sample Depth (ft)		2-4					0.5-1					0.5-1					0.5-1				
	i-SL	r-SL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Metals (mg/kg)																						
Antimony	41	3.1	0.59	U		0.37	2	0.45	J		0.37	1.9	0.68	J	J	0.39	2	0.63	U		0.4	2.1
Copper	4100	310	1.6	J Q	J	0.21	4.9	3.9	J Q	J	0.21	4.8	5.1	Q		0.22	5.1	3.2	J Q	J	0.23	5.3
Lead	800	400	0.91			0.27	0.88	4.2			0.26	0.87	6.3			0.27	0.92	3.8			0.29	0.95
Zinc	31000	2300	1.7	J	J	0.39	7.9	13			0.39	7.7	19			0.4	8.1	7.6	J	J	0.42	8.5

Analyte	Sample ID		FR501-LS008-SB02-008-FD					FR501-LS009-SB02-009-PS					FR501-LS010-SB02-010-PS					FR501-LS011-SB01-011-PS				
	Sample Date		11/7/12					11/7/12					11/7/12					12/4/12				
	Sample Depth (ft)		0.5-1					0.5-1					0.5-1					0-0.5				
	i-SL	r-SL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Metals (mg/kg)																						
Antimony	41	3.1	0.68	U		0.43	2.3	0.59	U		0.37	2	0.57	U		0.36	1.9	0.56	U		0.35	1.9
Copper	4100	310	2.9	J Q	J	0.24	5.6	3.9	J Q	J	0.21	4.9	2.3	J Q	J	0.21	4.8	18			0.2	4.7
Lead	800	400	3.2			0.3	1	4.3			0.26	0.88	3.4			0.26	0.86	33			0.25	0.84
Zinc	31000	2300	7.3	J	J	0.45	9	10			0.39	7.8	7.2	J	J	0.38	7.6	7.3	J	J	0.37	7.4

All analyte concentrations are reported in milligram per kilogram (mg/kg).
PS=Primary Sample, FD=Field Duplicate, NT=not tested, ft=feet/foot

12	J	Shading indicates an United State Environmental Protection Agency (USEPA) Industrial Screening Level (i-SL) exceedance. USEPA, May 2014.
12	J	Bold outline indicates a USEPA Residential Screening Level (r-SL) exceedance. USEPA, May 2014
12	*12*	Shading in the Method Detection Limit (MDL)/Method Reporing Limit (MRL) columns indicates the MDL exceeds a screening level.

Laboratory (Lab Q) and Validation Qualifiers (Val Q):
J = The reported positive result is considered estimated because the result is less than the level of quantitation (LOQ) or because certain quality control criteria were not met.
U = The analyte was not detected and is reported as less than the limit of detection (LOD)
Q = One or more quality control criteria failed [e.g., Laboratory control sample (LCS) recovery, surrogate spike recovery or continuing calibration verification (CCV)]

Table 5-2 Sample Results - Firing-In-Buttress #1 (Continued)

Analyte	Sample ID		FR501-LS011-SB04-011-PS					FR501-LS011-SB08-011-PS					FR501-LS012-SB01-012-PS					FR501-LS012-SB04-012-PS				
	Sample Date		12/4/12					12/4/12					12/4/12					12/4/12				
	Sample Depth (ft)		0.5-2					2-4					0-0.5					0.5-2				
	i-SL	r-SL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Metals (mg/kg)																						
Antimony	41	3.1	0.59	U		*0.37*	*2*	0.56	U		*0.36*	*1.9*	0.57	U		*0.36*	*1.9*	0.59	U		*0.37*	*2*
Copper	4100	310	15			*0.21*	*4.9*	3.9	J	J	*0.2*	*4.7*	12	Q		*0.21*	*4.7*	5.7	Q		*0.21*	*4.9*
Lead	800	400	26			*0.26*	*0.88*	4.5			*0.25*	*0.85*	13			*0.26*	*0.85*	7.6			*0.27*	*0.88*
Zinc	31000	2300	5.5	J	J	*0.39*	*7.8*	2.6	J	J	*0.37*	*7.5*	7.6			*0.38*	*7.6*	3.5	J	J	*0.39*	*7.9*

Analyte	Sample ID		FR501-LS012-SB08-012-PS					FR501-LS012-SB08-012-FD					FR501-LS013-SB01-013-PS					FR501-LS014-SB01-014-PS				
	Sample Date		12/4/12					12/4/12					12/4/12					12/4/12				
	Sample Depth (ft)		2-4					2-4					0-0.5					0-0.5				
	i-SL	r-SL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Metals (mg/kg)																						
Antimony	41	3.1	0.56	U		*0.35*	*1.9*	0.59	U		*0.37*	*2*	0.55	U		*0.35*	*1.8*	0.52	J	J	*0.39*	*2*
Copper	4100	310	1.1	J Q	J	*0.2*	*4.7*	0.76	J Q	J	*0.21*	*4.9*	53	Q		*0.2*	*4.6*	160	Q		*0.22*	*5.1*
Lead	800	400	0.38	J	J	*0.25*	*0.84*	0.78	U		*0.26*	*0.88*	87			*0.25*	*0.83*	120			*0.28*	*0.92*
Zinc	31000	2300	1.3	J	J	*0.37*	*7.4*	0.93	J	J	*0.39*	*7.8*	9.2			*0.37*	*7.4*	21			*0.41*	*8.2*

Analyte	Sample ID		FR501-LS015-SB01-015-PS					FR501-LS016-SB01-016-PS					FR501-LS017-SB01-017-PS					FR501-LS018-SB01-018-PS				
	Sample Date		12/4/12					12/4/12					12/4/12					12/4/12				
	Sample Depth (ft)		0-0.5					0-0.5					0-0.5					0-0.5				
	i-SL	r-SL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Metals (mg/kg)																						
Antimony	41	3.1	0.56	U		*0.36*	*1.9*	0.54	U		*0.34*	*1.8*	0.57	U		*0.36*	*1.9*	0.58	U		*0.36*	*1.9*
Copper	4100	310	21	Q		*0.2*	*4.7*	1.1	J	J	*0.2*	*4.5*	45			*0.21*	*4.8*	33	Q J	J	*0.21*	*4.8*
Lead	800	400	31			*0.25*	*0.84*	0.48	J	J	*0.24*	*0.81*	140			*0.26*	*0.86*	32			*0.26*	*0.86*
Zinc	31000	2300	5.3	J	J	*0.37*	*7.5*	1.8	J	J	*0.36*	*7.2*	9.4			*0.38*	*7.6*	8.6			*0.38*	*7.7*

Analyte	Sample ID		FR501-LS019-SB02-019-PS					FR501-LS020-SB02-020-PS				
	Sample Date		12/5/12					12/5/12				
	Sample Depth (ft)		0.5-1					0.5-1				
	i-SL	r-SL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Metals (mg/kg)												
Antimony	41	3.1	0.59	U		*0.37*	*2*	0.59	U		*0.37*	*2*
Copper	4100	310	3.8	J Q	J	*0.21*	*4.9*	3.2	J Q	J	*0.21*	*4.9*
Lead	800	400	3.6			*0.26*	*0.88*	4			*0.27*	*0.89*
Zinc	31000	2300	6.7	J	J	*0.39*	*7.9*	7.5	J	J	*0.39*	*7.9*

All analyte concentrations are reported in milligram per kilogram (mg/kg).
PS=Primary Sample, FD=Field Duplicate, NT=not tested, ft=feet/foot

12	J	Shading indicates an United State Environmental Protection Agency (USEPA) Industrial Screening Level (i-SL) exceedance. USEPA, May 2014.
12	J	Bold outline indicates a USEPA Residential Screening Level (r-SL) exceedance. USEPA, May 2014
12	*12*	Shading in the Method Detection Limit (MDL)/Method Reporing Limit (MRL) columns indicates the MDL exceeds a screening level.

Laboratory (Lab Q) and Validation Qualifiers (Val Q):
J = The reported positive result is considered estimated because the result is less than the level of quantitation (LOQ) or because certain quality control criteria were not met.
U = The analyte was not detected and is reported as less than the limit of detection (LOD)
Q = One or more quality control criteria failed [e.g., Laboratory control sample (LCS) recovery, surrogate spike recovery or continuing calibration verification (CCV)]

Table 5-3 SPLP Sample Results - Firing-In-Buttress #1 (FR501)

Analyte	Sample ID	FR501-LS005-SB01-005-PS					FR501-LS005-SB01-005-PS					FR501-LS005-SB04-005-PS					FR501-LS005-SB04-005-PS				
	Sample Date	12/4/12					12/4/12					12/4/12					12/4/12				
	Sample Depth (ft)	0-0.5					0-0.5					0.5-2					0.5-2				
	Sample Type	Total (mg/kg)					SPLP (ug/L)					Total (mg/kg)					SPLP (ug/L)				
	MCL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Metals																					
Lead	15	49	J	J	0.33	1.1	160			2.6	9	75			0.27	0.9	61			2.6	9

Analyte	Sample ID	FR501-LS005-SB08-005-PS					FR501-LS005-SB08-005-PS				
	Sample Date	12/4/12					12/4/12				
	Sample Depth (ft)	2-4					2-4				
	Sample Type	Total (mg/kg)					SPLP (ug/L)				
	MCL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Metals											
Lead	15	0.91			0.27	0.88	16			2.6	9

All analyte concentrations are reported in milligram per kilogram (mg/kg) and microgram per liter (µg/L).
PS=Primary Sample, ft=feet/foot

12	J	Shading indicates an United State Environmental Protection Agency (USEPA) Industrial Screening Level (i-SL) exceedance. USEPA, May 2014.
12	J	Bold outline indicates a USEPA Residential Screening Level (r-SL) exceedance. USEPA, May 2014

Laboratory (Lab Q) and Validation Qualifiers (Val Q):

J = The reported positive result is considered estimated because the result is less than the level of quantitation (LOQ) or because certain quality control criteria were not met.

Appendix A-2

Former Rifle Range #1/Machine Gun Range (SR503)

Source: EA, 2016

Pre-Excavation Soil Sample ID	Sample Depth (Inches) 0-6	6-12
	Lead Concentration (mg/kg)	
1	1250	598
2	99.6	--
3	1010	610
4	56.5	--
5	276	--
6	1130	1640
7	5.4	--
8	825	857
9	360	--
10	618	1010
11	267	--
12	83.2	--
13	32.4	--
14	119	--
15	183	--
16	352	--
17	118	--
18	1970	19
19	393	--
20	119	--
21	291	--
22	297	--
23	303	--
24	244	--
25	922	1260
26	483	20

RI Soil Sample ID	Sample Depth (Inches)	Lead Concentration (mg/kg) XRF	Analytical Lab	RI Soil Sample ID	Sample Depth (Inches)	Lead Concentration (mg/kg) XRF	Analytical Lab
001	0-6	38	-	026	0-6	74	-
002	0-6	169	190	027	0-6	22	-
003	0-6	437	625	028	0-6	89	110
003	6-12	62	18	029	0-6	191	-
004	0-6	308	-	030	0-6	542	760
004	6-12	<LOD	-	030	6-12	454	460
005	0-6	1926	2300	030	6-24	-	6800
005	6-12	111	-	030	24-48	-	4600
006	0-6	43	-	031	0-6	<LOD	-
007	0-6	38	-	032	0-6	315	340
008	0-6	65	-	032	6-12	490	5
009	0-6	<LOD	-	032	12-18	275	320
010	0-6	202	-	032	18-24	86	-
010	6-12	37	-	033	0-6	38	62
011	0-6	<LOD	-	034	0-6	17	-
012	0-6	49	-	035	0-6	722	750
013	0-6	99	-	035	6-12	104	800
014	0-6	15	-	036	0-6	9	-
015	0-6	151	140	037	0-6	105	-
016	0-6	35	-	037	6-12	<LOD	-
017	0-6	189	-	038	0-6	46	-
018	0-6	378	-	039	0-6	18	-
018	6-12	49	-	040	0-6	15	-
019	0-6	288	-	041	0-6	<LOD	-
019	6-12	<LOD	-	042	0-6	<LOD	-
020	0-6	<LOD	-	043	0-6	<LOD	-
021	0-6	58	-	044	0-6	18	-
022	0-6	37	-	045	0-6	22	-
023	0-6	346	-	046	0-6	<LOD	-
023	6-12	14	-	047	0-6	<LOD	51
024	0-6	<LOD	-	048	0-6	<LOD	75
025	0-6	<LOD	-	049	0-6	<LOD	300

Legend

XRF/Analytical Results (RI)
- ≤ 400 mg/kg Lead
- > 400 mg/kg Lead

Pre-Excavation Characterization Results (IRA)
- ≤ 400 mg/kg Lead
- > 400 mg/kg Lead

Excavation Areas and Depths (Estimated)
- > 400 mg/kg (0-6 Inches)
- > 400 mg/kg (6-12 Inches)
- > 400 mg/kg (12-24 Inches)
- > 400 mg/kg (24-48 Inches)
- Area of Soil to be Sifted (Estimated) and Tree Clearing
- Manhole
- SAN Sanitary Sewer
- SR503 MRS
- Adjacent IRA MRS
- Installation Boundary

50 25 0 50 Feet

N

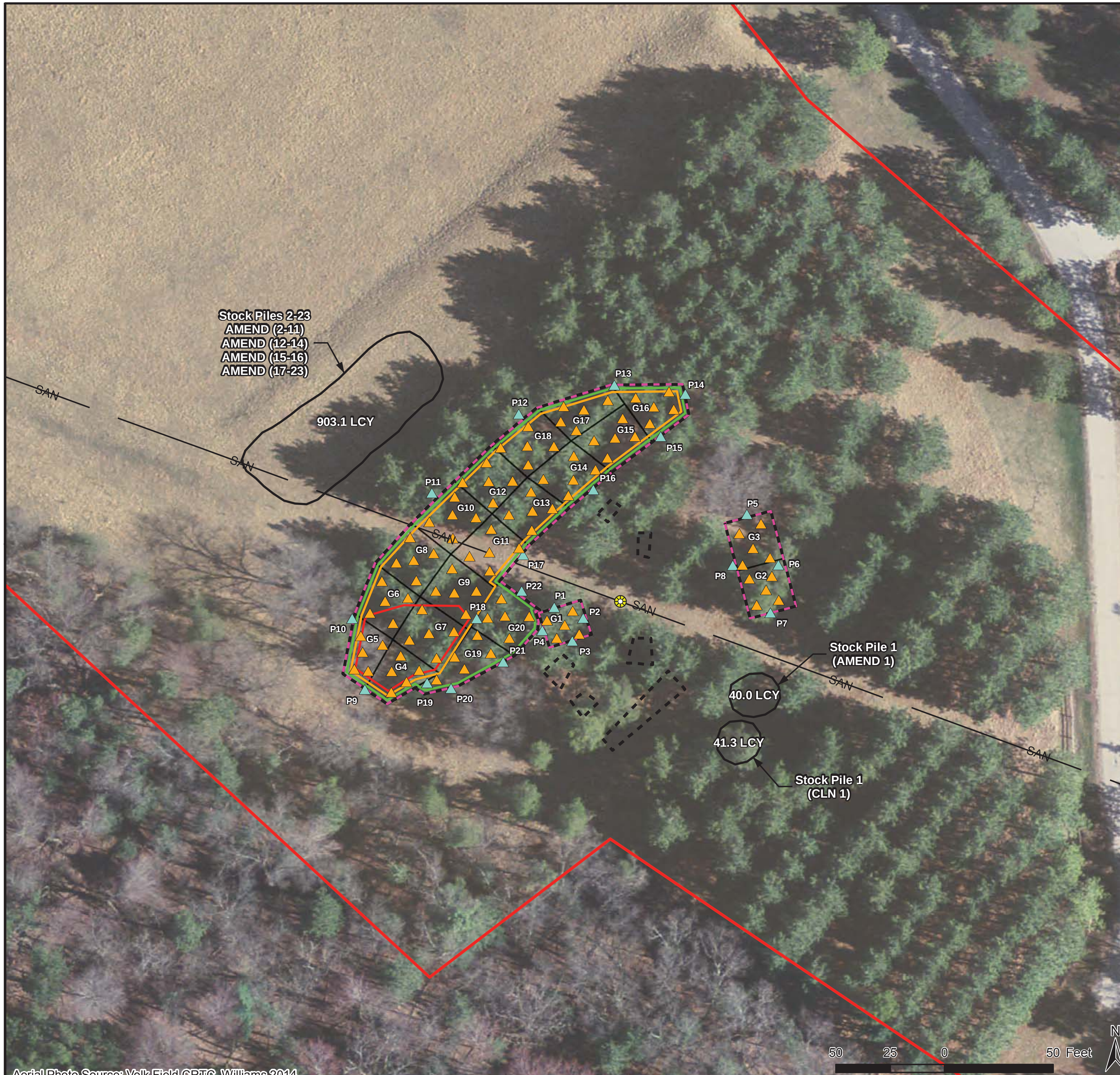
FORMER RIFLE RANGE #1/MACHINE GUN RANGE (SR503) PRE-EXCAVATION CHARACTERIZATION RESULTS

VOLK FIELD CRTC
JUNEAU COUNTY, WISCONSIN

EA Engineering, Science, and Technology, Inc., PBC

FIGURE	5-3
DRAWING NO.	—
FILE NAME	SEE STAMP
PROJECT NO.	6246608
SCALE	AS SHOWN
DATE	MAR 2016
CHECKED BY	JMR
DRAWN BY	MAW
DESIGNED BY	RRS
PROJECT MGR.	JMR

Document Path: F:\Federal\DOD\USACE\PROJECTS\6246608 Volk Field IRA\009A - SSFR\Figures\SR503\Figure 5-4 - IRA Results MC Removal-SR503.mxd



5-Point Composite Grid Confirmation Sample ID	Lead Concentration (mg/kg)
G1	26.2
G2	11.5
G3	2.5
G4	4.7
G5	3.0
G6	28.3
G7	44.4
G8	33.4
G9	39.4
G10	18.0
G11	71.8
G12	8.7
G13	68.2
G14	67.0
G15	78.1
G16	37.7
G17	146
G18	31.1
G19	4.1
G20	1.4
G27*	142
G33**	2.4

* Duplicate of G17, ** Duplicate of G3

Discrete Perimeter Confirmation Sample ID	Lead Concentration (mg/kg)
P1	29.5
P2	96.3
P3	19.4
P4	307
P5	35
P6	25.2
P7	30.7
P8	4.1
P9	65.2
P10	265
P11	16.7
P12	6.9
P13	63.2
P14	211
P15	1.9
P16	50.7
P17	155
P18	N/A
P19	N/A
P20	107
P21	288
P22	12.9
P24***	209
P31****	298
P34*****	342

*** Duplicate of P14
**** Duplicate of P21
***** Duplicate of P4

Legend

IRA Confirmation Samples

- Grid Subsample
- Perimeter Sample

Excavation Areas and Depths (Completed)

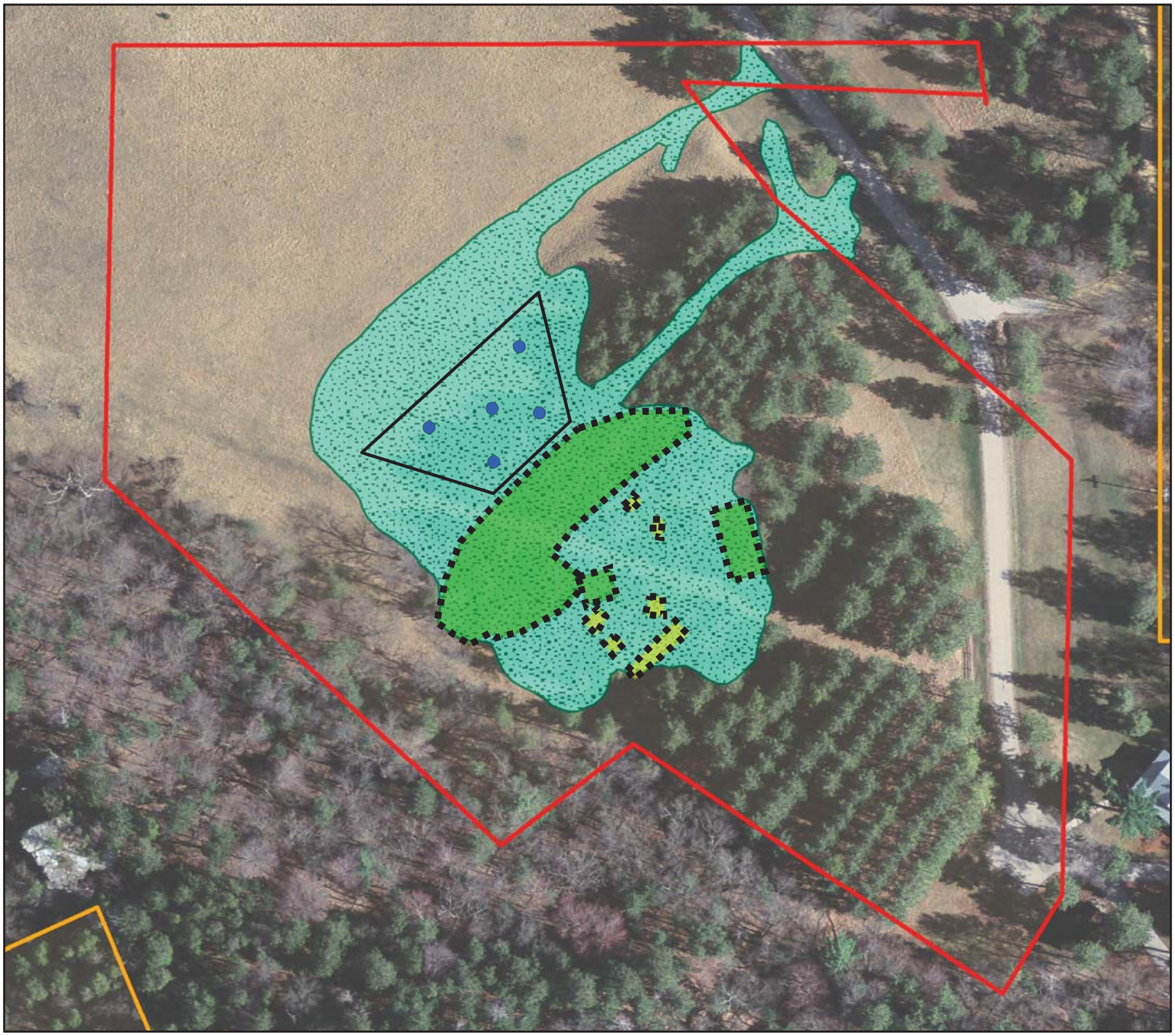
- 0-6 Inches
- 6-12 Inches
- 12-24 Inches
- 24-48 Inches
- Stock Piles
- Area of Soil Excavated and Sifted
- Manhole
- SAN Sanitary Sewer
- Confirmation Grid
- SR503 MRS
- Adjacent IRA MRS
- Installation Boundary

FORMER RIFLE RANGE #1/MACHINE GUN RANGE (SR503) MC REMOVAL

VOLK FIELD CRTC
JUNEAU COUNTY, WISCONSIN

EA Engineering, Science, and Technology, Inc., PBC

FIGURE	5-4
DRAWING NO.	—
FILE NAME	SEE STAMP
PROJECT NO.	6246608
SCALE	AS SHOWN
DATE	MAR 2016
CHECKED BY	JMR
DRAWN BY	MAW
DESIGNED BY	RRS
PROJECT MGR.	JMR



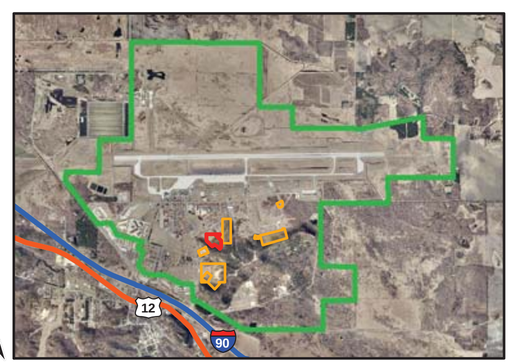
Aerial Photo Source: Volk Field CRTC, Williams 2014.

100 50 0 100 Feet

Legend

- Borrow Soil Subsample Loactions
- Soil from Existing Berm Used for Backfill (Lead ≤ 27 mg/kg)
- Area Excavated and Sifted
- Area Backfilled with Clean Soil (Lead ≤ 27 mg/kg)
- Area Backfilled with Soil Not Requiring Disposal (Lead > 27 mg/kg and ≤ 400 mg/kg)
- Hydroseeded Area
- Adjacent IRA MRS
- SR503 MRS
- Installation Boundary

N



EA Engineering, Science, and Technology, Inc., PBC

VOLK FIELD CRTC
JUNEAU COUNTY, WISCONSIN

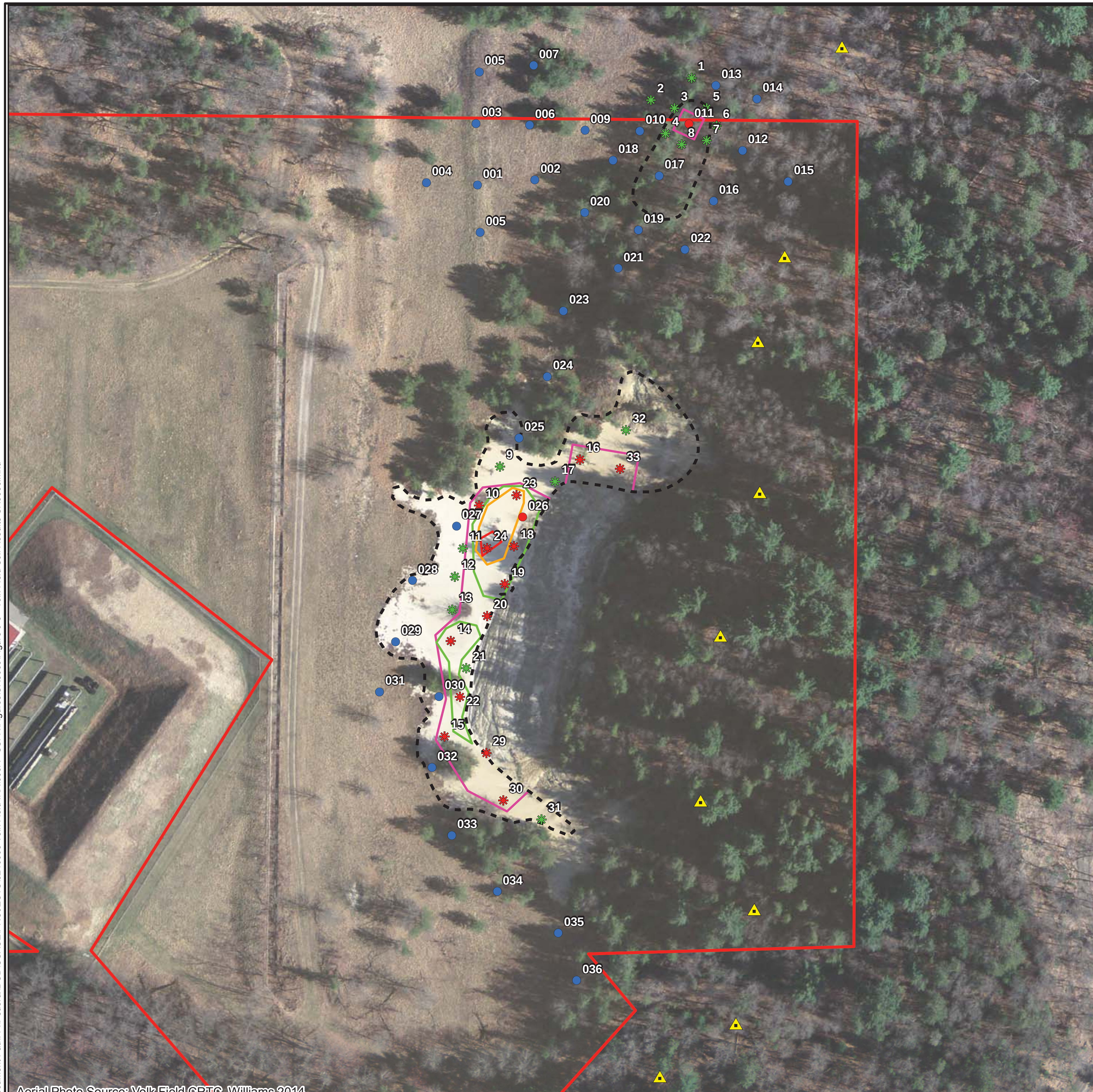
FORMER RIFLE RANGE #1/ MACHINE GUN RANGE (SR503) SITE RESTORATION

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
JMR	RRS	MAW	JMR	AS SHOWN	MAR 2016	6246608	5-5

Appendix A-3

Former Rifle Range #5/Range #250 (SR503c)

Source: EA, 2016



Pre-excavation Soil Sample (ID)	Sample Depth (Inches)				Total Hand Auger Depth (ft) (Material Encountered at Bottom)
	0-6	6-12	12-18	>18	
	Lead Concentration (mg/kg)				
1	37.9	--			0.5 (ROCK)
2	54.5	--			
3	79.6	--			
4	72.6	--			0.3 (ROCK)
5	186	--			
6	75.7	--			
7	19.8	--			
8	144	--			
9	131	--			4.1' NATIVE SOIL
10	417	300			
11	223	--			
12	328	--			1.5' NATIVE SOIL
13	170	--			
14	2470	652			1.6' ROCK
15	1040	151			
16	640	352			1.0' ROCK
17	45.9	--			0.3' ROCK
18	7220	NA			0.8' ROCK
19	3950	2230*			0.75' ROCK
20	747	NA			
21	883	251			2.0' ROCK
22	2270	425			
23	739	500	556	175**	4.1' ROCK
24	2360	315	1150	516***	2.7' ROCK
29	2230	--			
30	451	--			
31	176	--			
32	198	--			
33	588	--			

* Sample Depth (6-9 in)
** Sample Depth (44-49 in)
*** Sample Depth (26-32 in)

RI Soil Sample ID	Sample Depth (Inches)	Lead Concentration (mg/kg)	
		XRF Method	Analytical Lab Testing
001	0-6	22	-
002	0-6	13	-
003	0-6	15	-
004	0-6	10	-
005	0-6	12	-
006	0-6	14	-
007	0-6	<LOD	-
008	0-6	<LOD	-
009	0-6	58	-
010	0-6	92	-
011	0-6	629	540
011	6-12	15	-
012	0-6	213	-
012	6-12	<LOD	-
013	0-6	164	-
014	0-6	<LOD	-
015	0-6	<LOD	-
016	0-6	33	-
017	0-6	364	370
017	6-12	<LOD	-
018	0-6	107	-
019	0-6	414	230
019	6-12	<LOD	-
020	0-6	91	-
021	0-6	0	-
022	0-6	29	-
023	0-6	44	-
024	0-6	115	-
025	0-6	126	-
026	0-6	368	-
026	6-12	205	1100
026	12-18	19	-
027	0-6	99	-
028	0-6	156	-
029	0-6	182	-
030	0-6	206	-
030	6-12	159	210
031	0-6	17	-
032	0-6	60	-
033	0-6	13	-
034	0-6	11	-
035	0-6	<LOD	-
036	0-6	21	-

Legend

XRF/ Analytical Results (RI)

- ≤ 400 mg/kg Lead
- > 400 mg/kg Lead

Pre-Excavation Characterization Results (IRA)

- ≤ 400 mg/kg Lead
- > 400 mg/kg Lead

Excavation Areas and Depths (Estimated)

- > 400 mg/kg (0-6 Inches)
- > 400 mg/kg (6-12 Inches)
- > 400 mg/kg (12-24 Inches)
- > 400 mg/kg (24-48 Inches)
- Area of Soil to be Sifted (Estimated)
- Existing Range Warning Sign
- SR503c MRS
- Adjacent IRA MRS
- Installation Boundary

100 50 0 100 Feet

N

FORMER RIFLE RANGE #5/RANGE #250 (SR503c) PRE-EXCAVATION CHARACTERIZATION RESULTS

VOLK FIELD CRTC
JUNEAU COUNTY, WISCONSIN

EA Engineering, Science, and Technology, Inc., PBC

FIGURE	6-3
DRAWING NO.	—
FILE NAME	SEE STAMP
PROJECT NO.	6246608
SCALE	AS SHOWN
DATE	MAR 2016
CHECKED BY	JMR
DRAWN BY	MAW
DESIGNED BY	RRS
PROJECT MGR.	JMR

Document Path: F:\Federal\DOD\USACE\PROJECTS\6246608 Volk Field IRA\009A - SSFR\Figures\SR503c\Figure 6-3 - Volk Field Soil Results-SR503c.mxd

5-Point Composite Grid Confirmation Sample ID	Lead Concentration (mg/kg)	5-Point Composite Grid Confirmation Sample ID	Lead Concentration (mg/kg)
G1	197	DG19	172
G2	349	DG20	287
G3	319	DG21	48.5
G4	339	DG22	49.7
G5	233	DG23	123
G6	185	DG24	172
G7	258	DG25	49.3
G8	220	DG26	Bedrock*
G9	Bedrock	DG27	248
G10	Bedrock	DG28	Bedrock*
G11	Bedrock	DG29	52
G12	Bedrock	DG30	Bedrock*
G13	Bedrock	DG31	40.8
G14	Bedrock	DG32	Bedrock*
G15	Bedrock	DG33	30.8
G16	Bedrock	DG34	173
G17	196	**DG35**	149
G18	Bedrock	DG36	179
G19	258	SG1	301
G20	186	SG2	170
G21	Bedrock	SG3	49.3
G22	Bedrock	SG4	91.7
G23	73.1	SG5	62.5
G24	Bedrock	SG6	23.2
G25	213	SG7	141
G26	40.8	SG8	Bedrock
G27	77.6	SG9	59.2

5-Point Composite Grid Confirmation Sample ID	Lead Concentration (mg/kg)	5-Point Composite Grid Confirmation Sample ID	Lead Concentration (mg/kg)
DG1	38.5	SG10	148
DG2	74.5	SG11	291
DG3	Bedrock	SG12	191
DG4	Bedrock	SG13	289
DG5	269	SG14	109
DG6	Bedrock	G30[1]	300
DG7	208	G36[2]	43.2
DG8	123	SG19[3]	99.7
DG9	Bedrock	DG03[4]	136
DG10	Bedrock	G02[5]	173
DG11	117	SG25[6]	54.4
DG12	85.5	SG30[7]	55.2
DG13	143	DG46[8]	191
DG14	124	DG42[9]	48.2
DG15	246	DG45[10]	145
DG16	49.5	DG41[11]	43
DG17	243	DG49[12]	47
DG18	185	-	-

Discrete Perimeter Confirmation Sample ID	Lead Concentration (mg/kg)	Discrete Perimeter Confirmation Sample ID	Lead Concentration (mg/kg)
P1	163	P6	127
P2	14.9	P7	157
P3	196	P8	179
P4	71.3	P12[13]	126
P5	128	-	-

NOTES:
1 Duplicate of G3
2 Duplicate of G26
3 Duplicate of SG9
4 Duplicate of DG13
5 Duplicate of G20
6 Duplicate of SG5
7 Duplicate of SG3
8 Duplicate of DG16
9 Duplicate of DG22
10 Duplicate of DG35
11 Duplicate of DG31
12 Duplicate of DG29
13 Duplicate of P6
*Original DG26, 28, 30, 32 Sample > 400 mg/kg and soil subsequently removed to bedrock.

NOTES:
1. Material on the rock face was removed by compressed air and vacuum truck, stockpiled, and sifted.
2. XRF screening results outside G27, SG1, SG3, SG6, SG8, SG9, and SG14 were all ≤ 400 mg/kg lead.

Legend

- Perimeter Confirmation Sample
- Test Pit
- Final Demolition Location

Excavation Areas and Depths (Completed)

- 0-6 Inches
- 6-12 Inches
- 12-24 Inches
- 24-48 Inches
- Area of Soil Excavated and Sifted
- Stock Pile
- G Grid Sample - Original Excavation Limit
- DG Grid Sample - Deeper Layer
- SG Grid Sample - Shallow Layer
- Soil Excavated to Bedrock
- Site Grids
- SR503c MRS
- Adjacent IRA MRS
- Installation Boundary

100 50 0 100 Feet
N

FORMER RIFLE RANGE #5/ RANGE #250 (SR503c) MEC AND MC REMOVAL

VOLK FIELD CRTC
JUNEAU COUNTY, WISCONSIN

EA Engineering, Science, and Technology, Inc., PBC

FIGURE	6-4
DRAWING NO.	—
FILE NAME	SEE STAMP
PROJECT NO.	6246608
SCALE	AS SHOWN
DATE	MAR 2016
CHECKED BY	JMR
DRAWN BY	MAW
DESIGNED BY	RRS
PROJECT MGR.	JMR

Document Path: F:\Federal\DOD\USACE\PROJECTS\6246608 Volk Field IRA\009A - SSFR\Figures\SR503c\Figure 6-4 - IRA Results MEC Removal-SR503c.mxd

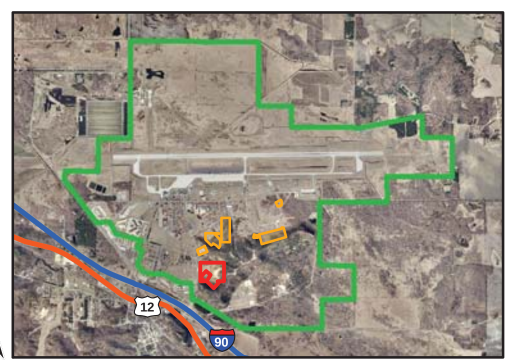
Aerial Photo Source: Volk Field CRTC, Williams 2014.

Legend

- Area Excavated and Sifted
- Area Backfilled with Soil Not Requiring Disposal (Lead > 27 mg/kg and ≤ 400 mg/kg)
- Hydroseeded Area
- Installation Boundary
- SR503c MRS
- Adjacent IRA MRS

100 50 0 100 Feet

N



EA Engineering, Science, and Technology, Inc., PBC

VOLK FIELD CRTC
JUNEAU COUNTY, WISCONSIN

FORMER RIFLE RANGE #5/RANGE #250 (SR503c) SITE RESTORATION

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
JMR	RRS	MAW	JMR	AS SHOWN	MAR 2016	6246608	6-5

2016-03-01 F:\Federal\DOD\USACE\PROJECTS\6246608 Volk Field IRA\009A - SSFR\Figures\SR503c\Figure 6-5 - Volk Field Restoration-SR503c.mxd EA-Lincoln rsmith

Appendix A-4

Former Small Arms Range #251 (SR504)

Source: EA, 2016

Pre-Excavation Soil Sample ID	Sample Depth (Inches) 0-6	6-12
	Lead Concentration (mg/kg)	
1	46.8	--
2	319	--
3	225	--
4	409	263
5	77.7	--
6	11.8	--
7	9.2	--
8	41.2	--
9	51.4	--
10	13.9	--
11	75.9	--
12	35.9	--
13	12.8	--
14	2.8	--
15	1.1	--

Legend

XRF/ Analytical Results (RI)

- ≤400 mg/kg Lead
- >400 mg/kg Lead

Pre-Excavation Characterization Results (IRA)

- ≤400 mg/kg Lead
- >400 mg/kg Lead
- SR504 MRS
- Adjacent IRA MRS
- Installation Boundary
- Area of Soil to be Sifted (Estimated)

Excavation Areas and Depths (Estimated)

- > 400 mg/kg (0-6 Inches)

RI Soil Sample ID	Sample Depth (Inches)	Lead Concentration (mg/kg) XRF	Analytical Lab
001	0-6	620	720
001	6-12	84	--
002	0-6	263	300
002	6-12	17	--
003	0-6	879	850
003	6-12	39	--
004	0-6	79	92
005	0-6	<LOD	--
006	0-6	15	--
007	0-6	83	--
008	0-6	96	--
009	0-6	<LOD	--
010	0-6	297	320
010	6-12	73	--
011	0-6	107	--
012	0-6	96	--
013	0-6	354	350
013	6-12	99	--
014	0-6	494	8
014	6-12	86	--
015	0-6	367	270
015	6-12	214	--
015	12-18	248	--
015	0-6	78	--
016	0-6	50	--
017	0-6	56	--
018	0-6	<LOD	--
019	0-6	82	--
020	0-6	56	--
021	0-6	133	--
022	0-6	138	--
023	0-6	158	230
026	0-6	18	--
029	0-6	29	--

FORMER SMALL ARMS RANGE #251 (SR504) PRE-EXCAVATION CHARACTERIZATION RESULTS

VOLK FIELD CRTC
JUNEAU COUNTY, WISCONSIN

EA Engineering, Science, and Technology, Inc., PBC

FIGURE	7-3
DRAWING NO.	—
FILE NAME	SEE STAMP
PROJECT NO.	6246608
SCALE	AS SHOWN
DATE	MAR 2016
CHECKED BY	JMR
DRAWN BY	MAW
DESIGNED BY	RRS
PROJECT MGR.	JMR

Document Path: F:\Federal\DOD\USACE\PROJECTS\6246608 Volk Field IRA\009A - SSFR\Figures\SR504\Figure 7-3 - Pre Results Soil Map-SR504.mxd

Legend

IRA Confirmation Samples

- Grid Subsample
- Perimeter Sample

Excavation Areas and Depths (Completed)

- 0-6 Inches
- 6-12 Inches
- 12-24 Inches
- Area of Soil Excavated and Sifted
- SR504 MRS
- Adjacent IRA MRS
- Installation Boundary

Confirmation Sample ID	Sample Type	Lead Concentration (mg/kg)
G1	5-Point Composite	6.8
G2	5-Point Composite	63.7
G3	5-Point Composite	224
G4	5-Point Composite	222
P1	Discrete Perimeter	9.7
P2	Discrete Perimeter	123
P3	Discrete Perimeter	23.1
P4	Discrete Perimeter	260
P5	Discrete Perimeter	206
P6	Discrete Perimeter	360
P7	Discrete Perimeter	21.3
P8	Discrete Perimeter	9.6
G13*	5-Point Composite	215
P14**	Discrete Perimeter	236

* Duplicate of G3

** Duplicate of P4 (Fragment in original duplicate sample resulted in Lead = 1,920 mg/kg)

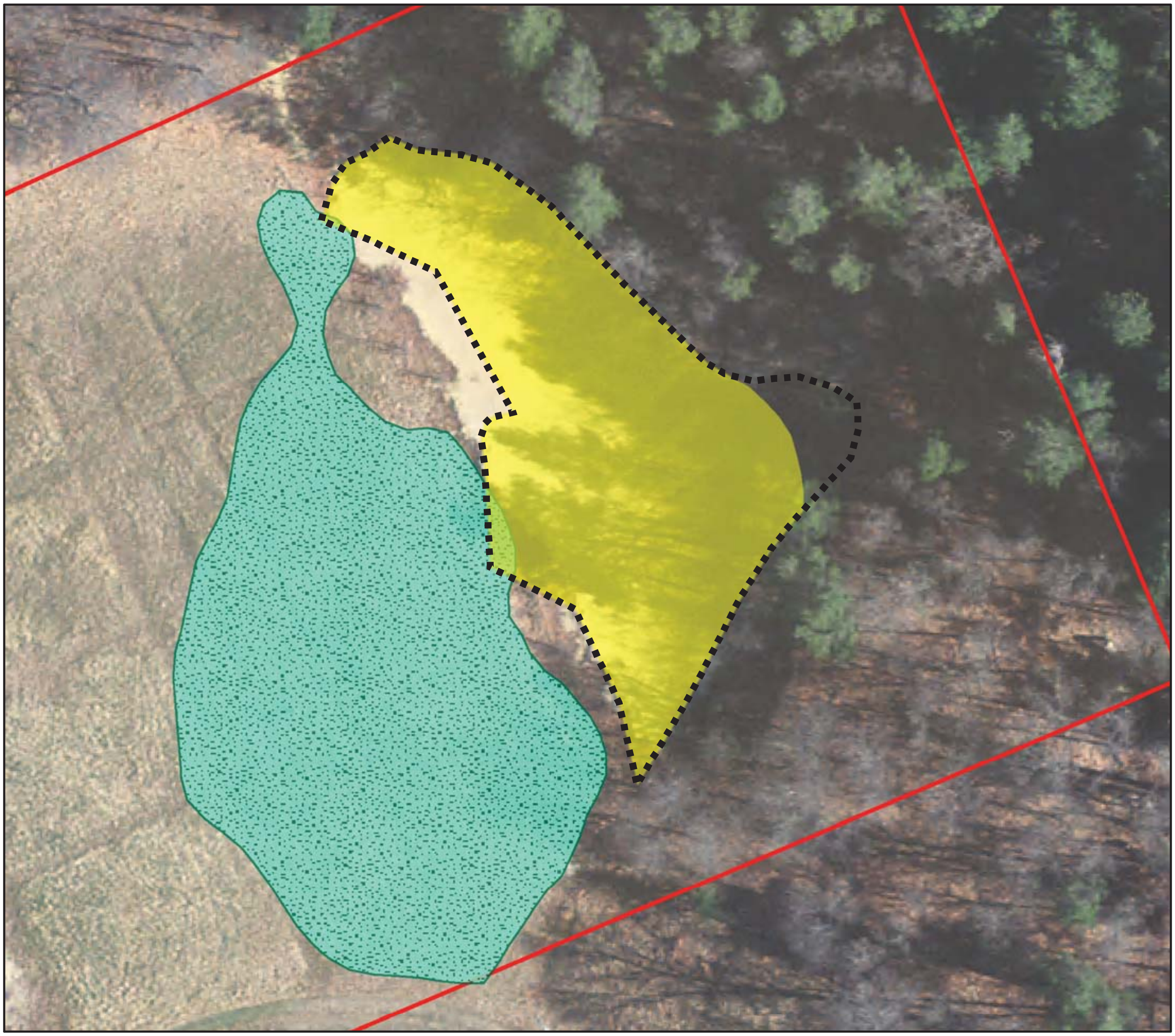
FORMER SMALL ARMS RANGE
#251 (SR504) MC REMOVAL

VOLK FIELD CRTC
JUNEAU COUNTY, WISCONSIN

EA Engineering, Science, and Technology, Inc., PBC

FIGURE	7-4
DRAWING NO.	—
FILE NAME	SEE STAMP
PROJECT NO.	6246608
SCALE	AS SHOWN
DATE	MAR 2016
CHECKED BY	JMR
DRAWN BY	MAW
DESIGNED BY	RSS
PROJECT MGR.	JMR

Document Path: F:\Federal\DOD\USACE\PROJECTS\6246608 Volk Field IRA\009A - SSFR\Figures\SR504\Figure 7-4 - IRA Results Soil Map-SR504.mxd



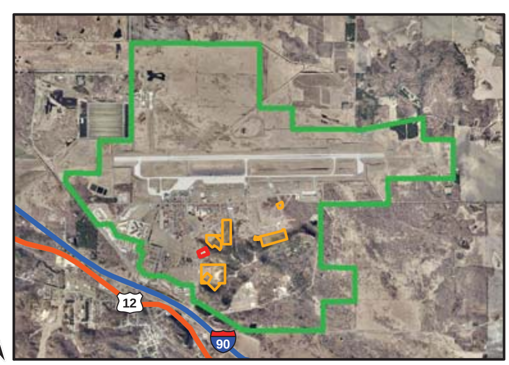
Aerial Photo Source: Volk Field CRTC, Williams 2014.

40 20 0 40 Feet

Legend

- Area Excavated and Sifted
- Area Backfilled with Soil Not Requiring Disposal (Lead > 27 mg/kg and ≤ 400 mg/kg)
- Hydroseeded Area
- SR504 MRS
- Adjacent IRA MRS
- Installation Boundary

N



EA Engineering, Science, and Technology, Inc., PBC

VOLK FIELD CRTC
JUNEAU COUNTY, WISCONSIN

FORMER SMALL ARMS RANGE #251 (SR504) SITE RESTORATION

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
JMR	RSS	MAW	JMR	AS SHOWN	MAR 2016	6246608	7-5

2016-03-01 F:\Federal\DOD\USACE\PROJECTS\6246608 Volk Field IRA\009A - SSFR\Figures\SR504\Figure 7-5 - Volk Field Restoration Map-SR504.mxd EA-Lincoln rsmith

Appendix A-5

Former Small Arms Debris Area (SR506)

Source: EA, 2016

Document Path: F:\Federal\DOD\USACE\PROJECTS\6246608 Volk Field IRA\009A - SSFR\Figures\SR506\Figure 9-3 - IRA Pre Results Soil Map-SR506.mxd

Legend

XRF/Analytical Results (RI)

- ≤ 400 mg/kg Lead
- > 400 mg/kg Lead

Pre-Excavation Characterization (RI)

- ≤400 mg/kg Lead
- > 400 mg/kg lead
- Adjacent IRA MRS
- Fence Line
- Adjacent RI MRS
- SR506 MRS
- Installation Boundary

RI Soil Sample ID	Sample Depth (Inches)	Lead Concentration (mg/kg)	
		XRF	Analytical Lab
001	0-6	20	24
002	0-6	<LOD	-
003	0-6	<LOD	-
004	0-6	<LOD	910*
005	0-6	<LOD	-
006	0-6	<LOD	-

* Duplicate result, sample concentration = 330 mg/kg

Pre-Excavation Soil Sample ID	Sample Depth (Inches)	
	0-6	6-12
	Lead Concentration (mg/kg)	
1	128	--
2	56.9	--
3	243	--
4	33.9	--
5	131	--
6	97.3	--
7	72.4	--
8	15.7	--
9	77.3	--
10	7.2	--
11	128	--
12	19.1	--

FORMER SMALL ARMS DEBRIS AREA (SR506) PRE-EXCAVATION CHARACTERIZATION RESULTS

VOLK FIELD CRTC
JUNEAU COUNTY, WISCONSIN

EA Engineering, Science, and Technology, Inc., PBC

FIGURE	9-3
DRAWING NO.	--
FILE NAME	SEE STAMP
PROJECT NO.	6246608
SCALE	AS SHOWN
DATE	MAR 2016
CHECKED BY	JMR
DRAWN BY	MAW
DESIGNED BY	RRS
PROJECT MGR.	JMR

Legend

IRA Confirmation Samples

- Grid Subsample
- Perimeter Sample
- Excavation Area/Confirmation Sample Grid
- Soil Stockpile
- Fence Line
- Inaccessible Area
- Site Grid
- SR506 MRS
- Adjacent IRA MRS
- Adjacent RI MRS
- Installation Boundary

Confirmation Sample ID	Sample Type	Lead Concentration (mg/kg)
G1	5-Point Composite	60.3
P1	Discrete Perimeter	133
P2	Discrete Perimeter	144
P3	Discrete Perimeter	173
P4	Discrete Perimeter	20.1
P14*	Discrete Perimeter	6.6

* Duplicate of P4

FORMER SMALL ARMS DEBRIS AREA (SR506) MC REMOVAL

VOLK FIELD CRTC
JUNEAU COUNTY, WISCONSIN

EA Engineering, Science, and Technology, Inc., PBC

FIGURE	9-5
DRAWING NO.	—
FILE NAME	SEE STAMP
PROJECT NO.	6246608
SCALE	AS SHOWN
DATE	MAR 2016
CHECKED BY	JMR
DRAWN BY	MAW
DESIGNED BY	RSS
PROJECT MGR.	JMR

Document Path: F:\Federal\DOD\USACE\PROJECTS\6246608 Volk Field IRA\009A - SSFR\Figures\SR506\Figure 9-5 - IRA Results Soil Map-SR506.mxd

Appendix A-6

Potential Civil War Impact Area (MU507)

Source: Bay West, 2015a

Figure 5-19 Potential Civil War Era Impact Area (MU507) Sample Location Map

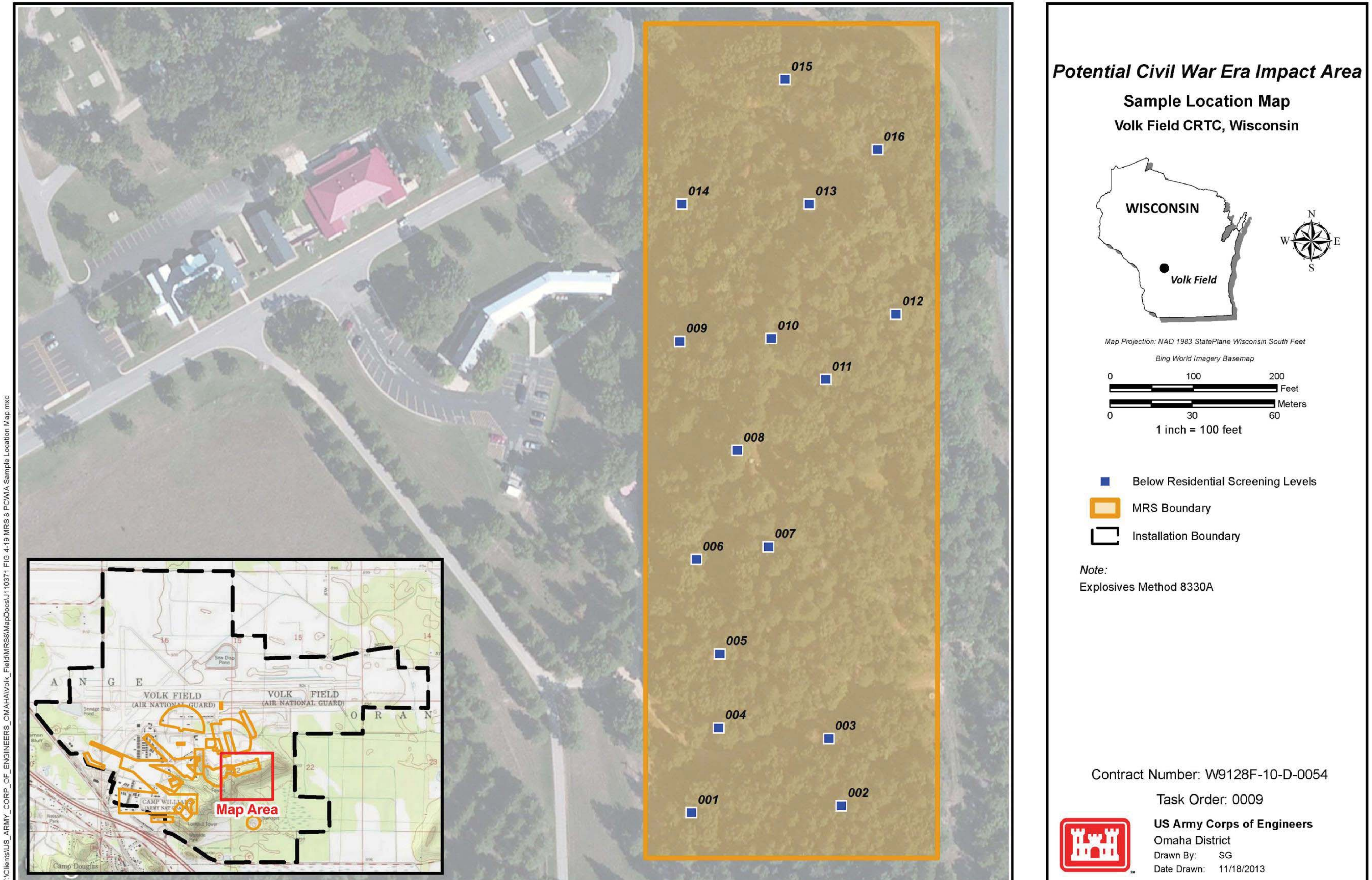


Table 5-27 Sample Data - Potential Civil War Era Impact Area (MU507)

Analyte	i-SL	r-SL	PCWIA-LS001-SB01-001-PS 12/5/12 0-0.5 Result	Lab Q	Val Q	MDL	MRL	PCWIA-LS002-SB01-002-PS 12/5/12 0-0.5 Result	Lab Q	Val Q	MDL	MRL	PCWIA-LS003-SB01-003-PS 12/5/12 0-0.5 Result	Lab Q	Val Q	MDL	MRL	PCWIA-LS004-SB01-004-PS 12/5/12 0-0.5 Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																						
1,3,5-Trinitrobenzene	2700	220	0.085	U		*0.067*	*0.24*	0.086	U		*0.068*	*0.24*	0.085	U		*0.067*	*0.24*	0.087	U		*0.069*	*0.24*
1,3-Dinitrobenzene	6.2	0.61	0.085	U		*0.058*	*0.24*	0.086	U		*0.058*	*0.24*	0.085	U		*0.058*	*0.24*	0.087	U		*0.059*	*0.24*
2,4,6-Trinitrotoluene	79	19	0.085	U		*0.055*	*0.24*	0.086	U		*0.055*	*0.24*	0.085	U		*0.055*	*0.24*	0.087	U		*0.056*	*0.24*
2,4-Dinitrotoluene	5.5	1.6	0.085	U		*0.047*	*0.24*	0.086	U		*0.048*	*0.24*	0.085	U		*0.047*	*0.24*	0.087	U		*0.048*	*0.24*
2,6-Dinitrotoluene	1.2	0.33	0.085	U		*0.051*	*0.24*	0.086	U		*0.052*	*0.24*	0.085	U		*0.051*	*0.24*	0.087	U		*0.053*	*0.24*
2-amino-4,6-Dinitrotoluene	200	15	0.085	U		*0.043*	*0.24*	0.086	U		*0.044*	*0.24*	0.085	U		*0.043*	*0.24*	0.087	U		*0.044*	*0.24*
2-Nitrotoluene	13	2.9	0.085	U		*0.079*	*0.24*	0.086	U		*0.08*	*0.24*	0.085	U		*0.08*	*0.24*	0.087	U		*0.082*	*0.24*
3-Nitrotoluene	6.2	0.61	0.085	U		*0.052*	*0.47*	0.086	U		*0.052*	*0.48*	0.085	U		*0.052*	*0.47*	0.087	U		*0.053*	*0.49*
4-amino-2,6-Dinitrotoluene	190	15	0.085	U		*0.037*	*0.24*	0.086	U		*0.037*	*0.24*	0.085	U		*0.037*	*0.24*	0.087	U		*0.038*	*0.24*
4-Nitrotoluene	110	30	0.17	U		*0.1*	*0.38*	0.17	U		*0.1*	*0.38*	0.17	U		*0.1*	*0.38*	0.17	U		*0.11*	*0.39*
HMX	4900	380	0.085	U		*0.073*	*0.24*	0.086	U		*0.074*	*0.24*	0.085	U		*0.074*	*0.24*	0.087	U		*0.075*	*0.24*
Nitrobenzene	24	4.6	0.085	U		*0.058*	*0.24*	0.086	U		*0.059*	*0.24*	0.085	U		*0.058*	*0.24*	0.087	U		*0.06*	*0.24*
RDX	24	5.6	0.085	U		*0.081*	*0.25*	0.086	U		*0.082*	*0.25*	0.085	U		*0.081*	*0.25*	0.087	U		*0.083*	*0.25*
Tetryl	250	24	0.085	U		*0.052*	*0.47*	0.086	U		*0.052*	*0.48*	0.085	U		*0.052*	*0.47*	0.087	U		*0.053*	*0.49*
Nitroglycerin	6.2	0.61	0.94	U		*0.74*	*4.8*	0.96	U		*0.75*	*4.9*	0.95	U		*0.74*	*4.8*	0.97	U		*0.76*	*5*
PETN	430	120	0.85	U		*0.82*	*3.8*	0.86	U		*0.84*	*3.8*	0.85	U		*0.83*	*3.8*	0.87	U		*0.85*	*3.9*

Analyte	i-SL	r-SL	PCWIA-LS005-SB01-005-PS 12/5/12 0-0.5 Result	Lab Q	Val Q	MDL	MRL	PCWIA-LS006-SB01-006-PS 12/5/12 0-0.5 Result	Lab Q	Val Q	MDL	MRL	PCWIA-LS006-SB01-006-FD 12/5/12 0-0.5 Result	Lab Q	Val Q	MDL	MRL	PCWIA-LS007-SB01-007-PS 12/5/12 0-0.5 Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																						
1,3,5-Trinitrobenzene	2700	220	0.083	U		*0.066*	*0.23*	0.08	U		*0.063*	*0.22*	0.084	U		*0.067*	*0.23*	0.085	U		*0.067*	*0.24*
1,3-Dinitrobenzene	6.2	0.61	0.083	U		*0.056*	*0.23*	0.08	U		*0.054*	*0.22*	0.084	U		*0.057*	*0.23*	0.085	U		*0.058*	*0.24*
2,4,6-Trinitrotoluene	79	19	0.083	U		*0.053*	*0.23*	0.08	U		*0.051*	*0.22*	0.084	U		*0.054*	*0.23*	0.085	U		*0.055*	*0.24*
2,4-Dinitrotoluene	5.5	1.6	0.083	U		*0.046*	*0.23*	0.08	U		*0.044*	*0.22*	0.084	U		*0.047*	*0.23*	0.085	U		*0.047*	*0.24*
2,6-Dinitrotoluene	1.2	0.33	0.083	U		*0.05*	*0.23*	0.08	U		*0.048*	*0.22*	0.084	U		*0.051*	*0.23*	0.085	U		*0.051*	*0.24*
2-amino-4,6-Dinitrotoluene	200	15	0.083	U		*0.042*	*0.23*	0.08	U		*0.04*	*0.22*	0.084	U		*0.043*	*0.23*	0.085	U		*0.043*	*0.24*
2-Nitrotoluene	13	2.9	0.083	U		*0.078*	*0.23*	0.08	U		*0.075*	*0.22*	0.084	U		*0.079*	*0.23*	0.085	U		*0.08*	*0.24*
3-Nitrotoluene	6.2	0.61	0.083	U		*0.051*	*0.46*	0.08	U		*0.049*	*0.44*	0.084	U		*0.051*	*0.47*	0.085	U		*0.052*	*0.47*
4-amino-2,6-Dinitrotoluene	190	15	0.083	U		*0.036*	*0.23*	0.08	U		*0.035*	*0.22*	0.084	U		*0.037*	*0.23*	0.085	U		*0.037*	*0.24*
4-Nitrotoluene	110	30	0.17	U		*0.1*	*0.37*	0.16	U		*0.097*	*0.36*	0.17	U		*0.1*	*0.37*	0.17	U		*0.1*	*0.38*
HMX	4900	380	0.083	U		*0.072*	*0.23*	0.08	U		*0.069*	*0.22*	0.084	U		*0.073*	*0.23*	0.085	U		*0.074*	*0.24*
Nitrobenzene	24	4.6	0.083	U		*0.057*	*0.23*	0.08	U		*0.055*	*0.22*	0.084	U		*0.057*	*0.23*	0.085	U		*0.058*	*0.24*
RDX	24	5.6	0.083	U		*0.079*	*0.24*	0.08	U		*0.076*	*0.23*	0.084	U		*0.08*	*0.24*	0.085	U		*0.081*	*0.25*
Tetryl	250	24	0.083	U		*0.051*	*0.46*	0.08	U		*0.049*	*0.44*	0.084	U		*0.051*	*0.47*	0.085	U		*0.052*	*0.47*
Nitroglycerin	6.2	0.61	0.92	U		*0.72*	*4.7*	0.89	U		*0.69*	*4.5*	0.93	U		*0.73*	*4.8*	0.95	U		*0.74*	*4.8*
PETN	430	120	0.83	U		*0.8*	*3.7*	0.8	U		*0.78*	*3.6*	0.84	U		*0.82*	*3.7*	0.85	U		*0.83*	*3.8*

All analyte concentrations are reported in milligram per kilogram (mg/kg).
PS=Primary Sample, FD=Field Duplicate, ft=feet/foot

12	J	Shading indicates an United State Environmental Protection Agency (USEPA) Industrial Screening Level (i-SL) exceedance. USEPA, May 2014.
12	J	Bold outline indicates a USEPA Residential Screening Level (r-SL) exceedance. USEPA, May 2014
12	*12*	Shading in the Method Detection Limit (MDL)/Method Reporing Limit (MRL) columns indicates the MDL exceeds a screening level.

Laboratory (Lab Q) and Validation Qualifiers (Val Q):
U = The analyte was not detected and is reported as less than the limit of detection (LOD)

Table 5-27 Sample Data - Potential Civil War Era Impact Area (Continued)

Analyte	Sample ID Sample Date Sample Depth (ft)		PCWIA-LS008-SB01-008-PS 12/5/12 0-0.5					PCWIA-LS009-SB01-009-PS 12/5/12 0-0.5					PCWIA-LS010-SB01-010-PS 12/5/12 0-0.5					PCWIA-LS011-SB01-011-PS 12/5/12 0-0.5					PCWIA-LS012-SB01-012-PS 12/5/12 0-0.5				
	i-SL	**r-SL**	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																											
1,3,5-Trinitrobenzene	2700	220	0.087	U		*0.068*	*0.24*	0.085	U		*0.067*	*0.23*	0.083	U		*0.066*	*0.23*	0.087	U		*0.069*	*0.24*	0.083	U		*0.066*	*0.23*
1,3-Dinitrobenzene	6.2	0.61	0.087	U		*0.059*	*0.24*	0.085	U		*0.057*	*0.23*	0.083	U		*0.056*	*0.23*	0.087	U		*0.059*	*0.24*	0.083	U		*0.057*	*0.23*
2,4,6-Trinitrotoluene	79	19	0.087	U		*0.056*	*0.24*	0.085	U		*0.054*	*0.23*	0.083	U		*0.053*	*0.23*	0.087	U		*0.056*	*0.24*	0.083	U		*0.054*	*0.23*
2,4-Dinitrotoluene	5.5	1.6	0.087	U		*0.048*	*0.24*	0.085	U		*0.047*	*0.23*	0.083	U		*0.046*	*0.23*	0.087	U		*0.048*	*0.24*	0.083	U		*0.046*	*0.23*
2,6-Dinitrotoluene	1.2	0.33	0.087	U		*0.052*	*0.24*	0.085	U		*0.051*	*0.23*	0.083	U		*0.05*	*0.23*	0.087	U		*0.053*	*0.24*	0.083	U		*0.05*	*0.23*
2-amino-4,6-Dinitrotoluene	200	15	0.087	U		*0.044*	*0.24*	0.085	U		*0.043*	*0.23*	0.083	U		*0.042*	*0.23*	0.087	U		*0.044*	*0.24*	0.083	U		*0.042*	*0.23*
2-Nitrotoluene	13	2.9	0.087	U		*0.081*	*0.24*	0.085	U		*0.079*	*0.23*	0.083	U		*0.078*	*0.23*	0.087	U		*0.082*	*0.24*	0.083	U		*0.078*	*0.23*
3-Nitrotoluene	6.2	0.61	0.087	U		*0.053*	*0.48*	0.085	U		*0.051*	*0.47*	0.083	U		*0.051*	*0.46*	0.087	U		*0.053*	*0.49*	0.083	U		*0.051*	*0.46*
4-amino-2,6-Dinitrotoluene	190	15	0.087	U		*0.038*	*0.24*	0.085	U		*0.037*	*0.23*	0.083	U		*0.036*	*0.23*	0.087	U		*0.038*	*0.24*	0.083	U		*0.036*	*0.23*
4-Nitrotoluene	110	30	0.17	U		*0.1*	*0.38*	0.17	U		*0.1*	*0.38*	0.17	U		*0.1*	*0.37*	0.17	U		*0.11*	*0.39*	0.17	U		*0.1*	*0.37*
HMX	4900	380	0.087	U		*0.075*	*0.24*	0.085	U		*0.073*	*0.23*	0.083	U		*0.072*	*0.23*	0.087	U		*0.075*	*0.24*	0.083	U		*0.072*	*0.23*
Nitrobenzene	24	4.6	0.087	U		*0.059*	*0.24*	0.085	U		*0.058*	*0.23*	0.083	U		*0.057*	*0.23*	0.087	U		*0.06*	*0.24*	0.083	U		*0.057*	*0.23*
RDX	24	5.6	0.087	U		*0.082*	*0.25*	0.085	U		*0.08*	*0.24*	0.083	U		*0.079*	*0.24*	0.087	U		*0.083*	*0.25*	0.083	U		*0.079*	*0.24*
Tetryl	250	24	0.087	U		*0.053*	*0.48*	0.085	U		*0.051*	*0.47*	0.083	U		*0.051*	*0.46*	0.087	U		*0.053*	*0.49*	0.083	U		*0.051*	*0.46*
Nitroglycerin	6.2	0.61	0.96	U		*0.75*	*4.9*	0.94	U		*0.73*	*4.8*	0.92	U		*0.72*	*4.7*	0.97	U		*0.76*	*5*	0.93	U		*0.72*	*4.7*
PETN	430	120	0.87	U		*0.84*	*3.8*	0.85	U		*0.82*	*3.8*	0.83	U		*0.8*	*3.7*	0.87	U		*0.85*	*3.9*	0.83	U		*0.81*	*3.7*

Analyte	Sample ID Sample Date Sample Depth (ft)		PCWIA-LS013-SB01-013-PS 12/5/12 0-0.5					PCWIA-LS014-SB01-014-PS 12/5/12 0-0.5					PCWIA-LS014-SB01-014-FD 12/5/12 0-0.5					PCWIA-LS015-SB01-015-PS 12/5/12 0-0.5					PCWIA-LS016-SB01-016-PS 12/5/12 0-0.5				
	i-SL	**r-SL**	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Explosives (mg/kg)																											
1,3,5-Trinitrobenzene	2700	220	0.081	U		*0.064*	*0.23*	0.084	U		*0.066*	*0.23*	0.082	U		*0.065*	*0.23*	0.081	U		*0.064*	*0.23*	0.088	U		*0.069*	*0.24*
1,3-Dinitrobenzene	6.2	0.61	0.081	U		*0.055*	*0.23*	0.084	U		*0.057*	*0.23*	0.082	U		*0.056*	*0.23*	0.081	U		*0.055*	*0.23*	0.088	U		*0.06*	*0.24*
2,4,6-Trinitrotoluene	79	19	0.081	U		*0.052*	*0.23*	0.084	U		*0.054*	*0.23*	0.082	U		*0.053*	*0.23*	0.081	U		*0.052*	*0.23*	0.088	U		*0.056*	*0.24*
2,4-Dinitrotoluene	5.5	1.6	0.081	U		*0.045*	*0.23*	0.084	U		*0.046*	*0.23*	0.082	U		*0.045*	*0.23*	0.081	U		*0.045*	*0.23*	0.088	U		*0.049*	*0.24*
2,6-Dinitrotoluene	1.2	0.33	0.081	U		*0.049*	*0.23*	0.084	U		*0.05*	*0.23*	0.082	U		*0.049*	*0.23*	0.081	U		*0.049*	*0.23*	0.088	U		*0.053*	*0.24*
2-amino-4,6-Dinitrotoluene	200	15	0.081	U		*0.041*	*0.23*	0.084	U		*0.042*	*0.23*	0.082	U		*0.042*	*0.23*	0.081	U		*0.041*	*0.23*	0.088	U		*0.044*	*0.24*
2-Nitrotoluene	13	2.9	0.081	U		*0.076*	*0.23*	0.084	U		*0.078*	*0.23*	0.082	U		*0.077*	*0.23*	0.081	U		*0.076*	*0.23*	0.088	U		*0.082*	*0.24*
3-Nitrotoluene	6.2	0.61	0.081	U		*0.05*	*0.45*	0.084	U		*0.051*	*0.47*	0.082	U		*0.05*	*0.46*	0.081	U		*0.049*	*0.45*	0.088	U		*0.053*	*0.49*
4-amino-2,6-Dinitrotoluene	190	15	0.081	U		*0.035*	*0.23*	0.084	U		*0.036*	*0.23*	0.082	U		*0.036*	*0.23*	0.081	U		*0.035*	*0.23*	0.088	U		*0.038*	*0.24*
4-Nitrotoluene	110	30	0.16	U		*0.099*	*0.36*	0.17	U		*0.1*	*0.37*	0.16	U		*0.1*	*0.37*	0.16	U		*0.098*	*0.36*	0.18	U		*0.11*	*0.39*
HMX	4900	380	0.081	U		*0.07*	*0.23*	0.084	U		*0.072*	*0.23*	0.082	U		*0.071*	*0.23*	0.081	U		*0.07*	*0.23*	0.088	U		*0.076*	*0.24*
Nitrobenzene	24	4.6	0.081	U		*0.056*	*0.23*	0.084	U		*0.057*	*0.23*	0.082	U		*0.056*	*0.23*	0.081	U		*0.055*	*0.23*	0.088	U		*0.06*	*0.24*
RDX	24	5.6	0.081	U		*0.077*	*0.24*	0.084	U		*0.079*	*0.24*	0.082	U		*0.078*	*0.24*	0.081	U		*0.077*	*0.23*	0.088	U		*0.083*	*0.25*
Tetryl	250	24	0.081	U		*0.05*	*0.45*	0.084	U		*0.051*	*0.47*	0.082	U		*0.05*	*0.46*	0.081	U		*0.049*	*0.45*	0.088	U		*0.053*	*0.49*
Nitroglycerin	6.2	0.61	0.9	U		*0.71*	*4.6*	0.93	U		*0.73*	*4.7*	0.91	U		*0.71*	*4.7*	0.9	U		*0.7*	*4.6*	0.98	U		*0.76*	*5*
PETN	430	120	0.81	U		*0.79*	*3.6*	0.84	U		*0.81*	*3.7*	0.82	U		*0.8*	*3.7*	0.81	U		*0.79*	*3.6*	0.88	U		*0.85*	*3.9*

All analyte concentrations are reported in milligram per kilogram (mg/kg).
PS=Primary Sample, FD=Field Duplicate, ft=feet/foot

12	J	Shading indicates an United State Environmental Protection Agency (USEPA) Industrial Screening Level (i-SL) exceedance. USEPA, May 2014.
12	J	Bold outline indicates a USEPA Residential Screening Level (r-SL) exceedance. USEPA, May 2014
12	*12*	Shading in the Method Detection Limit (MDL)/Method Reporing Limit (MRL) columns indicates the MDL exceeds a screening level.

Laboratory (Lab Q) and Validation Qualifiers (Val Q):
U = The analyte was not detected and is reported as less than the limit of detection (LOD)

Appendix B

Remedial Alternatives Cost Worksheets

Volk Field CRTC, Six MRSs

COST ESTIMATE SUMMARY

Alternative 1
No Action

Site: Six Munitions Response Sites (MRS)
Location: Volk Field CRTC, Wisconsin
Phase: Feasibility Study
Base Year: 2016

Capital Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
None	0	LS	$0	$0	Baseline for comparison

TOTAL CAPITAL COST **$0**

Annual Operation and Maintenance (O&M) Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
None	0	EA	$0	$0	Baseline for comparison

TOTAL ANNUAL COST **$0**

Periodic Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
None	0	EA	$0	$0	Baseline for comparison

TOTAL PERIODIC COST **$0**

TOTAL COST **$0**

Total Present Worth Cost: **$0**

Volk Field CRTC, Six MRSs

Alternative 2
Land Use Controls

COST ESTIMATE SUMMARY

Site: Six Munitions Response Sites (MRS)
Location: Volk Field CRTC, Wisconsin
Phase: Feasibility Study
Base Year: 2016

Capital Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
Institutional Controls					
Public meeting, Admin Record Update	1	LS	$ 5,000	$ 5,000	Develop a Work Plan
Master Plan Input	1	LS	$ 2,000	$ 2,000	Update installation - wide planning
Signs	12	EA	$ 110	$ 1,320	Engineer's Estimate
Training/Education Materials	1	LS	$ 5,000	$ 5,000	Engineer's Estimate
			SUBTOTAL	$ 13,320	
Project Contingency	25%			$ 3,330	
Program Management	15%			$ 1,998	
TOTAL CAPITAL COST				**$ 18,648**	

Annual Operation and Maintenance (O&M) Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
Annual LUC Inspection	30	EA	$ 29,879	$ 896,379	See Cost Worksheet
MRSPP Annual Update	30	EA	$ 1,000	$ 30,000	
			SUBTOTAL	$ 926,379	
TOTAL ANNUAL COST				**$ 926,379**	

Periodic Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
Five Year Review	6	EA	$ 15,000	$ 90,000	Update every 5 years for 30 years
TOTAL PERIODIC COST				**$ 90,000**	

TOTAL COST **$ 1,035,027**

Total Present Worth Cost: $ 830,159

Volk Field CRTC, Six MRSs

Alternative 2
Land Use Controls

PRESENT WORTH SUMMARY

Site: Six Munitions Response Sites (MRS)
Location: Volk Field CRTC, Wisconsin
Phase: Feasibility Study
Base Year: 2016

Present Value Analysis

30-year discount rate 1.5%

YR	Capital -	O&M Annual	Review 5-Year	Total Costs -	Present Worth -
0	$18,648	-	-	$18,648	$18,648
1	-	$30,879	-	$30,879	$30,423
2	-	$30,879	-	$30,879	$29,973
3	-	$30,879	-	$30,879	$29,530
4	-	$30,879	-	$30,879	$29,094
5	-	$30,879	$ 15,000	$45,879	$42,588
6	-	$30,879	-	$30,879	$28,240
7	-	$30,879	-	$30,879	$27,823
8	-	$30,879	-	$30,879	$27,412
9	-	$30,879	-	$30,879	$27,007
10	-	$30,879	$ 15,000	$45,879	$39,533
11	-	$30,879	-	$30,879	$26,214
12	-	$30,879	-	$30,879	$25,827
13	-	$30,879	-	$30,879	$25,445
14	-	$30,879	-	$30,879	$25,069
15	-	$30,879	$ 15,000	$45,879	$36,697
16	-	$30,879	-	$30,879	$24,334
17	-	$30,879	-	$30,879	$23,974
18	-	$30,879	-	$30,879	$23,620
19	-	$30,879	-	$30,879	$23,271
20	-	$30,879	$ 15,000	$45,879	$34,064
21	-	$30,879	-	$30,879	$22,588
22	-	$30,879	-	$30,879	$22,254
23	-	$30,879	-	$30,879	$21,925
24	-	$30,879	-	$30,879	$21,601
25	-	$30,879	$ 15,000	$45,879	$31,620
26	-	$30,879	-	$30,879	$20,968
27	-	$30,879	-	$30,879	$20,658
28	-	$30,879	-	$30,879	$20,353
29	-	$30,879	-	$30,879	$20,052
30	-	$30,879	$ 15,000	$45,879	$29,352
TOTALS	**$18,648**	**$926,379**	**$90,000**	**$1,035,027**	**$830,159**

Volk Field CRTC, Six MRSs

Alternative 2
Land Use Controls

COST WORKSHEET

Site: Six Munitions Response Sites (MRS)
Location: Volk Field CRTC, Wisconsin
Phase: Feasibility Study
Base Year: 2016

Cost Analysis

LUC Inspection

		QTY	UNIT	UNIT COST	TOTAL	NOTES
Planning Documents						
	Work Plan, APP, UFP-QAPP	1	EA	$ 2,500	$ 2,500	Planning Document for LTM
Field Work						
	Mob/demob	1	EA	$ 1,000	$ 1,000	Travel, hotel, truck, per diem
	Project Management	4	HR	$ 130	$ 520	Project coordination, subcontracts, mgmt
	SUXOS	30	HR	$ 135	$ 4,050	Site management
	UXOSO/QCS	30	HR	$ 110	$ 3,300	Health and safety/QC
	UXO Tech 3 (1)	30	LS	$ 95	$ 2,850	Field team
	UXO Tech 2 (1)	30	EA	$ 80	$ 2,400	Field team
Reporting						
	Annual Memo Report	1	EA	$ 7,000	$ 7,000	Includes findings, figures, data validation
				SUBTOTAL	$ 23,620	
	Prime Contractor Overhead			15%	$ 3,543	
	Prime Contractor Profit			10%	$ 2,716	Profit includes 15% overhead
	TOTAL COST				**$ 29,879**	

Volk Field CRTC, Six MRSs

Alternative 3

Soil Excavation and LUCs

COST ESTIMATE SUMMARY

Site: Six Munitions Response Sites (MRS)
Location: Volk Field CRTC, Wisconsin
Phase: Feasibility Study
Base Year: 2016

Capital Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
Institutional Controls					
Public meeting, Admin Record Update	1	LS	$ 5,000	$ 5,000	Develop a Work Plan
Master Plan Input	1	LS	$ 2,000	$ 2,000	Update installation - wide planning
Signs	12	EA	$ 110	$ 1,320	Engineer's Estimate
Training/Education Materials	1	LS	$ 5,000	$ 5,000	Engineer's Estimate
			SUBTOTAL	$ 13,320	
Subsurface Removal/Report	1	LS	$ 1,964,679	$ 1,964,679	See Cost Worksheet
			SUBTOTAL	$ 1,964,679	
Other Project Costs					
Project Contingency	25%			$ 494,500	10% scope +15% bid
Program Management	15%			$ 296,700	
			TOTAL CAPITAL COST	**$ 2,769,198**	

Annual Operation and Maintenance (O&M) Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
Annual LUC Inspection	30	EA	$ 29,879	$ 896,379	Same as Alternative 2
MRSPP Annual Update	30	EA	$ 1,000	$ 30,000	Same as Alternative 2
			SUBTOTAL	$ 926,379	
TOTAL ANNUAL COST				**$ 926,379**	

Periodic Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
Five Year Review	6	EA	$ 15,000	$ 90,000	Update every 5 years for 30 years
TOTAL PERIODIC COST				**$ 90,000**	

TOTAL COST **$ 3,785,577**

Total Present Worth Cost: $ 3,580,709

Volk Field CRTC, Six MRSs

Alternative 3

Soil Excavation and LUCs

PRESENT WORTH SUMMARY

Site: Six Munitions Response Sites (MRS)
Location: Volk Field CRTC, Wisconsin
Phase: Feasibility Study
Base Yea 2016

Present Value Analysis

30-year discount rate 1.5%

YEAR	Capital -	O&M Annual	Review 5-Year	Total Costs -	Present Worth -
0	$2,769,198	-	-	$2,769,198	$2,769,198
1	-	$30,879	-	$30,879	$30,423
2	-	$30,879	-	$30,879	$29,973
3	-	$30,879	-	$30,879	$29,530
4	-	$30,879	-	$30,879	$29,094
5	-	$30,879	$ 15,000	$45,879	$42,588
6	-	$30,879	-	$30,879	$28,240
7	-	$30,879	-	$30,879	$27,823
8	-	$30,879	-	$30,879	$27,412
9	-	$30,879	-	$30,879	$27,007
10	-	$30,879	$ 15,000	$45,879	$39,533
11	-	$30,879	-	$30,879	$26,214
12	-	$30,879	-	$30,879	$25,827
13	-	$30,879	-	$30,879	$25,445
14	-	$30,879	-	$30,879	$25,069
15	-	$30,879	$ 15,000	$45,879	$36,697
16	-	$30,879	-	$30,879	$24,334
17	-	$30,879	-	$30,879	$23,974
18	-	$30,879	-	$30,879	$23,620
19	-	$30,879	-	$30,879	$23,271
20	-	$30,879	$ 15,000	$45,879	$34,064
21	-	$30,879	-	$30,879	$22,588
22	-	$30,879	-	$30,879	$22,254
23	-	$30,879	-	$30,879	$21,925
24	-	$30,879	-	$30,879	$21,601
25	-	$30,879	$ 15,000	$45,879	$31,620
26	-	$30,879	-	$30,879	$20,968
27	-	$30,879	-	$30,879	$20,658
28	-	$30,879	-	$30,879	$20,353
29	-	$30,879	-	$30,879	$20,052
30	-	$30,879	$ 15,000	$45,879	$29,352
TOTALS	**$2,769,198**	**$926,379**	**$90,000**	**$3,785,577**	**$3,580,709**

Volk Field CRTC, Six MRSs

Alternative 3

Soil Excavation and LUCs

COST WORKSHEET

Site: Six Munitions Response Sites (MRS)
Location: Volk Field CRTC, Wisconsin
Phase: Feasibility Study
Base Year: 2016

Cost Analysis

Soil Excavation/Hauling/Disposal/Reporting (Capital Expense)

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Prepare Site/Soil Stockpile Area					
Clear/Grub vegetation	5	LS	$ 2,400	$ 12,000	Lump sum per site
Erosion and sediment control	3000	LF	$ 13	$ 39,000	Silt fencing around excavation areas
Collect baseline soil samples	5	LS	$ 500	$ 2,500	Baseline stockpile areas
Analytical cost	10	sample	$ 25	$ 250	Lead analysis
UXO oversight	10	day	$ 2,100	$ 21,000	
Soil Excavation					
Mechanical excavation	9937	CY	$ 12	$ 119,244	Excavate soil > 27 mg/kg lead
UXO oversight - excavation	100	day	$ 2,100	$ 210,000	Assume 100 CY per day
Stockpiling	9937	CY	$ 2	$ 19,874	Stockpile excavated soil
Air Monitoring	10	sample	$ 300	$ 3,000	1 per dig team x 84 days
Collect confirmation samples	5	LS	$ 500	$ 2,500	
Analytical cost	150	sample	$ 25	$ 3,750	Lead analysis
Site Restoration					
Soil backfill (90% of total)	13415	ton	$ 10.08	$ 135,218	Assume 1.5 ton/CY
Top soil (10% of total)	1490.5	ton	$ 25.75	$ 38,380	Assume 1.5 ton/CY
Soil placement/compaction	9937	CY	$ 9.50	$ 94,402	
Collect characterization samples	5	LS	$ 500	$ 2,500	
Analytical cost (TCLP)	25	sample	$ 75	$ 1,875	
Site stabilization	5	LS	$ 2,000	$ 10,000	Cleanup, stabilization, seeding
Disposal					
Waste profile and manifest	5	LS	$ 1,200	$ 6,000	
T&D non-hazardous soil	14905	ton	$ 50	$ 745,250	Includes 25% of backfill from previous excavations
Planning/Reporting					
Workplan/APP	1	EA	$ 60,000	$ 60,000	
Completion Report	1	EA	$ 45,000	$ 45,000	
			SUBTOTAL	**$ 1,571,743**	
Prime Contractor Overhead			15%	$ 235,761	
Prime Contractor Profit			10%	$ 157,174	
TOTAL COST				**$ 1,964,679**	

Appendix C

Definitions

Anomaly – Any identified subsurface mass that may be geologic in origin, unexploded ordnance (UXO), or some other man-made material. Such identification is made through geophysical investigation and reflects the response of the sensor used to conduct the investigation. (Handbook on the Management of Munitions Response Actions, Interim Final, EPA, May 2005)

Anomaly Avoidance –Techniques employed on property known or suspected to contain unexploded ordnance, other munitions that may have experienced abnormal environments (e.g., discarded military munitions), munitions constituents in high enough concentrations to pose an explosive hazard, or chemical agents, regardless of configuration, to avoid contact with potential surface or subsurface explosive or CA hazards, to allow entry to the area for the performance of required operations. (AF Manual 91-201 and DOD 6055.09-M)

Applicable or Relevant and Appropriate Requirements – Applicable requirements are cleanup standards, standards of control, and other substantive environmental protection requirements promulgated under Federal or state environmental law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at a CERCLA site. Relevant and appropriate requirements are cleanup standards that, while not "applicable," address situations sufficiently similar to those encountered at a CERCLA site where their use is well suited to the particular site. (NCP, 40 CFR Part 300, July 2005)

Chemical Agent (CA) – An agent that, through its chemical properties, produces lethal or other damaging effects on human beings, except that such term does not include riot control agents, chemical herbicides, smoke, and other obscuration materials. This definition is based on the definition of "chemical agent and munition" in 50 U.S.C. 1521(j)(1).

Chemical Warfare Materiel (CWM) – Items generally configured as a munition containing a chemical compound that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. CWM includes V- and G-series nerve agents or H-series (mustard) and L-series (lewisite) blister agents in other-than-munition configurations; and certain industrial chemicals (e.g., hydrogen cyanide [AC], cyanogen chloride [CK], or carbonyl dichloride [called phosgene or CG]) configured as a military munition. CWM does not include riot control devices, chemical defoliants and herbicides, industrial chemicals (e.g., AC, CK, or CG) not configured as a munition, smoke and other obscuration producing items, flame and incendiary producing items, or soil, water, debris or other media contaminated with low concentrations of chemical agents where no CA hazards exist. (MRSPP, 32 CFR Part 179, October 2005)

CWM contains the following four subcategories:

1) CWM, explosively configured – All UXO or DMM that contain a CA fill and any explosive component. Examples are M55 rockets with CA, the M23 VX mine, and the M360 105 mm GB artillery cartridge.
2) CWM, non-explosively configured – All UXO or DMM that contain a CA fill but that do not contain any explosive components. Examples are any chemical munitions that do not contain explosive components and VX or mustard agent spray canisters.
3) CWM, bulk container – All discarded (e.g., buried) non-munitions-configured containers of CA (e.g., a ton container) and CAIS K941, toxic gas set M-1 and K942, toxic gas set M-2/E11.
4) Chemical Agent Identification Sets (CAIS) – Military training aids containing small quantities of various CA and other chemicals. All forms of CAIS are scored the same in this rule, except CAIS K941, toxic gas set M-1; and CAIS K942, toxic gas set M-2/E11,

which are considered forms of CWM, bulk container, due to the relatively large quantities of agent contained in those types of sets.

Closed Range – A military range that has been taken out of service as a range and that either has been put to new uses that are incompatible with range activities or is not considered by the military to be a potential range area. A closed range is still under the control of a Component. (MGDERP, March 2012)

Defense Sites – Locations that are or were owned by, leased to, or otherwise possessed or used by the Department of Defense. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used for or was permitted for the treatment or disposal of military munitions. (10 U.S.C. 2710(e)(1))

Department of Defense Components – The Office of the Secretary of Defense (OSD), the Military Departments, the Defense Agencies, the Department Field Activities, and any other Department organizational entity or instrumentality established to perform a government function. (MRSPP, 32 CFR Part 179, October 2005)

Discarded Military Munitions (DMM) – Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations. (10 U.S.C. 2710(e)(2))

Explosive Ordnance Disposal (EOD) Personnel – Active duty military personnel of any military service branch that are trained in the detection, identification, field evaluation, safe rendering, recovery, and final disposal of explosive ordnance and of other munitions that have become an imposing danger, for example, by damage or deterioration. (Handbook on the Management of Munitions Response Actions, Interim Final, EPA, May 2005)

Facility – A building, structure, or other improvement to real property, in relation to work classification. (10 U.S.C. 2801)

Formerly Used Defense Sites (FUDS) – Facility or site (property) that was under the jurisdiction of the Secretary of Defense and owned by, leased to, or otherwise possessed by the United States at the time of actions leading to the contamination by hazardous substances. By the DoD Environmental Restoration Program (ERP) policy, the FUDS program is limited to those real properties that were transferred from DoD control prior to 17 October 1986. FUDS properties can be located within the 50 States, District of Columbia, Territories, Commonwealths, and possessions of the United States. (FUDS Program Policy, ER 200 3-1, May 2004)

Hazardous Substance – (A) Any substance designated pursuant to Section 1321(b)(2)(A) of title 33, (B) any element, compound, mixture, solution, or substance designated pursuant to Section 9602 of this title, (C) any hazardous waste having the characteristics identified under or listed pursuant to Section 3001 of the Solid Waste Disposal Act [42 U.S.C. 6921] (but not including any waste the regulation of which under the Solid Waste Disposal Act [42 U.S.C. 6901 et seq.] has been suspended by Act of Congress), (D) any toxic pollutant listed under section 1317(a) of title 33, (E) any hazardous air pollutant listed under Section 112 of the Clean Air Act [42 U.S.C. 7412], and (F) any imminently hazardous chemical substance or mixture with respect to which the Administrator has taken action pursuant to Section 2606 of Title 15. The term does not include petroleum, including crude oil or any fraction thereof, which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas). (CERCLA, 42 U.S.C. § 9601 et seq.)

Installation (as defined by the RMIS Data Element Dictionary for a Federal Facility Identification [FFID]) – The FFID number is a unique identifier, assigned to an installation/property in RMIS. The 14-character aggregate string is used in RMIS as the key column for each data table and is used to track all associated records for each installation. An installation may have a single range or multiple ranges (and each range may have more than one site contained within its boundaries) and a single or multiple sites, not associated with a range. (Management Guidance for the Defense Environmental Restoration Program, September 2001)

Land Use Controls (LUCs) – Physical, legal, or administrative mechanisms that restrict the use of, or limit access to, contaminated property in order to reduce risk to human health and the environment. Physical mechanisms encompass a variety of engineered remedies to contain or reduce contamination and/or physical barriers to limit access to property, such as fences or signs. The legal mechanisms are generally the same as those used for institutional controls (ICs) as discussed in the NCP. ICs are a subset of LUCs and are primarily legal mechanisms imposed to ensure the continued effectiveness of land use restrictions imposed as part of a remedial decision. Legal mechanisms include restrictive covenants, negative easements, equitable servitudes, and deed notices. Administrative mechanisms include notices, adopted local land use plans and ordinances, construction permitting, or other existing land use management systems that may be used to ensure compliance with use restrictions (MGDERP, March 2012). Continuing obligations under Section 292.12 of the Wisconsin Statutes are a form of IC.

Material Potentially Presenting an Explosive Hazard (MPPEH) – Material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris), or material potentially containing a high enough concentration of explosives such that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization or disposal operations). Excluded from MPPEH are munitions within DoD's established munitions management system and other hazardous items that may present explosion hazards (e.g., gasoline cans, compressed gas cylinders) that are not munitions and are not intended for use as munitions. (DoD Instruction 4140.62, Management and Disposition of MPPEH, 2008)

Military Installation – A base, camp, post, station, yard, center, or other activity under the jurisdiction of the Secretary of a Military Department, or, in the case of an activity in a foreign country, under the operational control of the Secretary of a military department or the Secretary of Defense, without regard to the duration of operational control. (10 U.S.C. 2801)

Military Munitions – All ammunition products and components produced for or used by the Armed Forces for national defense and security, including ammunition products or components under the control of the Department of Defense, the Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives and chemical warfare agents; chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, and demolition charges; and devices and components of any item thereof. The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, nuclear components, other than non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) have been completed. (10 U.S.C. 101(e)(4))

Military Range – Designated land and water areas set aside, managed, and used to research, develop, test, and evaluate military munitions, other ordnance, or weapon systems, or to train military personnel in their use and handling. Ranges include firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, and buffer zones with restricted access and exclusionary areas. (40 CFR 266.201)

Munitions and Explosives of Concern (MEC) – Military munitions that are 1) unexploded ordnance, as defined in 10 U.S.C. 101(e)(5); 2) abandoned or discarded, as defined in 10 U.S.C. 2710(e)(2); 3) MC (e.g., TNT, RDX) present in soil, facilities, equipment, or other materials in high enough concentrations so as to pose an explosive hazard. (MRSPP, 32 CFR Part 179, October 2005)

Munitions Constituent (MC) – Any material that originates from UXO, DMM, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C. 2710(e)(4))

Munitions Debris – Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal. (DoD 6055.09-M)

Munitions Response – Response actions, including investigation, removal actions, and remedial actions, to address the explosives safety, human health, or environmental risks presented by UXO, DMM, or MC or to support a determination that no removal or remedial action is required. (MRSPP, 32 CFR Part 179, October 2005)

Munitions Response Area (MRA) – Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples include former ranges and munitions burial areas. A munitions response area is comprised of one or more munitions response sites. (MRSPP, 32 CFR Part 179, October 2005)

Munitions Response Site (MRS) – A discrete location within an MRA that is known to require a munitions response. (MRSPP, 32 CFR Part 179, October 2005)

Operational Range – A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities, or although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities. (10 U.S.C. 101(e)(3))

Outlier – An outlier is an observation that lies an abnormal distance from other values in a random sample from a population. In a sense, this definition leaves it up to the analyst (or a consensus process) to decide what will be considered abnormal. Before abnormal observations can be singled out, it is necessary to characterize normal observations.

Pollutant and Contaminant – These terms include, but are not be limited to, any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring; except that the term pollutant or contaminant shall not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of paragraph (14) and shall not include natural gas, liquefied natural gas, or synthetic gas of pipeline quality (or mixtures of natural gas and such synthetic gas). (CERCLA, 42 U.S.C. § 9601 et seq.)

Range Activities – Research, development, testing, and evaluation of military munitions, other ordnance, and weapons systems; and the training of members of the Armed Forces in the use and handling of military munitions, other ordnance, and weapons systems. (10 U.S.C. 101(3)(2))

Range-Related Debris – Debris, other than munitions debris, collected from operational ranges or from former ranges (e.g., targets, military munitions packaging and crating material). (DoD 6055.09-M)

Range Residue – Material, including but not limited to, parts and sections of practice bombs, artillery, small arms, mortars, projectiles, bombs, missiles, rockets, rocket mortars, targets, grenades, incendiary devices, experimental items, demolition devices, and any other material fired on or discovered on a range. (AFI 13-212, Range Planning and Operations, August 2001)

Real Property – Real estate owned by the United States and under the control of the DoD. Includes lands, buildings, structures, utilities systems, improvements and appurtenances thereto. Includes equipment attached to and made part of buildings and structures (such as heating systems) but not moveable equipment (such as plant equipment). (MGDERP, March 2012)

Relative Risk – The evaluation of individual sites to determine high, medium, or low relative risk to human health and the environment, based on contaminant hazards, migration pathways and receptors, in accordance with the DoD's *Risk-Based Site Evaluation Primer*. (MGDERP, March 2012)

Removal – The cleanup or removal of released hazardous substances from the environment. Such actions may be taken in the event of the threat of release of hazardous substances into the environment, such actions as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances, the disposal of removed material, or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release. The term includes, in addition, without being limited to, security fencing or other measures to limit access, provision of alternative water supplies, temporary evacuation and housing of threatened individuals not otherwise provided for, action taken under Section 9604(b) of this title, and any emergency assistance which may be provided under the Disaster Relief and Emergency Assistance Act [42 U.S.C. 5121 et seq.] The requirements for removal actions are addressed in 40 CFR §§300.410 and 300.415. The three types of removals are emergency, time-critical, and non-time critical removals. (CERCLA, 42 U.S.C. § 9601 et seq.)

There are three types of removals:

1) Emergency – Emergency removal or response is performed when an immediate or imminent danger to public health or the environment is present and action is required within hours. Trained responders identify the explosive threat and make the decision as to whether the munitions and explosive of concern should be moved or blown in place and ensure the threat is removed safely and expeditiously.

2) Time-critical – A response to a release or threat of release that poses such a risk to public health (serious injury or death), or the environment, that cleanup or stabilization actions must be initiated within six months.

3) Non-time critical – An action initiated in response to a release or threat of a release that poses a risk to human health and welfare, or the environment. Initiation of removal cleanup actions may be delayed for six months or more.

Risk Reduction – The movement of any site from a higher to lower relative risk category as a result of natural attenuation, interim remedial, remedial, or removal actions taken. (DoD Instruction 4715.7, Environmental Restoration Program, April 1996)

Site (as defined in the Restoration Management Information System Data Element Dictionary for a SITE_ID) – A unique name given to a distinct area of an installation containing one or more releases or threatened releases of hazardous substances treated as a discreet entity or consolidated grouping for response purposes. Includes any building, structure, impoundment, landfill, storage container, or other site or area where a hazardous substance was or has come to be located, including formerly used sites eligible for building demolition/debris removal. Installations and ranges may have more than one site. (MGDERP, March 2012)

Stakeholder – Groups or individuals who were interested in, concerned about, affected by, who had a vested interest in, or would be involved in the munitions response at an MRA/MRS.

Transferred Range – A property formerly used as a military range that is no longer under military control and had been leased by the DoD, transferred, or returned from the DoD to another entity, including federal entities. This includes a military range that is no longer under military control but was used under the terms of a withdrawal, executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager. (MGDERP, March 2012)

Transferring Range – A military range that is proposed to be transferred or returned from the DoD to another entity, including federal entities. This includes a military range that is used under the terms of a withdrawal, executive order, act of Congress, public land order, special-use permit or authorization, right-of-way, or other instrument issued by the federal land manager or property owner. An operational or closed range will not be considered a “transferring range” until the transfer is imminent. (MGDERP, March 2012)

Unexploded Ordnance (UXO) – Military munitions that have been primed, fuzed, armed, or otherwise prepared for action and have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material, and remain unexploded either by malfunction, design, or any other cause. (10 U.S.C. 101(e)(5))

UXO Technicians – Personnel who are qualified for and filling Department of Labor, Service Contract Act, Directory of Occupations, and contractor positions of UXO Technician I, UXO Technician II, and UXO Technician III. (Department of Defense Explosive Safety Board TP18, December 2004)