FINAL

Site Inspection Report for Fort Devens, Ayer, MA

DERP FUDS Project No. **D01MA058701**

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Massachusetts Army National Guard, located on the former grenade range (MRS 1), Ayer, MA

December 2011

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Prepared Under: **Contract No. W912DY-04-D-0017**
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CONTRACTOR STATEMENT OF AUTHORSHIP AND INDEPENDENT TECHNICAL REVIEW

Human Factors Applications, Inc. (HFA), a wholly-owned subsidiary of TerranearPMC LLC (TPMC), prepared this Site Inspection Report for Fort Devens, Ayer, MA, Formerly Used Defense Site (FUDS), Project No. D01MA058701. An independent technical review was conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Programmatic Work Plan. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of assumptions; methods, procedures, and material used in analyses; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with existing Corps policy. In accordance with Corps requirements, significant authors to this report are presented below.

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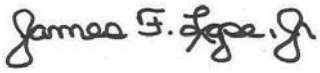
Jim Lape Risk Assessor Integral Consulting, Inc. (Under contract to TPMC/HFA)	12/29/11	
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Significant concerns and explanation of the resolutions are documented within the project file.

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LIST OF ACRONYMS AND ABBREVIATIONS

Alion	Alion Science and Technology Corporation
AP	Anti-Personnel
ASR	Archive Search Report
AWQC	National Ambient Water Quality Criteria
BG	Background
bgs	Below ground surface
BRAC	Base Realignment and Closure
CAS	Chemical Abstract Service
CDQAR	Chemical Data Quality Assessment Report
CENAB	Corps of Engineers North Atlantic Division Baltimore District
CENAE	Corps of Engineers North Atlantic Division New England District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHE	Chemical Warfare Materiel Hazard Evaluation
CNFZ	Clinton Newbury Fault Zone
CONUS	Continental United States
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
CQAR	Chemical Quality Assurance Report
CSM	Conceptual Site Model
CTT	Closed Transferring and Transferred
CWM	Chemical Warfare Materiel
CX	Center of Expertise
DA	Department of the Army
DC	Design Center
DERP	Defense Environmental Restoration Program
DMM	Discarded Military Munitions
DNB	Dinitrobenzene
DNT	Dinitrotoluene
DoD	Department of Defense
DoI	Department of Interior
DQI	Data Quality Indicator
DQO	Data Quality Objective
DWS	Drinking Water Standard
Eco-SSL	Ecological Soil Screening Level
EDMS	Environmental Data Management System
EDS	Environmental Data Services, Inc.
EHE	Explosive Hazard Evaluation
EM	Engineering Manual

LIST OF ACRONYMS AND ABBREVIATIONS

EOD	Explosive Ordnance Disposal
EP	Engineering Pamphlet
˚F	Degree (s) Fahrenheit
ft	Foot or Feet
FUDS	Formerly Used Defense Site(s)
FUDSMIS	FUDS Management Information System
GI	Gastro-intestinal
GIS	Geographic Information Systems
HFA	Human Factors Applications, Inc.
HHE	Health Hazard Evaluation
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
HRS	Hazard Ranking System
HTRW	Hazardous Toxic and Radiological Waste
ID	Identification
In.	Inch (es)
INPR	Inventory Project Report
J	Analyte is present. Reported value may not be accurate or precise.
LC50	Lethal concentration that kills 50% of test animals in a given time.
M	Model
MassDEP	Massachusetts Department of Environmental Protection
MC	Munitions Constituents
MCL	Maximum Contaminant Level
MD	Munitions Debris
MDL	Method Detection Limit
MEC	Munitions and Explosives of Concern
mg/kg	Milligram per kilogram
MHC	Massachusetts Historical Commission
mi	mile(s)
Mk	Mark
mm	millimeter(s)
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MQO	Measurement Quality Objective
MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol

LIST OF ACRONYMS AND ABBREVIATIONS

msl	Mean Sea Level
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAD	North American Datum
NB	Nitrobenzene
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDAI	No Department of Defense Action Indicated
NG	Nitroglycerin
NSL	No Screening Level
NTCRA	Non-Time Critical Removal Action
OEW	Ordnance and Explosive Waste
ORNL	Oak Ridge National Laboratory
PACE	People of Ayer Concerned about the Environment
PFSP	Programmatic Field Sampling Plan
PGM	Program Manager
PM	Project Manager
PMMQL	Preferred Maximum Method Quantitation Limits
PWP	Programmatic Work Plan
PWS	Performance Work Statement
QA	Quality Assurance
QC	Quality Control
QR	Qualitative Reconnaissance
QSM	Quality Systems Manual
RAC	Risk Assessment Code
RAGS	Risk Assessment Guidance for Superfund
RBC	Risk-Based Concentration
RCWM	Recovered Chemical Waste Materiel
RfD	Reference Dose
RI/FS	Remedial Investigation /Feasibility Study
RL	Reporting Limit
RMIS	Restoration Management Information System
ROE	Right-of-Entry
ROTC	Reserve Officers Training Corp
SD	Sediment
SHPO	State Historic Preservation Office
SI	Site Inspection
SL	Screening Level
SLERA	Screening Level Ecological Risk Assessment

LIST OF ACRONYMS AND ABBREVIATIONS

SS	Surface Soil
SSL	Soil Screening Level
SS-WP	Final Site-Specific Work Plan Addendum to the MMRP Programmatic Work Plan for the Site Inspection of Fort Devens
SW	Surface Water
T&E	Threatened and Endangered
TCRA	Time Critical Removal Action
TNB	Trinitrobenzene
TNT	Trinitrotoluene
TPMC	TerranearPMC, LLC
TPP	Technical Project Planning
U	Not detected
µg/L	Microgram per Liter.
UJ	Not detected. The associated detection limit is an estimate and may be inaccurate or imprecise. Value are reporting limits (RLs)
USACE	U.S. Army Corps of Engineers
USAESCH	U.S. Army Engineering and Support Center, Huntsville
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
VB	Viven-Bessiere
WOE	Weight-of-Evidence
WWI	World War I
WWII	World War II

GLOSSARY OF TERMS

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) – Congress enacted CERCLA, commonly known as Superfund, on 11 December 1980. This law created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment (USACE 2004b).

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 USC 2710(e)(2)) (Department of the Army [DA] 2005).

Explosive Ordnance Disposal (EOD) – The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded explosive ordnance and of other munitions that have become an imposing danger, for example, by damage or deterioration (DA 2005).

Explosives Safety – A condition where operational capability and readiness, people, property, and the environment are protected from the unacceptable effects or risks of potential mishaps involving military munitions (DA 2005).

Formerly Used Defense Site (FUDS) – A FUDS is defined as a 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 contamination by hazardous substances. By the Department of Defense Environmental Restoration Program (DERP) 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. ER 200-3-1 (May 10, 2004).

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 (DA 2005).

GLOSSARY OF TERMS

Military Munitions – 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 DoD, 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, demolition charges; and devices and components thereof. The term does not include wholly inert items; improvised explosive devices; and nuclear weapons, nuclear devices, and nuclear components, other then nonnuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after required sanitization operations under the Atomic Energy Act of 1954 (42 USC 2011 et seq.) have been completed. (10 USC 101(e)(4)(A) through (C)) (DA 2005).

Munitions and Explosives of Concern (MEC) – This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) Unexploded ordnance (UXO), as defined in 10 USC 101(e)(5); (B) DMM, as defined in 10 USC 2710(e)(2); or (C) Munitions constituents (e.g., trinitrotoluene, hexahydro-1,3,5-trinitro-1,3,5-triazine), as defined in 10 USC 2710(e)(3), present in high enough concentrations to pose an explosive hazard (DA 2005).

Munitions Constituents (MC) – Any materials originating 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 USC 2710(e)(3)) (DA 2005).

Munitions Debris (MD) – Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal (DA 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 (32 Code of Federal Regulations [CFR] 179.3).

Munitions Response Site (MRS) – A discrete location within a Munitions Response Area that is known to require a munitions response (32 CFR 179.3).

GLOSSARY OF TERMS

Munitions Response Site Prioritization Protocol (MRSPP) – The MRSPP was published as a rule on 5 October 2005. This rule implements the requirement established in Section 311(b) of the National Defense Authorization Act for Fiscal Year 2002 for the DoD to assign a relative priority for munitions responses to each location in the DoD's inventory of defense sites known or suspected of containing UXO, DMM, or MC. The DoD adopted the MRSPP under the authority of 10 USC 2710(b). Provisions of 10 USC 2710(b) require that the DoD assign to each defense site in the inventory a relative priority for response activities based on the overall conditions at each location and taking into consideration various factors related to safety and environmental hazards.

Non-Time Critical Removal Action (NTCRA) – Actions initiated in response to a release or threat of a release that poses a risk to human health or the environment where more than six months planning time is available (USACE 2007).

Range – A designated land or water area that is set aside, managed, and used for range activities of the DoD. The term includes firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access and exclusionary areas. The term also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration. (10 USC 101(e)(1)(A) and (B)) (DA 2005).

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 USC 101(e)(2)(A) and (B)) (DA 2005).

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

Risk Assessment Code (RAC) – An expression of the risk associated with a hazard. The RAC combines the hazard severity and accident probability into a single Arabic number on a scale from 1 to 5, with 1 being the greatest risk and 5 the lowest risk. The RAC is used to prioritize response actions (USACE 2004b).

Time Critical Removal Action (TCRA) – Removal actions conducted to respond to an imminent danger posed by the release or threat of a release, where cleanup or stabilization actions must be initiated within 6 months to reduce risk to public health or the environment (DA 2005).

Unexploded Ordnance (UXO) – Military munitions that (A) have been primed, fuzed, armed, or otherwise prepared for action; (B) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (C) remain unexploded whether by malfunction, design, or any other cause. (10 USC 101(e)(5)(A) through (C)) (DA 2005).

EXECUTIVE SUMMARY

ES.1 Under contract with the United States Army Corps of Engineers (USACE), Human Factors Applications, Inc., a wholly-owned subsidiary of TerranearPMC, LLC, prepared this Site Inspection (SI) Report to document SI activities and findings for the Fort Devens Formerly Used Defense Site (FUDS), Property No. D01MA0587, located in Middlesex and Worcester Counties, Ayer, Massachusetts. The Department of Defense (DoD) established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to address potential munitions and explosives of concern (MEC) and munitions constituents (MC) remaining at the FUDS. This SI is completed under MMRP Project No. D01MA058701 and addresses potential MMRP hazards remaining at the Fort Devens FUDS.

ES.2 Site Inspection Objectives and Scope. The primary objective of the MMRP SI is to determine if the FUDS project warrants further action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The SI collects the minimum amount of information necessary to make this determination. The SI also (i) determines the potential need for a Time Critical Removal Action (TCRA); (ii) collects or develops additional data, as appropriate, for potential Hazard Ranking System (HRS) scoring by the United States Environmental Protection Agency (USEPA); and (iii) collects data, as appropriate, to characterize the hazardous substance release for effective and rapid initiation of the remedial investigation/feasibility study (RI/FS). An additional objective of the SI is to collect the data necessary to evaluate munitions response sites (MRSs) using the Munitions Response Site Prioritization Protocol (MRSPP).

ES.3 The scope of the SI is restricted to the evaluation of the presence of MEC or MC related to historical use of the FUDS prior to property transfer. Potential releases of hazardous, toxic, or radioactive waste (HTRW) are not within the SI scope.

ES.4 Fort Devens. The United States leased approximately 11,000 acres in 1917 and created Fort Devens. Fort Devens was used during World War I (WWI) and World War II (WWII) as a training facility, and reception and demobilization center for soldiers in the New England region. During interwar periods, Fort Devens was alternatively placed under caretaker status or was used as a training area by the Reserve Officers' Training Corp (ROTC), National Guard, and Army Reserve. As the necessity for Fort Devens decreased, portions of Fort Devens were transferred to other non-DoD entities.

ES.5 Technical Project Planning. The SI approach was developed in concert with stakeholders through USACE's technical project planning (TPP) framework, which was applied at the initial

TPP meeting on 27 January 2009. Stakeholders agreed to the SI approach as presented and modified during the TPP meeting and finalized in the Site-Specific Work Plan (SS-WP). In summary, these agreements specified inspecting the MRSs and completing soil, sediment, surface water and groundwater sampling in accordance with the Data Quality Objectives (DQOs) and Final SS-WP.

ES.6 Munitions Response Sites. USACE programmatic range documents identified two MRS areas at the Fort Devens FUDS that cover approximately 183.5 acres: MRS 1 - WWI Grenade Range (Restoration Management Information System [RMIS] Range ID No. D01MA058701R01) (11.4 acres) and MRS 2 - Range Complex No. 1 (RMIS Range ID No. D01MA058701R02) (143.6 acres). [1]

ES.7 Qualitative Reconnaissance. SI field activities were performed on 17–20 August 2009 and 22 June 2010. Although the Final SSWP issued in June 2009 proposed sampling and reconnaissance within the PanAm Railways portion of MRS 1, a Right of Entry (ROE) agreement could not be established between PanAm Railways and USACE; therefore, no fieldwork was conducted within the PanAm Railways property during the August 2009 field event. The August 2009 Fort Devens field work focused on the eastern portion of MRS 1 within property under control of the Commonwealth of Massachusetts (Army National Guard) and the MRS 2 property (owned by the Town of Ayer). Based on internal discussion between the contractor and the USACE during development of the SI Report, the decision was made that for the completeness of the MRSPP and SI for MRS 1, it would be advantageous to pursue an ROE agreement with PanAm Railways in order to complete the field investigation of this portion of MRS 1.

ES.8 After further negotiation, PanAm Railways agreed to allow access to this portion of MRS 1 under the supervision of a railroad safety officer. An addendum to the Final SS-WP was issued on 11 June 2010 and additional field work was conducted at MRS 1 in June 2010. A total of 139,760 ft^2 (3.2 acres) of land were assessed during the two field events using analog Qualitative Reconnaissance (QR). Additionally, 85,660 ft^2 (1.96 acres) of visual reconnaissance was completed at the northern and southern portions of MRS 1 along the PanAm railroad tracks. The field sampling approach included magnetometer-assisted reconnaissance following a meandering path in and around sampling locations to identify the presence/absence of MEC/munitions debris (MD) or other areas of interest (i.e. areas containing indications of munitions use) at the FUDS.

[1] Acreage discrepancies exist between the ASR Supplement and the current USACE GIS data. See ES.20 Recommendations on page ES-5 for further explanation.

ES.9 During the 2009 SI field event, one item of MD (an expended 7.62 mm shell casing) was discovered within MRS 2. Additionally, cultural debris (refuse/trash) was observed on the surface and underground utilities were detected by the magnetometer. No MEC or MD items were observed during the June 2010 field event.

ES.10 Munitions and Explosives of Concern Assessment. A qualitative MEC screening level risk assessment was conducted based on the SI QR, historical data documented in the Inventory Project Report (INPR), Archives Search Report (ASR), and the ASR Supplement. Historical records did not indicate the quantity of munitions used and/or fired at the FUDS.

ES.11 A MEC explosive safety hazard level is based on the presence or absence of a MEC source, the accessibility or pathway to that source, and potential receptor contact with the source. A clearance conducted in 1995 found several items of inert scrap (MD) south of MRS 1. Each of these items were outside of the FUDS property. The 1997 ASR FUDS property visit discovered a the end of a claymore mine firing wire (inert) inside the MRS 1 boundary that was determined to be MD. During the August 2009 and June 2010 SI field events, no MEC or MD was observed in MRS 1. The access to MRS 1 is limited because a chain-link fence surrounds the area; however, human interaction is characterized as moderate due to the active Army National Guard installation and active PanAm Railways rail yard. Based on this information, the MEC hazard is low at MRS 1.

ES.12 A 1995 clearance discovered an expended M18 smoke grenade (inert/MD) west, and outside, of the MRS 2 boundary (outside of the FUDS). The 1997 ASR FUDS property visit did not observe any MEC/MD in MRS 2. During the 2009 SI field event, one expended 7.62 mm shell casing (MD) was observed within MRS 2. Access to MRS 2 is partially restricted because a chain-link fence surrounds most of the area. The Town of Ayer operates a wastewater treatment plant within the MRS; therefore, human interaction is considered moderate. Based on this information, the MEC hazard at MRS 2 is expected to be low. The overall MEC hazard for the Fort Devens FUDS is low.

ES.13 Munitions Constituents Sampling. At MRS 1, a total of nine surface soil, two subsurface soil, one sediment, and one surface water sample were collected within the Army National Guard and PanAm Railway properties and analyzed for a reduced list of explosive constituents. Additionally, one groundwater sample was collected northeast of the Army National Guard property boundary and analyzed for explosive constituents.

ES.14 Five surface soil and two sediment samples were collected within MRS 2 and analyzed for a select list of metals and explosive constituents. Two surface water samples were analyzed for perchlorate and a list of select explosive constituents. One groundwater sample was collected from a preexisting well on the northwestern boundary of MRS 2.

ES.15 In addition, three surface soil samples were collected east of the MRS 2 boundary to support background metals analysis. Background surface water and sediment samples were collected from the southern shore of Grove Pond to support perchlorate and metals analyses, respectively. A background groundwater sample was collected from a preexisting well northeast of Ayer, in the vicinity of Spectacle Pond, to support background comparison of perchlorate analyses.

ES.16 A list of MC potentially associated with munitions used at MRS 1 and MRS 2 was developed and used to support analysis of results and the risk screening. The list of site-specific MC analyzed at MRS 1 included the explosive constituents nitroglycerin (NG), tetryl, trinitrotoluene (TNT), and TNT breakdown products (2,4,6-TNT; 1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2-Amino-4,6-Dinitrotoluene (DNT); 4-Amino-2,6-DNT, and Nitrobenzene). Per stakeholder agreement in the SSWP, metals were not sampled due to the industrialized and developed nature of MRS 1. The list of site-specific MC analyzed at MRS 2 included explosive constituents (DNT and DNT breakdown products {2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, and 4-nitrotoluene} and NG), metals (aluminum, antimony, barium, copper, iron, lead, magnesium, nickel, strontium and zinc) and perchlorate (water only).

ES.17 Risk Screening. Tetryl was the only explosive constituent detected in any media sampled at MRS 1 (soil, sediment, groundwater, surface water). Tetryl was detected in a single surface soil sample (DEV-PA-SS-01-05), at a concentration below the screening levels selected for the HHRA and SLERA. No Chemicals of Potential Concern (COPC) or Chemicals of Potential Ecological Concern (COPEC) were identified within MRS 1.

ES.18 No explosive constituents were detected within any media sampled at MRS 2. In surface soil, the maximum detected concentration of two analytes, aluminum and iron, exceeded human health screening criteria and background. These MCs were identified as COPCs. However, weight-of-evidence (WOE) evaluations determined that there are no unacceptable risks associated with exposure to these MCs in surface soil. In surface soil, lead exceeded the ecological screening criterion (and was therefore identified as a COPEC), but not background. No COPCs were identified in sediment; however, lead was determined to be a COPEC because it

exceeded the ecological screening criterion. No unacceptable risk to ecological receptors in sediment was determined based on a WOE evaluation. Perchlorate was detected in groundwater; however, none of the detected concentrations exceeded the screening criterion for perchlorate. Analysis of surface water yielded no detections of explosive constituents or perchlorate within MRS 2. Therefore, no additional risk from FUDS related activity is expected.

ES.19 Recommendations.

- MRS 1 - WWI Grenade Range: A No Department of Defense Action Indicated (NDAI) designation is recommended at MRS 1. The MEC hazard is low and there were no MEC or MD observed during the 2009 and 2010 SI field events. Subsurface soil, surface water, sediment and groundwater analysis yielded no MC detections. Tetryl was detected in one surface soil sample. This detection was below the HHRA and SLERA screening levels (Table ES-1).

- MRS 2 - Range Complex No. 1: An NDAI designation is recommended at MRS 2. The MEC hazard is low. No MEC was observed during the SI. One expended 7.62 mm shell casing was found within MRS 2; however, expended small arms shell casings do not pose an explosive hazard. There were no exceedances of screening criteria in surface water or groundwater samples. COPCs and COPECs identified in surface soil and sediment were determined not to pose unacceptable risks to receptors based on a WOE evaluation.

ES.20 Acreage discrepancies for the FUDS property and MRS ranges exist between the ASR Supplement and the Geographic Information Systems (GIS) data provided by USACE for this SI. The ASR Supplement states that the total FUDS property acreage is 183.5; however based on revised GIS data provided by the USACE during the creation of the SS-WP, the total FUDS acreage as shown in this SI is 151.6 (yellow boundary shown in figures in this SI). The difference, 31.9 acres, is northeast of MRS 1 and is not eligible for the FUDS program since it is currently occupied and used by the National Guard. Furthermore, the acreages provided in the ASR Supplement for MRS 2, Range Complex No. 1, total 143.6 acres, comprised of three sub-ranges 79.2, 93.8, and 3.8 acres. The MRS 2 range sizes in the GIS data and reflected in the figures in this SI Report total 1,450.4 acres, but includes acreage that was determined in the ASR Supplement to be ineligible for FUDS due to their Base Realignment and Closure (BRAC) status. The ASR Supplement also does not include the Training Area sub-range of MRS 2 located in the northern FUDS portion as a distinct area. MRS 1 is 9.6 acres according to the GIS data and 11.4 acres according to the ASR Supplement. USACE should revise the USACE GIS data to match the MRS boundaries shown in the ASR Supplement. Additionally, USACE should

revise the INPR to remove the ineligible portions (range safety fans for MRS 2) of the FUDS property and match the USACE ASR Supplement GIS FUDS property.

ES.21 A TCRA or non-TCRA is not recommended at the Fort Devens FUDS (Table ES-1).

Table ES-1. Summary of MRS Recommendations for Fort Devens (FUDS Project No. D01MA058701)

MRS	Recommendation	Basis for Recommendation	
		MEC	**MC**
MRS 1 – WWI Grenade Range	NDAI designation TCRA/NTCRA not recommended	MEC Assessment: Low hazard One piece of MD, the end of a claymore mine firing wire, was observed during the 1997 ASR FUDS property visit. No MEC or MD was observed during the 2009 and 2010 SI field events.	***Surface Soil**:* Tetryl was detected in surface soil. No exceedance of screening criteria. No COPCs or COPECs. ***Subsurface Soil***: No MCs were detected. The subsurface soil pathway is not complete for human receptors. No COPCs. ***Sediment**:* No MCs were detected. The sediment pathway is incomplete for human receptors. It remains potentially complete for ecological receptors due to the failure of several MCs to meet their MQO for sensitivity for the SLERA. No COPCs or COPECs. ***Groundwater**:* No MCs were detected. The groundwater pathway remains potentially complete for human receptors due to the failure of several MCs to meet their MQO for sensitivity for the HHRA. No COPCs. ***Surface water**:* No MCs were detected. The surface water pathway is not complete for human or ecological receptors. No COPCs or COPECs. ***Risk Screening Assessment**:* No unacceptable risks to human or ecological receptors identified from exposure to MC in surface and subsurface soil, groundwater, sediment or surface water.
MRS 2 – Range Complex No. 1	NDAI designation TCRA/NTCRA not recommended	MEC Assessment: Low hazard One expended 7.62mm shell casing (MD) was observed during the 2009 SI field event. No MEC was observed.	***Surface soil**:* Aluminum and iron exceeded human health screening criteria and background concentrations; therefore, both were identified as COPCs. Lead exceeds the ecological screening criterion and was identified as a COPEC; however, lead does not exceed background concentrations. ***Sediment**:* Several metals detected. No exceedance of human health screening criteria (no COPCs). Lead exceeded the ecological screening criteria and background concentrations; therefore, it was identified as a COPEC. ***Groundwater**:* Perchlorate detected. No exceedance of human health screening criteria (no COPCs). ***Surface Water**:* No MCs were detected. Pathway is not complete. No COPCs or COPECs identified. ***Risk Screening Assessment**:* No unacceptable risks to human or ecological receptors identified from exposure to MC in surface soil, groundwater, sediment or surface water.
General: USACE should revise the GIS acreage to match the ASR Supplement.			

ASR – Archives Search Report	MRS – Munitions Response Site
COPC – Chemical of Potential Concern	NDAI – No Department of Defense Action Indicated
COPEC – Chemical of Potential Ecological Concern	NG - Nitroglycerin
FUDS – Formerly Used Defense Site	NTCRA – Non-Time Critical Removal Action
HHRA – Human Health Risk Assessment	RI/FS – Remedial Investigation/Feasibility Study
MC – Munitions Constituents	SI – Site Investigation
MD – Munitions Debris	SLERA – Screening Level Ecological Risk Assessment
MEC – Munitions and Explosives of Concern	TCRA – Time Critical Removal Action
MQO – Measurement Quality Objective	WW – World War

1 INTRODUCTION

1.0.1 This report documents the findings of the Military Munitions Response Program (MMRP) Site Inspection (SI) performed at the Fort Devens Formerly Used Defense Site (FUDS) located in Middlesex and Worchester Counties, Massachusetts with the MMRP Project No. D01MA058701. Human Factors Applications, Inc. (HFA), a wholly-owned subsidiary of TerranearPMC, LLC (TPMC), along with support from its subcontractors (Environmental Data Services, Inc. [EDS]; Integral Consulting, Inc.; and TestAmerica, Inc.) prepared this report under contract to the United States Army Engineering and Support Center, Huntsville (USAESCH). This work is being performed in accordance with Contract No. W912DY-04-D-0017, Task Order 00170001 for FUDS in the Northeast Region of the Continental United States. USAESCH transferred management of the contract to the Corps of Engineers North Atlantic Division Baltimore District (CENAB). CENAB is working with Corps of Engineers North Atlantic Division New England District (CENAE) and its contractor on the completion of this project in accordance with the SI Performance Work Statement (Appendix A).

1.0.2 The technical approach to this SI is based on the *Programmatic Work Plan for Formerly Used Defense Sites Military Munitions Response Program Site Inspections at Multiple Sites the Northeast Region* (Alion 2005 and 2009), the *Final Site-Specific Work Plan* (SS-WP) *Addendum to the MMRP Programmatic Work Plan for the Site Inspection of Fort Devens* (Alion 2008b), and the *Addendum to the June 2009 Final Site-Specific Work Plan for the Site Inspection of Fort Devens* (Alion 2010).

1.1 Project Authorization

1.1.1 The Department of Defense (DoD) established the MMRP to address sites suspected of containing munitions and explosives of concern (MEC) or munitions constituents (MC). Under the MMRP, the U.S. Army Corps of Engineers (USACE) is conducting environmental response activities at FUDS for the Army, as DoD's Executive Agent for the FUDS program.

1.1.2 Pursuant to USACE's Engineer Regulation 200-3-1 (USACE 2004b) and the *Management Guidance for the Defense Environmental Restoration Program (DERP)* (DoD 2001), USACE is conducting FUDS response activities in accordance with the DERP statute (10 USC 2701 et seq.), the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 USC Section 9620), Executive Orders 12580 and 13016, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations

Part 300). As such, USACE is conducting SIs, as set forth in the NCP, to evaluate hazardous substance releases or threatened releases from eligible FUDS.

1.1.3 While not every MEC/MC constitutes CERCLA hazardous substances, pollutants, or contaminants, the DERP statute provides DoD the authority to respond to releases of MEC/MC, and policy states that such responses shall be conducted in accordance with CERCLA and the NCP.

1.2 Project Scope and Objectives

1.2.1 The primary objective of the MMRP SI is to determine if the FUDS project warrants further response action under CERCLA. The SI collects the minimum amount of information necessary to make this determination. The SI (i) determines the potential need for a removal action; (ii) collects or develops additional data, as appropriate, for potential Hazard Ranking System (HRS) scoring by the U.S. Environmental Protection Agency (USEPA); and (iii) collects data, as appropriate, to characterize the hazardous substance release for effective and rapid initiation of the remedial investigation/feasibility study (RI/FS). An additional objective of the MMRP SI is to collect additional data necessary to evaluate munitions response site (MRS) using the Munitions Response Site Prioritization Protocol (MRSPP).

1.2.2 The scope of the SI is restricted to the evaluation of the presence of MEC or MC related to historical use of this FUDS prior to property transfer. The evaluation is performed through records review, qualitative reconnaissance (QR) to assess MEC presence/absence, and sampling where MC might be expected based on the conceptual site model (CSM). Evaluation of potential releases of hazardous, toxic, and radioactive waste (HTRW) is not within the scope of this SI.

1.3 Project Location

1.3.1 The Fort Devens FUDS is located in Ayer, Massachusetts and consists of three non-contiguous parcels (Figure 1-1). The North American Datum (NAD) 1983 Universal Transverse Mercator (UTM) Zone 19N, easting (X) and northing (Y) coordinates for the approximate center of the southern FUDS, which includes two parcels, is 286908 meters (m) and 4713453 m, respectively; and the northern FUDS area is 286004 m and 4715794 m, respectively. This FUDS falls under the geographical jurisdiction of CENAE and is being completed under DERP-FUDS Project No. D01MA058701 to address the potential MMRP hazards remaining (USACE 2004a).

1.4 Munitions Response Site Prioritization Protocol

1.4.1 This SI Report includes draft MRSPP rankings for MRS 1 (WWI Grenade Range) and MRS 2 (Range Complex No. 1) [Appendix K]. The MRSPP scores will be updated on an annual basis, or when necessary, to incorporate new information, as appropriate.

Ft. Devens

Ayer, Massachusetts
Middlesex and Worcester County

Legend

FUDS Boundary

Imagery Source: USGS (1965/04/06)

FUDS boundary: USACE (2004a)

N
W E
S

Feet
0 500 1,000 2,000

Figure 1-1. Historical Property Layout

2 SITE DESCRIPTION

2.1 Site Description and History

2.1.1 The Department of War leased 11,000 acres in 1917 and created Camp Devens, a reception center for draftees (USACE 1997). After WWI, the camp was used as a demobilization center. The Army began purchasing portions of the land, and by 1921 owned approximately 4,876 acres. In the 1920s, the camp was used as a target bombing field. The area was also used by the National Guard and the U.S. Army Reserve for training. In 1929, the area was used for rocket testing by R.H. Goddard. In 1931, Camp Devens became Fort Devens. After the beginning of WWII, the Fort increased by 5,289.26 acres (total size 10,165.26 acres) via fee, easement, and lease acquisitions. Fort Devens was used for training purposes during the Korean War and Vietnam conflict and sent units to the Middle East in 1990-1991. Fort Devens is comprised of three main areas: North, Main, and South Posts (USACE 1997).

2.1.2 As the necessity for Fort Devens decreased, several FUDS eligible properties were transferred to non-DoD entities. In 1956, Fort Devens turned over 60 acres, located in the former Main Post, to the Commonwealth of Massachusetts to be used by the Army National Guard. The Town of Ayer acquired 76.5 acres located in the former North Post and built a wastewater treatment plant in 1978. An additional 50 acres, located within the Main Post and adjacent to the Army National Guard property, were conveyed to several other entities including the former Boston and Main Railroad (now owned by PanAm Railways) (Figure 2-1). MRS 1 is composed of both the Army National Guard and Railroad properties and is the location of a former grenade range.

2.1.3 Currently, MRS 2 (owned by the Town of Ayer) contains two former sub-ranges and a training area: a 1000” Rifle and Machine-Gun Range (oriented to fire south from FUDS), a 1000” Anti-Tank Range (oriented to fire north from FUDS), and a Training Area (entire northern FUDS area; not shown as part of MRS 2, refer to Paragraph 2.2.3). The two former sub-ranges are shown in orange on Figure 2-1. The northern FUDS property, shown in yellow, is entirely encompassed by the training area.

2.1.4 In 1991, the remaining portions of Fort Devens were placed on the Base Realignment and Closure (BRAC) list (USACE 1997). The portions of Fort Devens included in the BRAC program were not investigated under the MMRP. Separate environmental investigations and restorations outside the purview of DERP FUDS will, and have, addressed the BRAC properties. Fort Devens was closed as an active duty installation in 1996. No evidence was found during the

archival research that would indicate that chemical warfare materiel (CWM) was ever used at the Fort Devens FUDS (USACE 1997).

2.2 Munitions Response Site Identification and Munitions Information

2.2.1 The Archives Search Report (ASR) Supplement identified a WWI Grenade Range (MRS 1) and Range Complex No. 1 (MRS 2) as the areas of interest at the Fort Devens FUDS (USACE 2004a) (Table 2-1). Figure 2-1 identifies the FUDS boundary and the boundaries of MRS 1 and MRS 2 (USACE 2004a). Munitions associated with MRS 1 and 2 were derived from the ASR and ASR Supplement and other USACE data sources and are summarized in Table 2-2 (USACE 1997 and 2004a).

2.2.2 The ASR Supplement defines the size of each MRS[2]. MRS 1 comprises approximately 11.4 acres; and MRS 2 a total of 143.6 acres containing three overlapping sub-ranges (Training Area: 79.2 acres; Rifle and Machine Gun Range: 93.8 acres; Anti-Tank Range: 3.8 acres) according to the ASR Supplement. Figure 2-2 identifies the FUDS boundary, MRS boundaries and the range fans associated with the MRS 2 Rifle and Machine Gun Range and the Anti-Tank Range (USACE 2004a).

2.2.3 The Training Area sub-range was not separately delineated in the USACE-provided geographic information system (GIS) data used to create the figures for this SI, but according to the ASR Supplement, it is located within the northern FUDS boundary. Therefore, the Training Area sub-range is represented in Figure 2-2 and was investigated as part of this SI. The majority of the MRS 2 range fans extend outside of the FUDS boundary. These areas were investigated under the BRAC program, prior to the SI and are not FUDS eligible.

2.3 Physical Setting

2.3.0.1 The following sections provide a physical description of the FUDS property with respect to relief, vegetation, and climate as well as the local demographic and land use.

2.3.1 Topography and Vegetation

2.3.1.1 The Fort Devens FUDS is located within the New England physiographic province. The region was affected by Wisconsin glaciation during the Pleistocene Epoch and is now characterized by rounded, long and narrow hills, called drumlins, consisting of glacial till. The

[2] Acreage discrepancies exist between the ASR Supplement and the current USACE GIS data. For more information regarding these discrepancies see Section 2.4.5.

surficial cover in the area is poorly sorted, with large cobbles and boulders (USACE 1997). Lakes and swamp areas are numerous. To the west of the FUDS, the Nashua River flows to the north and forms a small valley and floodplain. Elevations within the FUDS range from approximately 75 m to 82 m above mean sea level (MSL) (Figure 2-2).

2.3.1.2 Fort Devens is characterized by urban and developed cover types. Some of the more prominent features in the vicinity of the FUDS areas are developed land, a golf course, an airfield, a former municipal dump, and wastewater treatment plant. There are also undeveloped, vegetated areas (Figure 2-2). Early successional forest cover types are common and include black cherry-aspen hardwoods, oak-red maple hardwoods, and white pine-hardwood mixes. Various coniferous species, shrub habitats, and herbaceous covers are also present (URS 2008).

2.3.2 Climate

2.3.2.1 The climate of the Fort Devens area is influenced by the proximity of the Atlantic Ocean, Long Island Sound, and the Berkshire Hills. Local precipitation is abundant and temporally well-distributed. Annual snowfall is approximately 60 inches (in.). Summer temperatures are moderate with a typical mean temperature of 70 degrees Fahrenheit (°F) in July. Winters are cold with the coldest temperatures occurring between December and February and averaging approximately 25 °F (USACE 1997). As recorded at nearby Fitchburg Airport, the maximum temperature in 2009 was 93°F and the minimum temperature was -7°F. The average temperature for 2009, as of this report date, is 50°F (Weather Underground 2009).

2.3.3 Local Demographics

2.3.3.1 The Fort Devens FUDS is located in Middlesex and Worchester Counties, Massachusetts. The population density of Middlesex County is approximately 1,812 people per square mile (mi^2) and Worchester County is 519 people per mi^2. The 2008 Census estimate indicates that there were 1,482,478 people and 595,951 households in Middlesex County and 783,806 people and 315,875 households in Worchester County (U.S. Census Bureau 2009). The majority of the northern FUDS area is open land; however, a portion of the land is occupied by the Town of Ayer wastewater treatment plant. Several light industry buildings are located within the southern FUDS area. There are more than 26 residences within a two mile distance of the boundaries of each MRS; most are within the Towns of Ayer and Shirley (Google Earth 2009) (Figures 2-1 and 2-2). A golf course (recreational area) and educational institutions (Ayer Public Schools) are located within two miles of the MRS boundaries.

2.3.4 Current and Future Land Use

2.3.4.1 The FUDS has highly developed (commercial/industrial uses) and open land areas. The land within MRS 1 is nearly entirely developed and primarily occupied by the Massachusetts Army National Guard, who uses the area as a vehicle and equipment maintenance facility, and a PanAm Railway switching yard. MRS 2 contains undeveloped land and the Town of Ayer wastewater treatment plant. Future use of the Fort Devens FUDS is expected to be the same as the current use (Alion 2009a and b).

2.3.5 Geologic Setting

2.3.5.1 The northern Fort Devens FUDS area is underlain by thinly to massively bedded, light green-grey fine-grained metamorphosed calcareous siltstone, quartzite, and quartzofeldspathic granofels of the Silurian age Berwick Formation. The southern Fort Devens FUDS area is underlain by light to medium grey, buff to pink weathering, coarse-grained quartz-potassium feldspar-biotite granite-gneiss of the Silurian age Devens gneiss complex. The Fort Devens FUDS areas are located within and just west of the Clinton Newbury Fault Zone (CNFZ); a zone characterized by numerous northeast-southwest trending faults. The CNFZ separates two ancient geologic terranes. To the northwest of the CNFZ is the Merrimack terrane characterized by Ordovician to Devonian age metasedimentary rocks with metaigneous intrusives. To the southeast of the CNFZ are mafic, intermediate, and felsic volcanic, volcangenic, and plutonic rocks of the Nashoba terrane (Kopera 2006).

2.3.5.2 The typical soils found in the sampling areas at the Fort Devens FUDS are deep, gently sloping, and excessively drained glacial outwash deposits. These soils (sands, loamy sands, and sandy loams) are typically found on terraces, eskers, and outwash plains. The soil permeability is moderately rapid, and the available water capacity is very low. Seasonal high water tables within the sands, loamy sands, and sandy loams are typically greater than six feet (ft) deep (USDA 2009 and USACE 1997).

2.3.6 Hydrogeologic Setting

2.3.6.1 In the vicinity of Fort Devens, the primary aquifer (Glacial Aquifer) is composed of glacial drift which overlies bedrock. The depth to bedrock within the FUDS areas ranges from surface level to approximately 76 to 146 ft below ground surface (bgs). This aquifer consists of well-sorted sands and gravels, fine sands, silt, and clay and is known as the glacial outwash aquifer. It is capable of supplying large quantities of water (up to 300 gallons per minute) especially in areas that are located in valleys previously deepened by the abrasive affects of glaciation. The aquifer is used by Fort Devens and nearby municipalities as a water supply.

Groundwater is also present in the fractured bedrock beneath the glacial outwash aquifer. Because of fractures in the rock, the bedrock has a low permeability. The bedrock is not capable of supplying large amounts of water and is used for single family domestic water supply in the area of Fort Devens. Bedrock wells in the area of the Fort Devens FUDS typically yield two to ten gallons per minute (ETA 1993; USACE 2003).

2.3.6.2 No surface water bodies are located within the MRS 1 boundary. Grove Pond is approximately 200 m north of the northern tip of MRS 1 (Figure 2-2). One small pond is located within MRS 2. The pond is located along the northern boundary of MRS 2 (Figure 2-2).

2.3.7 Area Water Supply/Groundwater Use

2.3.7.1 The typical movement of groundwater flow, in the absence of pumping or other disturbance, involves recharge in upland areas with groundwater flowing from topographic highs to topographic lows and subsequently discharging into rivers, streams, wetlands, and ponds. This discharge of groundwater maintains the dry weather flow of the rivers and streams (ETA 1993; USACE 2003). Information regarding wells sampled in this SI is provided below (ETA 1993, USGS 2011) (Figure 2-4):

- Grove Pond Well (DEV-FU-GW-00-01)
    - Aquifer: Glacial
    - Depth to bedrock (estimated from nearby wells): Ranges from 114 to 137 ft bgs
    - Surface Elevation: 217 ft above MSL
    - Well Depth: 75 ft bgs
- Well WWTMW-13 (DEV-FU-GW-00-02)
    - Aquifer: Glacial
    - Well depth: 23 ft bgs
    - Surface Elevation: 217 ft above MSL
    - Screened: Between 8 and 23 ft bgs
- Spectacle Pond (Background) Well (DEV-BG-GW-00-01)
    - Aquifer: Glacial
    - Well depth: 45 ft bgs
    - Surface Elevation: 210 ft above MSL

2.3.8 Sensitive Environments

2.3.8.0.1 The following subsections discuss the sensitive environments associated with the FUDS and the process used to determine the necessity for completing an ecological risk assessment at the FUDS.

2.3.8.1 Army Checklist for Important Ecological Places

2.3.8.1.1 In accordance with USACE guidance, the Army Checklist for Important Ecological Places is used to determine if a FUDS requires a screening-level ecological risk assessment (USACE 2006a and 2007) (Table 2-3). Portions of both MRSs 1 and 2 are located within priority and estimated habitats that potentially contain state threatened and endangered (T&E) species as identified in Appendix L – Consultation Letters (MassWildlife 2009a). Additionally, wetlands were identified within MRS 2 (USFWS 2009a). Therefore, a screening level ecological risk assessment is required. No federally listed T&E species are known to be present (USFWS 2009b).

2.3.8.2 Wetlands

2.3.8.2.1 Wetlands are present in the northern FUDS within the Training Area sub-range of MRS 2 at Fort Devens according to the U.S. Fish and Wildlife Service (USFWS 1998 and 2009a) (Figure 2-3). Wetlands were encountered during the field sampling activities conducted at the Fort Devens FUDS. However, the field sampling activities were minimally intrusive and did not impact the FUDS wetlands.

2.3.8.3 Coastal Zones

2.3.8.3.1 The Fort Devens FUDS is not within the Massachusetts Coastal Zone (Massachusetts Office of Coastal Zone Management 2007).

2.4 Previous Investigations for Munitions Constituents and Munitions and Explosives of Concern

2.4.0.1 A summary of previous historical investigations and related discoveries of MEC and MC is provided in the following subsections. CWM was not known to be used or stored at the Fort Devens FUDS (USACE 1997).

2.4.1 Inventory Project Report

2.4.1.1 USACE issued the Inventory Project Report (INPR) for the Fort Devens FUDS in October 1995 (USACE 1995). The USACE INPR determined that the present condition of the project area was the result of prior DoD ownership, utilization, or activity. Moreover, the INPR indicated an environmental restoration project was an appropriate undertaking within the purview of the DERP for FUDS.

2.4.1.2 A site survey summary, project survey summary, risk assessment code (RAC) score, and the Findings and Determination of Eligibility were included in the INPR. The INPR noted that the property was used for training and as a target range. The INPR states that during the summer of 1995, two 3-inch Stokes mortars were located and detonated in place on the railroad yard property (outside of the FUDS and MRS 1) by the Fort Devens Explosive Ordnance Disposal (EOD) unit. It was not stated in the INPR if these items contained explosive materials (MEC) or where inert items (MD). Additionally, in the vicinity of the southern Fort Devens FUDS area, three parts of unfuzed and inert practice hand grenades, one inert French Viven-Bessiere (VB) rifle grenade, and a practice M2 Anti-Personnel (AP) mine were found. These items were each classified as MD and were located to the east and outside the FUDS boundary. In the northern FUDS area one expended M18 Smoke Grenade was found adjacent to the northern boundary of the FUDS. USACE determined that ordnance may still exist due to past use. A RAC score of 2 was assigned to the area. RAC scores range from 1, being the highest category of risk, to 5, being the lowest (USACE 1995).

2.4.2 Archives Search Report

2.4.2.1 The USACE prepared the Archives Search Report (ASR) Findings for Fort Devens in September 1997 (USACE 1997). The ASR Findings include results of previous investigations, a property description, the historical property summary, eligibility as a FUDS, a visual inspection, MEC/Recovered Chemical Warfare Materiel (RCWM) technical data, an evaluation of MEC/RCWM presence at the property, and recommendations. The ASR also includes ordnance technical data sheets, physical and chemical characteristics data sheets, maps, interview transcripts, a visual inspection property report, and photographs, and a preliminary assessment form.

2.4.2.2 During the 1997 ASR property visit, no MEC/MD was found within the northern FUDS area (Town of Ayer property). Within the southwestern FUDS area (PanAm property), an end to a firing wire for a claymore mine (Anti-personnel mine M68) was found. No MEC/MD items were found within the southwestern FUDS area (Army National Guard property) during the 1997 ASR property visit. No documentation was found to indicate the use, storage, or disposal of CWM at the Fort Devens FUDS areas (USACE 1997).

2.4.3 2004 Archive Search Report Supplement

2.4.3.1 The ASR Supplement was prepared for the FUDS in 2004 and documented the range boundaries of the FUDS based on historical documents, munitions used, and other information related to the property. The ASR Supplement identified two MRSs: MRS 1 – WWI Grenade

Range and assigned it Restoration Management Information System [RMIS] Range Identification (ID) D01MA058701R01. MRS 1 is 11.4 acres in size. MRS 2 - Range Complex No. 1 consisted of 3 sub-ranges: Training Area (79.2 acres) – RMIS ID D01MA058701R02-SR01; 1000" Rifle and Machine Gun Range (93.8 acres) – RMIS ID D01MA058701R02-SR02; and 1000" Anti-Tank Range (3.8 acres) – RMIS ID D01MA058701R02-SR03 (Table 2-1 and Figure 2-2). The ASR Supplement assigned a RAC score of 3 and 4 to MRS 1 and 2, respectively (USACE 2004a).

2.4.3.2 The information provided in the ASR Supplement was combined with the information regarding specific munitions presented in the ASR and the ASR property visit and used to generate Table 2-3, which lists the military munitions type and composition for the FUDS. USACE technical documents, manuals, and other technical resources, were used to identify the list of MC associated with each munitions type. As noted in Table 2-3, primers typically constitute 5% or less of the total ammunition weight. The primer associated with small arms is combusted when fired and expended in proximity to the firing point. Due to the diminutive size of the primer components in comparison to other portions of the munition (e.g., propellant), MC associated with the primer were not analyzed for in the SI samples collected. This approach was used in accordance with stakeholder agreements at the TPP meeting (Alion 2009a) and the Final SS-WP (Alion 2009b). A copy of the 2004 ASR Supplement is provided in Appendix L.

2.4.4 HFA Sampling Action

2.4.4.1 During the summer of 1995, the USACE requested two Unexploded Ordnance (UXO) clearance sampling actions to be undertaken by Human Factors Applications, Inc. (HFA) in areas adjacent to the Fort Devens FUDS. The area south of MRS 1 (WWI Grenade Range), outside of the FUDS, yielded only finds of MD including two sand filled 3-inch stokes mortars, three parts of unfuzed and inert practice hand grenades, one inert French VB rifle grenade, and a practice M2 AP mine. No MEC was found within this area (HFA 1995a). In the area adjacent to the northwestern boundary of MRS 2 (Training Area), one expended M18 smoke grenade (MD) was located in close proximity, but outside of, the FUDS boundary. No MEC was found during this sampling action (HFA 1995b).

2.4.5 FUDS Property and MRS Acreage

2.4.5.1 There are discrepancies between the ASR Supplement and the current USACE GIS data used to create the figures for this SI. The acreages that are submitted with this SI are shown in the accompanying Figures, Table 2-2, and GIS data package (located in Appendix H of the Final SI Report). The ASR Supplement states that the total FUDS property acreage is 183.5; however,

based on revised GIS data provided by the USACE during the creation of the SS-WP, the total FUDS acreage as shown in this SI is 151.6 (yellow boundary shown in figures in this SI). The difference, 31.9 acres, is northeast of MRS 1 and is not eligible for the FUDS program since it is currently occupied and used by the National Guard.

2.4.5.2 According to the GIS data used in this SI, MRS 1 is a total of 9.6 acres; however, the acreage shown for MRS 1 in the ASR Supplement is 11.4 acres. The ASR Supplement is likely correct since it is based on property ownership research.

2.4.5.3 The acreages provided in the ASR Supplement for MRS 2, Range Complex No. 1, total 143.6 acres, comprised of three sub-ranges 79.2, 93.8, and 3.8 acres. Also according to the GIS data, the Training Area of MRS 2 is 77.4 acres, the 1000" Rifle and Machine Gun Range is 891 acres, and the 1000" Anti-Tank Range is 482 acres. However, these acreages include large range fans/safety zones beyond the FUDS property boundaries that are ineligible under the FUDS program, as they fall on BRAC property. Therefore, the MRS boundaries end at the FUDS property boundaries and the acreages provided in the GIS data are inaccurate. Additionally the ASR Supplement does not include the Training Area sub-range of MRS 2 as a distinct area.

2.4.6 Citizen Reports of Munitions and Explosives of Concern

2.4.6.1 As discussed in Section 2.4.2.2 and 2.4.4.1, since military use of the FUDS ceased, no MEC/MD have been found by local residents within MRS 1 or 2 (USACE 1997).

2.4.7 Non-Department of Defense Contamination/Regulatory Status

2.4.7.1 There is no evidence, based on historical review and stakeholder comments, that activities occurring prior to or after DoD use of the area contributed to potential MEC, MD, or MC presence within the FUDS boundaries.

Table 2-1. Range Inventory (USACE 2004a)							
FUDS Name	**Range Name**	**Sub-Range Name**	**RMIS ID**	**Acres[2]**	**RAC Score**	**Type Of Munitions**	**Munitions ID**
Fort Devens	MRS 1: WWI Grenade Range	N/A	D01MA058701 R01	11.4 (9.6)	3	Small Arms, General; M21, Practice Hand Grenade; Mk I, VB Rifle Grenade, Live; 3-inch Stokes Mortar	Small Arms (CTT01) Hand Grenades, Practice (CTT06) Rifle Grenades, Live (CTT12)
	MRS 2: Range Complex No. 1	Training Area	D01MA058701 R02-SR01	79.2 (77.4)	4	Small Arms, General .50 Cal. Machine Gun M18, Smoke Grenade; M1, Smoke Pot, HC; M49A1, Flare, Surface; M110, Artillery Flash Simulator; M117, M118, M119, Booby Trap Simulator; M116A1, Grenade Simulator; M115A2 Artillery Simulator; M125A1, M158, M159, Signal, Illumination; M17A1, M19A1, M21A1, M51A1, Signal, Illumination; M62, M64, M65, M66, Signal, Smoke	Small Arms (CTT01) Hand Grenades (Incendiary, Smoke)(CTT 04) Flares, Signals, Simulators or Screening Smoke (other than white phosphorous) (CTT35)
		1000" Rifle and Machine Gun Range	D01MA058701 R02-SR02	93.8 (891)	5	Small Arms, General	Small Arms (CTT01)
		1000" Anti-tank Range	D01MA058701 R02-SR03	3.8 (482)	5	Small Arms, General	Small Arms (CTT01)

[1] The combined MRS acreage for Range Complex No 1 is 143.6 acres. This does not include double-counted acreage (USACE 2004).
[2] Acreages from the GIS data provided in this SI are shown in parentheses.

Table 2-1. Range Inventory (USACE 2004a)							
FUDS Name	**Range Name**	**Sub-Range Name**	**RMIS ID**	**Acres[2]**	**RAC Score**	**Type Of Munitions**	**Munitions ID**
CTT = Closed, Transferring, Transferred FUDS = Formerly Used Defense Site ID = Identification M = Model Mk = Mark				N/A= Not Applicable RAC = Risk Assessment Code RMIS = Restoration Management Information System VB = Viven-Bessiere WWI = World War I			

Table 2-2. FUDS Property and MRS Acreage (USACE 2004a)				
FUDS Property	**MRS**	**Sub-Range**	**ASR Supplement Acreage**	**USACE-Provided GIS Data Acreage Used in this SI**
Total FUDS	-	-	183.5	151.6
Commonwealth of Massachusetts – Army National Guard	-	-	Not Specified	31.3
PanAm Railways	-	-	Not Specified	42.9
Town of Ayer	-	-	Not Specified	77.4
-	MRS 1 – WWI Grenade Range	-	11.4	9.6
	MRS 2 – Range Complex No. 1	Training Area	79.2	77.4*
		1000” Rifle and Machine Gun Range	93.8	891
		1000” Anti-Tank Range	3.8	482
* Note: This acreage was not provided by USACE but is calculated from the GIS in accordance with the description of the Training Area provided in the ASR Supplement. This acreage is the total area of the northern portion of the FUDS (yellow polygon on Figure 2-1) minus the two areas in orange that represent the other two sub-ranges.				

Table 2-3. Military Munitions Type and Composition (USACE 2004a and other sources)

Range ID (MRS)	Subrange	Munitions ID	Munitions Type	Composition (explosives and metallic components) [c,d,e,f]	Associated MC Analysis[a,b,g]
MRS 1 - WWI Grenade Range	N/A	Hand Grenades, Practice (CTT06)	M21, Practice Hand Grenade	**Fuze and Primer:** Lead sulfocyanate, potassium chlorate, ground glass, barium nitrate, TNT, antimony sulfide, aluminum tetracene, zinc, silicon, calcium silicide **Delay Column:** Barium chromate, potassium perchlorate, nickel, zirconium-nickel alloy **Expellant Charge and Filler:** Black powder (sodium or potassium nitrate, charcoal, sulfur)	**Explosive Constituents:** NG, Tetryl, and TNT **Metals:** None **Note:** Samples collected were not analyzed for metals due to the extensive redevelopment and industrial presence at MRS 1.
		Rifle Grenades, Live (CTT12)	Mk I, VB Rifle Grenade, Live	**Main Charge:** Tetryl or TNT **Body:** Iron, steel, copper **Fuze:** Meal and black powder	
		Stokes Mortars (CTT 22)	3-inch Stokes Mortars	**Fuze and Primer:** Potassium chlorate, antimony sulfide, mercury fulminate, black powder **Filler:** Amatol 50-50 (Ammonium Nitrate & TNT) or Tridite (Picric acid & dinitrophenol) **Booster:** Tetryl or TNT **Propelling Charge:** Ballistite (NG, NC, diphenylamine, graphite)	
MRS 2 - Range No. 1	1000" Rifle and Machine Gun Range / 1000" Anti-Tank Range	Small Arms (CTT01)	Small arms, general (.22 to .50 caliber)	**Projectile:** Lead antimony alloy, copper, iron, zinc **Propellant:** Nitrocellulose, black powder, nitroglycerin, dinitrotoluene, diphenylamine, dibutylphthalate, polyester adipate, graphite, ethyl centralite, potassium nitrate, barium nitrate, calcium carbonate, sodium sulfate, potassium sulfate **Primer:** Lead styphanate, barium nitrate, ground glass, tetracene, antimony sulfide, nitrocellulose, PETN, potassium chlorate	**Metals:** Antimony, copper, iron, lead, zinc **Explosive Constituents:** NG and DNT **Note:** Both metals and explosive constituents associated with small arms were analyzed for at each sample location. Although MRS 1 is encompassed in the MRS 2, 1000" Rifle/Submachine Gun Range fan, due to the presence of a target berm during the use of the range, samples collected at MRS 1 were not analyzed for MC associated with MRS 2.

Table 2-3. Military Munitions Type and Composition (USACE 2004a and other sources)					
Range ID (MRS)	**Subrange**	**Munitions ID**	**Munitions Type**	**Composition (explosives and metallic components)[c,d,e,f]**	**Associated MC Analysis[a,b,g]**
MRS 2 - Range No. 1	Training Area	Screening Smoke (other than white phosphorous)(CTT35)	M18, M62, M64, M65, M66 signal smoke	**Propellant:** Nitrocellulose, nitroglycerin, ethyl centralite, potassium nitrate, dinitrotoluene, dibutylphthalate, diphenylamine, potassium sulfate **Charge+Igniter:** Black powder, nitrocellulose, fuze powder **Smoke:** Red dye, potassium perchlorate, sugar, diatomaceous earth, dibenzpyrene-3,4,8,9 Dione 5, 10, sodium bicarbonate, green dye, violet dye	**Explosive Constituents:** NG, DNT **Metals**: Aluminum, barium, copper, lead, magnesium, nickel, strontium **Other**: Perchlorate **Note:** Select metals and explosives associated with the Training Range munition items were analyzed for at each sample location.
		Flares, signals, simulators, screening smoke (CTT35)	M17A1, M19A1, M19A1B1, M21A1, M21A1B1, M49A1, M51A1, , M51A1B1, M110, M115A2, M116A1 M117, M118, M119, M125A1, M158, M159 [colored illum.; artillery, booby trap, and grenade simulators]	**Propellant:** Nitrocellulose, nitroglycerin, ethyl centralite, potassium nitrate, black powder, smokeless powder (nitrocellulose, dinitrotoluene, diphenylamine) **Assoc. Metals:** Aluminum, barium chromate, barium nitrate, barium oxalate, copper, lead azide, lead styphnate, magnesium, nickel, potassium perchlorate, strontium nitrate	

Table 2-3. Military Munitions Type and Composition (USACE 2004a and other sources)

[a] Complete munitions were expended at Fort Devens; therefore, MC related to the entire munition were sampled in this SI with the exception of the diminutive size components described in note d.

[b] DNT and TNT and their break-down products currently on the approved PWP (Alion 2005) explosive constituents analysis (2,4- and 2,6-dinitrotoluene; 2-amino-4,6-dinitrotoluene; 2- and 3-nitrotoluene; 4-amino-2,6-dinitrotoluene; 4-nitrotoluene and 2,4,6-trinitrotoluene; 1,3,5-trinitrobenzene; 1,3-dinitrobenzene; 2-amino-4,6-dinitrotoluene; 4-amino-2,6-dinitrotoluene, nitrobenzene) were analyzed.

[c] Simple single-based nitrocellulose readily breaks down in the environment and is not expected to persist while more complex nitrocellulose may persist longer in the environment (Duran et al. 1994). Nitrocellulose is not considered toxic, and consequently no risk-based screening values have been developed for the compound. Furthermore, there are no chemical analysis techniques that quantify nitrocellulose separately from the natural common essential nutrient nitrate. Based on this rationale, no sampling for nitrocellulose was conducted.

[d] Fuzes and other internal components (e.g. primer, delay columns, igniters) represent a small percentage by weight of the MC of concern in comparison to other portions of the munition (e.g., propellant). Additionally, the primer is typically combusted when fired. Therefore, due to the diminutive size of these components, MC associated with these were not analyzed for in the SI samples collected.

[e] Black powder is a rapidly burning material that, when fired, leaves little residue as either decomposition products or un-combusted compounds and the constituents of black powder are not expected to persist in the environment above background concentrations for a significant period of time after initial exposure. Black powder is not anticipated to be present or detected after the operations ceased over 50 years ago, therefore no constituents of black powder were analyzed (Interstate Technology and Regulatory Council [ITRC] 2003; USACE 2007b).

[f] Shell casings would have been removed and recycled and therefore not present at the firing point (USACE 2006b).

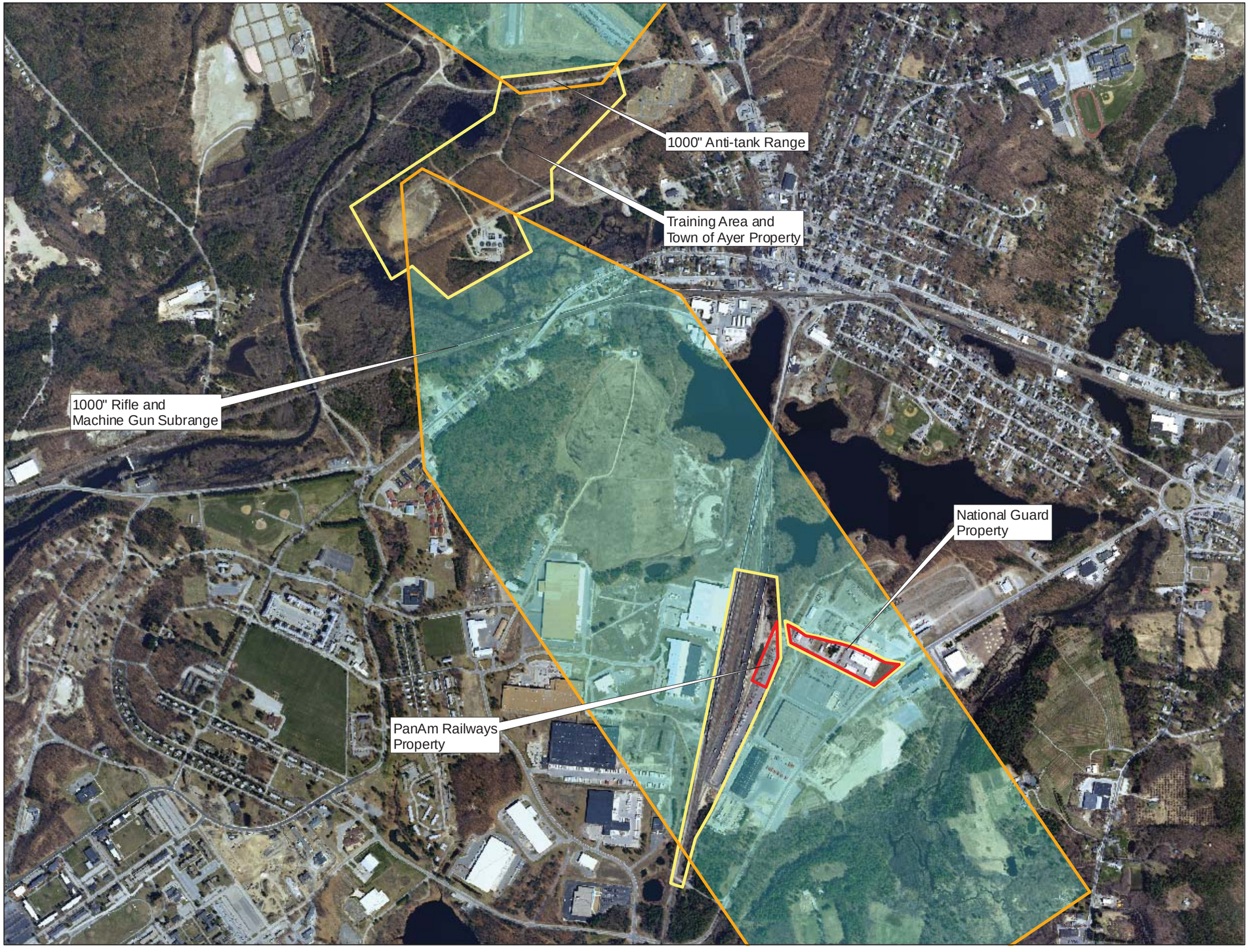
[g] Chemicals that are not CERCLA hazardous substances (e.g., aluminum, barium, iron) can be reported in the SI; however, the SI risk evaluation and conclusions will include a discussion of the limitations of the FUDS program to respond to such chemicals. Non-CERCLA chemical concentrations do not provide the basis for a RI/FS recommendation for MC in the SI Report.

Table 2-4. Army Checklist for Important Ecological Places

No.	Checklist Item	Yes / No		Comments
1.	Locally important ecological place identified by the Integrated Natural Resource Management Plan, Base Realignment and Closure Act Cleanup Plan or Redevelopment Plan, or other official land management plans.		No	
2.	Critical habitat for Federally designated endangered or threatened species. See No. 12 below.		No	
3.	Marine Sanctuary		No	
4.	National Park		No	
5.	Designated Federal Wilderness Area		No	
6.	Areas identified under the Coastal Zone Management Act		No	
7.	Sensitive Areas identified under the National Estuary Program or Near Coastal Waters Program		No	
8.	Critical areas identified under the Clean Lakes Program		No	
9.	National Monument		No	
10.	National Seashore Recreational Area		No	
11.	National Lakeshore Recreational Area		No	
12.	Habitat known to be used by Federally designated or proposed endangered or threatened species		No	
13.	National preserve		No	
14.	National or State Wildlife Refuge		No	
15.	Unit of Coastal Barrier Resources System		No	
16.	Coastal Barrier (undeveloped)		No	
17.	Federal land designated for protection of natural ecosystems		No	
18.	Administratively Proposed Federal Wilderness Area		No	
19.	Spawning areas critical for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters		No	
20.	Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which fish spend extended periods of time		No	
21.	Terrestrial areas utilized for breeding by large or dense aggregations of animals		No	
22.	National river reach designated as Recreational		No	
23.	Habitat known to be used by state designated endangered or threatened species	Yes		The Fort Devens FUDS is located within a Priority and/or Estimated Habitat which may have endangered species present (MassWildlife 2009).

Table 2-4. Army Checklist for Important Ecological Places

No.	Checklist Item	Yes / No		Comments
24.	Habitat known to be used by species under review as to its Federal endangered or threatened status		No	
25.	Coastal Barrier (partially developed)		No	
26.	Federally designated Scenic or Wild River		No	
27.	State land designated for wildlife or game management		No	
28.	State-designated Scenic or Wild River		No	
29.	State-designated Natural Areas		No	
30.	Particular areas, relatively small in size, important to maintenance of unique biotic communities		No	
31.	State-designated areas for protection or maintenance of aquatic life		No	
32.	Wetlands	Yes		Freshwater Emergent Wetland / Freshwater Forested-Shrub Wetlands identified in MRS 2.
33.	Fragile landscapes, land sensitive to degradation if vegetative habitat or cover diminishes		No	



Ft. Devens

Ayer, Massachusetts
Middlesex and Worcester County

Legend

- MRS 1 – WWI Grenade Range
- MRS 2 – Range Complex No. 1
- FUDS Boundary
- FUDS Ineligible Portion of MRS 2

Imagery Source: Massachusetts Geographic Information System (2005)

FUDS/MRS boundaries (USACE 2009)

N
W E
S

Feet
0 500 1,000 2,000

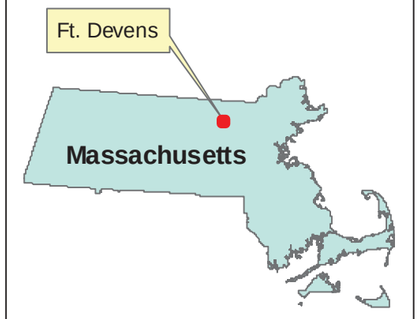


Figure 2-1. Munitions Response Property Boundary

Ft. Devens

Ayer, Massachusetts
Middlesex and Worcester County

Legend

- FUDS Boundary
- MRS 1 – WWI Grenade Range
- MRS 2 – Range Complex No. 1

Training Area Sub-range

Imagery Source: ESRI NGS 2D Topo Web Service

FUDS/MRS boundaries (USACE 2009)

N W E S

0 1,000 2,000 4,000 Feet

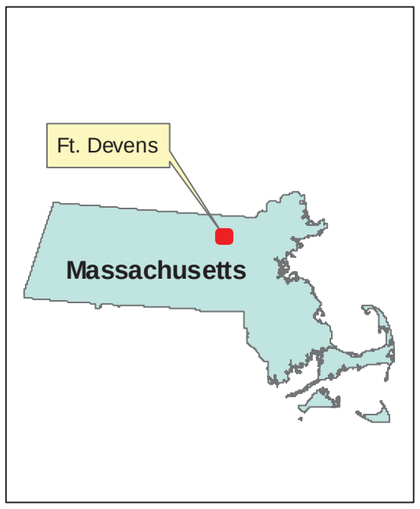


Figure 2-2. General Property Location

Ft. Devens

Ayer, Massachusetts
Middlesex and Worcester County

Legend

- MRS 1 – WWI Grenade Range
- MRS 2 – Range Complex No. 1
- FUDS Boundary
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Other

Imagery Source: ESRI NGS 2D Topo Web Service

FUDS/MRS boundaries (USACE 2009)

N
W E
S

Feet
0 1,000 2,000 4,000

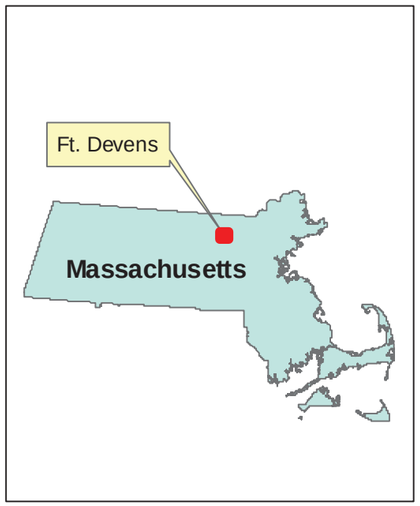


Figure 2-3. Topography and Wetlands in the vicinity of the FUDS.

Ft. Devens

Ayer, Massachusetts
Middlesex and Worcester County

Legend

- Groundwater Wells Sampled
- Public Community/Non-Community Water Supply Wells
- ¼, ½, 1, 2, 4 Mile Radii
- FUDS Boundary

Imagery Source: ESRI NGS Topo US 2D Web Service

Public Water Supply Source: Massachusetts Geographic Information System (2009)

FUDS/MRS boundaries (USACE 2009)

N
W E
S

0 3,750 7,500 15,000 Feet

Figure 2-4. Groundwater Well Locations in Proximity to the FUDS Property

3 SITE INSPECTION ACTIVITIES

3.1 Technical Project Planning

3.1.1 The first TPP Meeting for the Fort Devens FUDS was conducted on 27 January 2009 at the Ayer Town Hall, Ayer, Massachusetts. The Final TPP Memorandum documenting the meeting was issued in March 2009 (Alion 2009a). Representatives from Massachusetts Department of Environmental Protection (MassDEP), MassDevelopment, Town of Ayer, USEPA Region I, Massachusetts National Guard, People of Ayer Concerned about the Environment (PACE), CENAB, CENAE, and HFA participated in this meeting. The participants in the TPP meeting discussed the results of previous investigations, historical and current aerial photographs, the CSM, and Data Quality Objectives (DQOs).

3.1.2 DQO 1 – Determine if the MRS requires additional investigation through an RI/FS or if the MRS may be recommended for a No DoD Action Indicated (NDAI) designation based on the presence or absence of MEC and MC. The basis of an RI/FS recommendation is specified below:

- Historical data that indicate the presence of MEC or MD.
- Visual evidence of MEC/MD or surface anomalies which are classified as MEC or MD.
- One or more anomalies in a target area near historical or current MEC/MD finds or within an impact crater.
- Physical evidence indicating the presence of MEC (e.g., distressed vegetation, stained soil, ground scarring, bomb craters, burial pits).

3.1.2.1 The basis for an RI/FS recommendation related to the presence/absence of MC includes:

- Maximum concentrations at the FUDS exceed USEPA Regional Screening Values based on current and future land use.
- Maximum concentrations at the FUDS exceed USEPA interim ecological risk screening values.
- Maximum concentrations at the FUDS exceed site-specific background levels.
- Data indicating the presence or absence (less than Method Detection Limits [MDL] for metals and less than the Reporting Limit [RL] for explosive constituents) of analytes for which no screening criteria are available are to be used to support the weight-of-evidence (WOE) evaluation of MC at the FUDS.

3.1.2.2 In each of these instances, every line of evidence (e.g., historical data, field data) are to be used to make a final recommendation for an NDAI designation or RI/FS. If none of the above scenarios occur, then a recommendation for an NDAI designation for MEC/MC is a possible option.

3.1.3 DQO 2 – Determine the potential need for a Time Critical Removal Action (TCRA) for MEC and MC by collecting data from previous investigations/reports, conducting visits, performing analog geophysical activities, and by collecting MC samples. The basis for recommendations is specified below:

- A TCRA **–** If there is a complete pathway between source and receptor and if the MEC/MC and the situation are viewed as an imminent danger posed by the release or threat of a release. Cleanup or stabilization actions must be initiated within six months to reduce risk to public health or the environment.
- A non-TCRA (NTCRA) – If a release or threat of release that poses a risk where more than six months planning time is available.

3.1.3.1 In each of these instances, every line of evidence (e.g., historical data, field data) are to be used to make a final recommendation for a TCRA or NTCRA.

3.1.4 DQO 3 – Collect or develop additional data, as appropriate, to support potential Hazard Ranking System scoring by USEPA.

- Verification that data were collected in accordance with the Final SS-WP in the SI Report.

3.1.5 DQO 4 – Collect the additional data necessary to complete the MRSPP.

- Completion of the MRSPP for the MRS with available data and documentation of any data gaps for future annual MRSPP updates.

3.1.6 The participants concurred with the DQOs and the general technical approach for the planned SI activities discussed during the TPP meeting and as revised and subsequently documented in the Final SS-WP and Addendum to the Final SS-WP (Alion 2009b and Alion 2010). In summary, it was agreed to inspect the cited areas of concern and conduct sampling in accordance with the Final SS-WP and complete the assessment in accordance with the DQOs. As part of this SI Report, HFA evaluated the DQOs presented in the SS-WP (Alion 2009b) and

completed a DQO attainment verification worksheet to document completion of the DQOs (Appendix B). The field work conducted as part of the June 2010 SI complied with the DQOs as presented in the Fort Devens Final SS-WP. The four DQOs were attained during this SI. One deviation from
DQO 1 is detailed in Section 3.4.1.

3.2 Supplemental Records Review

3.2.0.1 State and federal agencies were contacted regarding threatened and endangered (T&E) species and cultural and ecological resources at the FUDS property.

3.2.1 Threatened and Endangered Species

3.2.1.1 The USFWS and the Commonwealth of Massachusetts Division of Fisheries and Wildlife (MassWildlife) were contacted regarding the possible presence of federal and state T&E species. According to the USFWS, no federally T&E species are present at the FUDS (USFWS 2009b). According to MassWildlife, MRS 1 is a Priority Habitat 841 for Houghton's Flatsedge. MRS 2 is Priority Habitat 1477 and Estimated Habitat 959 for the Blanding's Turtle, Zebra Clubtail, Blue-Spotted Salamander, Wild Senna, and New England Blazing Star. The area in proximity to well WWTMW-13 is Priority Habitat 1477 and Estimated Habitat 959 for the Blanding's Turtle, Wood Turtle, and Blue-Spotted Salamander (MassWildlife 2008, Appendix L). Priority Habitats are delineated based on records of State-listed Species observed within the 25 years prior to delineation and contained in the Division's NHESP database. Therefore, T&E species are known to be present in the vicinity of MRS 1 and 2 and have been found within the MRS in the past 25 years. The limited activities of the SI field event were exempt from review as an environmental assessment and no further consultation was required for the SI field event activities (321 Code of Massachusetts Regulations, Part 1, Section 10).

3.2.2 Cultural and Archaeological Resources

3.2.2.1 USACE requested information from the Massachusetts Historical Commission (MHC), which is the State Historic Preservation Office (SHPO) for the Commonwealth of Massachusetts, to ensure cultural, archaeological and water resources were not present at the Fort Devens FUDS and/or would not be disturbed during field activities. The MHC provided concurrence on 22 July 2009 with the request letter from USACE indicating that the project would have no effect upon known historic properties (MHC 2009) (Appendix L).

3.3 Site Inspection Fieldwork

3.3.1 Site Inspection Munitions and Explosives of Concern Field Observations

3.3.1.1 On 17 - 20 August 2009, the field team visited the Fort Devens FUDS to conduct SI field activities in accordance with the Programmatic Work Plan and the Final SS-WP (Alion 2005 and 2009b). During the August 2009 field event the western portion of MRS 1 (PanAm Railways) was unable to be investigated due to the lack of a Right-of-Entry (ROE) agreement between USACE and PanAm Railways. Subsequently, Field samples and QR proposed in the Final SS-WP for the PanAm Railways property were relocated to another area within MRS 1, as agreed to by USACE and MassDEP (Appendix C, Record of Communication). However, USACE later decided to further pursue an ROE agreement with PanAm Railways, and one was granted on 6 May 2010. Additional fieldwork was conducted on 22 June 2010 within MRS 1 in accordance with the SS-WP Addendum to the Final SS-WP (Alion 2010). The additional field work included the collection of environmental samples as well as limited magnetometer-assisted and visual QR within the western portion of MRS 1. A total of 139,760 ft^2 (3.2 acres) of land were assessed during the two field events using analog QR. Additionally, 85,660 ft^2 (1.96 acres) of visual reconnaissance was completed at the northern and southern portions of MRS 1 along the PanAm railroad tracks.

3.3.1.2 MRS 1 – WWI Grenade Range: As discussed previously, field work was conducted on the eastern portion of MRS 1 in August 2009 and additional field work was completed in the western portion of MRS 1 in June 2010. Reconnaissance findings are shown on Figures 3-1a and Figure 3-1b. A photograph log is included in Appendix E, and the photograph locations are shown on Figure 3-2. Area observations for both field events are presented below.

- The majority of the Army National Guard property is developed. The property is used for offices and vehicle maintenance. A chain-link fence surrounds the perimeter of the property with the exception of a small strip of land in the northwestern portion of the MRS. The PanAm property is occupied by railroad tracks, railroad storage areas and lightly forested land. Public access is not permitted to either of the properties; therefore, access to MRS 1 and the FUDS is restricted. A small retention basin was observed adjacent to the railroad tracks within MRS 1.
- Six subsurface anomalies were detected in the southeastern portion of the MRS; however these anomalies are suspected to be underground utilities based on above ground features. Reconnaissance was conducted in proximity to a road and a likely utility corridor.

- Numerous pieces of metallic railroad-related debris were observed adjacent to the tracks in the PanAm owned portions of MRS 1. Due to the railroad tracks and large quantity of metallic debris in the vicinity of the tracks only visual reconnaissance was performed in the yard.
- Within the areas where magnetometer-assisted QR was conducted in the forested areas of MRS 1 no subsurface anomalies were detected. Several pieces of cultural debris were observed within these forested areas; none appeared to be related to past military use.
- No MEC or MD was observed within the MRS.
- During the August 2009 sampling event, two surface samples and one subsurface soil sample were collected from the eastern portion of the MRS (National Guard property) and one subsurface soil sample and two surface soil samples were collected from the western portion of the MRS (National Guard property).
- During the June 2010 sampling event a total of five surface soil samples, one sediment sample, and one surface water sample were successfully collected.

3.3.1.3 MRS 2 – Range Complex No. 1: As mentioned previously the range/safety fans of the 1000" Anti-Tank and Rifle and Machine Gun Ranges extend beyond the FUDS boundary (shown in yellow on figures). Areas within the range/safety fans, but outside of the FUDS boundary were part of BRAC property and therefore are not eligible to be investigated as part of this SI. Analog QR of MRS 2 was completed using a ferrous and a multiple-metals geophysics detector (Schonstedt magnetometers and Whites XLT detectors) following a meandering path. The Whites XLT was utilized in and around the former Anti-Tank Range and the Schonstedt was used on the remaining portions of MRS 2. Reconnaissance findings are shown on Figures 3-1a. A photograph log is included in Appendix E, and the photograph locations are shown on Figure 3-2. Area observations are presented below.

- Most of the Town of Ayer property is not developed and heavily wooded. A wastewater treatment plant is located in the southeastern portion of the MRS. The treatment plant is not accessible to the public. The area of the former 1000" Rifle and Machine Gun Range is predominantly open land; however, the firing point of this range is heavily wooded and vegetated. The impact area (i.e., target berm) is no longer visible. The location of the former berm was reworked and disturbed. The area appears to be used as a gravel quarry. A chain-link fence surrounds the perimeter of the 1000" Machine Gun Range and Training Area. The firing point and impact area of the former Anti-Tank Range is heavily wooded. Access to MRS 2 is semi-restricted.
- No subsurface anomalies were detected.
- No MEC was observed within MRS 2.

- One item of MD (an expended 7.62 mm shell casing) was observed approximately 90 m northeast of the 1000" Rifle and Machine Gun Range firing point.

3.3.2 Site Inspection – Munitions Constituents Samples Collected

3.3.2.1 MRS 1 – WWI Grenade Range: During the August 2009 field event four surface soil samples (DEV-MR1-SS-01-01, DEV-MR1-SS-01-02, DEV-MR1-SS-01-03, DEV-MR1-SS-01-04) and two subsurface soil samples (DEV-MR1-SB-02-01 and DEV-MR1-SB-02-02), plus additional quality control (QC) samples and one duplicate sample, were collected within MRS 1. Five surface soil samples (DEV-PA-SS-01-01, DEV-PA-SS-01-02, DEV-PA-SS-01-03, DEV-PA-SS-01-04, and DEV-PA-SS-01-05), one sediment sample (DEV-PA-SD-01-01), and one surface water sample (DEV-PA-SW-00-01) and associated QC samples and three duplicate samples were collected during the June 2010 field event. The soil, sediment and surface water samples were analyzed for select explosive constituents including tetryl and TNT breakdown products (2,4,6-TNT; 1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2-Amino-4,6-DNT; 4-Amino-2,6-DNT, Nitrobenzene) in August 2009 and nitroglycerin (NG), tetryl, and TNT breakdown products in June 2010. NG is found in the propelling charge of the 3-inch Stokes mortar. Samples collected at MRS 1 during the August 2009 event were not analyzed for NG because the Stokes mortars were only observed in the PanAm Railways property, which was not investigated during the 2009 field event. NG was added to the MC list in the Final SS-WP Addendum. As discussed in Section 3.3.1.2, much of the property is developed; therefore, sample collection was restricted to the undisturbed areas (Figures 3-1a and 3-1b). One groundwater sample was collected from a preexisting well located outside of the FUDS boundary, northeast of the MRS and analyzed for tetryl and TNT breakdown products.

3.3.2.2 MRS 2 –Range Complex No. 1: Five surface soil samples (DEV-MR2-SS-01-05, DEV-MR2-SS-01-06, DEV-MR2-SS-01-07, DEV-MR2-SS-01-08, and DEV-MR2-SS-01-09), two sediment samples (DEV-MR2-SD-01-01 and DEV-MR2-SD-01-02), two surface water samples (DEV-MR2-SW-00-01 and DEV-MR2-SW-00-02), and one groundwater sample (DEV-FU-GW-00-02) were collected. In addition, QC samples, one duplicate surface soil sample, one duplicate sediment sample, one duplicate surface water sample, and one duplicate groundwater sample were collected. Surface soil and sediment were analyzed for NG, DNT breakdown products (2,4-DNT; 2,6-DNT; 2-Amino-4,6-DNT; 2-Nitrotoluene; 3-Nitrotoluene; 4-Amino-2,6-DNT, 4- Nitrotoluene) and metals (aluminum, antimony, barium, copper, iron, lead, magnesium, nickel, strontium, and zinc). Two of the five surface soil samples were collected at the firing point of the 1000" Rifle and Machine Gun Range. Two surface soil samples were collected in proximity to the impact area of the 1000" Anti-Tank Range. One surface soil and two sediment samples were collected within the Training Range. The sediment samples were collected from a

small pond located along the northwestern boundary of MRS 2. One groundwater sample was collected from a preexisting well (WMTMW-13), approximately 90 m northwest of the MRS 2 boundary. Two surface water samples were collected from the same pond as the sediment samples, but were not co-located. Groundwater and surface water were analyzed for nitroglycerin, DNT breakdown products and perchlorate.

3.3.2.3 Background Samples: As presented in the Final SS-WP (Alion 2009b), three surface soil samples were collected east of, and outside, the FUDS/MRS 2 boundary (Figure 3-1a). Two background sediment samples were collected from the southern shore of Grove Pond, north of MRS 1. The background soil and sediment samples were analyzed for select metals only (aluminum, antimony, barium, copper, iron, lead, magnesium, nickel, strontium, and zinc). Two background surface water samples were also collected from the south end of Grove Pond and were analyzed for perchlorate. One background groundwater sample was collected from a Town of Ayer public water supply well and analyzed for perchlorate. This well was completed in the glacial aquifer and is located approximately 5 km east of MRS 1.

3.3.3 An MEC screening level risk assessment and reconnaissance findings are discussed in Section 4. MC sample results are discussed in Section 5. As-collected sample locations, designations, rationale, and field observations are summarized in Table 3-1. Sampling locations are depicted on Figure 3-1a and Figure 3-1b. Additional information pertaining to the activities, including field notes, forms, and chain of custodies, are provided in Appendix D. A photo documentation log from the SI is included in Appendix E and photo locations are shown on Figure 3-2.

3.4 Work Plan Deviations and Field Determinations

3.4.1 Deviations from the Final SS-WP (Alion 2009b) and the Addendum to the Final SS-WP (Alion 2010) occurred mostly with respect to sample locations and the amount of QR completed. The total QR performed at the Ft. Devens FUDS exceeded the quantity proposed in the work plans. Samples were moved slightly due to the observed conditions (e.g., vegetation, topography, inaccessibility) and into areas where sampling media were present in adequate quantities. Samples DEV-MR2-SS-01-08 and DEV-MR2-SS-01-09, which were collected during the August 2009 field event, were collected a few meters north of the FUDS boundary, but within the MRS 2 boundary. Direct evidence of the 1000” Anti-Tank impact area could not be found; therefore, these samples were collected on an embankment in the general vicinity of the suspected impact berm, which was a minor deviation from the June 2009 Final SS-WP. As previously discussed, the investigation of the PanAm property was delayed until June 2010 due to initial ROE refusal. Other deviations from the Final SS-WP and the Addendum to the Final

SS-WP were minor in nature and did not affect the quality of data collected. Refer to the DQO Verification Worksheet included in Appendix B.

3.5 Site Inspection Laboratory Data Quality Indicators

3.5.1 This section summarizes the data quality assessment for the Fort Devens SI analytical data. Environmental data from the August 2009 field event were generated by TestAmerica under the 2006 DoD Quality Systems Manual (QSM) Version III[3] (DoD 2006). Environmental samples collected during the June 2010 event were generated by TestAmerica under the 2009 DoD Quality Systems Manual (QSM) Version 4.1 (DoD 2009). Environmental sample results were validated by a third-party validator (EDS) using USEPA Region I Functional Guidelines. The detailed TestAmerica and EDS reports are contained in Appendices F and G, respectively. The data were also analyzed using the Automated Data Review Version 8.1 based on the DoD QSM Version III and 4.1 guidelines, and these results are included in the Environmental Data Management System (EDMS) database. Data Quality Indicators (DQIs) include precision, accuracy, representativeness, completeness, and comparability as well as sensitivity. At Fort Devens, no quality assurance (QA) split samples were collected in accordance with USACE direction. Therefore, the USACE Memorandum for Record-Chemical Quality Assurance Report (CQAR) of Quality Assurance Split Samples is not applicable to this SI Report. However, CENAB provided a Chemical Data Quality Assessment Report (CDQAR) which is included in Appendix G of the Final SI Report.

3.5.2 Precision is a measure of the reproducibility of repetitive measurements of the same process under similar conditions. Precision is determined by measuring the agreement among individual measurements of the same property, under similar conditions, and is calculated as an absolute value. The degree of agreement was expressed as the relative percent difference between the separate measurements (usually matrix spike/matrix spike duplicate [MS/MSD] pairs) and the observed relative percent difference compared to acceptable values. Any differences between MS/MSD pairs for the Fort Devens data were examined and any affected sample results qualified as discussed in the Region I Functional Guidelines. The MS/MSD samples achieved acceptable values, except as noted in the validation reports where the affected samples were qualified appropriately (Appendix G). The evaluation of the qualified analytical data and its validity for use in the risk assessment screening process is presented in Section 5.1.2.2. None of the samples was rejected due to MS/MSD recoveries. Field precision is

[3] The latest version of the DoD QSM, Version 4.1, was issued in April 2009; however, this version was not available during the generation of the August 2009 data. .

measured by the comparison of field duplicate samples to their associated parent samples. The field duplicates met their comparison requirements and were not qualified. The precision DQI was met.

3.5.3 Accuracy is the degree of agreement of a measurement with an accepted reference or true value. Accuracy measures the bias or systematic error of the entire data collection process. To determine accuracy, a sample that has been spiked with a known concentration is analyzed by the laboratory as the MS, MSD, surrogate and blank spikes, or Laboratory Control Spike. EDS assessed accuracy according to Region I Functional Guidelines and assigned qualifiers as appropriate. The laboratory QA samples achieved acceptable values for most analytes, except where qualified appropriately in Appendix G. The evaluation of the qualified analytical data and its validity for use in the risk assessment screening process is presented in Section 5.1.2.2. None of the samples was rejected due to these spikes. The accuracy DQI was met (Appendix G).

3.5.4 Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is achieved through proper development of the field sampling program during the TPP and work plan development. Deviations from the Final SS-WP and Addendum to the SS-WP were minor: sample locations were moved slightly due to site-specific conditions. The samples were collected and analyzed as proposed; therefore, the representative Data Quality Indicator (DQI) was achieved for the Fort Devens FUDS.

3.5.5 Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. Data are complete and valid if the data achieve each acceptance criteria including accuracy, precision, and any other criteria specified by the particular analytical method being used. None of the 268 total analyte results associated with the Fort Devens SI sampling effort was rejected by EDS; therefore, the completeness indicator is 100 percent. The Fort Devens data meet the completeness data quality indicator.

3.5.6 Comparability expresses the confidence with which one data set can be compared to another. The comparability DQI was evaluated with respect to the comparability of sampling results within the data set based on analytical and data validation procedures prescribed in the DQOs. Standard methods for sampling and analyses were followed as documented in the SS-WP; therefore, the comparability DQI was achieved.

3.5.7 Sensitivity is a measure of the screening criteria as they compare to detection limits. If screening criteria are below detection limits (i.e., Reporting Limit (RL) for organics and MDL for inorganics), the certainty of the "non-detected" data to indicate that MCs are present at levels at which no unacceptable risks may occur is called into question.

The laboratory reported to the RL for organics (which represents the lowest concentration at which calibration standards were assessed) and the Method Detection Limit (MDL) for inorganics (which represents the minimum concentration of metal that can be measured and reported with 99% confidence that the analyte concentration is greater than zero). Consequently, if sensitivity Measurement Quality Objectives (MQOs) were achieved for MCs, the RLs (organics) and MDLs (inorganics) are adequate to detect risks at levels of concern for the identified receptor. In this instance, non-detected data sufficiently indicates that no unacceptable risk to receptors is present from the sample or group of samples.

The MQO for sensitivity was achieved for most analyte/receptor/matrix combinations with the exception of NG in soil (human health); 1,3-DNB, 2,4-DNT, 2-nitrotoluene, 3-nitrotoluene, NB, and NG in groundwater (human health); 1,3,5-TNB, 1,3-DNB, and NB in sediment (ecological). In addition, no human health screening values were available for magnesium in soil or sediment. No ecological screening values were available for 1,3,5-TNB, 1,3-DNB, NG, iron, magnesium, and strontium in soil; NG, magnesium, and strontium in sediment; and tetryl or perchlorate in surface water. Uncertainties associated with the cases in which the MQO for sensitivity was not met, and with the absence of screening values, are discussed within the context of analytical sample results in Section 5. This discussion indicates that for this particular FUDS, the absence of screening values does not undermine the certainty with which the determinations of risk for human and ecological receptors can be made.

3.6 Second Technical Project Planning Meeting

3.6.1 Following the completion of the Draft Final SI Report, stakeholders had the opportunity to participate in a second TPP meeting on 12 May 2011 to discuss the findings, conclusions, and recommendations of the Draft Final SI Report; review the MRSPP (Appendix K); and confirm that the project objectives and DQOs were achieved (Alion 2008a and 2008b). Refer to the TPP 2 Memorandum included in Appendix B of this SI Report for a summary of the information discussed during the second TPP meeting. In addition, responses to stakeholder comments on the Draft Final SI Report are included at the end of this Final SI Report

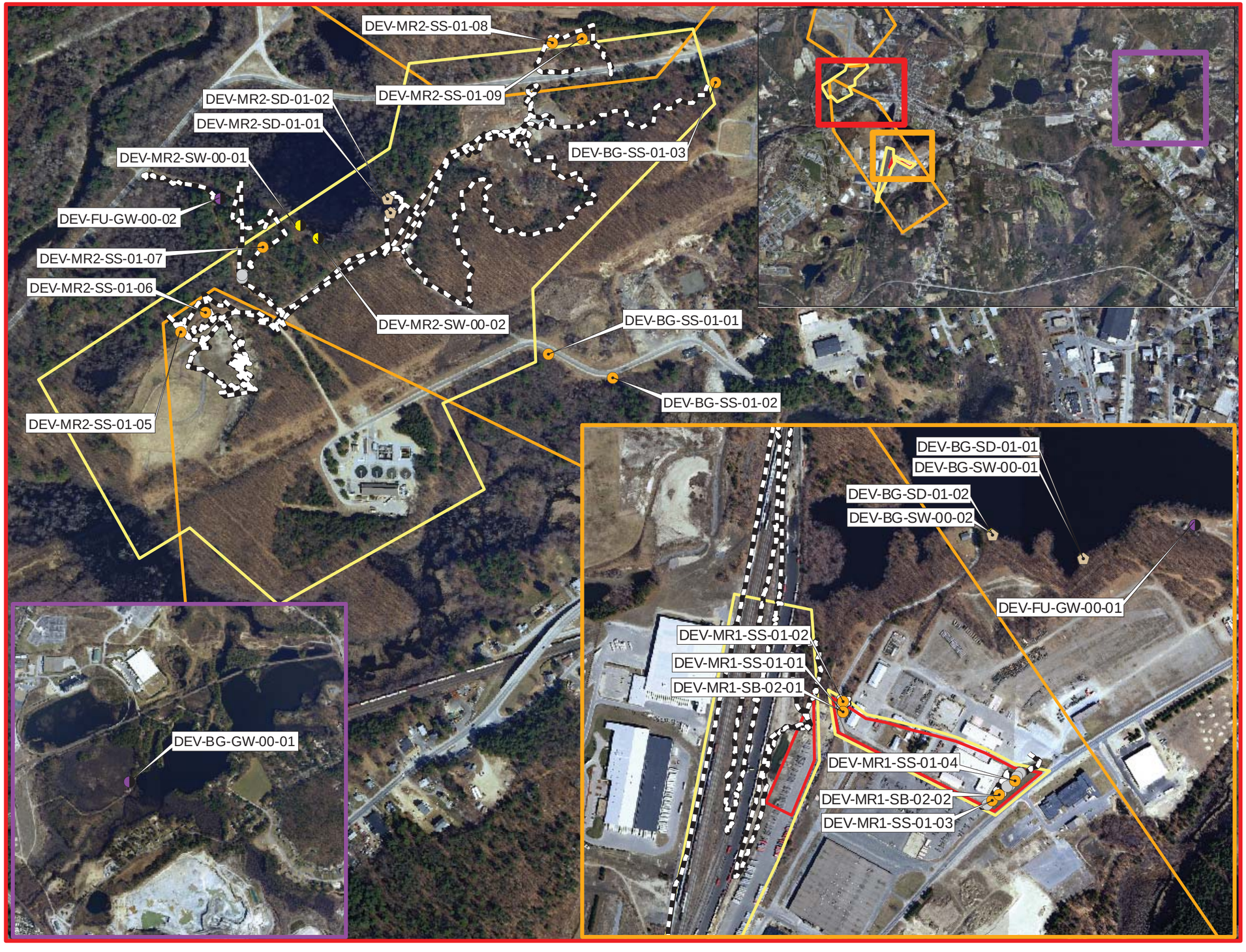
Table 3-1. Fort Devens Sample Locations and Descriptions				
Location	**Sample ID**	**Coordinate System: UTM Zone: 19N Datum: NAD 1983 CONUS**		**Area of Interest and Sampling Location Description (Sample Analyses)**
		Easting(m)	**Northing(m)**	
MRS 1 (WWI Grenade Range)	DEV-MR1-SS-01-01/ DEV-MR1-SB-02-01	287401.1	4713868.3	Collocated surface and subsurface soil samples from the northwestern portion of Commonwealth of Massachusetts property (explosive constituents).
	DEV-MR1-SS-01-02	287401.6	4713887.2	Surface soil sample from the northwestern portion of Commonwealth of Massachusetts property (explosive constituents).
	DEV-MR1-SS-01-03/ DEV-MR1-SB-02-02	287694.6	4713692.7	Collocated surface and subsurface soil samples from the southeastern portion of Commonwealth of Massachusetts property (explosive constituents).
	DEV-MR1-SS-01-04	287739.1	4713732.5	Surface soil sample from the southeastern portion of Commonwealth of Massachusetts property (explosive constituents).
	DEV-FU-GW-00-01	288090.4	4714234.7	Groundwater sample from a preexisting well near Grove Pond north of Commonwealth of Massachusetts property (explosive constituents).
	DEV-PA-SS-01-01*	287351.56	4714006.98	Surface soil sample from the PanAm property (explosive constituents).
	DEV-PA-SS-01-02*	287347.13	4713908.34	Surface soil sample from the PanAm property (explosive constituents).
	DEV-PA-SS-01-03*	287102.05	4713227.18	Surface soil sample from the PanAm property (explosive constituents).
	DEV-PA-SS-01-04*	287054.95	4713151.76	Surface soil sample from the PanAm property (explosive constituents).
	DEV-PA-SS-01-05*	287008.67	4713017.02	Surface soil sample from the PanAm property (explosive constituents).
	DEV-PA-SW-00-01/* DEV-PA-SD-01-01*	287283.87	4713828.44	Collocated surface water and sediment samples from the PanAm property (explosive constituents).
MRS 2 (Range Complex No 1)	DEV-MR2-SS-01-05	285989.4	4715498.6	Surface soil sample from the firing point of the 1000” Rifle and Machine Gun Range (explosive constituents and metals)
	DEV-MR2-SS-01-06	286026.8	4715528.4	Surface soil sample from the firing point of the 1000” Rifle and Machine Gun Range (explosive constituents and metals).
	DEV-MR2-SS-01-07	286111.5	4715625.4	Surface soil sample from the Training Area (explosive constituents and metals).
	DEV-MR2-SS-01-08	286543.3	4715931.4	Surface soil sample from the impact area of the 1000” Anti-Tank Range (explosive constituents and metals).
	DEV-MR2-SS-01-09	286588.0	4715936.5	Surface soil sample from the impact area of the 1000” Anti-Tank Range (explosive constituents and metals).

Table 3-1. Fort Devens Sample Locations and Descriptions				
		Coordinate System: UTM Zone: 19N Datum: NAD 1983 CONUS		
	DEV-MR2-SD-01-01	286302.2	4715677.5	Sediment sample from the bank of a fresh water body in the Training Area (explosive constituents and metals).
	DEV-MR2-SD-01-02	286297.4	4715698.2	Sediment sample from the bank of a fresh water body in the Training Area (explosive constituents and metals).
	DEV-MR2-SW-00-01	286168.3	4715658.4	Surface water sample from the fresh water body in the Training Area (perchlorate and explosive constituents).
	DEV-MR2-SW-00-02	286195.1	4715639.7	Surface water sample from the fresh water body in the Training Area (perchlorate and explosive constituents).
	DEV-FU-GW-00-02	286048.1	4715698.5	Groundwater sample from a preexisting well (WWTMW-13) adjacent to MRS 2. (perchlorate and explosive constituents).
Back-ground Samples	DEV-BG-SS-01-01	286538.2	4715466.3	Surface soil background sample (metals).
	DEV-BG-SS-01-02	286633.9	4715430.6	Surface soil background sample (metals).
	DEV-BG-SS-01-03	286760.1	4715870.3	Surface soil background sample (metals).
	DEV-BG-SW-00-01	287872.3	4714168.1	Surface water background sample (perchlorate).
	DEV-BG-SW-00-02	287694.3	4714216.1	Surface water background sample (perchlorate).
	DEV-BG-SD-01-01	287872.4	4714168.2	Sediment background sample (metals).
	DEV-BG-SD-01-02	287694.4	4714215.5	Sediment background sample (metals).
	DEV-BG-GW-00-01	292787.0	4715097.8	Groundwater background sample from a Town of Ayer preexisting well in the vicinity of Spectacle Pond, east of the Town of Ayer (perchlorate).

Note: See Table 2-2 for specific MC related analyses associated with each area.

*Samples collected during the field activities in June 2010 which was additional to the August 2009 field activities.

BG = Background
CONUS = Continental United States
DEV = Fort Devens
FU = FUDS
GW = Groundwater
ID = Identification
PA = PanAm Property
MR/ MRS = Munitions Response Site
NAD = North American Datum
SD = Sediment Sample
SS = Surface Soil Sample
SW = Surface Water Sample
UTM = Universal Transverse Mercator



Ft. Devens

Ayer, Massachusetts
Middlesex and Worcester County

Legend

- Ground Water Sample
- Sediment Sample
- Surface Soil Sample
- Surface Water Sample
- Anomaly
- Analog Geophysical Reconnaissance
- FUDS Boundary
- MRS 1 – WWI Grenade Range
- MRS 2 – Range Complex No. 1

Imagery Source: Massachusetts Geographic Information System (2005)

FUDS/MRS boundaries (USACE 2009)

N
W E
S

Feet
0 250 500 1,000

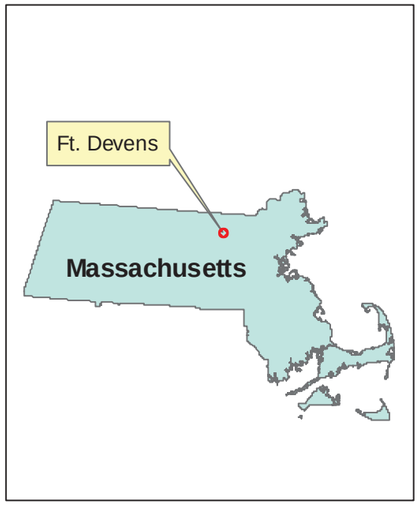
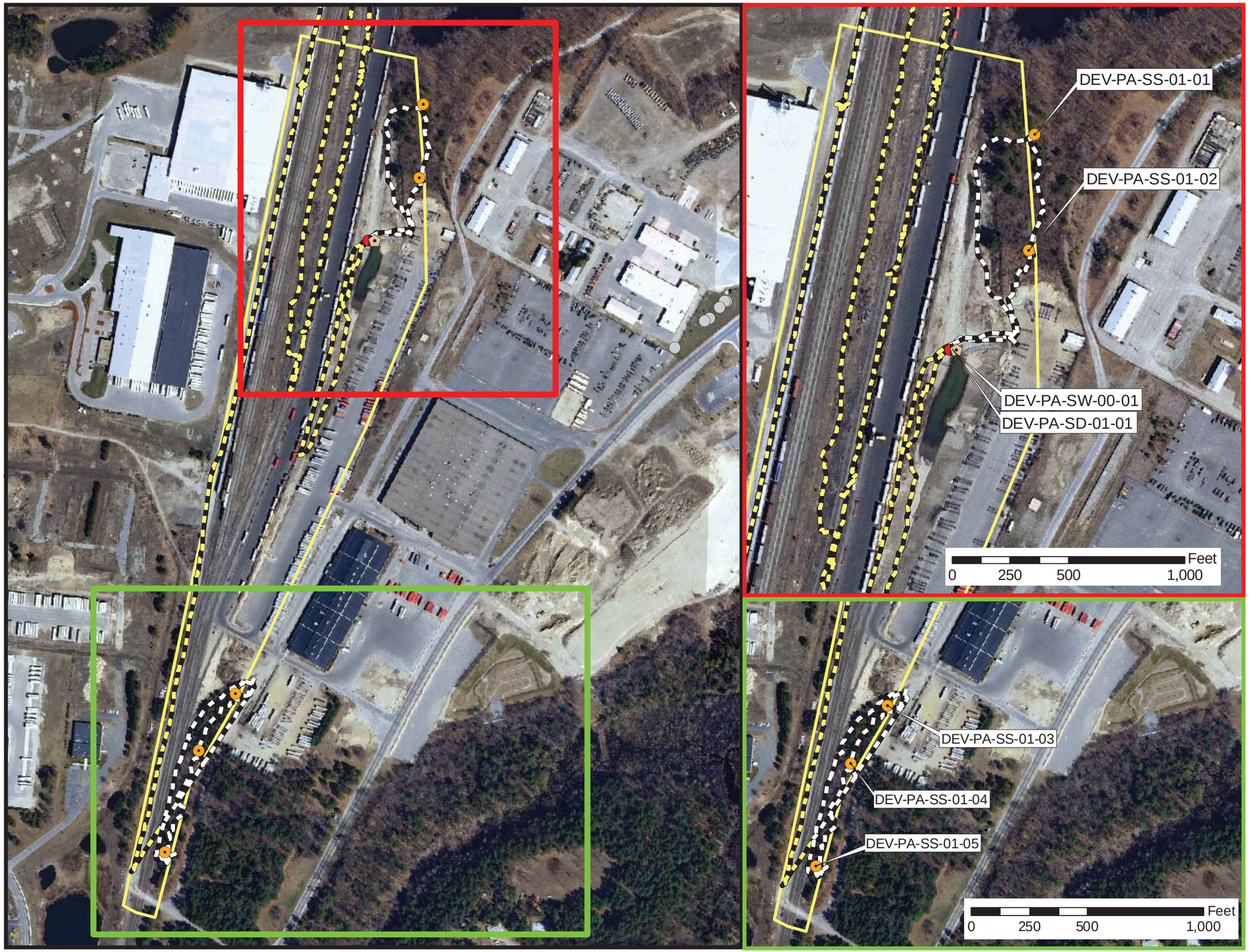


Figure 3-1a. Sample Locations and Geophysical Reconnaissance Route



Ft. Devens

Ayer, Massachusetts
Middlesex and Worcester County

Legend

- Sediment Sample
- Surface Soil Sample
- Surface Water Sample
- Anomaly
- Analog Geophysical Reconnaissance
- Visual Reconnaissance
- FUDS Boundary

Imagery Source: Massachusetts Geographic Information System (2005)

FUDS/MRS boundaries (USACE 2009)

Note: Due to expected magnetic interference, magnetometer assisted QR cannot be completed in the vicinity of railroad tracks or railroad cars.

N
W E
S

Feet
0 250 500 1,000

Figure 3-1b: Reconnaissance and Sample Locations, MRS 1 (PanAm Property).

Ft. Devens

Ayer, Massachusetts
Middlesex and Worcester County

Legend

- Photo Locations
- MRS 1 – WWI Grenade Range
- MRS 2 – Range Complex No. 1
- FUDS Boundary

Imagery Source: Massachusetts Geographic Information System (2005)

FUDS/MRS boundaries (USACE 2009)

N
W E
S

0 500 1,000 2,000 Feet

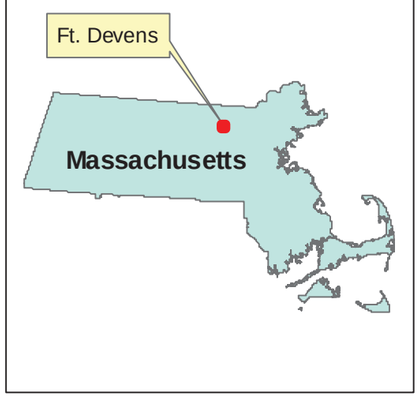


Figure 3-2. Property Inspection Photograph Locations

4 MUNITIONS AND EXPLOSIVES OF CONCERN SCREENING LEVEL HAZARD ASSESSMENT

4.1 Munitions and Explosives of Concern Hazard Assessment Criteria

4.1.1 A qualitative MEC screening level hazard assessment was conducted based on the SI reconnaissance, as well as historical data documented in the INPR, ASR, and ASR Supplement (USACE 1995, 1997, and 2004a). A qualitative hazard evaluation assesses the potential explosive safety hazard at the FUDS and communicates the hazard that may exist at the FUDS and the potential causes of this hazard (USAESCH 2001).

4.1.2 An explosive safety hazard is the probability for an MEC item to detonate and potentially cause harm as a result of human activities. An explosive safety hazard exists if a person can come near or in contact with MEC and act on it to cause a detonation. The potential for an explosive safety hazard depends on the presence of three elements (USAESCH 2001).

- Ordnance and Explosive Factors - a source (presence of MEC)
- Site Characteristics Factors – accessibility and stability
- Human Factors – a receptor (person) and interaction (e.g., touching or picking up an item).

Each of these primary hazard factors was used to evaluate the field and historical data to generate an overall hazard assessment rating of either low, moderate, or high (Table 4-1). The CSM for MRS 1 and MRS 2 reflects this MEC assessment strategy (Appendix J).

4.1.3 A source is based on the MEC type, sensitivity, density and depth distribution (Table 4-1). The type of MEC dictates the likelihood and severity of exposure, and thereby injury, if it should functions when encountered. MEC sensitivity affects the likelihood of an item functioning as designed when encountered by a receptor (e.g., pressure from stepping on the item, fuze activation from moving the item, etc.). MEC quantity/density and depth, if present, are generally unknown during the SI and are evaluated during follow on studies (RI/FS).

4.1.4 Site characteristics refer to the physical conditions of the site and natural events that occur (Table 4-1). Site accessibility affects the likelihood of receptor contact with MEC and include man-made (e.g., walls or fences) or natural barriers (e.g., terrain, topography, vegetation) that may prevent access to the site. A MEC item tends to remain in place unless disturbed through human or natural forces (e.g., frost heaving, erosion, tidal or wave action). If MEC movement

occurs, the probability of direct human contact may increase, but not necessarily result in direct contact or exposure.

4.1.5 Human interaction includes the type of activities that exist at the site, the human population that may have access, and the frequency of that access (Table 4-1). Activities are generally classified as recreational (hiking, camping, etc.) and occupational (farming, industrial, etc.). Activities at a site generate an exposure route for an MEC receptor. The MEC exposure route is typically direct contact with an item on the surface or through subsurface activities (e.g., digging during construction). The area population and frequency of use determines the likelihood of a receptor to encounter MEC. The risk to the surrounding community is based on site characteristics and location, access restrictions, natural and/or man-made barriers, and the surrounding population.

Based on the risk criteria delineated above, an MRS is qualitatively assigned a low, moderate, or high MEC hazard ranking. The MEC hazard assessment categories are defined below in Table 4-1.

4.2 Munitions and Explosives of Concern Hazard Assessment

4.2.1 MRS 1 – WWI Grenade Range

4.2.1.1 As discussed in Sections 2.4.2.2, 2.5.1, and 3.3.1.2, one item of MD (the end of a claymore mine firing wire) was identified and removed at MRS 1 during the 1997 USACE ASR visit and no MEC/MD was observed during the 2009 and 2010 SI field events. Every item discovered during the 1995 HFA sampling action was inert and removed (items were found outside the MRS boundaries). No MEC/MD has been reported by local residents and none was found during the 2009 and 2010 SI field events. The overall MEC hazard is low and is summarized in Table 4-2 and reflected as such in the CSM (Appendix J, J-1). Additional information regarding the MEC hazard at MRS 1 is provided in Section 4.2.1.2.

4.2.1.2 There is low hazard of MEC at MRS 1 due to the MEC source, site characteristics and potential for exposure. Only one item of MD, the end to a claymore mine firing wire, was observed in the MRS during the 1997 property visit and no MEC/MD was observed during the 2009 and 2010 SI field events. The items suspected to have been used at MRS 1 were practice munitions (black powder spotting charges only) and potential use of live grenades (Table 2-2). Based on the limited amount of historical finds and the munitions type, a low MEC hazard is expected. The majority of the MRS is developed and is surrounded by a chain-link fence or located on PanAm Railways property. The MRS is stable since MEC has not been exposed and

should not be exposed by natural events. The most likely human receptors are Army National Guard personnel and PanAm Railways employees; however, trespassers/visitors and biota are potential receptors. There is a moderate frequency for human interaction at MRS 1; however, access is restricted and therefore the hazard is low. Residential, commercial, and educational activities are conducted within two miles of the MRS. Parks and recreational areas are located within two miles of the MRS (Appendix K).

4.2.2 MRS 2 –Range Complex No. 1

4.2.2.1 As discussed in Sections 2.4.2.2, 2.5.1, and 3.3.1.2, no MEC was observed at MRS 2 during the 1997 USACE ASR property visit or during the 2009 SI. A single small arms shell casing (MD) was observed during the 2009 SI field event. The overall MEC hazard is low and is summarized in Table 4-3 and reflected as such in the CSM (Appendix J, J-2). Additional information regarding the MEC hazard at MRS 2 is provided in Section 4.2.2.2.

4.2.2.2 There is low hazard of MEC at MRS 2 due to the MEC source, site characteristics and potential for exposure. No MEC or MD was observed in the MRS during the 1997 property visit. One expended 7.62 mm shell casing was observed during the 2009 SI. The items suspected to have been used at MRS 2 were smoke signals, flares, simulators, and small arms (Table 2-2). Based on the limited amount of MD finds, a low MEC hazard is expected. The majority of the MRS is wooded or open land that is surrounded by a chain-link fence. The MRS is stable since MEC has not been exposed and should not be exposed by natural events. The Town of Ayer uses a portion of the MRS as a wastewater treatment plant and controls access to a majority of the property. The impact area of the former Anti-Tank Range is outside of the fence and is accessible to the public. The most likely human receptors are Town of Ayer personnel; however, trespassers/visitors and biota are potential receptors. There is a moderate frequency for human interaction at MRS 2; however, access is partially restricted and therefore the hazard is low. Residential, commercial, and educational activities are conducted within two miles of the MRS. Parks and recreational areas are located within two miles of the MRS (Appendix K).

4.3 Fort Devens FUDS MEC Hazard Summary

4.3.1 Tables 4-2 and 4-3 summarize the qualitative MEC hazard at MRS 1 (WWI Grenade Range) and MRS 2 (Range Complex No.1) at the Fort Devens FUDS. Based on this qualitative MEC hazard evaluation, the hazard to human receptors via contact with MEC at the FUDS is low. Further evaluation of potential MEC at this FUDS is not recommended.

Table 4-1. MEC Hazard Assessment Categories

MEC Hazard	MEC Type	MEC Sensitivity	MRS Access	MRS Stability	Human Interactions
High	MEC that will cause an individual's death if detonated by an individual's activities	Very sensitive - Handling or movement may cause detonation	No Restriction - No man-made or natural barriers (e.g., no fence, gentle sloping terrain, no vegetation, no water) that restrict access	Unstable - MEC most likely will be exposed by natural events	High potential for and frequency of contact (e.g., general public has open and frequent access, high potential for surface/subsurface intrusive activity)
Moderate	MEC that will cause major injury to an individual if detonated by an individual's activities	Less sensitive - Fuzed but may be moved safely if identified as such by a UXO Technician	Limited Restriction - Man-made barriers and/or natural barrier (e.g., dense vegetation, water, snow or ice cover, and/or terrain) that restrict access	Moderately Stable - MEC may be exposed by natural events	Moderate potential for and frequency of contact (e.g., a limited number of the general public has open and somewhat frequent access, few uses, surface/subsurface intrusive activity possible)
Low	MEC that will cause minor injury to an individual if detonated by an individual's activities	May have functioned correctly or is unfuzed but has a residual risk	Restricted Access- Points of entry are controlled (man-made and/or natural barriers present)	Stable - MEC should not be exposed by natural events	Low potential for and frequency of contact (e.g., no general public access, infrequent access primarily by personnel, no subsurface activity
None	Inert MEC or scrap (MD), will cause no injury	Inert MEC or scrap (MD), will cause no injury	-	-	-

Table 4-2. MRS 1 – WWI Grenade Range Hazard Impact Assessment			
	Historical Observations	**Site Inspection Observations**	**Qualitative Hazard**
MEC Type and Sensitivity			
Munitions Type	The munitions items suspected to have been used include; practice munitions (black powder spotting charges only) and potential use of live grenades The 1995 HFA sampling event discovered inert MD outside of the FUDS boundary. The items were removed. The ASR team identified one item of MD, an end to a claymore mine firing wire, within MRS 1. This item was removed No MEC was found. (USACE 1997).	No MEC/MD was observed during the 2009 and 2010 SI field events.	Low
MEC Sensitivity	Inert, practice and assumed use of live grenades	N/A	Low
MRS Access and Stability			
Accessibility	Restricted access. A chain-link fence surrounds the MRS. Non-DoD control. Heavily developed.	Restricted access. A chain-link fence surrounds the MRS. Non-DoD control. Heavily developed (buildings and pavement cover much of the MRS)	Low
Stability	Stable- MEC not exposed by natural events	Stable- MEC should not be exposed by natural events	Low
Human Interaction			
Population, Frequency of Use, Types of Activities	No documented injuries. MRS is used as a vehicle maintenance yard and office for the Army National Guard.	Visitor/trespassers and employees have access to the MRS. Moderate frequency of use by Army National Guard personnel. Approximately one mile from the Town of Ayer. There are greater than 26 inhabited structures within 2 miles of the MRS.	Moderate
Overall Hazard Ranking	Low Hazard		

Table 4-3. MRS 2 –Range Complex No. 1 Hazard Impact Assessment			
	Historical Observations	**Site Inspection Observations**	**Qualitative Hazard**
MEC Type and Sensitivity			
Munitions Type	The munitions items suspected to have been used include; smoke signals, flares, simulators, and small arms HFA sampling event discovered inert MD outside of FUDS boundary. Item was removed. 1997 ASR visit discovered no MEC/MD (USACE 1997).	One expended 7.62 mm shell casing. No MEC observed.	Low
MEC Sensitivity	Low	N/A	Low
MRS Access and Stability			
Accessibility	Restricted access. A chain-link fence surrounds much of the MRS. Non-DoD control.	Restricted access. A chain-link fence surrounds a portion of the MRS (1000" Rifle and Machine Gun Range and Training Area). Non DoD control.	Low
Stability	Stable- MEC not exposed by natural even	Stable- MEC should not be exposed by natural events	Low
Human Interaction			
Population, Frequency of Use, Types of Activities	No documented injuries. MRS is used by the Town of Ayer.	Visitor/trespassers and employees have access to the MRS. Moderate frequency of use to portions of the MRS by Town of Ayer personnel. The MRS is approximately 0.5 mile from the Town of Ayer. There are greater than 26 inhabited structures within 2 miles of the MRS.	Moderate
Overall Hazard Ranking	Low Hazard		

5 MUNITIONS CONSTITUENTS SAMPLING AND ANALYSIS

5.0.1 A screening level human health risk assessment (HHRA) and screening level ecological risk assessment (SLERA) were conducted to determine whether MCs in environmental media at the Fort Devens FUDS may warrant a more detailed assessment of potential risk to current or future human and ecological receptors. The screening methodology, CSM, analytical results for the MC sampling, and results of the screening assessment are presented below.

5.1 Data Evaluation Methodology

5.1.0.1 The methodology is designed to evaluate data for relevant MCs in the HHRA and SLERA using the appropriate risk-based screening criteria. The methodology also provides a means to evaluate uncertainty in the screening HHRA and SLERA process and provide context for the risk conclusions. This process is consistent with the decision rules outlined in Section 3.1 (TPP) of this report, and is described in more detail in the following sections.

5.1.1 Refinement of Munitions Constituents

5.1.1.1 During the SI process, MCs potentially associated with Fort Devens were evaluated and identified based on knowledge of munitions historically used at the FUDS. Information on historical use was obtained from munitions data sheets, historical documents, and other munitions reference documents.

5.1.1.2 The list of MCs for evaluation for two MRSs identified at the Fort Devens FUDS is provided below and presented in further detail in Table 2-2.

WWI Grenade Range (MRS 1)

- Explosive constituents (NG, Tetryl and TNT and TNT breakdown products).

Range Complex No. 1 (MRS 2)

- Explosive constituents (DNT and DNT breakdown products, and NG)
- Metals (aluminum[4], antimony, barium[4], copper, iron[4], lead, magnesium[4], nickel, strontium and zinc).
- Perchlorate

[4] Aluminum, barium, iron, and magnesium are not classified as hazardous substances under CERCLA. As per USACE guidance regarding non-CERCLA hazardous substances the screening results for these metals will not be used as the sole basis for determining a RI/FS recommendation for the site.

5.1.2 Data Quality

5.1.2.1 Only validated data were used in the screening process. The validated data were composed of the following samples[5]:

- Fourteen surface soil samples (collected 0-6 inches below ground surface (bgs))
- Three duplicate[6] surface soil samples
- Three background surface soil samples
- Two subsurface soil samples (collected 6-12 inches bgs)
- Three sediment samples (collected approximately 0-6 inches below the bottom of the water body)
- Two duplicate sediment sample
- Two background sediment samples
- Two groundwater samples
- One duplicate groundwater sample
- One background groundwater sample
- Three surface water samples (collected near the bottom of the water column)
- Two duplicate surface water sample
- Two background surface water samples

5.1.2.2 The first step in the screening risk assessments was the evaluation of the analytical data. Inclusion or exclusion of data on the basis of analytical qualifiers was performed in accordance with USEPA guidance (USEPA 1989). The following provides a listing of the qualifiers in the validated analytical data and their treatment in the risk assessments:

- Analytical results bearing the U qualifier (indicating that the analyte was not detected at the given detection limit) were retained in the dataset. The reporting limit (RL) was used for non-detected samples.

[5] These samples are composed of those obtained from two sampling events. Fieldwork conducted in August 2009 focused on the eastern portion of MRS 1 within the property under control of the Commonwealth of Massachusetts (Army National Guard) and the MRS 2 property. Although the Final SS-WP issued by Alion in June 2009 proposed sampling and reconnaissance within the PanAm Railways portion of MRS 1 an ROE agreement could not be established between the parties; therefore, no fieldwork was conducted within that portion of the FUDS. Following, discussions with USACE prompted the decision to pursue an ROE agreement with PanAm Railways in order to complete the field investigation of this portion of the MRS 1. This sampling was completed in June 2010.

[6] Duplicate samples were treated as discrete samples; duplicates were not averaged for the purpose of this risk screening

- Analytical results bearing the UJ qualifier (indicating that the analyte was not detected and the quantitation limits may be inaccurate or imprecise) were retained in the dataset. The RL was used for non-detected samples.
- Analytical results bearing the J qualifier (indicating that the reported value was estimated) were retained in the dataset. The estimated concentration provided by the laboratory was used for the samples.

5.1.3 Screening Values

5.1.3.1 Screening concentrations were used in the HHRA and SLERA to support risk-based conclusions and recommendations regarding the FUDS property. Maximum property concentrations for relevant MCs were compared to the risk-based concentrations as part of the selection process for chemicals of potential concern (COPCs) and chemicals of potential environmental concern (COPECs).

5.1.3.2 For the HHRA, USEPA regional screening levels (SLs) for residential soil, industrial soil, and tap water were selected as the screening criteria to select COPCs (USEPA 2011). The SLs are referred to as "regional SLs" throughout the remainder of this section. The regional SLs are developed from toxicity values and standard exposure factors to estimate contaminant concentrations that are protective of humans, including sensitive subgroups, over a lifetime. Water screening criteria from the Commonwealth of Massachusetts were selected as the basis for the groundwater and surface water human health assessment for perchlorate.

5.1.3.3 The regional SLs for residential and industrial soils consider exposures through direct contact (e.g., ingestion, dermal contact, and inhalation of particulates and vapors) and reflect exposure pathways identified for MCs in the SS-WP Addendum (Alion 2008b and 2010) that could occur at the FUDS (i.e., potentially completed pathways). Therefore, they are determined to be appropriate screening tools for surface and subsurface soils for the HHRA. For sediment, potentially complete pathways identified in the SS-WP Addendum for human receptors included the incidental ingestion of, and dermal contact with, MCs. Regional SLs or similar values are not available for screening risks from human exposure to sediments, and soil SLs are not directly applicable for screening sediment for human receptors given the likelihood of reduced exposure to sediment relative to soil. Therefore, for use in screening sediment concentrations of MCs in the HHRA, soils SLs were adjusted to account for the relatively lower exposure levels for human receptors to sediment. The adjustment is described in Section 5.1.3.8.

5.1.3.4 Regional tap water SLs available for screening groundwater reflect potential exposures via ingestion of drinking water and inhalation of volatile organic chemicals released during use

of contaminated groundwater. Potentially complete transfer pathways identified for MCs in groundwater in the SS-WP Addendum included ingestion, incidental ingestion, and dermal contact. The tap water SLs do not consider exposures via dermal contact or incidental ingestion, however their derivation does incorporate potential exposure via ingestion (drinking). It is expected that the rate of drinking water which is assumed in the derivation of the tap water SL (two liters a day, based on an estimate for residential use) would exceed exposures from ingestion that would occur for the human receptors at the FUDS (i.e., visitor/trespasser, construction worker, and employee), in addition to the exposures that these receptors would experience from other pathways identified as potentially complete (i.e., dermal contact and incidental ingestion). The regional tap water SLs are, therefore, considered appropriate screening values for groundwater in the HHRA. Potentially complete pathways identified for human receptors to surface water include dermal contact and incidental ingestion of MCs in surface water. The availability of screening values that specifically account for these exposures is limited. Human receptors' intake of surface water is presumed to be significantly less than the two liters assumed in the derivation of the regional SLs for tap water. Therefore, the tap water SLs were adjusted to account for the anticipated differences in intake of surface water compared to tap water. The adjustment is described in Section 5.1.3.8.

5.1.3.5 The MassDEP drinking water standard (DWS) for perchlorate is an enforceable standard of the highest level of a contaminant that is allowed in drinking water. It was established considering health risks from perchlorate and its presence in certain disinfectant solutions used to treat drinking water for pathogens. MassDEP concluded that the established level would reasonably minimize potential perchlorate exceedences attributable to chlorination, balancing perchlorate exposure and infectious disease control concerns (MassDEP 2006, Zewdie et al. 2009). The value was adopted for the screening criteria in the HHRA for both groundwater and surface water.

5.1.3.6 In some cases, SLs are based on the toxicity, or relative toxicity of related compounds. The regional SLs for 2-amino-4,6-DNT and 4-amino-2,6-DNT are based on toxicity information for 2,4-DNT. Because the amino-DNT isomers may behave differently from 2,4-DNT, the use of the regional SLs for these MCs may result in some uncertainty in the risk assessment.

5.1.3.7 The regional SLs for direct contact with soil and tap water correspond to typical risk thresholds of a one-in-one million (1E-06) cancer risk or a non-carcinogenic hazard quotient (HQ) of 1.0. The HHRA screening levels for explosive constituents 2,4,6-TNT, 2,4-DNT, 2-nitrotoluene, 4-nitrotoluene, and NB are based on carcinogenic endpoints. The HHRA screening levels for the explosive constituents 1,3,5-TNB, 1,3-DNB, 2,6-DNT, 2-amino-4,6-DNT, 3-

nitrotoluene, 4-amino-2,6-DNT, NG, and tetryl; and the metals aluminum, antimony, barium, copper, iron, lead, nickel, strontium, and zinc are based on non-carcinogenic endpoints. The toxicological endpoint for each of these non-carcinogenic MCs is not the same. Rather these MCs act at various different target organs including the spleen, kidney, gastro-intestinal (GI), and liver (USEPA 2010, USEPA 1997). The DWS for perchlorate, adopted as the screening criteria for groundwater and surface water in the HHRA, is not based solely on health effects associated with perchlorate, but rather additionally incorporates considerations of the benefits gained by using drinking water disinfectants that contain perchlorate.

5.1.3.8 As discussed in the SS-WP Addendum (Alion 2008b and 2010), the screening levels derived from non-carcinogenic endpoints were divided by ten to provide a means to account for potential occurrence of adverse non-carcinogenic health effects due to exposure to multiple non-carcinogens. The soil screening values used for the HHRA were increased by a factor of ten for application as sediment screening values to account for lower incidence of exposure to sediments relative to soils. Similarly, screening values for groundwater were increased by a factor of ten for application as surface water screening values to account for differences in exposure between tap water and those anticipated at the FUDS for surface water. The exceptions to the adjustments described are for lead and perchlorate. In the case of lead, regional SLs for soil are based on a blood lead level rather than a chronic daily intake, as is used for other non-carcinogens and; therefore, no adjustments were made to the lead regional SLs for use in evaluating soils or sediments. As described above, in Section 5.1.3.5 the groundwater and surface water screening values adopted for the HHRA for perchlorate are based on the DWS established by MassDEP. The level is not based solely on health effects associated with perchlorate; rather it incorporates considerations of the benefits gained by using disinfectants that contain perchlorate for water treatment. Therefore, no adjustments were made to the DWS adopted as the screening level for perchlorate in groundwater and surface water. The adjustments to the screening values described are consistent with previous HHRAs under this program. Every MC identified, with the exception of magnesium had screening values available for each of the studied environmental medium for application in the HHRA. The lack of a screening value for magnesium introduces some uncertainty into the HHRA. The application of HHRA screening values is described in Sections 5.1.3.17 and 5.1.3.18. Results of the HHRA are discussed in Sections 5.4 and 5.5, and are presented in Tables 5-1 through 5-4.

5.1.3.9 Screening for ecological-based COPECs was conducted by calculating an HQ, which represents the ratio of the maximum detected chemical concentration in environmental media to a medium specific ecological screening level. Screening levels derived from studies in specific medium and environmentally similar conditions to those at the FUDS are the most relevant and

appropriate for screening. In cases where screening values derived from environmentally specific testing environments are not available, alternative screening values may offer a sufficient screening tool.

5.1.3.10 Ecological soil screening levels (eco-SSLs) were used to screen for COPECs in soil. Eco-SSLs are screening level benchmark concentrations for contaminants in soil that have been determined to be protective of terrestrial-based ecological receptors that commonly come into contact with soil, or ingest biota that live in or on the soil. These benchmark concentrations are generally used for screening level purposes to identify COPECs in upland soils that may require further evaluation. Eco-SSLs are derived using information on toxicity and estimated ingestion exposure doses for terrestrial ecological receptors. As described in the SS-WP Addendum CSM diagram for Fort Devens, potentially complete transfer pathways for ecological receptors to surface soils at the FUDS are incidental ingestion of, and dermal contact with MCs in surface soil, and ingestion of vegetation and game exposed to MCs in surface soils. USEPA guidance (2005a) states that dermal pathways are generally less significant compared to ingestion, and that therefore they do not warrant inclusion in the derivation of eco-SSLs. Therefore, the eco-SSLs derived using exposure assumptions for ingestion only are determined to be adequate for the purposes of the SLERA.

5.1.3.11 USEPA sanctioned sediment screening values were adopted for the SLERA where available; in the cases that no USEPA supported value was available, screening values were obtained from peer-reviewed literature and other regulatory and advisory programs. Fort Devens is characterized as a freshwater area; therefore, freshwater-specific sediment screening values were adopted where available. In the case that no freshwater value was available, sediment screening values derived in marine environments were adopted for use in the SLERA. In the instance where no sediment screening values were available, eco-SSLs were used to screen for COPECs in sediment. USEPA states that eco-SSLs may provide utility for screening wetland soils like those found in MRS 2 (USEPA 2005a). The appropriateness of their use generally is determined by comparing the soil properties evaluated to the sediment properties in the site of interest, and the degree of flooding estimated to occur at the marsh. In general, USEPA considers the eco-SSLs to be conservative with respect to their use for wetlands, given that wetland sediments generally have conditions which limit bioavailability relative to upland soils (e.g., relatively higher total organic carbon present in sediments). Potentially complete pathways identified for ecological receptors to sediment at Fort Devens include incidental ingestion of, ingestion of benthos exposed to, and dermal contact with MCs in sediment. The sediment screening values and eco-SSLs described above were derived using assumptions of exposure via ingestion pathways. As described in Section 5.1.3.10, exposures via the dermal pathway are

generally less significant when compared to the ingestion pathway. Therefore, the sediment screening values and eco-SSLs derived using exposure assumptions for ingestion only are determined to be adequate for the purposes of sediment screening in the SLERA.

5.1.3.12 National Ambient Water Quality Criteria (AWQC) were used for screening COPECs in surface water. AWQC are derived from the results of laboratory tests completed under controlled conditions. Guidelines require that toxicity tests be completed on plants, invertebrates, and fish species. Species are normally submerged in freshwater or marine media, and; therefore, are exposed to the test chemical via multiple pathways (USEPA 1994). Second tier AWQC are derived using methods identical to those in the federal guidelines, however are rated as second tier because they have not been tested on the full suite of taxonomic groups specified under federal guidelines. Given that toxicity results for fewer taxonomic groups are available, uncertainty factors[7] are applied in determining the final screening value. Surface waters present at the Fort Devens FUDS are characterized as freshwater, and therefore where available, freshwater AWQC were selected for screening criteria. In the case that no freshwater value was available, a value derived for marine organisms was adopted for the SLERA. As discussed in the SS-WP Addendum for the Fort Devens, potentially complete transfer pathways for ecological receptors include incidental ingestion of, and dermal contact with, MCs in surface water. Given that test organisms are submerged in media and exposed to chemicals via multiple routes of exposure, the use of AWQC are determined to be appropriate for screening surface water in the SLERA.

5.1.3.13 For the soil screening, eco-SSLs developed by USEPA were used for screening the metals aluminum, antimony, barium, copper, lead, nickel, and zinc. No eco-SSLs were available from USEPA for any of the explosive constituents being evaluated or for the metals iron, magnesium, and strontium. Consistent with previous SLERAs completed under this program, screening values were obtained from Talmage et al. (1999) for 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 2-nitrotoluene, 2-amino-4,6-DNT, 3-nitrotoluene, 4-amino-2,6-DNT, 4-nitrotoluene, and tetryl. The eco-SSL for NB was obtained from Efroymson et al. (1997). No eco-SSLs, or appropriate alternative screening values, were available for the metals iron, magnesium, and strontium; or for the explosive constituents 1,3,5-TNB, 1,3-DNB, and NG.

5.1.3.14 In some cases eco-SSLs are based on the toxicity or relative toxicity of related compounds. The eco-SSL of 30 milligrams/kilograms (mg/kg) for 2,4-DNT, 2,6-DNT, 2-

[7] Uncertainty factors are commonly applied in risk assessment practice to account for gaps in the data, and assure that uncertainties are dealt with in a conservative manner and health protective measures are derived.

nitrotoluene, 3-nitrotoluene, and 4-nitrotoluene is based on toxicity data for 2,4,6-TNT. There is no conclusive evidence on the dominant process by which 2,4,6-TNT is reduced in soil. One study indicated that bacterial degradation of 2,4,6-TNT to 2- and 4-amino-DNT occurs under aerobic and anaerobic conditions (Vorbeck et al. 1998). An *in vitro* study completed in a *Pseudomonas bacterium* species suggests that 2,4,6-TNT breaks down to 2,4-DNT (Haidour and Ramos 1996). Laboratory studies support the observations of Haidour and Ramos (1996) that bacteria strains can generate 2,4-DNT from TNT (Martin et al. 1997). These findings provide some support for the use of TNT as a surrogate for DNT and DNT breakdown products. In addition, the soil eco-SL of 80 mg/kg for 4-amino-2,6-DNT is based on data for the chemical isomer 2-amino-4,6-DNT. There is some uncertainty associated with adopting surrogate screening values for the MCs from 2,4,6-TNT and 2-amino-4,6-DNT. In addition, some screening values are based on limited data. A limited amount of data were available for the derivation of the eco-SSL for 2-amino-4,6-DNT and tetryl. Each of these eco-SSLs was derived using data from a single study in plants.

5.1.3.15 For the sediment screening, sediment-specific screening values derived for freshwater organisms were available for the explosive constituents 1,3,5-TNB, 1,3-DNB, and the metals aluminum, copper, iron, lead, nickel and zinc. Although a sediment value derived for freshwater organisms was not available for antimony or NB; values for marine organisms were available, and were adopted for the SLERA. With the exception of NB, no sediment screening values were available for any of the explosive constituents being evaluated, or for the metals barium, magnesium, and strontium. In the absence of sediment-specific screening values for these MCs, eco-SSLs derived by USEPA and interim eco-SSLs derived by Talmage et al. (1999) were applied where available (barium, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-nitrotoluene, and tetryl). Although the use of eco-SSLs for screening sediments introduces some uncertainty into the SLERA results, as discussed in Section 5.1.3.12, the use of soil screening values for wetland soils is likely to result in a conservative evaluation, and therefore, is considered an adequate screening tool for the SLERA. No sediment SLs, or appropriate alternative screening values, were available for NG, magnesium, or strontium.

5.1.3.16 Primary tier AWQC were not available from USEPA for any of the MCs evaluated in surface water. A primary tier screening value, meeting the same testing requirements as USEPA's AWQC, was available for 2,4,6-TNT. Second tier AWQC were available for the explosive constituents 1,3,5-TNB, 1,3-DNB, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-DNT, 4-nitrotoluene, NB, and NG, and were adopted for surface water screening in the SLERA. The AWQC for 2,6-DNT is based on the value for

2,4-DNT and that for 4-amino-2,6-DNT is based on 2-amino-4,6-DNT. Because isomers of DNT and amino-DNT may behave differently, the use of the surrogate screening values may result in some uncertainty in the risk assessment. No AWQC or alternative surface water screening value was available for tetryl or perchlorate in surface water. The application of the ecological screening values is described in Sections 5.1.3.17 and 5.1.3.19. Results of the SLERA are discussed in Sections 5.4 and 5.5, and are presented in Tables 5-1, 5-2, and 5-4.

5.1.3.17 In accordance with USEPA Guidance, the following screening process is utilized.

1. The maximum concentration of each chemical detected in each medium is identified.

2. If a chemical was detected in at least one sample in a specific medium, it is retained for consideration in the screening of COPCs/COPECs.

3. If the concentration of a specific chemical exceeds its screening value and is above the mean background concentration, the chemical is retained as a COPC/COPEC.

4. If a screening concentration is not available for a specific chemical in a particular medium, the screening concentration for a structurally similar compound is used, if warranted. The screening tables list any surrogates that are used.

5. An analyte is eliminated from the list of COPCs/COPECs if it is an essential nutrient of low toxicity, and its reported maximum concentration is unlikely to be associated with adverse health impacts.

5.1.3.18 For the HHRA, the maximum detected concentration of detected MCs was compared to the screening criteria determined for use in the HHRA. If the maximum concentration was less than the screening value, the target analyte was eliminated from consideration. If the maximum concentration exceeded the screening value, the analyte was retained as a COPC.

5.1.3.19 Under the SLERA, an HQ analysis was completed for each detected analyte. An HQ is defined as the measured concentration divided by the screening criteria. If the maximum concentration was less than the screening value (HQ < 1.0), the analyte was eliminated from consideration as a COPEC. If the maximum concentration exceeded the screening value (HQ > 1.0), the analyte was retained as a COPEC.

5.1.3.20 For both the HHRA and SLERA, in cases in which no screening criteria are available, any available information regarding the potential for the MCs to present a risk to receptors is presented.

5.1.4 Comparison of Screening Levels with Detection Limits for Non-Detected Analytes

5.1.4.1 The usability of the analytical data for making conclusions regarding risk was evaluated by comparing the RLs for samples that were not detected to their respective screening values used for human health (Table 5-5) and ecological (Table 5-6) risk screening. If a chemical was not detected, but the RL was higher than the screening value, then the MQO for sensitivity was not met. Such non-detects are not usable for determining whether contamination is greater or less than the detection limit (i.e., RL). Where no screening values are available, no conclusions can be drawn regarding the adequacy of the RLs for screening risk, and as a result, uncertainty is introduced into the risk assessment. In these instances, a WOE approach is used in making risk-based decisions. The WOE approach used in the absence of screening values includes an assessment of the fate and transport of the chemical, and the frequency of detection of MCs that are likely to have been co-derived from a munitions source.

5.1.4.2 Table 5-5 shows a comparison of the RLs and human health screening values for every analyte not detected at any one MRS in surface soil, subsurface soil, sediment, groundwater, or surface water at either MRS by media. In surface and subsurface soils, each of the explosive constituents analyzed and antimony were not detected above their respective RLs in at least one MRS. With the exception of NG, the RLs for every not detected explosive constituents were lower than the respective soil screening criteria adopted for the HHRA. The maximum RL of 6 mg/kg for NG exceeds the residential soil screening value of 0.61 mg/kg. The MQO for sensitivity for NG was not met and any reported non-detects (<RL) do not demonstrate that NG contamination is less than the selected screening criterion. However, as described in Section 5.1.3.8, the residential screening value used in the HHRA is adjusted to account for the potential cumulative effect of simultaneous exposure to multiple non-carcinogens. Under the methodology employed in the HHRA for cumulative non-carcinogenic risk, ten chemicals are assumed to elicit toxic effects on the same target organ. At the Fort Devens FUDS, a maximum of 18 MCs were identified at any one MRS. Section 5.1.3.7 identifies the MC with non-carcinogenic endpoints. As described in Section 5.1.3.7, these MCs act at an array of target organs. Thus, in soil, each of the identified MCs is not anticipated to act by the same non-carcinogenic mode of action or at the same target organ. Further, seven MCs at MRS 1, and eight MCs at MRS 2 were organics that were not detected with RLs lower than their respective screening value. Considering these factors, the RL for NG is determined to be adequate for the HHRA screening at the Fort Devens FUDS. As described in Section 5.1.3.6, the regional SLs for 2-amino-4,6-DNT and 4-amino-2,6-

DNT are based on toxicity data for 2,4-DNT. The RL of 0.3 mg/kg in soil for the amino-DNT isomers is below the residential and industrial screening criteria developed from regional SLs for use in the HHRA (15 and 200 mg/kg for 2-amino-4,6-DNT; 15 and 190 mg/kg for 4-amino-2,6-DNT). Any uncertainties in the application of these screening levels to the risk assessment are, therefore, determined not to be significant for the HHRA.

5.1.4.3 In sediment, none of the explosive constituents analyzed were ever detected above their respective RLs, with the exception of NG. The maximum RL for NG at MRS 2 of 8 mg/kg exceeds the screening value of 6.1 mg/kg for sediment adopted for the visitor/trespasser. The MQO for sensitivity for NG was not met and any reported non-detects do not demonstrate that NG contamination is less than the selected screening criterion. As described in Section 5.1.3.8, the regional soil SL for NG was adjusted to account for the potential cumulative effect of simultaneous exposure to multiple non-carcinogens. As described above in Section 5.1.4.2 the adjustment results in a conservative screening value considering the characteristics of the FUDS. Moreover, the difference between the screening value of 6.1 mg/kg, and the maximum RL of 8 mg/kg is relatively small. The screening criterion for NG is therefore considered adequate for the HHRA. As described in Section 5.1.3.6, the regional SLs for 2-amino-4,6-DNT and 4-amino-2,6-DNT are based on toxicity data for 2,4-DNT. The maximum RL of 0.4 mg/kg in sediment for the amino-DNT isomers is below the residential and industrial screening criteria developed from regional SLs for use in the HHRA (150 and 2,000 mg/kg for 2-amino-4,6-DNT; 150 and 1,900 mg/kg for 4-amino-2,6-DNT). Any uncertainties in the application of these screening levels to the risk assessment are; therefore, determined not to be significant for the HHRA.

5.1.4.4 In groundwater, none of the explosive constituents analyzed were ever detected above their respective RLs. Of these non-detected analytes, 1,3-DNB, 2,4-DNT, 2-nitrotoluene, 3-nitrotoluene, NB, and NG had RLs that exceeded the screening criterion adopted for the HHRA (1,3-DNB, RL = 0.4 micrograms/liter {µg/L}, SL = 0.37 µg/L; 2,4-DNT, RL=0.4 µg/L; SL = 0.22 µg/L, 2-nitrotoluene, RL = 0.4, SL = 0.31; 3-nitrotoluene, RL = 0.4, SL = 0.37; NB, RL = 0.4 µg/L, SL = 0.12 µg/L; NG RL = 3 µg/L; SL = 0.37 µg/L). The MQO for sensitivity for these MCs were not met and any reported non-detects do not demonstrate that contamination is less than the selected screening criteria. As described in Section 5.1.3.8, the regional tap water SL for 1,3-DNB, 3-nitrotoluene, and NG were adjusted to account for the potential cumulative effect of simultaneous exposure to multiple non-carcinogens. At the Fort Devens FUDS, a maximum of nine MCs were identified in groundwater at any one MRS. As described in Section 5.1.3.7 and 5.1.4.2 each of these MCs is not anticipated to act by the same non-carcinogenic mode of action or at the same target organ. The difference between the RLs and screening criterion for 1,3-DNB, 2,4-DNT, 2-nitrotoluene, 3-nitrotoluene, and NB were small. Based on these considerations the

RLs are considered adequate for the HHRA. As described in Section 5.1.3.6, the regional SLs for 2-amino-4,6-DNT and 4-amino-2,6-DNT are based on the toxicity of 2,4-DNT. The RL of 0.2 µg/L in groundwater for the amino-DNT isomers is below the screening criteria developed from regional tap water SLs for use in the HHRA (7.3 µg/L). Any uncertainties in the application of these screening levels to the risk assessment are, therefore, determined not to be significant for the HHRA.

5.1.4.5 In surface water, none of the explosive constituents analyzed, or perchlorate, were ever detected above their respective RLs. The RLs for the not-detected MCs in surface water were lower than the respective screening criteria for surface water adopted for the HHRA. As described in Section 5.1.3.6, the regional SLs for 2-amino-4,6-DNT and 4-amino-2,6-DNT are based on the toxicity of 2,4-DNT. The RL of 0.2 µg/L for these MCs are below the 73 µg/L screening criteria developed from regional tap water SLs for use in the HHRA. Any uncertainties regarding the application of these screening levels to the HRRA are determined not to be significant.

5.1.4.6 Table 5-6 shows a comparison of the detection limits and ecological screening values for analytes not detected in surface soil, sediment, or surface water at either MRS. In surface soil, none of the explosive constituents analyzed, nor antimony, were detected above their respective RLs at one or more MRSs. The RLs for every not-detected explosive constituents for which eco-SSLs were available were lower than the respective ecological soil screening criteria adopted for the SLERA. As described in Section 5.1.3.14, the adoption of screening values from surrogates introduces some uncertainty into the risk assessment. The eco-SSL for 2,4,6-TNT was adopted for 2,4-DNT, 2,6-DNT, 2-nitrotoluene, 3-nitrotoluene, and 4-nitrotoluene. The maximum RLs of 0.3 mg/kg for 2,4-DNT, 2,6-DNT, and 2-nitrotoluene; 0.6 mg/kg for 3-nitrotoluene; and 0.5 mg/kg for 4-nitrotoluene are below the ecological soil screening value of 30 mg/kg adopted for these MCs in the SLERA. In addition, the eco-SSL for 2-amino-4,6-DNT was adopted for 4-amino-2,6-DNT. The RL of 0.3 mg/kg for 4-amino-2,6-DNT is below the ecological soil screening value of 80 mg/kg adopted for this MC in the SLERA. Therefore, any uncertainties associated with the use of 2,4,6-TNT and 2-amino-4,6-DNT as surrogates for the explosive MCs are determined not to be significant for the SLERA. No ecological screening values were available for 1,3,5-TNB, 1,3-DNB, or NG in soil. Therefore, no conclusions regarding the adequacy of the RLs obtained for these MCs can be made.

5.1.4.7 In sediment, none of the explosive constituents analyzed were ever detected above their respective RLs. The RLs for 1,3,5-TNB, 1,3-DNB, and NB were greater than the sediment screening criteria adopted for the SLERA (1,3,5-TNB, RL = 0.2 mg/kg, SL = 0.0024 mg/kg; 1,3-

DNB, RL=0.4 mg/kg, SL = 0.0067 mg/kg, NB, RL = 0.3 mg/kg, SL = 0.021 mg/kg). The MQO for sensitivity for these three MCs were not met and any reported non-detects do not demonstrate that contamination is less than the selected screening criteria. The RLs for the remainder of the non-detected explosive constituents were lower than the respective ecological sediment screening criteria adopted for the SLERA. As described in Section 5.1.3.14, the use of surrogates for screening values introduces some uncertainty into the risk assessment. The screening criterion for 2,4-DNT, 2,6-DNT, 2-nitrotoluene, 3-nitrotoluene, and 4-nitrotoluene are based on toxicity data for 2,4,6-TNT. The maximum RLs of 0.4 mg/kg for 2,4-DNT, 2,6-DNT, and 2-nitrotoluene; 0.8 mg/kg for 3-nitrotoluene, and 0.7 mg/kg for 4-nitrotoluene are below the ecological sediment screening value of 30 mg/kg adopted for these MCs in the SLERA. In addition the screening value for 4-amino-2,6-DNT is based on information for 2-amino-2,4-DNT. The maximum RL for 4-amino-2,6-DNT of 0.4 mg/kg is below the ecological soil screening value of 80 mg/kg adopted for this MC in the SLERA. Therefore, any uncertainties associated with the use of 2,4,6-TNT and 2-amino-4,6-DNT as surrogates for the explosive MCs are determined not to be significant for the SLERA. No ecological screening value was available for NG in sediment. Therefore, no conclusions regarding the adequacy of the RL obtained for this MC can be made.

5.1.4.8 In surface water, none of the explosive constituents analyzed or perchlorate were ever detected above their respective RLs. The RLs for every not-detected MCs in surface water were lower than the respective ecological screening criteria for surface water adopted for the SLERA. As described in Section 5.1.3.16, the use of surrogates for screening values introduces some uncertainty into the risk assessment. The AWQC for 2,4-DNT is based on toxicity data for 2,6-DNT. The maximum RL of 0.4 ug/L for 2,4-DNT is below the surface water screening value of 310 µg/L adopted for this MC in the SLERA. In addition, the surface water eco-SL for 4-amino-2,6-DNT is based on toxicity data for 2-amino-4,6-DNT. The RL of 0.2 µg/L for this MC is below the 20 µg/L surface water screening criteria adopted for the SLERA. Therefore, any uncertainties regarding the application of these screening levels to the SLERA are determined not to be significant. No ecological screening values were available for tetryl and perchlorate in surface water. Therefore, no conclusions regarding the adequacy of the RLs achieved for these MCs can be made.

5.2 Conceptual Site Model

5.2.0.1 The CSM diagrams for MRS1 and MRS2 at the Fort Devens FUDS are provided in Appendix J. Each CSM defines the source(s) (e.g., the secondary source/media), interaction (e.g., secondary release mechanism, tertiary source, exposure route), and receptors at the FUDS and provides an overview of completed and potentially completed pathways. The CSMs are limited

to those areas potentially impacted by MEC and/or MCs based on the site use and history. These areas are shown in Figure 2-1. In this SI Report, the CSMs were revised from the version presented in the SS-WP Addendum to reflect the results of the human and ecological risk screening.

5.2.0.2 Current and future potential human receptors for the Fort Devens FUDS are expected to be visitors/trespassers, construction workers, and employees, as depicted in the CSM diagrams in Appendix J. In the HHRA the soil and sediment screening values used for trespassers/visitors were based on regional SLs for direct contact with residential soil and the screening values used for construction workers and employees were based on the regional SLs for direct contact with industrial soil. With the exception of perchlorate, screening values for groundwater and surface water for every human receptors were based on the regional tap water SLs. The groundwater and surface water screening value for perchlorate for human receptors was the DWS for perchlorate established by MassDEP. The ecological receptors of concern for the FUDS are plants, soil and benthic invertebrates, terrestrial-feeding mammals, terrestrial-feeding birds, reptiles, amphibians, and aquatic-feeding animals. Screening values selected for the SLERA were applied uniformly to ecological receptors.

5.2.0.3 Potentially complete pathways for human and ecological receptors are based on the presence of MEC/MC and interactions, including transport and release mechanisms, and receptor use patterns.

5.2.0.4 A pathway is complete if each of the following conditions are present:

1. Source and mechanism of chemical release (e.g., a munitions-related organic chemical is detected or a munitions-related inorganic chemical is detected and the levels exceed maximum site background sample concentrations)[8].

2. Transfer mechanisms (e.g., overland flow of contaminants into an adjacent stream, advection of contaminants with groundwater flow).

3. Point of contact (exposure point, e.g., drinking water, soil).

4. Exposure route to receptor (e.g., ingestion, inhalation, etc.).

[8] In the case that an MC is not detected in samples collected and the MQO for sensitivity is not met (i.e., the RL is greater than the respective screening level for human or ecological receptors) the pathway remains potentially complete.

5.2.0.5 Comparisons of maximum detected site concentrations to risk-based screening values are used to determine if the MC is a COPC or COPEC, depending on the risk screening being conducted (human health or ecological, respectively). In the case that a complete pathway exists between media and receptors, and a COPC and/or COPEC is identified, a WOE approach may be used to further evaluate the potential risk. The WOE approach considers multiple aspects of the MCs presence including the frequency of detection, magnitude, and comparison to background, as well as the applicability of the screening criteria selected to the specific receptor groups and exposures that are likely to occur at the FUDS. A RI/FS may be recommended for MC where COPC and/or COPEC are determined to represent the potential for risks to an exposed receptor population. An NDAI designation may be recommended for MCs if no COPCs or COPECs are identified through the risk screening process, or if the WOE evaluation indicates that COPCs/COPECs do not pose an unacceptable risk to the exposed receptors.

5.2.0.6 In conclusion, pathway completeness will result in a RI/FS recommendation for MCs only in the instance where risk screening criteria exceedances occur. A pathway can be complete, but a RI/FS is not recommended if there are no exceedances of risk screening criteria, or if identified risks are determined to be at acceptable risk levels. When a pathway is incomplete, a RI/FS recommendation is not made.

5.3 Background Data Evaluation

5.3.0.1 During the SI field sampling, three background surface soil and two background sediment samples were collected from areas adjacent to the FUDS and that exhibit similar geological composition to MRS 2. In addition, a single background groundwater sample was obtained from a preexisting well in the vicinity of Spectacle Pond and two background surface water samples were collected at Grove Pond. Comparisons of concentrations of metals in background soil and sediment to on-site soil and sediment for MRS 2 are shown in Tables 5-7 and 5-8, respectively. Comparisons of perchlorate concentrations in background groundwater and surface water to on-site groundwater and surface water for MRS 2 are shown in Tables 5-9 and 5-10, respectively.

5.3.0.2 In surface soil within MRS 2, iron and nickel exhibited mean and maximum concentrations that were greater than the respective mean and maximum concentrations in background (Table 5-7). Aluminum and magnesium exhibited maximum concentrations that were greater than their maximum background concentrations. Antimony was not detected in surface soil obtained from MRS 2. Therefore, the background comparison for antimony in surface soil is not meaningful for the SI evaluation.

5.3.0.3 In sediment, copper and lead within MRS 2 exhibited mean and maximum concentrations that were greater than the respective mean and maximum concentrations in background (Table 5-8).

5.3.0.4 In groundwater the maximum concentration of perchlorate at MRS 2 was greater than the maximum concentration in background (Table 5-9).

5.3.0.5 Perchlorate was not detected in surface water obtained from MRS 2. The reported concentrations reflect the RLs; and therefore the background comparison for perchlorate in surface water is not meaningful for the SI evaluation (Table 5-10).

5.4 WWI Grenade Range (MRS 1)

5.4.0.1 As presented in Section 5.1.1, the explosive constituents NG, tetryl, and TNT and TNT breakdown products were identified as MCs at MRS 1. Surface soil, subsurface soil, sediment, groundwater, and surface water were identified as media of concern for this area. Tables 5-1, 5-2, 5-3, and 5-4 present results of the screening level analysis in surface and subsurface soil, sediment, groundwater, and surface water respectively.

5.4.1 Soil Pathway and Screening Results

5.4.1.1 Surface and subsurface soils were identified as media with potentially complete pathways for human and ecological receptors. A total of 13 soil samples were collected from MRS 1; nine surface soil samples, two duplicate surface soil sample, and two subsurface soil samples. Table 5-1 presents the analytical results for surface and subsurface soil, along with the human health and ecological screening values described previously in Section 5.1.3.

5.4.1.2 As shown in the SS-WP, incidental ingestion and dermal contact were identified as potentially complete transfer mechanisms for MCs in surface soils to visitors/trespassers, construction workers, and employees at MRS 1. Additionally, inhalation was identified as a potentially complete transfer mechanism for MCs in this area to construction workers. Incidental ingestion, dermal contact, and ingestion of game and vegetation exposed to MCs were identified as potentially complete pathways for ecological receptors at MRS 1.

5.4.1.3 Tetryl was the single explosive constituent detected in surface soil at MRS 1; however the detected concentration fell below the screening criteria selected for the HHRA. With the exception of NG, the RLs for every of the not-detected explosives constituent were below the

screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. Because the maximum RL of 6 mg/kg for NG was above the soil screening criterion of 0.61 mg/kg adopted for screening risks to visitors/trespassers, the MQO for sensitivity was not met for NG, and any reported non-detects do not demonstrate that NG contamination is less than the selected screening criterion. However, as described in Section 5.1.4.2, the RL for NG is determined to be adequate for the HHRA screening at Fort Devens. No COPCs were identified in surface soils at MRS 1.

5.4.1.4 As described above in Section 5.4.1.3, no explosive MCs were detected in the surface soil at MRS 1. The RLs for 2,4,6-TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, NB, and tetryl were below the screening criteria selected for the SLERA, and confirm the ability of the analytical techniques to detect the MCs at levels sufficient to screen for unacceptable risks to ecological receptors.

5.4.1.5 No eco-SSLs were available for , 1,3,5-TNB, 1,3-DNB, and NG and it is, therefore, not possible to make similar comparisons for these MCs. 1,3-DNB, and 1,3,5-TNB have relatively low octanol-water partitioning coefficients (K_{ow}) on the order of less than 2 (Talmage et al., 1999, U.S. NLM 2008). In general, K_{ow} in this range indicate inefficient partitioning into the lipid component of organisms and a low ability to bioconcentrate or biomagnify up the food chain (USEPA 2005, USEPA 2008b). Based on the fact that 1,3,5-TNB, 1,3-DNB, and NG were not detected above their respective analytical RLs, and considering fate and transport characteristics, these MCs were not identified as COPECs in MRS 1. The decision is not expected to introduce an unacceptable level of uncertainty into the SLERA. No COPECs were identified in surface soil at MRS 1.

5.4.1.6 As shown in the SS-WP, incidental ingestion and dermal contact were identified as potentially complete transfer mechanisms for MCs in subsurface soils to visitors/trespassers, construction workers, and employees at MRS 1. Inhalation was additionally identified as a pathway with a potentially complete transfer mechanism for MCs in subsurface soils to construction workers.

5.4.1.7 No explosive constituents were detected at concentrations above their respective RLs in subsurface soil at MRS 1. The RLs for each of the not-detected explosive constituents were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. No COPCs were identified in subsurface soils at MRS 1.

5.4.2 Sediment Pathway and Screening Results

5.4.2.1 Sediment was identified as media with potentially complete pathways for human and ecological receptors at MRS 1. A total of two sediment samples were collected from MRS 1; one sediment sample and one duplicate sediment sample. The analytical results for sediment, along with the human health and ecological screening values described previously in Section 5.1.3 are listed in Table 5-2.

5.4.2.2 As shown in the SS-WP, incidental ingestion and dermal contact were identified as potentially complete transfer mechanisms for MCs in sediment to visitors/trespassers, construction workers, and employees at MRS 1. Ingestion of benthos exposed to MCs in sediment and incidental ingestion, and dermal contact with MCs in sediment were identified as potentially complete pathways for ecological receptors at MRS 1.

5.4.2.3 No explosive constituents were detected in concentrations above their respective RLs in sediment at MRS 1. The RLs were below the screening criteria selected for the HHRA for every explosive constituent analyzed in samples collected from MRS 1, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. No explosive constituents were identified as COPCs in sediment at MRS 1.

5.4.2.4 As described above in Section 5.4.3.3, no explosive MCs were detected in sediment at MRS 1. 2,4,6-TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and tetryl, had RLs were below their respective screening criterion selected for the SLERA, confirming the ability of the analytical techniques to detect the MCs at levels sufficient to screen for unacceptable risks to ecological receptors. The RLs for 1,3,5-TNB, 1,3-DNB, and NB were greater than the sediment screening criteria adopted for the SLERA. The MQO for sensitivity for these three MCs were not met, and any reported non-detects do not demonstrate that contamination is less than the selected screening criteria. No SL was available for NG, and therefore it is not possible to make a definitive conclusion regarding the ability of the analytical techniques employed to make a comparison for this MC. The uncertainty introduced into the SLERA as a result the failed MQOs for sensitivity for 1,3,5-TNB, 1,3-DNB, and NB and lack of a screening value for NG are discussed below.

5.4.2.5 As described in Section 5.4.1.5 1,3,5-TNB, 1,3-DNB, and NG have relatively low K_{ow} (<2) which indicate that the explosive constituents have a low ability to bioconcentrate or biomagnify up the food chain (USEPA 2005, USEPA 2008b). NB also has a low k_{ow} of 1.9 (ORNL 2010); and exhibits similar fate and transport characteristics. Based on the fact that no

explosive MCs were detected at MRS 1 above their analytical RLs, and considering fate and transport characteristics, 1,3,5-TNB, 1,3-DNB, NB and NG were not identified as COPECs for MRS 1. The decision is not expected to introduce an unacceptable level of uncertainty into the SLERA. No explosive constituents were identified as COPECs in sediment at MRS 1.

5.4.3 Groundwater Pathway and Screening Results

5.4.3.1 As shown in the SS-WP, ingestion and dermal contact were identified as potentially complete transfer mechanisms for MCs in groundwater to visitors/trespassers, construction workers, and employees at MRS 1. Incidental ingestion was additionally identified as a potentially complete transfer mechanism for MCs in groundwater to construction workers and employees. One groundwater sample was collected from a preexisting groundwater monitoring well near MRS 1, and analyzed for the explosive constituents tetryl, and TNT and TNT breakdown products. Table 5-3 presents the analytical results for groundwater, along with human health screening values described previously in Section 5.1.3.

5.4.3.2 None of the explosive constituents were detected at concentrations above their respective RLs in groundwater at MRS 1. The RLs for 1,3,5-TNB, 2,4,6-TNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and tetryl were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. The RLs for 1,3-DNB, 3-nitrotoluene, and NB were above the screening values selected for the HHRA, and therefore the MQO for sensitivity was not met for these analytes. Any reported non-detects do not demonstrate that contamination is less than the selected screening criterion. However, as described in Section 5.1.4.4, the screening criterion for these MCs were determined to be adequate for the HHRA. No COPCs were identified in groundwater at MRS 1.

5.4.4 Surface Water Pathway and Screening Results

5.4.4.1 Surface water was identified as a medium with potentially complete pathways for human and ecological receptors at MRS 1. A total of two surface water samples were collected; one site samples and one duplicate sample. Table 5-4 presents the analytical results for surface water, along with human health and ecological screening values described previously in Section 5.1.3.

5.4.4.2 As shown in the SS-WP, incidental ingestion and dermal contact were identified as potentially complete transfer mechanisms for MCs in surface water to visitors/trespassers, construction workers and employees. An identical set of transfer mechanisms for MCs in surface water was identified for ecological receptors.

5.4.4.3 None of the explosive MCs were detected in concentrations above their respective RLs in surface water at MRS 1. The RLs for every explosive constituent evaluated were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. No explosive constituents were identified as COPCs in surface water at MRS 1.

5.4.4.4 As described above in Section 5.4.4.3, no explosive MCs were detected in surface water at MRS 1. The RLs for each of the explosive constituents for which surface water screening values were available were below the screening criteria selected for the SLERA, and confirm the ability of the analytical techniques to detect these MCs at levels sufficient to screen for unacceptable risks to ecological receptors.

5.4.4.5 No ecological screening level was available for tetryl in surface water and therefore, it is not possible to make a similar comparison for this MC. Tetryl has a low K_{ow} of 1.6 (ORNL 2010). Chemicals with k_{ow} in this range have a low ability to bioconcentrate or accumulate in the food chain (USEPA 2005a, USEPA 2008). Based on the fact that no explosive MCs were detected in MRS 1 surface water, and considering its fate and transport characteristics, tetryl was not selected as a COPEC for surface water at MRS 1. This decision is not anticipated to introduce unacceptable risk into the SLERA. No explosive constituents were identified as COPECs in surface water at MRS 1.

5.5 Range Complex No. 1 (MRS 2)

5.5.0.1 As presented in Section 5.1.1, the explosive constituents DNT and DNT breakdown products and NG; the metals aluminum, antimony, barium, copper, iron, lead, magnesium, nickel, strontium and zinc; and perchlorate were identified as MCs at MRS 2. Surface soil, sediment, groundwater, and surface water were identified as media of concern for this area. Table 5-1 presents results of the screening level analysis in surface soil. Table 5-2 presents results of the screening level analysis in groundwater. Table 5-3 presents results of the screening level analysis in sediment. Table 5-4 presents results of the screening level analysis in surface water.

5.5.1 Soil Pathway and Screening Results

5.5.1.1 Surface soil was identified as a medium with a potentially complete pathway for human and ecological receptors at MRS 2. Table 5-1 presents the analytical results for surface soil,

along with the human health and ecological screening values described previously in Section 5.1.3.

5.5.1.2 As shown in the SS-WP, incidental ingestion and dermal contact were identified as potentially complete transfer mechanisms for MCs in surface soils to visitors/trespassers, construction workers, and employees at MRS 2. Additionally, inhalation was identified as a potentially complete transfer mechanism for MCs in this area to construction workers. Incidental ingestion, dermal contact, and ingestion of game and vegetation exposed to MCs were identified as potentially complete pathways for ecological receptors at MRS 2.

5.5.1.3 No explosive constituents were detected at concentrations above their respective RLs in surface soil at MRS 2. With the exception of NG, the RLs for every explosive constituent were below the screening criteria selected for the HHRA, confirming the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. Because the RL for NG is above the NG soil screening value of 0.61 mg/kg adopted for screening risks to visitors/trespassers , the MQO for sensitivity was not met and any reported non-detects for NG do not demonstrate that NG contamination is less than the selected screening criterion. However, as described in Section 5.1.4.2, the RL for NG is determined to be adequate for the HHRA screening at the Fort Devens FUDS. No explosive constituents were identified as COPCs in surface soils at MRS 2.

5.5.1.4 The metals aluminum, barium, copper, iron, lead, magnesium, nickel, strontium and zinc were detected in surface soil at MRS 2. Antimony was not detected in surface soil. As described in Section 5.1.4.2, the RL for antimony was below the screening levels adopted for the HHRA, confirming the ability of the analytical techniques used to detect antimony at levels sufficient to screen for risks to human receptors. As described in Section 5.3.0.2 mean and/or maximum concentrations for aluminum, iron, magnesium, and nickel were elevated compared to their respective background levels. No screening level was available for magnesium, and therefore a definitive statement regarding the potential risks to humans exposed to magnesium in soil cannot be made. However, concentrations of magnesium at MRS 2 (range – 540-2,400 mg/kg) are well below the national average of 9,000 mg/kg and the average for the Eastern U.S. of 4,600 mg/kg. Based on this comparison to naturally occurring levels, it is not anticipated that concentrations of magnesium at the FUDS would pose unacceptable risks to human receptors; therefore magnesium was not selected as a COPC for surface soil at MRS 2. The choice not to select magnesium as a COPC is not expected to introduce an unacceptable level of uncertainty in to the HHRA.

Maximum aluminum and iron concentrations at MRS 2 exceeded the HHRA screening criterion used for screening surface soil for visitors/trespassers. Aluminum and iron are identified as COPCs in surface soil at MRS 2. The following factors were considered in a WOE evaluation to determine the risk significance for the COPCs in surface soil at MRS 2:

- Aluminum
  - One of the six surface soil samples had a detected concentration that exceeded the HHRA screening criterion selected for visitors/trespassers (sample: DEV-MR2-SS-01-07; site sample: 9,300 mg/kg; screening criterion: 7,700 mg/kg).
  - None of the six surface soil sample samples had a detected concentration that exceeded the HHRA screening criterion selected for construction workers and employees.
  - None of the three background surface soil samples had a detected concentration that exceeded the HHRA screening criterion selected for visitors/trespassers.
  - None of the three background surface soil samples had a detected concentration that exceeded HHRA screening criterion selected for construction workers and employees.
  - None of the six site surface soil samples had a detected concentration that exceeded the maximum background concentration.
  - One of the six site surface soil samples had a detected concentration that exceeded the mean background concentration (sample: DEV-MR2-SS-01-07; site sample: 9,300 mg/kg; mean background: 5,430 mg/kg).
  - Aluminum is not defined as a hazardous substance under CERCLA.

- Iron
  - Four of the six surface soil samples had detected concentrations that exceeded the HHRA screening criterion selected for visitors/ trespassers (samples: DEV-MR2-SS-01-05, DEV-MR2-SS-01-06, DEV-MR2-SS-01-06P, DEV-MR2-SS-01-07; site samples: 6,900 mg/kg, 10,000 mg/kg, 7,000 mg/kg, 8,300 mg/kg; screening criterion: 5,500 mg/kg).
  - None of the six surface soil samples had a detected concentration that exceeded the HHRA screening criterion selected for construction workers and employees.
  - Two of the three background surface soil samples had concentrations that exceeded the HHRA screening criterion selected for visitors/ trespassers (samples: DEV-BG-SS-01-01, DEV-BG-SS-01-02; background samples: 7,200 mg/kg, 8,600 mg/kg; screening value: 5,500 mg/kg).
  - None of the three background surface soil samples had a detected concentration that

exceeded HHRA screening criterion selected for construction workers and employees.

- One of the six site surface soil samples had a detected concentration that exceeded the maximum background concentration (sample: DEV-MR2-SS-01-06; site sample: 10,000; maximum background: 8,600).
- Four of the six site surface soil concentrations exceeded the mean background concentration (samples: DEV-MR2-SS-01-05, DEV-MR2-SS-01-06, DEV-MR2-SS-01-06P, DEV-MR2-SS-01-07; site samples: 6,900 mg/kg, 10,000 mg/kg, 7,000 mg/kg, 8,300 mg/kg; mean background: 6,570 mg/kg).
- Iron is not defined as a hazardous substance under CERCLA.

Only a single sample exceeded the aluminum screening criterion adopted for the visitor/trespasser, and the exceedance was minimal. Further, as described in Section 5.1.3.6 the HHRA screening value for aluminum was derived by dividing the regional SL for residential soil by ten to account for potential simultaneous exposure to multiple non-carcinogenic compounds. The resulting screening value (7,700 mg/kg) is conservative in nature for screening risk at this MRS where only nine MCs are detected, and where the maximum concentration of seven of the nine detected MCs fell below the respective screening values selected for the HHRA. None of the site aluminum concentrations exceed the unadjusted aluminum regional SL (77,000 mg/kg) for residential soil. In addition, aluminum is not defined as a hazardous substance under CERCLA. Similar to aluminum, the screening value for iron was derived by dividing the regional SL for residential soil by ten to account for potential simultaneous exposure to multiple non-carcinogenic compounds. The resulting screening value (5,500 mg/kg) is conservative in nature for screening risk at this MRS where only nine MCs are detected, and where the maximum concentration for seven of the nine detected MCs were below their respective screening values selected for the HHRA. None of the site iron concentrations exceed the unadjusted iron regional SL (55,000 mg/kg) for residential soil. In addition, iron is not defined as a hazardous substance under CERCLA. Based on the WOE evaluation, exposure to the COPCs identified in surface soil is not determined to represent an unacceptable risk to human receptors.

5.5.1.5 As described above in Section 5.5.1.3, no explosive MCs were detected above their respective RLs in surface soil at MRS 2. The RLs for every explosive constituent, with the exception of NG, were below the screening criteria selected for the SLERA, and confirm the ability of the analytical techniques to detect the MCs at levels sufficient to screen for unacceptable risks to ecological receptors.

5.5.1.6 No eco-SSL was available for NG. Therefore, it is not possible to make similar comparisons for this MC. NG has a relatively low octanol-water partitioning coefficients (K_{ow} < 2) (U.S. NLM 2008). In general, K_{ow}< 2 indicate inefficient partitioning into the lipid component of organisms and a low ability to bioconcentrate or biomagnify up the food chain (USEPA 2005, USEPA 2008a). In addition, NG is readily biodegradable, a characteristic which also makes food chain exposures unlikely (USACHPPM 2007). Based on the fact that NG was not detected above its respective analytical RL, and considering fate and transport characteristics, NG was not identified as a COPEC in MRS 2. The decision is not expected to introduce an unacceptable level of uncertainty into the SLERA. No explosive constituents were identified as COPECs in surface soils at MRS 2.

5.5.1.7 As described in Section 5.5.1.4, the metals, aluminum, barium, copper, iron, lead, magnesium, nickel, strontium and zinc were detected in surface soil at MRS 2. Antimony was not detected in surface soil at MRS 2. The RL for antimony was equivalent to the screening level applied in the SLERA, confirming the ability of the analytical techniques used to detect antimony at levels sufficient to screen for risks to ecological receptors. As described in Section 5.3.0.2, maximum and/or mean concentrations of aluminum, iron, magnesium, and nickel exceeded their respective maximum and mean concentrations in background. No eco-SSLs were available for iron and magnesium[9], and therefore no definitive conclusions regarding the risks to ecological receptors exposed to these MCs in soil can be made. Iron is required for synthesis processes in plant cells and a certain amount of iron is essential to plant growth. Iron concentrations in natural soils range from 20,000-550,000 mg/kg (USEPA 2003b). This range is above the maximum site iron concentration of 10,000 mg/kg found in soils at MRS 2. Similarly, as described in Section 5.5.1.4 the concentrations of magnesium at the site are below levels typically seen in soils across the US. Iron and magnesium are not anticipated to pose an unacceptable risk to ecological receptors at MRS 2 based on the fact that their concentrations at MRS 2 are below the natural range in soils. Therefore, iron and magnesium were not selected as COPEC in soil at MRS 2. The decision is not expected to introduce an unacceptable level of uncertainty into the SLERA.

Lead was the only metal with a detected concentration at MRS 2 that exceeded its soil screening criterion. Lead concentrations in three of six surface soil samples exceeded the eco-SSL of 11 mg/kg for lead (max HQ = 3.9). Therefore, lead is identified as a COPEC for surface soil at MRS 2. However mean and maximum concentrations of lead in surface soil were not elevated above

[9] No eco-SSL was available for strontium. Concentrations of strontium at MRS 2 do not exceed concentrations in background. Additionally, concentrations measured at MRS 2 are below the national average of 240 mg/kg. Therefore, no additional risks to ecological receptors from exposure to strontium in soils are anticipated.

respective mean and maximum concentrations in background. The eco-SSL of 11 mg/kg is a conservative screening value for many of the ecological receptors that would be present at the site. It was derived from a robust dataset including plants, soil invertebrates, and avian and mammalian wildlife. It is based on toxicological effects to the American woodcock, which was the most sensitive of the avian receptors evaluated. The next lowest eco-SSL in the dataset is 46 mg/kg (for doves); none of the six site samples exceed this value. None of the site samples exceed the most conservative eco-SSL value for the other potential site receptor groups (mammalian wildlife = 56 mg/kg, plants = 120 mg/kg, and soil invertebrates = 1,700 mg/kg) (USEPA 2005a). Therefore it is concluded that no additional risks from FUDS related activities from lead exposures for ecological receptors at MRS 2 are present.

5.5.2 Sediment Pathway and Screening Results

5.5.2.1 Sediment was identified as media with potentially complete pathways for human and ecological receptors at MRS 2. The analytical results for sediment, along with the human health and ecological screening values described previously in Section 5.1.3 are listed in Table 5-2.

5.5.2.2 As shown in the SS-WP, incidental ingestion and dermal contact were identified as potentially complete transfer mechanisms for MCs in sediment to visitors/trespassers, construction workers, and employees at MRS 2. Ingestion of benthos exposed to MCs in sediment and incidental ingestion, and dermal contact with MCs in sediment were identified as potentially complete pathways for ecological receptors at MRS 2.

5.5.2.3 No explosive constituents were detected in concentrations above their respective RLs in sediment at MRS 2. With the exception of NG, the RLs for every explosive constituent were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. The RL for NG is above the NG sediment screening criterion of 6.1 mg/kg adopted for screening risks to visitors/trespassers, and therefore the MQO for sensitivity was not met. Any reported non-detects for NG do not demonstrate that NG contamination is less than the selected screening criterion. However, as described in Section 5.1.4.3, the RL for NG is determined to be adequate for the HHRA screening at the Fort Devens FUDS. No explosive constituents were identified as COPCs in sediment at MRS 2.

5.5.2.4 The metals aluminum, antimony, barium, copper, iron, lead, magnesium, nickel, strontium and zinc were detected in sediment at MRS 2. As stated in Section 5.3.0.3 the mean and maximum concentrations of copper and lead were elevated above their respective concentrations in background. The maximum concentration of each of the detected metals did

not exceed the screening criteria selected for the HHRA[10], and therefore no inorganic COPCs were identified in sediment at MRS 2.

5.5.2.4 As described above in Section 5.5.2.2, no explosive MCs were detected in sediment at MRS 2. Each explosive constituent with available screening criterion had an RL that was below the respective criterion selected for the SLERA, confirming the ability of the analytical techniques to detect the MCs at levels sufficient to screen for unacceptable risks to ecological receptors.

5.5.2.5 No ecological sediment SL was available for NG and therefore, it is not possible to make similar comparisons for this MC. As described in Section 5.5.1.5 NG is unlikely to bioconcentrate or biomagnify, and is readily biodegradable. Based on the fact that NG was not detected above its analytical RL, and considering fate and transport characteristics, NG was not identified as a COPEC in MRS 2. The decision is not expected to introduce an unacceptable level of uncertainty into the SLERA. No explosive constituents were identified as COPECs in sediment at MRS 2.

5.5.2.6 As described in Section 5.5.2.4, the metals aluminum, antimony, barium, copper, iron, lead, magnesium, nickel, strontium and zinc were detected in sediment at MRS 2. As stated in Section 5.3.0.3 mean and maximum concentrations of copper and lead at MRS 2 were elevated above background. None of the site sediment samples or background sediment samples exceeded the eco SSL for copper (Table 5-3). The maximum concentration of lead at MRS 2 exceeded the ecological sediment SL of 36 mg/kg (max HQ = 1.6)[11]. Therefore, lead is considered a COPEC for sediment at MRS 2. The following factors were considered as part of the WOE approach for determining the risk significance for lead in sediment at MRS 2:

- Two of the three site sediment samples had detected concentrations that exceeded the

[10] It is noted that no screening level for magnesium was available for the HHRA. However, site concentrations of this MC did not exceed concentrations in background, and as stated in Section 5.5.1.4, site concentrations of magnesium in surrounding media (soil) at MRS 2 are below the average concentrations measured in U.S. soils. No risks to humans from exposure to magnesium in sediment at MRS 2 are anticipated.

[11] It is noted that no sediment screening criterion for barium, magnesium, or strontium were available for the SLERA. However, site concentrations of these MCs did not exceed concentrations in background. Additionally, as stated in Section 5.5.1.6, site concentrations of magnesium and strontium in surrounding media (soil) at MRS 2 were below the average concentrations measured in U.S. soils. Concentrations of barium in soil at MRS 2 are also below the average concentrations of barium measured in U.S. soils. No risks to ecological receptors from exposure to these MCs sediment at MRS 2 are anticipated.

ecological screening value (samples: DEV-MR2-SD-01-02, DEV-MR2-SD-01-02P; site samples: 39 mg/kg, 48 mg/kg; eco SSL: 36 mg/kg; maximum HQ = 1.3) (Table 5-3).

- Neither of the two sediment background samples had detected concentrations that exceeded the ecological screening value (Tables 5-3 and 5-8).
- Two of the three site sediment samples had detected concentrations that exceeded the maximum background concentration (samples: DEV-MR2-SD-01-02, DEV-MR2-SD-01-02P; site samples: 39 mg/kg, 48 mg/kg; maximum background = 32 mg/kg) (Table 5-8).
- Two of the three site sediment samples had detected concentrations that exceeded the mean background concentration (samples: DEV-MR2-SD-01-02, DEV-MR2-SD-01-02P; site samples: 39 mg/kg, 48 mg/kg; mean background = 29.5 mg/kg) (Table 5-8).

Concentrations of lead in sediment minimally exceeded the selected screening criterion. Lead in sediment is not anticipated to result in unacceptable risks to ecological receptors at MRS 2.

5.5.3 Groundwater Pathway and Screening Results

5.5.3.1 As shown in the SS-WP, ingestion and dermal contact were identified as potentially complete transfer mechanisms for MCs in groundwater to visitors/trespassers, construction workers, and employees at MRS 2. Incidental ingestion was additionally identified as a potentially complete transfer mechanism for MCs in groundwater to construction workers and employees. A total of two groundwater samples were collected; one site sample and one duplicate sample. The samples were collected from an area northwest and downgradient of MRS 2. Both samples were analyzed for the explosive constituents DNT and DNT breakdown products, and NG, and perchlorate. Table 5-2 presents the analytical results for groundwater, along with human health screening criteria described previously in Section 5.1.3.

5.5.3.2 None of the explosive constituents were detected in concentrations above their respective RLs in groundwater at MRS 2. The RLs for 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and 4-nitrotoluene were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. The RLs for 2,4-DNT, 2-nitrotoluene, 3-nitrotoluene, and NG are above the HHRA screening values selected for these MCs, and therefore the MQO for sensitivity was not met for these analytes. Any reported non-detects do not demonstrate that contamination is less than the selected screening criteria. However, as described in Section 5.1.4.6, the RLs for these MCs are considered adequate for the HHRA. No explosive constituents were identified as COPCs in groundwater at MRS 2.

5.5.3.3 Perchlorate was the single MC detected in groundwater from MRS 2. As stated in Section 5.3.0.5 the maximum concentration of perchlorate at MRS 2 was greater than the maximum concentration in background. However, the maximum concentration of perchlorate in groundwater at MRS 2 (site samples 0.03, 0.03, 0.02 µg/L) did not exceed the screening criterion of 2.0 µg/L selected for the HHRA (Table 5-2 and 5-9). No COPCs were identified in groundwater at MRS 2.

5.5.4 Surface Water Pathway and Screening Results

5.5.4.1 Surface water was identified as a medium with potentially complete pathways for human and ecological receptors at MRS 2. Table 5-4 presents the analytical results for surface water, along with human health and ecological screening values described previously in Section 5.1.3.

5.5.4.2 As shown in the SS-WP, incidental ingestion and dermal contact were identified as potentially complete transfer mechanisms for MCs in surface water to visitors/trespassers, construction workers and employees. An identical set of transfer mechanisms for MCs in surface water was identified for ecological receptors.

5.5.4.3 None of the explosive MCs were detected in concentrations above their respective RLs in surface water at MRS 2. The RLs for each explosive constituent evaluated were below the screening criteria selected for the HHRA, which confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. No explosive constituents were identified as COPCs in surface water at MRS 2.

5.5.4.4 Perchlorate was not detected above its RL in surface water at MRS 2. The RL for perchlorate was below the screening criterion selected for the MC for the HHRA, and confirms the ability of the analytical techniques employed to detect the MCs at levels sufficient to screen for unacceptable risks to human receptors. Perchlorate was not identified as a COPC in surface water at MRS 2.

5.5.4.5 As described in Section 5.5.4.3, no explosive MCs were detected in surface water at MRS 2. The RLs for each of the explosive constituents evaluated were below the screening criteria selected for the SLERA, and confirms the ability of the analytical techniques to detect the MCs at levels sufficient to screen for unacceptable risks to ecological receptors. No explosive constituents were identified as COPECs in surface water at MRS 2.

5.5.4.6 As described in Section 5.5.4.4 perchlorate was not detected above its RL in surface

water at MRS 2. No surface water screening level for perchlorate is available. Therefore, the adequacy of the RL to detect perchlorate at levels sufficient to screen for risks to ecological receptors cannot be confirmed. Perchlorate has a relatively low log K_{ow} of -5.8 (USEPA 2008b). In general, the octanol water partition coefficient (K_{ow}) in this range indicates inefficient partitioning into organisms. Chemicals with this characteristic generally do not bioconcentrate in organisms or biomagnify up the food chain (USEPA 1989, USEPA 2005, and USEPA 2008a). Based on the fact that perchlorate was not detected above its analytical RL, and considering fate and transport characteristics, perchlorate was not identified as a COPEC in MRS 2. The decision is not expected to introduce an unacceptable level of uncertainty into the SLERA.

Table 5-1 Summary of Soil Analytical Results

Analyte	CAS	Unit	Screening Values for Visitors/ Trespassers [a,b] (mg/kg)	Screening Values for Construction Workers and Employees [a,b] (mg/kg)	Screening Values for Biota (mg/kg)	DEV-MR1-SS-01-01 8/18/2009 MRS 1	DEV-MR1-SS-01-02 8/18/2009 MRS 1	DEV-MR1-SS-01-03 8/18/2009 MRS 1	DEV-MR1-SS-01-04 8/18/2009 MRS 1	DEV-MR1-SS-01-04P 8/18/2009 DEV-MR1-SS-01-04 MRS 1	DEV-PA-SS-01-01 6/22/2010 MRS 1
Explosive Constituents											
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	220	2,700	NSL	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.10 U
1,3-DINITROBENZENE	99-65-0	mg/kg	0.61	6.2	NSL	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.10 U
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	19	79	30 [c]	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.10 U
2,4-DINITROTOLUENE	121-14-2	mg/kg	1.6	5.5	30 [c,d]	--	--	--	--	--	--
2,6-DINITROTOLUENE	606-20-2	mg/kg	6.1	62	30 [c,d]	--	--	--	--	--	--
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	15 [e]	200 [e]	80 [c]	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.10 U
2-NITROTOLUENE	88-72-2	mg/kg	2.9	13	30 [c,d]	--	--	--	--	--	--
3-NITROTOLUENE	99-08-1	mg/kg	0.61	6.2	30 [c,d]	--	--	--	--	--	--
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	15 [e]	190 [e]	80 [c,f]	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.10 U
4-NITROTOLUENE	99-99-0	mg/kg	30	110	30 [c,d]	--	--	--	--	--	--
TETRYL	479-45-8	mg/kg	24	250	25 [c]	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.20 U
NITROBENZENE	98-95-3	mg/kg	4.8	24	40 [g]	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.30 U
NITROGLYCERIN	55-63-0	mg/kg	0.61	6.2	NSL	--	--	--	--	--	2.00 U
Metals											
ALUMINUM	7429-90-5	mg/kg	7,700	99,000	pH < 5.5 [h]	--	--	--	--	--	--
ANTIMONY	7440-36-0	mg/kg	3.1	41	0.27 [i]	--	--	--	--	--	--
BARIUM	7440-39-3	mg/kg	1,500	19,000	330 [j]	--	--	--	--	--	--
COPPER	7440-50-8	mg/kg	310	4,100	28 [k]	--	--	--	--	--	--
IRON	7439-89-6	mg/kg	5,500	72,000	NSL	--	--	--	--	--	--
LEAD	7439-92-1	mg/kg	400	800	11 [l]	--	--	--	--	--	--
MAGNESIUM	7439-95-4	mg/kg	NSL	NSL	NSL	--	--	--	--	--	--
NICKEL	7440-02-0	mg/kg	150	2,000	38 [m]	--	--	--	--	--	--
STRONTIUM	7440-24-6	mg/kg	4,700	61,000	NSL	--	--	--	--	--	--
ZINC	7440-66-6	mg/kg	2,300	31,000	46 [n]	--	--	--	--	--	--

[a] Screening values for human receptors at the site were derived from USEPA (2011) Regional Screening Levels for residential and industrial soils. Available from http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm.

[b] For non-carcinogens with the exception of lead, screening levels were divided by 10 to account for potential exposure to multiple non-carcinogens. No adjustment was made for carcinogens or lead..

[c] Talmage et al. 1999. Nitroaromatic munition compounds: environmental effects and screening values. Rev. Environ. Contam. Toxicol. 161: 1-156.

[d] Screening level based on 2,4,6-trinitrotoluene.

[e] Screening level based on 2,4-dinitrotoluene.

[f] Screening level based on 2-amino-4,6-dinitrotoluene.

[g] Efroymson et al. 1997. Toxicological benchmarks for screening contaminants of potential concern for effects on terrestrial plants: 1997 revision. ES/ER/TM-85/R3. U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN.

[h] USEPA. 2003. Ecological Soil Screening Level for Aluminum. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_aluminum.pdf. Accessed 15 July 2008.

[i] USEPA. 2005b. Ecological Soil Screening Level for Antimony. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_antimony.pdf. Accessed 15 July 2008.

[j] USEPA. 2005c. Ecological Soil Screening Level for Barium. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_barium.pdf. Accessed 7 July 2009.

[k] USEPA. 2007a. Ecological Soil Screening Level for Copper. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_copper.pdf. Accessed 15 July 2008.

[l] USEPA. 2005d. Ecological Soil Screening Level for Lead. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_lead.pdf. Accessed 7 July 2009.

[m] USEPA. 2007b. Ecological Soil Screening Level for Nickel. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_nickel.pdf. Accessed 15 July 2008.

[n] USEPA. 2007c. Ecological Soil Screening Level for Zinc. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_zinc.pdf. Accessed 8 June 2009.

CAS = Chemical Abstract Service.
J = Analyte is present. Reported value may not be accurate or precise.
mg/kg = Milligram per kilogram.
MRS = Munitions Response Site.
NSL = No screening level.
Tetryl = Methyl-2,4,6-trinitrophenylnitramine
U = Not detected. Values are reporting limits (RLs).
UJ = Not detected. The associated detection limit is an estimate and may be inaccurate or imprecise. Values are reporting limits (RLs).
USEPA = United States Environmental Protection Agency.
-- = Not analyzed.
Shaded and bold values represent detected values that exceed human health screening criteria.
Shaded and italicized values represent detected values that exceed ecological screening criteria.
Screening level exceedances were only identified for receptors for which the medium had a potentially completed pathway identified in the SS-WP addendum.

Table 5-1 Summary of Soil Analytical Results (continued)

			Screening Values for Visitors/ Trespassers [a,b]	Screening Values for Construction Workers and Employees [a,b]	Screening Values for Biota						
Sample Name:						DEV-PA-SS-01-02	DEV-PA-SS-01-03	DEV-PA-SS-DUP1	DEV-PA-SS-01-04	DEV-PA-SS-01-05	DEV-MR1-SB-02-01
Sample Date:						6/22/2010	6/22/2010	6/22/2010	6/22/2010	6/22/2010	8/18/2009
Parent Name:								DEV-PA-SS-01-03			
MRS:						MRS 1	MRS 1	MRS 1	MRS 1	MRS 1	MRS 1
Analyte	**CAS**	**Unit**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**						
Explosive Constituents											
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	220	2,700	NSL	0.10 U	0.10 U	0.10 U	0.10 U	0.10 UJ	0.25 U
1,3-DINITROBENZENE	99-65-0	mg/kg	0.61	6.2	NSL	0.10 U	0.10 U	0.10 U	0.10 U	0.10 UJ	0.25 U
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	19	79	30 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 UJ	0.25 U
2,4-DINITROTOLUENE	121-14-2	mg/kg	1.6	5.5	30 [c,d]	--	--	--	--	--	--
2,6-DINITROTOLUENE	606-20-2	mg/kg	6.1	62	30 [c,d]	--	--	--	--	--	--
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	15 [e]	200 [e]	80 [c]	0.10 U	0.10 U	0.10 U	0.10 U	0.10 UJ	0.25 U
2-NITROTOLUENE	88-72-2	mg/kg	2.9	13	30 [c,d]	--	--	--	--	--	--
3-NITROTOLUENE	99-08-1	mg/kg	0.61	6.2	30 [c,d]	--	--	--	--	--	--
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	15 [e]	190 [e]	80 [c,f]	0.10 U	0.10 U	0.10 U	0.10 UJ	0.10 UJ	0.25 U
4-NITROTOLUENE	99-99-0	mg/kg	30	110	30 [c,d]	--	--	--	--	--	--
TETRYL	479-45-8	mg/kg	24	250	25 [c]	0.20 U	0.19 U	0.20 U	0.20 U	0.60 J	0.50 U
NITROBENZENE	98-95-3	mg/kg	4.8	24	40 [g]	0.29 U	0.29 U	0.30 U	0.30 U	0.30 UJ	0.25 U
NITROGLYCERIN	55-63-0	mg/kg	0.61	6.2	NSL	2.00 U	1.90 U	2.00 U	2.00 U	2.00 UJ	--
Metals											
ALUMINUM	7429-90-5	mg/kg	7,700	99,000	pH < 5.5 [h]	--	--	--	--	--	--
ANTIMONY	7440-36-0	mg/kg	3.1	41	0.27 [i]	--	--	--	--	--	--
BARIUM	7440-39-3	mg/kg	1,500	19,000	330 [j]	--	--	--	--	--	--
COPPER	7440-50-8	mg/kg	310	4,100	28 [k]	--	--	--	--	--	--
IRON	7439-89-6	mg/kg	5,500	72,000	NSL	--	--	--	--	--	--
LEAD	7439-92-1	mg/kg	400	800	11 [l]	--	--	--	--	--	--
MAGNESIUM	7439-95-4	mg/kg	NSL	NSL	NSL	--	--	--	--	--	--
NICKEL	7440-02-0	mg/kg	150	2,000	38 [m]	--	--	--	--	--	--
STRONTIUM	7440-24-6	mg/kg	4,700	61,000	NSL	--	--	--	--	--	--
ZINC	7440-66-6	mg/kg	2,300	31,000	46 [n]	--	--	--	--	--	--

[a] Screening values for human receptors at the site were derived from USEPA (2011) Regional Screening Levels for residential and industrial soils. Available from http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm.

[b] For non-carcinogens with the exception of lead, screening levels were divided by 10 to account for potential exposure to multiple non-carcinogens. No adjustment was made for carcinogens or lead..

[c] Talmage et al. 1999. Nitroaromatic munition compounds: environmental effects and screening values. Rev. Environ. Contam. Toxicol. 161: 1-156.

[d] Screening level based on 2,4,6-trinitrotoluene.

[e] Screening level based on 2,4-dinitrotoluene.

[f] Screening level based on 2-amino-4,6-dinitrotoluene.

[g] Efroymson et al. 1997. Toxicological benchmarks for screening contaminants of potential concern for effects on terrestrial plants: 1997 revision. ES/ER/TM-85/R3. U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN.

[h] USEPA. 2003. Ecological Soil Screening Level for Aluminum. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_aluminum.pdf. Accessed 15 July 2008.

[i] USEPA. 2005b. Ecological Soil Screening Level for Antimony. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_antimony.pdf. Accessed 15 July 2008.

[j] USEPA. 2005c. Ecological Soil Screening Level for Barium. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_barium.pdf. Accessed 7 July 2009.

[k] USEPA. 2007a. Ecological Soil Screening Level for Copper. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_copper.pdf. Accessed 15 July 2008.

[l] USEPA. 2005d. Ecological Soil Screening Level for Lead. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_lead.pdf. Accessed 7 July 2009.

[m] USEPA. 2007b. Ecological Soil Screening Level for Nickel. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_nickel.pdf. Accessed 15 July 2008.

[n] USEPA. 2007c. Ecological Soil Screening Level for Zinc. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_zinc.pdf. Accessed 8 June 2009.

CAS = Chemical Abstract Service.
J = Analyte is present. Reported value may not be accurate or precise.
mg/kg = Milligram per kilogram.
MRS = Munitions Response Site.
NSL = No screening level.
Tetryl = Methyl-2,4,6-trinitrophenylnitramine
U = Not detected. Values are reporting limits (RLs).
UJ = Not detected. The associated detection limit is an estimate and may be inaccurate or imprecise. Values are reporting limits (RLs).
USEPA = United States Environmental Protection Agency.
-- = Not analyzed.
Shaded and bold values represent detected values that exceed human health screening criteria.
Shaded and italicized values represent detected values that exceed ecological screening criteria.

Table 5-1 Summary of Soil Analytical Results (Continued)

			Screening Values for Visitors/ Trespassers [a,b]	Screening Values for Construction Workers and Employees [a,b]	Screening Values for Biota					
Sample Name:						**DEV-MR1-SB-02-02**	**DEV-MR2-SS-01-05**	**DEV-MR2-SS-01-06**	**DEV-MR2-SS-01-06P**	**DEV-MR2-SS-01-07**
Sample Date:						**8/18/2009**	**8/19/2009**	**8/19/2009**	**8/19/2009**	**8/19/2009**
Parent Name:									**DEV-MR2-SS-01-06**	
MRS:						MRS 1	MRS 2	MRS 2	MRS 2	MRS 2
Analyte	**CAS**	**Unit**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**					
Explosive Constituents										
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	220	2,700	NSL	0.25 U	--	--	--	--
1,3-DINITROBENZENE	99-65-0	mg/kg	0.61	6.2	NSL	0.25 U	--	--	--	--
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	19	79	30 [c]	0.25 U	--	--	--	--
2,4-DINITROTOLUENE	121-14-2	mg/kg	1.6	5.5	30 [c,d]	--	0.26 U	0.26 U	0.26 U	0.29 U
2,6-DINITROTOLUENE	606-20-2	mg/kg	6.1	62	30 [c,d]	--	0.26 U	0.26 U	0.26 U	0.29 U
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	15 [e]	200 [e]	80 [c]	0.25 U	0.26 U	0.26 U	0.26 U	0.29 U
2-NITROTOLUENE	88-72-2	mg/kg	2.9	13	30 [c,d]	--	0.26 U	0.26 U	0.26 U	0.29 U
3-NITROTOLUENE	99-08-1	mg/kg	0.61	6.2	30 [c,d]	--	0.52 U	0.51 U	0.51 U	0.58 U
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	15 [e]	190 [e]	80 [c,f]	0.25 U	0.26 U	0.26 U	0.26 U	0.29 U
4-NITROTOLUENE	99-99-0	mg/kg	30	110	30 [c,d]	--	0.41 U	0.41 U	0.41 U	0.46 U
TETRYL	479-45-8	mg/kg	24	250	25 [c]	0.50 U	--	--	--	--
NITROBENZENE	98-95-3	mg/kg	4.8	24	40 [g]	0.25 U	--	--	--	--
NITROGLYCERIN	55-63-0	mg/kg	0.61	6.2	NSL	--	5.30 U	5.30 U	5.20 U	5.90 U
Metals										
ALUMINUM	7429-90-5	mg/kg	7,700	99,000	pH < 5.5 [h]	--	4,000.00 J	4,900.00 J	3,700.00 J	**9,300.00 J**
ANTIMONY	7440-36-0	mg/kg	3.1	41	0.27 [i]	--	0.21 UJ	0.21 UJ	0.21 UJ	0.23 UJ
BARIUM	7440-39-3	mg/kg	1,500	19,000	330 [j]	--	9.80	9.00	10.00	19.00
COPPER	7440-50-8	mg/kg	310	4,100	28 [k]	--	6.70	7.40	8.70	7.10
IRON	7439-89-6	mg/kg	5,500	72,000	NSL	--	**6,900.00 J**	**10,000.00 J**	**7,000.00 J**	**8,300.00 J**
LEAD	7439-92-1	mg/kg	400	800	11 [l]	--	4.10 J	5.90 J	5.90 J	*43.00 J*
MAGNESIUM	7439-95-4	mg/kg	NSL	NSL	NSL	--	1,600.00 J	2,400.00 J	1,500.00 J	1,100.00 J
NICKEL	7440-02-0	mg/kg	150	2,000	38 [m]	--	11.00 J	12.00 J	12.00 J	14.00 J
STRONTIUM	7440-24-6	mg/kg	4,700	61,000	NSL	--	1.80	3.40	2.40	1.70
ZINC	7440-66-6	mg/kg	2,300	31,000	46 [n]	--	21.00	23.00	22.00	23.00

[a] Screening values for human receptors at the site were derived from USEPA (2010a) Regional Screening Levels for residential and industrial soils. Available from http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm.

[b] For non-carcinogens with the exception of lead, screening levels were divided by 10 to account for potential exposure to multiple non-carcinogens. No adjustment was made for carcinogens or lead..

[c] Talmage et al. 1999. Nitroaromatic munition compounds: environmental effects and screening values. Rev. Environ. Contam. Toxicol. 161: 1-156.

[d] Screening level based on 2,4,6-trinitrotoluene.

[e] Screening level based on 2,4-dinitrotoluene.

[f] Screening level based on 2-amino-4,6-dinitrotoluene.

[g] Efroymson et al. 1997. Toxicological benchmarks for screening contaminants of potential concern for effects on terrestrial plants: 1997 revision. ES/ER/TM-85/R3. U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN.

[h] USEPA. 2003. Ecological Soil Screening Level for Aluminum. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_aluminum.pdf. Accessed 15 July 2008.

[i] USEPA. 2005b. Ecological Soil Screening Level for Antimony. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_antimony.pdf. Accessed 15 July 2008.

[j] USEPA. 2005c. Ecological Soil Screening Level for Barium. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_barium.pdf. Accessed 7 July 2009.

[k] USEPA. 2007a. Ecological Soil Screening Level for Copper. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_copper.pdf. Accessed 15 July 2008.

[l] USEPA. 2005d. Ecological Soil Screening Level for Lead. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_lead.pdf. Accessed 7 July 2009.

[m] USEPA. 2007b. Ecological Soil Screening Level for Nickel. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_nickel.pdf. Accessed 15 July 2008.

[n] USEPA. 2007c. Ecological Soil Screening Level for Zinc. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_zinc.pdf. Accessed 8 June 2009.

CAS = Chemical Abstract Service.
J = Analyte is present. Reported value may not be accurate or precise.
mg/kg = Milligram per kilogram.
MRS = Munitions Response Site.
NSL = No screening level.
Tetryl = Methyl-2,4,6-trinitrophenylnitramine
U = Not detected. Values are reporting limits (RLs).
UJ = Not detected. The associated detection limit is an estimate and may be inaccurate or imprecise. Values are reporting limits (RLs).
USEPA = United States Environmental Protection Agency.
-- = Not analyzed.
Shaded and bold values represent detected values that exceed human health screening criteria.
Shaded and italicized values represent detected values that exceed ecological screening criteria.
Screening level exceedances were only identified for receptors for which the medium had a potentially completed pathway identified in the SS-WP addendum.

Table 5-1 Summary of Soil Analytical Results (Continued)

Analyte	CAS	Unit	Screening Values for Visitors/ Trespassers [a,b] (mg/kg)	Screening Values for Construction Workers and Employees [a,b] (mg/kg)	Screening Values for Biota (mg/kg)	DEV-MR2-SS-01-08 8/18/2009 MRS 2	DEV-MR2-SS-01-09 8/18/2009 MRS 2	DEV-BG-SS-01-01 8/18/2009	DEV-BG-SS-01-02 8/18/2009	DEV-BG-SS-01-03 8/18/2009
Explosive Constituents										
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	220	2,700	NSL	--	--	--	--	--
1,3-DINITROBENZENE	99-65-0	mg/kg	0.61	6.2	NSL	--	--	--	--	--
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	19	79	30 [c]			--	--	--
2,4-DINITROTOLUENE	121-14-2	mg/kg	1.6	5.5	30 [c,d]	0.25 U	0.25 U	--	--	--
2,6-DINITROTOLUENE	606-20-2	mg/kg	6.1	62	30 [c,d]	0.25 U	0.25 U	--	--	--
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	15 [e]	200 [e]	80 [c]	0.25 U	0.25 U	--	--	--
2-NITROTOLUENE	88-72-2	mg/kg	2.9	13	30 [c,d]	0.25 U	0.25 U	--	--	--
3-NITROTOLUENE	99-08-1	mg/kg	0.61	6.2	30 [c,d]	0.50 U	0.50 U	--	--	--
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	15 [e]	190 [e]	80 [c,f]	0.25 U	0.25 U	--	--	--
4-NITROTOLUENE	99-99-0	mg/kg	30	110	30 [c,d]	0.40 U	0.40 U	--	--	--
TETRYL	479-45-8	mg/kg	24	250	25 [c]	--	--	--	--	--
NITROBENZENE	98-95-3	mg/kg	4.8	24	40 [g]	--	--	--	--	--
NITROGLYCERIN	55-63-0	mg/kg	0.61	6.2	NSL	5.10 U	5.10 U	--	--	--
Metals										
ALUMINUM	7429-90-5	mg/kg	7,700	99,000	pH < 5.5 [h]	4,400.00	4,200.00	6,400.00	6,500.00	3,400.00
ANTIMONY	7440-36-0	mg/kg	3.1	41	0.27 [i]	0.26 UJ	0.25 UJ	0.25 UJ	0.23 J	0.22 UJ
BARIUM	7440-39-3	mg/kg	1,500	19,000	330 [j]	9.60	16.00	31.00	46.00	12.00
COPPER	7440-50-8	mg/kg	310	4,100	28 [k]	4.80	5.30	19.00	*40.00*	4.20
IRON	7439-89-6	mg/kg	5,500	72,000	NSL	4,400.00	4,700.00	**7,200.00**	**8,600.00**	3,900.00
LEAD	7439-92-1	mg/kg	400	800	11 [l]	*15.00 J*	*25.00 J*	*110.00 J*	*71.00 J*	*47.00 J*
MAGNESIUM	7439-95-4	mg/kg	NSL	NSL	NSL	620.00	540.00	1,500.00	2,100.00	380.00
NICKEL	7440-02-0	mg/kg	150	2,000	38 [m]	5.40 J	5.00 J	12.00 J	12.00 J	2.60 J
STRONTIUM	7440-24-6	mg/kg	4,700	61,000	NSL	1.60 J	1.60 J	13.00	6.60	1.50 J
ZINC	7440-66-6	mg/kg	2,300	31,000	46 [n]	15.00	17.00	46.00	*93.00*	7.30

[a] Screening values for human receptors at the site were derived from USEPA (2010a) Regional Screening Levels for residential and industrial soils. Available from http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htu

[b] For non-carcinogens with the exception of lead, screening levels were divided by 10 to account for potential exposure to multiple non-carcinogens. No adjustment was made for carcinogens or lead..

[c] Talmage et al. 1999. Nitroaromatic munition compounds: environmental effects and screening values. Rev. Environ. Contam. Toxicol. 161: 1-156.

[d] Screening level based on 2,4,6-trinitrotoluene.

[e] Screening level based on 2,4-dinitrotoluene.

[f] Screening level based on 2-amino-4,6-dinitrotoluene.

[g] Efroymson et al. 1997. Toxicological benchmarks for screening contaminants of potential concern for effects on terrestrial plants: 1997 revision. ES/ER/TM-85/R3. U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN.

[h] USEPA. 2003. Ecological Soil Screening Level for Aluminum. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_aluminum.pdf. Accessed 15 July 2008.

[i] USEPA. 2005b. Ecological Soil Screening Level for Antimony. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_antimony.pdf. Accessed 15 July 2008.

[j] USEPA. 2005c. Ecological Soil Screening Level for Barium. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_barium.pdf. Accessed 7 July 2009.

[k] USEPA. 2007a. Ecological Soil Screening Level for Copper. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_copper.pdf. Accessed 15 July 2008.

[l] USEPA. 2005d. Ecological Soil Screening Level for Lead. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_lead.pdf. Accessed 7 July 2009.

[m] USEPA. 2007b. Ecological Soil Screening Level for Nickel. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_nickel.pdf. Accessed 15 July 2008.

[n] USEPA. 2007c. Ecological Soil Screening Level for Zinc. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_zinc.pdf. Accessed 8 June 2009.

CAS = Chemical Abstract Service.
J = Analyte is present. Reported value may not be accurate or precise.
mg/kg = Milligram per kilogram.
MRS = Munitions Response Site.
NSL = No screening level.
Tetryl = Methyl-2,4,6-trinitrophenylnitramine
U = Not detected. Values are reporting limits (RLs).
UJ = Not detected. The associated detection limit is an estimate and may be inaccurate or imprecise. Values are reporting limits (RLs).
USEPA = United States Environmental Protection Agency.
-- = Not analyzed.
Shaded and bold values represent detected values that exceed human health screening criteria.
Shaded and italicized values represent detected values that exceed ecological screening criteria.
Screening level exceedances were only identified for receptors for which the medium had a potentially completed pathway identified in the SS-WP addendum.

Table 5-2 Summary of Sediment Analytical Results

Analyte	CAS	Unit	Screening Values for Visitors/ Trespassers [a,b] (mg/kg)	Screening Values for Construction Workers and Employees [a,b] (mg/kg)	Screening Values for Biota [c] (mg/kg)	DEV-PA-SD-01-01 6/22/2010 MRS 1	DEV-PA-SD-DUP1 6/22/2010 DEV-PA-SD-01-01 MRS 1	DEV-MR2-SD-01-01 8/19/2009 MRS 2	DEV-MR2-SD-01-02 8/19/2009 MRS 2	DEV-MR2-SD-01-02P 8/19/2009 DEV-MR2-SD-01-02 MRS 2	DEV-BG-SD-01-01 8/17/2009	DEV-BG-SD-01-02 8/17/2009
Explosive Constituents												
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	2,200	27,000	0.0024 [d]	0.19 U	0.20 U	--	--	--	--	--
1,3-DINITROBENZENE	99-65-0	mg/kg	6.1	62	0.0067 [d]	0.19 U	0.20 U	--	--	--	--	--
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	190	790	30 [d,e]	0.19 U	0.20 U	--	--	--	--	--
2,4-DINITROTOLUENE	121-14-2	mg/kg	16	55	30 [d,e]	--	--	0.38 U	0.41 U	0.41 U	--	--
2,6-DINITROTOLUENE	606-20-2	mg/kg	61	620	30 [d,e]	--	--	0.38 U	0.41 U	0.41 U	--	--
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	150 [f]	2,000 [f]	80 [d,g]	0.09 U	0.10 U	0.38 U	0.41 U	0.41 U	--	--
2-NITROTOLUENE	88-72-2	mg/kg	29	130	30 [d,e]	--	--	0.38 U	0.41 U	0.41 U	--	--
3-NITROTOLUENE	99-08-1	mg/kg	6.1	62	30 [d,e]	--	--	0.75 U	0.81 U	0.81 U	--	--
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	150 [f]	1,900 [f]	80 [d,h]	0.09 UJ	0.10 U	0.38 U	0.41 U	0.41 U	--	--
4-NITROTOLUENE	99-99-0	mg/kg	300	1,100	30 [d,e]	--	--	0.60 U	0.65 U	0.65 U	--	--
TETRYL (METHYL-2,4,6-TRINITROPHENYLNITRAMINE)	479-45-8	mg/kg	240	2,500	25 [d,g]	0.19 U	0.20 U	--	--	--	--	--
NITROBENZENE	98-95-3	mg/kg	48	240	0.021 [i]	0.28 U	0.29 U	--	--	--	--	--
NITROGLYCERIN	55-63-0	mg/kg	6.1	62	NSL	1.90 U	2.00 U	7.70 U	8.30 U	8.30 U	--	--
Metals						--	--					
ALUMINUM	7429-90-5	mg/kg	77,000	990,000	58,000 [j]	--	--	4,500.00 J	5,900.00 J	5,700.00 J	7,500.00	8,000.00
ANTIMONY	7440-36-0	mg/kg	31	410	2.0 [k]	--	--	0.30 UJ	0.25 J	0.24 J	0.51 J	0.38 UJ
BARIUM	7440-39-3	mg/kg	15,000	190,000	330 [l]	--	--	12.00	24.00	24.00	26.00	31.00
COPPER	7440-50-8	mg/kg	3,100	41,000	16 [m]	--	--	6.80	13.00	11.00	5.20	7.70
IRON	7439-89-6	mg/kg	55,000	720,000	20,000 [m]	--	--	5,400.00 J	8,100.00 J	7,800.00 J	8,500.00	10,000.00
LEAD	7439-92-1	mg/kg	400	800	36 [n]	--	--	19.00 J	*39.00 J*	*48.00 J*	27.00 J	32.00 J
MAGNESIUM	7439-95-4	mg/kg	NSL	NSL	NSL	--	--	750.00 J	1,100.00 J	1,000.00 J	3,600.00	3,500.00
NICKEL	7440-02-0	mg/kg	1,500	20,000	16 [m]	--	--	5.00 J	7.80 J	6.70 J	14.00 J	*18.00 J*
STRONTIUM	7440-24-6	mg/kg	47,000	610,000	NSL	--	--	1.70 J	3.40	3.20	5.50	11.00
ZINC	7440-66-6	mg/kg	23,000	310,000	120 [n]	--	--	15.00	22.00	20.00	29.00	38.00

[a] Screening values for human receptors at the site were derived from USEPA (2011) Regional Screening Levels for residential and industrial soils. Available from http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm.
[b] With the exception of lead, screening levels for non-carcinogens were divided by 10; the resulting value were multiplied by 10 to account for reduced exposures to sediment compared to soil. No adjustment was made for lead.
[c] Ecological screening levels are for freshwater environments, with the exception of antimony, which was derived from a marine environment.
[d] Talmage et al. 1999. Nitroaromatic munition compounds: environmental effects and screening values. Rev. Environ. Contam. Toxicol. 161: 1-156.
[e] Screening level based on soil data for 2,4,6-trinitrotoluene.
[f] Screening level based on 2,4-dinitrotoluene.
[g] Screening level based on soil value.
[h] Screening level based on soil value for 2-amino-4,6-dinitrotoluene.
[i] Buchman, M.F. 2008. Screening Quick Reference Tables (SQuiRTs), NOAA OR&R Report 08-1, Seattle, WA, Office of Response and Restoration Division, National Oceanographic and Atmospheric Administration. 34p.
[j] USEPA. 1996. Calculation and evaluation of sediment effect concentrations for the amphipod *Hyalella azteca* and the midge *Chironomus riparius* . EPA 905/R96/008. U.S. Environmental Protection Agency, Great Lakes National Program Office, Chicago, IL.
[k] Long, E.R., and L.G. Morgan. 1990. The potential for biological effects of sediment-sorbed contaminants tested in the national status and trends program. NOAA Technical Memorandum NOS OMA 52.
[l] USEPA. 2005b. Ecological Soil Screening Level for Barium. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_barium.pdf.
[m] Persaud et al. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment and Energy. August. ISBN 0-7729-9248-7.
[n] MacDonald et al. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Arch. Environ. Contam. Toxicol* . 39: 20-31.

CAS = Chemical Abstract Service
J = Analyte is present. Reported value may not be accurate or precise.
mg/kg = Milligram per kilogram.
MRS = Munitions Response Site
NSL = No screening level.
RfD = Reference dose
U = Not detected. Values are reporting limits (RLs).
UJ = Not detected. The associated detection limit is an estimate and may be inaccurate or imprecise. Values are reporting limits (RLs).
USEPA = United States Environmental Protection Agency
-- = Not analyzed.
Shaded and italicized values represent detected values that exceed ecological screening criteria.
Screening level exceedances were only identified for receptors for which the medium had a potentially completed pathway identified in the SS-WP addendum.

Table 5-3 Summary of Groundwater Analytical Results

			Screening Values human receptors [a,b]				
		Sample Name:		DEV-FU-GW-00-01	DEV-FU-GW-00-02	DEV-FU-GW-00-02P	DEV-BG-GW-00-01
		Sample Date:		8/19/2009	8/19/2009	8/19/2009	8/19/2009
		Parent Name:				DEV-FU-GW-00-02	
		MRS:		MRS 1	MRS 2	MRS 2	
Analyte	CAS	Unit	(ug/L)				
Explosive Constituents							
1,3,5-TRINITROBENZENE	99-35-4	ug/L	110	1.00 U	--	--	--
1,3-DINITROBENZENE	99-65-0	ug/L	0.37	0.40 U	--	--	--
2,4,6-TRINITROTOLUENE	118-96-7	ug/L	2.2	0.40 U	--	--	--
2,4-DINITROTOLUENE	121-14-2	ug/L	0.22	--	0.40 U	0.40 U	--
2,6-DINITROTOLUENE	606-20-2	ug/L	3.7	--	0.20 U	0.20 U	--
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	ug/L	7.3 [c]	0.20 U	0.20 U	0.20 U	--
2-NITROTOLUENE	88-72-2	ug/L	0.31	--	0.40 U	0.40 U	--
3-NITROTOLUENE	99-08-1	ug/L	0.37	--	0.40 U	0.40 U	--
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	ug/L	7.3 [c]	0.20 U	0.20 U	0.20 U	--
4-NITROTOLUENE	99-99-0	ug/L	4.2	--	1.00 U	1.00 U	--
TETRYL (METHYL-2,4,6-TRINITROPHENYLNITRAMINE)	479-45-8	ug/L	15	0.24 U	--	--	--
NITROBENZENE	98-95-3	ug/L	0.12	0.40 U	--	--	--
NITROGLYCERIN	55-63-0	ug/L	0.37	--	3.00 U	3.00 U	--
PERCHLORATE	14797-73-0	ug/L	2 [d]	--	0.03 J	0.03 J	0.02 J

[a] Screening values for groundwater, with the exception of perchlorate, are derived from USEPA (2011). Regional Screening Levels. Available from http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm.

[b] With the exception of perchlorate screening levels for non-carcinogens were divided by 10. No adjustments were made for carcinogens or perchlorate.

[c] Screening level value based on 2,4-dinitrotoluene.

[d] Based on MassDEP drinking water screening level. Massachusetts Department of Environmental Protection (MassDEP). 2006. Perchlorate drinking water standard. http://www.mass.gov/dep/water/laws/perchlorate-310CMR22-07282006.pdf

CAS = Chemical Abstract Service.
J = Analyte is present. Reported value may not be accurate or precise.
MassDEP = Massachusetts Department of Environmental Protection.
MRS = Munitions Response Site.
U = Not detected. Values are reporting limits (RLs).
ug/L = Microgram per liter.
USEPA = United States Environmental Protection Agency.

Table 5-4 Summary of Surface Water Analytical Results

Analyte	CAS	Unit	Screening Values for Human Receptors [a,b] (ug/L)	Screening Values for Biota [c] (ug/L)	DEV-PA-SW-00-01	DEV-PA-SW-DUP1	DEV-MR2-SW-00-01	DEV-MR2-SW-00-01P	DEV-MR2-SW-00-02	DEV-BG-SW-00-01	DEV-BG-SW-00-02
Sample Name:					DEV-PA-SW-00-01	DEV-PA-SW-DUP1	DEV-MR2-SW-00-01	DEV-MR2-SW-00-01P	DEV-MR2-SW-00-02	DEV-BG-SW-00-01	DEV-BG-SW-00-02
Sample Date:					6/22/2010	6/22/2010	8/17/2009	8/17/2009	8/17/2009	8/17/2009	8/17/2009
Parent Name:						DEV-PA-SW-00-01		DEV-MR2-SW-00-01			
MRS:					MRS 1	MRS 1	MRS 2	MRS 2	MRS 2		
Explosive Constituents											
1,3,5-TRINITROBENZENE	99-35-4	ug/L	1,100	11 [d]	1.10 U	1.10 U	--	--	--	--	--
1,3-DINITROBENZENE	99-65-0	ug/L	3.7	20 [d]	0.43 U	0.43 U	--	--	--	--	--
2,4,6-TRINITROTOLUENE	118-96-7	ug/L	22	90 [d]	0.43 U	0.43 U	--	--	--	--	--
2,4-DINITROTOLUENE	121-14-2	ug/L	2.2	310 [f]	--	--	0.40 UJ	0.40 U	0.40 U	--	--
2,6-DINITROTOLUENE	606-20-2	ug/L	37	310 [f,e]	--	--	0.20 UJ	0.20 U	0.20 U	--	--
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	ug/L	73 [e]	20 [d]	0.21 U	0.21 U	0.20 UJ	0.20 U	0.20 U	--	--
2-NITROTOLUENE	88-72-2	ug/L	3.1	440 [g]	--	--	0.40 UJ	0.40 U	0.40 U	--	--
3-NITROTOLUENE	99-08-1	ug/L	3.7	380 [g]	--	--	0.40 UJ	0.40 U	0.40 U	--	--
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	ug/L	73 [e]	20 [d,h]	0.21 U	0.21 U	0.20 UJ	0.20 U	0.20 U	--	--
4-NITROTOLUENE	99-99-0	ug/L	42	950 [g]	--	--	1.00 UJ	1.00 U	1.00 U	--	--
TETRYL (METHYL-2,4,6-TRINITROPHENYLNITRAMINE)	479-45-8	ug/L	150	NSL	0.26 U	0.26 U	--	--	--	--	--
NITROBENZENE	98-95-3	ug/L	1.2	270 [f]	0.43 U	0.43 U	--	--	--	--	--
NITROGLYCERIN	55-63-0	ug/L	3.7	69 [g]	3.20 U	3.20 U	3.00 UJ	3.00 U	3.00 U	--	--
PERCHLORATE	14797-73-0	ug/L	2.0 [i]	NSL	--	--	0.05 U	0.05 U	0.05 U	0.02 J	0.05 U

[a] Screening values for human receptors for surface water are derived from USEPA (2011). Regional Screening Levels.
Available from http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm.

[b] With the exception of perchorate, values for non-carcinogens are divided by 10 and the resulting adjusted values were then multiplied by 10 to account for reduced exposures to surface water compared to tap water. No adjustment was made for perchlorate

[c] Ecological screening levels are for freshwater environments.

[d] Talmage et al. 1999. Nitroaromatic munition compounds: environmental effects and screening values. Rev. Environ. Contam. Toxicol. 161: 1-156.

[e] Screening level value based on 2,4-dinitrotoluene.

[f] USEPA. 2001. Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Originally published November 1995. Website version last updated November 30, 2001: http://www.epa.gov/region4/waste/ots/ecolbul.htm

[g] TNRCC (Texas Natural Resources Conservation Commission). 2006. Guidance for conducting ecological risk assessments at remediation sites in Texas. RG-263. January 2006 version. 83 pp.

[h] Screening level value based on 2-amino-4,6-dinitrotoluene.

[i] Based on MassDEP drinking water screening level. Massachusetts Department of Environmental Protection (MA DEP). 2006. Perchlorate drinking water standard. http://www.mass.gov/dep/water/laws/perchlorate-310CMR22-07282006.pdf

CAS = Chemical Abstract Service.
J = Analyte is present. Reported value may not be accurate or precise.
LC50 = Lethal concentration that kills 50% of test animals in a given time.
MassDEP = Massachusetts Department of Environmental Protection.
MRS = Munitions Response Site.
NSL = No screening level.
RAGS = Risk Assessment Guidance for Superfund.
U = Not detected. Values are reporting limits (RLs).
ug/L = Microgram per liter.
UJ = Not detected. The associated detection limit is an estimate and may be inaccurate or imprecise. Values are reporting limits (RLs).
USEPA = United States Environmental Protection Agency.

Table 5-5
Non-Detection Concentrations and Screening Values for Human Receptors for Non-Detected Analytes

Analyte	CAS	Units	Minimum Non-Detect Concentration [a]	Maximum Non-Detect Concentration [a]	Screening Value - Visitor/ Trespasser[e]	Screening Value - Construction Worker, Employee[e]
Surface Soil[b]						
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	0.3	0.3	220	2,700
1,3-DINITROBENZENE	99-65-0	mg/kg	0.3	0.3	0.61	6.2
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	0.3	0.3	19.0	79
2,4-DINTROTOLUENE	121-14-2	mg/kg	0.3	0.3	1.6	5.5
2,6-DINITROTOLUENE	606-20-2	mg/kg	0.3	0.3	6.1	62
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.3	0.3	15[g]	200[g]
2-NITROTOLUENE	88-72-2	mg/kg	0.3	0.3	2.9	13
3-NITROTOLUENE	99-08-1	mg/kg	0.5	0.6	0.6	6.2
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.3	0.3	15[g]	190[g]
4-NITROTOLUENE	99-99-0	mg/kg	0.4	0.5	30	110
TETRYL (METHYL-2,4,6-TRINITROPHENYLNITRAMINE)	479-45-8	mg/kg	0.5	0.5	24	250
NITROBENZENE	98-95-3	mg/kg	0.3	0.3	4.8	24
NITROGLYCERIN	55-63-0	mg/kg	5	6	0.61	6.2
ANTIMONY	7440-36-0	mg/kg	0.2	0.3	3.1	41
Subsurface Soil[b]						
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	0.3	0.3	220	2,700
1,3-DINITROBENZENE	99-65-0	mg/kg	0.3	0.3	0.61	6.2
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	0.3	0.3	19.0	79
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.3	0.3	15[g]	200[g]
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.3	0.3	15[g]	190[g]
TETRYL (METHYL-2,4,6-TRINITROPHENYLNITRAMINE)	479-45-8	mg/kg	0.5	0.5	24	250
NITROBENZENE	98-95-3	mg/kg	0.3	0.3	4.8	24
Groundwater[b]						
1,3,5-TRINITROBENZENE	99-35-4	ug/L	1	1	110	110
1,3-DINITROBENZENE	99-65-0	ug/L	0.4	0.4	0.37	0.37
2,4,6-TRINITROTOLUENE	118-96-7	ug/L	0.4	0.4	2.2	2.2
2,4-DINTROTOLUENE	121-14-2	ug/L	0.4	0.4	0.22	0.22
2,6-DINITROTOLUENE	606-20-2	ug/L	0.2	0.2	3.7	3.7
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	ug/L	0.2	0.2	7.3[g]	7.3[g]
2-NITROTOLUENE	88-72-2	ug/L	0.4	0.4	0.31	0.31
3-NITROTOLUENE	99-08-1	ug/L	0.4	0.4	0.37	0.37
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	ug/L	0.2	0.2	7.3[g]	7.3[g]
4-NITROTOLUENE	99-99-0	ug/L	1	1	4.2	4.2
TETRYL (METHYL-2,4,6-TRINITROPHENYLNITRAMINE)	479-45-8	ug/L	0.2	0.2	15	15
NITROBENZENE	98-95-3	ug/L	0.4	0.4	0.12	0.12
NITROGLYCERIN	55-63-0	ug/L	3	3	0.37	0.37
PERCHLORATE	14797-73-0	ug/L	0.03	0.03	2.0[f]	2.0[f]
Sediment[c]						
2,4-DINTROTOLUENE	121-14-2	mg/kg	0.4	0.4	16	55
2,6-DINITROTOLUENE	606-20-2	mg/kg	0.4	0.4	61	620
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.4	0.4	150[g]	2000[g]
2-NITROTOLUENE	88-72-2	mg/kg	0.4	0.4	29	130
3-NITROTOLUENE	99-08-1	mg/kg	0.8	0.8	6.1	62
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.4	0.4	150[g]	1900[g]
4-NITROTOLUENE	99-99-0	mg/kg	0.6	0.7	300	1,100
NITROGLYCERIN	55-63-0	mg/kg	8	8	6.1	62
Surface Water[d]						
2,4-DINTROTOLUENE	121-14-2	ug/L	0.4	0.4	2.2	2.2
2,6-DINITROTOLUENE	606-20-2	ug/L	0.2	0.2	37	37
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	ug/L	0.2	0.2	73[g]	73[g]
2-NITROTOLUENE	88-72-2	ug/L	0.4	0.4	3.1	3.1
3-NITROTOLUENE	99-08-1	ug/L	0.4	0.4	3.7	3.7
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	ug/L	0.2	0.2	73[g]	73[g]
4-NITROTOLUENE	99-99-0	ug/L	1	1	42	42
NITROGLYCERIN	55-63-0	ug/L	3	3	3.7	3.7
PERCHLORATE	14797-73-0	ug/L	0.05	0.05	2.0[f]	2.0[f]

Table 5-5 (continued)
Non-Detection Concentrations and Screening Values for Human Receptors for Non-Detected Analytes

[a] Detection limits are reporting limits (RLs).
[b] For non-carcinogens with the exception of lead in soils/sediment and perchlorate in water, screening levels were divided by 10 to account for potential exposure to multiple non-carcinogens. No adjustment was made for carcinogens, lead in soils/sediment, or perchlorate in water.
[c] With the exception of lead, screening levels for non-carcinogens were divided by 10; the resulting value were multiplied by 10 to account for reduced exposure to sediment compared to soil. No adjustment were made for lead.
[d] With the exception of perchorate, values for non-carcinogens are divided by 10 and the resulting adjusted values were then multiplied by 10 to account for reduced exposures to surface water compared to tap water. No adjustment was made for perchlorate.
[e] Screening values for human receptors were derived from USEPA (2011). Regional Screening Levels. Available from http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm.
[f] Based on MassDEP drinking water screening level. Massachusetts Department of Environmental Protection (MA DEP). 2006. Perchlorate drinking water standard. http://www.mass.gov/dep/water/laws/perchlorate-310CMR22-07282006.pdf
[g] Screening level value based on 2,4-dinitrotoluene.

CAS = Chemical Abstract Service.
mg/kg = Milligram per kilogram.
ug/L = Microgram per liter.

Table 5-6
Non-Detection Concentrations and Screening Values for Ecological Receptors for Non-Detected Analytes

Analyte	CAS	Units	Minimum Non-Detect Concentration [a]	Maximum Non-Detect Concentration [a]	Screening Value - Biota
Surface Soil					
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	0.3	0.3	NSL
1,3-DINITROBENZENE	99-65-0	mg/kg	0.3	0.3	NSL
2,4,6-TRINITROTOLUENE	118-96-7	mg/kg	0.3	0.3	30[b]
2,4-DINTROTOLUENE	121-14-2	mg/kg	0.3	0.3	30[b, c]
2,6-DINITROTOLUENE	606-20-2	mg/kg	0.3	0.3	30[b, c]
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.3	0.3	80[b]
2-NITROTOLUENE	88-72-2	mg/kg	0.3	0.3	30[b, c]
3-NITROTOLUENE	99-08-1	mg/kg	0.5	0.6	30[b, c]
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.3	0.3	80[b, g]
4-NITROTOLUENE	99-99-0	mg/kg	0.4	0.5	30[b]
TETRYL (METHYL-2,4,6-TRINITROPHENYLNITRAMINE)	479-45-8	mg/kg	0.5	0.5	25[b]
NITROBENZENE	98-95-3	mg/kg	0.3	0.3	40[d]
NITROGLYCERIN	55-63-0	mg/kg	5	6	NSL
ANTIMONY	7440-36-0	mg/kg	0.2	0.3	0.27[f]
Sediment					
2,4-DINTROTOLUENE	121-14-2	mg/kg	0.4	0.4	30[b, c]
2,6-DINITROTOLUENE	606-20-2	mg/kg	0.4	0.4	30[b, c]
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.4	0.4	80[b]
2-NITROTOLUENE	88-72-2	mg/kg	0.4	0.4	30[b, c]
3-NITROTOLUENE	99-08-1	mg/kg	0.8	0.8	30[b, c]
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.4	0.4	80[b, g]
4-NITROTOLUENE	99-99-0	mg/kg	0.7	0.7	30[b]
NITROGLYCERIN	55-63-0	mg/kg	8	8	NSL
Surface Water[h]					
2,4-DINTROTOLUENE	121-14-2	ug/L	0.4	0.4	310[i]
2,6-DINITROTOLUENE	606-20-2	ug/L	0.2	0.2	310[i]
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	ug/L	0.2	0.2	20[b]
2-NITROTOLUENE	88-72-2	ug/L	0.4	0.4	440[j]
3-NITROTOLUENE	99-08-1	ug/L	0.4	0.4	380[j]
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	ug/L	0.2	0.2	20[b, g]
4-NITROTOLUENE	99-99-0	ug/L	1	1	950[j]
NITROGLYCERIN	55-63-0	ug/L	3	3	69[j]
PERCHLORATE	14797-73-0	ug/L	0.05	0.05	NSL

Table 5-6 (continued)
Non-Detection Concentrations and Screening Values for Ecological Receptors for Non-Detected Analytes

[a] Detection limits are reporting limits (RLs).
[b] Talmage et al. 1999. Nitroaromatic munition compounds: environmental effects and screening values. Rev. Environ. Contam. Toxicol. 161: 1-156.
[c] Screening level based on 2,4,6-trinitrotoluene.
[d] Efroymson et al. 1997. Toxicological benchmarks for screening contaminants of potential concern for effects on terrestrial plants: 1997 revision. ES/ER/TM-85/R3. U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN.
[e] Screening level based on 2-amino-4,6-dinitroluene.
[f] USEPA. 2005b. Ecological Soil Screening Level for Antimony. Available at: www.epa.gov/ecotox/ecossl/pdf/eco-ssl_antimony.pdf. Accessed 15 July 2008.
[g] Screening level based on 2-amino-4,6-dinitrotoluene.
[h] Ecological surface water screening levels are for freshwater environments.
[i] USEPA. 2001. Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Originally published November 1995. Website version last updated November 30, 2001: http://www.epa.gov/region4/waste/ots/ecolbul.htm
[j] TNRCC (Texas Natural Resources Conservation Commission). 2006. Guidance for conducting ecological risk assessments at remediation sites in Texas. RG-263. January 2006 version. 83 pp.

CAS = Chemical Abstract Service.
mg/kg = Milligram per kilogram.
ug/L = Microgram per liter.

Table 5-7
Comparison of Onsite and Background Soil Concentrations for Metals at MRS 2

	Onsite: MRS 2				Background				Comparisons	
Chemical	Detection Frequency	Minimum Concentration/Qualifier (mg/kg) [a]	Maximum Concentration/Qualifier (mg/kg) [b]	Mean Concentration (mg/kg) [c]	Detection Frequency	Minimum Concentration/Qualifier (mg/kg) [a]	Maximum Concentration/Qualifier (mg/kg) [b]	Mean Concentration (mg/kg)	Site Maximum > Background Maximum	Site Mean > Background Mean
ALUMINUM	6/6	3,700 J	9,300 J	5,080	3/3	3,400	6,500	5,430	YES	NO
ANTIMONY	0/6	ND	ND	0.11	1/3	0.23 J	0.23 J	0.16	--	--
BARIUM	6/6	9.00	19.0	12.2	3/3	12.0	46.0	29.7	NO	NO
COPPER	6/6	4.80	8.70	6.67	3/3	4.20	40.0	21.1	NO	NO
IRON	6/6	4,400	10,000 J	6,880	3/3	3,900	8,600	6,570	YES	YES
LEAD	6/6	4.10 J	43.0 J	16.5	3/3	47.0 J	110 J	76.0	NO	NO
MAGNESIUM	6/6	540	2,400 J	1,290	3/3	380	2,100	1,330	YES	NO
NICKEL	6/6	5.00 J	14.0 J	9.90	3/3	2.60 J	12.0 J	8.87	YES	YES
STRONTIUM	6/6	1.60 J	3.40	2.08	3/3	1.50 J	13.0	7.03	NO	NO
ZINC	6/6	15.0	23.0	20.2	3/3	7.30	93.0	48.8	NO	NO

[a] Minimum concentration of analyte detected.
[b] Maximum concentration of analyte detected.
[c] Non-detects are carried forth as one-half of the reporting limit in the calculation of the mean concentration.

mg/kg = Milligram per kilogram.
MRS = Munitions Response Site.
ND = No detected results.
-- = Chemical not detected in site samples; therefore, comparison to background is not meaningful.

Table 5-8
Comparison of Onsite and Background Sediment Concentrations for Metals at MRS 2

	Onsite: MRS 2				Background				Comparisons	
Chemical	Detection Frequency	Minimum Concentration/Qualifier (mg/kg) [a]	Maximum Concentration/Qualifier (mg/kg) [b]	Mean Concentration (mg/kg) [c]	Detection Frequency	Minimum Concentration/Qualifier (mg/kg) [a]	Maximum Concentration/Qualifier (mg/kg) [b]	Mean Concentration (mg/kg) [c]	Site Maximum > Background Maximum	Site Mean > Background Mean
ALUMINUM	3/3	4,500 J	5,900 J	5,370	2/2	7,500	8,000	7,750	NO	NO
ANTIMONY	2/3	0.24 J	0.25 J	0.21	1/2	0.51 J	0.51 J	0.35	NO	NO
BARIUM	3/3	12.0	24.0	20.0	2/2	26.0	31.0	28.5	NO	NO
COPPER	3/3	6.80	13.0	10.3	2/2	5.20	7.70	6.45	YES	YES
IRON	3/3	5,400 J	8,100 J	7,100	2/2	8,500	10,000	9,250	NO	NO
LEAD	3/3	19.0 J	48.0 J	35.3	2/2	27.0 J	32.0 J	29.5	YES	YES
MAGNESIUM	3/3	750 J	1,100 J	950	2/2	3,500	3,600	3,550	NO	NO
NICKEL	3/3	5.00 J	7.80 J	6.50	2/2	14.0 J	18.0 J	16.0	NO	NO
STRONTIUM	3/3	1.70 J	3.40	2.77	2/2	5.50	11.0	8.25	NO	NO
ZINC	3/3	15.0	22.0	19.0	2/2	29.0	38.0	33.5	NO	NO

[a] Minimum concentration of analyte detected.
[b] Maximum concentration of analyte detected.
[c] Non-detects are carried forth as one-half of the reporting limit in the calculation of the mean concentration.

mg/kg = Milligram per kilogram.
MRS = Munitions Response Site.

Table 5-9
Comparison of Onsite and Background Groundwater Concentrations for Perchlorate at MRS 2

	Onsite: MRS 2				Background				Comparisons	
Chemical	Detection Frequency	Minimum Concentration/Qualifier (ug/L) [a]	Maximum Concentration/Qualifier (ug/L) [b]	Mean Concentration (ug/L)	Detection Frequency	Minimum Concentration/Qualifier (ug/L) [a]	Maximum Concentration/Qualifier (ug/L) [b]	Mean Concentration (ug/L)	Site Maximum > Background Maximum	Site Mean > Background Mean
PERCHLORATE	2/2	0.03 J	0.03 J	0.03	1/1	0.02 J	0.02 J	NA	YES	NA

[a] Minimum concentration of analyte detected.
[b] Maximum concentration of analyte detected.

MRS = Munitions Response Site.
NA = not applcable due to only 1 sample available.
ug/L = Microgram per liter.

Table 5-10
Comparison of Onsite and Background Surface Water Concentrations for Perchlorate at MRS 2

	Onsite: MRS 2				Background				Comparisons	
Chemical	Detection Frequency	Minimum Concentration/Qualifier (ug/L) [a]	Maximum Concentration/Qualifier (ug/L) [b]	Mean Concentration (ug/L) [c]	Detection Frequency	Minimum Concentration/Qualifier (ug/L) [a]	Maximum Concentration/Qualifier (ug/L) [b]	Mean Concentration (ug/L) [c]	Site Maximum > Background Maximum	Site Mean > Background Mean
PERCHLORATE	0/3	ND	ND	0.03	1/2	0.02 J	0.02 J	0.02	--	--

[a] Minimum concentration of analyte detected.
[b] Maximum concentration of analyte detected.
[c] Non-detects are carried forth as one-half of the reporting limit in the calculation of the mean concentration.

MRS = Munitions Response Site.
ND = No detected results.
ug/L = Microgram per liter.
-- = Chemical not detected in site samples; therefore, comparison to background is not meaningful.

6 SUMMARY AND CONCLUSIONS

6.0.1 Fort Devens has an extensive history of use beginning during WWI and continuing until Operation Desert Storm (mid-1990's). The FUDS areas were part of the Main and North Posts of the larger Fort Devens base and were transferred out of military control in 1956 and 1978 to the Commonwealth of Massachusetts and the Town of Ayer, respectively. During this time period, an additional FUDS property was transferred to PanAm Railways (formerly Boston and Maine Railroad).

6.0.2 During the SI, two MRSs were investigated at the Fort Devens FUDS: MRS 1 – WWI Grenade Range and MRS 2 – Range Complex No. 1.

6.0.3 A summary of the results and conclusions is presented below and is summarized in Table 6-1.

6.1 WWI Grenade Range (MRS 1)

6.1.0.1 Potential human receptors for MRS 1 include visitors/trespassers, employees, and construction workers. Potential ecological receptors are soil invertebrates, terrestrial-feeding mammals, and terrestrial-feeding birds.

6.1.0.2 Since military use of Fort Devens ended, one item of MD (end to a claymore mine firing wire) was found within the PanAm Railways property (MRS 1) (USACE 1997). No MEC/MD was found during the 2009 and 2010 SI field events. Numerous MD items including inert 3-inch Stokes mortars, practice land mines, practice grenades and expended VB rifles grenades have been identified in the vicinity of MRS 1, but outside the MRS 1 boundary (BRAC property). The access to MRS 1 is limited because a chain-link fence surrounds the area; however, human interaction is characterized as moderate due to the active Army National Guard installation and PanAm railroad facility. The MEC hazard is low at MRS 1.

6.1.0.3 As presented in the SSWP, surface soil, subsurface soil, sediment, groundwater, and surface water were media with potentially complete exposure pathways for human receptors in MRS 1. In addition surface soil, sediment, and surface water were media with potentially complete pathways for ecological receptors in MRS 1. The CSM MC pathways were updated in the SI to reflect the results of the analytical samples (Appendix J).

6.1.0.4 The surface soil pathway was determined to be complete for human receptors due to the detection of tetryl in surface soil. The single detected concentration of tetryl fell below the screening criteria selected for the HHRA. No COPCs were identified for surface soil at MRS 1. No explosive MCs were detected in subsurface soil at MRS 1, and the subsurface soil pathway is determined to be incomplete for human receptors at MRS 1. No COPCs were identified for subsurface soil at MRS 1.

6.1.0.5 The surface soil pathway was also determined to be complete for ecological receptors based on the detection of tetryl in surface soil. The single detected concentration of tetryl did not exceed the eco-SSL applied in the SLERA, and therefore no COPECs were identified for surface soils at MRS 1.

6.1.0.6. No explosive MCs were detected in sediment. The sediment pathway was determined to be incomplete for human receptors at MRS 1. No COPCs were identified for sediment at MRS 1.

6.1.0.7 Due to the failure of several MCs to meet the MQO for sensitivity for the SLERA, the sediment pathway was determined to be potentially complete for ecological receptors. No MCs were detected at concentrations that exceeded the screening values selected for the SLERA and therefore no COPECs were identified for sediment at MRS 1.

6.1.0.8 Due to the failure of several MCs to meet the MQO for sensitivity the groundwater pathway was determined to be potentially complete for human receptors. No MCs were detected in groundwater and therefore no COPCs were identified in groundwater at MRS 1.

6.1.0.9. No explosive MCs were detected in surface water. The surface water pathway was determined to be incomplete for human receptors at MRS 1. No COPCs were identified for sediment at MRS 1.

6.1.0.10 Due to the fact that no MCs were detected the surface water pathway was also determined to be incomplete for ecological receptors at MRS 1. No COPECs were identified for surface water at MRS 1.

6.2 Range Complex No. 1 (MRS 2)

6.2.0.1 Potential human receptors for MRS 2 include visitors/trespassers, employees, and construction workers. Potential ecological receptors are biota, including soil and benthic invertebrates, terrestrial-feeding mammals, terrestrial-feeding birds, amphibians, reptiles, and aquatic-feeding animals.

6.2.0.2 Prior to the 2009 SI, no MEC/MD has been found within MRS 2. However, an expended M18 smoke grenade (MD) was observed adjacent to, but outside the MRS 2 boundary in the mid 1990's. During the 2009 SI, one expended 7.62 mm shell casing (MD) was observed within MRS 2. MRS 2 is semi-restricted because a chain-link fence surrounds much of the area. The Town of Ayer operates a wastewater treatment plant within the MRS; therefore, human interaction is considered moderate. The MEC hazard at MRS 2 is expected to be low.

6.2.0.3 As presented in the SSWP, surface soil, sediment, groundwater, and surface water were identified as media with potentially complete exposure pathways for human receptors at MRS 2. In addition, surface soil, sediment, and surface water were identified as medium with potentially complete exposure pathways for ecological receptors at MRS 2. The CSM MC pathways were updated in the SI to reflect the results of the analytical samples (Appendix J).

6.2.0.4 A complete pathway for human receptors to surface soil was determined based on the presence of aluminum, iron, magnesium, and nickel at concentrations exceeding background. Aluminum and iron exceeded the screening criteria selected for the HHRA and were identified as COPCs for surface soil in this area. However, based on the WOE evaluation, exposure to surface soil was not determined to represent unacceptable risks to humans exposed to surface soil at MRS 2.

6.2.0.5 The surface soil pathway was also determined to be complete for ecological receptors due to the detection of several metals at concentrations above background. The maximum concentration of lead exceeded the eco-SSL selected for the SLERA, and lead was determined as a COPEC. However, because concentrations of lead in background exceeded concentrations at MRS 2, no additional risks from FUDS related activities from lead were identified.

6.2.0.6 The sediment pathway was determined to be complete for human receptors due to the detection of copper and lead at concentrations exceeding background. No MCs exceeded the screening criteria selected for the HHRA, and no COPCs for sediment were identified at MRS 2.

6.2.0.7 Due to the exceedance of copper and lead above background, sediment was also determined to be a medium with a complete pathway for ecological receptors. The maximum concentration of lead exceeded the screening criteria selected for the SLERA, and therefore lead was identified as a COPEC in sediment. However, based on the WOE evaluation, exposure to lead in sediment was not determined to represent an unacceptable risk to ecological receptors at MRS 2.

6.2.0.8 Due to the presence of perchlorate in groundwater samples at MRS 2 above concentrations in background groundwater was determined to be a medium with a complete exposure pathway for humans. No MCs exceeded the screening criteria selected for the HHRA, and no COPCs for groundwater were identified at MRS 2.

6.2.0.9 No MCs were detected in surface water. The surface water pathway was determined to be incomplete for human receptors at MRS 2. No COPCs were identified for surface water at MRS 2.

6.2.0.10 No MCs were detected in surface water. No complete pathways were identified for ecological receptors from surface water. No COPECs were identified for surface water at MRS 2.

Table 6-1
Summary of Human Health and Ecological Screening Level Risk Assessment Results

	MRS 1 - Grenade Range		MRS 2 - Range Complex No. 1	
Environmental Medium	**Human Health COPCs (HHRA) [a]**	**Ecological COPECs (SLERA) [a]**	**Human Health COPCs (HHRA) [a]**	**Ecological COPECs (SLERA) [a]**
Surface Soil	No exceedance of screening criteria. No COPC.	No exceedance of screening criteria. No COPEC.	Iron and aluminum exceed screening criterion and background. COPCs. No unacceptable risk determined based on WOE.	Lead exceeds screening criterion but not background. COPEC. No additional risks from FUDS related activities is determined.
Subsurface Soil	No exceedance of screening criteria. No COPC.	--	--	--
Groundwater	No exceedance of screening criteria. No COPC.	--	No exceedance of screening criteria. No COPC.	--
Sediment	No exceedance of screening criteria. No COPC.	No exceedance of screening criteria. No COPC.	No exceedance of screening criteria. No COPC.	Lead exceeds screening criterion and background. COPEC. No unacceptable risk determined based on WOE.
Surface Water	No exceedance of screening criteria. No COPC.	No exceedance of screening criteria. No COPC.	No exceedance of screening criteria. No COPC.	No exceedance of screening criteria. No COPEC.

a. Sources and derivations of screening levels for all receptors and environmental media in the HHRA and SLERA are detailed in Tables 5-1 through 5-4.
COPC = Chemical of potential concern.
COPEC = Chemical of potential environmental concern.
HHRA = Human health risk assessment.
MRS = Munitions Response Site.
SLERA = Screening level ecological risk assessment.
WOE = weight of evidence.
"-" = Samples not analyzed for specific receptors within specific MRS, in accordance with CSM and SS-WP

7 RECOMMENDATIONS FOR FURTHER ACTION

7.0.1 Based on the results and conclusions of this SI, the following recommendations are provided:

- ***MRS 1 (WWI Grenade Range)*** **-** An NDAI designation is recommended at MRS 1. There were no historical MEC observations within MRS 1. MD items including practice 3-inch Stokes mortars, practice grenades and landmines have been observed in the surrounding BRAC property, but not within MRS 1. These inert MD items were found outside of the FUDS and were removed in 1995.The potential hazard for MEC is evaluated as low based on the lack of source, predominant use of practice munitions, and the developed and semi-restricted nature of the MRS. Tetryl was the single explosive constituent detected at MRS 1, and this MC was detected in only a single surface soil sample at concentrations below the screening criteria adopted for the HHRA and SLERA. No COPC or COPEC were identified within MRS 1.
- ***MRS 2 (Range Complex No. 1)*** **-** An NDAI designation is recommended at MRS 2. There were no historical MEC observations within MRS 2. One inert MD item (expended M18 grenade) was discovered outside of the FUDS and was removed in 1995. The potential hazard for MEC is evaluated as low based on the use of small arms and simulator munitions only (low explosive hazard). No explosive constituents were detected within any media sampled at MRS 2. In surface soil two analytes, aluminum and iron, exceeded human health screening criteria and were identified as COPCs; however, a WOE evaluation determined that there are no unacceptable risks associated with exposure to these MCs. In surface soil, lead exceeded ecological screening criteria (COPEC), but not background. Therefore, although lead was determined to be a COPEC in surface soil, no additional risk from FUDS related activity was determined. No COPCs were identified in sediment. Lead was determined to be a COPEC because it exceeded ecological screening criteria. No unacceptable risk to ecological receptors in sediment was determined based on a WOE evaluation. Perchlorate was detected in groundwater at MRS 2; however, the detected concentrations did not exceed screening criteria adopted for the risk assessment. Analysis of surface water yielded no detections of explosive constituents or perchlorate within MRS 2.

Neither a TCRA nor a NTCRA are recommended for MRS 1 or MRS 2 at the Fort Devens FUDS.

7.0.2 Acreage discrepancies for the FUDS property and MRS ranges exist between the ASR Supplement and the GIS data provided by USACE for this SI. The ASR Supplement states that the total FUDS property acreage is 183.5; however, based on revised GIS data provided by the USACE during the creation of the SS-WP, the total FUDS acreage in the GIS data and reflected in the SI Report is 151.6 (yellow boundary shown in figures in this SI). The difference, 31.9 acres, is northeast of MRS 1 and is not eligible for the FUDS program since it is currently occupied and used by the National Guard. According to the GIS data used in this SI, MRS 1 is a total of 9.6 acres; however, the acreage shown for MRS 1 in the ASR Supplement is 11.4 acres. The ASR Supplement is likely correct since it is based on property ownership research. Furthermore, the acreages provided in the ASR Supplement for MRS 2, Range Complex No. 1, total 143.6 acres, comprised of three sub-ranges 79.2, 93.8, and 3.8 acres. However, the GIS data for MRS 2 shows a total area of 1,450.4 acres and includes the range fans/safety zones that fall on BRAC property. In addition, the GIS data does not separately delineate the Training Area sub-range of MRS 2. USACE should revise the USACE GIS data to match the MRS boundaries shown in the ASR Supplement. Additionally, USACE should revise the INPR to remove the ineligible portions (range safety fans for MRS 2) of the FUDS property and match the USACE ASR Supplement GIS FUDS property.

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APPENDIX A – SCOPE OF WORK

Located on CD.

APPENDIX B – TECHNICAL PROJECT PLANNING MEMORANDUM

- Data Quality Objective Verification Worksheets
- TPP #1 Memorandum (Located on CD)
- TPP #2 Memorandum (Located on CD)
- Public Notice of Availability of MRSPP (Located on CD)

Data Quality Objective Verification Worksheet			
Site: Fort Devens			
Project: FUDS MMRP SI Project Number D01MA058701			
DQO Statement Number: **1 of 4**			
DQO Element Description	**Site-Specific DQO Statement**	**Attained?**	**Required Corrective Action**
Intended Data Use(s):			
Project Objective(s) Satisfied	Determine if the site requires additional investigation through a remedial investigation/feasibility study (RI/FS) or if the site may be recommended for No Department of Defense Action Indicated (NDAI) based on the presence or absence of munitions and explosives of concern (MEC) and munitions constituents (MC).	Yes ☑ No ☐	
Data Needs Requirements:			
Data User Perspective(s)	Risk - MEC and MC, Compliance	Yes ☑ No ☐	
Contaminant or Characteristic of Interest	MEC or Material Potentially Presenting an Explosive Hazard (MPPEH) and MC	Yes ☑ No ☐	
Media of Interest	MEC - Surface soil MC - Surface soil, subsurface soil, surface water, sediment, groundwater	Yes ☑ No ☐	
Required Sampling Locations or Areas	MEC and MC: Areas where military munition-related operations occurred and/or where MEC or MPPEH has been identified historically based on existing documentation and interviews.	Yes ☑ No ☐	
Number of Samples Required	MEC – Analog geophysical and visual reconnaissance data, rather than discrete sampling data, will be collected to accomplish this objective. These data will be collected using "meandering path" to and from the sampling points. The UXO Technician will collect data on an approximate 6-ft wide path using the geophysical equipment. The visual reach of observations is approximately 12 ft, and may be limited by the presence of vegetation. Once at the individual sampling point, the geophysical equipment will be used to assess an approximately 25 ft diameter circle for anomalies around the sampling point as site conditions permit. In some areas, there may be limitations to the ability to complete geophysical and visual observations. The total estimated area on the paths to/from the sampling locations is approximately 93288 ft², and the area around the sampling locations is approximately 5400 ft² (Appendix A – Figure 8a+b).	Yes ☑ No ☐	Field work was conducted in August 2009 and in June 2010. A total of A total of 139,760 ft2 (3.2 acres) of land were assessed during the two field events using analog QR. Additionally, 85,660 ft2 (1.96 acres) of visual reconnaissance was completed at the northern and southern portions of MRS 1. All environmental samples proposed in the Final SS-WP were collected in August 2009. Additionally, during the June 2010 SI event five surface soil samples, one sediment and one surface water sample were collected.
	MC: A total of nine surface and two subsurface soil samples, two surface water samples, and one groundwater sample will be collected inside the FUDS. Three background soil, two background sediment, two background surface water, and one background groundwater sample will be collected outside of the two MRSs of interest. Additional QA/QC samples will also be collected (Appendix A – Figure 8a+b).		

Data Quality Objective Verification Worksheet			
Site: Fort Devens			
Project: FUDS MMRP SI Project Number D01MA058701			
DQO Statement Number: **1 of 4**			
DQO Element Description	**Site-Specific DQO Statement**	**Attained?**	**Required Corrective Action**
Reference Concentration of Interest or Other Performance Criteria	MEC: If historic data indicate the presence of MEC and one anomaly classified as MPPEH, or confirmed MEC are found with the magnetometer, or if physical evidence indicating the presence of MEC are found during the visual inspection, then an RI/FS may be recommended. If no anomalies, MPPEH, or confirmed MEC are found, or if the UXO Technician indicates that there is no potential hazard from past use of munitions or MEC discoveries, then an NDAI designation may be recommended. In each of these instances, all lines of evidence (e.g., historic data, field data, etc.) will be used to make a final decision for an NDAI designation or RI/FS recommendation. In both instances (RI/FS or NDAI), all lines of evidence (e.g., historic data, field data etc. for both MEC and MC) will be used to make a final decision for an NDAI or RI/FS.	Yes ☑ No ☐	
	MC: If the maximum concentrations measured at the site exceed USEPA Regional Screening Levels based on current and future land use, or USEPA interim ecological risk screening values, or site-specific background levels (highest value and mean value), then an RI/FS may be recommended for the site. If the maximum concentrations measured at the site do not exceed USEPA Regional Screening Levels or ecological risk screening values, then an NDAI designation may be recommended. In summary, all lines of evidence including secondary lines of evidence, such as historic data, field data, and comparison to regional background concentration ranges for metals (if available), will be used to make a final decision for an NDAI designation or RI/FS. Screening values selected for comparison at this site are specified in the chemical-specific measurement quality objective (MQO) tables.	Yes ☑ No ☐	
Appropriate Sampling and Analysis Methods:			
Sampling Method and Depths	MEC: Geophysics with a handheld analog magnetometer was used to collect related data. The magnetometer is accurate to an approximate depth of 2 ft. Global Positioning System (GPS) equipment was used to log locations of MEC items encountered by the magnetometer, subsurface anamolies, and the path of qualitative reconnissance. Visual observations provided a continuous source of additional information which was noted in the field log book, if appropriate. Munitions and munitions related debris were observed during field activities. Photographs were taken documentating the items found. Geophysical methods/procedures are described in detail in Section 3 of the SS-WP, and the Field Activities section of the programmatic field sampling plan (PFSP). MC: Sampling methods for MC are described in detail in Section 4 of the SS-WP, and Field Activities section of the PFSP.	Yes ☑ No ☐	

Data Quality Objective Verification Worksheet			
Site: Fort Devens			
Project: FUDS MMRP SI Project Number D01MA058701			
DQO Statement Number: **1 of 4**			
DQO Element Description	**Site-Specific DQO Statement**	**Attained?**	**Required Corrective Action**
Analytical Method	MEC: Analytical methods are not used with analog magnetometry. However, trained UXO professionals, engineers, and scientists reviewed all data to determine whether evidence gathered indicates the presence or absence of MEC. This analysis were subject to an independent review within the Alion Team, by the USACE North Atlantic New England (CENAE), USACE Baltimore District Design Center (CENAB), and USACE Center of Expertise. MC: The methods that can be used for analysis include the following: Explosives Methods – 8330A, 8330A (mod) for nitroglycerine; Metals Methods – 6010B (reduced), Perchlorate Method – 8312M; Explosives Prep Methods – 8330A, 8330A (mod) for nitroglycerine; Metals Prep Method – 3050B, 3050 (mod); Perchlorate Prep Method – 8312M.	Yes ☑ No ☐	

Data Quality Objective Verification Worksheet			
Site: Fort Devens			
Project: FUDS MMRP SI Project Number D01MA058701			
DQO Statement Number: **2 of 4**			
DQO Element Description	**Site-Specific DQO Statement**	**Attained?**	**Required Corrective Action**
Intended Data Use(s):			
Project Objective(s) Satisfied	Determine the potential need for a Time-Critical Removal Action (TCRA) for MEC and MC by collecting data from previous investigations/reports, conducting site visits, performing analog geophysical activities, and by collecting MC samples.	Yes ☑ No ☐	
Data Needs Requirements:			
Data User Perspective(s)	Risk - MEC and MC, Compliance	Yes ☑ No ☐	
Contaminant or Characteristic of Interest	MEC or Material Potentially Presenting an Explosive Hazard (MPPEH) and MC	Yes ☑ No ☐	
Media of Interest	MEC - Surface soil/subsurface, surface water, and sediment MC - Surface soil/subsurface soil, surface water, groundwater or sediment	Yes ☑ No ☐	
Required Sampling Locations or Areas	Areas where military munitions-related operations occurred and/or where MEC or MPPEH has been identified historically based on existing documentation and interviews.	Yes ☑ No ☐	
Number of Samples Required	Refer to DQO 1 for MC/MEC sampling parameters.	Yes ☑ No ☐	
Reference Concentration of Interest or Other Performance Criteria	If MC is reported in samples collected at the FUDS at concentrations exceeding screening criteria and those exceedances result in unacceptable risk and an imminent threat to receptors as identified through human health and ecological risk assessments or if one piece of confirmed MEC is found with the magnetometer or if physical evidence indicating the presence of MEC is found during the visual inspection, and if the item(s) is determined by a qualified UXO-Technician, explosive ordnance disposal (EOD) unit, and/or the USACE to be an immediate or imminent threat, then one of two actions may be initiated:		
	TCRA - If there is a complete pathway between source and receptor and the MEC and the situation is viewed as an "imminent danger threat posed by the release or threat of a release, where cleanup or stabilization actions must be initiated within six months to reduce risk to public health or the environment", the Alion Team will immediately notify the Military Munitions Design Center Project Manager at USACE and the property owner. USACE will determine, with input from the Alion Team and stakeholders, whether or not a TCRA will be implemented.	Yes ☑ No ☐	
	Non-TCRA - A non-TCRA (NTCRA) may be initiated in response to a release or threat of release that poses a risk where more than six months planning time is available.	Yes ☑ No ☐	
Appropriate Sampling and Analysis Methods:			
Sampling Method and Depths	MEC: Geophysical methods/procedures are described in detail in Section 3 of the SS-WP, and the Field Activities section of the programmatic field sampling plan (PFSP). MC: Sampling methods for MC are described in detail in Section 4 of the SS-WP, and Field Activities section of the PFSP.	Yes ☑ No ☐	
Analytical Method	Refer to DQO 1 for MEC and MC analytical methods to be incorporated.	Yes ☑ No ☐	

Data Quality Objective Verification Worksheet			
Site: Fort Devens			
Project: FUDS MMRP SI Project Number D01MA058701			
DQO Statement Number: **3 of 4**			
DQO Element Description	**Site-Specific DQO Statement**	**Attained?**	**Required Corrective Action**
Intended Data Use(s):			
Project Objective(s) Satisfied	Collect, or develop, additional data, as appropriate, in support of potential Hazard Ranking System (HRS) scoring by United States Environmental Protection Agency (USEPA).	Yes ☑ No ☐	
Data Needs Requirements:			
Data User Perspective(s)	Risk - MEC and MC, Compliance	Yes ☑ No ☐	
Contaminant or Characteristic of Interest	Data for HRS worksheet parameters will be compiled by gathering basic identifying information, general site description, site type, waste description, demographics, water use, sensitive environments, and response actions.	Yes ☑ No ☐	
Media of Interest	Surface soil, subsurface soil, surface water, groundwater and sediment	Yes ☑ No ☐	
Required Sampling Locations or Areas	Areas where MEC has been historically found, used, or disposed as documented in interviews or existing documentation.	Yes ☑ No ☐	
Number of Samples Required	Refer to DQOs 1and 2.		
Reference Concentration of Interest or Other Performance Criteria	The HRS levels of contamination are Level I (concentrations that meet the criteria for actual contamination and are at or above media-specific benchmark levels), Level II (concentrations that either meet the criteria for actual contamination but are less than media-specific benchmarks, or meet the criteria for actual contamination based on direct observation), and Potential (no observed release is required but targets must be within the target distance limit). These levels are weighted for each target by USEPA (Level I carries the greatest weight) and scores of 28.5 or above are then eligible for listing on the National Priorities List (NPL).	Yes ☑ No ☐	
Appropriate Sampling and Analysis Methods:			
Sampling Method and Depths	Methods associated with historic data field reconnaissance and sampling (see DQOs 1 and 2). Refer to NPL Characteristics Data Collection Form, Version 3.0 (USEPA 2001).	Yes ☑ No ☐	
Analytical Method	Refer to DQOs 1and 2 for associated methods.		

Data Quality Objective Verification Worksheet			
Site: Fort Devens			
Project: FUDS MMRP SI Project Number D01MA058701			
DQO Statement Number: **4 of 4**			
DQO Element Description	**Site-Specific DQO Statement**	**Attained?**	**Required Corrective Action**
Intended Data Use(s):			
Project Objective(s) Satisfied	Collect the additional data necessary to the complete the Munitions Response Site Prioritization Protocol (MRSPP).	Yes ☑ No ☐	
Data Needs Requirements:			
Data User Perspective(s)	Risk - MEC and MC, Compliance	Yes ☑ No ☐	
Contaminant or Characteristic of Interest	Explosive Hazard Evaluation (EHE), Chemical Warfare Materiel Hazard Evaluation (CHE), and Health Hazard Evaluation (HHE). For the EHE and CHE modules, factors evaluated include the details of the hazard, accessibility to the Munitions Response Site (MRS), and receptor information. HHE factors include an evaluation of MC and any non-munitions-related incidental contaminants present, receptor information, and details pertaining to environmental migration pathways. Typical information compiled includes details pertaining to historical use, current/future use and ownership, cultural/ecological resources, and structures.	Yes ☑ No ☐	
Media of Interest	Surface soil, surface water, sediment, and groundwater	Yes ☑ No ☐	
Required Sampling Locations or Areas	Areas where MEC has been identified historically and where sampling is recommended.	Yes ☑ No ☐	
Number of Samples Required	Refer to DQOs 1 and 2 for related sampling required.		
Reference Concentration of Interest or Other Performance Criteria	An MRS priority is determined by USACE based on integrating the ratings from the EHE, CHE, and HHE modules. Refer to Federal Register/Vol. 70, No. 192/Wednesday, October 5, 2005/Rules and Regulations.	Yes ☑ No ☐	
Appropriate Sampling and Analysis Methods:			
Sampling Method and Depths	Data gathering prior to field activities as well as additional data gathered during field reconnaissance and sampling (DoD 2005).	Yes ☑ No ☐	
Analytical Method	Refer to DQOs 1and 2 for associated methods.		

APPENDIX C – INTERVIEW DOCUMENTATION

Appendix not used.

APPENDIX D – FIELD NOTES AND FIELD FORMS

- Daily Quality Control Reports
- Field Forms
- Logbook
- Chain of Custody

Alion Science and Technology, Inc.

DAILY QUALITY CONTROL REPORT

Report Number: 08-17-09-01		Date: August 17, 2009	
Project Name: D01MA058701		Contract Number: W912DY-04-D-0017	
Location of Work: Ayer, MA			
Description of Work: Mobilization to project work area. Collect sediment and surface water background samples from outside of the FUDS and surface water samples from MRS 2.			
Weather: Clear	Rainfall: None	Temperature: Min. 87 f	Max. 92 f

1. Work performed today by Alion:

The Alion field team collected two sediment background soil samples and two background surface water samples in Grove Pond, north of MRS 1. Two surface water samples were collected from the pond in MRS 2.

Samples Collected: Some sample locations may vary from SS-WP maps due to accessibility.

DEV-MR2-SW-00-01	DEV-BG-SD-01-01
DEV-MR2-SW-00-02	DEV-BG-SD-01-02
DEV-BG-SW-00-01	
DEV-BG-SW-00-02	

Note:

Reconnaissance Acreage / Discussion:

No reconnaissance was conducted.

2. Work performed today by Subcontractors.

None

3. Type and results of Control Phases and Inspection. (Indicate whether Preparatory – P, Initial – I, or Follow-Up – F and include satisfactory work completed or deficiencies with actions to be taken)

Preparatory phase inspections for the field were completed prior to mobilization to Fort Devens. Initial phase of inspections were completed upon arrival at the site. No follow-up inspections were completed. Satisfactory work completed.

4. List type and location of tests performed and results of these tests.

GPS benchmark control point coordinates were collected prior to field work and then again after completion of the fieldwork (see below). Schonstedt checked ok.

Benchmark coordinates: Northing 924805.684 meters (m), Easting 206714.595 m (US State Plane, Massachusetts Mainland 2001, NAD 1983 Conus)

Initial GPS reading: Northing 924805.688 meters (m), Easting 206714.589 m (US State Plane, Massachusetts Mainland 2001, NAD 1983 Conus)

Post event GPS reading: Northing 924805.685 meters (m), Easting 206714.593 m (US State Plane, Massachusetts Mainland 2001, NAD 1983 Conus)

Benchmark was located on the Hampton Inn Westford property.

5. List material and equipment received.

All equipment (GPS unit, geophysical instrument) supplied by Alion.

DAILY QUALITY CONTROL REPORT

6. Submittals reviewed. (Include Transmittal No., Item No., Spec/Plan Reference, by whom, and any action.
None
7. Off-site surveillance activities, including action taken.
None
8. Job Safety. (Report safety violations observed and actions taken)
No health and safety violations occurred during the sampling event. All work was performed in a safe and efficient manner.
9. Remarks. (Instructions received or given. Conflicts in Plans or Specifications)
Two background water samples and two background sediment samples were collected within Grove Pond, north of MRS 1. Surface water was collected from MRS 2. No reconnaissance was performed. During collection of background samples no munitions related materials (MEC/MD, DMM) or objects were observed.

Alion Science and Technology, Inc's Verification: On behalf of Alion, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.

Curtis Mitchell

Alion Science and Technology, Inc.

DAILY QUALITY CONTROL REPORT

Report Number:	08-18-09-02	Date: August 18, 2009	
Project Name:	D01MA058701	Contract Number:	W912DY-04-D-0017
Location of Work:	Ayer, MA		
Description of Work: Conduct meandering path geophysics within MRS 1 and portions of MRS 2 with a focus around the former grenade range and impact areas. Collect surface and subsurface soil samples from target areas.			
Weather:	Clear and humid	Rainfall: None	Temperature: Min. 80 f Max. 93 f

1. Work performed today by Alion:

The Alion field team conducted qualitative reconnaissance on approximately 15,860 square feet (0.36 acres) within MRS-1 and approximately 8,167 square feet (0.19 acres) within MRS-2 at Fort Devens. Within MRS 1, the Alion field team collected four surface soil samples and two subsurface soil samples for select explosives analysis. Within MRS 2, the Alion field team collected 2 surface soil samples. Three background soil samples were collected outside the FUDS boundary.

Samples Collected: Some sample locations may vary from SS-WP maps due to accessibility.

DEV-MR1-SS-01-01	DEV-MR1-SB-02-01	DEV-BG-SS-01-01
DEV-MR1-SS-01-02	DEV-MR1-SB-02-02	DEV-BG-SS-01-02
DEV-MR1-SS-01-03	DEV-MR2-SS-01-08	DEV-BG-SS-01-03
DEV-MR1-SS-01-04	DEV-MR2-SS-01-09	

Note: No field evidence of the former grenade range (MRS 1), anti-tank range impact area (MRS 2). No MEC/MD was observed during the field work. Six subsurface anomalies were recorded in MRS 1.

Reconnaissance Acreage / Discussion:

Reconnaissance was conducted in the meandering path fashion. Travel paths varied slightly from the geophysical site reconnaissance on figures in the SS-WP due to natural terrain and accessibility.

2. Work performed today by Subcontractors.

None

3. Type and results of Control Phases and Inspection. (Indicate whether Preparatory – P, Initial – I, or Follow-Up – F and include satisfactory work completed or deficiencies with actions to be taken)

Preparatory phase inspections for the field were completed prior to mobilization to Fort Devens. Initial phase of inspections were completed upon arrival at the site. No follow-up inspections were completed. Satisfactory work completed.

4. List type and location of tests performed and results of these tests.

GPS benchmark control point coordinates were collected prior to field work and then again after completion of the fieldwork (see below). Schonstedt checked ok.

Benchmark coordinates: Northing 924805.684 meters (m), Easting 206714.595 m (US State Plane, Massachusetts Mainland 2001, NAD 1983 Conus)

Initial GPS reading: Northing 924805.679 meters (m), Easting 206714.600 m (US State Plane, Massachusetts Mainland 2001, NAD 1983 Conus)

Post event GPS reading: Northing 924805.681 meters (m), Easting 206714.598 m (US State Plane, Massachusetts Mainland 2001, NAD 1983 Conus)

Benchmark was located on the Hilton Garden Inn property.

DAILY QUALITY CONTROL REPORT

5. List material and equipment received.
All equipment (GPS unit, geophysical instrument) supplied by Alion.
6. Submittals reviewed. (Include Transmittal No., Item No., Spec/Plan Reference, by whom, and any action.
None
7. Off-site surveillance activities, including action taken.
None
8. Job Safety. (Report safety violations observed and actions taken)
No health and safety violations occurred during the sampling event. All work was performed in a safe and efficient manner.
9. Remarks. (Instructions received or given. Conflicts in Plans or Specifications)
Representatives from the MassDEP accompanied the Alion team to observe the field work. Within MRS 1, the field team collected four surface soil samples and two subsurface soil samples in proximity to the noted areas in the SSWP. Qualitative Reconnaissance (QR) was performed within the former grenade range (MRS 1) in the eastern and western portions of MRS 1. Six subsurface anomalies were recorded in the eastern portion of MRS 1 and were interpreted to be related to local utilities. The majority of MRS 1 (Army National Guard property) is developed. Two surface soil samples were collected within MRS 2, anti-tank range impact area in proximity to the noted areas in the SSWP. QR was performed in the former impact area. The representatives from MassDEP left the site. Three background soil samples were collected southeast and east of MRS 2 in proximity to the locations proposed in the SSWP. Property and site restrictions (fenced-off areas) prevented the three background soil samples from being collected as noted in the SSWP. No subsurface anomalies were detected in MRS 2. No munitions presenting a potential explosive hazard (MPPEH) [inclusive of or munitions debris (MD), munitions and explosives of concern (MEC), range related debris] were identified at the MRS.

Alion Science and Technology, Inc's Verification: On behalf of Alion, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.

Curtis Mitchell

Alion Science and Technology, Inc.

DAILY QUALITY CONTROL REPORT

Report Number:	08-19-09-03	Date: August 19, 2009	
Project Name:	D01MA058701	Contract Number:	W912DY-04-D-0017
Location of Work:	Ayer, MA		
Description of Work: Collected background groundwater samples outside the FUDS. Collected groundwater samples from wells in proximity, and downgradient, of MRS 1 and MRS 2. Collected surface soil and sediment samples from MRS 2.			
Weather: Clear	Rainfall: None	Temperature: Min. 79 f	Max. 90 f

1. Work performed today by Alion:

The Alion field team, in corporation with the Town of Ayer Department of Public Works, collected a background groundwater sample from a well in proximity to Spectacle Pond. Spectacle Pond is located northeast of, and outside, the FUDS areas. The field team proceeded to collect a groundwater sample from a monitoring well in proximity to the Grove Pond pumphouse, downgradient of MRS 1. Within MRS 2 (Machine Gun and Rifle Range), two surface soil samples were collected at the former firing point. One surface soil sample was collected within the training area. Two sediment samples were collected from a pond located in the MRS 2 – Training Area. One groundwater sample was collected from well WWTMW-13 located in proximity to the northwestern MRS 2 boundary. The Alion field team conducted qualitative reconnaissance on approximately 80,286 square feet (1.84 acres) within MRS-2 at Fort Devens.

Samples Collected: Some sample locations may vary from SS-WP maps due to accessibility.

DEV-MR2-SS-01-05	DEV-MR2-SD-01-02
DEV-MR2-SS-01-06	DEV-FU-GW-00-01
DEV-MR2-SS-01-07	DEV-FU-GW-00-02
DEV-MR2-SD-01-01	DEV-BG-GW-00-01

Note: No field evidence of the former MRS 2 – Machine Gun and Rifle range firing point or impact area were observed. One suspected 7.62 mm rifle shell casing was found along the northwestern boundary of MRS 2. No subsurface anomalies were recorded. Mandatory quality assurance and quality control (QA/WC) samples were also collected including duplicate samples and matrix spike (MS) and matrix pike duplicate (MSD) samples.

Reconnaissance Acreage / Discussion:

Reconnaissance was conducted in the meandering path fashion. Travel paths varied slightly from the geophysical site reconnaissance on figures in the SS-WP due to natural terrain and accessibility.

2. Work performed today by Subcontractors.

None

3. Type and results of Control Phases and Inspection. (Indicate whether Preparatory – P, Initial – I, or Follow-Up – F and include satisfactory work completed or deficiencies with actions to be taken)

Preparatory phase inspections for the field were completed prior to mobilization to the Fort Devens. Initial phase of inspections were completed upon arrival at the site. No follow-up inspections were completed. Satisfactory work completed.

4. List type and location of tests performed and results of these tests.

GPS benchmark control point coordinates were collected prior to field work and then again after completion of the fieldwork (see below). Schonstedt checked ok.

Benchmark coordinates: Northing 924805.684 meters (m), Easting 206714.595 m (US State Plane, Massachusetts Mainland 2001, NAD 1983 Conus)

DAILY QUALITY CONTROL REPORT

Initial GPS reading: Northing 924805.690 meters (m), Easting 206714.591 m (US State Plane, Massachusetts Mainland 2001, NAD 1983 Conus)
Post event GPS reading: Northing 924805.683 meters (m), Easting 206714.596 m (US State Plane, Massachusetts Mainland 2001, NAD 1983 Conus)
Benchmark was located on the Hilton Garden Inn property.
5. List material and equipment received.
Equipment supplied by Alion included a GPS unit and a geophysical instrument. One water properties meter was provided by Pine Environmental.
6. Submittals reviewed. (Include Transmittal No., Item No., Spec/Plan Reference, by whom, and any action.
None
7. Off-site surveillance activities, including action taken.
None
8. Job Safety. (Report safety violations observed and actions taken)
No health and safety violations occurred during the sampling event. All work was performed in a safe and efficient manner.
9. Remarks. (Instructions received or given. Conflicts in Plans or Specifications)
Alion met with a representative of the Town of Ayer Department of Public Works. Alion was escorted to the Ayer Public Water Supply at Spectacle Pond where a groundwater sample was collected from the spigot within the pumphouse. A Horiba water meter was used to record the water parameters at this site. Alion was then escorted to a monitoring well in proximity to the Grove Pond pumphouse. A groundwater sample and water quality parameters were collected at this location. Alion field personnel mobilized to MRS 2 where two surface soil samples were collected at the firing point of the former Machine Gun and Rifle Range. QR was performed at the firing point and the interpreted impact area. No berm was found. One surface soil sample was collected from within the MRS 2 – Training Area. QR was performed within the former Training Area. One groundwater sample was collected at well WWTMW-13 in proximity to the northwest boundary of MRS 2. No subsurface anomalies were detected in MRS 2. One 7.62 mm shell casing was found along the northwest boundary of MRS 2. No munitions presenting a potential explosive hazard (MPPEH) [inclusive of or munitions debris (MD), munitions and explosives of concern (MEC), range related debris] were identified at the MRS.

Alion Science and Technology, Inc's Verification: On behalf of Alion, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.

Curtis Mitchell

DAILY SITE SAFETY JOURNAL
Page 1 of 2

DATE: 8.18.08	PROJECT:
Field UXO Technician: Jonas Stanley	

AREA / ITEMS INSPECTED	SAT	UNSAT
Proper work attire (PPE)	✓	
Vehicle condition	✓	
Emergency equipment	✓	
Safe demolition procedures		N/A
Field office, inside	✓	
Field office grounds	✓	

- [ ] Last Work Days Events
- [ ] Site Description
- [ ] Work Area Description
- [ ] Work Area Hazards
- [ ] On-Site Emergency
- [ ] Site Evacuation Procedures
- [ ] Emergency Response Personnel
- [ ] Emergency Telephone Numbers
- [ ] Directions to Hospital
- [ ] First Aid
- [ ] Heat / Cold Stress
- [ ] Asbestos Awareness & ID
- [ ] Ticks
- [ ] Safety Concerns
- [ ] Personnel Protective Equipment
- [ ] Safe Work Practices
- [ ] Emergency Response Plan
- [ ] Chemical Hazards
- [ ] Emergency Equipment, Location
- [ ] Emergency Equipment, by Type
- [ ] Emergency Decontamination
- [ ] Safe Work Practices - General
- [ ] Site specific OE Safety Precautions
- [ ] Site specific OE Identification Features
- [ ] Liquid Contaminates / Landfill Material
- [ ] Other _____

Comments:

UXO Technician in Field SIGNATURE:

DAILY SITE SAFETY JOURNAL
MEETING ATTENDEES
DATE: 8.18.08
Page 2 of 2

	Name	Affiliation
1	John Heagey	HFA
2	TODD BEARSE	USA
3	Ben Clark	HFA
4	Joanne Deardin	Mass DEP
5	Jennifer Robérge	Mass DEP
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DAILY SITE SAFETY JOURNAL
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DATE: 8/19/09	PROJECT: FORT DEVENS
Field UXO Technician: John Healey	

AREA / ITEMS INSPECTED	SAT	UNSAT
Proper work attire (PPE)	✓	
Vehicle condition	✓	
Emergency equipment	✓	
Safe demolition procedures		N/A
Field office, inside	✓	
Field office grounds	✓	

[ ] Last Work Days Events	[ ] Safety Concerns
[ ] Site Description	[ ] Personnel Protective Equipment
[ ] Work Area Description	[ ] Safe Work Practices
[ ] Work Area Hazards	[ ] Emergency Response Plan
[ ] On-Site Emergency	[ ] Chemical Hazards
[ ] Site Evacuation Procedures	[ ] Emergency Equipment, Location
[ ] Emergency Response Personnel	[ ] Emergency Equipment, by Type
[ ] Emergency Telephone Numbers	[ ] Emergency Decontamination
[ ] Directions to Hospital	[ ] Safe Work Practices - General
[ ] First Aid	[ ] Site specific OE Safety Precautions
[ ] Heat / Cold Stress	[ ] Site specific OE Identification Features
[ ] Asbestos Awareness & ID	[ ] Liquid Contaminates / Landfill Material
[ ] Ticks	[ ] Other _____

Comments:

UXO Technician in Field SIGNATURE:

DAILY SITE SAFETY JOURNAL
MEETING ATTENDEES
DATE: 8/19/08
Page 2 of 2

	Name	Affiliation
1	TODD BELANGER	ARA
2	Justin Hearey	ARA
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DATE: 8·20·09	PROJECT: Fort Devens
Field UXO Technician: Jonathan Heaney	

AREA / ITEMS INSPECTED	SAT	UNSAT
Proper work attire (PPE)	✓	
Vehicle condition	✓	
Emergency equipment	✓	~~N/A~~
Safe demolition procedures	~~N/A~~	N/A
Field office, inside	✓	
Field office grounds	✓	

- [ ] Last Work Days Events
- [ ] Site Description
- [ ] Work Area Description
- [ ] Work Area Hazards
- [ ] On-Site Emergency
- [ ] Site Evacuation Procedures
- [ ] Emergency Response Personnel
- [ ] Emergency Telephone Numbers
- [ ] Directions to Hospital
- [ ] First Aid
- [ ] Heat / Cold Stress
- [ ] Asbestos Awareness & ID
- [ ] Ticks
- [ ] Safety Concerns
- [ ] Personnel Protective Equipment
- [ ] Safe Work Practices
- [ ] Emergency Response Plan
- [ ] Chemical Hazards
- [ ] Emergency Equipment, Location
- [ ] Emergency Equipment, by Type
- [ ] Emergency Decontamination
- [ ] Safe Work Practices - General
- [ ] Site specific OE Safety Precautions
- [ ] Site specific OE Identification Features
- [ ] Liquid Contaminates / Landfill Material
- [ ] Other _____

Comments:

UXO Technician in Field SIGNATURE: 

DAILY SITE SAFETY JOURNAL
MEETING ATTENDEES
DATE: 8-20-09
Page 2 of 2

	Name	Affiliation
1	John Healey	IAA
2		
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SITE ENTRY AND EXIT LOG

Project/Site : Fort Devens

Project No.: D01MA058701

Date	Name	Representing	Time In	Time Out
08/18/09	TODD BELANGER	~~HFA~~	0850	300
8.18.09	Justin Henley	~~HFA~~	0850	300
8-18-09	Ben Claus	HFA	0850	300
8-18-09	Joanne Deane	Mass DEP	0900	1230
8-18-09	Jennifer Roberge	Mass DEP	0900	1230
8-19-09	TODD BELANGER	~~HFA~~	0830	1530
8-19-09	Ben Claus	HFA	0830	1530
8-19-09	Justin Henley	~~HFA~~	0830	1530
8-20-09	TODD BELANGER	HFA	0900	1230
8-20-09	Ben Claus	HFA	0900	1230
8-20-09	Justin Henley	~~HFA~~	0940	1230

HEALTH AND SAFETY PLAN REVIEW RECORD

SITE: Fort Devens

ALION Project No. D01MA058701

I have read the Health and Safety Plan (s) and have been briefed on the nature, level, and degree of exposure likely as a result of participation of field activities. I agree to conform to all the requirements of this Plan.

Name	Signature	Affiliation	Date
TODD BLANKER		HFA	08/18/09
John Healey		HFA	8.18.09
Ben Claus		HFA	8-18-09
Joanne Deardon		MassDEP	8-18-09
Jennifer Roberge		MassDEP	8-18-09
TODD BLANKER		HFA	8-19-09
Ben Claus		HFA	8-19-09
John Healey		HFA	8.19.09
John Healey		HFA	8-20-09

WELL PURGING AND SAMPLING RECORD

WELL ID _____ SAMPLE NO. DEV-BG-GW-00-01

WELL/SITE DESCRIPTION monitoring background well

DATE 8/19/09 TIME 9:45 AIR TEMP. 87°F

WELL DEPTH 23 ft ft CASING HEIGHT NA ft
WATER DEPTH ~8 ft ft WELL DIAMETER 2-inch in
WATER COL. HEIGHT 15 ft ft SANDPACK DIAM. _____ in
EQUIVALENT VOLUME OF STANDING WATER _____
(gal) (L)
PUMP RATE ~500 mL/m (gpm)
(LPM)
PUMP TIME 20 min min
WELL WENT DRY? ( ) Yes (X) No PUMP TIME ~20 min
VOL. REMOVED 10 (gal) (L) RECOVERY TIME _____ min
PURGE AGAIN? ( )Yes ( ) No TOTAL VOL. REMOVED 10 (gal) (L)

Date	Time	Volume Removed Unit:	pH	Cond.	Temp.	ORP	Turb.	DO	Depth to Water from TOC	Pump Rate
8/19	9:25	2.5L	7.64	.439	11.23	-117	150	6.59	28	500ml/m
|	9:30	2.5L	7.62	.440	11.49	-118	93	6.00	|	|
|	9:35	2.5L	7.63	.441	11.30	-119	78	5.98	|	|
|	9:40	2.5L	7.64	.440	11.49	-119	51	5.73	|	|

WELL PURGING AND SAMPLING RECORD

WELL ID Grove Pond well SAMPLE NO. DEV-FU-GW-00-01

WELL/SITE DESCRIPTION Near Grove Pond

DATE 8/19/ TIME 1015 AIR TEMP. 85 F

WELL DEPTH 75 ft ft CASING HEIGHT NA ft
WATER DEPTH ~25 ft WELL DIAMETER 2-inch in
WATER COL. HEIGHT ~~~25~~ ft SANDPACK DIAM. _____ in
EQUIVALENT VOLUME OF STANDING WATER _____
(gal) (L)
PUMP RATE ~500 mL/m (gpm)
(LPM)
PUMP TIME 20 min min
WELL WENT DRY? ( ) Yes (X) No PUMP TIME 20 min
VOL. REMOVED 10 (gal) (L) RECOVERY TIME _____ min
PURGE AGAIN? ( )Yes ( ) No TOTAL VOL. REMOVED 10 (gal) (L)

Date	Time	Volume Removed Unit:	pH	Cond.	Temp.	ORP	Turb.	DO	Depth to Water from TOC	Pump Rate
8/19/09	10:00	~~20 gal~~ 10 L	7.53	.595	16.5	99	62	6.57	~10'	~500 mL/minute

Chain of Custody Record

Sampler ID _____

Temperature on Receipt _____

Drinking Water? Yes ☐ No ☒

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4124-280 (0508)

Client	Project Manager	Date	Chain of Custody Number
ALION SCIENCE AND TECHNOLOGY	TODD BELANGER	08/19/09	115288
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page 1 of 1**
3975 FAIR RIDGE DRIVE, SUITE 125 SOUTH	703.259.5158		
City / State / Zip Code	**Site Contact**	**Lab Contact**	
FAIRFAX / VA / 22033			
Project Name and Location (State)	**Carrier/Waybill Number**		
FORT DEVENS, MA			
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	Analysis: PERCHLORATE	NITROGLYCERINE	[illegible]	DNT + BREAKDOWN	[illegible]	Special Instructions/ Conditions of Receipt
DEV-BG-SW-00-01	8/17/09	1710		X									X					
DEV-BG-SW-00-02	8/17/09	1650		X									X					
DEV-MR2-SW-00-01	↓	1745											X	X		X		2 GLASS BOTTLES, 1 PLASTIC
DEV-MR2-SW-00-02	↓	1750											X	X		X		2 GLASS BOTTLES, 1 PLASTIC

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months
(A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☒ 21 Days ☐ Other _____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By (Todd Bel)	8/19/09	800	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Chain of Custody Record

Sampler ID _____

Temperature on Receipt _____

Drinking Water? Yes ☐ No ☒

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4124-280 (0508)

Client	Project Manager	Date	Chain of Custody Number
ALION SCIENCE AND TECHNOLOGY	TODD BELANGER	08/19/09	115297
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page 1 of 1**
3975 FAIR RIDGE DR, SUITE 125 SOUTH	703 259 5158		
City / State / Zip Code	**Site Contact**	**Lab Contact**	
FAIRFAX / VA / 22033			
Project Name and Location (State)	**Carrier/Waybill Number**		
FORT DEVENS, AYER, MA			
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	Analysis: Tetryl	TNT-TNT-Breakdown	Nitroglycerine	DNT-DNT breakdown	Aluminum, Antimony	Barium, Cobalt	Iron, Lead	Magnesium, Manganese	Nickel, Strontium	Zinc			Special Instructions/ Conditions of Receipt
DEV-MRI-SS-01-04	8/18/09	0930				X							X	X											
DEV-MRI-SS-01-04P	8/18/09	0935				X							X	X											
DEV-MRI-SS-01-03	8/18/09	0940				X							X	X											
DEV-MRI-SB-02-02	8/18/09	0945				X							X	X											
DEV-MRI-SS-01-02	8/18/09	1020				X							X	X											MS/MSD
DEV-MRI-SS-01-01	8/18/09	1030				X							X	X											
DEV-MRI-SB-02-01	8/18/09	1040				X							X	X											
DEV-MR2-SS-01-09	8/18/09	1155				X									X	X	X	X	X	X	X	X			
DEV-MR2-SS-01-08	8/18/09	1205				X									X	X	X	X	X	X	X	X			
DEV-MBG-SS-01-03	8/18/09	1335				X											X	X	X	X	X	X			
DEV-BG-SS-01-02	8/18/09	1345				X											X	X	X	X	X	X			
DEV-BG-SD-01-02	8/17/09	1650				X											X	X	X	X	X	X			
DEV-BG-SD-01-01	8/17/09	1710				X											X	X	X	X	X	X			

Possible Hazard Identification

☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal

☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months

(A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required

☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☒ 21 Days ☐ Other _____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By	8-19-09	1000	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Chain of Custody Record

Sampler ID _____

Temperature on Receipt _____

Drinking Water? Yes ☐ No ☒

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4124-280 (0508)

Client	Project Manager	Date	Chain of Custody Number
ALION SCIENCE AND TECHNOLOGY	TODD BELANGER tbelanger@alionscience.com	8/20/09	115289
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page** _____ **of** _____
3975 FAIR RIDGE DR. SUITE 125 SOUTH	703 259 5158		
City / **State** / **Zip Code**	**Site Contact**	**Lab Contact**	
FAIRFAX / VA / 22033			
Project Name and Location (State)	**Carrier/Waybill Number**		
FORT DEVENS, MA			
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	Analysis: NITROGLYCERINE	DNT+ BREAKDOWN	ALUMINUM, ANTIMONY	BARIUM, COPPER	IRON, LEAD	MAGNESIUM	NICKEL	STRONTIUM	ZINC	Special Instructions/ Conditions of Receipt
DEV-MR2-SS-01-05	8/19/09	1120				X							X	X	X	X	X	X	X	X	X	
DEV-MR2-SS-01-06	8/19/09	1105				X							X	X	X	X	X	X	X	X	X	MS-MSD
DEV-MR2-SS-01-06P	↓	1110				X							X	X	X	X	X	X	X	X	X	
DEV-MR2-SS-01-07		1140				X							X	X	X	X	X	X	X	X	X	
DEV-MR2-SD-01-01		1220			X								X	X	X	X	X	X	X	X	X	MS-MSD
DEV-MR2-SD-01-02		1230			X								X	X	X	X	X	X	X	X	X	
DEV-MR2-SD-01-02P		1230			X								X	X	X	X	X	X	X	X	X	

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months
(A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☒ 21 Days ☐ Other _____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By	8/20/09	0930	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Chain of Custody Record

Sampler ID _____

Temperature on Receipt _____

Drinking Water? Yes ☐ No ☒

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4124-280 (0508)

Client	Project Manager	Date	Chain of Custody Number
ALION SCIENCE AND TECHNOLOGY	TODD BLANGER tbelanger@alionscience.com	8/20/09	115290
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page _____ of _____**
3975 FAIR RIDGE DRIVE SUITE 125 S	703.259.5158		
City / State / Zip Code	**Site Contact**	**Lab Contact**	
FAIRFAX / VA / 22033			
Project Name and Location (State)	**Carrier/Waybill Number**		
FORT DEVENS, MA			
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	Analysis: TNT + BREAKDOWN	TETRYL	PERCHLORATE	NITROGLYCERINE	DNT + BREAKDOWN	Special Instructions/ Conditions of Receipt
DEV-BG-GW-00-01	8/19/09	0945		X											X			
DEV-FU-GW-00-01	8/19/09	1015		X									X	X				
DEV-FU-GW-00-02	8/19/09	1400		X											X	X	X	
DEV-FU-GW-00-02	8/19/09	1400		X									X	X	X	X	X	MS-MSD TETRYL + TNT IN MS-MSD ONLY, NOT PAHs
DEV-FU-GW-00-02P	8/19/09	1405		X											X	X	X	
DEV-MR2-SW-00-01P	8/17/09	1750		X											X	X	X	
DEV-MR2-SW-00-02	8/17/09	1750		X											X	X	X	MS-MSD

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months
(A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☒ 21 Days ☐ Other _____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By	8/20/09	0930	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Tel. (978) 772-8240
Fax (978) 772-8244
dpwsupt@ayer.ma.us

Public Works Department
TOWN OF AYER

DANIEL F. NASON, CPESC, CPSWQ
SUPERINTENDENT

25 Brook Street
Ayer, MA 01432

Solution of Right Triangles

For Angle A. $\sin = \frac{a}{c}$, $\cos = \frac{b}{c}$, $\tan = \frac{a}{b}$, $\cot = \frac{b}{a}$, $\sec = \frac{c}{b}$, $\operatorname{cosec} = \frac{c}{a}$

Given	Required	
a, b	A, B, c	$\tan A = \frac{a}{b} = \cot B,\ c = \sqrt{a^2 + b^2} = a\sqrt{1 + \frac{b^2}{a^2}}$
a, c	A, B, b	$\sin A = \frac{a}{c} = \cos B,\ b = \sqrt{(c + a)(c - a)} = c\sqrt{1 - \frac{a^2}{c^2}}$
A, a	B, b, c	$B = 90° - A,\ b = a \cot A,\ c = \frac{a}{\sin A}$
A, b	B, a, c	$B = 90° - A,\ a = b \tan A,\ c = \frac{b}{\cos A}$
A, c	B, a, b	$B = 90° - A,\ a = c \sin A,\ b = c \cos A$

Solution of Oblique Triangles

Given	Required	
A, B, a	b, c, C	$b = \frac{a \sin B}{\sin A},\ C = 180° - (A + B),\ c = \frac{a \sin C}{\sin A}$
A, a, b	B, c, C	$\sin B = \frac{b \sin A}{a},\ C = 180° - (A + B),\ c = \frac{a \sin C}{\sin A}$
a, b, C	A, B, c	$A + B = 180° - C,\ \tan \frac{1}{2}(A - B) = \frac{(a-b)\tan \frac{1}{2}(A+B)}{a+b},$ $c = \frac{a \sin C}{\sin A}$
a, b, c	A, B, C	$s = \frac{a+b+c}{2},\ \sin \frac{1}{2}A = \sqrt{\frac{(s-b)(s-c)}{bc}},$ $\sin \frac{1}{2}B = \sqrt{\frac{(s-a)(s-c)}{ac}},\ C = 180° - (A + B)$
a, b, c	Area	$s = \frac{a+b+c}{2},\ \text{area} = \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	$\text{area} = \frac{bc \sin A}{2}$
A, B, C, a	Area	$\text{area} = \frac{a^2 \sin B \sin C}{2 \sin A}$

CONTACTS

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ELLEN LORIO		978.318.8433
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JON ROBERGE	MASSDEP	617.292.5865
BRIAN DOUAT	MASSDEP	
DAVID TESSICINI	ARMY GUARD	508.233.6519
BOB SIMEONE		978.796.2205
RON OSTROWSKI		978.784.2936
CAROLYN McCREARY (AYER TOWN)		978.772.5870
DANA BANKS (PANAM)		978.663.1218
LAUREN BERG (ARMY N.G.)		978.821.7092

8/18/09 MRS 1 - GRENADE RANGE

HOT - MID 80's, SUNNY

0900 MEET WITH LAUREN BERG - ARMY NATIONAL GUARD
DISCUSS MMRP + SAMPLING

0905 LAUREN LEAVES

0910 MEET JOANNE DEARDEN + JEN ROBERGE MASS DEP

0915 JOHN HEALEY DOES SAFETY TALK + SIGN IN SHEETS

0920 START QR @ MRS 1

0930 DEU-MR1-SS-01-04 SURF. SOIL SAMP TEXTURE TNT

FIELD DUP DEU-MR1-SS-01-04B

0940 DEU-MR1-SS-01-03

0945 DEU-MR1-SB-02-02

0950 MOB TO WESTERN MRS 1 - QR WITHIN FUDS BOUND

1020 DEU-MR1-SS-01-02 TNT PETRYL

DEU-MR1-SS-01-02 MS MSD

(4)

8/18/09 MRS1 GRENADE RANGE

10[30] DEU-MR1-SS-01-01

1040 DEU-MR1-SB-02-01

MOB TO MRS 2

11[55] DEU-MR2-SS-01-09
METALS + EXP

ANTI-TANK TRENCH

12[05] DEU-MR2-SS-01-08
METALS - EXP

BAD GPS COVERAGE

12[15] JOANNE + JEN LEAVE SITE
DEU-BG-SS-01-02
* 6-2[15] TREATMENT PLANT HOURS

1335 DEU-BG-SS-01-01
BACKGROUND METALS

FENCE ON S. SIDE OF ROAD RESTRICTS ACCESS TO PROPOSED BG SAMPLES

1345 DEU-BG-SS-01-02

SPOKE TO SECRETARIES ABOUT ACCESS TO MRS 2, CAN DRIVE INTO MRS 2 FROM BROOKS ROAD, LEFT NOTE FOR K UNDE.

(5)

8/19/09 Fort Devens SI

0800: Containerize samples from 8-17-09, 8-18-09 to ship to test america.

0830: Personnel:
Todd Belanger: HFA
Ben Claus: HFA
John Healey: HFA - UXO Tech.

0840: John gives HES daily meting topics: heat stress, UXO Safety, Slips/trips/falls,

0845: @ Review todays sampling objectives, conduct QR in MRS-2, collect SS, SD, and GW samples.

Weather: 72°F-93°F, Clear, humid, 0-10 mph wind.

900: Meet at Ayer DPW to gain access to town wells, to collect MRS-1 GW sample.

910 DRIVE TO GROVE POND WELL TO MEET RICK (DPW).

920 FIND A MONITORING WELL @ GROVE POND

930 DRIVE TO SPECTACLE POND AYER PUBLIC WATER SUPPLY AT SPECTACLE POND

(6)

08/15/09

0945 DEV-BG-GW-00-01

COLLECT GW FROM PUMPHOUSE SPIGOT. PURGED SPIGOT. TWO BOTTLES, PERCHLORATE. RAN HORIBA FOR GW ~~&~~ DATA

RETURN TO MONITORING WELL AT GROVE POND

1015 DEV-FU-GW-00-01

COLLECT FROM MONITORING WELL W/ BAILERS. PURGED WELL. TWO BOTTLES TNT AND TETRYL.

1025 RETURN TO MRS 2 FROM BROOKS ROAD.

1045 QR AT MRS 2 - MACHINE GUN RANGE

MACHINE GUN E.P

1105 DEV-MR2-SS-01-06 MS/MSD

1110 ~~ANIMAL~~ EXP DEV-MR2-SS-01-06P + DUP

1120 DEV-MR2-SS-01-05

1140 DEV MR2 SS 01 07

INTAKING RCA METALS+EXP

1220 DEV-MR2-SD-01-01

EXP+metals

* MS+MSD

1230 DEV-MR2-SD-01-02

DEV-MR2-SD-01-02P

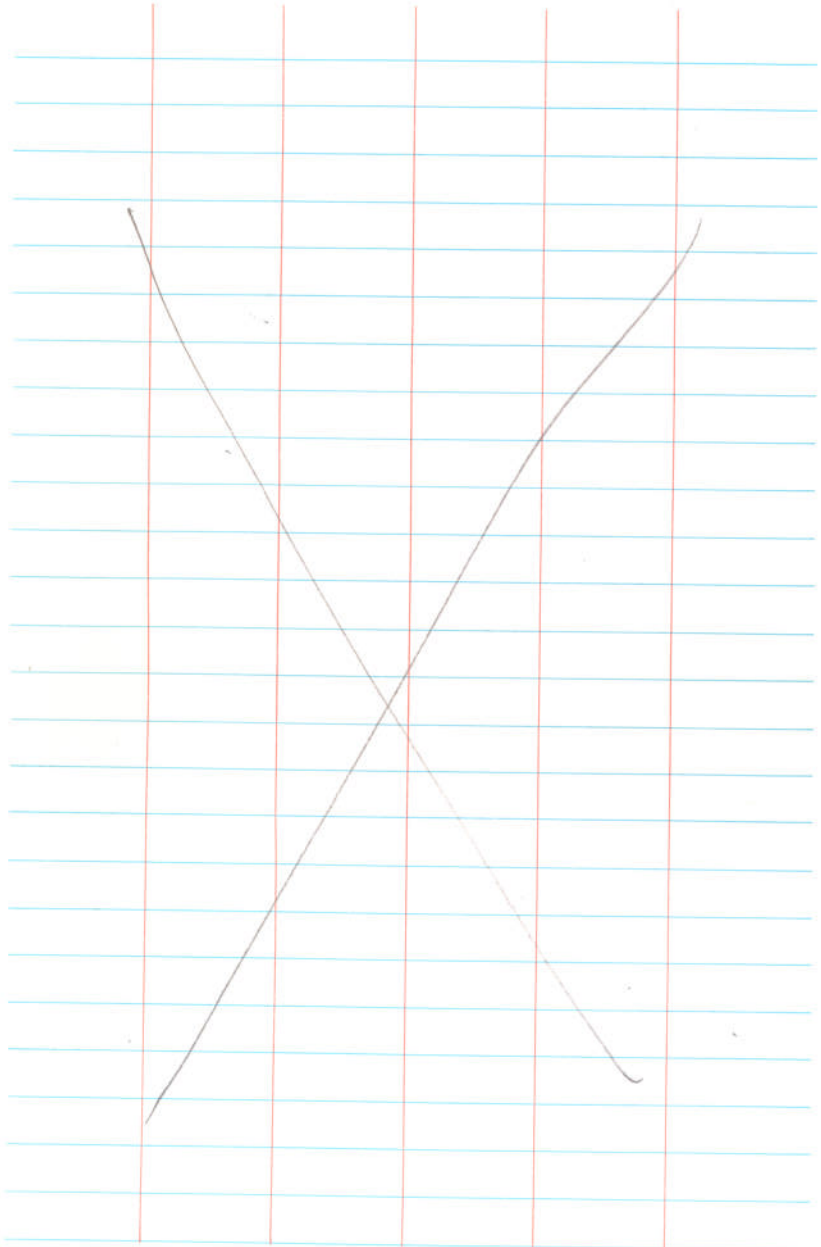
DUPLICATE

~~DEV-FU-GW-00-02~~

1400 DEV-FU-GW-00-02 + MS/MSD

1405 DEV-FU-GW-00-02P DUP

ACCESS WELL WWTMW-B. CUT LOCK. REPLACED LOCK. WILL SEND KEY TO BOB SOMEONE.



GPS COORDINATES

UTM NAD83 ZONE 19N (m)		
SAMPLE/ANUM	NORTHINGS (Y)	EASTINGS (X)
DEV-BG-GW-00-01	4715097.78	292787.03
DEV-FU-GW-00-02	4715698.48	286048.10
DEV-FU-GW-00-01	4714234.66	288090.35
DEV-MR1-SS-01-04	4713732.53	287739.08
DEV-MR1-SS-01-03	4713692.73	287694.6
DEV-MR1-SS-01-02	4713887.203	287401.566
DEV-MR1-SS-01-01	4713868.289	287401.053
DEV-MR1-SB-02-01	4713868.087	287401.409
DEV-MR2-SS-01-08	4715931.427	286543.275
DEV-MR2-SS-01-09	4715936.485	286588.023
DEV-BG-SS-01-03	4715870.246	286760.095
DEV-BG-SS-01-01	~~4715870.246~~	
	4715466.246	286838.151
DEV-BG-SS-01-02	4715430.601	286633.911
DEV-MR2-SS-01-06	4715516.644	286038.503
DEV-MR2-SS-01-05	4715498.633	285989.374
DEV-MR2-SS-01-06	4715528.353	286026.803
DEV-MR2-SS-01-07	4715625.353	286111.453
DEV-BG-SD-01-02	4714215.463	287694.425
DEV-BG-SD-01-01	4714168.159	287872.407
DEV-MR2-SD-01-01	4715677.502	286302.206
DEV-MR2-SD-01-02	4715698.18	286297.39

GPS COORDINATES CONT.

UTM NAD83 ZONE 19N (m)

SAMPLE / ANOM	NORTHING (Y)	EASTING (X)
DEU-BG-SW-00-02	4714216.05	287684.297
DEU-BG-SW-00-01	4714168.124	287872.282
DEU-MR2-SW-00-01	4715658.411	286668.279
DEU-MR2-SW-00-02	4715638.652	286695.135
SUBANOM	4713746.756	287750.849
SUBANOM	4713746.932	287748.569
	4713731.436	287741.851
	4713724.311	287728.257
	4713720.188	287722.053
	4713684.792	287683.355
	4715579.851	286082.441
SURFACE MD	4715583.829	286087.998

7.62mm BULLET

08/17/09 MRS1

ARRIVE @ GROSE POND PUMPHOUSE

1650 COLLECT DEU-BG-SD-01-02

DEU-BG-SW-00-02

LOTS OF GREEN ALGAE ON SURFACE

LOTS OF ORGANICS IN SEDIMENT

1710 COLLECT DEU-BG-SD-01-01

DUPLICATE DEU-BG-SW-00-01 01P

MOB TO MRS 2 - ACCESS MRS 2 FROM MACPHERSON RD. PULLOUT NEAR MACPHERSON & BISHOP ROAD INTERSECTION. WALK INTO SITE ON TRAIL - CHECK LOCATION OF WWTMW-13 WELL. WELL IN CORRECT LOCATION. LOCKED. WALKED OVER TO POND TO COLLECT SW SAMPLES.

1745 DEU-MR2-SW-00-01

1750

1750 DEU-MR2-SW-00-02 MS MSD

DEU-MR2-SW-00-01P

COULD NOT WALK FARTHER AROUND POND BARBED WIRE FENCE ON WATERLINE. RETURN TO CAR - MOSQUITOS!!!

Subject: Additional notes and comments regarding the August 2009 field sampling event at the Fort Devens FUDS.

Date: January 5, 2011

Notes:

-Although field sampling (background sample collection) occurred on August 17, 2009 a Daily Safety Journal is not included for field work conducted on August 17, 2009. Refer to the DQCR and field notebook for a summary of work conducted this day.

- Although the field team visited the site on August 20, 2009 a DQCR was not completed because no environmental sampling or site reconnaissance was conducted. The field team visited the National Guard office to inquire if any MEC/MD has been found within MRS 1, specifically an area currently under construction adjacent to the National Guard office. A National Guard employee stated that, to their knowledge, no MEC/MD has been reported in MRS 1 or the construction site.

JUNE 22, 2010
DQCRs, FIELD FORMS, FIELD NOTES AND COCs

Note- The QR acreage provided in the 6-22-2010 DQCR erroneously included QR collected on the road. The QR acreage was revised appropriately, and the correct acreage is shown in the remainder of the SI Report.

Alion Science and Technology, Inc.

DAILY QUALITY CONTROL REPORT

Report Number:	06-22-10-01	Date: June 22, 2010	
Project Name:	D01MA058701	Contract Number:	W912DY-04-D-0017
Location of Work:	Ayer, MA		
Description of Work: Collect surface soil, sediment and surface water samples from MRS 1 – WWI Grenade Range (PanAm Property). Conduct visual and magnetometer-assisted reconnaissance.			
Weather: Clear	Rainfall: None	Temperature: Min. 70 f	Max. 80 f

1. Work performed today by Alion:

The Alion field team collected five surface soil samples, one surface water, and one sediment sample from within the PanAm Railways property (MRS 1 – WWI Grenade Range). Visual and qualitative reconnaissance was performed.

Samples Collected: Some sample locations may vary from SS-WP maps due to accessibility.

DEV-PA-SS-01-01	DEV-PA-SS-01-05
DEV-PA-SS-01-02	DEV-PA-SW-00-01
DEV-PA-SS-01-03	DEV-PA-SD-01-01
DEV-PA-SS-01-04	

Note: No field evidence of the former grenade range (MRS 1) was observed. No MEC/MD was observed during the field work.

Reconnaissance Acreage / Discussion:

Reconnaissance was conducted on approximately 141,831 ft^2 (3.3 acres). Reconnaissance was conducted in the meandering path fashion. Travel paths varied slightly from the geophysical site reconnaissance on figures in the SS-WP due to natural terrain and accessibility.

2. Work performed today by Subcontractors.

None

3. Type and results of Control Phases and Inspection. (Indicate whether Preparatory – P, Initial – I, or Follow-Up – F and include satisfactory work completed or deficiencies with actions to be taken)

Preparatory phase inspections for the field were completed prior to mobilization to Fort Devens. Initial phase of inspections were completed upon arrival at the site. No follow-up inspections were completed. Satisfactory work completed.

4. List type and location of tests performed and results of these tests.

GPS benchmark control point coordinates were collected prior to field work and then again after completion of the fieldwork (see below). Schonstedt checked ok.

Benchmark coordinates: Northing 924805.484 meters (m), Easting 206714.395 m (US State Plane, Massachusetts Mainland 2001, NAD 1983 Conus)

Initial GPS reading: Northing 924805.488 meters (m), Easting 206714.489 m (US State Plane, Massachusetts Mainland 2001, NAD 1983 Conus)

Post event GPS reading: Northing 924805.475 meters (m), Easting 206714.403 m (US State Plane, Massachusetts Mainland 2001, NAD 1983 Conus)

Benchmark was located on the Hampton Inn Westford property.

5. List material and equipment received.

All equipment (GPS unit, geophysical instrument) supplied by Alion.

6. Submittals reviewed. (Include Transmittal No., Item No., Spec/Plan Reference, by whom, and any action.
None
7. Off-site surveillance activities, including action taken.
None
8. Job Safety. (Report safety violations observed and actions taken)
No health and safety violations occurred during the sampling event. All work was performed in a safe and efficient manner.
9. Remarks. (Instructions received or given. Conflicts in Plans or Specifications)
A representative of PanAm Railways accompanied the Alion Team during the site inspection. Within MRS 1, the field team collected five surface soil samples, one surface water sample, and one sediment sample in proximity to the noted areas in the SSWP-Addendum. Qualitative Reconnaissance (QR) was performed within the former grenade range (MRS 1). The majority of the PanAm Railways property is developed and is an active rail yard and truck depot. When in proximity to the railroad tracks, visual reconnaissance supplanted magnetometer-assisted QR. This was done due to the magnetic interference created by the tracks and other metallic debris (railroad spikes, brake shoes, railcars etc.). Numerous items of metallic cultural debris were observed visually and were detected by the Schonstedt. Cultural debris was abundant (railroad ties, spikes, parts, trash, utilities). No munitions related materials (MEC/MD, DMM) or objects were observed.

Alion Science and Technology, Inc's Verification: On behalf of Alion, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.

Curtis Mitchel

DAILY SITE SAFETY JOURNAL
Page 1 of 2

DATE: 6-22-10	PROJECT:
Field UXO Technician: Ken Stiel	

AREA / ITEMS INSPECTED	SAT	UNSAT
Proper work attire (PPE)	✓	
Vehicle condition	✓	
Emergency equipment	✓	
Safe demolition procedures	N/A	
Field office, inside	N/A	
Field office grounds	N/A	

- [ ] Last Work Days Events
- [✓] Site Description
- [ ] Work Area Description
- [✓] Work Area Hazards
- [ ] On-Site Emergency
- [ ] Site Evacuation Procedures
- [ ] Emergency Response Personnel
- [ ] Emergency Telephone Numbers
- [ ] Directions to Hospital
- [✓] First Aid
- [ ] Heat / Cold Stress
- [ ] Asbestos Awareness & ID
- [✓] Ticks
- [✓] Safety Concerns
- [ ] Personnel Protective Equipment
- [ ] Safe Work Practices
- [ ] Emergency Response Plan
- [ ] Chemical Hazards
- [ ] Emergency Equipment, Location
- [ ] Emergency Equipment, by Type
- [ ] Emergency Decontamination
- [✓] Safe Work Practices - General
- [ ] Site specific OE Safety Precautions
- [ ] Site specific OE Identification Features
- [ ] Liquid Contaminates / Landfill Material
- [ ] Other _____

Comments:

UXO Technician in Field SIGNATURE: [signature]

DAILY SITE SAFETY JOURNAL
MEETING ATTENDEES
DATE: 6/22/10
Page 2 of 2

	Name	Affiliation
1	TODD BEANSON	ALION
2	Ken Steel	Alion
3	Ben Claes	Alion
4	Scott Oesenault	Penn Am Railways
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

SITE ENTRY AND EXIT LOG

Project/Site : Fort Devens

Project No.: D01MA058701

Date	Name	Representing	Time In	Time Out
6/22/10	TODD SKAWICZ	Alion	810	
6/22/10	Ben Claus	Alion	810	
6/22/10	Ken Steel	Alion	810	
6/22/10	Scott G.	Pan Am	810	

HEALTH AND SAFETY PLAN REVIEW RECORD

SITE: Fort Devens

ALION Project No. D01MA058701

I have read the Health and Safety Plan (s) and have been briefed on the nature, level, and degree of exposure likely as a result of participation of field activities. I agree to conform to all the requirements of this Plan.

Name	Signature	Affiliation	Date
TODD BEANGER		ALION	6/22/10
Ken Steel		ALION	6/22/10
Jen Claus		Alion	6/22/10
Scott Cresseault		PAN Am Railways	6/22/10

Chain of Custody Record

Sampler ID _____

Temperature on Receipt _____

Drinking Water? Yes ☐ No ☒

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TAL-4124-280 (0508)

Client	Project Manager	Date	Chain of Custody Number
Alion Science and Technology	Todd Belcher	6/22/10	131310
Address 3975 Fair Ridge Dr.	**Telephone Number (Area Code)/Fax Number** 703-259	**Lab Number**	**Page** 1 of 1
City Fairfax / **State** VA / **Zip Code** 22033	**Site Contact**	**Lab Contact**	
Project Name and Location (State) Ft. Devens - Addendum	**Carrier/Waybill Number**		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	Analysis: Tetryl	TNT-& Breakdown	Nitroglycerin	Special Instructions/ Conditions of Receipt
DEV-PA-SS-01-01	6/22/10	920				X	1						X	X	X	
DEV-PA-SS-01-02	6/22/10	910				X	1						X	X	X	
DEV-PA-SS-01-03	6/22/10	940				X	1						X	X	X	
DEV-PA-SS-01-04	6/22/10	950				X	3						X	X	X	MS/MSD
DEV-PA-SS-01-05	6/22/10	1000				X	1						X	X	X	
DEV-PA-SD-01-01		855			X		3						X	X	X	MS/MSD
DEV-PA-SW-00-01		850		X			6						X	X	X	MS/MSD
DEV-PA-SS-DUP1		945				X	1						X	X	X	
DEV-PA-SD-DUP1		900			X		1						X	X	X	
DEV-PA-SW-DUP1		855		X			2						X	X	X	

Possible Hazard Identification
☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months
(A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☒ 7 Days ☐ 14 Days ☐ 21 Days ☐ Other _____

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By	6/22/10	1700	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments
TNT BREAKDOWNS 2,4,6 TNT; 1,3,5 TNB; 1,3 DNB; 2A 4,6 DNT; 4A 2,6, DNT, NITROBENZENE

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

CONTENTS VALUABLE
Please Return To:

Name: TODD BRANCH

Company: ALLONS

Street: 3975 FAIR RIDGE DRIVE, SUITE 125 S

City: FAIRFAX State: VA

Phone: _____

LEGEND, Inc.

ONE JOB FIELD BOOK

Project Name: FORT DEVENS

Project Number: D01MA058701

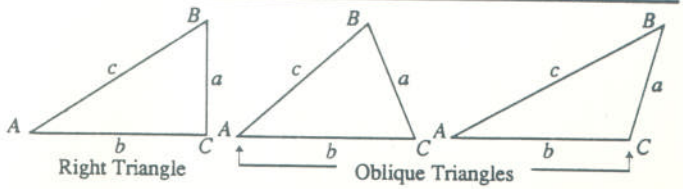
Date: 6/22/2010

16 Pages

50% cotton content

water-resistant paper

TRIGONOMETRIC FORMULÆ



Solution of Right Triangles

For Angle A. $\sin = \frac{a}{c}$, $\cos = \frac{b}{c}$, $\tan = \frac{a}{b}$, $\cot = \frac{b}{a}$, $\sec = \frac{c}{b}$, $\operatorname{cosec} = \frac{c}{a}$

Given	Required	
a, b	A, B, c	$\tan A = \frac{a}{b} = \cot B,\ c = \sqrt{a^2 + b^2} = a\sqrt{1 + \frac{b^2}{a^2}}$
a, c	A, B, b	$\sin A = \frac{a}{c} = \cos B,\ b = \sqrt{(c + a)(c - a)} = c\sqrt{1 - \frac{a^2}{c^2}}$
A, a	B, b, c	$B = 90° - A,\ b = a \cot A,\ c = \frac{a}{\sin A}$
A, b	B, a, c	$B = 90° - A,\ a = b \tan A,\ c = \frac{b}{\cos A}$
A, c	B, a, b	$B = 90° - A,\ a = c \sin A,\ b = c \cos A,$

Solution of Oblique Triangles

Given	Required	
A, B, a	b, c, C	$b = \frac{a \sin B}{\sin A},\ C = 180° - (A + B),\ c = \frac{a \sin C}{\sin A}$
A, a, b	B, c, C	$\sin B = \frac{b \sin A}{a},\ C = 180° - (A + B),\ c = \frac{a \sin C}{\sin A}$
a, b, C	A, B, c	$A + B = 180° - C,\ \tan \frac{1}{2}(A - B) = \frac{(a-b) \tan \frac{1}{2}(A+B)}{a+b},$ $c = \frac{a \sin C}{\sin A}$
a, b, c	A, B, C	$s = \frac{a+b+c}{2},\ \sin \frac{1}{2}A = \sqrt{\frac{(s-b)(s-c)}{b\,c}},$ $\sin \frac{1}{2}B = \sqrt{\frac{(s-a)(s-c)}{a\,c}},\ C = 180° - (A + B)$
a, b, c	Area	$s = \frac{a+b+c}{2},\ \text{area} = \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	$\text{area} = \frac{b\,c \sin A}{2}$
A, B, C, a	Area	$\text{area} = \frac{a^2 \sin B \sin C}{2 \sin A}$

CONTACTS

ROGER AZAR 301.399.7304
ELLEN 10210 978.318.8433
DANA BANKS 978.302.6140

BENCHMARK UTM 19N NAD83 (M)

	X	Y
HAMPTON INN	206714.385	924805.484
MOZN	206714.489	924805.488
ENE	206714.403	924805.475

6/22/10 FORT DEVENS

MRS 1 - GREW RANGE

8:15 LOW 70's, SUNNY, KEW STEEL, DEW CLASS
TODD BELANGER

8:20 MEET SCOTT W/ RAILROAD
SAFETY TALK, SIGN FORMS
MOB TO N END OF OF MRS 1

8:50 DEV-PA-SW-00-01 QR AROUND POND
DEV-PA-SW-DUP-01 LOTS OF FROG
PIC DEERS, BRANCHES

8:55 MS-MSD

9:00 DEV-PA-SD-01-01 / DEV-PA-SD-DUP-01

9:10 EPHEMERAL POND. WATER LEVEL LOW
DEV-PA-SS-01-02 SOIL
QR IN WOODS, NO ANOMALIES

9:20 DEV-PA-SS-01-03 N END OF MRS
NO ANOMALIES IN WOODS

9:40 DEV-PA-SS-01-03 PIC

9:45 DEV-PA-SS-DUP-01

CLOUDS

KMS

6/22 FORT DEVENS MRS 1

9⁵⁰ DEV-PA-SS-01-04
+MS/MSD

STILL IN WOODS. SOME CULTURAL DEBRIS WIRE, PAINT ROLLER

10⁰⁰ DEV-PA-SS-01-05

~~ADAM~~ CULTURAL DEBRIS, TIES

LOTS OF QR ALONG RAILROAD TRACKS NO MEC/MD. CULTURAL DEBRIS, RAIL SPIKES, TIES, ETC. ETC.

11³⁰ OFF SITE

NO MEC/MD OR MUNITIONS RELATED ITEMS OBSERVED, NUMEROUS CULTURAL DEBRIS ITEMS, ESP. CLOSE TO TRACKS.

KMS

6/22 FORT DEVENS MRS 1

UTM NAD83 Conus 19N (m)

	E	N
DEV-PA-SS-01-01	287351.588	4714006.988
DEV-PA-SS-01-02	287347.138	4713909.344
DEV-PA-SS-01-03	28702.053	4713227.188
DEV-PA-SS-01-04	287054.950	4713151.762
DEV-PA-SS-01-05	287008.676	4713017.024
DEV-PA-SW-00-01	287283.872	4713828.441
DEV-PA-SD-01-01	287283.877	4713828.472

KMS

APPENDIX E – PHOTO DOCUMENTATION LOG

APPENDIX E – PHOTOGRAPHIC LOG

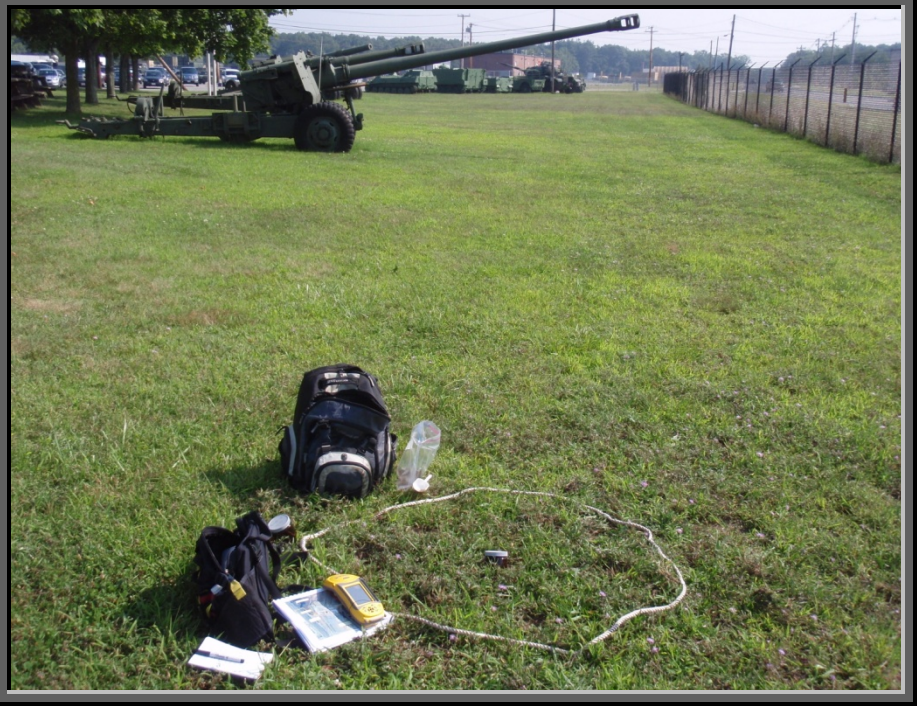
Project/Site: Fort Devens
Project No.: D01MA058701

Date	Photo ID	Description
4/18/2009	E.1	Conducting QR within MRS 1 – Massachusetts National Guard property.
4/18/2009	E.2	Sample DEV-MR1-SS-01-03. Taken within MRS 1, Mass National Guard property.
4/18/2009	E.3	Collecting surface soil sample DEV-MR1-SS-01-01, northwestern MRS 1.
4/18/2009	E.4	The area of the firing point, MRS 2 – 1000” Rifle and Machine Gun Range
4/18/2009	E.5	Collection of surface soil sample DEV-MR2-SS-01-05 at the firing point of the 1000” Rifle and Machine Gun Range.
4/18/2009	E.6	Wood remnants located in the MRS 2 – Training Area.
4/18/2009	E.7	Pond located in the training area, MRS 2.
4/18/2009	E.8	Former training area, MRS 2.
6/22/2010	E.9	PanAm Railroad property and small pond, MRS 1.
6/22/2010	E.10	Collection of surface soil sample DEV-PA-SS-01-04, MRS 1.

Fort Devens – Field Photographs

Site:	Fort Devens
Photographer:	B. Claus
Location of Photograph:	MRS 1 – WW1 Grenade Range
GPS Coordinates: (UTM Zone 19N)	N 4713726.17 E 287748.88
Direction of Photo:	West
Comments:	Conducting QR within MRS 1 – Massachusetts National Guard property.
Photograph No.:	E.1 Date: 08/18/09 Time: 09:27 AM

Site:	Fort Devens
Photographer:	T. Belanger
Location of Photograph:	MRS 1 – WWI Grenade Range
GPS Coordinates: (UTM Zone 19N)	N 4713662.07 E 287695.38
Direction of Photo:	East
Comments:	Sample DEV-MR1-SS-01-03. Taken within MRS 1, Mass National Guard property.
Photograph No.:	E.2 Date: 08/18/09 Time: 09:40 AM



Fort Devens – Field Photographs

Site:	Fort Devens
Photographer:	T. Belanger
Location of Photograph:	Northwest portion of MRS 1
GPS Coordinates: (UTM Zone 19N)	N 4713868.00 E 287401.03
Direction of Photo:	North
Comments:	Collecting surface soil sample DEV-MR1-SS-01-01, northwestern MRS 1.
Photograph No.:	E.3
Date:	08/18/09
Time:	10:33 AM

Site:	Fort Devens
Photographer:	T. Belanger
Location of Photograph:	MRS 2 – 1000” Rifle and Machine Gun Range
GPS Coordinates: (UTM Zone 19N)	N 4715530.94 E 286039.38
Direction of Photo:	North
Comments:	The area of the firing point, MRS 2 – 1000” Rifle and Machine Gun Range
Photograph No.:	E.4
Date:	08/19/09
Time:	10:45 AM

Fort Devens – Field Photographs

Site:	Fort Devens
Photographer:	T. Belanger
Location of Photograph:	MRS 2
GPS Coordinates: (UTM Zone 19N)	N 4715498.50 E 285989.27
Direction of Photo:	West
Comments:	Collection of surface soil sample DEV-MR2-SS-01-05 at the firing point of the 1000” Rifle and Machine Gun Range.
Photograph No.:	E.5 Date: 08/19/09 Time: 11:20 AM

Site:	Fort Devens
Photographer:	T. Belanger
Location of Photograph:	MRS 2
GPS Coordinates: (UTM Zone 19N)	N 4715634.13 E 286119.84
Direction of Photo:	West
Comments:	Wood remnants located in the MRS 2 – Training Area.
Photograph No.:	E.6 Date: 08/19/09 Time: 12:15 PM

Fort Devens – Field Photographs

Site: Fort Devens
Photographer: T. Belanger
Location of Photograph: MRS 2
GPS Coordinates: N 4715679.73 E 286289.08
(UTM Zone 19N)
Direction of Photo: East
Comments: Pond located in the training area, MRS 2.

Photograph No.: E.7 Date: 09/19/09 Time: 12:30 PM

Site: Fort Devens
Photographer: T. Belanger
Location of Photograph: MRS 2
GPS Coordinates: N 4715604.55 E 286178.57
(UTM Zone 19N)
Direction of Photo: South
Comments: Former training area, MRS 2.

Photograph No.: E.8 Date: 09/19/09 Time: 1:05 PM

Site:	Fort Devens
Photographer:	T. Belanger
Location of Photograph:	PanAm property at MRS 1
GPS Coordinates: (UTM Zone 19N)	N 4715567.75 E 286291.12
Direction of Photo:	West
Comments:	PanAm Railroad property and small pond, MRS 1.

Photograph No.: E.9 Date: 06/22/2010 Time: 10:35 AM

Site:	Fort Devens
Photographer:	T. Belanger
Location of Photograph:	PanAm property at MRS 1
GPS Coordinates: (UTM Zone 19N)	N 4715512.06 E 2862722.43
Direction of Photo:	North
Comments:	Collection of surface soil sample DEV-PA-SS-01-04, MRS 1.

Photograph No.: E.10 Date: 06/22/2010 Time: 12:05 PM

APPENDIX F – ANALYTICAL DATA

- Automated Data Review Library
- Automated Data Review EDDs
- EDMS
- Analytical Summary Reports
- Analytical Data Reports
- SEDD Deliverable

Located on CD.

APPENDIX G – ANALYTICAL DATA QUALITY ASSURANCE/ QUALITY CONTROL REPORT

- Validated Data from EDS
- USACE Memorandum for Record-CQAR of Quality Assurance Split Samples. (Split Samples not collected in accordance to CENAB direction.)
- Chemical Quality Data Assessment Report (CDQAR)

Located on CD.

APPENDIX H – GEOGRAPHIC INFORMATION SYSTEMS DATA

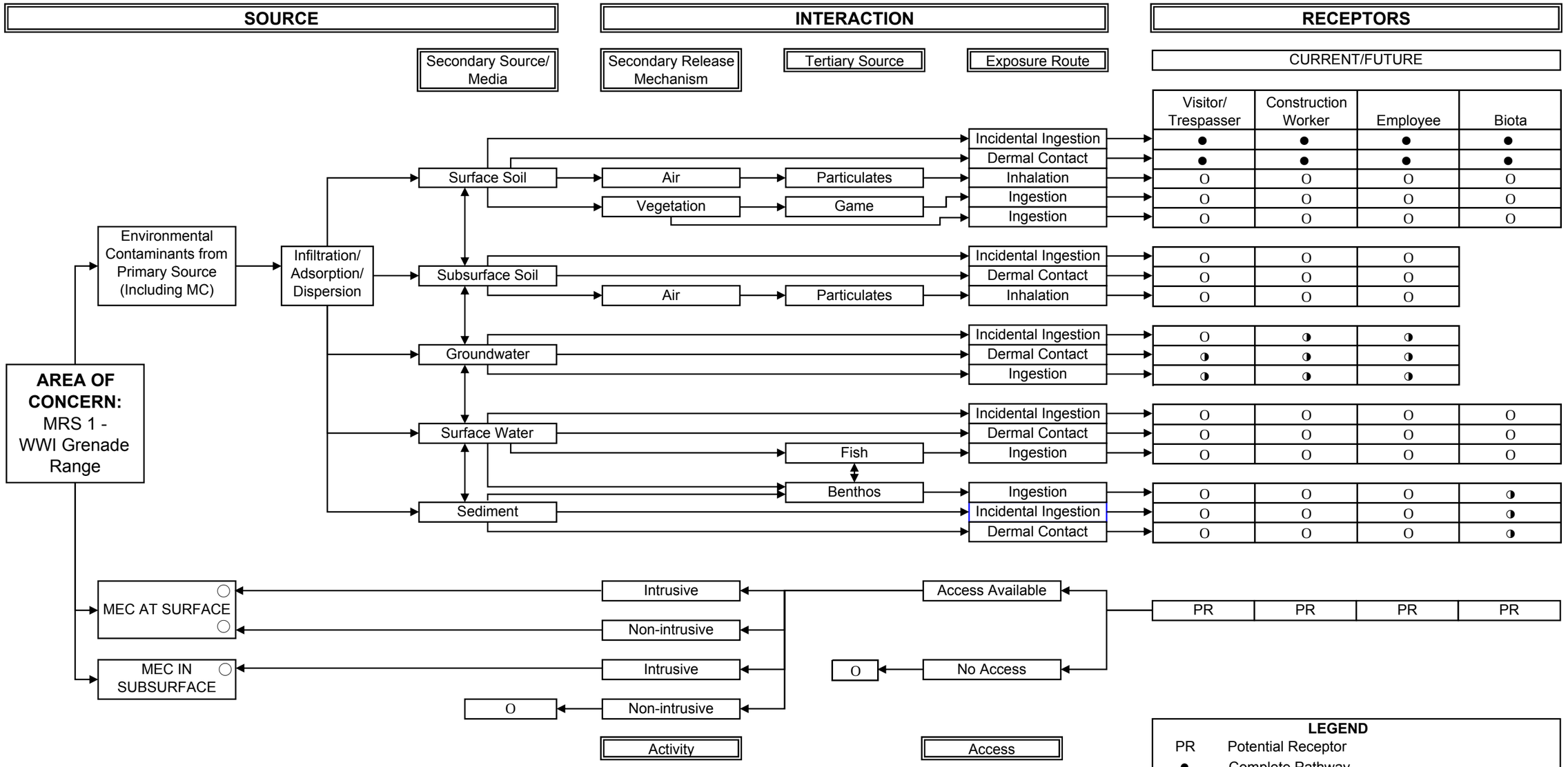
Located on CD.

APPENDIX I – GEOPHYSICAL DATA

Appendix not used.

APPENDIX J – CONCEPTUAL SITE MODEL

MRS 1 – WWI Grenade Range
MRS 2 – Range Complex No. 1



NOTES:

1. For the MMRP SI at Fort Devens, this CSM summarizes the potential risk exposure scenarios for MRS 1 - WWI Grenade Range. For a pathway to be complete, it must include a source, an exposure medium, an exposure route, and a receptor. A complete pathway may also include a release mechanism and a transport medium. Interaction between a potential receptor and MEC has two components: access and activity.

2. During the 2009 and 2010 SI field event, no MEC or MD was observed therefore the pathway for MEC is incomplete.

3. The surface soil pathway is complete since tetryl was detected in one surface soil sample. No explosive MC were detected in subsurface soil or surface water; therefore, the pathway is incomplete for these media. No explosive constituents were detected in groundwater or sediment; however, due to the failure of several explosive analytes to meet the MQO for sensitivity for the HHRA (groundwater) or SLERA (sediment), the groundwater human health receptor and sediment ecological receptor pathways remain potentially complete.

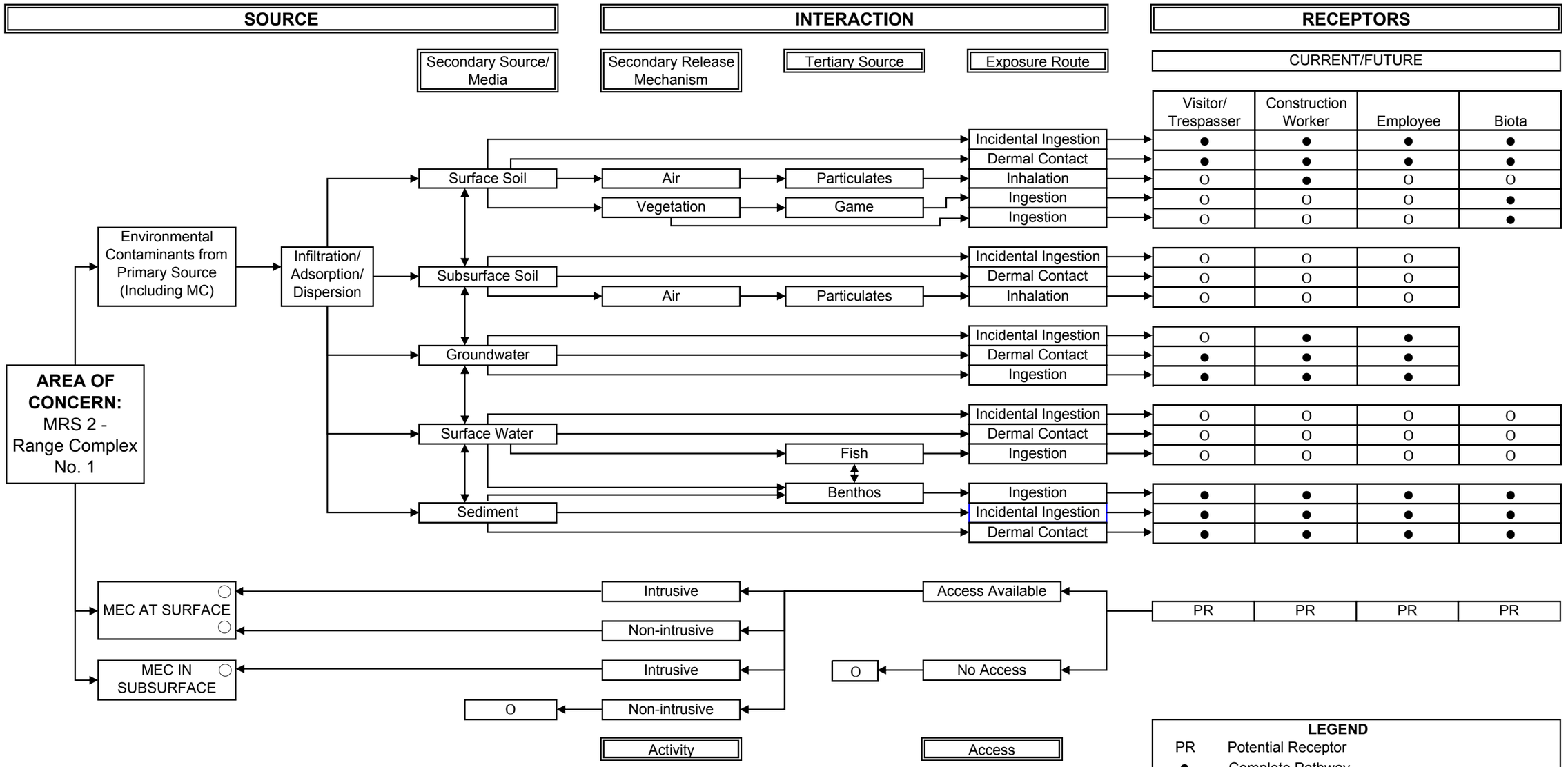
DIAGRAM OF THE INTEGRATED CONCEPTUAL SITE MODEL FOR

Fort Devens [1, 2 and 3]

MRS 1 - WWI Grenade Range

Revised January 2011 **Appendix J-1**

Source: U.S. Army Corps of Engineers (USACE). 2003. *Conceptual Site Models for Ordnance and Explosives (OE) and Hazardous, Toxic, and Radioactive Wastes (HTRW) Projects.* EM 1110-1-1200.



NOTES:

1. For the MMRP SI at Fort Devens, this CSM summarizes the potential risk exposure scenarios for MRS 2 - Range Complex No. 1. For a pathway to be complete, it must include a source, an exposure medium, an exposure route, and a receptor. A complete pathway may also include a release mechanism and a transport medium. Interaction between a potential receptor and MEC has two components: access and activity.

2. During the 2009 and 2010 SI field event, no MEC or MD was observed; therefore, the pathway for MEC is incomplete.

3. Due to detections of metals in surface soil and sediment that exceeded background concentrations, the pathway is complete for human and ecological receptors. In addition, groundwater is a complete pathway for humans based on the detection of perchlorate above background concentrations. The surface water pathway is incomplete for human and ecological receptors since no MCs were detected in this medium.

DIAGRAM OF THE INTEGRATED CONCEPTUAL SITE MODEL FOR

Fort Devens [1, 2 and 3]

MRS 2 - Range Complex No. 1

Revised January 2011 **Figure J-2**

Source: U.S. Army Corps of Engineers (USACE). 2003. *Conceptual Site Models for Ordnance and Explosives (OE) and Hazardous, Toxic, and Radioactive Wastes (HTRW) Projects.* EM 1110-1-1200.

APPENDIX K – MUNITIONS RESPONSE SITE PRIORITIZATION PROTOCOL RESULTS

- MRS 1 – WWI Grenade Range
- MRS 2 – Range Complex No. 1

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the MRS summary, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: MRS 1 - WWI Grenade Range

Component: U.S. Army

Installation/Property Name: FT DEVENS / FFID MA19799F936300

Location (City, County, State): Ayer, Worchester, and Middlesex Counties, Massachusetts

Site Name/Project Name (Project No.): FT DEVENS (RMIS D01MA058701R01) / D01MA058701

Date Information Entered/Updated: 11/8/2011 10:45:48 AM

Point of Contact (Name/Phone): Ellen Iorio (978-318-8433)

Project Phase (check only one):

☐ PA	■ SI	☐ RI	☐ FS	☐ RD
☐ RA-C	☐ RIP	☐ RA-O	☐ RC	☐ LTM

Media Evaluated (check all that apply):

■ Groundwater	■ Sediment (human receptor)
■ Surface soil	■ Surface Water (ecological receptor)
■ Sediment (ecological receptor)	■ Surface Water (human receptor)

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

MRS 1 - WWI Grenade Range comprises approximately 11.4 acres and was in use from 1918 until 1924 (USACE 2004a). The MRS 1 property was transferred to the Commonwealth of Massachusetts in 1956. Additional acreage was conveyed to the Boston and Main Railroad (now owned by PanAm Railways). MRS 1 was used as a training range for soldiers to practice throwing or shooting hand and rifle grenades. Potential munitions used at MRS 1 include practice hand grenades, live rifle grenades, and mortars. Refer to Paragraph 2.1.2 and Table 2-3 of the SI Report.

Per the direction of the Army QA panel, the HHE module score was revised to "No known or suspected MC hazard" to reflect the NDAI designation recommended for MRS 1 in the SI Report.

The MRSPP process was reviewed with stakeholders at the initial TPP meeting. The TPP #1 and #2 memorandums and a copy of the newspaper advertisement indicating the availability of the MRSPP are included in Appendix B of the Final SI Report.

Description of Pathways for Human and Ecological Receptors:

Surface soil, subsurface soil, sediment, surface water and groundwater were identified as media with potentially complete pathways for human and ecological receptors. Refer to the CSM (Appendix J) and Section 5.2.0.1 and 5.2.0.2.
Description of Receptors (Human and Ecological):
Visitor/Trespasser, Employee (Army National Guard and PanAm Railways), Biota

Table 1

EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms practice munitions, small arms ammunition, physical evidence, and historical evidence are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	◆ UXO that are considered likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). ◆ Hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazardard.	30
High explosive (used or damaged)	◆ UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive." ◆ DMM containing a high-explosive filler that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	25
Pyrotechnic (used or damaged)	◆ UXO containing a pyrotechnic fillers other than white phosphorous (e.g., flares, signals, simulators, smoke grenades). ◆ DMM containing pyrotechnic fillers other than white phosphorous (e.g., flares, signals, simulators, smoke grenades) that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	20
High explosive (unused)	◆ DMM containing a high explosive filler that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	15
Propellant	◆ UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	15
Bulk secondary high explosives, pyrothechnics, or propellant	◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	10
Pyrotechnic (not used or damaged)	◆ DMM containing a pyrotechnic fillers (i.e., red phosphorous), other than white phosphorous filler, that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	10
Practice	◆ UXO that are practice munitions that are not associated with a sensitive fuze. ◆ DMM that are practice munitions that are not associated with a sensitive fuze and that have not: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	5
Riot control	◆ UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ Used munitions or DMM that are categorized as small arms ammunition [Physical evidence or historical evidence that no other types of munitions (e.g., grenades, subcaliber training rockets, demolition charges) were used or are present on the MRS is required for selection of this category.].	2
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	(0)
MUNITIONS TYPE	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	(0)

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided.

Munitions debris, an end to a firing wire for a claymore mine (Anti-personnel mine M68), was found during the 1997 ASR site visit. No other historical reports of MEC or MD have been reported within MRS 1. No MEC or MD was observed during the 2009 and 2010 SI field events. Refer to Sections ES.8, 2.4.2.2, 2.4.3.2, 2.5.1, 3.3.1.2, 4.2.1.1, 4.2.1.2, and Table 2-1, 2-3, and 4-2 of the SI Report for more information concerning the types of munitions used at MRS 1.

TABLES 2 - 9 ARE INTENTIONALLY OMITTED ACCORDING TO ARMY GUIDANCE

Table 10
Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	0	0
Source of Hazard	Table 2		
Accessibility Factor Data Elements			
Location of Munitions	Table 3		0
Ease of Access	Table 4		
Status of Property	Table 5		
Receptor Factor Data Elements			
Population Density	Table 6		0
Population Near Hazard	Table 7		
Types of Activities/ Structures	Table 8		
Ecological and /or Cultural Resources	Table 9		
EHE MODULE TOTAL			*0*

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	***No Known or Suspected Explosive Hazard***

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond to **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms CWM/UXO, CWM/DMM, physical evidence, and historical evidence are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS is: ◆ CWM that are UXO (i.e., CWM/UXO). ◆ Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	◆ The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	◆ The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS is: ◆ Nonexplosively configured CWM/DMM either damaged or undamaged ◆ Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	◆ The CWM/DMM known or suspected of being present at the MRS is CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	12
CAIS (chemical agent identification sets)	◆ CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	10
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	(0)
CWM CONFIGURATION	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	(0)

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

Based on the ASR and ASR Supplement, there are no known or suspected CWM hazards used, stored, or disposed of at Fort Devens (USACE 1997, 2004a). Refer to Sections 2.4.0.1 and 2.4.2.2 of the SI Report.

TABLES 12 - 19 ARE INTENTIONALLY OMITTED ACCORDING TO ARMY GUIDANCE

Table 20
Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	0	0
Sources of CWM	Table 12		
Accessibility Factor Data Elements			
Location of CWM	Table 13		0
Ease of Access	Table 14		
Status of Property	Table 15		
Receptor Factor Data Elements			
Population Density	Table 16		0
Population Near Hazard	Table 17		
Types of Activities/ Structures	Table 18		
Ecological and /or Cultural Resources	Table 19		
CHE MODULE TOTAL			*0*

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	***No Known or Suspected CWM Hazard***

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the maximum concentrations of all contaminants in the MRS's groundwater and their comparison values (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the ratios for each contaminant by dividing the maximum concentration by the comparison value. Determine the CHF by adding the contaminant ratios together, including any additional groundwater contaminants recorded on Table 27. Based on the CHF, use the CHF Scale to determine and display the CHF Value. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

Note: Use dissolved, rather than total, metals analyses when both are available.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	*CHF* = [Maximum Concentration of Contaminant] / [Comparison Value for Contaminant]	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the groundwater is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in groundwater has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the groundwater to a potential point of exposure (possibly due to geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater receptors at the MRS.

Classification	Description	Value
Identified	There is a threatened water supply well downgradient of the source and the groundwater is a current source of drinking water or source of water for other beneficial uses such as irrigation/agriculture (equivalent to Class I or IIA aquifer).	H
Potential	There is no threatened water supply well downgradient of the source and the groundwater is currently or potentially usable for drinking water, irrigation, or agriculture (equivalent to Class I, IIA, or IIB aquifer).	M
Limited	There is no potentially threatened water supply well downgradient of the source and the groundwater is not considered a potential source of drinking water and is of limited beneficial use (equivalent to Class IIIA or IIIB aquifer, or where perched aquifer exists only).	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Groundwater MC Hazard ■

Table 21 Comments: One groundwater sample (DEV-FU-GW-00-01) was collected from a pre-existing well located east of MRS 1. The groundwater sample was analyzed for tetryl and TNT and TNT breakdown products. No analytes were detected in groundwater at MRS 1. Refer to CSM and Tables 5-3 and 6-1 in the SI Report.

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the maximum concentrations of all contaminants in the MRS's surface water and their comparison values (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the ratios for each contaminant by dividing the maximum concentration by the comparison value. Determine the CHF by adding the contaminant ratios together, including any additional surface water contaminants recorded on Table 27. Based on the CHF, use the CHF Scale to determine and record the CHF Value. If there is no known or suspected MC hazard for human endpoints present in the surface water, select the box at the bottom of the table.

Note: Use dissolved, rather than total, metals analyses when both are available.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	*CHF* = [Maximum Concentration of Contaminant] / [Comparison Value for Contaminant]	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Human Endpoint) MC Hazard ■

Table 22 Comments: One surface water sample (DEV-PA-SW-00-01) and one duplicate sample were collected from a small retention pond near the railroad tracks at MRS 1. The surface water sample was analyzed for NG, tetryl, TNT and TNT breakdown products. No analytes were detected in surface water at MRS 1. Refer CSM, Table 5-4, Table 6-1 and Figure 3-1b of the SI Report for further information.

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the maximum concentrations of all contaminants in the MRS's sediment and their comparison values (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the ratios for each contaminant by dividing the maximum concentration by the comparison value. Determine the CHF by adding the contaminant ratios together, including any additional sediment contaminants recorded on Table 27. Based on the CHF, use the CHF Scale to determine and record the CHF Value. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	*CHF* =	[Maximum Concentration of Contaminant] / [Comparison Value for Contaminant]
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Sediment (Human Endpoint) MC Hazard ■

Table 23 Comments: One sediment sample (DEV-PA-SD-00-01) and one duplicate sample were collected from a small pond located near the railroad tracks in MRS 1. The sediment sample was analyzed for NG, tetryl and TNT and TNT breakdown products. No analytes were detected in sediment at MRS 1. Refer to the CSM, Table 5-2, Table 6-1 and Figure 3-1b in the SI Report for further information.

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the maximum concentrations of all contaminants in the MRS's surface water and their comparison values (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the ratios for each contaminant by dividing the maximum concentration by the comparison value. Determine the CHF by adding the contaminant ratios together, including any additional surface water contaminants recorded on Table 27. Based on the CHF, use the CHF Scale to determine and record the CHF Value. If there is no known or suspected MC hazard with ecological endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	*CHF* =	[Maximum Concentration of Contaminant] / [Comparison Value for Contaminant]
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Ecological Endpoint) MC Hazard ■

Table 24 Comments: One surface water sample (DEV-PA-SW-00-01) and one duplicate sample were collected from a small retention pond near the railroad tracks at MRS 1. The surface water sample was analyzed for NG, tetryl, TNT and TNT breakdown products. No analytes were detected in surface water at MRS 1. Refer CSM, Table 5-4, Table 6-1 and Figure 3-1b of the SI Report for further information.

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the maximum concentrations of all contaminants in the MRS's sediment and their comparison values (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the ratios for each contaminant by dividing the maximum concentration by the comparison value. Determine the CHF by adding the ratios together, including any additional sediment contaminants recorded on Table 27. Based on the CHF, use the CHF Scale to determine and record the CHF Value. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	*CHF* = [Maximum Concentration of Contaminant] / [Comparison Value for Contaminant]	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Sediment (Ecological Endpoint) MC Hazard ■

Table 25 Comments: One sediment sample (DEV-PA-SD-00-01) and one duplicate sample were collected from a small pond located near the railroad tracks in MRS 1. The sediment sample was analyzed for NG, tetryl and TNT and TNT breakdown products. No analytes were detected in sediment at MRS 1. Refer to the CSM, Table 5-2, Table 6-1 and Figure 3-1b in the SI Report for further information.

Table 26
HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the maximum concentrations of all contaminants in the MRS's surface soil and their comparison values (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the ratios for each contaminant by dividing the maximum concentration by the comparison value. Determine the CHF by adding the contaminant ratios together, including any additional surface soil contaminants recorded on Table 27. Based on the CHF, use the CHF Scale to determine and record the CHF Value. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios
Tetryl	0.6	240	mg/Kg	0.0025

CHF Scale	CHF Value	Sum The Ratios	0.0025
CHF > 100	H (High)	*CHF* = [Maximum Concentration of Contaminant] / [Comparison Value for Contaminant]	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	(L)

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface soil is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface soil has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface soil to a potential point of exposure (possibly due to presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	(L)

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface soil to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface soil to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface soil to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	(L)
	No Known or Suspected Surface Soil MC Hazard	■

Table 26 Comments: Nine surface soil samples and two duplicate samples were collected within MRS 1 (DEV-MR1-SS-01-01, DEV-MR1-SS-01-02, DEV-MR1-SS-01-03, DEV-MR1-SS-01-04, DEV-MR1-SS-01-04P, DEV-PA-SS-01-01, DEV-PA-SS-01-02, DEV-PA-SS-01-03, DEV-PA-SS-01-04, DEV-PA-SS-01-05 and DEV-PA-SS-DUP1) and were analyzed for tetryl and TNT and TNT breakdown products. Some samples were also analyzed for NG. Tetryl was dectected in one site surface soil sample (DEV-PA-SS-01-05) at MRS 1. Refer to CSM, Figure 3-1a, Figure 3-1b and Tables 5-1, 5-5, 5-6, and 6-1 in the SI report. Because the detection was not above the screening level, the MC does not pose a threat to receptors and the alternative MRS rating of No Known or Suspected Hazard applies.

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

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

Note: Dissolved, rather than total, metals analyses are used when both are available.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio

Table 28
Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the Contaminant Hazard, Migration Pathway, and Receptor Factors for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the Three-Letter Combination boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the HHE Ratings provided below, determine each media's rating (A-G) and record the letter in the corresponding Media Rating box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)					
Surface Water/Human Endpoint (Table 22)					
Sediment/Human Endpoint (Table 23)					
Surface Water/Ecological Endpoint (Table 24)					
Sediment/Ecological Endpoint (Table 25)					
Surface Soil (Table 26)	L	L	L	LLL	G

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the HHE Module Rating box.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING	***No Known or Suspected MC Hazard***

HHE Ratings (for reference only)	
Combination	**Rating**
HHH	A
HHM	B
HHL	C
HMM	C
HML	D
MMM	D
HLL	E
MML	E
MLL	F
LLL	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter rating for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical priority for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the MRS Prioriy or Alternative MRS Rating at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	C	4
D	5	E	5	D	5
E	6	F	6	E	6
F	7	G	7	F	7
G	8			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		*No Known or Suspected CWM Hazard*		*No Known or Suspected MC Hazard*	
MRS PRIORITY or ALTERNATIVE MRS RATING				*No Known Or Suspected Hazard*	

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the MRS summary, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: MRS 2 - Range Complex No. 1

Component: U.S. Army

Installation/Property Name: FT DEVENS / FFID MA19799F936300

Location (City, County, State): Ayer, Worchester and Middlesex Counties, Massachusetts

Site Name/Project Name (Project No.): FT DEVENS (RMIS D01MA058701R02) / D01MA058701

Date Information Entered/Updated: 11/8/2011 11:00:16 AM

Point of Contact (Name/Phone): Ellen Iorio (978-318-8433)

Project Phase (check only one):

☐ PA	■ SI	☐ RI	☐ FS	☐ RD
☐ RA-C	☐ RIP	☐ RA-O	☐ RC	☐ LTM

Media Evaluated (check all that apply):

■ Groundwater	■ Sediment (human receptor)
■ Surface soil	■ Surface Water (ecological receptor)
■ Sediment (ecological receptor)	■ Surface Water (human receptor)

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

MRS 2 - Range Complex No. 1 comprises approximately 144 acres and was in use from 1942 until 1961 (USACE 2004). The MRS 2 property was transferred to the Town of Ayer in 1978. Range Complex No. 1 included three subranges: 1000" Rifle and Machine Gun Range, 1000" Anti-Tank Range (sub-caliber munitions only), and Training Area. Potential munitions used at MRS 2 included small arms, simulators, smoke grenades, and flares. Refer to Paragraph 2.1.3 and Table 2-3 of the SI Report.

Per the direction of the Army QA panel, the HHE module score was revised to "no known or suspected hazard" to reflect the NDAI designation recommended for MRS 2 in the SI Report.

The MRSPP process was reviewed with stakeholders at the initial TPP meeting. The TPP #1 and #2 memorandums and a copy of the newspaper advertisement indicating the availability of the MRSPP are included in Appendix B of the Final SI Report.

Description of Pathways for Human and Ecological Receptors:

Surface soil, sediment, surface water, and groundwater were identified as media with potentially complete pathways for human and ecological receptors. Refer to the CSM (Appendix J) and Section 5.2.0.1 and 5.2.0.2.
Description of Receptors (Human and Ecological):
Visitor/Trespasser, Employee (Town of Ayer), Biota

Table 1

EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms practice munitions, small arms ammunition, physical evidence, and historical evidence are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	◆ UXO that are considered likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). ◆ Hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazardard.	30
High explosive (used or damaged)	◆ UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive." ◆ DMM containing a high-explosive filler that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	25
Pyrotechnic (used or damaged)	◆ UXO containing a pyrotechnic fillers other than white phosphorous (e.g., flares, signals, simulators, smoke grenades). ◆ DMM containing pyrotechnic fillers other than white phosphorous (e.g., flares, signals, simulators, smoke grenades) that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	20
High explosive (unused)	◆ DMM containing a high explosive filler that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	15
Propellant	◆ UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	15
Bulk secondary high explosives, pyrothechnics, or propellant	◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	10
Pyrotechnic (not used or damaged)	◆ DMM containing a pyrotechnic fillers (i.e., red phosphorous), other than white phosphorous filler, that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	10
Practice	◆ UXO that are practice munitions that are not associated with a sensitive fuze. ◆ DMM that are practice munitions that are not associated with a sensitive fuze and that have not: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	5
Riot control	◆ UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ Used munitions or DMM that are categorized as small arms ammunition [Physical evidence or historical evidence that no other types of munitions (e.g., grenades, subcaliber training rockets, demolition charges) were used or are present on the MRS is required for selection of this category.].	2
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	(0)
MUNITIONS TYPE	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	(0)

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided.

No MEC or MD has been found historically inside the MRS. No MEC was found during the 2009 Alion SI; however, one expended 7.62 mm shell casing (MD) was found. Munitions used at the 1000" Rifle and Machine Gun Range and the Anti -Tank Range were small arms. Small arms projectiles and expended shell casings do not pose an explosive hazard. Other munitions were used at the Training Area. Refer to Sections ES.8, 2.4.2.2, 2.4.3.2, 2.5.1, 3.3.1.2, 4.2.2.1, 4.2.2.2 and Table 2-1, 2-2, and 4-3 of the SI Report for more information concerning the types of munitions used at MRS 2.

TABLES 2 - 9 ARE INTENTIONALLY OMITTED ACCORDING TO ARMY GUIDANCE

Table 10
Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	0	0
Source of Hazard	Table 2		
Accessibility Factor Data Elements			
Location of Munitions	Table 3		0
Ease of Access	Table 4		
Status of Property	Table 5		
Receptor Factor Data Elements			
Population Density	Table 6		0
Population Near Hazard	Table 7		
Types of Activities/ Structures	Table 8		
Ecological and /or Cultural Resources	Table 9		
EHE MODULE TOTAL			*0*

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	***No Known or Suspected Explosive Hazard***

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond to **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms CWM/UXO, CWM/DMM, physical evidence, and historical evidence are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS is: ◆ CWM that are UXO (i.e., CWM/UXO). ◆ Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	◆ The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	◆ The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS is: ◆ Nonexplosively configured CWM/DMM either damaged or undamaged ◆ Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	◆ The CWM/DMM known or suspected of being present at the MRS is CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	12
CAIS (chemical agent identification sets)	◆ CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	10
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	(0)
CWM CONFIGURATION	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	(0)

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

Based on the ASR and ASR Supplement, there are no known or suspected CWM hazards used, stored, or disposed of at Fort Devens (USACE 1997, 2004a). Refer to Sections 2.4.0.1 and 2.4.2.2 of the SI Report.

TABLES 12 - 19 ARE INTENTIONALLY OMITTED ACCORDING TO ARMY GUIDANCE

Table 20
Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	0	0
Sources of CWM	Table 12		
Accessibility Factor Data Elements			
Location of CWM	Table 13		0
Ease of Access	Table 14		
Status of Property	Table 15		
Receptor Factor Data Elements			
Population Density	Table 16		0
Population Near Hazard	Table 17		
Types of Activities/ Structures	Table 18		
Ecological and /or Cultural Resources	Table 19		
CHE MODULE TOTAL			*0*

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	***No Known or Suspected CWM Hazard***

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the maximum concentrations of all contaminants in the MRS's groundwater and their comparison values (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the ratios for each contaminant by dividing the maximum concentration by the comparison value. Determine the CHF by adding the contaminant ratios together, including any additional groundwater contaminants recorded on Table 27. Based on the CHF, use the CHF Scale to determine and display the CHF Value. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

Note: Use dissolved, rather than total, metals analyses when both are available.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios
Potassium perchlorate	0.034	25	ug/L	0.0014

CHF Scale	CHF Value	Sum The Ratios	0.0014
CHF > 100	H (High)	*CHF* = [Maximum Concentration of Contaminant] / [Comparison Value for Contaminant]	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	*L*

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the groundwater is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in groundwater has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the groundwater to a potential point of exposure (possibly due to geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	*M*

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater receptors at the MRS.

Classification	Description	Value
Identified	There is a threatened water supply well downgradient of the source and the groundwater is a current source of drinking water or source of water for other beneficial uses such as irrigation/agriculture (equivalent to Class I or IIA aquifer).	H
Potential	There is no threatened water supply well downgradient of the source and the groundwater is currently or potentially usable for drinking water, irrigation, or agriculture (equivalent to Class I, IIA, or IIB aquifer).	M
Limited	There is no potentially threatened water supply well downgradient of the source and the groundwater is not considered a potential source of drinking water and is of limited beneficial use (equivalent to Class IIIA or IIIB aquifer, or where perched aquifer exists only).	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	*L*

No Known or Suspected Groundwater MC Hazard ☐

Table 21 Comments: One groundwater sample and one duplicate sample (DEV-FU-GW-00-02 and DEV-FU-GW-00-02P) were collected from a preexisting well located on the northern boundary of MRS 2. The groundwater sample was analyzed for DNT and DNT breakdown products, NG, and perchlorate. Analytical results report non-detect for the explosive compounds. Perchlorate concentrations in both samples was 0.03 ug/L. These concentrations are far below the MRSPP screening value of 25 ug/L and within the range of the background sample concentration (0.02 ug/L). Refer to the CSM, Sections 5.1.3.4, 5.1.3.5, 5.1.3.7, 5.1.4.4, 5.3.0.4, 5.5.3 and Tables 5-3 and 5-9 in the SI Report.

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the maximum concentrations of all contaminants in the MRS's surface water and their comparison values (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the ratios for each contaminant by dividing the maximum concentration by the comparison value. Determine the CHF by adding the contaminant ratios together, including any additional surface water contaminants recorded on Table 27. Based on the CHF, use the CHF Scale to determine and record the CHF Value. If there is no known or suspected MC hazard for human endpoints present in the surface water, select the box at the bottom of the table.

Note: Use dissolved, rather than total, metals analyses when both are available.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios
CHF > 100	H (High)	$CHF = \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$
100 > CHF > 2	M (Medium)	
2 > CHF	L (Low)	

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to geological structures or physical controls).	L

MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L

RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Human Endpoint) MC Hazard ■

Table 22 Comments: Two surface water samples and one duplicate sample were collected within MRS 2 (DEV-MR2-SW-00-01, DEV-MR2-SW-00-02, DEV-MR2-SW-00-02P). Samples were analyzed for DNT and DNT breakdown products, NG, and perchlorate. No analytes were detected in surface water at MRS 2. Refer to Sections 2.3.6.2, 5.2.0.2, 5.5.4, Figure 2-3, and Tables 5-4, 5-10 and 6-1 of the SI Report for further information.

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the maximum concentrations of all contaminants in the MRS's sediment and their comparison values (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the ratios for each contaminant by dividing the maximum concentration by the comparison value. Determine the CHF by adding the contaminant ratios together, including any additional sediment contaminants recorded on Table 27. Based on the CHF, use the CHF Scale to determine and record the CHF Value. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios
Lead	48	400	mg/Kg	0.12
Copper	13	3100	mg/Kg	0.0042

CHF Scale	CHF Value	Sum The Ratios	0.12
CHF > 100	H (High)		
100 > CHF > 2	M (Medium)	*CHF* = [Maximum Concentration of Contaminant] / [Comparison Value for Contaminant]	
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	(L)

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	(L)

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	(L)

No Known or Suspected Sediment (Human Endpoint) MC Hazard ☐

Table 23 Comments: Two sediment samples and one duplicate sample were collected within water bodies inside MRS 2. The samples were analyzed for a reduced list of metals and explosive constituents. Analytes and their associated samples that exceeded site maximum background concentrations include: copper – Sample DEV-MR2-SD-01-02 and lead - DEV-MR2-SD-01-03. No explosive constituents were detected in any of the sediment samples collected at MRS 2. Refer to Sections 5.1.3.8, 5.1.4.2, 5.1.4.3, 5.3.0.1, 5.3.0.3, 5.5.2, 6.2.0.4, and Tables 5-2, 5-8, and 6-1 in the SI Report.

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the maximum concentrations of all contaminants in the MRS's surface water and their comparison values (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the ratios for each contaminant by dividing the maximum concentration by the comparison value. Determine the CHF by adding the contaminant ratios together, including any additional surface water contaminants recorded on Table 27. Based on the CHF, use the CHF Scale to determine and record the CHF Value. If there is no known or suspected MC hazard with ecological endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	*CHF* =	[Maximum Concentration of Contaminant] / [Comparison Value for Contaminant]
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Ecological Endpoint) MC Hazard ◉

Table 24 Comments: Two surface water samples and one duplicate sample were collected within MRS 2 (DEV-MR2-SW-00-01, DEV-MR2-SW-00-02, DEV-MR2-SW-00-02P). Samples were analyzed for DNT and DNT breakdown products, NG, and perchlorate. No analytes were detected in surface water at MRS 2. Refer to Sections 2.3.6.2, 5.2.0.2, 5.5.4, Figure 2-3, and Tables 5-4, 5-10 and 6-1 of the SI Report for further information.

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the maximum concentrations of all contaminants in the MRS's sediment and their comparison values (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the ratios for each contaminant by dividing the maximum concentration by the comparison value. Determine the CHF by adding the ratios together, including any additional sediment contaminants recorded on Table 27. Based on the CHF, use the CHF Scale to determine and record the CHF Value. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios
Lead	48	35.8	mg/Kg	1.3
Copper	13	31.6	mg/Kg	0.41

CHF Scale	CHF Value	Sum The Ratios	1.8
CHF > 100	H (High)		
100 > CHF > 2	M (Medium)	*CHF* = [Maximum Concentration of Contaminant] / [Comparison Value for Contaminant]	
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	(L)

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	(L)

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	(L)

No Known or Suspected Sediment (Ecological Endpoint) MC Hazard ☐

Table 25 Comments: Two sediment samples and one duplicate sample were collected within water bodies inside MRS 2. The samples were analyzed for a reduced list of metals and explosive constituents. Analytes and their associated samples that exceeded site maximum background concentrations include: copper – Sample DEV-MR2-SD-01-02 and lead - DEV-MR2-SD-01-03. No explosive constituents were detected in any of the sediment samples collected at MRS 2. Refer to Sections 5.1.3.8, 5.1.4.2, 5.1.4.3, 5.3.0.1, 5.3.0.3, 5.5.2, 6.2.0.4, and Tables 5-2, 5-8, and 6-1 in the SI Report. Refer to Section 2.3.8.1.1 and Table 2-4 the SI Report.

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the maximum concentrations of all contaminants in the MRS's surface soil and their comparison values (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the ratios for each contaminant by dividing the maximum concentration by the comparison value. Determine the CHF by adding the contaminant ratios together, including any additional surface soil contaminants recorded on Table 27. Based on the CHF, use the CHF Scale to determine and record the CHF Value. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios
Iron	10000	23000	mg/Kg	0.43
Aluminum	9300	76000	mg/Kg	0.12
Nickel	14	1600	mg/Kg	0.0088

CHF Scale	CHF Value	Sum The Ratios	0.57
CHF > 100	H (High)	*CHF* = [Maximum Concentration of Contaminant] / [Comparison Value for Contaminant]	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	(L)

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface soil is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface soil has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface soil to a potential point of exposure (possibly due to presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	(M)

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface soil to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface soil to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface soil to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	(L)
	No Known or Suspected Surface Soil MC Hazard	☐

Table 26 Comments: Four surface soil samples and one duplicate were collected within MRS 2 and were analyzed for a reduced list of metals and explosive constituents. Analytes and their associated samples that exceeded site maximum background concentrations include: aluminum and nickel – Sample DEV-MR2-SS-01-07, iron and magnesium - DEV-MR2-SS-01-06. No explosive constituents were detected in any of the soil samples collected at MRS 2. Note - The MRSPP does not provide a human health comparison value for magnesium (Appendix B-1, MRSPP Primer, OEM 2007). Refer to Sections 5.1.4.2, 5.1.4.6, 5.3.0.2, 5.5.0.1, 5.5.1.1, 5.5.1.3, 5.5.1.4, 5.5.1.5, 5.5.1.6, 6.2 and Tables 5-1, 5-5, 5-7, and 6-1 in the SI Report.

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

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

Note: Dissolved, rather than total, metals analyses are used when both are available.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio

Table 28
Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the Contaminant Hazard, Migration Pathway, and Receptor Factors for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the Three-Letter Combination boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the HHE Ratings provided below, determine each media's rating (A-G) and record the letter in the corresponding Media Rating box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)	L	M	L	MLL	F
Surface Water/Human Endpoint (Table 22)					
Sediment/Human Endpoint (Table 23)	L	L	L	LLL	G
Surface Water/Ecological Endpoint (Table 24)					
Sediment/Ecological Endpoint (Table 25)	L	L	L	LLL	G
Surface Soil (Table 26)	L	M	L	MLL	F

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the HHE Module Rating box.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING	***No Known or Suspected MC Hazard***

HHE Ratings (for reference only)	
Combination	**Rating**
HHH	A
HHM	B
HHL	C
HMM	C
HML	D
MMM	D
HLL	E
MML	E
MLL	F
LLL	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter rating for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical priority for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the MRS Prioriy or Alternative MRS Rating at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	C	4
D	5	E	5	D	5
E	6	F	6	E	6
F	7	G	7	F	7
G	8			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		*No Known or Suspected CWM Hazard*		*No Known or Suspected MC Hazard*	
MRS PRIORITY or ALTERNATIVE MRS RATING				*No Known Or Suspected Hazard*	

APPENDIX L – REFERENCE COPIES

Located on CD.

Response to Stakeholder Comments on the Site Inspection Report for Fort Devens, Ayer, MA

DERP FUDS Project No. **D01MA058701**

U.S. Army Engineering and Support Center, Huntsville
4280 University Square
Huntsville, AL 35807

U.S. Army Corps of Engineers, Baltimore District
City Crescent Building
10 S. Howard St. 10th Floor
Baltimore, MD 21201

U.S. Army Corps of Engineers, New England District
696 Virginia Road
Concord, Massachusetts 01742-2751

December 2011

PROJECT: FORT DEVENS MMRP SITE INSPECTION (SI) D01MA058701			
REVIEW COMMENTS			
		REVIEW: DRAFT FINAL SI REPORT DATE: 02 April 2011 NAME: Joanne Dearden (MassDEP)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
1.	General	No Comment.	No action required

PROJECT: FORT DEVENS MMRP SITE INSPECTION (SI) D01MA058701			
REVIEW COMMENTS			
		REVIEW: DRAFT FINAL SI REPORT DATE: 07 April 2011 NAME: Nancy Smith (USEPA)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
1.	General	No Comment.	No action required

PROJECT: FORT DEVENS MMRP SITE INSPECTION (SI) D01MA058701			
REVIEW COMMENTS			
		REVIEW: DRAFT FINAL SI REPORT DATE: 24 March 2011 NAME: Ron Ostrowski (Mass Development)	
ITEM	DRAWING NO OR REFERENCE	COMMENT	ACTION
1.	General	No Comment.	No action required

ACTION CODES: A-ACCEPTED/CONCUR; D-ACTION DEFERRED; W-WITHDRAWN; N-NON-CONCUR; V-VE POTENTIAL/VEP ATTACHED