FINAL

Site Inspection Report for Assateague Island

DERP FUDS Project No. **C03MD093001**

Prepared Under: **Contract No. W912DY-04-D-0017**
Task Order # 00170001

Prepared for:
U.S. Army Engineering and Support Center, Huntsville
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Huntsville, AL 35807
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U.S. Army Corps of Engineers, Baltimore District
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September 2007

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ALION
SCIENCE AND TECHNOLOGY

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September 2007

CONTRACTOR STATEMENT OF AUTHORSHIP AND INDEPENDENT TECHNICAL REVIEW

Alion Science and Technology Corporation has prepared this Final Site Inspection Report for Assateague Island, Formerly Used Defense Site (FUDS), Project No. C03MD093001. An independent technical review has been 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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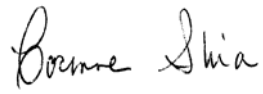
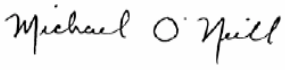
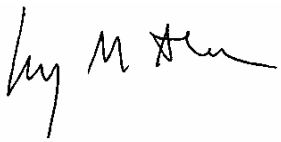
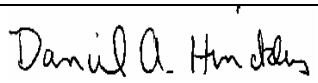
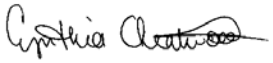
Corinne Shia Deputy Program Manager Alion Science and Technology Corporation	9/26/07	
Mike O'Neill Project Manager EA Engineering, Science, and Technology, Inc. (Under contract to Alion Science and Technology Corporation)	9/26/07	
Ivy Able Task Leader EA Engineering, Science, and Technology, Inc. (Under contract to Alion Science and Technology Corporation)	9/26/07	
Daniel Hinckley, PhD Ecological Risk Assessor EA Engineering, Science, and Technology, Inc. (Under contract to Alion Science and Technology Corporation)	9/26/07	
Cynthia Cheatwood Human Health Risk Assessor EA Engineering, Science, and Technology, Inc. (Under contract to Alion Science and Technology Corporation)	9/26/07	
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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
ASR	Archive Search Report
bgs	Below Ground Surface
$CaCO_3$	Calcium Carbonate
CENAB	Corps of Engineers North Atlantic Baltimore
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPC	Chemicals of Potential Concern
COPEC	Chemicals of Potential Ecological Concern
CSM	Conceptual Site Model
DERP	Defense Environmental Restoration Program
DMM	Discarded Military Munitions
DNR	Department of Natural Resources
DNT	Dinitrotoluene
DoD	Department of Defense
DQI	Data Quality Indicator
DQO	Data Quality Objective
EA	EA Engineering, Science, and Technology, Inc.
EDS	Environmental Data Services, Inc.
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
°F	Degrees Fahrenheit
ft	Foot or Feet
FUDS	Formerly Used Defense Site(s)
GPL	General Physics Laboratories
GPS	Global Positioning System

LIST OF ACRONYMS AND ABBREVIATIONS

HQ	Hazard Quotient
HRS	Hazard Ranking System
HTRW	Hazardous Toxic and Radiological Waste
INPR	Inventory Project Report
km^2	Square Kilometer(s)
LLLP	Limited Liability, Limited Partnership
MC	Munitions Constituents
MD	Munitions Debris
MDL	Method Detection Limit
MEC	Munitions and Explosives of Concern
mg/L	Milligram(s) Per Liter
mi^2	Square Mile(s)
MK	Mark
mm	Millimeter(s)
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDAI	No Department of Defense Action Indicated
NG	Nitroglycerin
NPS	National Park Service
NTCRA	Non-Time Critical Removal Action
OEW	Ordnance and Explosive Waste
PA	Preliminary Assessment
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability

LIST OF ACRONYMS AND ABBREVIATIONS

PWP	Programmatic Work Plan for Formerly Used Defense Sites FUDS) Military Munitions Response Program (MMRP) Site Inspections at Multiple Sites in the Northeast Region
QA/QC	Quality Assurance/ Quality Control
QSM	Quality Systems Manual
RAC	Risk Assessment Code
RBC	Risk-Based Concentration
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
RI/FS	Remedial Investigation /Feasibility Study
SI	Site Inspection
SLERA	Screening-Level Ecological Risk Assessment
SS-WP	Final Site-Specific Work Plan Addendum to the MMRP Programmatic Work Plan for the Site Inspection of Assateague Island
TCRA	Time Critical Removal Action
tetryl	2,4,6-Trinitrophenyl-n-methylnitramine
TNT	Trinitrotoluene
TPP	Technical Project Planning
U.S.	United States
USACE	U.S. Army Corps of Engineers
USAESCH	U.S. Army Engineering and Support Center, Huntsville
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
UXO	Unexploded Ordnance
WWII	World War II
µg/L	Microgram(s) Per Liter

GLOSSARY OF TERMS

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)—Also known as "Superfund," this congressionally enacted legislation provides the methodology for the removal of hazardous substances resultant from past / former operations. Response actions must be performed in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (United States Army Corps of Engineers [USACE] 2003).

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 USC2710(e)(2)) (DoA 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 (DoA 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 (DoA 2005).

Formerly Used Defense Site (FUDS)—Locations that were owned by, leased to, or otherwise possessed by the Department of Defense (DoD) are considered FUDS. A FUDS is eligible for the Military Munitions Response Program if the release occurred prior to October 17, 1986; the property was transferred from DoD control prior to October 17, 1986; and the property or project meets other FUDS eligibility criteria. The FUDS Program focuses on compliance and cleanup efforts at FUDS (USACE 2004a).

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 munitions constituents (MC). The DoD adopted the MRSPP under the authority of 10 USC 2710(b). Provisions of 10 USC 2710(b) require that the Department assign to each defense site in the inventory required by 10 USC 2710(a) 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 (710 FR 58016).

GLOSSARY OF TERMS

Military Munitions—Military munitions means all ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the Department of Defense, the Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives, and chemical warfare agents; chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, 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 all required sanitization operations under the Atomic Energy Act of 1954 (42 USC 2011 et seq.) have been completed. (10 U.S.C 101(e)(4)(A) through (C)) (DoA 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) Discarded military munitions (DMM), as defined in 10 USC 2710(e)(2); or (C) Munitions constituents (e.g., TNT, RDX), as defined in 10 USC 2710(e)(3), present in high enough concentrations to pose an explosive hazard (DoA 2005).

Munitions Constituents (MC)—Any materials originating from unexploded ordnance (UXO), discarded military munitions (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)) (DoA 2005).

Munitions Debris (MD)—Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal (DoA 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 CFR 179.3).

Munitions Response Site (MRS) —A discrete location within an MRA 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 October 5, 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 (710 FR 58016).

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 2000).

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)) (DoA 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)) (DoA 2005).

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 2004a).

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 six months to reduce risk to public health or the environment (DoA 2005).

Unexploded Ordnance (UXO)—Military munitions that (A) have been primed, fused, 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 U.S.C 101(e)(5)(A) through (C)) (DoA 2005).

EXECUTIVE SUMMARY

ES.1 Under contract with the United States Army Corps of Engineers (USACE), Alion Science and Technology Corporation (Alion) prepared the following Site Inspection (SI) Report to document SI activities and findings for the Assateague Island Formerly Used Defense Site (FUDS), Property No. C03MD0930. The Department of Defense (DoD) has 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 FUDS. This SI is completed under MMRP project No. C03MD093001 and addresses potential MMRP hazards remaining at the Assateague Island FUDS.

ES.2 **SI Objectives and Scope**. The primary objective of the MMRP SI is to determine whether or not the FUDS project warrants further response action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The SI collects the minimum amount of information necessary to make this determination as well as (i) determines the potential need for a removal action; (ii) collects or develops additional data, as appropriate, for Hazard Ranking System (HRS) scoring by the U.S. Environmental Protection Agency (EPA); 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 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. Evaluation of potential releases of hazardous, toxic, or radioactive waste are not within the SI scope.

ES.4 **Assateague Island**. Assateague Island occupies 17,552 acres of land located off the eastern shore of Maryland and Virginia in Worcester County, Maryland and Accomack County, Virginia. From 1944 to 1947, the U.S. Navy and the U.S. Army Air Corps established two separate rocket ranges, which were used by the Navy during World War II (WWII) for target practice by land-based aircraft. At the end of WWII, two or possibly three ordnance burial sites were created. Assateague currently is part of several state and federal park systems, including Chincoteague National Wildlife Refuge (U.S. Fish and Wildlife Service), Assateague Island National Seashore (National Park Service), Assateague Island State Park (State of Maryland), and a salt-marshland owned by the Commonwealth of Virginia. Additionally, 4 acres are held by private owners, and the U.S. Coast Guard operates a lighthouse on less than 1 acre.

ES.5 **Technical Project Planning.** The SI approach was developed in concert with stakeholders through the USACE's technical project planning (TPP) framework, which was applied at the initial TPP meeting on 28 March 2006. Stakeholders agreed to the SI approach, as presented and modified during the TPP meeting and finalized in the site-specific work plan (SS-WP). These agreements included inspection and multimedia sampling of the two munition response sites (MRSs) in accordance with the approved data quality objectives.

ES.6 USACE programmatic range documents (including the Supplemental Archive Search Report [ASR] and the DERP Fiscal Year 2005 Annual Report to Congress) identified two ranges: Rocket Range North and Rocket Range South. These two areas were designated as MRS 1 and MRS 2, respectively. The designated ranges include approximately 1,146 acres of land located within the FUDS property boundary, and the remaining acreage, 5,070 acres of tidal waters, is beyond the designated FUDS property boundary. Currently, DERP management guidance and USACE guidance have determined that the range area in the water beyond the 100-yard mean high tide line is not eligible for inclusion in DERP-FUDS. Therefore, the area of the range fans that is beyond 100 yards from shore (during mean high tide) to include the majority of the 5,070 acres of tidal waters beneath the range fans for both rocket ranges (MRS 1 and MRS 2)is not addressed in the SI findings or recommendations.

ES.7 **Qualitative Site Reconnaissance and MEC Assessment**. SI field activities were performed from 6 December through 8 December 2006. A qualitative site reconnaissance of the FUDS was performed and based on visual observations and analog geophysics. The field sampling approach included meandering reconnaissance in and around sampling locations to identify ranges, target areas, MEC, munitions debris (MD), or other areas of interest (areas containing possible bomb craters, backstops, or other areas containing distressed vegetation). The qualitative site reconnaissance was conducted on approximately 12 acres of the designated MRSs. An additional 20 acres was inspected adjacent to and outside the two MRS boundaries in the vicinity of the suspect burial areas in accordance with the SS-WP. Suspect MD and/or possible cultural debris were identified at Rocket Range North (MRS 1) during the site inspection, and numerous subsurface anomalies were identified at the FUDS. No MEC or MD was identified at Rocket Range South (MRS 2) during the SI. Field work did not include intrusive investigation of subsurface anomalies in accordance with the Performance Work Statement for this SI.

ES.8 A qualitative MEC screening level risk assessment was conducted based on the SI qualitative reconnaissance, as well as historical data documented in the Inventory Project Report (INPR), Archives Search Report (ASR), and the ASR Supplement. Historical documentation

and interview reviews indicated the following munitions were used and/or found at the Assateague Island FUDS: 2.25- and 5-inch inert practice rockets, practice bombs, and 20-millimeter (mm) medium caliber ammunition. There are several historical accounts of MEC and MD being found at the FUDS. These discoveries included rocket motors, rocket tips, 5-inch shells, mark (MK) 43 practice bombs, and 20-mm casings along with one account of MEC (two live 5-inch shells). Several surveys have been conducted in search of burial pits reportedly existing within the FUDS. One burial pit was identified and further investigated, but the remaining two suspect burial pits have yet to be identified and investigated. Suspect MD and multiple subsurface anomalies were observed during the December 2006 SI reconnaissance and sampling activities. The potential risk posed by MEC, assessed through three risk factors (i.e., presence of MEC source, accessibility or pathway presence, and potential receptor contact), was determined to be low to moderate for both MRS 1 and MRS 2.

ES.9 **MC Sampling and Risk Screening**. A total of 17 soil (including five surface soil, nine subsurface soil, and three background soil samples), two sediment, two surface water, and two groundwater samples were collected during the SI. Samples were analyzed for MC, specifically a target compound list of explosives and target analyte list of metals. In addition, groundwater samples were analyzed for perchlorate in accordance with the approved SS-WP. A list of MC potentially associated with munitions used at the FUDS was developed and used to support analysis of results and the risk screening. The list of associated MC includes four explosives (including RDX, tetryl, nitroglycerin and DNT); eight metals (aluminum, antimony, iron, lead, magnesium, potassium, titanium, and zinc); and perchlorate. No munitions-related MC were reported as exceeding human health screening criteria for surface water, sediment, soil, or groundwater in MRS 1. No munitions-related MC were reported as exceeding human health screening criteria for surface water, sediment, or soil in MRS 2. One munitions-related MC (aluminum) was reported as exceeding human health screening criteria for groundwater in MRS 2. However, this analyte was not retained as a chemical of potential concern (COPC) since the sample was from a temporary well point which was not filtered and likely contained sediment particles as evidenced by elevated levels of essential nutrients.

ES.10 A screening level ecological risk assessment (SLERA) was required given the former FUDS is located in an area regulated by the Maryland and Virginia Coastal Zone Management Programs, contains numerous salt-marsh wetland areas, and provides valuable and recognized habitat for ecological receptors, including rare, threatened, and endangered species. The SLERA identified antimony as exceeding ecological soil screening criteria at MRS 1 and MRS 2. However, when compared to background soil concentrations, the maximum concentrations of antimony, although at levels above its respective screening value, were not above the range of

background concentrations. These exceedances were not considered significant and antimony was not retained as a chemical of potential ecological concern (COPEC) in either MRS.

ES.11 **Recommendations.** ***Rocket Range North (MRS 1) –*** This area was historically was used as a bomb and rocket target and both MD and MEC have been found in MRS 1. Based on the MEC assessment, MEC risk is considered low to moderate. An RI/FS is recommended for MRS 1 and additional studies should focus on MEC (Table ES-1). Acceptable human health and ecological risks were identified based on the risk screening results. ***Rocket Range South (MRS 2) –*** MRS 2 historically was used as a bomb and rocket target and MD has been found at MRS 2. Based on the MEC assessment, MEC risk is considered low to moderate. An RI/FS is recommended for MRS 2 and additional studies should focus on MEC (Table ES-1). Acceptable human health and ecological risks were identified based on the risk screening results. In conjunction with this recommendation, neither a time critical removal action (TCRA) nor non-time critical removal action (NTCRA) is required for this FUDS (including MRS 1 and MRS 2).

ES.12 The boundary and acreage of the MRSs in the ASR Supplement should be reviewed and possibly revised for MRS 1 and 2. This review also should also address suspect disposal areas located within the FUDS but outside each MRS range boundaries (for investigation and delineation during the RI/FS).

Table ES-1 Summary of Site Recommendations: Assateague Island

(FUDS Project No. C03MD093001)

MRS	Recommendation	Basis for Recommendation	
		MEC	**MC**
MRS 1 (Rocket Range North)	Remedial Investigation/ Feasibility Study Additional studies should focus on MEC TCRA/NTCRA not recommended	MEC Assessment: Low to moderate risk Past finds of MEC/MD	Risk Screening Assessment: No risks to human or ecological receptors ***Surface Soil***-Antimony exceeded screening criteria for ecological receptors (but was not above the range of background). Based on this weight of evidence, antimony was not identified as a COPEC.
MRS 2 (Rocket Range South)	Remedial Investigation/ Feasibility Study Additional studies should focus on MEC TCRA/NTCRA not recommended	MEC Assessment: Low to moderate risk Past finds of MD	Risk Screening Assessment: No risks to human or ecological receptors ***Groundwater*** –Aluminum exceeded risk screening criteria for human receptors (the sample was from a temporary well point which was not filtered and likely contained sediment particles as seen in elevated levels of essential nutrients). Based on this weight of evidence, aluminum was not identified as a COPC. ***Surface Soil***-Antimony exceeded screening criteria for ecological receptors (but was not above the range of background). Based on this weight of evidence, antimony was not identified as a COPEC.
General	The boundary and acreage of each MRS in the ASR Supplement should be reviewed and possibly revised for MRS 1 and 2. This review also should also address suspect disposal areas that lie within the FUDS property and outside the current two MRS range boundaries (for investigation and delineation during the RI/FS).		

COPC=Chemical of Potential Concern
COPEC=Chemical of Potential Ecological Concern
FUDS=Formerly Used Defense Site
MRS=Munitions Response Site
MD=Munitions Debris
MEC=Munitions and Explosives of Concern
MC=Munitions Constituents
NDAI=No Department of Defense Action Indicated
NTCRA=Non -Time Critical Removal Action

1. INTRODUCTION

1.0.1 This report documents the findings of the Military Munitions Response Program (MMRP) Site Inspection (SI) performed at the Assateague Island Formerly Used defense Site (FUDS) located near Berlin, Maryland MMRP Project No. C03MD093001. Alion Science and Technology Corporation (Alion), along with its subcontractors [EA Engineering, Science, and Technology, Inc. (EA), Environmental Data Services (EDS), Inc., and General Physics Laboratories, Limited Liability, Limited Partnership (GPL, LLLP)], prepared this report under contract to the U. S. 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 Baltimore (CENAB). CENAB is working with USAESCH and its contractor, Alion, on the completion of this project in accordance with the SI Performance Work Statement (see Appendix A).

1.0.2 The technical approach to this SI is based on the *Programmatic Work Plan for Formerly Used Defense Sites (FUDS) Military Munitions Response Program (MMRP) Site Inspections at Multiple Sites the Northeast Region* (PWP) (Alion 2005) and the *Final Site-Specific Work Plan Addendum to the MMRP Programmatic Work Plan for the Site Inspection of Assateague Island* (SS-WP) (Alion 2006b).

1.1 Project Authorization

1.1.1 The Department of Defense (DoD) has established the MMRP to address DoD 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 the 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, 10 May 2004b) and the *Management Guidance for the Defense Environmental Response Program (DERP)* (Office of the Deputy Under Secretary of Defense [Installations and Environment], September 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 §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 all MEC/MC constitute CERCLA hazardous substances, pollutants, or contaminants, the DERP statute provides DoD the authority to respond to releases of MEC/MC, and DoD policy states that such responses shall be conducted in accordance with CERCLA and the NCP.

1.2 Project Scope and Objectives

1.2.1 The primary objective of the MMRP SI is to determine whether or not the FUDS project warrants further response action under CERCLA. The SI collects the minimum amount of information necessary to make this determination as well as (i) determines the potential need for a removal action; (ii) collects or develops additional data, as appropriate, for Hazard Ranking System (HRS) scoring by the U.S. Environmental Protection Agency (EPA); 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 sites (MRSs) 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 transfer through records review, qualitative site reconnaissance 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 Assateague Island is a 36-mile-long barrier island located along the eastern shore of Maryland and Virginia coastlines and within the Delmarva Peninsula. The FUDS is comprised of 17,552 acres situated within two counties/states – Worcester County, Maryland and Accomack County, Virginia. The North American Datum 83 coordinates for the most central part of the island are Universal Transverse Mercator X (486960) and Y (4229877). This FUDS falls under the geographical jurisdiction of the CENAB. This SI is being completed under DERP FUDS Project No. C03MD093001 to address potential MMRP hazards remaining at the FUDS.

1.4 Munitions Response Site Prioritization Protocol

1.4.1 This SI Report includes draft MRSPP rankings that apply to the two designated MRSs identified in this report (Appendix K). The MRSPP scoring will be updated on an annual basis to incorporate new information.

2. SITE DESCRIPTION AND HISTORY

2.1 Site Description and History

2.1.1 Military activity in defense of the coastline occurred in the waters near Assateague Island during and immediately following World War II (WWII). From 1944 to 1947, the U.S. Navy and the U.S. Army Air Corps established two separate rocket ranges at Assateague Island, which were used by the Navy during WWII for target practice by land-based aircraft. The ranges were identified as Rocket Range North and Rocket Range South.[1] Training activities on Assateague Island consisted of air-to-ground target practice, where practice rockets, practice bombs, and machine guns were fired. Most of the planes that used these ranges originated from Chincoteague Naval Air Station traveled up the eastern shore of Assateague Island. Once the north of the target area, the planes circled around the island and fired eastward during the approach to the western shore of Assateague. The practice munitions discharged smoke on impact, indicating the final location of the munitions (USACE 1994). At the end of WWII, DoD created two (possibly three) suspect ordnance burial sites during site clean up. No known DoD maps exist of the ranges; however, the 1994 Archive Search Report (ASR) reported that a Navy veteran identified the ranges from memory. Although the FUDS boundary includes the entire island, the 1994 ASR indicates the only known training areas included two rocket ranges, which were located in Maryland. Therefore, this SI focused on the Maryland portion of Assateague Island (USACE 1994).

2.2 Munitions Response Site Identification and Munitions Information

2.2.1 USACE programmatic range documents (including the ASR Supplement and the DERP Fiscal Year 2005 Annual Report to Congress) identified two ranges at the Assateague Island FUDS (USACE 2004a and DoD 2005), as shown on Figure 2-1. These ranges include Rocket Range North, and Rocket Range South, designated MRS 1 and MRS 2, respectively (refer to Table 2-1). Restoration Management Information System range identification numbers for these MRSs are C03MD093001R01 and C03MD093001R02, respectively. Munitions associated with these MRSs are derived from the ASR and ASR Supplement and are summarized on Table 2-2.

[1] The 1994 Archive Search Report (ASR) uses the terms Stinger-One Range and Stinger-Two Range to refer to Rocket Range North and Rocket Range South, respectively. The 2004 ASR Supplement uses the terminology Rocket Range North and Rocket Range South. This SI Report uses the ASR Supplement terminology unless referring to the ASR.

2.2.2 Both designated ranges include a total of approximately 1,146 acres of land located within the FUDS property boundary, and the remaining acreage, 5,070 acres of tidal waters, is beyond the designated FUDS property boundary (Figure 2-1 and Table 2-1). Currently, DERP management guidance and USACE guidance have determined that the range area in the water beyond the 100-yard mean high tide line is not eligible for inclusion in DERP-FUDS. Therefore, the area of the range fans that is beyond 100 yards from shore (during mean high tide) to include the majority of the 5,070 acres of tidal waters beneath the range fans for both rocket ranges (MRS 1 and MRS 2) is not addressed in the SI findings or recommendations.

2.3 Physical Setting

2.3.0.1 The following subsections provide a physical description of the FUDS property with respect to relief, vegetation, geology, hydrology, climate, local demographic, and land uses.

2.3.1 Topography and Vegetation

2.3.1.1 Assateague Island is a barrier Island dividing Chincoteague Bay from the Atlantic Ocean in Worcester County, Maryland, and Accomack County, Virginia. The topography of Assateague Island consists mainly of flat to gently rolling sand dunes. The FUDS lies just above sea level and is relatively flat with low relief; island elevations range from sea level to approximately 15 feet (ft) (USACE 1994). The eastern shore predominately is sand dunes, while the western shore is covered with dense brush and salt-marsh wetlands.

2.3.2 Climate

2.3.2.1 The region has a humid mesothermal climate that is influenced by maritime tropical air masses in the summer and by continental polar air masses in the winter. Most high and low pressure systems track from west to east, as the region lies in a zone of prevailing westerlies. The region is vulnerable to hurricanes primarily between June and November. Normal daily maximum temperatures range from 45 degrees Fahrenheit (˚F) in January to 85˚F in July. Normal daily minimum temperatures range from 30˚F in January to 65˚F in July. Average annual precipitation is approximately 49 inches. Rainfall, derived from cyclonic weather systems in the fall, winter, and spring, and from local convective storms in the summer, is distributed fairly evenly throughout the year. The lowest average monthly precipitation of 3.41 inches occurs in December, while the highest average monthly precipitation of 5.67 inches occurs in August. Thunderstorms occur on average 20-40 days a year, primarily in the summer months. Mean average annual snowfall is 6-12 inches (USACE 1994).

2.3.3 Local Demographics

2.3.3.1 Assateague Island is a barrier island dividing Chincoteague Bay from the Atlantic Ocean. The northern tip of the island lies within a mile of Ocean City, Maryland and the southern tip of the island lies within a mile of Chincoteague, Virginia. The MRSs are in the middle of the island, which is over ten miles from these populated areas (Figure 2-1). As of 2000, Ocean City had a population density of 607.3 persons per square kilometer (km^2) [1,574.7 persons per square mile (mi^2)], consisting of a year-round population of 7,173 people, 3,750 households, and 1,829 families. In 2000, Chincoteague had a population density of 159.2/km^2 (412.2/mi^2), consisting of a population of 4,317 people, 2,068 households, and 1,244 families (U.S. Census Bureau 2000). The Maryland portion of Assateague Island where the former rocket ranges are located, is located within Worcester County, Maryland, and has a population density of 98 persons per square mile (mi^2) (U.S. Census Bureau 2000).

2.3.3.2 MRS 1 consists of both a national seashore and state park and as such has a significant flux of visitors during the summer months. According to the National Park Service, in close proximity to Ocean City (less than 20 miles) the northern part of Assateague Island has up to 7,500 visitors per day (MRS 1). Additionally there are 150 campsites on the National Seashore and approximately 200 camp sites on state property. This transient population significantly impacts the population density at MRS 1 during summer months. MRS 2, which is much more remote, does not have the same flux of visitors as does MRS 1 (refer to TPP #2 Memorandum, Appendix B).

2.3.3.3 A backcountry campground is located within the MRS 2 site boundary. The campground has three sites, with a maximum use of 15 people at any given time. The site receives minimal use during the summer and winter months; moderate use during the spring and fall. Annual use of this area is probably no more than 1,500 visitors per year (Appendix C - Zimmerman 2007). The three designated campsites at MRS 2 are projected to support a maximum of three temporary structures (i.e. tents) at any given time.

2.3.3.4 The following schools are located within 4 miles of Assateague Island in Ocean City: Ocean City Elementary School, University of Maryland Eastern Shore–Continuing Education, Training Station Nursery School, and Ocean City Christian School. Chincoteague High School is also within 4 miles of Assateague Island. No schools were identified within 4 miles of MRS 1 or MRS 2.

2.3.4 Current and Future Land Use

2.3.4.1 Presently, Assateague Island FUDS is owned by many different owners. The southern part of Assateague Island consists of the Chincoteague National Wildlife Refuge, which was established in 1943 and is owned by the U.S. Fish and Wildlife Service (USFWS). The remainder of Assateague Island is comprised of natural areas and parks, including the Assateague Island National Seashore, established in 1965 and owned by the U.S. National Park Service (NPS), Assateague Island State Park, owned by the State of Maryland, and a salt-marshland, owned by the Commonwealth of Virginia. Additionally, the U.S. Coast Guard operates a lighthouse on less than 1 acre of land, and private interest groups own 4 acres (USACE 1994). The current use of Assateague Island is a national park/national seashore area open to visitors, lighthouse operations, and private use of the 4 acres. Land use is not projected to change in the future (Alion 2006a, Appendix B).

2.3.4.2 Rocket Range North (MRS 1) is located on the State of Maryland and NPS properties, but the entire area is managed by the NPS and is open to the public for recreational purposes as a State Park and National Seashore. Rocket Range South (MRS 2) is located entirely on NPS property and is open to the public for recreational purposes as a National Seashore. There are no known inhabited structures on MRS 1 or MRS 2. Within a two mile radius of MRS 1, there is a residential area comprised of more than 26 homes. There are no known inhabited structures within a 2 mile radius of MRS 2. The 2 mile area surrounding MRS 2 consists of land comprised of Assateague Island National Seashore and tidal waters, including Chincoteague Bay to the west and the Atlantic Ocean to the east.

2.3.5 Geologic Setting

2.3.5.1 The subsurface sediments of the Delmarva Peninsula rest on a seaward sloping basement of Paleozoic crystalline rocks. The basement is folded and faulted into a series of northwest-southeast trending ridges and depressions. The axis of one major depression, the Salisbury Embayment, crosses the Delmarva Peninsula near the Virginia-Maryland border. Cretaceous Cenozoic and Mesozoic sands, silts and clays account for more than half of the thickness of subsurface sediments. Lower Cretaceous formations representing non-marine deposition in river channels, flood plains, and swamps are overlain by Upper Cretaceous lagoonal, estuarine, and deep-water marine rocks. This feature represents the gradual encroachment of the Upper Cretaceous Sea over the region (USACE 1994).

2.3.5.2 The sand barrier of Assateague Island, composed of beach and washover sands and gravels topped by wind-blown sand dunes, rests on soft lagoonal mud containing oyster, clam,

and snail shells. The lagoonal mud overlies organic coastal salt-marsh mud, and peat, which, in turn, overlies organic debris-rich sandy mud. This entire sequence overlies pre-Halocene sediments undergoing transgression. Except for steep slopes on dunes, this "soil" is nearly level and is composed of light-gray to white marine sand and shell material. The sand is constantly shifted by waves and supports little vegetation (USACE 1994). The coastline of the island has migrated towards the west over the past 60 years as the Atlantic Ocean has reclaimed parts of the eastern shore.

2.3.5.3 Tidal marsh soils are sandy to clayey, poorly drained, acidic, and saline and can contain peat or highly organic black muck. These soils are included in the Tidal Marsh–Coastal Beach Association. Additionally, a small amount of Plummer soils can be found in stabilized depressions on coastal beaches (USACE 1994).

2.3.6 Hydrogeologic Setting

2.3.6.1 Groundwater in the region surrounding Assateague Island is supplied primarily by the Manokin, Pokomoke, and Quaternary aquifers (USACE 1994). The Manokin aquifer is recharged by the overlying Pokomoke aquifer, which is recharged by the downward movement of water from the Quaternary sediments. Recharge of the Manokin and Pokomoke aquifers occurs along a drainage divide between the Atlantic Ocean and Chesapeake Bay. The Quaternary aquifer is recharged by precipitation over a broad area (USACE 1994).

2.3.6.2 Regional movement of groundwater in the Manokin and Pokomoke aquifers is away from the drainage divide and towards the ocean, bays, rivers and areas of pumping. Groundwater movement in the Quaternary aquifer is from areas of high water table to streams, bays, and the ocean (USACE 1994).

2.3.6.3 Tide ranges and tidal currents in the inshore waters of Assateague Island are controlled by the position of ocean inlets. The two ocean inlets on Assateague Island are the Ocean City inlet on the north, which leads to Sinepuxent Bay, and the Chincoteague inlet 30 miles to the south, which leads to Chincoteague Bay (USACE 1994). Mean tide range at the Ocean City and Chincoteague inlets is 3.4 to 3.8 ft, but near the midpoint tide range is only 0.4 ft. High water at the midpoint occurs approximately 7 hours after high water at the inlets. Tidal currents in the bays range from 0.15 to 0.5 knots. Through the tides, approximately 7 percent of the water in the bays is renewed each day (USACE 1994).

2.3.7 Area Water Supply/Groundwater Use

2.3.7.1 Drinking water on Assateague Island is provided by two groundwater wells (DW1 and DW2) located near the ranger station for the Assateague Island National Seashore. Water from DW1 and DW2 is used for the ranger station and support buildings at the National Seashore headquarters. The wells are within 1 mile of Rocket Range North (MRS 1), and are completed to a depth of 370 and 390 ft below ground surface (bgs). Additionally, there is a non-potable well, used for construction support, located within 1 mile of MRS 1 at a depth of less than 75 ft bgs (Zimmerman 2006b). Table 2-3 provides a summary of these groundwater supply wells. Pumping rates for the wells were unavailable. The southern portion of Assateague Island is isolated and no drinking water supply wells were identified within 4 miles of Rocket Range South (MRS 2). Currently available water supply well information in the vicinity of the island is identified on Figure 2-2. The response to a request for additional well information submitted to Assateague Island State Park was not available for inclusion in this version of the SI Report.

2.3.8 Sensitive Environments

2.3.8.0.1 The following sections 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 HTRW Center of Expertise guidance, the Army Checklist for Important Ecological Places is completed to determine if a FUDS requires a screening level ecological risk assessment (SLERA) (USACE 2006d and 2007). In the case of Assateague Island, the FUDS is regulated by the Maryland and Virginia Coastal Zone Management Programs (authorized by the Coastal Zone Management Act of 1972, Public Law 92-583, 16 USC 1451-1456), contains numerous salt-marsh wetland areas, and provides valuable and recognized habitat for ecological receptors, including rare, threatened, and endangered species; therefore, the performance of a SLERA is required (USACE 2006d). Refer to Table 2-4 for the completed checklist for Assateague Island.

2.3.8.2 Wetlands

2.3.8.2.1 Numerous salt-marsh wetland areas are present on and surrounding Assateague Island.

2.3.8.3 Coastal Zones

2.3.8.3.1 Assateague Island is bordered on the east by the Atlantic Ocean and on the west by Chincoteague Bay. Both MRSs are within the Assateague National Seashore and considered to be located within the Maryland and Virginia designated coastal zone areas.

2.4 Summary of 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 MC and MEC/MD (if applicable) is provided in the following subsections.

2.4.1 1988 Case Incident

2.4.1.1 An incident was reported in July 1988 when Army and Navy Explosive Ordnance Disposal (EOD) Teams were deployed to Assateague Island to address ordnance items washing ashore at the North Ocean Beach[2]. The North Ocean Beach area likely coincides with the Rocket Range North (MRS 1) (USACE 1994). The 144th EOD from Fort Meade, Maryland was the first EOD unit to deploy to the FUDS on 14 July 1988. The 144th EOD recovered and disposed of three 5-inch rockets, with at least one containing a rocket motor. On 15 July 1988, the 144th EOD returned to the FUDS to recover and dispose of another 5-inch rocket that had washed ashore in the same area. At this time, the origin of the ordnance was noted as being from a "hole" approximately 15 meters offshore (USACE 1994). On 16 July 1988, the U.S. Navy EOD Mobile Unit II arrived at the FUDS and assumed operations from the 144th EOD. From 17 to 20 July, the Navy EOD conducted an underwater survey of the area around the "hole." Based on the results of the underwater survey, a Navy EOD team leader suspected that the "hole" was a trench dug to bury expended shells, etc. This trench was presumed to be on Assateague Island originally; however, the trench is now underwater due to island migration (USACE 1994). The ordnance items recovered by both EOD Teams included seven rocket motors (one not expended); six 5-inch shells, two of which were live; and numerous ballistic tips used to improve the aerodynamics of practice rockets (USACE 1994).[3]

[2] A complete report on the EOD team deployments is located in U.S. Department of the Interior, National Park Service Supplementary Case/Incident Record Number 880407.

[3] No evidence was found to determine the origin of the six 5-inch shells. These items were not identified as having been used at the site and only vague references were identified indicating the Navy/Coast Guard may have dumped out-of-date ordnance in offshore areas during WWII during patrol of the coastal waters. These items were not used to evaluate MC in impact areas; however, this ordnance was used to evaluate MEC risk.

2.4.2 1991 Preliminary Assessment

2.4.2.1 In 1991, a Preliminary Assessment (PA) of Assateague Island was completed under DERP FUDS by CENAB. At that time, the Findings and Determination of Eligibility, dated 19 December 1991, concluded that the 17,552-acre FUDS located on Assateague Island in Worcester County, Maryland and Accomack County, Virginia, had been used formerly by the War Department (USACE 1994).

2.4.2.2 Neither acquisition nor disposal documentation for the FUDS was available during the PA. However, military use of Assateague Island was substantiated by a former Navy spotter statements and evidence of ordnance washing ashore in July 1988 near an area suspected of being a rocket range (USACE 1994).

2.4.2.3 The PA investigation concluded that there were eligible categories of hazards under the DERP FUDS program. Given that the FUDS was determined to have been used as a practice rocket target range for Navy pilots (and possibly Army Air Corps pilots), an Ordnance and Explosive Waste (OEW)[4] project was recommended; DERP FUDS OEW Project Number C03MD093001 (USACE 1994).

2.4.3 1991 Inventory Project Report (Contracted Site Visit)

2.4.3.1 In 1991, a research and a site visit in support of the Inventory Project Report (INPR) for Assateague Island was completed. Research indicated a National Park Ranger found an expended mark (MK) 43 practice bomb and 20-millimeter (mm) shell casing. During the site visit, additional MD was identified. Part of a 5-inch rocket motor was uncovered on the southern part of the island near the Stinger-Two Range (MRS 2) during a sweep of the island. At the conclusion of the site visit, a large scale sweep using "ground penetrating and electric pulse induction search equipment" was recommended to locate the ordnance burial trenches (USACE 1994). A sweep was completed in 1992, as discussed in Section 2.4.4.

2.4.4 1992 Interim Sweep of North Ocean Beach

2.4.4.1 In 1992 a sweep of the North Ocean Beach area was conducted where ordnance had washed ashore previously. Over a 3-week period, a 570,000-square–foot area of the beach was swept. During this investigation, no ordnance or ordnance-related items were discovered,

[4] The terminology "ordnance and explosive waste" has been updated and is referred to as munitions and explosives of concern (MEC) throughout this report.

although some fencing, metal piping, and a shipwreck were discovered and reported (USACE 1994).

2.4.5 1994 Archive Search Report

2.4.5.1 The 1994 ASR noted there was historical evidence WWII-era ordnance uses, including rockets and bombs. The archive search noted two target ranges, Stinger-One (MRS 1) and Stinger-Two (MRS 2), were developed on Assateague Island in the 1940s and used for target practice by the Navy. No certificates of ordnance clearance or decontamination associated with the FUDS were located. The ASR noted no evidence of chemical warfare material being used or present at the site.

2.4.5.2 The ASR concluded both the north and south rocket ranges (Figure 2-3) have the potential for MEC and MC and recommended these areas for further inspection (USACE 1994). The site visit of remaining lands indicated no evidence of MEC or MD; therefore, these areas were considered to be non-impact areas (USACE 1994). A copy of the 1994 ASR is provided in Appendix L.

2.4.6 1994 Site Investigation

2.4.6.1 In 1994, a site investigation was conducted on Assateague Island to assess two areas having the highest probability for MEC encounters , the beach and dune zones.. The SI report summary stated, “two grid systems 4,500 feet long from 400 to 800 feet wide were set up in both areas” (Parsons 1995). The magnetometer sweeps in the northern area documented 20 pieces of MD on the surface and 109 pieces of MD west of the present-day artificial sand dunes. When a large anomaly along the shoreline was detected, a partial excavation of the anomaly was completed and resulted in identifying an additional 36 pieces of MD. All of the discovered MD were determined to be inert and were classified as munitions scrap, and all but two items were transferred to a local scrap dealer. In the southern area, MD on the surface or subsurface was not identified based on the magnetometer sweeps (Parsons 1995).

2.4.7 2003 Baltimore District Site Visit

2.4.7.1 USACE Baltimore District conducted completed a site visit in 2003 to further characterize the MEC risk on the island. Due to heavy brush conditions, the visit was limited to the beach areas. Schonstedts magnetometers were used to assess the impact areas (Stinger-One Range [MRS 1] and Stinger-Two Range [MRS 2]) and potential burial sites. Suspect anomalies and two possible burial pits were located in the Stinger-One Range area. The memorandum indicates that “the possible burial sites were just outside the projected impact area.” The

memorandum also noted that four large anomalies, possibly burial pits, were located. "Several dozen" additional anomalies were identified in the area of the Stinger-Two Range[5]. According to the memo, approximately 10 percent of the ranges were searched (Follett 2003). A removal action was not completed as a result of the survey.

2.4.8 2004 Archive Search Report Supplement

2.4.8.1 In 2004, the ASR Supplement (USACE 2004a) assigned Risk Assessment Code (RAC) scores to each of the areas identified in the ASR as potential areas of concern regarding MEC and MC (Table 2-1). Rocket Range North (MRS 1) and Rocket Range South (MRS 2) were assigned a RAC score of 4. A RAC is the numerical value assigned to a FUDS describing the hazard severity and the hazard probability. A RAC of 5 indicates no action is required while a RAC of 1 indicates an imminent hazard. The ASR Supplement did not identify any additional ranges (USACE 2004a).

2.4.8.2 The ASR Supplement provides the general class of munitions used in each MRS. The information provided in the ASR Supplement was combined with the information regarding specific munitions presented in the ASR and used to generate Table 2-2, which lists the military munitions type and composition for the FUDS for each MRS. USACE technical documents, manuals, etc. were used to identify the list of MC associated with each munitions type. The list of associated MC includes explosives (including nitroglycerin) as well as aluminum, antimony, iron, lead, magnesium, potassium, titanium and zinc. As noted in Table 2-2, MC associated with primers and tracers generally were not included in the list of MC for this FUDS given that these constituents typically represent less than 5 percent of the MC associated with the munitions. The exception to this approach is perchlorate, which was included in accordance with stakeholder agreements at the TPP meeting (Alion 2006a) and the Final SS-WP (Alion 2006b). A copy of the 2004 ASR Supplement is provided in Appendix L.

2.5 Citizen Reports of Munitions and Explosives of Concern

2.5.1 There have been no citizen reports identified that document MEC at Assateague Island except for those reports identified in Section 2.4. At the TPP meeting, in March 2006, stakeholders confirmed there have been no reports of MEC on the property (Appendix B, Alion 2006a).

[5] USACE provided the Global Positioning System (GPS) coordinates for three of the anomalies located in this report to the Alion Team (Follet 2006).

2.6 Non-Department of Defense Contamination/Regulatory Status

2.6.1 There is no evidence that activities occurring prior to or after DoD use of the land contributed to present day MEC or munitions debris (MD) and MC findings.

Table 2-1 Range Inventory

Site Name	Range Name	Subrange Name	RMIS Range Number	RAC Score	Acreage[1]
Assateague Island	Rocket Range North (MRS 1)	N/A	C03MD093001R01	4	3,108
	Rocket Range South (MRS 2)	N/A	C03MD093001R02	4	3,108

RMIS = Restoration Management Information System

N/A – not applicable

CTT – Closed, Transferred and Transferring

RAC – Risk Assessment Code. The RAC allows a score of 1 to 5.

1 – Total acreage included in Range inventory.

Munitions Response Site (MRS) designation completed by Alion.

Table 2-2. Military Munitions Type and Composition (USACE 1994 and 2004)

Range ID (MRS)	Munitions ID	Munitions Type	Composition (Filler, Projectile, Body, Propellant, other)	Associated MC Analysis[1]
Stinger-One Range (MRS1) and Stinger-Two Range (MRS2)	Medium Caliber (CTT17)	Cartridge, 20MM MKI/HE-I Ball	*Projectile:* Tetryl/RDX (HE Filler) and lead/steel *Propellant:* Flashless Non-hygroscopic (FNH) powder, Type II (nitrocellulose, dibutylphthalate, dinitrotoluene (DNT), diphenylamine) *Primer:* Lead thiocynate, potassium chlorate, antimony sulfide, PETN) Incendiary Mixture: barium nitrate, magnesium, aluminum alloy *Fuse:* mercury fulminate, and Tetryl	Explosives: • Tetryl • Nitrocellulose (no analysis) • DNT • RDX Metals: • Iron • Lead Other • Dibutylphthalate (no analysis) • Diphenylamine (no analysis) • Perchlorate[2]
		Cartridge, 20 MM T23, M97/HE-I	*Projectile:* Tetryl (HE Filler) and steel shot *Propellant:* Nitrocellulose, Tin, Potassium sulfate, diphenylamine, Graphite, DNT *Incendiary Mixture:* Barium nitrate, Magnesium/Aluminum Powder, Asphaltum, Graphite *Primer:* Potassium chlorate, Lead thiocyanate, Antimony sulfide PETN, Barium nitrate, Lead styphnate, Calcium silicide, Gum Arabic, Acetylene black *Fuse:* Mercury fulminate, Lead azide, Tetryl, Lead styphnate	Explosives: • Tetryl • Nitrocellulose (no analysis) • DNT Metals: • Iron • Potassium • Tin (no analysis)[3] Other • Diphenylamine (no analysis) • Perchlorate[2]

Table 2-2. Military Munitions Type and Composition (USACE 1994 and 2004)

Range ID (MRS)	Munitions ID	Munitions Type	Composition (Filler, Projectile, Body, Propellant, other)	Associated MC Analysis[1]
		Cartridge, 20 MM T18, M96/HE-I	*Projectile:* steel/zinc nose *Propellant*: Nitrocellulose, Diphenylamine, Tin, Potassium Sulfate *Incendiary Mixture:* barium nitrate, strontium peroxide, Magnesium and Aluminum powder, Calcium resinate *Primer:* Potassium Chlorate, Lead Thiocyanate, Antimony Sulfide, PETN, Lead Styphnate, Barium Nitrate, Calcium Silicade, TNR, Acacia Technical, Acetylene Black	Explosives: • Nitrocellulose (no analysis) Metals: • Iron • Tin (no analysis)[3] • Zinc Other • Diphenylamine (no analysis) • Perchlorate[2]
	Medium Caliber (20-mm, 25-mm, 30-mm), Practice (CTT17)	Cartridge, 20MM M75/AP-T	*Projectile:* Solid steel shot *Propellant:* Nitrocellulose, Diphenylamine, Tin, Potassium sulfate, Graphite, DNT *Tracer :* Strontium nitrate, strontium peroxide, Magnesium powder, Calcium resinate, Strontium oxalate *Primer:* Potassium chlorate, Lead thiocyanate, Antimony sulfide, PETN	Explosives: • Nitrocellulose (no analysis) • DNT Metals: • Iron • Potassium • Tin (no analysis)[3] Other • Diphenylamine (no analysis) • Perchlorate[2]
		Cartridge, 20 MM T9E5, M95/AP-T	*Projectile*: Solid steel shot *Propellant:* Nitrocellulose, Diphenylamine, Tin, Potassium sulfate, Diphenylamine, Graphite, DNT *Primer:* Potassium chlorate, Lead thiocyanate, Antimony sulfide PETN, Barium nitrate, Lead	Explosives: • Nitrocellulose (no analysis) • DNT Metals: • Iron • Potassium • Tin (no analysis)[3] Other • Diphenylamine (no analysis)

Table 2-2. Military Munitions Type and Composition (USACE 1994 and 2004)

Range ID (MRS)	Munitions ID	Munitions Type	Composition (Filler, Projectile, Body, Propellant, other)	Associated MC Analysis[1]
			styphnate, Calcium silicide, Gum Arabic, Acetylene black	• Perchlorate[2]
Stinger-One Range/MRS1 and Stinger-Two/MRS2	Practice Bomb (CTT10)	3 lb bomb, practice with signal: AN-Mk23	Inert (cast iron) 10 g zinc oxide 3 g black powder (74% Potassium nitrate, 11% sulfur, 6% charcoal) 3 g smokeless powder (Nitrocellulose) Titanium tetrachloride	Explosives: • Black Powder (no analysis) • Nitrocellulose (no analysis) Metals: • Potassium • Zinc • Iron • Titanium
		4.5 lb bomb, practice with signal: AN-Mk43	Inert (lead/antimony alloy) 10 g zinc oxide 3 g black powder 3 g smokeless powder Titanium tetrachloride	Explosives: • Black Powder (no analysis) Metals: • Antimony • Zinc • Lead • Titanium
		25 lb bomb, practice with signal: AN-Mk76	Inert (cast metal) 10 g zinc oxide 3 g black powder 3 g smokeless powder Titanium tetrachloride	Explosives: • Black Powder (no analysis) Metals: • Zinc • Iron • Titanium
	Rocket, Practice (CTT28)	Rocket,2.25-in SCAR, Mk 6	Inert warhead (Machined steel, cast iron or zinc), aluminum body Motor – 14 g black powder 1.75 lb ballistite (60% nitrocellulose, 39% nitroglycerine (NG), 0.75% diphynylamine), magnesium igniter	Explosives: • Black Powder (no analysis) • Nitrocellulose (no analysis) • NG Metals: • Aluminum • Iron • Magnesium • Zinc Other: • Diphenylamine (stabilizer - no analysis)

Table 2-2. Military Munitions Type and Composition (USACE 1994 and 2004)

Range ID (MRS)	Munitions ID	Munitions Type	Composition (Filler, Projectile, Body, Propellant, other)	Associated MC Analysis[1]
		3.25-in M2, M2A1, M2A2	Inert ogival nose Motor – black powder 3.2 lb propellant grains	Explosives: • Black Powder (no analysis) Metals: • Iron
		3.5-in AR	Inert warhead (steel) Motor – black powder 8.5 lb ballistite	Explosives: • Black Powder (no analysis) • Nitrocellulose (no analysis) • NG Metals: • Iron Other: • Diphenylamine (stabilizer - no analysis)
		Rocket, 5-in: HVAR, Mk 8	Inert warhead (steel) Motor – 55 g black powder 24.8 lb ballistite	Explosives: • Black Powder (no analysis) • Nitrocellulose (no analysis) • NG Metals: • Iron Other • Diphenylamine (stabilizer - no analysis)

(MRS) = Munitions Response Site designation
MC=munitions constituents
AP=Armor Piercing
Mk=Mark
lb=pound(s)
in=inch(es)
HE=High Explosive
RDX= Cyclotrimethylenetrinitramine, also called Cyclonite or Hexahydro-1,3,5-trinitro-1,3,5-triazine
Tetryl = Methyl-2,4,6-trinitrophenylnitramine
PETN = Pentaerythrite Tetranitrate
FNH = Flashless Non-hygroscopic
CTT = Closed Transferred and Transferring
DNT=dinitrotoluene
NG= nitroglycerine
ID = Identification
AN= standardized for use by Army and Navy
HVAR = High Velocity Aircraft Rocket
SCAR = Sub-caliber Aircraft Rocket

[1] Based on available technical manuals, MC identified for site munitions includes the following: Primer (potassium chlorate, lead thiocyanate, antimony sulfide, PETN, lead styphnate, barium nitrate, calcium silicade, acacia technical, acetylene black; Fuze (mercury fulminate, lead azide, tetryl, lead styphnate); Tracer (strontium nitrate, strontium peroxide, magnesium powder, calcium resinate, strontium oxalate);Incendiary mixtures (barium nitrate, magnesium/aluminum powder, asphaltum, graphite). These materials when combined typically represent less than 5% of the weight of the material projectile for small and medium caliber munitions. Typical volumes are broken out as follows: Primer (less than 1% or 1 gram), Tracer (less than 1% or < 1 gram), Incendiary (less than 2% or < 2 grams) and fuze (less than 1% or < 1 gram). These materials along with the propellant typically burn as the projectile is fired. Therefore, the MC sampling/analysis typically focuses on primary constituents present in propellants and the projectile/casings.
[2] According to available technical manuals, perchlorate is not a component of the specific munitions listed in the ASR/Table 2-2 which were used during World War II. However, perchlorate is an ingredient in some of the tracer mixtures associated with 20mm that were manufactured/used after World War II. In accordance with the Final Site Specific Work Plan, perchlorate was included in the list of analytes. Refer to the TPP Memorandum (Alion 2006a) and Final SS-WP (Alion 2006b) for additional detail.
[3] Tin was not included in USACE's Programmatic Sampling and Analysis Plan and therefore not included in the PWP or SS-WP.

Table 2-3. Groundwater Wells Near Assateague Island (Zimmerman 2006b; USGS 2005)

Well Name	UTM NAD 83, Zone 18 North		Well Depth (ft)	Well Screened (ft)	Well Yield (gpm)	Aquifer
	Easting (m)	Northing (m)				
WO Bg 48	490466	4249124	420	-	-	Anokin aquifer of Upper Miocene Age
WO Bh 31	493740	4246963	278	-	-	Ocean City aquifer of Upper Miocene Age
CT 1	486492.09	4228900.27	<75	-	-	-
DW 1	486477.68	4228661.74	370	-	-	-
DW 2	486574.72	4228572.81	390	-	-	-

gpm-gallons per minute
m-meter
ft-feet

UTM-Universal Transverse Mercator
NAD-North American Datum
-, information unknown/unavailable

Table 2-4 Army Checklist for Important Ecological Places

No.	Checklist Item	Yes / No[1]		Comments
1.	Locally important ecological place identified by the Integrated Natural Resource Management Plan, BRAC Cleanup Plan or Redevelopment Plan, or other official land management plans.		X	
2.	Critical habitat for Federal designated endangered or threatened species. See No. 12 below.	X		FUDS is used by designate Rare, threatened and Endangered Species.
3.	Marine Sanctuary		X	
4.	National Park	X		FUDS is part of Assateague Island National Seashore.
5.	Designated Federal Wilderness Area		X	
6.	Areas identified under the Coastal Zone Management Act	X		Eco habitat to various species within the Coastal Management Zone
7.	Sensitive Areas identified under the National Estuary Program or Near Coastal Waters Program		X	
8.	Critical areas identified under the Clean Lakes Program		X	
9.	National Monument		X	
10.	National Seashore Recreational Area	X		FUDS is part of Assateague Island National Seashore where recreational users are considered under human receptors
11.	National Lakeshore Recreational Area		X	
12.	Habitat known to be used by Federal designated or proposed endangered or threatened species	X		FUDS is used by designate Rare, threatened and Endangered Species.
13.	National preserve		X	
14.	National or State Wildlife Refuge	X		FUDS is part of Chincoteague National Wildlife refuge
15.	Unit of Coastal Barrier Resources System		X	
16.	Coastal Barrier (undeveloped)	X		Coastal barrier island dividing Chincoteague Bay from the Atlantic Ocean
17.	Federal land designated for protection of natural ecosystems		X	
18.	Administratively Proposed Federal Wilderness Area		X	
19.	Spawning areas critical for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters		X	
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		X	
21.	Terrestrial areas utilized for breeding by large or dense aggregations of animals		X	
22.	National river reach designated as Recreational		X	

Table 2-4 Army Checklist for Important Ecological Places

No.	Checklist Item	Yes / No[1]		Comments
23.	Habitat known to be used by state designated endangered or threatened species		X	
24.	Habitat known to be used by species under review as to its Federal endangered or threatened status		X	
25.	Coastal Barrier (partially developed)		X	
26.	Federally designated Scenic or Wild River		X	
27.	State land designated for wildlife or game management		X	
28.	State-designated Scenic or Wild River		X	
29.	State-designated Natural Areas	X		Assateague Island State Park and a salt-marshland owned by the Commonwealth of Virginia
30.	Particular areas, relatively small in size, important to maintenance of unique biotic communities		X	
31.	State-designated areas for protection or maintenance of aquatic life		X	
32.	Wetlands	X		FUDS includes various salt-water wetland areas
33.	Fragile landscapes, land sensitive to degradation if vegetative habitat or cover diminishes		X	

Note1: A SLERA is implemented if any of the questions are noted as a ‘yes’.

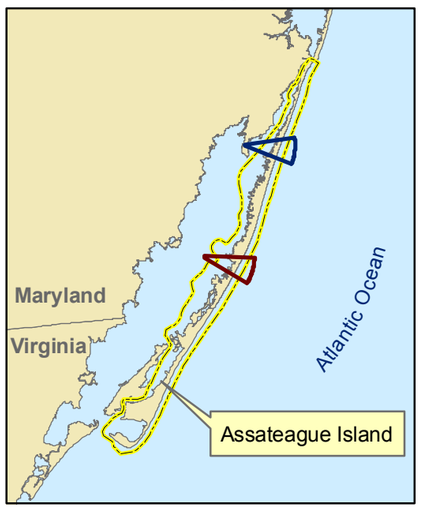
Assateague Island
Worcester, Maryland

Legend

- Rocket Range North (MRS1)
- Rocket Range South (MRS2)
- FUDS Boundary

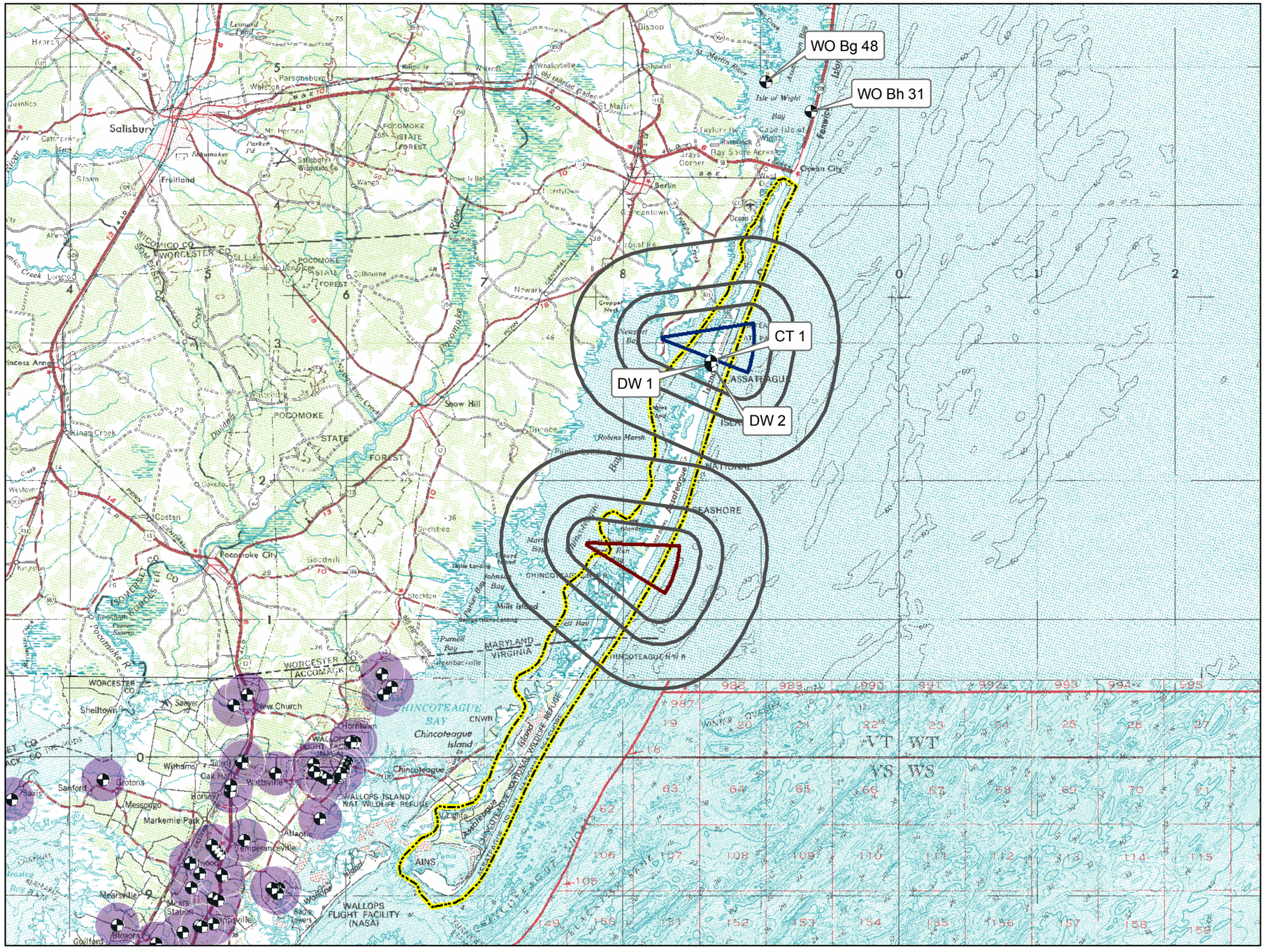
Sources:
USACE 1994, 2002
USDA Data Gateway - Topographic Map 1969

0 10
Miles



Q:\projects\GIS\6202301\assateague\FINAL\2007\Figure2-1.mxd

Figure 2-1. Munitions Response Sites for Assateague Island.



Assateague Island
Worcester, Maryland

Legend

- Well
- Wellhead Protection Area
- 1, 2 and 4 Mile Radii
- Rocket Range North (MRS1)
- Rocket Range South (MRS2)
- FUDS Boundary

Sources:
USACE 1994, 2002
VDH Office of Drinking Water 2005
USGS Water Resources Division 2005
Division of Resource Management
Assateague Island National Seashore 2007
Aerial Image - USDA Data Gateway 2005

N W E S

0 10
Miles

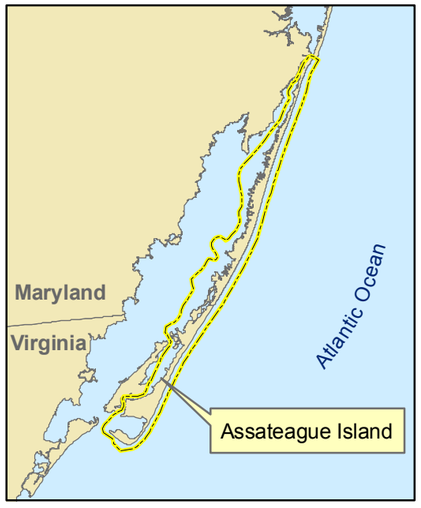


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Figure 2-2. Wells and Wellhead Protection Areas.

Assateague Island
Worcester, Maryland

1988 Incident
- Ordnance washed ashore
- EOD recovered, 7 rocket motors (one not expended), 6 5-inch shells (two live), and numerous ballistic tips

1992 Sweep
- No ordnance discovered
- Fencing, metal piping, and shipwreck found

1994 Site Visit (ASR)
- MD observed on shoreline
- Nose section of a 3.25-inch AA target rocket observed

1994 Site Investigation (Parsons 1995)
- 165 pieces of MD uncovered

Additional Findings (Locations Unknown)
- One expended mark 43 practice bomb (INPR)
- One 20mm casing (INPR)

1991 Site Visit (INPR)
- 5-inch rocket motor was discovered

1994 Site Visit (ASR)
- MD from a 5-inch HVAR rocket observed

Legend

- Anomalies Noted During January 2003 Review
- Approximate Flight Pattern (USACE 1994)
- Rocket Range North (MRS1)
- Rocket Range South (MRS2)
- Possible Disposal Areas (As indicated in INPR)
- 1994 Magnatometer Sweep
- FUDS Boundary

Sources:
USACE 1994, 2002
Parsons 1995
Follett 2003
USDA Data Gateway - Topographic Map 1969

0 5
Miles

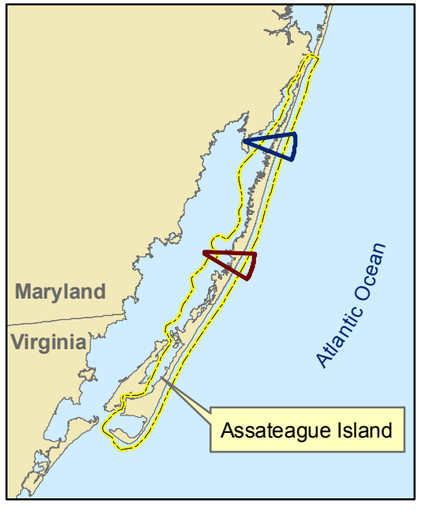

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Figure 2-3. Historical Munitions Related Findngs.

3. SITE INSPECTION ACTIVITIES

3.1 Technical Project Planning

3.1.1 The first TPP Meeting for Assateague Island was conducted on 28 March 2006 at the Assateague Island National Seashore Headquarters in Berlin, Maryland. The Final TPP Memorandum documenting the meeting was issued in April 2006 (Alion 2006a). The meeting participants included representatives from USACE Baltimore District, NPS–Assateague, Maryland Department of the Environment, Virginia Department of Environmental Quality, and the Alion Team. Participants in the TPP discussed the results of previous investigations, historical aerial photographs, the conceptual site model (CSM), and Data Quality Objectives (DQOs). Six DQOs were defined for this SI (Alion 2006a). These decision rules are stated in the DQO worksheets and summarized below.

3.1.2 **DQO 1 – Determine the presence/absence of MEC.** The basis of recommendation for RI/FS related to the presence/absence of MEC includes:

- Historic data that indicates the presence of MEC or MD
- Visual evidence or anomalies classified as MEC, MD, or material potentially presenting and explosive hazard (MPPEH)
- One or more anomalies in a target area near historic 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, MD, etc.)

3.1.3 In each of these instances, all lines of evidence (e.g., historic data, field data, etc.) are to be used to make a final recommendation for a No Department of Defense Action Indicated (NDAI) or RI/FS. If none of the above scenarios occur, then the recommendation for NDAI for MEC is a possible option.

3.1.4 **DQO 2 – Eliminate from further consideration those releases that pose no significant threat to public health or the environment by collecting adequate samples to assess the presence or absence of MC at the site.** The basis of recommendation for RI/FS related to the presence/absence of MC includes:

- Maximum concentrations at the site exceed EPA Region III Risk-Based Concentrations (RBCs) based on current and future land use.

- Maximum concentrations at the site exceed EPA interim ecological risk screening values.
- Maximum concentrations at the site exceed site-specific background levels.
- Data indicating the presence or absence (less than method detection limits for metals and less than the reporting limit for explosives) of analytes for which no screening criteria (decision limits: RBCs, etc.) are available are to be used to support the weight-of-evidence evaluation of MC at the site.

3.1.5 In each of these instances, all lines of evidence (e.g., historic data, field data, etc.) are to be used to make a final recommendation for NDAI or RI/FS. If none of the above scenarios occur, then the recommendation for NDAI for MC is a possible option.

3.1.6 **DQO 3 – Determine the potential need for an emergency response action and/or Time Critical Removal Action (TCRA) of MEC by collecting and analyzing data from previous investigations/reports, conducting site visits, and performing analog geophysical activities, as appropriate.** The basis for recommendations are specified below:

- A TCRA **–** If there is a complete pathway between source and receptor and the MEC 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 6 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 6 months planning time is available.

3.1.7 In each of these instances, all lines of evidence (e.g., historic data, field data, etc.) are to be used to make a final recommendation for a TCRA or NTCRA.

3.1.8 **DQO 4 – Collect data and complete related analyses to determine if an RI/FS is necessary.**

- Refers to culmination of DQOs 1 and 2

3.1.9 **DQO 5 – Collect or develop additional data, as appropriate for EPA to support potential HRS scoring.**

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

3.1.10 **DQO 6 – Collect the additional data necessary to complete the MRSPP.**

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

3.1.11 The TPP meeting participants concurred with the DQOs and the general technical approach for the planned SI activities discussed during the TPP and as revised and subsequently documented in the Final SS-WP (Alion 2006b). In summary, these agreements were to inspect the cited areas of concern and conduct multimedia sampling in accordance with the Final SS-WP and complete the assessment in accordance with the DQOs (see Appendix B). As part of this SI Report, Alion evaluated the DQOs presented in the SS-WP (Alion 2006b) and completed a DQO attainment verification worksheet to document completion of the DQOs (see Appendix B).

3.2 Supplemental Records Review

3.2.0.1 State 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 All of the species located within Assateague State Park and Assateague Island National Seashore (including surrounding waters) and their statuses are listed in Table 3-2 of the SS-WP, as provided by Mr. Carl Zimmerman, the Resource Management Specialist for Assateague Island National Seashore and confirmed by the Maryland Department of Natural Resources (DNR) (Zimmerman 2006a, DNR 2004, and DNR 2006).

3.2.2 Cultural and Archaeological Resources

3.2.2.1 Several historical sites exist on Assateague Island, some of which are included in the NPS List of Classified Structures. Some artifacts of Native American hunting and fishing tools have been found on the island (USACE 1994). A thorough archaeological survey of the island has not been conducted. Given the island's setting and dynamics, undisturbed archaeological sites are unlikely to be discovered in the future (USACE 1994). Past and current improvements include: the Pope Island Boathouse, the site of the former North Beach Lifesaving Station, the site of Birchs Saltworks, the former site of Green Run Lifesaving Station, the site of Scotts Ocean House, the site of Green Run Village, Green Run Cemetery, Assateague Beach Coast Guard Station, the ruins of Seaboard Oil and Guano Co., Conant Brothers Fish Factory, the site of Pope Island Lifesaving Station, and Assateague Lighthouse (USACE 1994). These cultural and archaeological areas were avoided during the SI field work.

3.3 Site Inspection Fieldwork

3.3.1 On 6 through 8 December 2006 the Alion field team visited Assateague Island to conduct SI field activities in accordance with the PWP and the Final SS-WP (Alion 2005, 2006d). A qualitative site reconnaissance for MEC and sample collection and analysis for possible MC contamination was completed. A total of 32 acres were assessed through qualitative reconnaissance.[6] A total of 8 surface soil (including 3 background samples), 9 subsurface soil, 2 sediment, 2 surface water, and 2 groundwater samples were collected.

3.3.2 MEC reconnaissance findings and MC sample results are discussed in Sections 4 and 5, respectively. As-collected sample locations, sample designations, and sampling rationale are summarized in Table 3-1. Sampling locations are depicted on Figures 3-1 and 3-2. Additional information pertaining to the field activities, including field notes, forms, and chain of custodies, has been included in Appendix D. A photo documentation log from the SI is included in Appendix E.

3.4 Work Plan Deviations and Field Determinations

3.4.1 Deviations from the Final SS-WP (Alion 2006b) occurred mostly with respect to sample locations. No ROE could be obtained from the State of Maryland. Consequently two samples (one groundwater sample ASI-RN-GW-15-01 [from a U.S. Geological Survey well] and one soil sample ASI-RN-SB-12-18-01) originally located on State of MD property had to be relocated to NPS property. The groundwater sample from Rocket Range North (MRS 1) was collected from the red outdoor faucet within the northern parking lot area, just south of MRS 1 (refer to Figure 3-1). The soil sample was moved into the range on NPS property. [7]Additionally, surface soil sample ASI-RS-SS-02-03 was modified in the field to be a subsurface soil sample (12 to 18 inches deep), ASI-RS-SB-12-18-05. This sample was collected in an area suspected to be a former burial area and it was determined in the field that the most likely impacted area would be beneath the top 12 inches of soil cover.

[6] A qualitative site reconnaissance is a site survey technique using both visual observations and analog geophysics to identify if MEC/MD is present or absent . Analog geophysics is implemented using a meandering reconnaissance in and around sampling locations to identify ranges, target areas, MPPEH/MEC, MD or other areas of interest (areas containing possible bomb craters, backstops, or other areas containing distressed vegetation. Visual observations, documented through GPS, field log notes, and photography, are used to support this reconnaissance, both to identify possible areas of concern as well as classify any identified MPPEH.

[7] The Alion Team contacted the CENAB Project manager at various times during the week of 4 December 2006 to discuss sampling options, ROE issues etc. The Alion team received concurrence to move/relocate samples based on access issues and the observed presence of groundwater/surface in the MRSs.

3.4.2 The groundwater sample planned in Rocket Range South (MRS 2) was not collected from the monitoring well specified in the SS-WP due to accessibility issues. The sampling team could not reach the planned western location due to water formations. The sample was collected from a hand-dug hole in the sand (refer Figure 3-2 for sample location).

3.4.3 According to the SS-WP, two surface water samples, with co-located sediment samples, were planned for Rocket Range South (MRS 2) because surface water was not presumed to be present in Rocket Range North (MRS 1) based on available data. During the field work, surface water was located in the north, and one of the surface water samples, along with a co-located sediment sample, was relocated to MRS1.

3.4.4 Soil samples planned for the beach area in the Southern Range (MRS 2) were relocated to the target area when planned sampling locations did not provide evidence of target impacts. Additional information pertaining to the field activities, including the field notes and forms is provided in Appendix D.

3.4.5 The deviations noted above did not affect the merit of the SI and, in several instances, enhanced the data collection process by biasing samples towards areas of expected contamination where feasible.

3.5 SI Laboratory Data Quality Indicators

3.5.1 This section summarizes the data quality assessment for the Assateague Island SI analytical data. Data were generated by GPL Laboratories under the DoD Quality Systems Manual (QSM) Version III and validated by a third-party validate (EDS) using EPA Region III Functional Guidelines. The data also were analyzed using the Automated Data Review (ADR) Version 8.1 based on the DoD QSM Version III guidelines, and these results are included in the EDMS data base. The detailed GPL and EDS reports are contained in Appendix F and G, respectively. Data Quality Indicators (DQIs) include precision, accuracy, representativeness, completeness, and comparability (PARCC) as well as sensitivity. At Assateague Island, quality assurance split samples were not collected as per CENAB direction; therefore, a Corps Quality Assurance Report was not included for this FUDS.

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 (RPD) between the separate measurements [usually matrix spike/matrix spike duplicate (MS/MSD) pairs] and the observed RPD compared to acceptable values based on and Region III Functional

Guidelines. Any differences between MS/MSD pairs for the Assateague Island data were examined and any affected sample results qualified as discussed in the Region III Functional Guidelines. Field precision is measured by the comparison of field duplicate samples, which also are discussed as appropriate in Appendix G. No significant RPD was observed in field duplicates from Assateague Island.

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 which has been spiked with a known concentration is analyzed by the laboratory as the MS, MSD, or Laboratory Control Spike, Surrogate, and Blank Spikes. EDS assessed accuracy according to Region III Functional Guidelines and have qualified any affected analytical results as necessary as shown in 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. All planned samples were collected and analyzed, although some sample locations were moved. The representative DQI has been achieved for Assateague Island.

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 all acceptance criteria including accuracy, precision, and any other criteria specified by the particular analytical method being used. All field samples were collected as planned in the SS-WP (although some were relocated to different areas, and no analyses were rejected out of the total 1,073 analytical measurements taken for this FUDS (refer to Appendix G). Consequently, the Assateague Island data meet the completeness data quality indicator.

3.5.6 Comparability expresses the confidence with which one data set can be compared to another. There are no previous analyses of MC at Assateague Island for comparison of reported concentrations from this project. Standard methods for sampling and analyses were followed as documented in the SS-WP; therefore, the comparability DQI has been achieved.

3.5.7 Sensitivity is a measure of the screening criteria as they compare to detection limits[8]. If screening criteria are below detection limits the certainty of "non-detected" data is called into question. The laboratory reported to the reporting limit (RL) for explosives, which represents the lowest concentration for which a standard was assessed; consequently, if screening values are greater than explosive detection limits, the DQI is achieved. For metals, the laboratory report to the method detection limit, this represents the lowest concentration that is detectable above instrument noise. No calibration standards are analyzed between the MDL and RL; consequently, this adds uncertainty for nondetected metals. Based on the data sensitivity analysis with respect to non-detections presented in Section 5.1.4, the objective for sensitivity has been achieved for all analytes where screening values are available, except for nitroglycerin (NG). In the later instance, the screening value was revised recently from the value presented in the Final SS-WP and without factoring in this recent revision, the sensitivity objective would have been achieved for NG. Because the revised NG screening value is lower than the laboratory detection limit the sensitivity MQO for NG in groundwater has not been achieved, and this represents a source of uncertainty in the evaluation. A discussion on data sensitivity with respect to non-detections is presented in Section 5.1.4.

3.6 Second TPP Meeting

3.6.1 On the 10th and 25th of September 2007, stakeholders had the opportunity to participate in a second and third TPP meeting 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 have been achieved (Alion 2006a and 2006d). Two memorandums, which summarize the discussions that occurred during each meeting, are included in Appendix B.

3.6.2 The following decisions were agreed upon during the second TPP meeting which included NPS and USACE personnel:

- A footnote will be added to Table 6 of the EHE Module in the MRSPP Tables for both MRS 1 and MRS 2 indicating the number of visitors on Assateague Island during the summer months. Additionally this information will be included in Section 2.3.3 of the SI Report.
- The HHE Module of the MRSPP Tables for MRS 2 will be revised to depict that there is a low potential for human interaction with each media potentially affected by MC.

[8] The method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater then zero and is determined from analysis of a sample in a given matrix containing the analyte (Alion 2005).
The method reporting limit (RL) is established at a factor of five to ten times the MDL for the majority of target analytes but no lower then three times the MDL for any target analyte (Alion 2005).

- Comments regarding the Draft Final SI Report were to be submitted to Anisha Downs by 7 September 2007 to be included in the Final SI Report. Additional comments received after this date will be incorporated into the Final SI Report as replacement pages and/or an addendum.
- TPP #2 Memorandum would be submitted to stakeholders within a few days for review and comment. Comments on TPP Meeting #2 are due by 14 September 2007.
- The USACE and NPS agreed that a RI/FS was warranted at this time for MRS 1 and MRS 2 for Assateague Island.

3.6.3 The following decisions were agreed upon during the third TPP meeting which included Maryland Department of the Environment (MDE), Environmental Protection Agency (EPA) and USACE personnel:

- Table 2 of the EHE Module in the MRSPP Tables for MRS 1 will be revised to indicate the area may have been used as a former range.
- Ms. Able will contact Mr. Zimmerman to find out if MRS 2 is used for camping and, if so, determine the approximate number of annual campers that visit the area. Table 7 will be revised to reflect the additional information provided. This comment is presumed to apply to MRS 1 as well even though stakeholders did not specifically call out this MRS. [*The information was received from NPS and the MRSPP Table 7 for MRS 2 have been updated from a 0 to a 1.]*
- Comments regarding the Draft Final SI Report were to be submitted to Anisha Downs by 7 September 2007 to be included in the Final SI Report. Additional comments received after this date will be incorporated into the Final SI Report as replacement pages and/or an addendum.
- TPP #3 Memorandum would be submitted to stakeholders within a day for review and comment. Comments on TPP Meeting #3 are due by 27 September 2007.
- There were no objections to the conclusions presented in the SI (i.e. that an RI/FS was warranted at this time for MRS 1 and MRS 2 for MEC at Assateague Island).
- Ms. Anisha Downs will contact with Mr. Zimmerman to determine what is currently is being done at Assateague Island and determine a future course of action regarding educating the public on MEC.

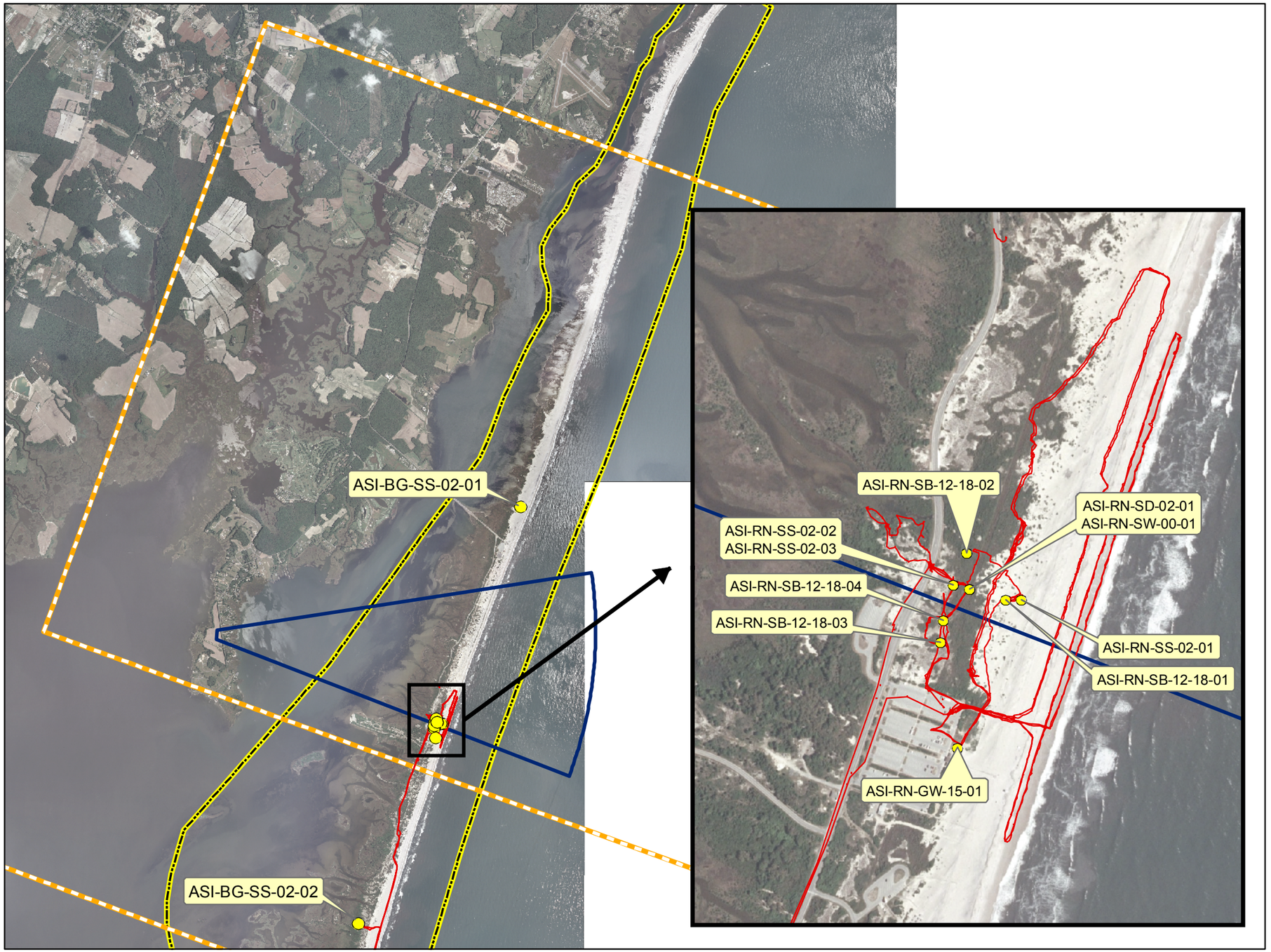
Table 3-1. Sample Locations					
Range	**Sampling ID**	**Coordinates (UTM NAD 83, Zone 18, Meters)**		**Area of Interest / Rationale of Sampling Locations**	**Field Observations or Modifications**
		Easting (m)	**Northing (m)**		
Rocket Range North (MRS1)	ASI-RN-SS-02-01*	486862	4228990	Slightly north of 1994 magnetometer sweep.	Near metal debris.
	ASI-RN-SS-02-02	486743	4229016	Near historical findings of munitions debris.	Adjacent to surface metal debris.
	ASI-RN-SS-02-03	486743	4229017	Near historical findings of munitions debris, southern part of Stinger-One Rocket Range.	None.
	ASI-RN-SB-12-18-01	486835	4228990	Slightly north of 1994 magnetometer sweep, near Stinger-One target area.	None.
	ASI-RN-SB-12-18-02	486766	4229072	Near historical findings of munitions debris, southern part of Stinger-One Rocket Range.	In location of 2 subsurface anomalies in dense vegetation.
	ASI-RN-SB-12-18-03	486720	4228916	Area of historical findings of munitions debris, southern part of Stinger-One Rocket Range.	Near anomaly.
	ASI-RN-SB-12-18-04	486725	4228954	Near historical findings of munitions debris, southern part of Stinger-One Rocket Range.	None.
	ASI-RN-SW-00-01	486771	4229009	Near Northern range bombing target area.	One surface water sample was moved from MRS 2 to MRS 1 when surface water was identified on the MRS.
	ASI-RN-SD-02-01	486771	4229009	Near Northern range bombing target area.	One sediment sample was moved from MRS 2 to MRS 1 when surface water was identified on the MRS.

Table 3-1. Sample Locations					
Range	**Sampling ID**	**Coordinates (UTM NAD 83, Zone 18, Meters)**		**Area of Interest / Rationale of Sampling Locations**	**Field Observations or Modifications**
		Easting (m)	**Northing (m)**		
Rocket Range North (MRS 1) (continued)	ASI-RN-GW-15-01	486750	4228732	Groundwater sample near Stinger-One Rocket range.	Collected from red spicket at parking lot area near northern range.
Rocket Range South (MRS 2)	ASI-RS-SS-02-01*	481479	4213792	Southern part of Stinger-Two Rocket Range, near possible disposal site / anomaly identified in 2003.	None.
	ASI-RS-SS-02-02	481693	4214356	Southern part of Stinger-Two Rocket Range, near possible disposal site on western shore.	None.
	ASI-RS-SB-12-18-01	481512	4214508	Middle part of Stinger-Two Rocket Range, near possible disposal site, western shore.	None.
	ASI-RS-SB-12-18-02	482195	4215135	Middle part of Stinger-Two Rocket Range, near possible disposal site, eastern shore.	None.
	ASI-RS-SB-12-18-03	483161	4216918	Central part of Stinger-Two Rocket Range, near possible disposal site.	None.
	ASI-RS-SB-12-18-04	483036	4217145	Southern part of Stinger-Two Rocket Range, near possible disposal site / anomaly identified in 2003.	None.
	ASI-RS-SB-12-18-05	483160	4217317	Southern part of Stinger-Two Rocket Range, near possible disposal site / anomaly identified in 2003.	This sample was modified from a surface soil sample to be a subsurface soil sample. It was located in a suspect disposal area.

Table 3-1. Sample Locations

Range	Sampling ID	Coordinates (UTM NAD 83, Zone 18, Meters)		Area of Interest / Rationale of Sampling Locations	Field Observations or Modifications
		Easting (m)	Northing (m)		
Rocket Range South (MRS 2) (continued)	ASI-RS-SD-02-01	481609	4214464	Sediment from water body on southwest part of Stinger-Two Rocket Range.	None.
	ASI-RS-SW-00-01	481609	4214464	Surface water on southwest part of Stinger-Two Rocket Range.	None.
	ASI-RS-GW-02-01*	481725	4214449	Southern portion Stinger-Two Rocket Range.	This sample was modified due to accessibility issues. The sampling team could not reach the planned western location due to water formations. The sample was collected from a hand-dug hole in the sand (approved by CENAB prior to field event).
Background	ASI-BG-SS-02-01	488238	4232792	North of Stinger-One Rocket Range.	None.
	ASI-BG-SS-02-02	485400	4225471	Located between Stinger-One and Stinger-Two Rocket Ranges (central part of the island).	None.
	ASI-BG-SS-02-03	483947	4219755	South of Stinger-Two Rocket Range.	None.

Assateague Island Site Inspection – December 2006
* Indicates a duplicate sample was collected.



Assateague Island
Worcester, Maryland

Legend

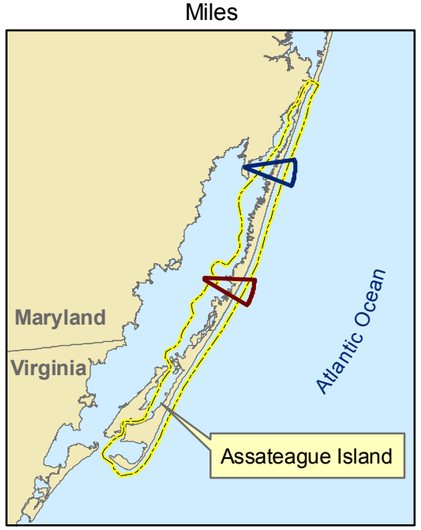
- Field Sample Location
- Geophysical Reconnaissance Route
- Approximate Flight Pattern (USACE 1994)
- Rocket Range North (MRS1)
- Rocket Range South (MRS2)
- FUDS Boundary

Sample ID Designation
"ASI-RN-SS-02-01"
Site Name-Sampling Location-Sample Type-Sample Depth-Sample #

Note:
Samples were collected during December 2006

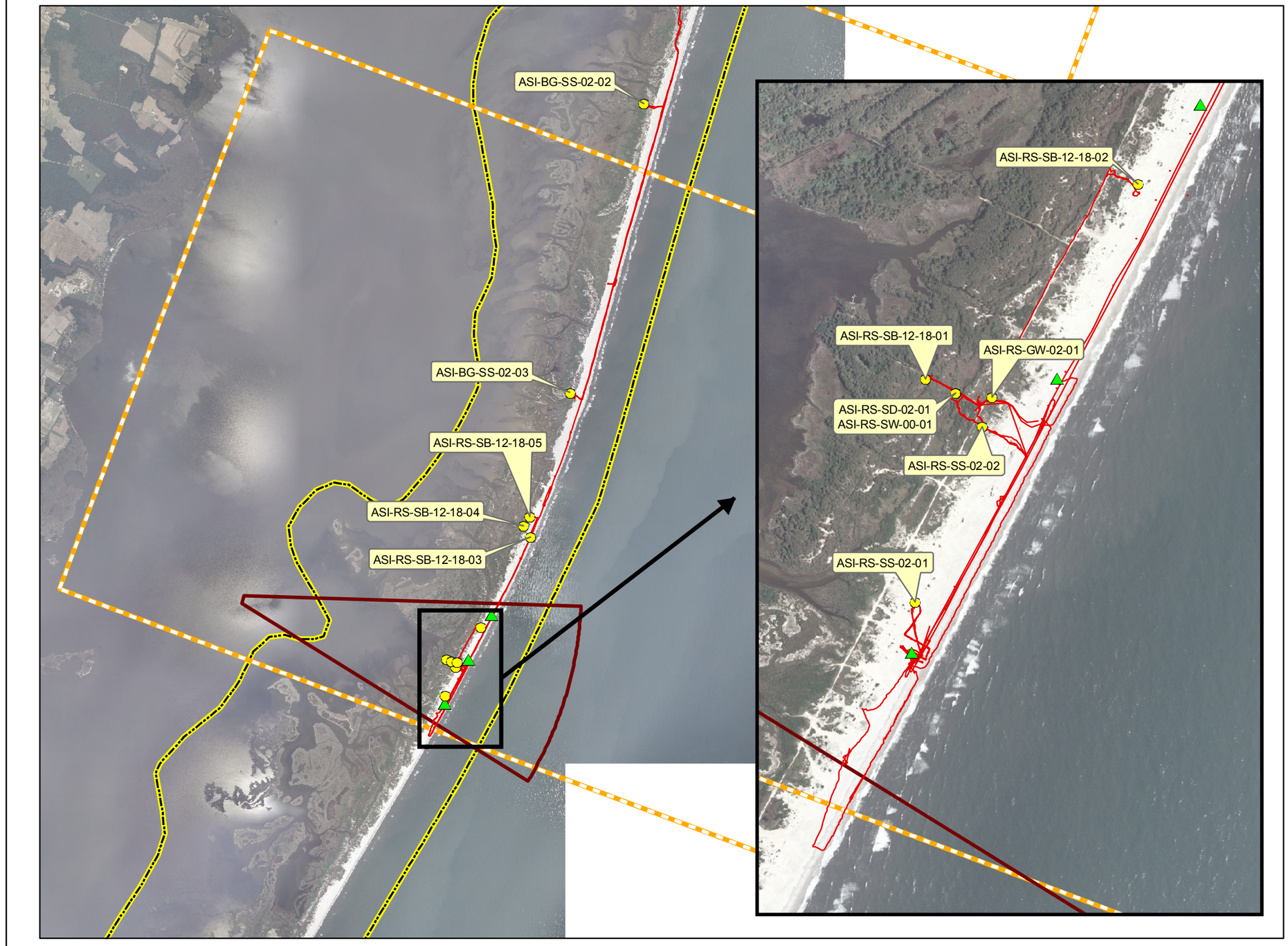
Sources:
USACE 1994, 2002
Aerial Image - USDA Data Gateway 2005

0 2
Miles



Q:\projects\GIS\6202301\assateague\FINAL\2007\Figure3-1.mxd

Figure 3-1. Stinger One Range Sample Locations and Geophysical Site Reconnaissance.



Assateague Island
Worcester, Maryland

Legend

- Field Sample Location
- Anomalies noted during January 2003 review
- Geophysical Reconnaissance Route
- Approximate Flight Pattern (USACE 1994)
- Rocket Range North (MRS1)
- Rocket Range South (MRS2)
- FUDS Boundary

Sample ID Designation
"ASI-RN-SS-02-01"
Site Name-Sampling Location-Sample Type-Sample Depth-Sample #

Note:
Samples were collected during December 2006

Sources:
USACE 1994, 2002
Aerial Image - USDA Data Gateway 2005

0 2
Miles

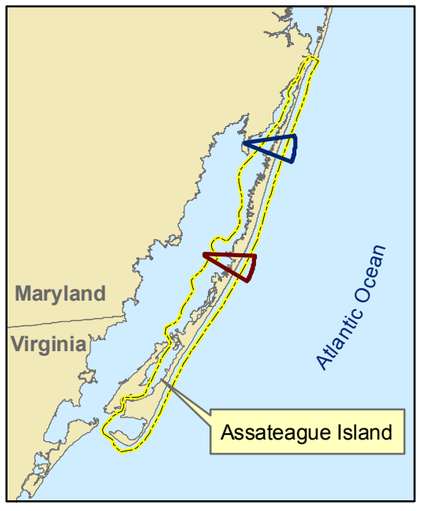


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Figure 3-2. Stinger Two Range Sample Locations and Geophysical Site Reconnaissance.

4. MEC SCREENING LEVEL RISK ASSESSMENT

4.1 Operational History

4.1.1 Historical documentation and interview reviews performed as part of the SI indicated munitions including: rocket motors, 5-inch shells, rocket tips, MK 43 practice bombs, and 20-mm casings were used and/or found at the Assateague Island. Historical documents, including the INPR, ASR, and ASR Supplement, confirmed that MEC and MD have been found at the FUDS.

4.1.2 The ranges, as documented in the ASR Supplement and described in Section 2.2, include Rocket Range North (MRS 1) and Rocket Range South (MRS 2), which are presented in Table 2-2.

4.2 Site Inspection Munitions and Explosives of Concern Field Observations

4.2.0.1 A qualitative reconnaissance based on both visual observations and analog geophysics was completed. A visual reconnaissance of the site surface was completed to identify MPPEH, MD, MEC, suspect areas, such as distressed vegetation, stained soil, target remnants, and visual metallic debris. Analog geophysics was used primarily to support anomaly avoidance activities for the field crew. Where appropriate, subsurface anomalies possibly attributable to MEC or MD were documented.

4.2.0.2 The total estimated acreage subject to the qualitative reconnaissance is approximately 32 acres.[9] .

4.2.1 Rocket Range North (MRS 1)

4.2.1.1 Rocket Range North encompasses 583 acres. Alion completed qualitative reconnaissance of the former rocket range target area (MRS 1). The field team focused additional reconnaissance south of MRS 1, along the shoreline (conducted during low and high tides), where suspect burial pits potentially were located. Site reconnaissance and sampling locations are shown on Figure 3-1. Range observations are presented below:

- This MRS is located on a public beach/park area accessible by paved road.
- An asphalt parking lot lined the south boarder of the MRS.

[9] Extent of reconnaissance estimated from global positioning system (GPS) tracks and includes a 25-ft radius around each sample and observations along the GPS tracks covering a 6-ft swath.

- The eastern shoreline was void of vegetation and separated by sand dunes from the densely vegetated western part of the site.
- There was no visible evidence of craters, impact areas, or the former target.
- Cultural debris, which included remnants of a metal and wooden fence, was observed near sand dunes.
- Suspect MD or cultural debris was observed in the former target area.
- No MPPEH or MEC was observed.
- 19 subsurface anomalies were identified.
- A pool of surface water was noted in the former target area; therefore, a surface water sample and a sediment sample were relocated to this area.
- Three composite surface soil samples (at a depth of 0 to 2 inches), four discrete subsurface soil samples (at a depth of 12 to 18 inches), one sediment sample, one surface water sample, and one groundwater sample were collected in the rocket range area.

4.2.2 Rocket Range South (MRS 2)

4.2.2.1 Rocket Range South encompasses 563 acres. Alion completed qualitative reconnaissance of the former rocket range target area (MRS 2). The field team focused additional reconnaissance along the shoreline (conducted during low and high tides) of MRS 2 where suspect burial pits could be located and near three subsurface anomalies identified during the 2003 Baltimore District Site Visit (Follett 2003). Site reconnaissance and sampling locations are shown on Figure 3-2. Range observations are presented below:

- This MRS is located remotely on the south part of the island and accessible to recreational users (hunters) by vehicular transport along the beach.
- The eastern shoreline was void of vegetation and separated by sand dunes from the densely vegetated western part of the site.
- There was no visible evidence of craters, impact areas, or the former target area.
- Cultural debris, which included remnants of a metal and wooden fence, was observed near sand dunes.
- Historical anomalies (noted during the 2003 Baltimore District Site Visit) were not identified, although one “large metal float” was noted near one of the suspect anomalies.
- One subsurface anomaly was identified.
- No MD, MPPEH, or MEC was observed.
- A surface soil sample was changed to a subsurface soil sample (ASI-RS-SB-12-18-05) because it was located in a potential disposal area.

- Two composite surface soil samples (at a depth of 0 to 2 inches), five discrete subsurface soil samples (at a depth of 12 to 18 inches), one sediment sample, one surface water sample, and one groundwater sample were collected in the rocket range area.

4.2.3 Background Samples

4.2.3.1 As discussed at the TPP meeting, three surface soil background samples were collected on Assateague Island in areas with similar soil types as the primary soil samples and outside former range areas (i.e., in areas where there is no historic munitions-related use). No evidence of MEC or MD was observed in the vicinity of or at any of the background sample locations. Site reconnaissance and sampling locations are shown on Figures 3-1 and 3-2.

4.3 MEC Risk Assessment

4.3.0.1 A qualitative MEC screening level risk assessment was conducted based on the SI qualitative reconnaissance, as well as historical data documented in the INPR, ASR, and ASR Supplement (USAESCH 2001). An explosive safety risk is the probability for an MEC item to detonate and potentially cause harm as a result of human activities. An explosive safety risk 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 risk depends on the presence of three elements: a source (presence of MEC), a receptor (person), and interaction (e.g., touching or picking up an item). The CSM for each MRS reflects this MEC assessment strategy (Appendix J).

4.3.0.2 The exposure route for an MEC receptor typically is direct contact with an MEC item on the surface or through subsurface activities (e.g., digging during farming or construction). A MEC item tends to remain in place unless disturbed through human or natural forces (e.g., frost heaving and erosion). If MEC movement occurs, the probability of direct human contact may increase, but not necessarily result in direct contact or exposure.

4.3.0.3 Each of these primary risk factors were used to evaluate the field and historic data to generate an overall hazard assessment rating of either low, moderate, or high. An evaluation of low risk indicates that the MEC type would not result in major injury or the item is insensitive or inert; site characteristics are such that there is limited to no site access and the site is stable; and potential for contact is low for either surface or subsurface based on human receptor activities and the population accessing the site. An evaluation of high risk indicates that the MEC type would result in major injury or the item is sensitive; site characteristics are such that there is frequent access and the site is unstable; and potential for contact is high for either surface or subsurface based on human receptor activities and the population accessing the site.

4.3.1 Rocket Range North (MRS 1)

4.3.1.1 As discussed in Sections 3 and 4, MEC and MD have been recovered in MRS 1. During a previous investigation in 1988, an EOD team recovered seven rocket motors (one not expended), six 5-inch shells (two were live), and numerous ballistic tips from practice rockets in and around Rocket Range North (Figure 2-3) (USACE 1994). During the 1994 site visit (Parsons 1995), the ASR survey team located 165 pieces of rocket MD in Rocket Range North (MRS 1). Previous munitions-related findings are noted on Figure 2-3. No MEC was identified during the SI reconnaissance; however, suspect MD or potential cultural debris and 19 subsurface anomalies were observed in the former target area.

4.3.1.2 No documented injuries have occurred since the FUDS property was transferred . There are no fences restricting access to Rocket Range North (MRS 1) and there is a paved road running north to south through the site. The MRS contains a public beach, trails, and campgrounds which are accessible to park visitors. The most likely human receptors are recreational users and park personnel who may travel through the park on foot or by vehicle.

4.3.1.3 Based on the 1994 site investigation (Parsons 1995), which included extensive reconnaissance on the eastern shore of MRS 1 and the removal of MD, the extent of the remaining contamination is estimated to be relatively small. This conclusion is based on the historical use of the area and the numerous follow-up investigations of the area that were a result of the 1988 Case Incident. The overall MEC risk is considered low to moderate.

4.3.2 Rocket Range South (MRS 2)

4.3.2.1 As discussed in Sections 3 and 4, historical investigations or sweeps of MRS 2 have not identified MEC on the surface or subsurface; however, MD was observed during the 1991 and 1994 site visits. The MD observed was associated with 5-inch rocket motors during both visits. A summary of previous munitions-related findings is included on Figure 2-3. The 1994 INPR and ASR identified possible burial pits for munitions in this area (USACE 1994). During the SI reconnaissance, the field team was unable to relocate the subsurface anomalies potentially associated with these burial pits identified during 2003 site visit. No MEC or MD was identified and only one subsurface anomaly was observed during the SI reconnaissance.

4.3.2.2 No documented injuries have occurred since the FUDS property was transferred. There are no fences restricting access to Rocket Range South (MRS 2) and vehicles may access the site by driving along the beach, in designated areas. The MRS contains beaches and trails, predominately used by hunters, which are accessible to park visitors. The most likely human

receptors are recreational users and park personnel who may travel through the park on foot or by vehicle.

4.3.1.3 Given the limited historical findings during previous investigations, MD from rockets and no MEC, the extent of the contamination is estimated to be relatively small. This conclusion is based on the historical use of the area and the numerous follow-up investigations of the area that were a result of the 1988 Case Incident (USACE 1994) on Rocket Range North (MRS 1). The overall MEC risk is considered low to moderate.

5. MUNITIONS CONSTITUENTS SAMPLING AND ANALYSIS

5.0.1 The analytical results for the MC sampling are presented below along with the screening methodology and the results of the screening assessment. Data are provided by MRS and grouped by media within each MRS.

5.1 Data Evaluation Methodology

5.1.0.1 The following sections present the process used to evaluate the MC data collected for the FUDS. This process is consistent with the decision rules outlined in Section 3.1. Identification/refinement of MC associated with munitions used at each MRS is discussed below.

5.1.1 Refinement of Munitions Constituents

5.1.1.1 During the SI process, the Alion Team further evaluated the munitions reportedly used at the site. Research was conducted to refine the specific list of constituents potentially associated with each MRS/range based on munitions reportedly used. Refinement of the MC list is presented in Table 2-2. **Samples were analyzed for the full target analyte list of metals and target compound list of explosives** in accordance with the approved SS-WP (Alion 2006b). **Summary tables are arranged by media and contain the complete analyte lists**. ***However, the following discussions are limited to those analytes associated with past munitions use.*** The revised list of MC for each MRS is provided below (refer to Table 2-2):

5.1.1.2 Rocket Range North (MRS 1)

- Explosives (methyl-2,4,6-trinitrophenylnitramine [tetryl], hexahydro-1,3,5-trinitro-1,3,5-triazine [RDX], dinitrotoluene[DNT], black powder[10], nitrocellulose[11], NG)
- Metals (aluminum, antimony, iron[12], lead, magnesium[9], potassium[9], titanium, zinc)
- Perchlorate[13]

[10] Black powder is composed of 75 percent saltpeter, 16 percent charcoal, and 11 percent sulfur. No analysis was performed on this MC given its composition.

[11] Nitrocellulose, or guncotton, is cotton nitrated with nitric acid and sulfuric acid. No analysis was performed on this MC given its composition.

[12] Iron, magnesium, and potassium are essential nutrients and are excluded from further consideration as chemicals of potential concern/chemicals of potential ecological concern (COPC/COPEC). For completeness, iron, magnesium, and potassium are listed with the other MC but they are not further evaluated as MC. Refer to Section 5.1.3 for additional information regarding the screening process.

5.1.1.3 Rocket Range South (MRS 2)

- Explosives (tetryl, RDX, DNT, black powder[7], nitrocellulose[8], NG)
- Metals (aluminum, antimony, iron[9], lead, magnesium[9], potassium[9], titanium, zinc)
- Perchlorate[10]

5.1.1.4 Both rocket ranges were likely used for the same purpose with the same munitions. Therefore, each MRS was evaluated for the combined list of MC of potential use which includes four explosives (RDX, tetryl, NG, and DNT), five metals (aluminum, antimony, lead, titanium, and zinc), and perchlorate[11]. The list used to evaluate excludes those essential nutrients as discussed below.

5.1.2 Data Quality

5.1.2.1 All of the samples noted in this bulleted list below have been sampled by Alion, analyzed by GPL Laboratories, and validated using EPA Region III validation guidance:

- five surface soil samples (between 0 and 2 inches bgs)
- nine subsurface soil samples[14] (between 12 and 18 inches bgs)
- two surface water samples
- two sediment samples
- two groundwater samples
- three background surface soil samples
- three duplicate samples (one groundwater and two soil)

5.1.2.2 The first step in the process of identifying chemicals of potential concern (COPCs) and chemicals of potential environmental concern (COPECs) is the evaluation of analytical data on the basis of qualifiers in each medium of concern. Inclusion or exclusion of data on the basis of analytical qualifiers is performed in accordance with EPA guidance (EPA 1989) and considers the following:

[13] Perchlorate is a common tracer in munitions which represents less than 5 percent of the MC. MC sampling typically focuses on primary constituents. Nevertheless, perchlorate was included as an analyte in accordance with USACE guidance and stakeholder agreements.

[14] During the planning process, stakeholders agreed "subsurface" soil samples at a depth of 12 to 18 inches would be collected (Alion 2006b). General human and ecological interaction with soil occurs at a depth of less than 1 ft, which for the purpose of the risk screening, was considered to be surface soil. Subsurface soil constitutes soil at a depth greater than 1 ft, where both human and ecological interaction with the soil is much less likely and specific to isolated circumstances; therefore, these "subsurface" soil samples were evaluated in terms of human health risk screening only in accordance with EPA guidance (EPA 1997).

- Analytical results bearing the U or UJ qualifiers (indicating that the analyte was not detected at the given detection limit) are retained in the data set.
- Analytical results bearing the J qualifier (indicating that the reported value was estimated) are retained at the measured concentration.
- Analytical results bearing the K qualifier (indicating that the reported value may be biased high) are retained at the measured concentration.
- Analytical results bearing the L qualifier (indicating that the reported value may be biased low) are retained at the measured concentration.
- Analytical results bearing the N qualifier (indicating that the spiked recovery was not within normal limits) are retained at the measured concentration.
- Analytical results bearing the B qualifier (indicating the chemical was detected in an associated blank) are retained at the measured concentration if greater than five times the concentration reported for the associated blank or ten times for common laboratory contaminants.
- Analytical results bearing the R qualifier (indicating that the analytical results are not usable) are deleted from the data set.

5.1.3 Screening Values

5.1.3.1 Initial screening for metals is conducted against background concentrations (Table 5-1) to determine which analytes proceed to the human health and ecological screening evaluation. Screening for human health COPCs is conducted by comparing maximum detected chemical concentrations to EPA Region III RBCs, as shown in Tables 5-2 through 5-5. The complete report of the analytical results and the analytical quality assurance/quality control (QA/QC) report are included in Appendix F and G, respectively. In accordance with EPA guidance, RBC values used are those at a cancer risk level of $1x10^{-6}$ and a non-cancer hazard quotient (HQ) of 0.1, for the purposes of screening. To account for potential additivity of non-carcinogenic hazards, non-carcinogenic PRGs have been divided by 10 for screening purposes.

5.1.3.2 For the ecological risk screening, the soil sample analytical results are compared to ecological soil screening levels presented in Table 5-6. The site concentrations in the various media were compared to the corresponding screening value (Tables 5-2 through 5-5). If the concentration exceeded the screening value that analyte was retained as a possible COPC/COPEC. In accordance with EPA guidance, the following screening process is utilized:

1. The concentration of each detected chemical is identified.

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

3. 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.

4. An analyte is eliminated from the list of COPCs/COPECs if the analyte is an essential nutrient of low toxicity, and its reported maximum concentration is unlikely to be associated with adverse health impacts. COPCs/COPECs excluded from further consideration on this basis include iron, magnesium, and potassium.

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

5.1.4.1 Current EPA guidance (EPA 1989 and 2001) requires that detection limits be addressed, particularly as related to the screening values used to select COPCs/COPECs. For explosives the laboratory reported down to the laboratory reporting limit and for metals the laboratory reported down to the method detection limit. If a chemical is never detected, but the detection limit is higher than the screening value, or there is no screening value, then it may or may not be appropriate to designate the chemical as a COPC/COPEC, depending on whether the chemical is site-related or not. Insufficient information is available in this case to exclude or include the chemical and this would be noted as a source of uncertainty in the risk assessment screening. The detection limit reported by the laboratory was the reporting limit for organic chemicals (explosives) and to the method detection limit for inorganics (metals) consistent with standard environmental analytical processes as well as CLP methods.

5.1.4.2 The detection limits for those analytes never detected in sediment, soil, and surface water are compared with human health and ecological risk screening values in Tables 5-7 and 5-8, respectively. Based on these tables and for the munition-related analytes identified (see Table 2-2 and Section 5.1.1), the screening values are higher than the detection limits for all analytes, except for (1) NG in groundwater, surface water, and soil, and (2) aluminum and lead in surface water. The NG screening values were revised in April 2007 and the revised screening criteria are below the detection limits, as noted in the summary (Tables 5-2 through 5-5) and comparison tables (Tables 5-7 and 5-8). However, since the screening limits accepted in the approved SS-WP are above the detection limit, the NG results are considered non-detections and the measurement quality objectives are achieved for this analyte (Tables 5-7 and 5-8). The revised NG values are proposed, not final values, and the EPA website provides no detail regarding the significant change in the RBCs. The exceedance of the aluminum and lead screening values results from a necessary 10-fold dilution during analysis of a single surface water sample at MRS

2. As discussed earlier, the surface water at Assateague ranges from fresh to brackish. For this particular sample (ASI-RS-SW-00-01) the high sodium concentration (2,180 mg/L) is indicative of brackish water therefore marine ecological screening values are more appropriate than fresh water. The aluminum fresh water screening value of 87 µg/L is based on low pH (approximately 6-6.5) water effects on trout, and because the pH of marine water is buffered to higher pHs than that applicable to the toxicity tests used to base the screening value, it is not applicable to this water. No aluminum toxicity data are available for marine aquatic organisms, although the toxicity of aluminum is ameliorated by the higher pH of seawater. Consequently the relatively high aluminum detection limit of 220 µg/L is unlikely to represent a risk to marine aquatic organisms. The marine chronic screening value of lead is 8.1 µg/L, which is higher than the detection limit of 3.4 µg/L for sample ASI-RS-SW-00-01. Consequently the sensitivity DQI has been achieved for aluminum and lead for Assateague. Related uncertainties are addressed in Section 5.5.2. The remaining non-detection results are valid and the measurement quality objectives have been achieved. Where no screening values are available, no conclusions can be drawn regarding whether or not the available reporting limits were sufficient to detect these chemicals at concentrations that may pose risk to ecological receptors.

5.2 Conceptual Site Model

5.2.1 A CSM diagram for each MRS evaluated at Assateague Island is provided in Appendix J. Each CSM defines the source (s) (e.g., the secondary source/media), interaction (e.g., the secondary release mechanism, the tertiary source, and the exposure route), and receptors. In this SI Report, the CSMs have been revised from those presented in the Final SS-WP to reflect the results of the human health and ecological risk screening.

5.2.2 Current and future potential human receptors for MC are expected to be trespassers, construction workers, visitors, and site workers, as depicted in the CSM diagram for MRS 1 and MRS 2 in Appendix J. Both residential and industrial receptor scenarios are evaluated in the human health screening-level risk assessment. The residential scenario was assessed for the protection of recreational users (campers) on the FUDS. The industrial scenario was assessed for the protection of construction or other workers that may frequent the site. The ecological receptors of concern for the two MRSs include terrestrial plant/invertebrates (insects and worms), benthic organisms, aquatic organisms, terrestrial-feeding/predatory animals, terrestrial feeding/predatory birds, aquatic-feeding mammals, and aquatic-feeding birds.

5.2.3 The media of concern are distinct for each class of receptor and are based on the CSMs presented in the Final SS-WP (Alion 2006b). The media of concern for human receptors at the site are surface soil, surface water, sediment, and groundwater. The media of concern for ecological receptors for each MRS are similar to the media of concern for human health. The

exception to this statement is that groundwater is not a medium of concern for ecological receptors.

5.2.4 A pathway is considered potentially complete if all of the following conditions are present:

1. Source and mechanism of chemical release
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 (ingestion, inhalation, etc.)

5.2.5 If a munition-related chemical is detected, than a given pathway is complete. A complete pathway may or may not pose risk to the specific receptor.

5.2.6 Consistent with DQOs, a weight of evidence approach is used to determine if identified COPC/COPEC (s) should be retained. In the case where screening criteria are exceeded, a weight of evidence approach is used to determine if the identified exeedances warrant an RI/FS recommendation. See the discussion in Section 5.1 and 5.4 for additional detail on the risk screening.

5.3 Background Data Evaluation

5.3.1 Table 5-1 presents a range of concentrations in background soil samples for chemicals detected on-site. A qualitative comparison was made between the range (minimum to maximum) of concentrations for on-site samples and the range (minimum to maximum) of background samples for the metals associated with past munitions use at the site (including aluminum, antimony, lead, titanium, and zinc). Some of the ranges of background concentrations are noted in Table 5-1 as being above ecological screening criteria (antimony and titanium). In those cases where analytes exceed screening criteria but not background values, a weight of evidence approach is applied to determine if those analytes are considered COPECs in a particular MRS. These instances are documented in the results sections below and conclusions are drawn based on the weight of evidence in each case.

5.4 Rocket Range North (MRS 1)

5.4.0.1 As presented in Section 5.1.1, four explosives (RDX, tetryl, NG, and DNT) along with five metals (aluminum, antimony, lead, titanium, and zinc), and perchlorate (in groundwater only) are the MC of interest in MRS 1. Tables 5-2 through 5-5 include a summary of all data

including those analytes not specifically associated with the munitions used in MRS 1 (as detailed in Table 2-2).

5.4.1 Groundwater Pathway and Screening Results

5.4.1.1 The locations of nearby drinking water wells were discussed in Section 2.3.7. The two water supply wells are located near the ranger station at the Assateague Island National Seashore within MRS 1. The wells were viewed as potentially complete pathways in CSM documented in the SS-WP (Alion 2006b). Table 5-2 presents a summary of groundwater sample results compared to human health screening values (EPA Region III RBCs) by MRS. No perchlorate or explosives were detected in the groundwater sample above human health screening criteria. Four of the metals related to munitions at the site (aluminum, lead, titanium, and zinc) were detected in the groundwater sample (ASI-RN-GW-15-01); therefore, the groundwater pathway in the CSM (Appendix J) is identified as complete for MRS 1 for human receptors. As Table 5-2 indicates, there are no human health screening criteria for titanium in groundwater. The risk from titanium is uncertain but likely to be acceptable since titanium is not known to be extremely toxic to humans. The remaining metals (aluminum, lead, and zinc) did not exceed screening criteria. Based on the weight of evidence associated with these sample results, there are no COPCs for groundwater.

5.4.2 Surface Water and Sediment Pathway and Screening Results

5.4.2.1 Surface water exists across MRS 1 in the form of fresh-to-brackish ponds/pools. The surface water pathway was viewed as a potentially complete pathway for human and ecological receptors for MC in the CSM documented in the SS-WP (Alion 2006b). Samples were collected from one of the pools located in MRS 1 to evaluate the surface water pathway. Table 5-3 presents a summary of surface water sample results compared to human health and ecological screening values for MRS 1. No explosives related to munitions used at the site were detected in the surface water sample as exceeding adjusted tap water RBCs or ecological screening criteria. Three metals related to munitions used at the site (lead, titanium, and zinc) were detected in the surface water sample (ASI-RN-SW-00-01) collected from MRS 1; therefore the surface water pathway in the CSM (Appendix J) is complete for MRS 1 for human and ecological receptors. No MC was detected above the adjusted tap water RBCs or ecological screening criteria; however, there is no human health or ecological screening criteria for titanium. The risk from this metal is uncertain but likely to be acceptable since titanium is not known to be extremely toxic to humans or ecological receptors. Based on the weight of evidence associated with these sample results, there are no COPCs/COPECs for surface water.

5.4.2.2 The sediment pathway was viewed as a potentially complete pathway for human and ecological receptors for MC in the CSM documented in the SS-WP (Alion 2006b). One sediment sample was collected from MRS 1 to evaluate the sediment pathway. Table 5-4 presents a summary of sediment sample results compared to human health and ecological screening values for MRS 1. No explosives related to munitions used at the site were detected in the sediment sample as exceeding screening criteria. Five metals related to munitions used at the site (aluminum, antimony, lead, titanium, and zinc) were detected in the sediment sample (ASI-RN-SD-02-01) collected from MRS 1; therefore, the sediment pathway in the CSM (Appendix J) is considered complete for human and ecological receptors. No MC was detected above the adjusted soil RBCs or ecological screening criteria; however, there is no human health or ecological screening criteria for titanium. The risk from this metal is uncertain but likely to be acceptable since titanium is not known to be extremely toxic to humans or ecological receptors. Based on the weight of evidence associated with these sample results, there are no sediment COPCs/COPECs identified for MRS 1.

5.4.3 Terrestrial Pathway and Screening Results

5.4.3.1 The site contains no natural barriers and is predominantly rolling sand dunes with brush and fresh-to-brackish surface water with numerous wetland areas. Surface soil in MRS 1 was viewed as a potentially complete pathway for human and ecological receptors for MC in CSM documented in the SS-WP (Alion 2006b). A total of three surface soil samples and four subsurface samples (between 12 and 18 inches bgs) were collected from MRS 1. Table 5-5 presents a summary of soil sample results compared to human health screening values (residential and industrial) and ecological screening criteria for MRS 1. For surface soil samples, no explosives related to munitions used at the site were detected as exceeding human health or ecological screening criteria. Five metals related to munitions used at the site (aluminum, antimony, lead, titanium, and zinc) were detected in the surface soil samples. Several of these metals related to the munitions used at this site (including aluminum and zinc) slightly exceeded maximum background concentrations; therefore, the surface soil pathway in the CSM (Appendix J) is complete for all receptors. None of these metals exceeded human health criteria for soil. One analyte (antimony) was detected in surface soil samples above ecological screening criteria; however, the results are within the range of background concentrations for antimony detected at the site. The detections of titanium are within the range of background concentrations. There are no human health or ecological screening criteria for titanium and no ecological screening criteria for aluminum. The risk from these metals is uncertain but likely to be acceptable since titanium and aluminum are not known to be extremely toxic to humans or ecological receptors. Based on the weight of evidence associated with these sample results, there are no surface soil COPCs/COPECs identified for MRS 1. .

5.4.3.2 No explosives related to munitions used at the site were detected in the subsurface soil samples. Five metals related to munitions used at the site (aluminum, antimony, lead, titanium, and zinc) were detected in the subsurface soil samples; therefore, the subsurface soil pathway in the CSM (Appendix J) is complete for human receptors. In accordance with EPA guidance, subsurface soil is not evaluated for ecological receptors (EPA 1997). None of the metals detected in subsurface soil samples exceeded human health criteria for soil. Based on the weight of evidence associated with these sample results, there were no COPCs/COPECs identified for subsurface soil. ,

5.4.4 Air Pathway

5.4.4.1 The air migration pathway for MRS 1 has an extremely low potential, if any, for human and/or environmental receptors to come into contact with surface soil (metals and explosives). Only low levels of metals were detected in soil given the non-volatile nature of the constituents detected, and the suspension of constituents in air is limited to airborne particulate. Therefore, the fraction of COPCs susceptible to being suspended in air is negligible. With a negligible air contamination source, there is low potential for the air pathway at MRS 1 to negatively impact any human or environmental receptors. Therefore, the air pathway is incomplete for all receptors in the CSM (Appendix J).

5.5 Rocket Range South (MRS 2)

5.5.0.1 As presented in Section 5.1.1, four explosives (RDX, tetryl, NG, and DNT), five metals (aluminum, antimony, lead, titanium, and zinc), and perchlorate (in groundwater only) are the MC of interest in MRS 2. Tables 5-2 through 5-5 include a summary of all data including those analytes not specifically associated with the munitions used in MRS 2 (Table 2-2).

5.5.1 Groundwater Pathway and Screening Results

5.5.1.1 The locations of nearby drinking water wells were discussed in Section 2.3.7. The two water supply wells are located near the ranger station for the Assateague Island National Seashore within MRS 2. The wells are not within a 4 mile radius of MRS 2. The wells were viewed as potentially complete pathways for a construction or site worker in the CSM documented in the SS-WP (Alion 2006b). Table 5-2 presents a summary of groundwater sample results compared to human health screening values (EPA Region III RBCs) by MRS. No perchlorate or explosives were detected in the groundwater sample as exceeding screening criteria. Four of the metals related to munitions used at the site (aluminum, lead, titanium, and zinc) were detected in the groundwater sample (ASI-RS-GW-02-01) collected from MRS 2; therefore, the groundwater pathway in the CSM (Appendix J) is complete for human receptors. One of the metals related to munitions used at the site (aluminum) was detected above the tap

water RBCs and identified as a COPC. The groundwater sample for this MRS was collected from a hand-augered point and no filtering of this sample was completed. Given the high level of other analytes in this sample including high levels of essential nutrients, the exceedance is likely related to particles/sediment in the sample; therefore, aluminum is not retained as a COPC. There are no human health screening criteria for titanium. The risk from titanium is uncertain but likely to be acceptable since titanium is not known to be extremely toxic to humans. Based on the weight of evidence associated with these sample results, there are no COPC identified for groundwater.

5.5.2 Surface Water and Sediment Pathway and Screening Results

5.5.2.1 Surface water exists across MRS 2 in the form of fresh-to-brackish ponds. The surface water pathway was viewed as a potentially complete pathway for human and ecological receptors for MC in the CSM documented in the SS-WP (Alion 2006b). One sample was collected from MRS 2 to evaluate the surface water pathway. Table 5-3 presents a summary of surface water sample results compared to human health and ecological screening values for MRS 2. No explosives related to munitions used at the site were detected in the surface water sample as exceeding screening criteria. One metal related to munitions used at the site (antimony) was detected in the surface water sample (ASI-RS-SW-00-01) collected from MRS 2; therefore, the surface water pathway in the CSM (Appendix J) is considered complete for MRS 2 for all receptors. No MC was detected above the adjusted tap water RBCs or ecological screening criteria; however, there are no human health or ecological screening criteria for titanium. The risk from this metal is uncertain but likely to be acceptable since titanium is not known to be extremely toxic to humans or ecological receptors. Based on the weight of evidence associated with these sample results, there are no COPCs/COPECs for surface water.

5.5.2.2 The sediment pathway was viewed as a potentially complete pathway for human and ecological receptors for MC in the CSM documented in the SS-WP (Alion 2006b). One sediment sample was collected from MRS 2 to evaluate the sediment pathway. Table 5-4 presents a summary of sediment sample results compared to human health and ecological screening values for MRS 2. No explosives related to munitions used at the site were detected in the sediment sample as exceeding screening criteria. Four metals related to munitions used at the site (aluminum, lead, titanium, and zinc) were detected in the sediment sample (ASI-RS-SD-02-01) collected from MRS 2; therefore, the sediment pathway in the CSM (Appendix J) is considered complete in MRS 2 for all receptors. No MC was detected above the adjusted soil RBCs or ecological screening criteria; however, there are no human health or ecological screening criteria for titanium. The risk from this metal is uncertain but likely to be acceptable since titanium is not known to be extremely toxic to humans or ecological receptors. Therefore,.

Based on the weight of evidence associated with these sample results, there are no sediment COPCs/COPECs identified for MRS 2.

5.5.3 Terrestrial Pathway and Screening Results

5.5.3.1 The site contains no natural barriers and is predominantly rolling sand dunes with brush and fresh-to-brackish surface water with numerous wetland areas. Surface soil in MRS 1 was viewed as a potentially complete pathway for human and ecological receptors for MC in the SS-WP (Alion 2006b). A total of two surface soil samples and five subsurface samples (between 12 and 18 inches bgs) were collected from MRS 2. Table 5-5 presents a summary of soil sample results compared to human health screening values (residential and industrial) and ecological screening criteria for MRS 2. For surface soil samples, no explosives related to munitions used at the site were detected in the soil samples as exceeding human health or ecological screening criteria. Five metals related to munitions used at the site (aluminum, antimony, lead, titanium, and zinc) were detected in the surface soil samples. None of the metals detected in surface soil samples exceeded the maximum background concentration; therefore, the soil pathway in the CSM (Appendix J) is considered incomplete in MRS 2 for all receptors. None of the metals detected in surface soil samples exceeded human health criteria for soil. One analyte (antimony) was detected in surface soil samples above ecological screening criteria. However, antimony results are within the range of background concentrations detected at the site; therefore, this constituent is not identified as a COPEC. There are no human health or ecological screening criteria for titanium and no ecological screening criteria for aluminum and titanium. The respective risk from these metals is uncertain but likely to be acceptable since titanium and aluminum are not known to be extremely toxic to humans or ecological receptors. The detections of aluminum and titanium in surface soil are within the range of background concentrations; therefore, no surface soil COPCs/COPECs are identified for MRS 2.

5.5.3.2 No explosives related to munitions used at the site were detected in the subsurface soil samples. Five metals related to munitions used at the site (aluminum, antimony, lead, titanium, and zinc) were detected in the subsurface soil samples; therefore the subsurface soil pathway in the CSM is identified as complete. None of the metals detected in subsurface soil samples exceeded human health screening criteria for soil. In accordance with EPA guidance, subsurface soil is not evaluated in terms of ecological receptors (EPA 1997). Therefore, there were no COPCs/COPECs identified for subsurface soil.

5.5.4 Air Pathway

5.5.4.1 The air migration pathway for MRS 2 has an extremely low potential, if any, for human and/or environmental receptors to come into contact with the analytes detected in surface soil

(metals and explosives). Only low levels of metals were detected in soil given the non-volatile nature of the constituents detected, and the suspension of constituents in air is limited to airborne particulate. Therefore, the fraction of COPCs susceptible to being suspended in air is negligible. With a negligible air contamination source, there is low potential for the air pathway at MRS 2 to negatively impact any human or environmental receptors. Therefore, the air pathway is as incomplete in the CSM (Appendix J) for all receptors.

TABLE 5-1
COMPARISON OF ON-SITE AND BACKGROUND SURFACE SOIL CONCENTRATIONS
ASSATEAGUE ISLAND MMRP FUDS SITE

	On-site				Background				Comparisons	
Chemical	Minimum Concentration/Qualifier	Maximum Concentration/Qualifier	Mean Concentration	Detection Frequency	Minimum Concentration/Qualifier	Maximum Concentration/Qualifier	Mean Concentration	Detection Frequency	Site Maximum > Background Maximum	Site Mean > Background Mean
ALUMINUM	170 K	2300 K	377	16/16	256 K	362 K	314	3/3	Yes	Yes
ANTIMONY	0.2 UL	0.47 B	0.28	2/16	0.23 U	0.49 J	0.34	2/3	No	No
ARSENIC	0.28 B	2.2	0.57	1/16	0.28 B	0.68 B	0.50	0/3	Yes	Yes
BARIUM	0.81	5.8	1.8	16/16	1.4	2.8	1.9	3/3	Yes	No
BERYLLIUM	0.015 U	0.058 B	0.02	0/16	0.019 B	0.03 B	0.03	0/3	Yes	No
CADMIUM	0.015 U/U/U	0.05 B	0.02	0/16	0.019 U	0.034 U	0.03	0/3	Yes	No
CALCIUM	48.6 J	1360	177	16/16	65.1 J	135	101	3/3	Yes	Yes
CHROMIUM	0.67	6.3	2	16/16	1.5	3.5	2.2	3/3	Yes	No
COBALT	0.023 U	0.43	0.06	2/16	0.032 U	0.061 U	0.04	0/3	Yes	Yes
COPPER	0.12 B	3.5	0.4	1/16	0.099 B	0.43 B	0.3	0/3	Yes	Yes
IRON	182	2370	505	16/16	374	673	531	3/3	Yes	No
LEAD	0.72 B	7.5	2	13/16	2.2	4.5	3.0	3/3	Yes	No
MAGNESIUM	37.4 B	552	91	7/16	71.9 B	74.5 B	74	0/3	Yes	Yes
MANGANESE	1.7	13.7	6	16/16	5.7	13.3	8	3/3	Yes	No
MERCURY	0.0086 U/U	0.026 J	0.01	1/16	0.0096 U	0.026 J	0.02	2/3	No	No
MOLYBDENUM	0.065 B	0.25 B	0.09	0/16	0.065 U	0.13 U	0.09	0/3	Yes	No
NICKEL	0.094 J	2.3	0.30	14/16	0.13 J	0.73 J	0.3	3/3	Yes	No
POTASSIUM	20.8	358	49	16/16	31.6	65.4	43	3/3	Yes	Yes
SELENIUM	0.15 UL	0.31 B	0.25	0/16	0.25 U	0.48 U	0.33	0/3	No	No
SILVER	0.031 U	0.62	0.07	1/16	0.032 U	0.063 U	0.04	0/3	Yes	Yes
SODIUM	70.8 B	662	160.0	2/16	77.2 B	134 B	98.2	0/3	Yes	Yes
STRONTIUM	0.65	6.9	1.99	16/16	1	2.2	1.67	3/3	Yes	Yes
THALLIUM	0.48 U	0.61 U	0.55	0/16	0.49 U	0.95 U	0.66	0/3	No	No
TITANIUM	24.2	162	79	16/16	83.8	227	134	3/3	No	No
VANADIUM	0.66 J	6.9	1.6	16/16	1.3	3	2.0	3/3	Yes	No
ZINC	1.5 J	6.6	4	16/16	2.6	2.8	2.7	3/3	Yes	Yes
ZIRCONIUM	5.9 J	84.5 L	33.5	16/16	26.8 L	106 L	55.5	3/3	No	No

Qualifiers:
B = Value is less than the reporting limit (RL) but greater than the method detection limit (MDL).
J = Analyte is present. Reported value may not be accurate or precise.
K = Reported value may be biased high.
L = Reported value may be biased low.
U = Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
Yellow shaded analytes are those constituents associated with past munitions use.

Table 5-2 Summary of Groundwater Analytical Results

			Sample Name:	EPA Region III RBC Screening Value [1,2]	ASI-RN-GW-15-01	ASI-RS-GW-02-01	FD #3
			Sample Date:		12/8/2006	12/8/2006	12/8/2006
			Parent Name:				ASI-RS-GW-02-01
			MRS:		MRS 1	MRS 2	MRS 2
Analyte	**CAS**	**Unit**					
Explosives							
1,3,5-TRINITROBENZENE	99-35-4	ug/L		110	0.21 UL	0.2 UL	0.2 UL
1,3-DINITROBENZENE	99-65-0	ug/L		0.37	0.21 U	0.2 U	0.2 U
2,4-DINITROTOLUENE	121-14-2	ug/L		7.3	0.21 U	0.2 U	0.2 U
2,6-DINITROTOLUENE	606-20-2	ug/L		3.7	0.21 U	0.2 U	0.2 U
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	ug/L		7.3	0.21 U	0.2 U	0.2 U
2-NITROTOLUENE	88-72-2	ug/L		6.1	0.42 U	0.41 U	0.41 U
3-NITROTOLUENE	99-08-1	ug/L		NSL	0.42 U	0.41 U	0.41 U
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	ug/L		7.3	0.21 U	0.2 U	0.2 U
4-NITROTOLUENE	99-99-0	ug/L		NSL	0.42 U	0.41 U	0.41 U
HMX	2691-41-0	ug/L		180	0.42 UL	0.41 UL	0.41 UL
NITROBENZENE	98-95-3	ug/L		0.35	0.21 U	0.2 U	0.2 U
NITROGLYCERIN	55-63-0	ug/L		0.37	21 U	20 U	20 U
PERCHLORATE	14797-73-0	UG/L		24	0.200 U	2.00 U	2.00 U
PETN	78-11-5	ug/L		NSL	1.1 U	1 U	1 U
RDX	121-82-4	ug/L		0.61	0.42 U	0.41 U	0.41 U
TETRYL	479-45-8	ug/L		15	0.42 U	0.41 U	0.41 U
TNT	118-96-7	ug/L		2.2	0.21 U	0.2 U	0.2 U
Metals							
ALUMINUM	7429-90-5	ug/L		3700	22 U	**9980**	**5660**
ANTIMONY	7440-36-0	ug/L		1.5	0.12 U	1.2 U	1.2 U
ARSENIC	7440-38-2	ug/L		0.045	0.8 U	**14 J**	**13.7 J**
BARIUM	7440-39-3	ug/L		730	10	88.2	52.2
BERYLLIUM	7440-41-7	ug/L		7.3	0.028 U	0.38 J	0.28 U
CADMIUM	7440-43-9	ug/L		1.8	0.11 U	1.1 U	1.1 U
CALCIUM	7440-70-2	ug/L		NUT	15300	200000	198000
CHROMIUM	7440-47-3	ug/L		11	1.8 U	18 U	18 U
COBALT	7440-48-4	ug/L		NSL	0.044 U	1.3 J	0.82 J
COPPER	7440-50-8	ug/L		150	2.5	17.8 J	13.5 J
IRON	7439-89-6	ug/L		NUT	71.8	5410	3660
LEAD	7439-92-1	ug/L		15	0.67 B	8.8 J	6.2 J
MAGNESIUM	7439-95-4	ug/L		NUT	4600	601000	606000
MANGANESE	7439-96-5	ug/L		73	1.6 J	**101**	**83**
MERCURY	7439-97-6	ug/L		0.37	0.034 U	0.065 J	0.064 J
MOLYBDENUM	7439-98-7	ug/L		18	0.32 B	2.3 U	2.3 U
NICKEL	7440-02-0	ug/L		73	0.65 J	4.2 J	3.6 U
POTASSIUM	7440-09-7	ug/L		NUT	6860	199000	198000
SELENIUM	7782-49-2	ug/L		18	0.59 U	17.9 J	10.4 J
SILVER	7440-22-4	ug/L		18	0.023 U	0.23 U	0.23 U
SODIUM	7440-23-5	ug/L		NUT	112000	5720000	5220000
STRONTIUM	7440-24-6	ug/L		2200	124	**3680**	**3620**
THALLIUM	7440-28-0	ug/L		0.26	0.17 U	1.7 U	1.7 U
TITANIUM	7440-32-6	ug/L		NSL	2.6	483	255
VANADIUM	7440-62-2	ug/L		3.7	3.2 U	32 U	32 U
ZINC	7440-66-6	ug/L		1100	25.8	44.9 J	30.2 J
ZIRCONIUM	7440-67-7	ug/L		NSL	2.4 U	24 U	24 U

(1) USEPA Region III Risk Based (RBCs) Table, April 2007. For non-carcinogens, value shown is equal to 1/10 the tap water RBC value. For carcinogens the value shown is equal to the tap water RBC value.
(2) The screening values for lead in groundwater is the USEPA Action Level.

Notes:
Yellow shaded analytes are those constituents associated with past munitions use.
Blue shaded and bolded values represent exceedance of human health screening criteria.
GW=ground water
J=Analyte is present. Reported value may not be accurate or precise.
UL=Not detected, quantitation limit is probably higher.
U=Not detected. The associated
B=Not detected substantially above
K=Analyte is present. Reported value may be biased high.
Actual value is expected to be lower.
R=Unreliable result. Data is rejected or unusable.
ug/L=micrograms per liter
CAS=Chemical Abstract Service
NA=not available
NUT=Essential Nutrient

Table 5-3 Summary of Surface Water Analytical Results

Sample Name:			EPA Region III RBC Screening Value [1]	Ecological Screening Values (2)	ASI-RN-SW-00-01	ASI-RS-SW-00-01
Sample Date:					12/7/2006	12/8/2006
Parent Name:						
MRS:					MRS 1	MRS 2
Analyte	**CAS**	**Unit**				
Explosives						
1,3,5-TRINITROBENZENE	99-35-4	ug/L	1100	11	0.21 UL	0.21 UL
1,3-DINITROBENZENE	99-65-0	ug/L	3.7	20	0.21 U	0.21 U
2,4-DINITROTOLUENE	121-14-2	ug/L	73	310	0.21 U	0.21 U
2,6-DINITROTOLUENE	606-20-2	ug/L	37	81	0.21 U	0.21 U
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	ug/L	73	20	0.21 U	0.21 U
2-NITROTOLUENE	88-72-2	ug/L	61	750	0.42 U	0.42 U
3-NITROTOLUENE	99-08-1	ug/L	NSL	750	0.42 U	0.42 U
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	ug/L	73	NSL	0.21 U	0.21 U
4-NITROTOLUENE	99-99-0	ug/L	NSL	1900	0.42 U	0.42 U
HMX	2691-41-0	ug/L	1800	330	0.42 UL	0.32 K
NITROBENZENE	98-95-3	ug/L	3.5	6680	0.21 U	0.21 U
NITROGLYCERIN	55-63-0	ug/L	3.7	138	21 U	21 U
PETN	78-11-5	ug/L	NSL	85000	1.1 U	1 U
RDX	121-82-4	ug/L	6.1	190	0.42 U	0.42 U
TETRYL	479-45-8	ug/L	150	NSL	0.42 U	0.42 U
TNT	118-96-7	ug/L	22	90	0.21 U	0.21 U
Metals						
ALUMINUM	7429-90-5	ug/L	37000	87	22 U	220 U
ANTIMONY	7440-36-0	ug/L	15	30	0.12 U	1.4 B
ARSENIC	7440-38-2	ug/L	0.45	5	**0.93 B**	8 U
BARIUM	7440-39-3	ug/L	7300	4	3 J	7.4 U
BERYLLIUM	7440-41-7	ug/L	73	0.66	0.028 U	0.28 U
CADMIUM	7440-43-9	ug/L	37	0.25	0.11 U	1.1 U
CALCIUM	7440-70-2	ug/L	NUT	NUT	23000	72800
CHROMIUM	7440-47-3	ug/L	110	74	1.8 U	18 U
COBALT	7440-48-4	ug/L	NSL	23	0.077 B	0.44 U
COPPER	7440-50-8	ug/L	1500	9	1.1 B	9.2 U
IRON	7439-89-6	ug/L	NUT	NUT	58 B	687
LEAD	7439-92-1	ug/L	15	2.5	0.39 J	3.4 U
MAGNESIUM	7439-95-4	ug/L	NUT	NUT	4050	234000
MANGANESE	7439-96-5	ug/L	730	120	3.6	20.7
MERCURY	7439-97-6	ug/L	3.7	0.94	0.041 J	0.082 J
MOLYBDENUM	7439-98-7	ug/L	180	370	0.3 B	2.3 U
NICKEL	7440-02-0	ug/L	730	52	0.95 J	3.6 U
POTASSIUM	7440-09-7	ug/L	NUT	NUT	1290	83100
SELENIUM	7782-49-2	ug/L	180	71	0.59 U	10.3 J
SILVER	7440-22-4	ug/L	180	3.2	0.023 U	0.23 U
SODIUM	7440-23-5	ug/L	NUT	NUT	27300	2180000
STRONTIUM	7440-24-6	ug/L	22000	1500	106	1280
THALLIUM	7440-28-0	ug/L	2.6	NSL	0.17 U	1.7 U
TITANIUM	7440-32-6	ug/L	NSL	NSL	3.1	20 U
VANADIUM	7440-62-2	ug/L	37	19	3.2 U	32 U
ZINC	7440-66-6	ug/L	11000	81	12.3	20 U
ZIRCONIUM	7440-67-7	ug/L	NSL	17	2.4 U	24 U

(1) USEPA Region III Risk-Based (RBCs) Table, April 2007. For non-carcinogens, value shown is equal to 1/10 the tap water RBC value. For carcinogens the value shown is equal to the tap water RBC value. To account for surface water exposures, the resulting values have been increased by a factor of ten.
(2) Ecological Screening Value refernces are found in Table 5-6.

Notes:
SW=surfacewater
B=Not detected substantially above the level reported in the laboratory field blanks.
J=Analyte is present. Reported value may not be accurate or precise.
K=Analyte is present. Reported value may be biased high. Actual value is expected to be lower.
U=Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
UL=Not detected, quantitation limit is probably higher.
ug/L=micrograms per liter
CAS=Chemical Abstract Service
NA=not available
NSL=No Screening Level
NUT= Essential Nutrient
Blue shaded and bolded values represent exceedance of human health screening criteria.
Blue shaded and italicized values represent exceedance of ecological screening criteria.
Blue shaded, bolded and italicized values represent exceedance of both human health and ecological screening criteria.
Yellow shaded analytes are those constituents associated with past munitions use.

Table 5-4 Summary Of Sediment Analytical Results

Sample Name:			EPA Region III RBC Screening Value Residential (1)	EPA Region III RBC Screening Value Industrial (2)	Ecological Screening Values (3)	ASI-RN-SD-02-01	ASI-RS-SD-02-01
Sample Date:						12/7/2006	12/8/2006
Parent Name:							
MRS:						MRS 1	MRS 2
Analyte	**CAS**	**Unit**					
Explosives							
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	2300	31000	2659	0.04 U	0.04 U
1,3-DINITROBENZENE	99-65-0	mg/kg	7.8	100	371	0.04 U	0.04 U
2,4-DINITROTOLUENE	121-14-2	mg/kg	160	2000	0.0416	0.04 U	0.04 U
2,6-DINITROTOLUENE	606-20-2	mg/kg	78	1000	0.0416	0.04 U	0.04 U
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	160	2000	876	0.04 U	0.04 U
2-NITROTOLUENE	88-72-2	mg/kg	780	10000	4.06	0.08 U	0.08 U
3-NITROTOLUENE	99-08-1	mg/kg	NSL	NSL	4.06	0.08 U	0.08 U
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	160	2000	444	0.04 U	0.04 U
4-NITROTOLUENE	99-99-0	mg/kg	NSL	NSL	4.06	0.08 U	0.08 U
HMX	2691-41-0	mg/kg	3900	51000	2.17	0.08 U	0.08 U
NITROBENZENE	98-95-3	mg/kg	39	510	4729	0.04 U	0.04 U
NITROGLYCERIN	55-63-0	mg/kg	7.8	100	NSL	4 U	4 U
PETN	78-11-5	mg/kg	NSL	NSL	34627	0.2 U	0.2 U
RDX	121-82-4	mg/kg	58	260	NSL	0.08 U	0.08 U
TETRYL	479-45-8	mg/kg	310	4100	NSL	0.08 U	0.08 U
TNT	118-96-7	mg/kg	210	950	100	0.04 U	0.04 U
Metals							
ALUMINUM	7429-90-5	mg/kg	78000	1000000	pH < 5.5	460 K	1080 K
ANTIMONY	7440-36-0	mg/kg	31	410	2	0.34 J	0.34 U
ARSENIC	7440-38-2	mg/kg	4.3	19	9.8	0.44 B	0.68 B
BARIUM	7440-39-3	mg/kg	16000	200000	NSL	2.2	2.6
BERYLLIUM	7440-41-7	mg/kg	160	2000	NSL	0.043 B	0.022 U
CADMIUM	7440-43-9	mg/kg	78	1000	0.99	0.023 U	0.033 B
CALCIUM	7440-70-2	mg/kg	NUT	NUT	NUT	156	335
CHROMIUM	7440-47-3	mg/kg	230	3100	43.4	4.7	3.1
COBALT	7440-48-4	mg/kg	NSL	NSL	50	0.11 B	0.058 J
COPPER	7440-50-8	mg/kg	3100	41000	31.6	0.22 B	1.5
IRON	7439-89-6	mg/kg	55000	720000	NSL	426	856
LEAD	7439-92-1	mg/kg	400	800	35.8	2.8	3.6
MAGNESIUM	7439-95-4	mg/kg	NUT	NUT	NUT	95.4 B	538
MANGANESE	7439-96-5	mg/kg	1600	20000	460	7.8	8.6
MERCURY	7439-97-6	mg/kg	7.8	100	0.18	0.012 U	0.017 J
MOLYBDENUM	7439-98-7	mg/kg	390	5100	NSL	0.086 U	0.16 B
NICKEL	7440-02-0	mg/kg	1600	20000	22.7	1.2	0.79 J
POTASSIUM	7440-09-7	mg/kg	NUT	NUT	NUT	37.8	218
SELENIUM	7782-49-2	mg/kg	390	5100	2	0.33 U	0.38 U
SILVER	7440-22-4	mg/kg	390	5100	1	0.043 U	0.049 U
SODIUM	7440-23-5	mg/kg	NUT	NUT	NUT	99.9 N	1620
THALLIUM	7440-28-0	mg/kg	5.5	72	NSL	0.65 U	0.74 U
TITANIUM	7440-32-6	mg/kg	NSL	NSL	NSL	115	124
VANADIUM	7440-62-2	mg/kg	78	1000	NSL	7.3	3.1
ZINC	7440-66-6	mg/kg	23000	310000	121	3.5	3.9
ZIRCONIUM	7440-67-7	mg/kg	NSL	NSL	NSL	35.5 L	36.6 L

(1) USEPA Region III Risk Based (RBCs) Table, April 2007. For non-carcinogens, value shown is equal to 1/10 the residential soil RBC value.
For carcinogens the value shown is equal to the residential soil RBC value. To account for sediment exposure, the resulting values have been increased by a factor of ten.
(2) USEPA Region III Risk Based (RBCs) Table, April 2007. For non-carcinogens, value shown is equal to 1/10 the industrial soil RBC value.
For carcinogens the value shown is equal to the industrial soil RBC value. To account for sediment exposure, the resulting values have been increased by a factor of ten.
(3) Ecological Screening Value refernces are found in Table 5-6.

Notes:
SD=sediment
B=Not detected substantially above the level reported in the laboratory field blanks.
J=Analyte is present. Reported value may not be accurate or precise.
K=Analyte is present. Reported value may be biased high. Actual value is expected to be lower.
L=Analyte is present. Reported value may be biased low. Actual value is expected to be higher.
U=Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
mg/kg=milligrams per kilogram
CAS=Chemical Abstract Service
NA=not available
NSL=No Screening Level
NUT= Essential Nutrient
Blue shaded and bolded values represent exceedance of human health screening criteria.
Blue shaded and italicized values represent exceedance of ecological screening criteria.
Blue shaded, bolded and italicized values represent exceedance of both human health and ecological screening criteria.
Yellow shaded analytes are those constituents associated with past munitions use.

Sample Name:			EPA Region III RBC Screening Value Residential (1)	EPA Region III RBC Screening Value Industrial (2)	Ecological Screening Values (3)	ASI-RN-SS-02-01	FD #1	ASI-RN-SB-12-18-01	ASI-RN-SS-02-02	ASI-RN-SB-12-18-02	ASI-RN-SS-02-03	ASI-RN-SB-12-18-03
Sample Date:						12/7/2006	12/7/2006	12/7/2006	12/7/2006	12/7/2006	12/7/2006	12/7/2006
Parent Name:							ASI-RN-SS-02-01					
MRS:						MRS 1	MRS 1	MRS 1	MRS 1	MRS 1	MRS 1	MRS 1
Analyte	**CAS**	**Unit**										
Explosives												
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	230	3100	NSL	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
1,3-DINITROBENZENE	99-65-0	mg/kg	0.78	10	NSL	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
2,4-DINITROTOLUENE	121-14-2	mg/kg	16	200	30	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
2,6-DINITROTOLUENE	606-20-2	mg/kg	7.8	100	30	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
2-AMINO-4,6-DINITROTOLU	35572-78-2	mg/kg	16	200	20	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
2-NITROTOLUENE	88-72-2	mg/kg	78	1000	30	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
3-NITROTOLUENE	99-08-1	mg/kg	NSL	NSL	30	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
4-AMINO-2,6-DINITROTOLU	19406-51-0	mg/kg	16	200	30	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
4-NITROTOLUENE	99-99-0	mg/kg	NSL	NSL	30	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
HMX	2691-41-0	mg/kg	390	5100	NSL	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
NITROBENZENE	98-95-3	mg/kg	3.9	51	40	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
NITROGLYCERIN	55-63-0	mg/kg	0.78	10	NSL	4 U	4 U	4 U	4 U	4 U	4 U	4 U
PETN	78-11-5	mg/kg	NSL	NSL	NSL	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
RDX	121-82-4	mg/kg	5.8	26	100	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
TETRYL	479-45-8	mg/kg	31	410	NSL	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
TNT	118-96-7	mg/kg	21	95	30	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Metals												
ALUMINUM	7429-90-5	mg/kg	7800	100000	pH < 5.5	245 K	217 K	267	367	225 K	264	243
ANTIMONY	7440-36-0	mg/kg	3.1	41	0.27	0.26 U	*0.3 B c*	*0.28 J c*	0.21 UL	*0.31 J c*	0.2 UL	0.21 UL
ARSENIC	7440-38-2	mg/kg	0.43	1.9	18	**0.48 B a**	**0.48 B a**	**0.56 B a**	**0.61 B a**	**0.46 B a**	0.39 B	**0.65 B a**
BARIUM	7440-39-3	mg/kg	1600	20000	330	1.6	2.1	2	1.4	1.1	2.8	1.1
BERYLLIUM	7440-41-7	mg/kg	16	200	21	0.017 U	0.016 U	0.021 B	0.029 B	0.023 B	0.03 B	0.03 B
CADMIUM	7440-43-9	mg/kg	3.9	51	0.36	0.03 B	0.022 B	0.016 U	0.015 U	0.021 U	0.015 U	0.015 U
CALCIUM	7440-70-2	mg/kg	NUT	NUT	NUT	68.2 J	70 J	131	118	99.6	115	48.6 J
CHROMIUM	7440-47-3	mg/kg	23	310	81	1.8	1.6	2.5	1.4	1.3	1.2	1.1
COBALT	7440-48-4	mg/kg	NSL	NSL	13	0.036 U	0.035 U	0.025 U	0.031 B	0.038 U	0.023 U	0.035 B
COPPER	7440-50-8	mg/kg	310	4100	28	0.32 B	0.28 B	0.13 B	0.26 B	0.14 B	0.24 B	0.16 B
IRON	7439-89-6	mg/kg	NUT	NUT	NUT	401	387	400	550	333	412	339
LEAD	7439-92-1	mg/kg	400	800	11	2.9	2.7	3.4	4.5	1.8	2.9	1.1
MAGNESIUM	7439-95-4	mg/kg	NUT	NUT	NUT	45.9 B	41.7 B	50.7 B	69.3 B	44.9 B	58.3 B	41.4 B
MANGANESE	7439-96-5	mg/kg	160	2000	500	6.3	6.2	7.6	5.5	3.4	6.3	4.3
MERCURY	7439-97-6	mg/kg	0.78	10	0.1	0.0092 U	0.0089 U	0.0091 U	0.0096 U	0.01 U	0.0097 U	0.0094 U
MOLYBDENUM	7439-98-7	mg/kg	39	510	2	0.073 U	0.072 U	0.083 U	0.082 U	0.077 U	0.078 U	0.082 U
NICKEL	7440-02-0	mg/kg	160	2000	38	0.15 J	0.16 J	0.11 U	0.47 J	0.14 J	0.14 J	0.11 U
POTASSIUM	7440-09-7	mg/kg	NUT	NUT	NUT	23.3	21	24.3	27.6	22.7	28.5	24.2
SELENIUM	7782-49-2	mg/kg	39	510	1	0.28 U	0.28 U	0.22 B	0.16 UL	0.3 U	0.15 UL	0.18 B
SILVER	7440-22-4	mg/kg	39	510	4.2	0.037 U	0.036 U	0.043 U	0.043 U	0.62	0.041 U	0.043 U
SODIUM	7440-23-5	mg/kg	NUT	NUT	NUT	75.3 B	70.8 B	94.1 B	94.2 B	89.3 B	81.9 B	103 B
STRONTIUM	7440-24-6	mg/kg	4700	61000	NSL	1.2	1.2	2.3	1.4	0.96	1.5	0.65
THALLIUM	7440-28-0	mg/kg	0.55	7.2	1	0.56 U	0.54 U	0.6 U	0.59 U	0.59 U	0.56 U	0.59 U
TITANIUM	7440-32-6	mg/kg	NSL	NSL	NSL	101	95.9	162	66.8	59.7	65	51.7
VANADIUM	7440-62-2	mg/kg	7.8	100	7.8	1.5	1.3	1.9	1.6	1.2	1.2	1.1
ZINC	7440-66-6	mg/kg	2300	31000	50	3.9	4.5	4.8	6.6	6.5	4.7	2.8
ZIRCONIUM	7440-67-7	mg/kg	NSL	NSL	NSL	28.7 L	60.6 L	45.7	22.4	23.8 L	20.9	8.3 J

Sample Name:			EPA Region III RBC Screening Value Residential (1)	EPA Region III RBC Screening Value Industrial (2)	Ecological Screening Values (3)	ASI-RN-SB-12-18-04	ASI-RS-SB-12-18-01	ASI-RS-SS-02-01	FD #2	ASI-RS-SS-02-02	ASI-RS-SB-12-18-02	ASI-RS-SB-12-18-03
Sample Date:						12/7/2006	12/8/2006	12/8/2006	12/8/2006	12/8/2006	12/8/2006	12/8/2006
Parent Name:									ASI-RS-SS-02-01			
MRS:						MRS 1	MRS 2	MRS 2	MRS 2	MRS 2	MRS 2	MRS 2
Analyte	**CAS**	**Unit**										
Explosives												
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	230	3100	NSL	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
1,3-DINITROBENZENE	99-65-0	mg/kg	0.78	10	NSL	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
2,4-DINITROTOLUENE	121-14-2	mg/kg	16	200	30	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
2,6-DINITROTOLUENE	606-20-2	mg/kg	7.8	100	30	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
2-AMINO-4,6-DINITROTOLU	35572-78-2	mg/kg	16	200	20	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
2-NITROTOLUENE	88-72-2	mg/kg	78	1000	30	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
3-NITROTOLUENE	99-08-1	mg/kg	NSL	NSL	30	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
4-AMINO-2,6-DINITROTOLU	19406-51-0	mg/kg	16	200	30	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
4-NITROTOLUENE	99-99-0	mg/kg	NSL	NSL	30	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
HMX	2691-41-0	mg/kg	390	5100	NSL	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
NITROBENZENE	98-95-3	mg/kg	3.9	51	40	0.04 U	0.04 U	0.016 J	0.014 J	0.04 U	0.04 U	0.01 J
NITROGLYCERIN	55-63-0	mg/kg	0.78	10	NSL	4 U	4 U	4 U	4 U	4 U	4 U	4 U
PETN	78-11-5	mg/kg	NSL	NSL	NSL	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
RDX	121-82-4	mg/kg	5.8	26	100	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
TETRYL	479-45-8	mg/kg	31	410	NSL	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
TNT	118-96-7	mg/kg	21	95	30	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Metals												
ALUMINUM	7429-90-5	mg/kg	7800	100000	pH < 5.5	346	2300 K	255 K	264 K	237 K	254 K	170 K
ANTIMONY	7440-36-0	mg/kg	3.1	41	0.27	0.22 UL	0.23 U	*0.47 B c*	0.26 U	*0.4 B c*	*0.35 B c*	0.26 U
ARSENIC	7440-38-2	mg/kg	0.43	1.9	18	**0.46 B a**	**2.2 ab**	**0.53 B a**	**0.47 B a**	0.28 B	0.29 B	0.32 B
BARIUM	7440-39-3	mg/kg	1600	20000	330	2.5	5.8	1.4	1.5	1.4	1.4	0.81
BERYLLIUM	7440-41-7	mg/kg	16	200	21	0.018 B	0.058 B	0.02 B	0.017 U	0.026 B	0.017 U	0.016 U
CADMIUM	7440-43-9	mg/kg	3.9	51	0.36	0.016 U	0.05 B	0.019 U	0.02 U	0.017 U	0.02 U	0.02 U
CALCIUM	7440-70-2	mg/kg	NUT	NUT	NUT	97.2	173	138	103	80	84.5	1360
CHROMIUM	7440-47-3	mg/kg	23	310	81	1.7	6.3	1.6	1.5	1.4	1.5	0.67
COBALT	7440-48-4	mg/kg	NSL	NSL	13	0.032 B	0.43	0.039 J	0.036 U	0.031 U	0.036 U	0.035 U
COPPER	7440-50-8	mg/kg	310	4100	28	0.17 B	3.5	0.12 B	0.19 B	0.19 B	0.15 B	0.2 B
IRON	7439-89-6	mg/kg	NUT	NUT	NUT	394	2370	442	443	421	417	274
LEAD	7439-92-1	mg/kg	400	800	11	2	7.5	1.8	1.8	1.9	1.8	0.81 B
MAGNESIUM	7439-95-4	mg/kg	NUT	NUT	NUT	60.7 B	552	69	69.5	55.9	60.3	73.9
MANGANESE	7439-96-5	mg/kg	160	2000	500	6.7	13.7	6.7	6.8	5.3	6.8	2.6
MERCURY	7439-97-6	mg/kg	0.78	10	0.1	0.026 J	0.0086 U	0.0093 U	0.009 U	0.0088 U	0.0093 U	0.0086 U
MOLYBDENUM	7439-98-7	mg/kg	39	510	2	0.085 U	0.25 B	0.069 U	0.074 U	0.065 B	0.073 U	0.073 U
NICKEL	7440-02-0	mg/kg	160	2000	38	0.18 J	2.3	0.11 J	0.13 J	0.094 J	0.16 J	0.12 J
POTASSIUM	7440-09-7	mg/kg	NUT	NUT	NUT	26.5	358	34.7	36.4	29.2	28.9	32
SELENIUM	7782-49-2	mg/kg	39	510	1	0.31 B	0.25 U	0.27 U	0.29 U	0.24 U	0.28 U	0.28 U
SILVER	7440-22-4	mg/kg	39	510	4.2	0.044 U	0.033 U	0.034 U	0.037 U	0.031 U	0.036 U	0.036 U
SODIUM	7440-23-5	mg/kg	NUT	NUT	NUT	94.9 B	410	81.9 B	88 B	78.8 B	84.6 B	367 B
STRONTIUM	7440-24-6	mg/kg	4700	61000	NSL	0.98	3	1.7	1.4	1.4	1.2	5.3
THALLIUM	7440-28-0	mg/kg	0.55	7.2	1	0.61 U	0.5 U	0.53 U	0.56 U	0.48 U	0.55 U	0.55 U
TITANIUM	7440-32-6	mg/kg	NSL	NSL	NSL	88.2	136	86.3	97.7	73.8	91	24.2
VANADIUM	7440-62-2	mg/kg	7.8	100	7.8	1.3	6.9	1.4	1.4	1.3	1.2	0.66 J
ZINC	7440-66-6	mg/kg	2300	31000	50	3.4	6.2	2.6	2.1	2.5	3.8	1.7
ZIRCONIUM	7440-67-7	mg/kg	NSL	NSL	NSL	29.7	23.8 L	51.2 L	50.2 L	84.5 L	51.8 L	9 L

Sample Name: / **Sample Date:** / **Parent Name:** / **MRS:**			EPA Region III RBC Screening Value Residential (1)	EPA Region III RBC Screening Value Industrial (2)	Ecological Screening Values (3)	ASI-RS-SB-12-18-04 12/8/2006 MRS 2	ASI-RS-SB-12-18-05 12/8/2006 MRS 2	ASI-BG-SS-02-01 12/7/2006 BACKGROUND	ASI-BG-SS-02-02 12/7/2006 BACKGROUND	ASI-BG-SS-02-03 12/7/2006 BACKGROUND
Analyte	**CAS**	**Unit**								
Explosives										
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	230	3100	NSL	0.04 U	0.04 U	-	-	-
1,3-DINITROBENZENE	99-65-0	mg/kg	0.78	10	NSL	0.04 U	0.04 U	-	-	-
2,4-DINITROTOLUENE	121-14-2	mg/kg	16	200	30	0.04 U	0.04 U	-	-	-
2,6-DINITROTOLUENE	606-20-2	mg/kg	7.8	100	30	0.04 U	0.04 U	-	-	-
2-AMINO-4,6-DINITROTOLU	35572-78-2	mg/kg	16	200	20	0.04 U	0.04 U	-	-	-
2-NITROTOLUENE	88-72-2	mg/kg	78	1000	30	0.08 U	0.08 U	-	-	-
3-NITROTOLUENE	99-08-1	mg/kg	NSL	NSL	30	0.08 U	0.08 U	-	-	-
4-AMINO-2,6-DINITROTOLU	19406-51-0	mg/kg	16	200	30	0.04 U	0.04 U	-	-	-
4-NITROTOLUENE	99-99-0	mg/kg	NSL	NSL	30	0.08 U	0.08 U	-	-	-
HMX	2691-41-0	mg/kg	390	5100	NSL	0.08 U	0.08 U	-	-	-
NITROBENZENE	98-95-3	mg/kg	3.9	51	40	0.04 U	0.013 J	-	-	-
NITROGLYCERIN	55-63-0	mg/kg	0.78	10	NSL	4 U	4 U	-	-	-
PETN	78-11-5	mg/kg	NSL	NSL	NSL	0.2 U	0.2 U	-	-	-
RDX	121-82-4	mg/kg	5.8	26	100	0.08 U	0.08 U	-	-	-
TETRYL	479-45-8	mg/kg	31	410	NSL	0.08 U	0.08 U	-	-	-
TNT	118-96-7	mg/kg	21	95	30	0.04 U	0.04 U	-	-	-
Metals										
ALUMINUM	7429-90-5	mg/kg	7800	100000	pH < 5.5	198 K	184 K	323 K	256 K	362 K
ANTIMONY	7440-36-0	mg/kg	3.1	41	0.27	0.25 U	0.24 U	*0.3 J c*	0.23 U	*0.49 J c*
ARSENIC	7440-38-2	mg/kg	0.43	1.9	18	**0.55 B a**	0.38 B	**0.53 B a**	0.28 B	**0.68 B a**
BARIUM	7440-39-3	mg/kg	1600	20000	330	0.93	0.9	2.8	1.4	1.6
BERYLLIUM	7440-41-7	mg/kg	16	200	21	0.016 U	0.015 U	0.03 B	0.019 B	0.028 U
CADMIUM	7440-43-9	mg/kg	3.9	51	0.36	0.022 B	0.021 B	0.019 U	0.028 B	0.034 U
CALCIUM	7440-70-2	mg/kg	NUT	NUT	NUT	54.4 J	96.6	103	135	65.1 J
CHROMIUM	7440-47-3	mg/kg	23	310	81	0.81	0.9	3.5	1.7	1.5
COBALT	7440-48-4	mg/kg	NSL	NSL	13	0.035 U	0.033 U	0.034 U	0.032 U	0.061 U
COPPER	7440-50-8	mg/kg	310	4100	28	0.24 B	0.21 B	0.099 B	0.32 B	0.43 B
IRON	7439-89-6	mg/kg	NUT	NUT	NUT	319	182	673	374	545
LEAD	7439-92-1	mg/kg	400	800	11	1 B	0.72 B	4.5	2.2	2.3
MAGNESIUM	7439-95-4	mg/kg	NUT	NUT	NUT	37.4 B	117	74.2 B	74.5 B	71.9 B
MANGANESE	7439-96-5	mg/kg	160	2000	500	3.2	1.7	13.3	6.3	5.7
MERCURY	7439-97-6	mg/kg	0.78	10	0.1	0.0087 U	0.01 U	0.0096 U	0.0097 J	0.026 J
MOLYBDENUM	7439-98-7	mg/kg	39	510	2	0.071 U	0.067 U	0.07 U	0.065 U	0.13 U
NICKEL	7440-02-0	mg/kg	160	2000	38	0.16 J	0.2 J	0.13 J	0.18 J	0.73 J
POTASSIUM	7440-09-7	mg/kg	NUT	NUT	NUT	20.8	43.7	31.6	32.3	65.4
SELENIUM	7782-49-2	mg/kg	39	510	1	0.28 U	0.26 U	0.27 U	0.25 U	0.48 U
SILVER	7440-22-4	mg/kg	39	510	4.2	0.036 U	0.034 U	0.035 U	0.032 U	0.063 U
SODIUM	7440-23-5	mg/kg	NUT	NUT	NUT	82 B	662	83.5 B	77.2 B	134 B
STRONTIUM	7440-24-6	mg/kg	4700	61000	NSL	0.69	6.9	2.2	1.8	1
THALLIUM	7440-28-0	mg/kg	0.55	7.2	1	0.54 U	0.51 U	0.53 U	0.49 U	0.95 U
TITANIUM	7440-32-6	mg/kg	NSL	NSL	NSL	33.9	26.4	227	92.3	83.8
VANADIUM	7440-62-2	mg/kg	7.8	100	7.8	0.83	0.7 J	3	1.3	1.6
ZINC	7440-66-6	mg/kg	2300	31000	50	2.1	1.5 J	2.8	2.6	2.7 J
ZIRCONIUM	7440-67-7	mg/kg	NSL	NSL	NSL	19.7 L	5.9 J	106 L	26.8 L	33.8 L

(1) USEPA Region III Risk Based (RBCs) Table, April 2007. For non-carcinogens, value shown is equal to 1/10 the residential soil RBC value.
For carcinogens the value shown is equal to the residential soil RBC value.
(2) USEPA Region III Risk Based (RBCs) Table, April 2007. For non-carcinogens, value shown is equal to 1/10 the industrial soil RBC value.
For carcinogens the value shown is equal to the industrial soil RBC value.
(3) Ecological Screening Value refernces are found in Table 5-6.

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EPA. 2007. USEPA Region III Risk-Based Concentration Table, April 2007. Available from http://www.epa.gov/reg3hwmd/risk/human/rbc/RBCapr07.pdf Accessed April 2007.

BG=background sample
SS=surface soil
SB=subsurface soil
B=Not detected substantially above the level reported in the laboratory field blanks.
J=Analyte is present. Reported value may not be accurate or precise.
K=Analyte is present. Reported value may be biased high. Actual value is expected to be lower.
L=Analyte is present. Reported value may be biased low. Actual value is expected to be higher.
U=Not detected. The associated number indicates the approximate sample concentration necessary to be detected.
UL=Not detected, quantitation limit is probably higher.
mg/kg=milligrams per kilogram
CAS=Chemical Abstract Service
NA=not available
NSL=No Screening Level
NUT=Essential Nutrient

Notes:

Blue shaded and bolded values represent exceedance of human health screening criteria.
Blue shaded and italicized values represent exceedance of ecological screening criteria.
Blue shaded, bolded and italicized values represent exceedance of both human health and ecological screening criteria.
Yellow shaded analytes are those constituents associated with past munitions use.

Table 5-6. Soil, Sediment, and Surface Water Ecological Screening Values and Sources for Compounds Detected at Assateague Island

Analyte	Value	Source
Surface Soil (mg/kg)		
Nitrobenzene	40	Efroymson et. al. (1997b)
Aluminum	pH <5.5	USEPA (2003a)
Antimony	0.27	USEPA (2005a)
Arsenic	18	USEPA (2005b)
Barium	330	USEPA (2005c)
Calcium	EN	--
Chromium	81	USEPA (2005d)
Cobalt	13	USEPA (2005e)
Copper	28	USEPA (2007a)
Iron	EN	--
Lead	11	USEPA (2005f)
Magnesium	EN	--
Manganese	500	Efroymson et. al. (1997a)
Mercury	0.1	Efroymson et. al. (1997b)
Nickel	38	USEPA (2007b)
Potassium	EN	--
Silver	4.2	USEPA (2006a)
Sodium	EN	--
Strontium	NA	--
Titanium	NA	--
Vanadium	7.8	USEPA (2005g)
Zinc	50	Efroymson et al. (1997a)
Zirconium	NA	--
Sediment (mg/kg)		
Aluminum	NA	--
Antimony	2	Long and Morgan (1990)
Barium	NA	--
Calcium	EN	--
Chromium	43.4	MacDonald et al. (2000)
Iron	EN	--
Lead	35.8	MacDonald et al. (2000)
Manganese	460	Persaud et. al. (1993)
Nickel	22.7	MacDonald et al. (2000)
Potassium	EN	--
Sodium	EN	--
Strontium	NA	--
Titanium	NA	--
Vanadium	NA	--
Zinc	121	MacDonald et al. (2000)
Zirconium	NA	--
Surface Water* (µg/L)		
HMX	NA	--
Barium	4	Suter and Tsao (1996)
Calcium	EN	--
Iron	EN	--
Lead	8.1	USEPA (2006b)
Magnesium	EN	--
Manganese	120	Suter and Tsao (1996)

Analyte	Value	Source
Mercury	0.94	USEPA (2006b)
Nickel	8.2	USEPA (2006b)
Potassium	EN	--
Selenium	71	USEPA (2006b)
Sodium	EN	--
Strontium	NA	--
Titanium	NA	--
Zinc	81	USEPA (2006b)

EN = Essential Nutrient
NA = Screening Value Not Available
* using screening values for salt water
*Yellow shaded analytes are those constituents associated with past munitions use.

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USEPA. 2007b. Ecological Soil Screening Level for Nickel. Available from . http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_nickel.pdf

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Table 5-7 Non-Detection Concentrations and Screening Values for Human Health at Assateague Island MMRP FUDS Site

Analyte	Cas no.	Units	Minimum Non-Detect Concentration	Maximum Non-Detect Concentration	Screening [1] Value
Sediment					
Explosives					
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	0.04	0.04	2300
1,3-DINITROBENZENE	99-65-0	mg/kg	0.04	0.04	7.8
2,4-DINITROTOLUENE	121-14-2	mg/kg	0.04	0.04	160
2,6-DINITROTOLUENE	606-20-2	mg/kg	0.04	0.04	78
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.04	0.04	160
2-NITROTOLUENE	88-72-2	mg/kg	0.08	0.08	780
3-NITROTOLUENE	99-08-1	mg/kg	0.08	0.08	---
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.04	0.04	160
4-NITROTOLUENE	99-99-0	mg/kg	0.08	0.08	---
HMX	2691-41-0	mg/kg	0.08	0.08	3900
NITROBENZENE	98-95-3	mg/kg	0.04	0.04	39
NITROGLYCERIN	55-63-0	mg/kg	4	4	1300
PETN	78-11-5	mg/kg	0.2	0.2	---
RDX	121-82-4	mg/kg	0.08	0.08	58
TETRYL	479-45-8	mg/kg	0.08	0.08	310
TNT	118-96-7	mg/kg	0.04	0.04	210
Inorganics					
ANTIMONY	7440-36-0	mg/kg	0.3	0.34	31
ARSENIC	7440-38-2	mg/kg	0.23	0.27	4.3
BERYLLIUM	7440-41-7	mg/kg	0.02	0.022	160
CADMIUM	7440-43-9	mg/kg	0.023	0.027	78
COBALT	7440-48-4	mg/kg	0.042	0.048	---
COPPER	7440-50-8	mg/kg	0.066	0.075	3100
MAGNESIUM	7439-95-4	mg/kg	0.49	0.55	---
MERCURY	7439-97-6	mg/kg	0.012	0.012	7.8
MOLYBDENUM	7439-98-7	mg/kg	0.086	0.098	390
SELENIUM	7782-49-2	mg/kg	0.33	0.38	390
SILVER	7440-22-4	mg/kg	0.043	0.049	390
THALLIUM	7440-28-0	mg/kg	0.65	0.74	5.5
Surface Soil					
Explosives					
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	0.04	0.04	230
1,3-DINITROBENZENE	99-65-0	mg/kg	0.04	0.04	0.78
2,4-DINITROTOLUENE	121-14-2	mg/kg	0.04	0.04	16
2,6-DINITROTOLUENE	606-20-2	mg/kg	0.04	0.04	7.8
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.04	0.04	16
2-NITROTOLUENE	88-72-2	mg/kg	0.08	0.08	78
3-NITROTOLUENE	99-08-1	mg/kg	0.08	0.08	---
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.04	0.04	16
4-NITROTOLUENE	99-99-0	mg/kg	0.08	0.08	---
HMX	2691-41-0	mg/kg	0.08	0.08	390
NITROBENZENE	98-95-3	mg/kg	0.04	0.04	3.9
NITROGLYCERIN	55-63-0	mg/kg	4	4	130
PETN	78-11-5	mg/kg	0.2	0.2	---
RDX	121-82-4	mg/kg	0.08	0.08	5.8
TETRYL	479-45-8	mg/kg	0.08	0.08	31
TNT	118-96-7	mg/kg	0.04	0.04	21
Inorganics					
ANTIMONY	7440-36-0	mg/kg	0.2	0.27	3.1
ARSENIC	7440-38-2	mg/kg	0.17	0.34	0.43
BERYLLIUM	7440-41-7	mg/kg	0.0064	0.018	16
CADMIUM	7440-43-9	mg/kg	0.015	0.021	7.8
COBALT	7440-48-4	mg/kg	0.023	0.038	---
COPPER	7440-50-8	mg/kg	0.046	0.06	310
MAGNESIUM	7439-95-4	mg/kg	0.36	0.5	---
MERCURY	7439-97-6	mg/kg	0.0086	0.011	0.78
MOLYBDENUM	7439-98-7	mg/kg	0.063	0.085	39
SELENIUM	7782-49-2	mg/kg	0.15	0.3	39
SILVER	7440-22-4	mg/kg	0.031	0.044	39
SODIUM	7440-23-5	mg/kg	8.3	18.4	---
THALLIUM	7440-28-0	mg/kg	0.48	0.61	0.55

Table 5-7 Non-Detection Concentrations and Screening Values for Human Health at Assateague Island MMRP FUDS Site

Analyte	Cas no.	Units	Minimum Non-Detect Concentration	Maximum Non-Detect Concentration	Screening [1] Value
Groundwater					
Explosives					
1,3,5-TRINITROBENZENE	99-35-4	ug/L	0.2	0.21	110
1,3-DINITROBENZENE	99-65-0	ug/L	0.2	0.21	0.37
2,4-DINITROTOLUENE	121-14-2	ug/L	0.2	0.21	7.3
2,6-DINITROTOLUENE	606-20-2	ug/L	0.2	0.21	3.7
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	ug/L	0.2	0.21	7.3
2-NITROTOLUENE	88-72-2	ug/L	0.41	0.42	6.1
3-NITROTOLUENE	99-08-1	ug/L	0.41	0.42	---
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	ug/L	0.2	0.21	7.3
4-NITROTOLUENE	99-99-0	ug/L	0.41	0.42	---
HMX	2691-41-0	ug/L	0.41	0.42	180
NITROBENZENE	98-95-3	ug/L	0.2	0.21	0.35
NITROGLYCERIN	55-63-0	ug/L	20	21	62
PERCHLORATE	14797-73-0	ug/L	0.2	2	---
PETN	78-11-5	ug/L	1	1.1	---
RDX	121-82-4	ug/L	0.41	0.42	0.61
TETRYL	479-45-8	ug/L	0.41	0.42	15
TNT	118-96-7	ug/L	0.2	0.21	2.2
Inorganics					
ANTIMONY	7440-36-0	ug/L	0.12	1.2	1.5
CADMIUM	7440-43-9	ug/L	0.11	1.1	1.8
CHROMIUM	7440-47-3	ug/L	1.8	18	11
MOLYBDENUM	7439-98-7	ug/L	0.23	2.3	18
SILVER	7440-22-4	ug/L	0.023	0.23	18
THALLIUM	7440-28-0	ug/L	0.17	1.7	0.26
VANADIUM	7440-62-2	ug/L	3.2	32	3.7
ZIRCONIUM	7440-67-7	ug/L	2.4	24	---
Surface water					
Explosives					
1,3,5-TRINITROBENZENE	99-35-4	ug/L	0.21	0.21	1100
1,3-DINITROBENZENE	99-65-0	ug/L	0.21	0.21	3.7
2,4-DINITROTOLUENE	121-14-2	ug/L	0.21	0.21	73
2,6-DINITROTOLUENE	606-20-2	ug/L	0.21	0.21	37
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	ug/L	0.21	0.21	73
2-NITROTOLUENE	88-72-2	ug/L	0.42	0.42	61
3-NITROTOLUENE	99-08-1	ug/L	0.42	0.42	---
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	ug/L	0.21	0.21	73
4-NITROTOLUENE	99-99-0	ug/L	0.42	0.42	---
HMX	2691-41-0	ug/L	0.42	0.42	1800
NITROBENZENE	98-95-3	ug/L	0.21	0.21	3.5
NITROGLYCERIN	55-63-0	ug/L	21	21	620
PETN	78-11-5	ug/L	1	1.1	---
RDX	121-82-4	ug/L	0.42	0.42	6.1
TETRYL	479-45-8	ug/L	0.42	0.42	150
TNT	118-96-7	ug/L	0.21	0.21	22
Inorganics					
ALUMINUM	7429-90-5	ug/L	22	220	---
ANTIMONY	7440-36-0	ug/L	0.12	1.2	15
ARSENIC	7440-38-2	ug/L	0.8	8	0.45
BARIUM	7440-39-3	ug/L	0.74	7.4	7300
BERYLLIUM	7440-41-7	ug/L	0.028	0.28	73
CADMIUM	7440-43-9	ug/L	0.11	1.1	18
CHROMIUM	7440-47-3	ug/L	1.8	18	110
COBALT	7440-48-4	ug/L	0.044	0.44	---
COPPER	7440-50-8	ug/L	0.92	9.2	1500
IRON	7439-89-6	ug/L	24.8	248	11000
LEAD	7439-92-1	ug/L	0.34	3.4	150
MOLYBDENUM	7439-98-7	ug/L	0.23	2.3	180
NICKEL	7440-02-0	ug/L	0.36	3.6	730
SELENIUM	7782-49-2	ug/L	0.59	5.9	180
SILVER	7440-22-4	ug/L	0.023	0.23	180
THALLIUM	7440-28-0	ug/L	0.17	1.7	2.6
TITANIUM	7440-32-6	ug/L	2	20	---
VANADIUM	7440-62-2	ug/L	3.2	32	37
ZINC	7440-66-6	ug/L	2	20	11000
ZIRCONIUM	7440-67-7	ug/L	2.4	24	---

[1]USEPA Region III Risk Based (RBCs) Table, April 2007. For non-carcinogens, value shown is equal to 1/10 the residential soil RBC value. For carcinogens the value shown is equal to the residential soil RBC value. To account for ssediment and surface water exposure, the resulting value has been increased by a facto of ten.
NA - No screening value
mg/kg = milligram per kilogram
ug/L = microgram per liter
Yellow shaded analytes are those constituents associated with past munitions use.

Table 5-8 Non-Detection Concentrations and Screening Values for Ecological Receptors at Assateague Island MMRP FUDS Site

Analyte	Cas no.	Units	Minimum Non-Detect Concentration	Maximum Non-Detect Concentration	Screening [1] Value	Screening Source
Sediment						
Explosives						
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	0.04	0.04	2,659	Spectrum (2003a), from K_{ow} values
1,3-DINITROBENZENE	99-65-0	mg/kg	0.04	0.04	371	Spectrum (2003b), from K_{ow} values
2,4-DINITROTOLUENE	121-14-2	mg/kg	0.04	0.04	0.0416	USEPA (2006c), from Kow values
2,6-DINITROTOLUENE	606-20-2	mg/kg	0.04	0.04	0.0416	2,4-Dinitrotoluene as surrogate
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.04	0.04	876	Robb et al. (2002), from K_{ow} values
2-NITROTOLUENE	88-72-2	mg/kg	0.08	0.08	4.06	4-Nitrotoluene as surrogate
3-NITROTOLUENE	99-08-1	mg/kg	0.08	0.08	4.06	4-Nitrotoluene as surrogate
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.04	0.04	444	Robb et al. (2002), from K_{ow} values
4-NITROTOLUENE	99-99-0	mg/kg	0.08	0.08	4.06	Talmage et al. (1999)
HMX	2691-41-0	mg/kg	0.08	0.08	2.17	Robb et al. (2002), from K_{ow} values
NITROBENZENE	98-95-3	mg/kg	0.04	0.04	NSL	
NITROGLYCERIN	55-63-0	mg/kg	4	4	NSL	
PETN	78-11-5	mg/kg	0.2	0.2	34,627	USCHPPM (2001), from K_{ow} values
RDX	121-82-4	mg/kg	0.08	0.08	0.36	Calculated from K_{ow} value[1]
TETRYL	479-45-8	mg/kg	0.08	0.08	NSL	
TNT	118-96-7	mg/kg	0.04	0.04	100	USEPA (2006c), from Kow values
Inorganics						
ARSENIC	7440-38-2	mg/kg	0.23	0.23	9.8	MacDonald et al. (2000)
BERYLLIUM	7440-41-7	mg/kg	0.02	0.02	NSL	
CADMIUM	7440-43-9	mg/kg	0.023	0.023	0.99	MacDonald et al. (2000)
COBALT	7440-48-4	mg/kg	0.042	0.042	50	Persaud et al. (1993)
COPPER	7440-50-8	mg/kg	0.066	0.066	31.6	MacDonald et al. (2000)
MAGNESIUM	7439-95-4	mg/kg	0.49	0.49	EN	
MERCURY	7439-97-6	mg/kg	0.012	0.012	0.18	MacDonald et al. (2000)
MOLYBDENUM	7439-98-7	mg/kg	0.086	0.086	NSL	
SELENIUM	7782-49-2	mg/kg	0.33	0.33	2	Lemley (2002)
SILVER	7440-22-4	mg/kg	0.043	0.043	NSL	
THALLIUM	7440-28-0	mg/kg	0.65	0.65	NSL	
Surface Soil						
Explosives						
1,3,5-TRINITROBENZENE	99-35-4	mg/kg	0.04	0.04	NSL	
1,3-DINITROBENZENE	99-65-0	mg/kg	0.04	0.04	NSL	
2,4-DINITROTOLUENE	121-14-2	mg/kg	0.04	0.04	30	TNT as surrogate
2,6-DINITROTOLUENE	606-20-2	mg/kg	0.04	0.04	30	TNT as surrogate
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	mg/kg	0.04	0.04	20	Talmage et al. (1999)
2-NITROTOLUENE	88-72-2	mg/kg	0.08	0.08	30	TNT as surrogate
3-NITROTOLUENE	99-08-1	mg/kg	0.08	0.08	30	TNT as surrogate
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	mg/kg	0.04	0.04	30	TNT as surrogate
4-NITROTOLUENE	99-99-0	mg/kg	0.08	0.08	30	TNT as surrogate
HMX	2691-41-0	mg/kg	0.08	0.08	NSL	
NITROBENZENE	98-95-3	mg/kg	0.04	0.04	40	Efroymson et al. (1997b)
NITROGLYCERIN	55-63-0	mg/kg	4	4	NSL	
PETN	78-11-5	mg/kg	0.2	0.2	NSL	
RDX	121-82-4	mg/kg	0.08	0.08	100	Talmage et al. (1999)
TETRYL	479-45-8	mg/kg	0.08	0.08	NSL	
TNT	118-96-7	mg/kg	0.04	0.04	30	Talmage et al. (1999)
Inorganics						
ANTIMONY	7440-36-0	mg/kg	0.2	0.34	0.27	USEPA (2005a)
ARSENIC	7440-38-2	mg/kg	0.17	0.34	18	USEPA (2005b)
BERYLLIUM	7440-41-7	mg/kg	0.0064	0.022	21	USEPA (2005h)

Table 5-8 Non-Detection Concentrations and Screening Values for Ecological Receptors at Assateague Island MMRP FUDS Site

Analyte	Cas no.	Units	Minimum Non-Detect Concentration	Maximum Non-Detect Concentration	Screening [1] Value	Screening Source
CADMIUM	7440-43-9	mg/kg	0.015	0.027	0.36	USEPA (2005i)
COBALT	7440-48-4	mg/kg	0.023	0.048	13	USEPA (2005e)
COPPER	7440-50-8	mg/kg	0.046	0.075	28	USEPA (2007a)
MAGNESIUM	7439-95-4	mg/kg	0.36	0.55	NSL	
MOLYBDENUM	7439-98-7	mg/kg	0.063	0.098	2	Efroymson et al. (1997a)
SELENIUM	7782-49-2	mg/kg	0.15	0.38	1	Efroymson et al. (1997a)
SILVER	7440-22-4	mg/kg	0.031	0.049	4.2	USEPA (2006a)
SODIUM	7440-23-5	mg/kg	8.3	18.4	EN	
THALLIUM	7440-28-0	mg/kg	0.48	0.74	1	Efroymson et al. (1997a)
Surface water						
Explosives						
1,3,5-TRINITROBENZENE	99-35-4	ug/L	0.21	0.21	11	Talmage et al. (1999)
1,3-DINITROBENZENE	99-65-0	ug/L	0.21	0.21	20	Talmage et al. (1999)
2,4-DINITROTOLUENE	121-14-2	ug/L	0.21	0.21	44	Ohio USEPA (2002)
2,6-DINITROTOLUENE	606-20-2	ug/L	0.21	0.21	81	USEPA (2005j), from LC50 values
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	ug/L	0.21	0.21	80	Talmage et al. (1999)
2-NITROTOLUENE	88-72-2	ug/L	0.42	0.42	750	3-Nitrotoluene as surrogate
3-NITROTOLUENE	99-08-1	ug/L	0.42	0.42	750	USEPA (2005j), from LC50 values
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	ug/L	0.21	0.21	750	3-Nitrotoluene as surrogate
4-NITROTOLUENE	99-99-0	ug/L	0.42	0.42	1900	USEPA (2005j), from LC50 values
HMX	2691-41-0	ug/L	0.42	0.42	330	Talmage et al. (1999)
NITROBENZENE	98-95-3	ug/L	0.21	0.21	6680	USEPA (1995)
NITROGLYCERIN	55-63-0	ug/L	21	21	138	USEPA (2005j), from LC50 values
PETN	78-11-5	ug/L	1	1.1	85000	USEPA (2005j), from LC50 values
RDX	121-82-4	ug/L	0.42	0.42	190	Talmage et al. (1999)
TETRYL	479-45-8	ug/L	0.42	0.42	NSL	
TNT	118-96-7	ug/L	0.21	0.21	100	USEPA (2005j), from LC50 values
Inorganics						
ALUMINUM	7429-90-5	ug/L	22	220	87	USEPA (2006b)
ANTIMONY	7440-36-0	ug/L	0.12	1.2	30	Suter and Tsao (1996)
ARSENIC	7440-38-2	ug/L	0.8	8	5	USEPA (1996)
BARIUM	7440-39-3	ug/L	0.74	7.4	4	Suter & Tsao (1996)
BERYLLIUM	7440-41-7	ug/L	0.028	0.28	0.66	Suter & Tsao (1996)
CADMIUM	7440-43-9	ug/L	0.11	1.1	0.25	USEPA (2006b)
CHROMIUM	7440-47-3	ug/L	1.8	18	11	USEPA (2006b)
COBALT	7440-48-4	ug/L	0.044	0.44	23	Suter & Tsao (1996)
COPPER	7440-50-8	ug/L	0.92	9.2	9	USEPA (2006b)
IRON	7439-89-6	ug/L	24.8	248	EN	
LEAD	7439-92-1	ug/L	0.34	3.4	8.1	USEPA (2006b)
MOLYBDENUM	7439-98-7	ug/L	0.23	2.3	73	CCME (2003)
NICKEL	7440-02-0	ug/L	0.36	3.6	8.2	USEPA (2006b)
SELENIUM	7782-49-2	ug/L	0.59	5.9	5	USEPA (2006b)
SILVER	7440-22-4	ug/L	0.023	0.23	3.2	USEPA (2006b)
THALLIUM	7440-28-0	ug/L	0.17	1.7	0.8	CCME (2003)
TITANIUM	7440-32-6	ug/L	2	20	NSL	
VANADIUM	7440-62-2	ug/L	3.2	32	20	Suter and Tsao (1996)
ZINC	7440-66-6	ug/L	2	20	81	USEPA (2006b)
ZIRCONIUM	7440-67-7	ug/L	2.4	24	17	Suter and Tsao (1996)

Yellow shaded analytes are those constituents associated with past munitions use.

Table 5-8 Non-Detection Concentrations and Screening Values for Ecological Receptors at Assateague Island MMRP FUDS Site

NSL - No screening level
EN - Essential nutrient
mg/kg = milligram per kilogram
ug/L = microgram per liter
(1) Calculated from Kow = 100 (Talmage et al. 1999), assuming 1% organic carbon, using water concentration from USEPA (2005j)

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6. SUMMARY AND CONCLUSIONS

6.0.1 From 1944 to 1947, the U.S. Navy and the U.S. Army Air Corps established two separate rocket ranges on Assateague Island. These rocket ranges were used by the Navy during WWII for target practice by land-based aircraft. At the end of WWII, two (possibly three) ordnance disposal sites were created. The following two MRSs were addressed during this SI (see Table 2-1):

- MRS 1 – Rocket Range North (Range Identification No. C03MD093001R01)
- MRS 2 – Rocket Range South (Range Identification No. C03MD093001R02).

6.0.2 The MRSs listed above are consistent with the MMRP Inventory in the DERP Fiscal Year 2005 Annual Report to Congress (DoD 2005). The designated ranges include approximately 1,146 acres of land located within the FUDS property boundary, and the remaining acreage, 5,070 acres of tidal waters, is beyond the designated FUDS property boundary. Currently, DERP management guidance and USACE guidance have determined that the range area in the water beyond the 100-yard mean high tide line is not eligible for inclusion in DERP-FUDS. Therefore, the area of the range fans that is beyond 100 yards from shore (during mean high tide) to include the majority of the 5,070 acres of tidal waters beneath the range fans for both rocket ranges (MRS 1 and MRS 2) is not addressed in the SI findings or recommendations. A summary of results and conclusions, by designated MRS, is presented below.

6.1 Rocket Range North (MRS 1)

6.1.1 MRS 1 consists of approximately 583 land acres and is bordered by Chincoteague Bay on the west and the Atlantic Ocean on the east. MEC discoveries include at least one rocket motor and two live 5-inch shells. MD discovered at the site includes numerous rocket parts. No documented injuries have occurred at the site. Qualitative reconnaissance covered approximately 4.2 acres during the SI. Suspect MD along with cultural debris and subsurface anomalies were identified during the SI reconnaissance. No MEC was identified during the SI reconnaissance. The site is part of state and federal park systems. The eastern shore is predominately sand dunes, while the western shore is covered with dense brush and salt-marsh wetlands. Access is fairly unrestricted and recreational camping and hunting/fishing in the vicinity of the MRS is common. The overall MEC risk is considered low to moderate.

6.1.2 No COPCs were reported for the human health screening assessment for MRS 1. Assateague Island provides valuable and recognized habitat for ecological receptors, including rare species, and is within the Coastal Management Zone. Consequently, a SLERA was performed. One analyte (antimony) was detected in surface soil samples above ecological screening criteria. However, this exceedance is comparable to background concentrations. No COPECs were reported for the ecological screening assessment for MRS 1 (refer to Table 6-1). All pathways to all receptors are considered complete for MRS 1, but based on these screening results do not pose significant risk to human or ecological receptors.

6.2 Rocket Range South (MRS 2)

6.2.1 MRS 2 consists of approximately 563 land acres and is bordered by Chincoteague Bay on the west and the Atlantic Ocean on the east. MRS 2 is located in the southern portion of the Assateague Island FUDS area. MEC has not been found/identified in MRS 2; however, subsurface anomalies were identified. MD includes rocket, bomb, and 20-mm casings recovered in MRS 2. No documented injuries have occurred at the site. Qualitative reconnaissance was conducted on approximately 8 acres of MRS 2 during this SI. An additional 20.5 acres was inspected outside of the MRS boundaries. No MEC/MD was identified during the SI reconnaissance. The site is part of state and federal park systems. The eastern shore is predominately sand dunes, while the western shore is covered with dense brush and salt-marsh wetlands. Access is fairly unrestricted and recreational camping and hunting/fishing in the vicinity of the MRS is common. The overall MEC risk is considered low to moderate.

6.2.2 One MC (aluminum) was reported as exceeding human health screening criteria for groundwater in MRS 2. However, it was concluded that the analyte not be retained as a COPC since the sample was from a temporary well point which was not filtered and likely contained sediment particles as evidenced by elevated levels of essential nutrients. Assateague Island provides valuable and recognized habitat for ecological receptors, including rare species, and is within the Coastal Management Zone. Consequently, an SLERA was performed. Antimony exceeded the ecological screening criteria for surface soil for MRS 2 (refer to Table 6-1). However, it was noted that this exceedance was comparable to background concentrations; therefore, antimony was not identified as a COPEC. All pathways, except those for surface soil, to all receptors are considered complete for MRS 2, but based on these screening results do not pose significant risk to human or ecological receptors.

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

Medium of Concern	Human Health COPCs[1]		Ecological COPECs (SLERA)[2]	
	MRS 1. Rocket Range North	MRS 2. Rocket Range South	MRS 1. Rocket Range North	MRS 2. Rocket Range South
Groundwater	No exceedances of EPA Region III screening values.	One exceedance (aluminum) of EPA Region III screening values. Aluminum was not retained as a chemical of potential concern (COPC) since the sample was from a temporary well point which was not filtered and likely contained sediment particles as evidenced by elevated levels of essential nutrients. Based on this weight of evidence aluminum was not identified as a COPC.	Not applicable.	Not applicable.
Surface Water	No exceedances of EPA Region III screening values.	No exceedances of EPA Region III screening values.	No exceedances of ecological screening values.	No exceedances of ecological screening values.
Sediment	No exceedances of EPA Region III screening values	No exceedances of EPA Region III screening values	No exceedances of ecological screening values.	No exceedances of ecological screening values.
Surface Soil	No exceedances of EPA Region III screening values.	No exceedances of EPA Region III screening values.	One exceedance (antimony) ecological screening values. Antimony was not detected above background; therefore, was not identified as a COPEC.	One exceedance (antimony) of ecological screening values. Antimony was not detected above background; therefore, was not identified as a COPEC.

1. For the Human Health Risk Screen, EPA Region III RBC screening values were used for soil, sediment, surface water, and groundwater comparisons. See Tables 5-2 through 5-5 for the screening values.
2. For Ecological Risk Screen, the screening values identified in Tables 5-6 were applied.

7. RECOMMENDATIONS FOR FURTHER ACTION

7.0.1 The Assateague FUDS has two designated MRSs, and the recommendations for these MRSs are presented below:

MRS 1 – Rocket Range North: This area was historically was used as a bomb and rocket target and MEC have been found in MRS 1. Based on the MEC assessment, MEC risk is considered low to moderate. An RI/FS is recommended for MRS 1 and additional studies should focus on MEC. Acceptable human health and ecological risks were identified based on the risk screening results.

MRS 2 – Rocket Range South: MRS 2 historically was used as bomb/rocket target and MD has been found at MRS 2. Based on the MEC assessment, MEC risk is considered low to moderate. An RI/FS is recommended for MRS 2 and additional studies should focus on MEC. Acceptable human health and ecological risks were identified based on the risk screening results.

7.0.2 A TCRA/NTCRA is not recommended for any of the MRSs addressed in this SI.

7.0.3 The boundary and acreage of the MRSs in the ASR Supplement should be reviewed and possibly revised for MRS 1 and 2. This review should also address suspect disposal areas that lie within the FUDS and outside each of MRS range boundaries (for investigation and delineation during the RI/FS).

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Zimmerman, Carl. 2007. Email to Ivy Able Regarding camping in and around the former southern rocket range. Dated 26 September 2007.

APPENDIX A - SCOPE OF WORK

Located on CD.

APPENDIX B - TPP MEMORANDUM

- DQO Verification Worksheets
- TPP #1 Memorandum
- TPP #2 Memorandum

Located on CD

APPENDIX C - INTERVIEW DOCUMENTATION

- Mr. Zimmerman 2006
- Mr. Zimmerman 2007

ALION
SCIENCE AND TECHNOLOGY

COMMUNICATIONS RECORD FORM

Date: 05/17/06

Contract Number:W912DY-04-D-0017

Delivery Order #: 00170001

Distribution: SIs MMRP

Person Contacted: Carl Zimmerman

Affiliation: NPS, Assateague Island National Seashore – Site Manager

Address: 7206 National Seashore Lane, Berlin, MD 21811

Type of Contact: Office visit.

Person Making Contact: Ivy Able

Communications Summary: As a follow up to several action items documented in the Final TPP Memorandum for Assateague Island (Alion 2006) Ivy Able visited Mr. Zimmerman at his office in Berlin, MD. The purpose of this meeting was to retrieve site-specific information on Assateague Island for inclusion in the Site-Specific Work Plan. The data that was retrieved included aerial photos, historical shoreline data, maps noting access roads, T&E species information, etc. In addition Ms. Able provided Mr. Zimmerman with sampling coordinates so that he could confirm the suggested locations would not interfere with protected areas. Mr. Zimmerman was able to confirm this in a follow up email.

From: Carl_Zimmerman@nps.gov
Sent: Wednesday, September 26, 2007 8:31 AM
To: Able, Ivy
Subject: Re: camping on the southern part of Assateage

Hello Ivy:

Yes, there is a backcountry campsite located within in the MRS2 site boundary. The campground has three sites, with a maximum use of 15 people at any given time. The site receives minimal use during the summer and winter months; moderate use during the spring and fall. Annual use is probably no more than 1,500 visitors per year

Carl

Carl S. Zimmerman
Chief, Division of Resource Management
Assateague Island National Seashore
7206 National Seashore Lane
Berlin, MD 21811
(410) 641-1443, extension 213
(410) 641-1099 Fax

"Able, Ivy"
<iable@eaest.com>
09/25/2007 02:09 PM AST

To: <Carl_Zimmerman@nps.gov>
cc: "Shia, Corinne M " <cshia@alionscience.com>, "O'Neill, Mike" <moneill@eaest.com>
Subject: camping on the southern part of Assateage

Carl,

Today we had the third TPP meeting for Assateague Island. During this meeting the question arose as to the number of people that camp near MRS 2 (near the former southern rocket range). As I recall camping is allowed in and around MRS 2, is that correct? If so, approximately how many people would you speculate that camp in the area each year?

Thanks for your help!
Regards,
Ivy

Ivy Able
Engineer
EA Engineering
1319 Woodbridge Station Way, Suite 200
Edgewood, MD 21040
Telephone: (410) 538-8202 x126
Fax: (410) 538-8207

APPENDIX D - FIELD NOTES AND FIELD FORMS

- Daily Quality Control Reports
- Logbook
- Fieldsheets
- Chains of Custody

Field Log Book for the Site Inspection at Assateague Island

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(EA) (Alion)

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Fairfax, VA 22033

Phone 410-329-5114 /

Project MMRP_FUDS - Assateague Island - C03MD093001
QC'D by Michael O'Neill

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CONTENTS

Reference Page Index

Location Assateague Island Date 12/6/06

Project / Client C03M0093001 / USACE

Michael O'Neill & Rusty Mitchell onsite
Conditions observed onsite at arrival:
— Clear / sunny with breezy conditions
11:30 A.M Arrived on site and met with NPS personnel to go over site conditions and guidelines for accessing the site. Reviewed/ Sampling locations with NPS personnel. Met with Mr. Carl ZIMMERMAN, Mr. of NPS
NPS personnel provided copies of Hunting information / regulations, information on benchmark locations, off road instructions (for accessing Sampling locations in the South Rocket Range), and general site Maps. [redacted] Alion team members reviewed Sampling locations with NPS personnel to determine which Samples were located on State park property. NPS officials were informed that the Alion team would not Samples State property but would likely move those Samples to

Location Assateague Island Date 12/6/06

Project / Client C03M0093001 / USACE

NPS property, within the Northern Rocket Range. The Alion team received contact information (for park personnel) to use in case of an emergency. Alion provided addition / updated contact information. Meeting ended around 12:15 PM.
- Went offsite to collect additional equipment (shovels, tire gauge, etc.) for off-roading activities. Performed Health & Safety Briefing. Signed Field Logs.
Arrived at GPS-7 Location 1320 (Near Sign which says "Fee Area" but on eastern side of the Road).

Benchmark Readings As documented by USGS should be
N 4229625.42 E 486835.32

Alion team Readings
N 4229625.18 E 486835.35
GPS check = OK Mitchell O'Neill

Location Assateague Island Date 12/6/06

Project / Client CO3MD0093001 / USACE

1345 Shoreteck checked OK by rec tech.
1400 Began traveling down Beach to the Southern Rocket Range. Beach travel was slow going but after some time arrived down at some of northern sampler locations associated with the Southern Rocket Range. Ended up down at Mile Marker KM 29. Began Recon along the beach in the area below Mean ~~high~~ MHW high tide and mean low tide (approximately 100 feet below mean high tide). Went down to Marker KM 30.7 and came back up the beach. Did not detect any evidence of Southern Rocket Range or view any surface debris. No subsurface anomalies were detected. Team traveled to ~~both~~ 2 suspect locations ~~were~~ (identified by USACE and noted on sampling maps as "Anomalies noted during JAN 2003 Review"). NO anomalies could be located. One Large Metal Float was located on the surface near the location of one suspected subsurface anomaly. The team left the Site at 1:95 PM. NO Samples collected.

Location Assateague Island Date 12/7/06

Project / Client CO3MD0093001 / USACE

0730 Mike O. & Rusty M. arrived on site and benchmarked GPS units
Benchmarked against same location as previous day GPS-7.
Readings were N 4229625.10 E 486834.86

Began Reconnaissance in Northern Rocket Range Area. Walked between ~~the~~ top of the dune and high tide area in meandering path. Noted cultural debris up in area near dunes (remnants of a wooden/metal fence & metal fence posts spaced evenly along the dune). Walked through central part of target area associated with Northern Rocket Range. Scanned proposed sample locations and marked new sample locations near surface & subsurface debris/anomalies. Noted surface water body (very small) & streams / wet area in former target area.

Location Assateague Island Date 12/7/06
Project / Client CO3MD0930001 / USACE

0900 Ivy A. & Aelyn A. arrived on site. Met with Mike & Rusty, who conducted a safety review.

1000 Discussed general plan for the day - field team to identify sample locations, then Rusty would conduct recon. during sampling.

1030 Gathered soil collection materials together

1050 Collected soil sample (discrete) (subsurface) - sand, dark in color
ASI-RN-12-15-01
- near target area at
4228990.3
486835.6

1100 Collected soil sample (composite wheel) (surface) - brown sand
ASI-RN-02-01 + FD
~~02~~ 4228996.66
IA 12/7 486862.8
- near metal debris

1105 ~~Sub~~surface hit/debris (at 1107) / 422903.7 / 486895.9
IA 12/7 4229025.8
486842.4

lm M Arn

Location Assateague Island Date 12/7/06
Project / Client CO3MD0930001 / USACE

1120 Collected subsurface sample ASI-RN-12-15-02 (discrete) at the following location
4229072.2
486766.6
- location had 2 subsurface anomalies ± 3ft of sample
- soil - sand, v moist, hole fills w/ water
IA 12/7 ~~sandy, brown~~ highly vegetated area

1125 3 subsurface hits
① → 4229050.2
486780.4
② → 4229038.8
486777.7
③ → 4229010.9
486767.2

1140 subsurface hit - large
4228974.1
486745.8

lm M Arn

Location Assateague Island Date 12/7/06

Project / Client CO3MD093001 / USACE

1145 - subsurface hit noted at,
4228904.9
486733.7
- in grassy/shrub area

1150 4228989.2
486726.5 Surface Anomaly

1200 Collected surface sample near metal debris. (3 wheel composite)
~~ASI-SS-02-02~~ IA 12/7
ASI-RN-SS-02-02

1225 0486743.3 Adjacent to surface metal debris (1 foot away)
~~IA 4229020~~ 4229016.9
12/7
ASI-RN-SS-02-03
Subsurface Hits:
① → 4229020
486742
② → 4229011
486742.0

1235 Calibrated YSI meter; recorded calibration on Field calibration Form

1240 Began Recon of area to the west of Main Road (flyover area for the north target). Noted several subsurface anomalies. Logged on GPS Unit-7 locations.
by M Ann

Location Assateague Island Date 12/7/06

Project / Client CO3MD093001 / USACE

1255 Collected sediment sample and surface water from pond of water near North Range bombing target area, some fish in pond, lots of grass

YSI Readings

pH 8.47 temp. 42.7°F
Cond 161 µS/cm
DO 14.24 mg/L
NTU 0.8
ORP 145

discrete samples located at:
486771.9
IA 12/7 ~~ASI~~ 4229009.5
+ ASI-RN-SW-00-01
ASI-RN-SD-02-01

Note: Two surface water/sediment samples were planned for the South Rocket Range, assuming no surface water was present on the North Range. Upon finding SW one of the two samples was relocated to the North Range.
IA 12/7
by M Ann

Location Assateague Island Date 12/7/06

Project / Client CO3M0093001 / USACE

1415 Collected background sample
IA ~~zt~~ ASI-BG-SS-02-01 - brown
12/7 at 488235E sand
4232792 (7-wheel composite)

1438 ASI-BG-SS-02-02 (7-wheel composite)
4229421 - brown
487133 sand

1503 ASI-BG-SS-02-03 (7-wheel composite)
4229444 - brown
487139 sand

1530 Field team began Recon of beach area in low water mark (area between mean high tide + mean low tide). Walked North + South completing several transects looking for reported burial ~~areas~~ MTC 12/7 areas.

1600 Subsurface Hits (noted on beach)
IA ~~4229421~~ 4228996.6 332
12/7 ~~487133~~ 486862.8
IA ~~4229444~~ 4228990.3 331
12/7 ~~487139~~ 486835.6

1610 Filtered SW sample (for metals) using a 0.45 micron filter.

by M Ann

Location Assateague Island Date 12/7/06

Project / Client CO3M0093001 / USACE

1635 Collected subsurface discrete sample ~~ASI-RN-SB~~ 12/7
ASI-RN-SB-12-18-03
at the following location:
4228916.9
486720.5
- near anomaly
- sandy soil

1650 Collected subsurface discrete soil sample
ASI-RN-SB-12-18-04
at the following location:
4228954.0
486725.4
- Sandy brown soil
- located in Northe Rocket Range target area in grassy/shrub area

1700 Returned to vehicle & packed samples on ice in coolers.

Note: samples to be collected on beach were relocated ~~to~~ target area when biased sampling ~~locations~~ did not have evidence of Target impacts.

by M Ann

Location Assateague Island Date 12/8/06

Project / Client CO3MD093001 / USACE

720 Arrived on site:
Ivy Ashe
Rusty Mitchell
delyn Alumbaugh

730 Conducted a safety meeting, reviewed remedy samples to be collected, and formulated a plan of execution. Also, discussed the very cold weather and high winds. ~~The team~~ IA 12/8

800 Benchmarked the GPS units against same benchmark as before Readings were: 4229625.52N
482534.64E

830 We let the air out of the tires in preparation for driving down the beach, on designated park roads, to the ~~south~~ IA 12/8 former south rocket range.

855 Started meandering path ocean. No MD &/or anomalies noted.
Ivy M Ashe

Location Assateague Island Date 12/8/06

Project / Client CO3MD093001/USACE

910 Collected AS1-RS-SS-02-01
4213792.74 N
481479.57E

1020 + FD #2

IA ~~1115~~ Collected subsurface soil sample
12/8 AS1-RS-SB-12-18-01
at the following location
~~IA 12/8~~
4214508.66
12/8 481512.1

IA ~~1020~~ Collected ~~→~~ near former (possible) disposal area
- sample made of sandy brown soil - on the beach

1035 Collected AS1-RS-SS-02-02 near subsurface hit, noted as #358 in Garmin log.
- sample made of sandy brown soil, in vegitated area with grass & shrubs around - lots of organics

Ivy M Ashe

Location Assateague Island Date 12/8/06
Project / Client CO3M0093001 / USACE

1115 - Collected SW & SD + ASI-RS-SW-00-01 ASI-RS-SD-00-01
note: as SW1 - in Garmin
7 421444.32
4716C9.91
YSI Readings:
Temp. - 36.52°F
Cond. - 9462 µS/cm
pH - 6.65
turb - 10.0 NTU
8 ORP - 105
- samples were collected from a pond on the western side, near where a possible disposal area
8 may have been
- lots of trees, shrubs, and grasses surrounding the marsh/pond area
- several hunters were in the area, hunting for
9 deer.
- prior to use YSI was calibrated by [illegible] to Field Calibration Form

Location Assateague Island Date 12/8/06
Project / Client CO3M0093001 / USACE

1150 - Collected subsurface sample, very sandy
ASI-RS-SB-12-15-02
~~IA~~ 12/8 ~~SB12151-02~~
Note: No surface debris observed, only one subsurface hit found - where sample was collected at 1035
1245 Collected subsurface near areas shown on map:
483161
4216918
near possible disposal area
ASI-RS-SB-12-15-03
- no anomalies or surface debris encountered
1315 Collected sub surface sample inland - around ~~former~~ (possible) disposal area IA 12/8
ASI-RS-SB-12-15-04
483036
4217145
- no anomalies or surface debris encountered

My M Am

Location Assateague Island Date 12/8/06
Project / Client CO3MD093001/USACE

1400 Collected subsurface soil sample (~4 feet bf surface*)
ASI-RS-SB-12-15-05
*b/c near possible disposal area
7 4T 3160
4217317
- lake/water made traveling west not feasible to area indicated in the SS-WP

1430 Collected GW sample in southern range → along hole to obtain sample
8 461725
4214449
* collected ☐ ☐
YSI Readings
8 For ASI-RS-GW-02-01
pH 6.44
turb 24.4 NTU
DO ~~2.0~~ 12/15 1.76 mg/L
cond. 31994 µS/cm
temp. 37.8°F
8 ORP. -126.1

by M Bu

Location Assateague Island Date 12/8/06
Project / Client CO3MD093001/USACE

1630 Collected GW sample at parking lot area near North Range, Range a red spike at
ASI-RN-GW-~~05~~-01
at 463771 E
4228734 N
Collected the following YSI Readings:
pH 5.34 @ 12/15
ORP ~~+31.0~~ 123.4
DO 12.~~64~~ mg/L
turb. 0.7 NTU
cond. 790 µS/cm
temp. 41.9°F
Note: Both groundwater samples were relocated due to issues accessing the monitoring well specified in the SS-WP. The new locations selected were near the former ranges (one in the north & one in the south)

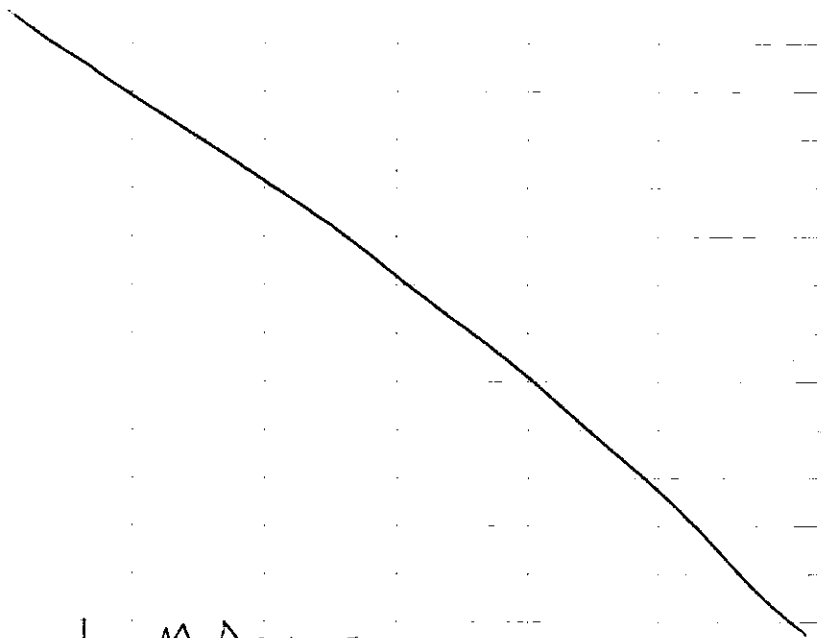
by M Bu

Location Assateague Island Date 12/8/06

Project / Client CO3MD093001/USACE

1700 Filtered both ground water samples (specified for perchlorate analysis) ~~=~~ using a 0.2 micron filter. Also filtered surface water sample (specified for metals analysis) using a 0.45 micron filter.

1730 Put samples on ice, packed up and left site.



M Ann

Location Date

Project / Client

Alion Science and Technology, Inc.

DAILY QUALITY CONTROL REPORT

Report Number: 12-18-06-01		**Date:** 12-18-06	
Project Name: Assateague Island C03MD093001		**Contract Number:** W912DY-04-D-0017	
Location of Work: Assateague Island, Maryland			
Description of Work: Meandering path geophysical reconnaissance, field sampling, and anomaly avoidance.			
Weather: Clear/Sunny	**Rainfall:** none	**Temperature:** **Min.** 30	**Max.** 35

1. Work performed today by Alion Team.

- Meeting with NPS personnel to go over site rules/proceedures for accessing sampling locations

-Health and Safety briefing with NPS personnel and then with just team.

-recorded anomaly counts, locations, descriptions, if present while performing reconnaissance (meandering paths)

Reconnaissance Acreage / Discussion:

Reconnaissance was conducted in the meandering path fashion. Travel paths varied from the geophysical site reconnaissance figures in the SS-WP due to natural terrain and the addition of more reconnaissance to try and verify sample and range locations.

Samples Collected:

No samples were collected.

Field Tests:

Schonstedt checked ok.

Trimble-Benchmark Assateague Island GPS 7 checked/confirmed to be within 1 meter.

Calibration of Instruments:

None

Other:

None.

2. Work performed today by other 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)

All preparatory phase inspections for field work were completed prior to mobilizing to Maryland. Initial phase of inspections were completed upon site arrival. No follow-up inspections were completed today. Satisfactory work completed.

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

None

5. List material and equipment received.

None.

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 safety violations.
9. Remarks. (Instructions received or given. Conflicts in Plans or Specifications)
Today, we performed meandering path geophysical reconnaissance in and around the southern part of Assateague
Island, located in Maryland. USACE reports indicate that this area was one of two former rocket ranges located
on Assateague (referred to as the South Rocket Range). In addition, USACE reports indicated the possible
presence of two disposal areas. According to a previous USACE site visit in 2003 three subsurface anomalies
were located in this area. Given the coordinates of these anomalies we used the GPS unit to return to the areas
corresponding to each anomaly. Following substantial meandering path geophysical reconnaissance we were
unable to locate the anomalies due to the continually changing landscape of shifting sands. We continued to
conduct meandering path reconnaissance through out the South Rocket Range area, up to 150 feet beyond mean
high tide. No munitions debris was found. No subsurface anomalies were noted. It was noted that access off the
beach to complete the sampling in the locations around the South Rocket Range could be hampered due to site
conditions (heavy vegetation) and site activities (hunting season was ongoing and the area in question contained
hunters with guns). Consideration was given to relocating samples based on site conditions.

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.

Quality Control System Manager (Sign and Print Name)

Alion Science and Technology, Inc.

DAILY QUALITY CONTROL REPORT

Report Number: 12-07-06-01		**Date:** 12-07-06	
Project Name: Assateague Island C03MD093001		**Contract Number:** W912DY-04-D-0017	
Location of Work: Assateague Island, Maryland			
Description of Work: Field sampling and anomaly avoidance			
Weather: Cloudy in a.m.; Sunny in p.m.	**Rainfall:** none	**Temperature:** **Min.** 40	**Max.** 52

1. Work performed today by Alion Team.

-Health and Safety briefing

-recorded anomaly counts, locations, descriptions while performing reconnaissance (meandering paths)

-surface and subsurface soil, surface water, and sediment sampling

Reconnaissance Acreage / Discussion:

Reconnaissance was conducted in the meandering path fashion during travel to sample locations. Travel paths varied from the sampling figures in the SS-WP due to natural terrain and a revision to the sampling order.

Samples Collected:

ASI-RN-SS-02-01 (and Field Duplicate #1)	ASI-RN-SW-00-01*
ASI-RN-SS-02-02	ASI-RN-SD-02-01*
ASI-RN-SS-02-03	ASI-BG-SS-02-01
ASI-RN-SB-12-18-01	ASI-BG-SS-02-02
ASI-RN-SB-12-18-02	ASI-BG-SS-02-03
ASI-RN-SB-12-18-03	
ASI-RN-SB-12-18-04	

*****In the SS-WP two surface water/sediment samples were planned for the South Rocket Range, with the anticipation that the South Rocket Range was the only area with surface water. Upon finding surface water within the central part of the North Rocket Range one of the two surface water/sediment samples planned for the South Rocket Range was relocated to the North Rocket Range.

Field Tests:

Schonstedt checked ok.

Trimble-Benchmark Assateague Island GPS 7 checked/confirmed to be within 1 meter.

Calibration of Instruments:

YSI Calibration Info: See field sheet.

Other:

None.

2. Work performed today by other 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)
All preparatory phase inspections for field work were completed prior to mobilizing to Maryland. Initial phase of
inspections were completed upon site arrival. No follow-up inspections were completed today. Satisfactory
work completed.
4. List type and location of tests performed and results of these tests.
YSI Readings for surface water sample ASI-RN-SW-00-01
T = 42.7 °F, pH =8.47, turbidity = 0.8 NTU,
conductivity = 0.161 mS/cm.
5. List material and equipment received.
None.
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 safety violations.
9. Remarks. (Instructions received or given. Conflicts in Plans or Specifications)
Today, we performed reconnaissance and sampling on Assateague Island, just south of Assateague State Park.
USACE reports indicate that this area was the North Rocket Range. According to USACE reports, just south
of the North Rocket Range was a disposal area. Initial recon occurred on area along the beach looking for
Anomalies. During reconnaissance activities metal debris was located which was not confirmed to be munitions
debris and additional metal debris confirmed to be associated with dune sand fencing was observed throughout the
site on the surface and protruding from the subsurface. Several subsurface anomalies were also located within the
Suspect target area. Samples were located near the metal debris and subsurface anomalies. As discussed a
surface water and sediment sample were relocated to an area containing surface water. Small fish and a dead frog
were observed in what appeared to be a shallow source of surface water. We continued to conduct
reconnaissance and relocate samples into the central part of the suspect target area adjacent to anomalies and
surface debris (metal). Reconnaissance was conducted on the western side of the park access road on the
accessible part of the suspect flight path associated with the North rocket Range. Several subsurface anomalies
were noted. Additional reconnaissance was conducted along the beach throughout the North Rocket Range area,
up to 150 feet beyond mean high tide. No munitions debris was found. Two subsurface anomalies were noted.

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.

Quality Control System Manager (Sign and Print Name)

Alion Science and Technology, Inc.

DAILY QUALITY CONTROL REPORT

Report Number:	12-08-06-01	**Date:** 12-08-06	
Project Name:	Assateague Island C03MD093001	**Contract Number:** W912DY-04-D-0017	
Location of Work:	Assateague Island, Maryland		
Description of Work:	Field sampling and anomaly avoidance		
Weather:	Sunny and Very Windy.	**Rainfall:** none	**Temperature:** **Min.** 20 **Max.** 34

1. Work performed today by Alion Team.

-Health and Safety briefing

-Recorded anomaly counts, locations, descriptions while performing reconnaissance (meandering paths)

-Surface and subsurface soil, groundwater, surface water, and sediment sampling

Reconnaissance Acreage / Discussion:

Reconnaissance was conducted in the meandering path fashion during travel to sample locations. Travel paths varied from the sampling figures in the SS-WP due to natural terrain and a revision to the sampling order.

Samples Collected:

ASI-RS-SS-02-01 (and Field Duplicate #2)	ASI-RS-SW-00-01
ASI-RS-SS-02-02	ASI-RS-SD-02-01
ASI-RS-SB-12-18-01	ASI-RS-GW-02-01 (and Field Duplicate #3) **
ASI-RS-SB-12-18-02	ASI-RN-GW-15-01**
ASI-RS-SB-12-18-03	
ASI-RS-SB-12-18-04	
ASI-RS-SB-12-18-05*	

*Surface soil sample ASI-RS-SS-02-03 was changed to subsurface soil sample ASI-RS-SB-12-18-05 during field activities due to the fact that no surface debris was observed and the sampling location was thought to be associated with a possible disposal area.

**Due to limited access to the USGS monitoring wells that were originally proposed for sampling in the SS-WP, alternate locations were selected to collect groundwater for each rocket range. On the North Rocket Range a groundwater sample was collected from a non-potable water well owned by Assateague National Seashore. On the South Rocket Range a groundwater samples was collected by hand-augering down to a foot beneath the surface, to obtain the perched groundwater which was present.

Field Tests:

Schonstedt checked ok.

Trimble-Benchmark Assateague Island GPS 7 checked/confirmed to be within 1 meter.

Calibration of Instruments:

YSI Calibration Info: See field sheet.
Other:
None.
2. Work performed today by other 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)
All preparatory phase inspections for field work were completed prior to mobilizing to Maryland. Initial phase of
inspections were completed upon site arrival. No follow-up inspections were completed today. Satisfactory
work completed.
4. List type and location of tests performed and results of these tests.
YSI Readings for surface water sample ASI-RS-SW-00-01
T = 36.5 °F, pH =6.63, turbidity = 10.0 NTU,
conductivity = 9.462 mS/cm.
YSI Readings for groundwater sample ASI-RS-GW-02-01
T = 37.8 °F, pH =6.44, turbidity = 24.4 NTU,
conductivity = 31.994 mS/cm.
YSI Readings for groundwater sample ASI-RN-GW-15-01
T = 41.9 °F, pH =8.34, turbidity = 0.7 NTU,
conductivity = 0.790 mS/cm.
5. List material and equipment received.
None.
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 safety violations.
9. Remarks. (Instructions received or given. Conflicts in Plans or Specifications)
Today, the team performed reconnaissance and sampling at the South Rocket Range and collected a groundwater
sample from the North Rocket Range. No surface debris was observed. Only one subsurface anomaly was noted.
Soil sample ASI-RS-SS-02-02 was relocated near the subsurface anomaly.

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.

Quality Control System Manager (Sign and Print Name)

SITE ENTRY AND EXIT LOG

Project/Site : Assateague Island

Project No.: 6202301.0007

Date	Name	Representing	Time In	Time Out
12/6/06	Michael O'Neill	EA Engineering (Alion)	11:30	5:15
12/6/06	[signature]	HEA/Alion	1130	5:15
12/7/06	Michael O'Neill	EA Engineering	0730	17:30
12/7/06	[signature]	HEA/Alion	0730	17:30
12/7/06	[signature]	EA Engineering	0900	17:30
12/7/06	delyn Alumbaugh	EA Engineering	0900	17:30
12/8/06	Ivy Able	EA Engineering	0720	1730
12/8/06	delyn Alumbaugh	EA Engineering	0720	1730
12/8/06	Rusty Mitchell	HEA/Alion	0720	1730

HEALTH AND SAFETY PLAN REVIEW RECORD

SITE: Assateague Island

EA Project No. C03MD093001 / 62023.01

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
Michael O'Neill	Michael O'Neill	EA/Alpoint team	12/06/06
Rusty M. Ticher		HFA/Alion Team	12/06/06
Ivy Able	Ivy M Able	EA/Alion Team	12/07/06
delynn Armbruster	delynn Armbruster	EA/Alion Team	12/7/06

DAILY SITE SAFETY JOURNAL
MEETING ATTENDEES
DATE: 12/06/06
Page 2 of 2

	Name	Affiliation
1	Michael O'Neil	EA Engineering
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DAILY SITE SAFETY JOURNAL

Page 1 of 2

DATE: 12/06/06	PROJECT: ASSATEAGUE
SUXOS: Mitchell	PM: ONeill
SSO: Mitchell	QCO:

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:

SSO SIGNATURE: [signature]

DAILY SITE SAFETY JOURNAL
MEETING ATTENDEES
DATE: 12/07/06
Page 2 of 2

	Name	Affiliation
1	Michael O'Neill	EA
2	[illegible] M Ahl	EA
3	Jaclyn Alumbaugh	EA
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DAILY SITE SAFETY JOURNAL
Page 1 of 2

DATE: 12/07/06	PROJECT: ASSATEAGUE
SUXOS: Mitchell	PM: ONEILL
SSO: Mitchell	QCO:

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:

SSO SIGNATURE: [signature]

F-13

DAILY SITE SAFETY JOURNAL
MEETING ATTENDEES
DATE: 6/8/06
Page 2 of 2

	Name	Affiliation
1	Ivy Tolk	EA / Alion Team
2	cRL/N Alumbaugh	EA/Alion Team
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DAILY SITE SAFETY JOURNAL
Page 1 of 2

DATE: 9/8/06	PROJECT: ASSATEAGUE
SUXOS: Mitchell	PM: ONeill
SSO: Mitchell	QCO:

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:

SSO SIGNATURE:

F-13

FIELD CALIBRATION FORM - YSI

(pH, CONDUCTIVITY, TURBIDITY)

Site Name: Assateague Island MMRP SI

CALIBRATION	
DATE:	12/7/06
TIME:	1215
METER ID:	95I

pH CALIBRATION

pH STANDARD	INITIAL READING	FINAL READING
4.0	3.92	4.00
7.0	7.11	7.00

CONDUCTIVITY CALIBARATION

CONDUCTIVITY STANDARD	STANDARD READING	FINAL READING
1.409	1.093	1.407

TURBIDITY CALIBRATION

STANDARD	INITIAL READING	FINAL READING
0 NTU	-2.4	0.0
100 NTU	96.4	100.0

FIELD CALIBRATION FORM (continued) - YSI

COMMENTS

None

SIGNATURE

FIELD CALIBRATION FORM - YSI

(pH, CONDUCTIVITY, TURBIDITY)

Site Name: Assateague Island MMRP SI

CALIBRATION
DATE: 12/8/06
TIME: 1134
METER ID: YSI -

pH CALIBRATION

pH STANDARD	INITIAL READING	FINAL READING
4.0	3.81	4.01
7.0	6.96	7.00

CONDUCTIVITY CALIBARATION

CONDUCTIVITY STANDARD	STANDARD READING	FINAL READING
1.409	1.187	1.409

TURBIDITY CALIBRATION

STANDARD	INITIAL READING	FINAL READING
0 NTU	0.3	0.0
100 NTU	96.0	99.9

FIELD CALIBRATION FORM (continued) - YSI

COMMENTS

None.

SIGNATURE

GPL LABORATORIES, LLLP

7210A Corporate Court
Frederick, MD 21703
(301) 694-5310
Fax (301) 620-0731

Contract #/Billing Reference:

1 of 3 Pgs.

Project: Assateague Island - MMRP Fuels
Client: Alion/Corinne Shea
Send Results To: Corinne Shea
Address: 3975 Fair Ridge, Suit 125
Fairfax, VA 22033
Phone: 703-259-5147

Sample ID#	Date Sampled	Time Sampled	Sample Matrix	Sampler's Initials	Metals (6010B)	Explosives (8330A)	PETN (8330A) & NG (8330M)	Mercury (7471B) & Zirconium (6020)	Explosives (8330A)	PETN (8330A) & NG (8330M)	Metals (6020)	Mercury (7470A)	Lab Cooler No.	CLIENT COMMENTS
ASI-RN-SS-02-03	12/7	1225	SS	IA	X	X	X	X					1	SS = soil
ASI-RN-SS-02-02	12/7	1200	SS	IA	X	X	X	X					1	SD = sediment
ASI-RN-SB-12-15-04	12/7	1650	SS	IA	X	X	X	X					1	SW = surface water
ASI-RN-SB-12-15-03	12/7	1635	SS	IA	X	X	X	X					1	GW = groundwater
ASI-RN-SB-12-10-01	12/7	1050	SS	IA	X	X	X	X					1	*abbreviations
ASI-RN-SS-02-01	12/7	1100	SS	IA	X	X	X	X					1	applicable to all
ASI-RN-SS-12-15-02	12/7	1120	SS	IA	X	X	X	X					1	3 COC's
ASI-RN-SW-02-01	12/7	1255	SW	IA					X	X	X	X	2, 3	Filtered for metals (6020)
ASI-RN-SD-02-01	12/7	1255	SD	IA	X	X	X	X					1	
ASI-BG-SS-02-01	12/7	1415	SS	IA	X			X					1	
ASI-BG-SS-02-02	12/7	1438	SS	IA	X			X					1	
ASI-BG-SS-02-03	12/7	1503	SS	IA	X			X					1	

Turnaround Time	Std							
# of Containers	2	2	2	2	3	3	2	2
Container Type	8oz	8oz	8oz	8oz	1L AMBER	1L AMBER	HNO_3 + Filtered	
Preservative Used	—	—	—	—	—	—	HDPE Liter	HDPE Liter

Relinquished By:	Date/Time	Received By:	Relinquished By:	Received for Laboratory By:	Date/Time
Ivy Able	12/11 1400				
Relinquished By:	Date/Time	Received By:	Date/Time / Shipper:	Airbill No.:	
Relinquished By:	Date/Time	Received By:	Lab Comments:	Temp:	

 G.P. W.O. _____

GPL LABORATORIES, LLLP

7210A Corporate Court
Frederick, MD 21703
(301) 694-5310
Fax (301) 620-0731

Contract #/Billing Reference:

Project: Assateague Island - MMRP FUDS
Client: Alion / Corinne Shea
Send Results To: Corinne Shea
Address: 3975 Fair Ridge Drive, Suite D55
Fairfax, VA 22033
Phone: 703-259-5147

Turnaround Time: Std

Sample ID#	Date Sampled	Time Sampled	Sample Matrix	Sampler's Initials	# of Containers	Container Type	Preservative Used	Type of Analysis: Metals (6010B)	Explosives (8330A)	PETN (8330 mod)	NG (8330 mod)	mercury (747113)	2 viranium (6020)	Explosives (8330A)	PETN (8330 m)	NG (8330M)	Metals (6020)	mercury (7470A)	Perchlorate (EPA Method 332.0 M)	Lab Cooler No.	CLIENT COMMENTS
					8	8oz	—														
					2	2	—														
					2	2	—														
					2	2	—														
					3	3	—														
					3	1L AMBER	—														
					2	1 HDPE Liter	HNO3														
					2	500 ML Plastic	Filtered														
FD#1	12/7	—	SS	IA				X	X	X	X									1	
FD#2	12/8	—	SS	IA				X	X	X	X									1	
FD#3	12/8	—	GW	IA										X	X	X	X	X		3	Perchlorate Filtered 0.2µ
ASI-RS-SB-12-15-01	12/8	1035	SS	IA				X	X	X	X									1	
ASI-RS-SD-02-01	12/8	1115	SD	IA				X	X	X	X									1	
ASI-RS-SB-12-15-04	12/8	1315	SS	IA				X	X	X	X									1	
ASI-RS-SB-12-15-05	12/8	1400	SS	IA				X	X	X	X									1	
ASI-RS-SB-12-15-03	12/8	1245	SS	IA				X	X	X	X									1	
ASI-RS-SB-12-15-02	12/8	1150	SS	IA				X	X	X	X									1	
ASI-RS-SS-02-02	12/8	1050	SS	IA				X	X	X	X									1	
ASI-RS-SS-02-01	12/8	910	SS	IA				X	X	X	X									1	
ASI-RN-GW-15-01	12/8	1630	GW	IA										X	X	X	X	X		3	Perchlorate Filtered 0.2µ

Relinquished By:	Date/Time	Received By:	Relinquished By:	Received for Laboratory By:	Date/Time
Ivy Able	12/11 1400				
Relinquished By:	Date/Time	Received By:	Date/Time / Shipper:	Airbill No.:	
Relinquished By:	Date/Time	Received By:	Lab Comments:	Temp:	

G.P. W.O. _____

GPL LABORATORIES, LLLP

7210A Corporate Court
Frederick, MD 21703
(301) 694-5310
Fax (301) 620-0731

Contract #/Billing Reference

3 of 3 Pgs.

Project: Assateague Island - MMRP FUDS
Client: Alion / Corinne Shea
Send Results To: Corinne Shea
Address: 3975 Fair Ridge Dr.
Suite 125 South, Fairfax, VA 22033
Phone: 703-259-5147

Sample ID#	Date Sampled	Time Sampled	Sample Matrix	Sampler's Initials	Turnaround Time	# of Containers	Container Type	Preservative Used	Type of Analysis: Explosives (8330A)	RDX/TNT (8330M)	NG (8330M)	Metals (6020)	mercury (7470A)	Perchlorate (EPA method SPE6321.1)	Lab Cooler No.	CLIENT COMMENTS
AOI-RS-GW-02-01	12/5	1430	GW	IA	std	3	1L AMBER	—	X	X	X	X	X		2	Perchlorate filtered 0.2µ
AOI-RS-SW-00-01	12/5	1115	SW	IA		3	1L AMBER	—	X	X	X	X	X		2	*filtered for metals analyses 0.45 micron
						2	HDPE 1L LIST	HNO3								
						2	500mL Plastic	H2SO4								
						1		Filtered								

Relinquished By:	Date/Time	Received By:	Relinquished By:	Received for Laboratory By:	Date/Time
Ivy Able	12/11 1400				
Relinquished By:	Date/Time	Received By:	Date/Time	Shipper:	Airbill No.:
Relinquished By:	Date/Time	Received By:	Lab Comments:		Temp:

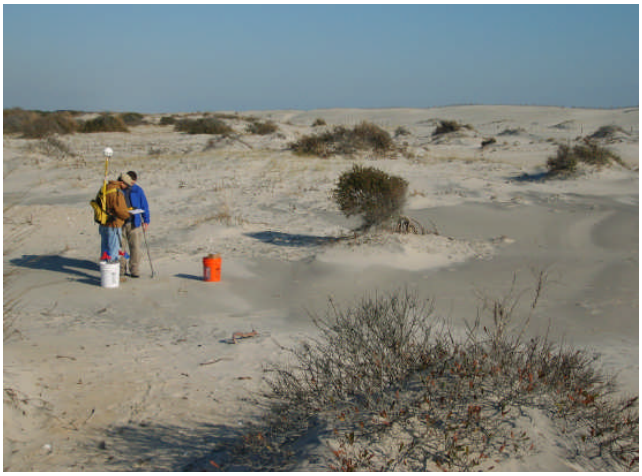
 G.P. W.O. _____

APPENDIX E - PHOTO DOCUMENTATION LOG

PHOTOGRAPHIC LOG

Project/Site : Assateague Island
Project No.: C03MD093001

Date	Taken By	Photo ID	Description
12/7/2006	I. Able	E.1	Collecting Soil Sample in Rocket Range North (Target Area)
12/7/2006	I. Able	E.2	Suspect MD or Cultural Debris Observed in Rocket Range North (Target Area)
12/7/2006	I. Able	E.3	Suspect MD or Cultural Debris Observed in Rocket Range North (Target Area)
12/7/2006	I. Able	E.4	Surface Water Sampled in the North Rocket Range
12/7/2006	I. Able	E.5	Metal and Wood Fence Identified Along the Sand Dunes in Rocket Range North
12/7/2006	I. Able	E.6	Reconnaissance of the North Rocket Range (at low tide)
12/8/2006	I. Able	E.7	Rocket Range South, Eastern Beach Area
12/8/2006	I. Able	E.8	Large Metal Float Near One of the Three Anomalies Identified During the 2003 Site Visit
12/8/2006	I. Able	E.9	Looking West on Rocket Range South
12/8/2006	I. Able	E.10	Collection of a Subsurface Soil Sample Near Potential Disposal Area
12/8/2006	I. Able	E.11	Terrain of Rocket Range South on the Western Side
12/8/2006	I. Able	E.12	E.12 – Terrain of Rocket Range South in the Central Part of the Island



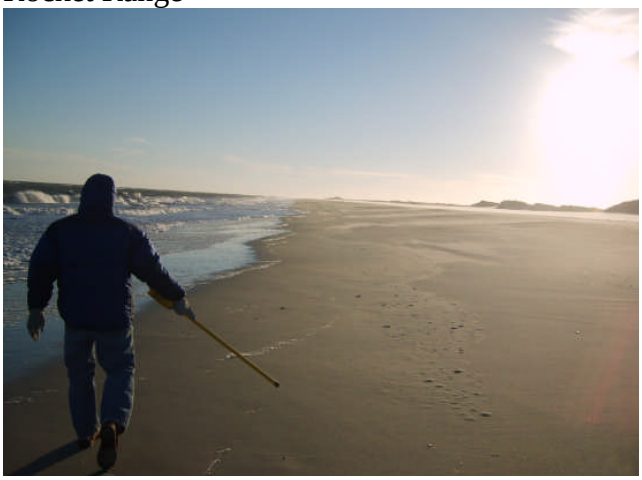
E.1– Collecting Soil Sample in Rocket Range North (Target Area)

E.2 – Suspect MD or Cultural Debris Observed in Rocket Range North (Target Area)

E.3 – Suspect MD or Cultural Debris Observed in Rocket Range North (Target Area)

E.4 – Surface Water Sampled in the North Rocket Range

E.5 – Metal and Wood Fence Identified Along the Sand Dunes in Rocket Range North



E.6 – Reconnaissance of the North Rocket Range (at low tide)

E.7 – Rocket Range South, Eastern Beach Area

E.8 – Large Metal Float Near One of the Three Anomalies Identified During the 2003 Site Visit

E.9 – Looking West on Rocket Range South

E.10 – Collection of a Subsurface Soil Sample Near Potential Disposal Area

E.11 – Terrain of Rocket Range South on the Western Side

E.12 – Terrain of Rocket Range South in the Central Part of the Island

APPENDIX F - ANALYTICAL DATA

- ADR Library
- ADR EDDs
- EDMS
- Analytical Summary Reports
- Analytical Data Reports
- SEDD Deliverable

Located on CD.

APPENDIX G - ANALYTICAL DATA QA/QC REPORT

- Validated Data from EDS

Located on CD.

APPENDIX H - GEOGRAPHIC INFORMATION SYSTEMS DATA

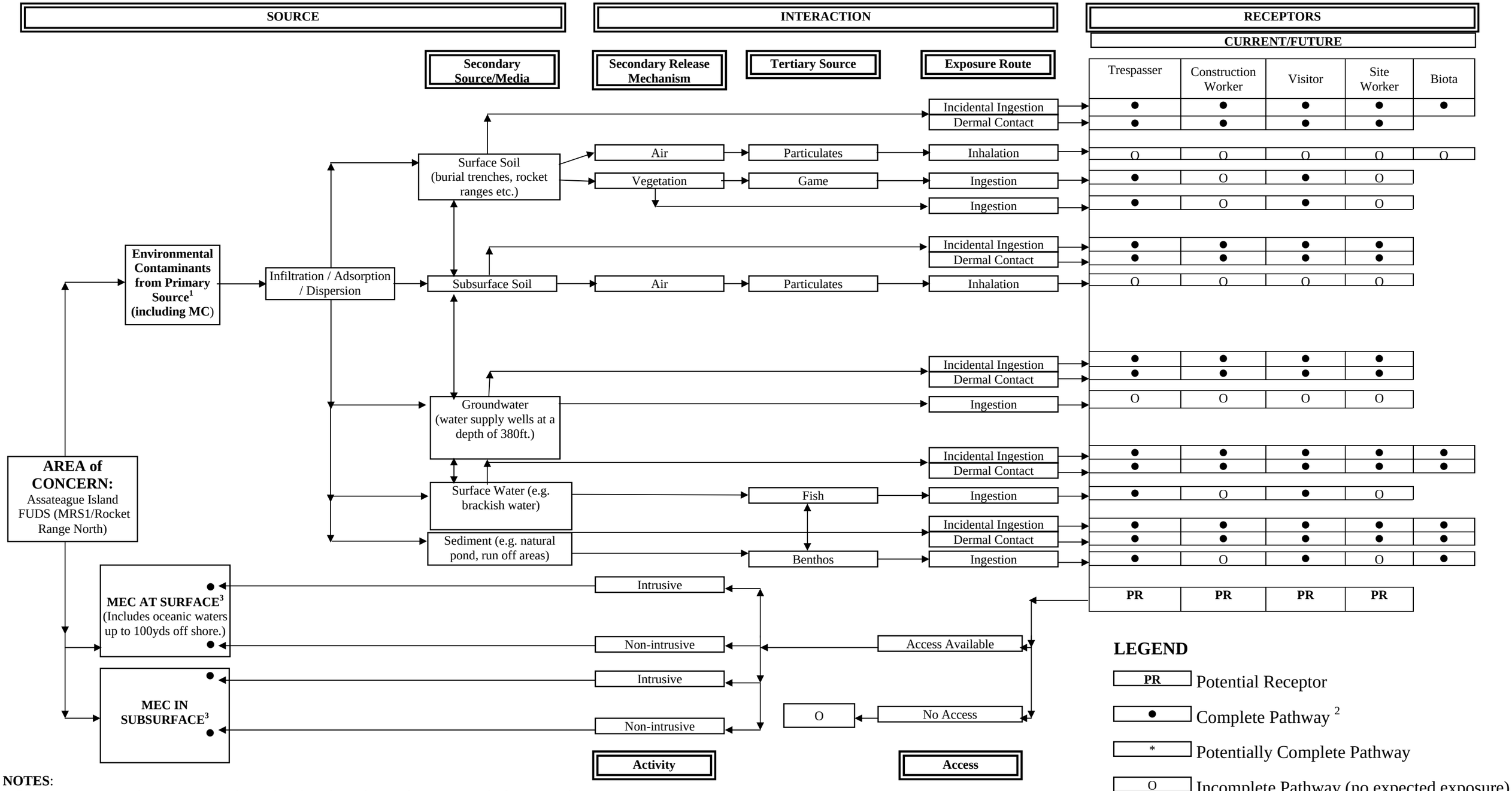
Located on CD.

APPENDIX I - GEOPHYSICAL DATA

Appendix not used.

APPENDIX J - CONCEPTUAL SITE MODEL

- MRS 1
- MRS 2

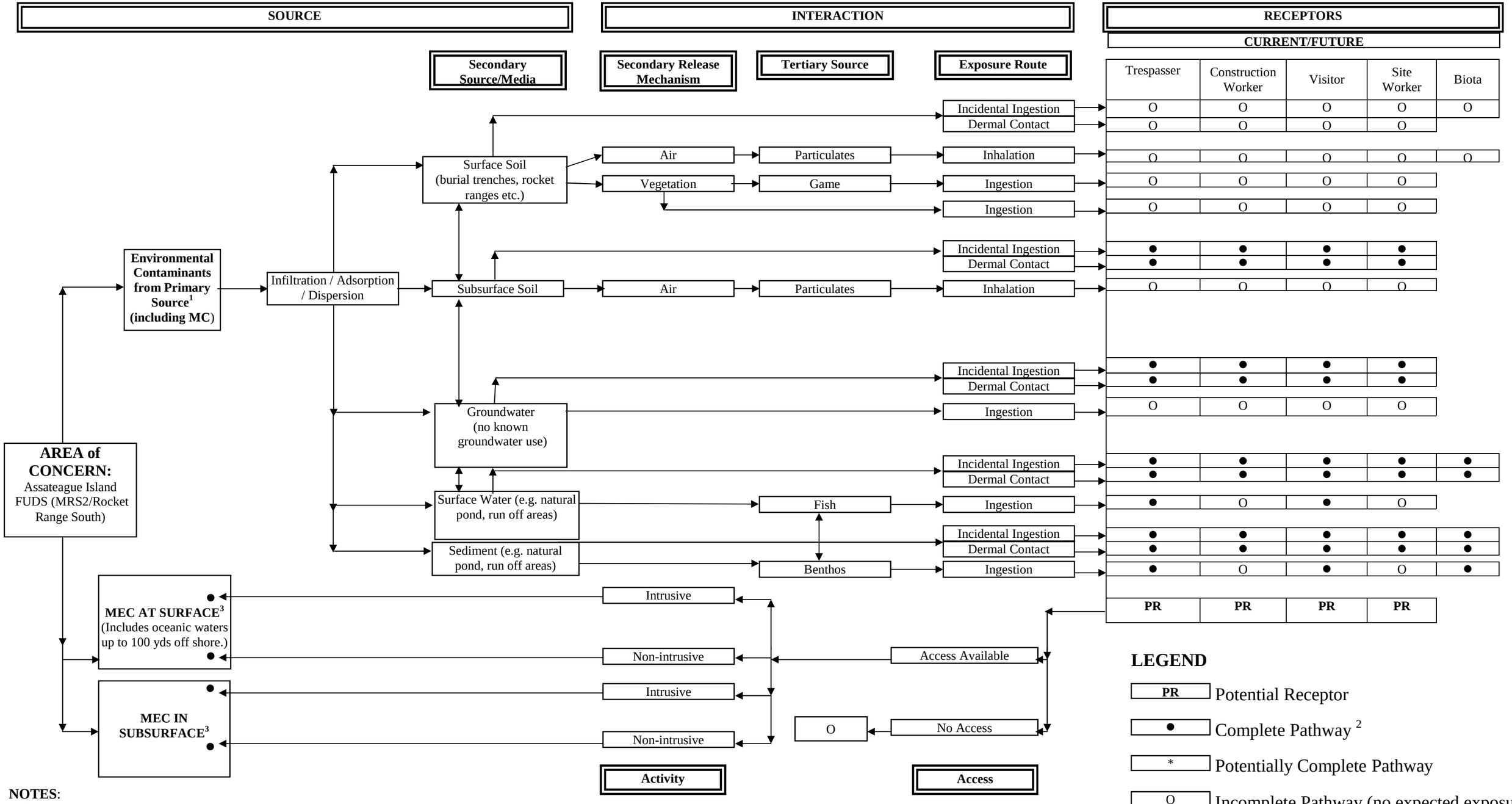


NOTES:

1. Primary sources vary but were expected to include burial trenches, rocket ranges, and other areas where MEC was historically observed.
2. 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.
3. Interaction between a potential receptor and MEC has two components: access and activity.
4. This CSM has evolved throughout the SI process to reflect a current understanding following the SI of the source, pathway, and receptors potentially affected by MEC and MC.

DIAGRAM OF THE INTEGRATED CONCEPTUAL SITE MODEL FOR ROCKET RANGE NORTH (MRS 1) AT ASSATEAGUE ISLAND MMRP FUDS[4]

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.* EM1110-1-1200.



NOTES:

1. Primary sources vary but were expected to include burial trenches, rocket ranges, and other areas where MEC was historically observed.
2. 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.
3. Interaction between a potential receptor and MEC has two components: access and activity.
4. This CSM has evolved throughout the SI process to reflect a current understanding following the SI of the source, pathway, and receptors potentially affected by MEC and MC.

DIAGRAM OF THE INTEGRATED CONCEPTUAL SITE MODEL FOR ROCKET RANGE SOUTH (MRS 2) AT ASSATEAGUE ISLAND MMRP FUDS[4]

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.* EM1110-1-1200.

APPENDIX K - MUNITIONS RESPONSE SITE PRIORITIZATION PROTOCOL RESULTS

- MRS 1
- MRS 2

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from DoD databases, such as RMIS. 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 non-munitions related contaminants found at the MRS (e.g., benzene, trichloroethylene), and any potentially exposed human and ecological receptors. Include a map of the MRS, if one is available.

Munitions Response Site Name: Rocket Range North – MRS 1

Component: U.S. Army

Installation/Property Name: Assateague Island

Location (City, County, State): Berlin, Worcester County, Maryland

Site Name (RMIS ID)/Project Name (Project No.): Assateague Island C03MD093001R01/Assateague Island C03MD093001

Date Information Entered/Updated: September 2007

Point of Contact (Name/Phone): Julie Kaiser – (410)-962-4006

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 (by type of munition, if known) or munitions constituents (by type, if known) known or suspected to be present): Assateague Island was used for target practice by the Navy from 1944 to 1947. Munitions used at the site included 20 mm ammunition, practice rockets and practice bombs. Potential MC includes metals, explosives and perchlorate. Four explosives (RDX, tetryl, NG, and DNT), five metals (aluminum, antimony, lead, titanium, and zinc), and perchlorate (in groundwater only) are the MC of interest in MRS 1. MRS 1 consists of 583 acres of land and 2,525 acres of water. MRSPP addresses land portion and water area within 100 yards of the mean high tide.

Description of Pathways for Human and Ecological Receptors: The following media pathways were sampled for: Surface Water, Sediment, Surface Soil, Subsurface Soil and Groundwater.

Description of Receptors (Human and Ecological): Human Receptors include trespassers, construction workers, visitors/recreational users, site workers, and biota.

Table 1

EHE Module: Munitions Type Data Element Table

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

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

Classification	Description	Score
Sensitive	◆ All 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]. ◆ All hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30
High explosive (used or damaged)	◆ All UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive." ◆ All 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)	◆ All UXO containing pyrotechnic fillers other than white phosphorous (e.g., flares, signals, simulators, smoke grenades). ◆ All 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)	◆ All 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	◆ All UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ All DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	(15)
Bulk secondary high explosives, pyrotechnics, or propellant	◆ All DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor), that are deteriorated. ◆ 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)	◆ All 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	◆ All UXO that are practice munitions that are not associated with a sensitive fuze. ◆ All 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	◆ All UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ All 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).	(25)

Table 1

EHE Module: Munitions Type Data Element Table

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

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

Classification	Description	Score

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

The 1988 Case Incident documented practice rockets (5-in. HVAR), rocket motors (black powder propellant) and ballistic tips from practice rockets along with 5 (5-inch) shells (reported as MEC) being found at Assateague Island in MRS 1 (Stinger-One Range) (USACE 1994). Additionally, 20 mm ammunition, which may contain high-explosive filler, was likely used at MRS 1. See Sections 2.1 and 4.3.1 and Table 2-2 of the SI Report.

Table 2
EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the score(s) that correspond with **all** sources of explosive hazards known or suspected to be present at the MRS.

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

Classification	Description	Score
Former range	◆ The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include: impact or target areas, associated buffer and safety zones, firing points, and live-fire maneuver areas.	**10**
Former munitions treatment (i.e., OB/OD) unit	◆ The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	◆ The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	**6**
Former maneuver area	◆ The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	◆ The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	**5**
Former industrial operating facilities	◆ The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	◆ The MRS is a firing point, ◆ where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	◆ The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	◆ The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	2
Former small arms range	◆ The MRS is a former military range where only small arms ammunition was used [There must be evidence that no other types of munitions (e.g., grenades) were used or are present to place an MRS into this category.].	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	**10**

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

Practice bombs (Mk) 43, practice rockets (5-in. HVAR) and 5-inch shells, and ballistic tips from practice rockets were used or found at MRS1 (Stinger-One Range) on Assateague Island (USACE 1994). Historic documentation indicates that MRS 1 was a former practice rocket range. There has been one past discovery of 5-inch shells (reported as MEC) along the beach in MRS 1. The source of the 5-inch shells is not clear (i.e. historic dumping along the coast or the use of MRS 1 for offshore target practice); therefore, former range has been selected. See Sections 2.1 and 4.3.1 of the SI Report.

Table 3

EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the score(s) that correspond with **all** locations where munitions are located or suspected of being found at the MRS.

Note: The terms *surface, subsurface, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are UXO or DMM on the surface of the MRS ◆ Historical evidence (e.g., a confirmed incident report or accident report) indicates there are UXO or DMM on the surface of the MRS.	(25)
Confirmed subsurface, active	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost, heat heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost, heat heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	(20)
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence (e.g., munitions debris, such fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	(10)
Suspected (historical evidence)	◆ There is historical evidence indicating that UXO or DMM may be present at the MRS.	(5)
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	(2)
Small arms (regardless of location)	◆ The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability [There must be evidence that no other types of munitions (e.g., grenades) were used or are present at the MRS to place an MRS into this category.].	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	(25)

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

MD / MEC include practice bombs (Mk) 43, practice rockets (5-in. HVAR) and 5-inch shells (MEC), and ballistic tips were found at MRS 1 (USACE 1994). Refer to Section 4.3.1 of the SI Report. The INPR, ASR, and ASR Supplement all provided confirmed surface and suspected historical evidence of MEC/MD (USACE 1994).

Table 4

EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to any explosive materiel. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	◆ There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	**(10)**
Barrier to MRS access is incomplete	◆ There is a barrier preventing access to parts of the MRS, but not the entire MRS.	8
Barrier to MRS access is complete but not monitored	◆ There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	◆ There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	**(10)**

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

Assateague Island is part of a National Seashore and Park open to the public and recreational users. There are also approximately 4 acres owned by private citizens and less than 1 acre is used by the U.S. Coast Guard for the operation of a lighthouse. See Sections 2.3.4 and 4.3.1 of the SI Report.

Table 5

EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	◆ The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies.	(5)
Scheduled for transfer from DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the rule is applied.	3
DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	(5)

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

Assateague Island is part of a National Park open to the public and recreational users. There are also approximately 4 acres owned by private citizens and less than 1 acre is used by the U.S. Coast Guard for the operation of a lighthouse. See Sections 2.1, 2.3.3 and 2.3.4 of the SI report.

Table 6

EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications of population density and their descriptions. Determine the population density per square mile in the vicinity of the MRS and circle the score that corresponds with the associated population density.

Note: If an MRS is located in more than one county, use the largest population density value among the counties. If the MRS is within or borders a city or town, use the population density for the city or town, rather than that of the county.

Classification	Description	Score
> 500 persons per square mile	◆ There are more than 500 persons per square mile in the county in which the MRS is located, based on U.S. Census Bureau data.	5
100–500 persons per square mile	◆ There are 100 to 500 persons per square mile in the county in which the MRS is located, based on U.S. Census Bureau data.	3
< 100 persons per square mile	◆ There are fewer than 100 persons per square mile in the county in which the MRS is located, based on U.S. Census Bureau data.	(1)
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	(1)

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

The U.S. Census Bureau cited there are 98 persons per square mile in Worcester County, Maryland. (U.S. Census Bureau 2000). MRS 1 consists of both a national seashore and state park and as such has a significant flux of visitors during the summer months. According to the National Park Service, in close proximity to Ocean City (less than 20 miles) Assateague Island has up to 7,500 visitors per day. Additionally there are 150 campsites on the National Seashore and approximately 200 camp sites on state property. This transient population significantly impacts the population density at MRS 1 during summer months. See Section 2.3.3 of the SI Report.

Table 7

EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the population near the hazard. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the associated population near the known or suspected hazard.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	◆ There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	**(5)**
16 to 25 inhabited structures	◆ There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	◆ There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	◆ There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	◆ There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	◆ There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	**(5)**

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

There is a residential area within the 2 mile radius of MRS 1 which encompasses more than 26 homes. See Section 2.3.4 of the SI report.

Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures near the hazard and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the score(s) that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	(5)
Parks and recreational areas	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	(4)
Agricultural, forestry	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	◆ There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	(5)

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

MRS 1 is comprised of a National Seashore and State Park open to the public for camping, fishing, and other recreational uses. Additionally there is a residential area within the 2 mile radius of MRS 1. See Section 2.3.4 of the SI Report.

Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resource classifications at the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	◆ There are both ecological and cultural resources present on the MRS.	**5**
Ecological resources present	◆ There are ecological resources present on the MRS.	3
Cultural resources present	◆ There are cultural resources present on the MRS.	3
No ecological or cultural resources present	◆ There are no ecological resources or cultural resources present on the MRS.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	**5**

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

The site is a National Park and within the Coastal Management Zone. See Sections 2.3.8 and 3.2 of the SI Report.

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	25	**35**
Source of Hazard	Table 2	10	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	25	**40**
Ease of Access	Table 4	10	
Status of Property	Table 5	5	
Receptor Factor Data Elements			
Population Density	Table 6	1	**16**
Population Near Hazard	Table 7	5	
Types of Activities/ Structures	Table 8	5	
Ecological and /or Cultural Resources	Table 9	5	
EHE MODULE TOTAL			**91**

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	**B**

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the score(s) that correspond to **all** 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, explosive configuration either UXO or damaged DMM	The CWM known or suspected of being present at the MRS is: ◆ Explosively configured 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 explosively configured CWM/DMM that have not been damaged, or nonexplosively configured 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, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS is: ◆ Nonexplosively configured CWM/DMM. ◆ Bulk CWM/DMM (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)	◆ Only 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.

CWM is not present at the MRS (USACE 1994). Refer to Section 2.4.5 of the SI Report. _____

_____

_____

TABLES 12 THROUGH 19 EXCLUDED AS PER CX 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	
Sources of CWM	Table 12		
Accessibility Factor Data Elements			
Location of CWM	Table 13		
Ease of Access	Table 14		
Status of Property	Table 15		
Receptor Factor Data Elements			
Population Density	Table 16		
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) 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** for each medium together, including additional contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

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

Evaluation Note: Sample ASI-RN-GW-15-01. Includes munitions-related MC only.

Contaminant	Maximum Concentration (μg/L)	Comparison Value (μg/L)	Ratios
LEAD	6.70E-01	1.05E+01	6.38E-02
TITANIUM	2.60E+00	1.05E+05	2.48E-05
ZINC	2.58E+01	1.10E+04	2.35E-03
CHF Scale	**CHF Value**	**Sum The Ratios**	6.62E-02
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		

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

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 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) 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** for each medium together, including additional 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.

Evaluation Note: Samples ASI-RN-SW-00-01. Includes review of munitions-related MC only.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
LEAD	3.90E-01	1.50E+01	2.60E-02
TITANIUM	3.10E+00	1.50E+01	2.07E-01
ZINC	1.23E+01	1.10E+04	1.12E-03
CHF Scale	**CHF Value**	**Sum The Ratios**	2.34E-01
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		**L**

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).	**L**

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).	**H**

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

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the site's sediment and their **comparison values** (from Appendix B) 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** for each medium together, including additional 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 sediment, select the box at the bottom of the table.

Evaluation Note: Sample ASI-RN-SD-02-01. Includes review of munitions-related MC only.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
ANTIMONY	3.40E-01	3.10E+01	1.10E-02
LEAD	2.80E+00	4.00E+02	7.00E-03
TITANIUM	1.15E+02	1.00E+05	1.15E-03
ZINC	3.50E+00	2.30E+04	1.52E-04
CHF Scale	**CHF Value**	**Sum The Ratios**	1.93E-02
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		

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

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

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B) 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** for each medium together, including additional 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 ecological 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.

Evaluation Note: Sample ASI-RN-SW-00-01. Includes review of munitions-related MC only.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
LEAD	3.90E-01	8.10E+00	4.81E-02
ZINC	1.23E+01	8.10E+01	1.52E-01
CHF Scale	**CHF Value**	**Sum the Ratios**	2.00E-01
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		

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

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).	**L**

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).	**H**

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

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B) 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** for each medium together, including additional 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 ecological endpoints present in the sediment, select the box at the bottom of the table.

Evaluation Note: Includes review of munitions-related MC only.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
ANTIMONY	3.40E-01	9.30E+00	3.66E-02
LEAD	2.80E+00	3.02E+01	9.27E-02
ZINC	3.50E+00	1.24E+02	2.82E-02
CHF Scale	**CHF Value**	**Sum the Ratios**	1.58E-01
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		**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).	**H**

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

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B) 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** for each medium together, including additional 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.

Evaluation Note: Samples: ASI-RN-SB-12-18-01, ASI-RN-SB-12-18-02, ASI-RN-SB-12-18-03, ASI-RN-SB-12-18-04, ASI-RN-SS-02-01 (and Field Duplicate #1), ASI-RN-SS-02-02, and ASI-RN-SS-02-03. No munitions-related MC detected above background.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
CHF Scale	**CHF Value**	**Sum the Ratios**	Not Applicable (N/A)
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		N/A

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).	N/A

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).	N/A

No Known or Suspected Surface Soil MC Hazard ☑

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Only use this table if there are more than five contaminants 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) in the table below. Calculate and record the **ratio** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** for each medium on the appropriate media-specific tables.

Note: Remember not to add ratios from different media.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio

Table 28
Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard, Migration Pathway, and Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the reference 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	L	L	LLL	**G**
Surface Water/Human Endpoint (Table 22)	L	L	H	HLL	**E**
Sediment/Human Endpoint (Table 23)	L	L	H	HLL	**E**
Surface Water/Ecological Endpoint (Table 24)	L	L	H	HLL	**E**
Sediment/Ecological Endpoint (Table 25)	L	L	H	HLL	**E**
Surface Soil (Table 26)	Not Applicable (N/A)	N/A	N/A	N/A	N/A

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 below.

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.

Evaluation Note: N/A=not applicable

HHE MODULE RATING	E

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 number in the **MRS or Alternative Priority** box 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 or ALTERNATIVE PRIORITY				**3**	

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from DoD databases, such as RMIS. 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 non-munitions related contaminants found at the MRS (e.g., benzene, trichloroethylene), and any potentially exposed human and ecological receptors. Include a map of the MRS, if one is available.

Munitions Response Site Name: Rocket Range South – MRS 2

Component: U.S. Army

Installation/Property Name: Assateague Island

Location (City, County, State): Berlin, Worcester County, Maryland

Site Name (RMIS ID)/Project Name (Project No.): Assateague Island C03MD093001R02/Assateague Island C03MD093001

Date Information Entered/Updated: September 2007

Point of Contact (Name/Phone): Julie Kaiser – (410)-962-4006

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 (by type of munition, if known) or munitions constituents (by type, if known) known or suspected to be present): Assateague Island was used for target practice by the Navy from 1944 to 1947. Munitions used at the site included 20 mm ammunition, practice rockets and practice bombs. Potential MC includes metals, explosives and perchlorate. Four explosives (RDX, tetryl, NG, and DNT), five metals (aluminum, antimony, lead, titanium, and zinc), and perchlorate (in groundwater only) are the MC of interest in MRS 2. MRS 2 consists of 563 acres of land and 2,545 acres of water. MRSPP addresses land portion and water area within 100 yards of the mean high tide.

Description of Pathways for Human and Ecological Receptors: The following media pathways were sampled for: Surface Water, Sediment, Surface Soil, Subsurface Soil and Groundwater.

Description of Receptors (Human and Ecological): Human Receptors include trespassers, construction workers, visitors/recreational users, site workers, and biota.

Table 1

EHE Module: Munitions Type Data Element Table

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

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

Classification	Description	Score
Sensitive	◆ All 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]. ◆ All hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30
High explosive (used or damaged)	◆ All UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive." ◆ All 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)	◆ All UXO containing pyrotechnic fillers other than white phosphorous (e.g., flares, signals, simulators, smoke grenades). ◆ All 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)	◆ All 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	◆ All UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ All DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	**15**
Bulk secondary high explosives, pyrotechnics, or propellant	◆ All DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor), that are deteriorated. ◆ 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)	◆ All 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	◆ All UXO that are practice munitions that are not associated with a sensitive fuze. ◆ All 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	◆ All UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ All 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).	**25**

Table 1

EHE Module: Munitions Type Data Element Table

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

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

Classification	Description	Score

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

20 mm ammunition (which may potentially contain high-explosive filler), practice bombs, and practice rockets were likely used at MRS 2. Only MD from rockets has been observed on MRS 2. The INPR, ASR, and Supplemental ASR all provided confirmed surface MD and suspected historical evidence of MEC/MD (USACE 1994). See Sections 2.1 and 4.3.2 and Table 2-2 of the SI Report.

Table 2
EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the score(s) that correspond with **all** sources of explosive hazards known or suspected to be present at the MRS.

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

Classification	Description	Score
Former range	◆ The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include: impact or target areas, associated buffer and safety zones, firing points, and live-fire maneuver areas.	10
Former munitions treatment (i.e., OB/OD) unit	◆ The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	◆ The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	**6**
Former maneuver area	◆ The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	◆ The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	**5**
Former industrial operating facilities	◆ The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	◆ The MRS is a firing point, ◆ where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	◆ The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	◆ The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	2
Former small arms range	◆ The MRS is a former military range where only small arms ammunition was used [There must be evidence that no other types of munitions (e.g., grenades) were used or are present to place an MRS into this category.].	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	**6**

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

20 mm ammunitions, practice bombs, and practice rockets were used at MRS 2. Only MD from rockets has been observed on MRS 2. The INPR, ASR, and Supplemental ASR all provided confirmed surface MD and suspected historical evidence of MEC/MD (USACE 1994). See Sections 2.1 and 4.3.2 and Table 2-2 of the SI Report.

Table 3

EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the score(s) that correspond with **all** locations where munitions are located or suspected of being found at the MRS.

Note: The terms *surface, subsurface, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are UXO or DMM on the surface of the MRS ◆ Historical evidence (e.g., a confirmed incident report or accident report) indicates there are UXO or DMM on the surface of the MRS.	25
Confirmed subsurface, active	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost, heat heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost, heat heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence (e.g., munitions debris, such fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	**10**
Suspected (historical evidence)	◆ There is historical evidence indicating that UXO or DMM may be present at the MRS.	**5**
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	**2**
Small arms (regardless of location)	◆ The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability [There must be evidence that no other types of munitions (e.g., grenades) were used or are present at the MRS to place an MRS into this category.].	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	**10**

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

20 mm ammunitions, practice bombs, and practice rockets were used at MRS 2. Only MD from rockets has been observed on MRS 2. Refer to Section 4.3.2 of the SI Report. The INPR, ASR, and Supplemental ASR all provided confirmed surface MD and suspected historical evidence of MEC/MD (USACE 1994).

Table 4

EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to any explosive materiel. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	◆ There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	**(10)**
Barrier to MRS access is incomplete	◆ There is a barrier preventing access to parts of the MRS, but not the entire MRS.	8
Barrier to MRS access is complete but not monitored	◆ There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	◆ There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	**(10)**

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

Assateague Island is part of a National Seashore and Park open to the public and recreational users. There are also approximately 4 acres owned by private citizens and less than 1 acre is used by the U.S. Coast Guard for the operation of a lighthouse. See Sections 2.3.4 and 4.3.2 of the SI Report.

Table 5

EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	◆ The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies.	(5)
Scheduled for transfer from DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the rule is applied.	3
DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	(5)

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

Assateague Island is part of a National Park open to the public and recreational users. There are also approximately 4 acres owned by private citizens and less than 1 acre is used by the U.S. Coast Guard for the operation of a lighthouse. See Sections 2.1, 2.3.3, and 2.3.4 of the SI report.

Table 6

EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications of population density and their descriptions. Determine the population density per square mile in the vicinity of the MRS and circle the score that corresponds with the associated population density.

Note: If an MRS is located in more than one county, use the largest population density value among the counties. If the MRS is within or borders a city or town, use the population density for the city or town, rather than that of the county.

Classification	Description	Score
> 500 persons per square mile	◆ There are more than 500 persons per square mile in the county in which the MRS is located, based on U.S. Census Bureau data.	5
100–500 persons per square mile	◆ There are 100 to 500 persons per square mile in the county in which the MRS is located, based on U.S. Census Bureau data.	3
< 100 persons per square mile	◆ There are fewer than 100 persons per square mile in the county in which the MRS is located, based on U.S. Census Bureau data.	(1)
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	(1)

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

The U.S. Census Bureau cited there are 98 persons per square mile in Worcester County, Maryland. (U.S. Census Bureau 2000). See Section 2.3.3 of the SI Report.

Table 7

EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the population near the hazard. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the associated population near the known or suspected hazard.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	◆ There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	5
16 to 25 inhabited structures	◆ There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	◆ There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	◆ There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	◆ There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	**(1)**
0 inhabited structures	◆ There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	**(1)**

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

A backcountry campground is located within the MRS 2 site boundary. The campground has three sites, with a maximum use of 15 people at any given time. The site receives minimal use during the summer and winter months; moderate use during the spring and fall. Annual use is probably no more than 1,500 visitors per year. See Sections 2.3.3 of the SI report.

Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures near the hazard and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the score(s) that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	5
Parks and recreational areas	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	**(4)**
Agricultural, forestry	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	◆ There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	**(4)**

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

MRS 2 is comprised of a National Seashore open to the public for camping, fishing, and other recreational uses. See Section 2.3.4 of the SI Report.

Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resource classifications at the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	◆ There are both ecological and cultural resources present on the MRS.	**5**
Ecological resources present	◆ There are ecological resources present on the MRS.	3
Cultural resources present	◆ There are cultural resources present on the MRS.	3
No ecological or cultural resources present	◆ There are no ecological resources or cultural resources present on the MRS.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	**5**

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

The site is a National Park and within the Coastal Management Zone. See Sections 2.3.8 and 3.2 of the SI Report.

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	25	**31**
Source of Hazard	Table 2	6	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	10	**25**
Ease of Access	Table 4	10	
Status of Property	Table 5	5	
Receptor Factor Data Elements			
Population Density	Table 6	1	**11**
Population Near Hazard	Table 7	1	
Types of Activities/ Structures	Table 8	4	
Ecological and /or Cultural Resources	Table 9	5	
EHE MODULE TOTAL			**67**

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	**D**

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the score(s) that correspond to **all** 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, explosive configuration either UXO or damaged DMM	The CWM known or suspected of being present at the MRS is: ◆ Explosively configured 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 explosively configured CWM/DMM that have not been damaged, or nonexplosively configured 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, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS is: ◆ Nonexplosively configured CWM/DMM. ◆ Bulk CWM/DMM (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)	◆ Only 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.

CWM is not present at the MRS (USACE 1994). Refer to Section 2.4.5 of the SI Report

TABLES 12 THROUGH 19 EXCLUDED AS PER CX 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		
Sources of CWM	Table 12		
Accessibility Factor Data Elements			
Location of CWM	Table 13		
Ease of Access	Table 14		
Status of Property	Table 15		
Receptor Factor Data Elements			
Population Density	Table 16		
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) 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** for each medium together, including additional contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

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

Evaluation Note: Sample ASI-RS-GW-02-01 **Includes munitions-related MC only. Receptor factor is based on the potential impact to drinking water supply wells.**

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
LEAD	8.80E+00	1.50E+01	5.87E-01
TITANIUM	4.83E+02	1.50E+05	3.22E-03
ZINC	4.49E+01	1.10E+04	4.08E-03

CHF Scale	CHF Value	Sum The Ratios	5.94E-01
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

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

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 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) 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** for each medium together, including additional 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.

Evaluation Note: Samples ASI-RS-SW-00-01. **Includes munitions-related MC only.**

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
ANTIMONY	1.40E+00	1.50E+01	9.33E-02
CHF Scale	**CHF Value**	**Sum The Ratios**	9.33E-02
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		**L**

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** (circled)
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 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** (circled)
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 Water (Human Endpoint) MC Hazard ❑

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the site's sediment and their **comparison values** (from Appendix B) 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** for each medium together, including additional 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 sediment, select the box at the bottom of the table.

Evaluation Note: Sample ASI-RS-SD-02-01. **Includes munitions-related MC only.**

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
LEAD	3.60E+00	4.00E+02	9.00E-03
TITANIUM	1.24E+02	1.00E+05	1.24E-03
ZINC	3.90E+00	2.30E+04	1.70E-04

CHF Scale	CHF Value	Sum The Ratios	1.04E-02
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	**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 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) 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** for each medium together, including additional 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 ecological 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.

Evaluation Note: Sample ASI-RS-SW-00-01. **Includes munitions-related MC only.**

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
ANTIMONY	1.40E+00	5.00E+02	2.80E-03
CHF Scale	**CHF Value**	**Sum the Ratios**	2.80E-03
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		**L**

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).	**L**

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).	**H**

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

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B) 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** for each medium together, including additional 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 ecological endpoints present in the sediment, select the box at the bottom of the table.

Evaluation Note: Sample ASI-RS-SD-02-01. **Includes munitions-related MC only.**

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
LEAD	3.60E+00	3.02E+01	1.19E-01
ZINC	3.90E+00	1.24E+02	3.15E-02
CHF Scale	**CHF Value**	**Sum the Ratios**	1.51E-01
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		**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).	**H**

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

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B) 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** for each medium together, including additional 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.

Evaluation Note: Samples: ASI-RS-SB-12-18-01, ASI-RS-SB-12-18-02, ASI-RS-SB-12-18-03, ASI-RS-SB-12-18-04, ASI-RS-SB-12-18-05, ASI-RS-SS-02-01 (and Field Duplicate #2), ASI-RS-SS-02-02. No munitions related MC detected above background.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
CHF Scale	**CHF Value**	**Sum the Ratios**	Not Applicable (N/A)
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		N/A

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).	N/A

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).	N/A

No Known or Suspected Surface Soil MC Hazard ☑

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Only use this table if there are more than five contaminants 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) in the table below. Calculate and record the **ratio** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** for each medium on the appropriate media-specific tables.

Note: Remember not to add ratios from different media.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio

Table 28
Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard, Migration Pathway, and Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the reference 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	L	L	LLL	**G**
Surface Water/Human Endpoint (Table 22)	L	L	L	LLL	**G**
Sediment/Human Endpoint (Table 23)	L	L	L	LLL	**G**
Surface Water/Ecological Endpoint (Table 24)	L	L	H	HLL	**E**
Sediment/Ecological Endpoint (Table 25)	L	L	H	HLL	**E**
Surface Soil (Table 26)	Not Applicable (N/A)	N/A	N/A	N/A	N/A

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 below.

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.

Evaluation Note: N/A=not applicable

HHE MODULE RATING	E

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 number in the **MRS or Alternative Priority** box 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 or ALTERNATIVE PRIORITY				**5**	

APPENDIX L - REFERENCE COPIES

Located on CD.